Foundations of Artificial Intelligence

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Exercise Sheet 5

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Hint: If you want to describe a state space, it suffices to draw the state space with action costs directly denoted as transition labels (no formal definition needed).

Exercise 5.1 (1.5+1.5 marks)

Are the following statements about best-first search correct? Justify your answer.

(a) Greedy best-first search always finds an optimal solution when using h^*.

(b) For every solvable state space and weight $1 \leq w < \infty$ there exists a heuristic such that weighted A* (with reopening) will find an optimal solution.

Exercise 5.2 (2 marks)

Execute the first two iterations of IDA* on the route planning in Romania problem from the lecture (chapter 16, slide 8 printout version) where we start from Arad. For each iteration specify in a nested manner with which arguments the recursive function was called and what was returned.

For example the first iteration when starting from Hirsova can be specified the following way:

```
dls(Hirsova, 0, 151)
  dls(Urziceni, 98, 151)
    return ⟨178, none⟩
  dls(Eforie, 86, 151)
    return ⟨247, none⟩
  return ⟨178, none⟩
```

Exercise 5.3 (2 marks)

In Chapter 18 we showed that A* with reopening is optimal when using admissible heuristics. If you would try to apply the proof to weighted A* instead of A*, where would it fail? Justify why it fails at the point you specify and briefly explain why it does not fail earlier.

Exercise 5.4 (1 mark)

Would A* without reopening behave identical to A* with reopening with a consistent but inadmissible heuristic? Briefly justify your ansewr.

Exercise 5.5 (2 marks)

Give an example of a state space and admissible heuristic where A* search will expand fewer nodes than greedy best-first search. Explain in 2-3 sentences why your example has the required properties.

Submission rules:

Upload a single PDF file (ending .pdf). If you want to submit handwritten parts, include their scans in the single PDF. Put the names of all group members on top of the first page. Use page numbers or put your names on each page. Make sure your PDF has size A4 (fits the page size if printed on A4).