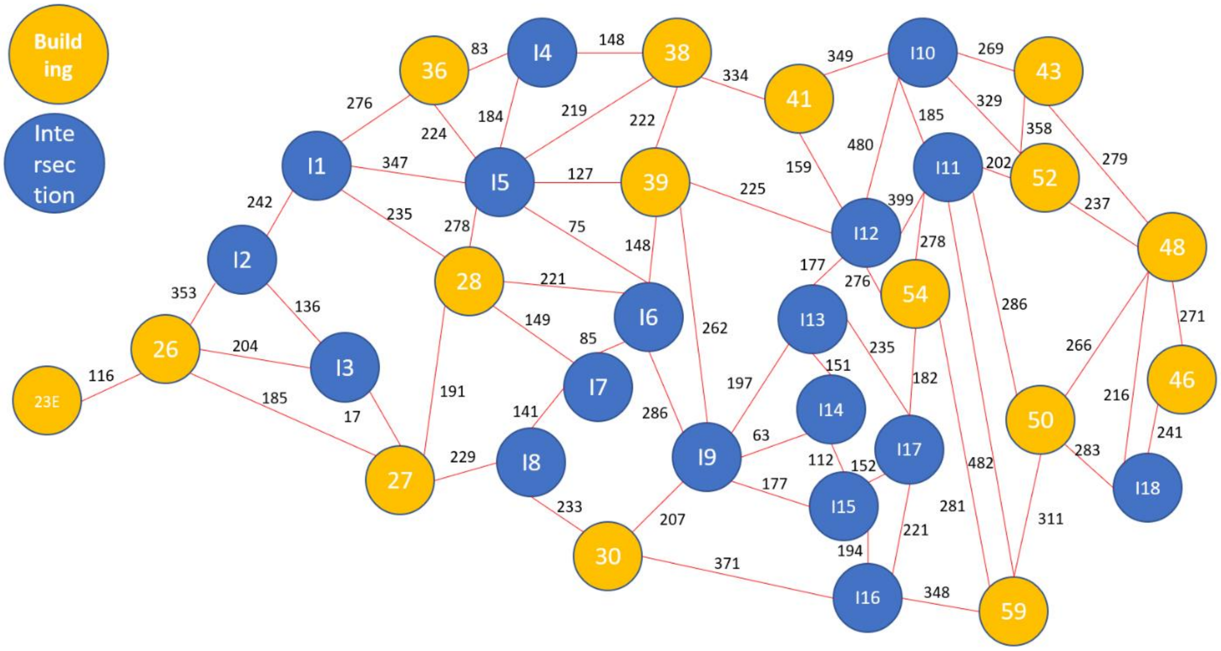
7205 HW5

Name: Xuebao Zhao   NUID: 002108354

Q1:

