Computer Engineering

EGR101 Lecture

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Computer Engineering

- Electrical Engineers make hardware?

Computer Engineering

- Electrical Engineers make hardware?
- Computer Scientists make software?

Computer Engineering

- Electrical Engineers make hardware?
- Computer Scientists make software?
- Computer Engineers make it all work:
  - System software; compilers & OS
  - Hardware architecture, logic, & VLSI
  - Understand, design, and implement ***computing systems*** to meet goals (performance and/or new abilities)

Computer Engineering Core Topics Include…

- Programming & software engineering
- Basic circuits & digital logic
- Computer architecture
- Embedded systems
- Compilers
- Operating Systems (OS)

U.S. Bureau of Labor Statistics (www.bls.gov)

- Various types of computer engineers
- 2008 stats
  - 32% growth for 2008-2018
  - median salary $87,790 - $94,180
- 2009 stats
  - Systems software, median $93,470
  - Hardware, median $98,610

What Is A Computer?

- Originally:
  a person employed to do arithmetic
- 50 years ago:
  a machine that does arithmetic
- Now:
  a machine that uses arithmetic and logic to accomplish some task

Early Computers

Personal Computers

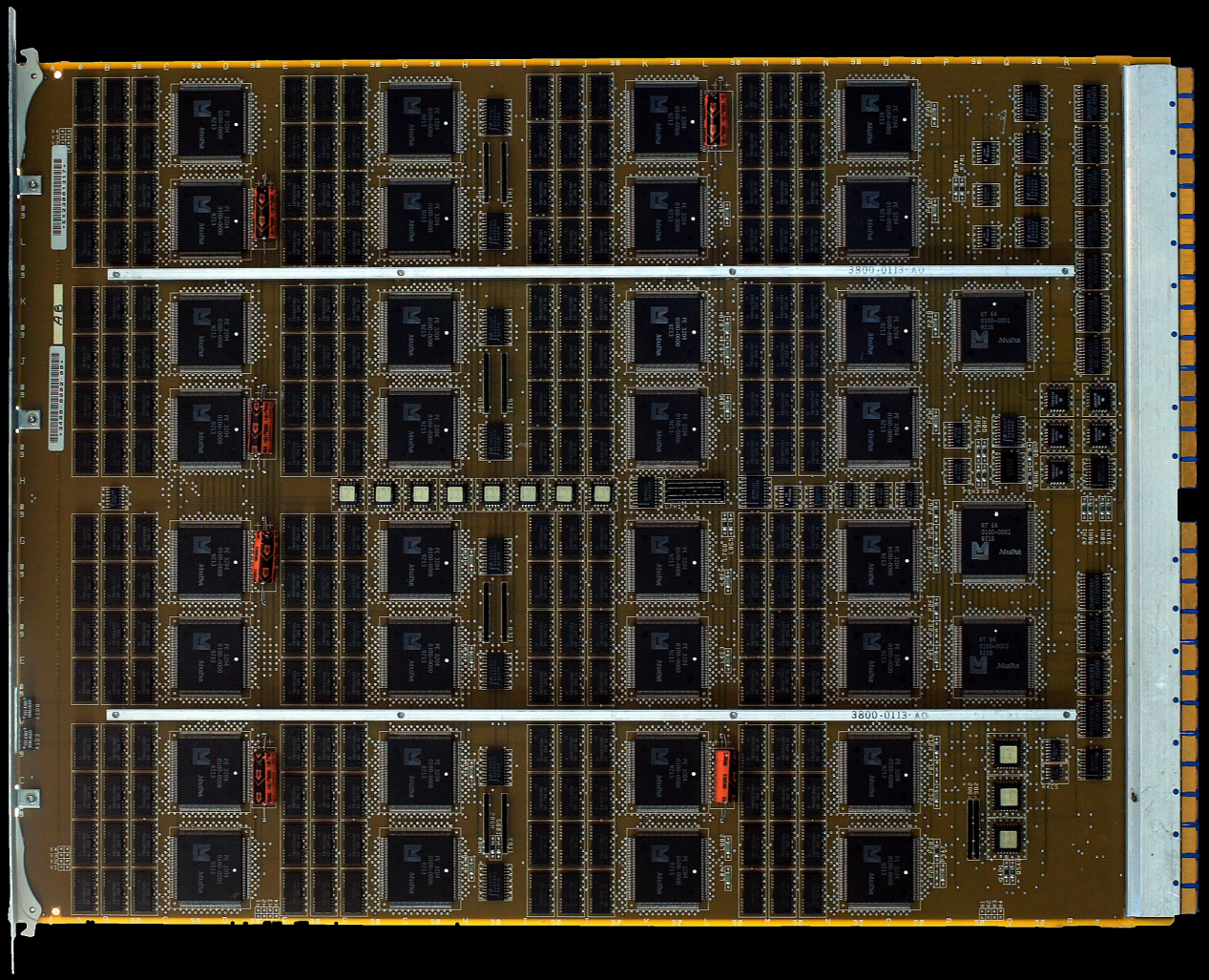
Supercomputers

- One of the most expensive computers?
- A very fast computer?
- Two key characteristics:
  - Computer that solves big problems...
    stuff that wouldn't fit on a PC
    stuff that would take too long to run
  - Performance can scale...
    more money buys a faster machine

The Key Is Parallel Processing

- Process *N* "pieces" simultaneously, get up to factor of *N* speedup
- Modular hardware designs:
  - Relatively easy to scale – just add modules
  - Higher availability (if not reliability)

