Projeto 2: identificação das rotas de menor custo em uma cidade.

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Introdução:

O projeto tem como objetivo determinar a menor distancia e tempo de uma cidade representada por um grafo de um ponto para o outro. Para execução foi criada uma matriz IJ onde a coordenada guarda os valores de tempo e distancia da linha I para a coluna J e para calcular a menor distancia e tempo foi utilizado o algoritmo de Floyd-Wharshall para poder trabalhar com várias distancias ao mesmo tempo. As linhas e colunas representam as esquinas (vértices) da cidade. O código foi divido em três partes: Descritor.h, Floyd.c e Programa.c.

Descritor.h

A parte inicial do código e a mais simples. Declara o typedef struct Rua para armazenar os valores int tempo e int distancia que serão utilizados na matriz.

Floyd.c

Contém o algoritmo de Floyd-Wharshall para calcular a menor distancia e tempo e recebe como parâmetros uma matriz bidimensional e o numero de vértices. A primeira parte do código é criar uma matriz tridimensional KIJ e é alocada conforme o numero de vértices, ou seja, é um conjunto de matrizes bidimensionais do tamanho do numero de vértices. A primeira matriz desse conjunto é criada em base da original com a aplicação do algoritmo de Floyd-Wharshall. Com a primeira criada, o processo se repete com as demais e por fim a matriz original é atualizada com a última matriz gerada pelo algoritmo.

Programa.c

Possui a função principal que executa o programa. Inicialmente cria uma matriz do tipo Rua alocada conforme o numero de esquinas recebidas e é inicializada com o tempo e distancia igual a 1000 (infinito). Em seguida recebe a esquina inicial, a esquina final e o numero de ruas. Com base do numero de ruas são feitas linhas de leitura para receber a esquinas e formam a rua e o tempo e distancia entre elas. Por fim imprime a matriz do grafo gerado e as matrizes do algoritmo de Floyd-Wharshall, no final mostra o menor tempo e distancia total em base da ultima matriz gerada.

