

Nurturing ECSU Research Talent

1996-97

Annual Report



SEIZING
OPPORTUNITIES
FOR
ADVANCING
RESEARCH
SCHOLARS

NORTH CAROLINA FALL CONFERENCE
ON UNDERGRADUATE RESEARCH

November 14-15, 1996
Elizabeth City State University

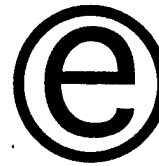
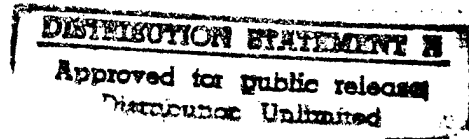
Conference Sponsor:

This conference is being sponsored and organized by the North Carolina Consortium for Undergraduate Research (Elizabeth City State University, Fayetteville State University, North Carolina A&T State University, North Carolina Central University, Pembroke State University, The University of North Carolina at Asheville and Winston-Salem State University.)

Corporate Sponsor
GLAXO, INC.
Research Triangle Park, NC

Featured Speakers:
DR. LINDA BAILEY HAYDEN, Elizabeth City State University
DR. SLAYTON A. EVANS, JR., The University of North Carolina at Chapel Hill
DR. PAULINUS CHIGBU, Elizabeth City State University

This conference will bring together undergraduates to report research results from a wide range of disciplines, including the arts, humanities, social sciences, and natural sciences.



**National Association for Equal Opportunity
in Higher Education (NAFEO)**

1997 High Tech Expo Student Presentations

Focus 
Georgia Tech **1996**

19970912 044



ERIC QUALITY ASSURED

Elizabeth City State University
Elizabeth City, North Carolina

REPORT DOCUMENTATION PAGE


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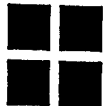
This program, entitled "Nurturing ECSU Research Talent" focuses on undergraduate education and undergraduate research experiences. Nurturing these young researchers is our primary concern. Highest priority is given to providing them with the guidance and skills to insure their entrance and success in graduate school. Further, each student in our program learns the fundamentals of scientific research. Program activities are as follows:

I. Student development activities:

- a) Recruitment of 5 high ability minority students each year.
- b) Providing a precollege/summer experience for recruited students.
- c) Providing research experiences;
- d) Providing a mentor, graduate school counseling and GRE preparation.
- e) Providing financial support for students in the form of research scholarships.
- f) Providing funds for student travel.

2. Infrastructure activities

- a) Enhancement of current computer graphics and operating systems courses.
- b) Development of a new course in computer visualization.
- c) Establishing a visiting lecture series in computer science.
- d) Hiring a UNIX network manager.
- e) Acquisition of computer equipment appropriate to support research training activities.





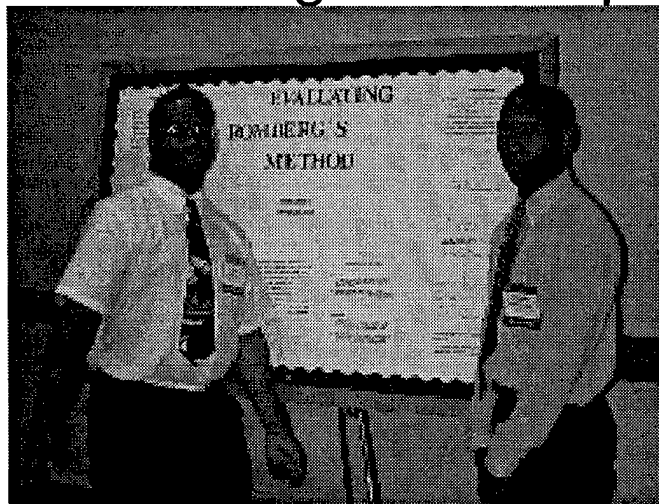
1996-97 Research Teams

<u>Research Focus</u>	<u>Mentor</u>	<u>Team Members</u>
Fractals/Chaos	Dr. D. Sengupta	Donald Charity, Fr/Math Corey Ellis, Jr/Applied Math Brian Jordan, Sr/Applied Math Ayonda Moore, Jr/Math Tammara Ward Jr/Math.
Visualization	Dr. K. Edoh	Lakisha Mundon, So/Math Felica Bowser, Sr/CS Laverne Williams, Jr/CS
HTML/JAVA	Mrs. T. Chamberlain Dr. L. Hayden	Courtney Fields, So/CS Kuchumbi Hayden, So/CS Katrina Godwin, Fr/CS Shakiya Rodgers, Fr/CS
ATM Networks	Mr. D. Archer Dr. L. Hayden	Curtis Felton, Jr/CS Derrek Burrus, So/CS Antonio Rook, So/CS Fred Sessoms, Jr/CS Stacia McFadden, Sr/CS Charles Gatling, Jr/CS Melvin Anderson, Jr/CS Jamaal Turner, Jr/Ind Tech
Statistical Analysis	Dr. M. Mannan	Arthur Fenner, Jr/Math Tamara McCray, Jr/Math Toinette Jenkins, Fr/CS

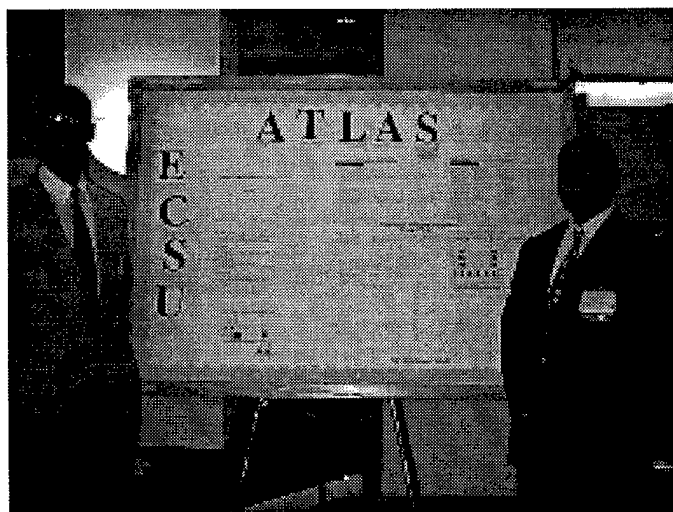


Highlights from the 1996-97 Research Program

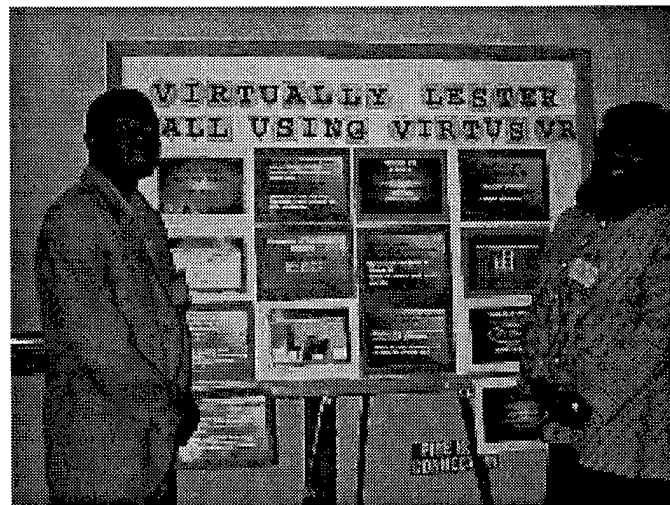
NAFEO High Tech Expo



Brian Jordan and Arthur Fenner

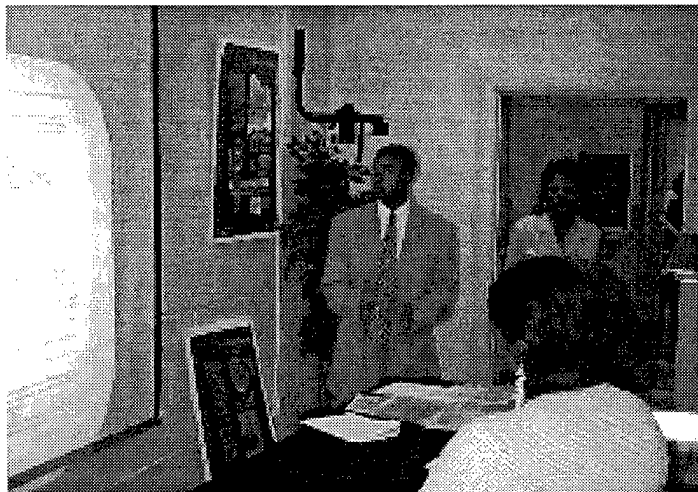


Curtis Felton and Derrek Burrus

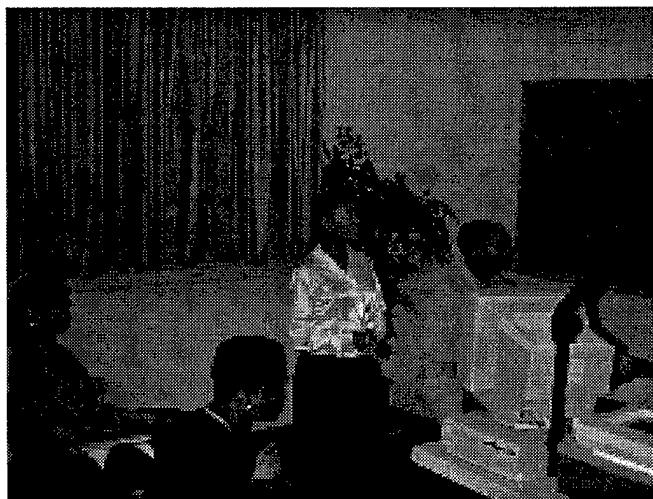


Melvin Anderson and Lavern Williams

Highlights from the 1996-97 Research Program



Donald Charity, Ayonda Moore and Lakisha Mundon (Fractals/Chaos)



Shakiya Rodgers, Courtney Fields, Katrina Godwin & Kuchumbi Hayden (HTML/JAVA)

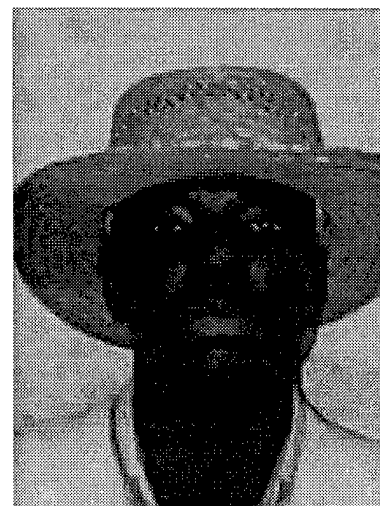
Highlights from the 1996-97 Research Program



Toinette Jenkins, Fr/CS



Tamara McCray, Jr/Math



Melvin Anderson, Jr/CS



Lavern Williams, Jr/CS



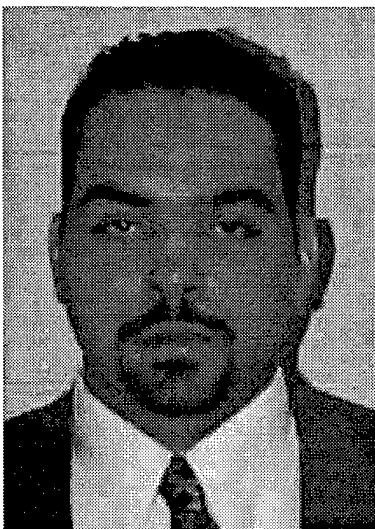
Lakisha Mundon, So/Math



Katrina Godwin, Fr/CS



Jamal Turner, Jr/Tech

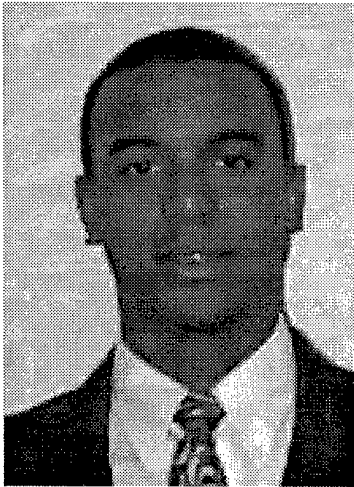


Fred Sessoms, Jr/CS

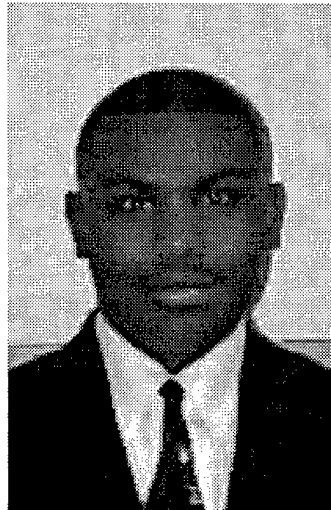


Felica Bowser, Sr/CS

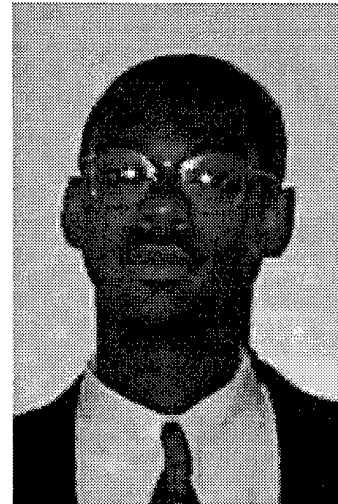
Highlights from the 1996-97 Research Program



Donald Charity Fr/Math



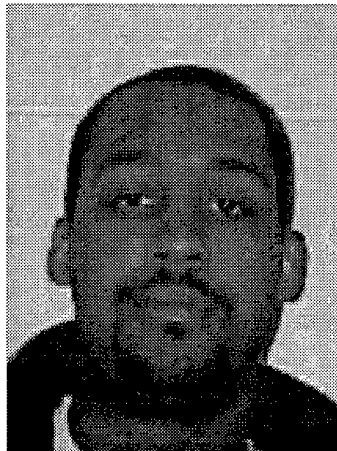
Derrek Burrus, So/CS



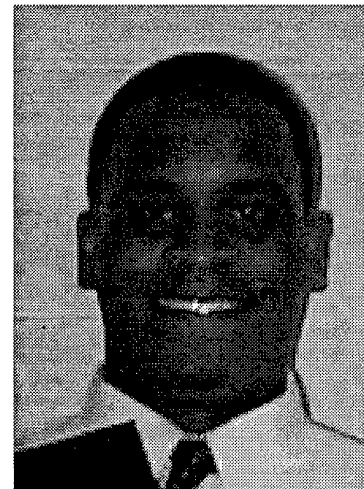
Curtis Felton, Jr/CS



Courtney Fields, So/CS



Corey Fields, Jr/Math



Charles Gatling, Jr/CS



Brian Jordan, Sr/Math



Arther Fenner, Jr/Math

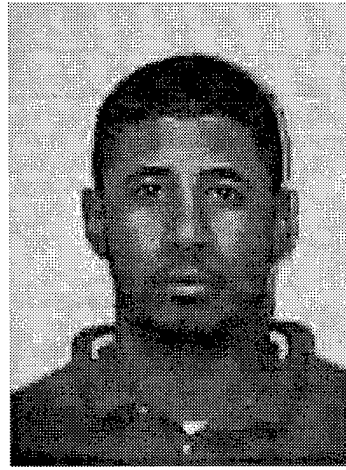


Ayonda Moore, Jr/Math

Highlights from the 1996-97 Research Program



Kuchumbi Hayden, So/CS



Antonio Rook, So/CS



Shakiya Rodgers, Fr/CS



Stacia McFadden Sr/CS

Umfort Locus Lecture Hall and Reception Center Dedication Service



Dr. James Donaldson, Professor
Howard University

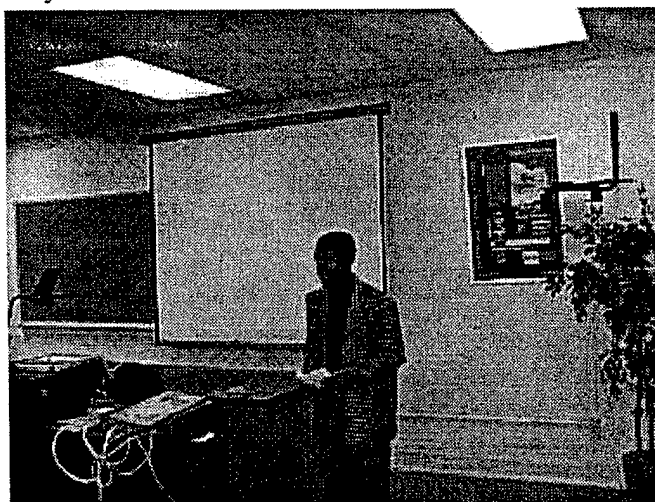


Dr. Mickey Burnim, Mrs. Delmo Locus, Umfort Locus III
Dr. Helen Caldwell, Dr. Sohindar Sachdev, Dr. Johnny
Houston, Dr. Linda Hayden, Mrs. Locus (seated)

Feb. 4, 1997



Wayman White and Felica Bowser
Past Umfort Locus Award Winners

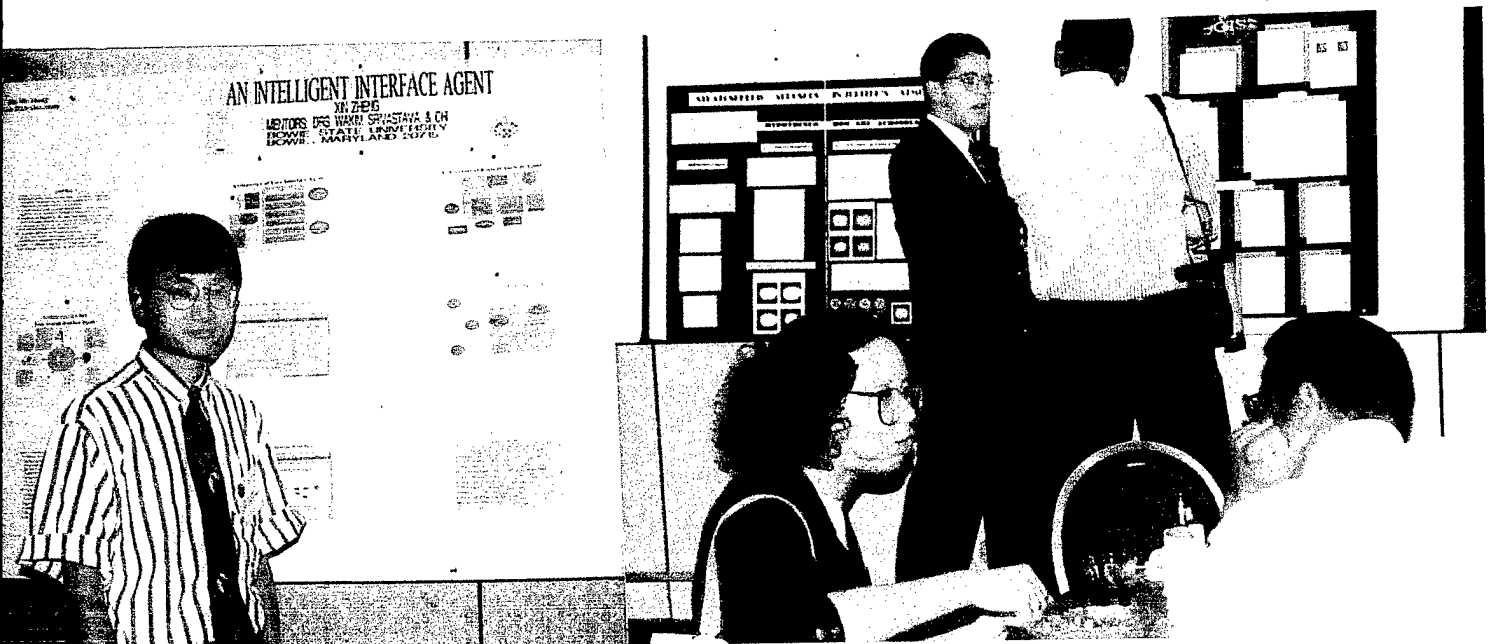
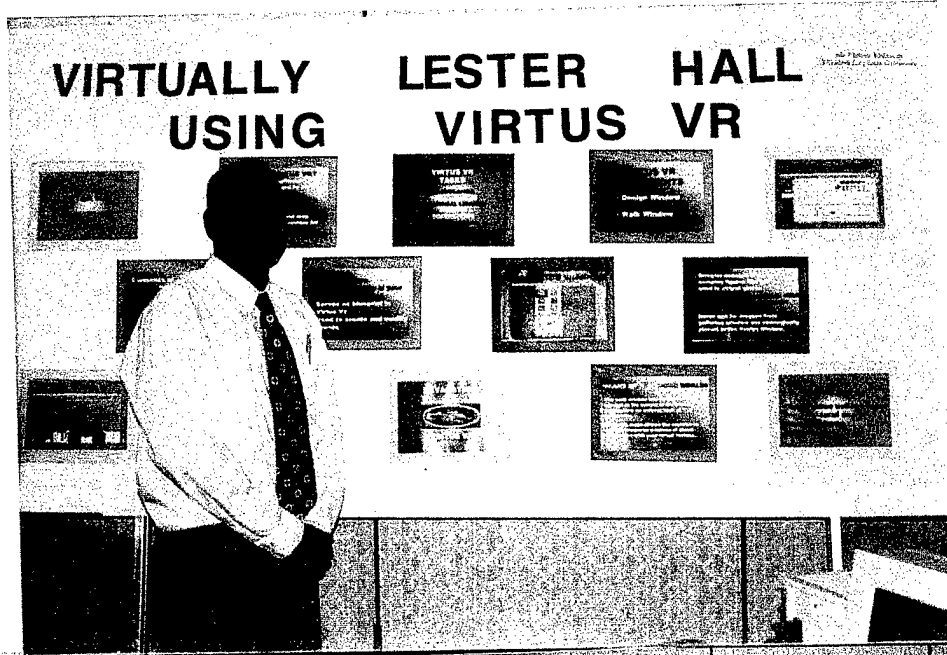


Rev. Wilkens, Academic Computing Center
Manager and past student of Umfort Locus Jr.