1992, MasPar MP1



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1994, Linux PC Cluster

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1996, 30MP Video Wall

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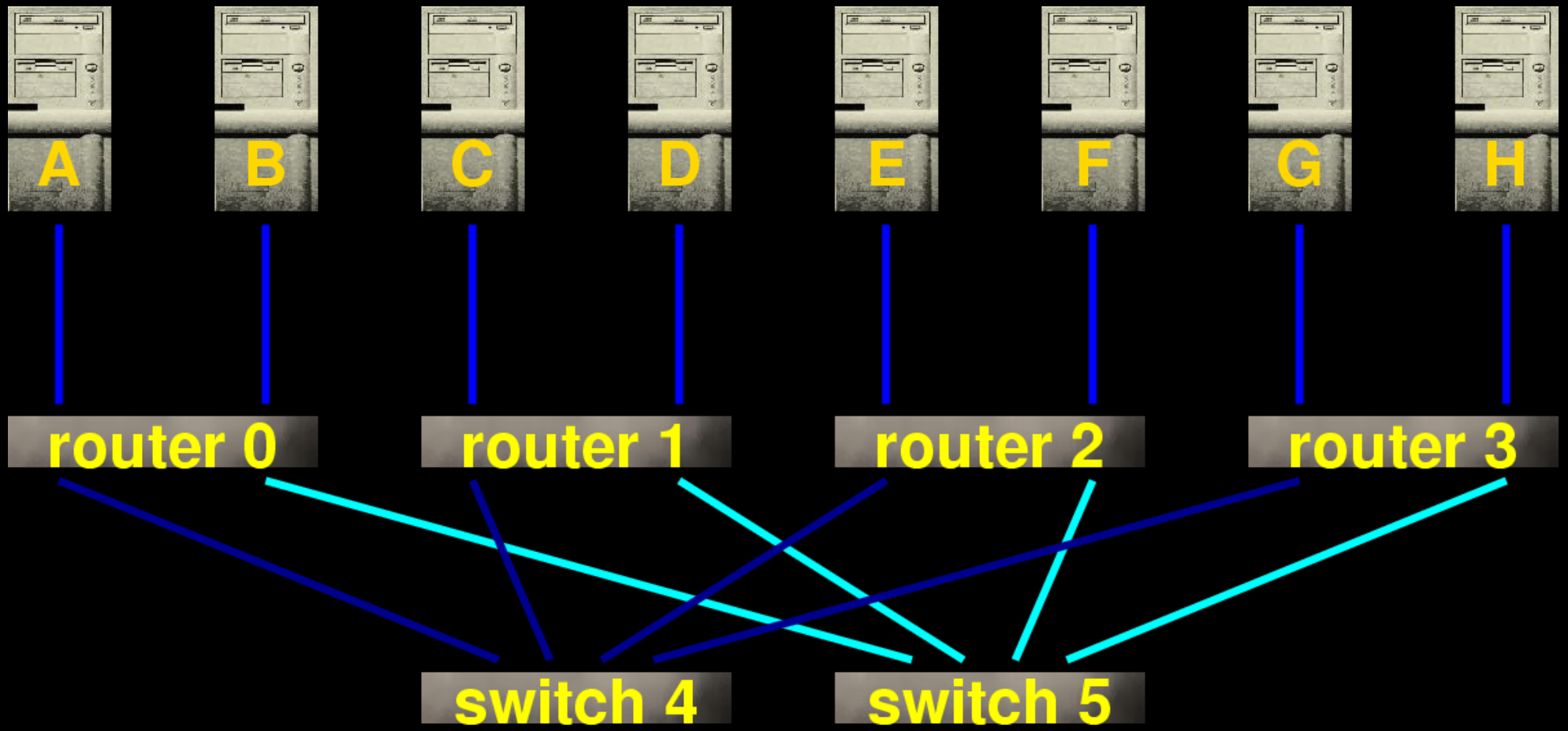
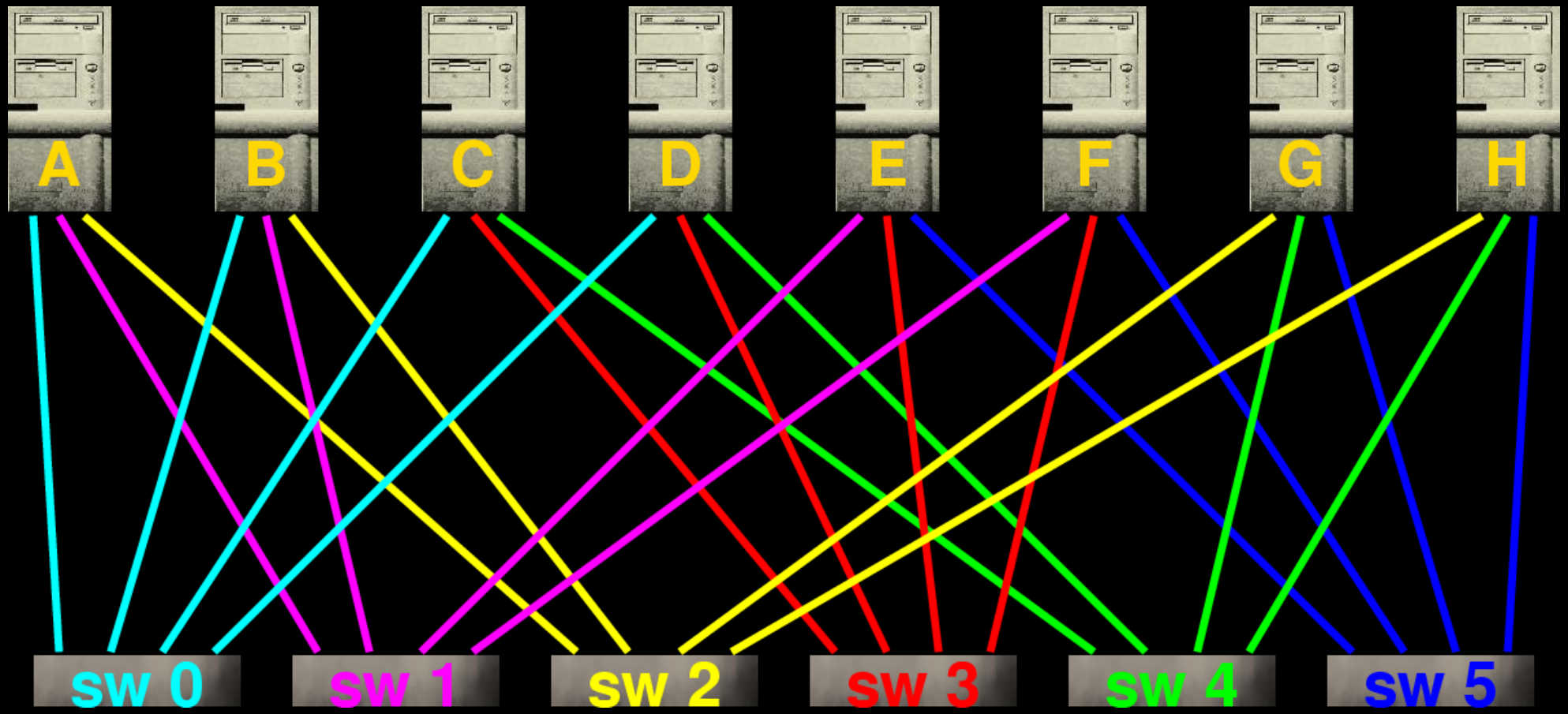
Fat Tree


