Assignment #1

Date Due: October 17, 2025

Total: 100 marks

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1. Chapters 1 and 2 (maximum 15 marks)

   Please use primarily the information achived from class lectures to answer the following questions.

   (a) (5 marks) What kind of applications use the language called PL/I?

   (b) (5 marks) What was the reason why PL/I did not become a mainstream language,m like Fortran and Cobol?

   (c) (5 marks) What control statements were added to FORTRAN IV to get FORTRAN 77 and why?

   (d) (5 marks) Why does C++ include features of C that are known to be unsafe?

   (e) (5 marks) What kind of applications use scripting languages and why?

   (f) (5 marks) How do type declaration statements for simple variables affect the readability of a language, considering that some languages do not require them? Give at least two examples supporting your conclusion about readability.

2. Chapters 3 and 4 (maximum 70 marks)

   (a) (10 marks) Using the grammar:

$$
\begin{array}{ccl}
< assign > & \rightarrow & < id > = < expr > \\
< id > & \rightarrow & a|b|c \\
< expr > & \rightarrow & < expr > + < term > \mid < expr > - < term > \mid < term > \\
< term > & \rightarrow & < term > * < factor > \mid < term > / < factor > \mid < factor > \\
< factor > & \rightarrow & (< expr >) \mid < id >
\end{array}
$$

   show a parse tree and a rightmost derivation for: $a = b - (a - c * b)$

   (b) (7 marks) Modify the above grammar to add the ***unary*** cubic root value, with the symbol \, whose precedence is higher than either of these binary operations: +, -, /, or *.

   (c) (10 marks) Prove that the following grammar is ambiguous

$$\cancel{S >\rightarrow aSSa|b} \qquad\qquad S \rightarrow aSSa|b|a$$

(d) (20 marks) Consider the following sequence of a program written in an unknown programming language:

```
type int128=signed integer[8] ;
    uint16=unsigned integer[4];
    int64 =signed integer[7];
   long=signed integer[64]
   double= signed floatingpoint[8][55];
```

Construct a context-free grammar (in BNF/EBNF format) such that the above sequence of program can be generated as a variable declaration.

(e) (28 marks maximum) Consider the following sequence of a generic program written in an unknown programming language:

```
switch  (j+4)
           1 { <statement>}
           a,b,c{ <statement>}
          2..10 { <statement>}
          12,abx,22{ <statement>}
          <statement>;
```

i. (15 marks) Construct a context-free grammar (in BNF/EBNF format) such that the above sequence of program can be generated as a case statement.

ii. (15 marks) Construct corresponding syntax graphs such that the above sequence of program can be accepted as a case statement.

3. Shells and scripts (maximum 30 marks)

This part has to be submitted on moodle as instructed in the slides.

(a) (20 marks) Write one python script that performs the following two actions:

i. (10 marks) We have an input ASCII file say `f.in`. The python script reads the content of `f.in` from the standard input, and produces the result at the standard output. The standard output of the python script is redirected to the file `f.out` using the execution command line.

ii. (10 marks) The python script has a built-in constant `x` (`x`$\geq$ 1), and will swap the content of the file between lines `1` to `x-1` with the content of the file between lines `x` and the end of the file. We assume the value of `x` is the value of the line number. If `x` is grater then the lenth of the file measured in lines, then the content of the file between lines `x` and the end of the file is empty.

(b) (20 marks) Repeat problem one, but this time using a UNIX Bourne shell script (use either sh, or bash).

For this problem, do not use any other construction than what we learned in this course. Do not use language contructs[1] that are not in the slides.

[1] instructions, function calls, libraries, and so on