IRGF Final Report
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Project Title: Experimental Evaluation of Algorithms for the Thief Orienteering Problem

1.1 Project Summary

The Thief Orienteering Problem (ThOP) combines routing and packing decisions. The input consists of a weighted graph with designated start and end vertices and a collection of items located at vertices. Each item has a weight and profit. A thief chooses a route from the start to the end and selects items encountered along that route, subject to a knapsack capacity and an overall travel-time limit. An important interaction between the two components is that carrying additional weight reduces the thief's travel speed. The objective is therefore to choose both a route and a set of items that maximize total collected profit while remaining feasible. This project developed computational tools for studying exact and approximation algorithms for ThOP, with particular emphasis on graph classes for which additional structure can be exploited. A major focus was ThOP on directed acyclic graphs (DAGs), together with methods for transforming structured undirected graphs into DAG instances. We also developed an experimental framework in which several ThOP algorithms can be run on common input instances, compared using common output formats, and checked using automated tests.

1.2 Student involvement

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1.3 Dissemination and Knowledge Mobilization

The project produced a substantial reusable software repository containing ThOP algorithms, graph data structures, graph-transformation methods, benchmark instances, experiment configurations, automated tests, and reporting tools. The framework records solver outputs in common machine-readable formats and includes reproducibility information such as experiment configurations and random seeds. Our work is available on GitHub, making it possible for future students and collaborators to repeat experiments and compare new algorithms against existing implementations without rebuilding the experimental infrastructure. The student presented the work at our School's Annual Student Computing Conference.

1.4 Project Outcomes and Impacts

The primary outcome of the project is an extensible experimental framework for studying algorithms for ThOP on DAGs. Several substantial algorithms were incorporated into this framework, including an exact dynamic-programming solver, an approximation algorithm, a CPLEX solver, and a competing algorithm from the literature. This is an ongoing project within my research program and the progress made with this student will support future experimental

investigations. These results establish a strong foundation for continued research on ThOP. Future work will implement and evaluate more algorithms on additional structured graph classes, including series-parallel and outerplanar graphs, and will use the framework for broader experimental comparisons of ThOP algorithms.