CS 61BL Lab 16

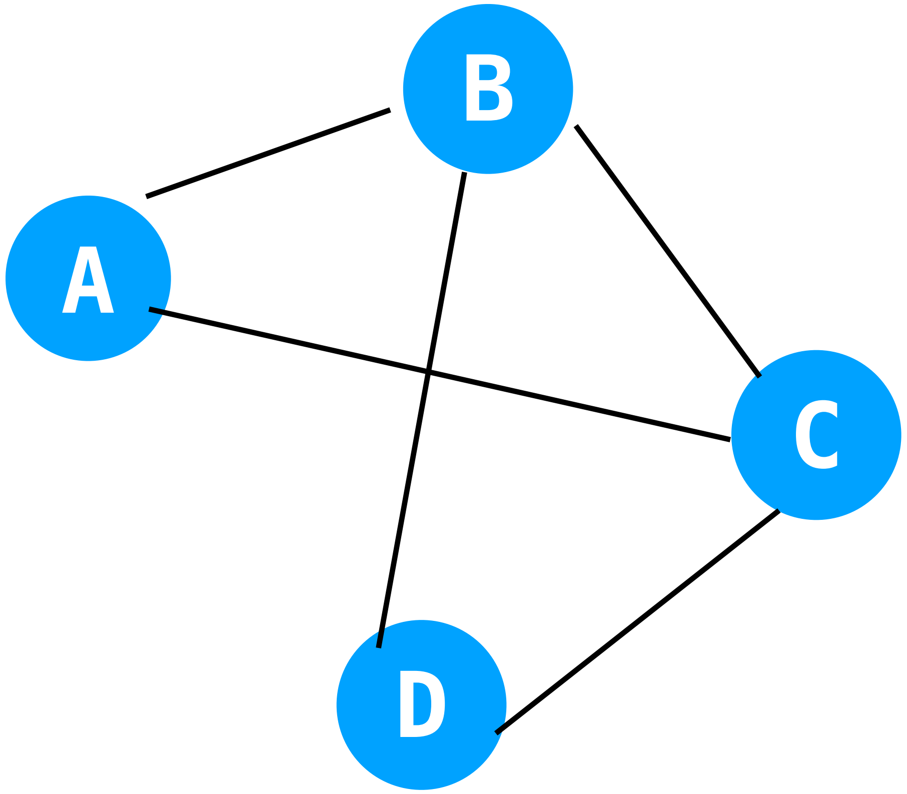
Ryan Purpura

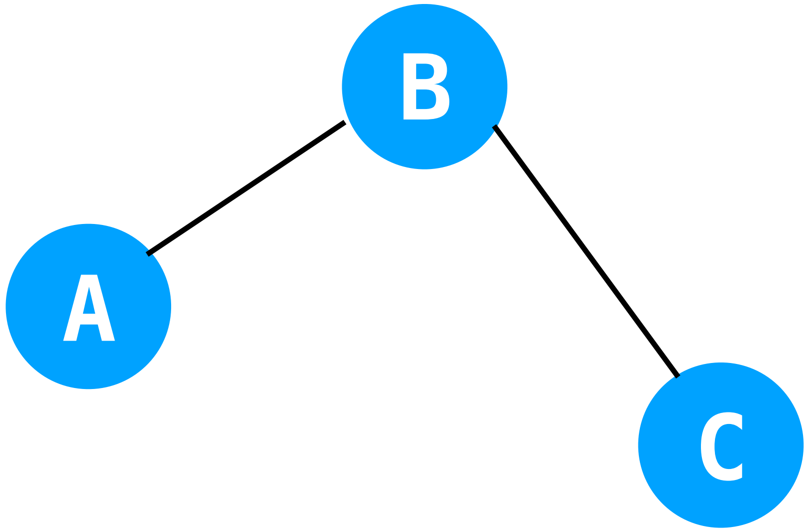
Take a moment to reflect...

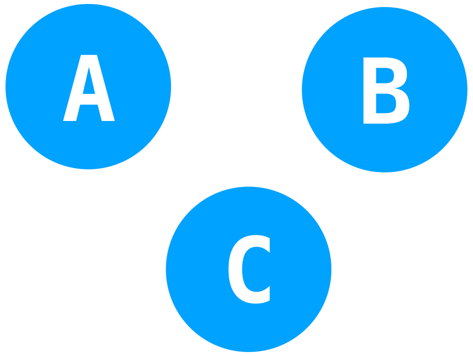
- Midterm 2 is all said and done.
- We've covered an incredible amount of material in 6 short weeks so far.
  - Java, Enigma, Linked Lists, Asymptotics, BSTs, Higher-order functions, B-Trees, LLRBs, Exceptions, Iteration, Hash Tables, Heaps...
- We have two and a half weeks left, don't give up!

Graphs

- Graphs are a set of nodes connected by edges.
- Unlike trees or linked lists, there is no limitation on how nodes can or cannot be connected.

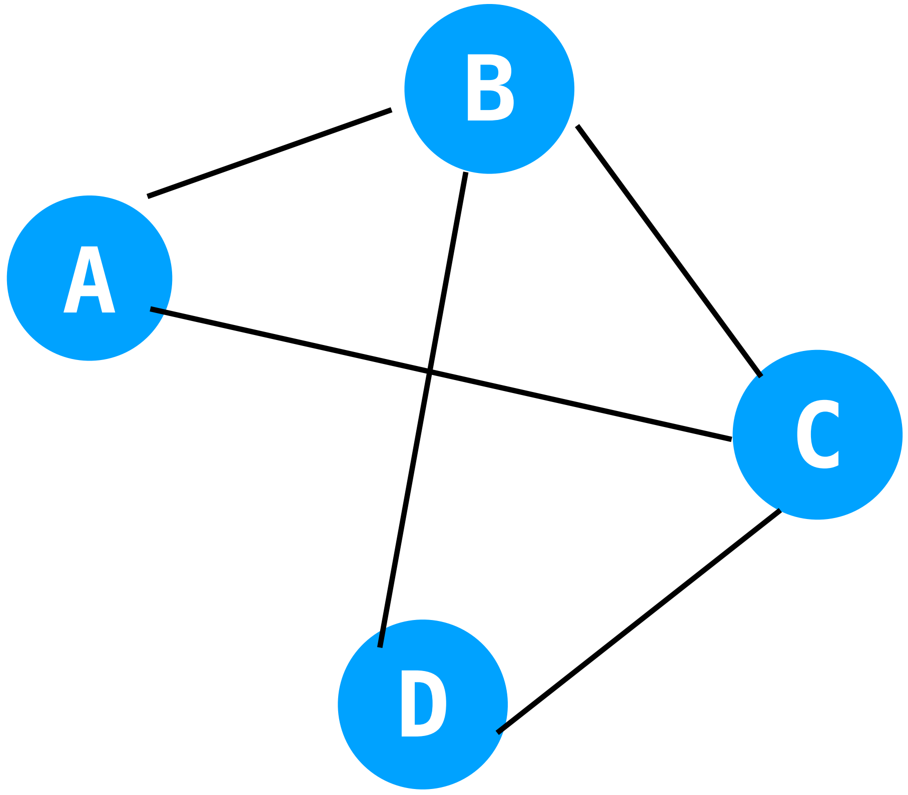






Paths

- A path is a sequence of edges from one vertex to another where no edge or vertex is repeated (except possibly the first and last vertex, as we'll see later)



- ***Your definitions may vary based on textbook, instructor, moon phase, astrological sign, etc.)

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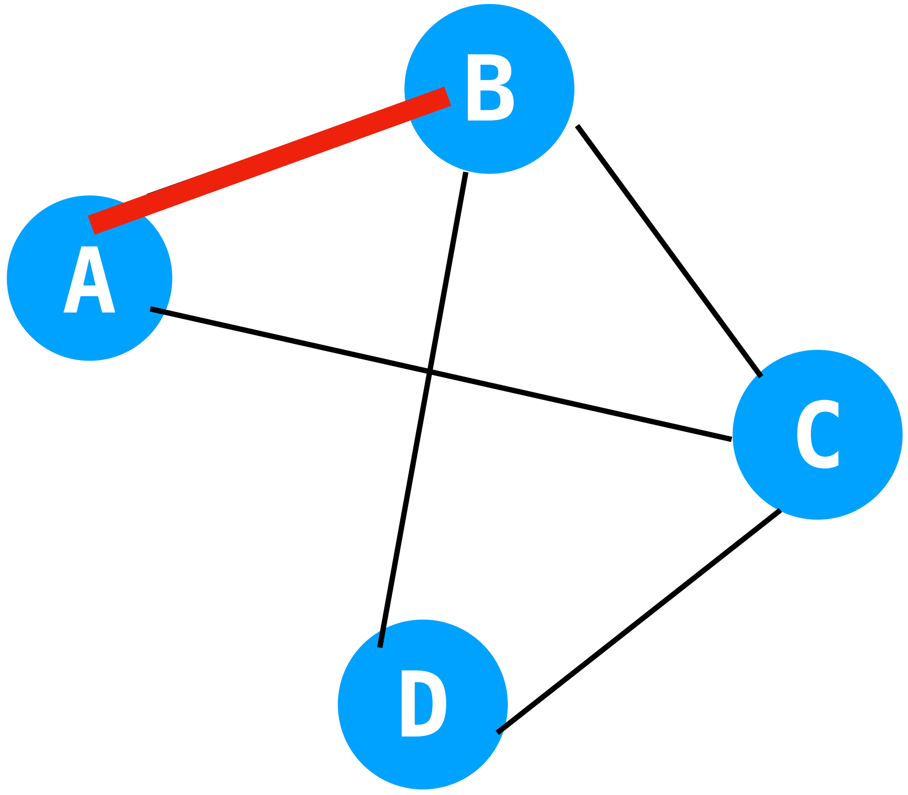
(A, B)



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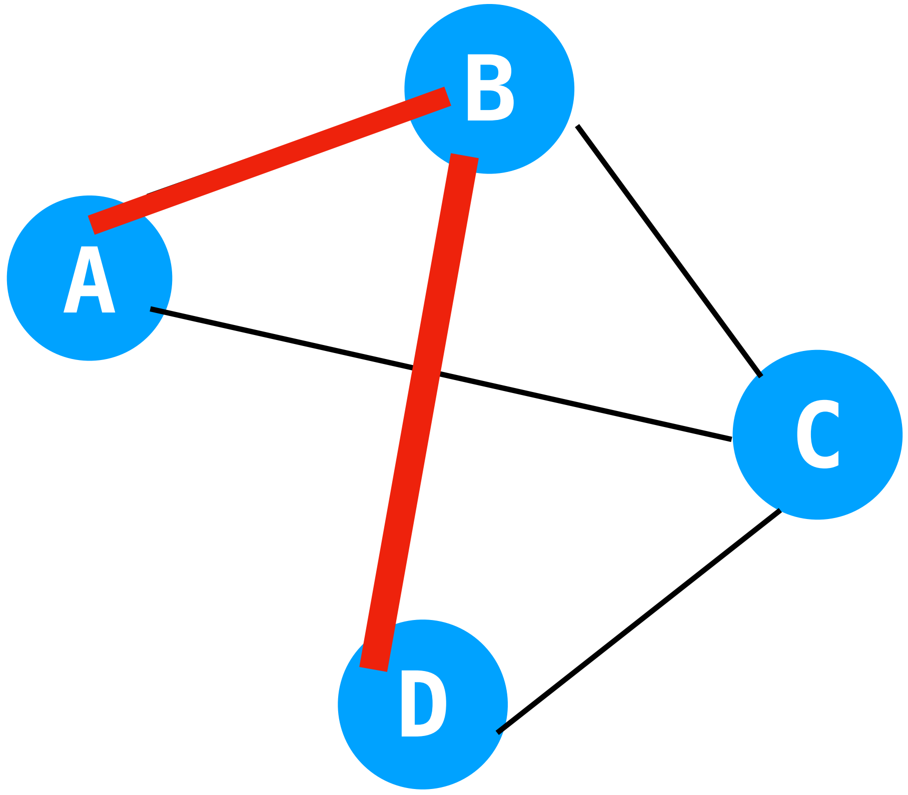
(A, B)
(B, D)



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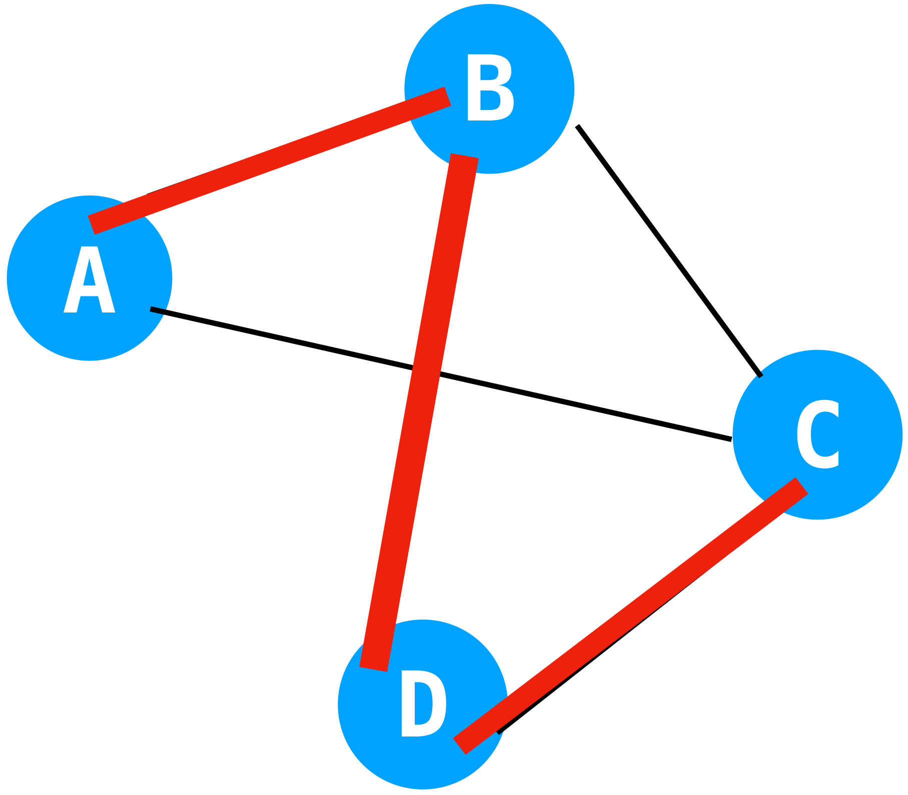
(A, B)
(B, D)
(D, C)



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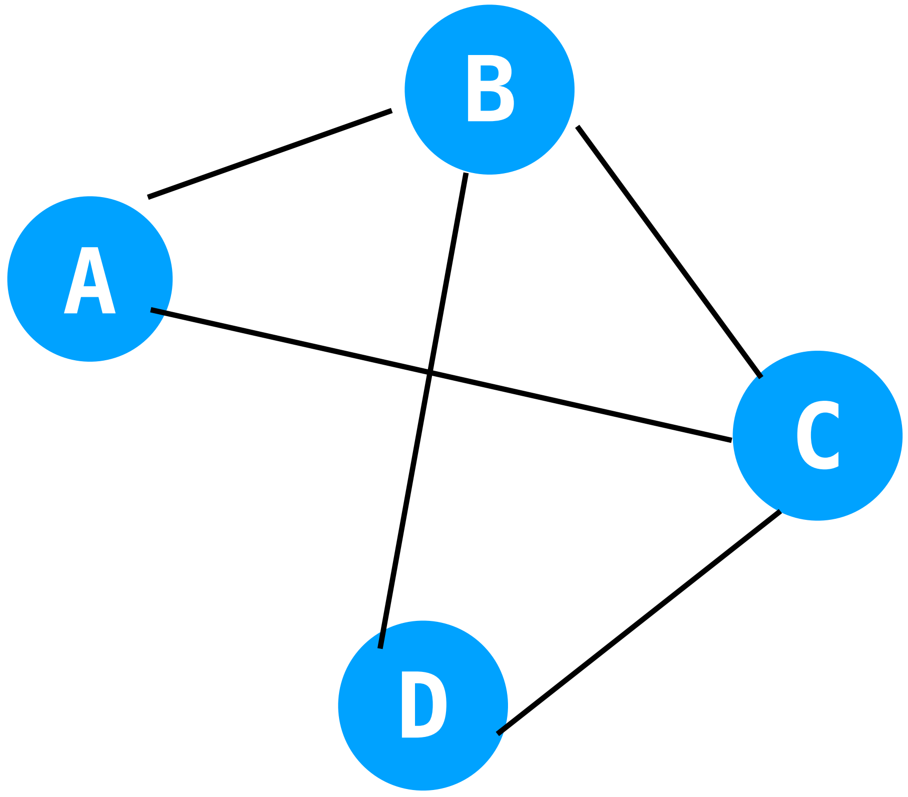
Cycles

- A cycle is a path that ends at the same vertex where it originally started.



