Trabalho de Grafos
Parte 3

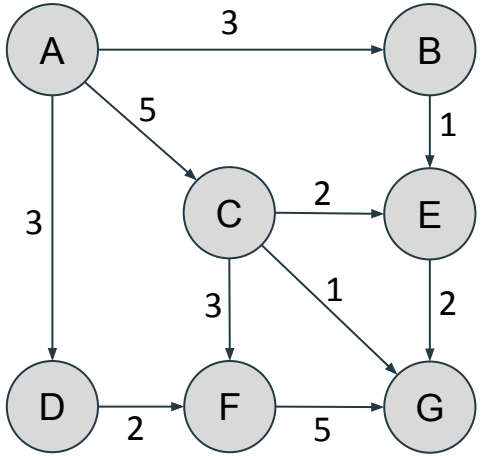
Fluxo máximo (com Ford Fulkerson)

Código

Linguagem:

Algoritmo implementado de 2 formas.

Ford Fulkerson V1 (Duplicar grafo)



Estrutura:

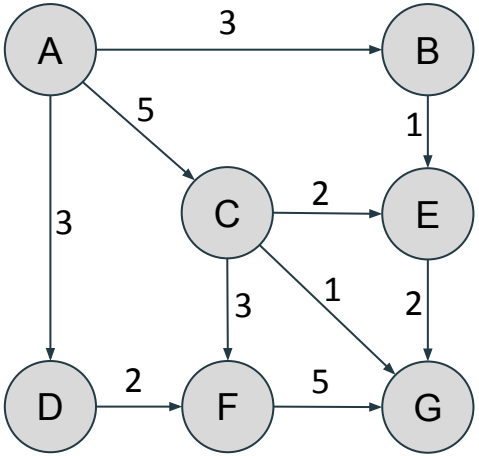
```
type Edge struct {
    origin uint32
    dest   uint32
    weight float64
    comp   *Edge
}
```

lista_adjacencia [][]*Edge

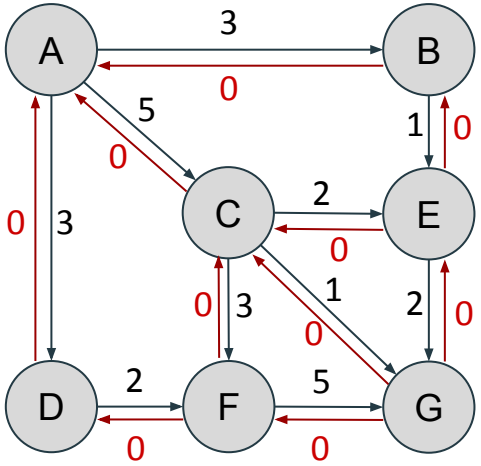
lista_adjacencia = [
1: [&Edge, &Edge, …],
2: [&Edge, …],
…
]

Ford Fulkerson V1 (Duplicar grafo)

Original:

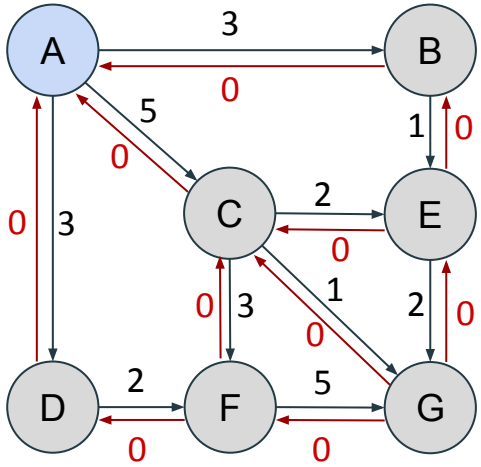


Residual:




```
correlacao_de_arestas [][2]*Edge

correlacao_de_arestas = [
(&original, &residual),
(&original, &residual),
. . .
]
```