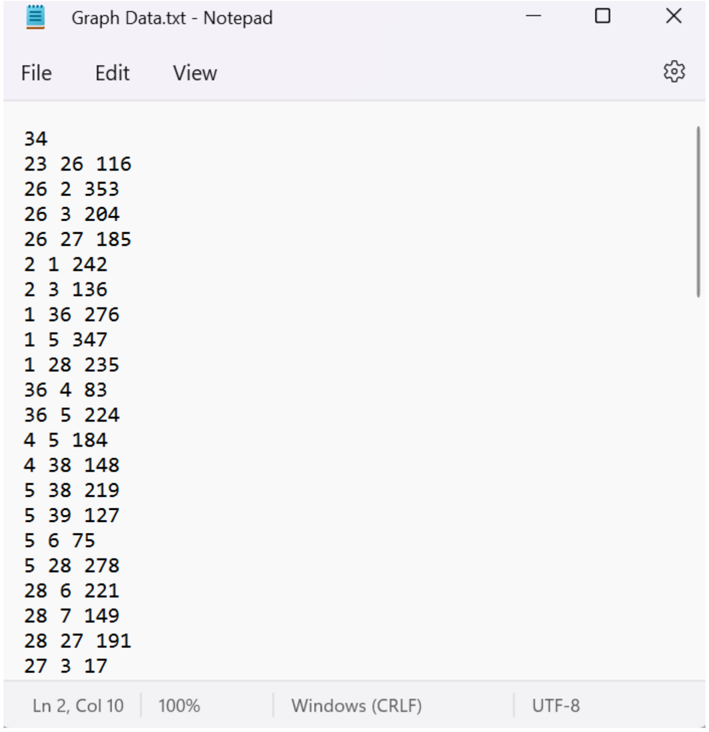
Undirected graph drawing

Select 16 buildings which makes the graph has four buildings from each one of the following numbering ranges:
20’s: 23, 26, 27, 28
30’s: 30, 36, 38, 39
40’s: 41, 43, 46, 48
50’s: 50, 52, 54, 59
Use yellow color to mark the buildings and blue color to mark the intersections. And the undirected graph is drawn as follows:



Create a text file

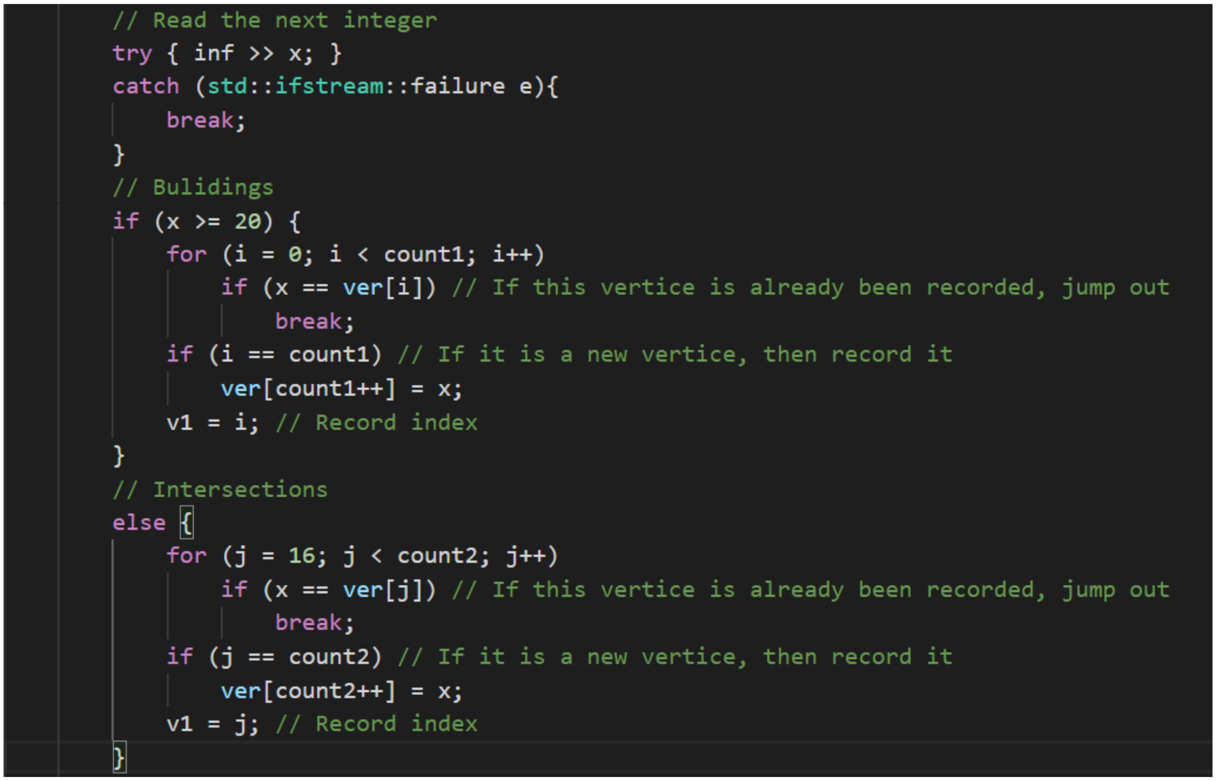
The text file includes the total number of vertices followed by the data of the graph edges. For each edge, provide its <vertex1> <vertex2> <distance>. Because the numbers of buildings are all greater than 20, I use the number under 20 to the intersections which making sure that they are different than the used building numbers. And the text file is as follows:



