Problem 0: Warm-up (2 points)

Facebook is hiring hardware engineers. What do you think they are building?

Any answer is accepted.

Problem 1 (43 points)

Part a (5 points): A microarchitecture is predicting whether a branch is taken or not taken using a 1-bit predictor. The last five branches were: taken, taken, taken, taken, not taken. What does the branch predictor predict (choose): Taken or Not Taken?

Not Taken

Part b (5 points): In a typical Linux/Unix terminal, when you hit Ctrl + Z, which state are you putting the foreground process to (choose): Running, Stopped, Terminated?

Stopped

Part c (5 points): Cache blocking is a software-level performance optimization technique that improves what aspect of a program (choose): Locality, Parallelism, Concurrency, Security?

Locality

Part d (5 points): An application that is 90% parallelizable is executed on a single processor in 1.5 hours. If the application is allowed to run with an unlimited number of processors, what is the lower bound on its execution time?

9 mins. With an unlimited number of processors, the parallelizable part of a program would finish in no time, and the execution time is equivalent to the sequential part, which is 90 mins * 0.1 = 9 mins.

Part e (5 points): On a page fault, the operating system often loads a page from the disk into memory. How does the operating system know whether it is necessary to write the previously occupied page in the memory back to the disk? Answer in fifteen words or fewer.

Check the dirty bit in the corresponding page table entry.