

# Questions and Answers Vol. 3

*or*

“The quick and the decaf.”

*2AM Edition!*

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24 April 2017

University of Queensland

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# But first...

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Some house keeping

# Calendar at a glance

Week	Dates	Lecture	Reviews	Demos	Assessment submissions
1	28/2 – 3/3	Introduction			
2	6/3 – 10/3	Principles of Mechatronic Systems design			Problem analysis
3	13/3 – 17/3	Professional Engineering Topics			
4	20/3 – 24/3	Introduction to Practical PCB Design	Progress review 1		
5	27/3 – 31/4	Your soldering is (probably) terrible			
6	3/4 – 7/4				
7	10/4 – 14/4		Progress seminar	25% demo	
<b>Break</b>	17/4 – 21/4				
8	24/4 – 28/4				
9	1/5 – 5/5			50% demo	
10	8/5 – 12/5		Progress review		
11	15/5 – 19/5			75% demo	Preliminary report
12	22/5 – 26/5				
13	29/5 – 2/6	Closing lecture		Final testing	Final report and reflection

You are here →

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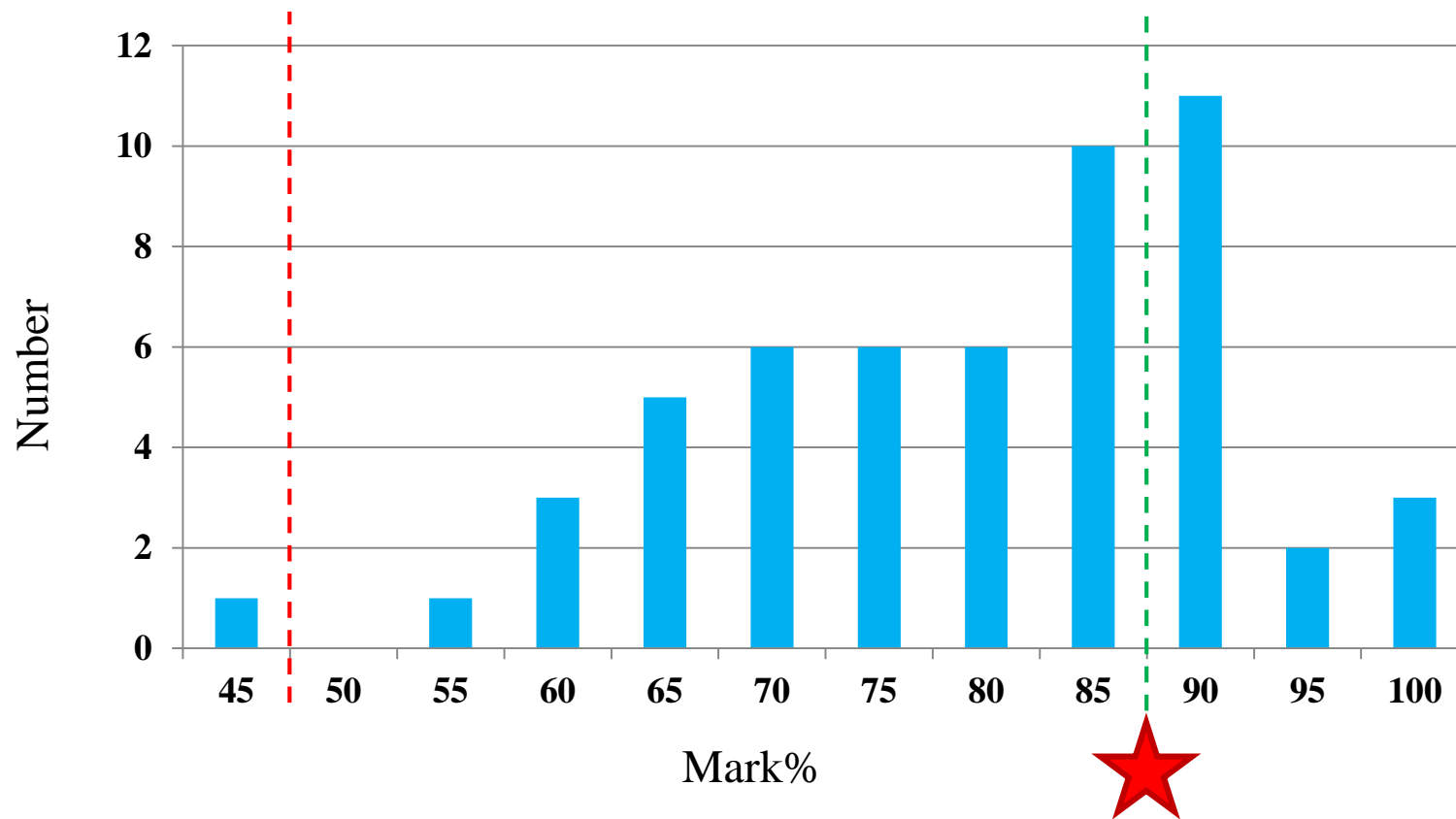
# Marks should all be updated

