國立中央大學100學年度碩士班考試入學試題卷

所別：資訊工程學系碩士班 不分組(一般生)
資訊工程學系軟體工程碩士班 不分組(一般生)

科目：作業系統與計算機組織 共 2 頁 第 1 頁

本科考試禁用計算器

＊請在試卷答案卷（卡）內作答

1. (10 %) Are the following statements about memory addressing true or false? For each statement, you will get 2 points for correct answer, zero point for blank, or -2 point for incorrect answer. Note that the minimum score of this question is zero.
   (a) Logical address is the address seen by the memory unit.
   (b) Logical and physical addresses are the same in load-time address-binding schemes.
   (c) Logical memory can be divided into blocks of same size called frames.
   (d) For a two-level paging architecture, two memory accesses are required to convert a logical address to a physical one.
   (e) The translation look-aside buffer is a software data structure that supports the virtual memory address translation operation.

2. (10 %) One recent trend in operating systems research is virtualization, particularly in the management and operation of large-scale systems such as cloud computing facilities. Are the following statements about virtualization true or false? For each statement, you will get 2 points for correct answer, zero point for blank, or -2 point for incorrect answer. Note that the minimum score of this question is zero.
   (a) A virtual machine provides an interface that is identical to the underlying bare hardware.
   (b) In the virtual machine approach each process is provided with a virtual copy of the underlying computer.
   (c) In the Java virtual machine, the Java interpreter turns the native machine language into architecture-neutral bytecodes for the host computer.
   (d) A virtual file system (VFS) reveals the details of the file system implementation to users or applications.
   (e) The distributed file system, such as Hadoop Distributed File System (HDFS) or Google File System (GFS), creates multiple replicas of data blocks and distributes them throughout a cluster.

3. (5 %) Consider the following page-reference string:
   1, 2, 3, 4, 7, 6, 5, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.
   Assume that there are five frames and all frames are initially empty. How many page faults would occur for the following replacement algorithms? Note that your first unique pages will all cost one fault each.
   (a) (3 %) LRU replacement
   (b) (2 %) FIFO replacement

4. (10 %) A sequential circuit has two flip-flops A and B, one input x and one output z. The state diagram is given in **Fig.1**. Derive the state equations $D_A(Q_A, Q_B, x)$, $D_B(Q_A, Q_B, x)$, and the output equation $z(Q_A, Q_B, x)$.

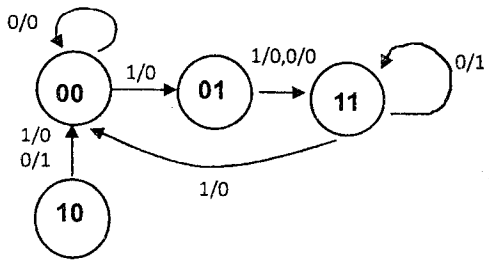

Fig.1 x/z=input/output

5. (15 %) (a) Convert the decimal number 0.6875_{10} to binary format(5 point).
   (b) Sketch a 4-bits Adder-Subtractor Circuit using 4 Full-Adder(FA) and 4 XOR gates. The input are $(B_3B_2B_1B_0)$, $(A_3A_2A_1A_0)$ and the signal S controls the add/sub operation(S=0 for addition).

6. (7 %) **Fig.2** shows a direct-mapped cache with 4K blocks and each block has ***64 bits***. Assume ***28***-bit ***physical address*** is used.
   (a) (3 %) What are the values of M and N?
   (b) (4 %) Describe how this cache will work with TLB, Page Table, Memory and Disk (Secondary Memory) to complete a memory access.

