

CENG 420 | ELEC 569A

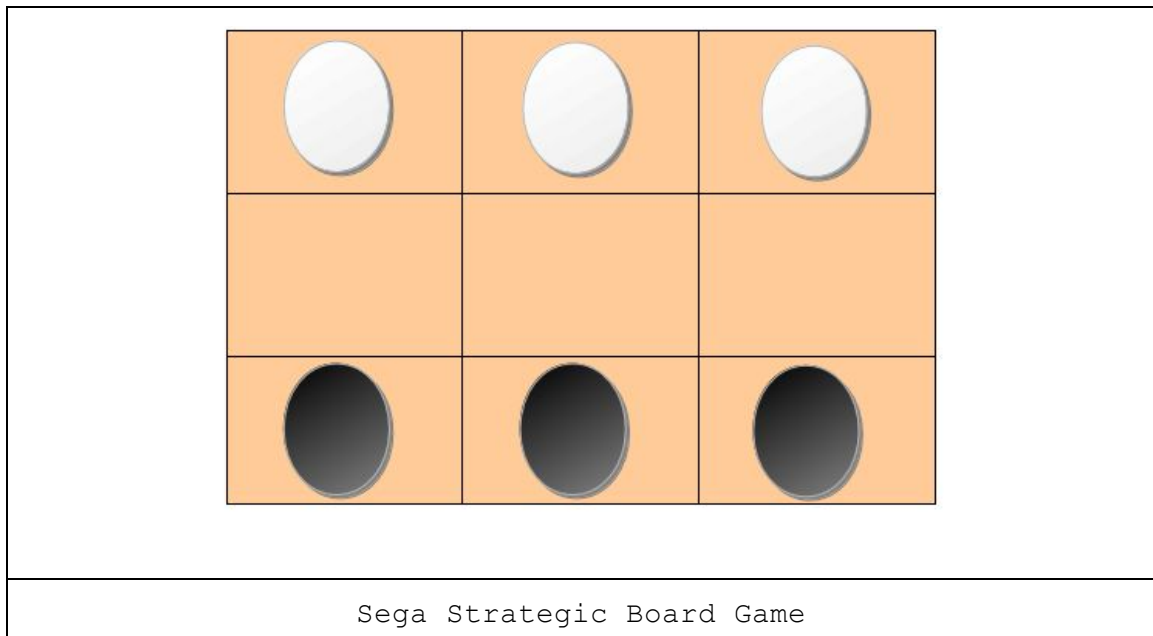
Assignment One due date (May 26, 2017)

There are 5 pages and 4 questions in this assignment. Read the questions carefully before you attempt to answer the assignment

QUESTION 1) [CENG-420: 100 Points] [ELEC-569A: 50 Points]

Sega is a board game that could be traced back to ancient Egypt. It is a very common street game in the Middle-East. It is 2 players (white and black) board game who take turns moving white and black pieces. There are two versions of the game. The adult's version and the kid's version. The adult's version each player has 24 pieces and the board of the game is 24*24 squares. The kid's version each player has 3 pieces.

In the kid version, the winner is the first player who succeeds in placing his 3 pieces in a horizontal, vertical, or diagonal row. When the game starts, each player puts his 3 pieces (usually small stones, white or black) on the top row and the bottom row leaving the row in the middle empty. Then the game proceeds with each player moving one of their pieces per turn. A piece may move to any empty square on the board, not just an adjacent one. The Figure below illustrates the state of the board at the beginning of the game.



Given the above game (Sega) description, please answer the following questions.

Q1.1) Model this game as a search problem and calculate the branching factor of this game, is the branching factor uniform or not? *[CENG-420: 20 Points] [ELEC-569A: 10 Points]*

Q1.2) Draw the search tree of depth 2 for this game starting from the initial state. *[CENG-420: 20 Points] [ELEC-569A: 10 Points]*

