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E-fólio B | Instruções para a realização do E-fólio



INTRODUÇÃO À INTELIGÊNCIA ARTIFICIAL | 21071 | 2023/2024

O e-fólio B é inspirado na expansão ferroviária no Velho Oeste. A introdução dos caminhos de ferro transformou a paisagem, substituindo os cavalos como principal meio de transporte e facilitando o movimento de pessoas e mercadorias. Este avanço tecnológico não só aproximou as comunidades, mas também promoveu a expansão territorial.



Vamos considerar territórios de $N \times M$ zonas, com número de famílias em cada zona, de modo idêntico ao e-fólio A. É preciso identificar as localizações das estações, de modo a melhor servir a população. O trajeto do caminho de ferro para ligar as estações, bem como a ligação a outros territórios, fica a cargo dos engenheiros da companhia de caminhos de ferro, após a localização das estações estar decidida.

Após muita ponderação, chegou-se aos seguintes critérios para avaliar as localizações das estações, a minimizar:

- A - número de estações
- B - custo médio de deslocação para a estação mais próxima

Para custo de deslocação, foram adotados os seguintes custos unitários, mediante a distância (movimentos horizontal, vertical e diagonal) à estação mais próxima:

Distância	0 ou 1	2	3	4	5	6 ou superior
Custo	0	1	2	4	8	10

Pretende-se minimizar primeiramente o número de estações, e só depois o custo médio de deslocação. No entanto, não se pretende soluções cujo custo médio de deslocação seja igual ou superior a 3. Assim, definiu-se uma fórmula única para minimizar o custo da solução, arredondada para o inteiro mais baixo:

$$\text{Minimizar Custo} = 1000A + 100B$$

Como o valor de B não será superior a 3, os três dígitos menos significativos não serão superiores a 300, pelo que esta fórmula permite efetuar o desejado, minimizar o número de estações, e entre as soluções com o mesmo número de estações, minimizar o custo médio de deslocação. A distância é o menor caminho entre zonas, podendo um movimento ocorrer de uma zona para qualquer uma das adjacentes (ligadas por lado ou canto).

Exemplo instância 1 (duas soluções):

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<p>Nesta solução para este território há uma só estação na zona azul. A zona verde está a distância 1, não existe custo de deslocação. As zonas a amarelo distam 2 zonas da estação, tendo custo unitário 1. Como existem 14 famílias, contribuem para um custo total de deslocação de 14. As zonas a laranja distam 3 zonas da estação, tendo custo 2, vezes 17 famílias, o custo total é de 34. Assim, somando os custos de deslocação obtém-se 48. Como existem 42 famílias, o custo médio de deslocação é de $B=48/42=1,142$. Assim, como há uma estação, $A=1$, o valor da solução de acordo com a fórmula única a minimizar, é de $1000*1+1,142*100=1114$. A solução é válida porque o custo médio de deslocação é inferior a 3.</p>	<p>Ao adicionar mais uma estação à solução ao lado, ficamos com 8 famílias em zonas a amarelo, tendo custo de deslocação de 8. A laranja estão apenas 4 famílias, com custo unitário de 2, ficam com custo de deslocação de 8. Assim, o custo total de deslocação é de 16, a dividir por 25 dá $B=0,64$. Como há duas estações, $A=2$, o custo da solução é de 2064. Esta alteração não é valorizada, tendo o custo da solução aumentado, relativamente à solução do lado.</p> <p style="text-align: center;">$16/42=0,38$ sendo o custo 2038</p>																																																		

Exemplo instância 3 (suas soluções)

