Breadth-First Search (BFS)

Lecture Question

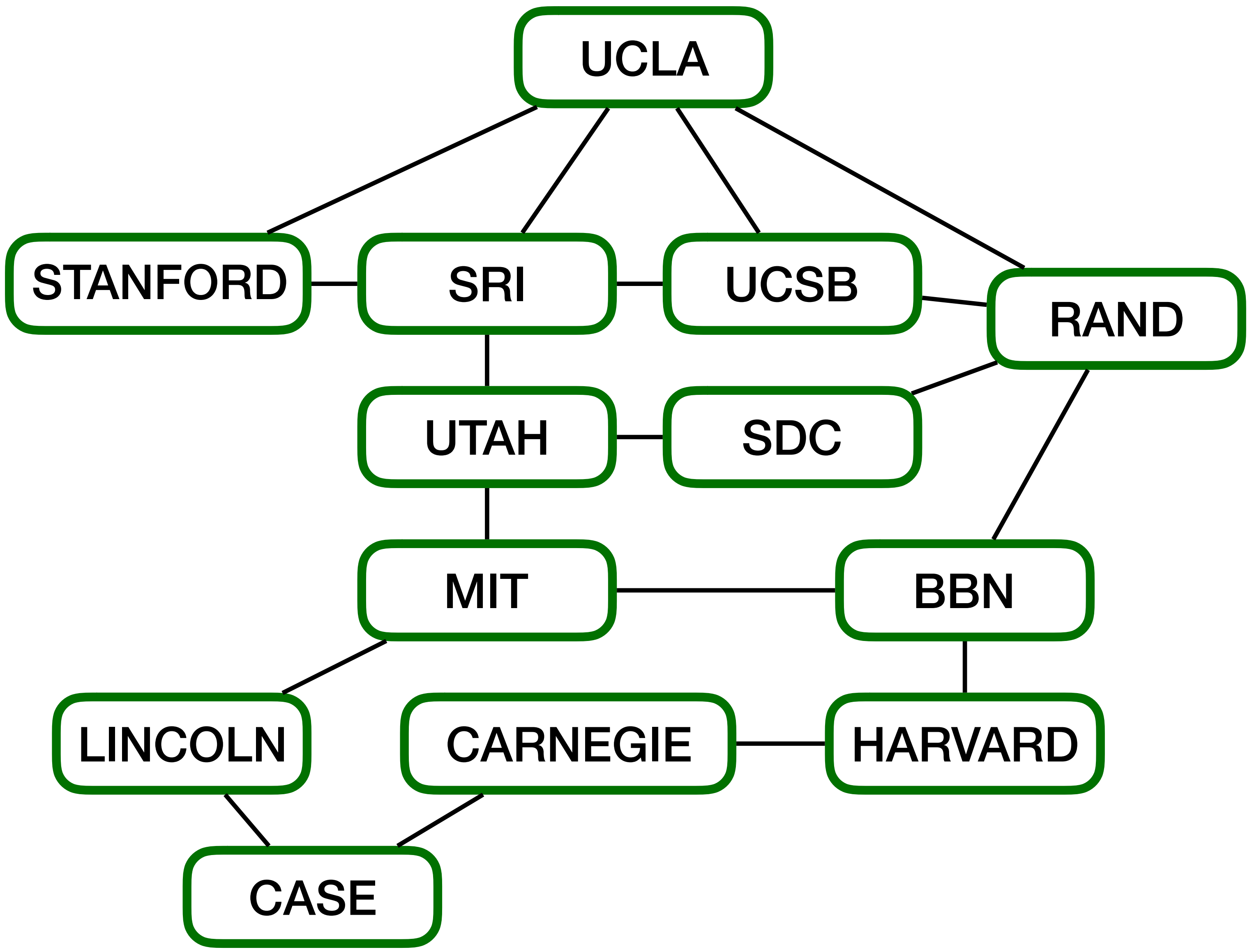
Task: Determine if two nodes connected

- In the Graph class
    - Write a method named areConnected that takes two node indices (Ints) and determines if the two nodes are connected in the graph
    - Return true if they are connected, false if they are not

* This question will be open until midnight

Connected Component

- This graph is connected
  - There exists a path between any 2 nodes in the graph



