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Факультет ПИиКТ

Системы искусственного интеллекта
Лабораторная работа №2
Вариант №7

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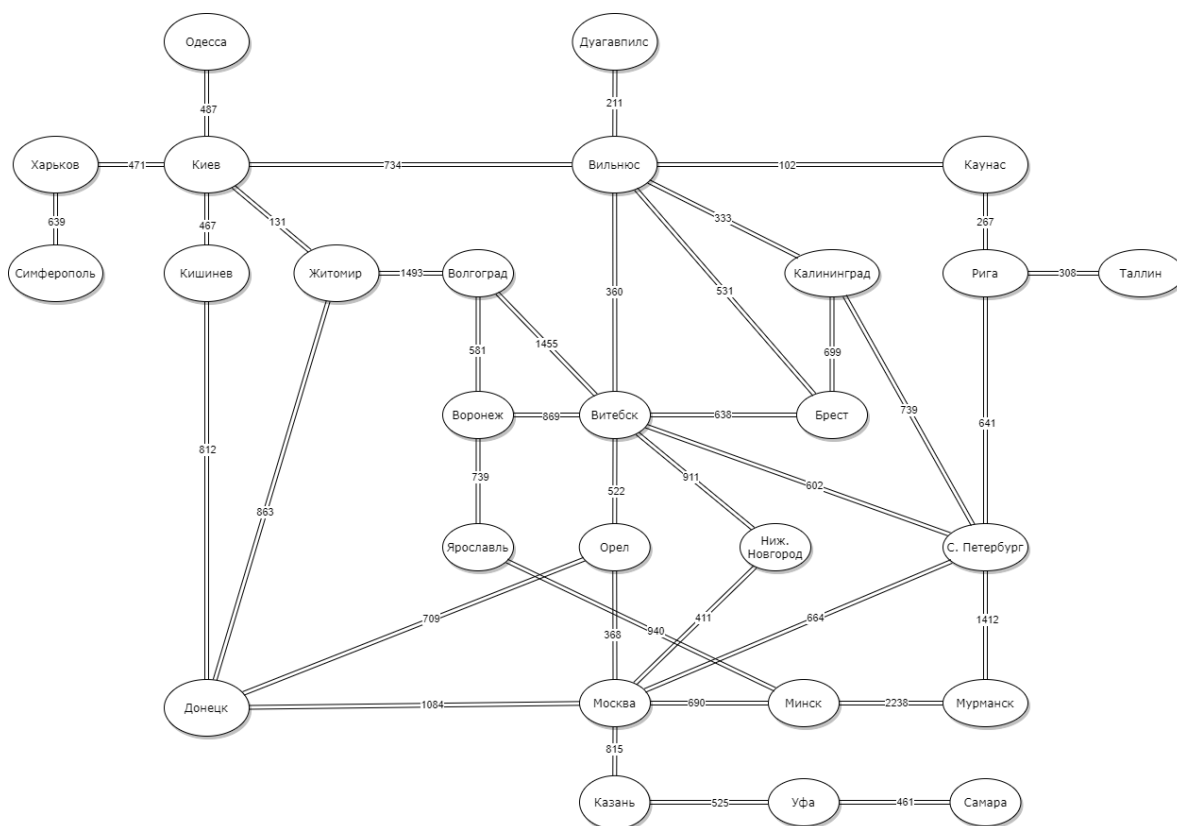
Исследование алгоритмов решения задач методом поиска.

Описание предметной области. Имеется транспортная сеть, связывающая города СНГ. Сеть представлена в виде таблицы связей между городами. Связи являются двусторонними, т. е. допускают движение в обоих направлениях.

Необходимо проложить маршрут из одной заданной точки в другую.

- 1) поиск в ширину;
- 2) поиск глубину;
- 3) поиск с ограничением глубины;
- 4) поиск с итеративным углублением;
- 5) двуправленный поиск.

- 1) жадный поиск по первому наилучшему соответствию;
- 2) затем, используя информацию о расстоянии до цели по прямой от каждого узла, выполнить поиск методом минимизации суммарной оценки A^* .