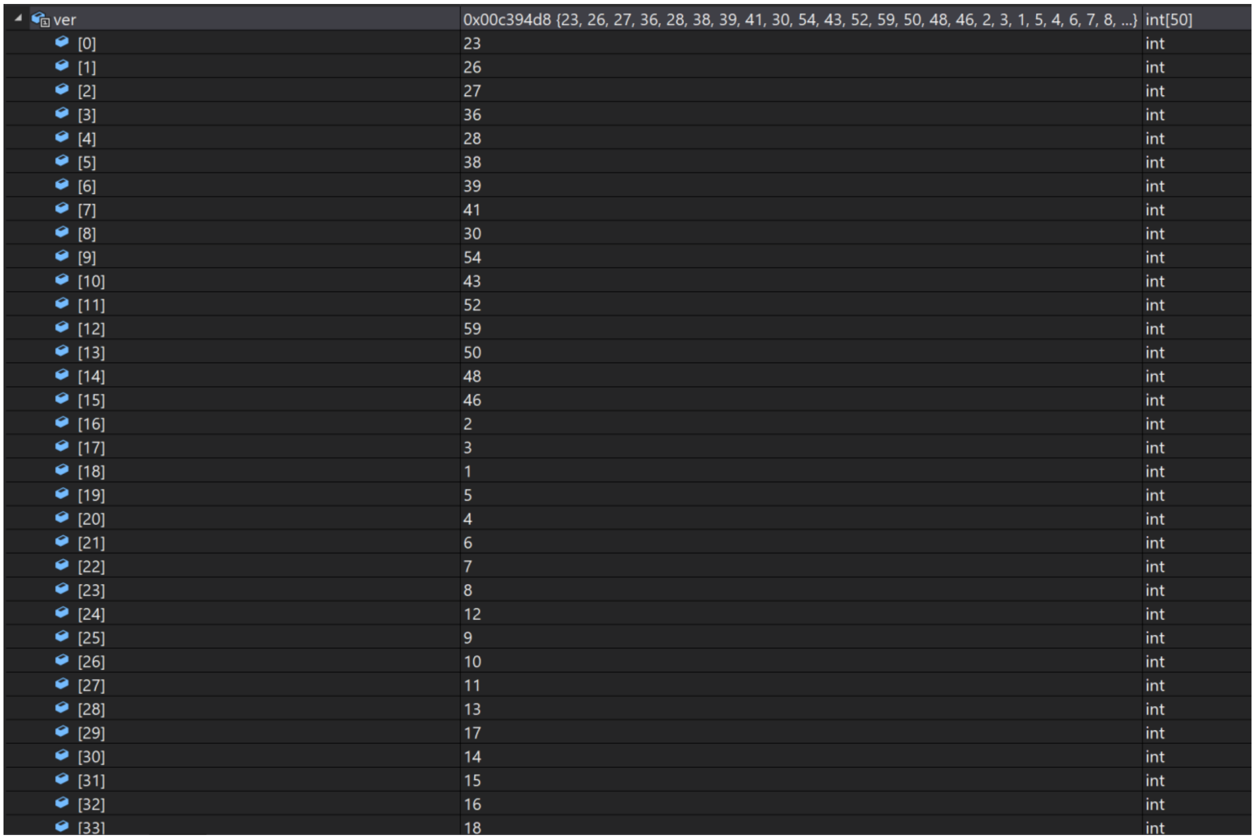
```
34
23 26 116
26 2 353
26 3 204
26 27 185
2 1 242
2 3 136
1 36 276
1 5 347
1 28 235
36 4 83
36 5 224
4 5 184
4 38 148
5 38 219
5 39 127
5 6 75
5 28 278
28 6 221
28 7 149
28 27 191
27 3 17
```

Store the vertices and edges

The program reads the '.txt' file and use an array to map the program indices to the user-friendly building and intersections numbers as stored in the text file. The first number in the file is the total number of the vertices. The remaining integers in groups of three represent an edge. When the program reads the first two integers in a group, first determines whether it is a building or an intersection. Then the program determines whether the vertex has been recorded in the array. If it is already in the array, record the index. Else store the numbers of buildings in the first fifteen positions of the array and store the numbers of intersections in the rest of the array. Then record the index.