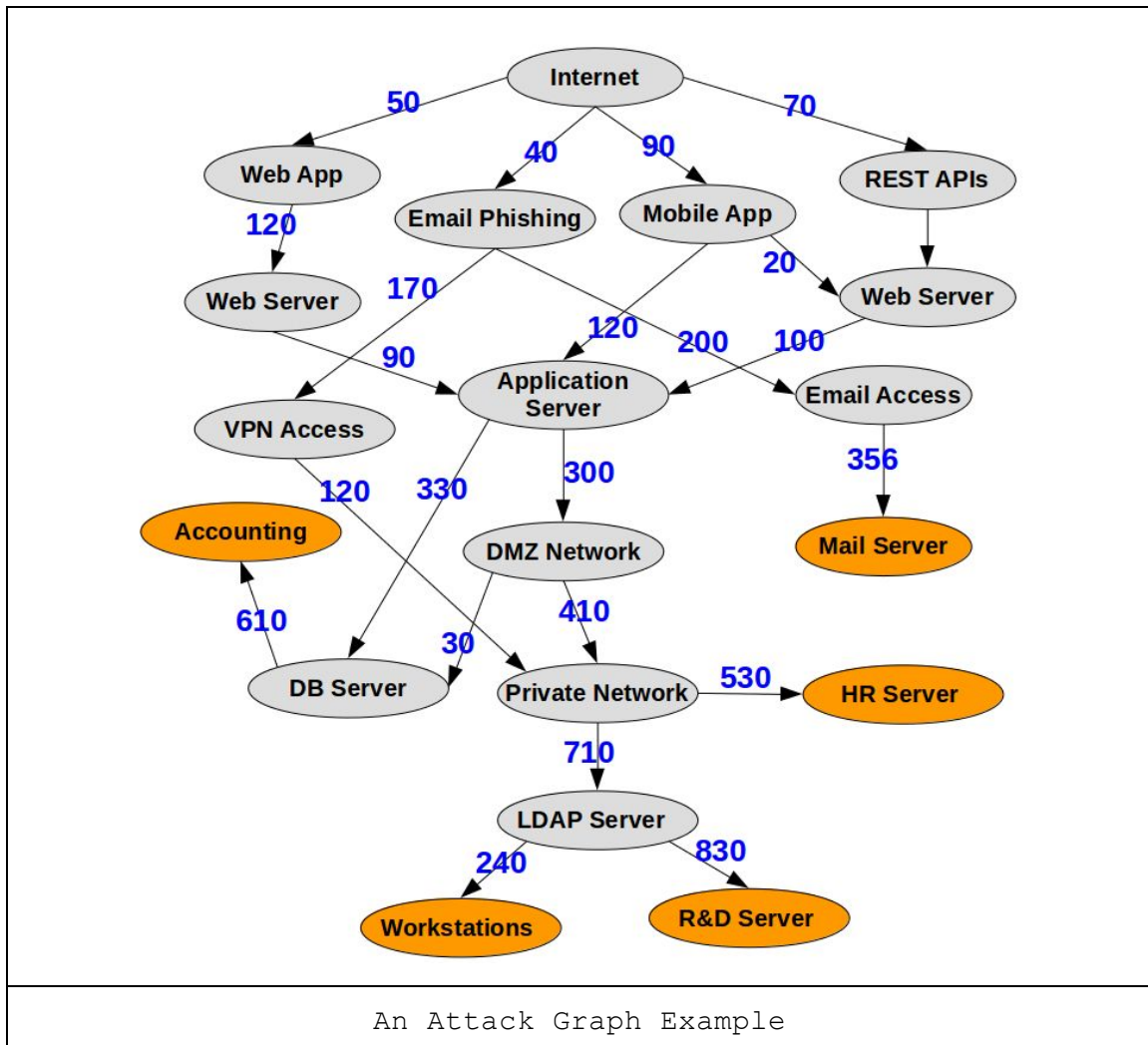
Q1.3) Using uninformed search technique to implement a computer program that plays this game against a human, which technique from the techniques we covered in the class is the best to implement this program. Make sure that you base your answer on the four criteria we use to evaluate search techniques. *[CENG-420: 20 Points] [ELEC-569A: 10 Points]*

Q1.4) Design a heuristic function or model to advance or recommend the next moves based on the current state of the game. Implement this function using any programming language. *[CENG-420: 20 Points] [ELEC-569A: 10 Points]*

Q1.5) Is it possible that the game gets stuck in a loop or a cycle? Explain your answer *[CENG-420: 20 Points] [ELEC-569A: 10 Points]*

QUESTION 2) [CENG-420: 50 Points] [ELEC-569A: 50 Points]

An attack graph is a technique to model how multiple vulnerabilities may be combined to execute a cyber-attack. In other words, each attack graph represents a collection of possible attack scenarios in a computer network. The figure below is an example of a weighted attack graph



The weight on each edge (link) in the graph represent the cost (e.g., time, money, etc) an attacker trying to penetrate the network need to spent to take down a countermeasure that protects a network or an organization asset (e.g. mail server, database, employee records, etc.). An asset in the attack graph is represented by a vertex (node). An attacker's target (end-goal of the attack) is usually key (most valuable) assets in the network. In the attack graph, the target asset is any leaf node.

Each simple path from the root of the attack graph to any target asset represents an attack scenario

Given the above cybersecurity analysis problem, please answer the following questions.

Q2.1) Model the above cybersecurity analysis problem as search problem. Suggest an algorithm to extract all possible attack scenarios and the cost the attacker needs to pay to complete each attack scenario *[CENG-420: 15 Points] [ELEC-569A: 15 Points]*

Q2.2) Given the following facts, design a heuristic search algorithm that an attacker can use to maximize it is gain from attacking the network. The cybersecurity analyst can use to rethink the allocation of the countermeasures and the budget he/she willing to spent to secure the network

- The cost for taking down a countermeasure less than or equal the cost of implementing the countermeasure.
- The total value of the assets is greater than the total cost of implementing the countermeasures
- The most expensive countermeasure protects the most valuable assets.
- An attack has a limited budget for completing his attack, and this budget is at most enough to attack and reach one or more target asset. *[CENG-420: 35 Points] [ELEC-569A: 35 Points]*

Note: for more information about risk analysis and attack graph please read the attached paper or download it for the course Github repo.

QUESTION 3) [ELEC-569A: 50 Points] for Graduate Students only

Q3.1) Search Techniques in AI are examples of intelligent search. In your opinion, is using Turing test a valid and fair approach to measuring the intelligence of these search techniques. [CENG-420: 0 Points] [ELEC-569A: 25 Points]

Note: refer to Alan Turing paper "Computing Machinery and Intelligence."

Q3.2) In the AI literature, it is very common to describe search technique (algorithms) as search agent. In your opinion using the term "agent" to describe search techniques in AI is appropriate (accurate). Base your opinion on the paper. "Is it an Agent, or Just a Program?" [CENG-420: 0 Points] [ELEC-569A: 25 Points]

QUESTION 4) Write your own Final Exam|Quiz

Write or design one question in one of the following topics

- Philosophy of Artificial Intelligence
- Search techniques in AI

The group with the best or the most interesting question will be awarded **20 bonus points** limited to the assignments (any of the three assignments).

Finally, one of the top (best) suggested questions by all the groups will be **included** in the final quiz|exam