Computer Architecture Exam Questions And Solutions

Computer Architecture Exam Questions And Solutions Decoding Computer Architecture Exam Questions and Solutions Computer architecture exams can be daunting encompassing a vast landscape of concepts from instruction sets to memory hierarchies This article aims to equip you with the knowledge and strategies to tackle common exam questions providing both indepth explanations and practical solutions Well cover key areas offering examples and highlighting crucial understanding I Instruction Set Architecture ISA ISA questions often focus on understanding how instructions are fetched decoded and executed They might involve analyzing assembly code calculating instruction cycle times or comparing different ISA designs Common Question Types Assembly Language Programming Translate highlevel code snippets into assembly language considering register allocation and memory addressing modes Instruction Pipelining Analyze the performance implications of pipeline hazards data hazards control hazards structural hazards and describe solutions like forwarding and branch prediction RISC vs CISC Compare and contrast Reduced Instruction Set Computer RISC and Complex Instruction Set Computer CISC architectures highlighting their advantages and disadvantages Example Question Write an assembly program to add two numbers stored in memory locations A and B storing the result in C Assume a simple ISA with LOAD ADD and STORE instructions Solution assembly LOAD R1 A Load the value at memory location A into register R1 LOAD R2 B Load the value at memory location B into register R2 ADD R3 R1 R2 Add the values in R1 and R2 storing the result in R3 2 STORE R3 C Store the value in R3 into memory location C This simple example showcases the fundamental operations involved in assembly programming More complex questions might involve loops conditional statements and function calls requiring a deeper understanding of stack operations and memory management II Memory Hierarchy and Cache Memory Understanding memory hierarchy is crucial Questions frequently explore cache organization replacement policies and performance analysis Common Question Types Cache Mapping Describe different cache mapping techniques directmapped associative setassociative and their impact on performance Analyze hit and miss ratios Cache Replacement Policies Explain various replacement algorithms LRU FIFO random and their effectiveness under different workload patterns Memory Performance Calculate effective memory access time considering cache hit rates and memory access times Example Question A system has a cache with a hit rate of 90 The cache access time is 10 ns and the main memory access time is 100 ns Calculate the average memory access time AMAT Solution AMAT Hit rate Cache access time Miss rate Main memory access time AMAT 09 10 ns 01 100 ns 9 ns 10 ns 19 ns III Pipelining and Parallelism Pipelining and parallel processing are vital for enhancing computer performance Exam questions might involve analyzing pipeline stages identifying hazards or comparing different parallel architectures Common Question Types Pipeline Stages Describe the different stages of a typical instruction pipeline fetch decode execute memory access write back and explain how they contribute to performance Pipeline Hazards Identify and explain the different types of pipeline hazards and propose solutions to mitigate their impact 3 Parallel Architectures Compare different parallel architectures eg SIMD MIMD and discuss their strengths and weaknesses Example Question Explain how branch

prediction improves pipeline performance Solution Branch prediction attempts to anticipate the outcome of a branch instruction before its actually executed If the prediction is correct the pipeline can continue fetching and executing instructions along the predicted path avoiding stalls Incorrect predictions result in pipeline flushes but overall accurate branch prediction significantly reduces pipeline stalls and improves performance IV InputOutput IO Systems IO systems are often examined through questions relating to IO devices interrupts and DMA Common Question Types Interrupt Handling Explain the interrupt handling process including how interrupts are generated handled by the CPU and returned to the main program flow DMA Describe the function of Direct Memory Access DMA and how it improves IO performance IO Controllers Explain the role of IO controllers in managing communication between the CPU and peripheral devices V Multiprocessors and Multicore Systems Understanding multiprocessor and multicore architectures is increasingly important Expect questions on various aspects of parallel processing and synchronization Common Question Types Multiprocessor Architectures Compare different multiprocessor architectures eg shared memory distributed memory and their advantages and disadvantages Synchronization Techniques Explain different synchronization techniques eg semaphores mutexes monitors used to coordinate access to shared resources in multiprocessor systems Cache Coherence Describe cache coherence problems and solutions eg snooping protocols directorybased protocols in sharedmemory multiprocessor systems Key Takeaways Master the fundamentals of ISA including assembly programming and instruction execution Develop a strong understanding of memory hierarchy including caching and virtual memory 4 Thoroughly grasp pipelining and parallel processing concepts Familiarize yourself with IO systems and interrupt handling Understand the principles of multiprocessor and multicore architectures Frequently Asked Questions FAQs 1 What is the best way to prepare for a computer architecture exam Practice solving a variety of problems focusing on understanding the underlying concepts rather than rote memorization Utilize textbooks online resources and past exam papers 2 How important is understanding assembly language While not always heavily weighted understanding assembly language provides a crucial foundation for grasping how instructions are executed and how the CPU interacts with memory 3 What are the most common mistakes students make on computer architecture exams Common mistakes include failing to understand the implications of different cache replacement policies misinterpreting pipeline hazards and neglecting the intricacies of synchronization techniques in multiprocessor systems 4 How can I improve my problemsolving skills in computer architecture Work through numerous examples and practice problems Start with simpler problems and gradually progress to more complex ones Dont be afraid to ask for help if you get stuck 5 Are there any specific resources recommended for studying computer architecture Several excellent textbooks are available along with online courses and tutorials Look for resources that provide clear explanations ample examples and practice problems Remember to tailor your resources to the specific syllabus and learning objectives of your course

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