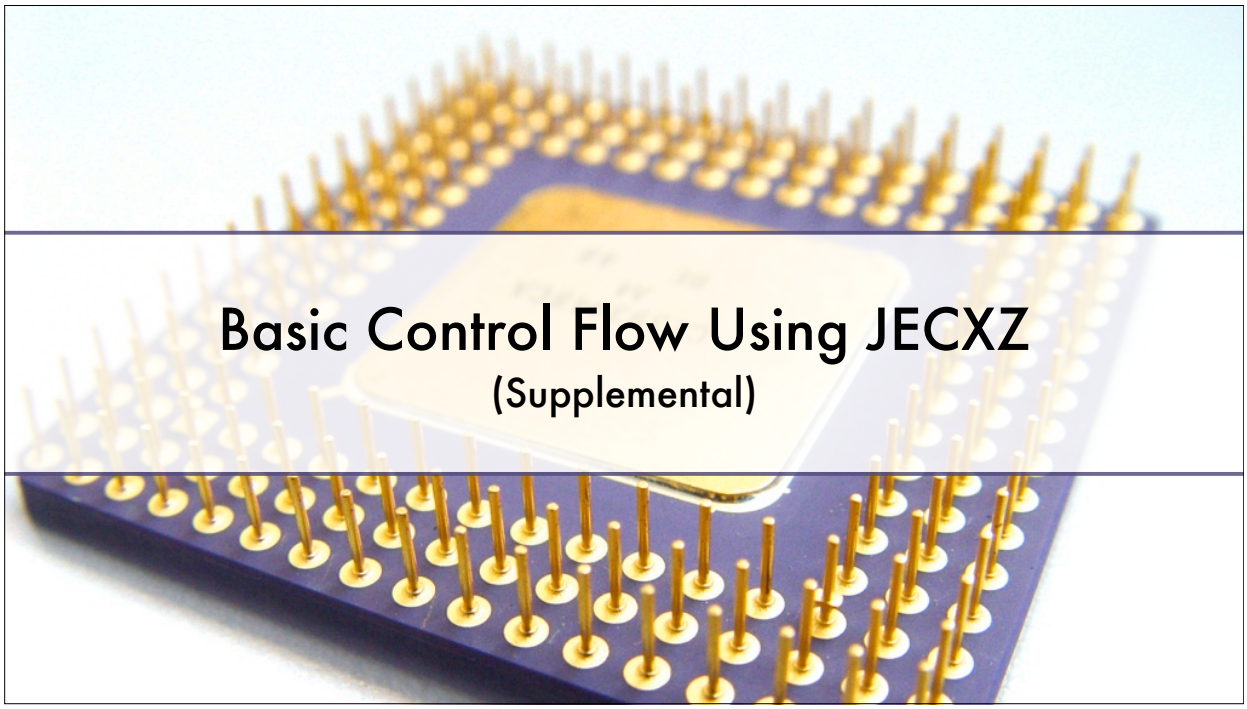
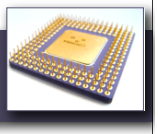


Basic Control Flow Using JECXZ

(Supplemental)

JMP Instruction (Review)



- **`jmp`** Instruction (*unconditional jump*)
  - Like a "goto" statement – go to the instruction with a given label
  - Prefix any instruction with *label*: – then you can `jmp` to that *label*

Example 1

```
        mov eax, 2
        jmp write
        mov eax, 1
write:  call WriteDec
```

Skips over mov eax, 1 and displays 2

Example 2

```
start:  mov eax, 0
        jmp start
```

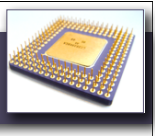
Infinite loop: keep setting EAX to 0

Example 3

```
top:  call ReadDec
      call WriteDec
      jmp top
```

Infinite loop: read unsigned integer, then display it

Conditional Jump: Jump if ECX is Zero (JECXZ)



- Recall: `jmp` is like a goto statement – go to the given label, no matter what
- The **`jecxz`** instruction (jump if ECX is zero) behaves as follows:
  - If the value in ECX is 0, go to the given label
  - If it is nonzero, *don't* go to the given label; continue with the next instruction instead

Example 1

```
        mov ecx, 2
        sub ecx, 2
        jecxz write
        mov ecx, 99
write:  mov eax, ecx
        call WriteDec
```

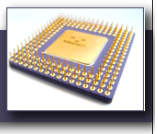
Skips over mov eax, 99 and displays 0

Example 2

```
        mov ecx, 2
        sub ecx, 1
        jecxz write
        mov ecx, 99
write:  mov eax, ecx
        call WriteDec
```

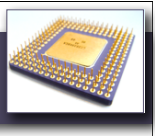
Does not jump; displays 99

Conditional Jumps



- The `jecxz` instruction is an example of a **conditional jump** instruction
- A **conditional jump** instruction
  - jumps if some condition is true
  - doesn't jump (continues to the next instruction) otherwise
- The `jecxz` instruction
  - jumps if ECX == 0
  - doesn't jump otherwise
- **Q.** Why are conditional jumps useful?
  - **A.** Control flow. Java uses *if* statements, *while* loops, etc.; assembly uses jumps.
  - We'll use `jecxz` to illustrate this
- We'll learn more powerful conditional jump instructions later in the course
  - *Example:* jump if the last arithmetic instruction caused an overflow
  - *Example:* compare values in two registers, then jump if they're equal *<< Useful!*

A Do-While Loop



- **Q.** Translate the following pseudocode into assembly, using **`jecxz`** to implement the do-while loop.

