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HW2

1. - EAX: Used by multiplication and division instructions
- EBX: Often set to a commonly used value in a function to speed up calculations
- ECX: Used as a loop counter
- EDX: Used as a function parameter and for storing short-term variables
- EBP: Used to reference function parameters and local variables on the stack
- ESP: Addresses data on the stack (a system memory structure)
- ESI: Used by high-speed memory transfer instructions
- EDI: Also used by high-speed memory transfer instructions

EAX, EBX, ECX, and EDX registers can be addressed in parts as 8-bit values.

2. - Sign flag indicates the result of an arithmetic or logical operation has generated a negative result when set
- Zero flag indicates the result of an arithmetic or logical operation has generated a result of zero when set
- Auxillary flag indicates an arithmetic operation caused a carry from a bit 3 to bit 4 in an 8-bit operand when set
- Parity flag indicates the least significant byte in the result contains an even number of 1 bits when set.

3. - Overflow flag indicates the result of a signed arithmetic operation is too large or too small to fit into the destination when set.
- Carry flag indicates the result of an unsigned arithmetic operation is too large to fit into the destination.

Overflow flag is only relevant to to signed arithmetic operations while the carry flag is relevant to unsigned.

4. Instructions and data are held in the memory storage unit. When the central processor unit (CPU) requests data from the storage unit data is transferred from random access memory (RAM) to the CPU, and data is also transferred from the CPU into memory. The data is transferred via the data bus with the help of the control and address busses which synchronize actions and hold addresses. Once the instructions and data are in the CPU they can be processed and executed.

5. Cache memory is a special memory storage unit that allows the CPU to access some instructions and data very quickly. When certain instructions and data are used repeatedly they are put into the cache for quick access. For example, when a CPU begins to execute a program it can look ahead and move the next thousand instructions into the cache so they can be accessed quickly.

6. - Real-address mode is one of three primary modes of operation for an x86 processor. This mode implements a programming environment of an early Intel processor with additional features such as the ability to switch to other modes. This mode is useful for direct access to system memory and hardware devices. This mode can only address 1 MB of memory from hex 00000 to FFFFF and only run one program at a time. Although, this mode can momentarily interrupt a program to process requests called interrupts from peripherals. Application programs ran in this mode are permitted access to any memory location including ones linked directly to hardware.

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HW 2 (cont.)

6. (cont.). - Protected mode is one of three primary modes of operation for an x86 processor. This mode is the native state of a processor where all instructions and features are available. Programs are given separate memory areas called Segments and the programs cannot reference memory outside of these assigned Segments. Multiple programs can be ran at one time and each running program is given 4 GB of memory.

- Multi-segment model is another model for an x86 processor where each program held in the memory storage unit, specifically in the RAM, has a local descriptor table (LDT). The LDT contains the base address of a segment within the linear address space.

7. The maximum memory amount that can be addressed in real-addressed mode is 1 MB. The maximum amount in protected mode is 4 GB per running program. The linear address corresponding to the following segment-offset: 07B4:0238 is

$$\begin{array}{r} 0x\,07B40 \\ +\ 0x\,00238 \\ \hline 0x\,07D78 \end{array}$$

8. P = 3 GHz

T = 1/P = 1/3 ns

MUL = 6 clock cycles

$$1/3 \cdot 6 = 2\ ns$$