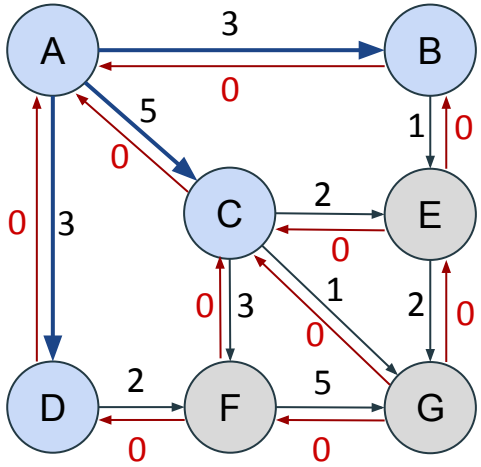
Ford Fulkerson V1 (BFS)




```
5  type Edge struct {
6      origin uint32
7      dest   uint32
8      weight float64
9      comp   *Edge
10 }
```

pais:	A	B	C	D	E	F	G
aresta	[x,	nil,	nil,	nil,	nil,	nil,	nil]

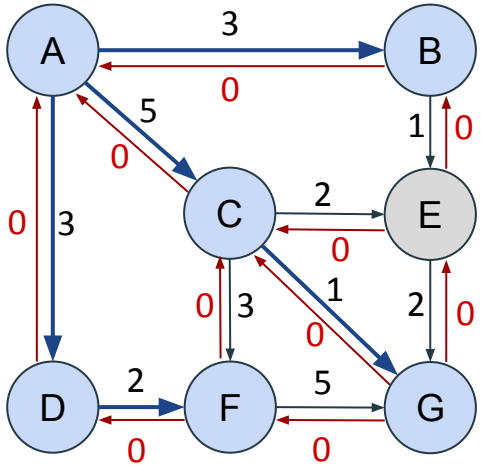
Ford Fulkerson V1 (BFS)




```
5  type Edge struct {
6      origin uint32
7      dest   uint32
8      weight float64
9      comp   *Edge
10 }
```

pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	nil,	nil,	nil]

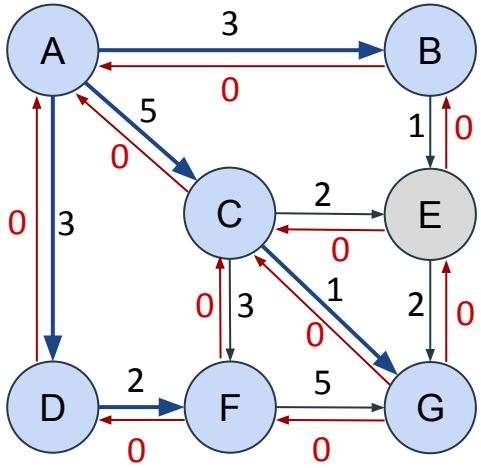
Ford Fulkerson V1 (BFS)




```
5  type Edge struct {
6      origin uint32
7      dest   uint32
8      weight float64
9      comp   *Edge
10 }
```

pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	nil,	&e,	&e]

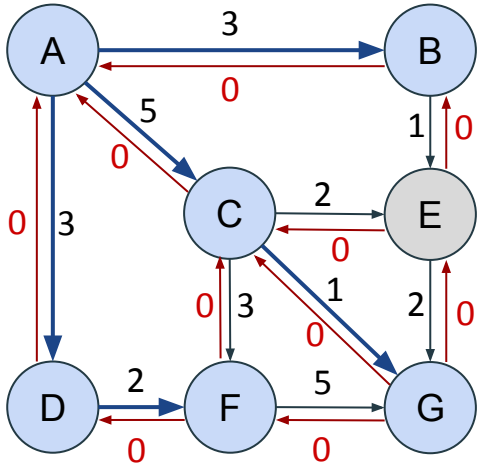
Ford Fulkerson V1 (BFS)



origin C
dest G
weight 1
comp &edge

pais: A B C D E F G
aresta [x, &e, &e, &e, nil, &e, &e]

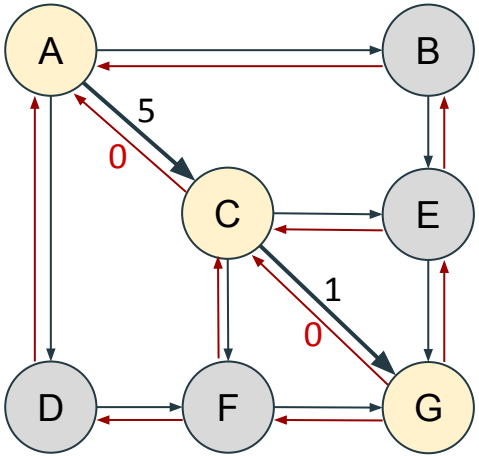
Ford Fulkerson V1 (BFS)



origin A
dest C
weight 5
comp &edge

pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	nil,	&e,	&e]