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<p>Nesta solução para este território há uma só estação na zona azul. A zona verde tem custo é 0, a amarelo estão zonas de custo 1, com 5 famílias, com custo de deslocação de 5. A laranja estão zonas de custo 2, com 15 famílias, contribuindo com 30 para o custo de deslocação. A azul claro estão zonas de custo 4, com 48 famílias. Assim, estas zonas contribuem com um custo de deslocação em 192. Finalmente as zonas a cinzento têm custo 8, existindo 4 famílias, que contribuem 32 para o custo de deslocação. Ficamos com um custo total de deslocação de 259. Como há 82 famílias, o custo médio de deslocação é de B=3,158. Atendendo a que este valor é igual ou superior a 3, esta solução não é válida.</p>	<p>Foi adicionada outra estação à solução anterior. Assim, ficamos com 25 famílias na zona amarela, a custo unitário 1. Na zona laranja, com custo unitário 2, temos 18 famílias, contribuindo em 36 para o custo de deslocação. Finalmente, a azul temos apenas 2 famílias, existindo custo unitário 4, contribui para um custo de deslocação de 8. O custo total de deslocação é de 69, como há 82 famílias o custo médio de deslocação fica em B=0,841. Como existem duas estações, A=2, ficando o custo da solução em 2084. Esta alteração é valorizada, embora tenha um valor maior, é agora uma solução válida, enquanto que a solução do lado é inválida.</p>																																																																																																		

Exemplo instância 6 (suas soluções)

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Considere as 20 instâncias no anexo (10 são iguais ao e-fólio A).

Para reportar uma solução válida pode ser utilizado um formato em texto, com se exemplifica de seguida para os exemplos dados atrás, para a solução da esquerda:

0	7	0	0	4				
0	0	0#	4	0				
1	0	0	0	0				
4	4	1	0	0				
6	0	3	4	4				
Custo: 1114								
0	8	0	4	5	10	0		
0	4	0	7	0	4	0		
0	2	4	2	0	0	2		
0	7	0	1	2	0	0		
2	4	0	0	3	0#	2		
0	4	0	0	3	0	0		
2	0	0	0	0	0	0		
Custo: 1315								
0	0	0	0	0	0	0	0	0
4	0	8	4	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	3	0	0	1	0
0	3	0	0	0	0	0	0	0
0	0	0	1#	1	0	0	3	0
0	0	2	4	0	0	0	1#	0
0	2	0	0	8	0	4	3	10
0	0	3	0	0	4	0	0	0
Custo: 2133								

Devem ser marcadas as zonas com estação, calculando o custo de acordo com a fórmula dada. Alternativamente pode-se apresentar as soluções de forma gráfica, via folha de calculo, conforme utilizado neste enunciado. O formato pode ser alterado, desde que se mantenha o conteúdo: **posição das estações e calculo do custo**.

Deve utilizar procuras informadas lecionadas para resolver o e-fólio, utilizando apenas os algoritmos lecionados. Caso utilize um algoritmo não lecionado, é aplicável uma penalização de 0,5 valores no critério dos algoritmos.

Deve entregar:

- Relatório;
- Código fonte dos algoritmos implementados.

O relatório deve conter uma tabela com os resultados da execução dos algoritmos/configurações testados vs as instâncias fornecidas. Para cada algoritmo/instância deve mostrar:

- Número de avaliações (máximo 100.000 avaliações);
- Custo;
- Tempo gasto (máximo de 1 minuto).

Para cada instância deve ter a melhor informação obtida considerando todas as execuções, nomeadamente o valor da melhor solução. Essa solução deve ser apresentada em anexo, num formato idêntico ao utilizado neste enunciado.

Deve fazer um critério de paragem no tempo gasto e no número de avaliações, de modo a obter corridas com no máximo 1 minuto, e no máximo de 100.000 avaliações (o que ocorrer primeiro). Naturalmente que não precisam de verificar o critério de paragem em cada instante, pelo que se um destes limites for ultrapassado ligeiramente não tem problema.

Template para a tabela de resultados:

Instância		1	2	...	20
Algoritmo 1 / configurações 1	Avaliações				
	Gerações				
	Custo				
	Tempo (msec)				
...					
	Melhor resultado				

Em anexo deve apresentar a melhor solução obtida para cada instância resolvida, num formato idêntico ao apresentado para a instância de exemplo (pode omitir as cores).

