

x86-64 Programming III

CSE 351 Autumn 2023

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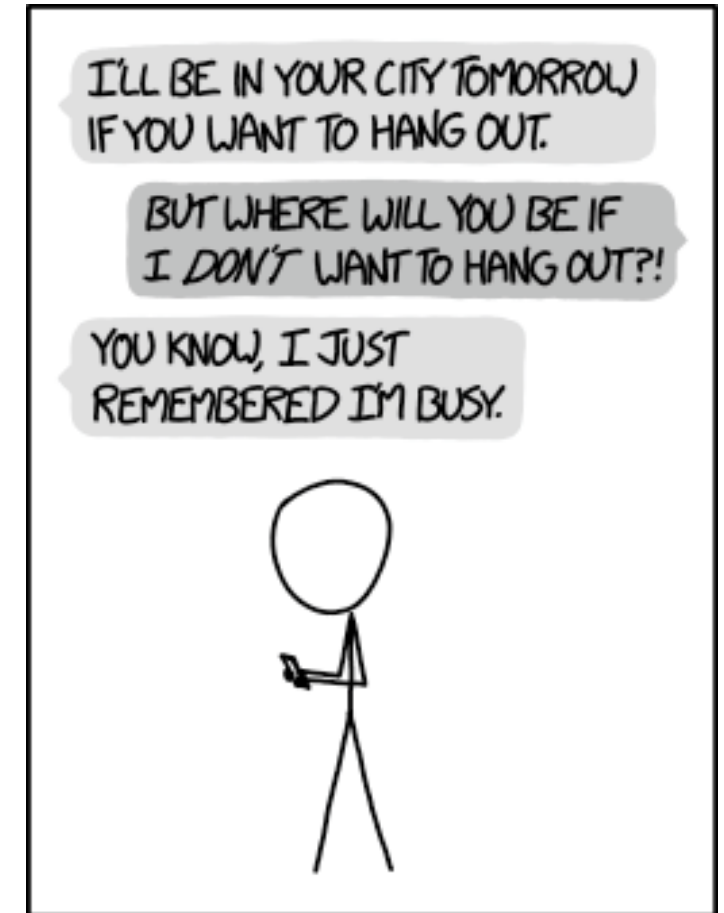
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WHY I TRY NOT TO BE
PEDANTIC ABOUT CONDITIONALS.

<http://xkcd.com/1652/>

Relevant Course Information

- ❖ Lab submissions that fail the autograder get a **ZERO**
 - No excuses – make full use of tools & Gradescope’s interface
 - Leeway on Lab 1a won’t be given moving forward

- ❖ Lab 2 (x86-64) released Wednesday
 - Learn to trace x86-64 assembly and use GDB

- ❖ Midterm is in two weeks (take home, 11/2–4)
 - Open book; make notes and use [midterm reference sheet](#)
 - Individual, but discussion allowed via “Gilligan’s Island Rule”
 - Mix of “traditional” and design/reflection questions
 - Form study groups and look at past exams!

Extra Credit

- ❖ All labs starting with Lab 2 have extra credit portions
 - These are meant to be fun extensions to the labs
- ❖ Extra credit points *don't* affect your lab grades
 - From the course policies: “they will be accumulated over the course and will be used to bump up borderline grades at the end of the quarter.”
 - Make sure you finish the rest of the lab before attempting any extra credit

A detailed, colorful micrograph of a microchip die, showing a complex grid of circuitry and various colored regions (purple, blue, yellow, green, red) representing different functional blocks.

x86-64 Programming III

Lesson Summary (1/2)

- ❖ Control flow in x86 determined by Condition Codes
 - Showed **C**arry, **Z**ero, **S**ign, and **O**verflow, though others exist
 - Set flags with arithmetic & logical instructions (implicit) or Compare and Test (explicit)
 - Set instructions read out flag values
 - Jump instructions use flag values to determine next instruction to execute
 - Usually combinations of two instructions with result of first instruction compared against 0 in a way determined by second instruction

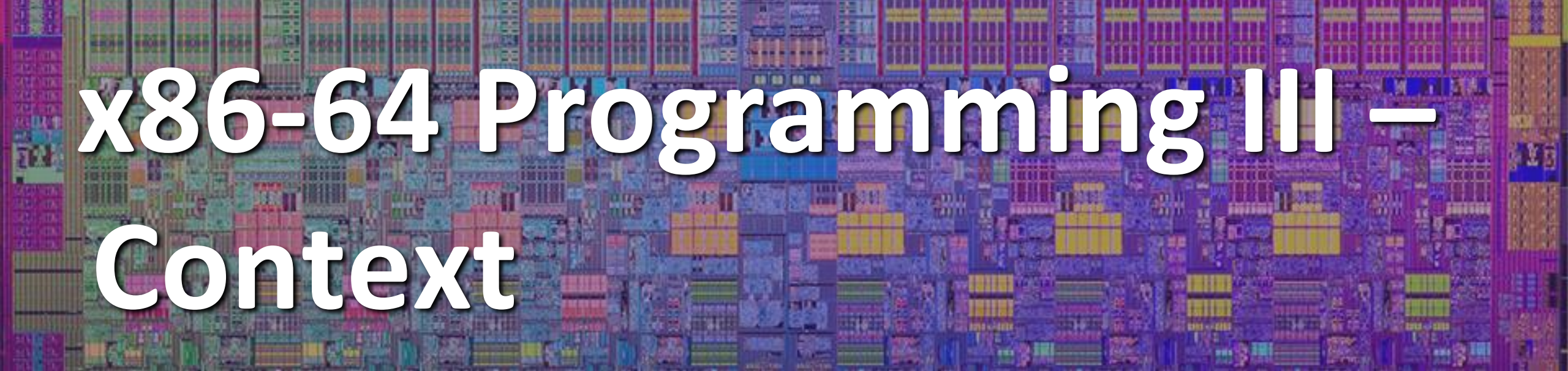
- ❖ Labels are a way to refer to specific instruction addresses as jump targets in assembly