Ford Fulkerson V1 (Atualizar residual)

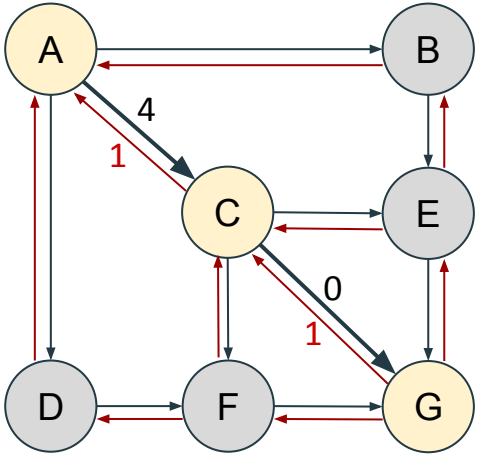


origin	A
dest	C
weight	5
comp	&edge

origin	C
dest	G
weight	1
comp	&edge

pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	nil,	&e,	&e]

Ford Fulkerson V1 (Atualizar residual)

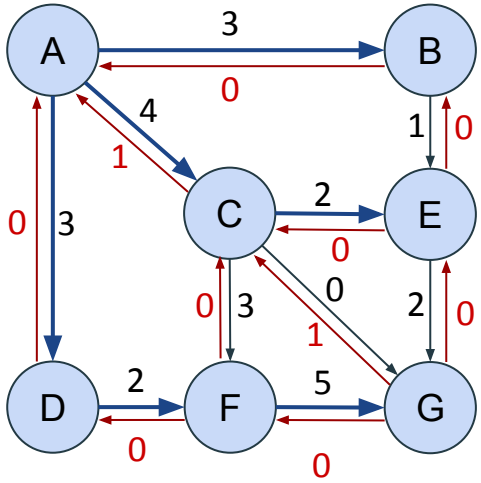


origin	A
dest	C
weight	4
comp	&edge

origin	C
dest	G
weight	0
comp	&edge

pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	nil,	&e,	&e]

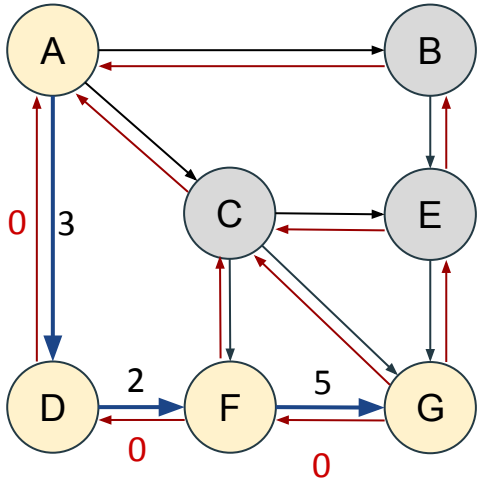
Ford Fulkerson V1 (BFS)




```
5  type Edge struct {
6      origin uint32
7      dest   uint32
8      weight float64
9      comp   *Edge
10 }
```

pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	&e,	&e,	&e]

Ford Fulkerson V1 (BFS)



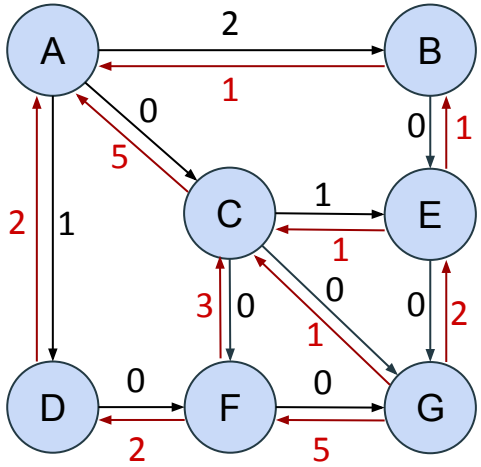
origin	A
dest	D
weight	3
comp	&edge

origin	D
dest	F
weight	2
comp	&edge

origin	F
dest	G
weight	5
comp	&edge

pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	nil,	&e,	&e]