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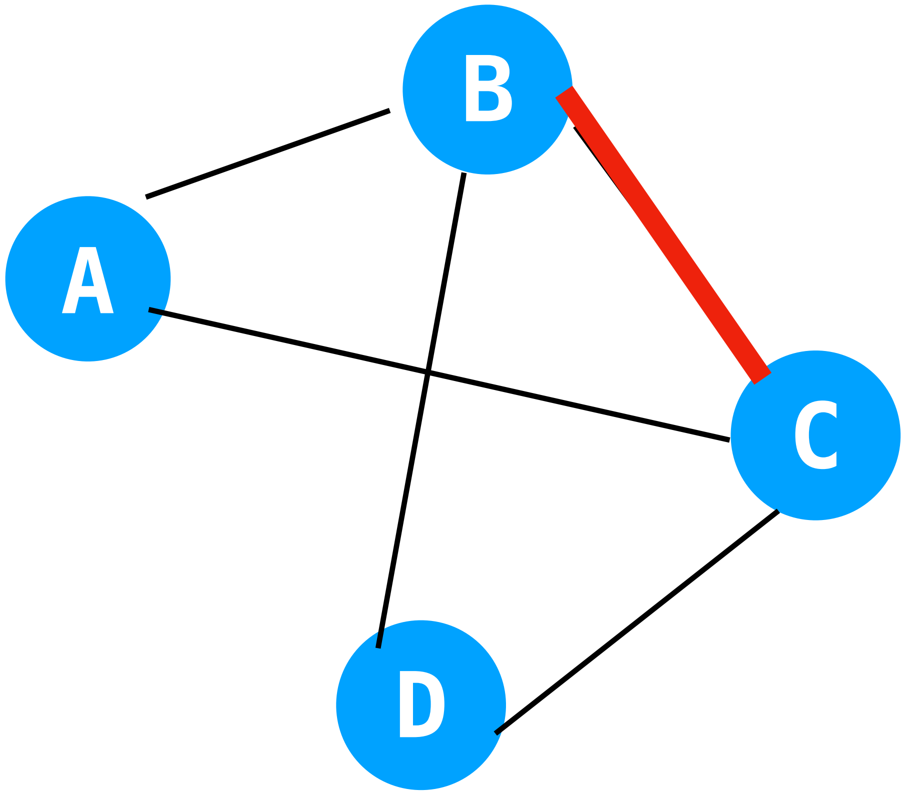
(B, C)



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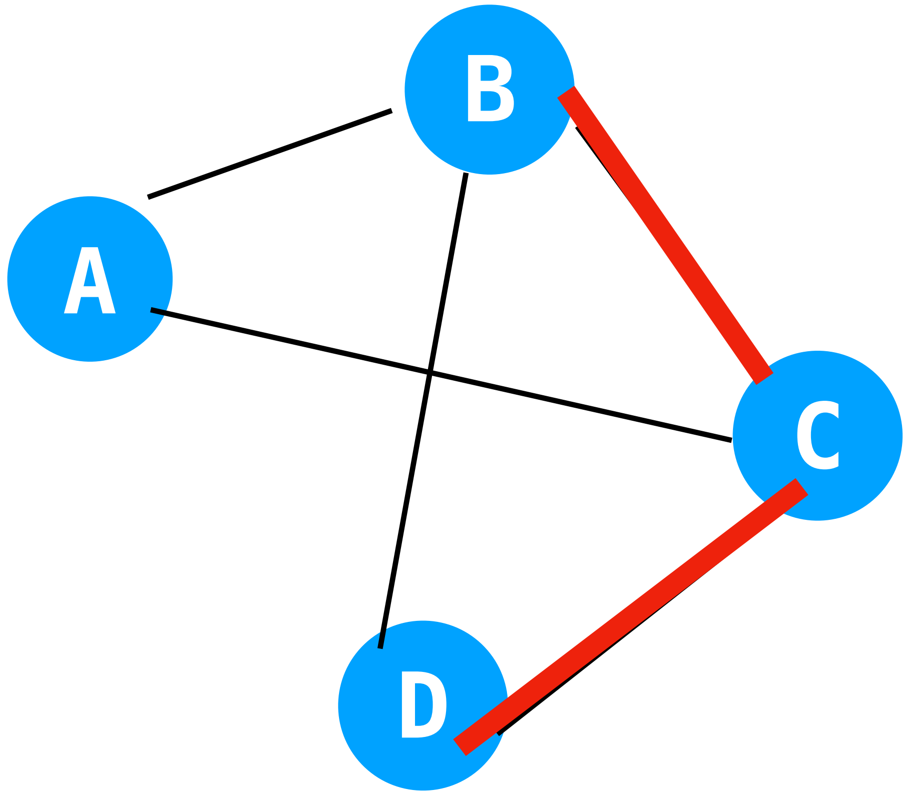

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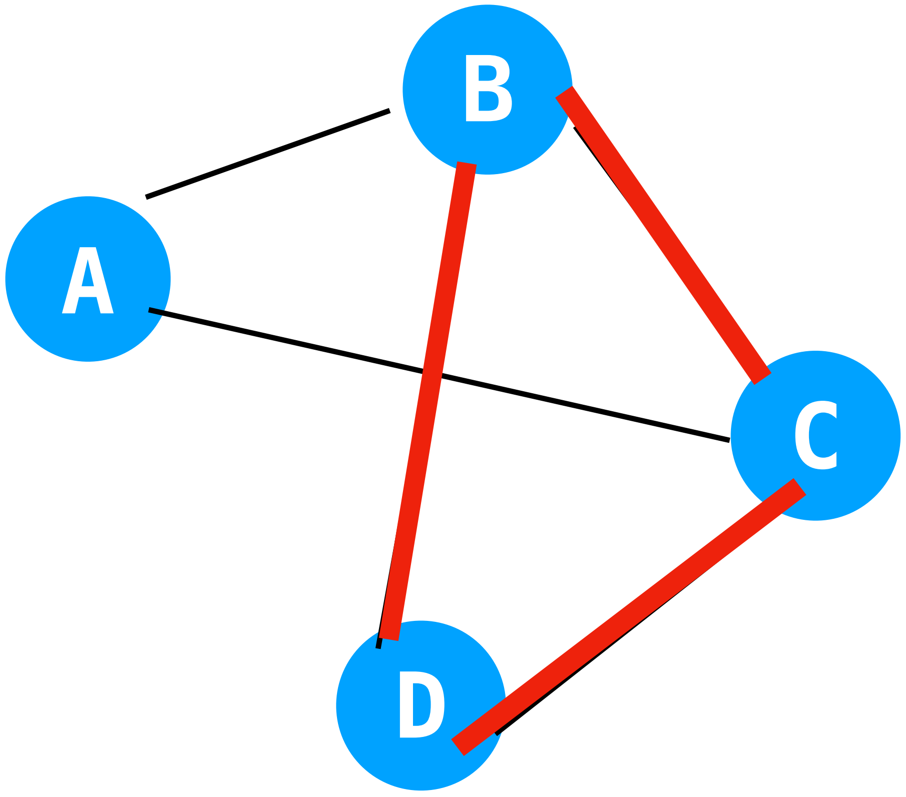
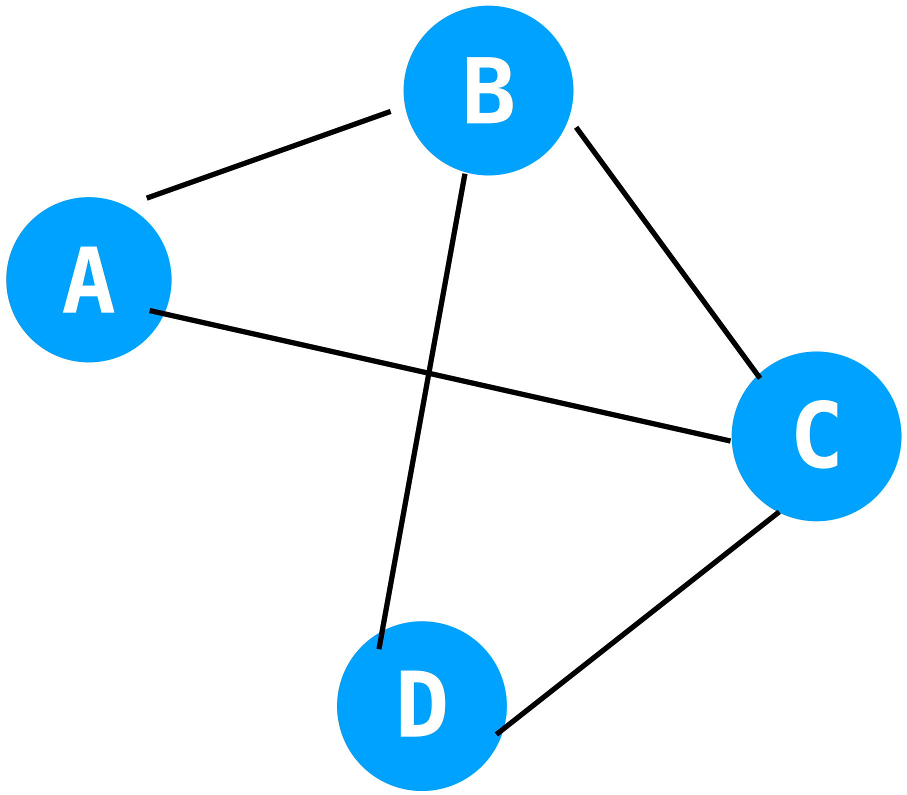
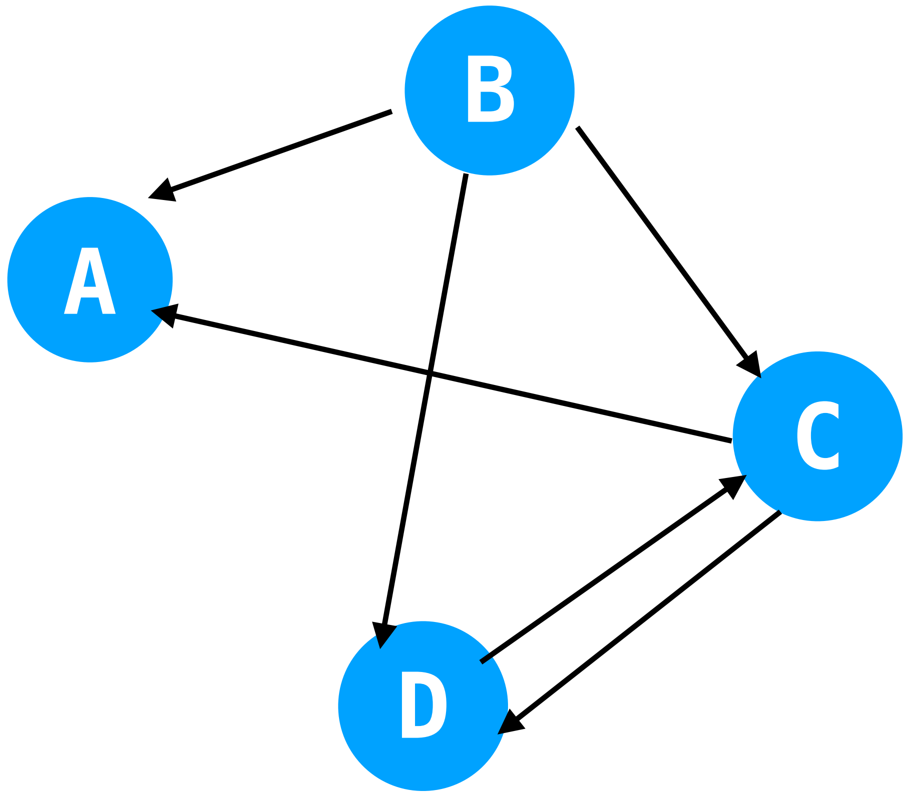
(B, C)
(C, D)
(D, B)



Directed vs. Non-directed

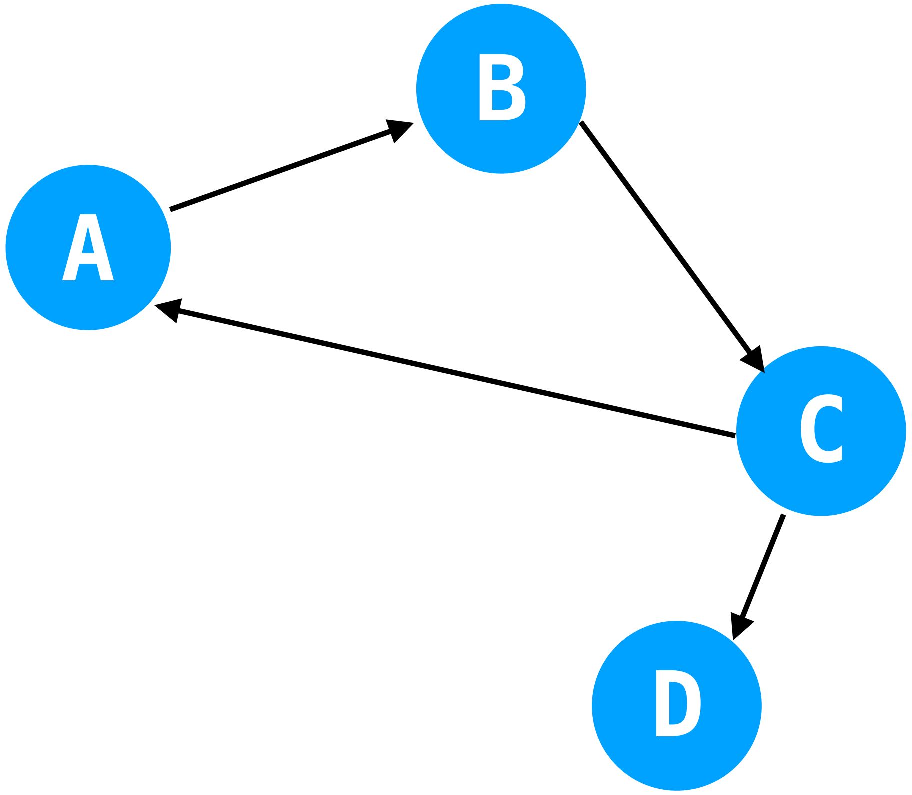
- Directed graphs have one-way edges.





Depth First Search

- Depth-first search is defined just like with trees, with a slight modification.



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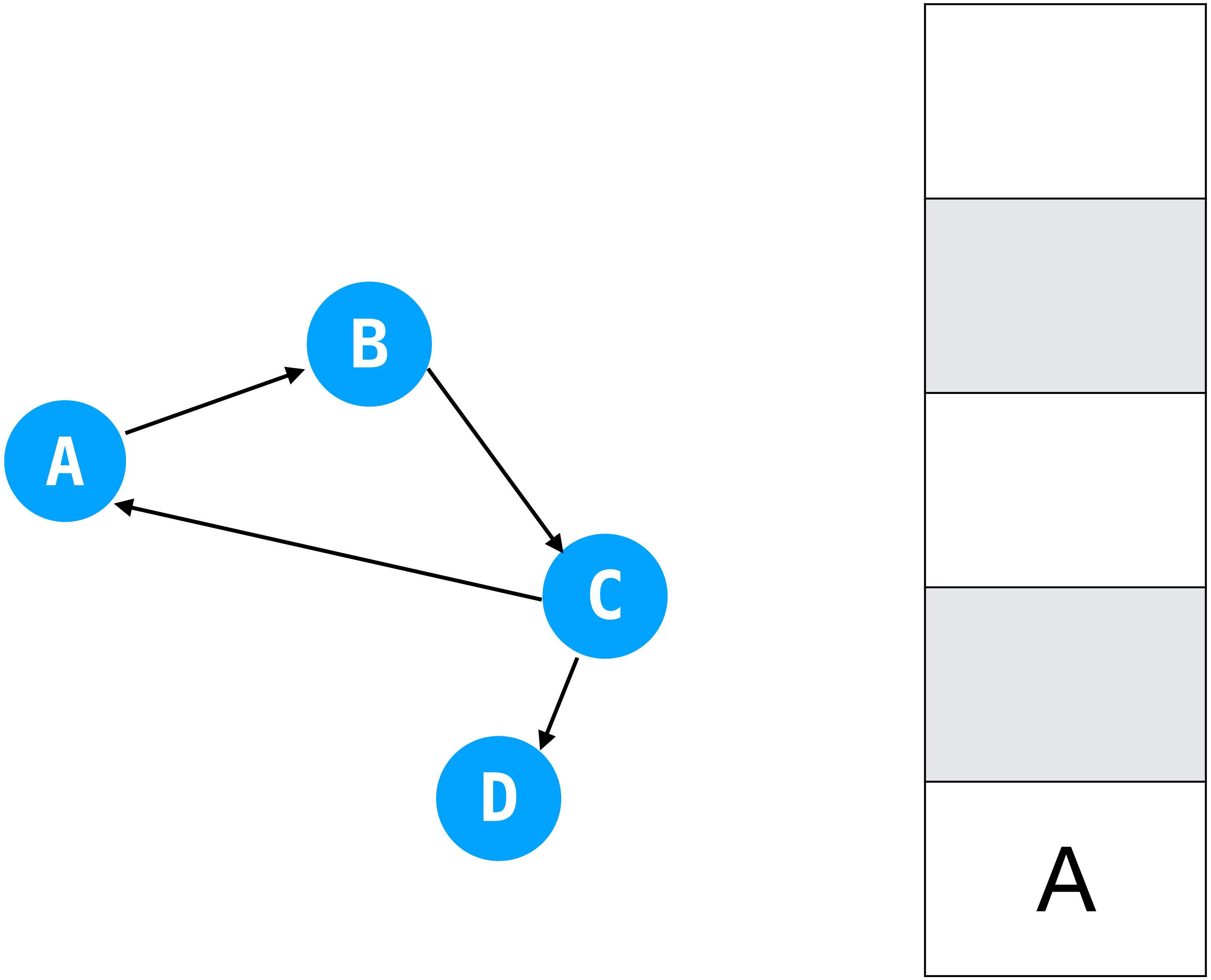