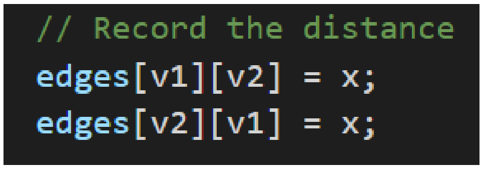


```cpp
// Read the next integer
try { inf >> x; }
catch (std::ifstream::failure e){
    break;
}
// Bulidings
if (x >= 20) {
    for (i = 0; i < count1; i++)
        if (x == ver[i]) // If this vertice is already been recorded, jump out
            break;
    if (i == count1) // If it is a new vertice, then record it
        ver[count1++] = x;
    v1 = i; // Record index
}
// Intersections
else {
    for (j = 16; j < count2; j++)
        if (x == ver[j]) // If this vertice is already been recorded, jump out
            break;
    if (j == count2) // If it is a new vertice, then record it
        ver[count2++] = x;
    v1 = j; // Record index
}
```



ver	0x00c394d8 {23, 26, 27, 36, 28, 38, 39, 41, 30, 54, 43, 52, 59, 50, 48, 46, 2, 3, 1, 5, 4, 6, 7, 8, ...}	int[50]
[0]	23	int
[1]	26	int
[2]	27	int
[3]	36	int
[4]	28	int
[5]	38	int
[6]	39	int
[7]	41	int
[8]	30	int
[9]	54	int
[10]	43	int
[11]	52	int
[12]	59	int
[13]	50	int
[14]	48	int
[15]	46	int
[16]	2	int
[17]	3	int
[18]	1	int
[19]	5	int
[20]	4	int
[21]	6	int
[22]	7	int
[23]	8	int
[24]	12	int
[25]	9	int
[26]	10	int
[27]	11	int
[28]	13	int
[29]	17	int
[30]	14	int
[31]	15	int
[32]	16	int
[33]	18	int

Store the edges in a two-dimensional array ‘edge’, such as ‘edge[i][j]’ represents distance from ‘vertice I’ to ‘vertice j’



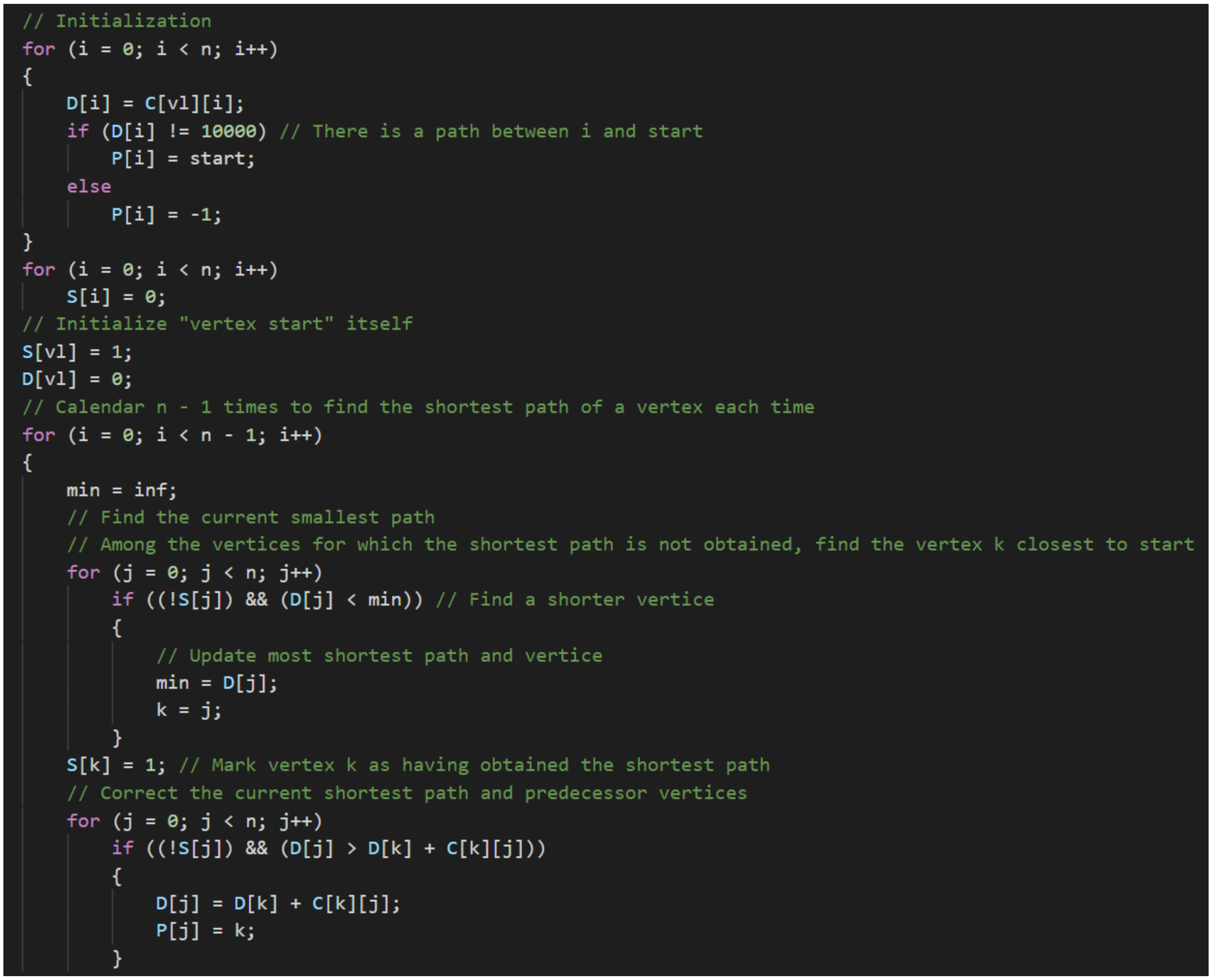
```
// Record the distance
edges[v1][v2] = x;
edges[v2][v1] = x;
```