*MUSPSJN Conference
 El Paso, Tx*



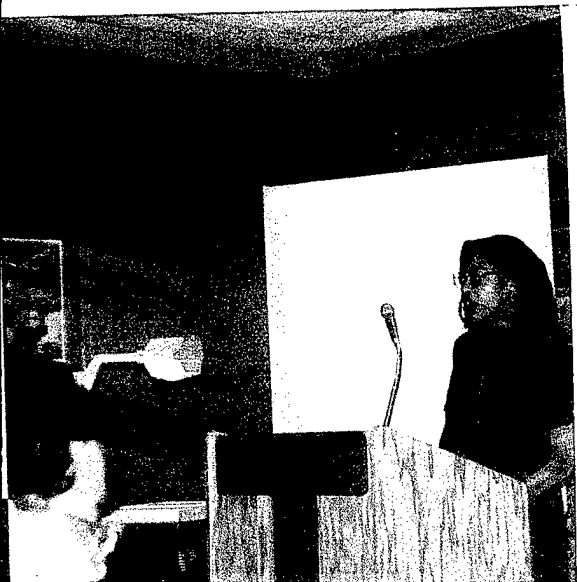


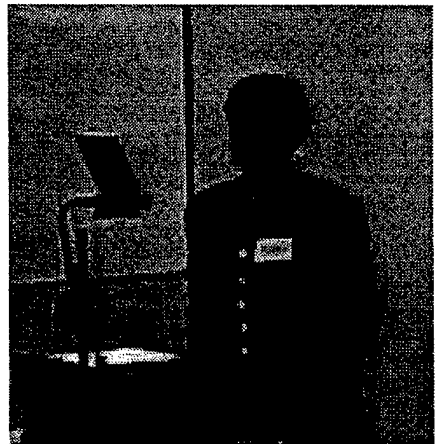
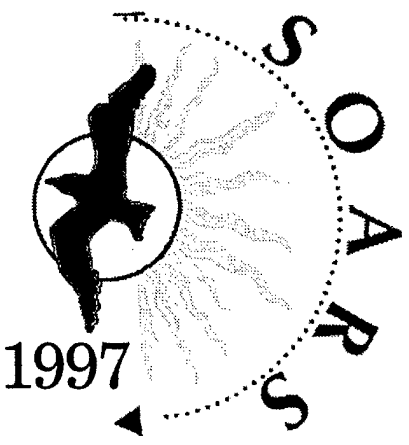


*ADMS Conference
Mayaguez, Puerto Rico*

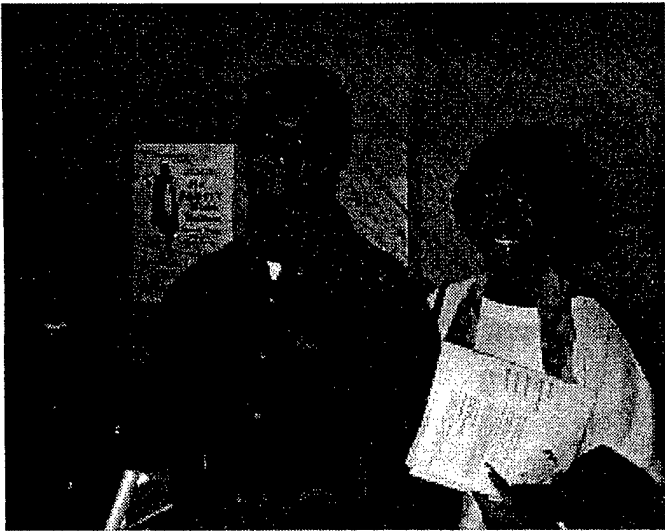
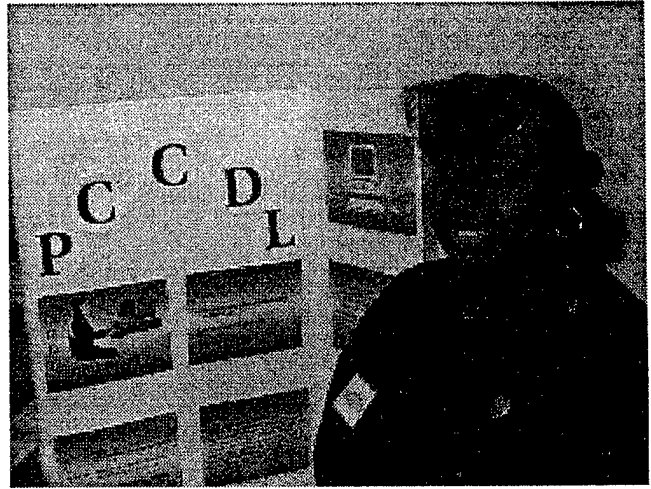
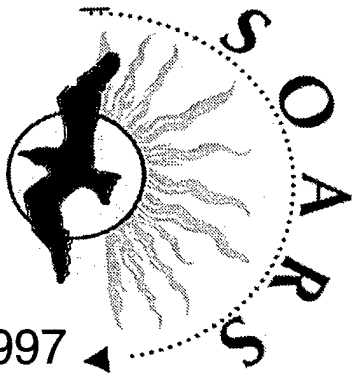


ADMS Conference
Mayaguez, Puerto Rico





K. E. White Graduate And Contin Education Center



Summer 1997 Internship Application Report			
Student Researcher	class	Internship/Summer Study	accepted or pending
Anderson, Melvin	jr	ITS	Accepted
Bowser, Felicia	sr	Langley Research Center - LARSS	Accepted
Burrus, Derrek	so	Educational Data Systems- Raleigh	Accepted
Charity, Donald	fr	FERMILAB	Pending
Ellis, Corey	jr	Langley Research Center - LARSS	Accepted
Felton, Curtis	jr	Georgia Institute of Technology	Accepted
Fenner, Arthur	jr	Argonne Lab	Pending
Fields, Courtney	so	Ronald McNair Program	Accepted
Gatling, Charles	jr	Naval Research Lab	Accepted
Godwin, Katrina	fr	NAFEO Internship Program	Accepted
Hayden, Kuchumbi	so	Ronald McNair Program-Trainer	Accepted
Jenkins, Toinette	fr	Department of Energy	Pending
Jordan, Brian	sr	Goddard Space Flight Center Internship	Accepted
McFadden, Stacia	sr	GEM Fellowship - Timken Corp.	Accepted
McCray, Tamara	jr	Ronald McNair Program	Accepted
Moore, Ayonda	jr	Ronald McNair Program	Accepted
Mundon, Lakisha	so	Ronald McNair Program	Accepted
Rodgers, Shakiya	fr	Department of Energy	Pending
Rook, Antonio	so	Albermarle Hospital	Accepted
Sessoms, Fred	jr	IBM	Accepted
Turner, Jamaal	jr	Ronald McNair Program	Accepted
Turner, Reginal	sr	Webmaster - NASA NRTS	Accepted
Williams, Laverne	jr	FERMILAB	Accepted
Ward, Tammara	jr	SERS	Completed

1996-97 Enrollment and GPA Report

<u>Major Discipline</u>	<u>Number of students enrolled at school (by year)</u>			<u>Number of students enrolled in ONR (by year)</u>			<u>Number of students graduated</u>	<u>Number Graduate Professional School</u>	<u>total ONR</u>
	<u>FR</u>	<u>SO</u>	<u>JR SR</u>	<u>FR</u>	<u>SO</u>	<u>JR SR</u>			
Engineering	NA	NA	NA NA	NA	NA	NA NA	NA NA	NA NA	NA NA
Biology	NA	NA	NA NA	NA	NA	NA NA	NA NA	NA NA	NA NA
Chemistry	9	5	3 3	0	0	0 0	4	0	0
Computer Science	58	39	29 25	2	4	1 3	18	4	3
Mathematics	8	5	13 18	1	1	2 2	13	1	1
Physics	1	1	0 1	0	0	0 0	1	0	0
Totals	76	48	47 47	3	5	3 5	36	5	4

<u>Class Year</u>	<u>Mean GPA for all Students</u>	<u>Mean GPA for ONR Students</u>
Freshman	2.3026	3.5180
Sophomore	2.2967	3.1022
Junior	2.7257	3.5000
Senior	2.9360	3.5678

Elizabeth City State University

ELIZABETH CITY, NORTH CAROLINA

MICKEY L. BURNIM, CHANCELLOR

Honors Convocation



*Thursday, April 17, 1997
2:00 o'clock in the afternoon
Moore Hall Auditorium*

Elizabeth City State University is a constituent institution of
THE UNIVERSITY OF NORTH CAROLINA

PRELUDE *'Adagio in g minor'* Tomaso Albinoni
 Dr. Rachel W. Gragson, Organist

Program

Dr. Helen M. Caldwell, *Vice Chancellor for Academic Affairs*
 - Presiding -

INVOCATION The Reverend Derrick Wilkins
Manager, ECSU Academic Computing Center
Graduate, Honors Program

MUSICAL SELECTION *'All The Earth Sing Unto The Lord'* Lena McLin
 The University Choir
 Mr. Billy Hines, *Conductor*

INTRODUCTION OF SPEAKER Miss Laverne Williams
Junior, Honors Program

ADDRESS Dr. Freddie T. Davy
Director of the Honors College
Hampton University, Hampton, Virginia

PRESENTATION OF AWARDS Dr. Rachel W. Gragson
Chairman, Honors Council

Dr. Carol C. Jones
Director, Honors Program
 Miss Dana Wood
Senior, Honors Program

CONGRATULATIONS Dr. Mickey L. Burnim
Chancellor

ANNOUNCEMENTS Miss Trina Payne
Senior, Honors Program

POSTLUDE *'Chorale and Allegro'* Ludwig Boellmann
 Dr. Rachel W. Gragson, Organist

Special Honors Awards

Certificates Presented by the Honors Program - Awarded to all Students for
 Spring Semester, 1995-96 and Fall Semester 1996-97 (as listed)

CHANCELLOR'S DISTINGUISHED EMBLEM AWARDS

Scholar's Blazers

Carmen Bolden Tamara Lewis Benjamin Roberts, Jr. Beatrice Shearn

THE HONORS PROGRAM

Certificates of Merit

Karen Backus	Derrek Burrus	Tamara Hedgebeth	Trina Payne
Stacey Baker	Tanisha Cowell	Nicole Hoffer	Natasha Peters
Chenay Beamon	Stephanie Dance	Crystal Keyes	Phillip Puryear
Felicia Best	Tarsha Darden	Karlton Lane	Alisha Reid
Bonita Boone	Sharmel Edwards	Harold Lawson, Jr.	Jason Riddick
Loukisha Boyd	Corey Ellis	Stacia McFadden	Felicia Saunders
Andrae Brown	Keywonna Everette	Terrica Nelson	Fredrika Simons
Samantha Brown	Judith Fields	Synetheia Newby	Tabetha Summerlin
Shelia Bryson	Steven Gilchrist	Jennifer Nooney	Angel Swimme
			Kenyatta Thomas
			Jarrod Turner
			Ahmad Ward
			Laverne Williams
			Dana Wood

HONORS PROGRAM DARIN L. COLE AWARD Samantha Brown Keywonna Everette
 Tamara Hedgebeth Fredrika Simons

GREEK HONORS CUP Angel Swimme Kenyatta Thomas Laverne Williams

BIOLOGY DEPARTMENT

Clarence E. Biggs Award	Sonya Longest
Evans/Patterson Science Award	Sonya Longest
Herman Cooke Research Excellence Award	Steven Gilchrist
Curtis D. Turnage Award	Karen Oakley
Freshman Achievement Award in Biology	Bettina Holloman Kimberly Knight
Sophomore Achievement Award in Biology	Scott Forbes

BUSINESS AND ECONOMICS DEPARTMENT

Graduating Senior Award	Allie Gladden
Junior Award	Rachelle Holmes
Excellence In Accounting Award	Ruth Thomas
Excellence In Business Education Award	Amy Disbennet
Excellence In Economics & Finance Award	Angela Sneed
Excellence in Management Award	Timothy White
Excellence in Marketing Award	Dana Wood
Excellence in Accounting Education Award	Willie Moore
Wachovia Fund for Excellence Award	Angela Sneed Angela Jennings
Professional Excellence Award - NABA Chapter	Chelsea Rayner
Professional Excellence Award - Phi Beta Lambda	Michelle Lane
Professional Excellence Award - SIFE	Brandon Scott
Becker CPA Scholarship	James McClellan

DIVISION OF EDUCATION

James & Elizabeth Cofield Award	Garrett Taylor Tikisha Joyner Stacey Baker
Charles A. Bryant Scholarship	Crystal Godfrey
Lois W. Green Graduating Senior Award in Teacher Education	Judith Fields
Outstanding Senior in Psychology Award	Diane Han
Outstanding Junior in Psychology Award	Natasha Peters
Outstanding Sophomore in Psychology Award	Jarrod Turner
Outstanding Psi Chi Graduate	Tracia Rountree
Elementary Education Outstanding Academic Performance Award	Stacey Baker Judith Fields Syvillia Futrell Brenda Nash

EDUCATIONAL TALENT SEARCH PROGRAM

Academic Excellence Award	Rocky Allen Nicole Woodard
Exemplary Service Award	Darrick Banks Naomi Pittman Keith Robinson
McNair Scholars Eagle Award	Melvin Anderson Courtney Fields Talesh Lane Tamara McCray
McNair Scholars Challenger Award	Lakishia Mundon Chengee White
McNair Scholars Excellence Without Excuse Award	Charles Gatling Sonya Longest Jamaal Turner Felicia Bowser Warren Judge Karen Oakley Laverne Williams

GENERAL STUDIES DIVISION

Division of General Studies Award	Lakisha Basnight
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GEOSCIENCES DEPARTMENT

Freshman/Sophomore Academic Award	Andre' Dean
Senior Academic Award	Sunday Tinnell

INCENTIVE SCHOLARSHIP PROGRAM

Outstanding Freshman Incentive Scholar	Bettina Holloman
Outstanding Sophomore Incentive Scholar	Scott Forbes, Jr.
Outstanding Junior Incentive Scholar	Angel Swimme
Outstanding Senior Incentive Scholar	Felicia Bowser

LANGUAGE, LITERATURE & COMMUNICATION DEPARTMENT

Graduating Senior Award	Phillip Puryear
E. M. Spellman Award	YuShawnda Thomas

MATHEMATICS & COMPUTER SCIENCE DEPARTMENT

The S. S. Sachdev Senior Award in Mathematics	Brian Jordan
The J. L. Houston Senior Award in Computer Science	Stacia McFadden Felicia Bowser
The Umfort E. Locus Sophomore Award in Computer Science	Nicole Hoffler
The Margaret G. Sharpe Award	Jennifer Felton
NASA-NRTS Service and Achievement Award	Katrina Godwin Kimberly Wright Tamara McCray
Fred Sessoms Shanita Powell Kuchumbi Hayden	Courtney Fields
ONR- Nurturing ECSU Research Program Award	Donald Charity Katrina Godwin Toinette Jenkins Kuchumbi Hayden Tamara McCray Tammara Ward

Office of Naval Research Scholars AwardMelvin Anderson · Derrek Burrus · Curtis Felton
 Courtney Fields · Laverne Williams · Jamaal Turner
 Lakisha Mundon · Fred Sessoms · Felicia Bowser
 Corey Ellis · Arthur Fenner · Charles Gatling
 Brian Jordan · Ayonda Moore · Antonio Rook
 Office of Naval Research Award of ExcellenceStacia McFadden

MUSIC DEPARTMENT

Music Department Award.....Delicia Wright
 Edna Davis Theory AwardBrian Snow
 Florence Folkes Lassiter Award.....Toneika Stephens

PHYSICAL SCIENCES DEPARTMENT

1997 Outstanding Student Chemist AwardAngelina Brown
 Rochelle Cleaners Excellence in Chemistry AwardAngelina Brown
 Physical Sciences Achievement Award.....Angelina Brown · Santiel Creekmore
 Craig Foster · Melinda Lee · Mark Mwaura
 Veronica Overton · Nadirah Shaw · Alethea Swan
 Charles Taft, Jr. · Timeka Whitehead · Scottie Williams

SOCIAL SCIENCES DEPARTMENT

Department of Social Sciences Award.....Carmen Bolden
 Timothy H. Wamack Scholarship.....Kenya Morris
 Butts/Simpson Scholarship.....Beatrice Shearn
 History Excellence Award.....Lee Robinson · Virginia Parker
 Political Science Academic Excellence Award.....William Scott
 Criminal Justice Excellence AwardCarmen Bolden · Melissa Ferrell · Beatrice Shearn
 Sheila Gordon · Synetheia Newby · Andre Howell
 Social Work Excellence AwardCherie Morris · Tracie Owens
 Sociology Excellence Award.....Cheryl Tate

STUDENT AFFAIRS DIVISION

Davis CupNew Complex
 Accepting - Felicia Best
 Honda Campus All-Star Challenge Team.....Harold Lawson, Jr. · James Martin, III
 Shaunell McMillan · Phillip Puryear · Ahmad Ward
 Henrietta B. Ridley Excellence in Leadership Award for 1996.....Antonio Porch
 Henrietta B. Ridley Excellence in Leadership Award for 1997Tamara McCray

STUDENT SUPPORT SERVICES AWARD

Bettina Holloman

TECHNOLOGY DEPARTMENT

Freshman Achievement Award in TechnologyTravis Evans
 Sophomore Achievement Award in TechnologyBarron Neal
 Junior Achievement Award in TechnologyJamaal Turner
 Industrial Technology Faculty Award.....Benjamin Roberts

CLUBS AND ORGANIZATIONAL AWARDS

The Alpha Kappa Alpha Sorority Scholarship
 Zeta Kappa Omega Chapter.....Tamara Hedgebeth
 The Delta Sigma Theta Sorority Scholarship
 Elizabeth City Alumnae Chapter.....Samantha Brown

WHO'S WHO

Travis Albritton
 Karen Backus
 Felicia Bowser ✓
 Loukisha Boyd
 Caprissa Brown
 Samantha Brown ✓
 Angela Burrus
 Zellene Cochran
 Keywonna Everette
 Curtis Felton ✓
 Judith Fields
 Elouise Francis

Charles Gatling ✓
 Julie Gregory
 Wendy Gurganus
 Tamara Hedgebeth
 Christopher Johnson
 Warren Judge
 Lena Kee
 Karlton Lane
 Karen Lowe
 Shayne Martin
 Willie Moore
 Cherie Morris

Tiffany Newell
 Pamela Owens
 Jason Pearce
 Allison Pendleton
 Natasha Peters
 Amy Priest
 Phillip Puryear
 Alisha Reid
 Benjamin Roberts, Jr.
 Francis Sakala
 Joyce Shaw
 Beatrice Shearn

Fredrika Simons
 Priscilla Smith
 Samantha Smith
 Brian Snow
 Angel Swimme
 Kenyatta Thomas
 Corey Tyler
 Ahmad Ward
 Gary Whidbee
 Debbie Wilkins
 Laverne Williams ✓
 Delicia Wright

Chancellor's Distinguished Emblem Award
Spring Semester 1995-96

Kimberly D. Ambrose
Pamela M. Armstrong
Tynoshia D. Barnes
Chenay Beamon
Crystal L. Belfield
Tiffany R. Belfield
Kelvin A. Black
Tonya D. Blair
Carmen T. Bolden
Felica A. Bowser
Tonya M. Brinkley
Lisa C. Chappell
Thomas H. Clifton
Jennifer L. Collins
Tarsha J. Darden
Kesha D. Dukes
Latisha O. Edwards
Trenace N. Fayton
Jennifer F. Felton
Karen A. Fennell
Judith L. Fields
Shawnetta D. Fleming
Scott L. Forbes
Uwezo B. Frazier
Charles L. Gatling ✓
Shawn T. Glasper
Susan M. Goodwin
Kimbala S. Goss
Eules M. Hall
Makesha S. Hinton
Susan M. Hodge
Rachel A. Holmes
Kendric A. Jacson
Louise Jefferson
Christopher K. Johnson
Kristie R. Jordan
April D. Keeter
Keisha M. Kent
Tiesha S. Kirkland
Tanya J. Kuno
Tamara T. Lewis
Sonya B. Longest
Dessalines M. McClure
Stacia L. McFadden ✓
Louis T. Meads

Ayonda D. Moore ✓
Corina R. Morris
Julia A. Motta
Anjanette D. Murphy
Synetheia N. Newby
Katrina M. Nixon
Karen A. Oakley
Trina Y. Payne
Deborah D. Phillips
Sypress J. Preston
Phillip E. Puryear
Tabitha L. Rice
Benjamin G. Roberts, Jr.
Jenny L. Roffo
Jean A. Samuel
Elizabeth B. Sawyer
Summer L. Sayers
Beatrice K. Shearn
Rachael M. Silverwood
Simona L. Simons
Tina D. Slone
Samantha G. Smith
Torie Y. Smith
Erle S. Solesbee
Teia S. Stephenson
Angel P. Swimme
Nakeisha S. Sylver
Charles J. Taft, Jr.
Kenyatta M. Thomas
Corey R. Tyler
Tamika C. Wallace
Kimberly R. Walston
Rebecca L. Walston
Betty T. Waters
Jorice J. Webb
Kimberly A. White
Roslyn R. White
Jenee E. Williams
Laverne S. Williams ✓
Melissa Williams
Raymond A. Williams
Angie L. Winfree
Dana L. Wood
Toni L. Wood

Chancellor's Distinguished Emblem Award
Fall Semester 1996-97

Rocky L. Allen
Karen D. Backus
Valerie W. Banks
Lakisha S. Basnight
Chenay Beamon
Theo N. Bohn
Carmen T. Bolden
Felica A. Bowser ✓
Tammy B. Bray
Tonya M. Brinkley
Nicholas T. Britt
Craig A. Byers
Miles C. Daniels
Tarsha J. Darden
Mark A. Delosreyes
Sharmel D. Edwards
Jo Ann Eiler
Marita C. Elliott
Larry C. Elmore
Jennifer F. Felton
Judith L. Fields
Scott L. Forbes
Monte T. Freeman
Freda J. Garland
Steven L. Gilchrist
Katrina Y. Godwin ✓
Tamara L. Hedgebeth
Bettina S. Holloman
Rachel A. Holmes
Frances E. Hughes
Sadie B. Jernigan
Christopher K. Johnson
Bessie C. Jones
Kristie R. Jordan
Jennie B. King

Kimberly N. Knight
Joseph Kurtzweil
Harold V. Lawson, Jr.
Sonya B. Longest
Ralisha M. Mercer
Stacia L. McFadden ✓
Julie A. Motta
Mark M. Mwaura
Anna W. O'Brien
Virginia G. Parker
Kenneth E. Perry
Karen A. Oakley
Veronica R. Overton
Tracie R. Owens
Trina Y. Payne
Phillip E. Puryear
Benjamin G. Roberts, Jr.
Summer L. Sayers
Beatrice K. Shearn
Casandra L. Smith
Bonnie W. Stroud
Angel P. Swimme
Byron D. Thigpen
Annette K. Tiller
Jamaal Turner ✓
Porchia L. Unthank
Bryan N. Walke
Tamika C. Wallace
Betty T. Waters
Debbie L. Watson
Gary D. Whidbee
Laverne S. Williams ✓
Angie L. Winfree
Delicia A. Wright

Honors Spring Semester 1995-96

Chancellor's List: 3.75 to 4.0 Average

Kimberly D. Ambrose
 Pamela M. Armstrong
 Parsha T. Bacenko
 Tynoshia D. Barnes
 Lee G. Barnhart
 Tammi Bass
 Chenay Beamon
 Crystal L. Belfield
 Tiffany R. Belfield
 Donna H. Bembridge
 Kelvin A. Black
 Tonya D. Blair
 Carmen T. Bolden
 Marsha G. Boniface
 Felicia A. Bowser
 Russell L. Boyd
 Anya M. Brinkley
 Marjeth L. Capraro
 Maria Leona Casey
 Samuel D. Chambers
 Lisa C. Chappell
 Cheryl L. Cherry
 Thomas H. Clifton
 Zylene S. Cochran
 Adam M. Collins
 Jennifer L. Collins
 Louise I. Crowait
 Karl B. Dail
 Tarsha J. Darden
 Kimberly J. Denby
 Keshia D. Dukas

Debra L. Eason
 Brenda O. Edwards
 Latisha O. Edwards
 Trenace N. Fayton
 Jennifer F. Felton
 Karen A. Fennell
 Melissa J. Ferrell
 Judith L. Fields
 Shawnetta D. Fleming
 Tywaz B. Forbes
 Uwazo B. Frazier
 Charles L. Gating
 Donna P. Gilbird
 Allie B. Gladden
 Shawn T. Glasper
 Deborah B. Goodman
 Ann H. Goodwin
 Susan M. Goodwin
 Shelia P. Gordon
 Kimbala S. Goss
 Karen A. Griffin
 Lorene R. Grunwald
 Rachel Marie S. Haines
 Euluss M. Hall
 Diane M. Han
 James W. Hardy
 Katherine B. Harrison
 Jacqueline R. Head
 Makesha S. Hinton
 Susan M. Hodge
 Ruby M. Holder

Rachel Ann Holmes
 James M. Hunsinger
 Kendric A. Jackson
 Louise Jefferson
 Angela M. Jennings
 James W. Jernigan, Jr.
 Christopher K. Johnson
 Lisa M. Johnson
 William D. Johnson
 Meri L. Jolin
 Heather W. Jones
 Kristie R. Jordan
 Warren D. Judge
 Joelle M. Karout
 April D. Keeter
 Robert H. Kelley
 Keisha M. Kent
 Mary K. Kincaid
 Rebecca U. Kirkbride
 Tiesha S. Kirkland
 George F. Koch, III
 Lynn A. Kotzian
 Tanya J. Kuno
 Michelle M. La Hair
 Sharon R. Lanneau
 Elaine M. Lawson
 Linda S. Lenau
 Nathan A. Leonard
 Tamara T. Lewis
 Dennis E. Linney
 Sonya B. Longest