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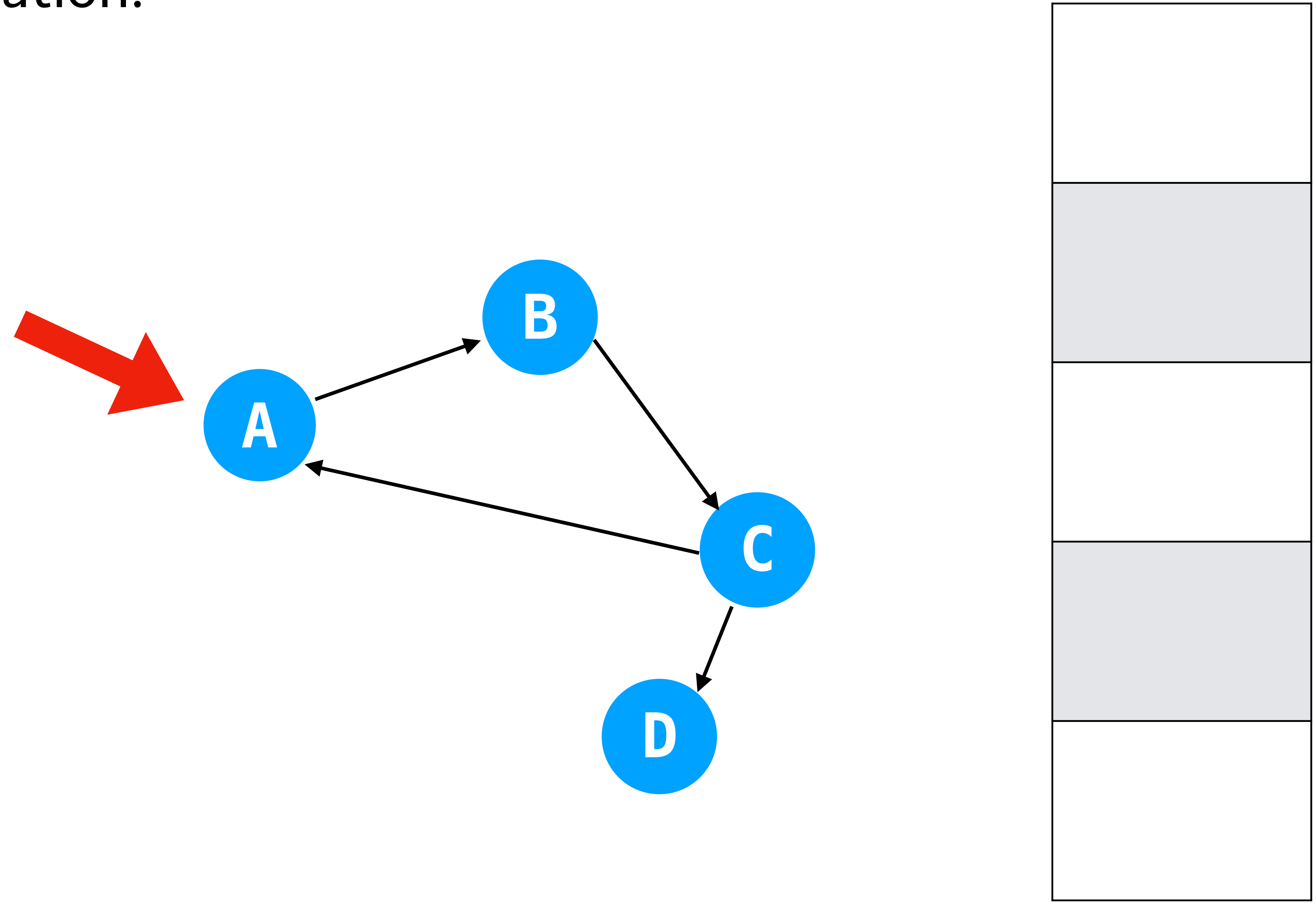

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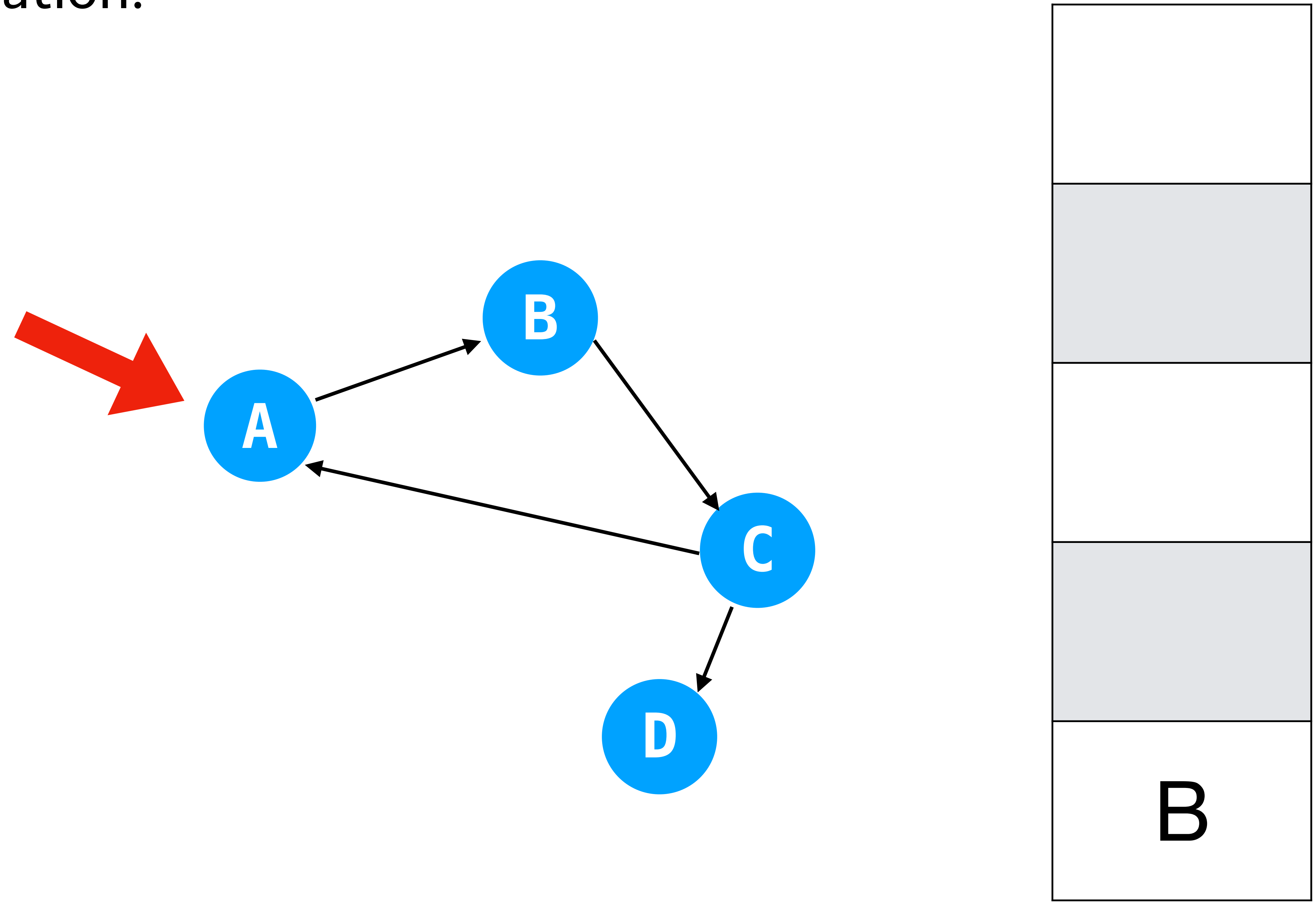

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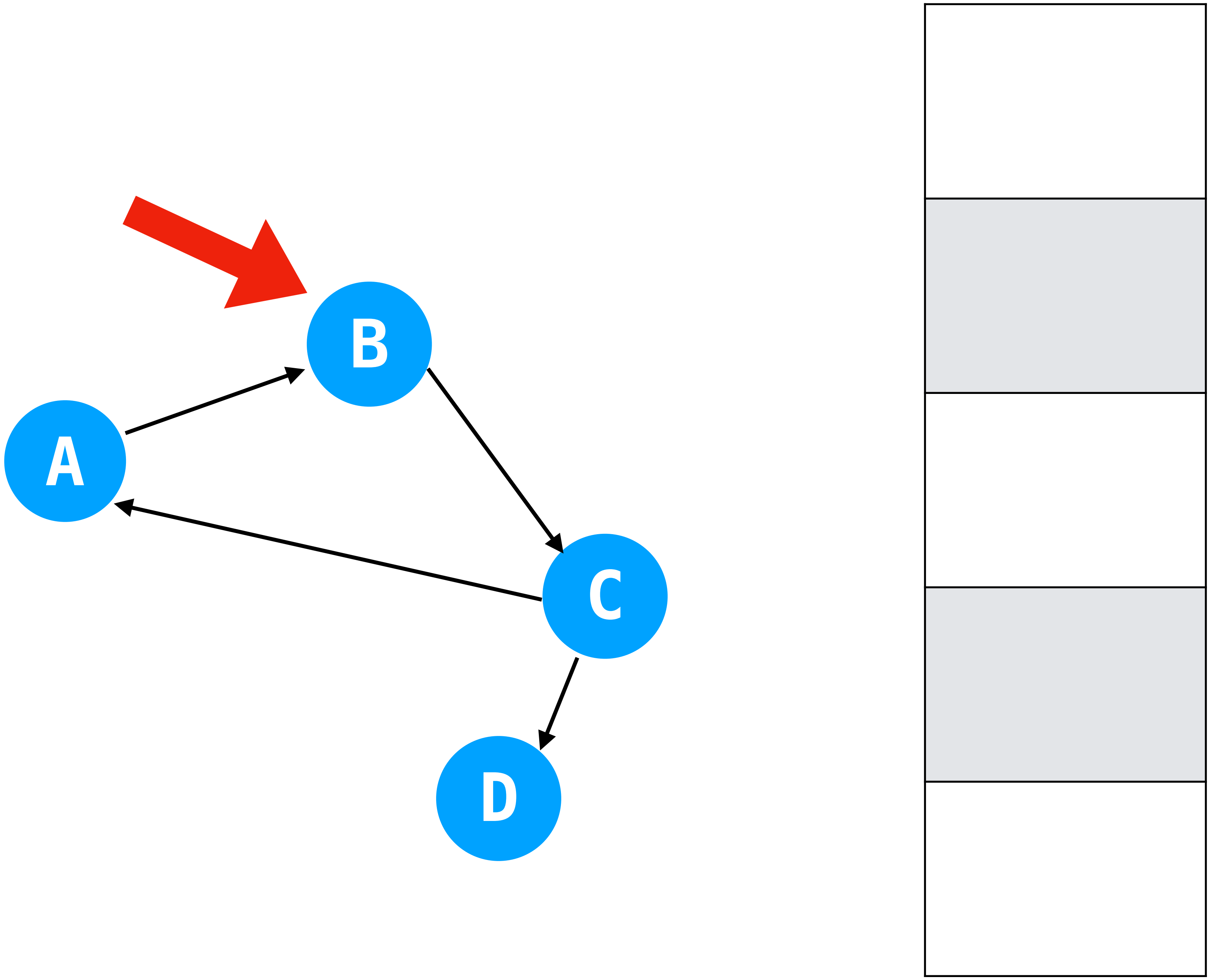

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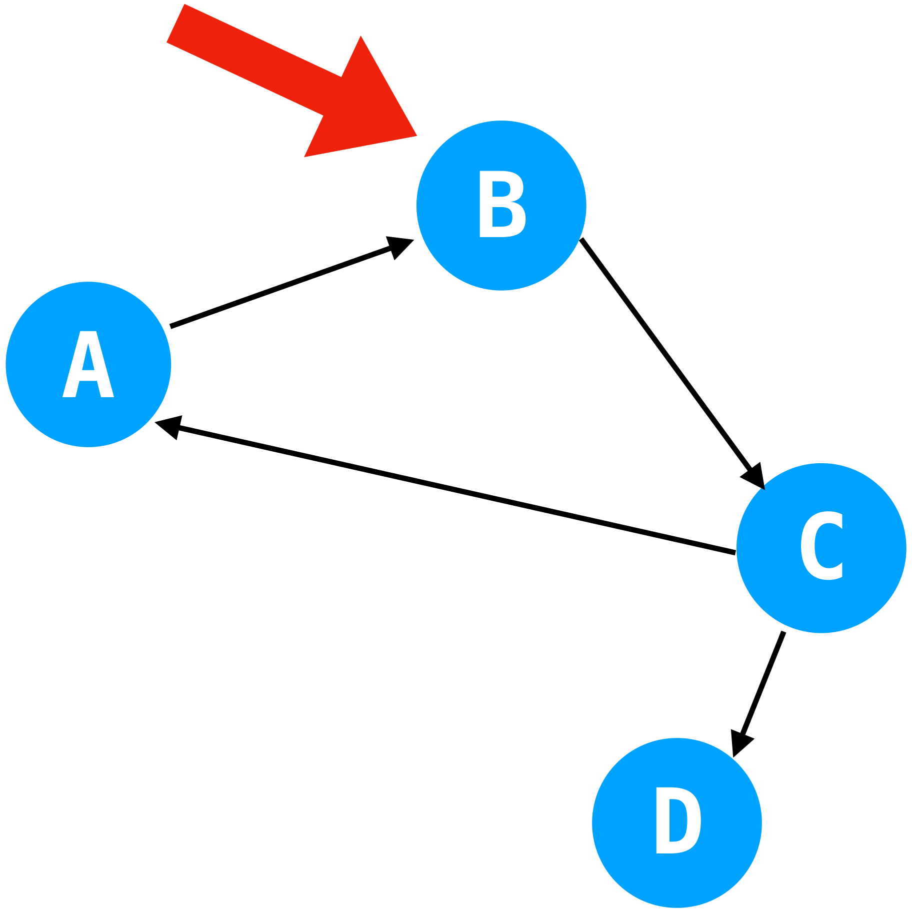

