

Grafos

Fundamentos

Prof. Edson Alves

Faculdade UnB Gama

Por que estudar grafos?

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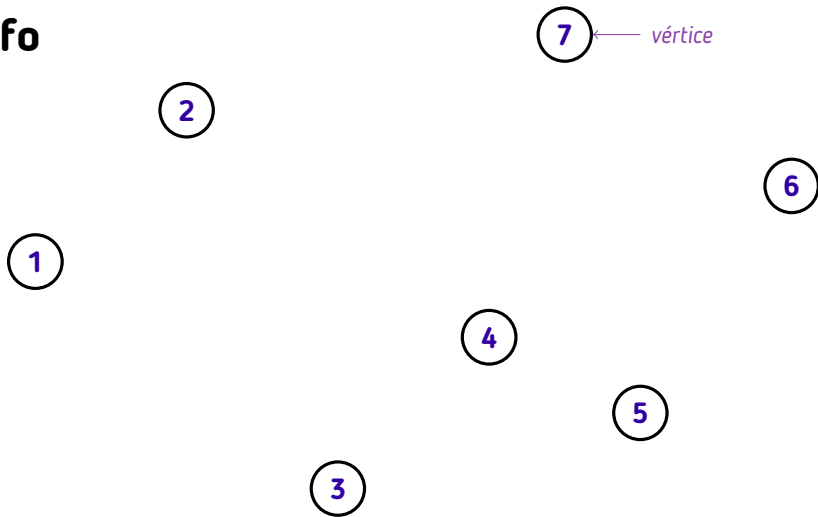
- ★ Os grafos abstraem todas as outras estruturas de dados
- ★ Grafos modelam muitos problemas reais
- ★ Travessias em grafos são eficientes e úteis

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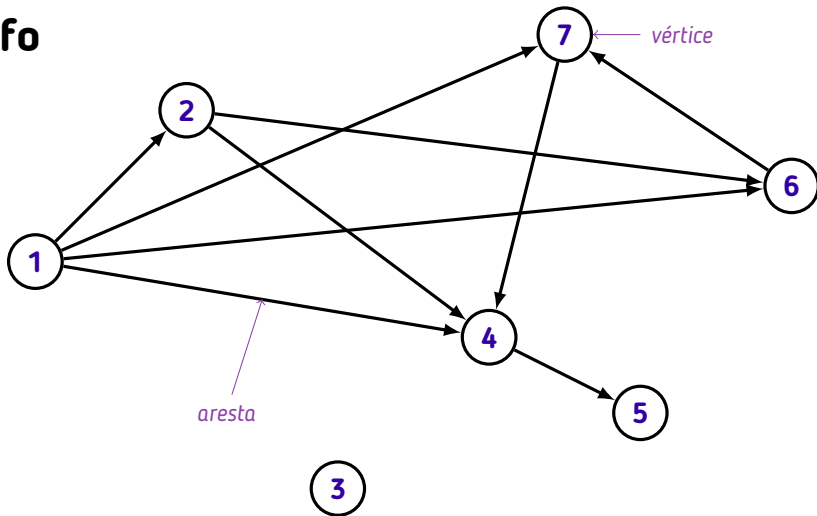
- ★ Os grafos abstraem todas as outras estruturas de dados
- ★ Grafos modelam muitos problemas reais
- ★ Travessias em grafos são eficientes e úteis
- ★ Algoritmos clássicos resolvem problemas recorrentes

