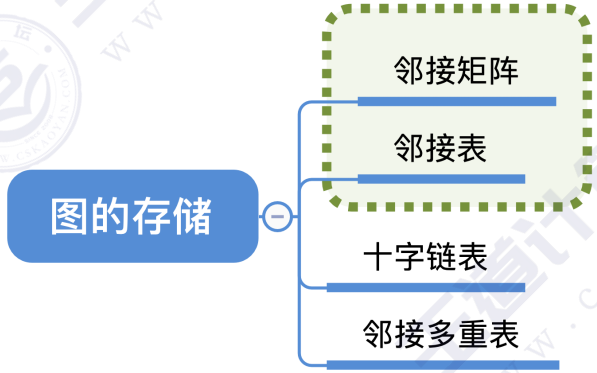
本节内容

图

基本操作

知识总览



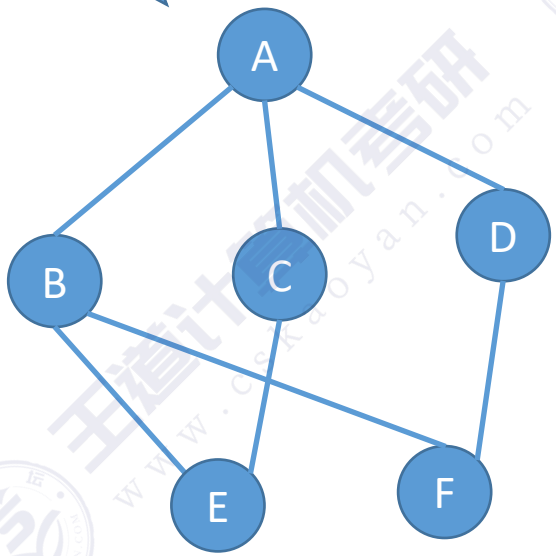
图的基本操作：

- Adjacent(G,x,y)：判断图*G*是否存在边<*x*, *y*>或(*x*, *y*)。
- Neighbors(G,x)：列出图*G*中与结点*x*邻接的边。
- InsertVertex(G,x)：在图*G*中插入顶点*x*。
- DeleteVertex(G,x)：从图*G*中删除顶点*x*。
- AddEdge(G,x,y)：若无向边(*x*, *y*)或有向边<*x*, *y*>不存在，则向图*G*中添加该边。
- RemoveEdge(G,x,y)：若无向边(*x*, *y*)或有向边<*x*, *y*>存在，则从图*G*中删除该边。
- FirstNeighbor(G,x)：求图*G*中顶点*x*的第一个邻接点，若有则返回顶点号。若*x*没有邻接点或图中不存在*x*，则返回-1。
- NextNeighbor(G,x,y)：假设图*G*中顶点*y*是顶点*x*的一个邻接点，返回除*y*之外顶点*x*的下一个邻接点的顶点号，若*y*是*x*的最后一个邻接点，则返回-1。
- Get_edge_value(G,x,y)：获取图*G*中边(*x*, *y*)或<*x*, *y*>对应的权值。
- Set_edge_value(G,x,y,v)：设置图*G*中边(*x*, *y*)或<*x*, *y*>对应的权值为*v*。

图的基本操作

- Adjacent(G,x,y)：判断图G是否存在边$<x, y>$或(x, y)。

无向图



邻接矩阵

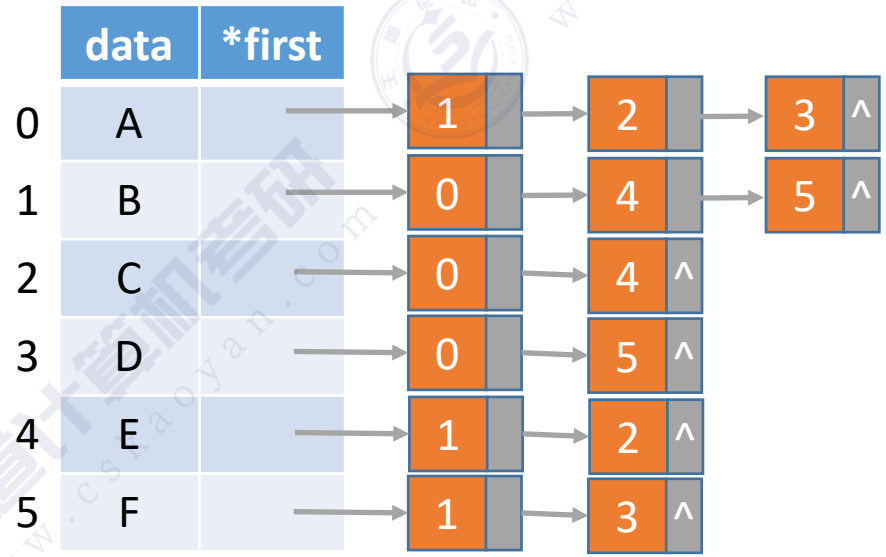
O(1)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	0	1	0
D	1	0	0	0	0	1
E	0	1	1	0	0	0
F	0	1	0	1	0	0