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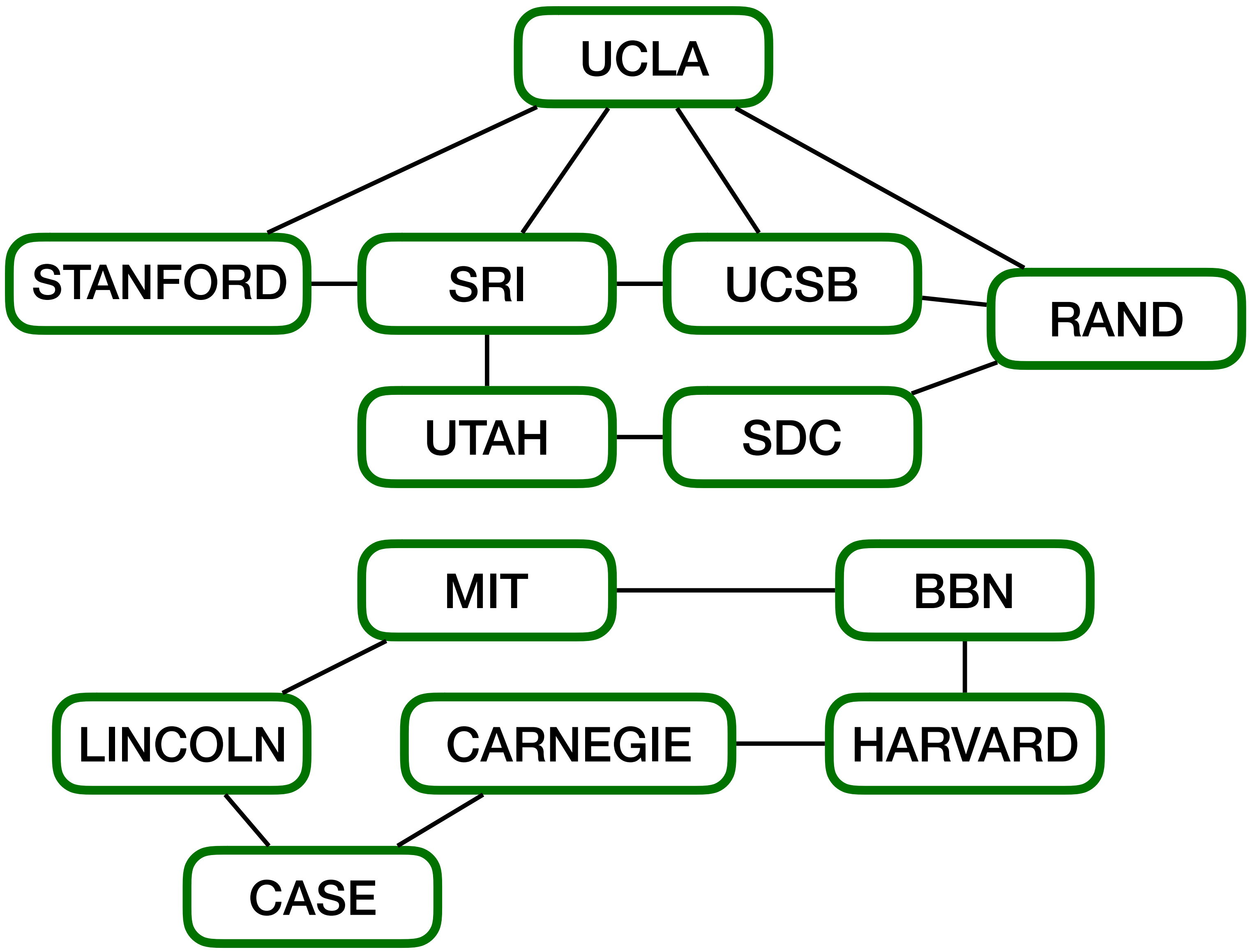
Connected Component

- What if a few connections a broken?
    - How can we tell if two nodes are connected?



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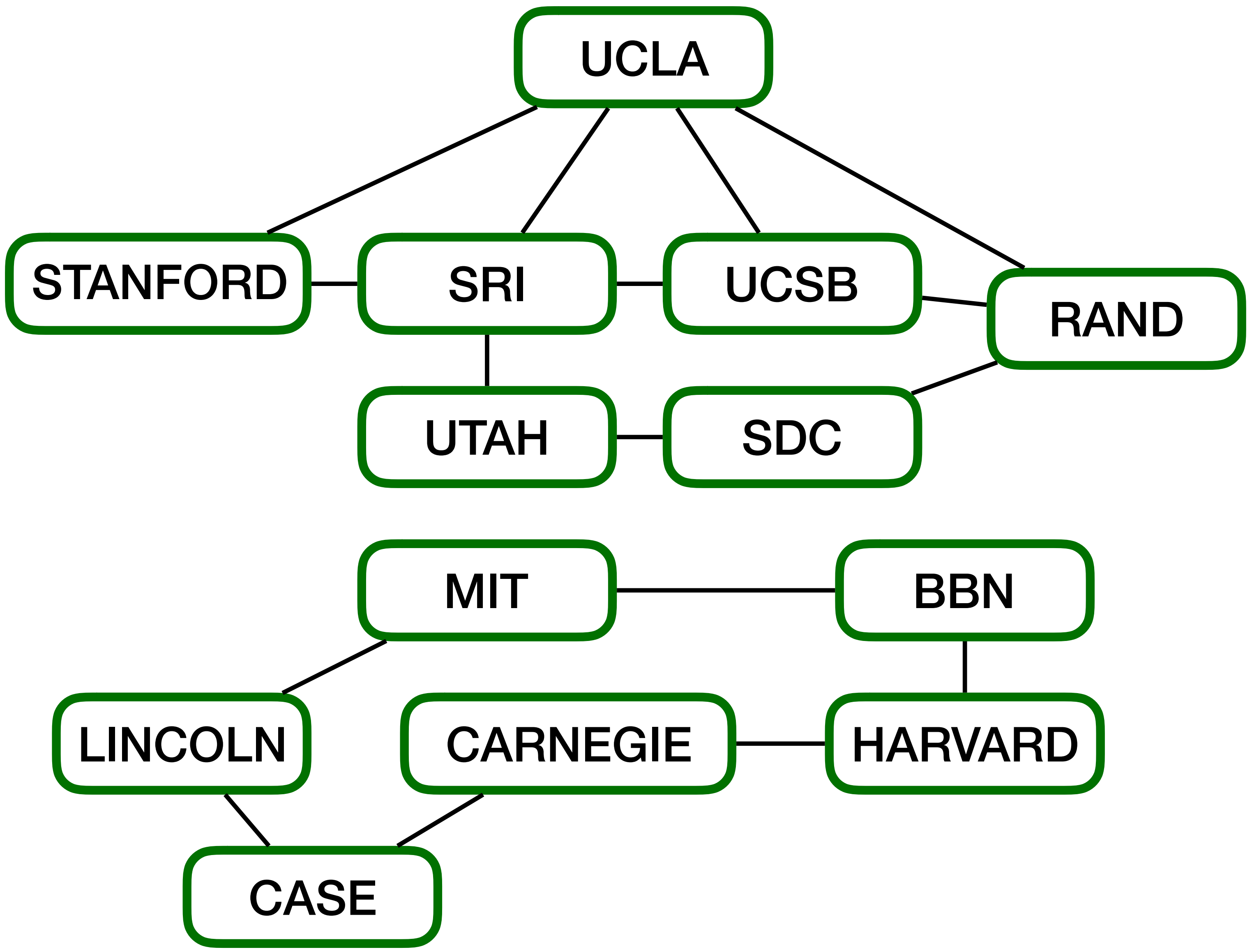