A
B
C
D
E
F
G
H
router 0
router 1
router 2
router 3
switch 4
switch 5

Flat Neighborhood Network



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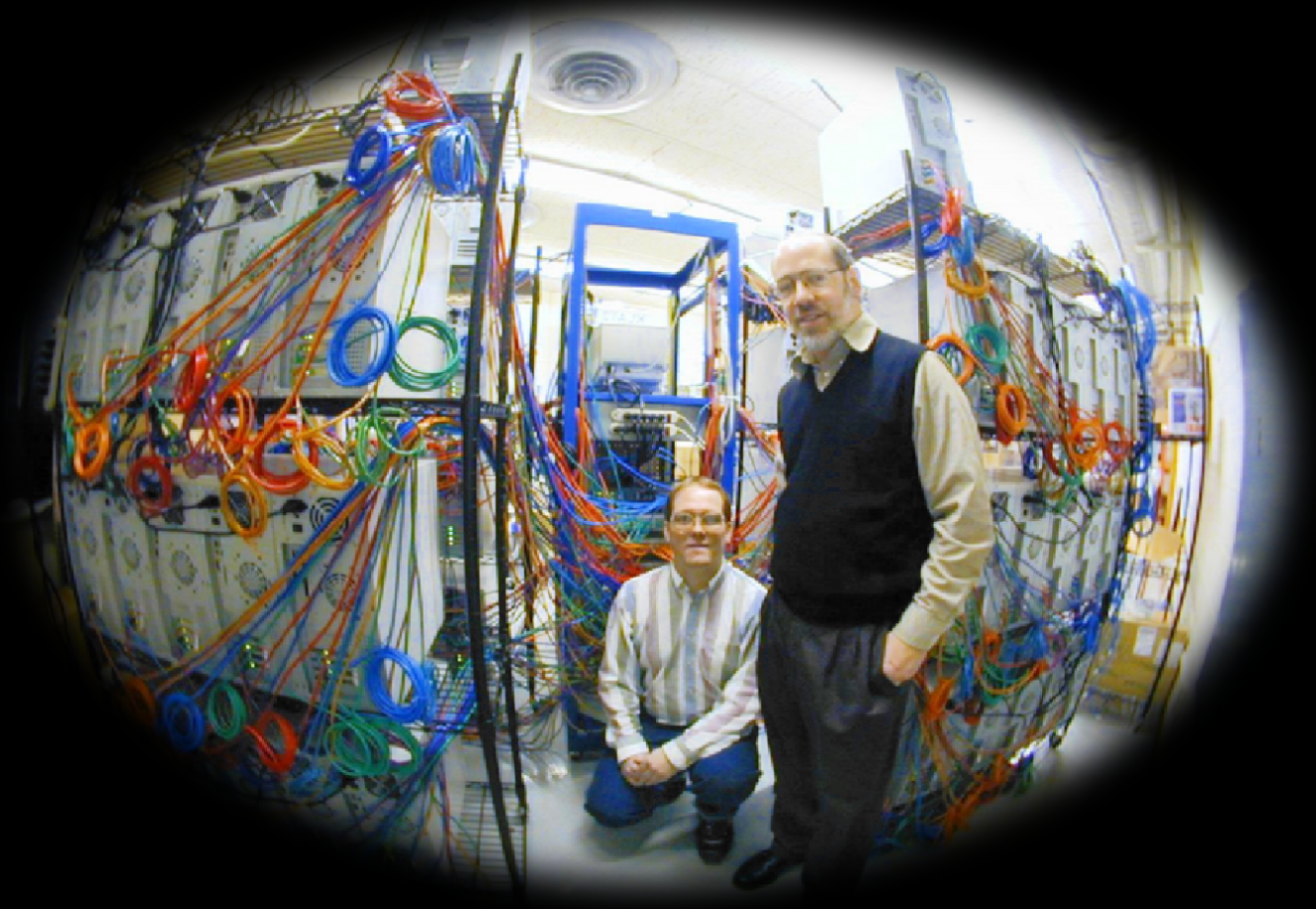
2000, KLAT2



