

# Graph Representations

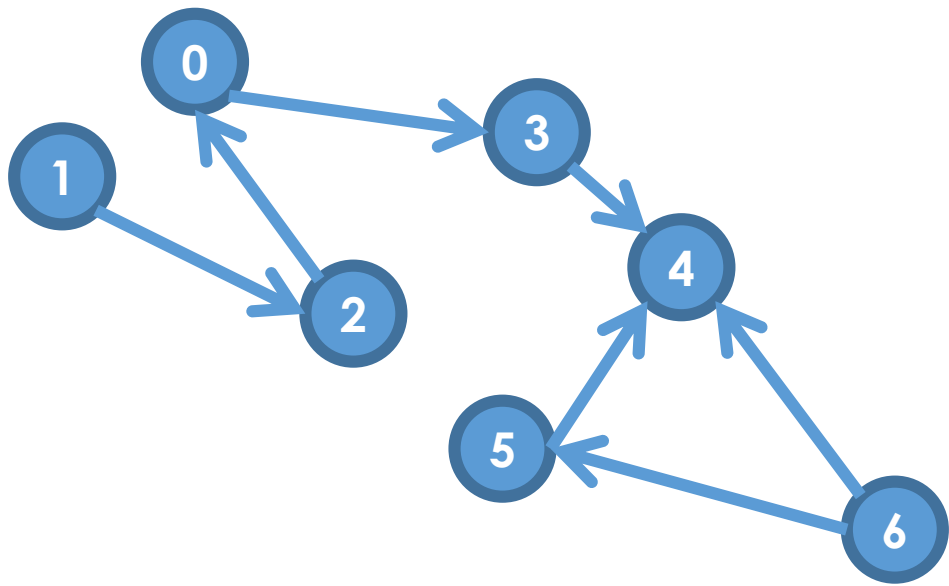


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by Christine Alvarado, Mia Minnes, and Leo Porter, 2015.

# Concept Challenge: Procedure

- **Pause** Try to solve the problem yourself
- **Discuss** with other learners (if you can)
- **Watch** the UC San Diego learners video
- **Answer** the question again
- **Confirm** your understanding with our explanation

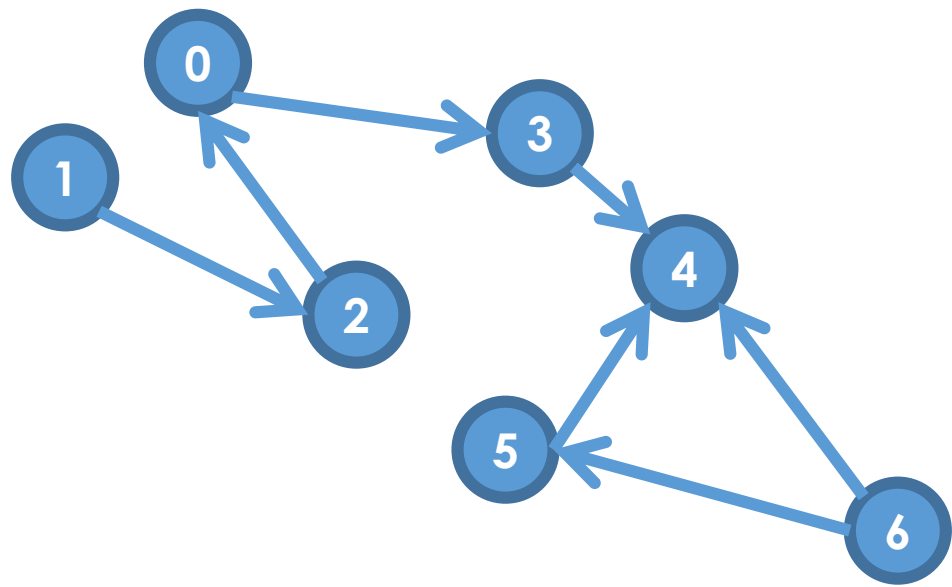




How much storage is required to represent a graph as a matrix? (Big-O, Tightest Bound)