Grafo

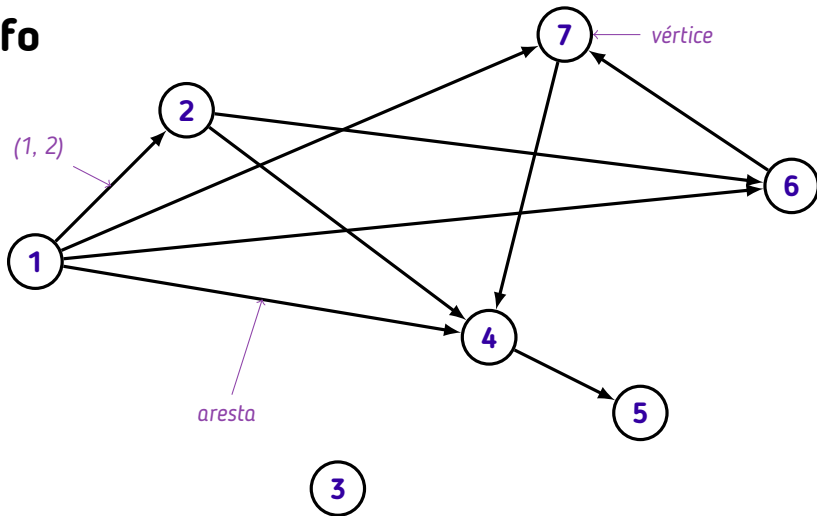
Grafo



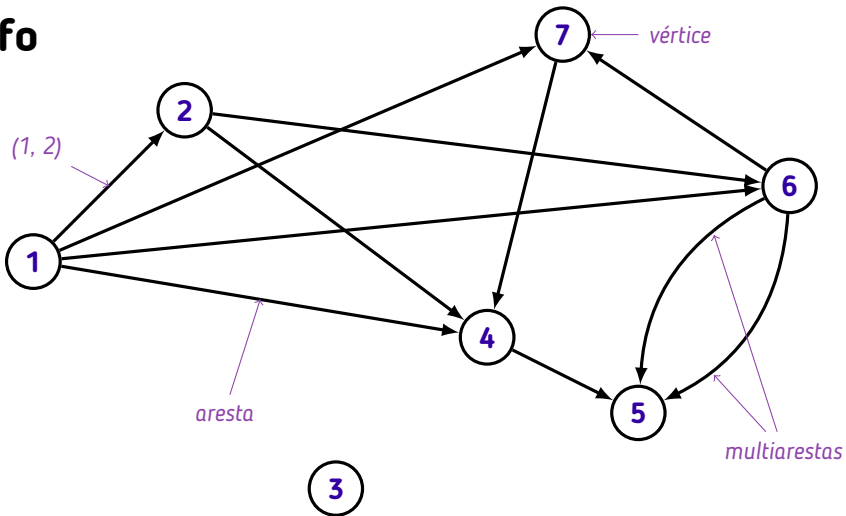
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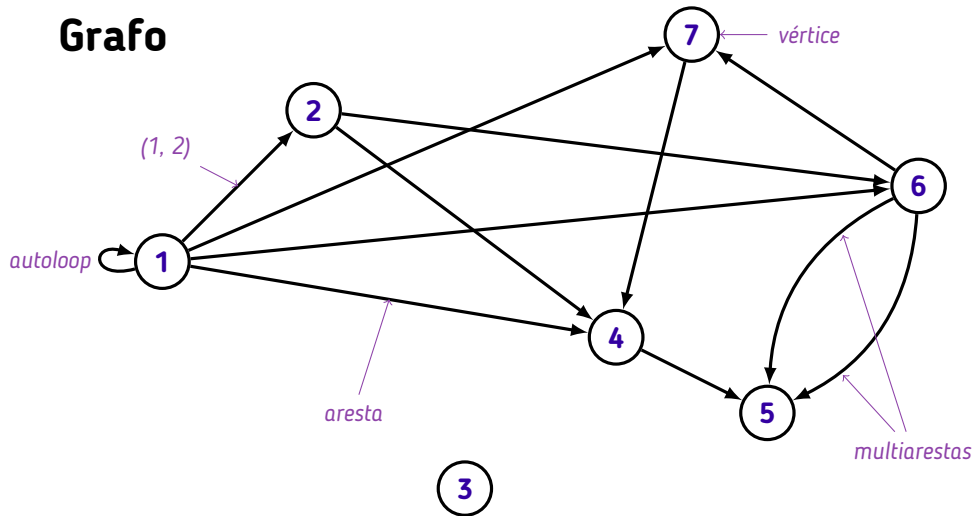
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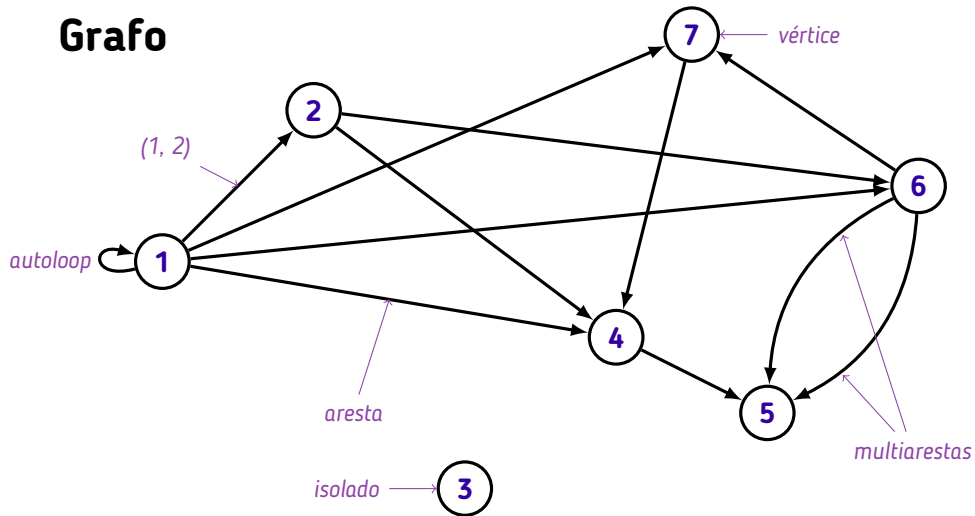