Ford Fulkerson V1 (BFS)

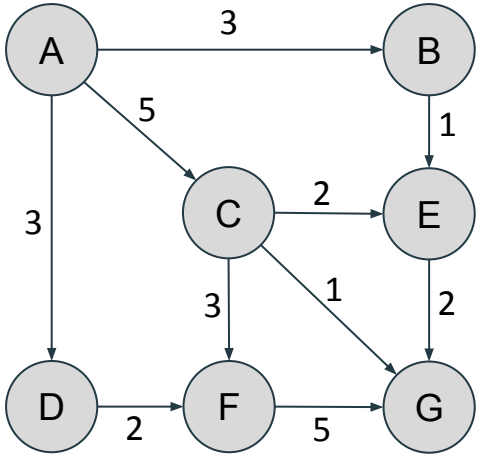



```
5  type Edge struct {
6      origin uint32
7      dest   uint32
8      weight float64
9      comp   *Edge
10 }
```

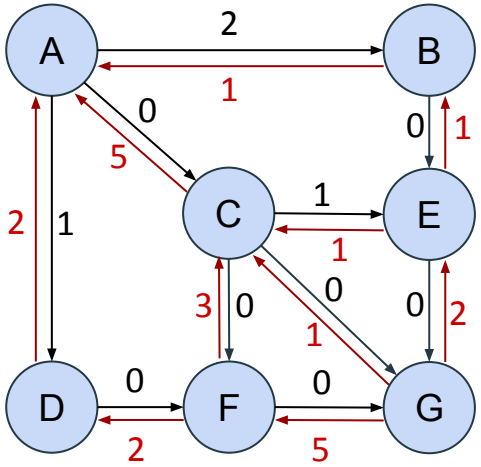
pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	&e,	&e,	&e]

Ford Fulkerson V1 (Encontrando fluxos)

Original:



Residual:

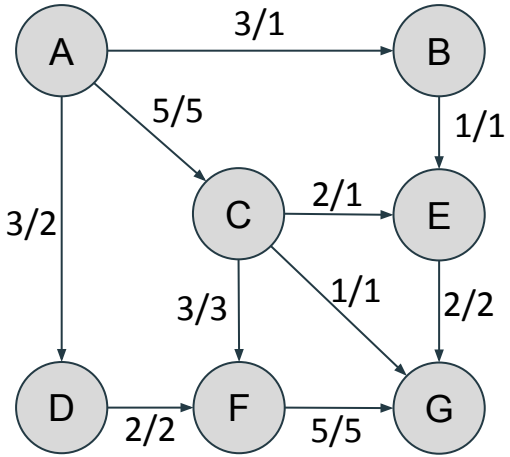



```
correlacao_de_arestas [][2]*Edge

correlacao_de_arestas = [
(&original, &residual),
(&original, &residual),
. . .
]
```

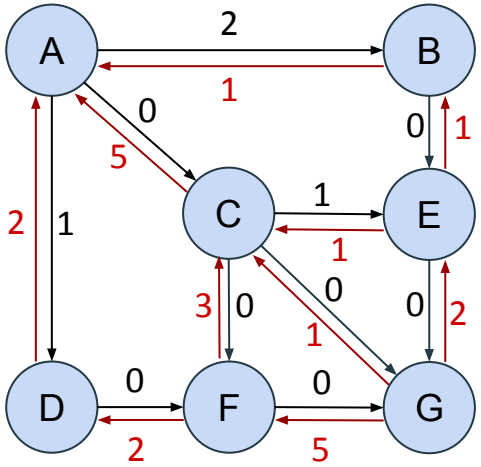
```
13  type EdgeFlow struct {
14      edge *Edge
15      flow float64
16  }
```

Ford Fulkerson V1 (Encontrando fluxos)

Original:



Residual:



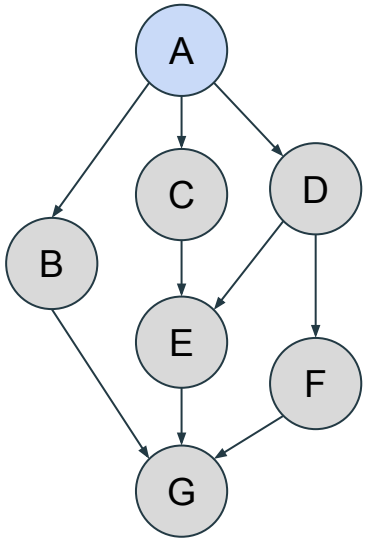

```
correlacao_de_arestas [][2]*Edge

correlacao_de_arestas = [
(&original, &residual),
(&original, &residual),
. . .
]
```

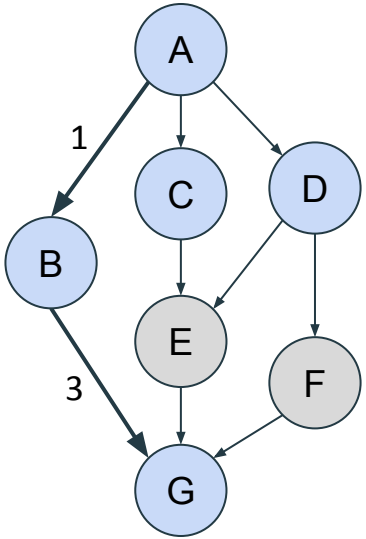
```
13  type EdgeFlow struct {
14      edge *Edge
15      flow float64
16  }
```

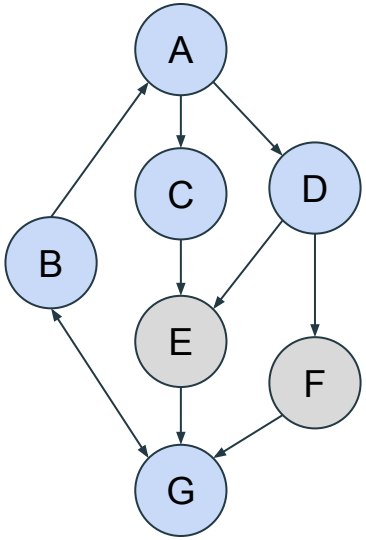
Resultados

Grafos	grafo 1	grafo 2	grafo 3	grafo 4	grafo 5	grafo 6	grafo 7	grafo 8
Fluxo máximo (entre vértices 1 e 2)	284	276820	291	253278	618	548517	611	5382665
Tempo médio de execução (Versão 1)	0.0044s (4.4ms)	0.0078s (7.8ms)	0.0795s (79.5ms)	0.1365s (135ms)	4.39314s	8.00897s	44.97805s	114.2085s (1m54s)

Melhorias (lista de visitados/pais)



