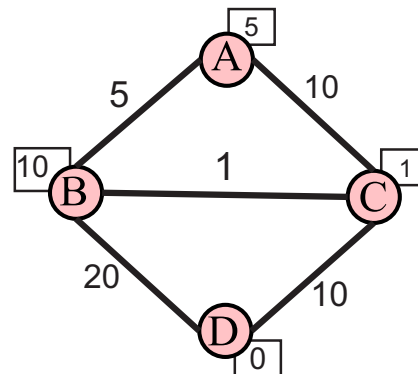


1 Presented Problems

Problem 2.5: Heuristics for Informed Search

Consider the following graph. We start from node A and our goal node is D. The path costs are shown on the arcs and the heuristic values are shown at each node.



Problem 2.5.1: What are the requirements on a heuristic for A* tree search and graph search to be optimal?

Problem 2.5.2: Is the given heuristic admissible? Is it consistent? If not, why not?

Problem 2.5.3: Perform A* graph search and tree search to verify your previous answers.

Problem 2.6: Application of Search Algorithms: Train Journey

We want to travel from Aberdeen to Birmingham. The (semi-fictional) map of the British rail system is available in Fig. 1. Routes have the same cost in both directions for both time and price. If there is no clear preference for the next node to explore, we explore first the node which is first alphabetically.

Problem 2.6.1: In the table below, we are given a heuristic for cost in time, which is based on the straight-line distances to Birmingham and the maximum speed of the train being no more than 120km/h. Perform Greedy Best-First and A* Search for time cost using graph search. For each step, write down the node which is currently expanded and the nodes in the frontier set, each with its value of the evaluation function $f(n)$ and the parent node.

node n	A	G	E	C	Y	P	M	W	S	D	B
heuristic function $h(n)$	259	203	197	138	86	76	56	55	31	28	0

Problem 2.6.2: For the problem with cost in price (see Fig. 1 right), would a heuristic based on distance be valid?

Problem 2.6.3: Which search algorithm would we use if we want to minimize train changes (assuming that we change train at every station)?

Problem 2.6.4: Is bidirectional search a good option for the train journey search?

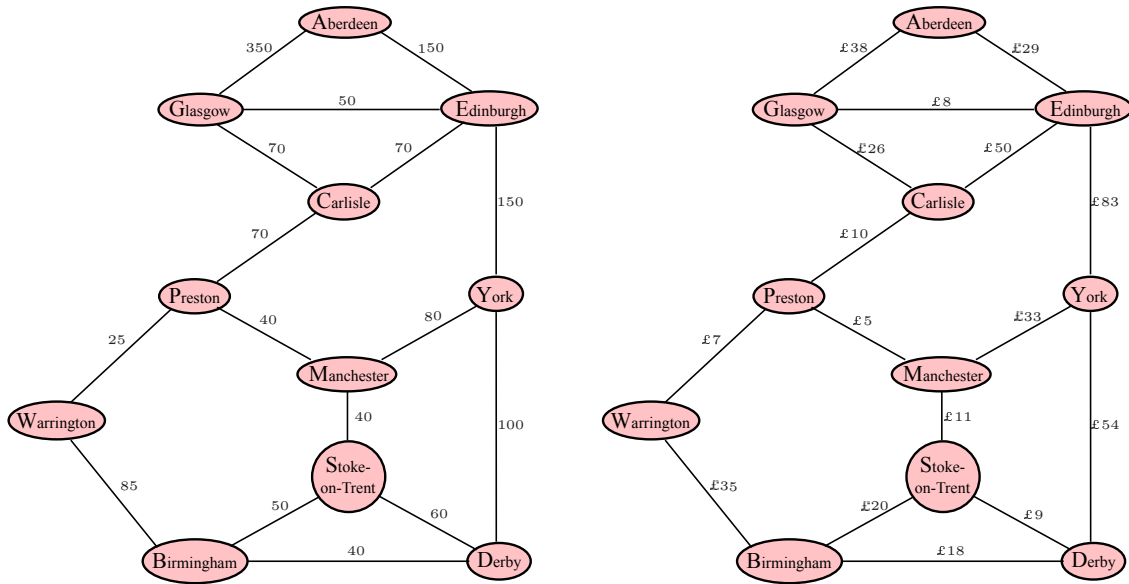


Figure 1: Rail map: left, cost in time (minutes); right, cost in price (£ sterling)

2 Additional Problems

Problem 2.7: Graph Search

Consider the graph of Problem 2.1 (of Exercise 2a). With the heuristic given in the table below, perform Greedy Best-First and A* Search, each with tree search and with graph search. For each step, write down the node which is currently expanded and the nodes in the frontier set, each with its value of the evaluation function $f(n)$ (and the nodes in the explored set in case of graph search).

node n	A	B	C	D	E	F
heuristic function $h(n)$	4	5	2	1	7	0

Problem 2.8: General Questions on Search

Problem 2.8.1: Can Uniform-Cost Search be more time-effective or memory-effective than the informed search algorithms? What about cost-effectiveness?

Problem 2.9: Application of Search Algorithms in Daily Life

Which search algorithm (out of those covered in lectures 3 and 4) do you think your brain uses in the following cases, and what are the advantages of this algorithm? (Note that there are no hard-and-fast solutions for these; it is a matter of personal preference. The purpose of this exercise is to think about situations where you use search algorithms in daily life.)

- Planning a route from Arad to Bucharest with a map.
- Finding an Easter egg:
 - in a building you are unfamiliar with, on your own.
 - in a building you are familiar with, on your own.
 - in a building you are familiar with, with a team of people who all have mobile phones.
 - if the Easter has a bell attached (which constantly rings).
- Playing a strategy game, e.g. chess.