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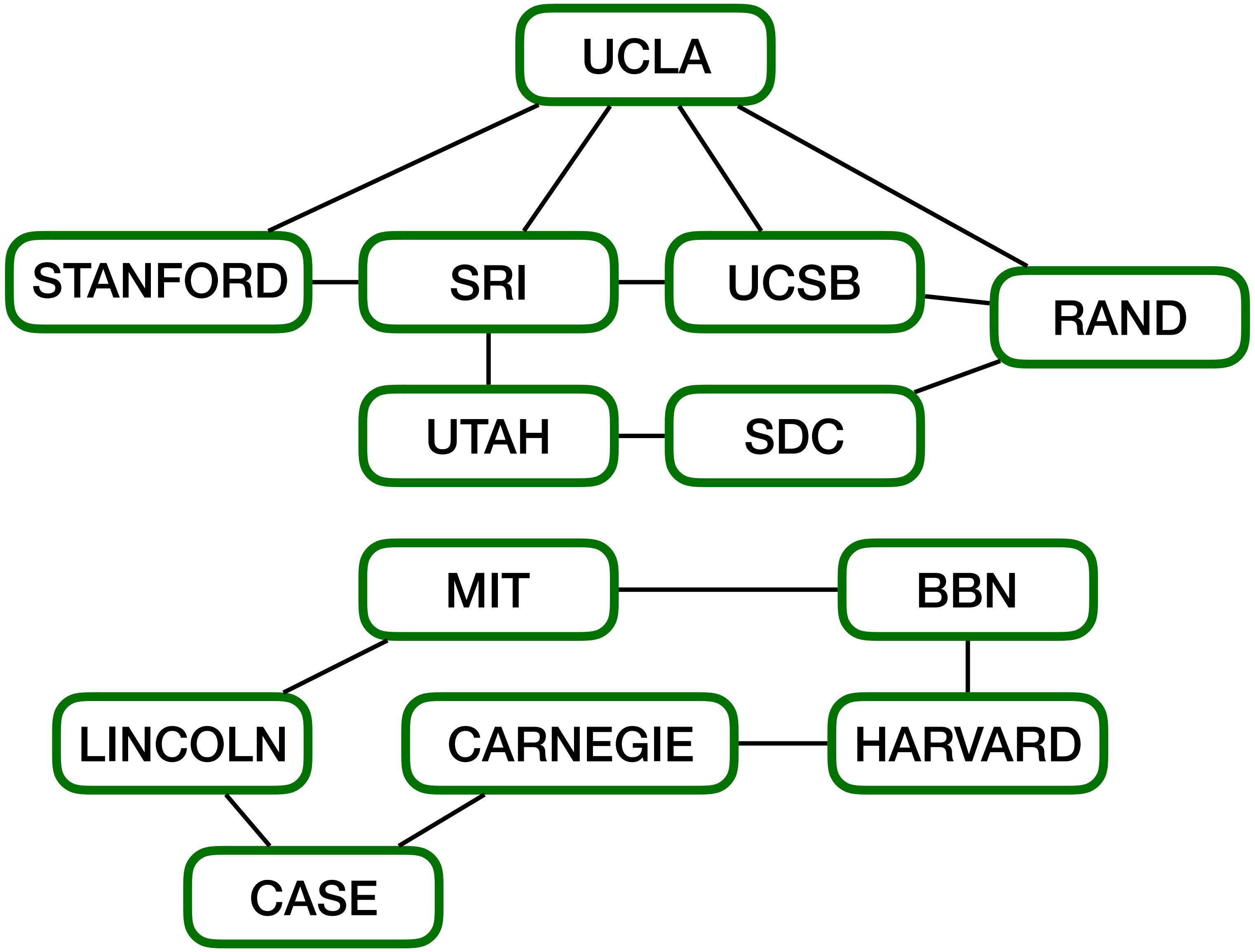
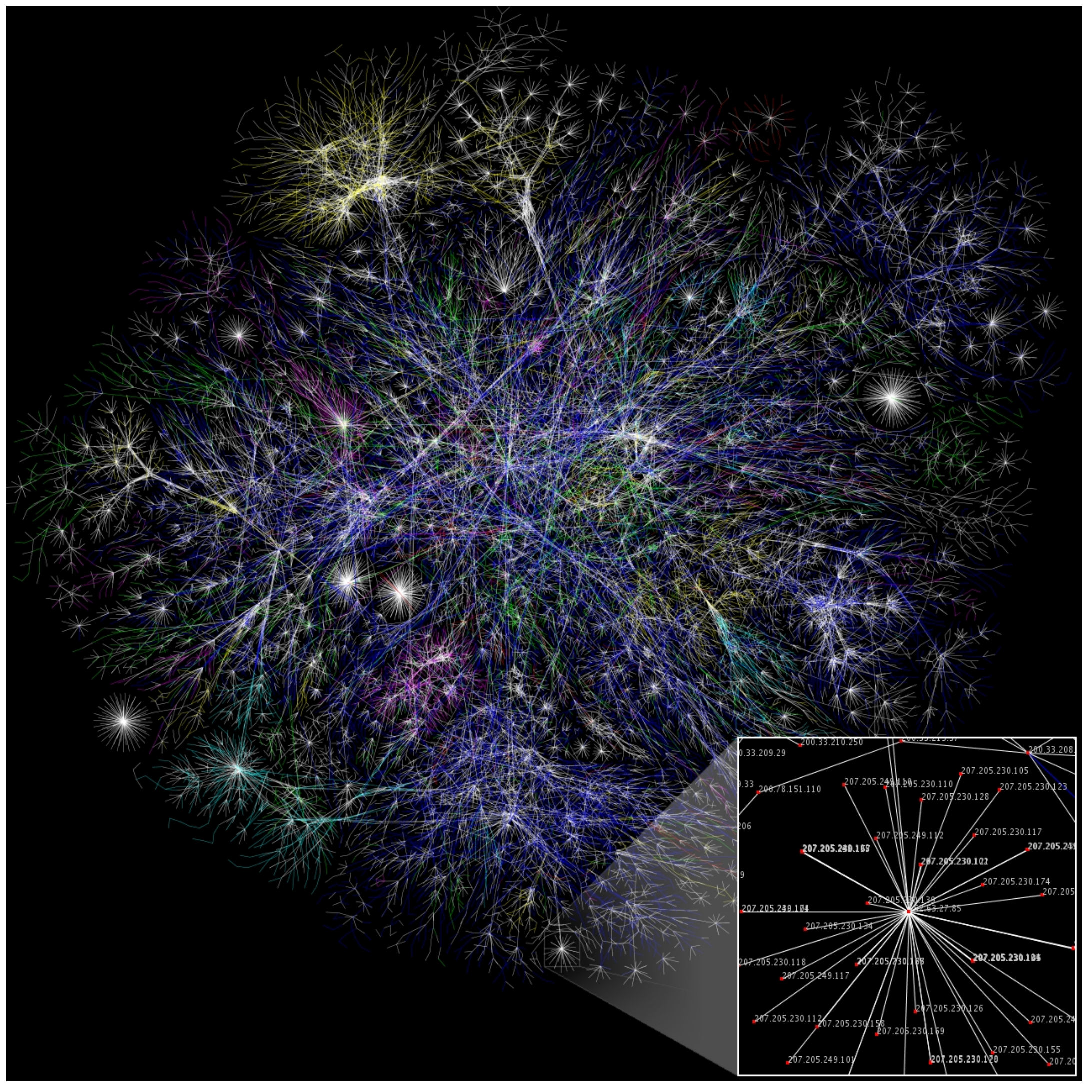
Connected Component

