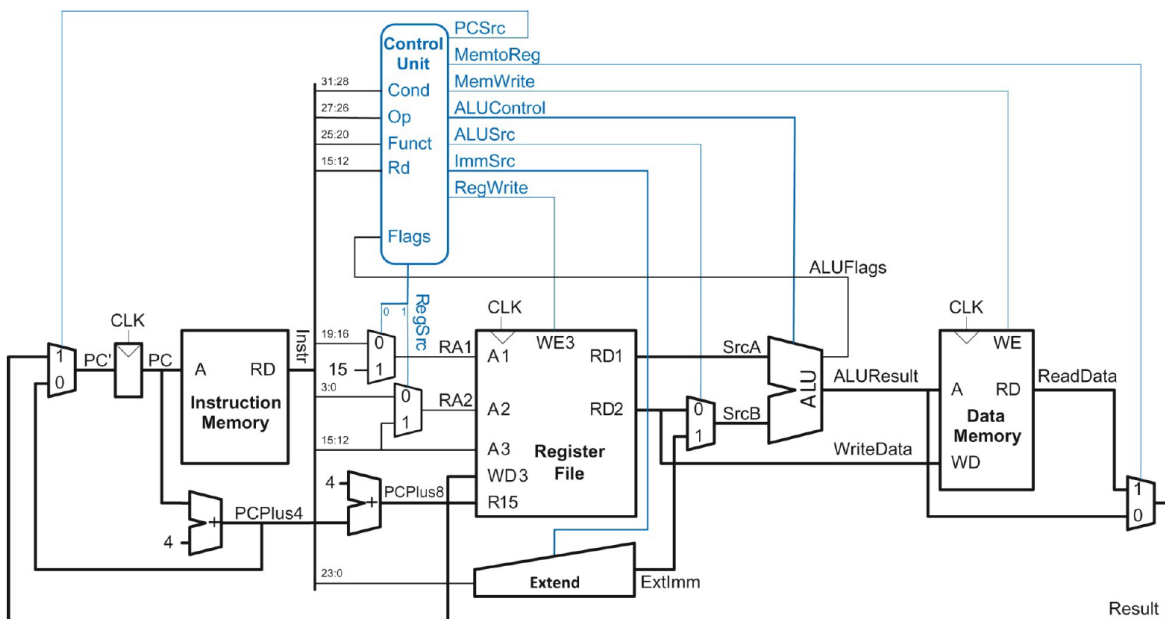*Note: This problem set is optional for your practice only and not part of the assessment scheme.*

Question 1:

For this question, we provide the following C code, the ARM CPU microarchitecture, and the delays of logic elements:

```
int array[32];
int k;
array[0] = 2;

for (k = 1; k < 32; k = k + 1)
    array[k] = array[k-1] + 16;
```


t_{pcq_pc} = 35 ps, t_{mem} = 180 ps, t_{dec} = 70 ps, t_{mux} = 25 ps, t_{RFread} = 110 ps, t_{ALU} = 128 ps, and $t_{RFsetup}$ = 66 ps

Part A: Transform the above C code to ARM assembly. Note that there are multiple ways to translate a given piece of C code to assembly. We are only concerned with correctness of your solution and not with code size or performance. A correct translation from C to assembly will receive full marks.

How long does the following instructions take to execute: (1) ORR, (2) STR, (3) B

Suppose your assembly code is executed on the single-cycle CPU above. Find the time it takes to execute the assembly code.

Question 2:

Compilers impact the performance of applications in different ways. For a program, compiler X results in an instruction count of 1 billion instructions, and an execution time of one second. A second compiler Y results in an execution time of 1.5 seconds, and an instruction count of 1.2 billion instructions. For a processor with a clock cycle time of one nano seconds, find the average CPI for each of the two programs.