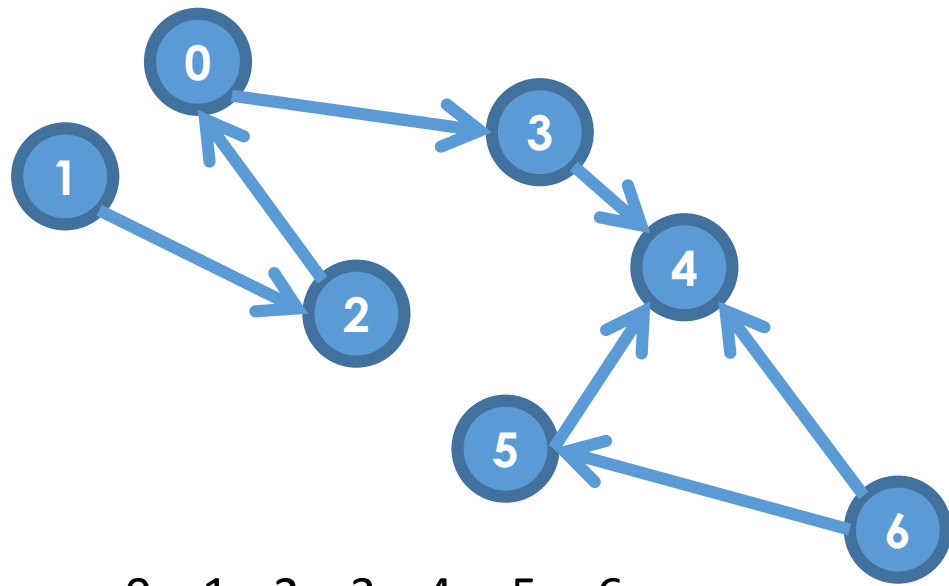
- A.  $|V|$
- B.  $|E|$
- C.  $|V| + |E|$
- D.  $|V|^2$
- E.  $|E|^2$

**Warmup  
Question**



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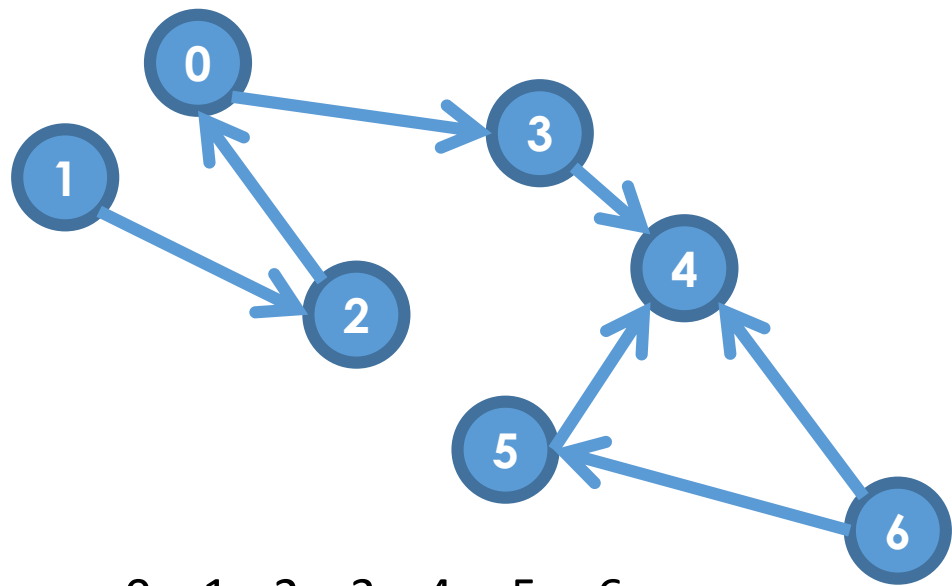
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- D.  $|V|^2$
- E.  $|E|^2$



	0	1	2	3	4	5	6
0				1			
1			1				
2	1						
3					1		
4							
5					1		
6					1	1	

