

I, for one, welcome our new machine overloads

The embedded future, and how to secure it

Gabe
CS Prof.
Operating Systems

Embedded Systems and the Internet of Things (IoT)

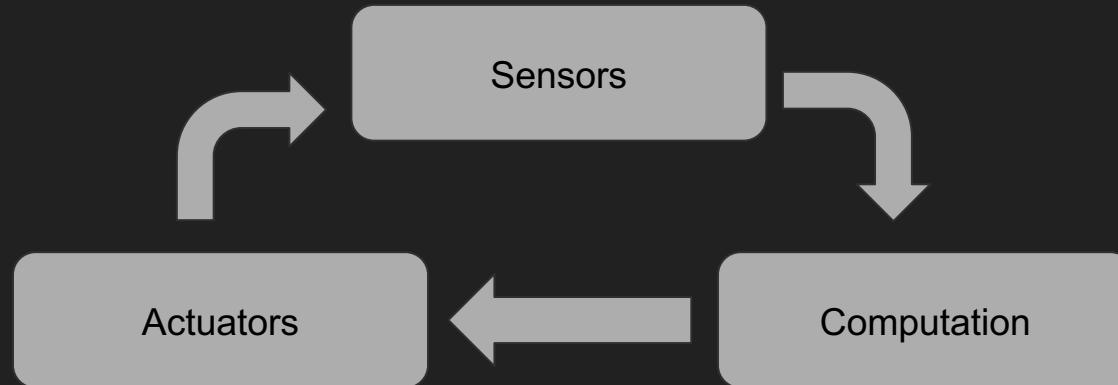
- What is an Embedded System?
- What is the Internet of Things?

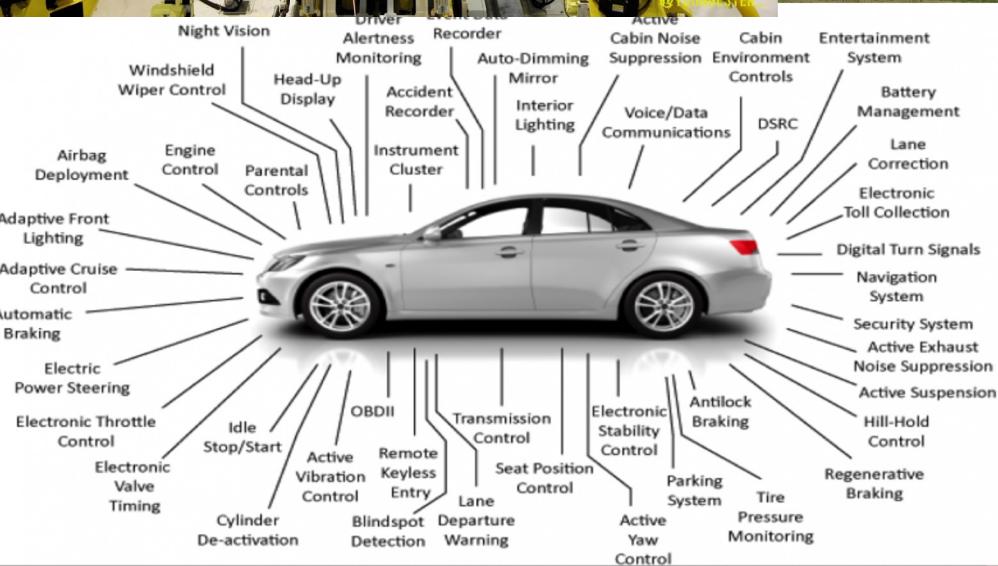
Embedded Systems

- Special purpose system
- Computation enclosed into form-factor of physical system
- Performs pre-defined tasks, often well-specified
- Interacts with the physical world

