THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
BACHELOR OF TECHNOLOGY
ECX6235 – COMPILER DESIGN

Date: 07 December 2016   **Time: 0930 – 1230 hrs.**

Important:
1. This question paper consists of **eight** questions.
2. Answer **all** questions in **Part A** (60 marks) and any **TWO** questions from **Part B** (40 marks).
3. Clearly state your assumptions, if any.

Part A – Answer all questions

Refer the following abstract in page 3 to answer the questions in Part A. Clearly state your assumptions.

C. W. S. Goonetilleke and C. J. Basnayakege. 2016. A WEB-BASED DOMAIN SPECIFIC COMPILER FOR DESIGNING EMBEDDED SYSTEMS. Open University Research Session 2016.

You are to design a compiler which could be used for implementing the given scenario.

[Q1]   Draw a block diagram and briefly explain how you interconnect the digital weight scale example which is explained in the given abstract.   [10 Marks]

[Q2]   Draw a block diagram and briefly explain the proposed layered architecture.
                                                                                            [10 Marks]

[Q3]   Define the Grammar **G** and write suitable production rules to implement a compiler which could implement the solution given in [Q1].   [20 Marks]

[Q4]   Write a suitable regular expression for a sample scenario of the digital weight scale example in [Q1] and derive it using the Grammar **G** in [Q3].
                                                                                            [15 Marks]

[Q5]   Write LEX implementation syntax for token of the Grammar **G** above [Q3].
                                                                                            [05 Marks]

Part B – Answer ANY TWO questions

[Q6] Consider the following grammar **G**. [*(,)*, ***number*** [0-9]* and ***identifier*** [a-z]* [0-9]* are terminals and all others are non-terminals].

> lexp → atom | list
> atom → ***number*** | ***identifier***
> list → (lexp_seq)
> lexp_seq → lexp_seq lexp | lexp

(a) Write leftmost and rightmost derivation for the string *(var1 77 (var4 var2 var3))*.

[04 Marks]

(b) Draw a parse tree for the string of (a). [02 Marks]

(c) Write C like type declarations required to implement an abstract syntax tree structure for the **G**. [05 Marks]

(d) Draw the abstract syntax tree for the given string (a) that would result from the C like type declarations you specified in (c).

[03 Marks]

(e) Draw the NDFA and DFA for the ~~given~~ string given in (a). [06 Marks]

[Q7] Consider the grammar rules given below (statement, if-stmt, exp, and else-part are non-terminals and others are terminals).

statement	→ if-stmt	***other***
if-stmt	→ ***if*** (exp) statement else-part
else-part	→ ***else*** statement	ε
exp	→ *0	1*

(a) Derive the string: ***if (0) other else other*** [02 Marks]

(b) Define the Chomsky Normal Form (CNF) for CFGs. [04 Marks]

(c) Convert the given grammar into CNF. [12 Marks]

(d) Derive the above string in (a) using new grammar in (c) [02 Marks]

[Q8] A Turing Machine accepts only the strings of the form $0^n 1^n 2^n$ for (n > 0) and the blank symbol B.

(a) Draw the transition graph. [14 Marks]

(b) List the moves made for the input "001122" using instantaneous descriptions.

[06 Marks]

A WEB-BASED DOMAIN SPECIFIC COMPILER FOR DESIGNING EMBEDDED SYSTEMS

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ABSTRACT

Today, we are using modern smart electronic appliances which are running on embedded systems to facilitate our needs. There are many industrial automation applications as well. In order to program them, programmers need specific programming skill related to the programming language. The aim of this research project is to design and develop a web-based graphical compiler for developing the embedded systems applications without depending on programming languages and facilitate a web based graphical building blocks to interface different input and output devices with the existing embedded system. The proposed system use compiler theory and tools such as Lex, YACC etc. The top layer of the proposed architecture has graphical web based UI consists of Physical design, Logical design and Code view in order to reduce the programming complexity of the users. The intermediate layer consists of Intermediate code as a regular expression. The final layer of the proposed architecture consists of Lexical analyzer, Syntax analyzer and Code generator. The language of the proposed domain specific compiler use context free grammar derived based on a microcontroller preferably 8051 in the implementation. The results show that the behavior of above three layers and produce zero error assembly codes which can be burned into the microcontroller. As an example, to programming a digital weight scale, the user needs to connect a weight sensor as an input device and seven segment display as an output device in the web based GUI using the visual blinding blocks while providing the expected behavior in the logic flow according to the user's choice. Then the system generates relevant assembly language codes which can be burned into the 8051 based embedded system. The main advantage of the proposed system is to provide a user friendly, simple web based interface to program the complex embedded system applications rather than following complex programming languages given by the deferent vendors for the different microcontrollers. The implementation stage, 8051 microcontroller based embedded system platform is used. However, this system can be extended to program or reprogram the other microcontrollers as well without changing the front end GUI and the proposed architecture.

KEYWORDS

Visual Programming Language, Domain Specific Language, Domain Specific Compiler

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