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Final Report: A Platform for AI and Deep Learning

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611103

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7. PERFORMING ORGANIZATION NAMES AND ADDRESSES
St. Mary's University
One Camino Santa Maria

San Antonio, TX 78228 -5433

8. PERFORMING ORGANIZATION REPORT NUMBER

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U.S. Army Research Office
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Research Triangle Park, NC 27709-2211

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73980-CS-RIP.10

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Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES
The views, opinions and/or findings contained in this report are those of the author(s) and should not contrued as an official Department of the Army position, policy or decision, unless so designated by other documentation.

14. ABSTRACT

15. SUBJECT TERMS

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a. REPORT	b. ABSTRACT	c. THIS PAGE			Vahid Emamian
UU	UU	UU	UU		19b. TELEPHONE NUMBER 210-431-2049

RPPR Final Report
as of 02-Aug-2021

Agency Code: 21XD

Proposal Number: 73980CSRIP **Agreement Number: W911NF-19-1-0159**
INVESTIGATOR(S):

Name: Ph.D. Vahid Emamian
Email: vemamian@stmarytx.edu
Phone Number: 2104312049
Principal: Y

Organization: **St. Mary's University**
Address: One Camino Santa Maria, San Antonio, TX 782285433
Country: USA

DUNS Number: 078500725 EIN: 741143128
Report Date: 14-Jun-2021 Date Received: 15-Jun-2021
Final Report for Period Beginning 15-Mar-2019 and Ending 14-Mar-2021
Title: A Platform for AI and Deep Learning
Begin Performance Period: 15-Mar-2019 **End Performance Period:** 14-Mar-2021
Report Term: 0-Other

Submitted By: Kathryn Aultman Email: kaultman@stmarytx.edu
Phone: (210) 436-3312

Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees: 3 **STEM Participants:** 18

Major Goals: The major goals of this project are to establish a deep learning platform at St. Mary's University so as to enhance the university's capacity for research and technical training in the area of deep machine learning. This will be accomplished by purchasing fourteen AMAX servers,, two AMAX clusters and the associated power distribution units. This equipment was situated into a space dedicated for this purpose and renovated to upgrade the cooling, air circulation and power systems necessary to support the system.

Upon completion of the installation, the system was made available for research projects led by St. Mary's faculty and engaging St. Mary's students. The PI developed a webpage through which faculty and students could learn about the platform and how to access it.
Numerous projects have been completed and are in process, constituting a form of outreach to the STEM community about the availability of the platform.

Accomplishments: The space has been renovated and upgraded at university expense to accept and support the new equipment. The PI had many meetings with the university IT and facilities personnel to decide on the space, power, network connectivity, security, and other requirements prior to installation of the equipment. As reflected in the appendixes, a clear plan was developed for where and how the equipment was installed, how the power was made available, and how network connectivity and security was assured.

The following equipment has been purchased and installed. Through this grant, we purchased the main equipment from AMAX. The equipment is listed individually with a description and cost in the following pages. Tagging and recording of equipment was performed by the St. Mary’s finance department which records property over the capitalization threshold into the Fixed Asset Records and identifies the equipment with a unique St. Mary’s University inventory control number.

Since the establishment of the platform, our students and faculty were exposed to cutting-edge research in deep machine learning and related areas. So far six journal papers have been submitted as a result of direct use of this platform, in which two are published and four are pending.
The PI’s research involves various aspects of deep machine learning, automatic health monitoring, signal and image processing. The developed deep learning platform has increased our processing power and enabled us to run more complex simulations in performing research in the following topics:

- Automatic Health Monitoring Platform Using Deep Machine Learning and Artificial Intelligence
- Application of Deep Machine Learning in Cybersecurity
- Wireless Security Concerns and Case Studies in Geolocation Data

- Deep Learning Algorithms for Android Malware Detection
- Covid-19: Application of Machine Learning for Wireless Security during a Pandemic

C. Research Enabled

Several research initiatives have been performed on the deep learning platform. Although this in an ongoing process, the following research have yielded results and been submitted for journal publications. Full manuscripts of these papers are uploaded elsewhere in the report.

Automatic health monitoring platform using deep machine learning and artificial intelligence
Team: Nahom G Ghebremeskel, Dr. Vahid Emamian
The goal of this research was to develop a human health monitoring platform using deep machine learning and artificial intelligence (AI). The signal collected from human body will be transmitted over a wireless channel to the platform using a Zigbee sensors. During this experimental research, we collected and processed real time ECG signals to detect and alert regarding health issues. Several human body signals such as heartbeat, blood pressure, brain activities, and body temperature were collected using various sensors, however, our focus was on Electrocardiogram (ECG) signals. ECG signal were collected and transmitted through Zigbee transceiver to the AI & deep learning platform where the signal was processed for diagnosis of heart issues. ZigBee transceivers acquired and transmitted/received signals over a wireless channel. Processing the ECG signals in real time and continuedly helped us detect heart issues at the early stage. We used the deep learning platform to train the machine and to detect and/or predict early stages of heart disease by real-time and continues processing of the ECG signals
.

Application of Deep Machine Learning in Cybersecurity
Team: Sarana Tse, Niharika Kakumani, Savannah Muniz, Dr. Vahid Emamian
In this research, we focused on adoption of machine learning in cyber security, using the deep learning platform. Since technology is available to everyone, it is raising security challenges and an immediate need for robust techniques to combat various complex-cyber security-attacks. The attackers are improving their skills and coming up with new techniques to break through security infrastructures. The traditional cybersecurity tools are unable to defend, detect, and keep up with all attacks. Thus, cybersecurity is becoming overwhelmingly complex and sophisticated. Our goal in this research was to implement cybersecurity techniques with the help of deep machine learning to improve the attacks detection rates and to respond quickly to the attacks.

