國立臺灣科技大學103學年度碩士班招生試題

系所組別： 資訊工程系碩士班

科　　目： 資訊工程概論

（總分為100分）

選擇題務必於答案卷內依序作答，否則不予計分。

1. 請將選擇題答案書寫於答案紙內，於試題作答不予計分。

   Considering the directory protocol for distributed shared memory, please associate proper statements to the following state transition diagram for the directory. Note that P in the following statements means the requesting processor number. (14%) (Note that each item has 2 points)
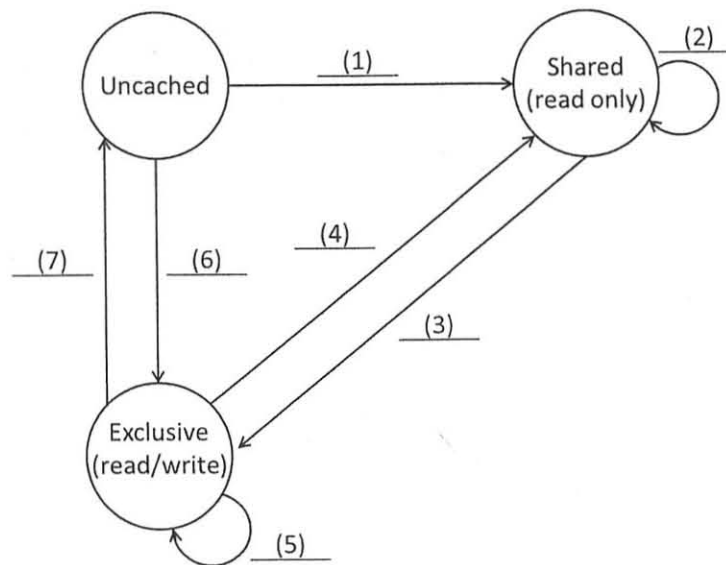
   A) Write Miss:
      send Fetch/Invalidate;
      send Data Value Reply msg to remote cache;
      Sharers = {P};

   B) Write Miss:
      send Invalidate to Sharers;
      then Sharers = {P};
      send Data Value Reply msg

   C) Write Miss:
      Sharers = {P};
      send Data Value Reply msg

   D) Read miss:
      Sharers += {P};
      send Data Value Reply

   E) Read miss:
      Sharers = {P}
      send Data Value Reply

   F) Read miss:
      Sharers += {P};
      send Fetch;
      send Data Value Reply msg to remote cache (Write back block)

   G) Data Write Back:
      Sharers = {} (Write back block)

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2. Suppose we summarize the cache optimization techniques with "+" meaning that the technique improves the factor, "−" meaning it hurts that factor, and blank meaning it has no impact. For example, items (1), (2), (3), and (4) are all blank. Given the following table, please identify which items are "+" and which items are "−" (in an increasing order). (Note that give the correct/incorrect answer for an item, get/lose 1 point; otherwise, no point. The maximum points got are 16; the minimum points got are 0.) (16%)

Technique	Hit time	Bandwidth	Miss penalty	Miss rate
Banked caches	(1)	(12)	(23)	(34)
Compiler techniques to reduce cache misses	(2)	(13)	(24)	(35)
Compiler-controlled prefetching	(3)	(14)	(25)	(36)
Critical word first and early restart	(4)	(15)	(26)	(37)
Hardware prefetching of instructions and data	(5)	(16)	(27)	(38)
Merging write buffer	(6)	(17)	(28)	(39)
Nonblocking caches	(7)	(18)	(29)	(40)
Pipelined cache access	(8)	(19)	(30)	(41)
Small and simple cache	(9)	(20)	(31)	(42)
Trace caches	(10)	(21)	(32)	(43)
Way-prediction cache	(11)	(22)	(33)	(44)

3. Assume a disk subsystem with the following components and FIT:

   - 12 disks, 1,000 FIT
   - 1 SCSI controller, 2,000 FIT
   - 1 power supply, 5,000 FIT
   - 1 fan, 5,000 FIT
   - 1 SCSI cable, 1,000 FIT

   Using the simplifying assumptions that the lifetimes are exponentially distributed and failures are independent, please compute the MTTF of the system as a whole. (5%)

4. Given a graph $G = \langle V, E \rangle$, the following is an algorithm to find a minimum spanning tree of G. Can you improve the algorithm for better efficiency? Some explanation is necessary! (10%)

```
MST(G)
1    T = ∅
2    while ((E not empty)) {
2        choose an edge (v, w) from E of lowest cost;
3        delete (v, w) from E;
4        if ((v, w) does not create a cycle in T) T = T ∪ (v, w);
5        else discard (v, w);
6    }
```
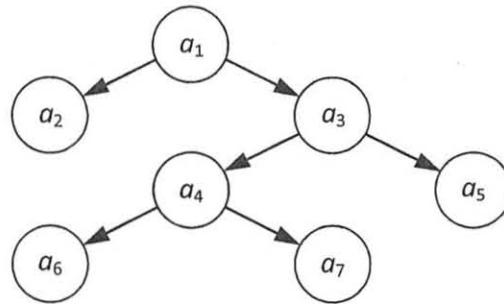
5. Answer the following two questions about binary search tree (BST):

   (a) The following is a BST with no other extra information. To search a number a on this BST, it takes n steps (n comparisons) to know a does not exist in this tree. What is the minimum and maximum of n? List one of the possible search sequences in each of the two cases. (10%)

   (b) Following part (a), what is the relation between a_6 and a_7? (3%)

   (c) (Independent from part (a)) Rearrange the following sequence of seven numbers (if there is a need), 10, 2, 30, 14, 5, 6, 7 to put into a BST from an empty tree so that the tree depth of the final tree after all the insertions is as small as possible; also, the rearrangement must take as few steps from the original ordering as possible. List the sequence after the rearrangement and draw the final tree after the insertions. (7%)

6. Answer the following question regarding virtual memory:

   (a) List at least three advantages and one drawback of demand paging technique comparing to the classic approach of loading the entire program into main memory when launching a program. (10%)

   (b) Explain what is thrashing and how to prevent thrashing from happening. (6%)

7. In shortest-job-first (SJF) scheduling, it is common to use exponential average as the predicted next burst time. Let t_i denote the measured ith burst time, π_i denote the ith guest rounding to the nearest integer.

   (a) Given $t_1 = 6$, $t_2 = 13$, $\pi_1 = 1$, $\pi_2 = 5$, $\pi_3 = 12$, what is the possible range of the parameter α (10%)?

   (b) Explain why SJF could result in process starvation and how do you suggest to solve this problem (9%)?