informatics

OXFORD BROOKES UNIVERSITY

BACHELOR OF SCIENCE (HONOURS)

DECEMBER 2010 EXAMINATION

6th DECEMBER 2010

U08182: INFORMATION SYSTEMS DESIGN

TIME : 2 Hours + 10 Minutes Reading

NUMBER OF PAGES : 1 Cover Sheet and 6 Pages of Questions

☞ **INSTRUCTIONS :**

- ❑ Answer any **THREE** questions.
- ❑ **PART A QUESTION IS COMPULSORY.**
- ❑ Choose any **TWO** questions from PART B.
- ❑ **Please start every question on a new page.**
- ❑ **Answers will not be marked if they are illegible.**
- ❑ **Enter the question numbers (in the order you have attempted) in the boxes provided in the answer script.**
- ❑ Write your **INDEX NUMBER** and **MODULE NUMBER** on the cover page of the answer script.

PART A
(COMPULSORY QUESTION)

QUESTION 1

(a) Compare the advantages and disadvantages of black-box testing and white-box testing. State any two advantages and disadvantages.

[8 marks]

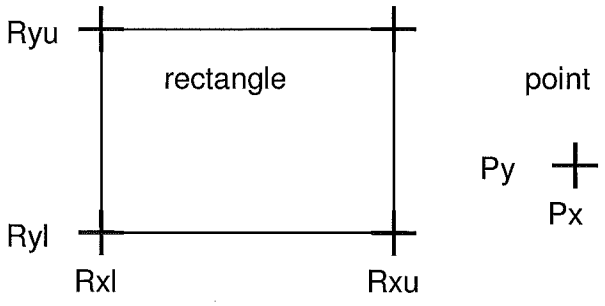
(b) A point can be represented by an x,y coordinate as (Px, Py).

A rectangle can most simply be represented by the coordinate of its bottom left corner (Rxl,Ryl) and top right corners (Rxu,Ryu), as illustrated below.

Assume all coordinate values are integer.

A function cover is required to determine if point (Px,Py) lies over a rectangle area (Rxl,Ryl,Rxu,Ryu). If the point lies within the rectangle then a true value is returned. If the point lies outside the rectangle, or lies exactly on the rectangle edge then a false is returned.

Rectangle and point coordinate representation is shown below:



The function cover has been specified in pseudocode as

```
inside_x = Rxl<Px AND Px<Rxu
inside_y = Ryl<Py AND Py<Ryu
inside = inside_x AND inside_y
return inside
```

It is important that this function returns the correct result for all positions of point and rectangle so a test plan is needed.

Devise a suitable set of tests for the black box dynamic testing of this function using an adequate approach but requiring the minimum number of tests. For each test show the relative position of the point and rectangle coordinates using suitable diagrams.

[8 marks]

(c) The following is a description of a use case for lecturers to select modules to teach at a university department.

Actor: Lecturer	**The system**
The lecturer enters his/her username and password.	The system verifies that the current password is valid, and prompts to select a semester.
Lecturer enters a semester number.	The system prompts the lecturer to select from a list of modules to be delivered in the semester - that has not been assigned to another lecturer.
The lecturer enters his/her module selection.	The system notifies the lecturer that the module selection is recorded.

(i) Identify the input and output variables of the system, and the data to be stored in the system using a table of the following form:

Test data for the Select Module use case

Variables		Test data
Input		
Output		
Stored data		

[6 marks]

(ii) Make a concrete scenario from the above use case description, and then derive test data from the scenario and fill the second column of the table above.

[6 marks]

(d) Construct a flow graph for the following selection sort procedure pseudocode. You may annotate the flow graph nodes using the pseudocode line numbers. State the McCabe complexity formula and determine the McCabe complexity value.

```
Selection_sort( a[1..n], n)
1  For i=1..n-1
2    imin := i+1
3    for j=i+1..n
4      if a[j]<a[imin]
5        imin:=j
6      endif
7    endfor
8    if a[imin]<a[i]
9      swap(a[i], a[imin])
10   endif
11 endfor
```

[8 marks]

[TOTAL MARKS FOR QUESTION 1: 36 MARKS]

PART B
(ANSWER ANY TWO QUESTIONS)

QUESTION 2

A text consists of a sequence of paragraphs separated by the 'new line' symbol; each paragraph consists of a sequence of words that are separated by spaces and punctuation symbols such as ',' and '.'. Each word is a sequence of letters. A paragraph can contain an arbitrary number of characters and letters. To display the text on screen or to print the text on pages, the text must be wrapped. That is, the paragraphs must be decomposed into a number of lines to fit into the width of the screen or page. Such decompositions should not break in the middle of a word. It should also let each line contain as many words as possible.

Assume that all letters and characters take the same size of space when displayed or printed. Select an appropriate software architectural style to design the architecture of a program that performs the text wrapping.

(a) Present your design of the Main Program / Subroutine using Software Architectural Visual Notation.

[10 marks]

(b) Describe the functions and properties of each component and connector in your design.

