CSE 420 Lab Tasks, Policy, and Guidelines

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Introduction

The general goal of the compiler design lab is to give students an experience of constructing a compiler for a programming language. Once they go through all the assignments, they should feel confident that they can design their own programming languages and make the computer executes code written in those languages.

We chose C as the target programming language for teaching compiler construction. Students are expected to implement a partial compiler step-by-step for C programming language in the lab assignments. Given the shortage of time and the reduced number of labs per semester, we can cover only up to intermediate code generation in five lab assignments. Furthermore, to make the task manageable in the short time span of a semester, we will skip complex features of C, such as, pointers, C structure variables, and multidimensional arrays. Interested students only need to implement intermediate code to the assembly code generation phase after that if they want to have an elementary but full C compiler implementation.

The General Nature of Assignments

Almost all compiler developments now use compiler generator tools such as FLEX and BISON. Furthermore, generation of the whole compiler involves several intermediate object/executable file generations. To avoid confusing students about how to solve an assignment, the lab instructors will provide a partially complete assignment bundle folder. The folder will contain necessary installation instructions, a script, one or more sample input files (when applicable), and an assignment description

file, along with the partially complete source files. Each assignment is basically a filling the gaps problem. The students are expected to add code, instructions, etc. in the partially complete source files, then run the script to check if their changes are adequate.

Notice that the compiler construction process is incremental. That means, the solution of the first assignment is used in the second, the solution of the second assignment is used in the third, and it goes on like that. So, spending enough time understanding and doing the assignments from the beginning of the semester is extremely important. Otherwise, the students will suffer with the later assignments after the midterm exam. In addition, students must be aware that the later assignments are increasingly more complex than the earlier assignments. Thus, it is critical that they reserve enough time and multiple days to work on the assignments.

Lab Policies

Assignment Submission Policy

Students can work solo or form a group of two for the assignment related work. If a pair of students form a group, it will remain fixed for the entire semester. If a student cannot find a fellow student to form a group or want to do all assignments on his/her own then he/she can do that. Since the assignments are incremental, and the instructor supplied bundle for the next assignment will hold a full solution of all previous assignments along with the partial solution of the next assignment; there is **absolutely no scope for late submission**. The advantage of forming a group is that if one student in a group cannot contribute to a particular assignment due to sickness, his/her groupmate can put extra effort on that assignment to complete the work within the deadline.

Students will be given **two weeks** to complete each assignment. However, they must submit their intermediate work at the **end of the first week**. If the intermediate submission is not made, **25% of points** will be taken away from the student group's final submission even if it is completely correct. If a group can solve the entire assignment within the first week, then the final and the intermediate submissions can be the same. Otherwise, the intermediate submission will have whatever partial changes students made to the original assignment bundle, a change description file whether they will write what they changed, and a query file (optional) where they will describe problems they may be facing solving the assignment.

Lab Attendance Policy

The new 90% attendance policy for lab as authorized by registrar office and academic counsel will be strictly followed in the course. Which means, a student cannot sit for the theory final exam if he/she cannot maintain 90% lab attendance.

Assignment Evaluation Strategy

Unlike in other courses, we cannot change assignments of compiler design every semester. This is for the obvious reason that the assignments are about compiler constructions and the standard practices for that task do not change easily. Consequently, there is a very high opportunity for copying assignments from others and little scope for plagiarism checking. To counter this problem, student/group groups will face viva exams with each assignment submission (when they do the final submission) where the instructors will assess whether the students understand the content of the submission they just made. All students, regardless of working solo or in pairs will face the viva exam for each submission. The assignment will be graded based on the correctness of the submission and the performance of the viva.

The grading scheme for the lab is as follows:

1. If plagiarism is detected for an assignment, then a zero for that assignment for the student or group.
2. Otherwise, 3 points on the submission's accuracy and 2 points for the viva exam performance. Note that, when there are two students working as a pair, the viva exam performance of one student will not affect the other.
3. Overall, 5 * 5 = 25 points for five assignments.

It may happen that the semester is curtailed or some classes are lost due to some unexpected events and there is not enough time for giving and assessing all five assignments. In such cases, the points allocated to the lab will be filled by proportionally increasing the weights of the fewer assignments that have taken place.

Lab Section Change Policy

A student can request a lab section change for this course if the lab of his/her theory section has a clash with some other course and there is no way to resolve that clash by changing sections. However, such a student must work solo and is not allowed to form pairs with some other student.