Deep Learning Algorithms for Android Malware Detection
Team: Ouda Adomuha, Alalmai M. Abdulhadi, Alqahtani S. Ibrahim, Ferenczi Tamas, Jose Garza, Dr. Vahid Emamian
Android is an open-source software designed for mobile devices such as smartphones and tablets with primarily touchscreen as input interface has grown exponentially in the last decade. This growth has been a catalyst for the increased rate of malware attacks on these types of systems. Since traditional antivirus software have been deficient at tackling the dynamic nature of attacks on them, deep learning was introduced and discovered to be a better approach in dealing with this challenge. Deep learning utilizes static, dynamic and hybrid approaches in the analysis of malware. In this research, we examined the efficacy of the malware detection using deep learning platform.

Application of Deep Machine Learning for Wireless Security during a Pandemic
Team: Gerso Guillen, Jorge Campuzano, Adan Guadarrama, Joshua Dare, Vahid Emamian
In this research, we used a data set of home routers to gather known security configurations commonly known for security issues. Deep learning techniques shown quicker identification of anomalies on any given network, which provided us the ability to check if the router had those presets enabled and if the router was vulnerable or not.

The deep learning platform has so far enhanced the quality of SET programs in the following ways: i. created an infrastructure for deep learning research and teaching, ii. increased research capacity and productivity, iii. students got involved in interdisciplinary research iv. introduced new techniques to pedagogical methods of teaching machine learning and new proficiencies for faculty and students in the use of current cutting-edge technology. The effort by the PI in developing the deep learning platform has been featured in university publications.

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Training Opportunities: Since the establishment of the platform, our students and faculty were exposed to cutting-edge research in deep machine learning and related areas. So far six journal papers have been submitted as a result of direct use of this platform, in which two are published and four are pending. New pedagogical techniques based on machine learning have been introduced into our classes.

The PI has made the platform available to all faculties and researchers at St. Mary's University. This requires addressing the unique and complex needs of each faculty or researcher that is performing research in one of the ARO interest areas. Prior to using the platform, each new user must receive basic training from the PI. This also includes a self-study document provided by the PI.
https://sites.stmarytx.edu/vemamian/access-request-to-deep-learning-platform/

Results Dissemination: The following articles are prepared using the funded deep learning platform, in which two are published and four are pending:
- N. Ghebremeskel, V. Emamian, "Classification of Cardiac Arrhythmia Using a 2D Convolutional Neural Network ", Int Journal of Scientific Research, 10(09), pp. 35620-35625, 2019
- N. Ghebremeskel, V. Emamian?, "ECG Arrhythmia Classification Using a Convolution Neural Network", Engineering and Technology Journal, Vol 4 No 04 (2019): Volume 04, 30 April 2019, Page No.: 570-577
- Sarana Tse, Niharika Kakumani, Savannah Muniz, Vahid Emamian, "Application of Deep Machine Learning in Cybersecurity", Pending
- Julie Brozovich, Aby Tino Thomas, Martin Bonugli, Luke Thurmond, Vahid Emamian, "A Survey of Wireless Security Concerns and Case Studies in Geolocation Data ", Pending
- Ouda Adomuha, Alalmai M. Abdulhadi, Alqahtani S. Ibrahim, Ferenczi Tamas, Garza I. Jose, Vahid Emamian," Deep Learning Algorithms for Android Malware Detection"
- Gerso Guillen, Jorge Campuzano, Adan Guadarrama, Joshua Dare, Vahid Emamian,"Covid-19: Application of Machine Learning for Wireless Security during a Pandemic", Pending

Full manuscripts will be uploaded elsewhere in the report.

Honors and Awards: Recognition by St. Marys through university publications:
1- "University gets $268K grant to enhance deep learning", https://www.stmarytx.edu/2019/268k-grant-deep-learning/
2- "Electrical Engineering professor uses artificial intelligence to predict heart disease", https://www.stmarytx.edu/2020/artificial-intelligence-heart-disease/

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI
Participant: Vahid Emamian
Person Months Worked: 3.00 **Funding Support:**
Project Contribution:
National Academy Member: N

ARTICLES:

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Publication Type: Journal Article Peer Reviewed: Y **Publication Status:** 0-Other
Journal: NONE
Publication Identifier Type: Other Publication Identifier:
Volume: Issue: First Page #:
Date Submitted: 6/15/21 12:00AM Date Published:
Publication Location:
Article Title: Application of Deep Machine Learning in Cybersecurity
Authors: Sarana Tse, Niharika Kakumani, Savannah Muniz, Vahid Emamian
Keywords: machine learning, cybersecurity, artificial neural networks
Abstract: The evolution of technology has brought in many changes across the globe. Technology has no limit in expanding its scope; there are smart gadgets like Alexa, Google Home and Apple Pod that act like a personal assistant; there are smart homes, with the control of home appliances from faraway places; so many more examples come to mind with the help of the Internet. The world is constantly looking for 'the next best thing' in terms of science and technology. As the world is becoming more digitalized and with increasing availability to technology, raising security challenges introduce an immediate need for robust techniques to combat various complex-cyber security-attacks. The attackers are improving their skills and coming up with new techniques to break through security infrastructures. The traditional cybersecurity tools are unable to defend, detect, and simply just keep up with the onslaught of today's attacks. Thus, cybersecurity is becoming an overwhelmingly complex and so
Distribution Statement: 2-Distribution Limited to U.S. Government agencies only; report contains proprietary info
Acknowledged Federal Support: **Y**

