

DEPARTMENT OF THE ARMY

UNITED STATES MILITARY ACADEMY

WEST POINT, NEW YORK 10996

MADN-EECS 23 May 2019

MEMORANDUM THRU

LTC Alexander Mentis, CS Program Director

Dr. Wenli Huang, Curriculum Coordinator

FOR COL James J. Raftery, Department of Electrical Engineering and Computer

Science, United States Military Academy, West Point, NY 10996

SUBJECT: Request for Approval of Advanced Individual Study (MA489) during Term 20-1

1. Project Title: Integer Programming and the Travelling Salesman Problem
2. Project Background: The Traveling Salesman Problem (TSP) asks: Given a set of cities and the distances between each pair, what is the shortest tour that visits each city once and returns to the starting point? The TSP is an NP-hard problem and a polynomial bounded algorithm for solving it would settle the P versus NP question, recognized as one of the most important open problems in theoretical computer science. Attempting to solve the TSP presents two challenges: to provide a “good” solution and provide a measure of that solution’s closeness to optimality.
3. Project Summary: This project involves a new approach to the TSP that differs from most heuristics which generate a tour efficiently but cannot guarantee how close the tour is to optimality. The new approach will guarantee an optimal tour but cannot guarantee a solution in any reasonable amount of time (We do not expect it to resolve P = NP). I will aim to first implement the Lin-Kernighan heuristic which usually finds good solutions and the Held-Karp algorithm which generally establishes a good bound on the distance from optimality of a tour. The approach will require solving two interconnected minimum cost network flow problems, combined using integer programming software, while investigating the properties of their interaction. My goal is to familiarize myself with known approaches and to research computational optimizations by means of data structures and parallelization.
4. Project Location: TH246
5. Principal Investigators: Cadet Matthew Houston (Computer Science)
6. Project Advisor: Dr. William Pulleyblank, Math.
7. Grading:

* Obtain access to TSPLIB 10% Week 2

(a database of standard TSP test problems)

and create initial test set

* Access standard codes and 25% Week 6

implement new approach

* Compare results and 25% Week 10

refine new approach

* Presentation 20% Week 15
* Final Paper 20% Week 16

1. Academic Background: My current CQPA is 3.73 and I have received the following letter grades in EECS/Math courses I have taken thus far:
   1. MA103: A
   2. IT105: A
   3. MA104: A-
   4. CY300: A
   5. CY355: A+
   6. MA206: A
   7. CS384: A-
   8. EE360: A
   9. MA372: A-
   10. CS380: A-
   11. CS478: B+
   12. MA461: A-
   13. CS385: B+
   14. CS403: A
   15. CS474: A
   16. CS484: A
2. Request Academic Credits: 3.0 (ES) for the 120 hours attributed to the MA489 course.

MATTHEW HOUSTON

CADET SERGEANT

Company E-4, USCC