

Survey of Branch Prediction, Pipelining, Memory Systems as Related to Computer Architecture

Honors Directed Study Research Project

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Abstract

This paper is a survey of topics introduced in Computer Engineering Course CEC470: Computer Architecture (CEC470). The topics covered in this paper provide much more depth than what was provided in CEC470, in addition to exploring new concepts not touched on in the course. Topics presented include branch prediction, pipelining, registers, memory, and the operating system, as well as some general design considerations for computer architecture as a whole.

The design considerations explored include a discussion on different types of instruction types specific to the ARM Instruction Set Architecture, known as ARM and Thumb, as well as an exploration of the differences between heterogeneous and homogeneous multi-processors.

Further sections explain the interoperability of various portions of the computer architecture with a focus on performance optimizations. Branch prediction is introduced, and the quality improvement which branch prediction provides is detailed. An explanation of pipelining is given followed by how pipelining on different types of processors may be difficult. Registers, one of the fundamental parts of a computer, are explained in detail, as well as their importance to computer systems as a whole.

The memory and operating systems sections tie this paper together by delving deeper into the architecture of computers, then resurfacing with how the software and hardware interact through the operating system.

This paper concludes by tying each section discussed together and presenting the importance of computer architecture.