邻接表

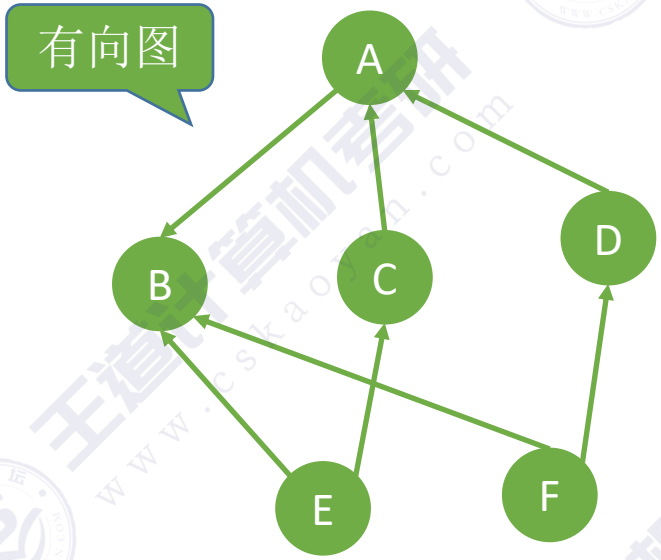
O(1)~O(|V|)



图的基本操作

- Adjacent(G,x,y)：判断图*G*是否存在边<*x*, *y*>或(*x*, *y*)。

有向图



邻接矩阵　O(1)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	0	0	0	0
B	0	0	0	0	0	0
C	1	0	0	0	0	0
D	1	0	0	0	0	0
E	0	1	1	0	0	0
F	0	1	0	1	0	0

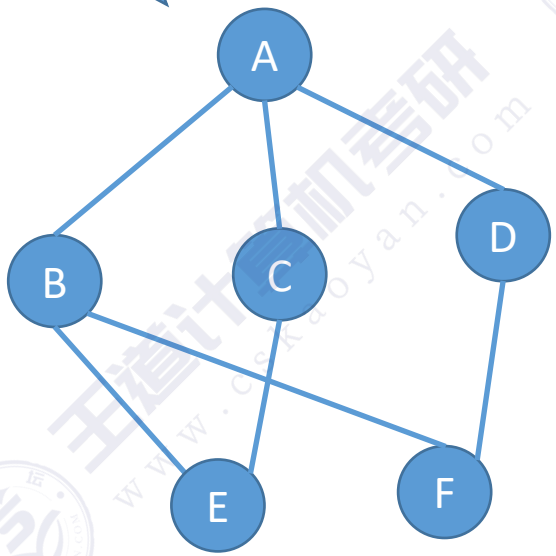
邻接表　O(1)~O(|V|)

	data	*first
0	A	→ 1 ^
1	B	^
2	C	→ 0 ^
3	D	→ 0 ^
4	E	→ 1 → 2 ^
5	F	→ 1 → 3 ^

图的基本操作

- Neighbors(G,x)：列出图*G*中与结点*x*邻接的边。

无向图

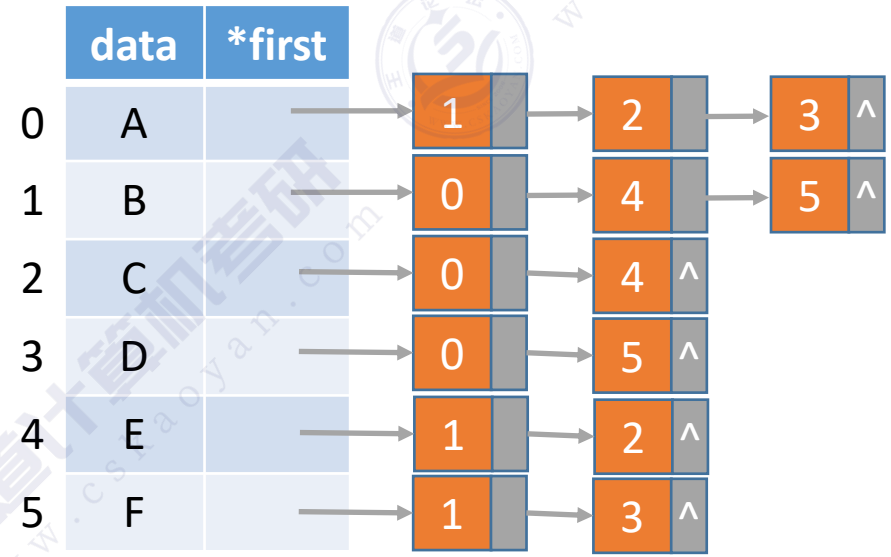


邻接矩阵 O(|V|)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	0	1	0
D	1	0	0	0	0	1
E	0	1	1	0	0	0
F	0	1	0	1	0	0

邻接表 O(1)~O(|V|)