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	0	1	2	3	4	5	6
0				1			
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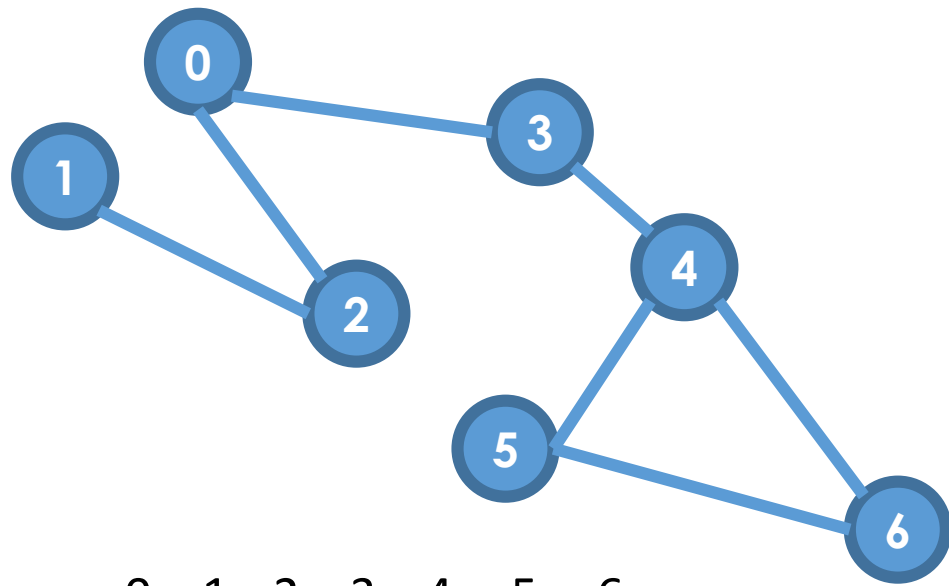
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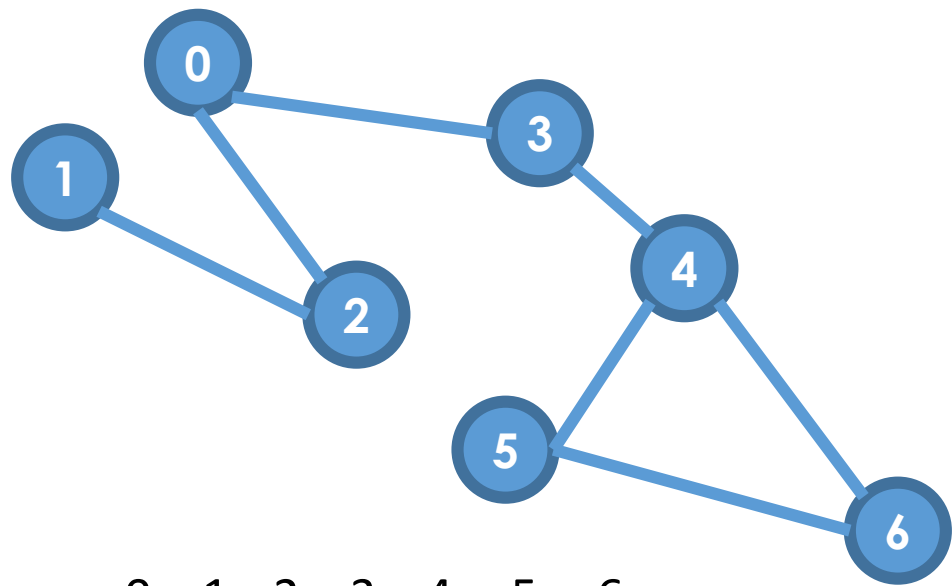


	0	1	2	3	4	5	6
0			1	1			
1			1				
2	1	1					
3	1				1		
4				1		1	1
5					1		1
6					1	1	

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**What would change if undirected?**



	0	1	2	3	4	5	6
0	1		1	1			
1		1					
2	1	1	1				
3	1			1			
4				1	1	1	
5					1	1	1
6					1	1	1