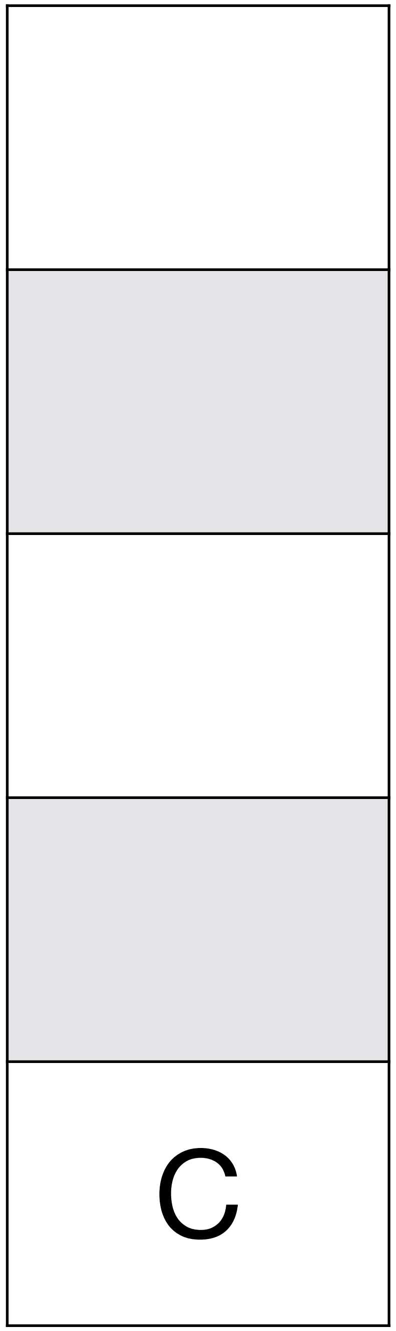

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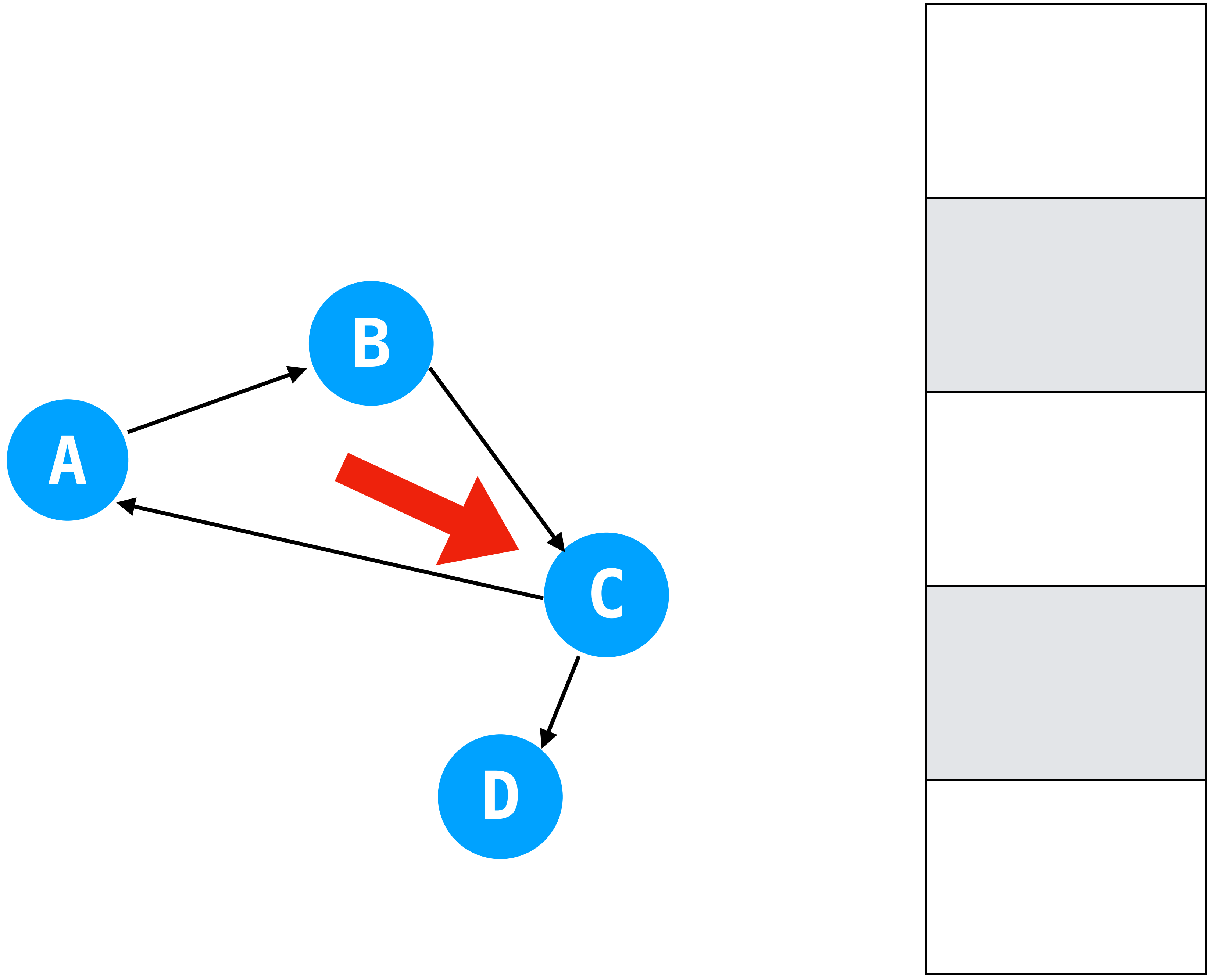

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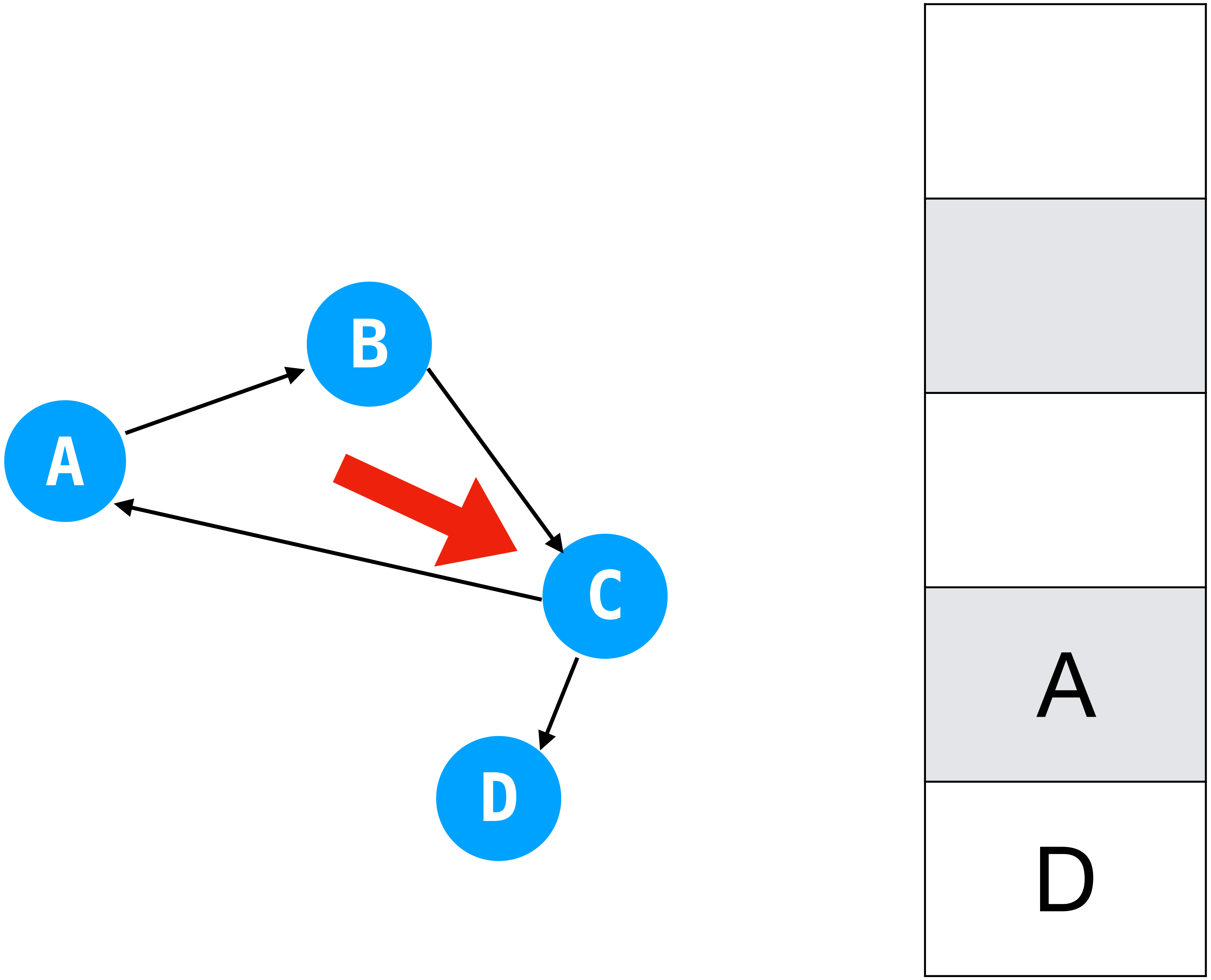

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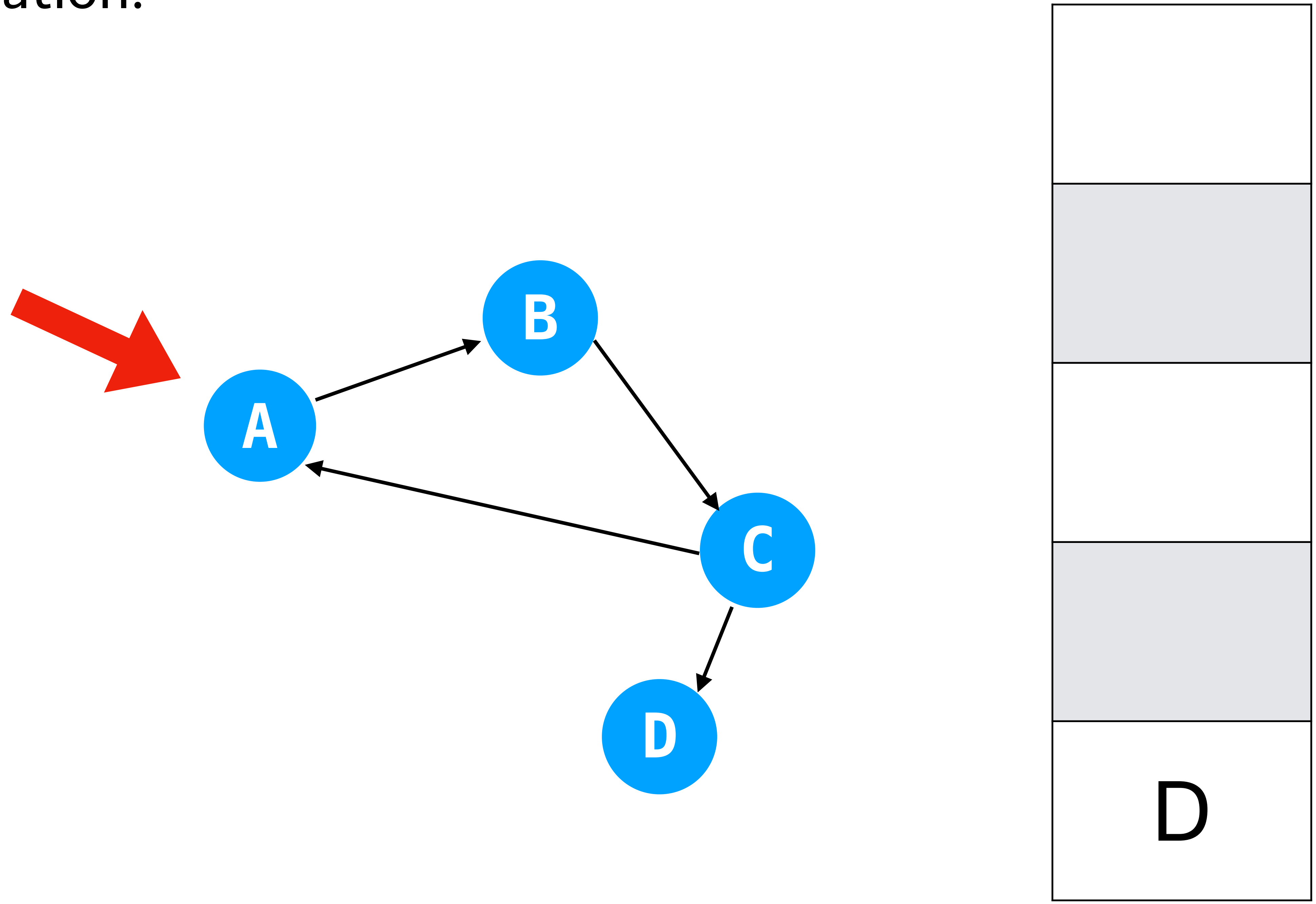

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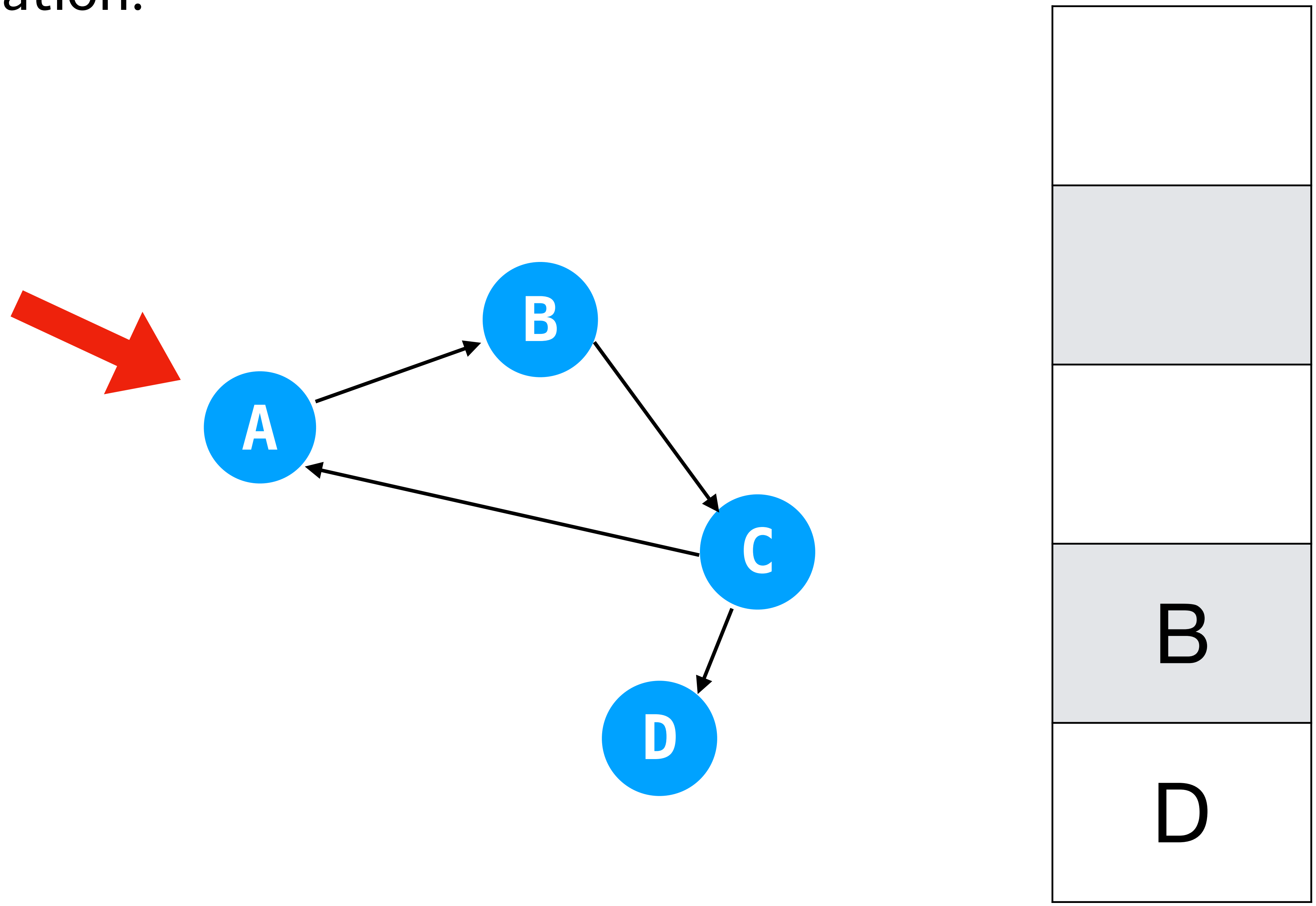
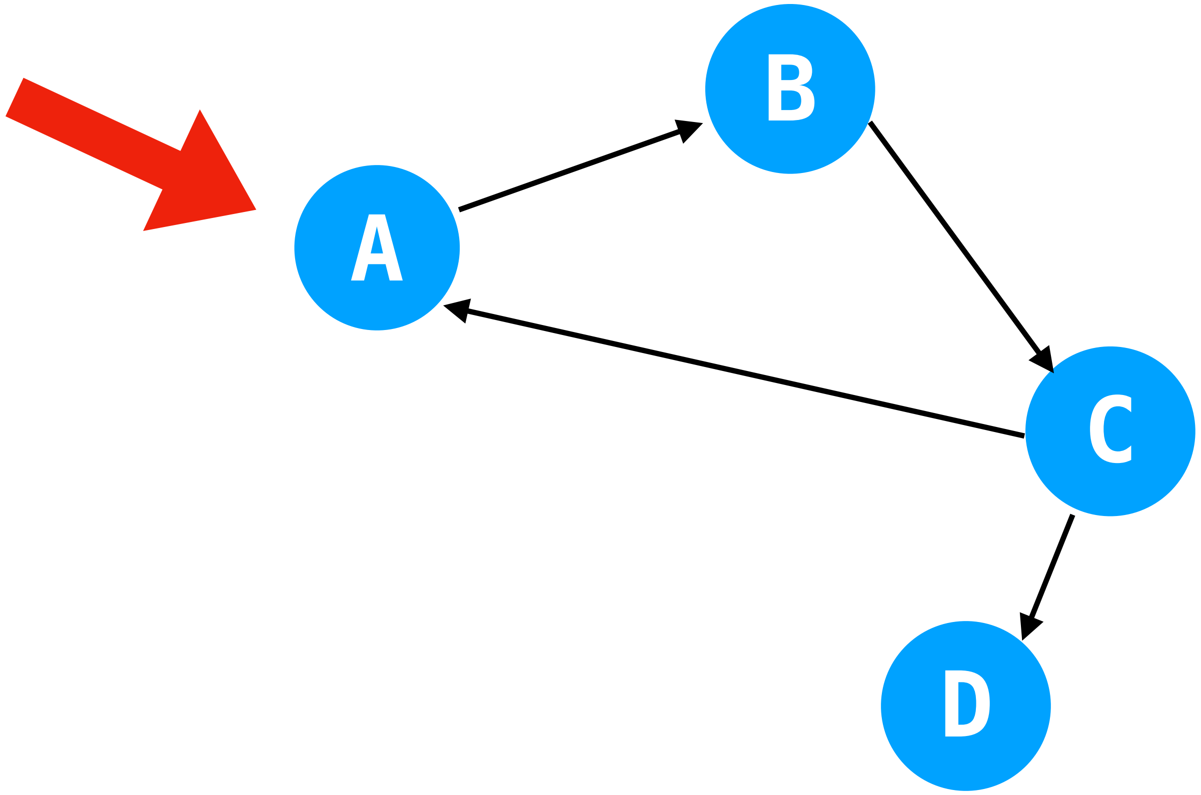


We need to remember visited nodes.