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2003, KASY0

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2006, ATI GPU

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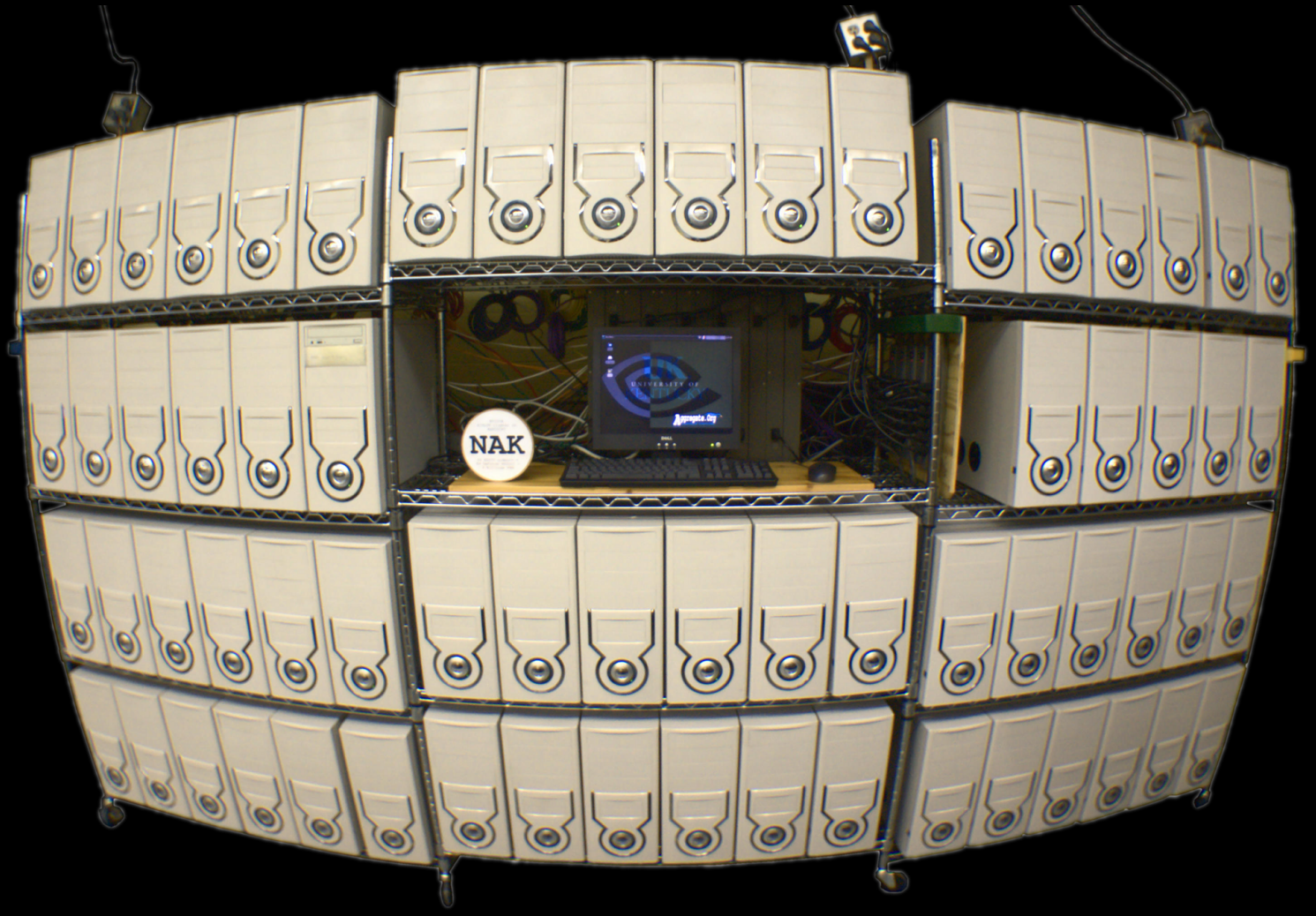
2010, NAK



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2012, GPU Clusters

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A *Little* Progress…

A GFLOPS is 1 Billion {+,*} per second

1992 MasPar MP1 $1,000,000 / GFLOPS

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A *Little* Progress…

A GFLOPS is 1 Billion {+,*} per second

1992	MasPar MP1	$1,000,000 / GFLOPS
2000	KLAT2	$650 / GFLOPS
2003	KASY0	$84 / GFLOPS
2010	NAK	$0.65 / GFLOPS

Our latest is about $0.25 / GFLOPS

So it's all about making better supercomputers?

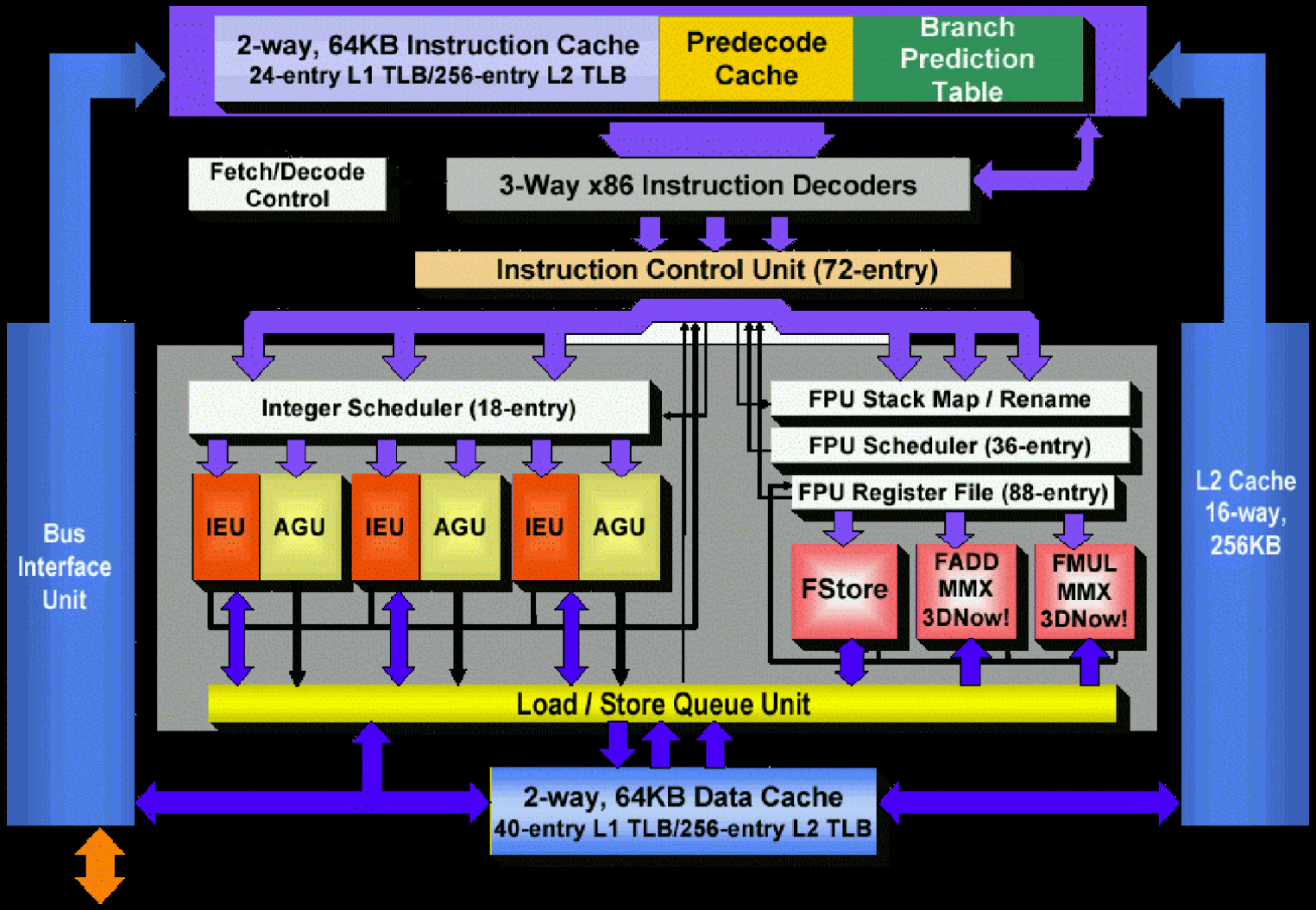
So it's all about making better supercomputers?

