Your Soldering is Terrible (probably)

or

"How I learned to stop worrying and love flux"

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University of Queensland

But first…

Some house keeping

Design Analysis

- The METR4810 marking elves (ie. me) worked solidly through the weekend to get you results for today
  - And don't think you can sneak in after the deadline unnoticed…

A few comments…

Design Analysis

General writing skills comments

- Putting your name on an anonymised peer-assessment is a double-edged sword
- Read the instructions: Platypus takes .pdf only
- And what's with cover-pages for a two page assignment? That's like... 33% cover page!

Design Analysis

General writing skills comments

- Lots of flowery, useless writing
  - Cut to the point; no sugar-coating or niceties
- Pointless introductions that go on and on…
  - You have two pages – use them wisely.
- Lots of pointless citation.
  - References must bring new, useful information

Design Analysis

- When you are writing, think about:
  - Who is the audience?
  - What does the audience know?
  - What do you need to tell them?
  - What *don't* you need to tell them?

Design Analysis

Design Analysis common threads:

- Lots of simply restating the problem spec
  - Don’t regurgitate – tell me something new.
- What about implicit constraints/requirements?
  - Not everything is in the spec!
- Limited translation of spec into challenges
  - Little pre-chewing of the problem

Design Analysis

Design Analysis common threads:

- Present your analysis before your solution
  - Don’t put the cart before the horse!
- Lots and lots of design decisions with precious little reasoning for it them
- Many people proposed three different designs
  - Not helpful – you only get to build one!

Design Analysis

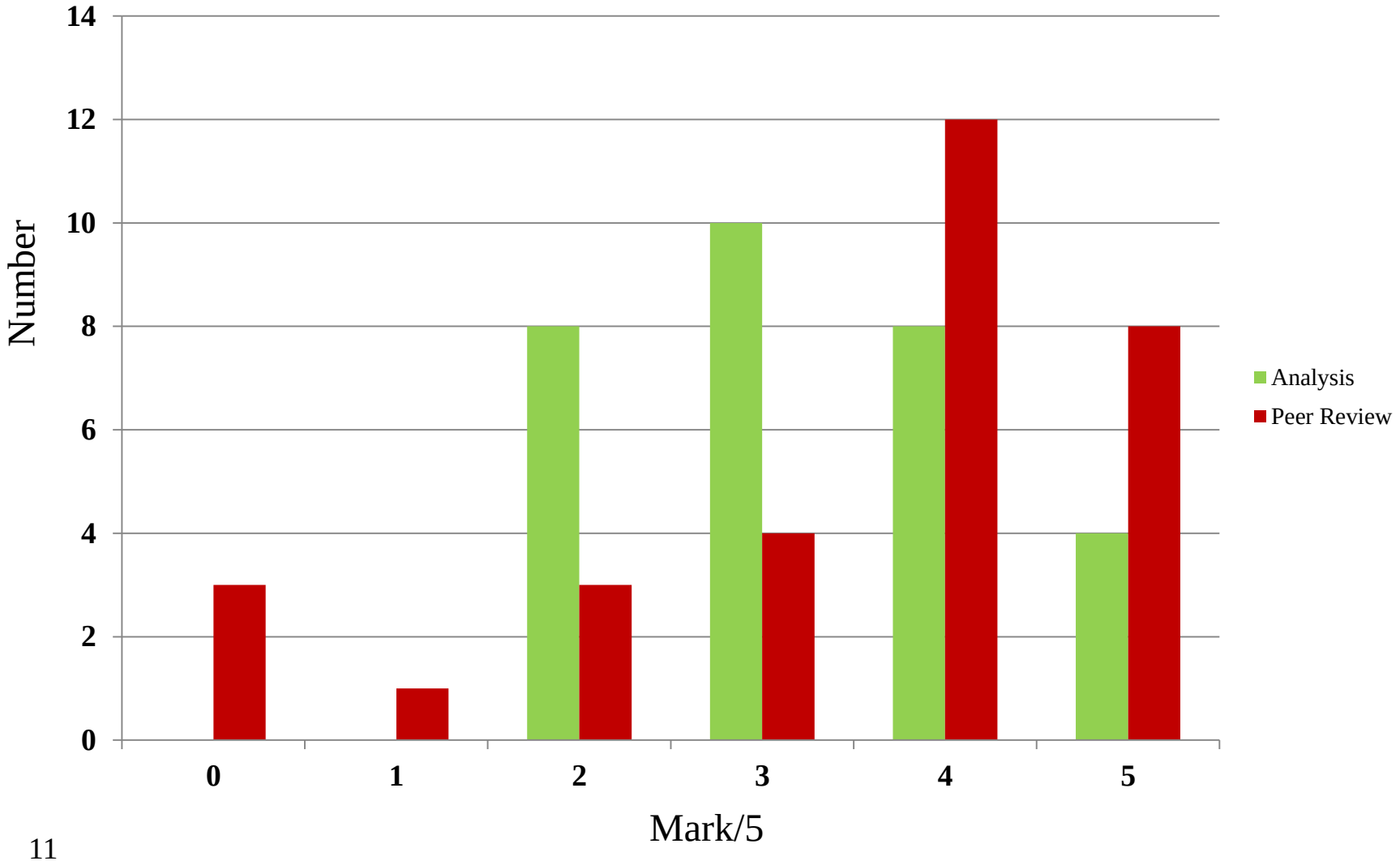
Comments on peer assessment:

- Students have low standards for what qualifies as good work – expect more!
  - Or you're all very kind!
- A single sentence isn't a useful review
  - Unless the grade is a really obvious one
- Some went way deep with detail and analysis
  - You are beautiful people

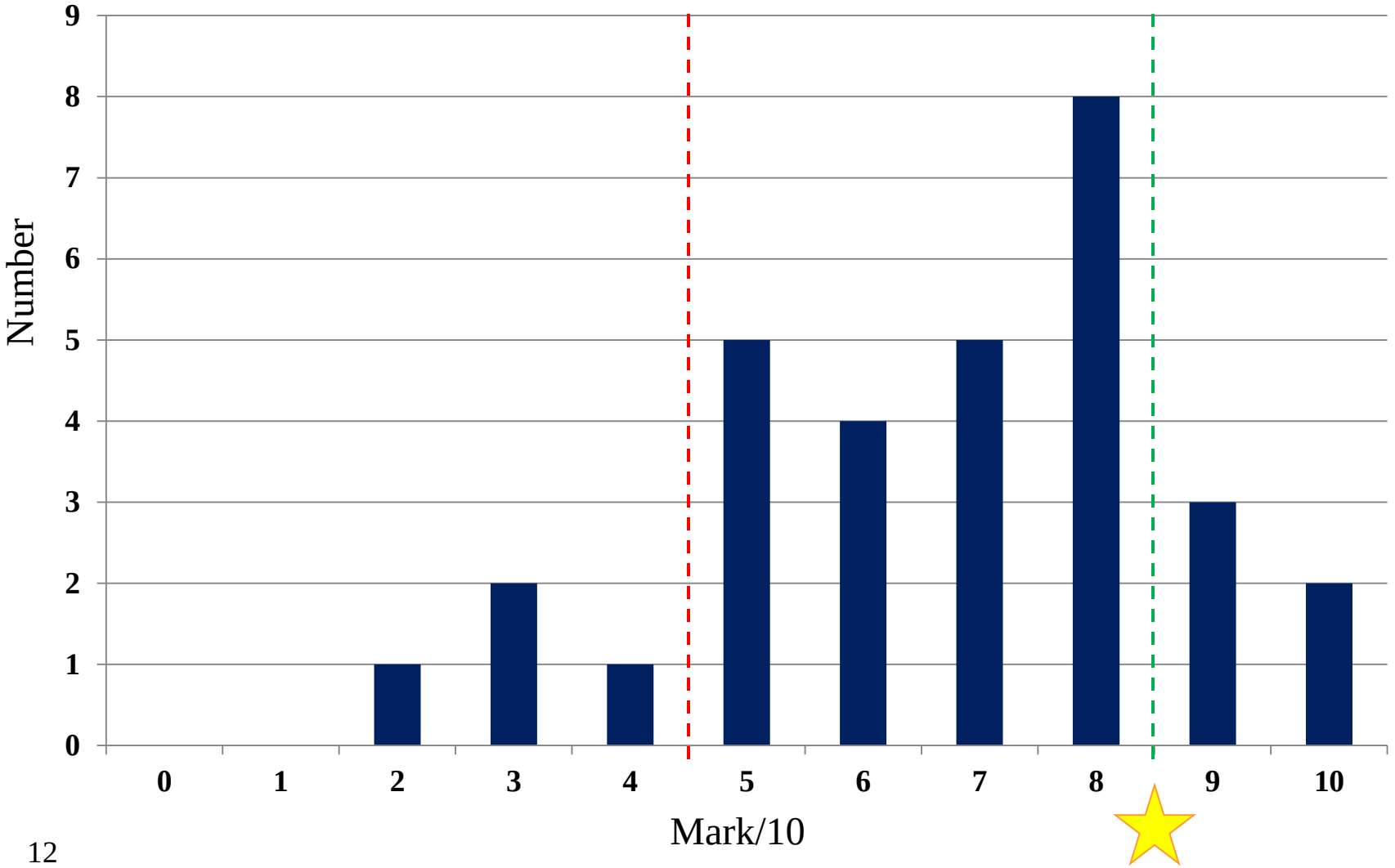
Design Analysis

- Results now available via Blackboard
- Comments are available via Platypus
  - Note that the score listed in Platypus is solely for the analysis part.
  - Scores awarded by your peers have NO bearing on your result (and were often nonsensical).
  - You got marks for the quality of *your* peer assessments, not the other way around.

Design Analysis



Design Analysis



House keeping

IMPORTANT:

- You must submit your designs to Doug for machining parts no later than week 7
  - No parts will be machined for you after then
  - You can machine your own parts, but you won't be able to go through the workshop

Calendar at a glance

You are here →

Week	Dates	Lecture	Reviews	Demos	Assessment submissions
1	2/3 – 6/3	Introduction			
2	9/3 – 13/3	Principles of Mechatronic Systems design			Problem analysis
3	16/3 – 20/3	Professional Engineering Topics			Analysis peer review
4	23/3 – 27/3	Your soldering is (probably) terrible			
5	30/3 – 3/4	???	Progress review 1		
Break	6/4 – 10/4				
6	13/4 – 17/4				
7	20/4 – 24/4		Progress seminar	25% demo	
8	27/4 – 2/5				
9	4/5 – 8/5			50% demo	
10	11/5 – 15/5		Progress review		
11	18/5 – 22/5			75% demo	Preliminary report
12	25/5 – 29/5				
13	1/6 – 5/6	Closing lecture		Final testing	Final report and reflection

Coming up soon!

Progress reviews

- Progress reviews are next week!
  - 15 minute slot per group
  - Each group member presents in turn
  - Should only take 3-4 mins each

- Sign up for session slots via Doodle poll
  - Link to poll will be sent out via Blackboard announcement after the lecture (closes Friday)

Progress reviews

- How to sign up:
  - Have **one and only one** member of your team nominate a time for your team on the
  - When they sign up, they must include their **full name and team number**. If they don't put both, the slot will be cleared.
- If you absolutely can't get a slot that works for all of your group, email me ASAP
  - *But this should never happen*

