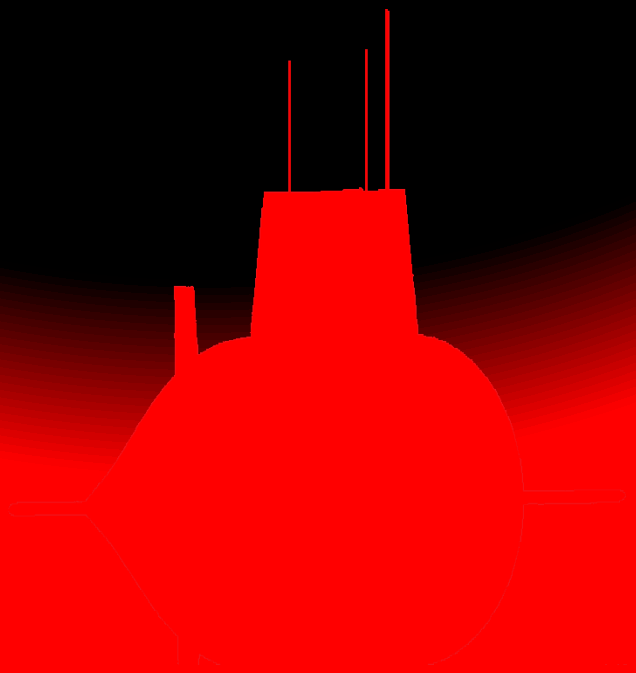
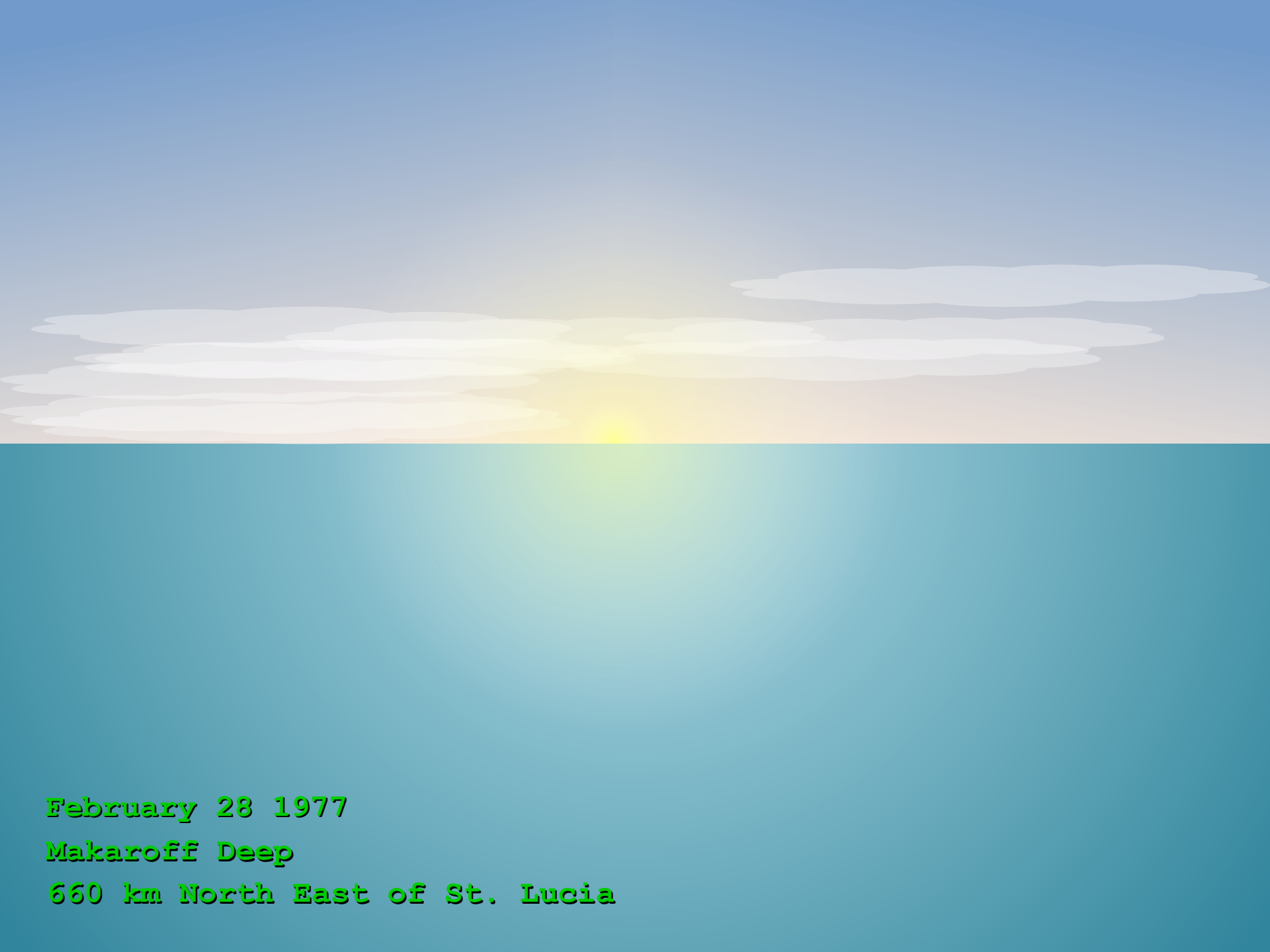