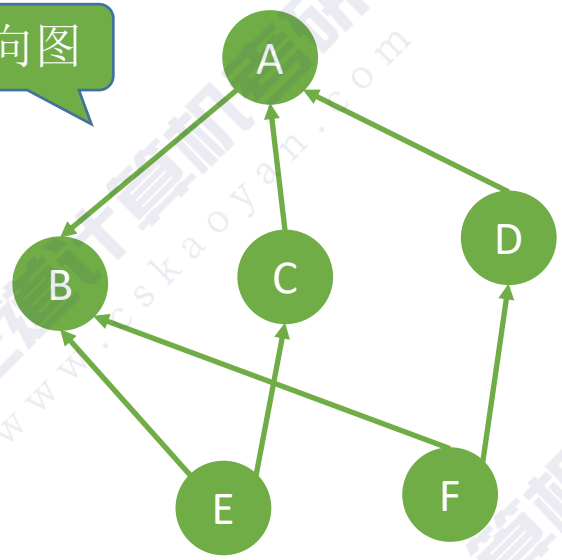
图的基本操作

- Neighbors(G,x)：列出图*G*中与结点*x*邻接的边。

万一是个稀疏图呢？

出边：O(1)~O(|V|)
入边：O(|E|)

有向图



邻接矩阵

O(|V|)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	0	0	0	0
B	0	0	0	0	0	0
C	1	0	0	0	0	0
D	1	0	0	0	0	0
E	0	1	1	0	0	0
F	0	1	0	1	0	0

邻接表

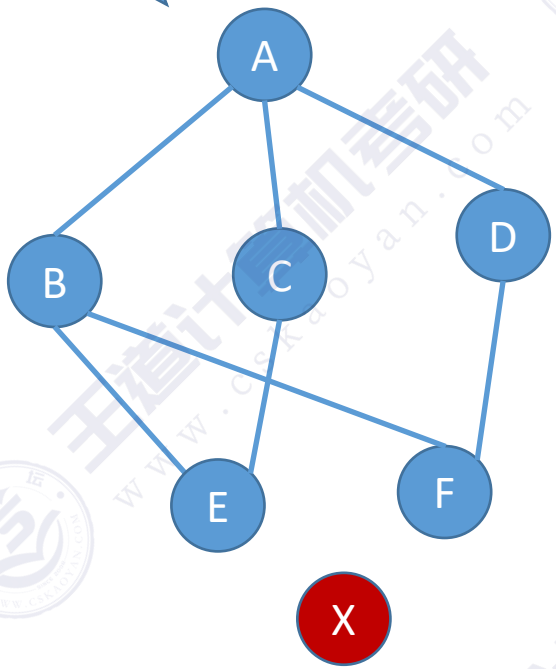
	data	*first
0	A	1 ^
1	B	^
2	C	0 ^
3	D	0 ^
4	E	1 → 2 ^
5	F	1 → 3 ^

图的基本操作

- InsertVertex(G,x)：在图*G*中插入顶点*x*。

有向图也类似

无向图



邻接矩阵 O(1)

	data
0	A
1	B
2	C
3	D
4	E
5	F
6	X

	A	B	C	D	E	F	X
A	0	1	1	1	0	0	0
B	1	0	0	0	1	1	0
C	1	0	0	0	1	0	0
D	1	0	0	0	0	1	0
E	0	1	1	0	0	0	0
F	0	1	0	1	0	0	0
X	0	0	0	0	0	0	0

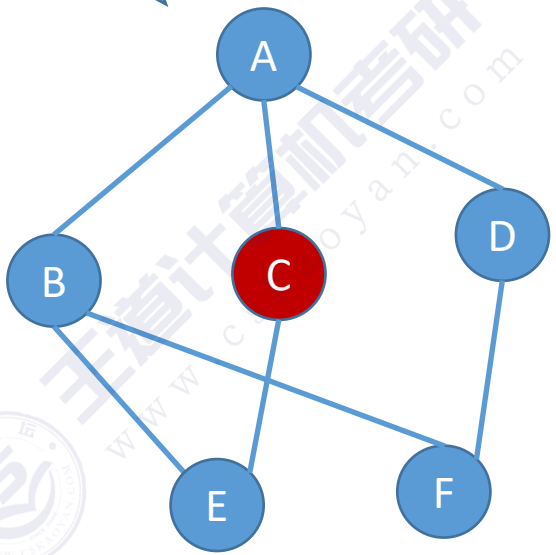
邻接表 O(1)

	data	*first
0	A	→ 1 → 2 → 3 ^
1	B	→ 0 → 4 → 5 ^
2	C	→ 0 → 4 ^
3	D	→ 0 → 5 ^
4	E	→ 1 → 2 ^
5	F	→ 1 → 3 ^
6	X	^