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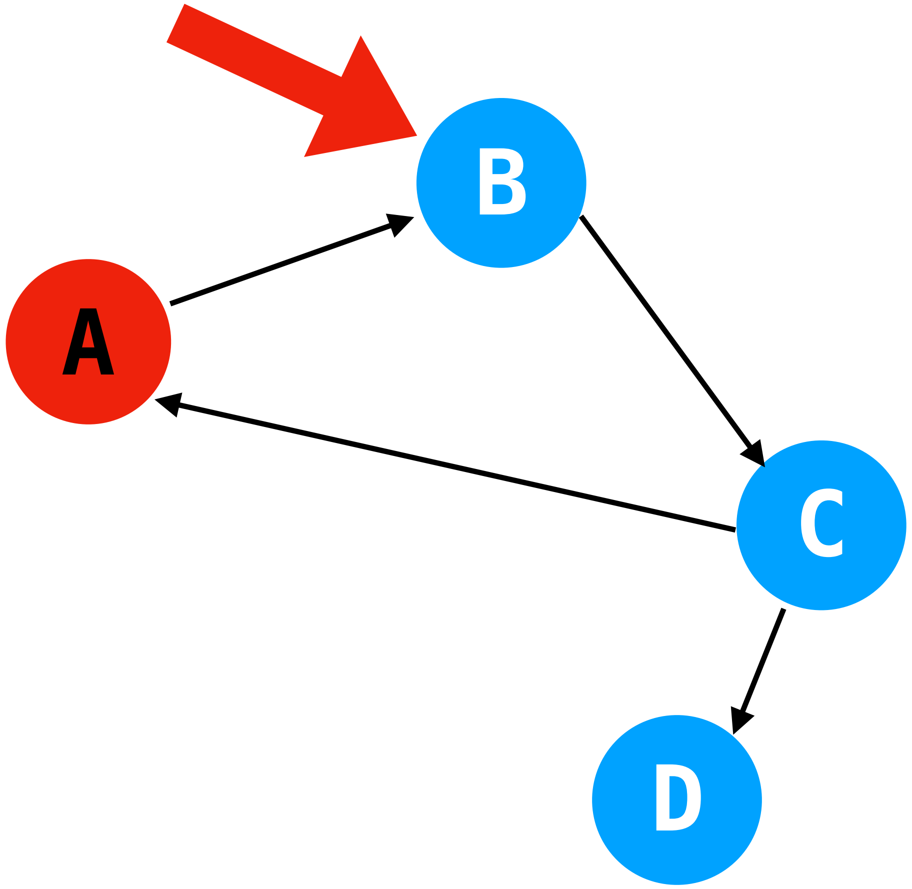

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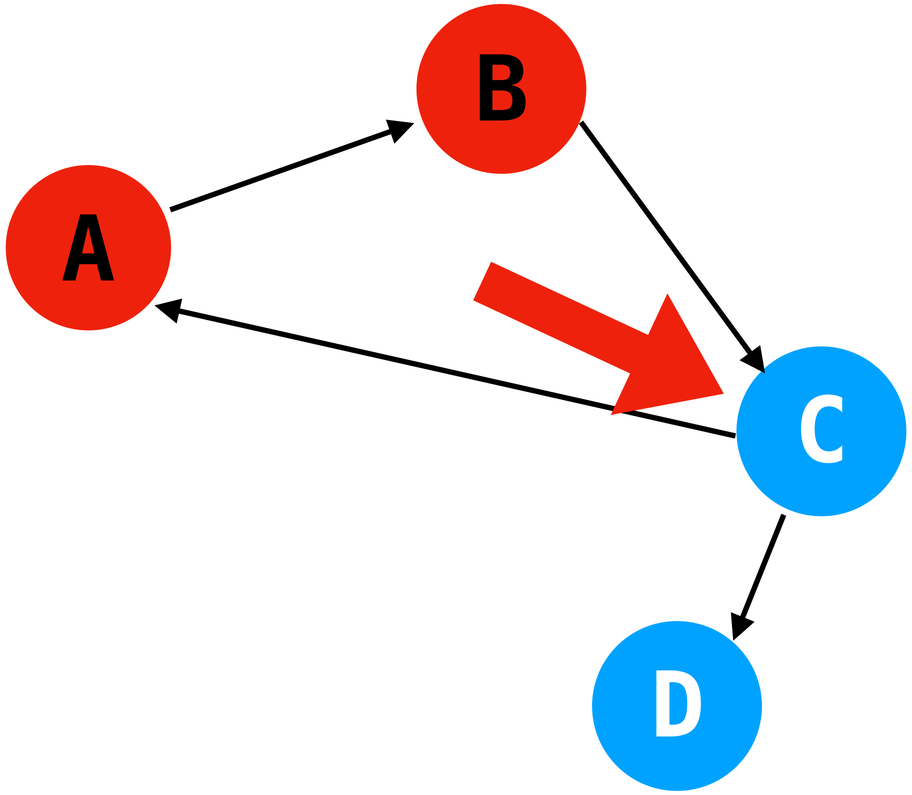

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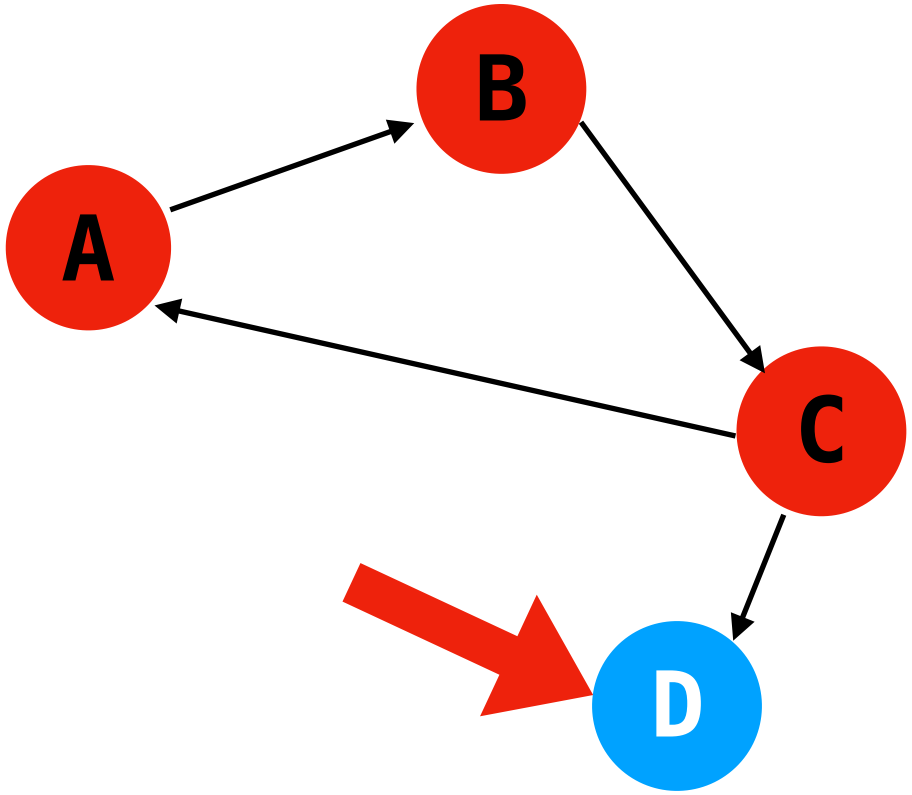

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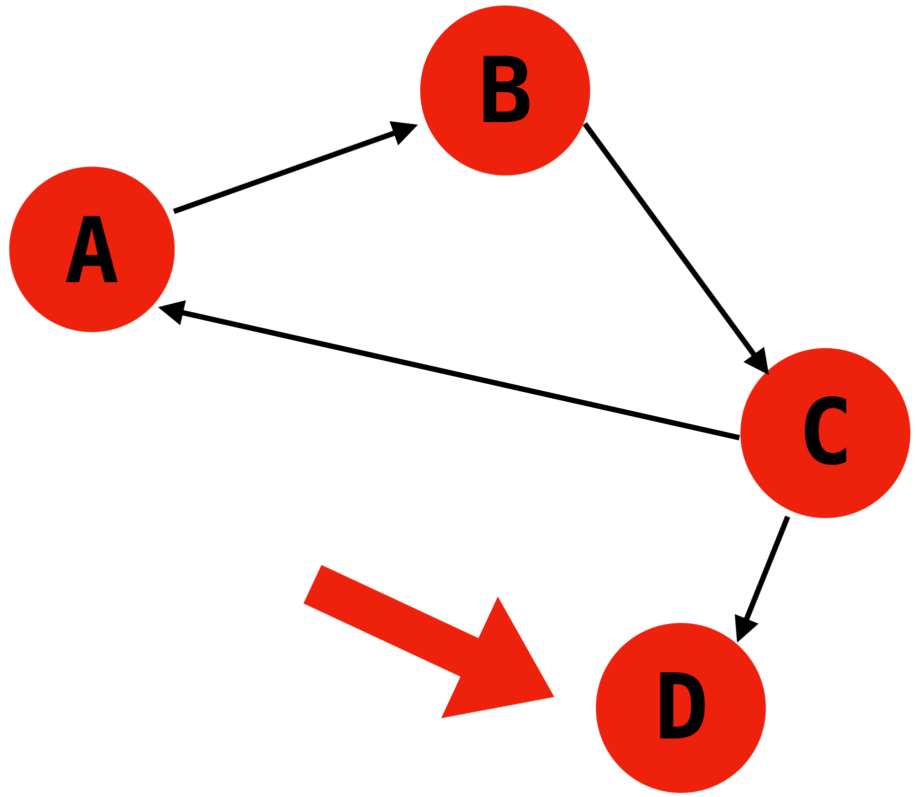
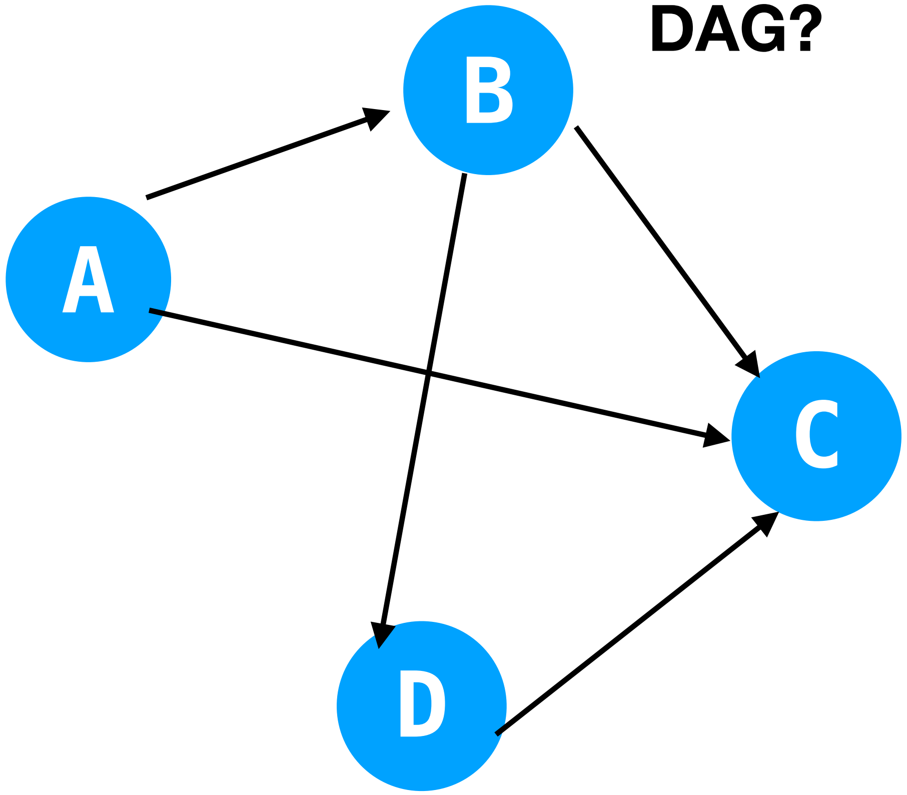


BFS is the same story: don't revisit nodes.

Directed Acyclic Graphs

- Directed Acyclic Graphs (aka DAGs) are graphs that have directed edges and no cycles.



DAG?

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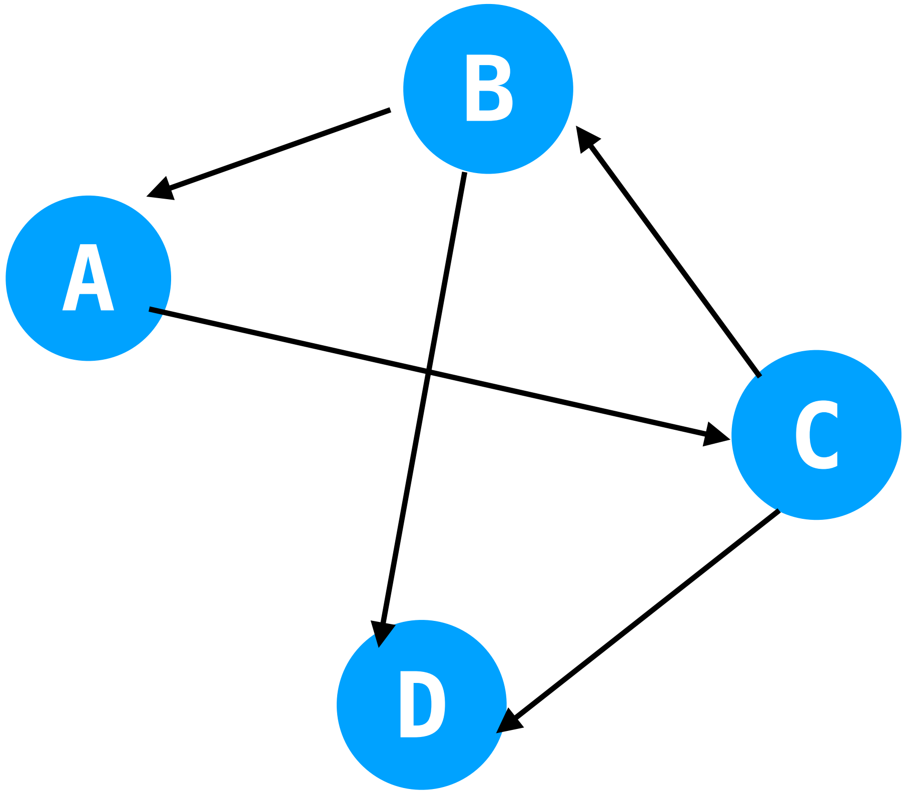
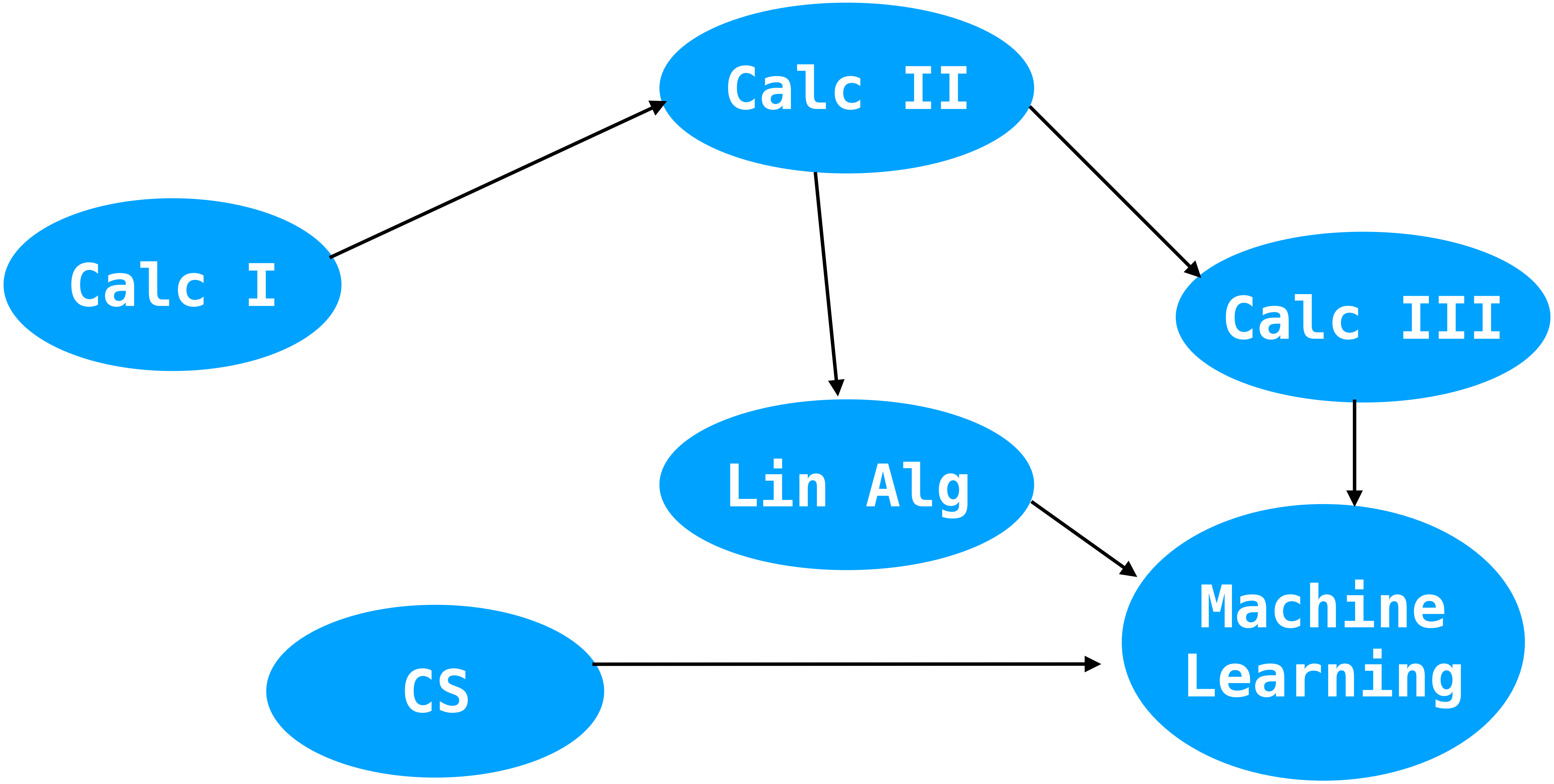


