INGI2261- AI - Project 2

Jacquet Charles - 27811200
Degryse Baptiste - 27641200
Groupe 34

19 octobre 2015

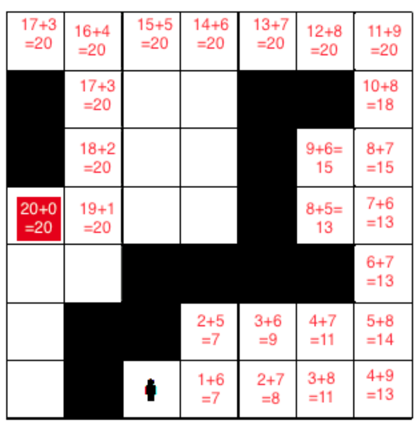
First set of questions

1) Heuristic

The heuristic can simple be the Manhattan distance between the guy and the goal. It's admissible beacuse if there is no wall, the estimation of the solution by the heuristic is actually the real value. And in other case the heuristic value is underestimated.

2) uniform-cost graph search

3) A* graph search



Second set of questions

Other dead-end ?

We first thought about the case where a line was made, creating a place without any goal where the perso can't go. But after thinking about it, testing this case was not an improvement at all. Actually it was quite the opposite because in that case, only one or two expand are needed to our algorithme to understand by other ways (like dead-end) that iss not a possible way. So checking that all the time is a lot of calculation for nearly nothing.

The importance of searching dead-state

It's really important because when a path cannot lead to a solution, we have to delete it as quickly as possible because the program can take a lot of time expanding these nodes for nothing. In order to do that, we looked for four dead-end position, when the box is in a corner (and the 3 other symmetric corner).

Our heuristic

We have decided to have the simplest heuristic as possible. We first tried to have only the heuristic on the Manhattan distance between boxes and there nearest free box goal ('.'). Then, we tried to improve it by adding an heuristic on the distance for the person but it was not a good idea at all ! Yes it did what we wanted to but we saw that it was not always the optimal solution. Moreover, it was a lot to calculate at each time. So we came back to our first choice which is admissible because in the best case, we have that the estimate distance is the same as said by the heuristic (if the perso has just to push the box without any direction modification). In other case, it underestimates the path.
Then it had to be consistent, thus, when the perso moves from n to n' we must have :

$$h(n) \leq c(n, a, n') + h(n')$$

to see that our heuristic is consistency the only possible cases are (cost is 1 for each moves) :

- h(n')=h(n)+cost = h(n)+1 (perso moved but didn't push any box)
- h(n')=h(n)+1+ cost =h(n)+2 (perso moved push a box)
- h(n')=h(n)-1 + cost = h(n) (perso moved push a box)

So we see that the consistency equation is satisfied.

The implementation is on the Inginious platform

A* (informed search) vs uniform-cost Search() (uninformed search)

With these results (cfr Table 1), we clearly see that informed search is more efficient than the other one, it takes less time and visit less states. It means that

TABLE 1 – uninformed vs informed search graph

	uninformed search (breadth first graph search)	informed search (A*)
sokoInst01-time	0.34653	0.01542
sokoInst01-node	2883	114
sokoInst02-time	1.07803	0.88283
sokoInst02-node	6990	4967
sokoInst07-time	1.07651	0.61504
sokoInst07-node	4252	2417
sokoInst08-time	1.31147	0.83353
sokoInst08-node	6403	3570
sokoInst015-time	13.91409	0.64684
sokoInst015-node	67875	2799

the heuristic is really helping in the choose of which state to expand first.

Performance without dead-end detection

TABLE 2 – My caption

	A* without dead-end detection	informed search (A*)
sokoInst01-time	0.0153	0.01542
sokoInst01-node	114	114
sokoInst02-time	2.86740	0.88283
sokoInst02-node	15613	4967
sokoInst07-time	1.51757	0.61504
sokoInst07-node	5497	2417
sokoInst08-time	1.4537	0.83353
sokoInst08-node	6297	3570
sokoInst015-time	time-out	0.64684
sokoInst015-node	204053	2799

We can see on the Table 2 that except for the first case, we have to visit twice more nodes when we are not checking for dead-ends!