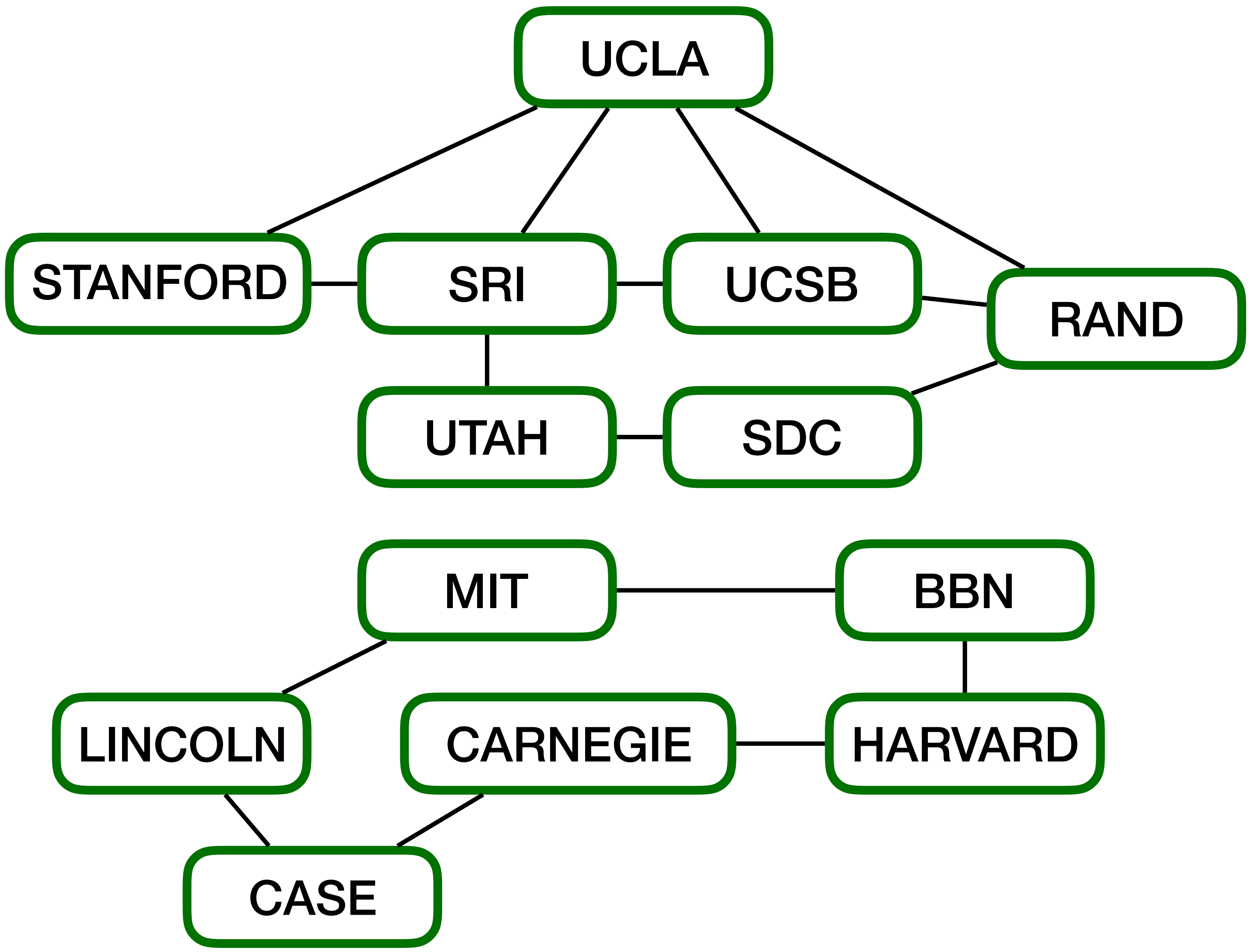
- We could verify manually for this graph
- But the Internet has gotten a *little* bigger over time
- Need to code an algorithm to solve this for us





