ECE457A Course Project

Statement of Work (SOW) Deadline: June 9, 2014

Final Project Deadline: July 18, 2014

1. Introduction

Team-based projects are integrated as an essential part of the course. These projects help students to get hands-on experience in applying different metaheuristic techniques studied in this course in solving combinatorial problems. Students select a combinatorial problem for which they will undertake an independent investigation and apply the studied algorithms in the course to solve it. Course instructor and TAs will provide support to help the students with searching and using the literature, analyzing the challenging aspects of the problem and writing the final report of the project. The programming parts of the project must be implemented in Matlab/Octave.

2. Project Work Flow

Fig. 1 shows the suggested work plan for the course project. The components of this plan are described in the following subsections.

2.1. Problem Characterization

This project should start by studying comprehensively the problem in order to characterize its complexity and its main challenges. Collect related resources and conduct a critical survey on similar solutions reported in the literature.

2.2. Problem Formulation

In this step, an initial statement of the problem should be made. The internal and external factors and the objective(s) of the problem must be outlined. Describe the problem as standard optimization problem as following:

Find $\mathbf{X} = \begin{Bmatrix} x_1 \\ x_2 \\ . \\ . \\ . \\ x_n \end{Bmatrix}$ which minimize /maximize $f(\mathbf{X})$

subject to set of inequality and/or equality constraints

$g_j(\mathbf{X}) \le 0, \quad j = 1,2,...,m$

$l_j(\mathbf{X}) = 0, \quad j = 1,2,..., p$

Define the decision variable or design vector, objective function/s and the problem constraints.

