**CSCI 3202**
**Sample Midterm**
**October 3, 2025**

**Structure**
- Midterm is worth 15% of you course grade
- Exam will consist of:
  - Definitions
  - Multiple Choice
  - Short Answers
  - Worked Out Problems
- You **will** need a calculator for the exam

**Define the following terms as they apply to our search algorithms (2 points each, 10 points total)**
- Optimal
- Complete
- Uninformed
- Heuristic
- Step Cost Function

**Define the following as they relate to Bayes Networks (2 points each, 6 points total)**
- Independence
- Conditional Independence
- Bayes Rule

**Multiple Choice**
*Question 1*
Assume that the cost function is positive and > 0 where applicable and that any heuristic is admissible if needed

- Which of the following is optimal? (5 points)
  - BFS
  - DFS
  - UCS

- Greedy
- A*

### Question 2
Assume that the cost function is positive and > 0 where applicable and that any heuristic is admissible if needed

- Which of the following is complete? (5 points)
    - Same list as above

## Short Answer
### Question 1
- You have two heuristics, h1 and h2. h1 is the Manhattan distance and h2 is the euclidean (straight line) distance. If you apply these to an route finding problem from class (travel from Chicago to Providence):
    - Are both heuristics admissible? Why or why not? (10 points)
    - If we use max(h1,h2) to create a new heuristic, will it be admissible? (5 points)
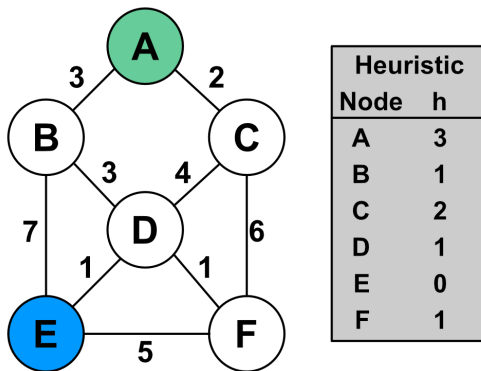
### Question 2
- If we have two heuristics, h3 and h4, explain how you can tell which one will visit the fewest nodes? Why? (5 points)

### Question 3
- Why do we assume conditional independence in our Bayes Networks (5 points)

## Worked Out Problems
### Question 1

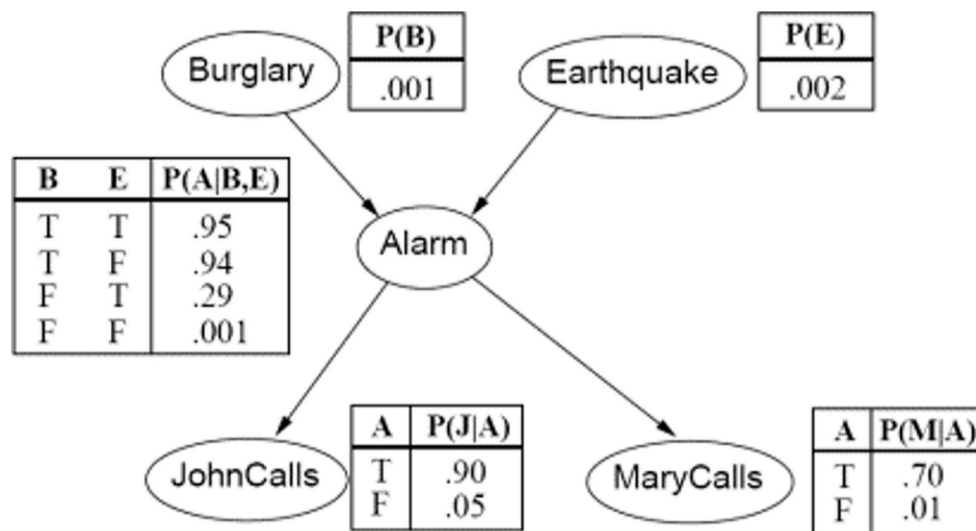| Heuristic | |
|---|---|
| Node | h |
| A | 3 |
| B | 1 |
| C | 2 |
| D | 1 |
| E | 0 |
| F | 1 |

Numbers are step cost between nodes.
Heuristic is for destination E

- Given the graph above, use BFS to find an optimal route from node A to node
  - Show the Frontier, Expanded nodes, and Visited nodes list for each step (10 points)
  - Construct the optimal path using BFS. (10 points)
  - What does optimality mean here? (5 points)

## Question 2

- Using the same graph , use A* to find an optimal route from A to E or A to F in an alternate version
  - Show the Frontier, Expanded nodes, and Visited nodes list for each step (20 points)
  - Construct the optimal path (10 points)
  - What does optimality mean here? (5 points)
  - Both BFS and A* are optimal. Why is the BFS path different from the A* path? (10 points)

## Question 3

| B | E | P(A\|B,E) |
|---|---|---|
| T | T | .95 |
| T | F | .94 |
| F | T | .29 |
| F | F | .001 |

| | P(B) |
|---|---|
| Burglary | .001 |

| | P(E) |
|---|---|
| Earthquake | .002 |

| A | P(J\|A) |
|---|---|
| T | .90 |
| F | .05 |

| A | P(M\|A) |
|---|---|
| T | .70 |
| F | .01 |

- Using the Burglar Alarm data given above do the following:
- Write the equation you would use to calculate P(A) using the data given in the problem (10 points)
- Calculate P(A) (5 points)
- Write the equation you would use to calculate $P(\overline{J})$ (J not) (15 points)

**End of Sample Midterm**