Projeto 2:
Identificação das rotas de menor custo em uma cidade

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Projeto:

- Descritor.h
- Floyd.c
- Programa.c

Descritor.h

```
#include <stdio.h>
#include <stdlib.h>

//Struct para armazenar os valores de distancia e tempo de cada rua
typedef struct{
        int distancia;
        int tempo;
}Rua;
```

Floyd.c

```
#include <stdio.h>
#include <stdlib.h>
#include "Descritor.h“

void floyd(Rua **matriz, int tamanho){
        int k, i, j; //Contadores
        Rua ***novamatriz;
}
```

Floyd.c

- A matriz novamatriz é alocada em 3 níveis [k][i][j] do tamanho do int tamanho
- A novamatriz[0][i][j] é criada em base da matriz original, aplicando a condição:

  D[k-1][i][j] < D[k-1][i][k] + D[k-1][k][j]

- Com a primeira matriz criada o mesmo processo acontece com as outras matrizes até chegarmos a n matrizes, sendo n = int tamanho.
- A matriz original é atualizada com a ultima matriz criada.

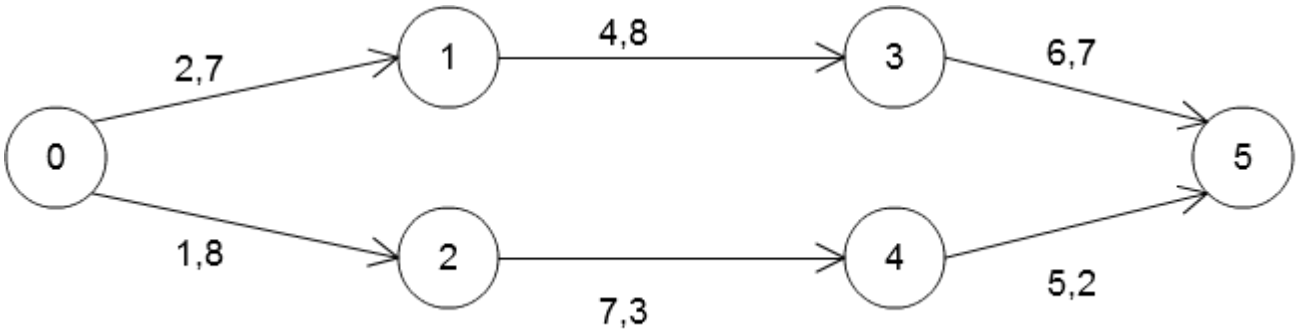
Programa.c

```
#include <stdio.h>
#include <stdlib.h>
#include "Floyd.c"

int main() {
   int i, j; // contadores
   int ne; // n de esquinas (vertices)
   int nr; //n de ruas (arestas)
   Rua **r; // matriz do grafo de ruas
   int u, v; // coordenadas
   int ei, ef; //esquina inicial e esquina final
}
```

Programa.c

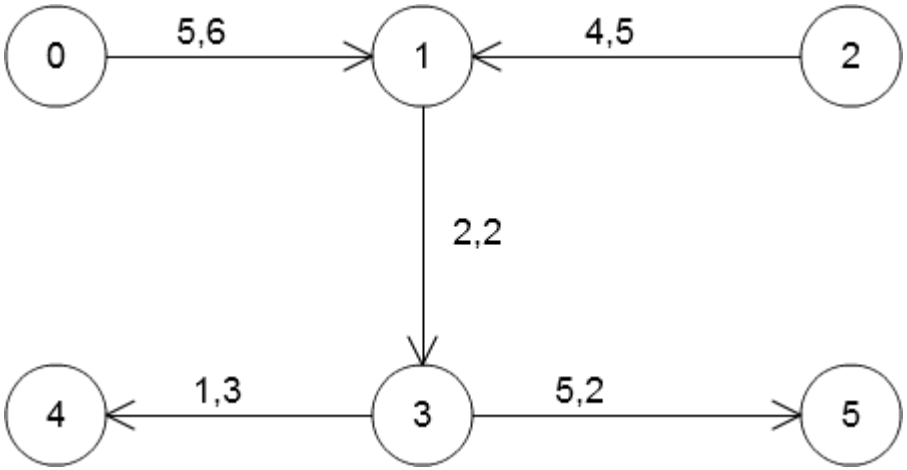
- É obtido o numero de esquinas para fazer a alocação da matriz r
- Com a alocação feita, a matriz r é iniciada com tempo e distancia infinito (1000)
- Em seguida é lido o ponto de origem e destino e o numero de ruas. Conforme o numero de ruas é feito n leituras para obter as equinas que foram a rua e seu tempo e distancia
- Por fim é imprimido a matriz original e a matriz com o floyd aplicado, mostrando o menor tempo e distancia total.

Grafo 1



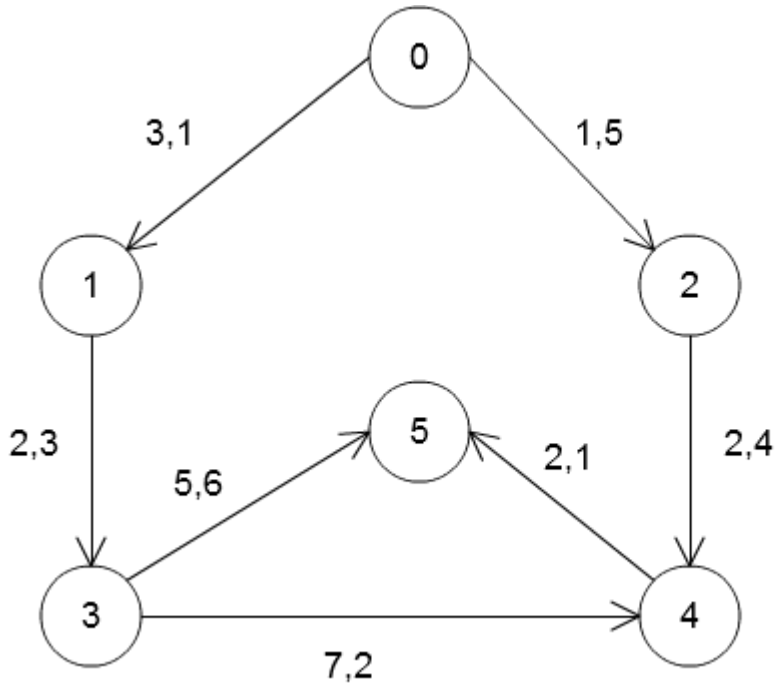
```
Matriz original:
 0: [0,0] [2,7] [1,8] [1000,1000] [1000,1000] [1000,1000]
 1: [1000,1000] [0,0] [1000,1000] [4,8] [1000,1000] [1000,1000]
 2: [1000,1000] [1000,1000] [0,0] [1000,1000] [7,3] [1000,1000]
 3: [1000,1000] [1000,1000] [1000,1000] [0,0] [1000,1000] [6,7]
 4: [1000,1000] [1000,1000] [1000,1000]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


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

--------------------------------
Process exited after 63.14 seconds with return value 0
Pressione qualquer tecla para continuar. . .
```

Grafo 2



```
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

--------------------------------
Process exited after 83.87 seconds with return value 0
Pressione qualquer tecla para continuar. . .
```

Grafo 3



```
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

--------------------------------
Process exited after 86.52 seconds with return value 0
Pressione qualquer tecla para continuar. . .
```