

University of Cape Town
Department of Computer Science
CSC3005H EXAM
Compilers part 2 & Web based Computing
2006

Marks : 50

Time : 90 minutes

Instructions:

Read the following instructions CAREFULLY before attempting any questions:

- Answer questions from distributed Computing in one book, and questions from Compilers in a *different* book.
 - Approximate marks per question are shown in brackets. Please show all your work in arriving at an answer since the reasoning is more important than merely a correct answer.
 - Please write the numbers of the questions you have answered on the front cover.
 - The use of calculators is permitted.
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SECTION A: COMPILERS

- Answer **any FIVE** of the seven questions in Section A

Question 1: Symbol Tables [5]

- a) A symbol table associates names with attributes. Give one example of an entity whose name could be found in a symbol table. Provide two types of attributes that could be associated with this entity. [3]
- b) Give two examples of static semantics that can be checked with the aid of a symbol table. [2]

Question 2: Activation Records [5]

- a) Assuming stack-based activation records, draw the full activation record stack corresponding to the function **not_main** at the position marked “%%%”, as called by the function **main** in the following program: [5]

```
procedure main
[
  call two(1, 2)
  procedure two (x, y)
  [
    call three(x+1, y)
    procedure three (x, y)
    [
      %%%
      call output (x, y)
    ]
  ]
]
```

Question 3: Intermediate Code [5]

- a) Discuss 1 advantage and 1 disadvantage of using intermediate representations. [2]
- b) Discuss 3 optimisations that may be applied to IR trees. [3]

Question 4: Basic Blocks [5]

- a) What is a basic block? [1]

- b) What is a trace? [1]
- c) For the following program, first separate the code into basic blocks, then rearrange the blocks into traces and finally optimise the code by removing redundant jumps. Show each step separately. [3]

```

Start:  Statement1
        Statement2
        Jump A
B:      Statement3
A:      Statement4
        Jump B

```

Question 5: Instruction Selection [5]

- a) Describe the steps of the maximal munch algorithm for instruction selection. [3]
- b) In the context of instruction selection by tiling, prove that an optimum tiling (with lowest possible cost) is also optimal (where no two adjacent tiles can be replaced by one with a lower cost than the sum of the two). Hint: use proof by contradiction. [2]

Question 6: Liveness Analysis [5]

- a) Use the iterative liveness analysis algorithm to calculate the live-in and live-out sets for each of the following statements in a program. Show succ, use, def, out and in sets. Assume the algorithm converges on the first iteration. [5]

```

1: if ( x > 1 )
2:   then y = x * x;
3:   else y = ( 1 / x ) * ( 1 / x );
4: return y+1;

```

Hint: The relevant formulae are:

$$out[n] = \bigcup_{s \in succ[n]} in[s]$$

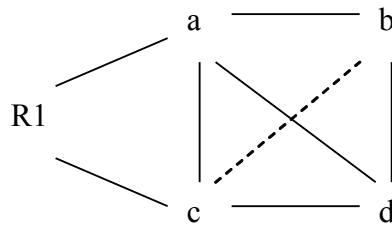
$$in[n] = use[n] \cup (out[n] - def[n])$$

Question 7: Register Allocation [5]

- a) Consider the following graph with nodes indicating temporaries and arcs indicating interference. Apply a register colouring algorithm to 3-colour the graph. Assume that R1 is a precoloured node and use George's criterion for conservative coalescing. Clearly show all steps in the algorithm and the final register allocation (R1, R2, R3) to temporaries.

George's criterion: coalesce AB only if all significant-degree neighbours of A interfere with B.

[5]



SECTION B: WEB BASED COMPUTING

- **Question 8** is compulsory.
- Select and answer **ONE question** from question 9, question 10 and question 11.

Question 8 (Marks 15) ** Marks do not add up (Should it be 5 marks for a and b)

- Provide a skeleton for the SOAP envelope and its content. [2]
- Show how you would build the body of a SOAP Message to represent the response to a request for the number of books written by the author "*Iva Rant*" from the database listed below.

Author	Title	Publisher
Iva Rant	One Too Many	My Book
Isabel Necessary	On a bicycle	Tired Books
Iva Rant	All About Me	My Bad Publications
I. Overdunem	How to bake Cakes	Hot Cooking

- Describe the *Web Services Stack* show the relationship between the three main levels and the functions performed at each level. [5]
- Give a motivation for WSDL and explain its role in the WEB services. [3]

Question 9 (Marks 10)

- Motivate the need for XACML. Where does it fit into the security structure? [2]
- Explain how XACML achieves access control through policies and decision. [8]

Question 10 (Marks 10)

Testing plays an important role in any application and web services is no different. Outline the principles of testing in the Web services environment; describe the areas of concern and strategies to cope with these concerns. [10]

Question 11 (Marks 10)

Part of the Web Services stack provides functionality for Orchestration and Choreography. What is the descriptive name given to this part of the stack? Give an overview of the services included in the section; in particular what is the relationship between WSFL, WSCI, and BPEL. Give examples of the way in which they function. [10]