

# Ph.D. Comprehensive Examination

Computer Science Department  
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Student Name:

Student Number:

Problem number	Points (10 max)
1	
2	
3	
4	
Total:	

## 1. I.B Program control and structure; I.C Programming language and notations

Suppose that procedure *swap* is declared as follows:

```
procedure swap( x, y: integer);  
  procedure f(): integer;  
    var z: integer;  
    begin // f  
      z = x; x = y; return z;  
    end // f  
  begin // swap  
    y = f();  
  end // swap
```

Describe the effect of the procedure call *swap*(i, A[i]) under each of the following parameter passing methods:

- (a) Call-by-value
- (b) Call-by-reference
- (c) Call-by-value-result

**2. II.D Networking and Communications**

- (a) Draw a diagram showing layers of the Internet Protocol Stack and briefly discuss role of each layer.
- (b) Describe functions of each layer when a file is transferred from a source to destination using (*file transfer protocol* (FTP)).

**3. III.A Algorithms and complexity**

Describe an algorithm that takes two input lists of integers  $A = a_1, \dots, a_n$  and  $B = b_1, \dots, b_m$  and delivers the list of all the elements that belong to  $A$  but not to  $B$ .  $A$  and  $B$  not contain redundant elements, however, the elements of  $A$  and  $B$  might have a large range.

The algorithm should run in  $O(n \log m + m \log m)$  time.

**4. Automata and language theory**

Consider the following grammar:

$$G \longrightarrow S \$\$$$

$$S \longrightarrow A M$$

$$M \longrightarrow S \mid \epsilon$$

$$A \longrightarrow a E \mid b A A$$

$$E \longrightarrow a B \mid b A \mid \epsilon$$

$$B \longrightarrow b E \mid a B B$$

- (a) Describe the language that the grammar generates in English.
- (b) Show a parse tree for the string **a b a a**.
- (c) Is the grammar LL(1)? If so, show the parse table; if not, identify a prediction conflict.