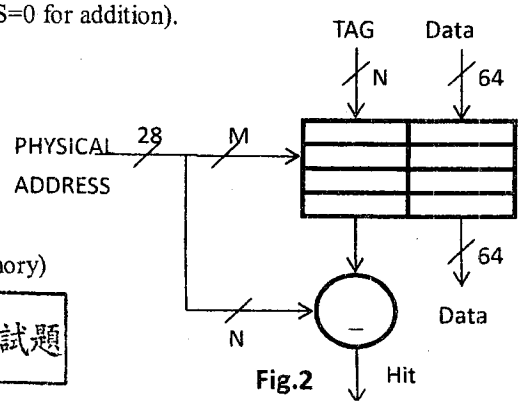

Fig.2

注意：背面有試題

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7. (18 %) **Fig.3** shows a datapath of a pipelining processor.
   (a) (10 %) Describe the ***operations*** of units "**A**", "**B**" and "**C**" and how they can work with the other parts of the datapath to deal with possible hazards.
   (b) (5 %) For the following instruction sequence and assuming that the branch (B) is taken, determine the cases of "***data hazards***" that will be solved/processed by these three units ***during the execution.***
   (You should write the instruction sequence on your answering sheet. Then please add circles on the registers and add a link on them. Mark the link with "A", "B" or "C" to help specify each case.)

```
(A)add $7, $6, $6          #Reg7=Reg6+Reg6
(S)sub $2, $6, $7          #Reg2=Reg6-Reg7
(O)ori $3, $4, $7          #Reg3=(Reg4 OR Reg7)
(L) lw $4, $2(0)       #Load from MEM(computed based on $2) to $4
(D)and $8, $4, $3          #Reg8=(Reg4 AND Reg3)
(B)beq $4, $8, loop        #Branch to loop if Reg4=Reg8
(R)sra $3, $8, 2           #Reg3=Reg8>>2
(T)slt $8, $3, $4          #Reg8=1 if Reg3<Reg4
(I)loop: addi $8, $4, 50   #Reg8=Reg4+50
```

   (c) (3 %) Continue with (b). How many cycles does it take to execute the above instruction sequence?

8. (10 %) The following program uses the Pthreads API. What would be output from the program at LINE C and LINE P?

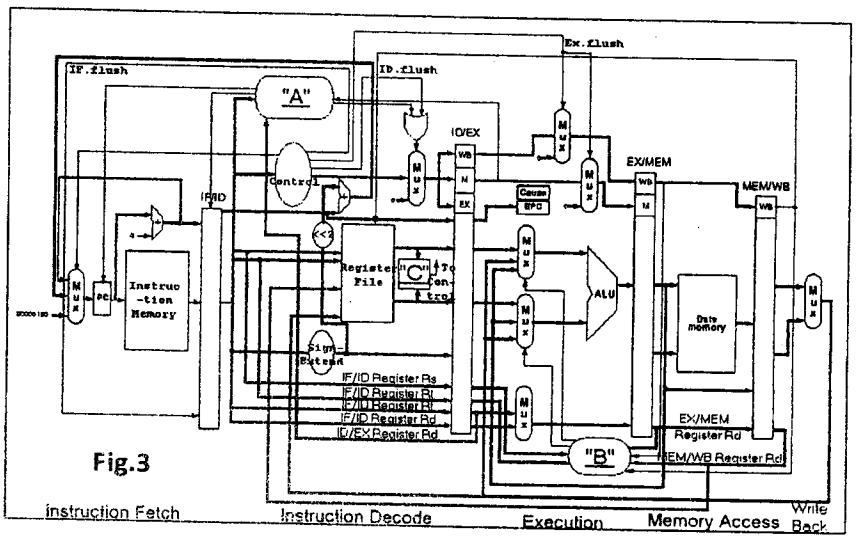

Fig.3

```
#include <pthread.h>
#include <stdio.h>
int value = 0;
void *runner(void *param);

int main(int argc, char *argv[])
{
  int pid;
  pthread_t tid;
  pthread_attr_t attr;
   pid = fork();
   if (pid == 0) {
     pthread_attr_init(&attr);
     pthread_create(&tid, &attr, runner, NULL);
     pthrad_join(tid, NULL);
     printf("CHILD: value = %d", value); /* LINE C */
   }
   else if (pid >0) {
     wait(NULL);
     printf("PARENT: value = %d", value); /* LINE P */
   }
}

void *runner(void *param) {
   value = 10;
   pthread_exit(0);
}
```

9. (15 %) (part-1) Explain why spinlocks are not appropriate for single-processor systems yet are often used in multiprocessor systems. (part-2) Explain why implementing synchronization primitives by disabling interrupts is not appropriate in single-processor system if the synchronization primitives are to be used in user-level programs. (part-3) Describe how the Swap() instruction can be used to provide mutual exclusion that satisfies the bounded-waiting requirement.

注意：背面有試題