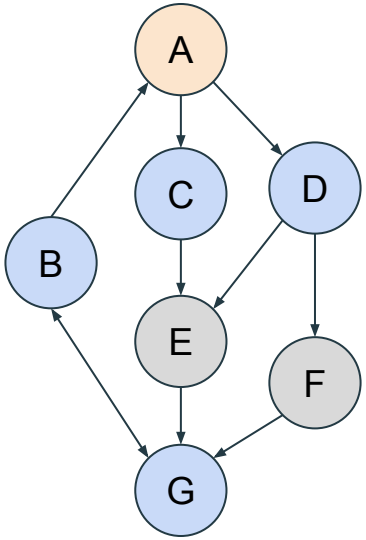


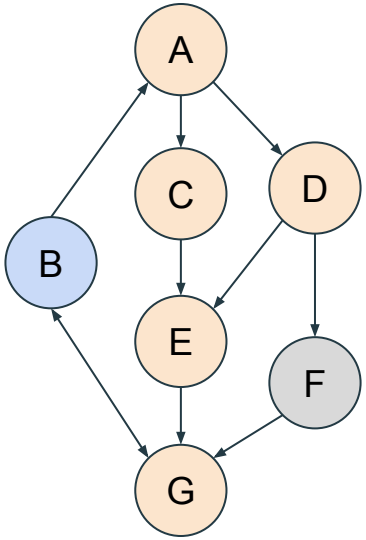


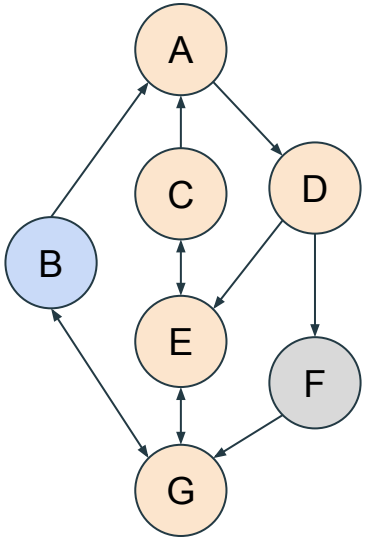
visitados:	A	B	C	D	E	F	G
aresta	[1,	0,	0,	0,	0,	0,	0]

visitados:	A	B	C	D	E	F	G
aresta	[1,	1,	1,	1,	0,	0,	1]

Melhorias (lista de visitados/pais)



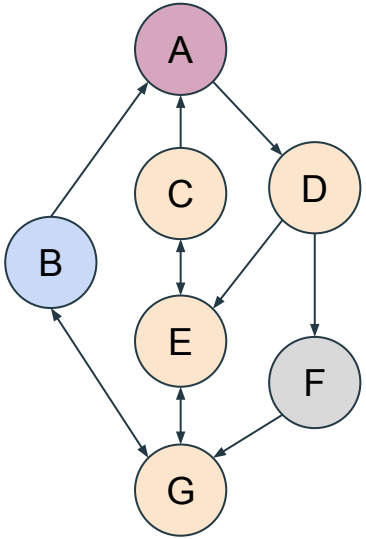


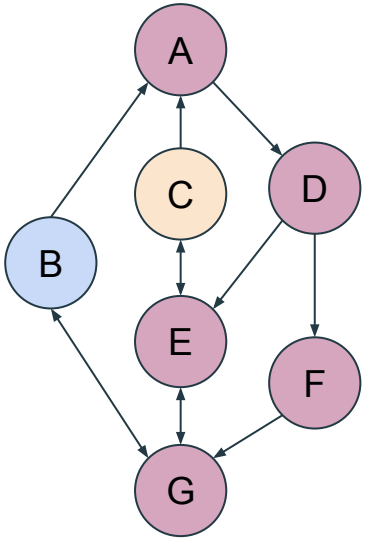


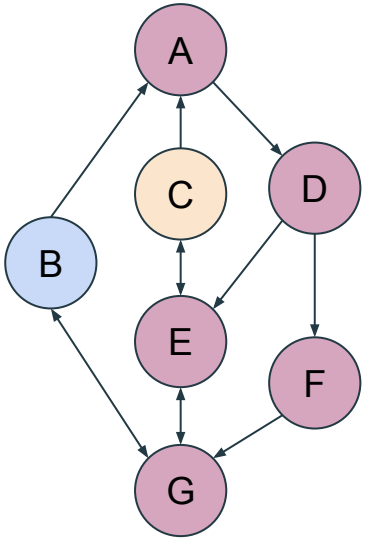
visitados:	A	B	C	D	E	F	G
aresta	[2,	1,	1,	1,	0,	0,	1]

visitados:	A	B	C	D	E	F	G
aresta	[2,	1,	2,	2,	2,	0,	2]

Melhorias (lista de visitados/pais)



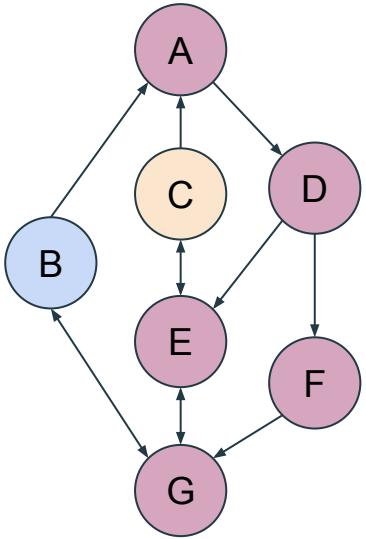




visitados:	A	B	C	D	E	F	G
aresta	[3,	1,	2,	2,	2,	0,	2]

visitados:	A	B	C	D	E	F	G
aresta	[3,	1,	2,	3,	3,	3,	3]