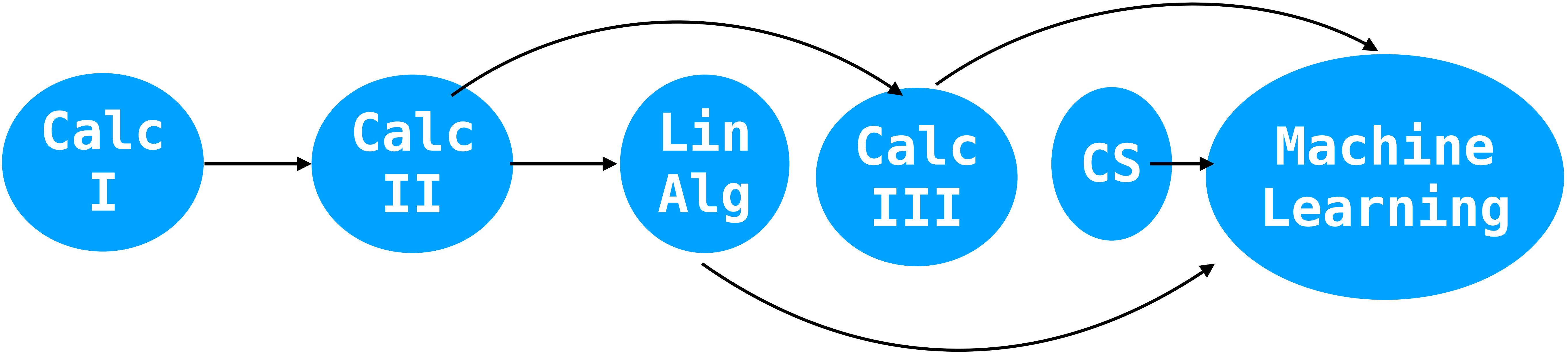
DAGs

- DAGs are great for representing dependency graphs.



Topological Sorting

- The properties of a DAG allow us to organize the nodes into a topological order, where nodes are arranged in order and edges are directed forward only.
- There may be more than one possible topological sort.
- One way of thinking about it is ordering courses so you don't violate any prerequisites.

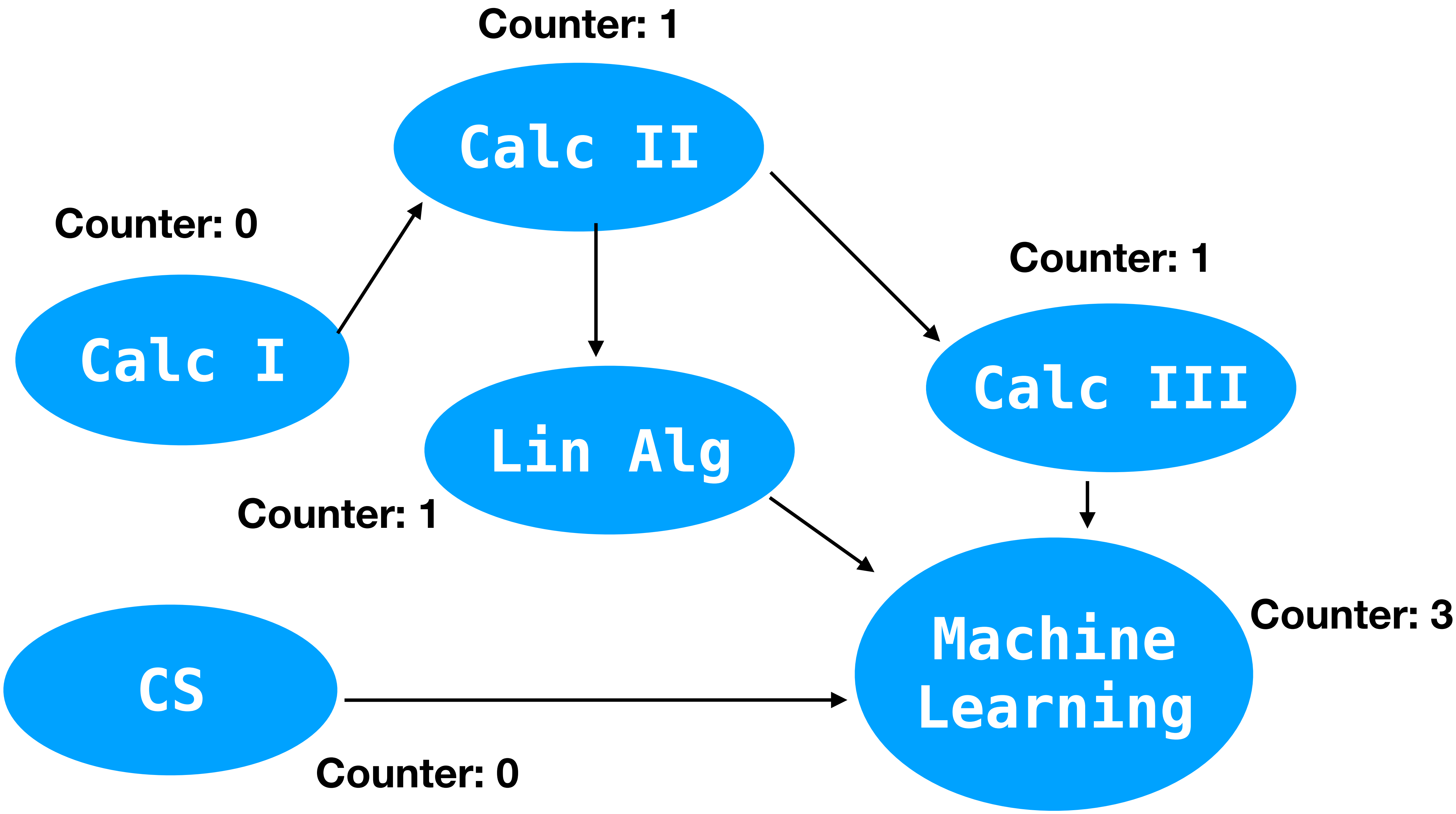


How to Topologically Sort?

1. Each node will have a counter that is initialized to the number of incoming edges.
2. Take all nodes with counter = 0 and add them to your result list.
3. Decrement the counter of neighbors by 1.
4. Repeat step 2.

How to Topologically Sort?

- We'll run a modified DFS.



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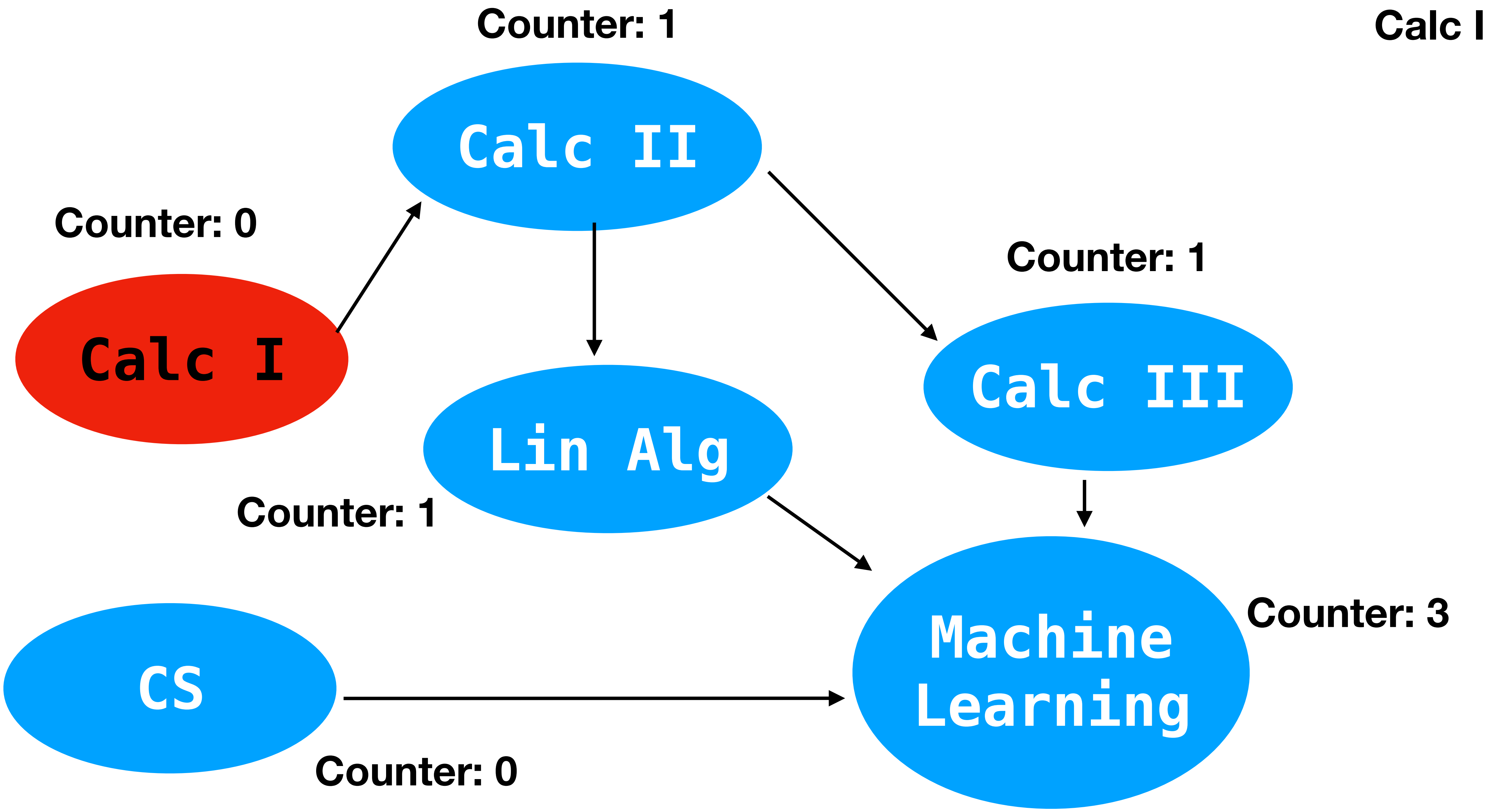

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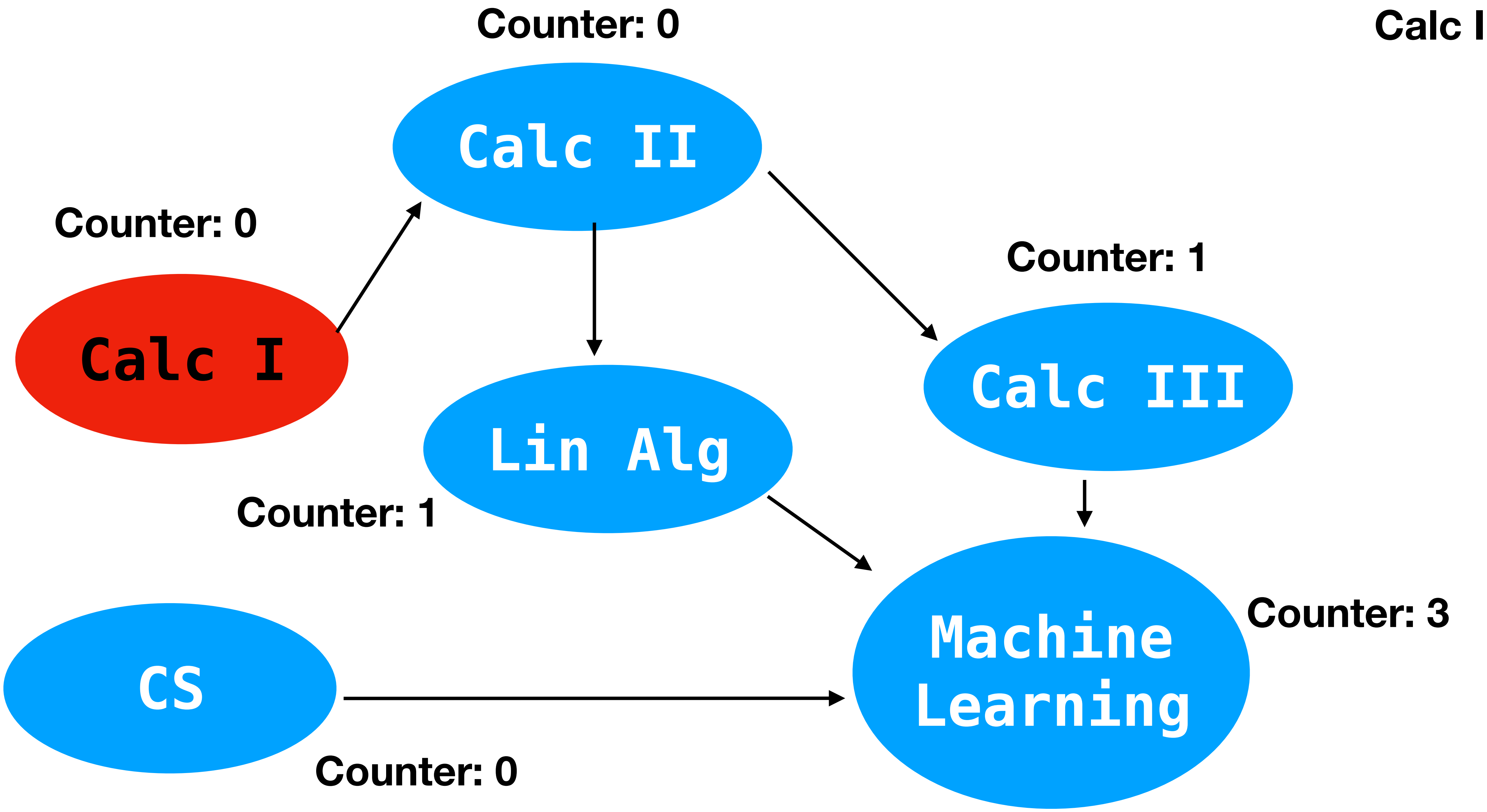

