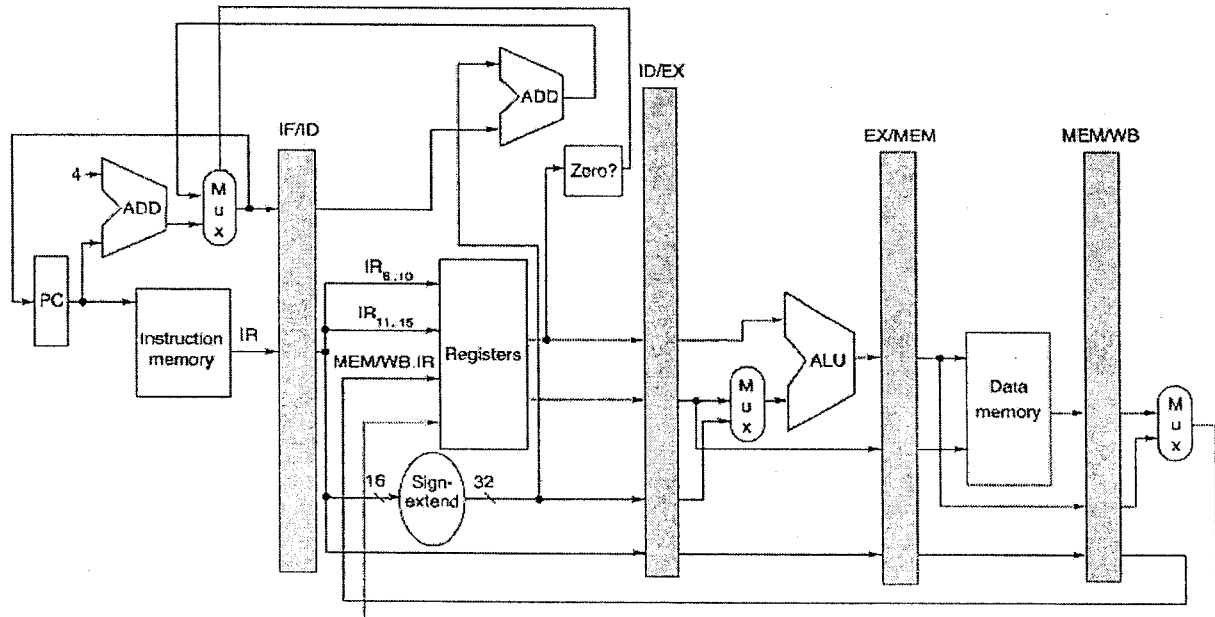


國立臺灣師範大學九十四學年度碩士班考試入學招生試題

計算機系統 科試題 (資訊工程研究所用, 本試題共 4 頁)

- 注意: 1. 依次序作答, 只要標明題號, 不必抄題。
2. 答案必須寫在答案卷上, 否則不予計分。

1. Consider the 5-stage pipeline shown below.



(a) Use the following load instruction as an example.

LD R5, 128(R1); # R5 \leftarrow M[128+R1]

Briefly explain the major operations of the pipeline at each stage. (10 分)

(b) Consider the following code sequence.

LD R5, 128(R1); # R5 \leftarrow M[128+R1]
ADD R3, R2, R5; # R3 \leftarrow R2+R5

Will the execution of the ADD instruction cause a data hazard? Justify your answer. If your answer is YES, determine whether the data hazard can be removed by a forwarding technique. (5 分)

(c) Consider the following code sequence.

```
ADD  R5, R6, R7;      # R5 ← R6+R7
BNZ  R5, exit;        # go to exit if R5 ≠ 0
LD   R2, 64(R1);      # R2 ← M[64+R1]
exit: ADD R8, R7, R8;  # R8 ← R7+R8
```

Will the execution of the BNZ instruction cause a data hazard? Justify your answer. If your answer is YES, determine whether the data hazard can be removed by a forwarding technique. (5 分)

2. Consider a cache having 8K blocks. There are two words in each block. Each word contains 4 bytes. Suppose the main memory is byte-addressed with a 32-bit address bus.
 - (a) Suppose the cache is a four-way set associative cache. Find the total number of sets and total number of tag bits. (5 分)
 - (b) Suppose the cache is a fully associative cache. Find the total number of sets and total number of tag bits. (5 分)
3. Briefly describe the LRU scheme for block replacement in a cache. Why the LRU scheme may not be well suited for a fully associative cache? Justify your answer. (5 分)
4. Consider all the RAID systems (except the RAID 2).
 - (a) Which RAID system has no redundancy to tolerate disk failure? (5 分)
 - (b) Which RAID system allows the recovery from the second failure? (5 分)
5. What is the dynamic branch prediction? Briefly describe how a branch prediction buffer can be used for the dynamic branch prediction. (5 分)

6. Compare the differences between soft real-time CPU scheduling and hard real-time CPU scheduling. (8 分)

7. Suppose that there are two processes, P_0 and P_1 , sharing the following variables:

var *flag*: **array**[0..1] **of** *boolean*; (*initially false*)

turn: 0..1;

A software solution to the critical section problem for two processes is developed, in which the structure of process P_i ($i=0$ or 1), with P_j ($j=0$ or 1) being the other process, is shown below:

repeat

```
flag[i]:=true;
while flag[j]
  do if turn=j
    then begin
      flag[i]:=false;
      while turn=j do no-op;
      flag[i]:=true;
    end;
```

critical section

```
turn:=j;
flag[i]:=false;
```

remainder section

until *false*;

Prove that this algorithm satisfies all three requirements for the critical section problem. (10 分)

8. Both the working-set model and the page-fault frequency strategy can be used to prevent thrashing.

(a) What is the major difficulty with the working set model? (4 分)

(b) Describe the typical operation of the page-fault frequency strategy. (4 分)

9. Consider a system consisting of four resources of the same type that are shared by three processes, each of which needs at most two resources. Show that the system is deadlock-free. (8 分)
10. How does DMA increase system consistency? (4 分) How does it complicate the hardware design? (4 分)
11. For remote file access in modern multiprocessor systems, caching is frequently implemented to reduce both network traffic and disk I/O. Describe at least two common cache update policies, as well as explain their advantages and disadvantages. (8 分)