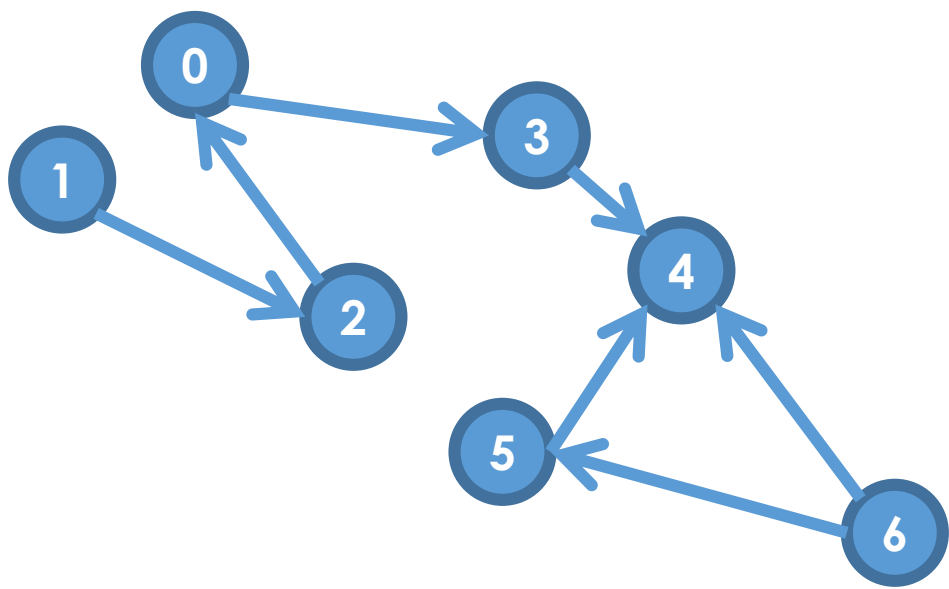
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**What would change if undirected?**

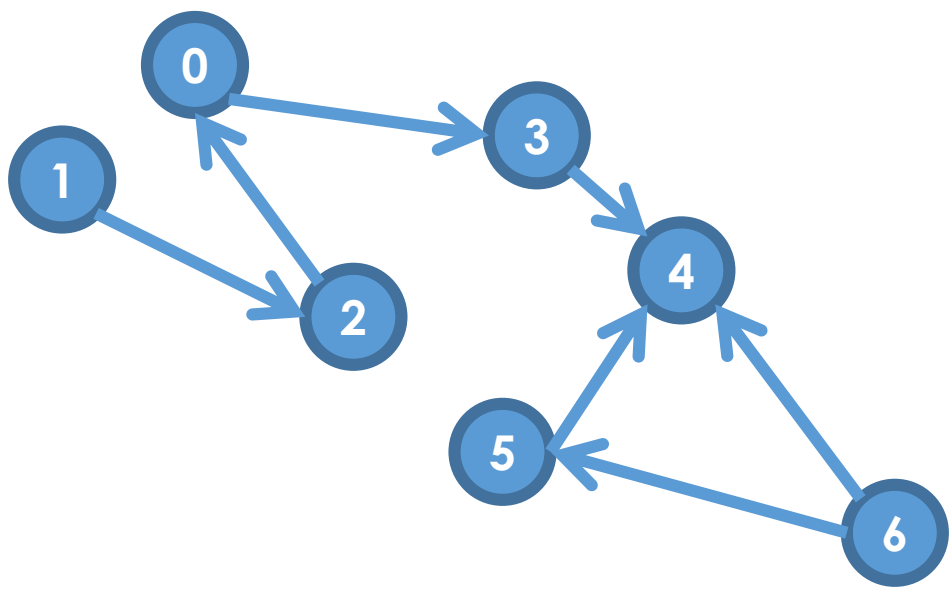
**Half is redundant, but still  $O(|V|^2)$**





