八十八學年度 資訊工程學 系(所) 組碩士班研究生招生考試

科目 計算機系統 科號 4102 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

1. (5%) Find the minterms of the expression $\bar{Y}Z + WX\bar{Y} + WX\bar{Z} + \bar{W}\bar{X}Z$ by first plotting each expression in a K-map.

2. (5%) Consider the 8-bit date word 11000100. In the Hamming code, we include 4 parity bits with the 8-bit word and arrange the 12 bits as below:

bit position	1	2	3	4	5	6	7	8	9	10	11	12
	P_1	P_2	1	P_4	1	0	0	P_8	0	1	0	0

What is $P_1P_2P_4P_8$?

3. (10%) Use 2 half adders and 4 and gates to design a 2-bit (A_0A_1) by 2-bit (B_0B_1) binary multiplier.

4. (5%) Use 4 full adders to design a 4-bit parallel adders.

5. (15%) The following table shows the operations performed in a pipelined processor for add and load instructions:

Stage	add instructions	load instructions
1	IR ← Memory[PC]; PC ← PC + 4;	
2	A = Reg[IR[25-21]], B = Reg[IR[20-16]];	
3	ALUoutput = A + B;	ALUoutput = A + sign-extend(IR[15-0]);
4	Reg[IR[15-11]] = ALUoutput;	MEMoutput = Memory[ALUoutput];
5		Reg[IR[20-16]] = MEMoutput;

In the above table, PC is the *program counter*, IR is the *instruction register*, and IR[25-21] means the 21st to 25th bits in IR.

(a) According to the above table, in which stage(s) the architectural state (i.e., the machine state as is visible to the assembly programs) are changed?

(b) Suppose we run a meaningless program, in which 60% of the instructions are add and the remaining 40% are load. What is the CPI (cycle per instruction) of the processor, assuming no pipeline stall?

(c) If the above program were executed on an unpipelined, multi-cycled processor using the same clock, how much slower it will run?

(d) Will the following code sequence cause a read-after-write hazard? (**Give your reasons to score points in this question.**)

```
load R1, 100(R2)        // R1 <- Memory[R2+100]
add  R1, R3, R4         // R1 <- R3 + R4
```

(e) Will there be any structural hazard in the register file? (**Give your reasons to score points in this question.**)

6. (5%) A computer with a direct-mapped cache has an instruction miss rate of 2% and data miss rate of 1.7%. Suppose the computer has a clock cycle time of 20 ns, and the CPI without memory stall is 2 cycles/instruction. Suppose further that the miss penalty is 200 ns and there are 0.5 memory references for data per instruction. What is the CPU time of the computer in executing a program with 10000 instructions?
(**Hint:** CPU time = (ideal CPU execution cycles + memory-stall cycles for instructions + memory-stall cycles for data) * cycle time)

7. (5%) DMA is a specialized controller that transfers a continuous block of data between an I/O device and memory, independent of the processor. However in a system with virtual memory, if an I/O request crosses a page boundary, then the memory locations to be transferred by DMA would not be continguous. (a) Why? (b) Suggest one way to allow the system to initiate DMA transfers that cross page boundaries.

8. (6%) What is "lightweight" process? What is the major difference between "lightweight" process and normal process?

9. (7%) How do we name the situation that the higher priority process needs to wait for a lower priority one to finish (when they share the resource)? How do you solve this situation?

10. (6%) Consider a system consisting of four resources of the same type that are shared by three processes, each of which needs at most n resources. Is there a constant c such that when $n = c$, the system is deadlock-free, but is not deadlock-free when $n = c + 1$? Explain your answer. Note that you have to find out the constant c if it exists.

11. (6%) Which of the following programming techniques and structures are "good" for a demand-paged environment? Explain your answers in a couple of sentences.

    (a) Stack
    (b) Hashed symbol table
    (c) Sequential search
    (d) Binary search
    (e) Vector operations
    (f) Indirection

12. (12%) In each of the following four questions, choose your answers.

    (1) Consider the following grammar G with BNF form:

```
S -> L = R
S -> R
L -> * R
L -> id
R -> L
```

    Which of the following classifications is true

    (a) the grammar is a LL(1) grammar.
    (b) the grammar is a SLR(1) grammar.
    (c) the grammar is a LR(1) grammar, but not a SLR(1) grammar.
    (d) the grammar is a LR(0) grammar.
    (e) the grammar is not a LR(1) grammar.

(2) If we use BNF form to write a grammar for an arithmetic expression includes "*" (multiplication), "-" (subtraction) operators, and parenthesis. We get a grammar below:

```
E -> E * E
E -> E - E
E -> ( E )
E -> identifier
```

Please choose the correct properties of the above grammar:

(a) It is an un-ambiguous grammar.

(b) It is a SLR(1) grammar.

(c) It is not a context-free grammar.

(d) It can be used in YACC and LALR(1) with the annotations of the precedences and associativities of operators.

(e) It is a LL(1) grammar.

(3) What is the main reason that a left-recursion grammar is not allowed in LL(1)?

(a) It consumes too many stack spaces over right recursion grammars.

(b) It needs two lookahead symbols in the top-down parsing.

(c) There is the possibility of infinite loops for LL(1) parser.

(d) The context-free grammar prohibits left-recursive grammars.

(e) The right-recursive grammar is easier to write than left-recursive grammar.

(4) Which of the following descriptions about garbage collections for storage managements is correct?

(a) The garbage collection problem is not addressed in Java language.

(b) The garbage collection problem can be solved by tombstone schemes.

(c) The garbage collection problem can be solved by mark-sweep schemes.

(d) Almost every language including C, C++, Java, and Pascal, provides solutions to solve the garbage collection problems automatically for users.

(e) The implementation of garbage collection algorithms with real-time considerations for a language will not slow down the execution of programs in that language.

13. (3%) Explain the essential concepts and constructs for object-oriented programming languages?

14. (10%) What are the implementation strategies for the following programming language constructs?

(a) What are the implementation strategies for parameterized type with static languages (For example, you can explain the strategy for a C++ compiler to implement parameterized type in C++)?

(b) In implementing the parser and compiler for a programming language, what are the strategies we use in handling the symbol tables?