**Cp468 Assignment One**

Group 13-Aoligei

2020-10-18

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# -\*- coding: utf-8 -\*-

import copy

import random

random.seed(1000)

max\_step = 2000

class Node:

def \_\_init\_\_(self, puzz, fvalue, gvalue, hvalue, parentnode):

self.puzz = puzz

self.gvalue = gvalue

self.fvalue = fvalue

self.hvalue = hvalue

self.parentnode = parentnode

def move(self, x1, y1, x2, y2, board):

copyboard = copy.deepcopy(board)

temp = copyboard[x1][y1]

if x2 >= 0 and x2 < len(board) and y2 >= 0 and y2 < len(board):

copyboard[x1][y1] = copyboard[x2][y2]

copyboard[x2][y2] = temp

return copyboard

else:

return -1

def search(x, puzzle):

for i in range(len(puzzle)):

for j in range(len(puzzle[i])):

if puzzle[i][j] == x:

return [i, j]

print(f"error ,not exist {x}")

return -1

def extend(node, goal,ls\_open\_node,heuristic\_func):

x, y = search("\_", node.puzz)

trylist = [[x - 1, y], [x + 1, y], [x, y + 1], [x, y - 1]] # try possible movement with order up down left right

for i in trylist:

resultboard = node.move(x, y, i[0], i[1], node.puzz)

if resultboard != -1:

newnode = Node(resultboard, 0, node.gvalue + 1, 0, node)

newnode.hvalue = heuristic\_func(newnode.puzz, goal)

newnode.fvalue = newnode.hvalue + newnode.gvalue

ls\_open\_node.append(newnode)

def heuristic\_1(startboard, goalboard):

"""

Counts the number of misplaced tiles

"""

misplaced = 0

for i in range(len(startboard)):

for j in range(len(startboard[i])):

if startboard[i][j] != "\_" and startboard[i][j] != goalboard[i][j]:

misplaced += 1

return misplaced

def heuristic\_2(startboard, goalboard):

totaldistance = 0

for i in range(0, len(startboard)):

for j in range(0, len(startboard)):

if startboard[i][j] != "\_":

totaldistance += abs(search(startboard[i][j], startboard)[0] - search(startboard[i][j], goalboard)[0])

totaldistance += abs(search(startboard[i][j], startboard)[1] - search(startboard[i][j], goalboard)[1])

return totaldistance

def heuristic\_3(startboard, goalboard):

totaldistance = 0

for i in range(0, len(startboard)):

for j in range(0, len(startboard)):

if startboard[i][j] != "\_":

x1,y1 = search(startboard[i][j], startboard)

x2,y2 = search(startboard[i][j], goalboard)

totaldistance += pow(pow(x1-x2,2)+pow(y1-y2,2),0.5)

#totaldistance += abs(search(startboard[i][j], startboard)[0] - search(startboard[i][j], goalboard)[0])

#totaldistance += abs(search(startboard[i][j], startboard)[1] - search(startboard[i][j], goalboard)[1])

return totaldistance

def findmin(openlist, closednodelist):

minnode = Node(openlist[0].puzz, 800, 0, 0, None)

for i in openlist:

if i.fvalue < minnode.fvalue and i.puzz not in closednodelist:

minnode = i

return minnode

def print\_list(list1):

print("SUCCESS")

print("")

for i in list1:

for k in i:

line = ""

for j in range(0, len(k)):

if j == len(k) - 1:

line += str(k[j])

else:

line = line + str(k[j]) + " "

print(line)

print("")

def findnode(node, list1):

for i in list1:

if node.puzz == i:

return True

return False

def path(node):

pathlist = []

pathlist.insert(0, node.puzz)

while True:

if node.parentnode == None or node == None:

return pathlist

break

else:

pathlist.insert(0, node.parentnode.puzz)

node = node.parentnode

def generate\_random\_puzzle(puzzle\_size = 3):

"""

num:need generate puzzle number

puzzle\_size:puzzle size

"""

tiles = []

for i in range(1,puzzle\_size\*puzzle\_size):

tiles.append(str(i))

tiles.append("\_")

random.shuffle(tiles)

puzzle = []

for i in range(puzzle\_size):

row = []

for j in range(puzzle\_size):

row.append(tiles[puzzle\_size\*i+j])

puzzle.append(row)

return puzzle

def main(num = 1,puzzle\_size = 3):

if puzzle\_size == 3:

goal\_tmp = [['\_', '1', '2'], ['3', '4', '5'], ['6', '7', '8']]

print(f"Goal {goal\_tmp}")

print("Number of puzzle:",num)

