|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Position | Start1 | Start2 | Start3 | Start4 | Start5 |
| N | 41 | 173 | 2409 | 9508 | 58419 |

**(a)**

Breadth first search, exclude repeated states:

**(b)**

Breadth first search, include repeated states:

|  |  |  |
| --- | --- | --- |
| Position | Start1(N=) | Start2 |
| N | 139 | 1857 |

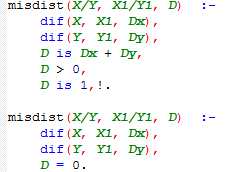
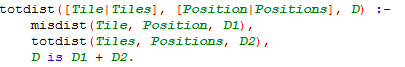
**(c)**

A\* with total Manhattan distance heuristic:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Position | Start1 | Start2 | Start3 | Start4 | Start5 |
| N | 6 | 11 | 19 | 61 | 213 |

**(d)**   
A\* with Misplace Tiles heuristic:

Changed parts:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Position | Start1 | Start2 | Start3 | Start4 | Start5 |
| N | 20 | 34 | 768 | Run out of time | Run out of time |

**(e)**   
Base on this result, the order from slowest to fastest is **c>a>b>d.**

**(f)**

**Position:**

|  |  |  |
| --- | --- | --- |
| 5 | 7 | 4 |
| 8 | 2 |  |
| 6 | 3 | 1 |

**Requiring 20: Requiring 23: Requiring 26:**

|  |  |  |
| --- | --- | --- |
| 5 | 7 | 4 |
| 8 | 2 | 1 |
|  | 6 | 3 |

|  |  |  |
| --- | --- | --- |
|  | 5 | 7 |
| 8 | 2 | 4 |
| 6 | 3 | 1 |

With A\* Manhattan Distance heuristic

|  |  |  |  |
| --- | --- | --- | --- |
| Requiring steps | **20** | **23** | **26** |
| N | 153 | 336 | 1305 |