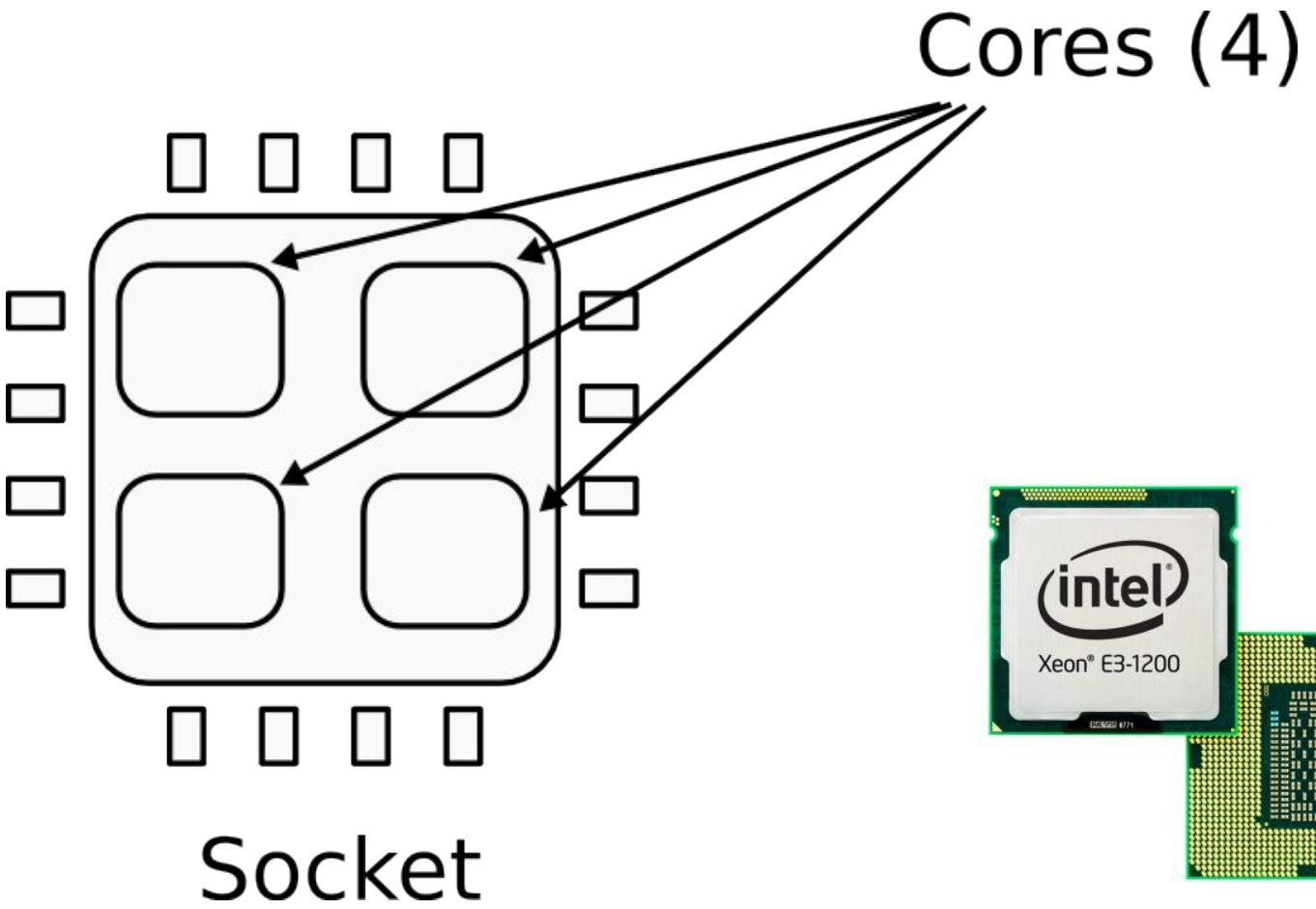
143A: Principles of Operating Systems

Lecture 4: PC Harware

Anton Burtsev
January, 2017

CPU

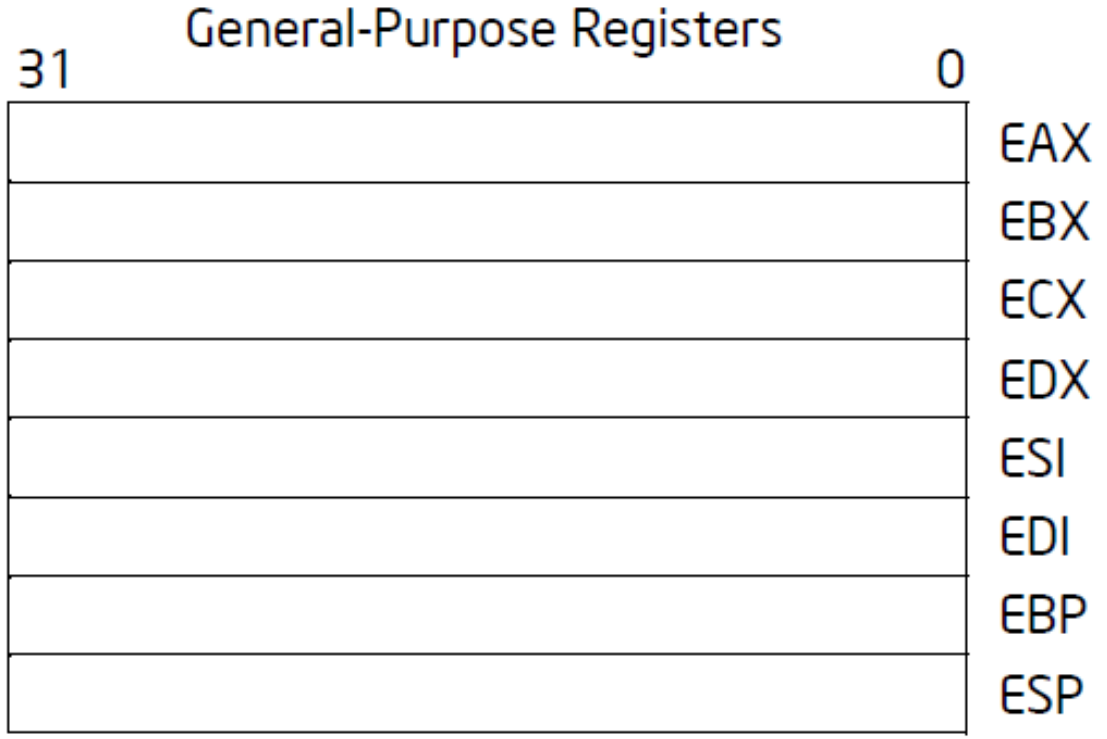
- CPU socket
  - 4 cores

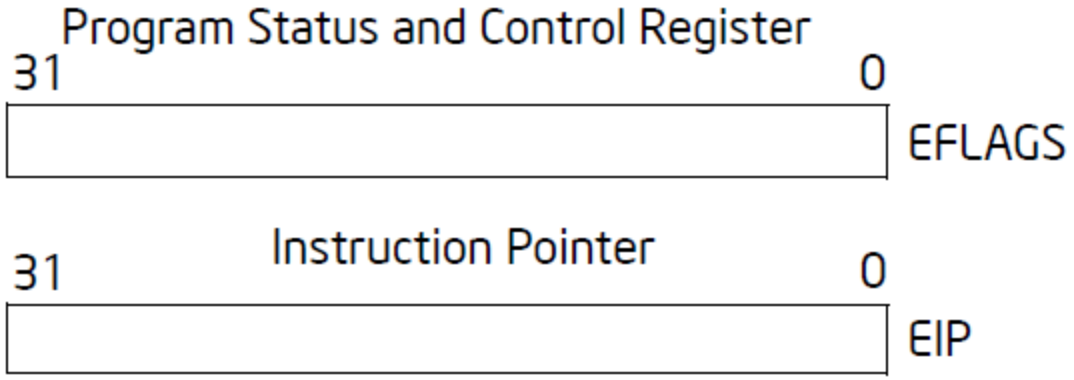


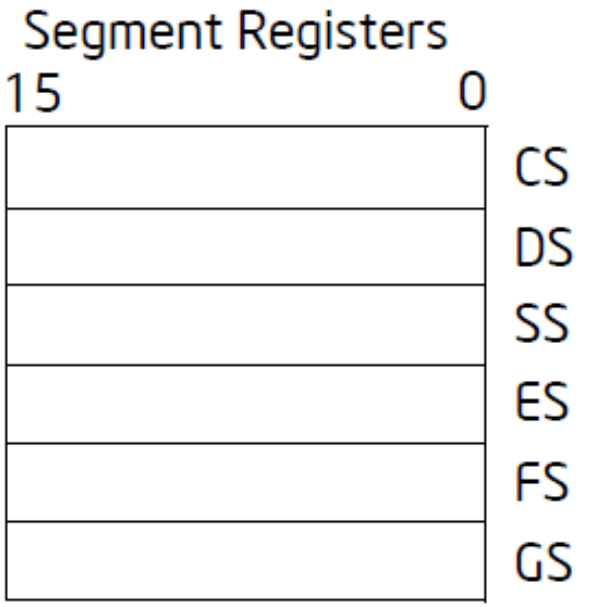
Register