Karen B. Lowe
 Deanna L. Marshall
 Christl T. Martin
 Shayne Martin
 Dessalines M. McClure
 Stacia L. McFadden
 Michael J. McMahon
 Louis T. Meads
 Cherrie A. Meredith
 Jeffrey E. Mickewski
 Paula W. Micky
 Tracy S. Mitchell
 Ayonda D. Moore
 Corina R. Morris
 Julie A. Motta
 Michael Munoz
 Anjanette D. Murphy
 Rebecca L. Myers
 Lynn E. Needham
 Syntheia N. Newby
 Judith A. Newsome
 Katrina M. Nixon
 Crystal Norton
 Karen A. Oakley
 Mary C. Owen
 Trina Y. Payne
 Valerie T. Paterson
 Deborah D. Phillips
 Sypress J. Preston
 Robert W. Privott
 Jennifer S. Pugh

Dondrea M. Purnell
 Phillip E. Puryear
 Tabitha L. Rice
 Benjamin G. Roberts, Jr.
 Lee T. Robinson
 Mary J. Rodgers
 Jenny L. Roffo
 Amy J. Ross
 Gladys H. Russell
 Jean A. Samuel
 Elizabeth B. Sawyer
 Summer L. Sayers
 Aleealynn H. Schenesty
 Charlotte A. Schoen
 Cliff R. Schweitzer
 William E. Scott, Jr.
 Shawn T. Sewell
 Harriet H. Shannon
 Beatrice K. Shearn
 Simona L. Simons
 Paula J. Simpson
 Tina D. Stone
 Samantha G. Smith
 Torie Y. Smith
 Erle S. Solesbee
 Katherine G. Soria
 Ann D. Spivey
 Robin T. Stallings
 Anita G. Staples
 Teia S. Stephenson
 Gene A. Stovall

Sandy D. Stroberg
 April M. Swift
 Angel P. Swimme
 Nakesha S. Sylvester
 Charles J. Talt, Jr.
 Cheryl L. Tate
 Albert L. Thomas
 Kenyatta M. Thomas
 Ruth D. Thomas
 Neema G. Tilley
 Sunday K. Tinnell
 Corey R. Tyler
 Tamika C. Wallace
 Kimberly R. Walston
 Rebecca L. Walston
 Trisha D. Walton
 Betty T. Waters
 Jorice J. Webb
 Cheryl D. Welch
 Diane C. Wnedbee
 Kimberly A. White
 Luanora W. White
 Melissa W. White
 Roslyn R. White
 Kenya L. Whittington
 Jenee E. Williams
 Laverne S. Williams
 Melvin L. Williams, Jr.
 Raymond A. Williams
 Angie L. Winifree
 Dana L. Wood
 Toni L. Wood

Vice-Chancellor's List: 3.50 to 3.74 Average

Floyd C. Adams
 Travis J. Albritton
 Kewanna F. Alexander
 Virginia L. Ambrose
 Diane E. Andersen
 Stacey L. Baker
 Amy C. Banks
 Anjanette R. Barnes
 Crystal L. Barnes
 Marcy L. Bergman
 Heather L. Biggs
 Demitrious R. Blount
 Dawn M. Boncek
 Irma H. Bonner
 Bonita L. Boone
 Kimberly S. Booth
 Kimberly D. Brothers
 Capriessa S. Brown
 Kimberly R. Bunch
 Lekesha D. Burge
 Bobby Burrus
 Tarsha R. Calhoun
 Jackie B. Cameron

Jennifer L. Capps
 Pamela W. Chamblee
 Annette E. Cherry
 Melissa W. Colombo
 Miles C. Daniels
 Amy Dawn Disbennett
 Twynisha Dorsey
 Edward L. Dula
 Tonya N. Eason
 Cheryl D. Estemon
 Sharmel D. Edwards
 Michelle M. Ellinwood
 Curtis W. Felton
 Janet R. Ferrall
 Michael G. Fields
 Coletta R. Fleming
 Elouise Francis
 John C. Gambrell
 Chonda S. Gayle
 James C. Gibbons
 Robert C. Golden
 Crystal D. Goodwin
 Mary C. Griffin

Wendy S. Gurganus
 Lynette M. Hall
 Marlon D. Hall
 Keisha Harrell
 Barbara D. Hines
 Nicole M. Hoffer
 Zabrina Y. Hoggard
 Sonya L. Hollay
 Jermon L. Holloman
 Melvin C. Hooker
 Andra T. Howell
 Stephanie C. Johnston
 Hope Y. Jones
 Sheretta L. Jones
 Tara L. Jones
 Lena L. Kee
 Gary W. Kehner
 Ray V. Keyes, Jr.
 Tracey E. Kinsey
 Vickie L. Lambert
 Karlton L. lane
 Carole B. Lawrence
 Norma G. Lawson

Carol A. Lewis
 Jenee M. Lewis
 Forrest W. Liverman
 Jamie C. Liverman
 William E. Luton
 Adam L. McGough
 Bryan I. Mitchell
 Juanita T. Mitchell
 Mario O. Moore
 Willie D. Moore
 Andra C. Morris
 Lakisha D. Mundern
 Mark M. Mwaura
 Tracy L. Nixon
 Lebechi A. Njoku
 Linda A. Njoku
 Andre C. Norwood
 Thanh V. On
 Tracie R. Owens
 Lillie B. Pailin
 Jason C. Pearce
 Judy E. Pearson
 Priscilla Perry

Nakisha D. Powell
 Nakia K. Pride
 Eric B. Quidley
 Tamara D. Rainey
 Alisha M. Reid
 Brandi Richardson
 Jason M. Riddick
 Latonia S. Riddick
 Courtney E. Robinson
 Nicole M. Robinson
 Marcenda J. Rogers
 Francis S. Sakala
 Bonnie S. Scarborough
 Crystal W. Schultz
 Daniel L. Smith
 Stacy M. Smith
 Fennessa L. Spruill
 Loryn M. Stevens
 Taburica R. Stewart
 Debbie K. Strawhand
 Bonnie W. Stroud
 Jannifer H. Sykes
 Varick T. Taylor

Edwana N. Thompson
 Jamaal Truner
 Jarrod W. Turner
 John R. Turner, Jr.
 Robin T. Turner
 Godwin C. Umozurike
 Brenton E. Underwood
 Bryan N. Waikie
 Celeste N. Wallace
 Ahmad T. Ward
 Tracy T. Webb
 Karin M. Whedbee
 Kimberly L. White
 Florie B. Wigelsworth
 Julia R. Wilkins
 Marlo L. Wilkins
 Ene G. Williams
 Xanda M. Williams
 Craig L. Woodward
 Vincent L. Wright

Honor List: 3.00 to 3.49 Average

Ever Alam
 Stephanie F. Alexander
 Lesley K. Alligood
 Natasha M. Ames
 Jennifer L. Amstutz
 David B. Andre
 Otika C. Archer
 Sharon C. Armstead
 Karen D. Backus
 Brian D. Baker
 Mary A. Baker
 Darrick J. Banks
 Elizabeth A. Banks
 Melody Banks
 Charles E. Barber
 Juliene Barragan
 Lisa A. Battle
 Jennifer M. Beatley
 Charles Belfield
 Latasha S. Bembury
 Raymond D. Bennett, II
 Alayna D. Benson
 Brenda D. Best
 Felicia N. Best
 Kimmi M. Birth
 Toney B. Black
 Chanda L. Blount
 Regina Blount
 Myra W. Blow
 April E. Bond
 Krystal P. Bond
 Khysa P. Bond
 Anita Boone
 Monique Boyce
 Larita M. Boyd
 Loukisha R. Boyd
 Vicky L. Braddy
 Betsy M. Bradley
 Patricia P. Brewer
 Jerome R. Britz, III
 Andrae' L. Brown
 Angelina M. Brown
 Pamela L. Brown
 Ivonne Brown
 Patrick L. Bryant
 Shelia T. Bryson
 Kendra Y. Bunch
 Lisa G. Bunch
 Kevin E. Burchette
 Kristi L. Burgess
 Angela Burrus
 Derrek W. Burrus
 Edgar C. Burstn
 Sabrina Butts

Tanya C. Chalk
 James W. Cherry, II
 Kimberly N. Cherry
 Latonya L. Cherry
 Kisha L. Clark
 Vickie B. Colfield
 Divern M. Combs
 Robert L. Comstock, Jr.
 Charna A. Cooper
 Keisha N. Cooper
 George D. Copeland
 Brent P. Council
 Tanisha S. Cowell
 Aaron B. Cox
 Marcus L. Croom
 Claire E. Culbreth
 Tammie S. Currie
 Stacey N. Curry
 Stephanie T. Dance
 Kisha La'Rae Darden
 Kenneth L. Davenport
 Regina Y. Davis
 Shondalyn L. Dawson
 Clarence Dickerson
 Adrian D. Dixon
 Keisha N. Douglas
 Felicia A. Downing
 Jacqueline G. Duncan
 Brandon A. Egerton
 Jo Ann Eller
 Re'ne L. Eller
 Larry C. Elmore
 Marjie L. English
 Lakira S. Evans
 Lynn R. Evans
 Keywonna S. Everette
 Cleveland S. Faison, Jr.
 Lavonna M. Felton
 Arthur L. Fenner
 Amy Ferber
 Nekesha D. Farebee
 Tracey M. Farebee
 Tyus S. Few, III
 Carrie J. Fledorczyk
 Juanita G. Figgs
 Kisha A. Figgs-Melton
 Ralph S. Flowers
 Abdoulaye Fofana
 William F. Folkes
 Wendy D. Forbes
 Kirk A. Fox
 Makeba Fussell
 Syvillia M. Futrell
 Tanisha H. Gabriel

Cherise S. Gardner
 Patricia Y. Garner
 Barbara G. Gibbs
 Steven L. Gilchrist
 Stephanie J. Gilliam
 Veronica L. Goddard
 Crystal O. Godfrey
 Shirley J. Godfrey
 Keashia T. Green
 Charlotte S. Gregory
 Julie H. Gregory
 Michelle N. Grier
 Tresha R. Griffin
 Kimberly L. Grover
 Charles C. Gunnings
 Janet L. Hall
 Natalia J. Hall
 Laura E. Hanusik
 Earnest Harris
 Reginald M. Harris
 Shantelle E. Harvey
 Treenice C. Hassell
 Nykeeya R. Hatten
 Rose M. Hawkins
 Kuchumbi L. Hayden
 Karen M. Hayes
 Tamara L. Hedgebeth
 Shina D. Hemingway
 Isaac M. Hendrix
 Inez T. Hoston
 Kimberly A. Hunter
 Nataniel D. Isaac
 Hope M. Jackson
 Cherelle K. Jenkins
 Hope F. Jennings
 Janet L. Jernigan
 Sadie B. Jernigan
 Denise Johnson
 Tajima S. Johnson
 Clarence M. Jones, Jr.
 Harvey R. Jones, Jr.
 Jermaine D. Jones
 Joyce S. Jones
 Kevin R. Jones
 Sharlene R. Jones
 Sharon R. Jones
 Christie L. Kearney
 Eugenia A. Kee
 Herman L. Kemp
 Crystal Keyes
 Jennie B. King
 Castity J. Kinsey
 Shondrieka N. Lamb
 Bobby J. Lane

Antoine C. Lassiter
 Shakellar L. Lassiter
 Harold V. Lawson
 Latonya N. Lee
 Thomas E. Lee
 Nelly M. Leigh
 Jacob C. Leonard
 Brian A. Lewis
 Troy L. Lewter
 Cynthia D. Lister
 Chiantil M. Lloyd
 Linda F. Logan
 Tonya F. Lyons
 Kenneth E. Mabine
 Kevin R. Markham
 Michael G. Marshall
 James C. Martin
 Anthony A. Mason
 Kenny L. May
 Lavonne L. McClain
 Carlos R. McCormick
 Elizabeth A. McGhee
 Trell D. McNeil
 Chantay P. McNeil
 Eunice I. Meekins
 Michelle L. Meketi
 Demetrius D. Melton
 Ralisha M. Mercer
 April C. Molett
 Barry D. Monk
 Cynthia B. Moore
 Dominique C. Moore
 Dovella P. Moore
 Elton K. Moore
 Gerald C. Moore
 Charmaine D. Morgan
 Leslie L. Morgan
 Kenya Morris
 Michael D. Morris
 Eric D. Mountain
 Janice D. Mudge
 Latisha D. Murphy
 Latoya S. Murphy
 Barron Neal
 Terrica D. Nelson
 Ronnell D. Nobles
 Jennifer G. Nooney
 Tonya A. Norman
 Ginger H. O'Neal
 Trequita D. Overton
 Ramona L. Patrick
 Takisha Q. Peacock
 Jaime S. Pele
 Allison F. Pendleton

Natasha D. Peters
 Courtney N. Phillips
 Dana C. Phillips
 Jason K. Pipkin
 Cindy L. Powell
 Eric W. Powell
 Kenisha L. Powell
 Latasha R. Powell
 Gwendolyn R. Poyner
 Regina G. Price
 Tangi S. Price
 Traci L. Pritchard
 Donetta R. Privott
 Pamela O. Ransom
 Debra M. Raymond
 Peritha Redmond
 Shena L. Reed
 Dedric S. Reid
 Rosa D. Riddick
 Tamika D. Riddick
 Thomas D. Ritchie
 Edward K. Rivers
 Christopher L. Roberts
 Aquita C. Robinson
 Keith L. Robinson
 Troy L. Robinson
 Eunice M. Rogers
 Isaac C. Rogers
 Antonio D. Rook
 Kendra L. Rouse
 Lashonda D. Ryan
 Pete E. Salitore
 Stefanica D. Saunders
 Shericka N. Sawyer
 Fred S. Sessoms
 Pamela E. Shannon
 Donna E. Shaw
 Melanie S. Shaw
 Latoya B. Sheard
 Fredrika C. Simons
 Alton Simpson, Jr.
 Casandra L. Smith
 Jason W. Smith
 Kelli S. Smith
 Angela D. Sneed
 Brian P. Snow
 Ernest B. Snow, Jr.
 Tricia L. Speller
 Tonda E. Spellman
 Elbretia M. Spencer
 Josephaina A. Spruill
 Leigh A. Spruill
 Latonya A. Square
 Lisa A. Staton

Crystal I. Streeter
 Tabetha L. Summerlin
 Latangia R. Sutton
 Nikita C. Sutton
 Sheva V. Tate
 Cher D. Taylor
 Jose F. Taylor
 Reshamah D. Taylor
 Taneka S. Taylor
 Andrea C. Temple
 Felicia D. Thigpen
 Sherri L. Thorpe
 Annette K. Tiller
 Drederick R. Tripp
 Reginald D. Turner
 Robert E. Turner
 Bridget R. Twine
 Marquita M. Valentine
 Donald D. Van De Walker
 Douglas J. Vann
 Vanessa B. Vinson
 Debra L. Wade
 Nekia D. Walker
 Reequita B. Warston
 Chirshonda A. Walters
 Darlene M. Walton
 Nikki S. Walton
 Sephina Walton
 Bernese Ward
 Gwendolyn Y. Ward
 August W. Ward
 Gary D. Warren
 Vickie M. Warren
 Tandra L. Warren
 Chenege E. Warren
 Melissa E. Warren
 Bryant L. Warren
 Rhonda S. Warren
 Debbie S. Warren
 Alfreda R. Warren
 Charles R. Warren
 Janice A. Warren
 Kimberley A. Warren
 Ronald C. Warren
 Terri S. Warren
 Constanza A. Warren
 Michelle A. Warren
 Lancelot A. Warren
 Faith A. Warren
 Tara S. Warren
 Delina A. Warren
 Sharon A. Warren

Honors Fall Semester 1996-97

Chancellor's List: 3.75 to 4.0 Average

Rocky ... Allen
 Karen P. Arizmendi
 Marsha T. Bacenko
 Karon D. Backus
 Valerie W. Banks
 David A. Bartley
 Lakisha S. Bashlight
 Tammi Bass
 Chonay Beamon
 Philip M. Belfield
 Thomas L. Blevins
 Theo N. Bohn
 Carmen T. Bolden
 Susan J. Bourassa
 Felicia A. Bowser
 Russell L. Boyd
 Tammy B. Bray
 Tonya M. Brinkley
 Nicholas T. Britt
 Craig A. Byers
 Larry T. Cobb, II
 Zellene S. Cochran
 Abby R. Corpwe
 Louise I. Croswait
 Karl B. Dail
 Miles C. Daniels
 Tarsha J. Darden

Cynthia R. Dashiell
 Mark A. Delosreyes
 Erica S. Derr
 Ronda L. Dorsey
 Lisa B. Earley
 Debra L. Eason
 Sharmel D. Edwards
 Jo Ann Eller
 Michelle M. Elinwood
 Marita C. Elliott
 Larry C. Elmore
 Sandy R. Farrow
 Jennifer F. Felton
 Melissa J. Ferrell
 Judith L. Fields
 Scott L. Forbes
 Mark K. Foster
 Renee W. Foy
 Patricia A. Frazier
 Monte T. Freeman
 Mary E. F. Friedman
 Freda J. Garland
 James C. Gibbons
 Donna P. Gilbird
 Steven L. Gilchrist
 Allie B. Gladden
 Katrina Y. Godwin

Ann H. Goodwin
 Karen A. Griffin
 Patricia S. Hall
 Deborah A. Hamon
 Diane M. Han
 Katherine B. Harrison
 Michael W. Hawkins
 Jacqueline R. Head
 Tamara L. Hedgebeth
 Mary S. Hobbs
 Susan C. Hoggard
 Bettina S. Holloman
 Rachel A. Holmes
 Melvin C. Hooker
 Andrew T. Howell
 Frances E. Hughes
 James M. Hunsinger
 Melissa R. Jackson
 Angela M. Jennings
 Sandie B. Jennigan
 Christopher K. Johnson
 Lisa M. Johnson
 William D. Johnson
 Stephanie C. Johnston
 Meri L. Jolin
 Bessie C. Jones
 Heather W. Jones

Kristie R. Jordan
 Warren D. Judge
 Sheryl A. Keagy
 Jennie B. King
 Rebecca U. Kirkbride
 Kimberly N. Knight
 Joseph Kurtzweil
 Prescott P. Lawrence
 Elaine M. Lawson
 Harold V. Lawson
 Pam C. Leary
 Sonya B. Longest
 Karen B. Lowe
 Andrea D. Malik
 Christl T. Martin
 Shayne Martin
 Susan S. McClanahan
 James K. McClellan
 Stacia L. McFadden
 Raisha M. Mercer
 Cherrie A. Meredith
 Tracy S. Mitchell
 Cherie A. Morris
 Julie A. Mutta
 Arvin Q. Mullen
 Mark M. Mwaura
 Brenda S. Nash

Judith A. Newsome
 Anna W. O'Brien
 Karen A. Oakley
 Veronica R. Overton
 Mary C. Owen
 Tracie R. Owens
 Virginia G. Parker
 Trina Y. Payne
 Judy E. Pearson
 Kenneth E. Perry
 Cynthia M. Pritchard
 Traci L. Pritchard
 Robert W. Privott
 Jennifer S. Pugh
 Michael D. Pugh
 Phillip E. Puryear
 Benjamin G. Roberts, Jr.
 Lee T. Robinson
 Shellee R. Rust
 Summer L. Sayers
 Mary E. Schuster
 Cliff R. Schweitzer
 William E. Scott, Jr.
 Beatrice K. Shearn
 Casandra L. Smith
 Brian P. Snow
 Katherine G. Soria

Letitia L. Stevens
 Bonnie W. Stoud
 Angel P. Swimme
 Cheryl L. Tate
 Byron D. Thigpen
 Ruth D. Thomas
 Annette K. Tiller
 Sunday K. Tinnell
 Jamaal Turner
 Porchia L. Unthank
 Bryan N. Walke
 Tamika C. Wallace
 Betty T. Waters
 Debbie L. Watson
 Gary D. Whidbee
 Timothy D. White
 Marlo L. Wilkins
 Laverne S. Williams
 Pam M. Williams
 Xanda M. Williams
 Angie L. Winfree
 Deicia A. Wright

Vice-Chancellor's List: 3.50 to 3.74 Average

Floyd C. Adams
 Monica D. Alexander
 Virginia L. Ambrose
 Diane E. Andersen
 Vivian A. Baars
 Amy C. Banks
 Sherry L. Bedsole
 Tiffany R. Belfield
 Demitrous R. Blount
 Myra W. Blow
 Monique L. Boyce
 Floyd G. Bracy
 Betsy M. Bradley
 Rodshawn L. Branch
 Kathleen J. Brooks
 Angelina M. Brown
 Caprissa S. Brown
 Samantha L. Brown
 Tahwana M. Burks

Bobby Burrus
 Sabrina Butts
 Beth A. Carpenter
 Donald D. Charity, Jr.
 Kristy S. Collins
 Melissa W. Colombo
 Michael A. Cox
 Claire E. Culbreth
 Tammie S. Currie
 Lisa V. Davis
 Samuel S. Davis, III
 Andre' D. Dean
 Jason C. Denham
 Terry M. Edwards
 Brandon A. Edgerton
 Travis R. Evans
 Janet R. Farrell
 Kisha A. Figgs-Melton
 Ralph S. Flowers

Elouise Francis
 Clarrissa E. Freshwater
 Makeba Fussell
 Ernestine Futrell
 Kathleen D. Gaither
 Melinda F. Gates
 Charles L. Gating
 Joyce A. Godwin
 Lorene R. Grunwald
 Wendy S. Gurganus
 Bethaney L. Hague
 Charisse M. Harney
 Carisa J. Harrell
 Nicole M. Hoffer
 Nathaniel D. Isaac
 Norma F. Jeffcoat
 Alicia M. Jones
 Joyce S. Jones
 Nathaniel L. Jones

Sheretta L. Jones
 Lena L. Kee
 Gary W. Kehner
 Lecia King
 Karlton L. Lane
 Nathan A. Leonard
 Linda F. Logan
 Irving Long
 James C. Martin
 William K. Martin
 Sharon C. Meads
 Paula W. Mickel
 Levar D. Mizelle
 Rufus A. Moore
 Willie D. Moore
 Charmaine D. Morgan
 Rebecca L. Myers
 Terrica D. Nelson
 Diamond L. Nollan

Jennifer G. Nooney
 Crystal Norton
 Kendra L. Parker
 Robin B. Pavey
 Thomas E. Perry
 Dana C. Phillips
 Jason K. Pipkin
 Tangi S. Price
 Mashawnda E. Razor
 Alisha M. Reid
 Susan E. Roberts
 Courtney E. Robinson
 Paul I. Rose
 Pete E. Salitore
 Felicia A. Saunders
 Elizabeth G. Sawyer
 Franklin G. Scott, Jr.
 Joycel L. Smith
 Priscilla A. Smith

Samantha G. Smith
 Angela D. Sneed
 Donna T. Stiles
 Karen S. Stokley
 Amy W. Taylor
 Reshamah D. Taylor
 Vanck T. Taylor
 Felicia D. Thigpen
 Vernecia V. Fcwnes
 Alvin Trotman
 Donald D. Van De Walker
 Rebecca L. Walston
 Theresa L. Walter
 Matthew W. Waymack
 Kathryn R. Wiborg
 Rhonda S. Wiggins
 Enetra N. Williams
 Pamela P. Williams
 Tiki T. Windley

Honor List: 3.00 to 3.49 Average

Travis J. Albritton
 Lesley K. Alligood
 Kimberly D. Ambrose
 Jennifer L. Amstutz
 Melvin L. Anderson
 Michael A. Arizmendi
 Sharon C. Armstead
 Pamela M. Armstrong
 Marsha T. Atkins
 Stephanie W. Bailey
 Crysta L. Banks
 Tynoshia D. Barnes
 Sophona A. Barrett
 Lisa A. Battie
 Jennifer M. Beatley
 Darrell L. Bell
 Charles L. Berry
 Heath L. Biggs
 Natarsha Y. Bloomfield
 Crystal R. Bond
 Khesa P. Bond
 Milton T. Bond
 Jonathan B. Bonner
 Latausha M. Boone
 Tru'Vonda E. Boone
 Valerie D. Bouldin
 Quinterlene C. Bowen
 Joshua S. Boyd
 George T. Branch
 Patricia P. Brewer
 Joy H. Brickhouse
 Jacqueline R. Britt
 Otelia F. Brooks
 Christine S. Buell
 Richard S. Bullock
 Kimberly R. Bunch
 Tinika L. Bunch
 Kristi L. Burgess
 Justin J. Burk
 Angela Burrus
 Derrek W. Burrus
 Jameka L. Cameron
 Karen M. Carver
 John J. Chapman
 Annette E. Cherry
 Ivy V. Cherry
 Kimberly N. Cherry
 Adam M. Collins
 Kivera M. Combs
 Lucy B. Cooper
 Sharon D. Cooper
 Erma R. Copeland