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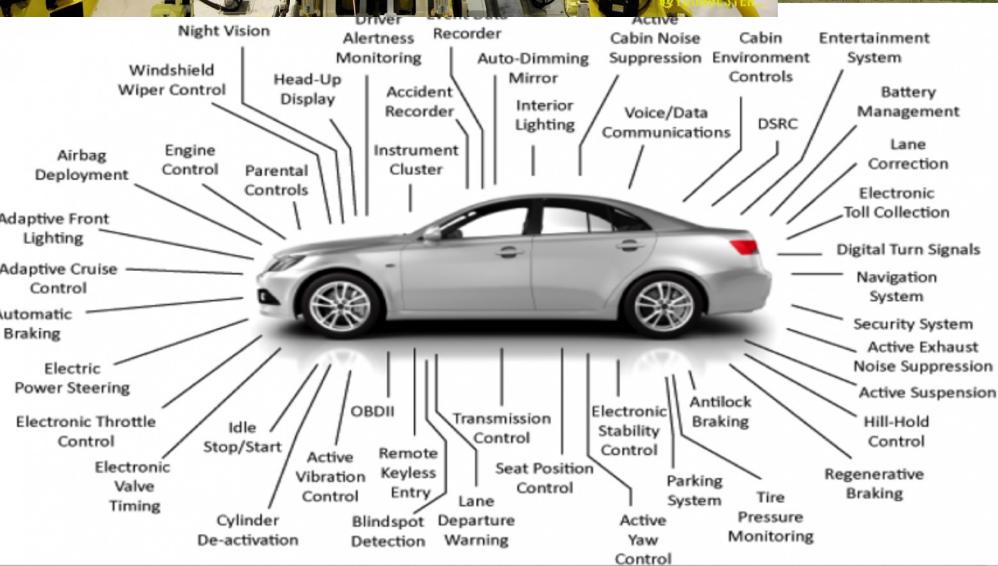




Embedded increasing popularity

What could possibly go wrong?

Think about this combination of things...



INTERNET

INTERNET
SWITCH
MUST BE ON
AT ALL TIMES

11-0866-501

Inboard attendant
occupant

Current date is Tue 1-01-1980

Enter new date:

Current time is 7:48:27.13

Enter new time:

The IBM Personal Computer DOS

Version 1.10 (C)Copyright IBM Corp 1981, 1982

A>dir/w

COMMAND	COM	FORMAT	COM	CHKDSK	COM	SYS	COM	DISKCOPY	COM
DISKCOMP	COM	COMP	COM	EXE2BIN	EXE	MODE	COM	EDLIN	COM
DEBUG	COM	LINK	EXE	BASIC	COM	BASICA	COM	ART	BAS
SAMPLES	BAS	MORTGAGE	BAS	COLORBAR	BAS	CALENDAR	BAS	MUSIC	BAS
DONKEY	BAS	CIRCLE	BAS	PIECHART	BAS	SPACE	BAS	BALL	BAS
COMM	BAS								

26 File(s)

A>dir command.com

COMMAND	COM	4959	5-07-82	12:00p
---------	-----	------	---------	--------

1 File(s)

A>

Current date is Tue 1-01-1980

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DISKCOMP	COM	COMP	COM
DEBUG	COM	LINK	EXE
SAMPLES	BAS	MORTGAGE	BAS
DONKEY	BAS	CIRCLE	BAS
COMM	BAS		

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A>dir command.com

COMMAND	COM	4959	5-07-
		1 File(s)	

A>



I am afraid that you have been bitten by the FEAR
bug. Just think, you may have passed it on to all of
your friends! What fun that will be when it goes off
all of their systems!

FEAR Copyright (c) 1992 NecroSoft Technologies
Developed in:

The Metropolis of Sodium Chloride in Hydrogeon Dioxide

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010INI	WRI	30130	01.1	V	7.11
PRINTERS	WRI	37760	01		7.11
WININI	WRI	23168	0		7.11
NETWORKS	WRI	22528			7.11
EXCEL	XLB	267			16.15
F-EXCEL	~EX	32352	0		17.31
F-COREL	~EX	32736	0	2	7.11
F-WORD	~EX	32736	0	2	7.11
F-AMIPRO	~EX	32352	3.1		17.31
F-WP	~EX	32352	1.1		17.31
GDW	SCR	489888	0	0	.20
GDWREAD	TXT	4667	17		.9
F-PROT	BAK	454	11.		.8
MOSAIC	<DIR>	20.			22
MOSAIC	BAK	10691			5.32
MOSAIC	INI	10683			19.50
APPLICATION	GRP	4693			15.33
		252 file(s)	136	591	s
			52	b	s free

C:\PROJEKT\IN\UIRUS\UD MO.HT



Computational Failures → Physical Failures

Accidental

- East coast blackout
- Water processing plant

Malicious

- Stuxnet
- German foundry meltdown
- Car hijacking

How to secure these systems?