Dijkstra

When calculating the shortest path in the graph by Dijkstra, the starting point ‘start’ needs to be specified.

Furthermore, three arrays P, S, and D are introduced. The role of P is to record the vertices for which the shortest path has been found (and the corresponding shortest path length), while S is to record the vertices for which the shortest path has not been found. And D is to record the distance from the vertex to the starting point).

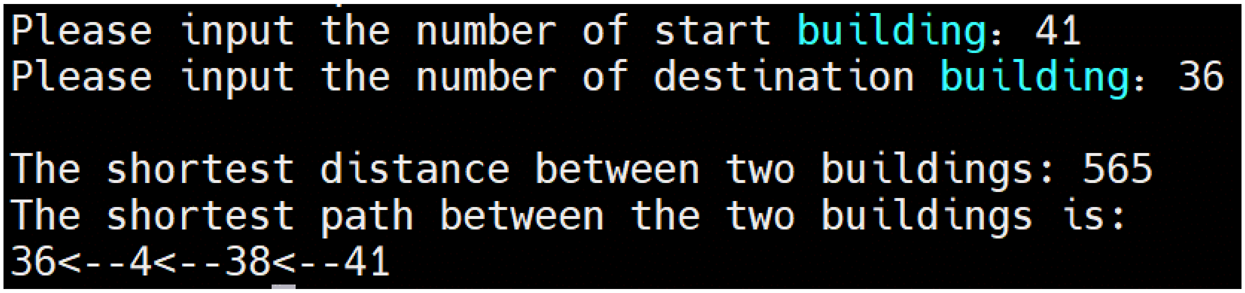
Initially, there is only the starting point ‘start’ in P; there are vertices other than ‘start’ in S, and the path of the vertices in D is "the path from the starting point s to this vertex". Then, find the vertex with the shortest path from S and add it to P; then, update the vertex in S and the path corresponding to the vertex. Then, find the vertex with the shortest path from S and add it to P; then, update the vertex in S and the path corresponding to the vertex. ... repeat this operation until all vertices have been traversed.



```
// Initialization
for (i = 0; i < n; i++)
{
    D[i] = C[vl][i];
    if (D[i] != 10000) // There is a path between i and start
        P[i] = start;
    else
        P[i] = -1;
}
for (i = 0; i < n; i++)
    S[i] = 0;
// Initialize "vertex start" itself
S[vl] = 1;
D[vl] = 0;
// Calendar n - 1 times to find the shortest path of a vertex each time
for (i = 0; i < n - 1; i++)
{
    min = inf;
    // Find the current smallest path
    // Among the vertices for which the shortest path is not obtained, find the vertex k closest to start
    for (j = 0; j < n; j++)
        if ((!S[j]) && (D[j] < min)) // Find a shorter vertice
        {
            // Update most shortest path and vertice
            min = D[j];
            k = j;
        }
    S[k] = 1; // Mark vertex k as having obtained the shortest path
    // Correct the current shortest path and predecessor vertices
    for (j = 0; j < n; j++)
        if ((!S[j]) && (D[j] > D[k] + C[k][j]))
        {
            D[j] = D[k] + C[k][j];
            P[j] = k;
        }
```

