Quiz 06

Problem 1

Jared and Joshua are designers of cache memory subsystem of a new chip at Sloppy Computing Systems (SCS). It was discovered late in the design that the power budget of the chip cannot be kept within the limits for cooling. An edict came from SCS's chief architect that each team must explore ways to reduce power consumption to help mitigate the crisis.

Jared declared that he has the answer. He suggested changing the 4-way set associate L2 cache to a direct-mapped cache can reduce power consumption and keep the chip within the power envelope of the design targets. He admitted that there will be a loss in performance, but since each cache access requires four comparisons and a complex replacement algorithm to be implemented, that the reduction in power was a fair tradeoff between performance and feasibility.

Joshua was adamant that Jared's idea is really bad. However, being overly shy and awkward, he was unable to articulate the reason. He dropped you a note to go explain his objection to the chief engineer and went on vacation. Unfortunately, he forgot to write down what his idea was. Your task is to figure out whether Joshua was correct and why, or to go tell the chief engineer to follow Jared's advice.

Problem 2

What is the size of an 8-entry TLB if the system has a 64-bit address space, a 44-bit physical address space, and a 4KB page?

Problem 3

Consider the stream benchmark. If we have a 4-way set associative cache, compare the performance of the following replacement algorithms:

- LRU
- FIFO
- Random

Explain your answers.

Problem 4

While running the daily regression tests, one application crashed with an "illegal instruction" exception. You have been called upon to find out what happened. An initial investigation identified the compiler as a possible cause for the problem. You read the report and it just did not make any sense to you. The code hasn't been modified since the night before, and when you tried to rerun the application, it succeeded. Explain what is happening.