图的基本操作

- DeleteVertex(G,x)：从图*G*中删除顶点*x*。

无向图

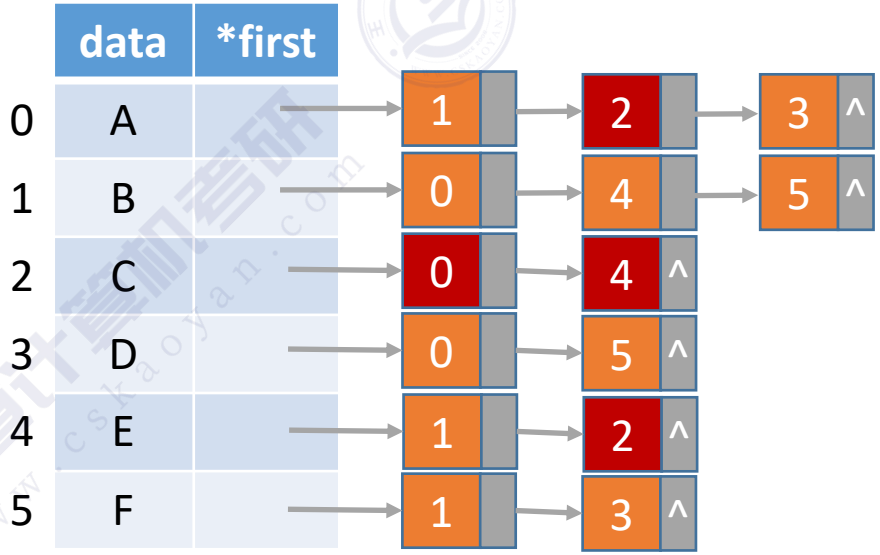


邻接矩阵

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	0	1	0
D	1	0	0	0	0	1
E	0	1	1	0	0	0
F	0	1	0	1	0	0

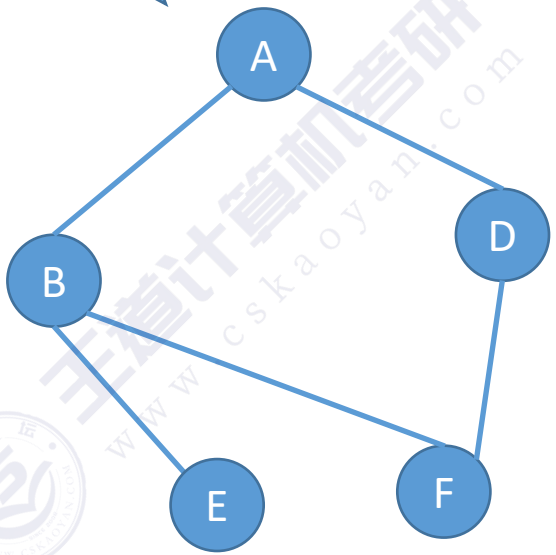
邻接表



图的基本操作

- DeleteVertex(G,x)：从图*G*中删除顶点*x*。

无向图



邻接矩阵

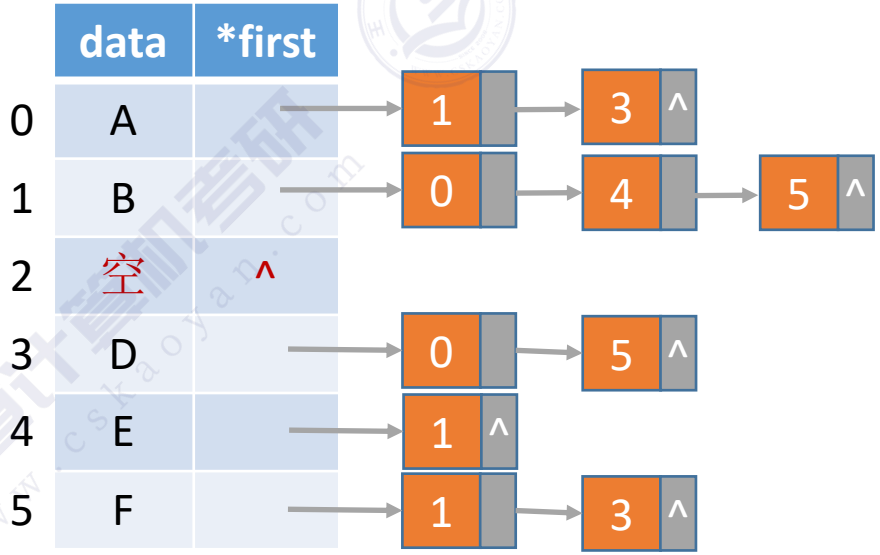
O(|V|)

	data
0	A
1	B
2	空
3	D
4	E
5	F

	A	B	空	D	E	F
A	0	1	0	1	0	0
B	1	0	0	0	1	1
空	0	0	0	0	0	0
D	1	0	0	0	0	1
E	0	1	0	0	0	0
F	0	1	0	1	0	0

邻接表

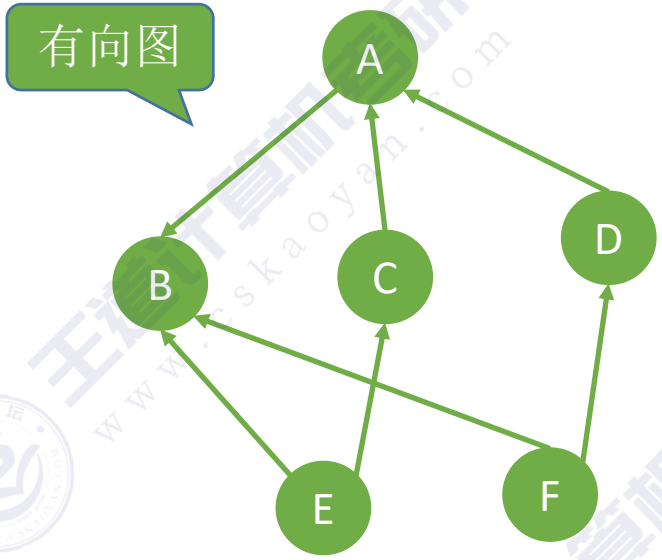
O(1)~O(|E|)