- The processor has an internal memory
  - Register file

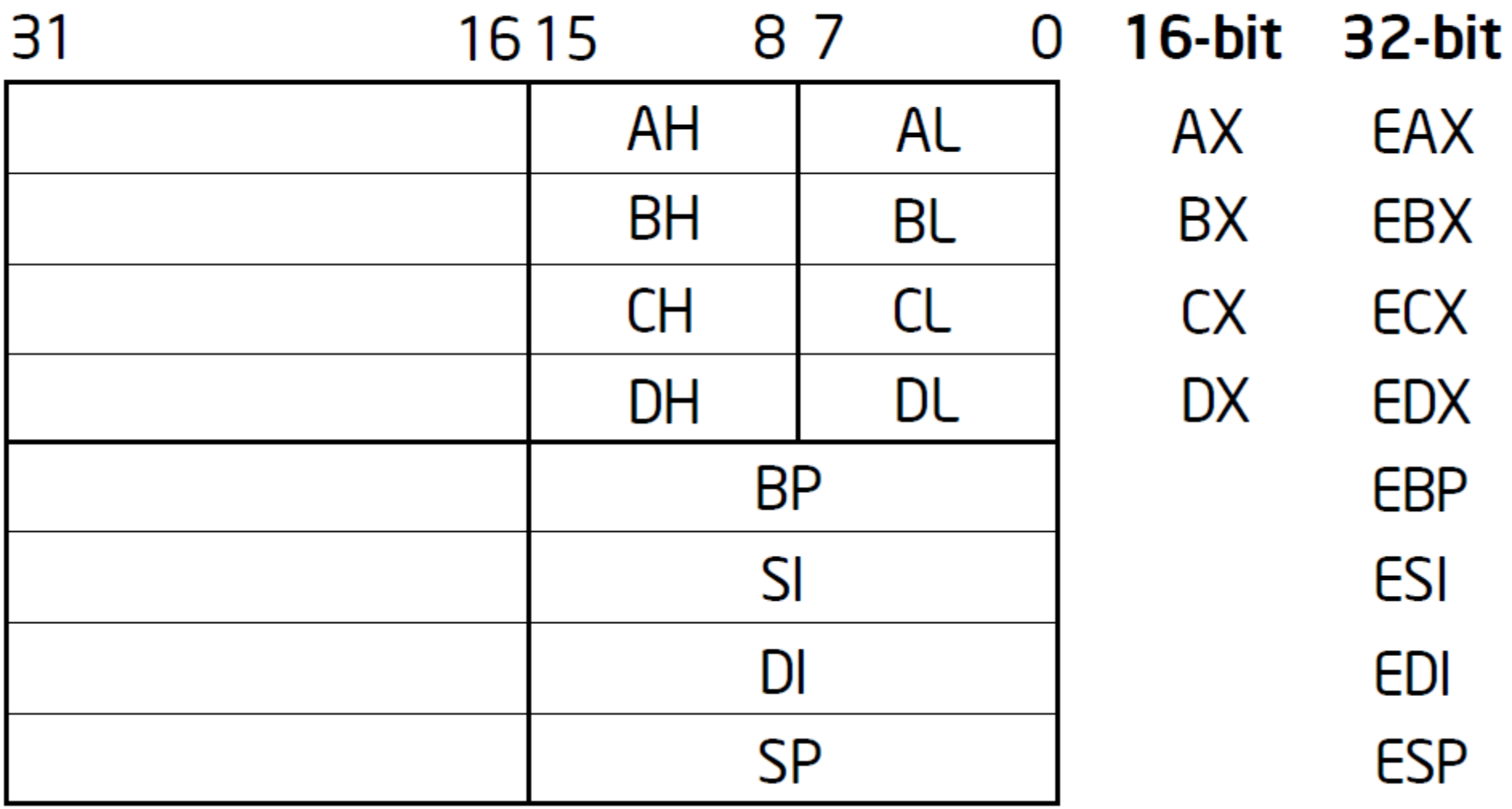
Registers


General-Purpose Registers
31
0
EAX
EBX
ECX
EDX
ESI
EDI
EBP
ESP


Program Status and Control Register
31
0
EFLAGS
Instruction Pointer
31
0
EIP


Segment Registers
15
0
CS
DS
SS
ES
FS
GS

