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CSE 3521

Homework #3

1. successor function and goal test function

1 2 3

4 5 6

7 8

Action:

Move 4 down

Resultant state:

1 2 3

5 6

4 8 7

-----------

Action:

Move 8 left

Resultant state:

1 2 3

4 5 6

8 7

-----------

Number of expanded states is 1 (as expected).

1 2 3

4 5 6

8 7

State IS NOT goal state

Number of evaluated states is 1 (as expected).

1 2 3

8 4

7 6 5

State IS goal state

Number of evaluated states is 1 (as expected).

1. Test functions

1 3

4 2 5

8 7 6

Action:

Move 6 down

Resultant state:

1 2 3

4 5

8 7 6

-----------

Action:

Move 7 right

Resultant state:

1 2 3

4 5 6

8 7

-----------

Number of expanded states is 1 (as expected).

1 2 3

4 5

8 7 6

Action:

Move 2 down

Resultant state:

1 3

4 2 5

8 7 6

-----------

Action:

Move 7 up

Resultant state:

1 2 3

4 7 5

8 6

-----------

Action:

Move 4 right

Resultant state:

1 2 3

4 5

8 7 6

-----------

Action:

Move 5 left

Resultant state:

1 2 3

4 5

8 7 6

-----------

Number of expanded states is 1 (as expected).

The function is capable to recognize all two, three, and four potential successors. Plus, the test we ran before (with only two successors), the function passed all scenarios.

1. breadth-first search

Number of states evaluated=705

Number of states expanded=420

Path length=11

-----------

1 2 3

4 5 6

8 7

-----------

Move 8 left

-----------

1 2 3

4 5 6

8 7

-----------

Move 7 left

-----------

1 2 3

4 5 6

8 7

-----------

Move 6 down

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

Number of states evaluated=11

Number of states expanded=10

Path length=6

-----------

Jug 1 volume: 7

Jug 2 volume: 0

-----------

Pour 3gal from Jug 1 into Jug 2

-----------

Jug 1 volume: 4

Jug 2 volume: 3

-----------

Empty Jug 2

-----------

Jug 1 volume: 4

Jug 2 volume: 0

-----------

Pour 3gal from Jug 1 into Jug 2

-----------

Jug 1 volume: 1

Jug 2 volume: 3

-----------

Empty Jug 2

-----------

Jug 1 volume: 1

Jug 2 volume: 0

-----------

Pour 1gal from Jug 1 into Jug 2

-----------

Jug 1 volume: 0

Jug 2 volume: 1

Number of states evaluated=6

Number of states expanded=5

Path length=4

-----------

Robot Left

Left dirt: 1

Right dirt: 1

-----------

Vaccuum: Left dirt 1 -> 0

-----------

Robot Left

Left dirt: 0

Right dirt: 1

-----------

Move right

-----------

Robot Right

Left dirt: 0

Right dirt: 1

-----------

Vaccuum: Right dirt 1 -> 0

-----------

Robot Right

Left dirt: 0

Right dirt: 0

1. depth-limited search

Number of states evaluated=643

Number of states expanded=643

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No solution found!

1. iterative-deepening search

Number of states evaluated=2657

Number of states expanded=2656

Path length=11

-----------

1 2 3

4 5 6

8 7

-----------

Move 8 left

-----------

1 2 3

4 5 6

8 7

-----------

Move 7 left

-----------

1 2 3

4 5 6

8 7

-----------

Move 6 down

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

1. A\* search algorithm

Number of states evaluated=29

Number of states expanded=15

Path length=11

-----------

1 2 3

4 5 6

8 7

-----------

Move 8 left

-----------

1 2 3

4 5 6

8 7

-----------

Move 7 left

-----------

1 2 3

4 5 6

8 7

-----------

Move 6 down

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

1. See Below
   1. Configuration 1, Breadth-first Search

Number of states evaluated=53335

Number of states expanded=36835

Path length=21

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 1 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 4 up

-----------

4 1 2

3 6

5 8 7

-----------

Move 5 up

-----------

4 1 2

5 3 6

8 7

-----------

Move 8 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 7 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 6 down

-----------

4 1 2

5 3

8 7 6

-----------

Move 3 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 5 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 4 down

