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Solving the 8 puzzle

Objective By completing this Lab successfully, we will be able to carry out simple experiments to solve the 8 puzzle via A* algorithm as implemented in the Search sub-system of AIMA package.

Part 1 Examining the solution to 8 puzzle

Modify the AIMA package search subsystem. Obtain the results of solving the 8 puzzle via the A* algorithm when

- (Case 1) The heuristic function used is the Manhattan Distance function
- (Case 2) The heuristic function used is the zero function

A short video is available for Part 1.

In particular, do the following:

For each of the above cases, set the initial state be the pattern represented by the number 349528396. Use the given A* algorithm in the AIMA package to determine the sequence of steps to get to the goal state (represented by the number 247893796). Copy the results from the screen (text) in the space provided at the final section of this document.

Part 2 More on the 8 puzzle problem domain

Write a program via lisp or via your favorite programming language, to help translate the results you obtained in case 1 into a sequence of board transitions. For example, with respective to the one given in the comment: your program will take a number 247893796 and return, say, a list of numbers 1, 2, 3, 8, 0, 4, 7, 6, 5 that represent the problem instance:

```
1 2 3
8 . 4 (*)
7 6 5
```

Use the program developed, print the sequence of steps obtained in case 1 in the space provided at the final section of this document. For each step, you need to show the problem instance as in (*), following the convention set (see line 17-29 in the associated pdf file).

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Answers

Part 1

Case 1

> (SOLVE (MAKE-8-PUZZLE-PROBLEM))

Action	State
	349528396
>	345276868
>	39166852
^	297092884
^	297505660
<	297505876
V	297492772
<	297521932
V	296991220
>	262978996
^	286861036
>	286493620
V	28567588
<	219886348
^	253321204
>	253006276
^	253183180
<	253183324
<	253183356
V	253182628
V	248936932
>	219176236
^	247834684
^	247860892
>	247860748
V	247683844
<	247893796

Total of 1431 nodes expanded.

Solved	Cost	Length	Nodes	Algorithm
2	26.0	26.0	1431.0	A*-SEARCH

Case 2

> (SOLVE (MAKE-8-PUZZLE-PROBLEM))

Action	State
	349528396
^	352181956
>	352170292
>	351855364
^	352268140
<	352268356
<	352268388
V	352266932
V	349613372
>	345361844
>	39251828
^	340165532
<	340480460
<	340509620
V	339978908
>	305966684
>	38120420
^	296046452
<	296308892
^	296335100
<	296335116
V	296334388
V	292088692
>	262327996
>	32745484
^	247683844
<	247893796

Total of 165391 nodes expanded.

Solved	Cost	Length	Nodes	Algorithm
2	26.0	26.0	165391.0	A*-SEARCH

Part 2

1. Copy and paste the source code of the program you use to answer this question.
2. Copy and paste the output you obtained. That is, the sequence of steps obtained in case 1 here.

Source Code

```
#include <stdio.h>

int main()
{
   int i,m,n;
printf("\nEnter value of m:\t");
          scanf("%d",&m);

   for(i=0;i<9;i++)
   {
      n=m%9;
      if(n!=0)
      {
      printf(" %d\n",n);
      }
      else
      {
         printf(" *\n");
      }
      m=(m-n)/9;
   }
   return 0;
}
```

Output:

```
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       349528396
 4 3 7 5 2 6 * 1 8
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       345276868
 4 3 7 5 2 6 1 * 8
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       39166852
```

```
 4 3 7 5 2 6 1 8 *
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       297092884
 4 3 7 5 2 * 1 8 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       297505660
 4 3 * 5 2 7 1 8 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       297505876
 4 * 3 5 2 7 1 8 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       297492772
 4 2 3 5 * 7 1 8 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       297521932
 4 2 3 * 5 7 1 8 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       296991220
 4 2 3 1 5 7 * 8 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       262978996
 4 2 3 1 5 7 8 * 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       286861036
 4 2 3 1 * 7 8 5 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       286493620
 4 2 3 1 7 * 8 5 6
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       28567588
 4 2 3 1 7 6 8 5 *
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       219886348
 4 2 3 1 7 6 8 * 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       253321204
 4 2 3 1 * 6 8 7 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m:       253006276
 4 2 3 1 6 * 8 7 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
```

Enter value of m: 253183180
4 2 * 1 6 3 8 7 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 253183324
4 * 2 1 6 3 8 7 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 253183356
* 4 2 1 6 3 8 7 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 253182628
1 4 2 * 6 3 8 7 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 248936932
1 4 2 8 6 3 * 7 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 219176236
1 4 2 8 6 3 7 * 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 247834684
1 4 2 8 * 3 7 6 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 247860892
1 * 2 8 4 3 7 6 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 247860748
1 2 * 8 4 3 7 6 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 247683844
1 2 3 8 4 * 7 6 5
vinu@vini:~/Documens/AI667/LAB5$ ./a.out
Enter value of m: 247893796
1 2 3 8 * 4 7 6 5