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- People have been asking for PAF results and other marks
  - Happy to oblige!
- With only a few exceptions, all your marks to-date should be online for your viewing pleasure
  - If not, you probably owe me an assessment

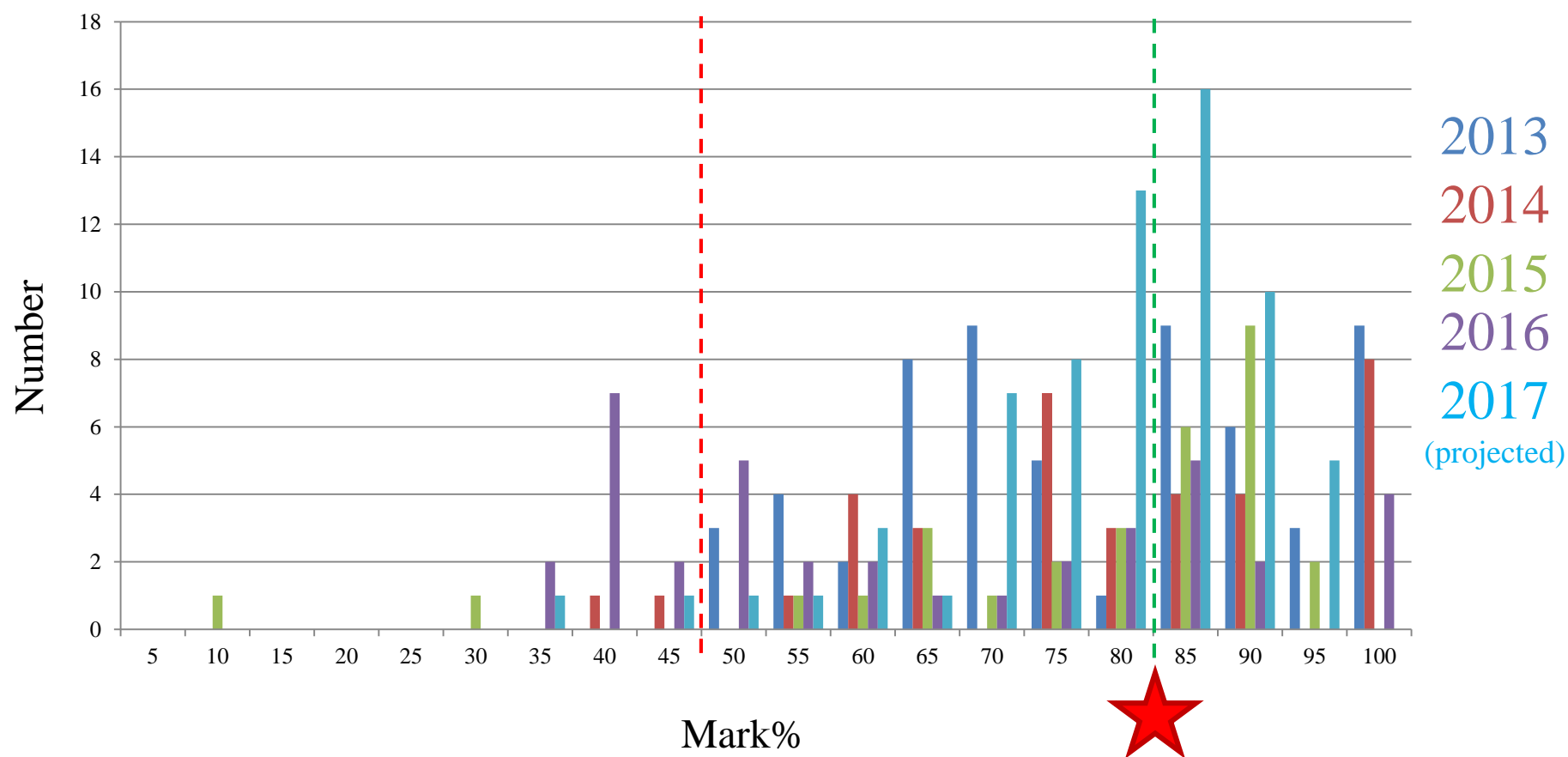
# Seminar results

- Interesting spread...



