You have to tick the prepared exercises in TUWEL at the latest before Friday, 19th April 2013, 13:00 (Exercise Sheet 1). Belated submission will be ignored.

Exercise 1 (Uninformed Search):

a) Let $b > 1$ be the maximal branching degree in the search tree and let $d$ be its depth. Estimate the number of nodes, $n_{bfs}(d)$, generated during a breadth-first search with depth $d$. Show that $n_{bfs}(d) = O(b^d)$ and estimate the constant $c_{bfs}$. (2 pts)

b) Let $b > 1$ be the maximal branching degree in the search tree and let $d$ be its depth. Estimate the number of nodes, $n_{dfid}(d)$, generated during a depth-first-iterated-deepening search with depth $d$. Show that $n_{dfid}(d)$ is $O(b^d)$ and estimate the constant $c_{dfid}$. What can you say about the overhead induced by dfid? (2 pts)

c) Describe a state space in which dfid is much worse than dfs, e.g., $O(n^2)$ vs. $O(n)$. (1 pt)

Exercise 2 (Informed Search - heuristics):

a) Prove that, if any given heuristics $h_1$, $h_2$ are both monotone (consistent), then

$$h(n) = \max(h_1(n), h_2(n)).$$

is also monotone (consistent). (2 pts)

b) Let $h_1$, $h_2$ both be admissible heuristics. Check whether the following heuristics $h(h_1, h_2)$, which are combinations of $h_1$, $h_2$, are also admissible. If $h(h_1, h_2)$ is not admissible, then estimate intervals for which admissibility is given.

1. $h(h_1, h_2) = \frac{h_1 + h_2}{c_h = \frac{1}{h_1}, h_2} \quad c > h_1, c > h_2$ (2 pts)

2. $h(h_1, h_2) = h_1 \cdot h_2$ (1 pt)

Exercise 3 ($A^*$-search and miscellaneous):

a) Let $f(n) = c_g g(n) + c_h h(n)$ be an evaluation function, where $c_g$, $c_h$ be constants.

1. Define $c_g$, $c_h$, $h(\cdot)$, $g(\cdot)$ such that $A^*$ with this evaluation function is bfs. (1pt)

2. Define $c_g$, $c_h$, $h(\cdot)$, $g(\cdot)$ such that $A^*$ with this evaluation function is dfs. (1pt)

b) Which of the following statements are true and which are false? Explain your answers.

1. Depth-first search always expands at least as many nodes as $A^*$ search with an admissible heuristic. (1 pt)

2. Assume that a rook can move on a chessboard any number of squares in a straight line, vertically or horizontally, but cannot jump over other pieces. Manhattan distance is an admissible heuristic for the problem of moving the rook from square A to square B in the smallest number of moves. (1 pt)

3. Breadth-first search is a special case of uniform-cost search. (1 pt)