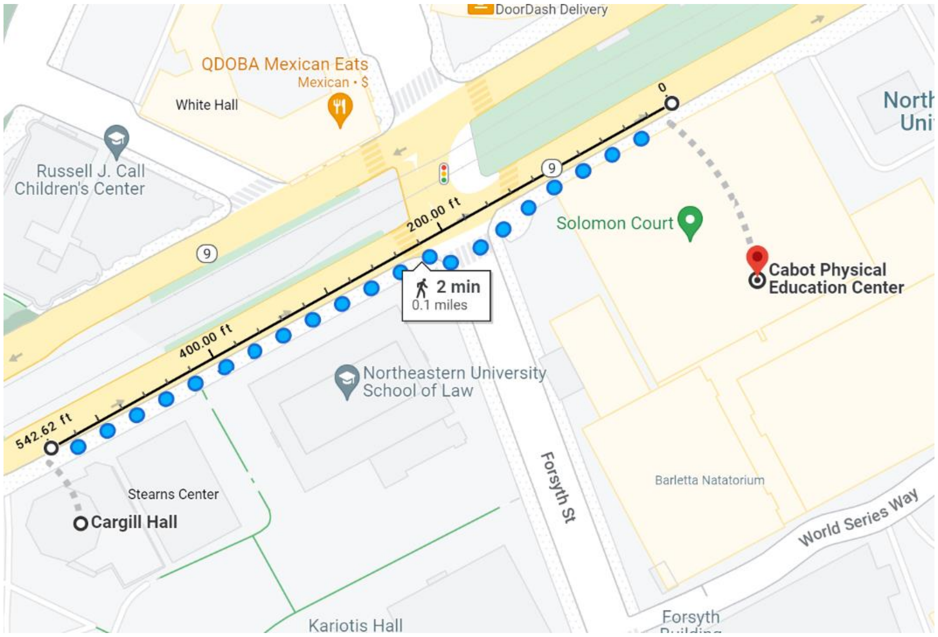
Result

Case1: 41 -> 36



```
Please input the number of start building: 41
Please input the number of destination building: 36

The shortest distance between two buildings: 565
The shortest path between the two buildings is:
36<--4<--38<--41