George D. Copeland
 Wanda P. Currin
 Giner S. Davenport
 Kenneth L. Davenport
 Uyless M. Dewberry, Jr.
 Linda L. Dietzway
 Danielle N. Drew
 Felicia N. Drew
 Robin J. Duckett
 Jody J. Dunlap
 Pamela S. Sunn
 Rose H. Eakings
 Peter M. Eley
 Re'ne L. Eller
 Corey M. Ellis
 Arlinda F. Ellison
 Marjie L. English
 Raymond J. Epps
 Keywonna S. Everette
 Curtis W. Felton
 Tracey M. Ferebee
 Courtney D. Fields
 Michael A. Fipps
 Coletta R. Fleming
 Wendy D. Forbes
 Craig P. Foster
 Kirk A. Fox
 Syvillia M. Futrell
 John C. Gambrell
 Edward P. Garner
 Robert C. Golden
 Clarence E. Goss, Jr.
 Tanya S. Granger
 Benjamin C. Gray, Jr.
 Keashia T. Green
 Julie H. Gregory
 Melvin Griffin
 Bret M. Grubb
 Kimberly L. Gruver
 Rachel Marie S. Haines
 Stephanie A. Haith
 Eules M. Hall
 Tamara J. Ham
 Tami S. Harper
 Keisha Harrell
 Keisha L. Harris
 Danielle Harrison
 Andrea S. Harvey
 Elnora Harvey
 Treneice C. Hassell
 Rose M. Hawkins
 Kuchumbi L. Hayden

Bobbie J. Hayman
 Antwane Heckstall
 Issac M. Hendrix
 Nikki S. Heyward
 Barbara D. Hines
 Kimberly T. Hines
 Lashauna K. Hinton
 Susan M. Hodges
 Shanise L. Holder
 James A. Jacobs
 Cherelle K. Jenkins
 Toinette T. Jenkins
 Dollette M. Johns
 Denise Johnson
 Tajima S. Johnson
 Brian A. Jones
 Harvey R. Jones, Jr.
 Hope Y. Jones
 Kevin H. Jones
 Kevin R. Jones
 Maris D. Jones
 Tyrone Jones
 Yvette M. Jones
 Brian N. Jordan
 Ta-Tanisha D. Jordan
 Neil A. Jordan
 Quinton M. Joyner
 Sheri D. Joyner
 Tikisha R. Joyner
 Rodriquez L. Kee
 Robert H. Kelley
 Crystal Daves
 Charles A. Lamb
 Shondrieka N. Lamb
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 Tetesh L. Lane
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 Tanacia C. Lee
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 Michael E. Lewis
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 Ayonca D. Moore
 Elton K. Moore
 Gerald C. Moore
 Tyrell L. Moore
 Kenya L. Morris
 Malanie M. Mute
 Michael Munoz
 Latisha D. Murphy
 Tamisha S. Murphy
 Tiffany M. Newell
 Ronnell D. Nobles
 Letisha Nowell
 Giner H. O'Neal
 Thanh Van On
 Aha O. Opoku
 Toni S. Padgett
 Lillie B. Pailin
 Kim S. Palmer
 Damon L. Parker
 Amy Parks
 Jaime S. Peele
 Melissa G. Pendleton
 Clinton M. Perli
 Shawanna Person
 Tonya R. Person
 Valerie T. Person
 Brian K. Phelps
 Teri S. Phitsich
 Naomi R. Pittman
 Shonda P. Pittman
 Brenda D. Powell
 Sypress J. Preston
 Amy G. Priest
 Eric B. Quidley
 Monica L. Rascoe
 Chelsa T. Raynor
 Monica M. Razor
 Dedic S. Reid
 Jason M. Riddick

Thomas W. Riddick
 Marcus D. Ritchie
 Katina L. Roberts
 Bonita J. Robinson
 Peter J. Rodrigues
 Jenny L. Rolfo
 Isaac. C. Rogers
 Polly J. Rollinson
 Antonio D. Rook
 Jennifer Ross
 Tracia C. Rountree
 Rashaud R. Rucker
 Francis S. Sakala
 Stephanie L. Scales
 Fred S. Sessoms
 Rhonda D. Sessoms
 Brenda A. Seymour
 Nadirah L. Shaw
 Fredrika C. Simons
 Tina D. Stone
 Kelli S. Smith
 Stacy M. Smith
 Torie Y. Smith
 Ernest B. Snow, Jr.
 Spanishia D. Spragley
 Josephaina A. Spruill
 Tamika Y. Spruill
 Yulanda N. Squire
 Shirely M. Stallings
 Eric W. Staten
 Danuail F. Stewart
 Everett J. Stewart
 Debbie K. Strawhand
 Crystal I. Streeter
 Tabwetha L. Summerlin
 Stephanie M. Sutton
 Alethea L. Swan
 Tavin L. Tate
 Tishania A. Tatem
 Benjamin M. Taylor
 Garrett T. Taylor
 Andrea C. Temple
 Yram S. Terry
 Kenyatta M. Thomas
 Luciana I. Thomas
 Yushawnda R. Thomas
 Terrance W. Thornton
 Blair B. Todd
 Jarrod W. Turner
 Nikki D. Vinson
 Nekia D. Walker

Darlene M. Walton
 Sandra J. Walton
 Sephina Walton
 Ahmad T. Ward
 Lynda J. Ward
 Raymond L. Weaver
 Twan D. Weaver
 Donald K. Webb, II
 Ryan R. Webber
 Diane C. Whedbee
 August V. Whidbee
 Shaketa D. Whitaker
 Tandeka L. Whitaker
 Chengee B. White
 Odell M. White
 Ronald K. White
 Stacy L. White
 Clifford C. Whitehurst
 Gienna M. Whitehurst
 Lisa Whitehurst
 Gloria B. Wiggins
 Debbie N. Wilkins
 James A. Wilkins
 Ailreda R. Williams
 Anton Williams
 Dawn N. Williams
 Ebonie L. Williams
 June G. Williams
 Ronald D. Williams
 Scottie O. Williams
 Tanisha R. Williams
 Tasha L. Williams
 Timothy G. Williams
 Jay Garrett Winslow
 Justin R. Winslow
 tancelot D. Winslow
 Shaquita E. Winslow
 Faith Y. Winston
 Xavier K. Wise
 Dana L. Wood
 Washuri N. Woodard
 Colin R. Woodley
 James A. Workack
 Kimberly L. Wright
 Sharon A. Wright
 Tabitha S. Wright
 Vincent L. Wright
 Christopher S. Yacobi
 Matthew D. Yelverton

Graduate Success Program Results

<u>Name</u>	<u>University</u>	<u>Degree Sought/Earned</u>
Jovita Harrell	Hampton	Masters Computer Science
Renee Basnight	Hampton	Masters Computer Science
Chonda Gayle	Hampton	Masters Computer Science
Eva Dail Koltuniak	Hampton	Masters Computer Science
Tim McCray	Hampton	Masters Computer Science
Sharon Saunders	Hampton	Masters Computer Science
Michelle Brown-Emmanual	Hampton	Masters Computer Science
Stephanie Vaughan	Hampton	Masters Computer Science
Cathy Thomas	Ohio State	Masters Computer Science
Felicia Bowser	NC State	Masters Computer Science
Clarence Jones	Hampton	Masters Physics
Michael Fields	Old Dominion	Masters Computer Science
Bonnie Gardner	Maryland	Masters Computer Science
Stacia McFadden	Michigan	Masters Computer Science
Cultilda Monk	Fayetteville	Math Education

Nurturing ECSU Research Talent (NERT) Program

Sponsored by
Elizabeth City State University
Office of Naval Research

Tuesday April 22, 1997 5:00 pm 116 LH

Fractals & Chaos Research Team

Dr. D. Sengupta, Mentor
Donald Charity, Fr/Math
Corey Ellis, Jr/Applied Math
Brian Jordan, Sr/Applied Math
Ayonda Moore, So/Applied Math
Tammara Ward, Jr/Math
Lakisha Mundon, So/Math

HTML/JAVA

Dr. L. Hayden, Mentor
Mrs. T. Chamberlain, Mentor
Courtney Fields, So/CS
Kuchumbi Hayden, So/CS
Katrina Godwin, Fr/CS
Shakiya Rodgers, Fr/CS

Statistical Analysis

Dr. M. Mannan, Mentor
Tamara McCray, Jr/Applied Math
Arthur Fenner, Jr/Math
Toinette Jenkins, Fr/CS

Thursday April 24, 1997 5:00 pm 116 LH

ATM Networks

Dr. L. Hayden, Mentor
Mr. D. Archer, Mentor
Curtis Felton, Jr/CS
Derrek Burrus, So/CS
Antonio Rook, So/CS
Fred Sessoms, Jr/CS
Stacia McFadden, Sr/CS
Charles Gattling, Jr/CS
Melvin Anderson, Jr/CS
Jamaal Turner, Jr/Ind Tech

Visualization

Dr. K. Edoh, Mentor
Felicia Bowser, Sr/CS
Laverne Williams, Jr/CS

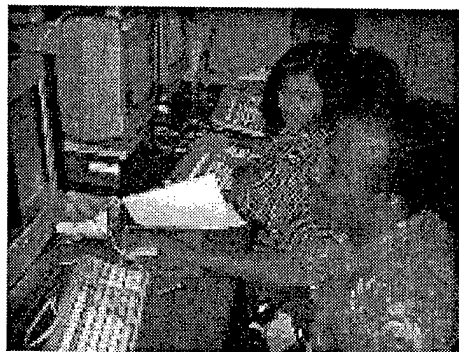
ONR Final Research Team Reports



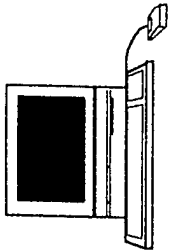
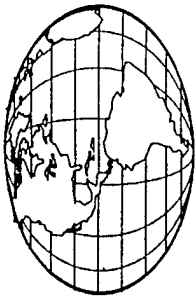
*Computer Visualization
Team Report*

Computer Visualization Team

The focus of the computer visualization research is use of data explorer visualization software running on a silicon graphics workstation. Students run visualizations on NASA and chemistry data sets. Visiting Lecture will be presented by Sharon Ramsey, visualization specialist from Alcoa Aluminum Co. Review of the literature will include chapters from *Animation and Scientific Visualization: Tools & Applications*, Edited by R A Earnshaw and D. Watson, Academic Press, 1993. ISBN 0-12-227745-7. References will also include *Communications of the ACM* Dec'94, vol. 37, no 12 p 29-102.



Dr. K. Edoh
Team Mentor

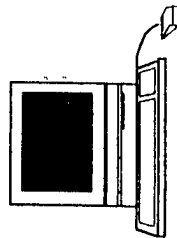


1996-97 COMPUTER VISUALIZATION TEAM

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"VISUALIZATION OF NASA DATASETS"

OFFICE OF NAVAL RESEARCH

1996-97 COMPUTER VISUALIZATION TEAM

DR. KOSSI EDOH, MENTOR
FELICA BOWSER
LAVERNE WILLIAMS

Abstract

Rapid and extensive advances in three-dimensional computer visualization have developed and are making a major impact on many industries. The use of three-dimensional viewing has become an essential issue in several academic sectors and the commercial product development. Advanced endeavors are worthless unless the results can be clearly communicated. Meaning, some type of verbal and/or visual medium should be used to interpret the data and to report the results to others.

The 1996-97 Computer Visualization team had the task of visualizing data sets provided by NASA's Earth Radiation Budget Experiment or ERBE. The ERBE scanner instrument package contains three instruments used to measure shortwave, longwave, and total waveband radiation. Among all of the data, it was decided to visualize the longwave radiation data between the years of 1984 and 1989.

The software package IRIS Explorer was used to perform the task mentioned above. IRIS Explorer is a visual programming system for data visualization, manipulation, and analysis. The system has a programming component which developers can use for creating new applications, and a user environment in which the applications run. IRIS Explorer runs on all Silicon Graphics workstations and is available for other Unix-based workstations and supercomputers.

Introduction

What is computer visualization? It is a graphic representation of numeric data. Visualization involves receiving and interpreting data in order to output a pictorial example of the data. It is used to help researchers interpret numerical data and report their findings. Without computer visualization, advanced science modeling are worthless because they cannot be clearly communicated to others.

There are many software packages that can be used to perform visualization; IRIS Explorer is a system for creating powerful visualization maps, each of which comprises of a series of small software tools called modules. A map carries out a series of operations on a dataset and produces a visual representation of the result. Explorer consists of three main components:

- (1) the DataScribe which is a data conversion tool for moving data between IRIS Explorer data format and other data formats,
- (2) the Map Editor which is a work area for creating and modifying maps, and
- (3) the Module Builder which lets people create their own custom modules.

In order to understand how these components work, one has to understand how a factory works. The purpose of a factory is to take raw materials (numeric data) and shape them into an end product (pictorial representation) according to a specific design. The raw materials are fed into an assembly line at one end, go through a number of alterations and manipulations as they pass through the machines (modules) on the factory floor (Map Editor), and then comes out at the other end in the form of a finished product (visual object or image). The product is inspected for qualities essential to the design; if they are not present or not satisfactory, the machines on the floor can be adjusted (purpose of Map Editor). The Module Librarian displays all available maps and modules. Single modules can be launched by dragging them into the Map Editor. Then they can be connected and wired according to their input and output ports.

- DataScribe has three main functions:
- (1) to convert data from an external source in ASCII or binary format into IRIS Explorer lattices,

- (2) to convert to and from different data types within IRIS Explorer itself, and
- (3) to convert data from one file format to another such as from ASCII to binary.

It creates scripts and control panels that can be saved as a module. The new module can be used in the map in order to convert the data to be used.

The Module Builder is used to build one's own IRIS Explorer modules. Existing IRIS Explorer modules can be modified and renamed, or new ones can be created. Module Builder's graphical user interface allows one to build a basic module with no programming beyond that needed to write the computational functions in C, C++, or Fortran. The module-building process has three stages:

- (1) defining the internal structure, or "the engine"
- (2) defining the external structure, or the user interface, and
- (3) building and installing the module in IRIS Explorer.

Project Definition

The 1996-97 computer visualization team focused on visualizing NASA datasets provided by the Earth Radiation Budget Experiment (ERBE). The goals of the ERBE are (1) to understand the radiation balance between the Sun, the Earth, the atmosphere, and space which moderates the weather and climate system and (2) to establish an accurate, long-term baseline dataset for studying climate changes. ERBE's data files were contained in the following thirteen parameters:

- box center latitude, degrees
- box center longitude, degrees
- short-wave reflected radiation, watts/meter²
- long-wave emitted radiation, watts/meter²
- net radiation, watts/meter²
- albedo, percent
- clear-sky short-wave radiation, watts/meter²
- clear-sky long-wave radiation, watts/meter²
- clear-sky net radiation, watts/meter²
- clear-sky albedo, percent
- long-wave cloud forcing, watts/meter²

- short-wave cloud forcing, watts/meter²
- net cloud forcing, watts/meter²

Due to time constraints, the long-wave emitted radiation was studied in this project. Fortunately, the data had already been gridded which means to be distributed on a uniform grid. In order to visualize the data in color, the RGB color scheme was chosen to represent the longwave radiation data. This project consisted of three concentrations: (1) DataScribe which involved the data conversion process, (2) Module Builder which assisted with the building or use of modules, and (3) Map Editor which performed the rest of the needed operations such as the design and assembly phases. Each concentration will be described in the following sections.

DataScribe or dscribe

DataScribe is a component of the IRIS Explorer visualization software package and was very important because it converted the gridded NASA data from ASCII into a lattice format that IRIS Explorer could understand. Several preparations had to be made before actually building the conversion module. They included knowing the format of the input referred to as scalars and/or array of scalars and deciding the format of the output data which comes in the form of lattices. The lattice data type consists of two parts: the data values and the position of the data values in Cartesian space. There are three types of lattices which come in one to three dimensional lattices. They are the uniform lattices (the most commonly used), the perimeter lattices, and the curvilinear lattices. The two dimensional curvilinear lattice was chosen for the output lattice because it best represented the data used.

In the setup of DataScribe, one has two templates: the input and the output. They can be differentiated by viewing the directional arrow in the top left-hand corner of the template. One also has a detailed and abstract view of the templates.

To build the conversion module to click and drag the desired glyph whether it is a scalar or lattice from the data type palette to the DataScribe workspace. Each glyph has its own parameter which should be specified by the user, and a component box that may be used for further specifications. Once all the glyphs have been

selected, the input and output templates must be wired or connected together which forms a script or module which is loaded in the Map Editor's Librarian. This is turn can be contained in a map with other modules. Lastly, a check should be conducted for errors by parsing the script to make sure all parameters are correct in the glyphs and the templates are wired correctly.

Module Builder or mbuilder

As mentioned earlier, the Module Builder is used to assemble modules. The modules provided by IRIS Explorer offer a range of functions, but sometimes it is necessary to construct new modules, providing a more specific function or a greater capacity than the existing ones. At first, it was thought that new modules would have to be constructed. But, it was determined that the existing ones could be used with a few modifications. The three main stages had to be followed.

The definition of the internal structure involves creating a user function, defining the input and output ports, defining the function arguments, and defining the relationships between the inputs, outputs, and function arguments. An existing user function written in C programming language was used instead of a newly created function. The input port had to accept data in the form of the lattice data type. The module had to receive data on both its input port before it could fire, so each port had to be made a "Required" port. The output port produces a lattice output. The function arguments defined each function argument in the user function; each argument had to be connected to an input or output item. After all of the ports had been defined, they were properly connected. The proper connections are critical to the proper operation of the module.

The definition of the external structure involves designing a control panel and associating input parameters with control mechanisms. A module has an interface that allows it to be controlled by the user. This interface is called the module control panel. Then the position, size, and limits of the control mechanisms were changed.

Finally, the construction and installation of the complete module finishes the process of module building. The module had to be turned into an executable program. The code was linked and

compiled during the build process. When this stage was complete, the new module was named "nasa_color", and it could be launched from IRIS Explorer's Module Librarian.

The Map Editor

IRIS Explorer's Map Editor is the environment in which maps are created and executed. The Module Librarian contains the available maps and modules. Maps can be used to perform a variety of tasks.

In visualizing NASA datasets, the modules were used to generate a visual image from a specified dataset. The modules used for the visualization can be grouped according to their general function:

- "nasa_color" read in the data files,
- "Contour" developed the geometric representations,
- "LatToGeom" performed the same function as "Contour" but with colors and structured patterns, and
- "Render" created the images.

In order to execute the "nasa_color" module, a data file had to be entered into the text box. As the module fires, its title bar turns yellow and stays yellow until the module has completed execution.

It was decided that the data collected for all of the year of 1988 and the November data from the years of 1984 to 1989 would be used. A program written in C was used to change the longitude and latitude measurements from degrees to radians. The program also coordinated the color scheme of the radiation levels. Once all preparations were completed, the individual datasets were ran separately through the map in order to form the images.

Conclusion

The ERBE provided many mediums in order to measure variations of regional radiative parameters. The study and visualization of other parameters such as shortwave radiation and cloud forcing are considerations for future work for the visualization team. Also, efficiency in the visualizations could provide a means to predicting future climate changes. Contact with online users and other professionals could provide more insight into

the world of visualization. It was observed that slight changes occurred in the longwave radiation each November over a four or five-year period. It can be loosely said that this is due to global warming of the earth. This observation needs further study.

REFERENCES

- The IRIS Explorer Users' Guide
The IRIS Explorer Module Writers' Guide
"IRIS Explorer Center"
http://www.nag.co.uk:80/Welcome_IEC.html
The Numerical Algorithms Group Ltd, Oxford UK. 1996

APPENDIX A

CONVERSION

PROGRAM


```

third);
    }
    else if(longwave < 275.0)
    { first = 0.0;
      second = 0.0;
      third = 0.4;
    fprintf(col,"%7.2f %7.2f %7.2f %7.2f %7.2f \n",oldlat, oldlong, first, second,
third);
    }
    else if(longwave < 285.0)
    { first = 0.0;
      second = 0.0;
      third = 0.2;
    fprintf(col,"%7.2f %7.2f %7.2f %7.2f %7.2f \n",oldlat, oldlong, first, second,
third);
    }
    else if(longwave < 295.0)
    { first = 0.0;
      second = 0.0;
      third = 0.1;
    fprintf(col,"%7.2f %7.2f %7.2f %7.2f %7.2f \n",oldlat, oldlong, first, second,
third);
    }
    else if(longwave = 999.99)
    { first = 0.5;
      second = 0.5;
      third = 0.5;
    fprintf(col,"%7.2f %7.2f %7.2f %7.2f %7.2f \n",oldlat, oldlong, first, second, third)
    }
    else
    { first = 1.0;
      second = 1.0;
      third = 1.0;
    fprintf(col,"%7.2f %7.2f %7.2f %7.2f %7.2f \n",oldlat, oldlong, first, second,
third);
    }
}
}

```

Statistical Analysis
Team Report

Statistical Analysis Team

The statistics team is responsible for the development of data concluded from research trips, meetings and other various seminars and lecturers. Our mission is to transform numerical data (appearing in the forms of various charts, graphs, and numbers), and transforming that data into a readable form.

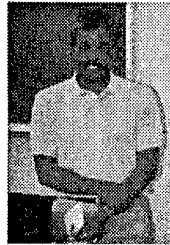
The team gathered data from the 27th SIGCSE Technical Symposium and the Dr. C. D. Turnage Science, Math, Technology Scholars Program for Girls. The three steps that will be taken to achieve this goal are as follows: obtaining the data, converting the data, presentation of the data.



Arthur Fenner



Toinette Jenkins



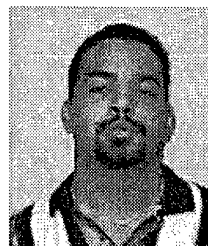
Dr. Mannan
Team Mentor



Tammara McCray



Charles Gatling



Fred Sessoms

**THE
STATISTICAL
ANALYSIS
TEAM**

ABSTRACT

The 1996-1997 Statistical Analysis Team had the honor of analyzing data taken from surveys which were designed to evaluate Dr. C. D. Turnage Science, Math, Technology Scholars Program for Girls. The program was designed to create a positive and permanent change in academic, social and scientific climates in order to allow the interest and aptitude women and girls display in science, engineering, mathematics to flourish. It also adds to the knowledge base about interactions between gender and infrastructure of science, engineering, and mathematics which can provide direction for further efforts. The purpose of the Turnage Program for Girls was to establish a comprehensive regional science, math, and technology program for girls through a partnership between Elizabeth City State University and Roanoke River Valley Consortium.

TEAM MEMBERS

DR. M. MANNAN (Mentor)

Arthur Fenner

Toinette Jenkins

Tamara McCray

Statistics and Analysis Team
Toinette Jenkins
Arthur Fenner
Tamara McCray
Mentor: Dr. Mannan

The Evaluation of Gender Equity

-INTRODUCTION

Teachers and other instructional leaders completed a gender equity survey which quizzed them on whether they were fair to students of both sexes.

-PURPOSE

The purpose of this survey was to determine whether teachers were fair to students of both sexes and whether they displayed any type of discrimination to boys or girls in the classroom setting.

-DESCRIPTION OF QUESTIONNAIRE

The questionnaire was composed of twenty-seven questions in which the surveyor responded "yes" or "no" to each question that applied to the grade level in which they were associated with.