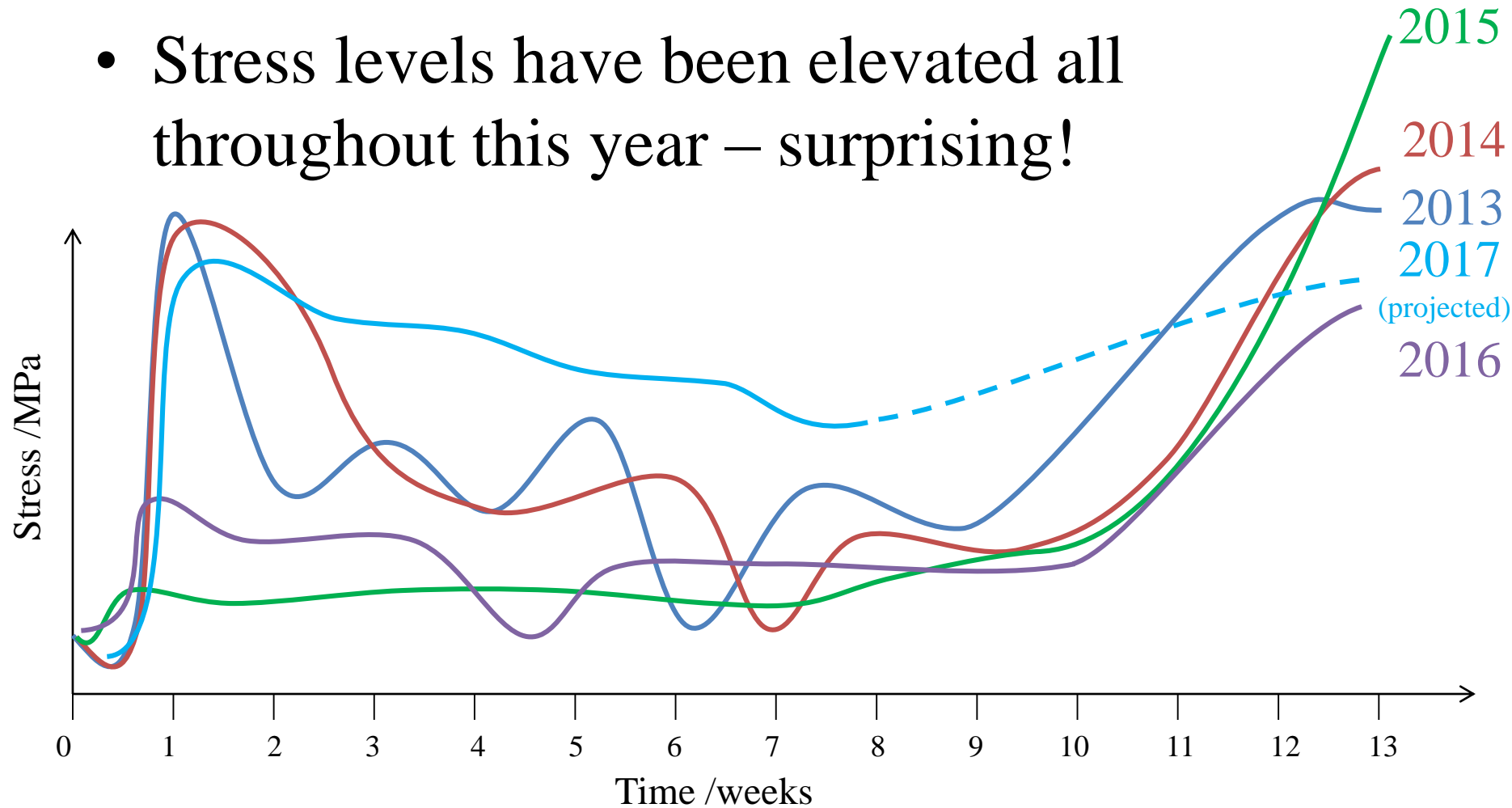
# Overall class progress

- Moving to the right!



# Managing your stress levels

- Stress levels have been elevated all throughout this year – surprising!