Warehouse vs. Containers



Container-centric design

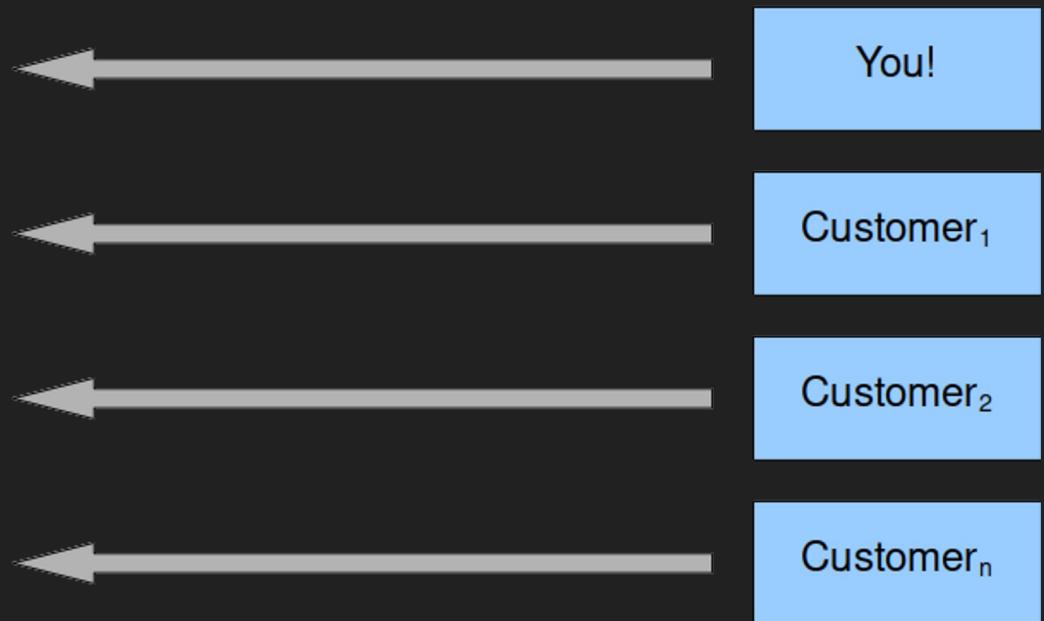
Three main system resources to protect:

Analogy: living space, plumbing, electricity

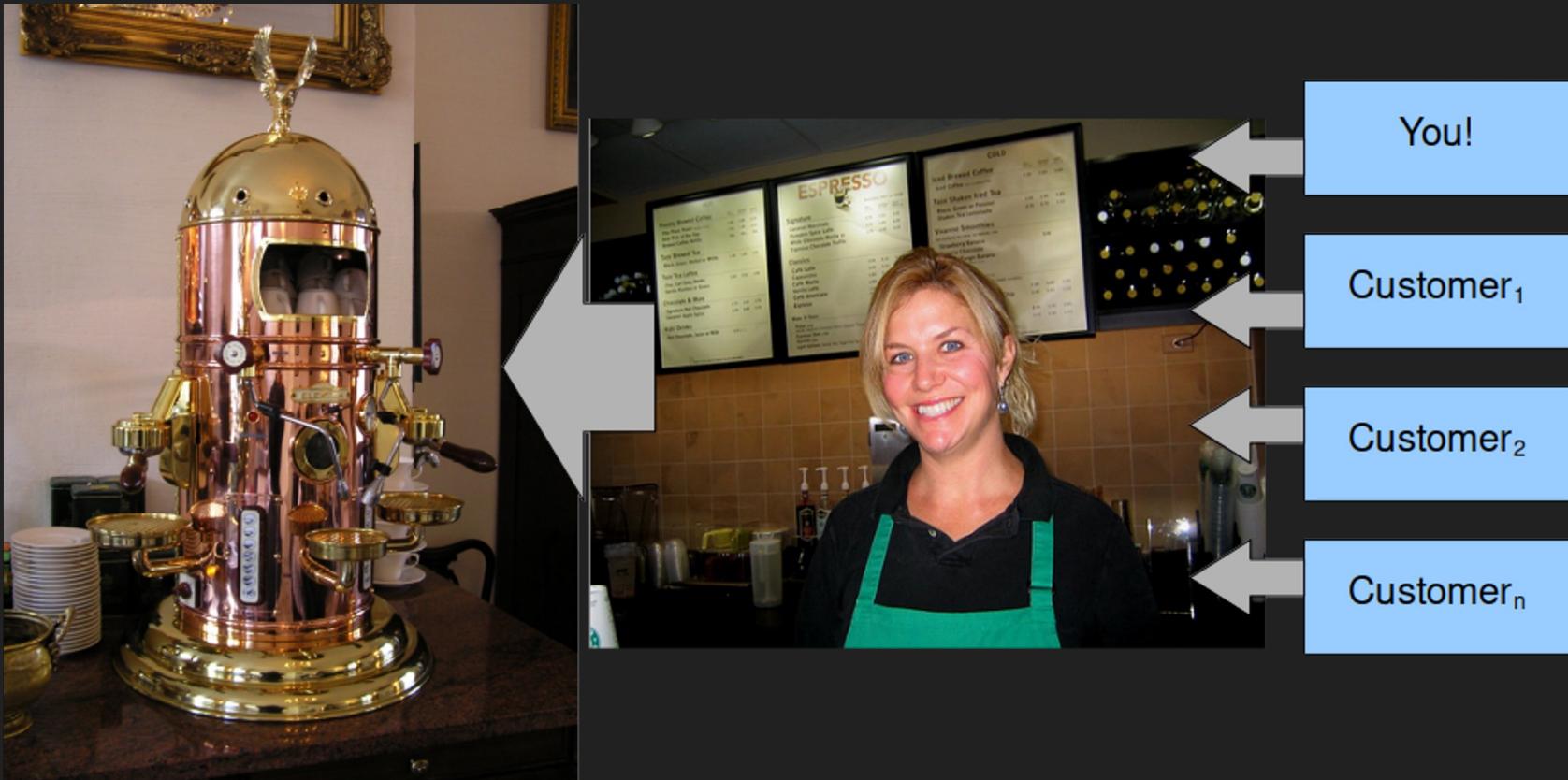
- CPU/processor
 - *When* do each part of the system execute?
- Memory
 - *Where* can we store our data?
 - How can we *separate* application's mem?
- I/O - net, disks, sensors, actuators
 - How do we control who can interact with the world, when?



