Book Review

Computer Architecture: A Quantitative Approach
J. L. Hennessy, D. A. Patterson
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An updated edition of the classic book on computer architecture by J. L. Hennessy and D. A. Patterson. Authors show their high level standards for technological ideas, writing style, and teaching methodologies, all in one book. In fact, they maintain their quality since the first edition of this book. As authors explain, one of the main reasons for the fourth edition of the book is the focus on parallel architectures for high performance, more specifically: multiple processors or processors cores per chip designs.

Distribution of material in chapters is as follows:
- Chapter 1: Fundamentals of Computer Design. This chapter introduce and define terms used throughout the book. Important issues such as power consumption and cost are included, along with performance measuring.
- Chapter 2: Instruction-Level Parallelism and Its Exploitation. A complete description of advantages, problems and solutions to ILP by pipelining techniques. Most of the concepts are explained by using MIPS and some possible implementations. Authors explicitly refer to Appendix A for a more detailed description of MIPS pipelining. Also, in the beginning of Appendix A authors refer to a more basic text on computer architecture and design for a more detailed description of instruction pipelining in general. These references give an idea of the advanced level of coverage given to ILP in the second chapter of the book.
- Chapter 3: Limits on Instruction Level Parallelism. This chapter explains strong studies to ILP limits, along with the main ideas underlying thread-level parallelism. Also, advanced concepts of speculative instruction execution are presented, comparing hardware and software approaches.
- Chapter 4: Multiprocessors and Thread-Level Parallelism. Multiprocessors are presented as a natural evolution of processing architecture due to limits in single processor performance. The introduction of the chapter begins with a simple but useful taxonomy of processing hardware. Other important concepts such as symmetric multiprocessing with shared memory and distributed shared memory are also discussed in this chapter. An interesting complete example is also included after discussing general concepts.
- Chapter 5: Memory Hierarchy Design. Memory plays a crucial role in processing performance, and most of the involved issues are included in this chapter. In fact, the previous chapter can be considered a thorough introduction to the memory hierarchy of computing systems. Again, a complete and real example is presented, which shows most of the design decisions made on a specific architecture produced for the market.
- Chapter 6: Storage Systems. Disks and general I/O design issues are presented in this chapter. As in the beginning of the book, specific definitions for performance measuring and benchmark are presented specifically for the I/O subsystem.

Clearly, there are chapters in two *general* classes: hardware for processing, and memory and storage harware, the latter including I/O because of the relationship of disks with the computers' I/O subsystem. Also, the printed book includes three long appendices:
- Appendix A. Pipelining: Basic and Intermediate Concepts.
- Appendix B. Instruction Set Principles and Examples.
- Appendix C. Review of Memory Hierarchy.

The book has a companion CD, with eight Appendices:
- Appendix D. Embedded Systems.

- Appendix E. Interconnection Networks.
- Appendix F. Vector Processors.
- Appendix G. Hardware and Software for VLIW and EPIC.
- Appendix H. Large Scale Multiprocessors and Scientific Applications.
- Appendix I. Computer Arithmetic.
- Appendix J. Survey of Instruction Set Architectures.
- Appendix K. Historical Perspectives and References.

Every appendix can be considered a thorough description and discussion of a specific computer architecture detail. Authors have been careful in including extensive and technical information on all of the appendices, many of them being complete and useful computing architecture reviews.

Finally, the book also has an online appendix: Appendix L. Solutions to Case Study Exercises, which is useful mainly for teachers and students.

This book is one of the main sources for advanced computer architecture courses at university grade and at post grade levels.

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