Assignment Four: Dijkstra's (Uniform Cost) Search

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**Question 1:**

*Apply Dijkstra's (Uniform Cost) Search to find the shortest path from the U.S. East Coast to Nigeria.*

Dijkstra’s Search, also known as Uniform-Cost Search, is defined as “the evaluation function is the cost of the path from the root to the current node. “ (Artificial Intellligence: A Modern Approach, 2021, p. 77) This uses the weight, value, or distance assigned to the node as the evaluation. It will evaluate the tree with the lowest cost value. (Artificial Intellligence: A Modern Approach, 2021, pp. 77-78)

**Lab Table:**

|  |  |  |
| --- | --- | --- |
| **Node 1** | **Node 2** | **Cost** |
| U.S. East Cost | Canada | 1.5 |
| U.S. East Cost | Spain | 2.7 |
| U.S. East Cost | Brazil | 3.3 |
| Canada | Turkey | 3.1 |
| Spain | Nigeria | 2.6 |
| Turkey | Nigeria | 0.5 |
| Brazil | Nigeria | 1.9 |

We have three possible routes to Nigeria: Spain, Turkey, and Brazil.

1. Route 1: US East Cost => Canada => Turkey => Nigeria (Cost = 5.1)
2. Route 2: US East Cost => Spain => Nigeria (Cost = 5.3)
3. Route 3: US East Cost => Brazil => Nigeria (Cost = 5.2)

Therefore, using Dijkstra’s Search (which will select the route which costs the least) we find that Route 1 is the shortest route to Nigeria. Which is US East Cost, to Canada, to Turkey, then finally in Nigeria with a cost of 5.1.

**Question 2:**

*Show the algorithm steps on how the different flight legs are expanded.*

Using figure 3.10 and the associated text describing uniform cost search (Artificial Intellligence: A Modern Approach, 2021, p. 77), we know that the it we be evaluated in the steps shown below:

1. Start at U.S. East Coast (Cost: 0)
   1. Expand nodes: Canada (Cost: 1.5), Spain (Cost: 2.7), Brazil (Cost: 3.3).
   2. Update Frontier: [(Canada, 1.5), (Spain, 2.7), (Brazil, 3.3)].
   3. Update Reached: {U.S. East Coast}.
2. Expand Canada (Cost: 1.5)
   1. Next nodes: Turkey (Total Cost: 1.5 + 3.1 = 4.6).
   2. Update Frontier: [(Spain, 2.7), (Brazil, 3.3), (Turkey, 4.6)].
   3. Update Reached: {U.S. East Coast, Canada}.
3. Expand Spain (Cost: 2.7)
   1. Next nodes: Nigeria (Total Cost: 2.7 + 2.6 = 5.3).
   2. Update Frontier: [(Brazil, 3.3), (Turkey, 4.6), (Nigeria, 5.3)].
   3. Update Reached: {U.S. East Coast, Canada, Spain}.
4. Expand Brazil (Cost: 3.3)
   1. Next nodes: Nigeria (Total Cost: 3.3 + 1.9 = 5.2).
   2. Update Frontier: [(Turkey, 4.6), (Nigeria, 5.2), (Nigeria, 5.3)].
   3. Update Reached: {U.S. East Coast, Canada, Spain, Brazil}.
5. Expand Turkey (Cost: 4.6)
   1. Next nodes: Nigeria (Total Cost: 4.6 + 0.5 = 5.1).
   2. Update Frontier: [(Nigeria, 5.1), (Nigeria, 5.2), (Nigeria, 5.3)].
   3. Update Reached: {U.S. East Coast, Canada, Spain, Brazil, Turkey}.
6. Expand Nigeria (Cost: 5.1)
   1. Nigeria is reached, and since it has the lowest cost among paths in the frontier, the path is confirmed as the shortest.

# References

Artificial Intellligence: A Modern Approach. (2021). In S. Russell, & P. Norvig. Hoboken, NJ: Pearson.