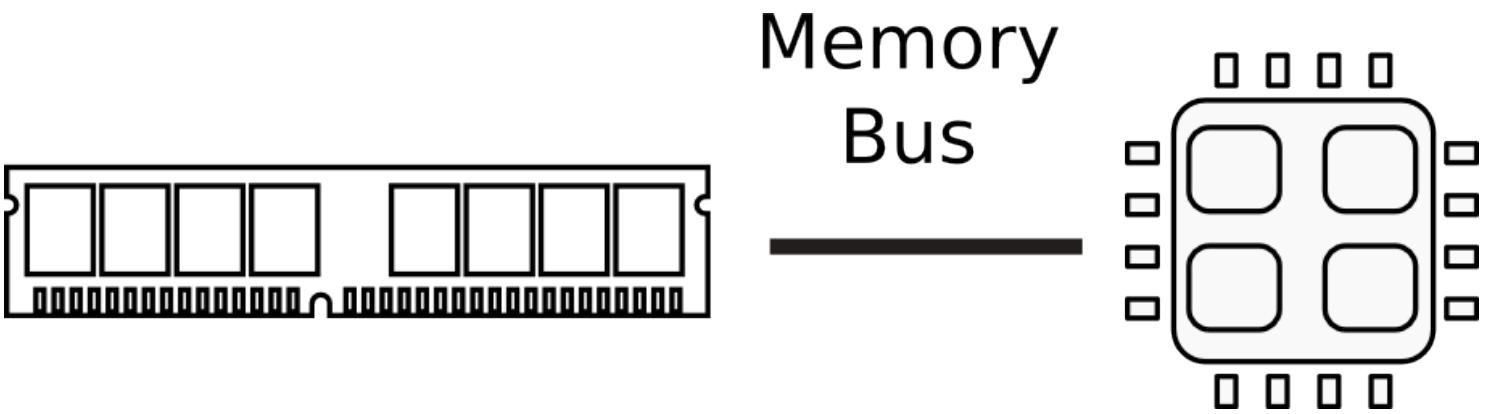
General-Purpose Registers

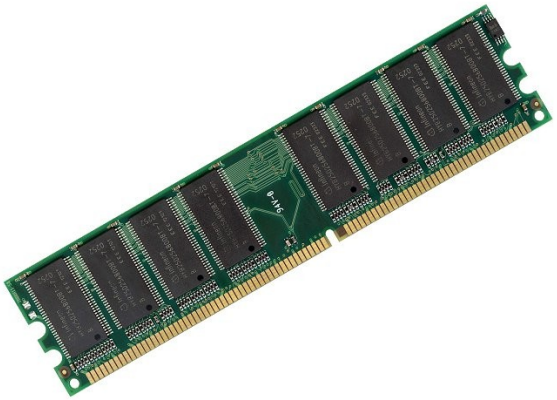


General registers

- EAX — Accumulator for operands and results data
- EBX — Pointer to data in the DS segment
- ECX — Counter for string and loop operations
- EDX — I/O pointer
- ESI — Pointer to data in the segment pointed to by the DS register; source pointer for string operations
- EDI — Pointer to data (or destination) in the segment pointed to by the ES register; destination pointer for string operations
- ESP — Stack pointer (in the SS segment)
- EBP — Pointer to data on the stack (in the SS segment)