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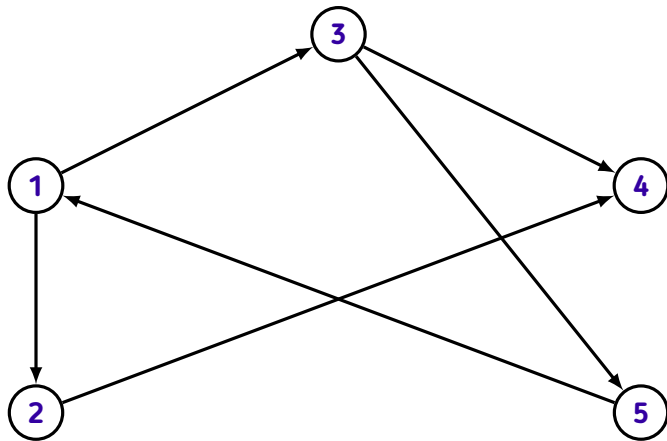
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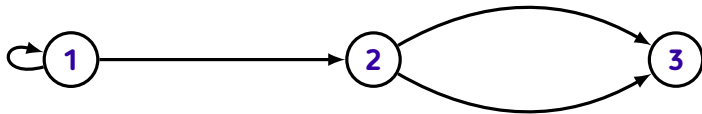
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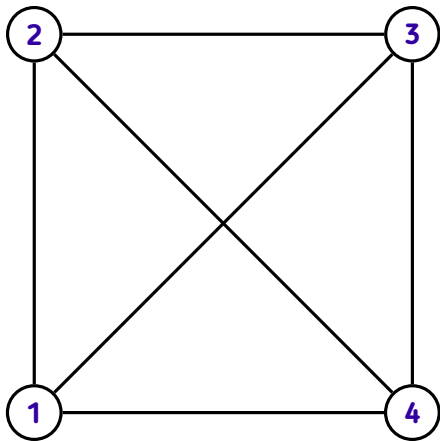
Grafo simples



