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TECHNICAL REPORT SUMMARY

Contract / Grant # N00014-90-J-1489

CMU Center # 1-51279

Report Date March 8, 1993 (XX) Interim Report ( ) Final Report

Date Sent to Sponsor : March 10, 1993

Report Title : Proposal to use rational analysis to design an architecture for learning and problem solving.

Name and Address of Individual at sponsoring agency to which report was sent:

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(Name)

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(X) Send one copy of the Technical Report transmittal letter or Cover Page with contract number or center number referenced to the Research Office.

Return one completed copy of this form to the Research Office.

CARNEGIE-MELLON UNIVERSITY

INTERNAL REPORT OF INVENTIONS AND PATENTS

Contract / Grant No. : N00014-90-J-1489
CMU Center Number: 1-51279
Period of Contract 01-01-90 through 12-31-92.

I hereby certify that , to the best of my knowledge and belief , no inventions , improvements or discoveries, which reasonably appear to be patentable or actual patents were conceived or first actually reduced to practice by persons engaged in the performance of the work under the above contract / grant during the work period indicated, except as follows:

Name of Invention | Title of Invention

By _____
Title Professor
Date March 8, 1993

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Office of Naval Research - Interim Report
N00014-90-J-1489
January 1, 1990 - December 31, 1992

Proposal to Use Rational Analysis to Design an Architecture for Learning and Problem Solving

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The goal of this research has been to develop a new production rule model of cognition which (a) is an extension of the ACT* theory (Anderson, 1983) and (b) incorporates the insights of the rational analysis of cognition (Anderson, 1990). A new computer simulation model, ACT-R, has been completed which achieves this goal. It has been implemented in Mac LISP and runs on Macintosh computers. We have distributed it to a number of sites and are actively supporting its use. In addition we have performed a series of experiments studying its application to navigation in an artificial environment, to the Tower of Hanoi task, and to the results from a number of skill acquisition studies.

The navigation studies involved subjects driving simulated vehicles through a computer display that involved different types of roads with different types of obstacles. Subjects had numerous decisions to make about which routes to take and we tried to simulate in ACT-R their choices and latencies to make their choices. We found that subjects were affected by the same factors as ACT-R—the distribution in quality of choices and experiences with different types of routes. The detailed evidence supported the ACT-R theory of conflict resolution.

The Tower of Hanoi studies investigated how goals are managed in a problem solving situation. Tower of Hanoi is a puzzle which requires a lot of goal management for successful solution. As ACT predicts we found that subjects were mainly influenced by the number of goals they must

set before making a mo d were not affected by the number of goals they are currently remembering. We were able to successfully predict latency and move choices over a number of variations on the basic puzzle.

The skill acquisition studies largely involved looking at data collected from our intelligent tutoring systems for programming and geometry proof skills. Here we are interested in whether the skill can be successfully divided into individual production rules, whether these rules are learned as the ACT-R theory predicts, and whether transfer among tasks can be predicted in terms of production rule overlap across the tasks. The results of these empirical studies were largely positive.

The ACT-R theory, its computer simulation, and the supporting empirical research were described in a new book to be published as Anderson (1993). This book will also contain a disk containing the ACT-R simulation system and the simulations in the book. We expect to be spending a great deal more time supporting use of the system after publication of the book.