

5. (a) (3 points) Briefly explain **two** advantages of a multi-cycle architecture when compared to a single-cycle architecture.

**Solution:**

- In a single-cycle architecture, all instructions are given 1-cycle to execute, therefore the slowest instruction determines the speed of the processor.
- In a multi-cycle processor, instructions are broken down into smaller pieces, decreasing the cycle time. Simpler instructions can be executed faster, reducing the average cycle time.
- A single cycle processor, needs multiple instances of memories, and adders which may be quite large. A multi-cycle processor can share these resources, using only a single memory and ALU. This reduces the area

- (b) (5 points) For each of the following statements about microarchitectures, write if their TRUE or FALSE. If they are FALSE, explain why.

- In a pipelined architecture, a given instruction is executed faster than in a single-cycle architecture.

**Solution:** FALSE, a given instruction runs even slightly slower, due to the overhead, but the throughput increases

- Control and Data Hazards can not occur in single or multi-cycle architectures.

**Solution:** TRUE, they only occur when instructions are executed at the same time in parallel, like in pipelined architectures.

- The higher the Cycles per Instruction (CPI) of a micro-architecture, the faster it will finish its operation.

**Solution:** FALSE, all other things being equal, a high CPI will lower the execution speed.

- A single-cycle architecture has less control overhead than a multi-cycle architecture

**Solution:** TRUE, a multi-cycle architecture has more resources to be shared, and there is overhead for the sequential processing.