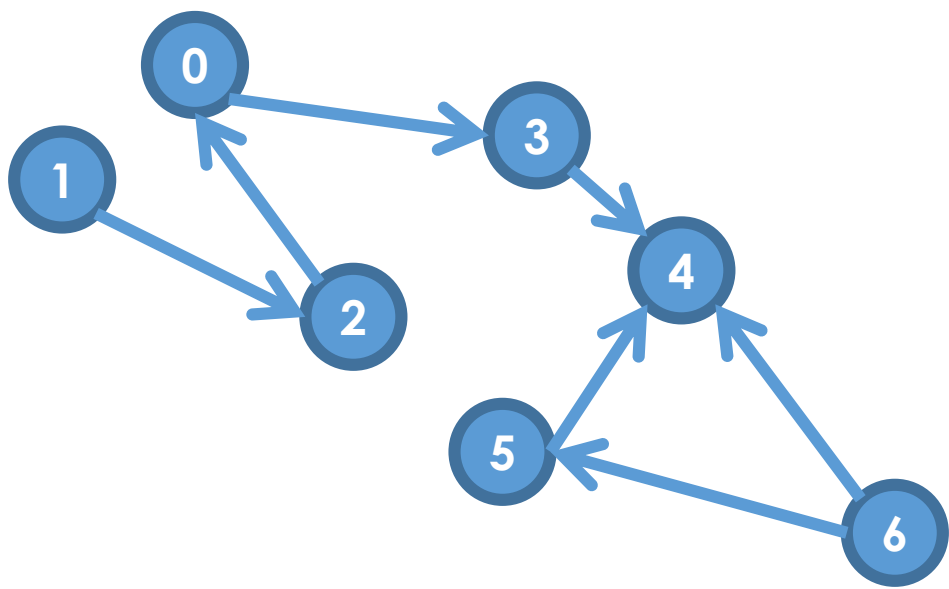
How much storage is required to represent a graph as an **adjacency list**? (Big-O, Tightest Bound)

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How much storage is required to represent a graph as an **adjacency list**? (Big-O, Tightest Bound)

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- C.  $|V| + |E|$
- D.  $|V|^2$
- E.  $|E|^2$



0 → { 3 }

1 → { 2 }

2 → { 0 }

3 → { 4 }

4 → { null }

5 → { 4 }

6 → { 4, 5 }

How much storage is required to represent a graph as an **adjacency list**? (Big-O, Tightest Bound)

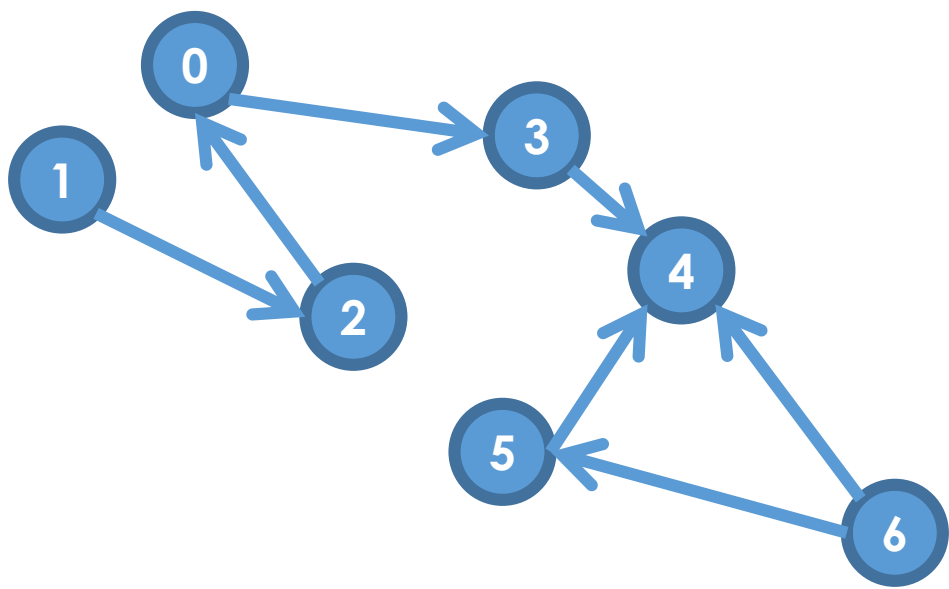
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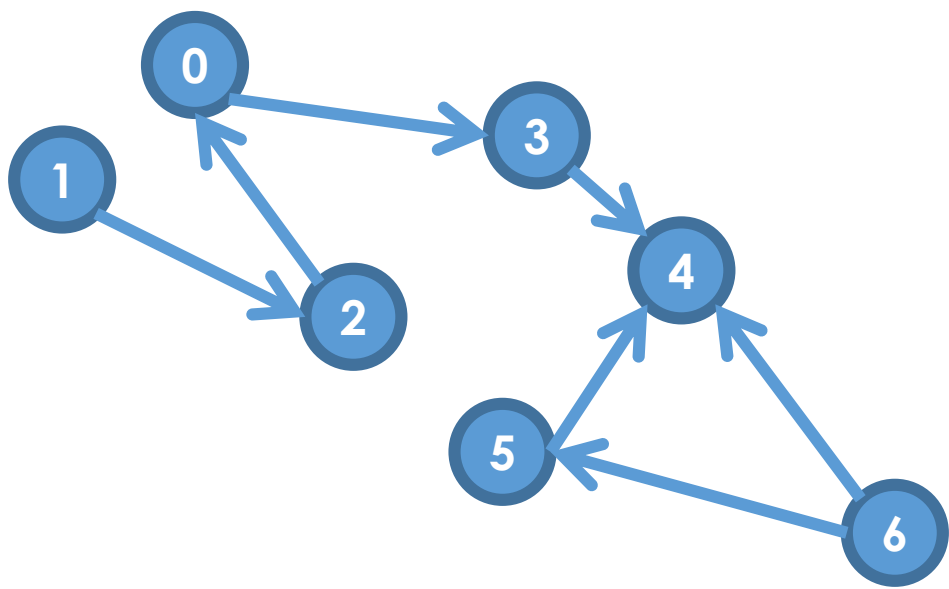
A.  $|V|$