Critérios de correção (4 valores):

- **Análise** (1 valor): Referência a aspetos importantes do problema no relatório, revelando independentemente de os implementar ou não, que tinha consciência dos mesmos, bem como as opções tomadas na implementação e respetiva justificação.
- **Algoritmos** (1 valor): Identificação clara dos algoritmos que implementou de acordo com a nomenclatura do livro e da UC, juntamente com as configurações utilizadas. Caso

não tenha uma implementação funcional, ou tenha implementado um algoritmo não lecionado, ou tenha realizado o e-fólio de forma manual, este critério pode ser valorizado pela metade, dependente do trabalho realizado.

- **Resultados** (2 valores): Este critério é avaliado apenas se existir uma tabela de resultados, e as soluções estiverem em anexo no relatório, valendo cada instância 0,1 valores (0,05 para instâncias com soluções de custo 1000, acima da melhor solução). Uma instância é considerada resolvida se for obtida uma solução por um algoritmo, mesmo que executado manualmente, e com a solução apresentada corretamente em anexo. Nas instâncias com ID 11 a 20 em que tenha obtido a melhor solução de entre as soluções válidas enviadas, a instância é valorizada em 0,15 valores, até ao máximo de 2 valores para este critério.

O trabalho é individual, mas caso os estudantes pretendam, podem partilhar resultados de custos finais das soluções obtidas, mas não as soluções em si, nem os algoritmos e abordagens utilizados.

Anexo – instâncias a utilizar no e-fólio

ID1

0	7	0	0	4
0	0	0	4	0
1	0	0	0	0
4	4	1	0	0
6	0	3	4	4

ID2

4	0	0	10	1
1	0	0	0	0
0	0	1	6	3
0	4	0	0	2
8	0	6	3	0

ID3

0	8	0	4	5	10	0
0	4	0	7	0	4	0
0	2	4	2	0	0	2
0	7	0	1	2	0	0
2	4	0	0	3	0	2
0	4	0	0	3	0	0
2	0	0	0	0	0	0

ID4

0	0	1	0	7	0	1
0	1	4	0	0	0	4
0	0	0	0	2	0	0
3	1	0	8	5	7	7
0	4	0	3	0	0	0
0	0	0	3	2	4	2
0	8	3	6	3	0	0

ID5

6	7	2	0	0	0	0	0	0
3	3	6	0	8	4	3	1	0
0	0	8	0	0	0	2	4	0
0	0	0	1	0	3	2	0	0
0	0	0	7	4	0	1	0	0
12	8	0	5	4	1	4	3	4
8	0	1	2	4	3	3	0	0
1	1	0	0	0	0	5	0	0
4	0	0	0	4	6	0	13	2

ID9

2	4	0	0	6	7	3	4	0	0	3	0	1
0	0	2	0	3	0	0	6	0	0	8	11	3
0	3	0	8	0	0	2	0	0	0	0	0	4
2	0	0	0	0	0	0	0	0	3	2	0	0
0	6	0	8	0	3	0	0	0	0	0	0	1
0	3	0	2	0	0	9	0	0	0	0	5	6
1	9	4	0	0	2	4	0	0	0	3	2	0
2	3	0	4	0	0	0	6	2	0	1	0	3
0	0	0	0	0	6	0	0	0	2	2	0	8
7	2	4	2	0	0	6	4	1	0	0	0	7
0	0	0	11	0	0	0	0	3	4	0	9	0
0	0	0	0	1	4	3	4	0	0	0	3	11
0	0	4	7	7	0	0	2	0	2	5	0	1

ID10

0	0	1	4	0	0	9	0	0	0	12	0	1
0	0	0	0	0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	2	0	0	2	0	0	0
0	0	0	0	0	9	4	0	0	0	6	0	0
0	6	9	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	6	10	0	1	4
0	3	0	0	0	1	0	0	0	0	0	2	0
0	0	0	1	3	0	0	0	0	9	0	0	0
9	0	0	3	3	0	0	0	0	3	4	0	0
0	1	4	0	0	0	0	0	0	5	0	1	0
0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	3	3	0	0	0	0	0	10
0	0	0	0	0	0	0	0	0	4	0	0	0