print("{:<8}{:-^51} {:<10}{:<10}{:<10}{:<12}{:<12}{:<12}".format("Index","8-Puzzle","H1\_step","H2\_step","H3\_step","H1\_expend","H2\_expend","H3\_expend"))

if puzzle\_size == 4:

goal\_tmp = [['\_', '1', '2', '3'], ['4', '5', '6', '7'], ['8', '9', '10', '11'], ['12', '13', '14', '15']]

print(f"\nGoal {goal\_tmp}")

print("Number of puzzle:",num)

print("{:<8}{:-^93} {:<10}{:<10}{:<10}{:<12}{:<12}{:<12}".format("Index","15-Puzzle","H1\_step","H2\_step","H3\_step","H1\_expend","H2\_expend","H3\_expend"))

if puzzle\_size == 5:

goal\_tmp = [['\_', '1', '2', '3', '4'], ['5', '6', '7', '8', '9'], ['10', '11', '12', '13', '14'], ['15', '16', '17', '18', '19'], ['20', '21', '22', '23', '24']]

print(f"\nGoal {goal\_tmp}")

print("Number of puzzle:",num)

print("{:<8}{:-^149} {:<10}{:<10}{:<10}{:<12}{:<12}{:<12}".format("Index","24-Puzzle","H1\_step","H2\_step","H3\_step","H1\_expend","H2\_expend","H3\_expend"))

functions = [heuristic\_1,heuristic\_2,heuristic\_3]

for i in range(num):

start = generate\_random\_puzzle(puzzle\_size)

print("{:^5} {} ".format(i,start),end='')

expend\_list = []

for func in functions:

goal = copy.deepcopy(goal\_tmp)

ls\_open\_node = [] # not extendend node append this list as node

closednodelist = [] # extended node append this list

lensuccess = len(start[0])

for i in start:

if len(i) != lensuccess:

#print("FAILURE")

return

firstnode = Node(start, 0, 0, -1, None)

extend(firstnode, goal,ls\_open\_node,func)

closednodelist.append(firstnode)

while len(ls\_open\_node) > 0:

newwillextendchild = findmin(ls\_open\_node, closednodelist)

closednodelist.append(newwillextendchild.puzz)

ls\_open\_node.remove(newwillextendchild)

if len(closednodelist) >= max\_step:

break

if newwillextendchild.hvalue == 0:

break

else:

extend(newwillextendchild, goal,ls\_open\_node,func)

solutionlist = path(newwillextendchild)

print("{:^7} ".format(len(solutionlist)-1),end='')

expend\_list.append(len(closednodelist))

for i in range(len(expend\_list)):

print("{:^9} ".format(expend\_list[i]),end='')

print()

print("{:-^150}\n".format("End"))

if \_\_name\_\_ == "\_\_main\_\_":

main(100,3)

main(100,4)

main(100,5)

# main(1,3)

# main(1,4)

# main(1,5)

Goal [['\_', '1', '2'], ['3', '4', '5'], ['6', '7', '8']]

Number of puzzle: 100

Index ---------------------8-Puzzle---------------------- H1\_step H2\_step H3\_step H1\_expend H2\_expend H3\_expend

0 [['6', '8', '5'], ['\_', '1', '3'], ['4', '2', '7']] 12 13 10 2000 2000 2000

1 [['5', '7', '1'], ['8', '\_', '2'], ['6', '4', '3']] 11 11 14 2000 2000 2000

2 [['6', '3', '5'], ['7', '\_', '1'], ['2', '8', '4']] 18 18 18 1560 100 213

3 [['6', '8', '3'], ['2', '\_', '5'], ['7', '1', '4']] 18 18 18 1426 63 115

4 [['6', '4', '7'], ['8', '1', '3'], ['\_', '5', '2']] 12 22 22 2000 415 624

5 [['6', '3', '4'], ['2', '1', '7'], ['8', '\_', '5']] 12 23 23 2000 1339 1981

6 [['\_', '7', '1'], ['8', '5', '3'], ['2', '4', '6']] 12 16 15 2000 2000 2000

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Goal [['\_', '1', '2', '3'], ['4', '5', '6', '7'], ['8', '9', '10', '11'], ['12', '13', '14', '15']]

Number of puzzle: 100

Index ------------------------------------------15-Puzzle------------------------------------------ H1\_step H2\_step H3\_step H1\_expend H2\_expend H3\_expend

0 [['3', '13', '2', '15'], ['6', '8', '5', '4'], ['10', '11', '1', '14'], ['7', '12', '\_', '9']] 9 7 9 2000 2000 2000

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