國立中興大學

109 學年度

碩士班考試入學招生

試　　題

學系：資訊科學與工程學系

甲組

科目名稱：資訊概論

109學年度碩士班招生考試試題

科目： 資訊概論　　系所： 資訊科學與工程學系 甲組

本科目不得使用計算機　　本科目試題共 5 頁

1. Memory addressing (6%)

Consider the following MIPS code segment. Initially, the memory contents are given as follows. Assume that the content of $t1 and $t2 are 3000 and 3004, respectively. Show the step-by-step operation taken by **each instruction** in the following code segment.

```
lw   $s1,0($t1)
sub  $s2, $s2, $s2
add  $s2,$2,100
lw   $s1,0($s1)
add  $s1,$s1,$s2
lw   $s3,0($t2)
add  $s3,$s3,$s2
sw   $s3,4($s1)
sw   $s1,0($s1)
```

memory address	content
1000	3000
1004	4
⋮	⋮
2000	4
2004	1000
⋮	⋮
3000	2000
3004	1000

2. Instruction set (6%)

There are three types of MIDS instructions: R-type, I-type, and J-type. The instruction formats are given below.

Name	Fields						Comments
Field size	6 bits	5 bits	5 bits	5 bits	5 bits	6 bits	All MIPS instructions 32 bits
R-format	op	rs	rt	rt	shamt	funct	Arithmetic instruction format
I-format	op	rs	rt	address/immediate			Transfer, branch, imm. format
J-format	op	Target address					Jump instruction format

(a) Decide what is the maximum ranges of (i) immediate, (ii) displacement, and (iii) PC-relative branch.

(b) Consider the following three instructions. What are the types of them?

```
(i)   sub   $s2, $s2, $s2      #subtraction
(ii)  lw    $s1,100($s1)       #load word
(iii) beq   $s0,$1,Exit        #branch to Exit if  $s0 = $1
```

3. Memory system (6%)

In a virtual memory system, it takes 10 ns to access a word in the cache. If a word is in main memory but not in the cache, 30 ns are needed to load it into the cache, and then the reference to it is started again. If the word is not in main memory, 12 ms are required to fetch the word from disc, followed by 30ns to copy it to the cache, and then the reference is started again.

(a) (3%) Let the cache hit ratio be 0.9 and the main-memory hit ratio be 0.6. What is the average time (in ns) to access a referenced word in the system?

(b) (3%) The operating system can improve the CPU utilization by trying to do something else other than idle for 12 ms to wait for the required data to be load from disc to the main memory. Explain how this process works.

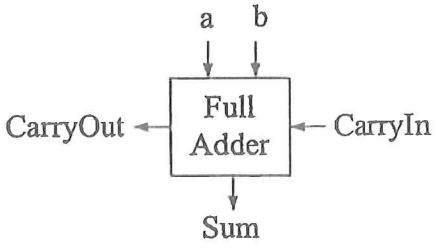
4. Arithmetic (7%)

(a) The 32-bit words in registers $s1 and $s2 are given below:
$s1: 0100 0000 0000 0000 0000 0000 0000 0000
$s2: 0111 1111 1111 1111 1111 1111 1111 1111

What are the results of executing the following instructions? Explain your answer.

```
addu    $s3, $s1, $s2
add     $s4, $s1, $s2
```

(b) The addition operation is execued by an adder. A 1-bit full adder takes three i-bit inputs (a, b, CarryIn) and produces a 2-bit outputs (CarryOut, Sum) representing sum of the input bits. A 32-bit adder can be constructed by cascating 32 1-bit full adders. Write down the logic function of CarryOut and Sum.



5. Given the value printed by the following code fragments (6%):

```
int resultA = (0 + 15) / 2;
double resultB = 2.0e-6 * 100000000.1;
boolean resultC = true && false || true && true;

System.out.println("a) " + resultA);
System.out.println("b) " + resultB);
System.out.println("c) " + resultC);
```

6. What is the outcome for the following recursive function when Test(3): (4%)

```
Test (int n){
 String s = Test(n-3) + n + Test(n-2) + n;
 If (n<=0) return " " ;
 Return s;
 }
```

7. Please show that the sink-based Heap construction uses ≤ 2 N compares and ≤ N exchanges (10 %)

8. The table below, from an old published road map, purports to give the length of the shortest pathes connecting the cities. It contains an error. Correct the table. Also, add a table that that show how to achieve the shortest routes. (10 %)

	Providence	Westerly	New London	Norwich
Providence	-	53	54	48
Westerly	53	-	18	101
New London	54	18	-	12
Norwich	48	101	12	-

9. Please indicate which of the following sort algorithms is/are stable? (Multiple Choice, 5%)

(a) Quick Sort

(b) Selection Sort

(c) Shell Sort

(d) Merge Sort

(e) Heap Sort

10. Suppose that the following processes arrive for execution at the times indicated. Each process will run for the amount of time listed. In answering the questions, use nonpreemptive scheduling, and base all decisions on the information you have at the time the decision must be made.

Process	Arrival Time	Burst Time
P_1	0.0	8
P_2	0.4	4
P_3	1.0	1

(a) What is the average turnaround time for these processes with the FCFS scheduling algorithm ? (3%)

(b) What is the average turnaround time for these processes with the SJF scheduling algorithm? (3%)

(c) The SJF algorithm is supposed to improve performance, but notice that we chose to run process P1 at time 0 because we did not know that two shorter processes would arrive soon. Compute what the average turnaround time will be if the CPU is left idle for the first 1 unit and then SJF scheduling is used. Remember that processes P1 and P2 are waiting during this idle time, so their waiting time may increase. This algorithm could be known as future-knowledge scheduling. (4%)

11. Please explain the following terms

(a) Semaphore (2%)

(b) Race Condition (2%)

(c) Trashing (2%)

(d) Demand Paging (2%)

(e) Fragmentation (2%)

12. Given the following array A = [19, 3, 5, 1, 2, 4, 6, 7, 11, 10, 8, 0]. Please use 3-way quick sort algorithm to sort the elements in A. (10 %)

13. What are necessary conditions which can lead to a deadlock situation in a system? (5%)

14. Given an array of distinct integers. The task is to count all the triplets such that sum of two elements equals the third element. Please write a problem to solve this task with a time complexity $O(n^2)$ (5%)