Question 1

Instruction	Clock Cycles																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
LD R1, 0(R2)	IF	ID	EX	M	W													
DADDI R1, R1, #1																		
SD 0(R2), R1																		
DADDI R2, R2, #4																		
DSUB R4, R3, R2																		
BENZ R4, Loop																		

Complete the above timing sequence.

A. Assume no forwarding unit

B. assume forwarding unit

No Forwarding	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
LD R1, 0(R2)	IF	ID	EX	M	W													
DADDI R1, R1, #1		IF	S	S	ID	EX	M	W										
SD 0(R2), R1				IF	S	S	ID	EX	M	W								
DADDI R2, R2, #4							IF	ID	EX	M	W							
DSUB R4, R3, R2								IF	S	S	ID	EX	M	W				
BENZ R4, Loop										IF	S	S	ID	EX	M	W		

With Forwarding	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
LD R1, 0(R2)	IF	ID	EX	M	W													
DADDI R1, R1, #1		IF	S	ID	EX	M	W											
SD 0(R2), R1				IF	ID	EX	M	W										
DADDI R2, R2, #4					IF	ID	EX	M	W									
DSUB R4, R3, R2						IF	ID	EX	M	W								
BENZ R4, Loop							IF	ID	EX	M	W							

Question 2

Suppose that in 1000 memory references there are 40 misses in the first-level cache and 20 misses in the second-level cache.

Assume the miss penalty from the L2 cache to memory is 200 clock cycles, the hit time of the L2 cache is 10 clock cycles, the hit time of L1 is 1 clock cycle. What is the average memory access time.

Question 3

Performance Evaluation

You are investigating the possible benefits of a way-predicting level 1 cache. Assume that the 32 KB two-way set-associative single-banked level 1 data cache is currently the cycle time limiter. It takes one cycle to hit this cache.

As an alternate cache organization you are considering a way-predicted cache modeled as a 16 KB direct-mapped cache with 85% prediction accuracy. Unless stated otherwise, assume a mispredicted way access that hits in the cache takes one more cycle.

What is the average memory access time of the current cache versus the way-predicted cache?

Given:

   Miss rate for 2 way LRU is 0.0056

   Miss rate for Direct-mapped is 0.015

   Miss penalty is 20 cycles for both types

   Hit time= Hit Rate* Hit Cycles