Memory



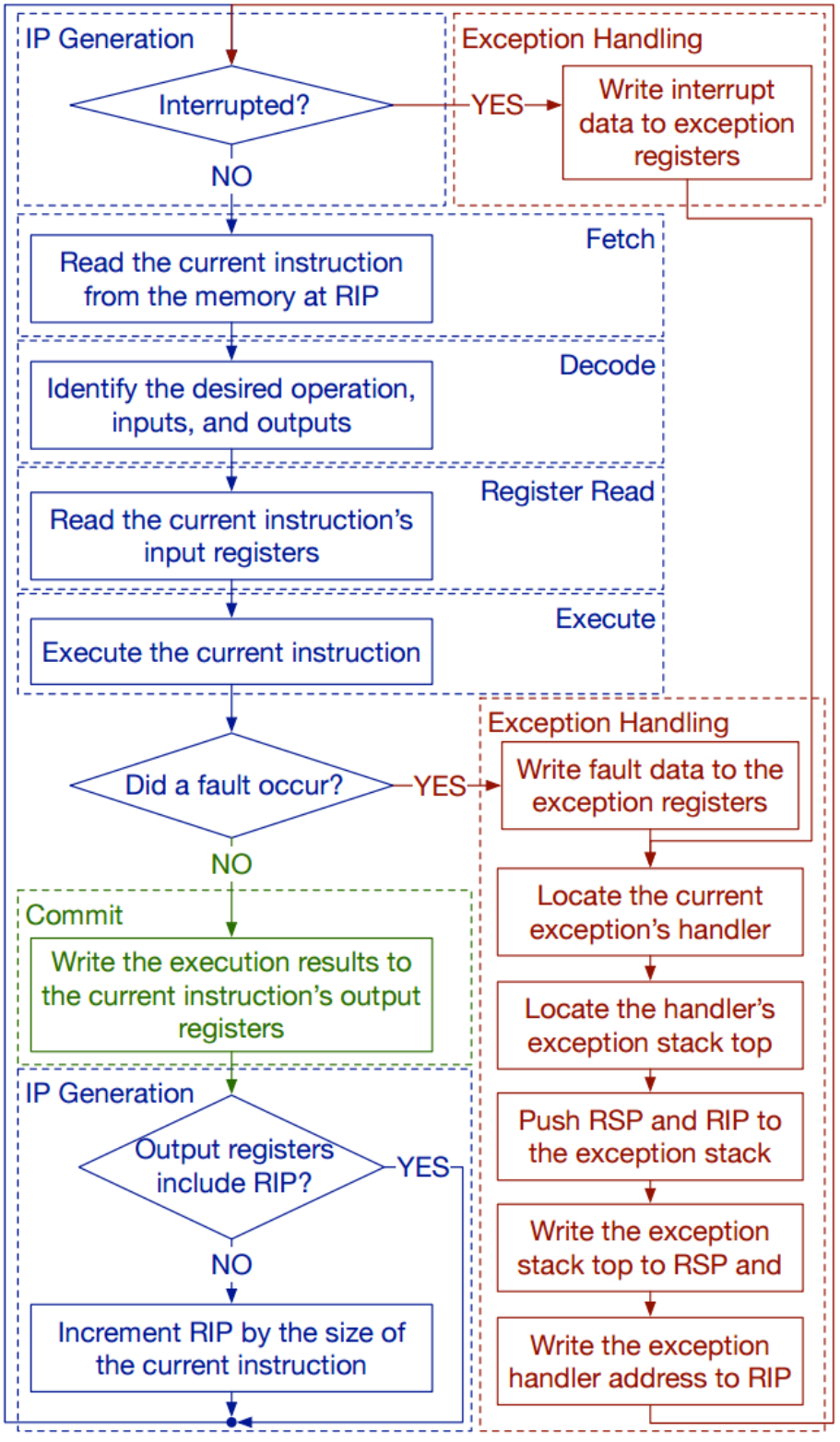


Memory abstraction

WRITE(*addr*, *value*) → ∅ Store *value* in the storage cell identified by *addr*.
READ(*addr*) → *value* Return the *value* argument to the most recent WRITE call referencing *addr*.