Progress reviews

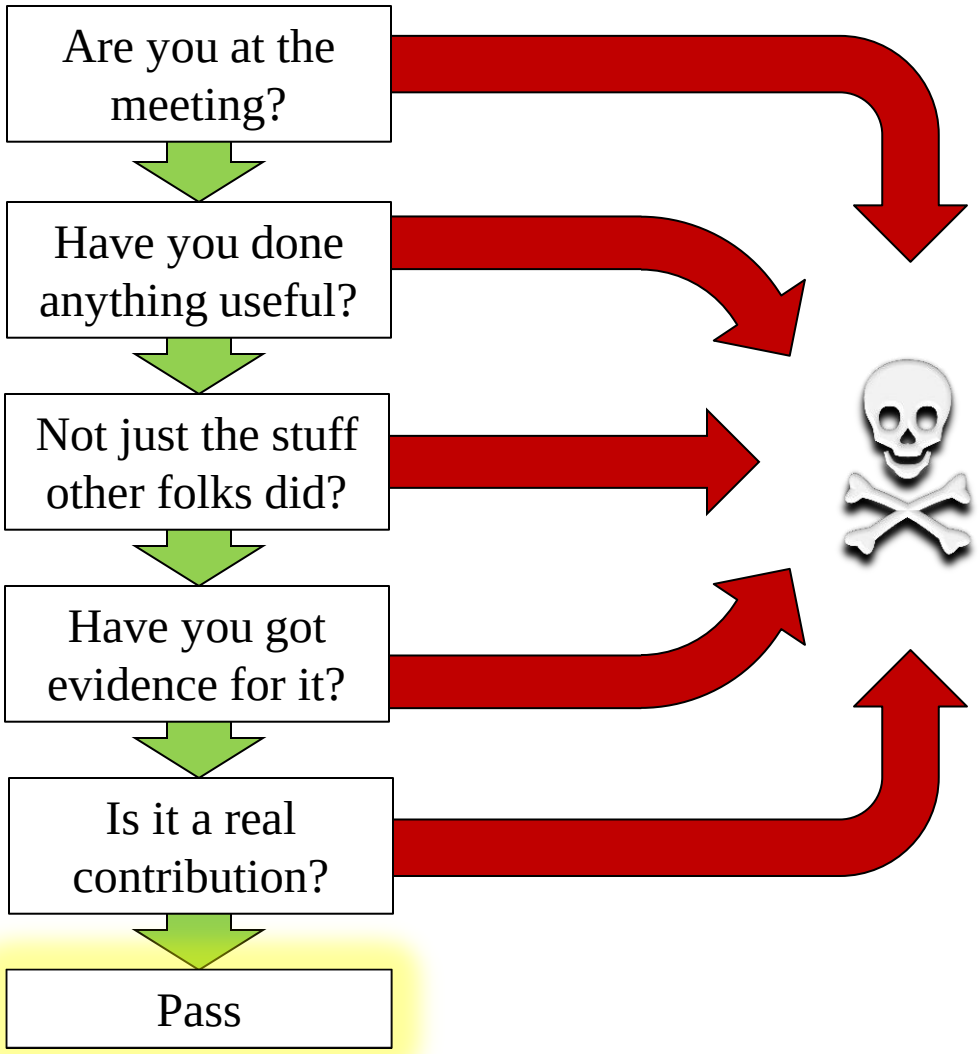
What is expected for the progress review?

- Need to show that you've made a decent start to the project: **tangible evidence**
  - Desired: rigorous analysis, detailed simulations working compiled code, breadboarded electronics, mockups of mechanical design
  - Inadmissible: scrawled pictures, isolated printouts of code, lousy rushed CAD or circuit diagrams, datasheets of that part you found

Progress reviews

- Don’t panic: we are reasonable
  - The progress review is entirely to motivate you to get started early, and check your progress
- We can tell very easily if you’ve actually made an effort – if you have, you’ll be fine!

Progress Review flow chart



And also…

- You will be doing PAFs for each of your team members
- The PAF will contribute towards the final scaling of your final product score
  - This really counts!