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# Incremental demo

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- Next week is the 50% incremental demo
  - I'm told we'll have an actual testing tank!
- Same process as last time:
  1. Send me an email request naming your team, you, and stating your desire to test
  2. Show up at the appointed time
  3. ???
  4. Profit!



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# FAQ Roundup

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- **None as of yet**

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# Wireless comms

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To radio, and beyond!

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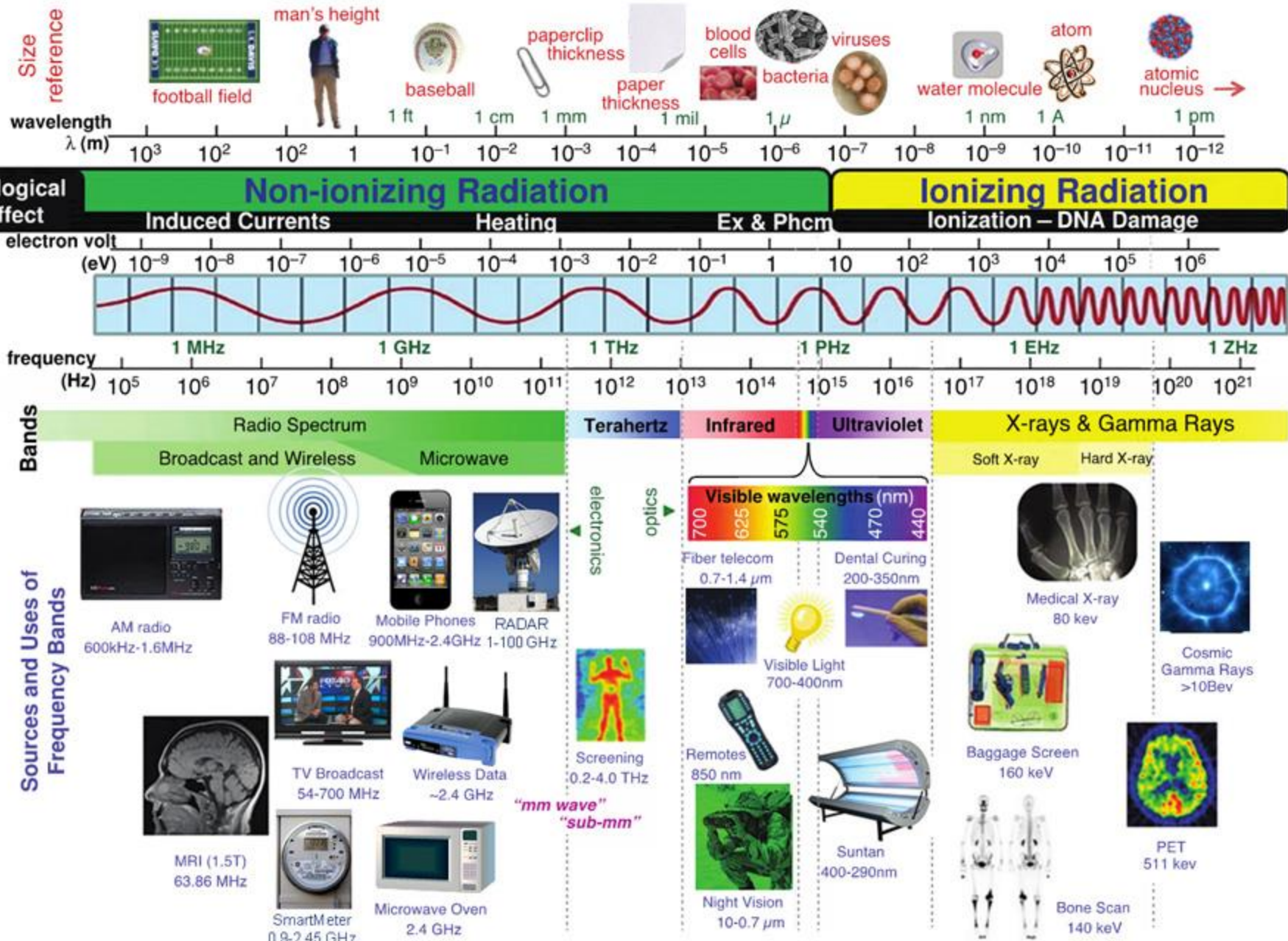
# Mini lecture on wireless comms

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- Wireless communications is fascinating, and you can practically get a whole degree on just it alone.
- For mechatronics engineers, it boils down to “Which radio module should I buy?”

