

**CPSC 428/528 – Artificial Intelligence**  
**East Stroudsburg University of Pennsylvania**

**Programming Assignment 1**

**Release date:** Feb 04, 2025

**Due Date:** Feb 27, 2025

**Max. Points:** 100

**Bonus Points:** 30

**Weightage:** This assignment is worth 15% of your course work (programming assignments)

**Assignment Title:** *Pathfinding Algorithms with A\* with heuristics and Greedy Best-First Search.*

**Objective:** The objective of this assignment is to implement and compare multiple pathfinding algorithms i.e., BFS and DFS, including A\* with Euclidean and Manhattan heuristics, and Greedy Best-First Search in a Unity game environment. This assignment allows students to explore various pathfinding algorithms and understand the impact of different heuristics on path quality and performance.

**Instructions:**

**Part 1: Project Setup and Preparation (5 points)**

1. Use the Unity project designed in the class for this assignment. Set up a grid-based game scene with obstacles, a player character (start node), and a goal either from a text file or image file.
2. Design and implement a grid system for pathfinding. Define grid nodes representing walkable and non-walkable areas.

**Part 2: Algorithm Implementations (40 points)**

1. Implement the A\* algorithm with both Euclidean and Manhattan heuristics, as well as the Greedy Best-First Search algorithm, in C# scripts within Unity.
2. Ensure that these algorithms provide optimal paths from the player character (start node) to the goal.

**Part 3: Visualization and User Interaction (10 points)**

1. Visualize the exploration process and path generated by the BFS, DFS, and Dijkstra, Greedy Best-First Search, A\* algorithms.
2. Allow the player to select which algorithm to use for pathfinding. Create a user interface that lets the player choose between BFS, DFS, Dijkstra, Greedy Best-First Search, and A\* for pathfinding. The chosen algorithm should then be executed.

**Part 4: Comparative Analysis (20 points)**

1. Provide a comparative analysis of the algorithms, discussing their strengths and weaknesses, and how they differ in finding paths. Pay special attention to the differences between the Euclidean and Manhattan heuristics.

**Part 5: Report and Presentation (25 points)**

1. Write a comprehensive report that includes:
  - Introduction to the A\* algorithm, Greedy Best-First Search, and the role of heuristics in pathfinding.
  - Details of your algorithm implementations, including code snippets and explanations.
  - Visualization screenshots of the pathfinding process.
  - In-depth comparative analysis results for the algorithms and heuristics.
2. Include video of live demonstrations of pathfinding using all algorithms and heuristics.

**Bonus Challenge (Optional):** For an extra challenge, you can implement additional features such as path smoothing, dynamic obstacle avoidance with real-time updates, or custom heuristics tailored to your game environment **(30 points)**

**Grading Criteria:** You will be evaluated based on:

- The successful implementation of A\* with both heuristics, Greedy Best-First Search, and effective visualization.
- The depth of the comparative analysis, including heuristics.
- Clarity, structure, and quality of your code report and presentation.

As this is an upper-level course, it's essential that students conduct sufficient research and avoid asking the instructor for assistance with syntax errors, as the course does not focus on teaching programming fundamentals.