國立臺灣師範大學100學年度碩士班招生考試試題

科目：計算機系統　　適用系所：資訊工程學系

注意：1.本試題共 2 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

1. (9 分) Write the MIPS assembly code for the C statement A[12] = h + A[8]; Assume that the variable *h* is stored in register $s0, and the base address of array *A* is stored in $s1.

2. (9 分) Draw the block diagram of a 32-bit multiplier, and explain how it works. Function units you can use are registers, adders, and other control logics.

3. (12 分) Consider a pipelined datapath has five stages, i.e. IF, ID, EX, MEM, and WB. Answer the following questions:
   (a) How do data hazards affect the execution of instructions?
   (b) What function unit can be added to resolve this hazard?
   (c) Describe the detailed function of this function unit.
   (d) What kind of data hazard cannot be resolved by this function unit? How to handle it?

4. (8 分) The processing times needed for the five stages in a pipelined datapath are 400ps, 150ps, 200ps, 350ps, and 150ps, respectively. A register with 50ps access time is needed between consecutive stages.
   (a) What is the fastest clock frequency this datapath can operate?
   (b) What is the maximum speed-up when compared to the single cycle implementation of the datapath?

5. (12 分) Answer the following questions:
   (a) What is the 3Cs model for cache misses?
   (b) What design changes can be used to improve any one of the 3Cs?
   (c) What possible negative effect may occur for each of the design changes?

6. (5 分) Illustrate how are the allocation of code section, registers, data section, stack, and OS resources of single-threaded process different from the multithreaded process.

7. (5 分) What are the 5 criteria used for comparing CPU scheduling algorithms? Describe them briefly.

8. (10 分) Why is FCFS not suitable for time sharing systems? Which scheduling algorithm is suitable for time sharing systems then? Describe it and give an example by illustrating how this algorithm schedule 3 processes in terms of processes, burst time, and time quantum.

9. (10 分) Which one of the 4 deadlocks necessary conditions is generally not preventable? How do we prevent the other three?

10. (10 分) Consider a paging system with the page table stored in memory.
    (a) If a memory reference takes 150 nanoseconds, how long does a paged memory reference take? (2 分)
    (b) If we add TLBs, and we have 90 percent hit ratio of the TLB, what is the effective memory reference time given TLB search time as 10 nanoseconds? (3 分)
    (c) Illustrate the operations in b, show how logical addresses are mapped to physical addresses in bothTLB hit and TLB miss situations. (5 分)

11. (10 分) Buffer overflow is one of the most common attack to operating systems. Please explain how a hacker can use the code below to gain a system shell and enter the system.

```
#include <stdio.h>
#define BUFFER_SIZE 256

int main(int argc, char *argv[ ])
{
     char buffer[BUFFER_SIZE];
     if (argc < 2)
          return -1;
     else {
          strcpy(buffer,argv[1]);
          return 0;
     }
}
```