

# 國立清華大學 102 學年度碩士班考試入學試題

系所班組別：資訊系統與應用研究所

考試科目（代碼）：計算機概論(2101)

共 4 頁，第 1 頁

\*請在【答案卷、卡】作答

## I. (25%) Answer the following questions.

1. (5%) If a term paper consisted 42 pages, each containing 40 lines of 100 symbols each (counting each space as a symbol), was to be encoded using Unicode, how many bytes of storage space would be required?
2. (5%) If it takes one microsecond to perform a context switch and processes use only half of their allotted 10 millisecond time slices, what percent of a CPU's time is spent performing context switches rather than executing processes?
3. (5%) At most, how many entries in a list of 5000 names will be interrogated when using the binary search algorithm?
4. (5%) The following procedure was designed to compute the largest integer whose square is no greater than  $N$ , where  $N$  is assumed to be a positive number. (If  $N$  is 5, then the procedure should report the value 2.) Find and correct the error.

```
procedure squareRoot (N)
X ← 0;
while (X2 ≤ N) do
  (X ← X + 1);
report the value of X
```

5. (5%) The following is a program segment and the definition of a procedure named sub.

```
X ← 3;
sub (X);
print the value of X;

procedure sub (Y)
Y ← 5;
```

- (a) What value will be printed by the program segment if parameters are passed by value?
- (b) What value will be printed by the program segment if parameters are passed by reference?

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## II. (25%) Answer the following questions.

1. (5%) How should a large array be passed to a procedure: by value or by address? Why?
2. (5%) Compare waterfall model with agile methods in software engineering.
3. (5%) Write an SQL command to obtain a list of the parts made by Company X along with each part's cost.

PART relation		MAKER relation		
PartName	Weight	CompanyName	PartName	Cost
Bolt 2X	1.0	Company X	Bolt 2Z	.03
Bolt 2Z	0.5	Company X	Bolt V5	.01
Bolt V5	0.5	Company Y	Bolt 2X	.02
		Company Y	Bolt V5	.01
		Company Y	Bolt 2Z	.04
		Company Z	Bolt V5	.03

Figure 1. PART and MAKER relations

4. (5%) Describe how heuristic values are used to speed up the time of reaching the goal in state space search.
5. (5%) Can you write a program A to read another program B and determine whether B will eventually stop after reading some input data? Justify your answer.

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III. (25%) Answer the following questions.

1. (5%) Given  $A = \begin{bmatrix} 1 & 2 & 3 & 3 & 3 \\ 0 & 2 & 3 & 3 & 3 \\ 0 & 0 & 4 & 3 & 3 \\ 0 & 2 & 3 & 6 & 6 \\ 0 & 0 & 0 & 3 & 6 \end{bmatrix}$ , compute the determinant of A.

2. (8%) Solve the following initial-valued problem:

$$\begin{aligned} \frac{dy_1}{dt} &= 2y_1 + 3y_2 \\ \frac{dy_2}{dt} &= 2y_1 + y_2 \end{aligned}, \quad y_1(0) = 1, y_2(0) = 4.$$

3. (12%) Let  $x = \begin{bmatrix} 2 \\ 2 \\ 3 \\ 4 \end{bmatrix}$  and  $y = \begin{bmatrix} 5 \\ 7 \\ -8 \\ 0 \end{bmatrix}$ .

- Compute  $\|x-y\|_1$ .
- Compute  $\|x-y\|_\infty$ .
- Compute the inner product between  $x$  and  $y$ .
- Find the angle between the vector  $x$  and the vector  $y$ .

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IV. (25%) Answer the following questions.

1. (8%) Find  $\bigcup_{i=1}^{\infty} A_i$  and  $\bigcap_{i=1}^{\infty} A_i$  if for every positive integer  $i$ ,

a)  $A_i = \{-i, -i + 1, \dots, -1, 0, 1, \dots, i - 1, i\}$ .

b)  $A_i = \{-i, i\}$ .

c)  $A_i = [-i, i]$ , that is, the set of real numbers  $x$  with  $-i \leq x \leq i$ .

d)  $A_i = [i, \infty]$ , that is, the set of real numbers  $x$  with  $x \geq i$ .

2. (6%) Let  $g(x) = \lfloor x \rfloor$ . Find

a)  $g^{-1}(\{0\})$ .

b)  $g^{-1}(\{-1, 0, 1\})$ .

c)  $g^{-1}(\{x \mid 0 < x < 1\})$ .

3. (5%) Suppose we know that  $n$  is the product of two unknown primes  $p$  and  $q$ . Show that we can easily find  $p$  and  $q$  if we know the value of  $(p-1)(q-1)$ .

4. (6%)

(a) How many one-to-one functions are there from a set with five elements to a set with seven elements?

(b) How many relations are there on the set  $\{a, b, c, d\}$ ?

(c) How many relations are there on a set with  $n$  elements that are symmetric?