1. Let $S[i,j]$ be a 2-dimensional array of size 512×512. Assume that the way to represent an array is in column-major order. Explain how this order will affect your program design in processing S. (10%)

2. (*a*) It is well known that any Boolean function can be realized by AND, OR, and NOT gates. Show that any Boolean functions can be realized by NAND gate only. (10%)
   (*b*) ROM can be used to implemented any combinational circuit. How ? (10%)

3. (*a*) Write down both the iterative and recursive algorithms to get the n-th Fibonacci number as shown below. (10%)
   (*b*) Which algorithm will run faster ? Why ? (10%)
   $$\begin{cases} f_n = f_{n-1} + f_{n-2}, & n \geq 3 \\ f_1 = f_2 = 1 \end{cases}$$

4. Under what condition(s) will the bubble sort run faster than the quick sort ? Why ? (10%)

5. What are the advantages and disadvantages of a *Interpreater* as compared with a *Compiler* ? State at least on advantage and one disadvantage. (10%)

6. What are the advantages and disadvantages of a *RISC* processor as compared with a *CISC* processor ? State at least on advantage and one disadvantage.(10%)

7. Suppose that the transfer speed of a network is fast enough. How would you use the e-mail system to realize a video phone system ? (10%)

8. Assume that you have now a FORTRAN compiler on VAX, i.e., you can use FORTRAN on VAX. Assume also that we do not have a FORTRAN compiler on PC. There is only an assembler on our PC and therefore, it is a tedious work to write a FORTRAN compiler on PC directly by using the assembly language of PC. But, we can use the FORTRAN compiler on VAX to develop a FORTRAN compiler for PC. How ? (10%)