BFS

- The Algorithm: Breath-First Search (BFS)
  - Choose a starting node
  - Continuously explore connected nodes



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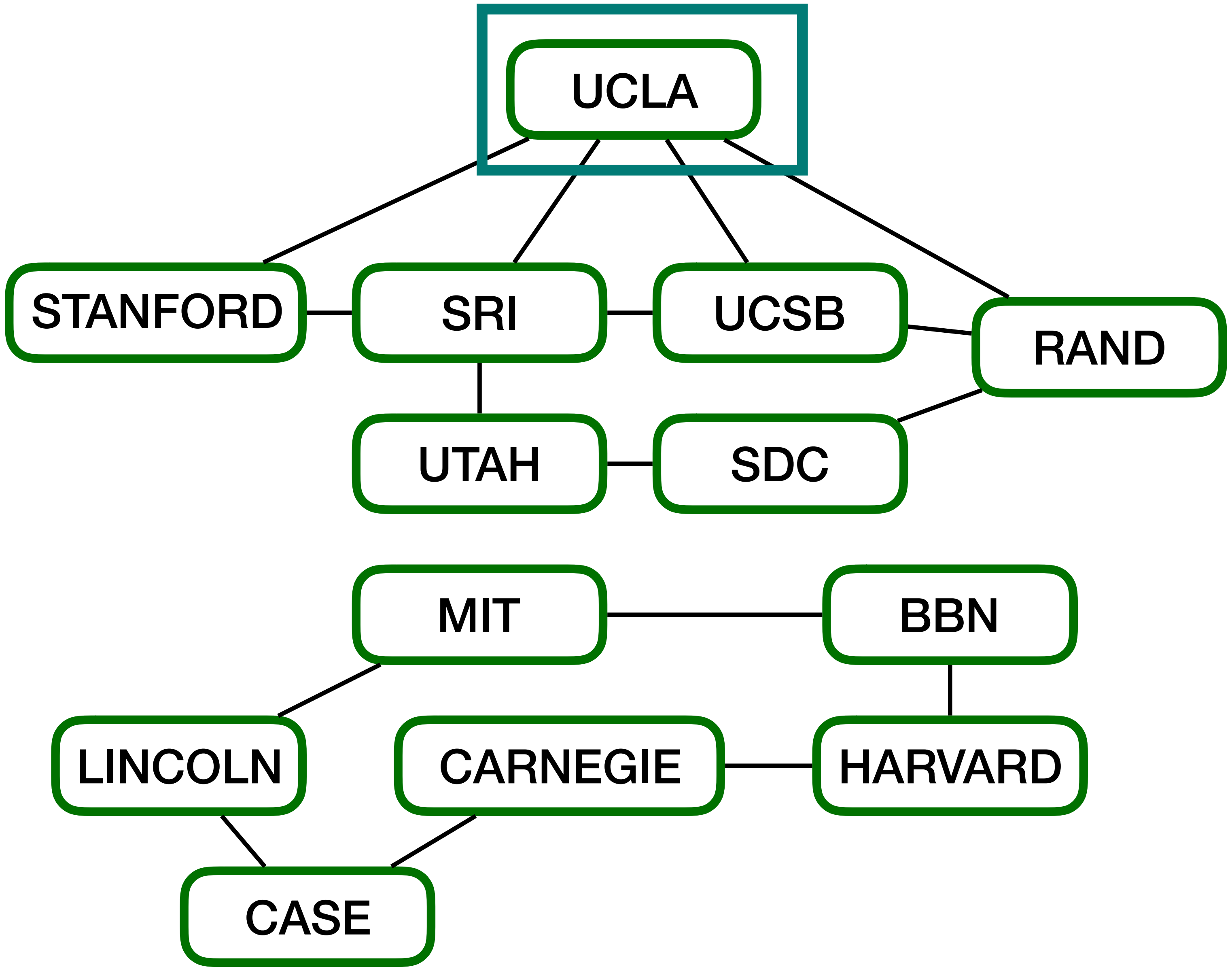
BFS

- Choose a starting node



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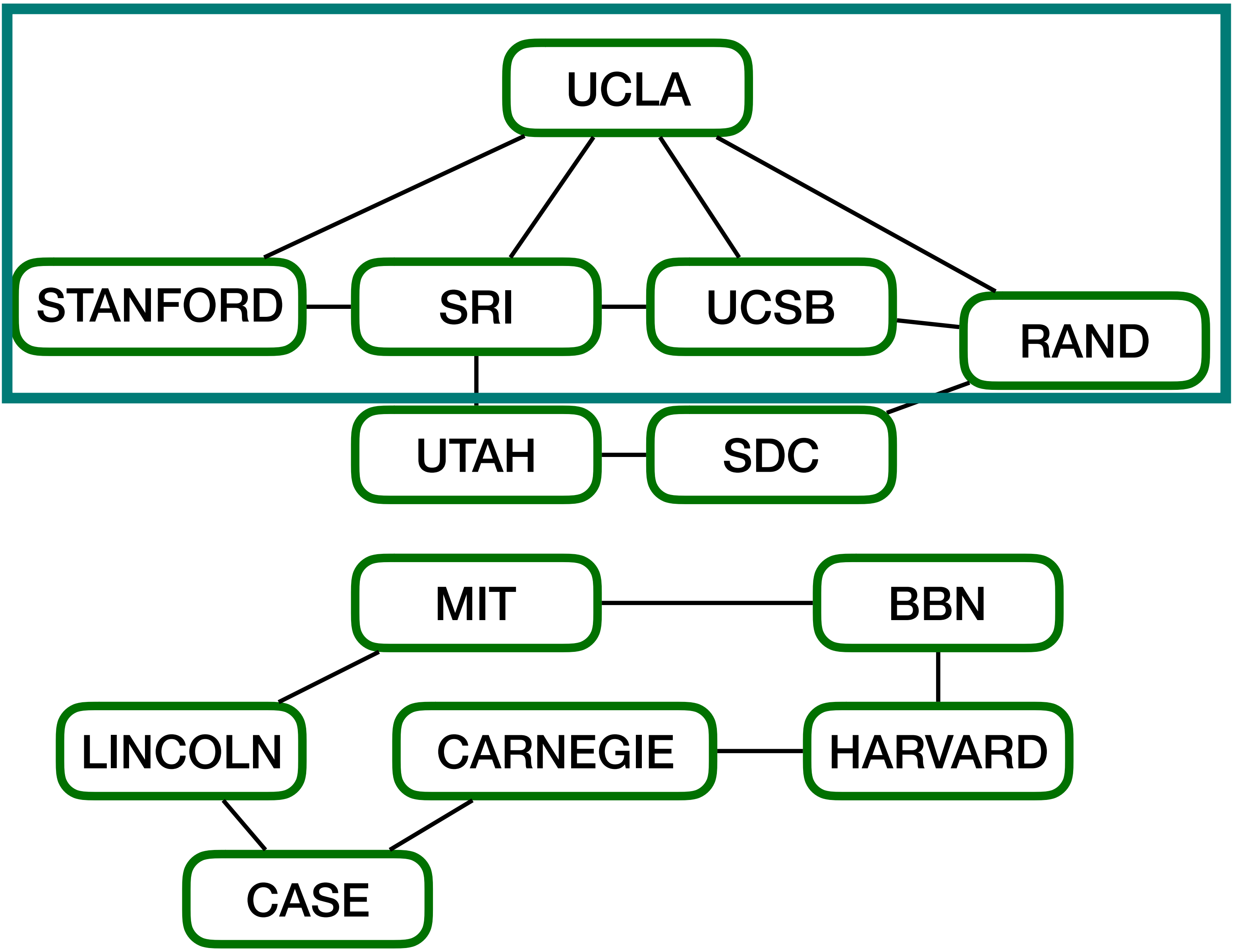
BFS