B.  $|E|$

C.  $|V| + |E|$

D.  $|V|^2$

E.  $|E|^2$



$O(|V|)$

$0 \rightarrow \{3\}$

$1 \rightarrow \{2\}$

$2 \rightarrow \{0\}$

$3 \rightarrow \{4\}$

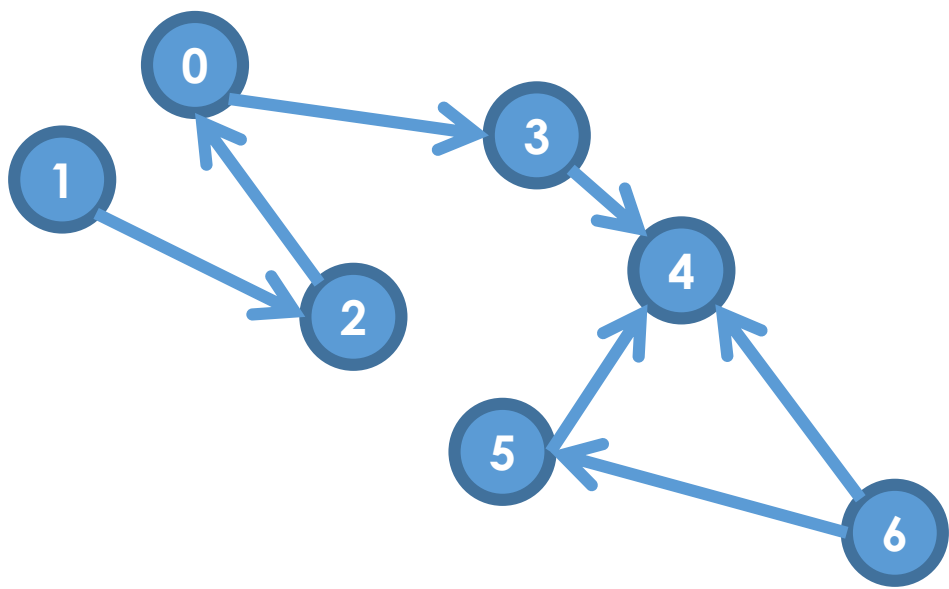
$4 \rightarrow \{\text{null}\}$

$5 \rightarrow \{4\}$

$6 \rightarrow \{4, 5\}$

How much storage is required to represent a graph as an **adjacency list**? (Big-O, Tightest Bound)