*Every discussion of RF starts with  
the electromagnetic spectrum*

# ELECTROMAGNETIC RADIATION SPECTRUM



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# Quick comments the radio spectrum

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- Radio spectrum is extremely valuable
  - You don't get much to play with
- “Open” spectrum is predominantly concentrated in the ISM bands
  - ISM: Industrial, Scientific and Medical
- Fortunately, most of the RF compliance work has been done for you

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# Frequency, data rate and power

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- The higher your radio frequency, the faster you can transfer data
  - But also the more difficult filtering becomes, thus shorter range
- The more power you transmit with, the greater your range
  - But also the more interference you cause

# The ISM bands\*

Frequency range		Bandwidth	Center frequency	Availability
6.765 MHz	6.795 MHz	30 kHz	6.780 MHz	Subject to local acceptance
13.553 MHz	13.567 MHz	14 kHz	13.560 MHz	Worldwide
26.957 MHz	27.283 MHz	326 kHz	27.120 MHz	Worldwide
40.660 MHz	40.700 MHz	40 kHz	40.680 MHz	Worldwide
433.050 MHz	434.790 MHz	1.74 MHz	433.920 MHz	Region 1
902.000 MHz	928.000 MHz	26 MHz	915.000 MHz	Region 2
<b>2.400 GHz</b>	<b>2.500 GHz</b>	<b>100 MHz</b>	<b>2.450 GHz</b>	<b>Worldwide</b>
5.725 GHz	5.875 GHz	150 MHz	5.800 GHz	Worldwide
24.000 GHz	24.250 GHz	250 MHz	24.125 GHz	Worldwide
61.000 GHz	61.500 GHz	500 MHz	61.250 GHz	Subject to local acceptance
122.000 GHz	123.000 GHz	1 GHz	122.500 GHz	Subject to local acceptance
244.000 GHz	246.000 GHz	2 GHz	245.000 GHz	Subject to local acceptance

[wikipedia “Radio Regulations”, International  
Telecommunications Union-R 2012]

\* “ISM” is a great name for a rock band

# A brief survey of radio standards

Module	Frequency	Typ. range	Typ. data rate	Typical application
FM	433/434 MHz	100 m	4.8 kbit/s	Garage door opener  Wireless POTS phone
	868 MHz	100 m	9.6 kbit/s	
	900/915 MHz	20 m	115.2 kbit/s	
Zigbee	868 MHz	70 m	40 kbit/s	Wireless sensor networks
	915 MHz	70 m	45 kbit/s	
	2.4 GHz	70 m	250 kbit/s	
Nordic	2.4 GHz	50 m	1 Mbit/s	Wireless sensor networks
Bluetooth	2.4 GHz	10-100 m	0.7 – 2 Mbit/s	Laptop/cellphone peripheral
Wi-Fi	2.4 GHz	30 m	11 Mbit/s+	Mobile network
0G	Various	80 km	9.6 kbit/s	Cellular telephony and data
1G	150 Mhz	40 km+	14.4 kbit/s	
2G	0.9 – 1.8 GHz	35 km	144 kbit/s	
3G	0.4 – 3 GHz	30 km	2 Mbit/s	
4G	1.7 – 1.8 GHz	5 km	100 Mbit/s?	



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# Pros, cons of comms systems

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FM:	Very cheap, lousy transfer rate
Bluetooth:	Good speed, limited range
Zigbee:	Mesh networking, limited speed
Wi-Fi:	Great speed, lots of overhead
Cellular:	Wide reach, very expensive
Satellite:	Global reach, crazy expensive
Pigeon:	High bandwidth, unreliable

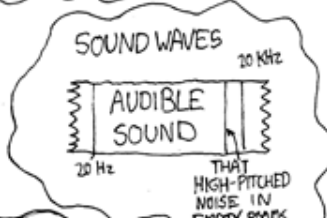
# THE ELECTROMAGNETIC SPECTRUM

THESE WAVES TRAVEL THROUGH THE ELECTROMAGNETIC FIELD. THEY WERE FORMERLY CARRIED BY THE AETHER, WHICH WAS DECOMMISSIONED IN 1897 DUE TO BUDGET CUTS.

