VCE General Mathematics Unit 4

Sample learning activity: Networks and decision mathematics: Greedy algorithms

Introduction

Greedy algorithms are based on choosing the best local/immediate option at each stage of a process. A greedy algorithm ‘chooses’ the smallest value or largest value available at each stage of the process according to the problem at hand and builds up a solution step by step. This algorithm may or may not lead to an optimal global solution; however, it will lead to a solution in a reasonable time, see, for example: [Greedy algorithm](https://en.wikipedia.org/wiki/Greedy_algorithm).

Two well-known greedy algorithms which are applicable to graphs/networks are Prim’s algorithm for finding a *minimal spanning tree* and Dijkstra’s algorithm for finding the *shortest path* between two vertices. Simple graph/network problems can often be solved by inspection; however, algorithms are used to solve problems involving larger graphs/networks (such as international carrier air routes) and implemented using technology.

Part 1

Prim’s algorithm

Prim’s algorithm determines a minimum spanning tree for a weighted graph/network, for example: [Visualgo](https://visualgo.net/en/mst?slide=1)

1. For a selection of graphs/networks, use Prim’s algorithm to find a minimal spanning tree.
2. Use a suitable web application or software to design several graphs/networks and apply Prim’s algorithm to determine a minimal spanning tree for each graph/network.

Part 2

Dijkstra’s shortest path algorithm

[Dijkstra’s algorithm](https://www.cs.usfca.edu/~galles/visualization/Dijkstra.html) can be used to find the shortest path between a given vertex and each of the other vertices in a weighted graph/network.

1. For a selection of graphs/networks, use Dijkstra’s algorithm to find the shortest path between a given vertex and other vertices.
2. Use a suitable web application or software to design several graphs/networks and apply Dijkstra’s algorithm to determine shortest paths between vertices for each graph/network.

Areas of study

The following content from the areas of study is addressed through this task.

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| **Unit 4** | | |
| **Area of study** | **Topic** | **Content dot point** |
| Discrete mathematics | Trees and minimum connector problems  Shortest path problems | 1, 2, 3  1, 2 |

Outcomes

The following outcomes, key knowledge and key skills are addressed through this task.

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| **Unit 4** | | |
| **Outcome** | **Key knowledge dot point** | **Key skills dot point** |
| 1 | 3, 5 | 3, 5 |
| **2** | 1, 2, 3, 4 | 1, 2, 3 |
| 3 | 5 | 9, 10, 12 |