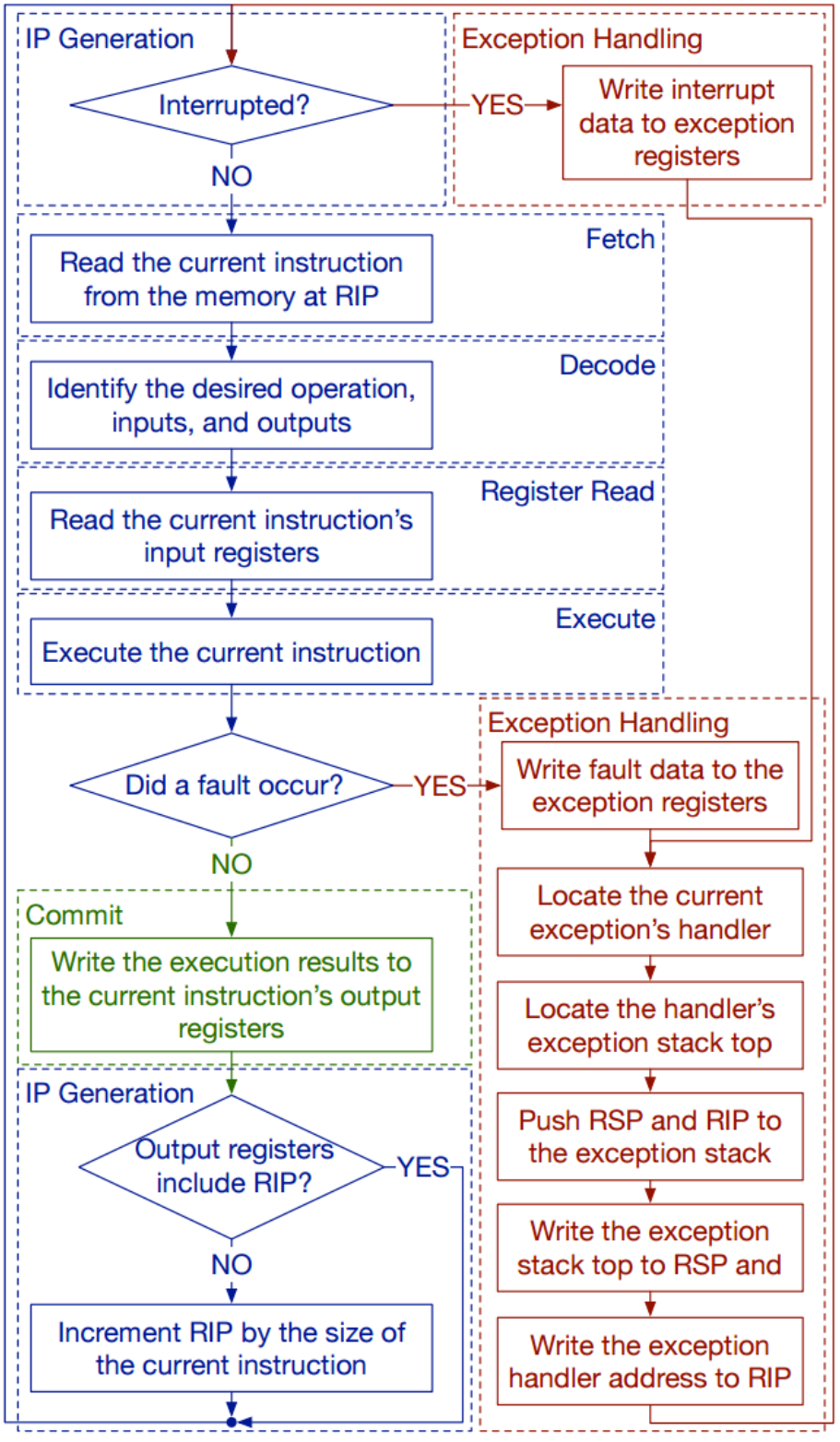
- x86 assembly examples:

```
mov eax, [ebx] ; Move 4 bytes in memory at the address contained in EBX into EAX
mov [var], ebx  ; Move the contents of EBX into the 4 bytes at memory address var.
mov eax, [esi-4]   ; Move 4 bytes at memory address ESI + (-4) into EAX
mov [esi+eax], cl  ; Move the contents of CL into the byte at address ESI+EAX
mov edx, [esi+4*ebx]       ; Move the 4 bytes of data at address ESI+4*EBX into EDX
```