-METHODODOLOGY

The results of the survey were computed by coding the status of each surveyor and coding each individual response. After all the responses were computed, a tally was then taken. After which, the percentage of yes, no, and non-applicable responses were

computed. The data was then compiled into table format which displayed the question asked and the results of the responses to each question.

-RESULTS

After manipulating the data from this survey we were able to clearly see how many people answered yes or no to the questions and how many people had a non-applicable response.

Out of 52 surveyors:

PRE-K-GRADE 1

27% of the surveyors answered yes regarding inviting fathers to perform classroom roles traditionally filled by mothers.(Q1)
Thirty-one percent of the surveyors answered yes to regarding whether they positioned themselves in certain areas of the classroom and on the playground to encourage girls and boys to play in nontraditional areas.(Q2) Seventeen percent invited parents and visitors with nontraditional careers to speak to the class.(Q3)
Thirty-three percent required both boys and girls to participate in activities that encourage investigation and spatial exploration.(Q4) Thirty-seven percent expected both boys and girls to follow the rules.(Q5)

GRADES 2-4

Thirty-five percent encouraged students to work in single-sex

groups and cross-gender groups for cooperative learning projects.(Q6) Thirty-eight percent balanced their questions to both boys and girls in classroom discussions.(Q7) Thirty-seven percent stated that they answer all student's questions equally and give in-depth guidance to girls as well as boys.(Q8) Thirty-seven percent chose books and texts that women, men, and minorities in nontraditional roles.(Q9) Nineteen percent stated that they did not invite visitors in nontraditional careers to the classroom.(Q10) Thirty-three percent discipline boys and girls equally.(Q11) Thirty-eight percent have expectations for achievement in all subject areas are the same for boys and girls.(Q12)

GRADES 5-8

40

Thirty-three percent encourage cooperative learning in both single-sex and cross-gender groupings.(Q13) Twenty-eight percent stated that they balanced their questions between boys and girls.(Q14) Twenty-eight percent give help equally to boys and girls with the same expectations of results.(Q15) Thirty-three percent allow adequate time for problem-solving activities.(Q16) Nineteen percent invite visitors in nontraditional careers to the classroom.(Q17) Twenty-one percent provide encouragement and role models for boys and girls in the areas of spatial problem-solving, math, and science.(Q18) Thirty-one percent provide encouragement and role models for boys and girls in the areas of literature, political science, and the arts.(Q19) Thirty-one

percent teach strategies for problem solving and conflict resolution.(Q20) Twenty-seven percent chose books and texts that have women, men, and minorities in nontraditional roles.(Q21) Thirty-one percent balance their request to both sexes for assistance with classroom management.(Q22) Twenty-nine percent balance affective questions and factual questions to both sexes.(Q23) Thirty-five percent balance their assignments of leadership roles to girls and boys.(Q24) Twenty-three percent encourage girls and boys to take on caregiver roles.(Q25) Twenty-one percent encourage physical activity in nontraditional sex roles.(Q26) Twenty-five percent test and quiz questions are worded in a gender-neutral fashion.(Q27)

-TECHNIQUES

The techniques and tools used in compiling and manipulating the data in this survey were an IBM computer in which we used the program MINITAB to help us translate the results to understandable data.

-RECOMMENDATIONS/SUGGESTIONS

In order to make this survey more accurate the surveyor should have been more specific of their position (status) of which grade level they taught and they should have answered only the questions which applied to them.

PARTICIPANT EVALUATION OF THE STAFF DEVELOPMENT ACTIVITY SURVEY

Responses to Questionnaire
 Strongly Disagree Disagree
 Undecided Agree Strongly Agree

1. The activity objectives were related to my educational concerns.
2. The activity objectives were related to practical educational application in my specific job setting.
3. The activity had some outstanding components which were unique or innovative.
4. Presentations were well organized.
5. The program schedule was well adapted to my educational needs.
6. My questions were satisfactorily answered by personnel conducting activity.
7. Meeting facilities were suitable.
8. The strategies utilized, including instructional resources, were appropriate for meeting the stated objectives.
9. Overall, personnel conducting the activity exhibited the qualities essential to the success of the workshop. (Consider creativity, specialized knowledge, communication skills, and the like.)
10. Overall, the activity was a successful training experience for me.
11. Adequate provisions were made for me to provide feedback to the personnel conducting the workshop.
12. Adequate provisions were made for me to identify needs which were not previously identified.
13. As a result of this staff development activity, I will alter my educational behavior in a more positive direction in my specific job setting.

The Participant Evaluation of the Staff Development Activity survey was assigned to evaluate the quality of the activity. The participants evaluate the activity by checking whether or not he or she strongly agrees, agrees, is undecided, disagrees or strongly disagrees with each statement. This survey has a total of 90 people participating in this particular activity which is unknown.

58.89% of the participants strongly agreed that the activity objectives were related to their educational concerns.

58.89% of the participants strongly agreed that the objective of the activity were related to practical educational application in their job setting.

67.78% strongly agreed that the activity had some outstanding components which were unique or innovative.

77.78% strongly agreed that the presentations were well organized.

51.11% of the participants strongly agreed that the program schedule was well adapted to their educational needs and 41.11% agreed.

65.56% of the participants strongly agreed that their questions were satisfactorily answered by personnel conducting the activity.

54.44% of the participants strongly agreed that the meeting facilities were suitable and 36.67% of the people agreed.

58.89% of the participants strongly agreed that the strategies utilized were appropriate for meeting the state objectives and 36.67% agreed.

74.44% of the participants strongly agreed that overall, personnel conducting the activity exhibited the qualities essential to the success of the workshop.

70% of the participants strongly agreed that the activity was a successful training experience for them.

71.11% of the participants strongly agreed that adequate provisions were made for them to provide feedback to the personnel conducting the workshop.

50% of the participants strongly agreed that adequate provisions were made for them to identify needs which were not previously identified and 41.11% agreed.

58.89% of the participants strongly agreed that as a result of this staff development activity, they will alter their educational behavior in a more positive direction in their job setting.

Overall, this particularly activity was effective. By this activity being so effective some of the participants are going to have a more positive attitude in their job setting.

-CONCLUSION

After all of the data was manipulated we were able to conclude that majority of the participants of this survey were fair to students of both sexes; they were also able to balance nontraditional sex roles in an equitable fashion. The results of this survey also displayed that the instructor created a classroom environment in which all children were free to live up to their potential.

Summary Report on Collegiality

This judgement of teacher opinion comes from 55 teachers interviewed on 'collegiality'. Their reports of their practice of collegiality varies from 'hardly ever' to 'almost always'.

About 47% 'quite often' allowed a free flow of ideas, and 29% did so 'as often as not'. Concerning the judgement of ideas on their merit rather than their source, 40% judge on merit 'quite often', and 33% 'as often as not'. Making suggestions to colleagues on touchy subjects was less popular: 42% 'not often' do so, and 22% 'hardly ever'. 44% agreed that 'almost always' and 25% agreed that 'quite often', their meetings include everyone who needs to attend them. 29% 'quite often' say that things are going well when actually they are not, and 25% 'as often as not' do so.

When asked if teachers receive respect as the key professionals in the educational enterprise, 27% responded 'as often as not', 25% 'quite often', and 25% 'almost always'. 42% agreed that 'quite often' authority and responsibility are shared, with 27% responding 'as often as not'. 33% said that 'quite often', 25% said that 'as often as not', and 25% said that 'not often' are decisions made by those most capable of making them. Personal and professional growth are 'quite often' encouraged, said 35%, with 27% apiece responding 'as often as not' and 'almost always'.

When asked if they take adequate time to discuss issues, reflect on them, and plan together, 38% said 'as often as not' and 25% said 'quite often'. Criticism is taken as a mark of disloyalty 'as often as not', said 36%, with 20% responding 'quite often' and another 20% responding 'not often'. 44% believe that the role of administrators as facilitators is encouraged 'quite often', and 27% 'almost always'.

35% say that 'as often as not' the organization seems as committed to them as they are to it, with 29% responding 'quite often'. When asked if identifying a problem is not only acceptable but is laudable, 36% responded 'as often as not' and 33% 'quite often'. Thoughtful listening is appreciated 35% as 'quite often followed by 'almost always which is also 35%. The most important praise comes from the administrator or supervisor as 'quite as often' is 38% followed by 'not often' which is 18%. 31% said that 'quite often' they feel responsible for their colleague followed by 'almost always' which is 27%. 44% said that 'quite often' committee move from several suggestion to concrete procedure followed by 'as often as not' which is 29%. 35% 'quite often agreed followed by 'as often as not' which is 29% for an honest conclusion that it is not working. 40% said 'as often as not followed by 'quite often' which is 25% for individual administrators model collegiality for teachers.

The *Who? Me?* survey was a survey of sexism and ask many questions dealing with whether the instructor was fair to both girls and boys in the classroom. The surveyors answered yes or no to the questions on the survey. There was a total of thirty people who answered the questions to the survey.

73.33% answered no to whether they expect boys to be loud and unruly, and girls to be quiet an well behaved.

96.67% answered no to whether they think girls have to try harder than boys to achieve.

86.67% answered no to whether they discourage boys from crying or expressing their emotions.

36.67% answered yes to whether they use sexist language like *policeman* or *mailman*, and refer to every nurse as *she* and every scientist as *he*.

36.67% answered yes to whether they assign duties based on gender stereotypes---like having boys to move tables and girls water

plants.

96.67% answered no to whether they allow boys to monopolize the computers or playground equipment.

86.67% answered no to whether the pictures of men outnumber pictures of women on your classroom bulletin boards and visual materials.

76.67% answered no to whether they usually use books written by men and whether most of them feature men or show women only in traditional roles.

Response Results
of the

Participant Evaluation of the Staff Development Activity Survey

1 - STRONGLY DISAGREE 2 - DISAGREE
3 - UNDECIDED 4 - AGREE 5 - STRONGLY AGREE

PERCENTAGE RESULTS
of the

Participant Evaluation of the Staff Development Activity Survey

Question 1 Question 2 Question 3 Question 4
4 38.89 4 38.89 3 2.22 3 4.44
5 58.89 5 58.89 4 30.00 4 17.78
9 2.22 9 2.22 5 67.78 5 77.78

Question 5 Question 6 Question 7 Question 8
3 2.22 3 4.44 1 2.22 3 2.22
4 41.11 4 27.78 2 2.22 4 36.67
5 51.11 5 65.56 3 4.44 5 58.89
9 5.56 9 2.22 4 36.67 9 2.22
4 54.44

Question 9 Question 10 Question 11 Question 12
3 2.22 3 2.22 3 2.22 3 8.89
4 23.33 4 27.78 4 26.67 4 41.11
5 74.44 5 70.00 5 71.11 5 50.00

Question 13
3 4.44
4 36.67
5 58.89

Question 1 Question 2 Question 3 Question 4
4 35 4 35 3 2 3 3
5 53 5 53 4 27 4 16
9 2 9 2 5 61 5 70
N = 90 N = 90 N = 90 N = 90

Question 5 Question 6 Question 7 Question 8
3 2 3 4 1 2 3 2
4 37 4 25 2 2 4 33
5 46 5 59 3 4 5 53
9 5 9 2 4 33 9 2
N = 90 N = 90 N = 90 N = 90

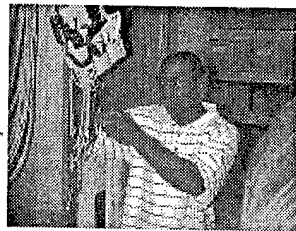
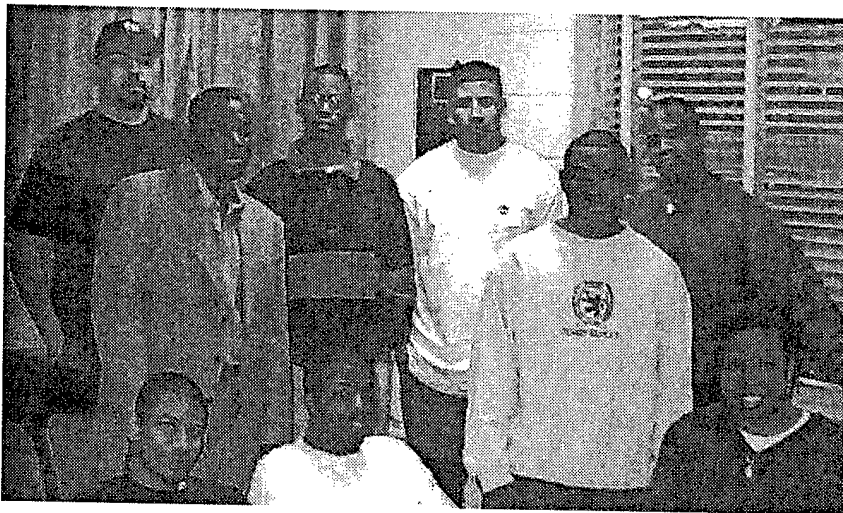
Question 9 Question 10 Question 11 Question 12
3 2 3 2 3 2 3 8
4 21 4 25 4 24 4 37
5 67 5 63 5 64 5 45
N = 90 N = 90 N = 90 N = 90

Question 13
3 4
4 33
5 53
N = 90

ATM Networks
Team Report

ATM Networks

The focus of the Networking Research in on Issues, challenges and Installation of Asynchronous Transfer Mode (ATM) networks in 115 Lester Hall and the conversion of the campus backbone to ATM. Student researchers get hands on experience while assisting with the installation of ATM Network to the desktop in Lester Hall and conversion of the campus backbone. Visiting Lecture have been presented by ADNET Systems, Inc, Jerry Trott, UNC-GA System Administrator, and Sunsil Punoose. Review of the literature will include articles from the Communications of the ACM, Feb. 1995, Vol. 38, no. 2, p 28-109.



ABSTRACT

Asynchronous Transfer Mode (ATM) is a connection-oriented transmission protocol, based on fixed-length cells of 53 bytes. ATM is predominantly utilized as a means of solving network inefficiencies while increasing the productivity of the network's users. Developed in the United States by Bellcore Laboratories, ATM serves as a means of communication between both Local Area Networks (LAN) and Wide Area Networks (WAN). The System Administration/ATM Networking research team at Elizabeth City State University will attempt to reaffirm the theory that ATM is a faster and more efficient means of network communication than Ethernet.

→ In order to perform the tests which are necessary in achieving the goals of reaffirmation, the research team must conceive a testbed. A testbed consists of the hardware and software required to verify the team's theory that ATM is the better means of data delivery and retrieval. The information that is recovered from the testbed will be obtained through benchmark testing. Benchmark testing measures the performance of a system or a subsystem on a well-defined task or set of tasks. These test are utilized in three ways: to predict performance, to ensure the minimum performance in a procurement specification, and as monitoring and diagnostic tools. By employing the elements necessary the research team will reinforce the notion that ATM is a faster more efficient means of data retrieval and delivery than Ethernet.

System Administration/ATM Networking Team

Final Report April 24, 1997

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Introduction

In today's rapidly advancing technological world, the delivery and retrieval of data becomes critical in the world of computer networking. One of the ways network managers are trying to keep up with endusers demands for rapid transfer of data, is to provide them with high bandwidth. To provide high bandwidth, network managers are exploring the capabilities of Asynchronous Transfer Mode (ATM). Our research will explore the essential elements required in comparing both ATM and Ethernet while analyzing results yielded from our testing. The project test the existing theory that ATM is a faster and more proficient means of data delivery than Ethernet.

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Overview

ATM

ATM is defined as a connection-oriented transmission protocol, based on fixed-length cells of 53 bytes. It is a means of communication used for both Local Area Network (LAN) and Wide Area Network (WAN) technologies. A LAN is a network which interconnects PC's, terminals, workstations, servers, printers and other peripherals at a high speed over short distances. An example of a LAN is a computer lab within a building. A WAN is a network which connects users across large distances often crossing the geographical boundaries of cities and states. An example of a WAN is a group of buildings on a campus interconnected.

The origin of ATM cannot be linked to a particular group. It is said in

the United States, Bellcore Laboratories were the first to propose the ideas behind ATM. While in Europe, several large telecommunication companies were developing their own ideas for ATM.

Being the "new technology on the block" everyone is trying to utilize it in various applications. Therefore, standards must be set on how it is to be used to the extent of its networking capability. The foremost group handling issues such as this is the ATM Forum. The ATM Forum is a consortium of organizations representing vendors, manufacturers, carriers, service providers, universities, research groups, consultants and users that make recommendations and define specifications for ATM. The ATM Forum also promotes industry cooperation in the implementation of ATM technologies to transfer packets across both private and public networks, and encourages the development of products that involve the use of ATM technologies (ATM Forum, <http://www.atmforum.com>).

The ATM Forum is currently looking for more prevalent areas in which to expand ATM. One of the major aspects that would allow many of these expansions to take place is the use of emulation. Emulation is a technology that allows excess bandwidth within network lines to be used therefore, maximizing the transferal of data between two existing points. By using emulation more data can be sent or received than by using regular data transmission methods. Without emulation, waiting for bandwidth within a network line to be allocated for use could bring up the possibility of the loss of bits, resulting in the loss of packets, which ultimately results in the loss of data.

The use of emulation in ATM gives it an advantage over other networking protocols by allowing transmission of data from point to point

to travel faster. With technologies such as this, ATM is beginning to be used for more tasks. Multimedia servers are becoming feasible because of this and the standards associated with it. Transmission of other data such as voice are also becoming possible with the use of ATM for companies, universities, etc.

Another new use of ATM is running real-time applications. Video conferencing is a discussion between two or more groups of people who are in different places but can see and hear each other using electronic communications. Sound and pictures are carried by a telecommunication network such conferences can take place across the world. With the help of ATM, video conferencing allows the user to communicate with other users as if they were standing face to face.

~~4~~ Testbed

In order for the System Administration/Networking team to make a logical comparison to ATM, we had to define our testbed. A testbed includes the hardware, software, test tools, and environment, all of which are necessary in conducting tests. A well devised testbed will ensure all of the needed materials are readily accessible. The following paragraphs will define our testbed.

One component of a testbed is the actual hardware used. Hardware consists of any physical equipment such as workstations, switches, hubs, and various other devices. Our testbed consists of an ATM Switch, Ethernet Hubs, an Ether Switching Hub, Fiber Distribution Centers, and Silicon Graphic workstations with ATM Cards.

The next component of the testbed is the software being used. The software includes the operating system, applications, or test tools. IRIX 5.3 is the operating system being used and InPerson is the software test application for desktop video conferencing. The test tools are used to test the software or equipment the researcher is using. Two examples of test tools are Netperf and TTCIP. Netperf and TTCIP are benchmarks that can be used to measure various aspects of networking performance. Currently, their focus lies in determining UDP (User Data Protocol) or TCP (Transmission Control Protocol) performance between two systems.

Finally, the environment is an important component of the testbed. This will be the place where most, if not all, of the testing will be conducted. An environment can range from a lab to an office. For instance, our environment consists of a communication closet which includes an ATM switch, Ethernet Hubs and switches along with a computer lab consisting of SGI workstations.

Benchmarking

Using software to retrieve data about hardware components, is commonly referred to as benchmark testing. To better understand benchmark testing, we must first formally define the term. A benchmark is a point of reference from which measurements are made. In computer science, "A benchmark is a test that measures the performance of a system or a subsystem on a well-defined task or set of tasks."

Benchmarks are commonly used in three ways: to predict performance, to ensure the minimum performance in a procurement

specification, and as monitoring and diagnostic tools. Benchmarks can predict the performance of an unknown system from the results of a known system. By running benchmarks and comparing the results against a known configuration, one can potentially pinpoint the cause of poor performance. Similarly, a developer can run benchmarks after making a change that can effect performance. Benchmarks can measure graphics, input/output, computations on integers and floating points, and communication performances. Most benchmarks measure specific tasks which include rendering polygons, reading and writing files, and performance operations on matrices.

ATM Testbeds

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O The NCSA/UTRC testbed consisted of 2 Fore Systems switches, a Sun SPARCstation, and SGI Indigo workstations. The testbed configuration was that of a Sun SPARC workstation and a SGI Indigo connected to an Fore ASX-100 switch. The testing software used was nettest. Nettest measures memory to memory transfer of data, therefore making it a more accurate estimate of network throughput. The nettest options used were packet size, transport layer protocol, window size, and the number of packets sent. The results concluded that the average read throughput (performance measurements for reading data sent from the SGI) was 11 Mb/s and the average write throughput (throughput on write operations from the Sun to the SGI) was 40 Mb/s.

To test the accuracy of your test you must have tests to compare them with. To compare the tests both your tests and your test tools and

theirs must be identical or very close. If not, your results will not be very accurate. In a test found from IAIK, they were testing the ATM TCP (transmission control protocol) performance of different workstations such as ULTRA SPARC, SPARCstation 10/512, and a SGI Power Challenge. The achieved throughput is compared to the theoretical limit which is about 135 Mb/s when reducing the bitrate of a 155Mb/s OC3 link by the SONET overhead, the AALS overhead, and the ATM cell overhead. In one test between a SPARCstation 10/512 and SGI Power Challenge where the SPARCstation was the machine sending the data and the SGI Power was the machine receiving the data, the measured maximum TCP performance was 60.98 Mbit/s with the percentage of maximum theoretical limit of 45.33%. In another test, ULTRA SPARC was the sender and SGI Power Challenge was the receiver, the maximum TCP performance was 100.73 Mbit/s at a percentage of 74.88%.

Ethernet Test Results

The System Administration/ ATM Networking Team used TTCP (which was found on the internet) to test the Transmission Control Protocol (TCP) over Ethernet from Indy to Indy. TCP is a standardized transport protocol developed for interconnection IP-based networks. TTCP times the transmission and reception of data between two systems using TCP or UDP (user datagram protocol).

In order to run TTCP, we compiled it as you would any C program so we could use the a.out file. Then the receiver types in a.out -r -s followed by the transmitter typing in a.out -t -s plus the name of machine receiving the data.

-t = transmit mode
-r = receiver mode
-s = if transmitting a data pattern to network
and if receiving sink (to discard the data).
Otherwise it will transmit data from stdin
or print received data to stdout.

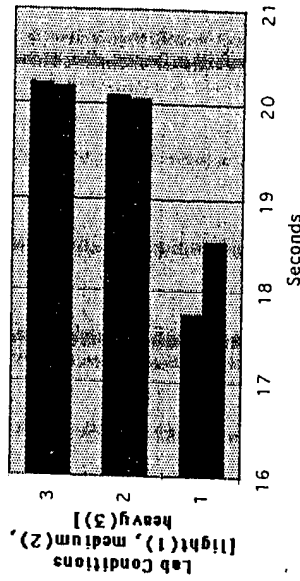
After running our test we took the average of three light, three medium, and three heavy lab conditions. We then graphed the Real Seconds and Kilobytes/Seconds (which is the format of the throughput rate) using Microsoft Excel. In one set of test, we used the processes being ran on the systems at that time and for the other set we used the processes running plus InPerson.

Note: There may be some discrepancy in our results do to events beyond our control.

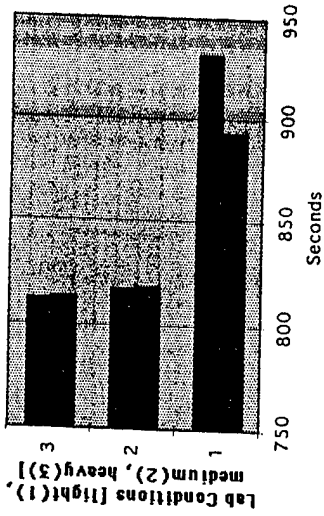
TTCP, C INDY TO INDY TEST RESULTS CHART			
AVERAGE			
	LIGHT	MEDIUM	HEAVY
SENDER			
REAL/SECOND	18.53	20.04	20.16
KB/SEC	892.91	817.48	812.99
RECEIVER			
REAL/SECOND	17.73	20.07	20.19
KB/SEC	931.25	816.67	811.70

Looking at the data above for both the sender and receiver, as the real seconds increase under the different lab conditions (light, medium, and heavy) the kilobytes/seconds decrease. The bar graphs below show the results of TCP in real seconds and kilobytes/second between the sender and receiver in relation to the lab conditions.