NO!

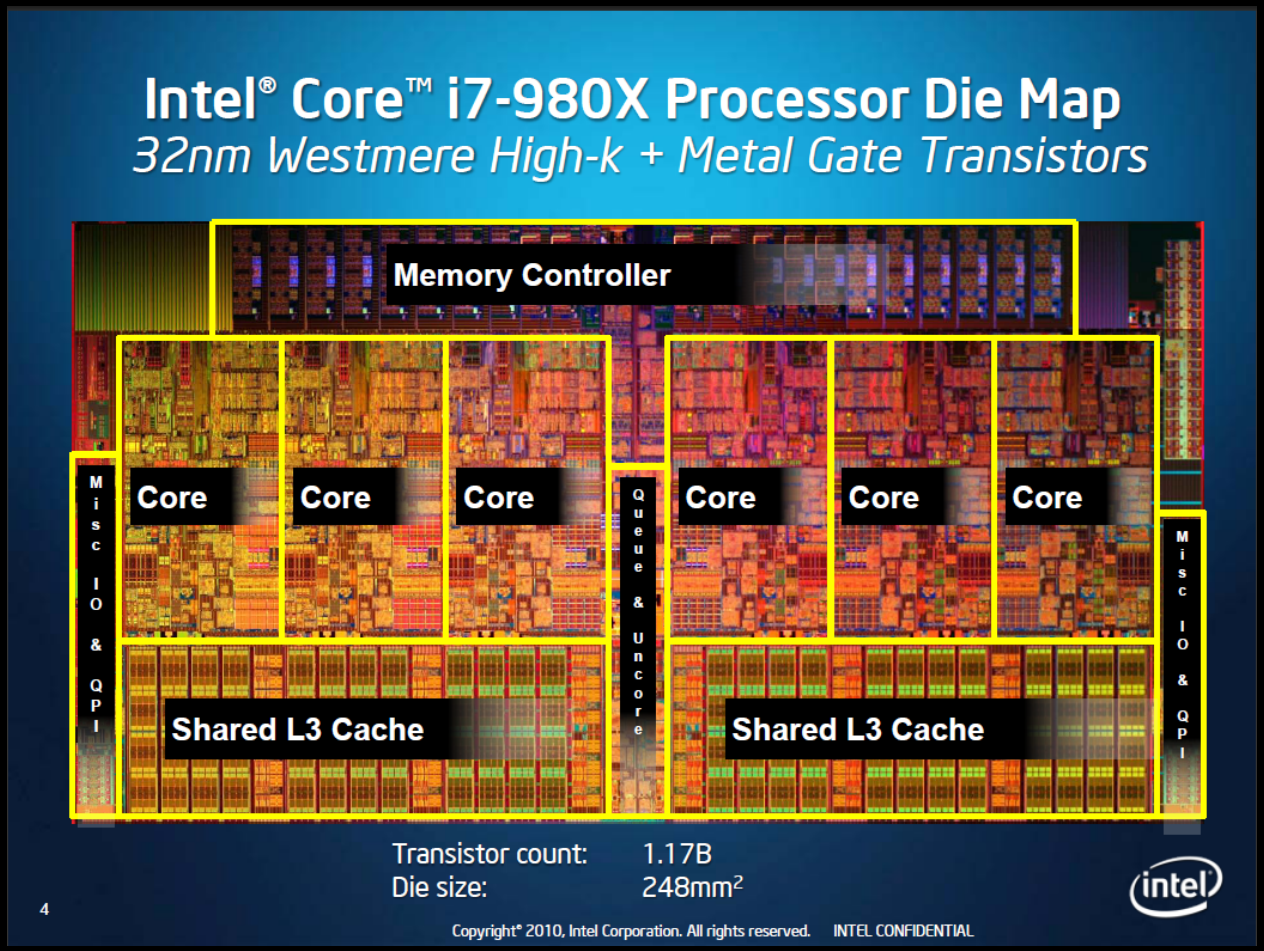
Chips Too!