Publication Type: Journal Article Peer Reviewed: Y **Publication Status:** 0-Other
Journal: NONE
Publication Identifier Type: Publication Identifier:
Volume: Issue: First Page #:
Date Submitted: 6/15/21 12:00AM Date Published:
Publication Location:
Article Title: A Survey of Wireless Security Concerns and Case Studies in Geolocation Data
Authors: Julie Brozovich1 , Aby Tino Thomas1 , Martin Bonugli1 , Luke Thurmond1 Vahid Emamian2
Keywords: Location, privacy, anonymity, wireless networks, ad hoc network routing, security
Abstract: In the past few decades, there was a revolution in information technology and its real-world implementations, which improved the overall lifestyle of every user and business. One of the key innovations in information technology and telecommunications is wireless devices, their secure communication, and location-specific functionalities. Early implementation was frequently used for commercial and military communications [1], but as the internet became an inseparable part of modern living, the popularity of wireless devices with internet capabilities has grown exponentially. To support this growing use of wireless devices across the world, wireless hotspots and mesh networks have been deployed. This resulted in location-related privacy concerns for normal users. In the modern world, location data is collected from wireless devices every second of every day which causes significant and on-going security concerns. Anyone who has access to this data can interpret information about
Distribution Statement: 2-Distribution Limited to U.S. Government agencies only; report contains proprietary info
Acknowledged Federal Support: **Y**

RPPR Final Report
as of 02-Aug-2021

Publication Type: Journal Article Peer Reviewed: Y **Publication Status:** 1-Published
Journal: Int. Journal of Scientific Research
Publication Identifier Type: ISSN Publication Identifier: 0976-3031
Volume: 10 Issue: 10 First Page #: 35620
Date Submitted: 6/14/21 12:00AM Date Published: 10/1/19 3:00PM
Publication Location:
Article Title: Classification of Cardiac Arrhythmia Using a 2D Convolutional Neural Network
Authors: Nahom Ghebremeskel, Vahid Emamian
Keywords: Electrocardiogram (ECG), Arrhythmia, Convolutional Neural Network (CNN), Data Augmentation, DeepMachine Learning
Abstract: We use Electrocardiogram (ECG) monitoring to detect heart diseases, particularly cardiac arrhythmia. The availability of easy-to-use wearable and high-tech medical devices have made it easy to increase the quantity and quality of ECG recordings. We have proposed a method for ECG arrhythmia classification which converts ECG signals to 2D images and uses a 2D convolutional neural networks (CNN). Deep machine learning, which has been proven as an effective means for supervision complex data analysis with minimal pre-and post-processing requirement, is the main tool in this research. We use our proposed CNN architecture for classifying the ECG arrhythmia into three distinct categories: normal sinus rhythm, paced rhythm, and other rhythm to be classified. The ECG signal is converted into a two-dimensional grayscale image as an input data for the CNN classifier. The proposed CNN architecture employs various deep learning techniques such as batch normalization, data augmentation, an
Distribution Statement: 1-Approved for public release; distribution is unlimited.
Acknowledged Federal Support: **N**

Publication Type: Journal Article Peer Reviewed: Y **Publication Status:** 1-Published
Journal: Engineering and Technology Journal
Publication Identifier Type: DOI Publication Identifier: 10.24327/ijrsr
Volume: 10 Issue: 10 First Page #:
Date Submitted: 6/15/21 12:00AM Date Published:
Publication Location:
Article Title: ECG Arrhythmia Classification Using a Convolution Neural Network
Authors: Nahom Ghebremeskel, Vahid Emamian
Keywords: Electrocardiogram (ECG), Arrhythmia, Convolutional Neural Network (CNN), Data Augmentation, DeepMachine Learning
Abstract: We use Electrocardiogram (ECG) monitoring to detect heart diseases, particularly cardiac arrhythmia. The availability of easy-to-use wearable and high-tech medical devices have made it easy to increase the quantity and quality of ECG recordings. We have proposed a method for ECG arrhythmia classification which converts ECG signals to 2D images and uses a 2D convolutional neural networks (CNN). Deep machine learning, which has been proven as an effective means for supervision complex data analysis with minimal pre-and post-processing requirement, is the main tool in this research. We use our proposed CNN architecture for classifying the ECG arrhythmia into three distinct categories: normal sinus rhythm, paced rhythm, and other rhythm to be classified. The ECG signal is converted into a two-dimensional grayscale image as an input data for the CNN classifier. The proposed CNN architecture employs various deep learning techniques such as batch normalization, data augmentation, an
Distribution Statement: 1-Approved for public release; distribution is unlimited.
Acknowledged Federal Support: **N**

WEBSITES:

RPPR Final Report
as of 02-Aug-2021

URL: https://sites.stmarytx.edu/vemamian/
Date Received: 15-Jun-2021
Title: WEBPAGE FOR THE DEEP LEARNING PLATFORM
Description: Information about the deep learning platform, information about how to access it, and summaries of some work done using it.

Partners

,

I certify that the information in the report is complete and accurate:
Signature: Kathryn S. Aultman
Signature Date: 6/15/21 2:35PM

Appendix F
Quotes and Invoices

Form 2/7/2007

ST. MARY'S UNIVERSITY OFFICE OF FACILITIES SERVICES
DEPARTMENTAL COST PROPOSAL

08/22/2019

To: Winston Erevelles, Dean, School of Science, Engineering & Technology
Cc: Gary Ogden, Associate Dean, School of Science, Engineering and Technology

RE: Richter Math & Engineering Deep Learning Cluster Server Room Project

Dear Dean Erevelles,

The Cost Proposal is good for 30 days and is based on the drawing (ME2.01) from Leaf Engineering/PBK Architects dated 07/29/2019 and the following scope of work not picked up in the drawing.