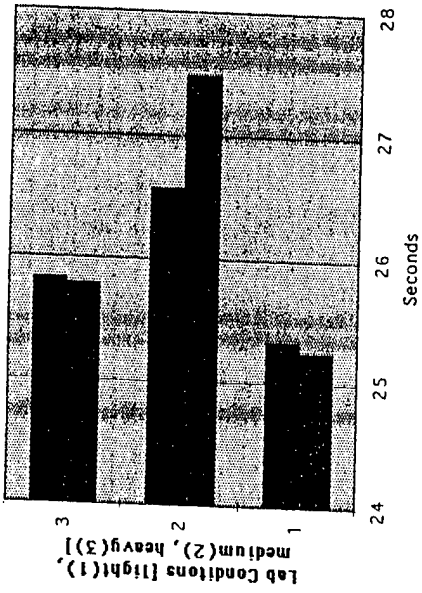
TTCP Real Seconds Average



TTCP KB/SEC AVERAGE

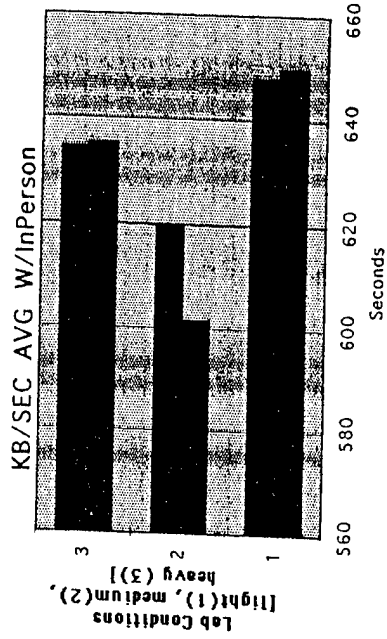


Real Seconds AVG W/InPerson



TTCP INDY TO INDY TEST RESULTS AVERAGE RUNNING IMPERSON			
	Light	Medium	Heavy
SENDER			
Real/Second	25.23	27.47	25.79
KB/Sec	649.98	601.23	635.23
RECEIVER			
Real/Second	25.31	26.56	25.83
KB/Sec	647.81	619.47	634.45

The data above is from the TTCP test we ran while using InPerson. Below are the bar graphs of real seconds and kilobytes/second test results we found.



Our test results, show how the transmitter and receiver transmission control protocol data transferring rate varies under different conditions. Some of the conditions that affect the rate of

data being transferred are the number of people in the lab, the number of processes being ran on the system, and how many packages are being sent during testing. After comparing both ATM and Ethernet test results, you can see that ATM has a faster transmission rate than Ethernet.

Summary

As ATM is becoming a leading technology in the field of computer science, more and more people are pursuing new avenues in which to advance ATM and its technology even further. But in order to accomplish this, test have to be run to ensure the capability and compatibility of ATM to a specific network.

Within our tests, Ethernet was used to run test using our current networking setup. These test results were compared to the ATM test results we obtained. These test results yielded that ATM was faster than Ethernet. The next steps include implementing the same tests that we ran with Ethernet on ATM. We will begin this phase of our report when ATM is implemented within our computer science department. In conclusion, we would be able to fully test and understand the capability of ATM.

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HTML/JAVA
Team Report

HTML/JAVA Team

Student HTML/JAVA researchers learn to produce documents in Hypertext Markup Language (HTML), the language used on the World Wide Web to create web pages. The web pages include: backgrounds, images, animated GIF images, tables, frames, JAVA applets, and shockwave technology.

Researchers are responsible for maintaining and updating the ONR/NERT web pages. Students also setup and maintain a http server for the ECSU homepage and are responsible for updating and maintaining all web pages for the university's homepage. They assist students, staff, and faculty in the scanning of logos and photos to be incorporated into web pages.



HTML/JAVA Team

Team Mentors: Mrs. Tracy Chamberlain, Dr. Linda Hayden

Team Members

Courtney Fields, Sophomore/Computer Science Major
Katrina Godwin, Freshman/Computer Science Major
Kuchumbi Hayden, Sophomore/Computer Science Major
Shakiya Rodgers, Freshman/Computer Science Major

The HTML/JAVA team consists of Computer Science majors this year. Each of us brings creativity to the team. The team members are our mentor, Tracy Chamberlain, Kuchumbi Hayden, Courtney Fields, Katrina Godwin, and Shakiya Rodgers. This year we have reviewed articles, learned HTML, made our own webpages, assist with training, assemble the ECSU Homepage, and much more.

HTML, which stands for HyperText Markup Language, is a type of SGML

(Standard Generalized Markup Language). It is usually a plain-text document that can be created under any text editor. HTML uses a series of tags in order to create a document (referred to as a webpage) that can be viewed on a browser, across the Internet by accessing a URL (Uniform Resource Locator). HTML documents provide valuable information for all types of organizations. From NASA, to the latest trends in fashion, to the closing figures in the stock exchange. Information at these sites and locations are changing all the time. Thus, many of these locations have what is known as a webmaster in order to keep the page maintained. This job is one of significance. Not only does the organization get to see the work the webmaster has done, but everyone that visits the site.

At the beginning of the fall semester, our mentor, Tracy Chamberlain presented every team member with a HTML Reference Manual. The manual described and defined elements which were used to tag and code text. In addition, the team had to gain some background knowledge on the World Wide Web and various languages such as HTML. We were instructed to read an article titled, *World Wide Web: Whence, Whither, What Next?*. It concerned the past, present, and future of the World Wide Web dealing with the different markup languages. After we read the article, each of us typed a one page report that summarized the article. If we did not turn the summary in on time, we had to read another article titled *Publishing on the World Wide Web: Organization and Design* and write another summary.

The team's first hands-on experience with HTML was the *Beginner's Guide to HTML* booklet. We read through the material discussing the various tags, what they stand

Abstract

The first generation of static World Wide Web Pages is gradually giving way to dynamic sites with elements that bounce, shake, shimmy, swirl, sing, and scroll. There also is a steadily rising number of elements with which users can interact. This has become possible through new technologies that enable browsers to handle in-line video, real-time audio, and animated graphics.

Student HTML/JAVA researchers will learn to produce documents in Hypertext Markup Language (HTML), the language used on the World Wide Web to create web pages. The web pages will include: backgrounds, images, animated GIF images, tables, frames, JAVA applets, and stockwave technology.

Researchers will learn to use JAVA to enhance our current web pages. JAVA connects with HTML and the web through a special HTML tag called APPLET, which allows developers to include special JAVA programs on Web pages. Students will integrate applets into existing web pages as well as create their own applets.

Researchers are responsible for maintaining and updating the ONR/NERT web pages. Students will also setup and maintain a http server for the ECSU homepage and are responsible for updating and maintaining all web pages for the university's homepage. They will assist students, staff, and faculty in the scanning of logos and photos for incorporating into web pages.

for, and how and when to use them. Besides text, the booklet contained samples of HTML tags. The team members opened a jot file in his or her account and began to do the practice tags. We learned the bold, center, italic, and font size tags. In addition, the team members could change the background, text, and link colors by using several combinations of letters and numbers. We learned how to open a file in Netscape to see the results of what we typed in the jot file. As the team began to progress, we began to make tables, frames, and other advanced features. We also downloaded and saved images and backgrounds into our accounts.

Our next assignment was very simple. We had to make sure that all of the links on the NASA school partners page were working. If a link was not working or if a page was under construction, then we had to write down the URL of that link or page. This took a little bit of time because every school had their own page with many links. Some of the schools included Emily Spong Elementary, Douglass Park Elementary, and many others. After the errors were located, the links were fixed.

The team also created a webpage for NetDay96. The idea behind NetDay96 was to get wiring installed in classrooms in selected secondary schools in North Carolina and Virginia. This allowed computers to form a local network and link to the Internet or other wide area networks. We typed newspaper articles in a jot file in the JAVA account and saved them into the NetDay96 folder. The newspaper articles pertained to the purpose of NetDay96, the participating schools, volunteers, and what would happen during NetDay96. Some of the items were from *The Daily Advance* and *The Virginian-Pilot*. Others were documents for Douglass Park and Emily Spong. Celebration of having ATM wiring in their schools for the Internet. After the documents were typed, the team put in HTML tags to change font size, to make certain text bold or italic, and to make the article appear presentable on the World Wide Web.

The Math and Computer Science page was a more challenging task for the HTML/JAVA team. We had to work hard on the page so it could be put into the ECSU

homepage. First of all, each team member was assigned three or four professors. We obtained the professors' resumes and took their pictures with the Quick Cam. We gave the professors' resumes computer backgrounds with their names in H1 font and their pictures. Depending on the amount of information that was on the resumes, different links were created for each section, like experiences, education, etc. For some of the sections, tables were created because there was so much information dealing with dates, degrees, and descriptions. In the table it is easier to read and understand. After we finished the professors' resumes, links, grammar, and correct information were checked.

The HTML/JAVA team is very dedicated. We spent part of our Christmas break working on various HTML documents in the computer lab. The team worked on the NRTS training page. We typed in the various workshops that people could attend, explaining each one, and how long the workshops would last. Furthermore, several links were made to the NRTS training page. The pages were then checked for defective links and grammatical errors. Then we labored on different parts of the ECSU homepage. We opened the ECSU page folder and different jot files to make sure the links were working, icons were appearing, and the text was grammatically correct. The team went through several curriculum guides to make sure everything was functioning. We also continued to toil over the NetDay96 page during the break. We had to make links from the NetDay96 main page to the articles that were typed earlier this year. After that task was completed, pages of pictures were created of the schools that were involved in NetDay96 and made links from the main page to the pages of the pictures. The pictures were various volunteers who helped out in NetDay96 and some of the schools were Sheep Harney Elementary, Camden County High School, among others.

Throughout the year the HTML/JAVA team has assisted with various training workshops. From October 31 to November 2, 1996, the Fall Training Event took place in Lester Hall. Some of the sessions that HTML participated in were WWW Search Engines, Graphics on the Internet, Graphics Converter, and GIF89 a Animation and Sound. Also

from September 23 through October 4, 1996, Workshops for Faculty took place in I15 Lester Hall. There were numerous workshops on retrieving information from the internet, search engines, and electronic discussion groups. On Friday, December 20, 1996, there was a Microcomputer Applications workshop in which HTML played a role. Some of the sessions were Intro to the Internet, Homepage Design, and the World Wide Web.

The team's biggest and most challenging project of the year was the ECSU homepage. We worked on the ECSU homepage in the AcadResearch directory. We had to create directories for the various Academic departments like the Art, Education, Geology, Social Studies, and etc. Then the appropriate files and pictures were placed into the directories that were pertaining to them. Everything had to be documented. For example, the names of all the files that were put into the separate directories had to be written on a sheet of paper. We proofread each HTML file in the directories and inserted a certain address where there was an img src tag and a certain address where there was an a href tag. Next, the team had to create new directories for different programs like the Aid Program and the Bookstore. We followed the same procedure for the new directories. At the bottom of almost all of the HTML documents, was a table that had to be corrected. The addresses had to be changed, certain links removed, and new addresses added. In addition, the team checked for errors in the documents and corrected them, if any. There were a few grammatical errors in a few of the documents. On February 4, 1997, the New ECSU Webpage was shown at the Umfort Locus Dedication Ceremony.

Each member of the team viewed the ECSU page on a different web browser like Mosaic 2.0 and Mosaic 3.0. We had to find out the differences between the latest browser and the old browser. On Mosaic, there was no centering, font color, or pictures. Now the team is making an all text version of the ECSU homepage for such browsers.

Each member of the team is currently working on his or her homepage. Some of the items that are mandatory are varied font sizes and colors, separators lines, unordered lists, animated gifs, photo, resume, and a background along with many other features.

The HTML/JAVA team has worked long and hard on the various assignments throughout the year. We started from the bottom and worked our way to the top. The team began with writing articles to creating and editing the ECSU webpage. Without HTML and other SGML's, there would not be the creative webpages we see today.

World Wide Web: Whence, Whither, What Next?

The World Wide Web, in a time frame about five years has become the most popular Internet application. It has made significant contributions to the Internet. The World Wide Web allows users to retrieve text and multimedia objects from servers located throughout the world, with objects connected by hypermedia links.

The underlying central functionality or Internet technologies of the Web are rather simple. The naming mechanism or the universal resource locator (URL) a typed, stateless retrieval protocol, and a minimal formatting language with hyperlinks. All of the basic technologies were around prior to the "invention" of the Web, generally credited to Tim Lee and Robert Caillou at CERN. However, the major accomplishment was not an individual protocol, but rather the integration of disparate pieces into a new more powerful way of using networks. The Web really didn't take off until the original ASCH-only browser was replaced by one based on X, did the Web really take off. Though originally conceived to integrate existing retrieval and access mechanisms.

In the early 1990's, there was a demand by every cable and telephone company to try-out trial versions of various forms of video-on-demand services, such as home shopping and banking, would be similar to what is now slowly

emerging on the Web, but the pool of providers would have been strictly controlled by the cable or telephone operator.

The roles of on-line services relative to the Web has seen much discussion, with some dismissing the on-line service providers as parts of a bygone area. Certainly, a number of new services seem to be heading towards being "Internet communities" rather than using proprietary technology shifting their focus from providing content to providing Internet access. However, the large majority of residential users still use on-line services. On-line services not only provide access but also, technical customer support services, a basic menu of standard content, aggregated, averaged billing for a range of content and parental access control features.

Courtney Fields
October 28, 1996
.HTML/JAVA Team

WWW(known as the World Wide Web) is the most popular computer application on the Internet. This application allows the user to retrieve text and connect them to servers located throughout the world. The Web contains three major components which are HTML, HTTP, and URLs.

HTML(Hypertext Markup Language) is a easy minimal formatting language. HTML can be both presentational and descriptive.

Presentational markup systems defines how text can be rendered, while descriptive markup renders content according to the capabilities of the screen resolution such as fonts, width, spacing, etc. HTML is generated from other capable systems, due to the fact that, the capabilities of HTML are limited. HTML has three hyperlinks which are wrapping text or an image in a tag, displaying the document in a news browser, and the IMG tag. Because HTML is in demand within the Internet, it has replaced many text systems.

Next, HTTP(Hypertext Transfer Protocol) is an application in which it is a client server protocol. This protocol has many advantages that servers on the Web can use. Because HTTP is a textual protocol, this simplifies the text for simple browsers on the Internet. The textual representation of HTTP

is the most noted feature of ftp(file transfer protocol). FTP gives HTTP the ability to define missing operations for different functions. Furthermore, HTTP is a more complex application than HTML, that will require an efficiency for the client and the server.

The final application discussed in this article is URLs and URNs. URLs(Universal resource locator) is a locator that designates objects within the World Wide Web. URNs(Universal resource name) is a identifier which name the physical location of an object. The difference between a URL and an URN is that URLs are considered to be temporary references until a more powerful device can be deployed. On the other hand, URNs leads the browser to their destination and give a listing of the location.

In conclusion, I feel that this particular article taught me there are many interesting Internet applications, which can continue the growth and success of the World Wide Web.

World Wide Web: Whence, Whither, What Next?

World Wide Web: Whence, Whither, What Next? by Henning Schulzrinne, speculates where the World Wide Web (WWW) might be improved and which directions it might take from a technical perspective. In the past five years, the WWW has become, next to electronic mail, the most popular Internet application. It has been a major contribution in turning the Internet into a household word. The WWW allows users to retrieve text and multimedia objects.

The main WWW protocol for data retrieval is Hypertext Transfer Protocol (HTTP) which is an application-level protocol that is used probably exclusively with the Transmission Control Protocol (TCP). HTTP is a client/server protocol where the client, a WWW browser, asks the server for some information via a GET request or transfers information to the server. The simple protocol has the advantage that clients and servers do not have to remember anything beyond the transfer of a single document. There are some efforts to replace HTTP with a binary, ASN.1-based version that supports pipelining of several objects. The extensions of HTTP will probably reach a large fraction of a revised protocol. Displacement of HTTP by a different protocol does not seem to happen soon.

Hypertext Markup Language (HTML) is the one media type all browsers understand and is a simple document type of the Standardized Generalized Markup Language (SGML). HTML is easy to understand and can be generated by translators from other text formats as well as written by hand and because it contains the actual text rather than font glyphs, it can be translated to Braille or synthetic speech. Within the Internet, HTML is replacing a number of similar text systems like multipurpose Internet mail extensions. While there have been extensions of SGML to the presentation of continuous media, they appear complex, but still do not offer the full programming flexibility of a client-side programming and scripting language like Java.

Universal resource locators (Urns) are used to designate objects within the WWW and name the physical location of an object and universal resource names (URNs) identify without regard to location. URNs are in widespread use and consist of an identifier for the protocol, the network location, and a path name within the server. URNs were considered to be temporary artifacts until a more powerful naming mechanism could be launched. However, URNs seem to be experiencing longevity as e-mail addresses.

One of the factors that have caused the success of the WWW is its ability to attract providers and serve as a base for new applications. There seem to be two contradictory directions for WWW applications: the browser that can do everything and having every application have WWW capabilities. The latter makes it difficult to integrate data types. Browsers are already incorporating mail tools, new readers, and primitive file system managers. Other mechanisms to integrate different applications are currently being created.

WWW stresses the Internet in that browsing has low latency requirements. The data transfers can be anything from a short burst for a small image to several tens of megabytes for a video or audio clip. For any of the more popular services, the WWW can only scale if information content is mirrored and cached. A mirror provides a complete copy of some server. Mirrors are trusted by the data source. Caches are placed between client and WWW server and have no direct trust relationship with the server.

The WWW model is currently rather limited: retrieve an object (text or audio) and render it. It is likely that future browsers will cease to be display-only and allow editing and storing back documents. This would make them more competitive with other computer-supported cooperative work environments.

