Homework 12-sol

1. Suppose we have some code as below. Try to optimize the function **SUM** with a combination of at least **4 optimizations** you learned in the ICS class. Comment briefly on your optimizations.

```
typedef struct{
    int lwh[3];
}block_t;
typedef struct{
    int length;
    block_t *blocks;
} blocklist;
int get_length(blocklist *bl) { return bl->length);
block_t* get_blocks(blocklist *bl) { return bl->blocks);
void SUM(blocklist *bl, long *dest){
    for(int i = 0; i < get_length(bl); i++){
        int size = 1;
        for(int j = 0; j < 3; j++)
            size = size * get_blocks(bl)[i].lwh[j];
        *dest = *dest + size;
    }
}
```

```
void SUM(blocklist *bl, long *dest){
    int length = get_length(bl); // reduce loop overhead
    block_t* blocks = get_blocks(bl); //reduce function call
    int tmp = 0;
    for(int i = 0; i < get_length(bl); i++){
        int* lwh = blocks[i].lwh; // reduce repeated calculation
        tmp = tmp + lwh[0]*lwh[1]*lwh[2]; //loop unrolling
    }
    *dest = tmp;  //reduce memory access
}
```

2. Suppose there's a program consisting of 3 parts A, B & C. Part A takes up 20% of the overall run time, while part B takes up 30%, part C 50%. You decide to optimize one of the three parts to improve the performance. For the same cost, you can speed up A by a factor of 3.0, or speed up B by a factor of 2.5, or C by a factor of 1.5. Which choice would maximize the performance? Why? And please give the speedup.

Use Amdahl's law to calculate the speedup.

Sa=1/(1-0.2 + 0.2/3) = 1.154

Sb=1/(1-0.3 + 0.3/2.5) = 1.220

Sc=1/(1-0.5 + 0.5/1.5) = 1.2

Choose part B.