Homework 11

Problem 1

The assembly code generated for the compiled loop of combine3 is shown below:

```
combine3: data_t = float, OP = *
i in %rdx, data in %rax, dest in %rbp
1 .L498:                        loop:
2 movss (%rbp), %xmm0           Read product from dest
3 mulss (%rax, %rdx, 4), %xmm0  Multiply product by data[i]
4 movss %xmm0, (%rbp)           Store product at dest
5 addq $1, %rdx                 Increment i
6 cmpq%rdx, %r12                Compare i: limit
7 jg .L498                      If >, goto loop
```

Illustrate the code above with data-flow graph like figure 5.14(a) or (b) in textbook. You can use "store" to identify operation in line 4.

Problem 2

How to test the latency of load a value from memory? Try to write a simple program to test it. Assume you can test your program's CPE.

Problem 3

The following code seems not very good.

```
void sum_array(float *arr, long n, long *sum) {
    float ans = 0;
    for (long i = 0; (i+1) < n; i += 2)
        ans = ans + (arr[i] + arr[i + 1]);
    if (i < n)
        ans += arr[i];
    *sum = ans;
}
```

(1) Please rewrite it.

(2) The code in line 4 is modified as the following code in the table. After the modification, the CPE measurement increases from X to 2X. Please point out why the CPE measurement increases.

```
ans = (ans + arr[i]) + arr[i + 1];
```