Computer Organization

Lecture 15
March 7th 2023 | COMP 211-002 | Joshua Bakita

Welcome!

Today:

- ➔ What's inside a computer, and what are the performance implications?

Logistics:

- ➔ Assignment 4 coming soon
- ➔ Change: Assignment 3 can be resubmitted without using a late day, up until the

Fun fact...

Most terminals support `Ctrl+a` to go to the start of the line, and `Ctrl+e` to go to the end

Opening the Box

Desktop, laptop, and phone—all have the same fundamental components

Time and Distance in a Computer

How long is a nanosecond, practically?

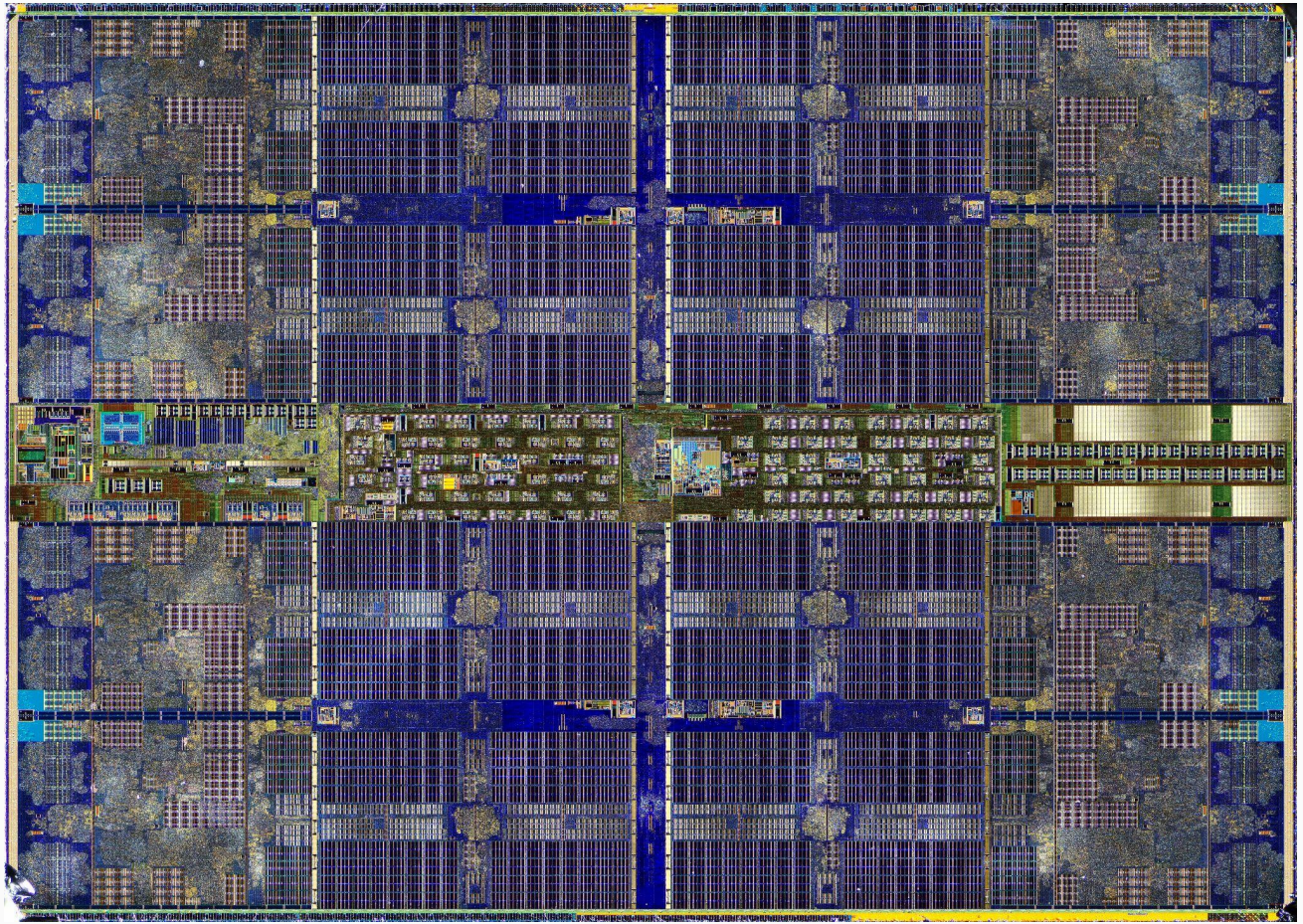
Table 1.1 **Numbers Everyone Should Know [Dean 2009]**

Action	Time	O(n)
L1 cache reference	0.5 nsec	O(1) nsec
Branch mispredict	5 nsec	O(10) nsec
L2 cache reference	7 nsec	O(10) nsec
Mutex lock/unlock	25 nsec	O(10) nsec
Main memory reference	100 nsec	O(100) nsec
Compress 1K bytes with Zippy	3,000 nsec	O(1) usec
Send 2K bytes over 1 Gbps network	20,000 nsec	O(10) usec
Read 1 MB sequentially from memory	250,000 nsec	O(100) usec
Round trip within same datacenter	500,000 nsec	O(1) msec
Disk seek	10,000,000 nsec	O(10) msec
Read 1 MB sequentially from disk	20,000,000 nsec	O(10) msec
Send packet CA->Netherlands->CA	150,000,000 nsec	O(100) msec