Operating Systems: Analogy



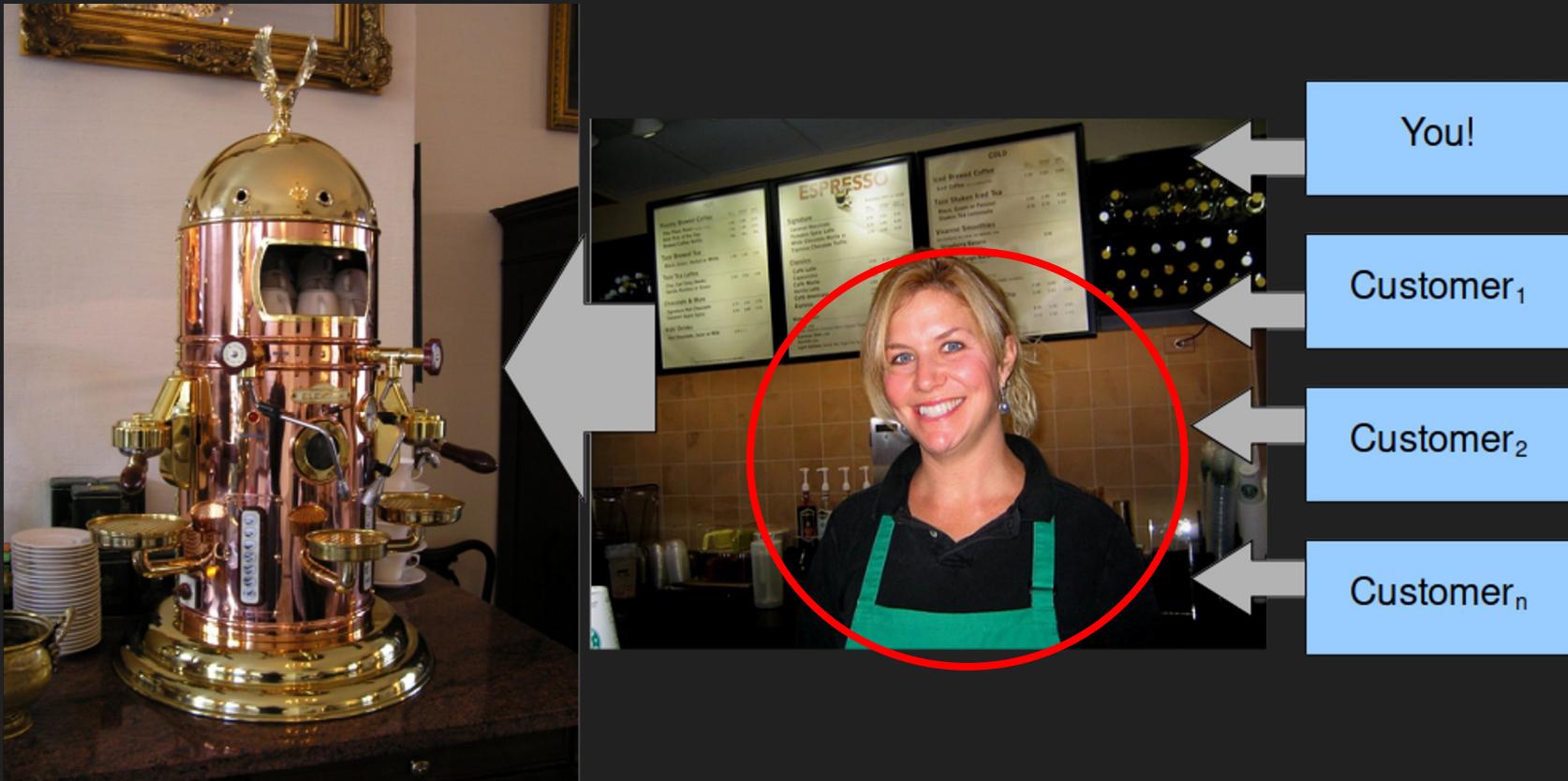
Operating Systems: Analogy



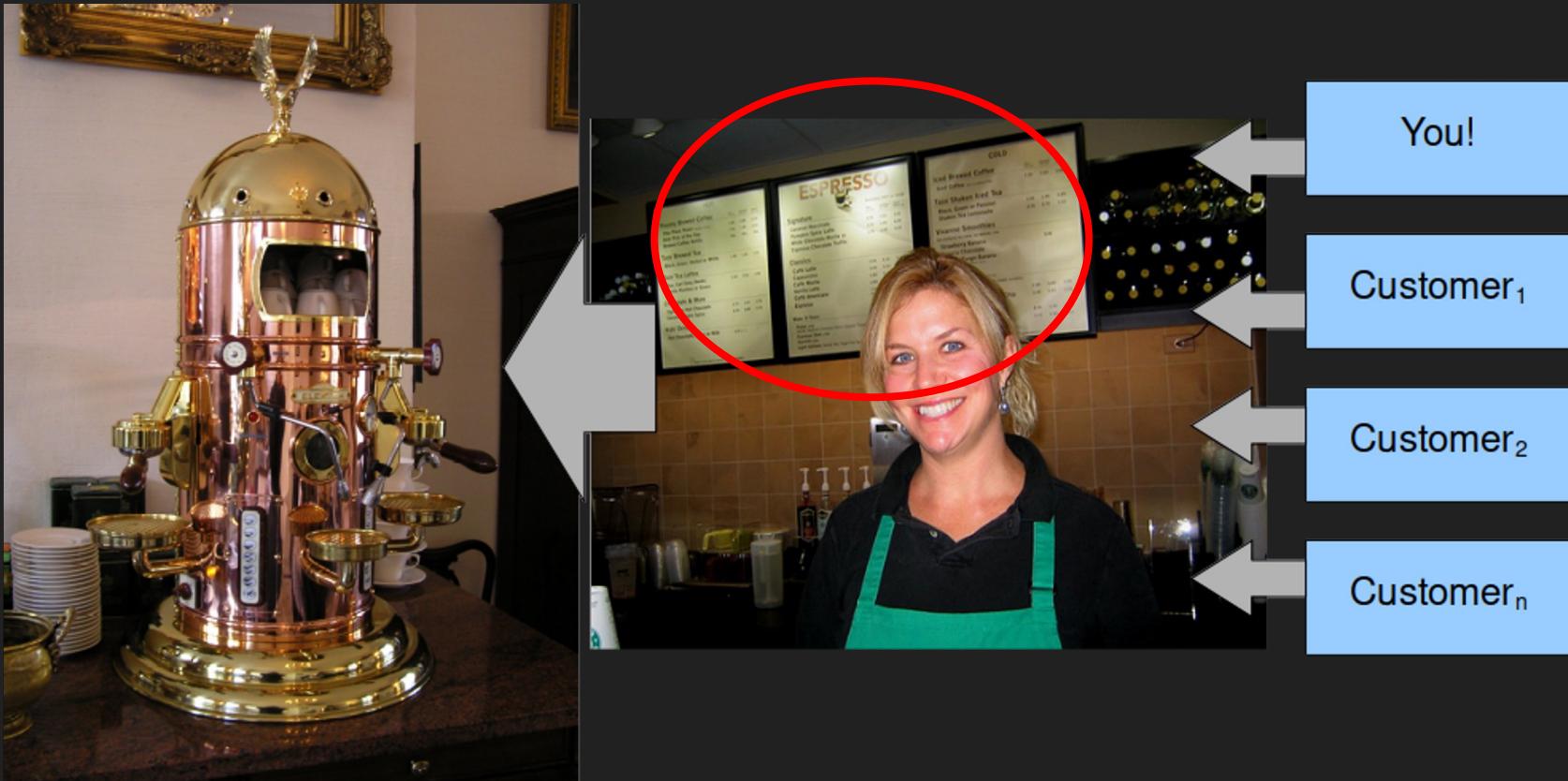
Operating Systems: Analogy



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Operating Systems: Analogy



Undergraduate education

- A *unique* environment
 - Peers with **diverse** views
 - A **community** of learners
 - Everyone is completely devoted to **self-improvement**
 - **Incentives** toward learning to work hard and become more capable

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 - Everyone is completely devoted to **self-improvement**
 - **Incentives** toward learning to work hard and become more capable
- A *limited* opportunity
 - **Only four years**
 - Hard to replicate this environment outside of University

How to **make the most** of this limited opportunity?

- Take ownership of your education
 - Lots of “crap jobs” in CS, work to make yourself competitive
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- Moderate Judgment
 - Failure & recovery are normal
 - Not a competition
 - All about your own path and accomplishments

Opportunities

- Informal groups, working toward goals
- Student clubs
- UTA/LA
- Research with Profs.

? || /* */

Embedded Systems: Caution required

- Civil and Mechanical Engineering vs. CS?
 - Certifications & regulations - why do they exist for other disciplines?