The integration of multimedia is currently very primitive. A video clip is transferred via HTTP and then played with buffering or from local temporary storage. Playing audio and video as it arrives from the network avoids waiting minutes for it to

```

<html>
<head>
<title>A Simple HTML Example</title>
</head>
<body>
<h1>HTML is Easy To Learn</h1>
<p>Welcome to the world of HTML.
This is the first paragraph. While short it is
still a paragraph.</p>
<p>And this is the second paragraph. While short it is
still a paragraph.</p>
</body>
</html>

<h1>Level-one heading</h1> <p>Welcome to the world of HTML. This is the
first paragraph. While short it is still a
paragraph! </p> <p>And this is the second paragraph.</p>

<p align=center>
This is a centered paragraph. [See the formatted version below.]
</p>

<ul>
<li> apples
<li> bananas
<li> grapefruit
</ul>

<ol>
<li> oranges
<li> peaches
<li> grapes
</ol>

<dl>
<dt> NCSA
<dd> NCSA, the National Center of Supercomputing Applications,
is located on the campus of the University of Illinois
at Urbana-Champaign.
<dt> Cornell Theory Center
<dd> CTC is located on the campus of Cornell University in Ithaca,
New York.
</dl>

<dl compact>
<dt> -1
<dd> invokes NCSA Mosaic for Microsoft Windows using the
initialization file defined in the path
<dt> -k
<dd> invokes NCSA Mosaic for Microsoft Windows in kiosk mode
</dl>

<ul>
<li> A few New England states:
<ul>
<li> Vermont
<li> New Hampshire
<li> Maine
</ul>
</li>
<li> Two Midwestern states:
<ul>
<li> Michigan
<li> Indiana
</ul>
</li>
</ul>

<pre>
#!/bin/csh
cd $SCR
cfs get mysrc.f.mycfsdir/mysrc.f
cfs get myinfile.mycfsdir/myinfile
fc -02 -o mya.out mysrc.f
mya.out
cfs save myoutfile.mycfsdir/myoutfile
rm *
</PRE>

<BLOCKQUOTE>
<p>Omit needless words.</p>
<p>Vigorous writing is concise. A sentence should contain no
unnecessary words, a paragraph no unnecessary sentences, for the
same reason that a drawing should have no unnecessary lines and a
machine no unnecessary parts.</p>
--William Strunk, Jr., 1918
</BLOCKQUOTE>

<ADDRESS>
A Beginner's Guide to HTML / NCSA / pub@ncsa.uiuc.edu / revised April 96
</ADDRESS>

National Center for Supercomputing Applications<BR>
605 East Springfield Avenue<BR>
Champaign, Illinois 61820-5518<BR>

<HR size=4 width=50%>

<A href='MaineStats.html'>Maine</A>
<A href='AtlanticStates/NYStats.html'>New York</A>
<A href='../US.html'>United States</A>
documentA.html;

In addition to the many state parks, Maine is also home to
<a href='MaineStats.html#ANP'>Acadia National Park</a>
<H2><A name='ANP'>Acadia National Park</a></H2>
...More information about <A href='#ANP'>Acadia National Park</a>
is available elsewhere in this document.
<A href='mailto:emailinfo@host'>Name</a>
<A href='mailto:pubs@ncsa.uiuc.edu'>NCSA Publications Group</a>
<img src=ImageName>
<img src=SelfPortrait.gif height=100 width=65>
<p align=center>
<img src = 'BarHotlist.gif'>
</p>
<body background='filename.gif'>
<body bgcolor=#000000 text='##### LINK=#9690CC'>
<A href='MyImage.gif'>link anchor</A>
<A href='LargerImage.gif'><img src='SmallImage.gif'></A>

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Mathematics and Computer Science Department

"Pictures of Lester Hall"



About the Department

Department Faculty and Staff

- Dr. Sohindar Sachdev, Department Chair
- William Barker
- George Coleman
- Dr. Stephen Nemecek
- Dr. Kossi Edoh
- Dr. Linda Hayden
- Dr. Johnny Houston
- Dr. Krishna Kulkarni
- Georgia Lawrence
- Vindod Manglik
- Dr. Muhammad Mannan
- Ralph Okojie
- Vadim Raskin
- Dr. Jhama Sengupta
- Dr. Dipendra Sengupta
- Dore Subrao

Funded Research Projects

- ONR - Nurturing ECSU Research Talent

Student Research Teams

- ATM
- Fractals and Chaos
- HTML/JAVA
- Statistics
- Visualization

- NASA - Network Resources and Training Site

Upcoming Events

- Conferences
- Training

Mathematics and Computer Science Club

About ECSU	Admissions Information	Academics & Research	The Library
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Athletics	Administrative Services	Alumni, Development & Planning
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About the Department



The Department of Mathematics and Computer Science offers B.S. degree programs in Mathematics, Applied Mathematics and Computer and Information Sciences. Students who are planning to teach high school and/or middle school mathematics should minor in Secondary and/or Middle Grades Education.

The Department also offers minors in mathematics, computer science, statistics, applied mathematics and airway science. The airway science minor prepares students for careers in aviation as air traffic controllers, aviation service managers, computer researchers and other aviation oriented professions in government and private industry. Also, the Department offers a second major option in Mathematics for Education Majors who are required to have a second major.

The Department offers general education courses in College Algebra and Pre-calculus. It also provides students with experiences, knowledge and skills in Mathematics, Applied Mathematics, Statistics and Computer and Information Sciences with courses above the General Education Core.

The Department has designed its curriculum to achieve the following objectives:

- ◆ To develop in all students proficiency in mathematical thinking and reasoning;
- ◆ To assist all students in developing computer literacy including skills needed to use a microcomputer and computer software;
- ◆ To prepare students who major in mathematics and minor in Secondary and/or Middle Grades Education to teach mathematics in the public and private schools;
- ◆ To prepare students who major in mathematics, applied mathematics or computer and information sciences for entry level positions in industry; multinational corporations, scientific establishments, and federal, state, and local governments; and

◆ To prepare students for graduate studies in mathematics, statistics, applied mathematics, computer and information sciences, and mathematics education.

Students majoring in Computer Science or Mathematics have numerous career opportunities available to them as system analysts, programmers, system designers, system administrators, mathematicians, statisticians and high and/or middle school mathematics teachers. It is strongly recommended that prospective students contact the office of the Department of Mathematics and Computer Sciences as soon as possible. It is best to begin planning early so that courses can be taken in the proper sequence.

Computer Science Course Descriptions

Computer Science Suggested Curriculum

Mathematics Course Descriptions

Mathematics Suggested Curriculum

Airway Science Course Descriptions

Airway Science Suggested Curriculum

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**Chairman of the Mathematics and Computer
Science Department**

You can E-Mail me at sachdss@alpha.ecsu.edu

[Back to Math & Computer Science Main Menu](#)

Elizabeth City State University

Elizabeth City, NC 27909



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Vita

Sohindar S. Sachdev

- Educational Qualifications
- Teaching/Educational Experience
- Books Published in India
- Professional Membership
- Papers Presented(Selected)
- Funded Projects
- Publications
- Unpublished Work

Fractals/Chaos
Team Report

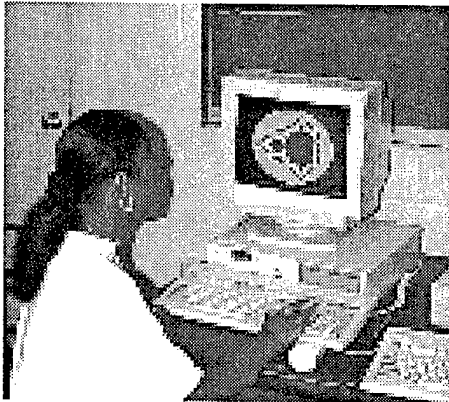
Fractals and Chaos

Most naturally occurring processes are inherently nonlinear and can give rise to very complex behaviors. Even very simple mathematical models can exhibit behavior that give rise to extremely convoluted (and often very beautiful) fractal shapes. The discovery of this fundamentally new area of mathematics has been crucially dependent on computational intensive graphic methods and has given birth to a radically new paradigm for mathematical research: experimental research.

In this project we will perform experimental mathematical investigation. The mathematical contents will comprise fractals, nonlinear dynamics and mathematical chaos.

We will study the orbits of a family of quadratic dynamical systems and investigate the period doubling route to chaos. We will design and develop mathematical materials and Mathematica programs necessary to do the investigation.

We will apply fundamental mathematical concepts to a wide variety of physical, biological and social processes (e.g., population growth, measles problem, growth of plant, problems of epidemiology, and the economics of arms race). The deep connection between geometry and nonlinear dynamics will be explored and computer programs will be developed to generate fractal maps and pictures of compelling beauty. Finally, through guided work in experimental mathematics students will acquire a deeper understanding of mathematical and scientific thinking.



Dr. D. Sengupta
Team Mentor

Fractals/Chaos Team Members



Experimental Research in Fractal and Chaos using Mathematica

Corey Ellis (cellis@umfport.cs.ecsu.edu)
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U. S. A.

discretely and from the continuous perspective. Our approach was to compare each model with actual population data. From this experimentation, we will make a conjecture as to see which model best describes the population.

Definition:

A discrete dynamical system is a rule $p_{n+1} = f(p_n)$ that can be used to generate each term of a sequence from the preceding term.

The discrete dynamical system that was studied is the Verhulst Population Model:

$$p_{n+1} = p_n + k p_n (1 - p_n)$$

Definition:

Equilibrium point or fixed point in a discrete dynamical system is the solution of the equation $p = f(p)$.

The fixed points for the Verhulst Model are 0 and 1.

Definition:

An Orbit is the path of a sequence as it approaches the limit L. When studying the orbit of a particular sequence in a dynamical system, the question is "What happens to the orbit over a period of time?"

Discrete Case:

While studying the Verhulst population model using a Mathematica Iterator program

(Appendix I). The question to be solved was "What values of k and initial values of p_0

$0 < p_0 < 1$, does the orbit of the discrete dynamical system

Introduction:

One of today's most exciting areas of mathematics is the study of dynamical systems.

There are numerous unsolved problems and the field is extremely active. Not only

mathematicians, but also ecologists, chemists, economists, and physicists have become involved in the field. The theory of dynamical systems is used in computer graphics, population models, and

meteorology, to name a few. Many mathematicians feel that some knowledge of the subject is

imperative. A leading biologist Robert M. May wrote as early as 1976: *I would therefore urge that people be introduced to, say, the Verhulst equation, early in their mathematical education.*

This equation can be studied phenomenologically by iterating it on a calculator, or even by hand.

Its study does not involve as much conceptual sophistication as does elementary calculus. Such

study would greatly enrich the student's intuition about non-linear systems. Not only in research,

but also in everyday world of politics and economics, we would all be better off if more people

realized that simple non-linear systems do not necessarily possess simple dynamical properties.

At Elizabeth City State University, the Fractal and Chaos research team performed

mathematical investigation on the Verhulst Population model. We investigated this model

$$P_{n+1} = P_n + k P_n (1 - P_n)$$

is

- a) simple (converge to 1)
- b) interesting (neither simple nor dangerous)
- c) dangerous (when the values get larger and larger beyond the computer capacity)

By experimentation we found that the orbits are simple when $0 < k \leq 2$, interesting when $2 < k \leq 2.57$ (this includes 2-cycles, 4-cycles, 8-cycles, etc), chaotic when $2.57 < k \leq 3$, and dangerous when $k > 3$. The bifurcation diagram that describes this behavior graphically was captured (Appendix II). Also the orbits of the dynamical system were graphed (Appendix III - IX).

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Noticed how the orbits tend to either converge to one or oscillate above and below one. The fixed point one is representing the maximum the population can be at any given time. The oscillation is representing the various cycles (2-cycles, 4-cycles, 8-cycles, etc); this can be translated into the up and down of the population (life and death).

Continuous Case:

They were two different population models that we studied for the continuous case. The first was the Malthus population model; this model of population growth is based on the assumption that the rate of growth of the population is proportional to the size of the population.

The rate of growth of the population is the derivative dP/dt . Being proportional to the population is expressed as the product kP , of the population P and the proportionality constant k . Hence the assumption is expressed as a differential equation

$$dP/dt = kP$$

where

- t = time (independent variable)
- P = population (dependent variable)
- k = proportionality constant between the rate of growth of the population and the size of the population or "Growth-Rate Coefficient"

In order to see how valid this model was we were given a U.S. Census figure Funk and Wagnalls 1994 World Almanac from 1790 - 1990. We wanted to find out how well the Malthus model fits with the actual U.S. population. In order to begin we had to first solve the differential equation for P.

Derivation:

$$dP/dt = kP$$

$$\ln P + C_1 = kt + C_2 - C_1 = C$$

$$e^{\ln P} = e^{kt + C}$$

$$P = e^{(kt + C)}$$

$$P = P_0 e^{kt}, \quad P_0 = e^C$$

then solve for k

$$P(t)/P_0 = e^{kt}$$

$$\ln(P(t)/P_0) = kt$$

$$k = \ln(P(t)/P_0)/t$$

Next, we took the values of the census, and plug them into the model, and tried to see how close the values were to the actual population at that year (Appendix X). Using Mathematica, we found out the model of $p(t)$ does an excellent job of predicting the population until roughly 1860, after 1860 the prediction is much too large (Appendix III). We concluded, that the model is valid when population is very small.

However, as time continues, the model predicts that the population will continue to grow without any limits, but realistically we know this to be ridiculous. Now we turn to the second model to see if adding a capacity restriction will account for the fact that population exists in a finite amount of space and with limited resources and a limited environment.

The second model studied was the Verhulst population model, we add the assumptions:

- 1) If the population is small, the rate of growth of the population is proportional to its size
- 2) If the population is too large to be supported by its environment and resources, the population will decrease. That is, the rate of growth is negative.

Our assumption about limited resources introduces another quantity, the size of the population that corresponds to being "too large". The quantity is the second parameter by m , that we call the maximum supportable population in "carrying capacity" of the environment. In terms of the maximum supportable capacity population, we assume that $p(t)$ is increasing if

$p(t) < m$. However, if $p(t) > m$, we can restate our assumption as :

$$dp/dt = k p$$

if p is small (first assumption).

if $p > m$, then

$$dp/dt < 0$$

(second assumption).

Modify the exponential model as little as possible, we want to look for an expression of the form

$$dp/dt = k (something) p$$

we want this 'something' factor to be close to 1 if p is small, but if $p > 0$ we want 'something' to be negative. The simplest expression that has these properties is

$$something = (1 - p/m)$$

Thus our model is

$$\begin{aligned} dp/dt &= k (1 - p/m) p \\ &= k m (m-p) p \\ &= k (m-p) p \\ &= k (m-p) p \\ P &= k m \end{aligned}$$

Hence the assumption is expressed as a differential equation

$$dp/dt = k (m - p) p$$

where

- t = time
- p = population
- k = growth rate
- m = maximum supportable population

Using the Funk and Wagnalls Census from 1790 to 1990 we again look at the validity of this model in comparison to the population. We want to see if adding a constraint or maximum to the model will cause the model to follow the population trend of the Funk and Wagnalls census better than the Malthus model.

Derivation:

First, solve for p

$$dp/dt = k p (m - p)$$

$$dp/p(m - p) = k dt$$

$$A/p + B/(m - p) = 1/p(m - p) \quad \text{Partial Fraction method}$$

$$A(m - p) + B(p) = 1$$

$$p = m$$

$$B = 1/m$$

$$A = 1/m$$

Integrate:

$$1/m [1/p + 1/(m-p)] = k dt$$

$$1/m (\ln p - \ln |m - p|) = kt + c$$

$$1/m * \ln p / (m - p) = kt + c$$

$$t = 0 \quad p = p_0$$

$$1/m * \ln p_0 / (m - p_0) = c$$

$$1/m * \ln p / (m - p) = kt + 1/m * \ln p_0 / (m - p_0)$$

$$\ln p / (m - p) = mkt + \ln p_0 / (m - p_0)$$

$$\ln p / (m - p) - \ln p_0 / (m - p_0) = mkt$$

$$\ln (p_0^{m-p} * m - p_0 / p_0) = mkt$$

$$(m - p_0)^m * p / p_0 (m - p) = e^{mkt}$$

$$p = p_0 m / [(m - p_0) e^{-mkt}]$$

Next, solve for k

$$p = p_0 m / (m - p_0) e^{-mkt}$$

$$p(t) = p_0 m / (m - p_0) e^{-mkt}$$

$$[p_0 + (m - p_0) e^{-mkt}] p(t) = p_0 m$$

$$p_0 + (m - p_0) e^{-mkt} = p_0 m / p(t)$$

$$(m - p_0) e^{-mkt} = p_0 m / p(t) - p_0$$

$$e^{-mkt} = p_0 m / (m - p) p(t) - p_0 / (m - p_0)$$

$$\ln (e^{-mkt}) = \ln [p_0 m / (m - p) p(t) - p_0 / (m - p_0)]$$

$$-mkt = \ln [p_0 m / (m - p) p(t) - p_0 / (m - p_0)]$$

$$k = \ln [(p_0 m / (m - p) p(t)) - (p_0 / (m - p_0))] / -m t$$

Now we solve for m (maximum value)

$$dp/dt = k(m - p)p$$

$$d^2 p / dt^2 = k dp/dt (m - p) - k dp/dt p$$

$$= k dp/dt m - 2k p dp/dt$$

$$= dp/dt (km - 2kp)$$

$$= dp/dt k (m - 2p)$$

Now look at

$$(m - 2p) = 0$$

$$m = 2p$$

We found that the maximum will be double the population. In order to find what the maximum population will be for the census (data) we used we needed to find what years had the greatest actual margin in between the population (Appendix XI). We found out that in between 1950 and 1960 the margin was greatest. The population was 179 million. Next we take that population in 1960 and double it. By doubling this population (358 million) we assume that this will be our maximum population.

Finally, we plug values from the census into the population model, and we analyze how effective the Verhulst model was in comparison to the Malthus model. We concluded that the second model followed the Funk and Wagnalls census extremely well compared to the Malthus model

(Appendix IV). Graphically the model coincides with the population census up certain year (Appendix IV), and Algebraically the model tends to follow the census (Appendix XI).

In Our study so far we have assumed that $p(t)$ is a continuing function of time variable t . In reality, we know that population does not change continuously but rather in discrete amounts at discrete times.

Rescaling:

For our convenience we now rescale our population measurements to represent fractions of the maximum supportable population. Thus, we introduce a new dependent variable P , which is defined in terms of population p by

$$P = p/m$$

This has the effect of making the maximum supportable population equivalent to one unit of population. The new dependent variable P takes only values between 0 and 1. Using the above scaling, the differential equation changes to

$$dp/dt = KP(1-P)$$

where

$$k = KM$$

and the solution becomes

$$P = P_0 / (1 - P_0) e^{-kt} + P_0$$

If times are measured in discrete steps dt , then the corresponding discrete model is

$$dp/dt = kp(1-p)$$

For our convenience assume $dt = 1$

Then we write

$$dp = P_{n+1} - P_n$$

and rewrite the above equation

$$P_{n+1} - P_n = kP_n(1-P_n)$$

$$P_{n+1} = P_n + kP_n(1-P_n) \text{ for } n = 0, 1, 2, \dots$$

Discrete vs Continuous:

The question after researching the discrete case and the continuous case was "Which case

(continuous or discrete) better relates to the overall picture of the actual population. In order to compare the two cases values needed to be taken for k and p_0 .

For the choices of $k = 0.5, 1.5, 2.2, 2.5, 2.9$ with $p_0 = 0.2$ we compared the graphical solution of discrete and continuous model using Mathematica.

For $k = 2.2$, they notice something peculiar. The discrete sequence does not close to any number; instead, within only few iterations, it starts to oscillate back and forth. This limiting behavior is called a cycle of period 2, or simply a 2-cycle. As k increases to 2.5 the iteration settles into an even more complicated pattern, a cycle of period 4. For $k = 3.9$, the sequence exhibits no discernible pattern. The values of p seem to jump around at random (Appendix VII - IX).

From studying Appendix VII - IX one can see the groups of the discrete and continuous models together. The continuous case seems to converge to one (maximum capacity of the population at any given time) and that is it . The continuous case does not exhibit the fluctuation of the population (life and death), but the discrete case from the graphical analysis shows fluctuation about the fixed point one (maximum capacity of the population at any given time). This oscillation or fluctuation can be considered mathematically to be a cycle of some type, but realistically this oscillation could very well be the representation of people being born and people dying throughout the whole population. The discrete case and continuous case tells us that the population can never reach its maximum which makes sense because people are constantly being born and dying everyday. Noticing all of the characteristics that the discrete case shows it is evident that this model best describes population in realistic terms.

References

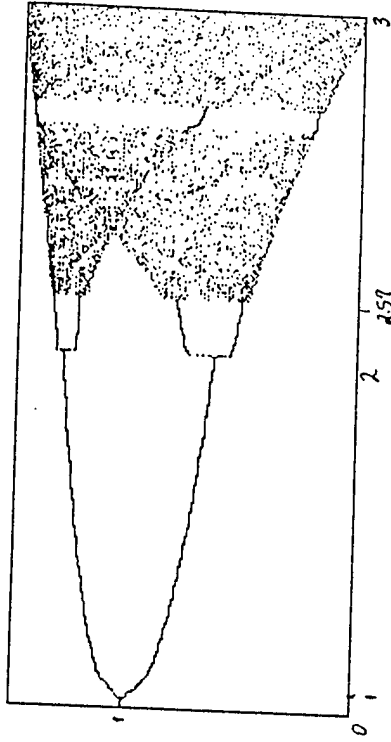
1. Devaney, R. *An Introduction to Chaotic Dynamical Systems, 2nd edition.* Addison - Wesley, 1989.
2. Holsinger, R. *A First Course in Discrete Dynamical Systems.* Springer - Verlag, 1994.
3. Peitgen, H and Richter, P. *The Beauty of Fractals.* Springer - Verlag, 1986.
4. Wattenberg, F. *Calculus in a Real and Complex World.* PWS - Kent Publishing Co., 1992.

```

Clear[h];
h[x_] := x + 3.1 x (1-x);
StartingValues = .1;
FirstIteration = 150;
LastIteration = 200;
i = 150;
y = N[StartingValues];
While[i <= LastIteration,
  If[i >= FirstIteration, Print[i, " ", N[y, 8]]];
  y = h[y];
  i = i + 1]

```

Bifurcation Diagram

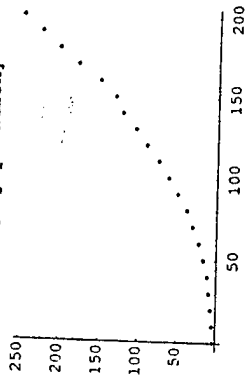


```

uspopulation=Table[{{0,3.9},{10,5.3},{20,7.2},
{30,9.6},{40,12},{50,17},
{60,23},{70,31},{80,38},
{90,50},{100,62},{110,75},
{120,91},{130,105},{140,122},
{150,131},{160,151},{170,179},
{180,203},{190,226},{200,249}}]

Pointplot= ListPlot[uspopulation]

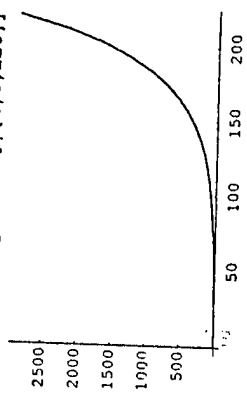
```



```

-Graphics-
Malthus=Plot[3.9*Exp[.03 t], {t,0,220}]

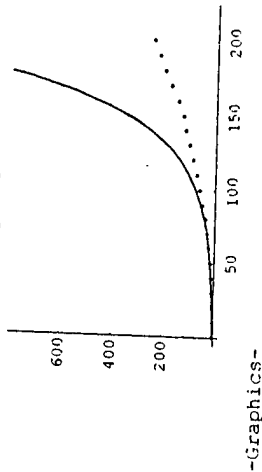
```



```

Show[Malthus, pointplot]

```



```

uspopulation=Table[{{0,3.9},{10,5.3},{20,7.2},
{30,9.6},{40,12},{50,17},
{60,23},{70,31},{80,38},
{90,50},{100,62},{110,75},
{120,91},{130,105},{140,122},
{150,131},{160,151},{170,179},
{180,203},{190,226},{200,249}}]

```

```

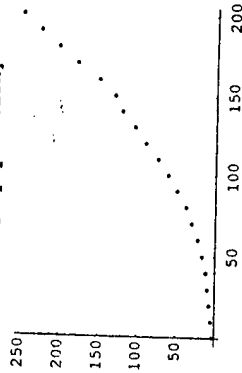
{{0, 3.9}, {10, 5.3}, {20, 7.2}, {30, 9.6}, {40, 12},
{50, 17}, {60, 23}, {70, 31}, {80, 38}, {90, 50},
{100, 62}, {110, 75}, {120, 91}, {130, 105},
{140, 122}, {150, 131}, {160, 151}, {170, 179},
{180, 203}, {190, 226}, {200, 249}}

```

```

Pointplot= ListPlot[uspopulation]

```

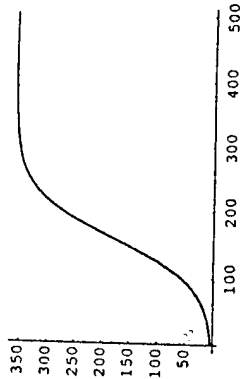


-Graphics-

```

Verhulst=Plot[(3.9*358)/((358-3.9)*Exp[-358*t]+3.9),
{t,0,500}]

```

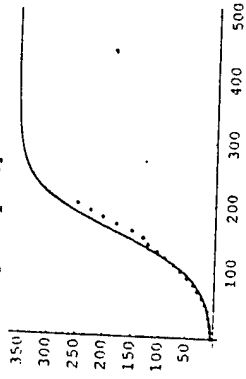


-Graphics-

```

Show[Verhulst, pointplot]

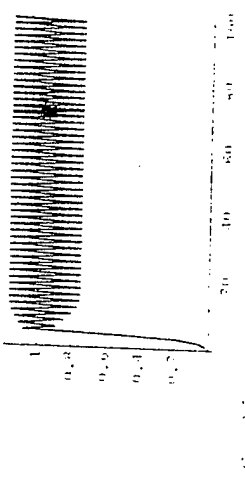
```



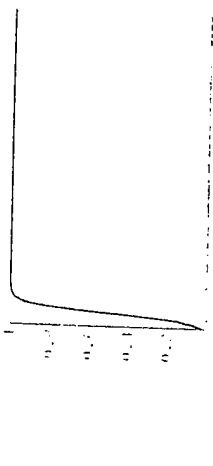
-Graphics-


```
f[x_] := x+2.2*x*(1-x)
iteration=NeatList[f, .02, 100]
{0.02, 0.06312, 0.193219, 0.536167, 1.08329,
0.884792, 1.10905, 0.842979, 1.13418, 0.799369,
1.1522, 0.766395, 1.16027, 0.751168, 1.16238,
0.747136, 1.16277, 0.746392, 1.16283, 0.74627,
1.16284, 0.74625, 1.16284, 0.746247, 1.16284,
0.746247, 1.16284, 0.746247, 1.16284, 0.746247,
1.16284, 0.746247, 1.16284, 0.746247, 1.16284,
0.746247, 1.16284, 0.746247, 1.16284, 0.746247,
1.16284, 0.746247, 1.16284, 0.746247, 1.16284,
0.746247, 1.16284, 0.746247, 1.16284, 0.746247,
1.16284, 0.746247, 1.16284, 0.746247, 1.16284,
0.746247, 1.16284, 0.746247, 1.16284, 0.746247,
1.16284}
```

```
joinedplot3=ListPlot[discretepoint, PlotJoined -> True]
```



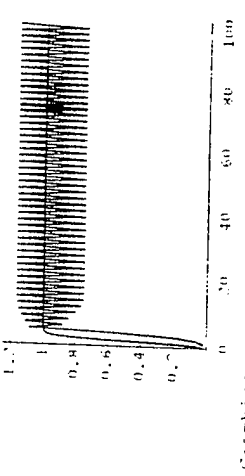
```
-Graphics-
P[t_] := .029/(.971*Exp[-2.2*t]+.029)
continuepic= Plot[p[t], {t, 0, 100}, PlotRange -> {0,1}]
```



```
discretepoint=Table[iteration]
```

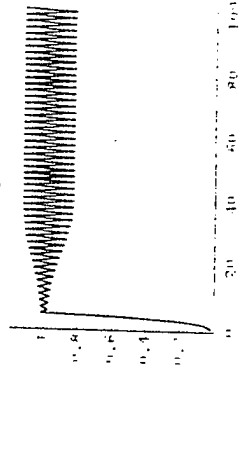
```
{0.02, 0.06312, 0.193219, 0.536167, 1.08329,
0.884792, 1.10905, 0.842979, 1.13418, 0.799369,
1.1522, 0.766395, 1.16027, 0.751168, 1.16238,
0.747136, 1.16277, 0.746392, 1.16283, 0.74627,
1.16284, 0.74625, 1.16284, 0.746247, 1.16284,
0.746247, 1.16284, 0.746247, 1.16284, 0.746247,
1.16284, 0.746247, 1.16284, 0.746247, 1.16284,
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0.746247, 1.16284, 0.746247, 1.16284, 0.746247,
1.16284, 0.746247, 1.16284, 0.746247, 1.16284,
0.746247, 1.16284, 0.746247, 1.16284, 0.746247,
1.16284}
```

```
Show[joinedplot3, continuepic, PlotRange -> {0,1.25}]
```

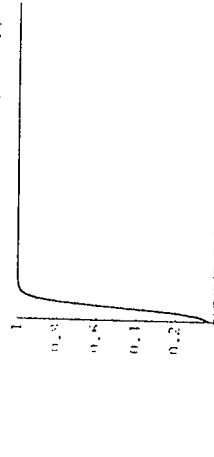


-Graphics-

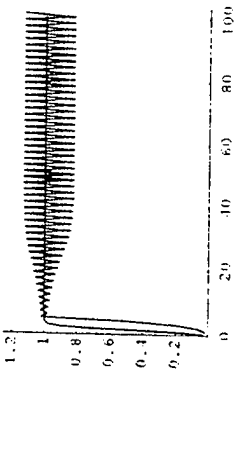
```
f[x_] := x + 2.1 * x * (1 - x)
iteration = NestList[f, .02, 100]
discretepic = ListPlot[discretepoint, PlotJoined -> True,
  PlotRange -> {0, 1.2}]
```