图的基本操作

- DeleteVertex(G,x)：从图*G*中删除顶点*x*。

有向图



邻接矩阵 O(|V|)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	0	0	0	0
B	0	0	0	0	0	0
C	1	0	0	0	0	0
D	1	0	0	0	0	0
E	0	1	1	0	0	0
F	0	1	0	1	0	0

邻接表

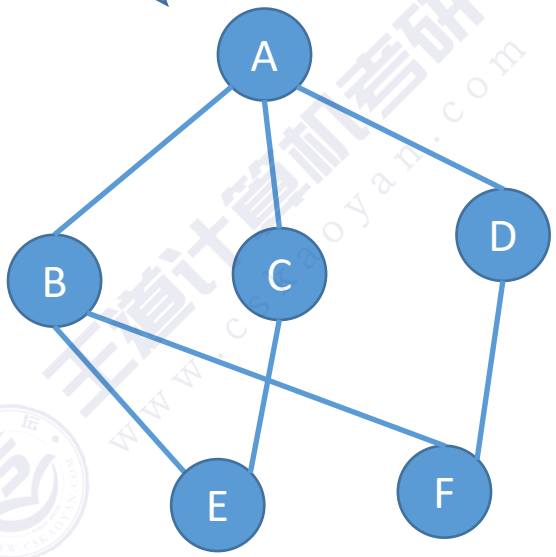
删出边：O(1)~O(|V|)
删入边：O(|E|)

	data	*first
0	A	→ 1 ^
1	B	^
2	C	→ 0 ^
3	D	→ 0 ^
4	E	→ 1 → 2 ^
5	F	→ 1 → 3 ^

图的基本操作

- AddEdge(G,x,y)：若无向边(*x*, *y*)或有向边<*x*, *y*>不存在，则向图*G*中添加该边。

无向图

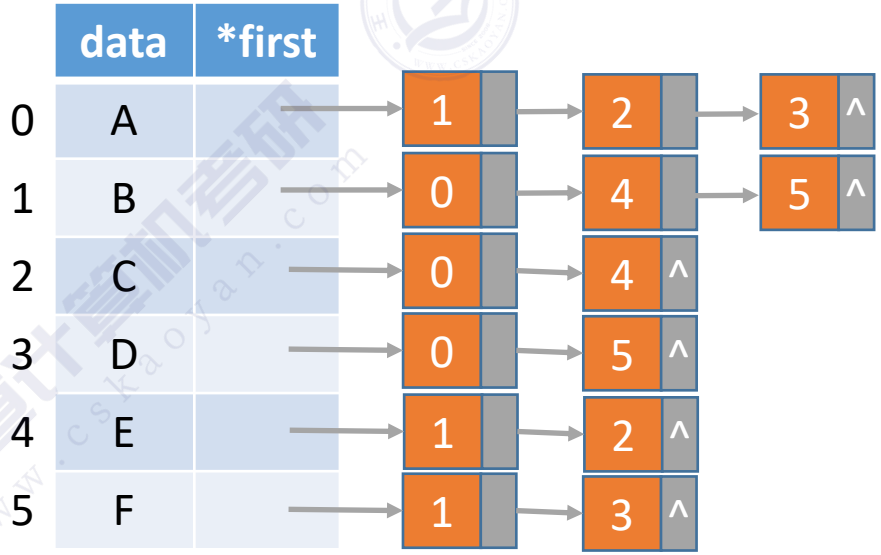


邻接矩阵 O(1)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	0	1	0
D	1	0	0	0	0	1
E	0	1	1	0	0	0
F	0	1	0	1	0	0

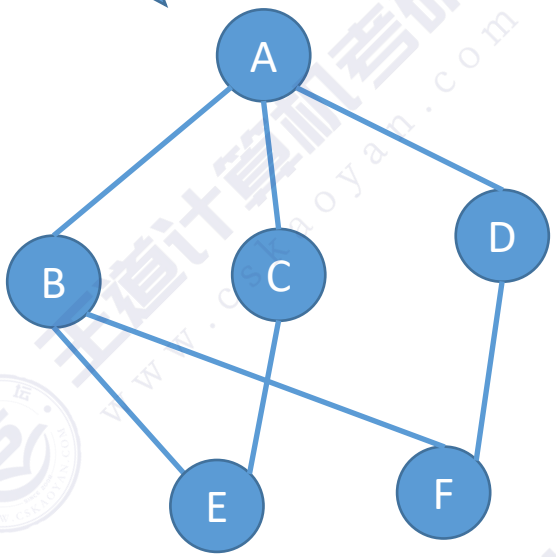
邻接表 O(1)



