Systems Design and Programming

Instructor:
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Text:

Supplementary text:

Lab Text:
Bob Neveln, 'Linux Assembly Language Programming', Prentice Hall PTR.

Web:
http://www.cs.umbc.edu/~cpatel2
**Course Description**

This course covers:

- Intel 80x86 assembly language.
- Architecture of the Intel microprocessors.
- Hardware configuration and control of:
  - Common microprocessor support chips, e.g. Interrupt controller.
  - Popular I/O devices, e.g. UART, sound card.

Prerequisites:

- Experience with the C programming language.
- Some familiarity with Operating Systems, such as Windows.
- Experience with the Linux operating system.

Projects:

- Assembly Language Programming
- Hardware Project
80x86 Evolution

4004:
- 4-bit microprocessor.
- 4KB main memory.
- 45 instructions.
- PMOS technology.
- 50 KIPS

8008: (1971)
- 8-bit version of 4004.
- 16KB main memory.
- 48 instructions.
- NMOS technology.

8080: (1973)
- 8-bit microprocessor.
- 64KB main memory.
- 2 microseconds clock cycle time; 500,000 instructions/sec.
- 10X faster than 8008.
Introduction

80x86 Evolution

8085: (1977)
- 8-bit microprocessor - upgraded version of the 8080.
- 64KB main memory.
- **1.3 microseconds** clock cycle time; 769,230 instructions/sec.
- 246 instructions.
- Intel sold 100 million copies of this 8-bit microprocessor.

8086: (1978) 8088 (1979)
- **16-bit** microprocessor.
- **1MB** main memory.
- 2.5 MIPS (400 ns).
- 4- or 6-byte instruction cache.
- Other improvements included more registers and additional instructions.

80286: (1983)
- 16-bit microprocessor very similar in instruction set to the 8086.
- **16MB** main memory.
- 4.0 MIPS (250 ns/8MHz).
80386: (1986)

- 32-bit microprocessor.
- 4GB main memory.
- 12-33MHz.
- Memory management unit added.
- Variations: DX, EX, SL, SLC (cache) and SX.

  80386SX: 16MB through a 16-bit data bus and 24 bit address bus.

80486: (1989)

- 32-bit microprocessor, 32-bit data bus and 32-bit address bus.
- 4GB main memory.
- 20-50MHz. Later at 66 and 100MHz
- Incorporated an 80386-like microprocessor, 80387-like floating point coprocessor and an 8K byte cache on one package.
- About half of the instructions executed in 1 clock instead of 2 on the 386.
- Variations: SX, DX2, DX4.

  DX2: Double clocked version:
  66MHz clock cycle time with memory transfers at 33MHz.
**80x86 Evolution**

**Pentium: (1993)**

- 32-bit microprocessor, 64-bit data bus and 32-bit address bus.
- 4GB main memory.
- 60, 66, 90MHz.
  - 1-and-1/2 100MHz version.
  - Double clocked 120 and 133MHz versions.
  - Fastest version is the 233MHz (3-and-1/2 clocked version).
- **16KB L1 cache (split instruction/data: 8KB each).**
- Memory transfers at **66MHz** (instead of 33MHz).
- **Dual integer processors.**

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**80486DX**

- Co-Processor
- 8K L1 cache
- 33 MHz
- CPU

**Pentium**

- Co-Processor
- Int CPU₁
- Int CPU₂
- 16K L1 cache
- 66 MHz
- memory

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**80x86 Evolution**

**Pentium Pro: (1995)**
- 32-bit microprocessor, 64-bit data bus and 36-bit address bus.
- **64GB** main memory.
- Starts at 150MHz.
- 16KB L1 cache (split instruction/data: 8KB each).
- **256KB L2 cache.**
- Memory transfers at 66MHz.
- **3 integer processors.**

![Pentium Pro Diagram](image)
80x86 Evolution

**Pentium II: (1997)**

- 32-bit microprocessor, 64-bit data bus and 36-bit address bus.
- 64GB main memory.
- Starts at 266MHz.
- **32KB** split instruction/data L1 caches (16KB each).
- **Module integrated 512KB L2 cache (133MHz).**
- Memory transfers at 66MHz to **100MHz** (1998).
80x86 Evolution

**Pentium III: (1999)**

- 32-bit microprocessor, 64-bit data bus and 36-bit address bus.
- 64GB main memory.
- 800MHz and above.
- 32KB split instruction/data L1 caches (16KB each).
- **On-chip 256KB L2 cache (at-speed).**
- Memory transfers 100MHz to **133MHz**.
- **Dual Independent Bus** (simultaneous L2 and system memory access).
80x86 Evolution

**Pentium IV: (2002)**

- 1.4 to 1.9GHz and the latest at 3.20 GHz and 3.46GHz (Hyper-Threading)!
- 1MB/512KB/256KB L2 cache.
- 800 MHz (about 6.4GB/s)/533 MHz (4.3 GB/s)/ 400MHz (3.2 GB/s) system bus.
- 1066 MHz front side bus just available.
- Specialized for streaming video, game and DVD applications (144 new SIMD 128-bit instructions).
- 0.13um, more than 55 million transistors, 60nm transistors.
- Newer ones are in 90nm transistors, more than 125 million possible.

Refer to the following URL for more details:

http://www.intel.com/design/pentium4/documentation.htm