```
-Graphics-
p[t_] := .028 / (.972 * Exp[-2.5 * t] + .028)
continuepic = Plot[p[t], {t, 0, 100}, PlotRange -> {0, 1.1}]
```



```
-Graphics-
Show[discretepic, continuepic, PlotRange -> {0, 1.25}]
```



```
-Graphics-
```

```
f[x_] := x + 2.1 * x * (1 - x)
iteration = NestList[f, .02, 100]
{0.02, 0.06116, 0.181741, 0.494034, 1.01896,
0.97839, 1.02279, 0.97384, 1.02734, 0.968357,
1.0327, 0.961779, 1.03898, 0.953937, 1.04621,
0.94468, 1.05443, 0.933912, 1.06352, 0.921648,
1.07329, 0.908094, 1.08336, 0.893714, 1.09319,
0.879251, 1.10221, 0.865638, 1.10989, 0.853767,
1.11595, 0.844222, 1.1204, 0.837125, 1.12345,
0.832196, 1.12545, 0.828952, 1.12671, 0.826899,
1.12749, 0.825634, 1.12796, 0.824867, 1.12824,
0.824407, 1.1284, 0.824133, 1.1285, 0.82397,
1.12856, 0.823874, 1.1286, 0.823817, 1.12862,
0.823784, 1.12863, 0.823764, 1.12864, 0.823752,
1.12864, 0.823745, 1.12864, 0.823741, 1.12864,
0.823739, 1.12864, 0.823737, 1.12865, 0.823736,
1.12865, 0.823736, 1.12865, 0.823736, 1.12865,
0.823735, 1.12865, 0.823735, 1.12865, 0.823735,
1.12865, 0.823735, 1.12865, 0.823735, 1.12865,
0.823735, 1.12865, 0.823735, 1.12865, 0.823735,
1.12865, 0.823735, 1.12865, 0.823735, 1.12865,
0.823735, 1.12865, 0.823735, 1.12865, 0.823735,
1.12865}
```

81

```
discretepoint = Table[iteration]
```

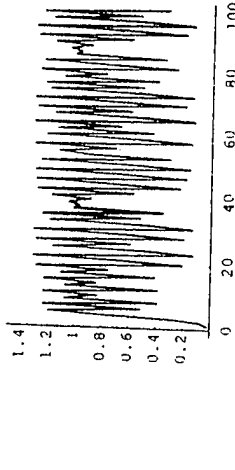
```
{0.02, 0.06116, 0.181741, 0.494034, 1.01896,
0.97839, 1.02279, 0.97384, 1.02734, 0.968357,
1.0327, 0.961779, 1.03898, 0.953937, 1.04621,
0.94468, 1.05443, 0.933912, 1.06352, 0.921648,
1.07329, 0.908094, 1.08336, 0.893714, 1.09319,
0.879251, 1.10221, 0.865638, 1.10989, 0.853767,
1.11595, 0.844222, 1.1204, 0.837125, 1.12345,
0.832196, 1.12545, 0.828952, 1.12671, 0.826899,
1.12749, 0.825634, 1.12796, 0.824867, 1.12824,
0.824407, 1.1284, 0.824133, 1.1285, 0.82397,
1.12856, 0.823874, 1.1286, 0.823817, 1.12862,
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0.823735, 1.12865, 0.823735, 1.12865, 0.823735,
1.12865}
```

```
f[x_] := x+2.9*x*(1-x)
iteration= NestList[f, .02, 100]
{0.02, 0.07684, 0.282553, 0.870432, 1.19749,
0.51165, 1.23626, 0.389243, 1.07867, 0.832585,
1.23681, 0.387438, 1.07569, 0.839566, 1.23018,
0.409005, 1.10999, 0.75593, 1.29098, 0.201598,
0.668372, 1.31116, 0.128018, 0.451744, 1.16999,
0.593217, 1.29302, 0.194274, 0.648215, 1.30951,
0.134126, 0.470921, 1.19347, 0.52386, 1.24721,
0.353076, 1.01547, 0.969903, 1.05456, 0.88771,
1.17678, 0.573477, 1.28282, 0.230678, 0.745329,
1.29579, 0.184277, 0.620203, 1.3033, 0.156951,
0.540672, 1.26087, 0.306977, 0.92393, 1.12775,
0.709941, 1.30712, 0.142926, 0.49817, 1.22316,
0.431575, 1.143, 0.669004, 1.31117, 0.127968,
0.451584, 1.16979, 0.593807, 1.29329, 0.193302,
0.645517, 1.30911, 0.135603, 0.475526, 1.19879,
0.507702, 1.23253, 0.401391, 1.09819, 0.785476,
1.27414, 0.261204, 0.820836, 1.24732, 0.352701,
1.01478, 0.971286, 1.05216, 0.892996, 1.1701,
0.592891, 1.29287, 0.194813, 0.649711, 1.30971,
0.133374, 0.468572, 1.19071, 0.532184, 1.25418,
0.329695}
```

```
discretepoint= Table[iteration]
```

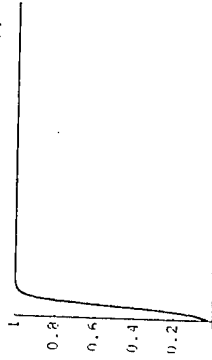
```
{0.02, 0.07684, 0.282553, 0.870432, 1.19749,
0.51165, 1.23626, 0.389243, 1.07867, 0.832585,
1.23681, 0.387438, 1.07569, 0.839566, 1.23018,
0.409005, 1.10999, 0.75593, 1.29098, 0.201598,
0.668372, 1.31116, 0.128018, 0.451744, 1.16999,
0.593217, 1.29302, 0.194274, 0.648215, 1.30951,
0.134126, 0.470921, 1.19347, 0.52386, 1.24721,
0.353076, 1.01547, 0.969903, 1.05456, 0.88771,
1.17678, 0.573477, 1.28282, 0.230678, 0.745329,
1.29579, 0.184277, 0.620203, 1.3033, 0.156951,
0.540672, 1.26087, 0.306977, 0.92393, 1.12775,
0.709941, 1.30712, 0.142926, 0.49817, 1.22316,
0.431575, 1.143, 0.669004, 1.31117, 0.127968,
0.451584, 1.16979, 0.593807, 1.29329, 0.193302,
0.645517, 1.30911, 0.135603, 0.475526, 1.19879,
0.507702, 1.23253, 0.401391, 1.09819, 0.785476,
1.27414, 0.261204, 0.820836, 1.24732, 0.352701,
1.01478, 0.971286, 1.05216, 0.892996, 1.1701,
0.592891, 1.29287, 0.194813, 0.649711, 1.30971,
0.133374, 0.468572, 1.19071, 0.532184, 1.25418,
0.329695}
```

```
Joinedplot4= ListPlot[discretepoint, PlotJoined -> True
,PlotRange -> {0,1.5}]
```



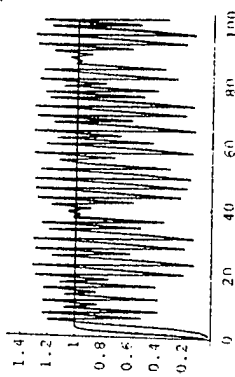
-Graphics-

```
p[t_] := .027/(-.973*Exp[-2.9*t]+.027)
continuouspic= Plot[p[t], {t, 0, 100}, PlotRange -> {0,1}]
```



-Graphics-

```
Show[joinedplot4, continuouspic, PlotRange -> {0,1.5}]
```



-Graphics-

Fractals

A fractal is a graphical representation of an equation. In a fractal the whole image is consisting of smaller copies of the whole. This is like a repeating pattern to form the whole image. In a fractal the area of one space is decreasing to form the new area of space for the image to be represented. Examples of two types of fractals using a repeating pattern and area will be discussed in Sierpinski's Triangle and the Tree fractal.

Sierpinski-Triangle and Its Variations

The fractal Sierpinski-Triangle is an older fractal, introduced in 1916 by a Polish mathematician Waclaw Sierpinski (1882-1969). If in Sierpinski's-Triangle a person were to take a part of the triangle and magnify it, he or she would find that it is an exact replicate of the larger triangle. If a person were to continue to do so they would find that the image of the larger triangle remains the same continuously unto infinity. This process of replication is recurrence.

Construction

The construction of the Sierpinski Triangle is quite simple, consider an equilateral triangle for the initial polygon. Let the iterative be to:

- a) Connect the midpoints of the sides with line segments.
- b) Remove the middle triangle of the four triangles formed.

At the first stage, three equilateral triangles replace the initial one. At the second stage, the rule is applied to each of these three triangles, subdividing each one into three smaller similar triangles.

The iterative process requires that the rule be applied repeatedly on all remaining equilateral triangles at each and every stage, once the middle triangles are removed. It is important to notice that as the number of triangles increases the area of the original triangle decreases. The process of using the midpoints to find new vertices for the triangle continue to infinity. The final result is generated by infinite iterations of the steps described; it is called Sierpinski's triangle.

Predicting Area and Number of Triangles Produced

Using the stages and images produced by using the midpoint method, a person can find a constant that can be used to determine the number of triangles produced and the amount of area the triangles use on any stage. In Sierpinski's Triangle the group counted how many triangles were shaded in the first stage, in which the amount was three. As the group went through each stage they found the number of triangle was increasing by multiples of three, that is determined by using the stage number as a power of the constant three. As the number of shaded triangles increased the area of shade in the image decreased.

As the group found that shaded area was decreasing because of the increase of shaded triangles, we found that for every triangle there were three midpoints. For example, in the first stage of the Sierpinski Triangle, a central triangle was formed from the midpoints of the shaded original triangle. The group observed that for every one triangle the area would decrease by three-fourths its original shaded area. Therefore by using the stage number as powers to the three-fourths constant we were able to determine the decrease in shaded area for any stage. We also found that if the shaded area decreases without bound that non-shaded area will increase and cause the shaded area to disappear. The vertices of the triangle generated at any stage in these activities identify points that remain parts of the final fractal.

OO 4

Tree Fractal

As we all know when trees grow they branch out. The process goes from large branches grow smaller ones and from them grow ever smaller branches. In the construction of the fractal tree, the group used 60 degree angles to determine where the placement of the next branch would occur from the trunk. At each new endpoint we would draw a new branch one-half the size of the previous branch at 60 degrees. As we completed the diagram we found that that every new branch was a smaller copy of the previous branch drawing magnified.

The group also noticed that the length of each new branch was a fraction of the length of the previous branch. This means that the original branch's length equals one, the next branch is one-half, and the branch derived after that is one-fourth of the original branch and so on to infinity. To obtain the next branch we had to take one-half of the previous branch; the new branch formed also has its length measurement. The interesting factor in this design is that the image does not cancel its self out during its approach to infinity as the shaded triangles of the Sierpinski's Triangle. The tree fractal just continues to grow in the number of branches. The new branches of the smaller fractions would probably be too small for the human eye to see but as long as the fractions can be reduced the tree still is producing new branches.

The completed tree, in its limiting state, has some very intriguing visual properties. Each segment can be viewed as the trunk of its own tree, boxed in its own smaller hexagonal boundary. Look for these successively smaller but complete trees are exact images of the initial tree. All trees of all sizes in the figure have the same number of branches. Also the complete tree have intriguing visual properties. In particular, the spirals, always turning clockwise or counterclockwise, have lengths tied to geometric series. Their numbers are also tied to geometric series.

Four branches start at the first branching point, eight from the second branching points and so on.

Summary

The Tree fractal and Sierpinski's Triangle are two most important examples of deterministic fractals. The fractals give us a graphical representation of a mathematical equation or constant. Fractals helps us to visualize what a mathematical function produces graphically. It also helps in predicting length and distances in objects before performing any mathematical function or equation. Through fractals much research and time can be saved by designing an image that represents a complex mathematical equation or function. In the next discussion, another example of self-similar figures using a constant within a fractal called Square Carpet.

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OJ

Fractals

A fractal is an object or quantity that displays Self-Similarity. This refers to parts of a figure which contain small replicas of the whole. It is created through several iterations and deals with shapes of infinite detail. They can be described as a graphical representation of an equation. Each branch or portion is exactly the same as the next. Fractals can be used to explain natural phenomenon and the dynamic behaviors in mathematics. An example is the veins in the body. They begin large at the heart and branch smaller and smaller until they are tiny capillaries in our fingers. The overall pattern is the same. Some examples of Fractals are the Sierpinski-Triangle, the Tree Fractal, Pascal's Triangle and the Square Carpet.

History

Although a fractal's roots can be traced back to Ancient Greece with spheres and cones, the first real fractals were discovered by a French mathematician Gaston Julia(1893-1978). He is known as one of the forefathers of the modern dynamical systems theory. At the age of 25, he published his 199 page masterpiece, which was full of classical fractals. He is known for the fractals, the "Julia Sets" most beautiful fractals today. They are important for the understanding of iterations of polynomials. Benoit B. Mandelbrot later developed the Mandelbrot set, which is the most famous of the fractals. He is largely

responsible for the present interest in Fractal Geometry. In 1945, Mandelbrot was introduced to Julia's 1918 masterpiece by his uncle. He did not like it because he could not relate to the style of mathematics used in the paper. Therefore, he chose a different course and with the aid of computer graphics he was able to show Julia's work as the source of the most beautiful fractals "Mandlebrot Set", known today. Mandelbrot was the first to state that the fractals could not be measured in whole-number dimensions but in an exponential dimension. One of his great discoveries was that nature tends toward fractals. He found that if you measure things such as clouds, coastlines, or even mountain ranges to the nearest irregularity, it would tend toward infinity.

Square Carpet

The Square Carpet is a fractal created by the great Polish mathematician Wacław Sierpinski (1882-1969). One begins with a square in plane and connect the trisection points on the sides. Then the square is subdivided into eight little congruent squares of which the center one is dropped. At each stage, each square is transformed into eight new subsquares with the sides one-third as long. This is repeated for several iterations until the area decreases. While the area becomes smaller, the number of squares is increasing. The stages of the number of squares can be represented by the following table:

Stage	0	1	2	3	4	...	n
-------	---	---	---	---	---	-----	---

Number	1	8	64	512	4096	8^n (to the power n)
--------	---	---	----	-----	------	------------------------

The stages of the area of squares can be represented by:

Stage	0	1	2	3	4	...	n
Area	1	8/9	64/81	512/729	4096/6561	$(8/9)^n$	

The final result generates by infinitely several iterations, the Square Carpet. This is a fractal.

This means it takes a quantity of (1) power of 2^1 and (1) power of 2^0 , thus the binary number is 11.

The color rule is: if the entry is 1 or 2, shade the cell, if it is zero, leave the cell unshaded.

A more interesting approach, modulo 9 arithmetic involves remainders of 0,1,2,3,4,5,6,7, and 8. However, the color rule is simply: if the entry is zero, shade the cell, else, leave it white.

Another example is the number 6:

$$(1)2^2 + (1)2^1 + (0)2^0$$

It takes a quantity of (1) power of 2^2 and (1) power of 2^1 . However, it does not require a value of 1 or 2^0 , thus the binary number is 110.

In determining the color code, you pair up the (x,y) binary number as if you were taking the sum, then if two 1's appear above each other, then the cell is left white, otherwise, it is shaded. So the cell (6,3) or (0110, 0011), would be left white because two 1's appear above each other.

00 0110
 00 0011

Comparing binary digits in this fashion is equivalent to performing a logical expression where both of the two conditions must be true for the conclusion to be true.

True	and	True	--->	True	1	and	1	--->	1
True	and	False	--->	False	1	and	0	--->	0
False	and	True	--->	False	0	and	1	--->	0
False	and	False	--->	False	0	and	0	--->	0

Modulo Arithmetic 3 and Modulo Arithmetic 9

In exercise 1.11A, we learn a modified coloring system based on modulo 3 arithmetic. We apply this to entries in Pascal's triangle. As expected, the only remainders in modulo 3 arithmetic (0,1,2) are of importance.

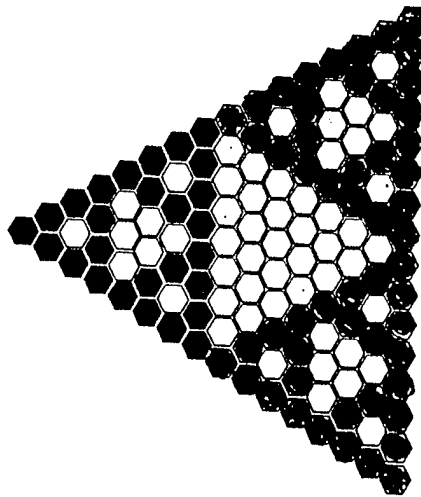
1.10 SIERPINSKI TRIANGLE REVISITED

The rule for coloring the cells in Pascal's triangle can be stated this way:
 If the two cells directly above are different in color, then shade in the cell so the color is black. If they are the same in color, leave the cell unshaded so the color is white. End cells in each row are always colored black.

The first eight rows of the triangular array below have been colored using this rule.

1. Do you see a geometric pattern in the first four rows of the display? How is it related to stage 1 in the construction of the Sierpinski triangle?
2. How are the first eight rows related to the first four rows? How are they related to stage 2 of the Sierpinski triangle?
3. Follow the rule above and color in the next eight rows on the triangle. What stage of the Sierpinski triangle appears from the completed figure?
4. How many rows would be needed in all to represent stage 4 of the Sierpinski triangle? stage 5?

STAGE	NUMBER OF ROWS	n
1	2	2
2	4	4
3	8	8
4	16	16
5	32	32
...
n	2^n	n



5. Now generalize the results in the table. How many rows are needed for stage n ?

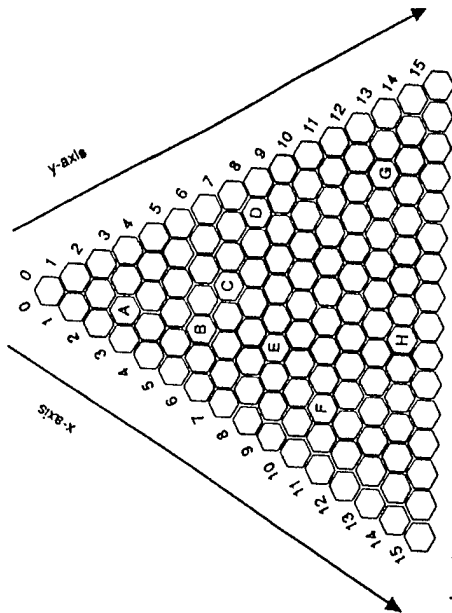
A COLORING SHORTCUT

1.10B

The question arises as to whether or not there is a direct way of finding the coloring of any given cell in Pascal's triangle without running the process through all rows above it. The answers is yes, but the process requires a binary coding of each location.

Start with the origin $(0, 0)$ as the top entry in the triangular array. Let the x -axis be diagonal to the left and the y -axis diagonal to the right. Then each pair of coordinates (x, y) corresponds to a specific location in the array. Cell A has coordinates $(2, 1)$.

1. Give the coordinates for cells B, C, and D.



To determine the color of a given cell, place the binary expansions of the two coordinates of the cell above each other and follow this rule:
 If two 1's appear above each other in any one of the columns, then the cell is left white. Otherwise, it is shaded in as black.

2. The 4-digit binary coordinates for cell E are $(0110, 0011)$. When placed above each other, do any columns have two 1's? Will the cell be colored black or white?
 3. What is the color of cell F? of cell G? of cell H?
- Convert these coordinates to binary form. Then determine if the corresponding cells are colored black or white.

4. $(7, 9)$
5. $(12, 16)$
6. $(25, 40)$

1.11 NEW COLORING RULES AND PATTERNS

1.11B

In this enrichment activity, a modified coloring system is applied to entries in Pascal's triangle based on modulo 3 arithmetic. A new, but predictable, pattern emerges in the coloring of the cells.

In modulo 3 arithmetic, only the remainders after division by 3 are of interest. As an example, consider $5 + 7 = 12$, $5 + 8 = 13$, and $5 + 9 = 14$. The sum 12 has a 0 remainder, the sum 13 has a 1 remainder, and the sum 14 has a 2 remainder.

$$5 + 7 = 0 \pmod{3} \quad 5 + 8 = 1 \pmod{3} \quad 5 + 9 = 2 \pmod{3}$$

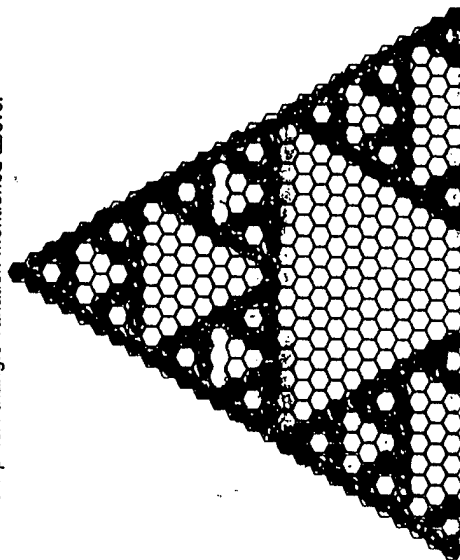
Since the only possible remainders upon division by 3 are 0, 1, and 2, every sum modulo 3 must be 0, 1, or 2.

1. Refer to the numerical entries in rows 0 through 8 of Pascal's triangle. Express each number in modulo 3 form and then color in the corresponding cell using the following rule:

If the entry is 1 or 2, shade the cell black. If the entry is 0, leave the cell unshaded as white.

2. Study the coloring on the cells thus far completed. How does it compare with stage 1 of the Sierpinski triangle variation on Activity sheet 1.1B?

3. Try coloring in the remaining rows by replicating the pattern that you see in the first nine rows. The pattern that emerges should contain the 18 small triangles found in stage 2 of the Sierpinski triangle variation mentioned above.



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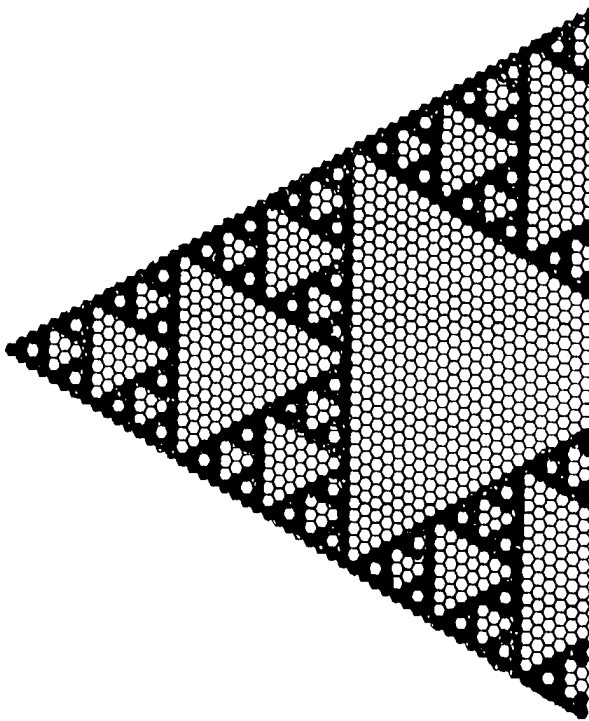
In modulo 9 arithmetic, only the remainders after division by 9 are of interest.

$$5 + 11 = 7 \pmod{9} \quad 5 + 12 = 8 \pmod{9} \quad 5 + 13 = 0 \pmod{9}$$

Since the only possible remainders upon division by 9 are 0, 1, 2, 3, 4, 5, 6, 7, and 8, every sum modulo 9 must be one of these numbers. This next activity requires finding the numbers in Pascal's triangle that are divisible by 9 with remainder 0. These are the numbers equal to 0 mod 9.

4. Refer to the numbers in Pascal's triangle and their mod 9 form. Color the corresponding cells in this array using the following rule:
If the entry mod 9 is 0, shade the cell black.
Otherwise, leave the cell unshaded as white.

See how quickly you can see a coloring pattern emerge that you can follow to complete the array.



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