CS 695: Advanced Computer Architecture
(Spring 2023)
Homework 2

Question 1

For the following code snippet:

```
for (i=0; i<=999; i=i+1)
    A[i] = A[i] + b;
```

Q1.1 [10 points] Please write down the corresponding MIPS assembly code without any optimization, assuming the data type of array A is floating point (double).
Q1.2 [10 points] Considering the following latencies of FP operations:

Instruction producing result	Instruction using result	Latency in clock cycles
FP ALU op	Another FP ALU op	3
FP ALU op	Store double	2
Load double	FP ALU op	1
Load double	store double	0

Please write the unscheduled loop execution with stalls. How many cycles are issued in total?
Q1.3 [10 points] Please write down the scheduled loop execution with stalls (if any), without loop unrolling. This time, how many cycles are issued?
Q1.4 [10 points] Show our loop unrolled so that there are four copies of the loop body, assuming the size of the array is initially a multiple of 32, which means that the number of loop iterations is a multiple of 4. Eliminate any obviously redundant computations and do not reuse any of the registers.
Q1.5 [10 points] With scheduling, we can eliminate all the stalls. Please show the unrolled loops with scheduling.

Question 2

Q2.1 [3 points] In MIPS architecture, what are the three types of instructions?
Q2.2 [3 points] What is the length of an instruction in MIPS architecture?
Q2.3 [4 points] Why do we design the instruction length to be the same?

Question 3

[10 points] What is the weakness of 1-bit branch predictor?