



SUBJECT: Advanced Modelling 3A (AMD3A)

TITLE: Practical Assessment 6 Outcome C

DATE: 25 April 2019

MARKS: 40 + (10 Optional)

Find the optimal path to optimise profit using the Monte carlo method

1.) Introduction:



You have been given a network of connection between different cities and towns within South Africa. Each connection connects two locations and provide the travel distance between those two locations. Starting at Johannesburg, you want to visit as many of these locations as you can without visiting the same location twice. You will receive R5000 for each location visited and must consider the distance traveled and fuel costs to maximise your profit for the entire trip.

The travelling salesman problem is a difficult, NP-hard problem to solve. You will develop a simple algorithm using Monte-carlo simulations to find a “good” solution that maximises your profit,

considering the constraints and cost of fuel. You will generate a random valid trip by connecting different paths, then you will calculate the distance traveled, fuel costs and profit of the generated trip. The latest generated trip can be compared to the best previously generated trip, where the best solution generated upto this point is then stored. This process can be repeated a few 1000 times, and the best or optimal travel plan that was generated can be stored as the solution to the problem. A skeleton of the solution has been provided with a clear indication of what pieces of the source code need to be completed.

2.) Development tasks:

- Generate random inputs:
 - Generate a random trip that will visit a number of locations by connecting paths.
 - You must always start your trip in Johannesburg and you are not allowed to visit the same location twice. If you are unable to add any more locations, considering the constraints, then the trip path is complete. Some trips will be longer than others.
- Perform Experiment:
 - Calculate the total distance traveled for the generated trip.
 - Calculate the total fuel cost, where the current fuel price is R14.23 per liter and your vehicle on average drives 7.5 km on 1 liter of petrol.
 - Calculate the total profit of the generated trip, you will received R5000 for each unique location visited. You do not receive money for your starting location. Remember to deduct your fuel costs.
- Combine results:
 - Save the trip path and info(distance travelled,total petrol costs,total profit) of the most profitable randomly generated trip.
 - Repeat this process many times to find a “good” solution to the problem.
- Display the information of the best solution using the format provided in the Example output.
- (For extra marks) Use OpenMP to accelerate the Monte carlo algorithm to take advantage of all the processors available on your computer.

3.) Example Solution and Output:

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Information of the optimal path
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Total Distance Travelled: 4919 km
Total Petrol cost: R 9332.98
Total Profit: R 40667
Travel plan:
Travel 202 km from Johannesburg to Sun City
Travel 480 km from Sun City to Tzaneen
Travel 282 km from Tzaneen to Nelspruit
Travel 679 km from Nelspruit to Durban
Travel 635 km from Durban to Bloemfontein
Travel 401 km from Bloemfontein to Kuruman
Travel 637 km from Kuruman to Springbok
Travel 561 km from Springbok to Cape Town
Travel 462 km from Cape Town to Beaufort West
Travel 588 km from Beaufort West to East London
  
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4.) Submission and Practical Notes:

- Submit only the “*.cpp” file (C++ source file) on Blackboard, the “*.exe” is not accepted as a valid submission.
- No group work allowed, but you can discuss the problem with the students in your direct vicinity.
- Your submission will be tested for Plagiarism, so don’t copy from other students’ work, or share your work.
- **“No submission = No Mark”** – No extensions will be given.
- All work must be completed and submitted before 17:00 on 8 May.
- Signed mark sheets (controlled by Demi’s) are used as attendance.
- You need to be able to describe your source code or no marks (0%) will be awarded.

5.) Mark Distribution Guide:

<u>Description</u>	<u>Marks (40)+(10 Optional)</u>
Not present	Fail the course
Program not working or running	Fail the practical
Generate random travel path	20 Marks
Calculating travel distance, petrol cost and profit	10 Marks
Saving most profitable trip and displaying solution	10 Marks
OpenMP Acceleration	(Optional) 10 marks