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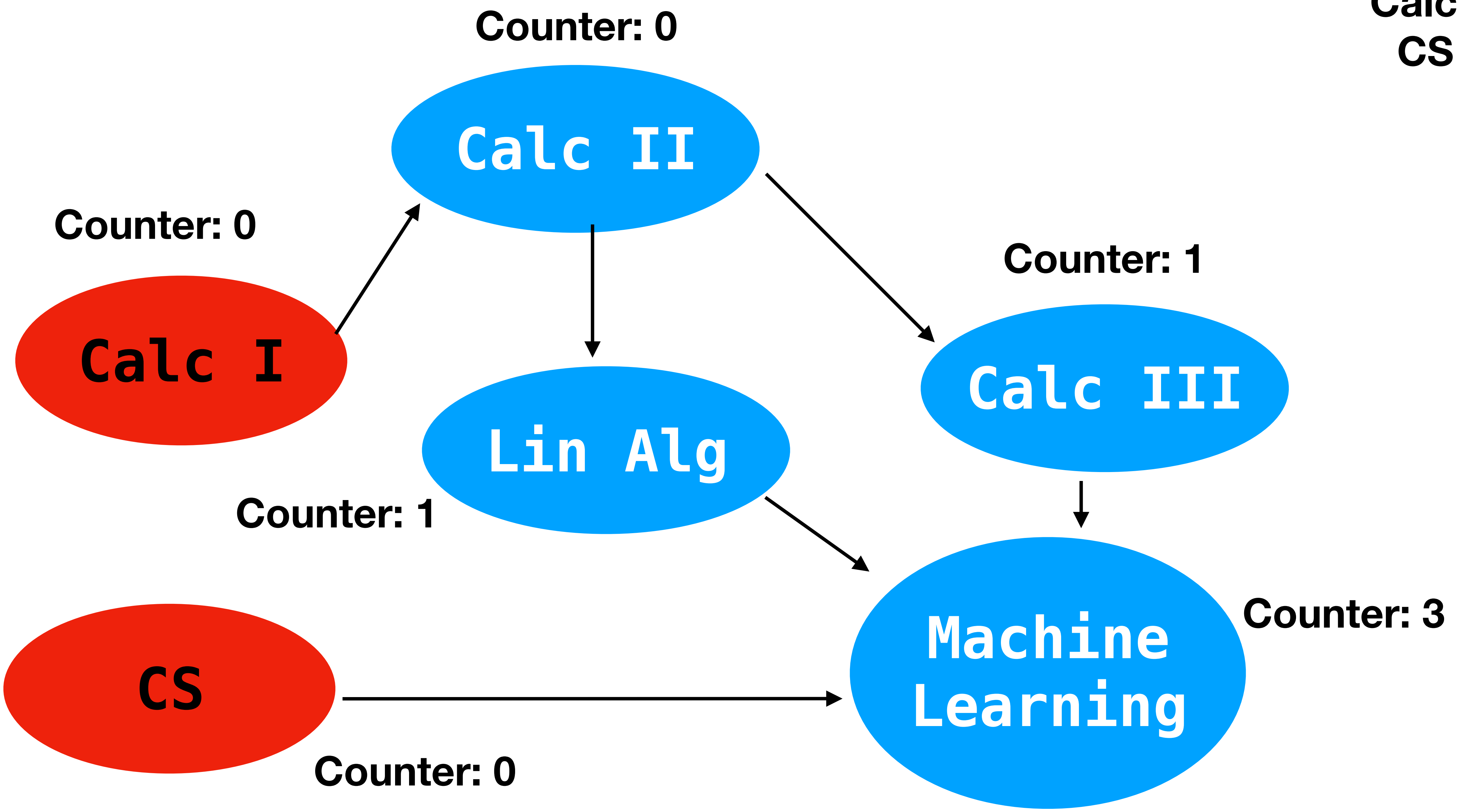

Calc I
CS

How to Topologically Sort?

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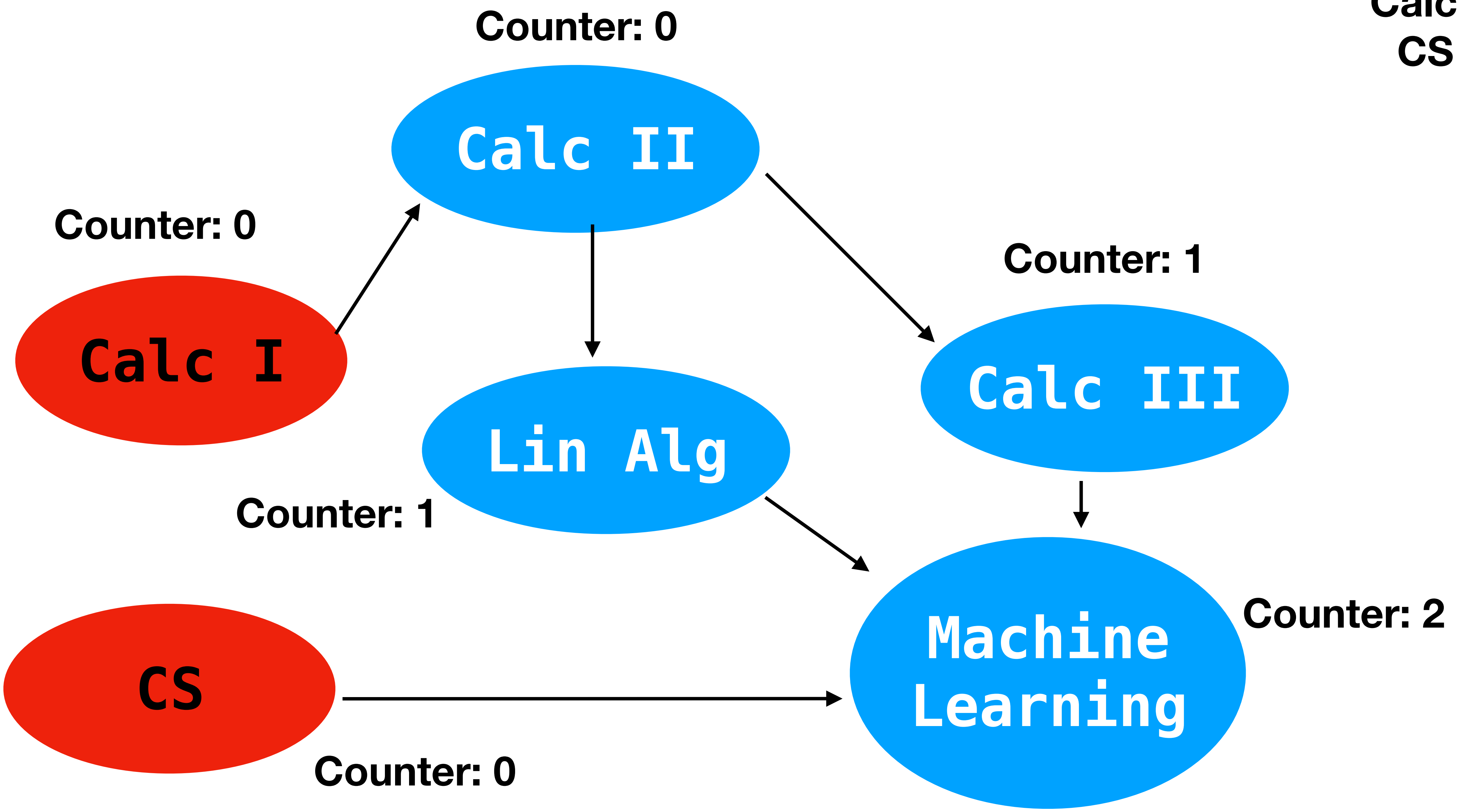

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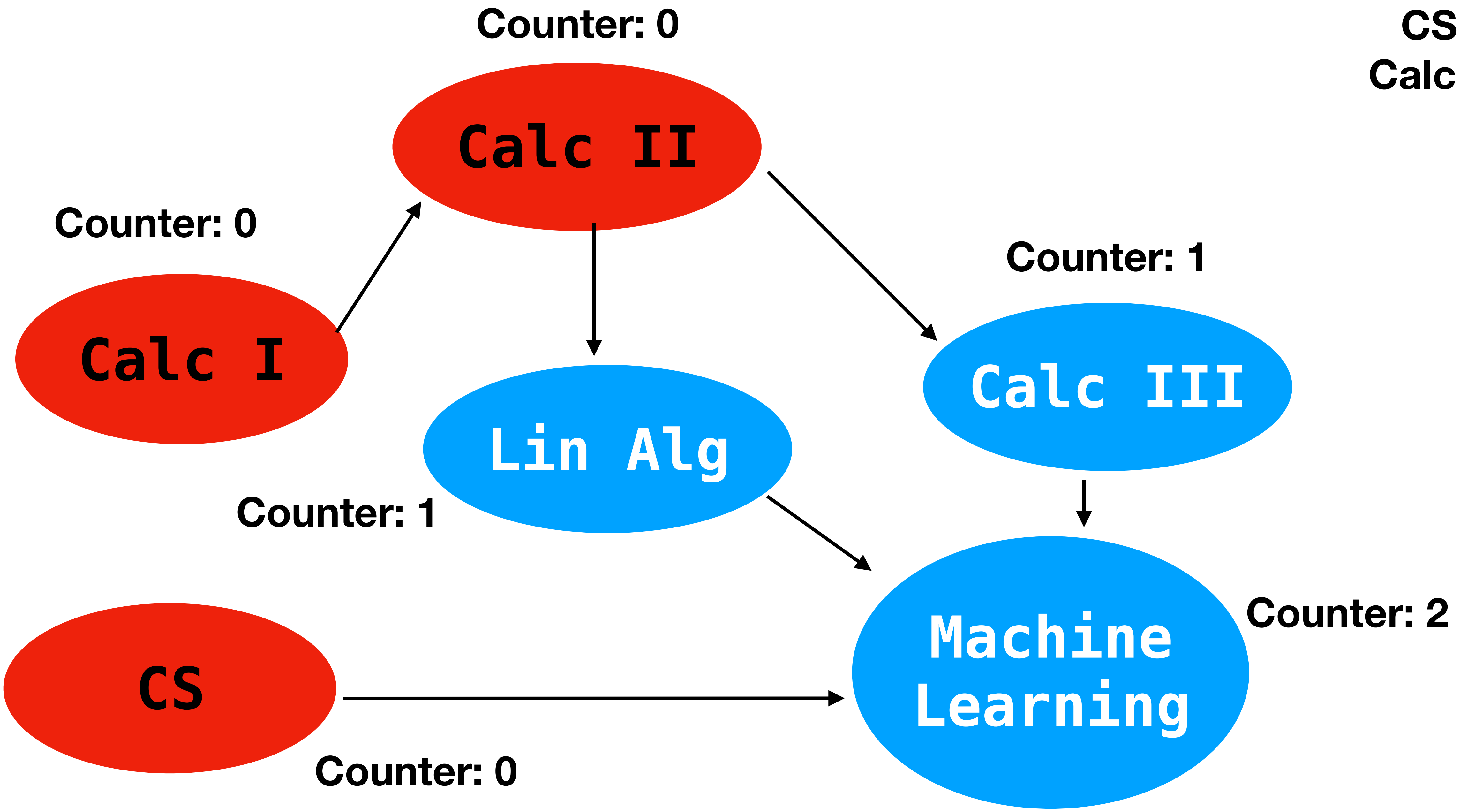

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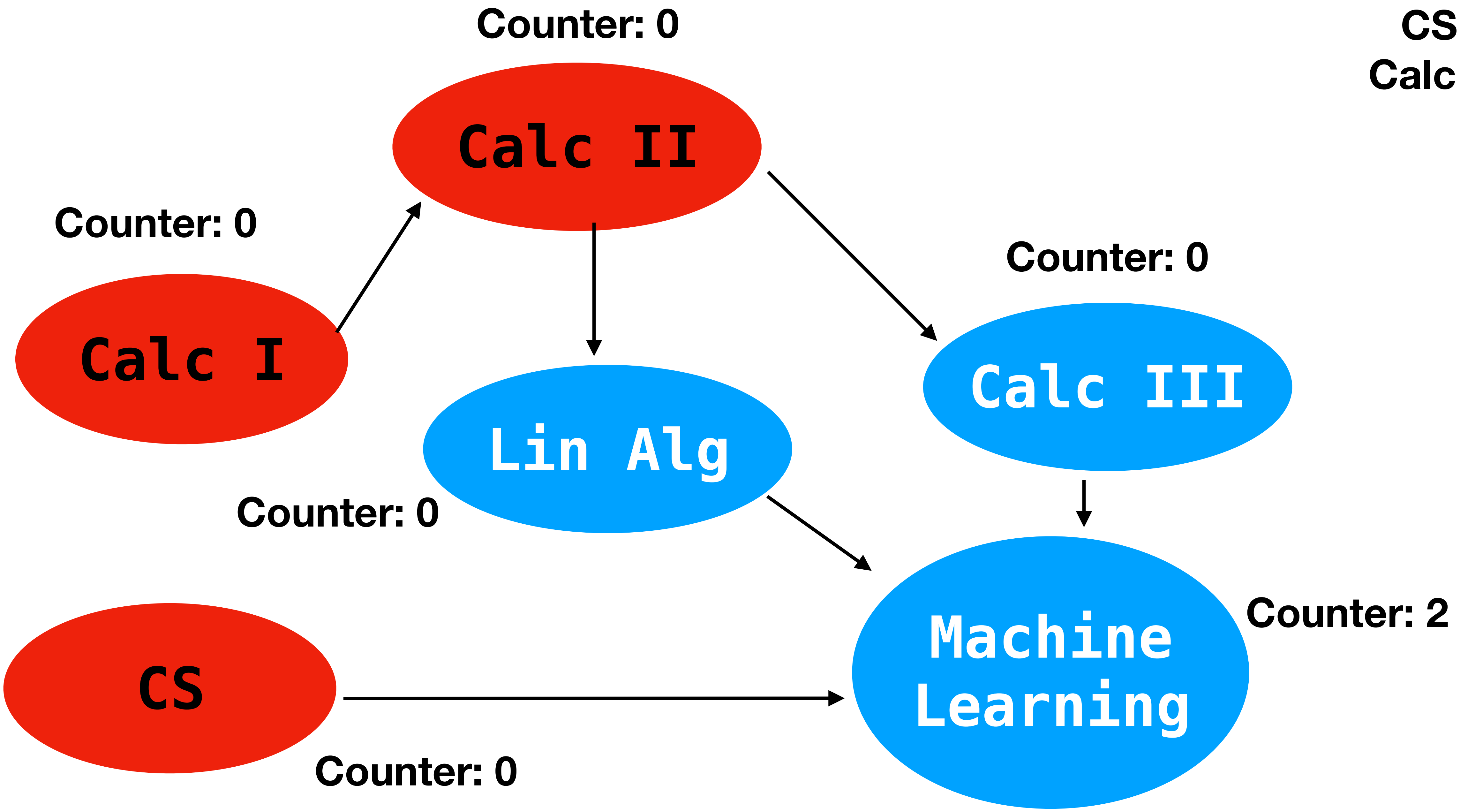

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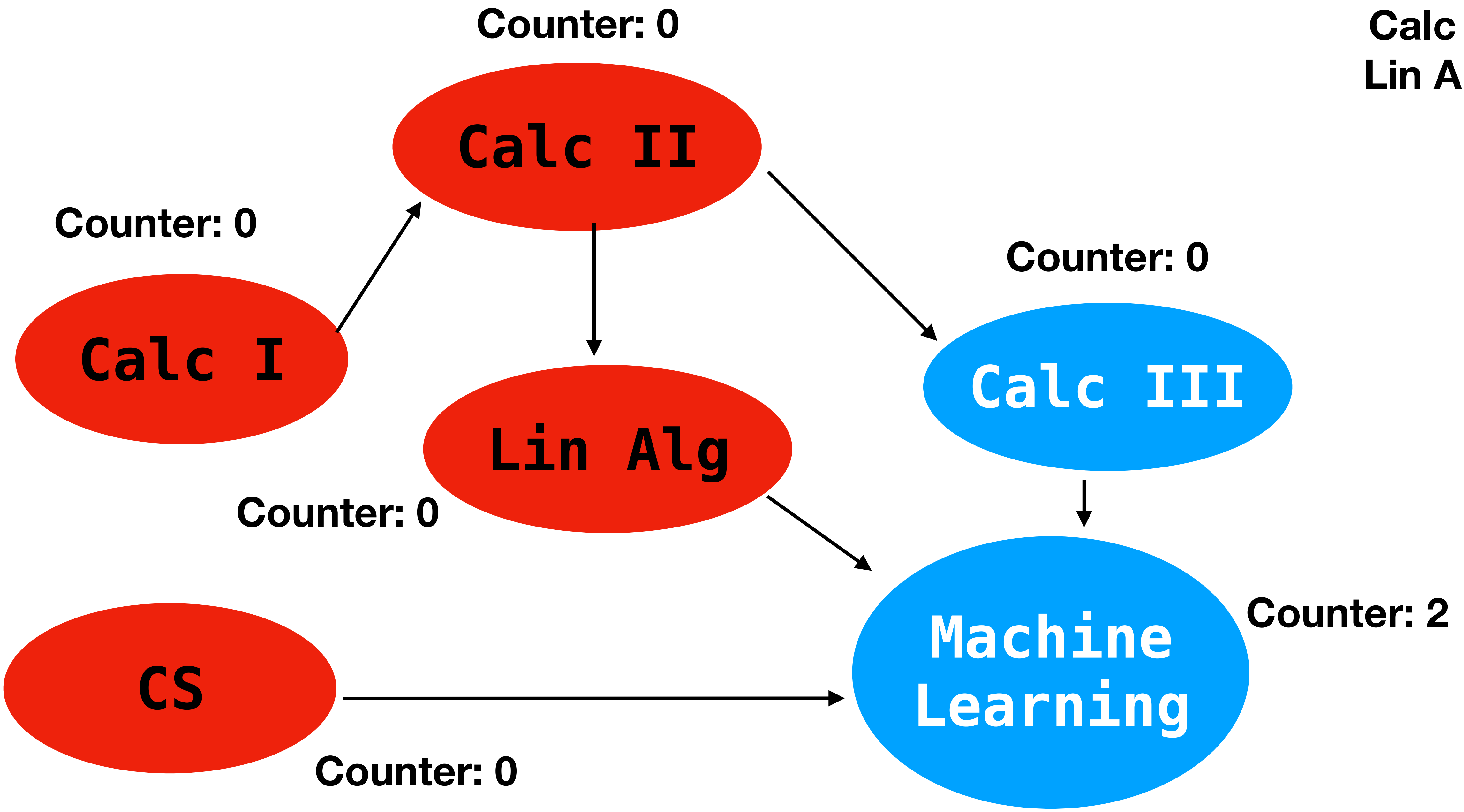

Calc I
CS
Calc II
Lin Alg

How to Topologically Sort?

