CSC447 - Mid Term Exam 2023

1- Three main programming models exist in parallel programming, enumerate them and explain briefly the difference, and how they relate to parallel computer hardware.

2- We have a program containing 30% of its instructions as memory access and 21% as floating operation. What would be a better hardware choice to speed up the program: adding cache memory that reduces memory access time by 2x, or adding floating processing unit to get 3 times quicker floating processing ? Justify by calculation.

3- The following code is used to calculate and store the n first numbers of the Fibonacci series into an array f. What do you thing about parallelizing this algorithm ?

```
int f[n];
f[0] = 0; f[1] = 1;
for(i = 2; i <= n; i++)
    f[i] = f[i - 1] + f[i - 2];
```

4- We suppose an algorithm that calculate a special king of sub-line, sub-column product as illustrated below.

```
double a[N][N];
double vect[N];

void seq_calc()
{
    for (int i = 0; i < N; i++)
    {
        vect[i] = 0;
        for (int j = 0; j <= i; j++)
            vect[i] = vect[i]+ a[i][j]*a[j][i];
    }
}
```
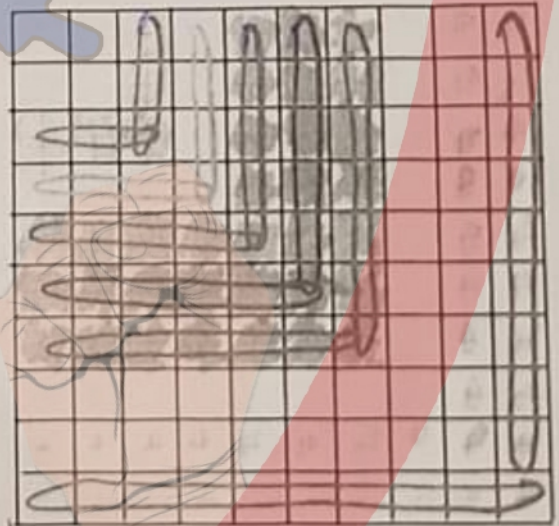

a- Write a naïve parallel version of this algorithm to make vector "vect" calculation in parallel using T_N threads. (without caring about any optimization)

b- Explain if this algorithm faces a false-sharing issue, how and where? If this is the case, propose a solution provided that cache lines are 64 bytes wide and a double variable is coded on 8 bytes. (don't write code, just explain your solution)

c- Can this code get benefit from load balancing ? justify your answer. Explains what changes to naïve version have to be done.

d- Does this algorithm exhibit any additional untreated issue in previous questions ? and if yes, do you have any insight about possible solution ?

Good Luck