

1. Pipelining (10 points)

- How many cycles would the following sequence of instructions take if they are executed in a 6-stage pipeline (assume one cycle per stage in the pipeline (FI-fetch instruction, DI-decode instruction, CO-calculate operand, FO-fetch operands, EI-execute instruction, WO-write operand)).

Instructions
 ADD R1, (R2)
 ADD R2, R1

- Suggest ways to overcome the problems above.

2. Cache (5 points)

- Locality of reference is an important feature of programs, in the context of memory hierarchies. Explain what locality of reference means, and why it is important
- Assume a main memory of size 64 bytes and a cache memory of size 16 bytes. The cache memory is organized as direct mapping and a cache line is of size 4 bytes. Explain what happens (decoding and memory read) when the CPU makes the following memory requests: (a) read at address 000000, (b) read at address 100111, and (3) read at address 111001.

Cache line	Tag	Byte address			
		00	01	10	11
00	00	A	B	C	D
01	10	E	F	G	H
10	01	I	J	K	L
11	00	M	N	O	P