- Billions of transistors on a single chip
- Lots of parallelism on a chip
- Systems on chips, not just processors

2001, AMD Athlon XP



2010, 6-core Intel i7



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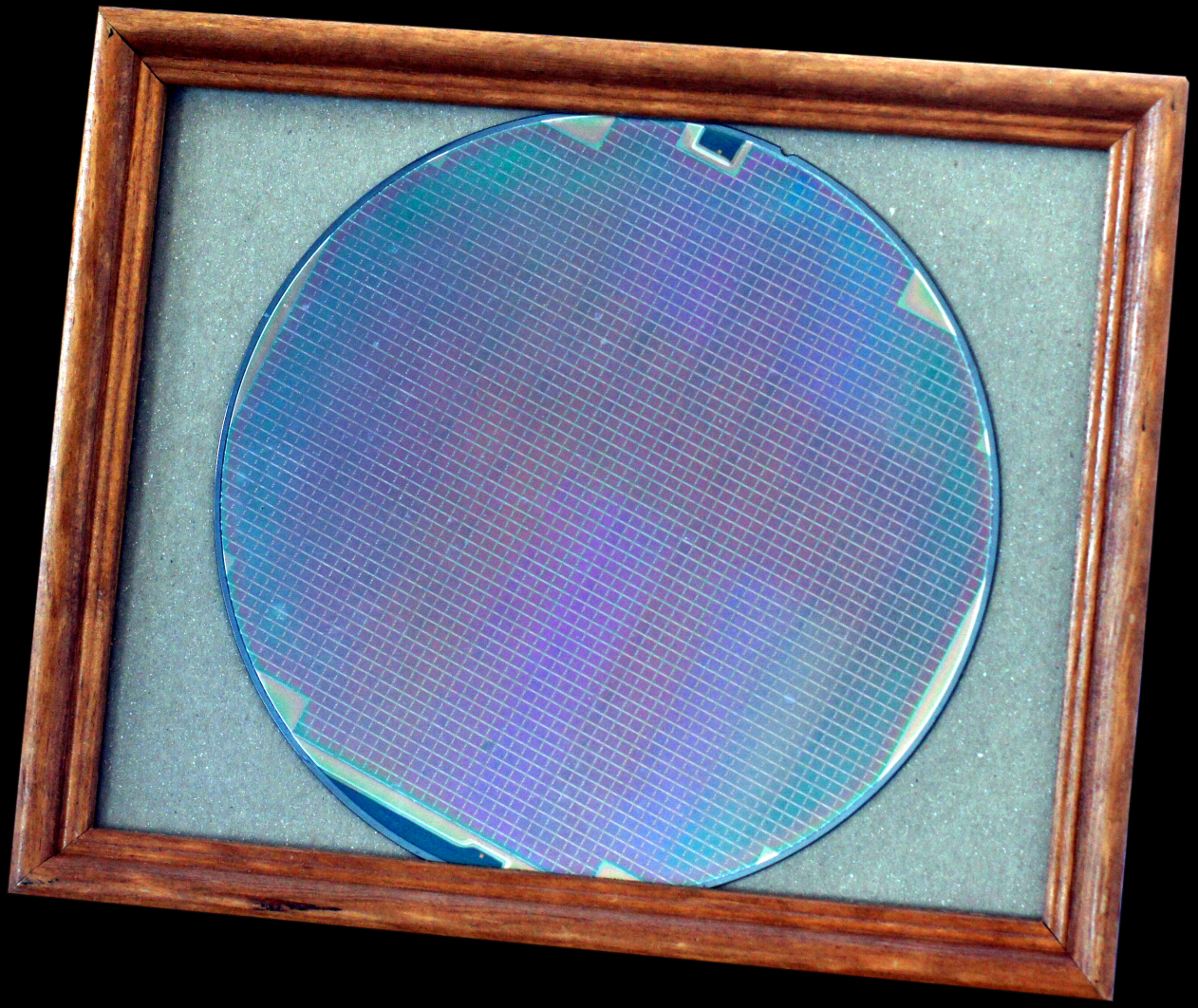
VLSI & Nanotechnology



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So it's all about making better processor chips?

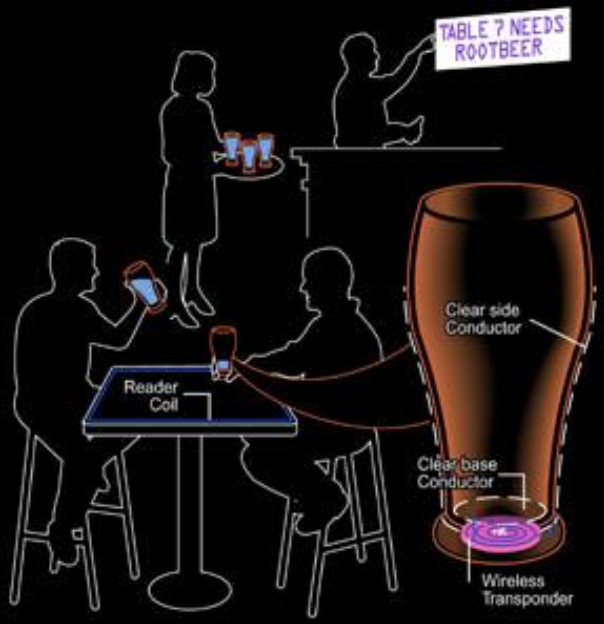
So it's all about making better processor chips?

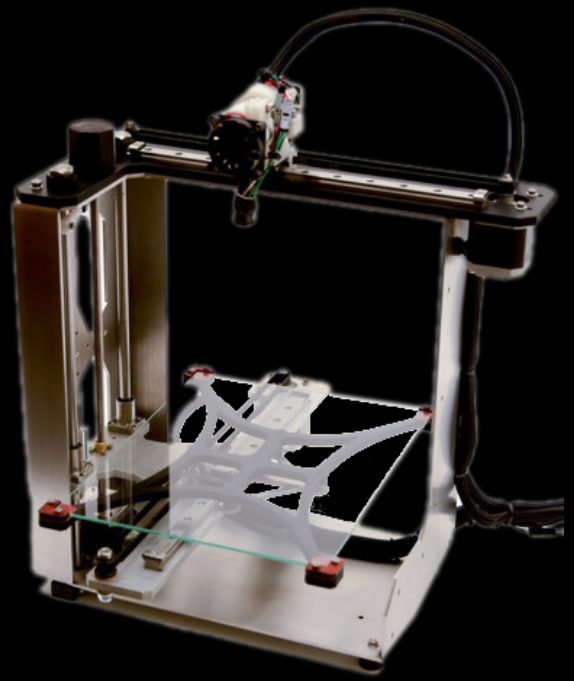
NO!