图的基本操作

- RemoveEdge(G,x,y)：若无向边(*x*, *y*)或有向边<*x*, *y*>存在，则从图*G*中删除该边。

无向图

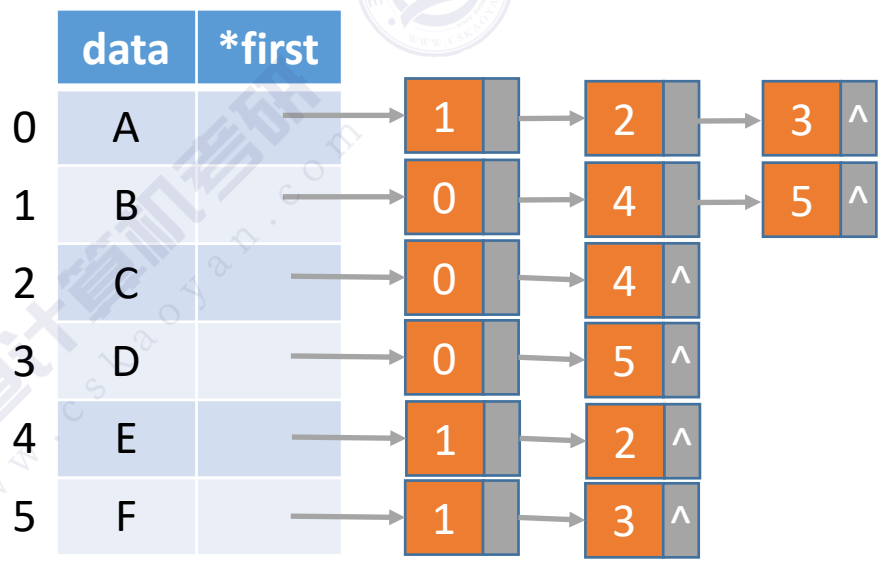


邻接矩阵 O(1)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	0	1	0
D	1	0	0	0	0	1
E	0	1	1	0	0	0
F	0	1	0	1	0	0

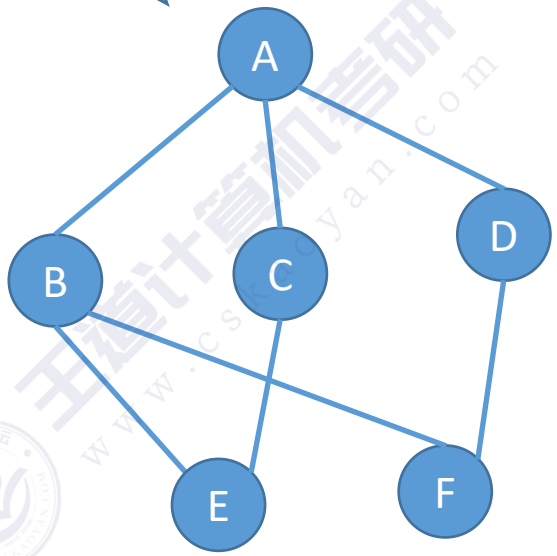
邻接表 O(1)~O(|V|)



图的基本操作

- FirstNeighbor(G,x)：求图*G*中顶点*x*的第一个邻接点，若有则返回顶点号。若*x*没有邻接点或图中不存在*x*，则返回-1。

无向图

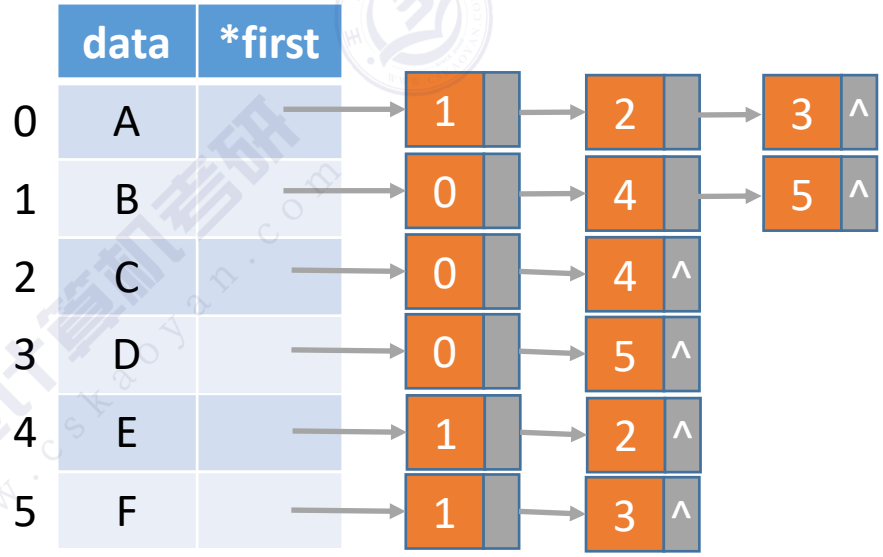


邻接矩阵 O(1)~O(|V|)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	0	1	0
D	1	0	0	0	0	1
E	0	1	1	0	0	0
F	0	1	0	1	0	0