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$O(|V|)$

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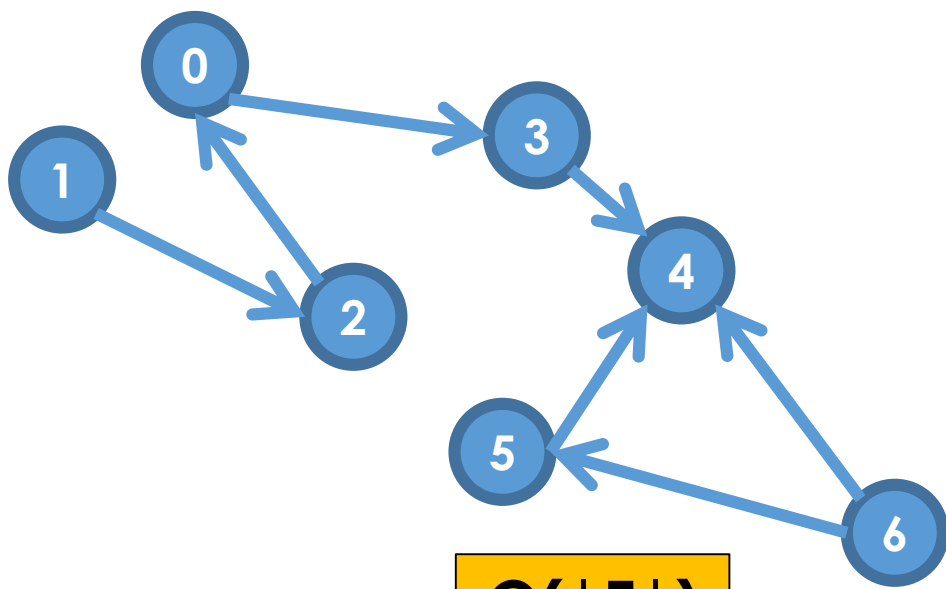
A.  $|V|$

B.  $|E|$

C.  $|V| + |E|$

D.  $|V|^2$

E.  $|E|^2$



$O(|E|)$

$O(|V|)$

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How much storage is required to represent a graph as an **adjacency list**? (Big-O, Tightest Bound)

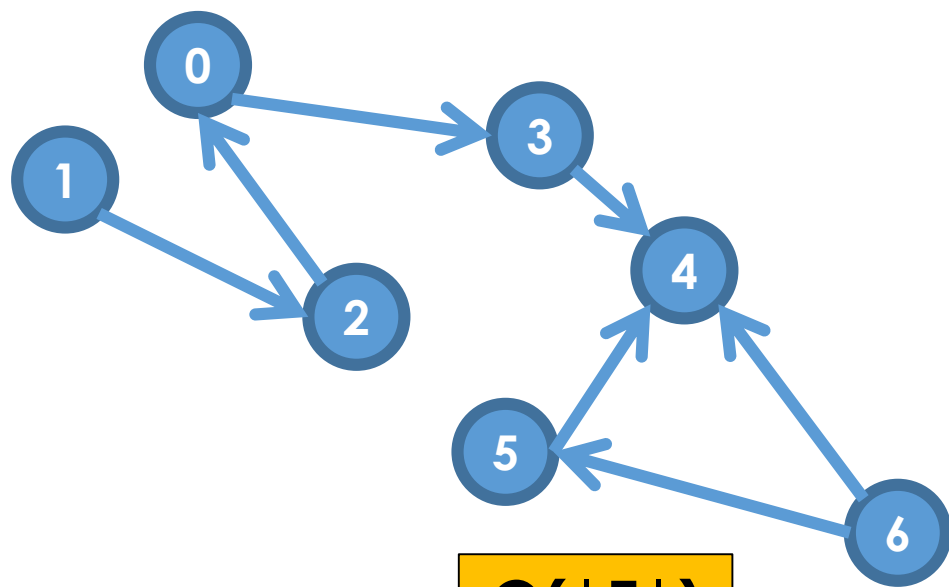
A.  $|V|$

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C.  $|V| + |E|$

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E.  $|E|^2$



$O(|E|)$

$O(|V|)$

0 → { 3 }

1 → { 2 }

2 → { 0 }

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How much storage is required to represent a graph as an **adjacency list**? (Big-O, Tightest Bound)