ID11

0	0	0	4	0	0	0	6	0	0	0	0	2	2	0
0	2	12	0	3	0	0	0	0	26	0	0	0	0	4
0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
0	0	0	0	0	0	0	3	3	1	0	0	0	0	0
0	0	0	0	0	1	3	0	0	6	4	0	0	0	0
0	0	0	0	0	0	0	5	4	0	0	3	0	0	0
9	12	0	0	0	4	1	6	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	4	0	0	0	0	0	0
0	3	0	0	0	2	0	0	0	7	0	4	0	0	0
0	0	2	0	0	9	2	0	0	0	0	0	0	0	0
0	2	0	0	2	16	0	8	0	2	0	0	0	0	7
0	0	5	0	6	0	0	0	0	0	8	0	0	0	0
0	4	0	0	0	0	0	0	1	2	3	0	0	0	0

ID12

0	0	0	0	0	0	0	10	3	0	0	0	0	2	0
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
0	1	0	3	0	0	0	0	4	0	0	0	4	0	0
0	0	0	10	3	8	11	0	0	0	0	0	2	0	0
0	4	0	0	0	0	0	0	0	0	0	2	0	0	1
0	4	2	0	0	0	4	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	5	0	10	0	0	1	0	0
0	0	0	0	0	0	0	0	3	0	0	2	8	0	15
0	1	0	0	0	0	0	0	0	0	0	0	11	0	0
0	0	0	0	0	3	0	0	0	0	0	1	0	2	0
0	0	0	11	0	0	0	0	0	0	0	0	0	0	2
8	0	0	0	0	4	0	0	0	0	0	4	2	0	4
0	0	0	0	0	0	0	0	0	0	0	0	0	8	1

ID13

0	0	0	3	0	0	0	0	5	0	0	0	0	0	0	0
0	0	0	0	3	0	0	0	4	2	0	3	0	0	0	0
6	0	3	0	0	0	6	0	30	0	1	8	6	10	0	0
0	7	0	1	4	0	0	1	0	0	0	0	0	0	4	4
0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	3
0	8	0	0	0	0	0	3	0	0	36	0	1	0	0	2
6	0	0	0	8	2	8	0	0	2	0	0	0	0	0	0
8	1	0	0	0	0	4	1	0	0	0	0	6	7	0	0
3	5	0	0	0	0	0	0	0	0	5	0	0	4	0	1
3	0	0	2	0	4	0	0	0	0	9	0	0	0	8	16
0	1	0	0	1	1	0	0	2	0	0	0	0	6	1	0
0	3	4	0	3	4	0	10	0	0	0	0	5	5	8	4
8	0	0	0	0	0	17	0	0	10	0	2	0	0	2	0

ID14

0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	0
0	6	0	0	0	0	8	0	10	0	0	0	0	2	2	3
0	0	0	0	0	4	0	8	3	0	0	0	0	0	0	0
0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0
4	0	8	1	0	0	7	0	0	0	0	0	5	3	0	0
0	0	3	0	1	0	0	3	0	0	3	0	3	0	8	0
0	0	0	0	11	0	0	0	0	0	0	0	0	0	0	1
0	6	0	0	0	0	0	1	0	2	0	1	0	0	0	0
0	0	2	0	1	3	0	1	0	4	0	0	6	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
4	8	0	0	0	0	0	0	0	0	2	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	3	0	0	6