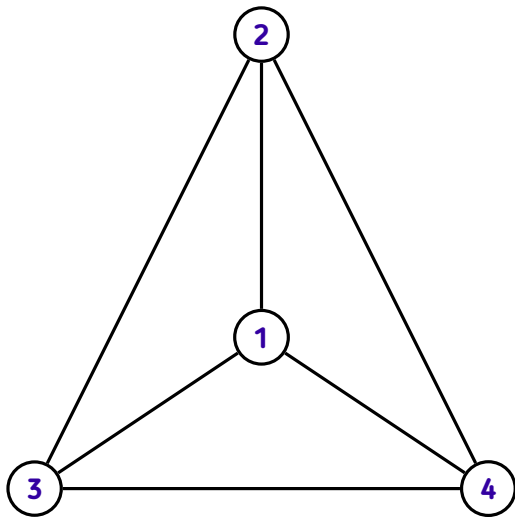
Multigrafo



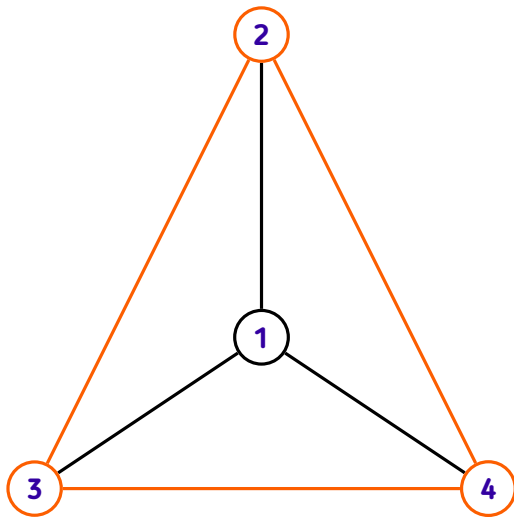
Grafo completo



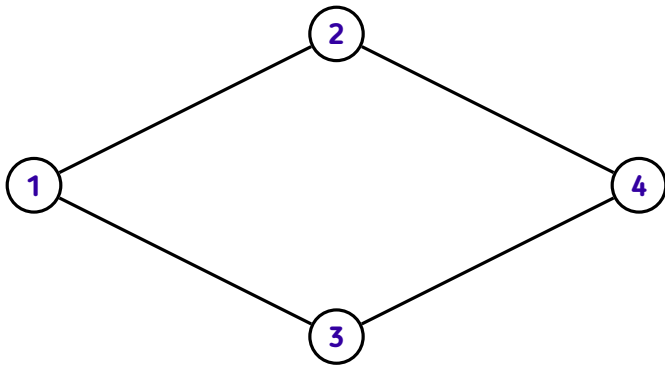
Subgrafo



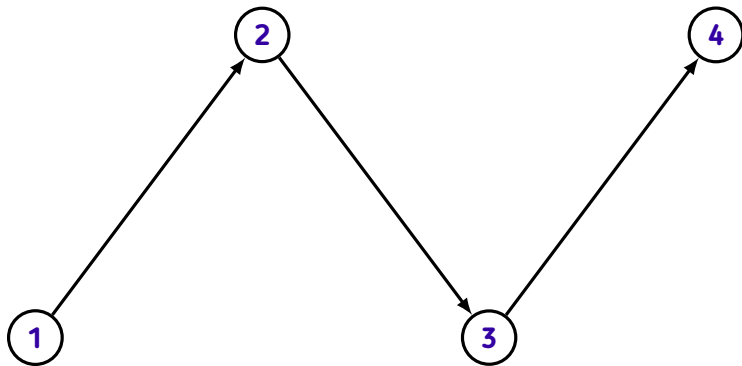
Subgrafo



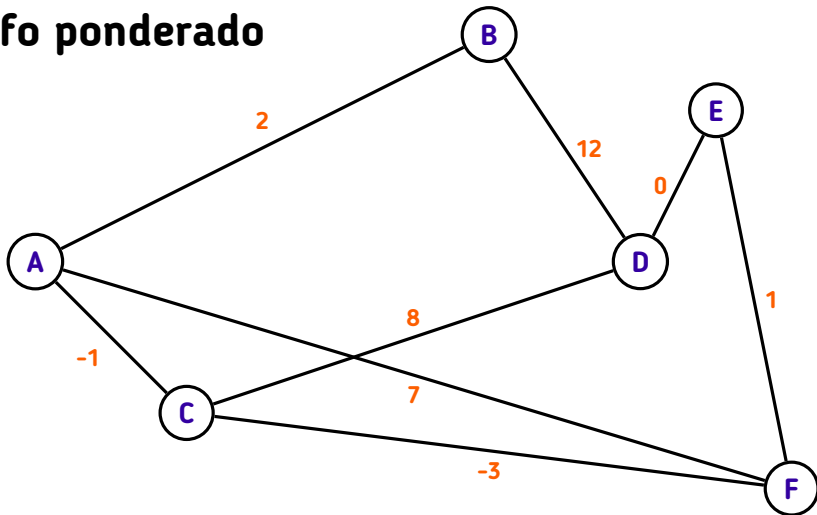
Grafo não-direcionado