-----------

1 2

4 5 3

8 7 6

-----------

Move 1 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 2 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 3 up

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 1, Iterative Deepening Search

Number of states evaluated=594689

Number of states expanded=594688

Path length=21

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

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1 2

4 3 6

5 8 7

-----------

Move 1 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 4 up

-----------

4 1 2

3 6

5 8 7

-----------

Move 5 up

-----------

4 1 2

5 3 6

8 7

-----------

Move 8 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 7 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 6 down

-----------

4 1 2

5 3

8 7 6

-----------

Move 3 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 5 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 4 down

-----------

1 2

4 5 3

8 7 6

-----------

Move 1 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 2 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 3 up

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 1, A\* Search

Number of states evaluated=646

Number of states expanded=373

Path length=21

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 1 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 4 up

-----------

4 1 2

3 6

5 8 7

-----------

Move 5 up

-----------

4 1 2

5 3 6

8 7

-----------

Move 8 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 7 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 6 down

-----------

4 1 2

5 3

8 7 6

-----------

Move 3 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 5 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 4 down

-----------

1 2

4 5 3

8 7 6

-----------

Move 1 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 2 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 3 up

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 1, Depth-limited Search (BFS)

Number of states evaluated=220837

Number of states expanded=220836

Path length=21

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 1 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 4 up

-----------

4 1 2

3 6

5 8 7

-----------

Move 5 up

-----------

4 1 2

5 3 6

8 7

-----------

Move 8 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 7 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 6 down

-----------

4 1 2

5 3

8 7 6

-----------

Move 3 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 5 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 4 down

-----------

1 2

4 5 3

8 7 6

-----------

Move 1 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 2 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 3 up

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 1, Depth-limited Search (Double BFS)

