請照題號次序作答

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

1. (25%) Assume you have a section of C program which looks like the following and given the running CPU has a cache of 4 Mbytes.
   (a) Do you think the following code is an efficient way to calculate the cross product of `data` and `weight`? Explain your reason.
   (b) What will you do if you want to improve the performance of the program?

```
int *data = (int *) malloc((2 << 24) * sizeof(int));
int weight[10] = {5, 3, 6, 7, 4, 8, 4, 2, 4, 5};
double sum = 0.0;

// assign the value to each element of data.
initialize(data);

// do the cross product
for (int j = 0; j < 10; j++) {
    for (int i = 0; i < (2<<24); i++) {
        sum += weight[j] * data[i];
    }
}
```

2. (25%) Wright a program/function `div(a, b, n)` which can output the division of any two integers at *n*-digit precision? (This `div` function should be workable for $0 < n < 1000$)
   For example,
   `div(2, 3, 5)` should output **6.6666**e-1,
   `div(100, 7, 10)` should output **1.428571428**e1

3. (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, "5812185" and "lifeefil" are both palindromes. Given a file of all ASCII texts. Find the positions and corresponding length of all **palindromes** (length > 2) occurred in this text file, output (offset, length) as the result. For example, in "mississippi", we can output the palindroms occurrences as the following:
   (1, 7) ississi
   (1, 4) issi
   (2, 5) ssiss
   (3, 3) sis
   (4, 4) issi
   (7, 4) ippi

4. (25%) **Sudoku** (數獨, digit-single) is a logic-based, combinatorial number-placement puzzle. The objective is to fill a 9×9 grid with digits so that each column, each row, and each of the nine 3×3 sub-grids that compose the grid (also called "boxes", "blocks", "regions", or "sub-squares") contains all of the digits from 1 to 9. The puzzle setter provides a partially completed grid, which for a well-posed puzzle has a unique solution.
   Please write a program to solve a **sudoku** and output the result. Your **sudoku** program read data from a file.

File format:

```
5 3 _ _ 7 _ _ _ _
6 _ _ 1 9 5 _ _ _
_ 9 8 _ _ _ _ 6 _
8 _ _ _ 6 _ _ _ 3
4 _ _ 8 _ 3 _ _ 1
7 _ _ _ 2 _ _ _ 6
_ 6 _ _ _ _ 2 8 _
_ _ _ 4 1 9 _ _ 5
_ _ _ _ 8 _ _ 7 9
```

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

→solve→

5	3	4	6	7	8	9	1	2
6	7	2	1	9	5	3	4	8
1	9	8	3	4	2	5	6	7
8	5	9	7	6	1	4	2	3
4	2	6	8	5	3	7	9	1
7	1	3	9	2	4	8	5	6
9	6	1	5	3	7	2	8	4
2	8	7	4	1	9	6	3	5
3	4	5	2	8	6	1	7	9