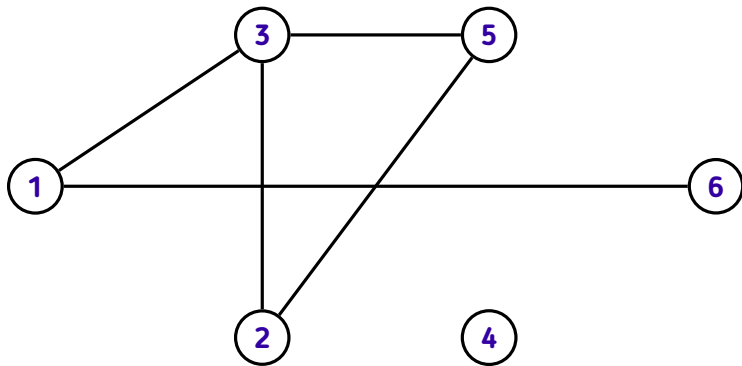
Grafo direcionado



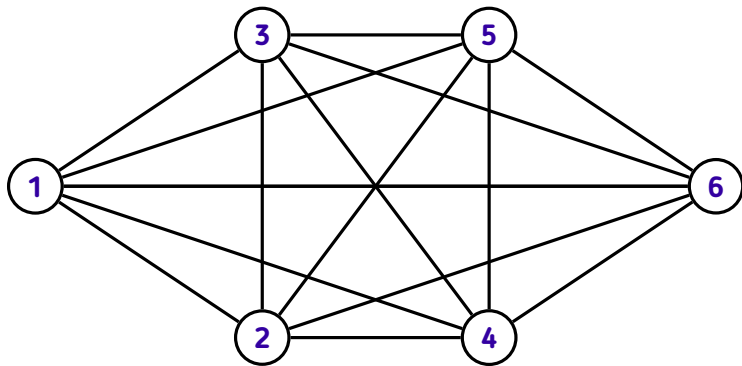
Grafo ponderado



Grafo esparso



Grafo denso



Graus

Graus

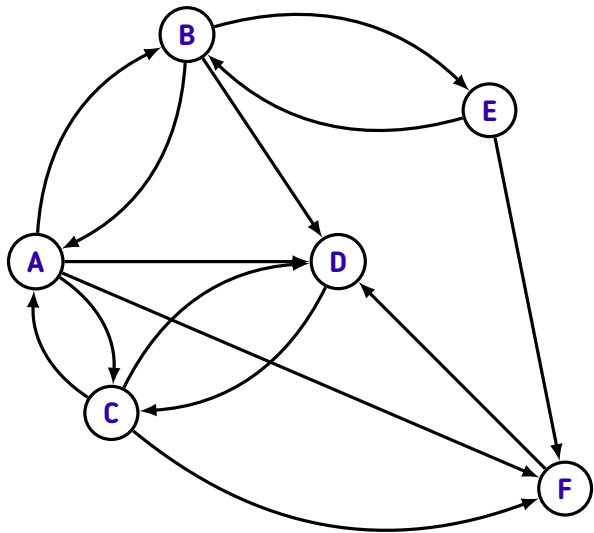
★ Grau de entrada $g_i(u)$: # vértices que chegam em u

