**CSCI 360 – Project #1**

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Theoretical Part: A\*

Let  break ties by smallestvalues first

Let  break ties by the largest  values first

Given an instance of a graph  we want to run  on, the goal state  will have a heuristic of 0 and a  -value equaling the distance from the start state  to  . Therefore:



Because in general  , we will be expanding smallest  -values first, every node with an -value less than the -value of the goal state will always be expanded. Similarly, every node with an -value greater than the -value of the goal state will never be expanded (since we will reach the goal state and terminate).

Therefore, for both  and :



Now consider the following  grid with the start cell at the upper-left, the goal cell at the lower right, and each cell’s heuristic being the true distance from the goal cell:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **A** | **B** | **C** | **D** |
| 1 | S:6 | 5 | 4 | 3 |
| 2 | 5 | 4 | 3 | 2 |
| 3 | 4 | 3 | 2 | 1 |
| 4 | 3 | 2 | 1 | G:0 |

 will produce the following expansions:



 will produce the following expansions:



For this specific search problem,  expands fewer nodes than . This is because when breaking ties, selecting the node with the greater -value has the effect of expanding the node that has progressed the furthest from . In this specific problem since all the -values of every single cell is 6, we want to make progress in terms of moving towards the goal state, and hence selecting the larger -value achieves this result.

For general search problems, both  and ensures smallest f-value first, which ensures progress towards our goal state from the aggregation of both the  and -values. However, when faced with ties,  will expands towards the goal state in terms of making progress in distance travelled, whereas  will expand the node furthest from the goal state, making less progress towards the goal state. This results in  always expanding the same node as  or expanding nodes that are closer to the goal state compared to the nodes  expands due to the heuristic being consistent.