Results

NOTE: this is the SOLUTION to Quiz 2.

The correct answers are indicated for each question, with explanations as needed.

Dr. Manikas

Your Answers:

1

4 / 4 points

The Testing Department has reported that our corporate server system has an FIT of 1000. What is the MTTF (hours) for this system?

✓ 1,000,000

Feedback

General Feedback

Recall that FIT is rate of failures per billion (10^9) hours, and is the reciprocal of MTTF.

Thus, **MTTF = 10^9/FIT = 10^9/1000 = 10^6 = 1 million hours**

2

4 / 4 points

We have a server system with a MTTF of 1 million hours. After failure, if it takes 5 days to get the system running again, what is the availability of the system?
Please show your answer to **6** significant digits after the decimal point.

✓ 0.999880

Feedback

It takes 5 days = 5 (24 hours/day) = 120 hours to get the system running again = MTTR

$$Availability = \frac{MTTF}{MTTF+MTTR}$$

$$= \frac{10^6}{10^6+120} = 0.999880 \ (rounded)$$

3

4 / 4 points

We have a program that is 60% “parallelizable”: 60% of the program can be run in parallel, while 40% must be run sequentially. This program is currently run on a uniprocessor machine. What is the speedup if we run this program on a machine with 4 processors (cores)?

1.818

Feedback

General Feedback

Amdahl's Law, applied to this instance:

Speedup = $\frac{1}{(1-F)+\frac{F}{N}}$

F = fraction parallelizable = 60% or 0.6, N = amount of improvement = # cores = 4

$$\text{Speedup}=\frac{1}{(1-F)+\frac{F}{S}}$$
$$=\frac{1}{(1-0.6)+\frac{0.6}{4}}$$
$$=\frac{1}{0.4+0.15}=\frac{1}{0.55}\approx 1.82$$

4

4 / 4 points

Your design team has designed a processor with code name of “Bronco”. This processor has a clock cycle time of 2 ns. When the processor is run on a SPEC benchmark with 10^9 instructions, the resultant execution time is 4 seconds. What is the **average CPI** for this processor?

2

Feedback

General Feedback

Execution time = (instruction count)(CPI)(clock cycle time)

- We are given Instruction count (IC) = 10^9
- We are given clock cycle time = 2 ns = 2 x 10^{-9} sec
- Execution time is 4 sec

Thus,

$$CPI = \frac{Execution\ Time}{(IC)(clock\ cycle\ time)}$$

$$= \frac{4}{(10^9)(2 \times 10^{-9})} = \mathbf{2}$$

5 4 / 4 points

Your design team has developed a new processor with code name of "Maverick". This processor has a clock rate of 2 GHz, and the average cycles per instruction is 2. The processor is tested on a SPEC benchmark program that has 10^9 instructions. What is the **execution time** for this program on this processor?

✓ 1 sec

Feedback

General Feedback

Recall that execution time = (instruction count)(CPI)(clock cycle time)

Also, clock rate = 1/(clock cycle time)

- We are given clock rate = 2 GHz = 2 x 10^9 Hz = 2 x 10^9 cycles/sec
- CPI (cycles/instruction) = 2
- Instruction count (IC) = 10^9

Thus

$$execution\ time = \frac{(IC)(CPI)}{clock\ rate}$$

$$= \frac{(10^9)(2)}{2\ x\ 10^9} = 1\ \text{sec}$$

6

4 / 4 points

Your design team has developed a new processor with code name of "Mustang". This processor has an average cycles per instruction of 2. When run on a SPEC benchmark program that has 2 x 10^9 instructions, the total processor execution time is 1 second. What is the **clock rate** for this processor?

4 GHz

Feedback

General Feedback

Recall that CPU time = (instruction count)(CPI)(clock cycle time) = (instruction count)(CPI)/(clock rate)

We are given the following:

- CPU time = total processor execution time = 1 second
- CPI = average cycles per instruction = 2
- Instruction count for SPEC benchmark program = 2 x 10^9 instructions

We need to determine the clock rate. Using algebra, we revise the above equation as:

$$clock\ rate = \frac{(instruction\ count)(CPI)}{CPU\ time} = \frac{(2{\times}10^9\ instructions)(\frac{2\ cycles}{instruction})}{1\ sec}$$

$$clock\ rate = 4 \times 10^9\,\frac{cycles}{sec} = 4\ GHz$$