Graus

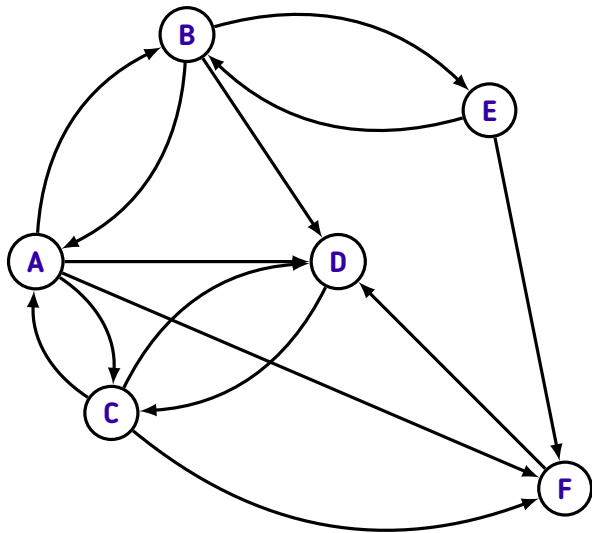
- ★ Grau de entrada $g_i(u)$: # vértices que chegam em u
- ★ Grau de saída $g_o(u)$: # vértices que partem de u

Graus

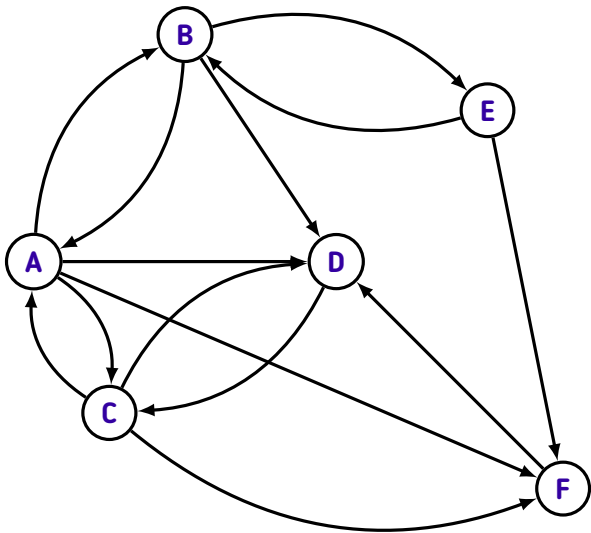
- ★ Grau de entrada $g_i(u)$: # vértices que chegam em u
- ★ Grau de saída $g_o(u)$: # vértices que partem de u
- ★ Se G é não-direcionado, então $g_i(u) = g_o(u)$, $\forall u \in V$