ID15

0	0	0	0	4	0	0	4	0	0	8	0	6	0	0	0	0	4	
0	0	0	0	0	2	0	6	0	0	0	0	0	0	0	0	3	1	
2	0	8	3	0	0	0	5	0	4	0	0	0	0	2	1	4	0	
0	0	1	0	4	0	0	0	0	0	1	0	0	0	18	10	0	0	
0	0	1	0	0	0	0	3	0	2	0	0	0	7	4	0	4	3	
0	0	0	0	0	2	0	0	0	0	0	0	0	0	3	2	0	2	
0	0	0	1	0	1	0	0	0	2	2	0	0	4	0	0	10	1	0
3	0	0	0	0	0	0	4	1	0	0	0	0	4	0	0	1	0	
2	0	2	0	0	0	0	1	0	0	4	1	0	3	0	0	0	3	3
0	0	0	0	4	0	1	1	3	0	0	0	0	0	0	0	0	0	0
0	0	0	4	0	0	4	2	4	0	0	0	0	0	4	0	0	0	0
0	0	2	0	3	22	0	0	0	0	2	7	0	0	0	0	0	0	1
0	9	0	0	6	0	0	0	0	0	0	0	0	5	1	4	0	8	

ID16

0	0	0	0	0	0	0	3	0	0	0	2	0	4	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
5	0	0	3	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0
0	0	4	0	0	0	0	0	14	0	0	0	0	2	0	7	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	2
0	0	3	3	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0
5	0	0	0	0	0	6	0	2	2	0	0	0	0	0	0	0	0	0
0	0	2	0	0	0	0	4	0	0	5	0	0	0	0	0	4	1	0
3	0	4	0	0	0	0	0	0	0	7	2	0	0	0	1	0	3	0
0	0	1	0	0	4	11	0	3	0	0	0	0	11	3	0	0	0	0
1	0	2	8	0	0	0	0	0	0	4	0	0	3	1	0	0	0	0
3	0	11	0	0	0	0	0	0	0	0	0	0	3	0	7	0	0	0
0	0	0	0	0	2	0	0	0	4	0	0	0	0	0	0	0	1	0

ID17

0	0	0	0	0	0	0	0	16	1	0	5	0	3	0	0	0	4	0
0	2	3	0	0	5	0	0	0	0	0	0	0	6	0	0	0	1	0
0	9	1	0	0	0	0	4	2	2	0	1	8	2	0	4	24	10	13
0	0	3	0	0	0	0	2	0	0	4	0	11	0	0	0	2	1	1
0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	2
0	3	12	0	4	0	0	0	0	0	0	0	10	0	0	0	0	0	0
0	0	2	0	0	0	9	0	0	0	0	0	8	4	0	0	0	0	0
3	0	0	0	0	2	0	0	6	0	3	0	6	0	0	0	0	0	0
1	0	0	0	0	0	0	2	5	0	0	12	2	4	0	0	7	0	1
6	4	4	0	0	8	0	3	2	0	0	0	9	0	0	0	0	0	0
0	0	0	0	0	0	4	8	0	0	2	0	0	8	0	0	0	0	2
0	4	18	0	0	0	0	0	0	0	4	1	2	0	0	0	0	8	3
2	0	7	0	7	0	0	9	0	0	0	0	0	0	0	2	0	0	0
0	0	0	0	7	2	0	0	1	0	0	0	0	0	0	11	0	30	0
1	0	0	0	0	0	0	7	0	0	0	3	0	0	0	0	0	0	0

ID18

0	0	0	0	14	0	0	0	0	0	0	0	0	3	7	0	0	0	0	0
0	2	5	7	2	0	0	0	6	0	0	0	1	0	0	3	0	0	0	1
0	7	0	2	0	0	0	0	0	0	0	10	0	0	4	2	0	0	0	0
0	0	0	4	0	0	0	5	0	0	0	0	0	0	0	0	0	0	2	0
0	0	5	0	4	0	0	3	4	0	0	0	3	0	0	0	0	0	7	0
0	0	0	0	0	0	3	0	6	0	0	5	0	4	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0
0	0	7	0	4	0	0	0	0	0	1	0	0	0	8	0	0	0	0	0
4	0	0	0	0	0	0	0	7	0	7	0	0	0	0	0	8	0	0	3
8	0	0	0	0	0	2	6	2	0	0	0	0	0	3	0	0	0	0	0
0	0	0	0	0	0	0	12	0	0	0	4	0	0	8	0	0	0	0	0
0	0	4	0	0	0	0	0	0	13	0	2	0	0	0	0	0	0	1	0
0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	3	0	2	0	0
0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	7	0
0	0	0	0	0	0	4	0	0	0	2	0	0	0	0	0	2	0	0	3

