UNIVERSITY OF PRETORIA
DEPARTMENT OF COMPUTER SCIENCE

COS710: Assignment 2 (ANT Colony Optimization)

Due date: 25th March 2018, at 23:00

Do the assignment explained below. Note that you have to submit a pdf document, containing a technical report wherein you describe what you have done, present and discuss your results. Find at the end of the assignment specifications guidelines for writing your report. You are also required to uploaded your source code and raw data.

Longest Maze Visit

A classic problem in combinatorial optimization is that for finding the shorted path between two vertices in a graph. Luckily there exist very efficient methods for finding shortest paths. In the presence of non-negative weights Dijkstra's algorithm is very effective (particularly if a priority queue implemented with Fibonacci heaps is used), and with negative weights Bellman—Ford is a reasonable option (excluding graphs with negative cycles).

A simple variant is the longest path problems. Specifically you need to find the longest simple path between two vertices. Where a path is called simple if it does not have any repeated vertices. While the problems sounds trivial it is actually NP-Complete for most weighted graphs (though special cases exist).

Your task for this assignment is to implement the ant colony system (ACS) as defined in (M. Dorigo and L.M. Gambardella. Ant Colony System: A Cooperative Learning Approach to the Traveling Salesman Problem. IEEE Transactions on Evolutionary Computation, 1(1):53–66, 1997.) to find the longest path from the entrance of a maze to the exit. You will also have to implement beam search, and compare the performance of ACS against it. You will have to construct your own heuristics for both beam search and ACS to use.

You have been provided with 11 mazes of varying sizes in an archive. Each maze is stored as an image file. The black pixels indicate the maze wall, with white pixels indicating the walk way. The entrance and exit of the maze are on the top and the bottom of the maze as a gap in the maze wall. See figure 1 as an very small example maze.
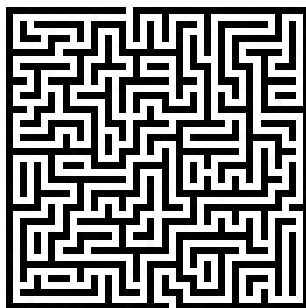

Figure 1: Small Maze

For this assignment you will need to report the longest found path for each graph an each approach and upload the solved mazes in the same format they where provide with the longest path being coloured red. You

should include smaller mazes directly in the report to assist with your discussion.

Something to keep in mind, is that in order to find the longest path you will need to build a graph structure. It is suggested that you think of a method to simple avoid having "redundant" vertices, particularly for the largest maze which are over a 50000 times bigger than the maze in figure 1.

Marking and general guidelines:

For this assignment you have to submit a research report where you discuss your findings. For this assignment your reports must follow the IEEE conference format `www.ieee.org/conferences/publishing/templates.html`, you may use the Latex or the Word template, however the it will serve as good academic writing practice to utilize latex. There is also a page limit of 8 pages for this assignment. Given the imposed two column format it would require a substantial amount of writing to exceed this limit.

This is not a course in technical and report writing; however, you should at least attempt to follow some accepted document writing techniques and to make your report as readable as possible. You are more likely to obtain a higher mark if your report generates a good impression with the marker and is void of general errors like spelling and grammar mistakes.

You are strongly advised to download some research papers from the CIRG members to get a feel for how to write a report. A quick search on through Google Scholar should yield good results.

The following is a general guideline of how to structure your report; however, strict adherence to this guideline is not a requirement for this assignment.

1. Abstract:

The abstract should briefly summarize the purpose and findings of the report.

2. Introduction:

The introduction sets the stage for the remainder of your report. You usually have very general statements here. The introduction prepares the reader for what to expect from reading your report. In general, the introduction should either contain or be a summary of your ENTIRE report.

3. Background:

A very high level discussion on the problem domain and the algorithms and/or approaches that you have used. Do not be too specific on the algorithms and approaches. This section is typically where the "base cases" of concepts that appear throughout the remainder of your report are discussed. It is also an ideal place to refer a reader to other sources containing relevant information on the topic but which is outside the scope of your assignment. It is the perfect place for pseudo code. Remember to discuss very generally. After reading this section the marker should be able to determine whether or not you know what you're talking about.

4. Implementation:

In this section you discuss how you approached, implemented and solved your assignment choice. Mention, for example, the values set for the algorithm's control parameters, how many simulations you have run and what the characteristics for candidate solutions to your problems are. After reading this section (in addition to the background) the reader should be able to duplicate your experiments to obtain similar results to those obtained by you. This is also the section where your discussion specializes on the concepts mentioned in the background section. Be very specific in your discussions in this section.

5. Research Results:

This is the section where you report your results obtained from running the experiments as discussed in the implementation section. You have to give, at least, averages and standard deviations for the experiments/simulations. Thoroughly discuss the results that you've obtained and reason about why you obtained the results that you have. Answer questions like "are these results to be expected?" and "why these results occurred?" and "would different circumstances lead to different results?".

6. Conclusion(s):

Very general conclusions about the assignment that you have done. This section "answers" the questions and issues that you've raised and investigated. This section is, in general, a summary of what you have done, what the results where and finally what you concluded from these results. This is the final section in your document so be sure that all the issues raised up until now are answered here. This is also the perfect section to discuss what you have learnt in doing this assignment.