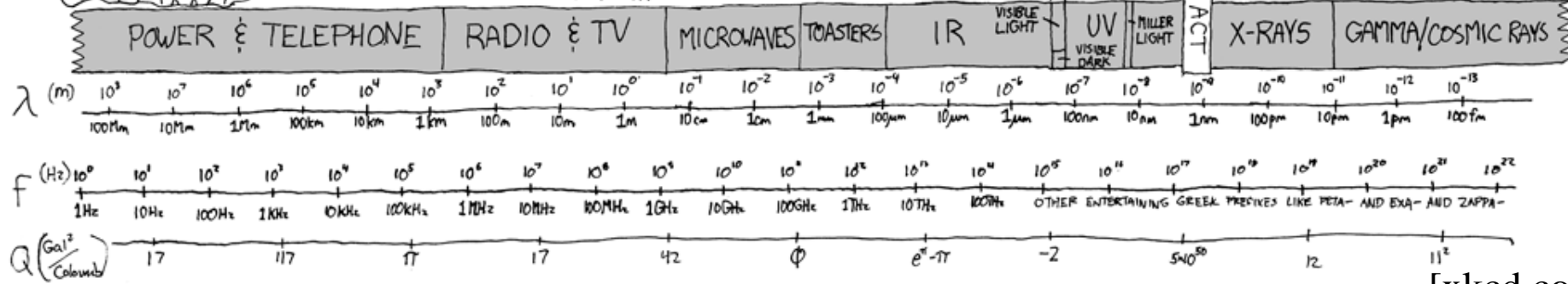
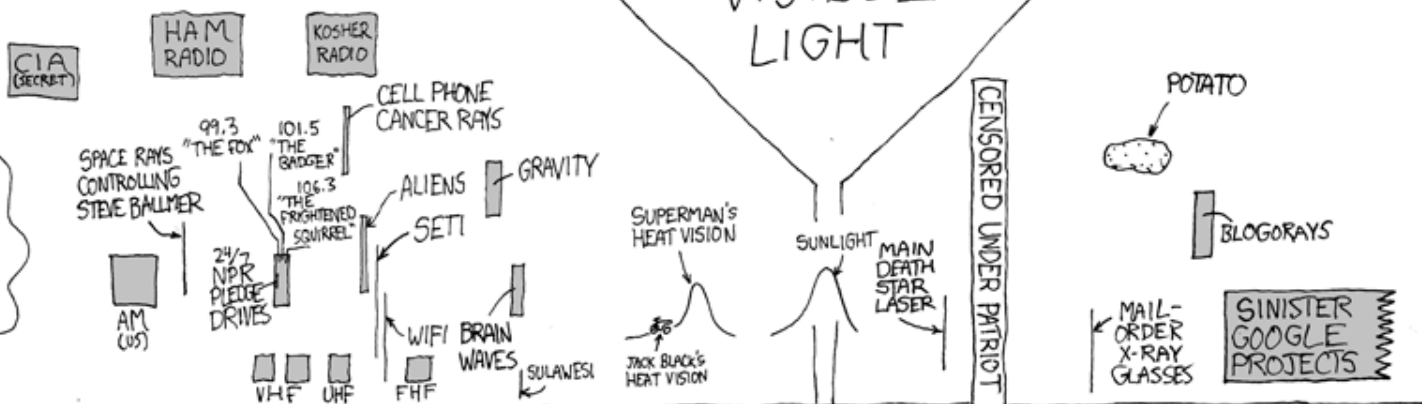
## ABSORPTION SPECTRA:



## OTHER WAVES:



SHOUTING CAR DEALERSHIP COMMERCIALS



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# And now...

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*Gratuitous project tips*

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# Gratuitous project tips!

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- Why are you doing what you're doing?
  - No rhyme or reason to the placement of winches, servos, batteries, etc.
  - You really need to think this through!
  - You don't need to lift the sub clear of the water
- Are you top-heavy? Probably!
  - This is a (potentially) really bad thing

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# Gratuitous project tips!

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- Your gripper is almost certainly terrible
  - No really – it sucks.
  - Your lousy gripper will be your undoing.
  - It will make you sad.

Think very carefully about how to do this.  
There are (probably) no easy solutions to it.

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# Gratuitous project tips!

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- Find someone else's codebase and use it
  - Some other poor schmuck, somewhere, has probably already solved your problem
  - There is no shame in open source
  
- Why do you need all that bulk, anyway?
  - Big clunky things are harder to move underwater

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# Questions

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# Tune-in next time for...

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## Questions and Answers Vol. 4

*or*

“I came to the lecture and all I got was  
educated and this lousy cup of coffee”

Fun fact: Money cannot buy happiness, but an annual income of \$70,000  
is correlated with the highest level of life satisfaction.