ID19

0	2	0	0	0	4	4	0	0	4	0	0	1	6	0	1	4	0	0	0
1	0	0	2	0	0	0	0	0	0	0	0	9	3	0	0	0	0	0	0
3	0	0	4	0	9	1	0	0	1	0	0	0	6	0	0	0	0	0	0
0	4	0	0	4	4	0	0	0	0	0	0	12	0	0	0	0	0	1	0
0	0	0	3	0	6	0	0	0	0	3	0	0	11	17	0	0	0	0	0
6	0	1	0	0	6	0	0	1	0	0	0	0	0	0	0	0	0	0	0
0	1	0	1	0	0	0	0	0	0	6	0	0	1	0	0	0	0	2	0
1	0	10	0	0	2	2	0	3	4	8	0	0	9	11	1	0	16	0	0
3	0	0	0	0	0	0	0	4	0	0	7	0	0	7	0	0	0	0	0
0	6	0	1	0	0	0	0	3	5	0	0	2	4	0	0	0	0	0	0
0	0	0	0	0	6	0	3	6	0	10	6	0	0	0	0	0	0	0	2
3	0	0	4	4	0	2	0	0	0	1	0	0	1	2	16	11	0	0	0
7	0	0	3	0	0	0	0	0	10	12	0	0	0	0	0	0	0	0	0
0	2	0	0	0	0	2	2	0	0	0	0	0	0	0	4	1	0	0	1
0	0	0	0	0	0	0	1	2	6	3	0	0	0	0	0	7	0	0	0
0	0	1	0	4	8	0	0	0	0	0	6	0	0	0	6	0	0	0	0
0	0	0	0	0	0	0	2	0	2	0	0	0	7	0	0	0	0	0	2

ID20

3	4	0	0	3	0	0	0	0	6	0	4	4	0	0	0	4	0	0
4	0	0	5	0	0	0	0	7	3	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1	0
0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
0	1	4	0	0	0	0	0	0	0	0	2	0	0	0	0	9	0	0
0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	4	0
4	0	0	5	0	0	0	0	0	0	0	11	0	0	0	0	0	3	0
2	0	7	0	0	11	0	0	0	0	0	5	0	7	0	0	0	0	0
9	0	0	0	1	0	1	15	0	0	0	0	1	0	0	0	1	4	3
0	3	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0
0	0	2	4	0	0	0	0	0	0	0	4	0	1	0	0	0	0	0
0	2	0	0	0	7	0	4	0	0	0	0	0	0	0	0	9	0	0
0	0	6	0	0	0	2	0	1	0	0	0	0	0	0	0	1	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	3
0	0	0	0	0	1	0	0	0	0	0	0	9	0	0	0	7	0	0
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	0	6	3	0	0	0	0	0	0	1	0	0