Код:

```
from data import *

def replace(a):
    if type(a) == str:
        return False
    return True

road_helper_dfs = {}
visit_dfs = {}

def DFS(start, end):
    for city in list_cities:
        visit_dfs[city] = False
    if not DFS_HELPER(start, end):
        return None
    current_city = end
    answer = list()
    answer.append(current_city)
    while current_city != start:
        current_city = road_helper_dfs[current_city]
        answer.append(current_city)
    answer.reverse()
    return answer

def DFS_HELPER(start, end):
    visit_dfs[start] = True
    for road_fr in roads[start]:
        road = list(road_fr)
        road.sort(key=replace)
        if visit_dfs[road[0]]:
            continue
        road_helper_dfs[road[0]] = start
        if road[0] == end:
            return True

        if DFS_HELPER(road[0], end):
            return True
    return False

road_helper_bfs = {}
visit_bfs = {}

def BFS(start, end):
    for city in list_cities:
        visit_bfs[city] = False

    if not BFS_HELPER(start, end):
        return None
    current_city = end
    answer = list()
    answer.append(current_city)
    while current_city != start:
        current_city = road_helper_bfs[current_city]
        answer.append(current_city)
    answer.reverse()
    return answer

def BFS_HELPER(start, end):
    queue = list()
    queue.append(start)
    visit_bfs[start] = True
```

```

while len(queue) != 0:
    current = queue[0]
    queue.pop(0)
    for road_fr in roads[current]:
        road = list(road_fr)
        road.sort(key=replace)
        if visit_bfs[road[0]]:
            continue
        road_helper_bfs[road[0]] = current
        if road[0] == end:
            return True
        visit_bfs[road[0]] = True
        queue.append(road[0])
    return False

road_helper_dls = {}

def DLS(start, end, max_depth):
    if not DLS_HELPER(start, end, 0, max_depth - 1, list()):
        return None
    current_city = end
    answer = list()
    answer.append(current_city)
    while current_city != start:
        current_city = road_helper_dls[current_city]
        answer.append(current_city)
    answer.reverse()
    return answer

def DLS_HELPER(start, end, depth, max_depth, visited_cities):
    if (depth >= max_depth):
        return False
    visited_cities.append(start)
    for road_fr in roads[start]:
        road = list(road_fr)
        road.sort(key=replace)
        if visited_cities.count(road[0]) != 0:
            continue
        road_helper_dls[road[0]] = start
        if road[0] == end:
            return True
        if DLS_HELPER(road[0], end, depth + 1, max_depth,
visited_cities.copy()):
            return True
    return False

def DFID(start, end):
    answer = None
    depth = 1
    while answer == None:
        answer = DLS(start, end, depth)
        depth += 1
    return answer

road_helper_ts = {}
visit_ts1 = {}
visit_ts2 = {}
queue1 = list()
queue2 = list()

def TwoSides(start, end):
    queue1.append(start)
    queue2.append(end)

```

```

for city in list_cities:
    visit_ts1[city] = False
    visit_ts2[city] = False

midPoint1 = None
midPoint2 = None
while midPoint1 == None:
    step1_res = TS_STEP_1()
    if (step1_res == False):
        return None
    if (step1_res != True):
        midPoint1, midPoint2 = step1_res
        continue
    step2_res = TS_STEP_2()
    if (step2_res == False):
        return None
    if (step2_res != True):
        midPoint1, midPoint2 = step2_res
        continue

ans1 = list()
ans2 = list()

curent1 = midPoint1
curent2 = midPoint2
ans1.append(curent1)
ans2.append(curent2)

while(curent1 != start):
    curent1 = road_helper_ts[curent1]
    ans1.append(curent1)
while (curent2 != end):
    curent2 = road_helper_ts[curent2]
    ans2.append(curent2)
ans1.reverse()
return ans1 + ans2

def TS_STEP_1():
    if (len(queue1) == 0):
        return False
    current = queue1[0]
    queue1.pop(0)
    for road_fr in roads[current]:
        road = list(road_fr)
        road.sort(key=replace)
        if visit_ts1[road[0]]:
            continue
        if visit_ts2[road[0]] == True:
            return current, road[0]
        road_helper_ts[road[0]] = current
        visit_ts1[road[0]] = True
        queue1.append(road[0])
    return True

def TS_STEP_2():
    if (len(queue2) == 0):
        return False
    current = queue2[0]
    queue2.pop(0)
    for road_fr in roads[current]:
        road = list(road_fr)
        road.sort(key=replace)
        if visit_ts2[road[0]]:
            continue