FAQ Roundup

- **Can we use a wire-frame rotor instead of a duct?**
  - No. This is a safety thing.
- **Can we buy a duct and a motor separately and combine them?**
  - Yes, if the manufacturer intended them to work together. But ABSOLUTELY do not power the rotor/fan outside of that duct.
- **Can we make a blimp/quad/VTOL/glider/skeeball?**
  - Sure, if you think it will solve the problem.
- **Can we make a harpoon/winch ... thing?**
  - No, sorry. It sounds cool, but it would violate various parts of the spec.

Lecture nominations

- Now is the time to nominate lecture topics
  - Send to me via e-mail before Wednesday
  - If I get more than one nomination, there will be a Doodle poll that will close Friday.

- The first bespoke lecture will be 30th March
  - If there are no nominations, it will be Q&A

Back to business…

Soldering ahoy!

Notes on safety

- Soldering is generally a low-risk activity, with the following exceptions:
  - Minor to moderate to severe burns
  - Cuts, punctures and lacerations
  - Electrocution
  - Lead poisoning, other chemical poisoning
  - Partial loss of eyesight, total loss of eyesight

… so nothing to worry about, right?

Helpful safety tips

Zeroth rule of soldering:

- Mind where you stick the hot pointy end
  - Take note of people around you when working
  - Return the iron to its cradle when not soldering
  - If you drop it, don’t try to catch it!

Helpful safety tips

First rule of soldering:

- Always assume a soldering iron is hot!
  - NEVER pick it up by the wrong end
  - Remains hot for a while, even when unplugged
  - Things heated by a soldering iron are also hot

Helpful safety tips

- Treat a hot-air gun or hot-air reflow soldering station like a tiny lightsabre
  - Invisible beam of destruction 30 cm from tip
  - Nozzles also get extremely hot! (>500^{o}C)
- Fumes are less good for you than they smell
  - They cannot get you high (I can confirm this)
  - Work in a well-ventilated area
  - Use the extractor if you have it

Helpful safety tips

- Wash hands before eating
  - … no matter how good the lead tastes
  - Lead is toxic: acceptable exposure level is ZERO
  - Use ROHS solder and materials
- Use and dispose of chemicals responsibly
  - Don’t flush PCB washing chemicals
  - Be *extremely* careful of etching chemicals
  - Do not eat the flux (tastes terrible)

Helpful safety tips

- Don’t solder on flammable surfaces (duh)
  - Ceramic tiles make excellent surfaces!
  - $5 worth of Not-Burning-Your-House-Down
- Keep flammable liquids and heat separated
  - Methylated spirits, kerosene, turpentine etc.
- Turn off circuit power before working on it
  - Pay particular attention to Lipo cells
  - Solder one lead at a time (insulate the other)

Helpful safety tips

Wear eye protection. Always.

It might only matter once in your career,
but you'll be grateful you did

Warning

"Do not attempt to solder
with remaining eye."

