

Lab 3

Due Sunday, October 1 by 10:00pm

Handout 9
CSCI 334: Fall 2023

Turn-In Instructions

Each question in this assignment must be written using \LaTeX . I provide a \LaTeX template in your repository for you to use to get started.

It is likely that you have not used \LaTeX before. Treat this homework as you would with any other new programming language: make small changes and compile frequently. The template I provide compiles without error as-is. For full credit, you must submit both your `.tex` source file as well as the rendered `.pdf` file. (5 points) Your source file should be called `lab-3.tex` and your PDF should be called `lab-3.pdf`. (5 points)

Note that your submission must be completed entirely using \LaTeX . To draw trees, please use the `forest` package. The supplied \LaTeX template includes an example for you to start with and modify.

Turn in your work using the `git` repository assigned to you. The name of the repository will have the form `https://aslan.barowy.net/cs334-f23/cs334-lab03-<USERNAME>.git`. For example, if your username is `abc1`, the repository would be `https://aslan.barowy.net/cs334-f23/cs334-lab03-abc1.git`.

Honor Code

This is a solo lab. You may work with another classmate to understand what the problems ask, but you are not permitted to develop solutions together. Submitted solutions must be exclusively your own. Please refer to the section “single author programming assignments” in the honor code handout for additional information. You do not need to submit a `collaborators.txt` file for this assignment. You are always welcome to ask me for clarification if the above is unclear in some circumstance.

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Sanity Check: Students sometimes submit incomplete assignments, accidentally forgetting to run `git add` for all of their files. Fortunately, there is an easy way to make sure that this does not happen to you. Before you are done, `git clone` your repository to a new folder and then try building/running everything. It only takes a couple minutes and can spare you from headaches later on.

Reading

1. (Required) “Introduction to the Lambda Calculus, Part 1”
2. (Required) “Grammars and Parse Trees”
3. (Required) “Introduction to \LaTeX ”

Problems

Q1. (30 points) Parse Tree

Draw the parse tree for the derivation of the expression “ $1 - 5 + 24$ ”. Is there another derivation for “ $1 - 5 + 24$ ”? If so, draw the other parse tree. Refer to the grammar on the bottom of the first page of the reading “Grammars and Parse Trees.”

Q2. (30 points) Parsing and Precedence

Draw derivation trees for the following expressions, assuming the grammar and precedence described in Example 4.2 of the reading “Grammars and Parse Trees”:

(a) $1 + 1 * 1$

(b) $1 + 1 - 1$

(c) $1 - 1 + 1 - 1 * 1$, if + is given higher precedence than -.

Q3. (30 points) Parsing Lambda Expressions

Given the following grammar for the lambda calculus,

```
<expression> ::= <variable>
               | <abstraction>
               | <application>
               | <parens>

<variable>    ::= x | y
<abstraction> ::=  $\lambda$ <variable>.<expression>
<application> ::= <expression><expression>
<parens>      ::= (<expression>)
```

draw derivation trees for the following expressions.

(a) $\lambda x.xy$

(b) $\lambda x.x\lambda y.xx$

(c) $(\lambda x.\lambda y.xy)(\lambda x.xy)$

Q4. ($\frac{1}{10}$ th bonus point) Optional: Feedback

I always appreciate hearing back about how easy or difficult an assignment is.

For $\frac{1}{10}$ th of a bonus to your final grade, please fill out the following Google Form.