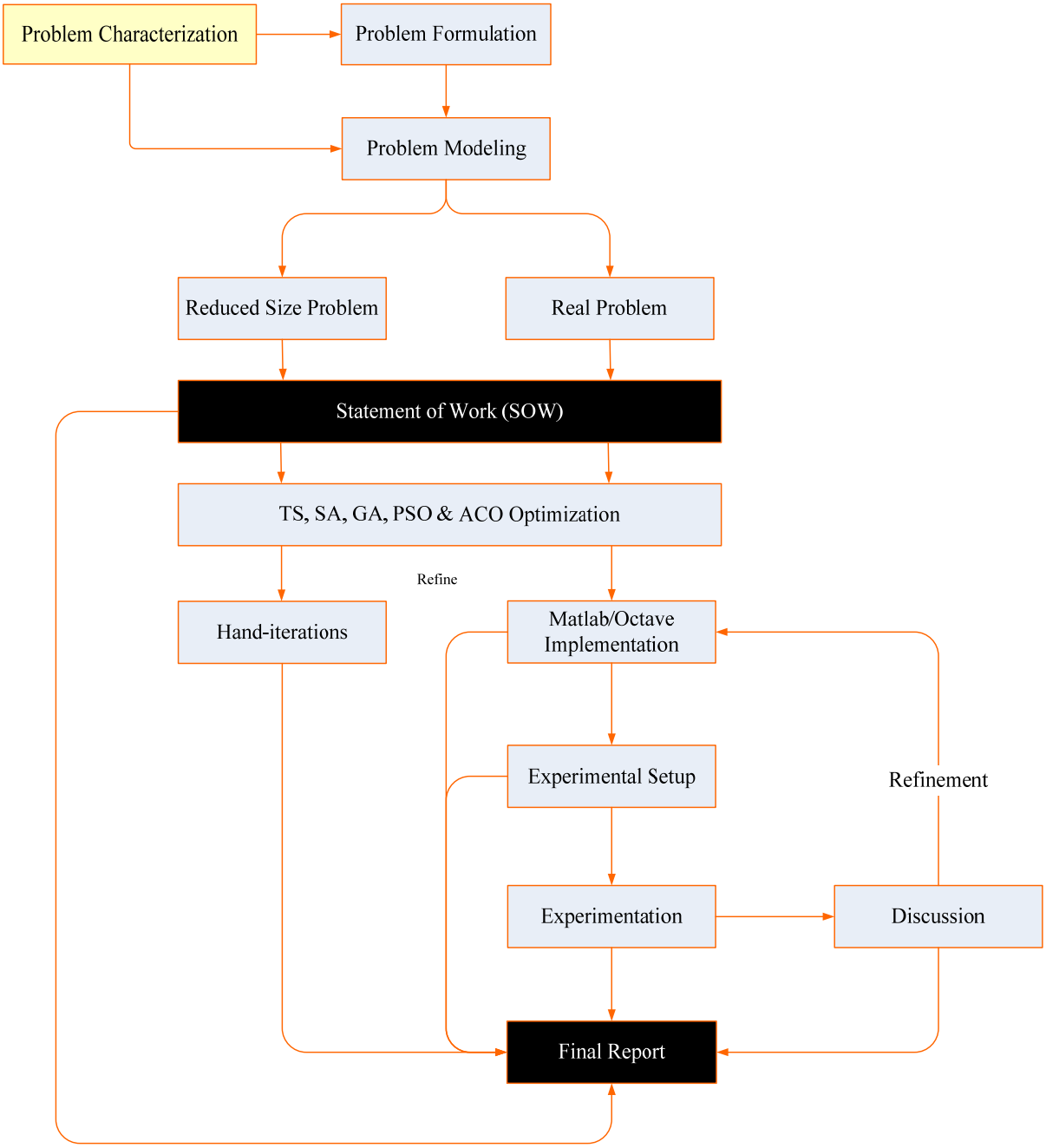

Fig. 1 Course Project Work Plan

2.3. Problem Modeling

In this important step, an abstract mathematical model is built for the problem. The modeler can be inspired by similar models in the literature. This will reduce the problem to well-studied optimization models. Usually, models we are solving are simplifications of the reality. They involve approximations and sometimes they skip processes that are complex to represent in a mathematical model. For example, travelling salesman problem (TSP) and multiple travelling salesman problem (mTSP) are commonly used as models for real-life problems such as school bus routing problem and complex task allocation problem.

2.4. Reduced Size Problem

Describe a reduced version of the problem in order to be used to perform hand-iterations. For example, if you are studying plant layout problem (PLP), a reduced size problem may contain only 4 departments (facilities) and 4 locations.

2.5. Real Problem

The real size problem formulation and modeling will be used to show the ability of the proposed solutions implemented in handling large size problems.

2.6. Statement of Work (SOW)

A Statement of work (SOW) report will be produced by including the above mentioned components. SOW must be uploaded to **SOW dropbox** on UW LEARN naming the file **SOW-Your Project number** no later than **June 9, 2014**. The file should be 2-3 page max.

2.7. Optimization

Once the problem is formulated and modeled, the five main algorithms studied in this course (TA, SA, GA, PSO and ACO) must be applied to generate a "good" solution for the problem. The solution may be optimal or suboptimal.

2.8. Hand-iterations

At least two hand iterations must be performed on the reduced size problem to show how to use the studied algorithms in solving the selected problem.

2.9. Matlab/Octave Implementation

The studied algorithms must be implemented from scratch using Matlab/Octave without using any toolboxes.

2.10. Experimental Setup

The implemented solutions should be tested against a set of well-defined evaluation metrics. These metrics may include, but are not limited to, the CPU time of the algorithm, number of iterations to converge, time per iteration, optimality (if the ground truth is known), etc.

2.11. Experiments

A number of experiments/scenarios should be conducted to quantitatively evaluate the performance of the proposed solutions. You should run each experiment several times and report the average results.

2.12. Discussion

Report your observation and interpret the obtained results. Suggest how to refine the implemented solutions to improve their performance.

2.13. Final Report

The objective of the final project is to provide a **comparative study** between different meta-heuristic optimization techniques to solve the selected problem. The project report must contain the following sections:

Summary: The Summary should be a brief version of the full report. It should give the reader an accurate overview. Be brief, but be specific.

Chapter 1. Introduction: summarize the importance of the problem you are trying to solve and the reason that motivated you to select this project. Explain what was the problem or challenge that you

were given? state the purpose of the project and how did you solve it? Enumerate the objectives of the project and describe in brief the structure of the report.

Chapter 2. Literature Review: Conduct a critical survey on different/similar solutions and explain how your solution extends or differs from these solutions.

Chapter 3. Problem Formulation and Modeling: Include the problem statement and describe its model.

Chapter 4. Proposed Solution:

- Generate an initial solution.
- Suggest a cost function (objective function) suitable for this problem.
- Define a suitable neighborhood operator.
- Define a suitable solving strategy for this problem.
- Select your own values for the parameter and explain the basis for your selection.
- Describe how each algorithm (TS, SA, GA, PSO and ACO) will proceed to solve this problem by performing at least two hand iterations on a reduced version of the problem.
- Implement the proposed solution using Matlab/Octave.

Chapter 5. Performance Evaluation: Establish a set of evaluation metrics and run some experiments with different values of algorithm parameters to **quantitatively** and qualitatively assess the performance of the developed solution using different meta-heuristic optimization techniques. Students must identify the pros and cons of each technique and assess the quality of work as well as its fit with project objectives.

Chapter 6. Conclusions & Recommendations: summarize the conclusion and future improvement. Explain how did you solve the problem, what problems were met? What did the results show? and how to refine the proposed solution? You may organize ideas using lists or numbered points, if appropriate, but avoid making your report into a check-list or a series of encrypted notes.

References: Every report needs references; in fact, your failure to consult references for guidance may be considered negligence. On the other hand, when you include sentences, photos, drawings or figures from other sources in your report, the complete reference must be cited. Failure to do so is plagiarism, an academic infraction with serious consequences.