Always wear eye protection

Principles of soldering

- Soldering is the process of joining two metal surfaces with a fusible metal

Heat both surfaces simultaneously and then introduce solder to the joint

Don't apply solder to iron first and *then* to join

- Enough heat, enough flux, clean surfaces
  - Quick zap and out

Helpful soldering tips

- Solder flux is the universe's gift to you

It is highly likely that–

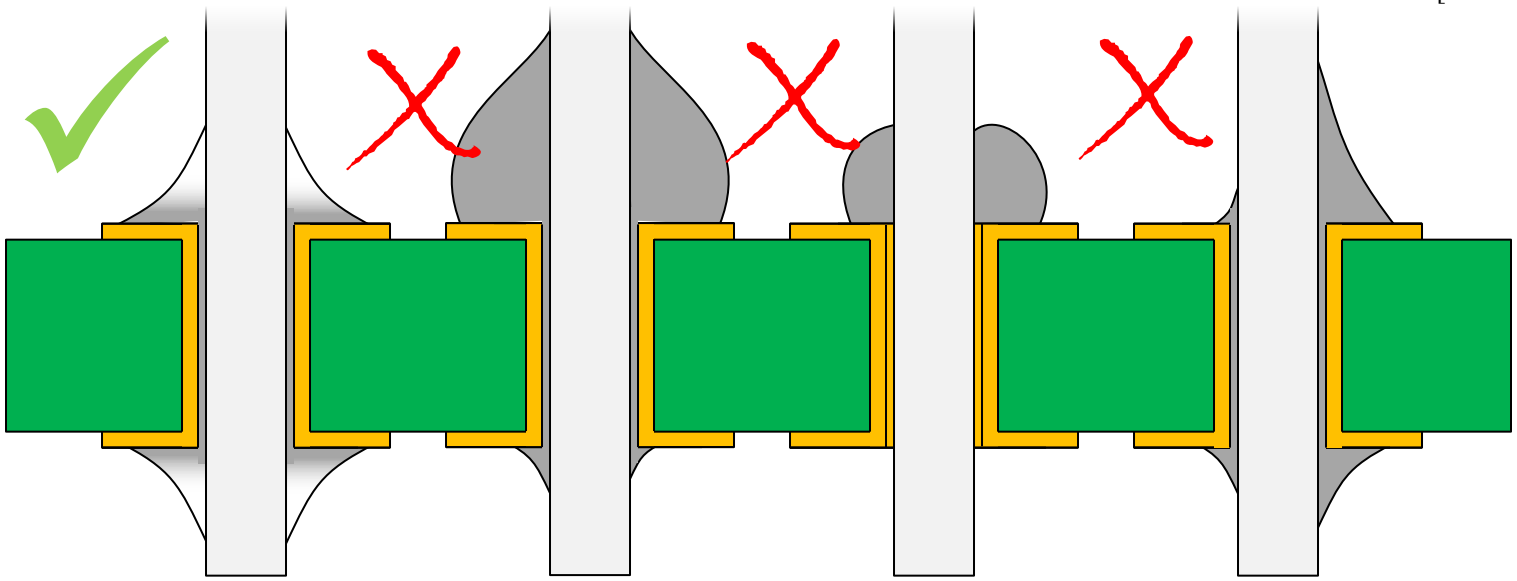
- You need to use less solder
- You need to use less heat
- You need to use more flux

~The solder must flow~

Helpful soldering tips

- How to identify a good joint
  - Even, shiny symmetric meniscus
  - No Hershey's Kisses, no blobs

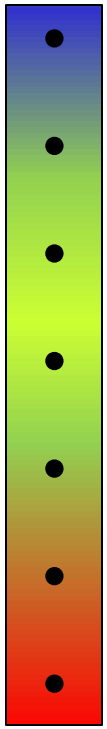
Hershey's Kiss
[Hershey's]



Good joint! Hershey's Kisses Dry joint Asymmetric joint

Helpful soldering tips

On temperature:



- 250°C is probably too cold – bump it up!
- 275°C can be ok for fragile parts
- 300°C is pretty comfortable
- 325°C is Just Right
- 350°C is more than enough
- 375°C – what are you *doing*?
- >400°C What the I don't even??

Different solders like different temperatures – know your solder!

Practical demonstration

- Working with wire
  - Striping, tinning, joining to PCB
  - Joining and splicing
  - Heat shrink and insulation
  - Thick, multi-core wires
- Through-hole parts
  - Journey to the Lost World

Topics to cover today

- SMD passives
  - Point to point, Pre-tin, Reflow
- SMD ICs: SOT-23/SOIC/TSSOP
  - Point to point, Tack and Drag, Pre-tin, Reflow
- Leadless SMD: LGA/QFN/BGA
  - Descent into the winding madness from which there is no escape, only the gnawing twisting spiralling frenzied desolation that chews upon the Ur-soul in the grip of endless torment

Questions

?

‘Hotflash’ aka “Princess Solderflux” [Firepixie]

Tune-in next time for…

Nothing!

or

"Coffee makes the world go round."

Fun fact: Biocompatible solder is 98% gold.

It is frighteningly expensive.