

請照題號次序作答

Please use C, C++, Java or Python programming language to design your computer programs.

1. (20%) The following table lists the performance measurement of 3 computer platforms with the same benchmark program. After benchmarking with the program, we know Computer B performs as fast as Computer A, and Computer C performs faster than Computer A.

Benchmark platform	Computer A	Computer B	Computer C
Number of executed instruction	100 millions	100 millions	180 millions
Clock rate	3.6 Ghz	2.8Ghz	?
Clocks per Instruction	1.8	?	1.2

- (5%) What is the value of cycles per instruction of Computer B?
- (5%) Computer A and B use the same CPU architecture with different clock rate and different cache size, which computer has larger cache? Explain your answer.
- (5%) What is the requirement for the clock rate of Computer C?
- (5%) Why the same benchmark program compiled for Computer C is larger than Computer A? If there is only one RISC machine among Computer A, B and C, which one looks like a RISC machine? Explain your answer according to the design philosophy RISC.

2. (15%) In C language, we can call the swap action of two numbers as the following code fragment.

```
int a = 10, b = 20; Swap(a, b);
```

There are 3 codes fragments that try to implement the above Swap () function.

Code A:	Code B:	Code C:
<pre>void Swap(int a, void b) { a ^= b; b ^= a; a ^= b; }</pre>	<pre>void Swap(int *a, void *b) { *a ^= *b; *b ^= *a; *a ^= *b; }</pre>	<pre>#define Swap(a, b) \ (a ^= b, b ^= a, a ^= b;)</pre>

- (5%) Is the Code A workable? Explain your answer.
- (5%) Prove that exclusive-OR (^) operation can swap two integers.
- (5%) Compare the advantages and disadvantages of Code B and C.

3. (20%) The Fibonacci Series is defined as:

$$Fib(n) = \begin{cases} 0 & \text{if } n = 0, \\ 1 & \text{if } n = 1, \\ Fib(n-1) + Fib(n-2) & \text{if } n > 1, \end{cases}$$

- (8%) Please use recursive approach to write a function `fib_rec(n)` that calculate the $Fib(n)$.
- (12%) Please use iterative/loop approach to write a function `fib_ite(n)` that calculate the $Fib(n)$.

4. (25%) 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 palindrome.

- (10%) Please write a function `palindrome(str)` to check whether the input string is a palindrome. (for example, `palindrome("abba")` returns true, `palindrome("xyz")` returns false)
- (10%) Please write a function `longest_palindrome(str)` to find the position and length of the longest palindrome (length > 2) in the input string. (for example, "ississi" is the longest palindrome in "mississippi", therefore the `longest_palindrome("mississippi")` returns 1 as position, 7 as length)
- (5%) Analysis the time complexity of your program in problem 4.b.

5. (20%) Permutation. There are 6 permutations of the set {a, b, c}, namely (a, b, c), (a, c, b), (b, a, c), (b, c, a), (c, a, b), (c, b, a). Given a list of k different symbols, write a program `permute(list)` to generate all the permutations of such a list.