**Runtime Analysis - Vector File Parsing**

*n -* number of courses

*m -* number of pre-requisites

| **Code** | **Line cost** | **# Times Executes** | **Total Cost** |
| --- | --- | --- | --- |
| Initialize std::set courseNumbers | 1 | 1 | 1 |
| Initialize std::set preReqs | 1 | 1 | 1 |
| Open file for reading | 1 | 1 | 1 |
| Initialize vector<string> line | 1 | 1 | 1 |
| While not end of file | 1 | n | n |
| Get the next line in the CSV file | 1 | n | n |
| Split line by comma delimiter | 1 | n | n |
| If number of fields < 2 | 1 | n | n |
| Exit program | n/a | n/a | n/a |
| Append line[0] to courseNumbers | 1 | n | n |
| For each prerequisite in line[2] to line.size() | m | n | mn |
| Append preReq to preReqs | 1 | mn | mn |
| Clear line vector fields | 1 | n | n |
| For each preReq in preReqs | 1 | m | m |
| If preReq not in courseNumbers | 1 | m | m |
| Exit program if invalid | n/a | n/a | n/a |
| Close file | 1 | 1 | 1 |
| **Total Cost** |  |  | **5n + 2mn + 2m + 5** |
| **Runtime** |  |  | **O(n)** |

**Runtime Analysis - Vector Course Creation**

*n -* number of courses

*m -* number of pre-requisites

| **Code** | **Line cost** | **# Times Executes** | **Total Cost** |
| --- | --- | --- | --- |
| DefineCourse struct | 1 | 1 | 1 |
| Initialize a vector of course objects | 1 | 1 | 1 |
| addCourse(vector<string> line) | 1 | n | n |
| Set newCourse.courseNumber = line[0] | 1 | n | n |
| Set newCourse.courseName = line[1] | 1 | n | n |
| If line.size() > 2 | 1 | n | n |
| For i in range(3, line.size()) | 1 | m | m |
| Append line[i] to newCourse.preRequisites | 1 | m | m |
| Vector push\_back newCourse | 1 | n | n |
| **Total Cost** |  |  | **5n + 2m + 2** |
| **Runtime** |  |  | **O(n)** |

**Runtime Analysis - Hash Table File Parsing**

*n -* number of courses

*m -* number of pre-requisites

| **Code** | **Line cost** | **# Times Executes** | **Total Cost** |
| --- | --- | --- | --- |
| Initialize std::set courseNumbers | 1 | 1 | 1 |
| Initialize std::set preReqs | 1 | 1 | 1 |
| Open file for reading | 1 | 1 | 1 |
| Initialize vector<string> line | 1 | 1 | 1 |
| While not end of file | 1 | n | n |
| Get the next line in the CSV file | 1 | n | n |
| Split line by comma delimiter | 1 | n | n |
| If number of fields < 2 | 1 | n | n |
| Exit program | n/a | n/a | n/a |
| Append line[0] to courseNumbers | 1 | n | n |
| For each prerequisite in line[2] to line.size() | m | n | mn |
| Append preReq to preReqs | 1 | mn | mn |
| Clear line vector fields | 1 | n | n |
| For each preReq in preReqs | 1 | m | m |
| If preReq not in courseNumbers | 1 | m | m |
| Exit program if invalid prerequisite | n/a | n/a | n/a |
| Close file | 1 | 1 | 1 |
| **Total Cost** |  |  | **5n + 2mn + 2m + 5** |
| **Runtime** |  |  | **O(n)** |

**Runtime Analysis - Hash Table Course Creation**

*n -* number of courses

*m -* number of pre-requisites

| **Code** | **Line cost** | **# Times Executes** | **Total Cost** |
| --- | --- | --- | --- |
| DefineCourse struct | 1 | 1 | 1 |
| Initialize a Hash Table of course objects | 1 | 1 | 1 |
| addCourse(vector<string> line) | 1 | n | n |
| Set newCourse.courseNumber = line[0] | 1 | n | n |
| Set newCourse.courseName = line[1] | 1 | n | n |
| If line.size() > 2 | 1 | n | n |
| For i in range(3, line.size()) | 1 | m | m |
| Append line[i] to newCourse.preRequisites | 1 | m | m |
| HashTable::Insert(course) | 1 | n | n |
| **Total Cost** |  |  | **3n + 2m + 1** |
| **Runtime** |  |  | **O(n)** |

**Runtime Analysis - Binary Search Tree File Parsing**

*n -* number of courses

*m -* number of pre-requisites

| **Code** | **Line cost** | **# Times Executes** | **Total Cost** |
| --- | --- | --- | --- |
| Initialize std::set courseNumbers | 1 | 1 | 1 |
| Initialize std::set preReqs | 1 | 1 | 1 |
| Open file for reading | 1 | 1 | 1 |
| Initialize vector<string> line | 1 | 1 | 1 |
| While not end of file | 1 | n | n |
| Get the next line in the CSV file | 1 | n | n |
| Split line by comma delimiter | 1 | n | n |
| If number of fields < 2 | 1 | n | n |
| Exit program | n/a | n/a | n/a |
| Append line[0] to courseNumbers | 1 | n | n |
| For each prerequisite in line[2] to line.size() | m | n | mn |
| Append preReq to preReqs | 1 | mn | mn |
| Clear line vector fields | 1 | n | n |
| For each preReq in preReqs | 1 | m | m |
| If preReq not in courseNumbers | 1 | m | m |
| Exit program if invalid prerequisite | n/a | n/a | n/a |
| Close file | 1 | 1 | 1 |
| **Total Cost** |  |  | **5n + 2mn + 2m + 5** |
| **Runtime** |  |  | **O(n)** |

**Runtime Analysis - Binary Search Tree Course Creation**

*n -* number of courses

*m -* number of pre-requisites

| **Code** | **Line cost** | **# Times Executes** | **Total Cost** |
| --- | --- | --- | --- |
| DefineCourse struct | 1 | 1 | 1 |
| Initialize an empty BST | 1 | 1 | 1 |
| Set newCourse.courseNumber = line[0] | 1 | n | n |
| Set newCourse.courseName = line[1] | 1 | n | n |
| If line.size() > 2 | 1 | n | n |
| For i in range(3, line.size()) | 1 | m | m |
| Append line[i] to newCourse.preRequisites | 1 | m | m |
| BinarySearchTree::Insert(course) | log(n) | n | n log n |
| **Total Cost** |  |  | **3n + n log(n) + 2m + 1** |
| **Runtime** |  |  | **O(n)** |