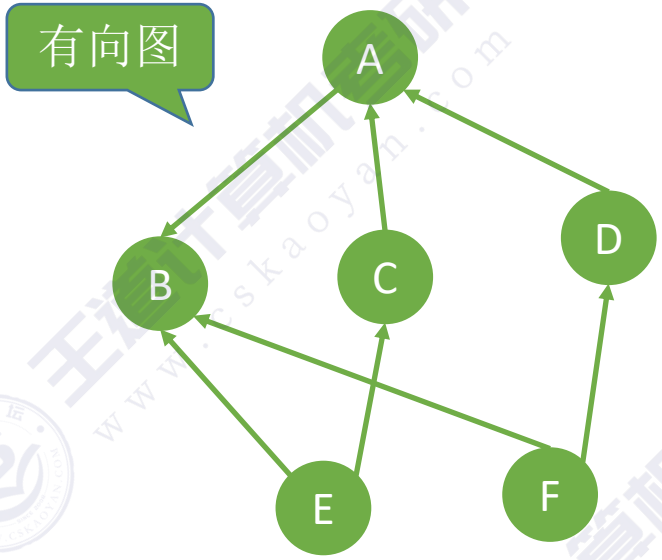
邻接表 O(1)



图的基本操作

- FirstNeighbor(G,x)：求图*G*中顶点*x*的第一个邻接点，若有则返回顶点号。若*x*没有邻接点或图中不存在*x*，则返回-1。

有向图



邻接矩阵

O(1)~O(|V|)

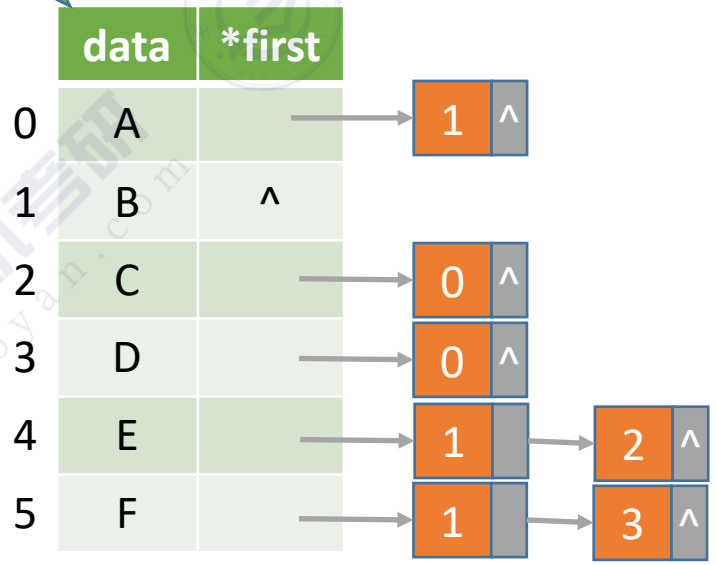
	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	0	0	0	0
B	0	0	0	0	0	0
C	1	0	0	0	0	0
D	1	0	0	0	0	0
E	0	1	1	0	0	0
F	0	1	0	1	0	0

邻接表

找出边邻接点：O(1)

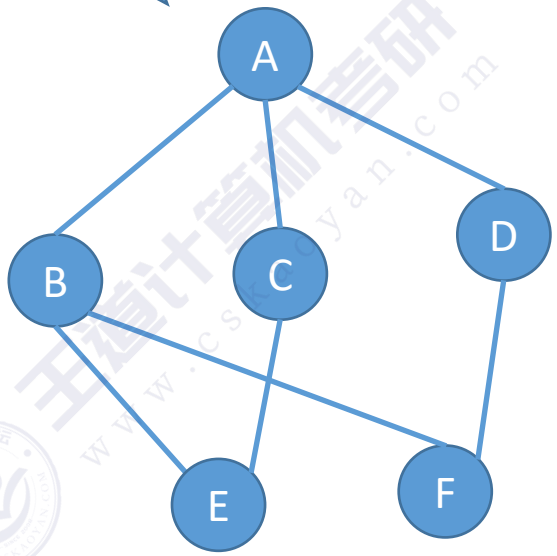
~~找入边邻接点~~：O(1) ~O(|E|)



图的基本操作

- NextNeighbor(G,x,y)：假设图*G*中顶点*y*是顶点*x*的一个邻接点，返回除*y*之外顶点*x*的下一个邻接点的顶点号，若*y*是*x*的最后一个邻接点，则返回-1。

无向图

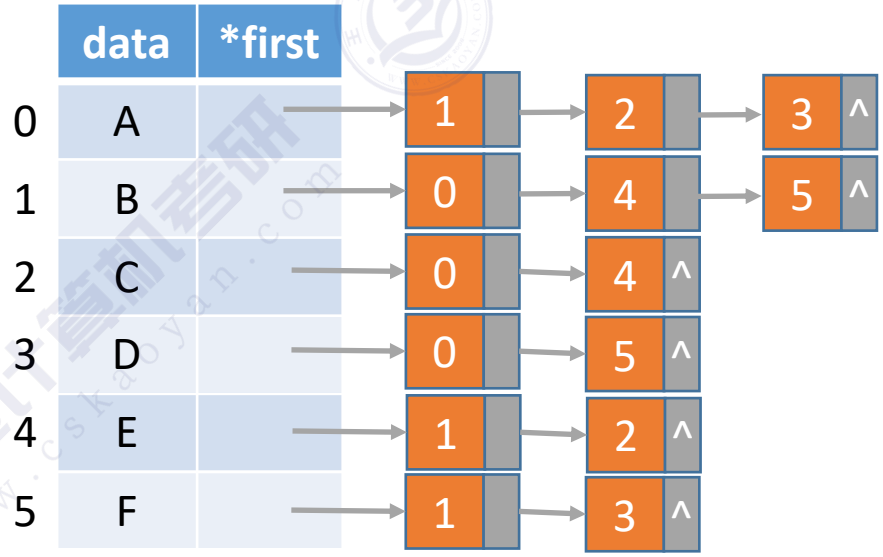


邻接矩阵 O(1)~O(|V|)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	0	1	0
D	1	0	0	0	0	1
E	0	1	1	0	0	0
F	0	1	0	1	0	0