Number of states evaluated=595536

Number of states expanded=595535

Path length=41

-----------

1 2

4 3 6

5 8 7

-----------

Move 6 up

-----------

1 2 6

4 3

5 8 7

-----------

Move 6 down

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 3 up

-----------

1 3 2

4 6

5 8 7

-----------

Move 8 up

-----------

1 3 2

4 8 6

5 7

-----------

Move 5 right

-----------

1 3 2

4 8 6

5 7

-----------

Move 4 down

-----------

1 3 2

8 6

4 5 7

-----------

Move 1 down

-----------

3 2

1 8 6

4 5 7

-----------

Move 3 left

-----------

3 2

1 8 6

4 5 7

-----------

Move 8 up

-----------

3 8 2

1 6

4 5 7

-----------

Move 5 up

-----------

3 8 2

1 5 6

4 7

-----------

Move 4 right

-----------

3 8 2

1 5 6

4 7

-----------

Move 1 down

-----------

3 8 2

5 6

1 4 7

-----------

Move 3 down

-----------

8 2

3 5 6

1 4 7

-----------

Move 8 left

-----------

8 2

3 5 6

1 4 7

-----------

Move 5 up

-----------

8 5 2

3 6

1 4 7

-----------

Move 4 up

-----------

8 5 2

3 4 6

1 7

-----------

Move 7 left

-----------

8 5 2

3 4 6

1 7

-----------

Move 6 down

-----------

8 5 2

3 4

1 7 6

-----------

Move 2 down

-----------

8 5

3 4 2

1 7 6

-----------

Move 5 right

-----------

8 5

3 4 2

1 7 6

-----------

Move 4 up

-----------

8 4 5

3 2

1 7 6

-----------

Move 2 left

-----------

8 4 5

3 2

1 7 6

-----------

Move 5 down

-----------

8 4

3 2 5

1 7 6

-----------

Move 4 right

-----------

8 4

3 2 5

1 7 6

-----------

Move 2 up

-----------

8 2 4

3 5

1 7 6

-----------

Move 3 right

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8 2 4

3 5

1 7 6

-----------

Move 8 down

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2 4

8 3 5

1 7 6

-----------

Move 2 left

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2 4

8 3 5

1 7 6

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Move 3 up

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2 3 4

8 5

1 7 6

-----------

Move 8 right

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2 3 4

8 5

1 7 6

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Move 1 up

-----------

2 3 4

1 8 5

7 6

-----------

Move 7 left

-----------

2 3 4

1 8 5

7 6

-----------

Move 6 left

-----------

2 3 4

1 8 5

7 6

-----------

Move 5 down

-----------

2 3 4

1 8

7 6 5

-----------

Move 4 down

-----------

2 3

1 8 4

7 6 5

-----------

Move 3 right

-----------

2 3

1 8 4

7 6 5

-----------

Move 2 right

-----------

2 3

1 8 4

7 6 5

-----------

Move 1 up

-----------

1 2 3

8 4

7 6 5

-----------

Move 8 left

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 2, Breadth-first Search

Number of states evaluated=53335

Number of states expanded=36835

Path length=21

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 1 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 4 up

-----------

4 1 2

3 6

5 8 7

-----------

Move 5 up

-----------

4 1 2

5 3 6

8 7

-----------

Move 8 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 7 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 6 down

-----------

4 1 2

5 3

8 7 6

-----------

Move 3 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 5 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 4 down

-----------

1 2

4 5 3

8 7 6

-----------

Move 1 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 2 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 3 up

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 2, Iterative Deepening Search

Number of states evaluated=594689

Number of states expanded=594688

Path length=21

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 1 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 4 up

-----------

4 1 2

3 6

5 8 7

-----------

Move 5 up

-----------

4 1 2

5 3 6

8 7

-----------

Move 8 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 7 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 6 down

-----------

4 1 2

5 3

8 7 6

-----------

Move 3 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 5 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 4 down

-----------

1 2

4 5 3

8 7 6

-----------

Move 1 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 2 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 3 up

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 2, A\* Search

Number of states evaluated=646

Number of states expanded=373

Path length=21

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 1 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 4 up

-----------

4 1 2

3 6

5 8 7

-----------

Move 5 up

-----------

4 1 2

5 3 6

8 7

-----------

Move 8 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 7 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 6 down

-----------

4 1 2

5 3

8 7 6

-----------

Move 3 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 5 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 4 down

-----------

1 2

4 5 3

8 7 6

-----------

Move 1 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 2 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 3 up

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 2, Depth-limited Search (IDS)

Number of states evaluated=220837

Number of states expanded=220836

Path length=21

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 1 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 4 up

-----------

4 1 2

3 6

5 8 7

-----------

Move 5 up

-----------

4 1 2

5 3 6

8 7

-----------

Move 8 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 7 left

-----------

4 1 2

5 3 6

8 7

-----------

Move 6 down

-----------

4 1 2

5 3

8 7 6

-----------

Move 3 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 5 right

-----------

4 1 2

5 3

8 7 6

-----------

Move 4 down

-----------

1 2

4 5 3

8 7 6

-----------

Move 1 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 2 left

-----------

1 2

4 5 3

8 7 6

-----------

Move 3 up

-----------

1 2 3

4 5

8 7 6

-----------

Move 5 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 4 right

-----------

1 2 3

4 5

8 7 6

-----------

Move 8 up

-----------

1 2 3

8 4 5

7 6

-----------

Move 7 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 6 left

-----------

1 2 3

8 4 5

7 6

-----------

Move 5 down

-----------

1 2 3

8 4

7 6 5

-----------

Move 4 right

-----------

1 2 3

8 4

7 6 5

* 1. Configuration 2, Depth-limited Search (Double IDS)