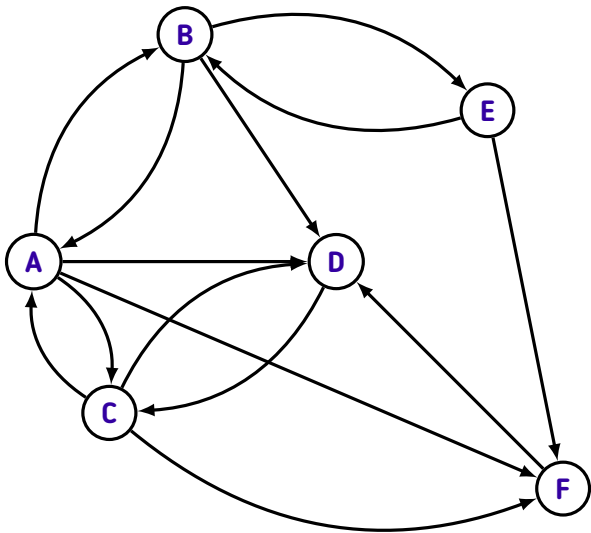
u	$g_i(u)$	$g_o(u)$



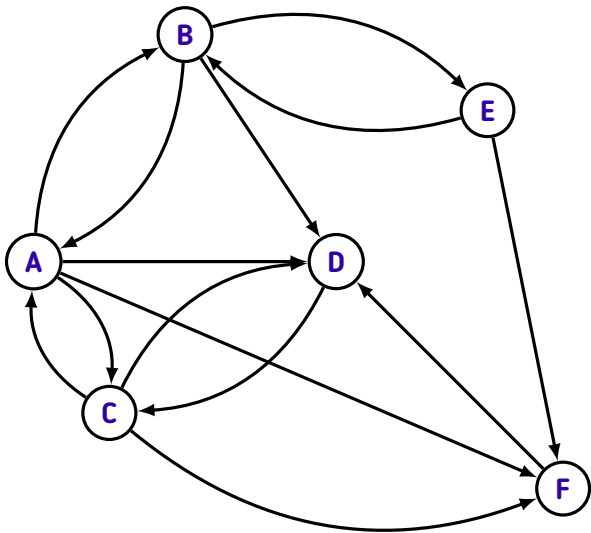
<i>u</i>	$g_i(u)$	$g_o(u)$
A	2	4
B	2	3



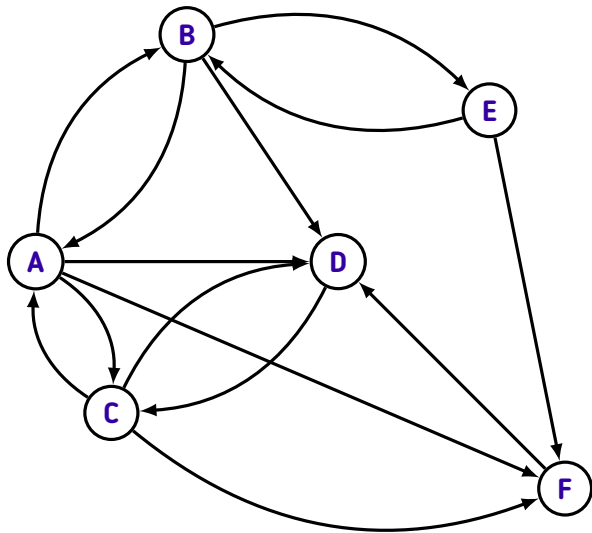
u	$g_i(u)$	$g_o(u)$
A	2	4
B	2	3
C	2	3



u	$g_i(u)$	$g_o(u)$
A	2	4
B	2	3
C	2	3
D	4	1



u	$g_i(u)$	$g_o(u)$
A	2	4
B	2	3
C	2	3
D	4	1
E	1	2



u	$g_i(u)$	$g_o(u)$
A	2	4
B	2	3
C	2	3
D	4	1
E	1	2
F	3	1

Caminhos

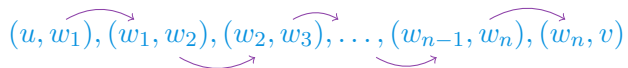
Um caminho é uma sequência não-nula de vértices da forma