```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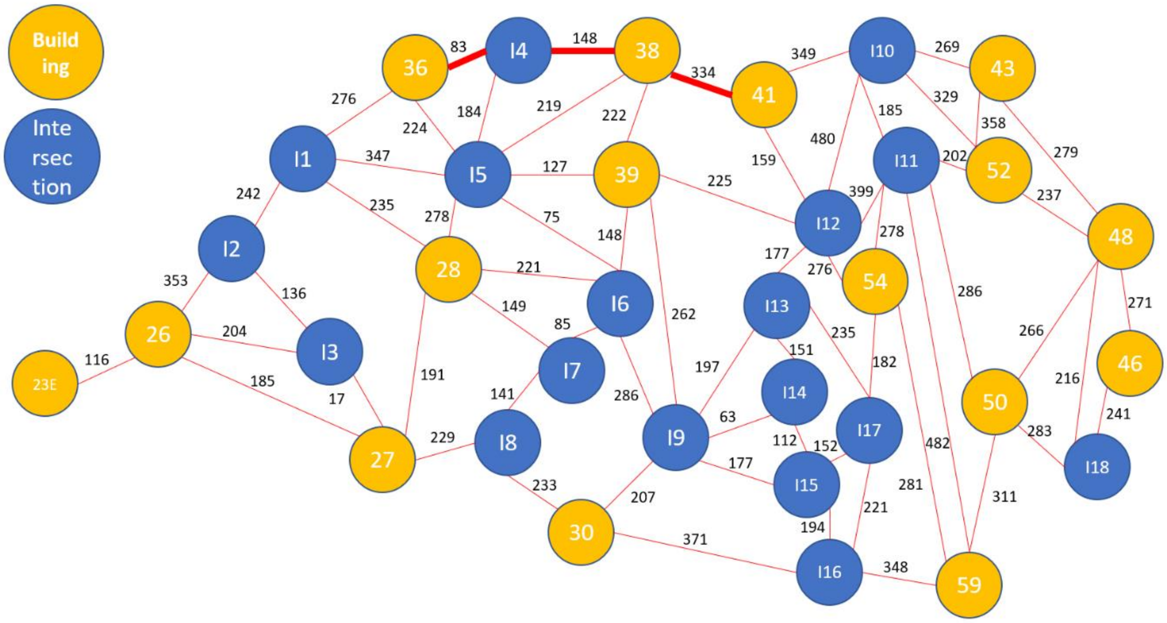
School of Law
Stearns Center
Cargill Hall
Forsyth St
Barletta Natatorium
World Series Way
Kariotis Hall
Forsyth
Building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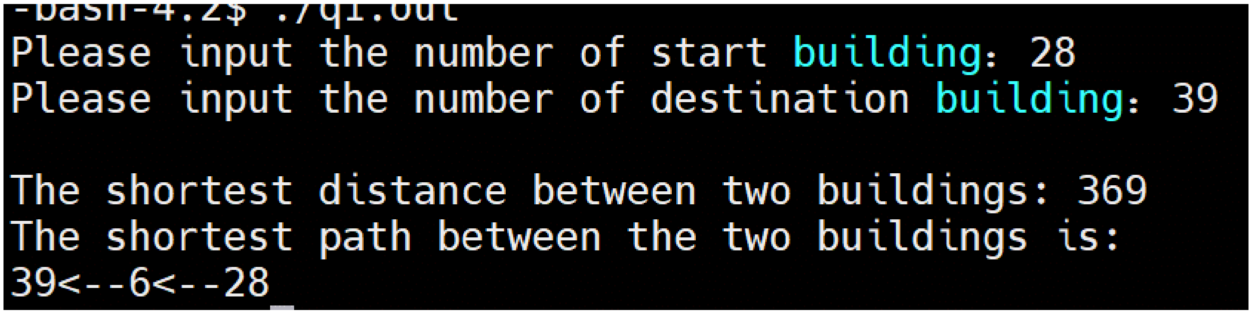
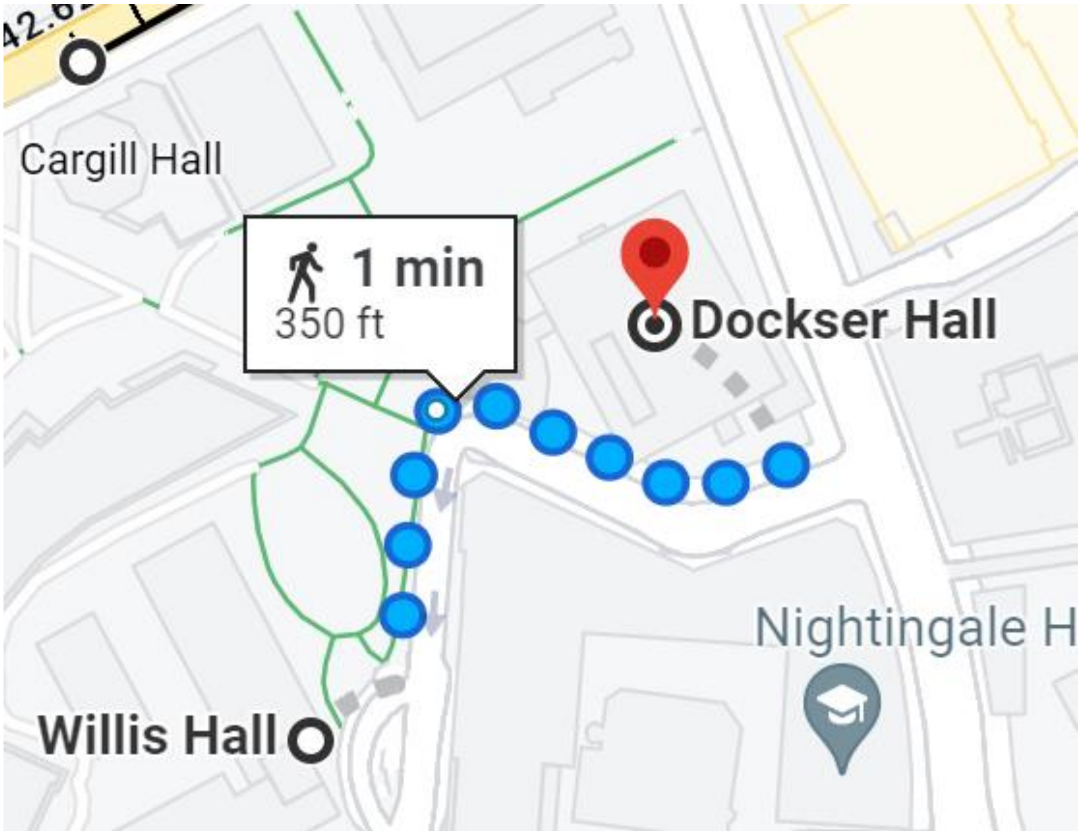
348

