

THE AUSTRALIAN NATIONAL UNIVERSITY  
*Second Semester Examination – November 1998*

**COMP3062 Advanced Databases**

*Study Period: 15 minutes*

*Time Allowed: 2 hours*

*Permitted Materials: None*

*Answer ALL questions*  
*Exam questions total 100 marks*

Greater marks will be awarded for answers that are simple, short and concrete than for answers of a sketchy and rambling nature. Marks will be lost for giving information that is irrelevant to a question.

**Question 1 [16 marks] Extensions of Relational DBMSs**

“Generalization and aggregation” and a “general reference mechanism” are two of the extensions to the relational model which are discussed in the textbook.

- (a) Describe in brief what these concepts are. [4 marks]
- (b) Is it possible to design a GOM or ONTOS scheme to support each of these two concepts? If so, show how, using an example. If it is impossible, give your reasons. [12 marks]

**Question 2 [18 marks] Inheritance**

- (a) The general idea behind inheritance is the implementation support of “is-a” relationships between object types. Briefly describe the three aspects that the “is-a” relationship implies. [6 marks]
- (b) An operation defined on a type can be refined in terms of the operation defined on one of its supertypes. Use an example to illustrate the violation of the principle of substitutability, if the refinement condition regarding the argument types of the operation is not satisfied. [4 marks]
- (c) Give an example of operation ambiguity in multiple inheritance and show the three possible methods to solve this problem. Which method is used by C++? [8 marks]

### Question 3 [24 marks] ONTOS

- (a) Describe the basic requirements for a class to be a persistent class in ONTOS. [5 marks]
- (b) Change the following non-persistent class to an ONTOS persistent class using “abstract reference”. [10 marks]

```
class Point {
    private:
        int x, y;
        Point *next;
    public:
        Point(int a, int b){x = a; y = b; next = NULL;}
        Point *getNext() {return next;}
        void setNext(Point *p) {next = p;}
};
```

- (c) What are the advantages and disadvantages of an abstract reference over a direct reference? [5 marks]
- (d) What is an extension? Why doesn't ONTOS allow users to use `instanceIterator` or `Object SQL` to access objects of the classes that don't have extensions? [4 marks]

### Question 4 [16 marks] Pointer Swizzling

- (a) What is pointer swizzling/unswizzling? Why is it necessary to swizzle/unswizzle pointers? [4 marks]
- (b) Describe the following four swizzling methods in brief. [12 marks]
- in-place swizzling.
  - copy swizzling.
  - eager swizzling.
  - lazy swizzling.

Time	Transaction-A	Transaction-B
t01		begin-transaction
t02	begin-transaction	
t03		read $a$ from DB;
t04	read $a$ from DB;	
t05	$a = a + 1$ ;	
t06		read $b$ from DB;
t07	write $a$ to DB;	$b = b + a$ ;
t08		write $b$ to DB;
t09	end-transaction	
t10		end-transaction

Table 1: Updates for a database.

**Question 5 [26 marks] Transaction Management**

- (a) Briefly describe each of the ACID properties. [4 marks]
- (b) What are the hypotheses behind conservative concurrency control and optimistic concurrency control? [2 marks]
- (c) Given a set of transactions  $T = \{t_1, t_2, \dots, t_n\}$ . Each transaction  $t_i$  is older than a transaction  $t'$  which is going to commit. Describe the three criteria for checking whether or not transaction  $t'$  can commit successfully under the method of optimistic concurrency control. [6 marks]
- (d) Suppose that the two transactions given in Table 1 use the optimistic concurrency control policy. Indicate whether or not the two transactions can be successfully committed? Justify your answer. [10 marks]
- (e) What are the main advantages/disadvantages of optimistic concurrency control over conservative concurrency control? [4 marks]