CS3061 Artificial Intelligence

Submit to Blackboard by Mon, Feb 12.[1]

This assignment asks you to apply the A* search algorithm to graphs over the set of nodes $\{1, 2, 3, \ldots\}$, with arcs `N,M` and costs `Cost` induced by a positive integer `Seed` as follows

```
arc(N,M,Seed,Cost) :- M is N*Seed, Cost=1.
arc(N,M,Seed,Cost) :- M is N*Seed + 1, Cost=2.
```

(E.g. `Seed` = 3 yields arc `1,3` with cost 1 and `1,4` with cost 2.) Let us agree also that the goal nodes are given by a positive integer `Target` as those nodes divisible by `Target` — i.e. `Target, 2*Target, 3*Target`, ...

```
goal(N,Target) :- 0 is N mod Target.
```

Given `Target`, let us set the heuristic function to 0 on goal nodes, and to the reciprocal elsewhere.

```
h(N,Hvalue,Target) :-  goal(N,Target), !, Hvalue is 0
                       ;
                       Hvalue is 1/N.
```

Your task is to define a predicate

```
a-star(+Start,+Seed,+Target,?Found)
```

that given positive integers `Start, Seed` and `Target` returns the lowest cost goal node `Found` calculated by A*.

The idea is to modify the skeletal search algorithm

```
search([Node|FRest]) :-  goal(Node).
search([Node|FRest]) :-  setof(X,arc(Node,X), FNode),
                         add-to-frontier(FNode,FRest,FNew),
                         search(FNew).
```

so that the list `FNew` obtained in `add-to-frontier` is (as prescribed by A*) sorted in order of increasing f-values, where $f(\text{node}) = \text{cost}(\text{node}) + h(\text{node})$.

Hint. Let the frontier be a list of node-cost pairs (instead of just nodes), being careful to add the cost of the parent to its children, and to bring in the heuristic function in ordering the frontier `FNew`.

```
less-than([Node1,Cost1],[Node2,Cost2],Target) :-
   h(Node1,Hvalue1,Target), h(Node2,Hvalue2,Target),
   F1 is Cost1+Hvalue1, F2 is Cost2+Hvalue2,
   F1 =< F2.
```

Test your definitions with queries such as

```
 ?- a-star(1,3,6,F).
```

[1] For any extensions beyond that date, email your demonstrator/marker, David Woods (dwoods@tcd.ie).