```

```

        if visit_ts1[road[0]] == True:
            return road[0], current
        road_helper_ts[road[0]] = current
        visit_ts2[road[0]] = True
        queue2.append(road[0])
    return True

road_helper_bcs = {}
visit_bcs = {}

def BCS(start, end):
    for city in list_cities:
        visit_bcs[city] = False

    if not BCS_HELPER(start, end):
        return None
    current_city = end
    answer = list()
    answer.append(current_city)
    while current_city != start:
        current_city = road_helper_bcs[current_city]
        answer.append(current_city)
    answer.reverse()
    return answer

def BCS_HELPER(start, end):
    queue = list()
    queue.append(start)
    visit_bcs[start] = True
    while len(queue) != 0:
        min_city = ''
        min_index = 0
        min_length = 1000000000000
        for ind in range(len(queue)):
            if (dist_to_odessa[queue[ind]] < min_length):
                min_length = dist_to_odessa[queue[ind]]
                min_city = queue[ind]
                min_index = ind
        current = min_city
        queue.pop(min_index)
        for road_fr in roads[current]:
            road = list(road_fr)
            road.sort(key=replace)
            if visit_bcs[road[0]]:
                continue
            road_helper_bcs[road[0]] = current
            if road[0] == end:
                return True
            visit_bcs[road[0]] = True
            queue.append(road[0])
    return False

road_helper_astar = {}
visit_astar = {}

def ASTAR(start, end):
    for city in list_cities:
        visit_astar[city] = False

    if not ASTAR_HELPER(start, end):
        return None
    current_city = end
    answer = list()
    answer.append(current_city)

```

```

while current_city != start:
    current_city = road_helper_astar[current_city]
    answer.append(current_city)
answer.reverse()
return answer

def ASTAR_HELPER(start, end):
    queue = list()
    queue_element = list()
    queue_element.append(start)
    queue_element.append(0)
    queue.append(queue_element)
    visit_astar[start] = True
    while len(queue) != 0:
        min_city = ''
        min_far = 0
        min_index = 0
        min_length = 1000000000000
        for ind in range(len(queue)):
            if (dist_to_odessa[queue[ind][0]] + queue[ind][1] < min_length):
                min_length = dist_to_odessa[queue[ind][0]] + queue[ind][1]
                min_far = queue[ind][1]
                min_city = queue[ind][0]
                min_index = ind
        current = min_city
        current_far = min_far
        queue.pop(min_index)
        for road_fr in roads[current]:
            road = list(road_fr)
            road.sort(key=replace)
            if visit_astar[road[0]]:
                continue
            road_helper_astar[road[0]] = current
            if road[0] == end:
                return True
            visit_astar[road[0]] = True
            queue_element = list()
            queue_element.append(road[0])
            queue_element.append(road[1] + current_far)
            queue.append(queue_element)
    return False

```

Результаты работы:

```

['Рига', 'С.Петербург', 'Мурманск', 'Минск', 'Москва', 'Орел', 'Витебск', 'Воронеж', 'Волгоград', 'Житомир', 'Киев', 'Одесса']
['Рига', 'Каунас', 'Вильнюс', 'Киев', 'Одесса']
['Рига', 'С.Петербург', 'Мурманск', 'Минск', 'Москва', 'Орел', 'Витебск', 'Вильнюс', 'Киев', 'Одесса']
['Рига', 'Каунас', 'Вильнюс', 'Киев', 'Одесса']
['Рига', 'Каунас', 'Вильнюс', 'Киев', 'Одесса']
['Рига', 'Каунас', 'Вильнюс', 'Киев', 'Одесса']
['Рига', 'Каунас', 'Вильнюс', 'Киев', 'Одесса']

```

Вывод:

При выполнении данной лабораторной работы были изучены и реализованы неинформированные и информированные методы поиска.