Embedded Computers

- Each serves a single purpose
- Controls or monitors real-world things
- Doesn't do Windows
  (well, some do, but more run Linux)
- Doesn't look like a “computer”
- These are an integral part of modern society – 1 ARM / person by 2014!

Embedded Computers





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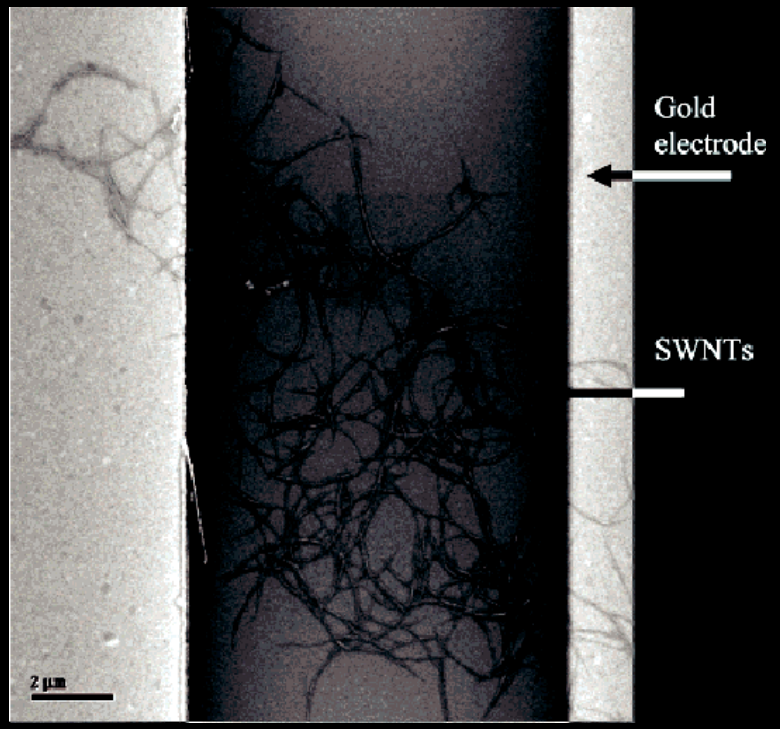
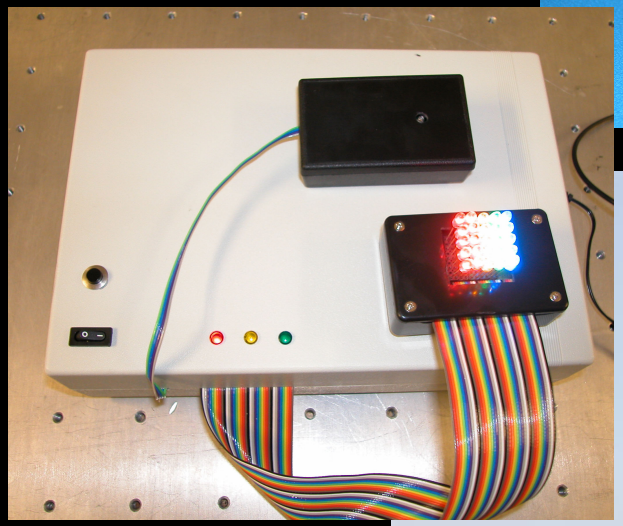
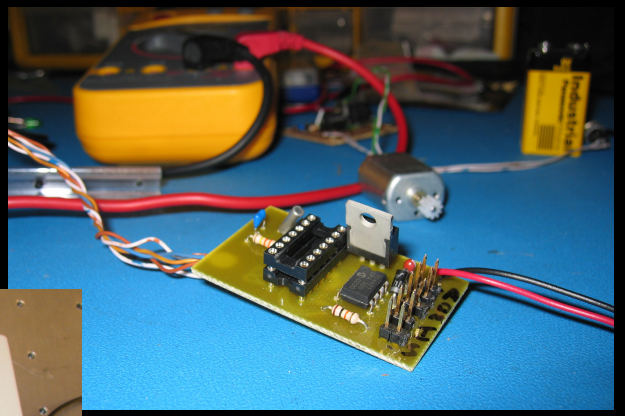
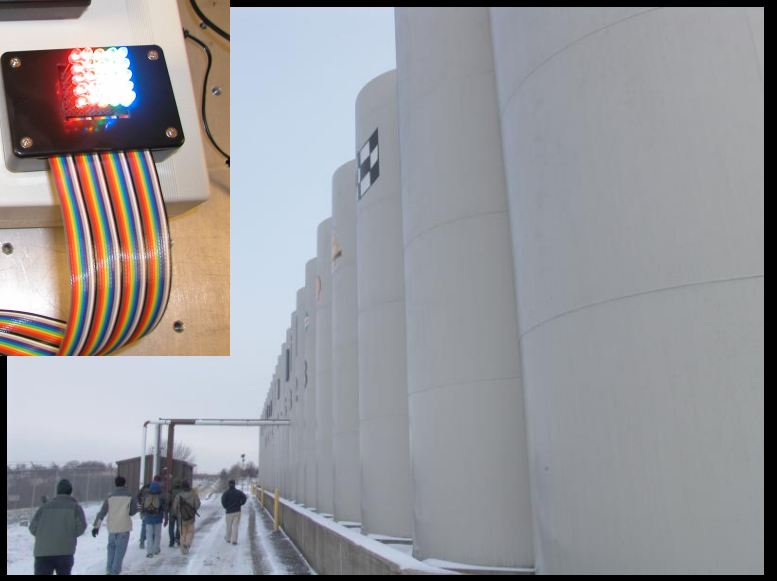
Smart Devices