CPU execution loop

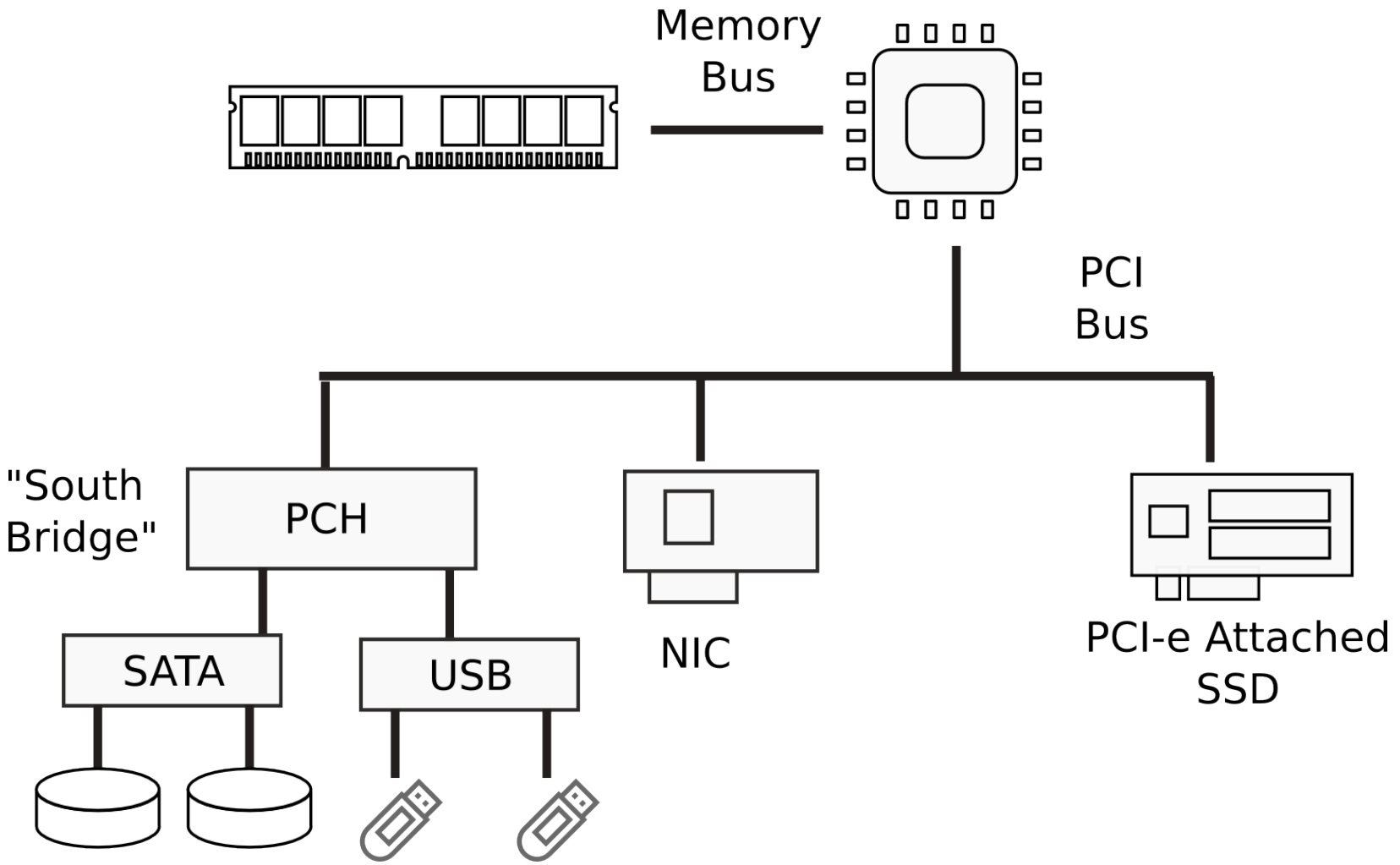
- CPU repeatedly reads instructions from memory
- Executes them
- Example
  - ADD EDX, EAX, EBX
  - EDX = EAX + EBX