Os mapas das instâncias podem ser definidos como matrizes com um valor máximo de 20x20, e serem inicializadas de forma estática no código:

```
{
// 5x5
{0,7,0,0,4},
{0,0,0,4,0},
{1,0,0,0,0},
{4,4,1,0,0},
{6,0,3,4,4},
},
{4,0,0,10,1},
{1,0,0,0,0},
{0,0,1,6,3},
{0,4,0,0,2},
{8,0,6,3,0},
},
// 7x7
{0,8,0,4,5,10,0},
{0,4,0,7,0,4,0},
{0,2,4,2,0,0,2},
{0,7,0,1,2,0,0},
{2,4,0,0,3,0,2},
{0,4,0,0,3,0,0},
{2,0,0,0,0,0,0},
},
{0,0,1,0,7,0,1},
{0,1,4,0,0,0,4},
{0,0,0,0,2,0,0},
{3,1,0,8,5,7,7},
{0,4,0,3,0,0,0},
{0,0,0,3,2,4,2},
{0,8,3,6,3,0,0},
},
// 9x9
{6,7,2,0,0,0,0,0,0},
{3,3,6,0,8,4,3,1,0},
{0,0,8,0,0,0,2,4,0},
{0,0,0,1,0,3,2,0,0},
{0,0,0,7,4,0,1,0,0},
{12,8,0,5,4,1,4,3,4},
{8,0,1,2,4,3,3,0,0},
{1,1,0,0,0,0,5,0,0},
{4,0,0,0,4,6,0,13,2},
},
}
```

```

{0,0,0,0,0,0,0,0,0},
{4,0,8,4,0,0,0,0,0},
{0,0,0,0,0,0,0,0,0},
{0,0,0,0,3,0,0,1,0},
{0,3,0,0,0,0,0,0,0},
{0,0,0,1,1,0,0,3,0},
{0,0,2,4,0,0,0,1,0},
{0,2,0,0,8,0,4,3,10},
{0,0,3,0,0,4,0,0,0},
// 11x11
{0,0,0,0,0,3,0,0,0,0,0},
{0,0,11,2,0,0,9,3,0,0,3},
{0,0,0,3,1,0,2,0,0,0,0},
{4,1,2,3,0,4,0,0,4,0,0},
{5,0,0,0,4,0,1,0,4,3,0},
{0,0,0,7,4,0,1,0,0,7,0},
{0,8,0,0,0,0,3,0,1,0,3},
{0,3,0,0,5,2,3,0,0,0,2},
{0,0,0,3,1,0,2,8,0,0,0},
{0,3,4,0,7,0,0,7,0,0,0},
{4,2,0,4,0,3,0,0,5,7,0},
,
{1,0,0,0,0,0,0,0,0,0,0},
{0,0,0,0,0,0,0,0,0,0,0},
{0,0,10,10,0,0,0,4,5,0,0},
{0,4,1,0,8,0,0,0,0,0,5},
{8,0,0,0,0,0,6,0,0,0,0},
{0,0,0,0,13,0,0,0,2,0,3},
{0,0,0,0,4,0,0,0,0,1,0},
{0,0,0,0,0,0,0,0,0,0,0},
{0,0,4,0,0,0,0,3,0,0,0},
{4,1,0,0,0,0,0,0,0,0,0},
{0,0,0,0,0,0,0,0,0,0,0},
// 13x13
{2,4,0,0,6,7,3,4,0,0,3,0,1},
{0,0,2,0,3,0,0,6,0,0,8,11,3},
{0,3,0,8,0,0,2,0,0,0,0,0,4},
{2,0,0,0,0,0,0,0,0,3,2,0,0},
{0,6,0,8,0,3,0,0,0,0,0,0,1},
{0,3,0,2,0,0,9,0,0,0,0,5,6},
{1,9,4,0,0,2,4,0,0,0,3,2,0},
{2,3,0,4,0,0,0,6,2,0,1,0,3},
{0,0,0,0,0,6,0,0,0,2,2,0,8},
{7,2,4,2,0,0,6,4,1,0,0,0,7},
{0,0,0,11,0,0,0,0,3,4,0,9,0},
{0,0,0,0,1,4,3,4,0,0,0,3,11},
{0,0,4,7,7,0,0,2,0,2,5,0,1},
,
{0,0,1,4,0,0,9,0,0,0,12,0,1},
{0,0,0,0,0,0,0,0,0,1,0,0,0},
{1,0,0,0,0,0,2,0,0,2,0,0,0},
{0,0,0,0,0,9,4,0,0,0,6,0,0},
{0,6,9,0,0,0,0,0,0,0,0,0,0},
{0,0,0,0,0,0,0,1,6,10,0,1,4},
{0,3,0,0,0,1,0,0,0,0,0,2,0},
{0,0,0,1,3,0,0,0,0,9,0,0,0},
{9,0,0,3,3,0,0,0,0,3,4,0,0},
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,
// 15x13
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,
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{0,0,0,0,0,0,0,0,0,0,1,0,0,0,0},

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// 17x13
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,
// 19x13
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,
// 19x15
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,
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// 19x17
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,
```

```
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