Grafos:
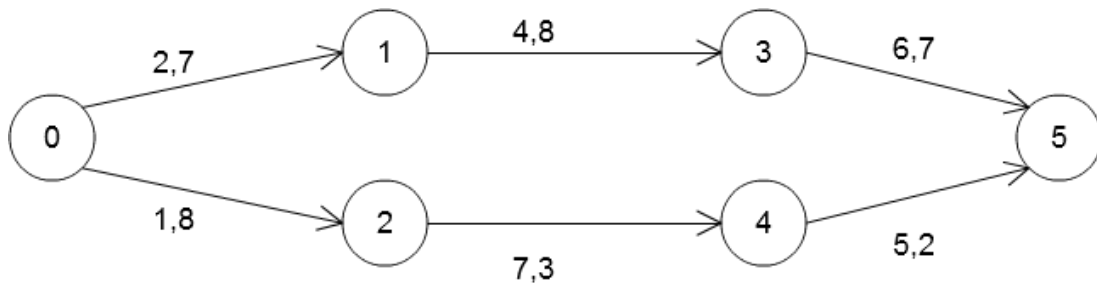

```
Matriz original:
0: [0,0]     [2,7]      [1,8]      [1000,1000] [1000,1000] [1000,1000]
1: [1000,1000] [0,0]      [1000,1000] [1000,1000] [4,8]      [1000,1000] [1000,1000]
2: [1000,1000] [1000,1000] [0,0]      [1000,1000] [7,3]      [1000,1000]
3: [1000,1000] [1000,1000] [1000,1000] [0,0]      [1000,1000] [6,7]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]      [5,2]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]


Matrizes com floyd:
0: [0,0]     [2,7]      [1,8]      [6,15]     [1000,1000] [1000,1000]
1: [1000,1000] [0,0]      [1000,1000] [4,8]      [1000,1000] [1000,1000]
2: [1000,1000] [1000,1000] [0,0]      [1000,1000] [7,3]      [1000,1000]
3: [1000,1000] [1000,1000] [1000,1000] [0,0]      [1000,1000] [6,7]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]      [5,2]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

0: [0,0]     [2,7]      [1,8]      [6,15]     [8,11]     [1000,1000]
1: [1000,1000] [0,0]      [1000,1000] [4,8]      [1000,1000] [1000,1000]
2: [1000,1000] [1000,1000] [0,0]      [1000,1000] [7,3]      [1000,1000]
3: [1000,1000] [1000,1000] [1000,1000] [0,0]      [1000,1000] [6,7]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]      [5,2]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

0: [0,0]     [2,7]      [1,8]      [6,15]     [8,11]     [12,22]
1: [1000,1000] [0,0]      [1000,1000] [4,8]      [1000,1000] [10,15]
2: [1000,1000] [1000,1000] [0,0]      [1000,1000] [7,3]      [1000,1000]
3: [1000,1000] [1000,1000] [1000,1000] [0,0]      [1000,1000] [6,7]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]      [5,2]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

0: [0,0]     [2,7]      [1,8]      [6,15]     [8,11]     [12,13]
1: [1000,1000] [0,0]      [1000,1000] [4,8]      [1000,1000] [10,15]
2: [1000,1000] [1000,1000] [0,0]      [1000,1000] [7,3]      [12,5]
3: [1000,1000] [1000,1000] [1000,1000] [0,0]      [1000,1000] [6,7]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]      [5,2]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

0: [0,0]     [2,7]      [1,8]      [6,15]     [8,11]     [12,13]
1: [1000,1000] [0,0]      [1000,1000] [4,8]      [1000,1000] [10,15]
2: [1000,1000] [1000,1000] [0,0]      [1000,1000] [7,3]      [12,5]
3: [1000,1000] [1000,1000] [1000,1000] [0,0]      [1000,1000] [6,7]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]      [5,2]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]


Menor distancia total de 0 a 5: 12
Menor tempo total de 0 a 5: 13

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Process exited after 63.14 seconds with return value 0
Pressione qualquer tecla para continuar. . .
```
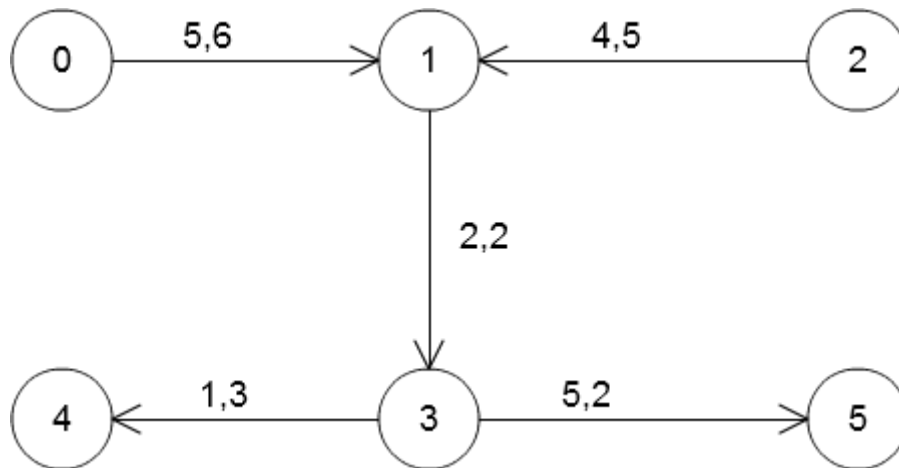
```
Matriz original:
 0: [0,0] [5,6] [1000,1000] [1000,1000] [1000,1000] [1000,1000]
 1: [1000,1000] [0,0] [1000,1000] [2,2] [1000,1000] [1000,1000]
 2: [1000,1000] [4,5] [0,0] [1000,1000] [1000,1000] [1000,1000]
 3: [1000,1000] [1000,1000] [1000,1000] [0,0] [1,3] [5,2]
 4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [1000,1000]
 5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]


Matrizes com floyd:
 0: [0,0] [5,6] [1000,1000] [7,8] [1000,1000] [1000,1000]
 1: [1000,1000] [0,0] [1000,1000] [2,2] [1000,1000] [1000,1000]
 2: [1000,1000] [4,5] [0,0] [6,7] [1000,1000] [1000,1000]
 3: [1000,1000] [1000,1000] [1000,1000] [0,0] [1,3] [5,2]
 4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [1000,1000]
 5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

 0: [0,0] [5,6] [1000,1000] [7,8] [1000,1000] [1000,1000]
 1: [1000,1000] [0,0] [1000,1000] [2,2] [1000,1000] [1000,1000]
 2: [1000,1000] [4,5] [0,0] [6,7] [1000,1000] [1000,1000]