[10 marks]

(c) Discuss the necessary modifications to the Main Program / Subroutine and components of your design, if the letters and characters in a text may take variable sizes of space when displayed on screen or printed on paper. (If new component(s) and/or connector(s) are introduced, also describe their functions and properties.)

[8 marks]

(d) If you were asked to use an alternative architectural style, discuss what your choice would be?

[4 marks]

[TOTAL MARKS FOR QUESTION 2: 32 MARKS]

QUESTION 3

The following is a simplified view of the structure of compilers.

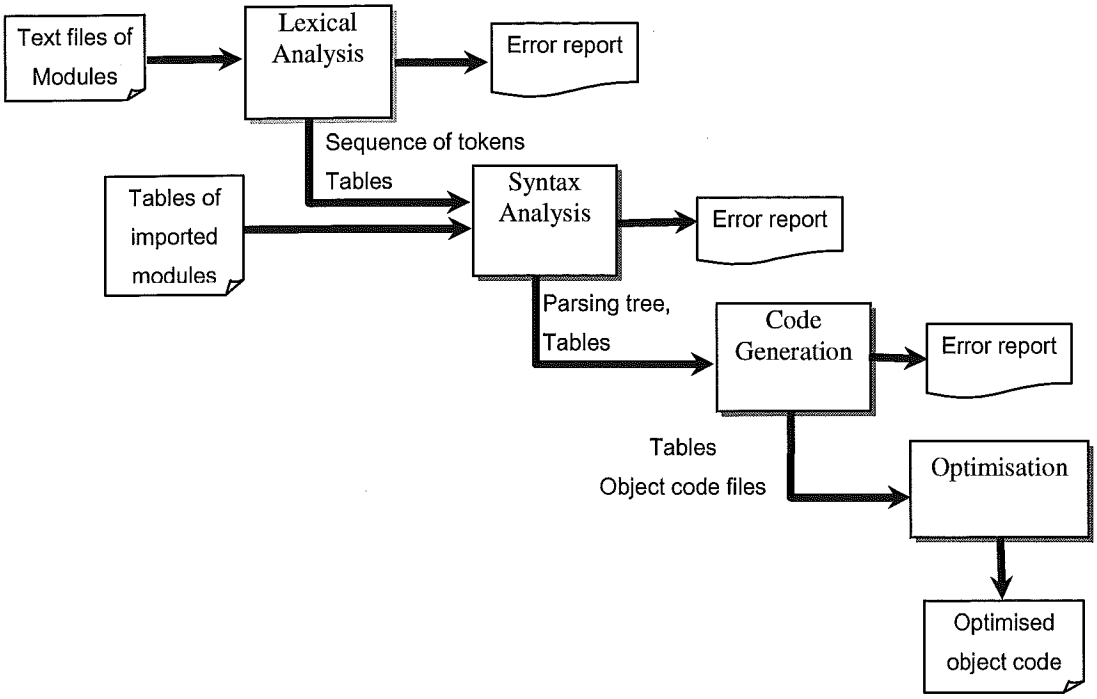


Figure. Structure of Compilers

In a compiler, the *lexical analysis* phase reads in the source code of the modules to be compiled, which are in the form of a sequence of characters stored in a text file. It generates a table of identifiers and a sequence of tokens, where each token represents a lexical element in the source code. The outputs are stored in a number of files. These files together with files previously generated in the compilation of the imported modules are passed to the syntax analysis phase. The *syntax analysis* phase parses the sequence of tokens into a parsing tree and generates some more tables. For example, there could be a table to associate variables with their types. These outputs are also stored in files for consumption by the code generation phase. The *code generation* phase reads in these files and produces object code and more tables, such as tables providing information about the exported procedures, variables and types for the linker program. These outputs are also stored into files. The *optimization* phase is optional, which improves the efficiency of the object code. Of course, in each phase, errors in the source code of the program may be discovered. In such cases, an error report may be generated and either displayed on the screen or written into an error report file. The compilation will terminate after an error is discovered.

(a) Use Pipe and Filter architectural visual notation to describe the architecture of compilers.

[12 marks]

(b) Give a brief definition of the notion of Pipe and Filter architectural style.

[10 marks]

(c) Compare the layered architecture styles and virtual architecture styles in terms of the two factors nature of computation and quality concern.

[10 marks]

[TOTAL MARKS FOR QUESTION 3: 32 MARKS]

QUESTION 4

(a) The design of a software system may need to combine different styles to solve the design problem since single style may not be efficient. This is known as Heterogeneous style.
Explain the available Heterogeneous styles and Describe with diagrams, any two different types of Heterogeneous styles.

[17 marks]

(b) Compare the following architecture styles in terms, of the attributes "Nature of Computation" and "quality concerns"

(i) Main-program-and-subroutine with shared data.
(ii) Independent components
(iii) Virtual machine

[15 marks]

[TOTAL MARKS FOR QUESTION 4: 32 MARKS]

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