Assignment #1

Date Due: October ~~7~~11, 2024

Total: 100 marks

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1. Chapters 1 and 2 (maximum 20 marks)

   (Please use primarily the information in the lecture notes)

   (a) (5 marks) What kind of applications use the language called COBOL?

   (b) (5 marks) Many programming languages use the keywords `begin` and `end` for their compound statements, while others use braces. What are the arguments for and against this design?

   (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) (6 marks) What kind of applications use javascript and why?

   (f) (6 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.

   (g) (4 marks) Discuss the advantages and disadvantages of single line comments versus multiple line comments in programming languages. Give both arguments for and against these types of comments.

2. Chapters 3 and 4 (maximum 70 marks)

   (a) (8 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: $a = b + (a/c - b)$

   (b) (5 marks) Modify the above grammar to add the ***unary*** absolut value, with the symbol \, whose precedence is higher than either of these binary operations: +, -, /, or *.

(c) (5 marks) Prove that the following grammar is ambiguous

$$S >\rightarrow SabcS|b$$

(d) (4 marks) Describe in English, as simple as possible, the language defined by the following grammar:

$$\begin{array}{rcl} <S> & \rightarrow & <A>;<B>;<C>, \\ <A> & \rightarrow & 0<A>|a \\ <B> & \rightarrow & <B>1|b \\ <C> & \rightarrow & <C>2|c \end{array}$$

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

```
var i,j,l: int128;
    m,n:uint16; l32:int64;
    fab,fac: float; la,ld,le:long double;
```

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

(f) (10 marks) Consider the following grammar

$$\begin{array}{rcl} S & \rightarrow & aSa|A|Bb \\ A & \rightarrow & cA|aB \\ B & \rightarrow & b|bB \end{array}$$

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

i. abba
ii. acccaa
iii. accca
iv. abcccaba
v. acabccaa

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

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

```
case (j+4) of 10: <statement>;
          a,b,c: <statement>;
          2..10: <statement>;
          12,abx,22: <statement>;
          default
          <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 a python script that performs the following actions:

i. 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`.

ii. The python script has a built-in constant `x`, and will swap the content of the file between lines `1` to `x` with the content of the file between lines `x+1` and the end of the file. We assume the value of `x` is a value line number.

(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