邻接表 O(1)



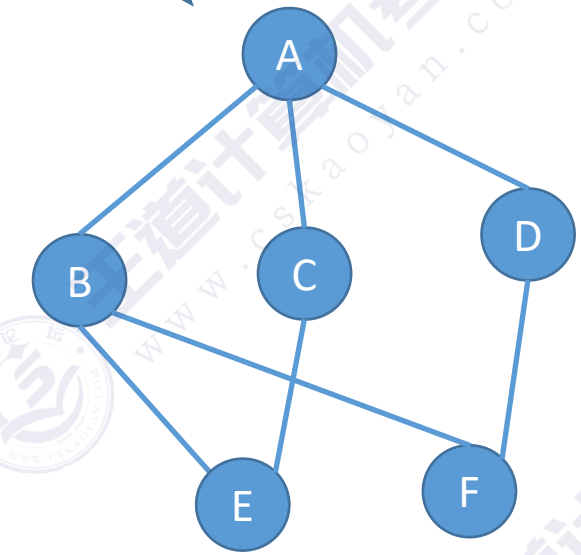
图的基本操作

- Get_edge_value(G,x,y)：获取图*G*中边(*x*, *y*)或<*x*, *y*>对应的权值。
- Set_edge_value(G,x,y,v)：设置图*G*中边(*x*, *y*)或<*x*, *y*>对应的权值为*v*。

- Adjacent(G,x,y)：判断图*G*是否存在边<*x*, *y*>或(*x*, *y*)。

雷同，核心在于找到边

无向图



邻接矩阵

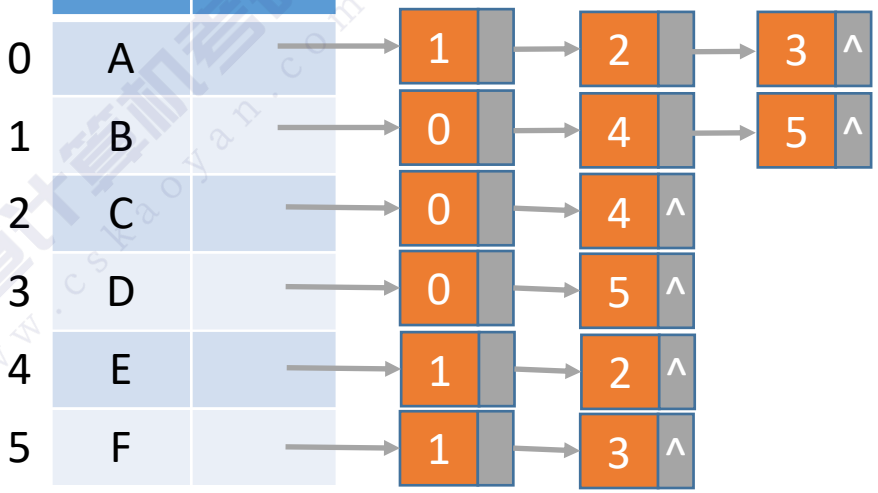
O(1)

	data
0	A
1	B
2	C
3	D
4	E
5	F

	A	B	C	D	E	F
A	0	1	1	1	0	0
B	1	0	0	0	1	1
C	1	0	0	0	1	0
D	1	0	0	0	0	1
E	0	1	1	0	0	0
F	0	1	0	1	0	0

邻接表

O(1)~O(|V|)



知识回顾与重要考点

- Adjacent(G,x,y)：判断图G是否存在边$<x, y>$或(x, y)。
- Neighbors(G,x)：列出图G中与结点x邻接的边。
- InsertVertex(G,x)：在图G中插入顶点x。
- DeleteVertex(G,x)：从图G中删除顶点x。
- AddEdge(G,x,y)：若无向边(x, y)或有向边$<x, y>$不存在，则向图G中添加该边。
- RemoveEdge(G,x,y)：若无向边(x, y)或有向边$<x, y>$存在，则从图G中删除该边。
- FirstNeighbor(G,x)：求图G中顶点x的第一个邻接点，若有则返回顶点号。若x没有邻接点或图中不存在x，则返回-1。
- NextNeighbor(G,x,y)：假设图G中顶点y是顶点x的一个邻接点，返回除y之外顶点x的下一个邻接点的顶点号，若y是x的最后一个邻接点，则返回-1。
- Get_edge_value(G,x,y)：获取图G中边(x, y)或$<x, y>$对应的权值。
- Set_edge_value(G,x,y,v)：设置图G中边(x, y)或$<x, y>$对应的权值为v。

此外，还有图的遍历算法，包括深度优先遍历和广度优先遍历。