Lesson Summary (2/2)

- ❖ Terminology:
 - Condition codes: Carry Flag (CF), Zero Flag (ZF), Sign Flag (SF), Overflow Flag (OF)
 - Test (`test`) and compare (`cmp`) assembly instructions
 - Jump (`j*`) and set (`set*`) families of assembly instructions
 - Label, jump target, program counter

- ❖ Learning Objectives:
 - Without executing, describe the overall purpose of snippets of x86-64 assembly code containing arithmetic, if-else statements, [and/or loops].

- ❖ What lingering questions do you have from the lesson?

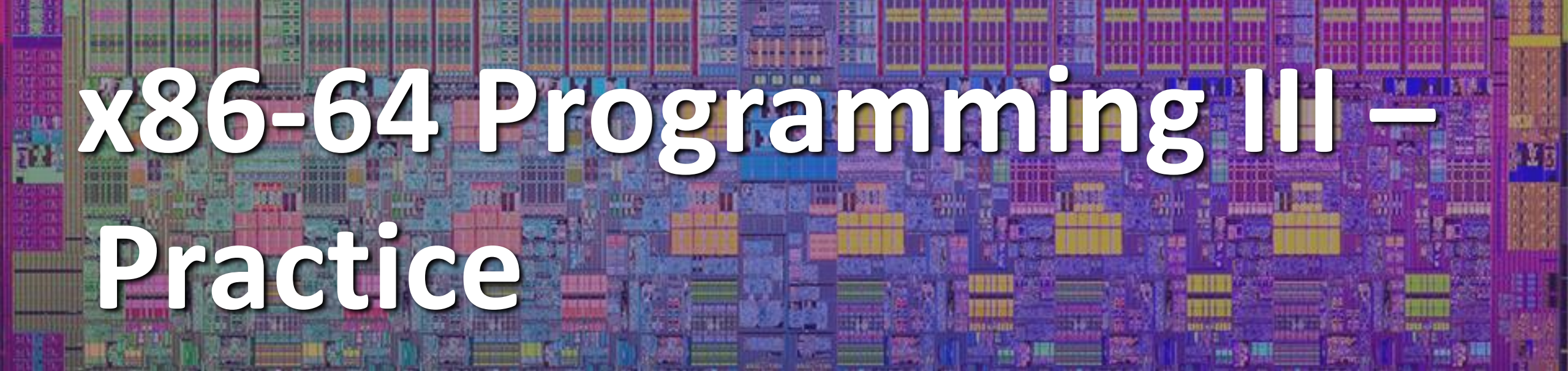
A detailed, colorful micrograph of a microchip die, showing intricate circuit patterns in shades of purple, blue, yellow, and green. The text is overlaid on this background.

x86-64 Programming II – Context

Free and Open Software

- ❖ Alternatives to software made by companies:
 - **Free Software:** Guaranteeing users the freedoms to run, study, modify, and share copies of software; based on the ethical rejection of proprietary software
 - Supported by the Free Software Foundation
 - **Open-Source Software:** Uses open-source licenses, which guarantees access to and the ability to modify the source code under a similar license
 - Steward organization is the Open Source Initiative

- ❖ In 351:
 - Linux is an *open-source* operating system; we currently use **Rocky Linux**
 - The GNU Compiler Collection (GCC) and the GNU Project Debugger (GDB) are *free* software

A detailed, colorful micrograph of a microchip die, showing intricate circuit patterns in shades of purple, blue, yellow, and red. The text is overlaid on this background.

x86-64 Programming II – Practice

Group Work Time

- ❖ During this time, you are encouraged to work on the following:
 - 1) If desired, continue your discussion
 - 2) Work on the lesson problems (solutions at the end of class)
 - 3) Work on the homework problems

- ❖ Resources:
 - You can revisit the lesson material
 - Work together in groups and help each other out
 - Course staff will circle around to provide support

Practice Question

Register	Use(s)
%rdi	1 st argument (x)
%rsi	2 nd argument (y)
%rax	return value

```
long absdiff(long x, long y) {
    long result;
    if (x > y)
        result = x-y;
    else
        result = y-x;
    return result;
}
```

- A. `cmpq %rsi, %rdi` x-y
`jle .L4`
- B. `cmpq %rsi, %rdi` x-y
`jg .L4`
- C. ~~`testq %rsi, %rdi`~~ x&y
~~`jle .L4`~~
- D. ~~`testq %rsi, %rdi`~~ x&y
~~`jg .L4`~~

```
absdiff:
    _____
    _____
                                     # x > y:
    movq    %rdi, %rax
    subq    %rsi, %rax
    ret

.L4:                                     # x <= y:
    movq    %rsi, %rax
    subq    %rdi, %rax
    ret
```

$x - y \leq 0$
 ↑
 less than or equal to
 (le)