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University Examinations 2023/2024

THIRD YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR
OF COMPUTER SCIENCE AND BACHELOR OF COMPUTER TECHNOLOGY

CCS 3355: COMPILER CONSTRUCTION

DATE: APRIL 2024

TIME: 2 HOURS

INSTRUCTIONS: Answer question *one* and any other *two* questions

QUESTION ONE (30 MARKS)

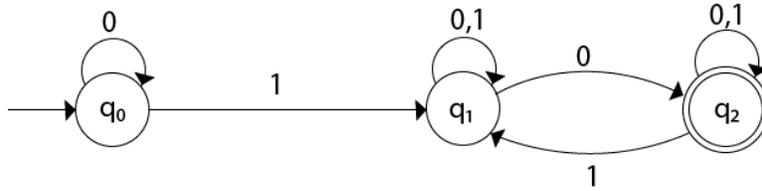
- Using a diagram, explain the functions of backend and front end of a compiler
(5 marks)
- Write FOUR members of language $L = \{ x \in \{a,b\}^* \mid |x| \geq 3 \text{ and } x \text{ begins with } b \}$.
(4 marks)
- Using an example, differentiate between Kleen closure star (Σ^*), and Kleen closure plus (Σ^+)
(4 marks)
- Convert the below NFA to a DFA. (Show the steps including, transition tables)
(6 marks)



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- e) Explain TWO primary functions of the following in compiler construction: -
- i) Lexical analysis (2 marks)
 - ii) Code optimization (2 marks)
 - iii) Semantic analysis (2 marks)
- f) Using a flow diagram, explain the process of source code compilation. (5 marks)

SECTION B (Answer two question from this section)

QUESTION TWO [20 MARKS]

- a) Below is a line of code of c programming language. Use it to answer the question below:

int num1 = 45;

- i) Write the lexical analysis output of the above line of code (4 marks)
- ii) Develop a CFG that can be used to parse the line of code (4 marks)
- iii) Using your CFG developed in (ii) above. Draw the parse tree of the line of code using the context free grammar (4 marks)
- iv) Draw an automata diagram, to check for the syntax analysis of that line of code. (assume the lexical outputs i.e. “variable-name” etc. had already been developed) (4 marks)
- v) Draw an automata diagram, to check for the semantic analysis of “variable –name” to test if “num1” is a valid variable-name. (4 marks)

QUESTION THREE [20 MARKS]

- a) With reference to LR tables, answer the following questions: -
- i) Using a tabular example, explain what an LR table is. (4 marks)



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ii) Explain four components of LR table parsing (6 marks)

iii) Using grammar below, develop a syntax tree for the language **aabbcc**. (5 marks)

$$\begin{aligned} T &\rightarrow R \\ T &\rightarrow aTc \\ R &\rightarrow \\ R &\rightarrow RbR \end{aligned}$$

b) Differentiate between single-pass and multi-pass compiler, giving an example in each case (5 marks)

QUESTION FOUR [20 MARKS]

a) Outline the functions of the following parts of compiler construction:-

i) Intermediate code generation (2 marks)

ii) Machine code generation (2 marks)

b) Explain FOUR features of a compiler (4marks)

c) Answer the questions below with reference to context free grammar (CFG).

i) Explain what is a context free grammar (CFG) (3 marks)

ii) Build a DFA of the language $L_6 = \{w \in \{0, 1\}^* \mid 101 \text{ is a substring of } w\}$. (5 marks)

iii) Show that 010011011 is a CFG of language L_6 in c(ii) above (4 marks)

QUESTION FIVE [20 MARKS]

a) Explain the functions of symbol table and error handler, during compilation process. (4 marks)

b) Explain FOUR differences between DFA and NFA (4 marks)



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- c) Explain FOUR characteristics of context free grammars (4 marks)
- d) Using a simple illustration, demonstrate compiler bootstrapping (4 marks)
- e) Using two sets A and B such that $A = \{2y \mid y \in \mathbb{N} \text{ and } 0 \leq y \leq 5\}$ and $B = \{x \in \mathbb{N} \mid 1 \leq x \leq 12\}$

Find the expression:

- i) $A \cup B$ (2 marks)
- ii) $A \cap B$ (2 marks)

