Lecture Deck 6 Ai Practice Questions

1. What is Moore's Law and what specific prediction did it make in 1970?

2. Name the five primary techniques discussed for increasing microprocessor speed from the slides.

3. What is pipelining in processor design and what analogy is used to explain it?

4. Explain what branch prediction is and how it helps improve processor performance.

5. What does the CPI (Cycles Per Instruction) metric measure, and what factors affect it?

6. What is Amdahl's Law used for in computer architecture?

7. Why did processor designers move towards multicore designs instead of just increasing clock speeds?

8. What is SPEC and what is its purpose in computer architecture?

9. Why is geometric mean used instead of arithmetic mean when calculating SPEC benchmark scores?

10. What is the difference between "base" and "peak" metrics in SPEC benchmarks?

---

1. Q: What is Moore's Law and what specific prediction did it make in 1970?
A: Moore's Law predicted that "the number of transistors that can be placed on a single chip will double every 1.5 years." It's noted that this wasn't actually a law but rather something that inspired chip designers and manufacturers.

2. Q: Name the five primary techniques discussed for increasing microprocessor speed from the slides.
A: The five techniques are:
- Pipelining
- Branch prediction
- Superscalar execution
- Data flow analysis
- Speculative execution

3. Q: What is pipelining in processor design and what analogy is used to explain it?
A: Pipelining is like an assembly line for instructions. It allows different instructions to be at different stages of processing simultaneously. Each instruction goes through phases (Fetch, Decode, Execute, Writeback) and different instructions can be in different phases at the same time, increasing overall throughput.

4. Q: Explain what branch prediction is and how it helps improve processor performance.
A: Branch prediction uses program behavior to predict future behavior. The processor keeps track of branch history and looks up instruction addresses in a table to predict whether a branch will be taken. When predictions are correct, it prevents pipeline stalls and improves performance by allowing the processor to continue working without waiting for branch resolution.

5. Q: What does the CPI (Cycles Per Instruction) metric measure, and what factors affect it?
A: CPI measures the average number of clock cycles needed to execute an instruction. It's affected by:
- The types of instructions being executed
- The instruction mix in the program
- The processor implementation
- Memory system performance

6. Q: What is Amdahl's Law used for in computer architecture?
A: Amdahl's Law helps evaluate potential performance improvements by calculating the maximum possible speedup when only part of a system is improved. It shows that the speedup is limited by the portion of the task that cannot be improved.

7. Q: Why did processor designers move towards multicore designs instead of just increasing clock speeds?
A: Designers moved to multicore designs because of:
- Power/heat limitations with higher clock speeds
- Memory latency issues
- The ability to achieve better performance through parallel execution
- Physical limits of increasing single-core performance

8. Q: What is SPEC and what is its purpose in computer architecture?
A: SPEC (Standard Performance Evaluation Corporation) provides standardized benchmarks to evaluate computer performance. It uses a collection of programs defined in high-level languages that provide a representative test of computers in particular usage domains.

9. Q: Why is geometric mean used instead of arithmetic mean when calculating SPEC benchmark scores?
A: Geometric mean is used because it normalizes ranges of values so that no single value dominates the overall weighting. It ensures that the percentage change in any benchmark component has the same impact on the final score, regardless of the absolute values involved.

10. Q: What is the difference between "base" and "peak" metrics in SPEC benchmarks?
A: Base metrics use benchmarks compiled with no special optimizations, while peak metrics use benchmarks compiled with full optimization enabled. Base represents standard performance while peak represents the best possible performance under optimal conditions.