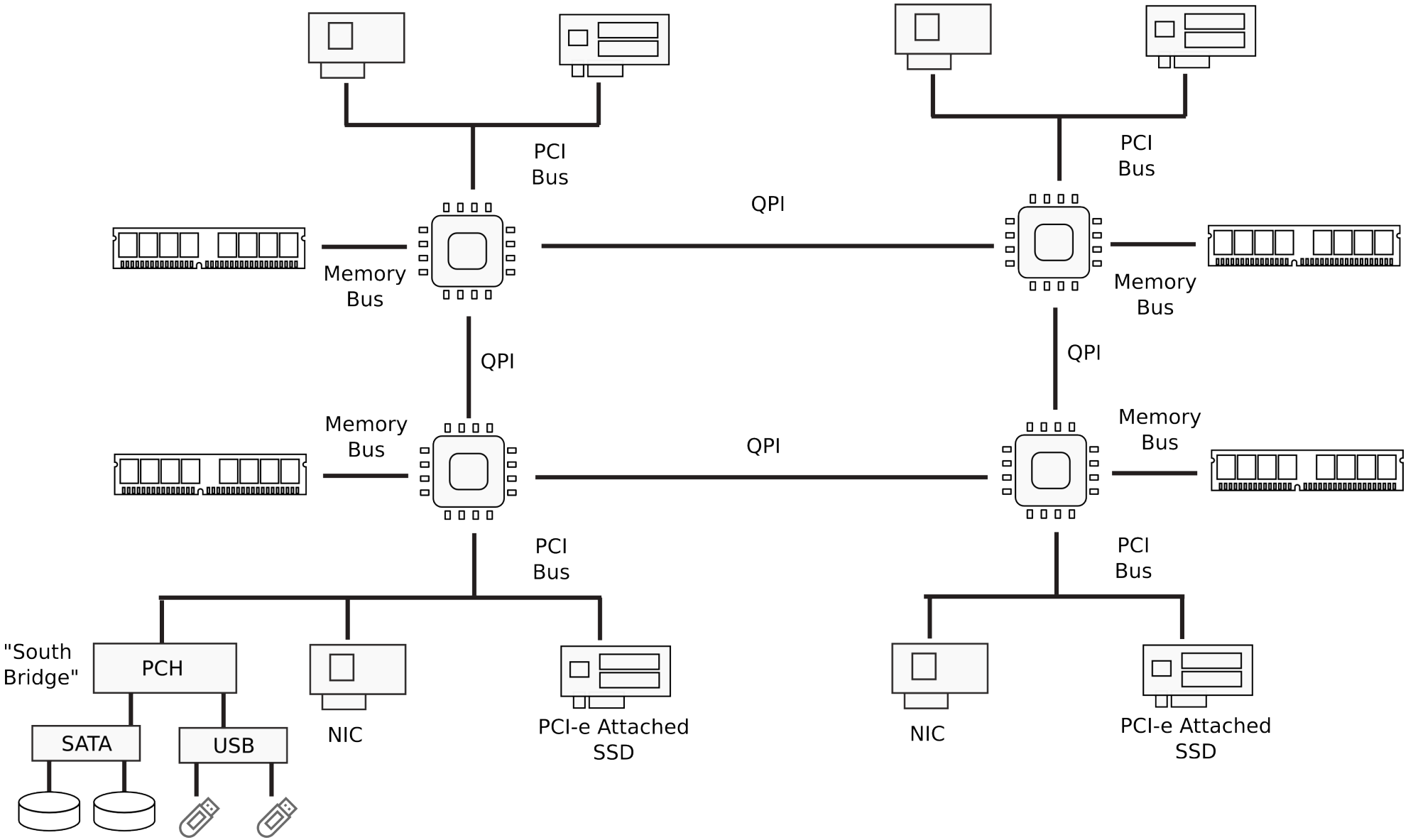
CPU execution loop

- Fault
  - Instruction's preconditions are not met
- Examples
  - Division by zero
  - Page not mapped

I/O Devices


Memory
Bus
PCI
Bus
"South
Bridge"
PCH
SATA
USB
NIC
PCI-e Attached
SSD

Multi-socket machines



Dell Poweredge R910 System Server 4-socket Lga1567 Motherboard P658h

Questions?