 3: [1000,1000] [1000,1000] [1000,1000] [0,0] [1,3] [5,2]
 4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [1000,1000]
 5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

 0: [0,0] [5,6] [1000,1000] [7,8] [8,11] [12,10]
 1: [1000,1000] [0,0] [1000,1000] [2,2] [3,5] [7,4]
 2: [1000,1000] [4,5] [0,0] [6,7] [7,10] [11,9]
 3: [1000,1000] [1000,1000] [1000,1000] [0,0] [1,3] [5,2]
 4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [1000,1000]
 5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

 0: [0,0] [5,6] [1000,1000] [7,8] [8,11] [12,10]
 1: [1000,1000] [0,0] [1000,1000] [2,2] [3,5] [7,4]
 2: [1000,1000] [4,5] [0,0] [6,7] [7,10] [11,9]
 3: [1000,1000] [1000,1000] [1000,1000] [0,0] [1,3] [5,2]
 4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [1000,1000]
 5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

 0: [0,0] [5,6] [1000,1000] [7,8] [8,11] [12,10]
 1: [1000,1000] [0,0] [1000,1000] [2,2] [3,5] [7,4]
 2: [1000,1000] [4,5] [0,0] [6,7] [7,10] [11,9]
 3: [1000,1000] [1000,1000] [1000,1000] [0,0] [1,3] [5,2]
 4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [1000,1000]
 5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]


Menor distancia total de 0 a 5: 12
Menor tempo total de 0 a 5: 10
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Process exited after 83.87 seconds with return value 0
Pressione qualquer tecla para continuar. . . _
```
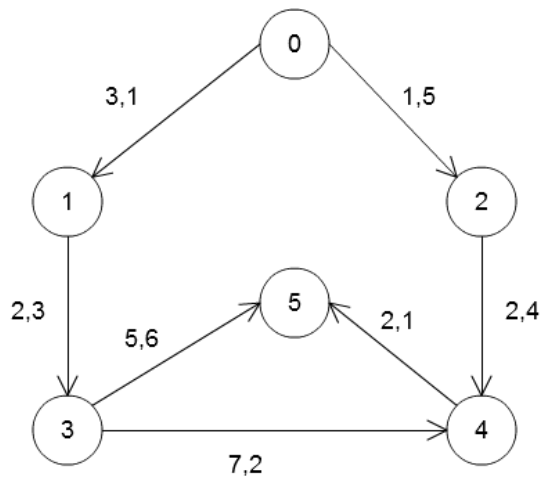
```
Matriz original:
0: [0,0] [3,1] [1,5] [1000,1000] [1000,1000] [1000,1000]
1: [1000,1000] [0,0] [1000,1000] [2,3] [1000,1000] [1000,1000]
2: [1000,1000] [1000,1000] [0,0] [1000,1000] [2,4] [1000,1000]
3: [1000,1000] [1000,1000] [1000,1000] [0,0] [7,2] [5,6]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [2,1]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]


Matrizes com floyd:
0: [0,0] [3,1] [1,5] [5,4] [1000,1000] [1000,1000]
1: [1000,1000] [0,0] [1000,1000] [2,3] [1000,1000] [1000,1000]
2: [1000,1000] [1000,1000] [0,0] [1000,1000] [2,4] [1000,1000]
3: [1000,1000] [1000,1000] [1000,1000] [0,0] [7,2] [5,6]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [2,1]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

0: [0,0] [3,1] [1,5] [5,4] [3,9] [1000,1000]
1: [1000,1000] [0,0] [1000,1000] [2,3] [1000,1000] [1000,1000]
2: [1000,1000] [1000,1000] [0,0] [1000,1000] [2,4] [1000,1000]
3: [1000,1000] [1000,1000] [1000,1000] [0,0] [7,2] [5,6]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [2,1]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

0: [0,0] [3,1] [1,5] [5,4] [3,6] [10,10]
1: [1000,1000] [0,0] [1000,1000] [2,3] [9,5] [7,9]
2: [1000,1000] [1000,1000] [0,0] [1000,1000] [2,4] [1000,1000]
3: [1000,1000] [1000,1000] [1000,1000] [0,0] [7,2] [5,6]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [2,1]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

0: [0,0] [3,1] [1,5] [5,4] [3,6] [5,7]
1: [1000,1000] [0,0] [1000,1000] [2,3] [9,5] [7,6]
2: [1000,1000] [1000,1000] [0,0] [1000,1000] [2,4] [4,5]
3: [1000,1000] [1000,1000] [1000,1000] [0,0] [7,2] [5,3]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [2,1]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]

0: [0,0] [3,1] [1,5] [5,4] [3,6] [5,7]
1: [1000,1000] [0,0] [1000,1000] [2,3] [9,5] [7,6]
2: [1000,1000] [1000,1000] [0,0] [1000,1000] [2,4] [4,5]
3: [1000,1000] [1000,1000] [1000,1000] [0,0] [7,2] [5,3]
4: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0] [2,1]
5: [1000,1000] [1000,1000] [1000,1000] [1000,1000] [1000,1000] [0,0]


Menor distancia total de 0 a 5: 5
Menor tempo total de 0 a 5: 7
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Process exited after 86.52 seconds with return value 0
Pressione qualquer tecla para continuar. . .
```