Number of states evaluated=595536

Number of states expanded=595535

Path length=41

-----------

1 2

4 3 6

5 8 7

-----------

Move 6 up

-----------

1 2 6

4 3

5 8 7

-----------

Move 6 down

-----------

1 2

4 3 6

5 8 7

-----------

Move 2 right

-----------

1 2

4 3 6

5 8 7

-----------

Move 3 up

-----------

1 3 2

4 6

5 8 7

-----------

Move 8 up

-----------

1 3 2

4 8 6

5 7

-----------

Move 5 right

-----------

1 3 2

4 8 6

5 7

-----------

Move 4 down

-----------

1 3 2

8 6

4 5 7

-----------

Move 1 down

-----------

3 2

1 8 6

4 5 7

-----------

Move 3 left

-----------

3 2

1 8 6

4 5 7

-----------

Move 8 up

-----------

3 8 2

1 6

4 5 7

-----------

Move 5 up

-----------

3 8 2

1 5 6

4 7

-----------

Move 4 right

-----------

3 8 2

1 5 6

4 7

-----------

Move 1 down

-----------

3 8 2

5 6

1 4 7

-----------

Move 3 down

-----------

8 2

3 5 6

1 4 7

-----------

Move 8 left

-----------

8 2

3 5 6

1 4 7

-----------

Move 5 up

-----------

8 5 2

3 6

1 4 7

-----------

Move 4 up

-----------

8 5 2

3 4 6

1 7

-----------

Move 7 left

-----------

8 5 2

3 4 6

1 7

-----------

Move 6 down

-----------

8 5 2

3 4

1 7 6

-----------

Move 2 down

-----------

8 5

3 4 2

1 7 6

-----------

Move 5 right

-----------

8 5

3 4 2

1 7 6

-----------

Move 4 up

-----------

8 4 5

3 2

1 7 6

-----------

Move 2 left

-----------

8 4 5

3 2

1 7 6

-----------

Move 5 down

-----------

8 4

3 2 5

1 7 6

-----------

Move 4 right

-----------

8 4

3 2 5

1 7 6

-----------

Move 2 up

-----------

8 2 4

3 5

1 7 6

-----------

Move 3 right

-----------

8 2 4

3 5

1 7 6

-----------

Move 8 down

-----------

2 4

8 3 5

1 7 6

-----------

Move 2 left

-----------

2 4

8 3 5

1 7 6

-----------

Move 3 up

-----------

2 3 4

8 5

1 7 6

-----------

Move 8 right

-----------

2 3 4

8 5

1 7 6

-----------

Move 1 up

-----------

2 3 4

1 8 5

7 6

-----------

Move 7 left

-----------

2 3 4

1 8 5

7 6

-----------

Move 6 left

-----------

2 3 4

1 8 5

7 6

-----------

Move 5 down

-----------

2 3 4

1 8

7 6 5

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Move 4 down

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2 3

1 8 4

7 6 5

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Move 3 right

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2 3

1 8 4

7 6 5

-----------

Move 2 right

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2 3

1 8 4

7 6 5

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Move 1 up

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1 2 3

8 4

7 6 5

-----------

Move 8 left

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1 2 3

8 4

7 6 5

The solution matches our expectations because when the number of paths from BFS or IDS means there must be a solution out there can be find for depth-limited search which totally make sense. Also, by restricting the depth of the solution can reduce the number of state evaluation because the algorithm will not generate more path since it has been restricted and it will only be evaluated from existing states. Compare to BFS and IDS, once the path is incorrect, the IDS will also search from all the wrong path no matter the path is doable or not and BFS will go through all states parallelly which is a better solution to find the solution. However, A\* performed much better for all of them because it will evaluate the current state and choose the best path.

1. non-trivial board configuration

BFS

Number of states evaluated=16554

Number of states expanded=10671

Path length=18

IDS

Number of states evaluated=135184

Number of states expanded=135183

Path length=18

Depth-limit search (BFS)

Number of states evaluated=30843

Number of states expanded=30842

Path length=18

Depth-limit search (Double BFS)

Number of states evaluated=13619

Number of states expanded=13618

Path length=34

A\* (Total Manhattan distance heuristic)

Number of states evaluated=281

Number of states expanded=156

Path length=18

A\* (Misplaced tiles heuristic)

Number of states evaluated=1358

Number of states expanded=771

Path length=18

A\* (Simplest heuristic (h(n)=0))

Number of states evaluated=14609

Number of states expanded=9544

Path length=18

As we discussed before, A\* algorithms have advantages to solve specific problems like 8-puzzle, however, the difference between number of states is occurred by implementations. In conclusion, A\* will “never overestimates actual distance to goal” which makes it performed better compared to BFS, IDS (even with the simplest heuristic, the performance is close to BFS which is the best case in uninformed search). In this 8-puzzle problem, we need to misplace some tile to reach the final goal which makes the number of evaluation larger than Manhattan distance which matches our expectations.