Melhorias (lista de visitados/pais)

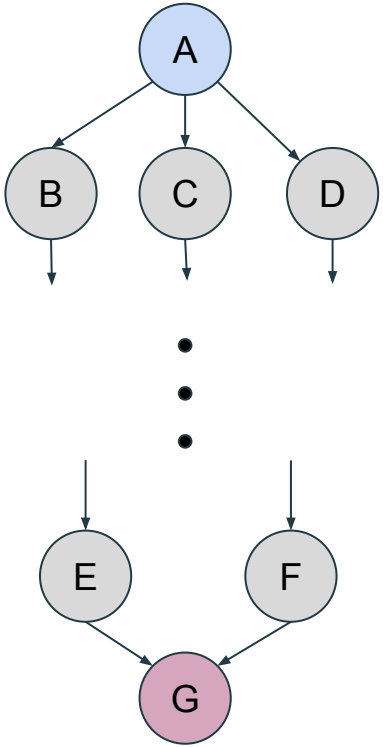


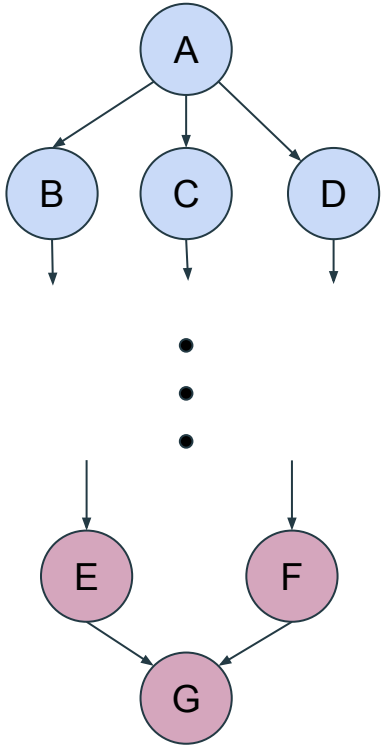

```
type Father struct {
    edge    *Edge
    treeID uint64
}
```

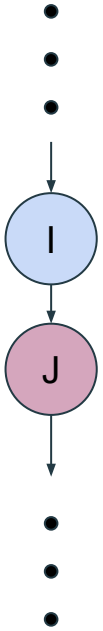
pais:	A	B	C	D	E	F	G
aresta	[x,	&e,	&e,	&e,	&e,	&e,	&e]

visitados:	A	B	C	D	E	F	G
aresta	[3,	1,	2,	3,	3,	3,	3]

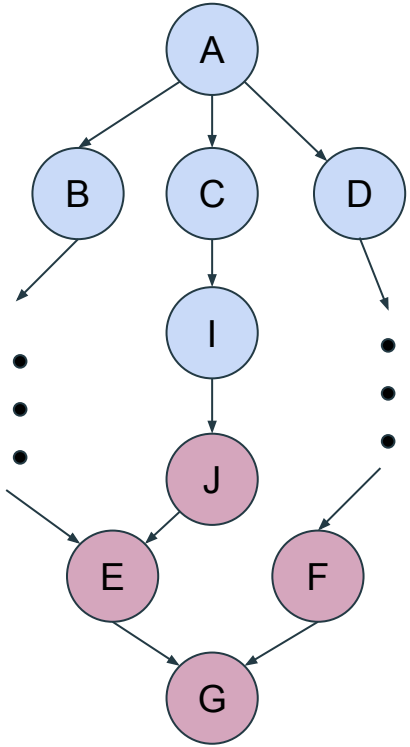
Melhorias (2 BFS)