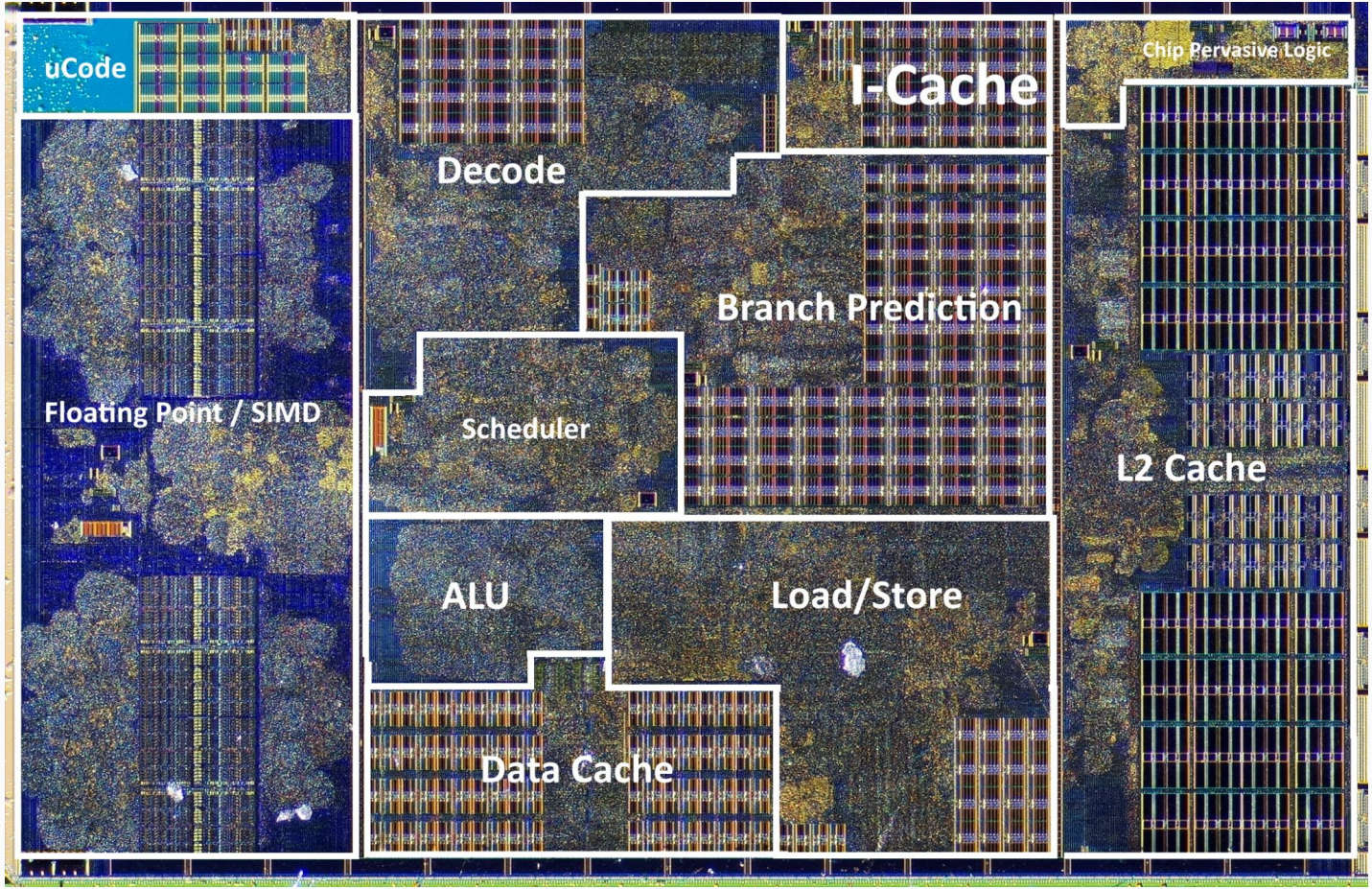
From *Understanding Software Dynamics*, Richard L. Sites

Caches

Let's look at a CPU die…



Polysilicon layer of a Core Complex Die of an AMD EPYC 7702 ES. Die size 10.32 mm × 7.34 mm.
Author: Fritzchens Fritz



Polysilicon layer of a Core in a Core Complex Die of an AMD EPYC 7702 ES.
Author: Fritzchens Fritz and moinmoin

Questions?

See office hour calendar on the website for availability.

Contact:
Email: hacker@unc.edu
Twitter: @JJBakita
Web: https://cs.unc.edu/~jbakita

Old Well, University of North Carolina at Chapel Hill, Winter 2017