1. Install one (1) new 125-amp, 42-circuit load center with one (1) 30-amp 3-pole breaker and six (6) 20-amp single pole breakers for new IDF cabinet power.
2. One (1) 45-KVA, 480/208/120-volt, 3-phase transformer fed from existing spare 480-volt breaker in "MOP".
3. Grounding.
4. Update panel schedules and labeling.
5. Safety.
6. Permit.

Exclusions:
1. Overtime or afterhours work schedule.
2. Renovation sales or use tax.
3. Bond (available upon request).
4. IDF cabinet.
5. Communication and/or Data Cabling.

1. Installation of fence to separate the university network and cyber lab servers.

The Scope of Work includes all possible costs related to this project. Any work beyond this initial scope will result in a change order. The cost provided is based on the following breakdown. The work will be performed by an outside contractor supervised by the Office of Facilities Services. Work is priced using regular time and overtime.

Once final approval is provided with authorizing signatures and a valid budget account number, a schedule will be developed as to when the work can begin. Project is expected to take 5 weeks to complete.

Project Cost			
Richter Math & Engineering Deep Learning Cluster Server Room Project			With OT Option
PBK			$5,500.00
Keller Martin			$49,675.00
Alterman			$7,182.00
De La Garza Fence			$1,000.00
TOTAL			$63,357.00

As always we make every attempt to work with your schedule; however, work after normal business hours (7:30 AM – 10:00 PM) and weekends will add to the price. Any changes to the scope of this project must be requested in writing as a change order and before completion of quoted work. Since this is a Cost-Not-To-Exceed, any savings in the project will be returned to you.

The cost proposal is intended to provide a complete cost of the project, including all labor, material, machinery, design, and supervision. The cost proposal provides a contingency amount to cover the costs from unforeseen conditions that may arise. This way, the project will not be delayed due to further approvals.

If you choose to accept this proposal please provide the appropriate account number and the required signatures as per below:

Less than $1,000 = Budget Director/Dean or Associate Dean (if delegated by Dean)

$1,000 up to $10,000 = Dean AND Vice President or Provost

Over $10,000 = Dean AND Provost or Vice President AND President

Thank you for your consideration in this matter and we look forward to serving you.

Luis H. Rodriguez
Senior Associate Director of Operations and Construction Services
(210) 431-5078

Approvals:

Department Director/Date

Winston Evers 8/22/19

Dean/Date

Account Number

Vice President/Date

Provost/Date

President/Date

INVOICE

Please Remit To:

AMAX

1565 Reliance Way
FREMONT , CA. 94539

Invoice No:	**HQ-0996142**
Invoice Date:	10/18/2019
Customer Number:	**00SMU3**
Customer PO:	**PO0056469**
Payment Terms:	NET30
Est. Due Date:	**11/17/2019**
Sales Person:	BRJ
S/O No:	**2681377**

Bill To:

ST. MARY'S UNIVERSITY
ONE CAMINO SANTA MARIA

SAN ANTONIO, TX 78228

Ship To:

St. Mary's University
Richter Math 2nd,One Camino Santa Maria
Engineering-rm212
San Antonio, TX. 78228

For billing questions, please call 510-651-8886

Ship From: AMAX

Line	Items	Serial No	Description	Qty Shipped	Unit Amt	Net Amt
1	**AX10000**	S/N: 910567824, 910567825, 910567826	BrainMax Tesla GPU HPC	**3**	$16,420.12	$49,260.36
2	**4019567**		4U DP Intel Xeon Scalable Processors 8x	**3**	$0.00	$0.00
3	**403080A**		Intel Xeon Silver 4210 Processor 10C/14M	**6**	$0.00	$0.00
4	**7008508**		Micron 8GB DDR4-2933 x8 SR RDIMM-CT8G4RFS8293-2G9E1	**36**	$0.00	$0.00
5	**4019690**		RTX 2080TI 11GB GDDR6 Blower	**24**	$0.00	$0.00
6	**600579E**		Intel SSD D3-S4510 240GB, 2.5in SATA 6Gb/s, Single Pack	**3**	$0.00	$0.00
7	**INS0049**		NVIDIA GPU CUDA Driver Installation & Co	**3**	$0.00	$0.00
8	**LST0001**		ATA Testing	**3**	$0.00	$0.00
9	**INS005A**		Dual boot installation of Windows & Linu	**3**	$0.00	$0.00
10	**BX0000D**		AMAX logo box label	**3**	$0.00	$0.00
11	**ISO2015**		ISO9001:2015 Certified facility	**3**	$0.00	$0.00
12	**W3Y20KS**		3-Year Parts & Labor Warranty	**3**	$0.00	$0.00
13	**INS0100**		5-Stage Quality Burn-in Testing	**3**	$0.00	$0.00
14	**INS0110**		Performance Optimized BIOS - Amax	**3**	$0.00	$0.00
15	**BBROWN0**		Original Chassis Packaging	**3**	$0.00	$0.00

Ship VIA: ME-TRUCK BOL:
Shipping Terms: FOB Origin - Frt Prepaid & Add

SUBTOTAL:	$49,260.36
Shipping:	$954.46
Sales Taxes:	
TOTAL AMOUNT:	**$50,214.82**

All purchases for software and GPUs are final.