Medical Emergencies Reporting Policy

Note that in case of medical emergencies, a student can request for his/her viva to be taken after he/she has recovered. However, it is the responsibility of the student to inform the lab instructors as early as possible and share the medical report as soon as he/she is fit enough to do online/offline activities. The instructors will decide whether a student should be given the opportunity to appear in the viva exam later. Even in case of medical emergencies, **late assignment submission is not acceptable. Only the viva exam appearance can be delayed.** If a student working solo face a medical emergency, he/she should submit whatever intermediate state his/her assignment work is currently in. If a second submission cannot be made, the viva will be taken based on the content of the first intermediate submission done at the end of the first week. In that case, the concerned assignment will be graded on 0 to 2 based on viva performance only. Hence, it is recommended that students form groups, instead of working solo, to avoid troubles due to medical emergencies.

Alertness and Pair Selection Guidelines

Students are responsible for being aware of all the rules and regulations of the labs. Arguments such as 'I joined the course late or I missed the previous class so I did not know this/that' are not acceptable'. Ask other students in the class about missing information or go to the consultation hours of the instructors as soon as possible for that. In addition, arguments, such as, 'my groupmate is not helping, I did the last assignment, he/she is supposed to do this one' are also not acceptable. Hence, students must form pair wisely and with fellow students they know to be sincere and who they can get along with nicely. Otherwise, working solo is better. In case two students form a pair and one student later drops the course, the remaining member of the group has to complete all remaining assignments working solo. So, students should have proper discussion among themselves at the beginning of the semester before they decide about their pairing.

High Level Assignment Description

Assignment 1: Lexical Analysis

The task is to complete a Lexical Analyzer for C using the Flex lexical analyzer generator. This is rather an easy assignment. Students will basically write regular expressions and very short C codes for each expression to detect keywords, numbers, function/variable names in a C program. Since students learned how to write regular expressions in the Automata Theory course, completing this assignment

should not take more than a day if they work sincerely. However, there are some installation requirements (FLEX, BISON, GIT) for this and subsequent assignments that must be completed before students start their work.

Assignment 2: Syntax Analysis

The task is to add Syntax Analysis to Assignment 1 output using the Bison Syntax analyzer. This assignment may also seem easy to the students as syntax analysis is done using context-free grammars and students learned who to write productions for context-free grammars in an earlier course. However, since the previous lexical analysis assignment solution must be integrated with the syntax analysis part, better understanding of how FLEX and BISON interact is important. Furthermore, language grammars are quite lengthy. So, more time investment is needed to solve this assignment.

Assignment 3: Symbol Table Generation

The task is to augment the solution of Assignment 2 with translation rules for symbol table generation and populate symbol table entries for different scopes found in the program. A symbol table holds the variables and functions you define in your program in various places and a scope is the confinement within which those functions and variables are accessible to your program. This assignment is a degree harder than Assignment 2 as students have to write mostly C codes to the solution of Assignment 2 to ensure that symbol table population can be done along with syntax analysis. It is extremely important that students start working early on this assignment.

Assignment 4: Type Checking

In assignment 3, students only add the symbols in the symbol tables for various scopes of the program without adding more details about the symbols. In this assignment, the students will add type, offset, width, etc. information about the symbols when adding them to the symbol tables. The translation rules for type checking are available in the reference text book. Hence, if the students can complete Assignment 3 successfully, this assignment should not appear particularly difficult.

Final Assignment: Three Address Code Generation

In the final assignment, the students will use the full solution of Assignment 4 to generate proper three-address code (a form of intermediate code that is very similar to assembly code) for an input C program. Although all the rules for generating three address codes for a C program are available in the reference textbook, this assignment may appear very tedious. The reason is that there are so many translation rules to add and the rules are scattered in the book. Consequently, the students have to be clever to combine the rules and also learn in what order they should apply them. Thus, spending enough time on this assignment is critical.

LAB Policy Questionnaire

1. Do you understand that you must maintain 90% attendance in Lab to be eligible for appearing in the final exam?	☐Yes
	☐No
2. Do you understand that if you get caught for plagiarism, no matter how minor the case may be, you will lose all points from the corresponding assignment?	☐Yes
	☐No
3. Do you understand that if there is no scope for late submission so you have to submit the assignments within the deadline?	☐Yes
	☐No
4. Do you understand that all students, regardless of working solo or in pairs, will face the viva exam for each submission?	☐Yes
	☐No
5. Do you understand that submitting each and every assignment within the deadline is the responsibility for both members of the group?	☐Yes
	☐No

Name: _____

Student ID: _____

Signature with Date: _____