- Explore all nodes connected to the striating node



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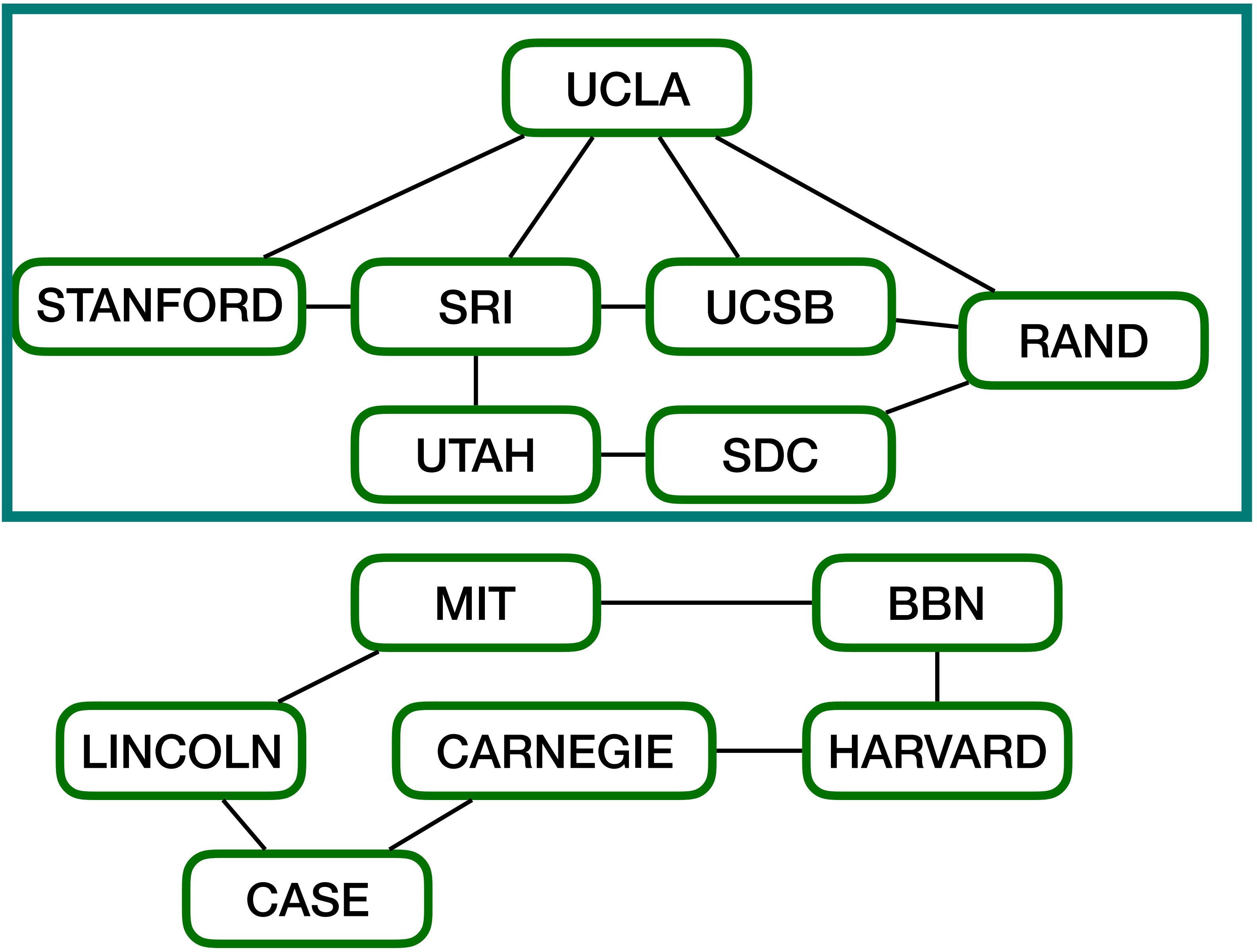
BFS

