

請照題號次序作答

Use C, C++ or Java programming language to design your computer programs.

1. (10%)
  - a. (2%) What is Dining Philosopher problem?
  - b. (4%) At what situation the **deadlock** will happen? Describe an algorithm to avoid **deadlock** happen. (you don't have to write a program)
  - c. (4%) At what situation **starvation** will happen? Describe an algorithm to avoid **starvation** happen. (you don't have to write a program)
2. (10%) The list [a, b, c] has 6 permutations, including [a, b, c], [a, c, b], [b, a, c], [b, c, a], [c, a, b], [c, b, a]. Given a list of characters, write a program to generate all the permutations of such a list.
3. (20%) A palindrome is a word, phrase, number or other sequence of units that can be read the same way in either direction. For example, "58285" and "malayalam" are both palindromes.
  - a. Please write a function / methods to check whether the input string is a palindrome.
  - b. Please write a function / methods to find the length of the longest palindrome in the input string. (for example, "ississi" is the longest palindrome in "mississippi", therefore the answer is 7)
4. (20%) Given the java code fragment in the following box.
  - a. (5%) What is the result of the following program?
  - b. (5%) Can we change the Line 12 to "private void m1() throws E2 {"? Explain why or why not it can be changed.
  - c. (5%) In the try block (Line 22 – 25), will we catch the exception? If so, which line (in Line 22 – 25) will throw the exception object?
  - d. (5%) Can we change the Line 26 to " catch (E2 e) {"? Why or why not?

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1. public class E1 extends Exception {
2.     public void printM() {System.out.println("40");}
3. }
4. public class E2 extends E1 {
5.     public void printM() {System.out.println("50");}
6. }
7. public class A {
8.     public void m1() throws E1 {{System.out.println("10");}}
9. }
10. public class B extends A {
11.     public class C extends A{
12.         public void m1() throws E2 {
13.             System.out.println("20");
14.             throw new E2();
15.         }
16.     }
17.     public void m1() {System.out.println("30");}
18. }
19. public class Test {
20.     public static void main(String[] args) {
21.         try {
22.             A ref = new B();
23.             A ref2 = ((B)ref).new C();
24.             ref.m1();
25.             ref2.m1();
26.         } catch (E1 e) {
27.             e.printM();
28.         }
29.     }
30. }

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5. (20%) The following table is the list of instructions for a simple computer A.

Instruction	Code				Action
	4-bit	4-bit	4-bit	4-bit	
	d1	d2	d3	d4	
HALT	0	0	0	0	Stops the execution of the program
LOAD	1	R <sub>D</sub>	M <sub>S</sub>		R <sub>D</sub> ← M <sub>S</sub>
STORE	2	M <sub>D</sub>		R <sub>S</sub>	M <sub>D</sub> ← R <sub>S</sub>
ADDI	3	R <sub>D</sub>	R <sub>S1</sub>	R <sub>S2</sub>	R <sub>D</sub> ← R <sub>S1</sub> + R <sub>S2</sub>
ADDF	4	R <sub>D</sub>	R <sub>S1</sub>	R <sub>S2</sub>	R <sub>D</sub> ← R <sub>S1</sub> + R <sub>S2</sub>
MOVE	5	R <sub>D</sub>	R <sub>S</sub>	0	R <sub>D</sub> ← R <sub>S</sub>
NOT	6	R <sub>D</sub>	R <sub>S</sub>	0	R <sub>D</sub> ← ¬R <sub>S</sub>
AND	7	R <sub>D</sub>	R <sub>S1</sub>	R <sub>S2</sub>	R <sub>D</sub> ← R <sub>S1</sub> AND R <sub>S2</sub>
OR	8	R <sub>D</sub>	R <sub>S1</sub>	R <sub>S2</sub>	R <sub>D</sub> ← R <sub>S1</sub> OR R <sub>S2</sub>
XOR	9	R <sub>D</sub>	R <sub>S1</sub>	R <sub>S2</sub>	R <sub>D</sub> ← R <sub>S1</sub> XOR R <sub>S2</sub>
INC	A	R	0	0	R ← R + 1
DEC	B	R	0	0	R ← R - 1
ROTATE	C	R	n	0 or 1	Rot <sub>n</sub> R (rotate n bits, )
JUMP	D	R	n		IF R <sub>0</sub> ≠ R then PC = n, otherwise continue

- d<sub>1</sub>, d<sub>2</sub>, d<sub>3</sub>, d<sub>4</sub>: First, second, third, and four hexadecimal digits.
- R<sub>S</sub>, R<sub>S1</sub>, R<sub>S2</sub>: Hexadecimal address of source registers
- R<sub>D</sub>: Hexadecimal address of destination register
- R<sub>0</sub> is always set to 0x0000.
- M<sub>S</sub>: Hexadecimal address of source memory location
- M<sub>D</sub>: Hexadecimal address of destination memory location
- n: Hexadecimal number or hexadecimal address

- a. (10%) The right table is the memory image of this simple computer. The program was allocated in the memory address 00 ~ 09, and the CPU executes code from memory address 00. After the program halted, what is the value in memory address 43?
- b. (5%) This RISC CPU was designed with 5-stage pipeline, and the 5 stages are (IF = Instruction Fetch, ID = Instruction Decode, EX = Execute, MEM = Memory access, WB = Register write back.) In which line of the program, the CPU will delay the execution and create a "bubble" in the pipeline?
- c. (5%) How many instructions are executed before the program halt?

Memory Address	Hex Code
00	1140
01	1241
02	1342
03	3423
04	5230
05	5340
06	B100
07	D103
08	2434
09	0000
...	
40	0009
41	0001
42	0001
43	0000

6. (20%) The following pictures depict the process of sorting the x-value of all nodes according to the y-value of these nodes in increasing order.
- a. (5%) What is the name of the sorting algorithm?
- b. (10%) Using this sorting algorithm, write a program which can sort an array of integer.
- c. (5%) What is the time complexity of best case and worst case of this sorting algorithm?

