國 立 清 華 大 學 命 題 紙

八十四學年度 資訊科學研究所 組碩士班研究生入學考試

科目 計算機系統 科號 0803 共 三 頁第 一 頁 *請在試卷【答案卷】內作答

1.(14%). True or false for the following statements. Briefly justify your answer.

(a). In terms of data accesses, temporal locality states that items whose addresses are near one another tend to be referenced close together in time.

(b). MIPS is not a good metric to justify the performance of the machines because MIPS may vary inversely to performance.

(c). In a bus–connected multiprocessor system, the objective in using cache and local memory is to shorten the memory cycle so that one processor does not slow down another through bus interference.

(d). An Ethernet is a standard bus with multiple masters and a centralized arbitration scheme using collision detection.

(e). Both arithmetic pipelining and instruction pipelining can improve the throughput of the system. Increasing the depth of instruction pipeline will not always increase performance, but increasing the depth of arithmetic pipeline will always increase performance.

(f). In general, instruction traffic for CISC and pure RISC machines are the same, but data traffic for pure RISC machines is higher than that in CISC machines.

(g). Hypercube machine uses a parallel–parallel control mechanism and uses message–passing for data/control communications between concurrent processes.

2. (6%) Determine the evaluation time of the arithmetic expression:
$S = a*b*c + d*e + f*g$
on each of the following computers.

(a). A SISD system with one adder and one multiplier.
(b). A SISD system with one adder and one two–stage pipelined multiplier.

The addition and multiplication require one and two time units, respectively (i.e., each stage in the pipe of the pipelined multiplier takes one time unit). The memory access time due to instruction and data fetch can be ignored.

3. (6%) What are the "write–back" and "write–through" techniques for updating main memory. What are the disadvantages of these techniques?

4. (8%) Elaborate on how the RISC style architecture shifts complexity from hardware and program runtime to software and program compile time?

5. (6%) Given the use of virtual memory, the DMA in the system can perform data transfer using either the virtual addresses or physical addresses. Which one is better and why?

18% 6. A grammar G is defined as a quadruple (V, T, S, P) of variables, terminal symbols, start variable and productions. The language L generated by G is a SET of a terminal strings which is derived by applying the productions in P in arbitrary order to S.

(a) (4%) When writing a grammar to generate tokens such as integers, real numbers, strings, and identifiers in programming languages, what is the appropriate set of T? What is the simplest form that one can use to write down P?
(b) (6%) When writing a grammar to generate control structures such as if-then-else, repeat-until, while-do statements , what is the appropriate set of T? What is the simplest form that one can use to write down P?
(c) (8%) Extend the type of the grammar used in (b), so that it generates a FUZZY SET instead of a SET. The language L generated by G is a FUZZY SET of a terminal strings which is derived by applying the productions in P in arbitrary order to S. The membership function of strings in the FUZZY SET is somehow connected to the productions being applied during the derivation. The membership of all strings in the FUZZY SET must sum to 1.

8% 7. (2% each) Programs are more readable and predictable

(a) using _____ (more/less) nonlocal variables.
(b) using _____ scoping rule for nonlocal vaiables.
(c) using _____ method for parameter passing.
(d) using _____ (both/only one) of a nonlocal variable and a parameter referring to the same memory location.

4% 8. (2% each) (a) What is the advantage of using nondeterministic versions of finite-state automata? (b) What is commonly done when writing a program to implement a finite-state automaton?

9. (15%) Explain the following terms as details as possible:

(a) Semaphores, (b) Threads, (c) Thrashing and working set concept, (d) Medium-term scheduling, (e) Demand paging and virtual memory.

10. (6%) (a) What are the three requirements that must be satisfied to solve the critical-section problem ?

(b) Does the following algorithm satisfy all the three requirements for the critical-section problem ? Why ? Assume that the two processes, P_0 and P_1, share the following variables:

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

The following program is for process P_i (i = 0 or 1), with P_j (j= 1 or 0) being the other process:

```
repeat
    flag[i] := true;
    while flag[j] do if turn = j then flag[i] := false;
        critical section
    turn := j
    flag[i] := false;
        remainder section
until false;
```

11. (4%) Consider a system consisting of m resources of the same type, being shared by n processes. Resources can be requested and released by processes only one at a time. Is the system deadlock free when the following two conditions hold ? Why ?

(a) The maximum need of each process is between 1 and m resources.

(b) The sum of all maximum needs is less than or equal to $m + n$.

12. (5%) (a) What is the Belady's Anomaly ? (b) Consider the following reference string: 1,2,3,4,1,2,5,1,2,3,4,5. Is it going to happen the Belady's Anomaly ? Why ?