Please include PO number on invoice

For Systems purchased with an AMAX Warranty, the warranty covers: 1) components installed in the case, for the time period of the warranty purchased by customer; 2) the external devices, including the mouse, keyboard and monitor for only the 30-day Dead On Arrival (DOA) period; and 3) Out of Warranty Service Charge is $150 per hour, with 2 hours/$300 as minimum charge requirement. Hardware and other optional service items will be quoted separately. All Rates subject to change without notification.

Asus provides fast, direct RMA service. For all Technical Support or RMA Services, Please contact ASUS directly at

INVOICE

Please Remit To:

AMAX

1565 Reliance Way
FREMONT , CA. 94539

Invoice No:	**HQ-0996142**
Invoice Date:	10/18/2019
Customer Number:	**00SMU3**
Customer PO:	**PO0056469**
Payment Terms:	NET30
Est. Due Date:	**11/17/2019**
Sales Person:	BRJ
S/O No:	**2681377**

Bill To:

ST. MARY'S UNIVERSITY
ONE CAMINO SANTA MARIA

SAN ANTONIO, TX 78228

Ship To:

St. Mary's University
Richter Math 2nd,One Camino Santa Maria
Engineering-rm212
San Antonio, TX. 78228

For billing questions, please call 510-651-8886

Ship From: AMAX

Line Items	Serial No	Description	Qty Shipped	Unit Amt	Net Amt

1-510-739-3777 or at http://livesupport.asus.com

The GPU included in this system carries a one year warranty. For maintenance support within the warranty period, AMAX will either replace or refund the defective card depending on the card availability. If AMAX offers a refund, the amount will be based on the Manufacturer's current component refund amount.

Response to

St. Mary's University
San Antonio, TX

Presented by

Certified Small Business **National Minority Disadvantaged**
IT Manufacturing Supplier

Calvin Chu
Minority Diversity , Business Development Manager
(510) 497-8642 calvin@amax.com
November 18, 2019

Contents

AMAX Certification & Programs:

NMSDC (National Minority Supplier Development Council, Certificate # **WR04857**)

SBIR/STTR Registered (Small Business Innovation Research/Small Business Technology Transfer)
*Powered by **US SBA**: Small Business Administration:* SBC Control ID: SBC_001616517

GIDEP (DOD Government-Industry Data Exchange Program)

ISO 9001 : Certified Quality Management Systems

ISO 13485 : Certified Medical Devices Quality Management Systems

ISO 26000 : Certified Social Responsibility

ISO 14001 : Certified Environmental Management System

ISO 26000 : Certified Telecom Quality Management System

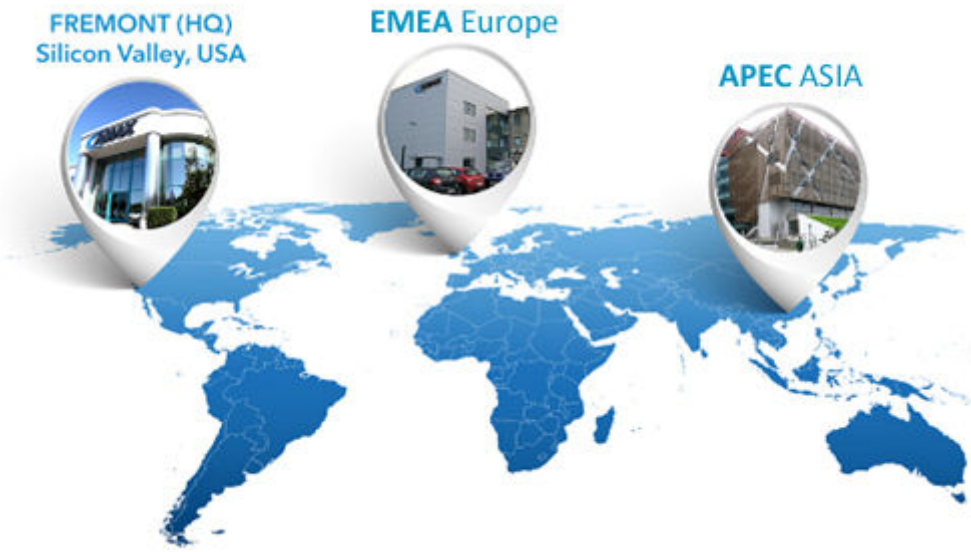
CSR : Corporate Social Responsibility: Aims to ensure that companies conduct their business in a way that is ethical. Taking account to social, economic, environmental impact, and consideration of human rights.

WHY AMAX?

Founded in 1979, AMAX is a leading manufacturer of turnkey appliances for ISV's and OEM's looking to deploy a total solution to their end users. AMAX's mission is to provide customers with **best-in-class** hardware & software engineering services and turnkey x86-based solutions that enable them to achieve the greatest performance results and utilize the most powerful computing tools on the market.

Global Manufacturing and Logistics Facilities

AMAX perfectly blends its leading technology development with large-scale manufacturing capabilities. AMAX features global manufacturing and logistics locations in San Francisco Bay Area (Silicon Valley), Europe and Asia to serve its worldwide customer base. All locations are capable of serving as an independent manufacturing or logistics hub, or acting as a single global footprint for a coordinated worldwide deployment.



AMAX's manufacturing facilities are ISO 9001, ISO 14001 and ISO 13485 certified to adhere to AMAX's commitment to the highest quality standards and green manufacturing processes. With the capability to stage, burn-in and complete acceptance testing of over 500 racks simultaneously, AMAX at no point outsources any stage of the manufacturing or testing. AMAX handles all phases of the project in-house under the highest security standards, with the core engineering design and deployment team overseeing all aspects of the manufacturing, testing and delivery to ensure total security of the process and complete adherence to the design specs and deliverables.