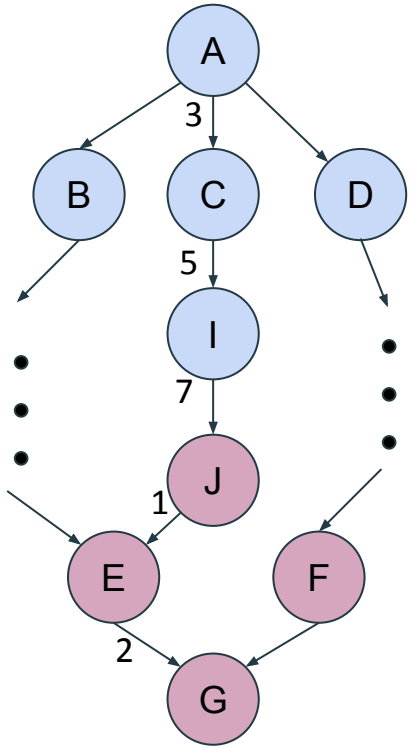


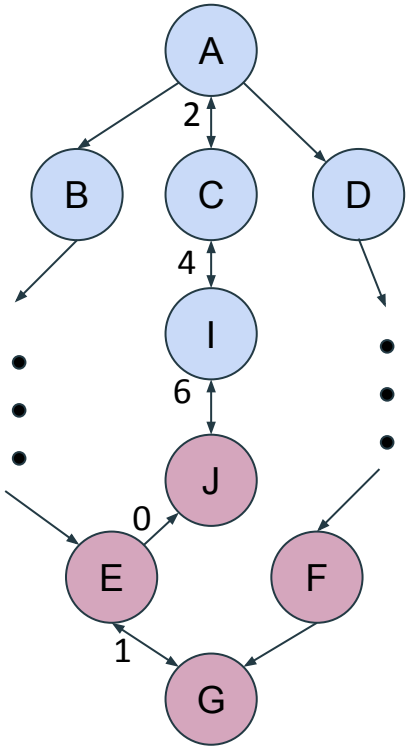




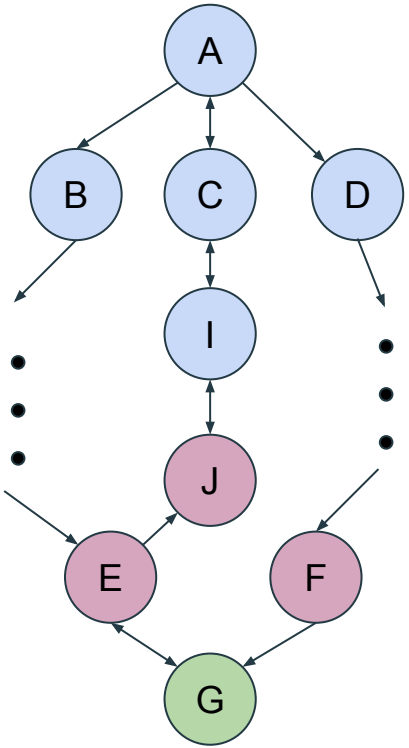
Melhorias (2 BFS)

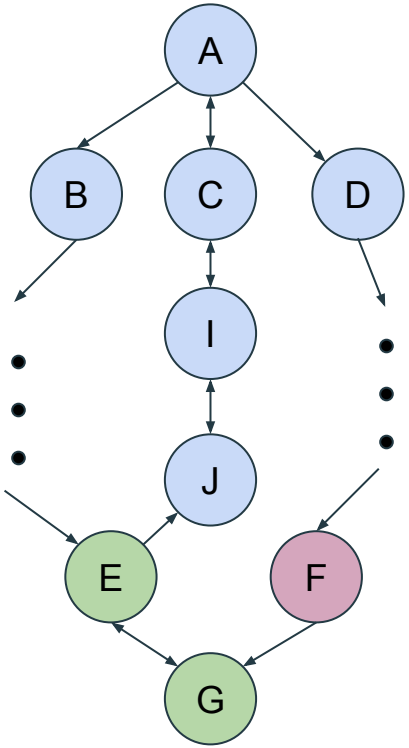






Melhorias (2 BFS)





Resultados

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Tempo médio de execução (Versão 1)	0.0044s (4.4ms)	0.0078s (7.8ms)	0.0795s (79.5ms)	0.1365s (135ms)	4.393s	8.009s	44.98s	114.21s (1m54s)
Tempo médio de execução (Versão 2)	0.0017s (1.7ms)	0.0016s (1.6ms)	0.0228s (22.8ms)	0.0238s (23.8ms)	0.472s	0.639s	8.96s	9.43s
Ganho de velocidade (vezes mais rápido)	2.59x	4.88x	3.49x	5.74x	9.31x	12.53x	5.02x	12.11x