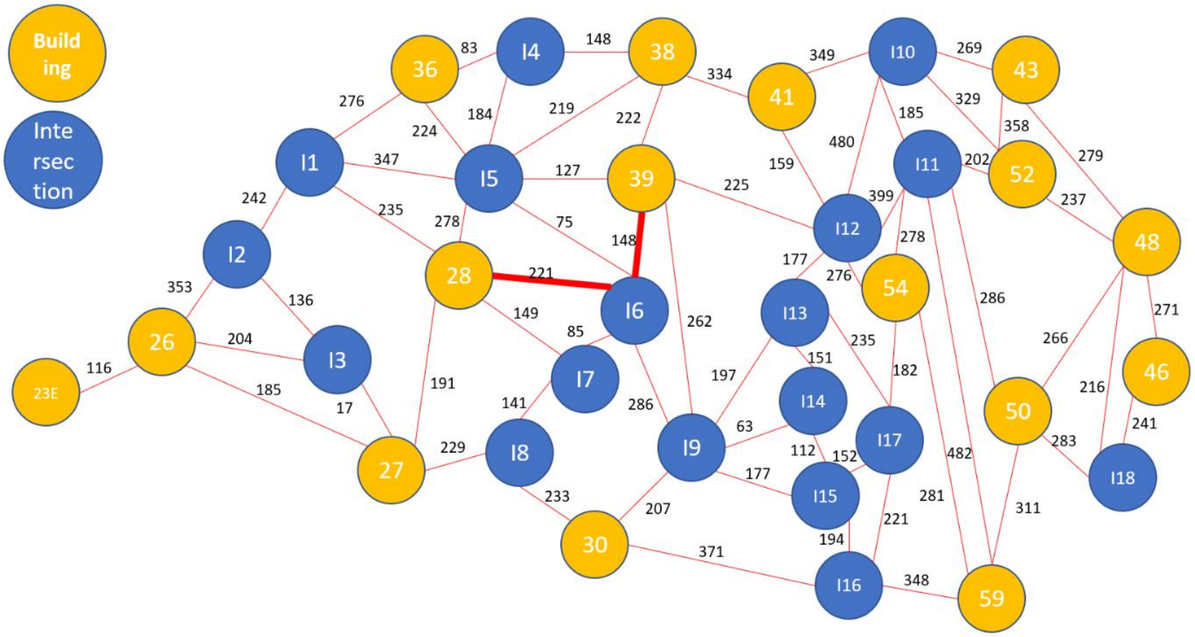
Case2: 28 -> 39



```
-bash-4.2$ ./q1.out
Please input the number of start building: 28
Please input the number of destination building: 39

The shortest distance between two buildings: 369
The shortest path between the two buildings is:
39<--6<--28
```




Building
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