A Leader in Technology

As a forward-thinking innovator and strong partnership with industry-leading technology partners, AMAX is helping progressive companies prepare for the IoT era by leveraging Open Commodity hardware, efficient Cloud architectures and GPU technology to deploy versatile solutions that will be ready to scale up and handle the rigorous compute requirements of tomorrow. And with a broad range of expertise that spans Virtualization, Cloud Infrastructure Development, Open Standards and High Performance Computing, AMAX is uniquely positioned to provide what every business sorely needs.

NVIDIA ELITE SOLUTION PROVIDER

NVIDIA Elite Partner to provide Deep Learning solutions powered by NVIDIA Tesla & Quadro GPUs.

intel Technology Provider Platinum 2019

Platinum level partner of the Intel® Technology Provider Program, Certified Intel Cloud Data Center Specialist, Cloud Specialist, and HPC Data Center Specialist.

AMD PARTNER PROGRAM ELITE EMBEDDED

AMD Elite Sever Partner to deliver cutting-edge solutions based on the latest AMD CPUs & GPUs.

Trusted By Industry Leaders

AMAX has built a 40 year reputation as a technology partner operating at the highest level of integrity and technology innovation, earning the trust of industry leaders. As a company that has been in business for decades and plans to stay in business for the long run to support our commitments to our customers, AMAX focuses not on short term sales, but on long-term relationships and collaborative technology development. While our core competency is in designing, manufacturing, deploying and scaling the highest-quality computing solutions tailored to specific customer requirements, we look to be a comprehensive partner in providing extensive supply chain, global logistics, support, engineering and platform development services.

A Safe and Secure Supply Chain

AMAX's commitment to a Safe & Secure, End-to-End supply chain means we take full responsibility for the authenticity of all components we use to build our servers, storage systems and clusters. Our engineering, manufacturing, quality control, logistics, support, and our safe & secure, end-to-end supply chain are all essential pieces of the puzzle that enable us to achieve our goal: Achieving complete customer satisfaction.

AMAX is GIDEC certified: we document every process in the supply chain and track the inflow of raw material from manufacturer through production, ensuring authentic, non-counterfeit parts. Security measures like tamper-evident labels, 24 hour surveillance and employee access control are taken to uphold the highest level of supply chain integrity.

High-Mix Manufacturing

AMAX achieves low-mix to high-mix, any-scale manufacturing by leveraging highly-efficient, reconfigurable production setups across all global manufacturing locations. Depending on the size of production run and the mix of SKUs required, AMAX adapts its globally-connected production processes and proprietary test automation suite to execute builds with precise manufacturing accuracy, nimble turnaround, and production efficiency that translates into cost savings to its customers.

Supply Chain Management

AMAX recognizes the backbone to a thriving company is a healthy, reliable supply chain. With over three decades of supply chain management experience, strong relationships with premier technology vendors, and best-in-class support services, AMAX works closely with its partners to implement global supply chains geared towards optimized operations and efficient planning and spending. Real-time material and production visibility through our robust ERP system provide the tools and transparency to enable precise decision making.

Logistics & Inventory Management

As a full-service OEM, AMAX is committed to providing our partners with the logistics and inventory management necessary to run a successful product pipeline. AMAX can handle every aspect of the shipping and handling process, giving you complete transparency through our robust ERP system.

- Global Drop Shipping
- Just-In-Time Delivery Tracking (JIT)
- Real-Time Inventory Status Tracking
- Revision Control
- AMAX And Client Part Number Control
- Serial Number Component Tracking
- Warehouse Consignment Inventory
- Web Enabled Access To System Status And Inventory

Our logistics services include the following: Just-in-Time (JIT) delivery tracking & planning, flexible delivery options, auto-notifications of product delivery, time-definite delivery, domestic and global drop shipping and support, customs brokerage and declaration/clearance, customizable shipping documentation & packaging, and freight forwarding capabilities.

AMAX Engineering Corporation

Consolidation Quotation

DATE 11/18/2019
Quotation #
Customer ID

1565 Reliance Way
Fremont, CA,94539
Phone: 5104978642 calvin@amax.com

Quotation For:

Quotation valid until: 11/28/2019

Prepared by: Calvin Chu

Dr. Emamian
St. Mary's University
One Camino Santa Maria
TX, 78228

Comments or Special Instructions: *None*

SALESPERSON	P.O. NUMBER	SHIP DATE	SHIP VIA	F.O.B. POINT	TERMS
				FREMONT	NET30

QUANTITY	DESCRIPTION		UNIT PRICE	TAXABLE?	AMOUNT
1	10 Server Quote with 8 GPU	Q# 710800	$ 164,366.00	n	$ 164,366.00
1	1 Server Quote with 5 GPU	Q# 710802	$ 12,924.00	n	$ 12,924.00
1	Rack Acc Quote	Q# 710782	$ 19,992.00	n	$ 19,992.00
				n	
				n	
				SUBTOTAL	$ 197,282.00
				TAX RATE	
				SALES TAX	$ -
				OTHER	$ -
				TOTAL	$ 197,282.00

1565 Reliance Way
Fremont, CA 94539
Office: 510-651-8886
Fax: 510-651-4119
www.amax.com

Quotation 710800

Attn:

St. Mary's Univeristy
Dr. Emamian

GSA Contract Number: GS-35F-0010W **CMAS Number 3-99-70-0903A**

Quote Date	11/18/2019	**Refer to RFQ**	
Valid To	11/23/2019	**Control No.**	TW03997
FOB Term	Shipping Point		