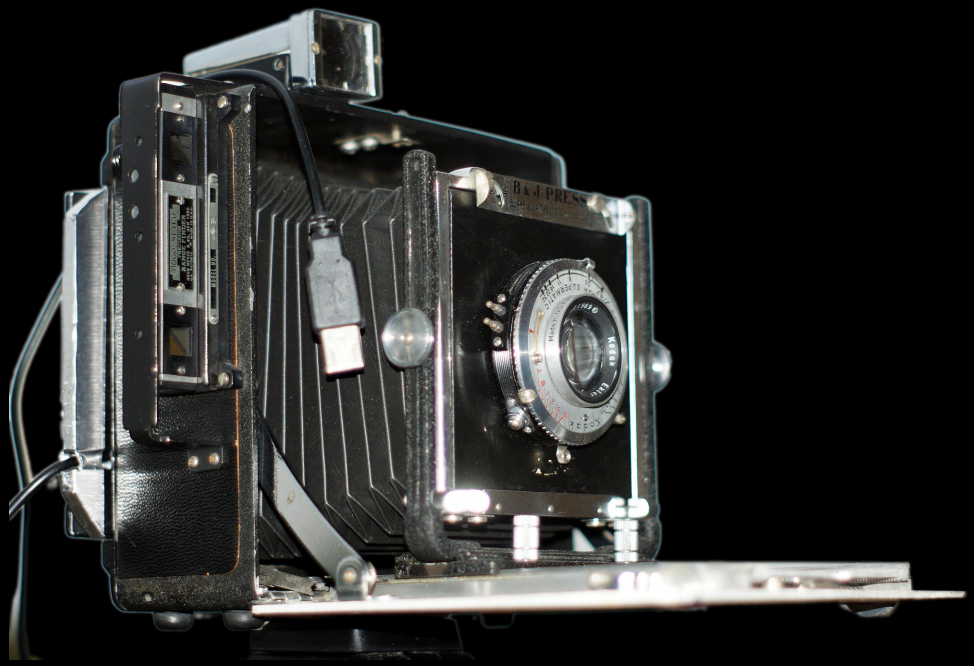


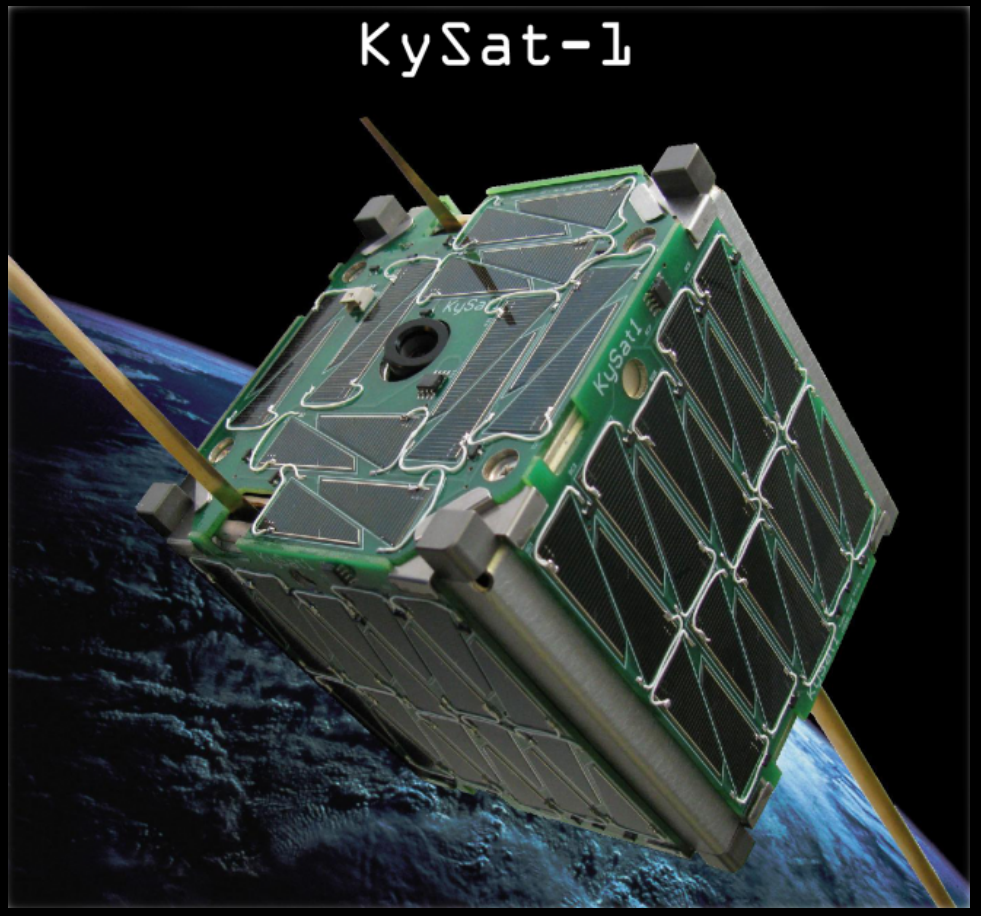






Active Research At UK





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So, it's about making everything “smarter”?

So, it's about making everything “smarter”?

YES!

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Smart Stuff

- Embedding computers in things makes them able to act intelligently
- Building and using powerful computers as tools amplifies human intelligence
- Typical benefits:
  - Improve performance
  - Reduce cost
  - Give new capabilities

Two Very Quick Examples...

- Embedded:
  A blender uses a microcontroller to save the cost of latching buttons and control motor current consumption.
- Cheap supercomputing:
  An inkjet printer's head is redesigned so that the motion of the printhead dries the current page before the next one can fall on it.

Be Smart.

- Take Computer Engineering courses; We're not a department, so you'll see a mix of ECE and CS faculty/courses
- Join student organizations, especially IEEE and ACM
- Take advantage of UK's environment:
  - Interact with other students & faculty
  - Get a taste of research

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