Assignment #1

Date Due: February 11, 2026

Total: 100 marks

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1. Chapters 1 and 2 (maximum 15 marks)

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

   (a) (5 marks) What's the meaning of the date January 1, 1970.

   (b) (5 marks) Explain the reasons why Algol was not successful.

   (c) (5 marks) List at least two reasons why Algol represents a landmark in the history of programming languages.

   (d) (5 marks) In some languages, you have single-line comments and in others, multiple-line comments. Which one do you prefer and why?

2. Chapters 3 and 4 (maximum 70 marks)

   (a) (10 marks) Using the grammar:

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

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

   (b) (5 marks) Modify the above grammar to add the ***unary*** operation $X \rightarrow e^X$, with the symbol #, whose precedence is higher than either of these binary operations: +, -, /, or *.

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

$$
\begin{array}{rcl}
S & \rightarrow & A * S | B - A \\
A & \rightarrow & a | b | a - A \\
B & \rightarrow & B - a | a | b
\end{array}
$$

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

```
int128:signed int[8] ;
uint16: unsigned int[4];
int64:signed int[7];
long:signed int[64]
double: signed float[8][55];
aa double;
bb,cd long;
d..h int128;
```

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

Assign a meaning to the code that you generate.

(e) (10 marks) Consider the following grammar

$$\begin{array}{lcl} S & \rightarrow & aSa|bA|Bb \\ A & \rightarrow & cA|c \\ B & \rightarrow & a|aB \end{array}$$

Which of the following sentences are in the language generated by this grammar?

i. abba
ii. acccaa
iii. accca
iv. abccca
v. aaaabaa

Justify your answer to get the marks. Just answering yes or no (for each word) will not give you any points.

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

```
case  (j+4) of
           10: { <statement>}
           b,c: { <statement>}
          -1..20: { <statement>}
          abx,27:{ <statement>}
          default: <statement>;
endcase.
```

i. (12 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. (12 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 two built-in constant `x`, `y`, ($y \geq x \geq 1$) and will output the content of the file between lines lines `y` and the end of the file, followed by the content of the file between lines `1` to `x`. We assume the values of `x` and `y` are valid values for the line numbers.

(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 constructs[1] that are not in the slides.

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