Classroom Exercise 2[1]

The files required for this exercise are on the Moodle of the course. For the runs with Fast Downward, set a time limit of 1 minute and a memory limit of 2 GB. Using Linux, such limits can be set with `ulimit -t 60` *and* `ulimit -v 2000000`*, respectively.*

Exercise 1

The goal of this exercise is to implement the A* search algorithm in the Fast Downward planner. We have prepared a stub of the class `AStarSearch` in the files

`hands-on-2/fast-downward/src/search/search_engines/astar_search.{cc,h}`.

Implement the parts marked as missing with a comment "`// insert your code here`":

- Add a comparison operator for two objects of type `AStarSearchNode`. You can find the stub in `astar_search.h` in the function

  ```
  bool operator()(const AStarSearchNode *lhs, const AStarSearchNode *rhs) const
  ```

  of the struct `Compare` within the `AStarSearchNode` class. Implement the comparison such that it returns `true` if the f-value of `lhs` is larger than the f-value of `rhs`, or if both f-values are equal and the h-value of `lhs` is larger than the h-value of `rhs`.

- The class `OpenList` internally works with the priority queue `std::priority_queue` from the C++ standard library. Based on the corresponding functions in `std::priority_queue`, implement the two functions to insert and remove `AStarSearchNodes` into and from `OpenList` in `astar_search.h`.

- In `astar_search.cc`, the implementation of the A* search algorithm in the search method of `AStarSearch` is missing. Implement A* based on the pseudo code that has been presented in the lecture.

Your implementation of A* based on the provided code stub uses a fixed admissible heuristic (the *LM-Cut* heuristic). Test the correctness of your implementation (called with `--search "planopt_astar()"`) by comparing to the Fast Downward version of A* and *LM-Cut* (called with `--search "astar(lmcut())"`) on all instances in the directory `hands-on-2/benchmarks`. Discuss the search time and the plan costs.

[1] Exercício de Malte Helmert.