Part #	Description	Qty	Each	Subtotal
AX10000	BrainMax Tesla GPU HPC	10	$16436.62	**$164366.20**
4019567	4U DP Intel Xeon Scalable Processors 8x GPU Server	10		
403080A	Intel Xeon Silver 4210 Processor 10C/14MB/2.20G/85W	20		
7008508	Micron 8GB DDR4-2933 x8 SR RDIMM-CT8G4RFS8293-2G9E1	120		
4019690	RTX 2080TI 11GB GDDR6 Blower	80		
600579E	Intel SSD D3-S4510 240GB, 2.5in SATA 6Gb/s, Single Pack	10		
LST0001	ATA Testing	10		
INS005A	Dual boot installation of Windows & Linux	10		
ISO2015	ISO9001:2015 Certified facility	10		
W3Y20KS	3-Year Parts & Labor Warranty	10		
INS0100	5-Stage Quality Burn-in Testing	10		
INS0110	Performance Optimized BIOS - Amax	10		

1. This is a custom configured system. The order will be non-cancelable and non-returnable.
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3. For all sales and product shipments outside of the United States, a VAT tax may apply to the recipient from the international country. The VAT tax percentage will vary country by country.
4. The pricing information herein constitutes Confidential Information of AMAX.
You agree that you and your employees who have need to see the information shall keep confidential all such Confidential Information, and that you and your employees shall not disclose this document or the information herein to any third party without AMAX's prior written consent.
You and your employees shall use such Confidential Information only for the purpose of evaluating the purchase of products from AMAX.
5. Prices for Memory are subject to change due to shortages in the market supply situation.
6. Quote prices do not include applicable state sales tax.

Quote Price ***$164,366.20***

4U GPU Server:
2x Xeon Silver 4210
12x 8GB DDR4 RDIMM
8x RTX 2080ti
1x 240GB SSD

The GPU included in this system carries a one year warranty. For maintenance support within the warranty period, AMAX with either replace or refund the defective card depending on the card availability. If AMAX offers a refund, the amount will be based on the Manufacturer's current component refund amount.

Due to the 25% tariff increase on Chinese imports, certain IT products will be affected. Quotations are subject to re-quote once the new price on affected products are announced by various suppliers.

Quote By CALVIN CHU CALVIN_CHU@AMAX.COM

Terms & Conditions

The pricing and terms are valid for the period specified on this quotation. Despite our best efforts, prices, specifications, availability and terms of offers may change without notice. Correct prices and promotions are validated at the time your order is placed. The quoted price reflects a cash discount of 3% and any payment via credit card will void the cash discount of 3%.

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Fremont, CA 94539
Office: 510-651-8886

www.amax.com

Quotation 710802

Attn:
St. Mary's Univeristy
Dr. Emamian

GSA Contract Number: GS-35F-0010W **CMAS Number 3-99-70-0903A**

Quote Date	11/18/2019	**Refer to RFQ**	
Valid To	11/23/2019	**Control No.**	TW03997
FOB Term	Shipping Point		
Payment Term	Net 30 Days		

Description	Qty	Each	Subtotal
BrainMax Tesla GPU HPC	1	$12923.64	**$12923.64**
4U DP Intel Xeon Scalable Processors 8x GPU Server	1		
Intel Xeon Silver 4210 Processor 10C/14MB/2.20G/85W	2		
Micron 8GB DDR4-2933 x8 SR RDIMM-CT8G4RFS8293-2G9E1	12		
RTX 2080TI 11GB GDDR6 Blower	5		
Intel SSD D3-S4510 240GB, 2.5in SATA 6Gb/s, Single Pack	1		
ATA Testing	1		
Dual boot installation of Windows & Linux	1		
ISO9001:2015 Certified facility	1		
3-Year Parts & Labor Warranty	1		
5-Stage Quality Burn-in Testing	1		
Performance Optimized BIOS - Amax	1		

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You agree that you and your employees who have need to see the information shall keep confidential all such Confidential Information, and that you and your employees shall not disclose this document or the information herein to any third party without AMAX's prior written consent.
You and your employees shall use such Confidential Information only for the purpose of evaluating
5. Prices for Memory are subject to change due to shortages in the market supply situation.
6. Quote prices do not include applicable state sales tax.

Quote Price ***$12,923.64***

4U GPU Server:

2x Xeon Silver 4210

12x 8GB DDR4 RDIMM

8x RTX 2080ti

1x 240GB SSD

The GPU included in this system carries a one year warranty. For maintenance support within the warranty period, AMAX with either replace or refund the defective card depending on the card availability. If AMAX offers a refund, the amount will be based on the Manufacturer's current component refund amount.

Due to the 25% tariff increase on Chinese imports, certain IT products will be affected. Quotations are subject to re-quote once the new price on affected products are announced by various suppliers.

