David Wasson

CS 300: Project One

Dr. Adamo

Southern New Hampshire University

6/22/2025

**Evaluate the run time and memory of data structures that could be used to address the requirements**

1. Specify the cost per line of code and the number of times the line will execute. Assume there are n courses stored in the data structure.
2. Assume the cost for a line to execute is 1 unless it is calling a function, in which case the cost will be the running time of that function.

Assuming there are n courses, each course has up to k prerequisites, each step has a cost of 1 unless a function I found the worst-case running time of each data structure. For vector structure I found the Big O to be O(n²). For a hash table structure, I found the Big O to be O(nk). For a binary tree I found the Big O to be O(n log n + nk log n). In this it seems that a Hash Table would be the fastest option, while the slowest option would be using a Vector. However, each option has its own weaknesses and strengths. While slower, a Vector may be easier for most users to use and the simplest to implement. However, a Vector is slower when doing searches or printing in alphanumeric order. A Hash Table excels in the speed it can look up courses, validates prerequisites, and parses large amounts of data. It is harder to implement and can ultimately use more memory. A Binary Search Tree is best at sorting the data in alphanumeric order while being efficient with searching and adding data. A BST has a tougher time validating prerequisites, uses a good amount of memory, and can become unbalanced, leading to deterioration of performance.

Upon review of each structure, I would recommend to use a Hash Table. It was very clear that a Hash table is the best option for a few reasons. One reason being efficiency and speed. The worst-case scenario for the Hash Table outperforms both Vector and BST. This is huge for the user as they try to review each course, its prerequisites, and make a determination on which course they would like to take. Another reason is the validation of prerequisites. The Hash Table is able to perform validations very efficiently. Especially if there is a large amount of data stored in the file it is reading. Additionally, the Hash Table is very efficient with adding and sorting course information.