ASSIGNMENT BRIEF

Module title	Computability & Optimisation
Module code	COM648
Module Assessor	Christos Kolaitis
Verified by	Lena Kapetanaki
Assessment title	Assignment
Launch date	5nd November 2025
Submission deadline	7th January 2026
Module outcomes assessed	1, 2, 3, 4
Assessment weighting	60
Word count (if relevant)	N/A

Assessment task details - provide a description of the task

Winter Road Maintenance Route Optimization Problem.

In a region with multiple road segments that require de-icing during winter, gritting machines needs to efficiently cover all designated roads to ensure safe driving conditions. The goal is to find the optimal route for the gritting machines to minimize the total distance travelled, thereby reducing operational costs, and enhancing the effectiveness of road maintenance. Petrol is not the concern in this implementation, instead the amount of grit (salt) used is key to this exercise. Efficiently solving this Winter Road Maintenance Route Optimization Problem can help local authorities and road maintenance teams ensure timely and effective de-icing operations, enhancing road safety and minimizing the environmental impact of road salt usage. Figure-1 illustrates the road network to be traversed with weightings related to grit usage.

There are several deviations from the real-world scenario. Generally, a fleet would be deployed, but in this exercise only one vehicle needs to be considered. Weather conditions usually require consideration as the priority for de-icing may vary based on temperature, precipitation, or other weather-related factors. Here, the conditions are uniform, and the distribution of grit required follows the standard plan outlined in Figure-1. Resource constraints are a factor in the real-world scenario - use of petrol and storage capacity for grit are factors and gritters often need "re-fuelling" of both. In this exercise assume the gritter has full capacity of

both "re-fuelling" can be discarded. Real world gritters have mechanisms to control the times that they grit and both the grit flow and density. For this exercise, grit flow and density are constant and is determined by the weightings specified in Figure-1. Finally, direction may be important in flow rate since, despite counter measures, going uphill results in more grit being spread than going downhill.

Mechanisms for importing and amending the network are required. It is recommended that an import function is created and that a structure like the JSON snippet provided in this document is utilised. Manual amendment via a graphical interface is beneficial but is not mandatory within the scope of the assignment and will not be marked. Similarly, displaying the proposed solution to the routing problem is required, though a simple node list will be sufficient for a pass. A graphical display, whilst beneficial, is not mandatory and accordingly will not be marked.

Submission instructions.

A single zipped file is required including all relevant source code, fully commented with detailed explanations of the processes being undertaken, together with any support documentation in Word (or similar format) describing the processes of the code in both narrative and graphical forms using flow charts, JSP, and/or UML where appropriate. This is a test of your understanding of the problem and its potential solutions; as such third party libraries that perform similar solutions to the problem are not allowed.

Marking and moderation

This a team assignment. Submissions will be made by each individual member of the team. Each members contribution to the assignment should be indicated. Team members will be questioned about the working processes of the team's solution during an in-class demonstration which will be done on 7th January 2026.

Marking criteria
Referral or Non-Submission (<40%): • No evidence of understanding or application of heuristic concepts to the road gritting exercise. • No attempt to create an optimized route planner. • Little to no demonstration of problem-solving skills related to route optimisation for road gritting. • Limited or no engagement with course materials or relevant algorithms. 40% to 49%: • Limited understanding of heuristic concepts, with minimal application to the road gritting exercise. • Basic attempt at creating a route planner, but the solution is incomplete or significantly flawed. • Limited evidence of problem-solving skills specific to route optimization for road gritting. • Limited engagement with course materials, and the solution lacks depth or proper implementation. 50% to 59%: • Partial understanding of heuristic concepts, with some application to the road gritting exercise. • The route planner shows basic optimization attempts but may have substantial room for improvement. • Some evidence of problem-solving skills related to route optimisation for road gritting. • Adequate engagement with course materials, but the solution lacks sophistication or comprehensive optimisation.

60% to 69%:

- Good understanding of heuristic concepts, applied effectively to the road gritting exercise.
- The route planner is reasonably optimised, demonstrating a solid grasp of problem-solving skills.
- Evidence of thoughtful consideration of factors affecting road gritting route optimisation.
- Engaged with course materials, and the solution is well-structured, though there may be minor areas for improvement.

70% to 100%:

- Excellent understanding of heuristic concepts, applied skilfully to the road gritting exercise.
- The route planner is highly optimised, showcasing advanced problem-solving skills.
- Comprehensive consideration of factors influencing road gritting route optimisation, with innovative solutions.
- Actively engaged with course materials, and the solution demonstrates a deep understanding of the subject matter, incorporating advanced optimisation techniques where applicable.

Code snippet – suggested JSON structure for importing into solution package.

```
{
    "area": {
        "name": "Gwersyllt",
        "nodes": [
            {"node": "A", "x-coord": "20", "y-coord": "30",
                "links": [
                    {"B": "5"},
                    {"C": "4"}
                ]
            },
            {"node": "B", "x-coord": "35", "y-coord": "25",
                "links": [
                    {"A": "5"},
                    {"C": "4"},
                    {"D": "6"}
                ]
            },
            ... etc ...
        ]
    }
}
```

Figure 1 – Graph of the road network to be traversed with weightings related to grit usage.