- Repeatedly explore nodes that were visited in the last round



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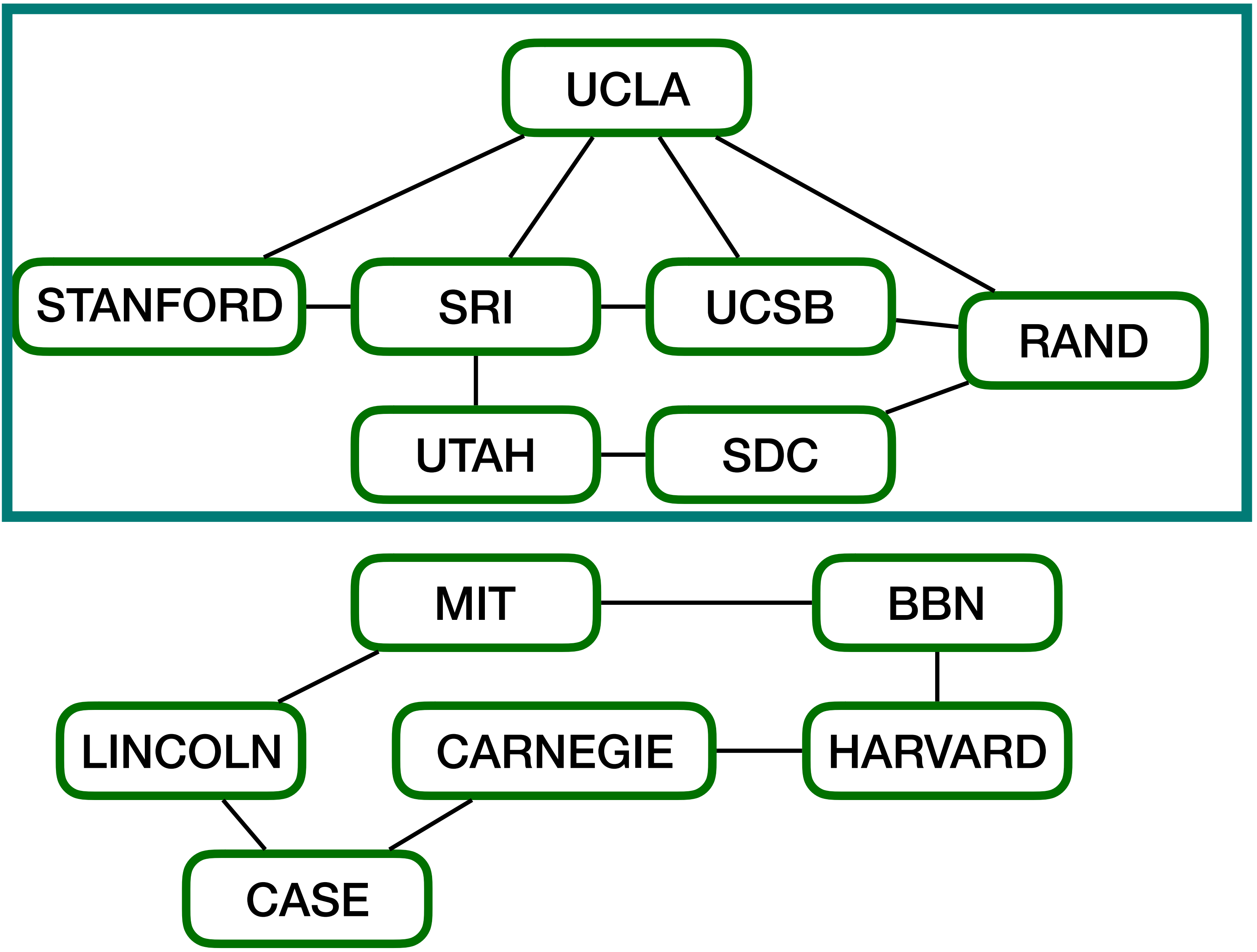
BFS

- Repeat until no new nodes are added
- Never visit a node twice



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BFS

- Use a queue to track the order of nodes to visit
- Start with starting node in the queue
- When visiting a node, add all unexplored neighbors to the queue
- Visit neighbors of the node at the front of the queue until the queue is empty

```scala
def bfs[A](graph: Graph[A], startID: Int): Unit = {

  var explored: Set[Int] = Set(startID)

  val toExplore: Queue[Int] = new Queue()
  toExplore.enqueue(startID)

  while (!toExplore.empty()) {
    val nodeToExplore = toExplore.dequeue()
    for (node <- graph.adjacencyList(nodeToExplore)) {
      if(!explored.contains(node)){
        println("exploring: " + graph.nodes(node))
        toExplore.enqueue(node)
        explored = explored + node
      }
    }
  }
}
```

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Connectivity

- If you start at one nodeA and explore nodeB during the algorithm
  - nodeA and nodeB are connected

Lecture Question

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