 - Impact of this on CS?
- Where do the jobs go?
 - Robots - awesome!
 - Robot replacing your job - OMGWTHBBQ!
 - Cheap labor impacts social order
- Skynet
 - Adama's Law: "If it can kill you, don't connect it to the network."
 - I, for one, welcome our new machine overlords



Embedded Systems + IoT : Caution required

What are the dangers of this movement?



THRONE MASTER

**FIND OUT WHO'S THE KING
OF THE PORCELAIN RING**

More IoT enabling technologies around the corner

- Connected embedded systems require wireless
 - 802.11*
 - Bluetooth
 - GSM/LTE
- Technological progress ticks along...

Embedded Systems + IoT : Lots of promise

- Automate the world
- Infrastructure more capable than humans
- Increased productivity
- Next front of innovation

IoT

- Connected embedded systems
- Communicate to perform broader goals
 - Smart houses
 - Smart roads
 - Smart coffee



IoT

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sensors + computation + **network**

sensors + computation + actuation + **network**

Today 8:32 AM

Nest smoke alarm here!
FYI: Your house is on fire.
What do you want to do?
Reply: A) Call the fire
department or B) Do
nothing

A

Oops, there was an error
trying to do that. 451:
you're not a premium
subscriber.

Don't worry though, we
can call the fire
department for a \$10 fee.
Reply YES and we'll do it
right now.



Text Message

Send