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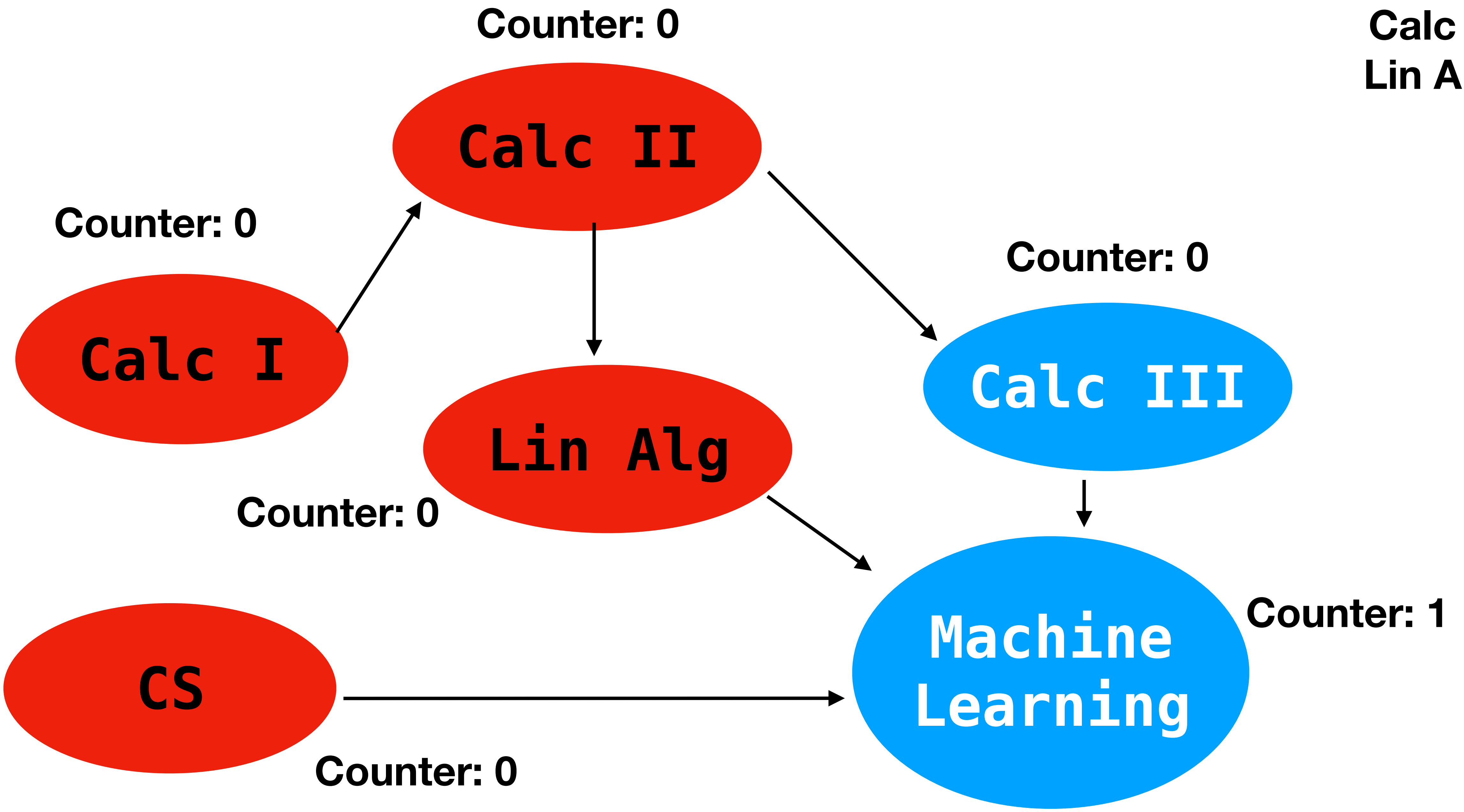

Calc I
CS
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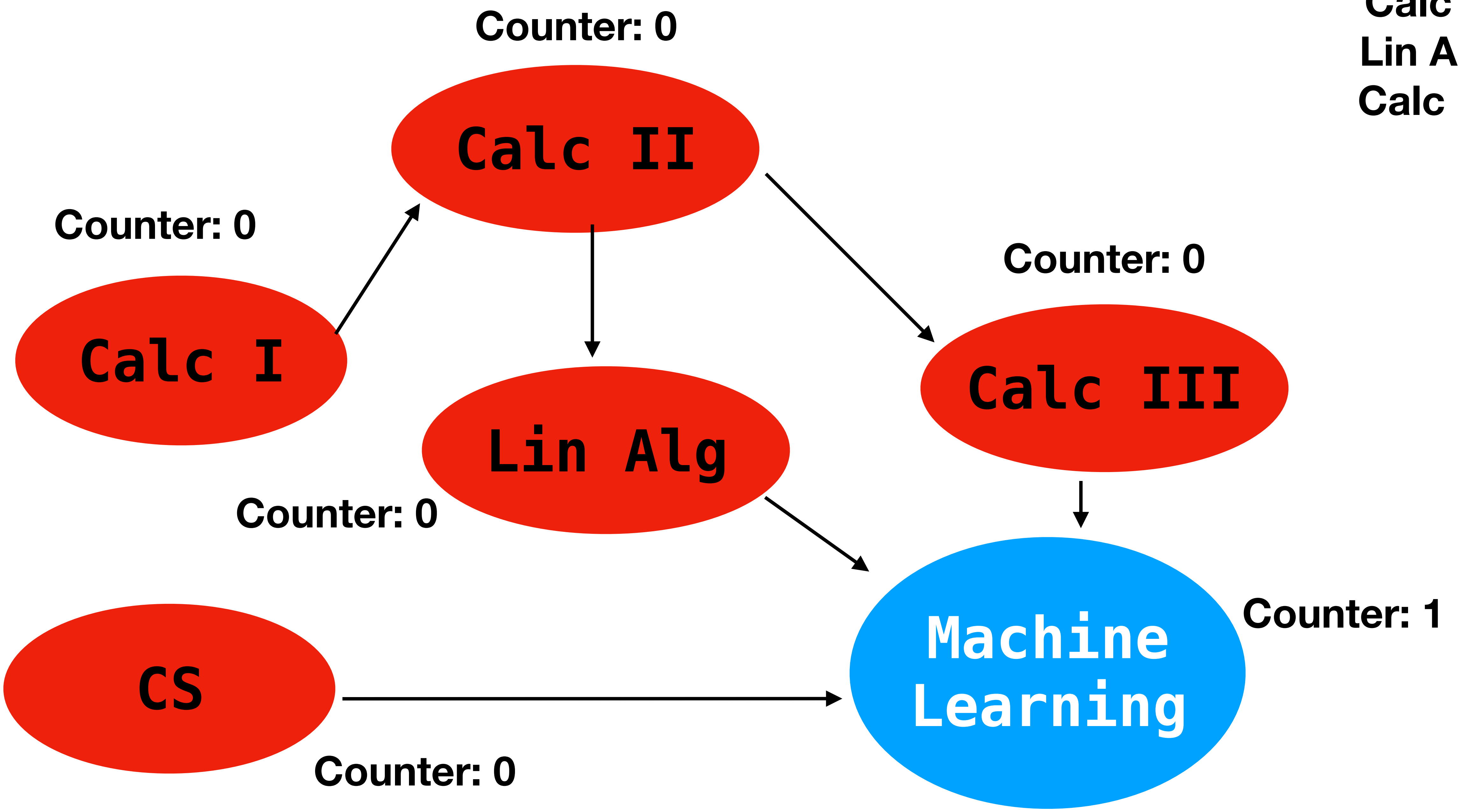
How to Topologically Sort?

- We'll run a modified DFS.

Calc I
CS
Calc II
Lin Alg
Calc III



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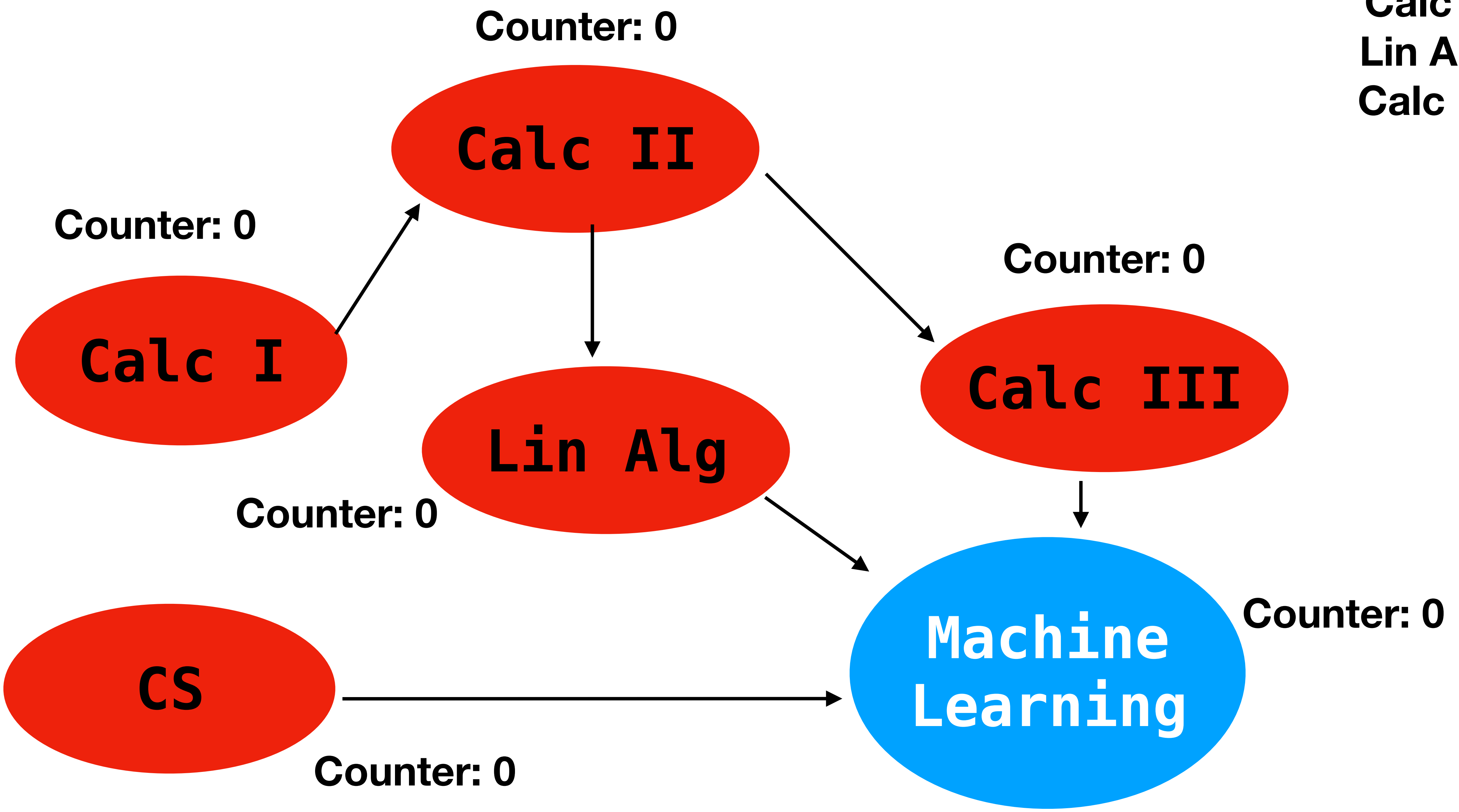

Calc I
CS
Calc II
Lin Alg
Calc III

How to Topologically Sort?

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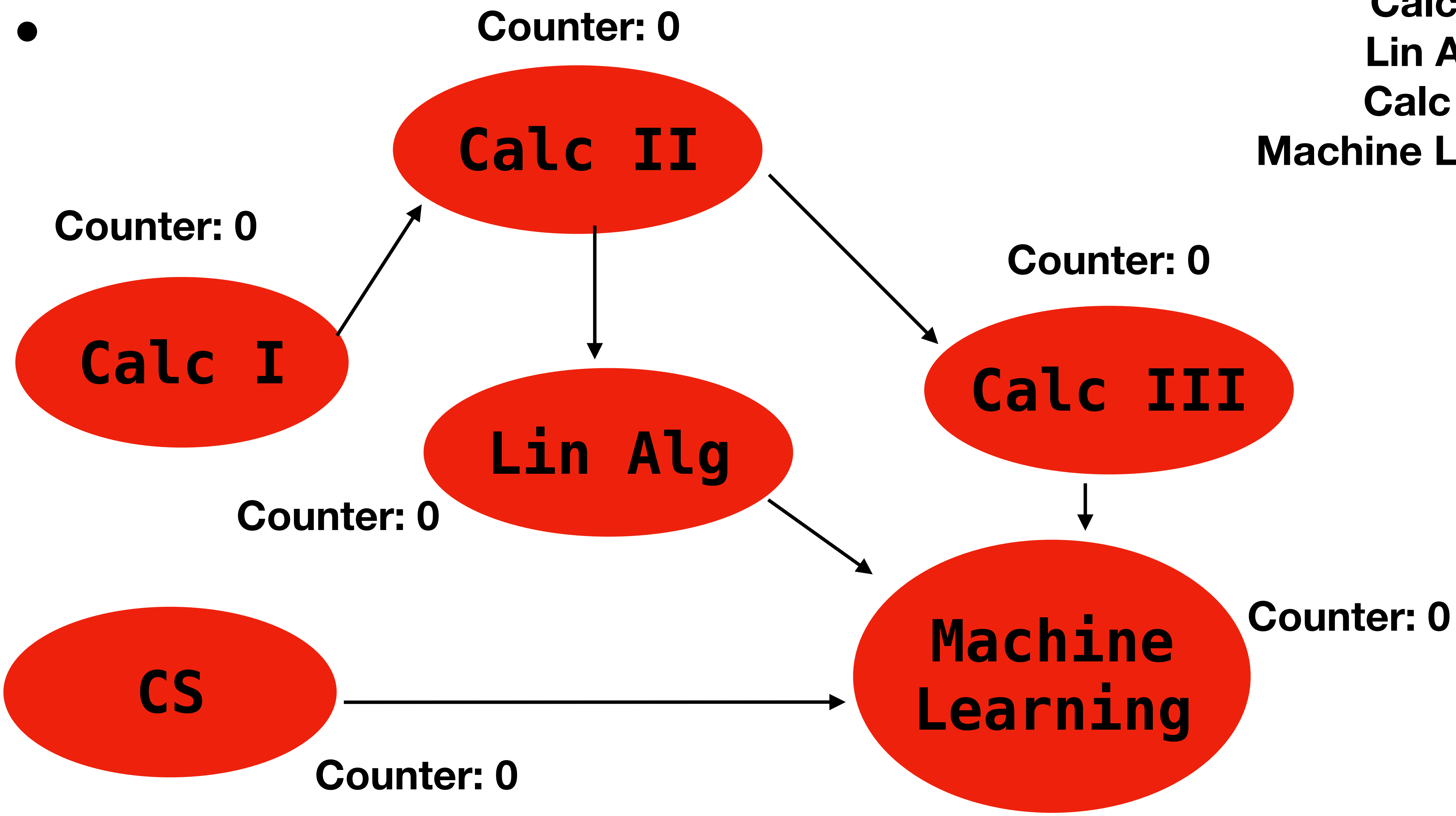

Calc I
CS
Calc II
Lin Alg
Calc III
Machine Learning