

CS252 HOMEWORK 1

Due Tue. 9/25/07

Problem 1:

Suppose that you have analyzed a benchmark that runs on your company's processor. This processor runs at 300MHz and has the following characteristics:

Instruction Type	Frequency (%)	Cycles
Arithmetic and logical	35	1
Load and Store	25	2
Branches	25	3
Floating Point	15	5

Your company is considering a cheaper, lower-performance version of the processor. Their plan is to remove some of the floating-point hardware to reduce the die size. The wafer on which the chip is produced has a diameter of 10cm, a cost of \$2000, and a defect rate of $1 / (\text{cm}^2)$. The manufacturing process has an 80% wafer yield and a value of 2 for alpha.

The current processor has a die size of 12mm x 12mm. The new chip has a die size of 10mm x 10mm, and floating point instructions will take 13 cycles to execute.

- What is the CPI and MIPS rating of this processor running this benchmark?
- What is the CPI and MIPS rating of the new processor?
- What is the original cost per (working) processor?
- What is the new cost per (working) processor?
- Assume that we are considering the other direction of improving the original processor by increasing the speed of floating point operations. What is the theoretical limit of the best possible overall speedup that we could ever get, and what would be the CPI and MIPS rating of the new processor?

Problem 2:

You are responsible for performing repairs to make sure a system has an availability of .9999 (99.99%). The system consists of a server with a mean time to failure of 2 million hours, and a disk with a mean time to failure of 1 million hours. For this problem, assume all lifetimes are exponentially distributed.

a) On a failure, how long do you have (on average) to repair the system in order to ensure a 99.99% availability?

b) The system is being upgraded to include 10 disks, each of which has the same MTTF as before. You're still expected to maintain 99.99% availability, and all of the disks need to be functional for the system to be considered "available". Now how long do you have to make a repair?

Problem 3:

Your company produces a handheld device. To extend the battery life in the newer version of device, someone proposes to simply reduce the processor clock speed by 50%, and make no other changes. Stating your assumptions, describe whether this is a good idea or a bad idea, and why. Make sure to address both power and energy.

Problem 4:

a) What are pipelining hazards? List the different types and describe how they can be resolved.

b) How do you optimize cache performance to achieve the following:

- a) Reduce miss rate
- b) Reduce miss penalty
- c) Reduce hit time