Store the value 5 in ECX

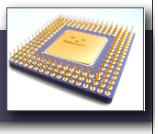
do {
    Decrease value in ECX by 1
} while (ECX == 0)

Display value in ECX

```
        mov ecx, 5
start:  sub ecx, 1
        jecxz start

        mov eax, ecx
        call WriteDec
```

A Do-While Loop



- **Q.** This is the same as the previous slide, but the condition is negated. Translate it using **`jecxz`** and **`jmp`** to implement the do-while loop.

Store the value 5 in ECX

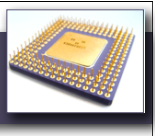
do {
    Decrease value in ECX by 1
} while (ECX ≠ 0)

Display value in ECX

```
        mov ecx, 5
start:  sub ecx, 1
        jecxz done
        jmp start

done:   mov eax, ecx
        call WriteDec
```

Translating Do-While Loops



Do Thing A
do {
    Do Thing B
} while (ECX == 0)
Do Thing C

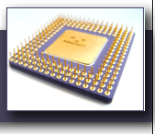
```
        Do Thing A
label:  Do Thing B
        jecxz label
        Do Thing C
```

Do Thing A
do {
    Do Thing B
} while (ECX ≠ 0)
Do Thing C

```
        Do Thing A
label1: Do Thing B
        jecxz label2
        jmp label1
label2: Do Thing C
```

Activity 5 #4

A While Loop



- Remember from Java:
  - do-while loops – test *after* executing the loop body
  - while loops – test *before* executing the loop body
- Example:

Store the value 5 in ECX

while (ECX ≠ 0) {
    Decrease value in ECX by 1
}

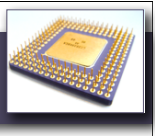
Display value in ECX

```
        mov ecx, 5

start:  jecxz done
        sub ecx, 1
        jmp start

done:   mov eax, ecx
        call WriteDec
```

A While Loop



- Remember from Java:
  - do-while loops – test *after* executing the loop body
  - while loops – test *before* executing the loop body
- Example:

  Store the value 5 in ECX

  while (ECX == 0) {
  Decrease value in ECX by 1
  }

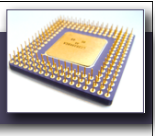
  Display value in ECX

```
        mov ecx, 5

start:  jecxz body
        jmp done
body:   sub ecx, 1
        jmp start

done:   mov eax, ecx
        call WriteDec
```

Translating While Loops



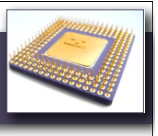
Do Thing A
while (ECX == 0) {
Do Thing B
}
Do Thing C

```
        Do Thing A
label1: jecxz label2
        jmp label3
label2: Do Thing B
        jmp label1
label3: Do Thing C
```

Do Thing A
while (ECX ≠ 0) {
Do Thing B
}
Do Thing C

```
        Do Thing A
label1: jecxz label3
        Do Thing B
        jmp label1
label3: Do Thing C
```

Summary: Translating Loops Involving ECX



Do Thing A
do {
Do Thing B
} while (ECX == 0)
Do Thing C

Do Thing A
L1: *Do Thing B*
jecxz L1
Do Thing C

Do Thing A
do {
Do Thing B
} while (ECX ≠ 0)
Do Thing C

Do Thing A
L1: *Do Thing B*
jecxz L2
jmp L1
L2: *Do Thing C*

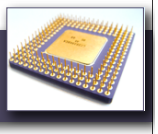
Do Thing A
while (ECX == 0) {
Do Thing B
}
Do Thing C

Do Thing A
L1: **jecxz L2**
jmp L3
L2: *Do Thing B*
jmp L1
L3: *Do Thing C*

Do Thing A
while (ECX ≠ 0) {
Do Thing B
}
Do Thing C

Do Thing A
L1: **jecxz L3**
Do Thing B
jmp L1
L3: *Do Thing C*

An If Statement: General Form

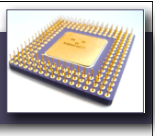


- You can also implement an *if* statement using `jecxz`:

Do Thing A
if (ECX ≠ 0) {
Do Thing B1
} else {
Do Thing B2
}
Do Thing C

Do Thing A
jecxz *???*
ifPart: *Do Thing B1*
jmp *???*
elsePart: *Do Thing B2*
endPart: *Do Thing C*

An If Statement: General Form

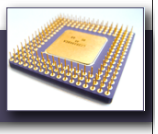


Do Thing A
if (ECX ≠ 0) {
    Do Thing B1
} else {
    Do Thing B2
}
Do Thing C

```
                Do Thing A
                jecxz elsePart
ifPart:         Do Thing B1
                jmp endPart
elsePart:       Do Thing B2
endPart:        Do Thing C
```

These are just ordinary labels.
You don't have to call them ifPart, elsePart, etc.
Any label—L1, or dog, or foo—will work (but it's less readable).

Translating If Statements



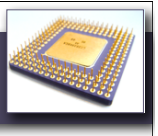
Do Thing A
if (ECX ≠ 0) {
    Do Thing B1
} else {
    Do Thing B2
}
Do Thing C

```
                Do Thing A
                jecxz elsePart
ifPart:         Do Thing B1
                jmp endPart
elsePart:       Do Thing B2
endPart:        Do Thing C
```

Do Thing A
if (ECX == 0) {
    Do Thing B1
} else {
    Do Thing B2
}
Do Thing C

```
                Do Thing A
                jecxz ifPart
                jmp elsePart
ifPart:         Do Thing B1
                jmp endPart
elsePart:       Do Thing B2
endPart:        Do Thing C
```

Administrivia



- **Homework 1** was due at 2:00 – late submission cutoff is 2 p.m. Sunday
- Meet in the **Lab on Monday** (2119 and 2122 Shelby)
  - Go to either one – wherever you can find a seat
  - If you want to work on your laptop, bring it