$$(u, w_1), (w_1, w_2), (w_2, w_3), \dots, (w_{n-1}, w_n), (w_n, v)$$

onde u é o ponto de partida e v o ponto de chegada

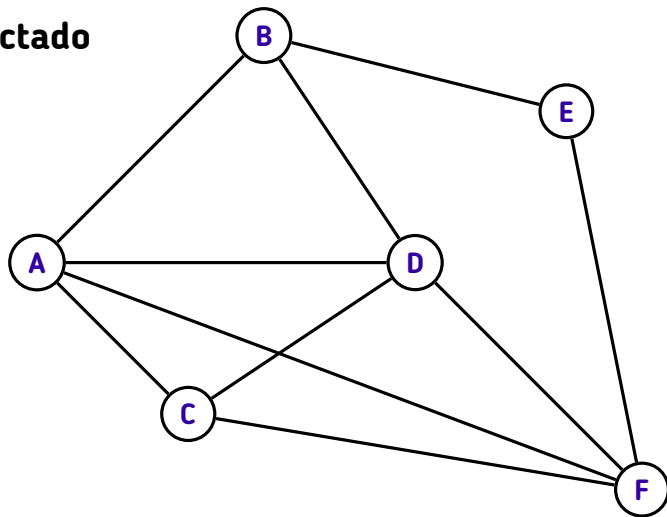
Caminhos

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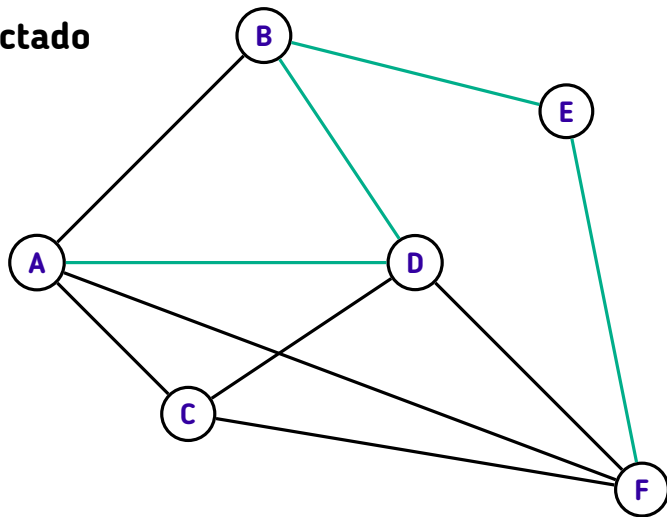
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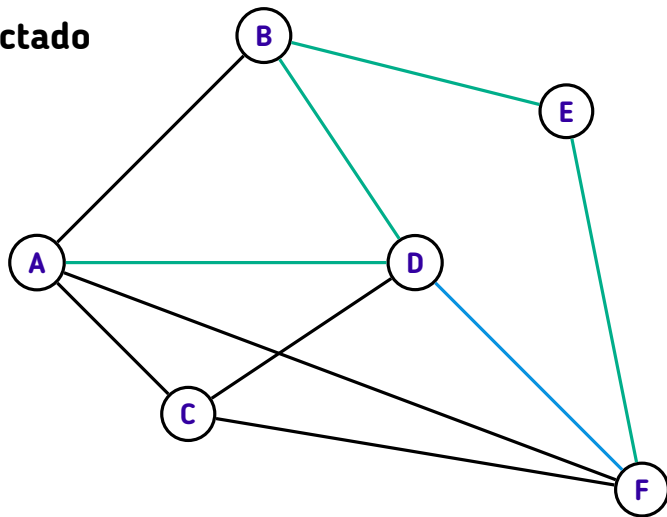
Grafo conectado



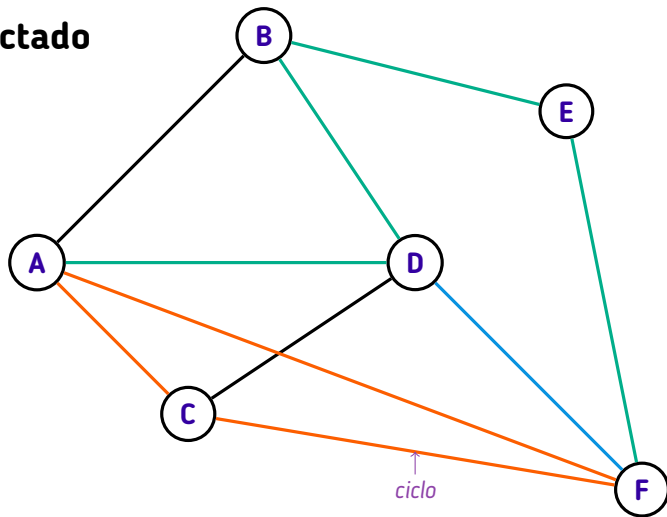
Grafo conectado



Grafo conectado



Grafo conectado



Referências

1. HALIM, Felix; HALIM, Steve. *Competitive Programming 3*, 2010.
2. LAAKSONEN, Antti. *Competitive Programmer's Handbook*, 2018.
3. SKIENA, Steven; REVILLA, Miguel. *Programming Challenges*, 2003.