CSE 571 Homework 1

Name: Student ID's:

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Due: September 8., 2016

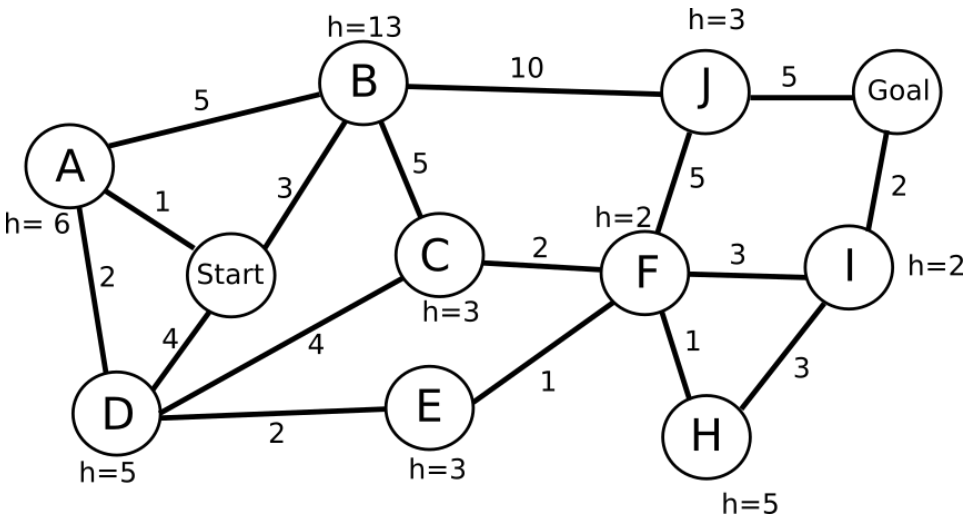
For each homework we will state here if you have to work alone or if you can team up with another student.
For this homework you are allowed to work in **teams of two students** for all questions. Each group has to submit one **handwritten** (!) copy and state their names on the front page. Failure to do so could result in the allegation of plagiarism! Use the same groups as in Blackboard. Submission is possible at the end of a lecture or during an office hour till the due date of this homework (which you can find above).
Print this homework and write all your answers in the space below the questions. If you need additional space you might want to use the backside of the pages.
Also,

- unstapled homework will result in a decrease of at least 30% of the achieved points.
- handwritten text which is not readable will be graded with zero points.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Sum
Points	20	6	1	2	1	5	6	35 + 6 Bonus
Achieved								

1. Question (20 Points)

Assume for the following questions, that the graph below is given. The value of h defines the heuristic value of each node. In the case of a tie during expansion, i.e. you can select betweent two or more nodes to expand, the node with the lower alphabetical value is expanded first. For example, if during UCS the nodes A and B have the same value and could be expanded, the node A is expanded first. Use for the Start and Goal state the first letter, i.e. S for Start and G for Goal.



1.1) (3 Points) Execute the DFS algorithm on the graph:

	Start	A	B	C	D	E	F	H	I	J	Goal
Expanded nodes	×										

Path:	Start										

Path cost:

1.2) (3 Points) Execute the BFS algorithm on the graph:

	Start	A	B	C	D	E	F	H	I	J	Goal
Expanded nodes	×										

Path:	Start										

Path cost:

1.3) (3 Points) Execute the UCS algorithm on the graph:

	Start	A	B	C	D	E	F	H	I	J	Goal
Expanded nodes	×										

Path:	Start										

Path cost:

1.4) (3 Points) Execute the Greedy algorithm on the graph:

	Start	A	B	C	D	E	F	H	I	J	Goal
Expanded nodes	×										

Path:	Start										

Path cost:

1.5) (3 Points) Execute the A* algorithm on the graph:

	Start	A	B	C	D	E	F	H	I	J	Goal
Expanded nodes	×										

Path:	Start										

Path cost:

1.6) (2 Points) Two algorithms find the same path with the same cost. Is there any difference regarding the execution/search between those algorithms in this example? Explain why or why not.

1.7) (1 Point) Is the heuristic for this graph admissible? Why?

1.8) (1 Point) Assume $h(C) = 7$. Is the heuristic for this graph still admissible? Why?

1.9) (1 Point) Assume $h(E) = 7$. Is the heuristic for this graph still admissible? Why?

2. Question (6 Points)

State if the following statements are true or false and give a short explanation.

2.1) (3 Points) DFS always expands at least as many nodes as A* search with an admissible heuristic.

2.2) (1 Point) A search tree is always finite.

2.3) (1 Point) BFS and UCS will always return the same path.

2.4) (1 Point) The heuristic $h = 0$ is admissible for the 8-Puzzle, presented in the lecture.

3. Question (1 Point)

What is a branching factor?

4. Question (2 Points)

Show, by stating an example **state space**, that cases exist in which iterative deepening is much more worse than DFS.

5. Question (1 Point)

But why is it benefitial to use iterative deepening instead of DFS? Name one very important benefit of iterative deepening.

6. Question (5 Points)

Below you can find an old map of the city Mannheim in Germany, known for its chessboard-like street layout built in 1606. Assume that we can only travel within the city walls (also without the street following the shape of the city walls!). Proof that the euclidian distance is an admissible heuristic given an arbitrary start and goal point within the city.

Hint: You are not a ghost, you cannot walk through buildings or walls!

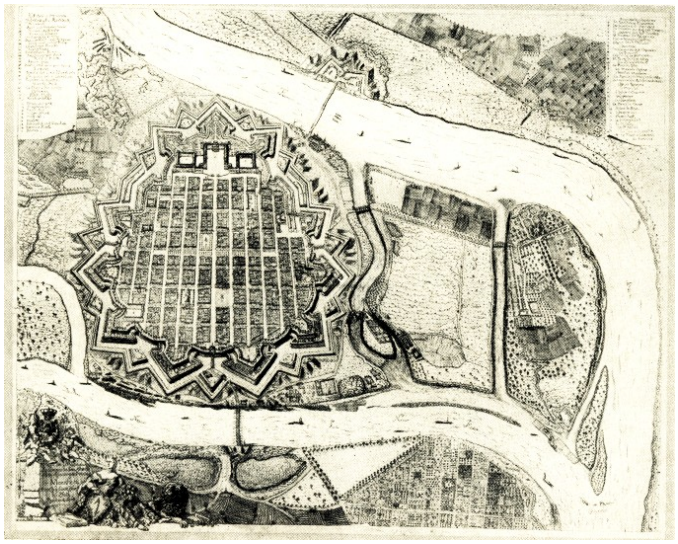


Figure 1: Residential city of Mannheim (copperplate print of Josef Anton Baertels 1758). Source: *Theo Piana: Friedrich Schiller. Volksverlag, Weimar 1957.*

7. Bonus Question (6 Points)

Proof that if a heuristic is consistent, it must be admissible.
Hint: You might want to proof this by using mathematical induction.