A.  $|V|$

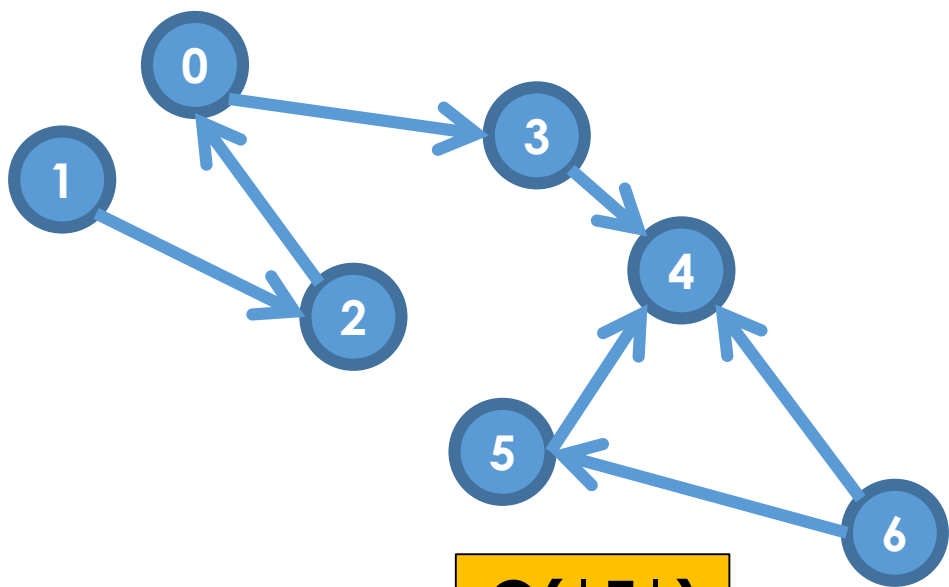
B.  $|E|$

C.  $|V| + |E|$

D.  $|V|^2$

E.  $|E|^2$





$O(|E|)$

$O(|V|)$

0 → { 3 }

1 → { 2 }

2 → { 0 }

3 → { 4 }

4 → { null }

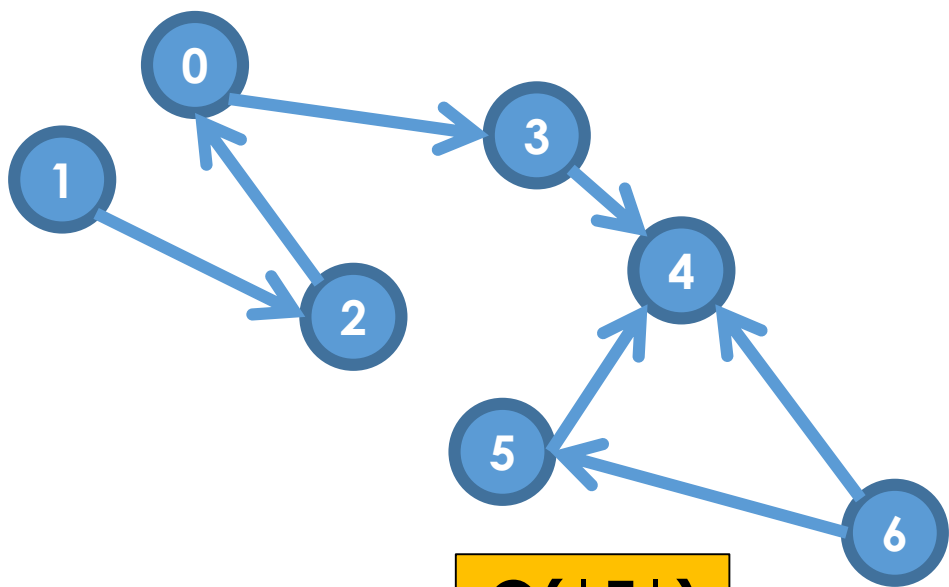
5 → { 4 }

6 → { 4, 5 }

How much storage is required to represent a graph as an **adjacency list**? (Big-O, Tightest Bound)

- A.  $|V|$
- B.  $|E|$
- C.  $|V| + |E|$
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**Much more efficient for sparse graphs!**



$O(|E|)$

$O(|V|)$

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5 → { 4 }

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How much storage is required to represent a graph as an **adjacency list**? (Big-O, Tightest Bound)

A.  $|V|$

B.  $|E|$

C.  $|V| + |E|$

D.  $|V|^2$

E.  $|E|^2$

For dense graphs with lots of edges,  $|E|$  will be as large as  $|V|^2$