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Fremont, CA 94539
Office: 510-651-8886
Fax: 510-651-4119
www.amax.com

Quotation 710782

Attn:
St. Mary's University
Dr. Vahid Emamian

GSA Contract Number: GS-35F-0010W **CMAS Number 3-99-70-0903A**

Quote Date	11/15/2019	**Refer to RFQ**	
Valid To	11/20/2019	**Control No.**	TW03997
FOB Term	Shipping Point		
Payment Term	Net 30 Days		

Part #	Description	Qty	Each	Subtotal

Quote By CALVIN CHU CALVIN_CHU@AMAX.COM

1565 Reliance Way
Fremont, CA 94539
Office: 510-651-8886
Fax: 510-651-4119
www.amax.com

Quotation 710782

Attn:
St. Mary's University
Dr. Vahid Emamian

GSA Contract Number: GS-35F-0010W **CMAS Number 3-99-70-0903A**

Quote Date	11/15/2019	**Refer to RFQ**	
Valid To	11/20/2019	**Control No.**	TW03997
FOB Term	Shipping Point		
Payment Term	Net 30 Days		

Part #	Description	Qty	Each	Subtotal
0577100	AMAX Cluster	1	$19991.68	**$19991.68**
401881F	SM YH 42U G1 Enclosure 1868 Meshed Door,	2		
6010187	(N)Tripp Lite PDU 3-Phase 14.5KW 230VAC	6		
9025531	50-Port (48x RJ45 + 2x SFP) 10/100/1000Mbps Switch	1		
6010198	Molded CAT6 UTP cable - 10 feet (blue)	14		
INSCL05	In-House Network and Node Provisioning T	2		
0099153	Crate for SRK-42SE-12 Rack (KD-HT &RoHS)	2		
6010293	Power cord - 4ft	42		
0030215	Cisco 3 Year Total Extended Warranty	1		
ISO2015	ISO9001:2015 Certified facility	2		
LBRN001	Per Node Cluster Assembly, 1U nodes	14		
LBRCABA	Half Rack Cluster Cabinet Assembly for 4	2		
W3YU10S	Warranty 3 Year Parts & Labor	2		

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You and your employees shall use such Confidential Information only for the purpose of evaluating
5. Prices for Memory are subject to change due to shortages in the market supply situation.
6. Quote prices do not include applicable state sales tax.

Quote Price ***$19,991.68***

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Quotation 710802

Attn:

St. Mary's Univeristy
Dr. Emamian

GSA Contract Number: GS-35F-0010W **CMAS Number 3-99-70-0903A**

Quote Date	11/18/2019	**Refer to RFQ**	
Valid To	11/23/2019	**Control No.**	TW03997
FOB Term	Shipping Point		
Payment Term	Net 30 Days		

Description	Qty	Each	Subtotal

Quote By CALVIN CHU CALVIN_CHU@AMAX.COM

Introducing AMAX®

CAPABILITY STATEMENT

MISSION CRITICAL SINCE 1979

World's **Mission Critical Tolerant** Technology Provider of Enterprise, Aerospace, and Defense Information Solutions.

Established in 1979, AMAX has pioneered the building of mission critical hardware applications throughout the United States. Delivering **mission-critical excellence over 40 years**, AMAX has supported our products from projects involving sensitive overseas military missions to hospitals where human lives are changed and saved every day. The positive impact to thousands of satisfied clients is our daily goal. To ensure satisfaction, we certify and train our staff on a monthly basis and rigorously test and validate each critical machine within our **Safe & Secure** facility. The level of competence and expertise AMAX builds with put us above and beyond our competition.

RHINO TOLERANT

AMAX'S RIGOROUS QUALITY PROGRAM

BUILT @ **SAFE & SECURE**

(Government Defense Level Secured Facility) [Audited by McAfee]

CONTRACT

 # GS-35F-0010W

GSA Product Catalog Available

Core Competencies

- AI & Deep Learning System Certified Manufacturer
- State-of-the-Art Integration Center
- In-House **RHINO TOLERANT** Quality program
- Professional Services: [Proudly Made in **USA**]
  - TAA Compliant
  - On-site Services
  - Special Configurations
  - USA Based Technical Support
  - Comprehensive Media Retention
  - Engineering Services
- ELITE & PLATINUM Partners with Tier 1 USA Suppliers

Why AMAX?

- 40 Years of quality excellence and engineering expertise
- Experience in the Federal Marketplace & Government Regulations
- Automated MES : Manufacturer Execution Systems
- **DoD GIDEP** Program Qualified Member
- ISO Certifications: 9001, 13485, 14001, 26000, TL9000
- **SAFE & SECURE** facility: Audited by McAfee
- Minority Owned Small Business Company

Products

- Deep Learning & AI GPU Solutions
- HPC & Hyper Converged Clusters
- Compute and Storage Servers
- Data Center Management
- On-Premise Private Cloud Hardware

Required Classifications:

NAICS Codes:	334111	334112	334118
	423430	541512	
DUNS Codes:	03-989-0892		
CAGE Codes:	0S049		
SIC Codes:	3570	3571	3572
SAM MPIN#:	A15652009		

Awards & Recognition

NMSDC Certification #: WR04857
Certified by the Western Regional Minority Supplier Development Council

US Small Business Administration
Eligible for Government Contract For NAICS Code # 334111, 334112, 423430

We have proudly served the following departments:

Point of Contact:
Calvin C.
calvin@amax.com
1-510-497-8642

Where they fail. **We don't.**

THIS CERTIFIES THAT

AMAX Engineering Corporation

dba AMAX

NMSDC
National Minority Supplier Development Council

* Nationally certified by the: **WESTERN REGIONAL MINORITY SUPPLIER DEVELOPMENT COUNCIL**

*NAICS Code(s): 334111; 334112; 334118; 423430; 541512

* Description of their product/services as defined by the North American Industry Classification System (NAICS)

04/30/2019		WR04857
Issued Date		**Certificate Number**
	Adrienne Trimble	
04/30/2020		
Expiration Date		**Cecil Plummer, President**

By using your password (NMSDC issued only), authorized users may log into NMSDC Central to view the entire profile: http://nmsdc.org

Certify, Develop, Connect, Advocate.

* MBEs certified by an Affiliate of the National Minority Supplier Development Council, Inc.®