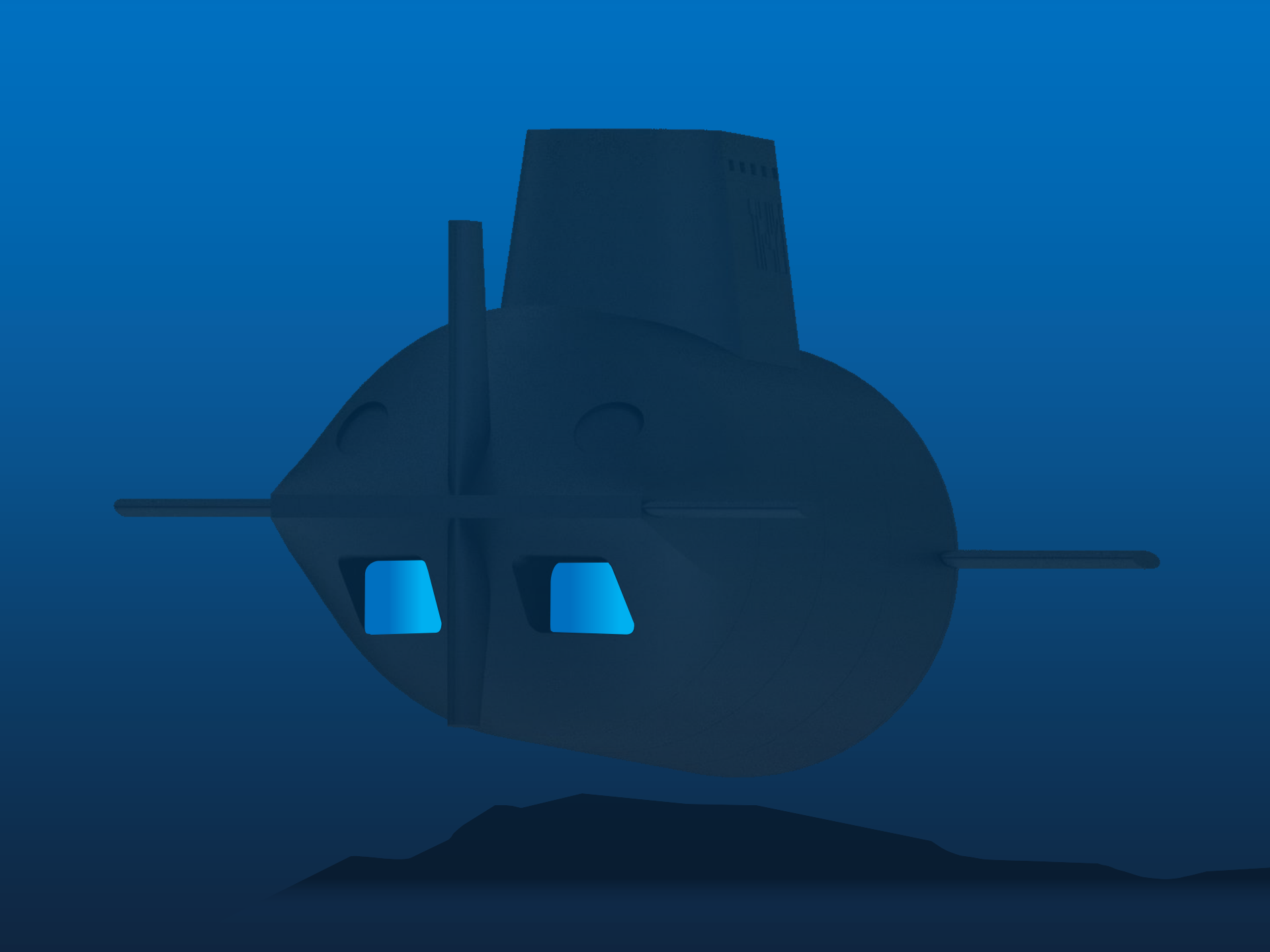
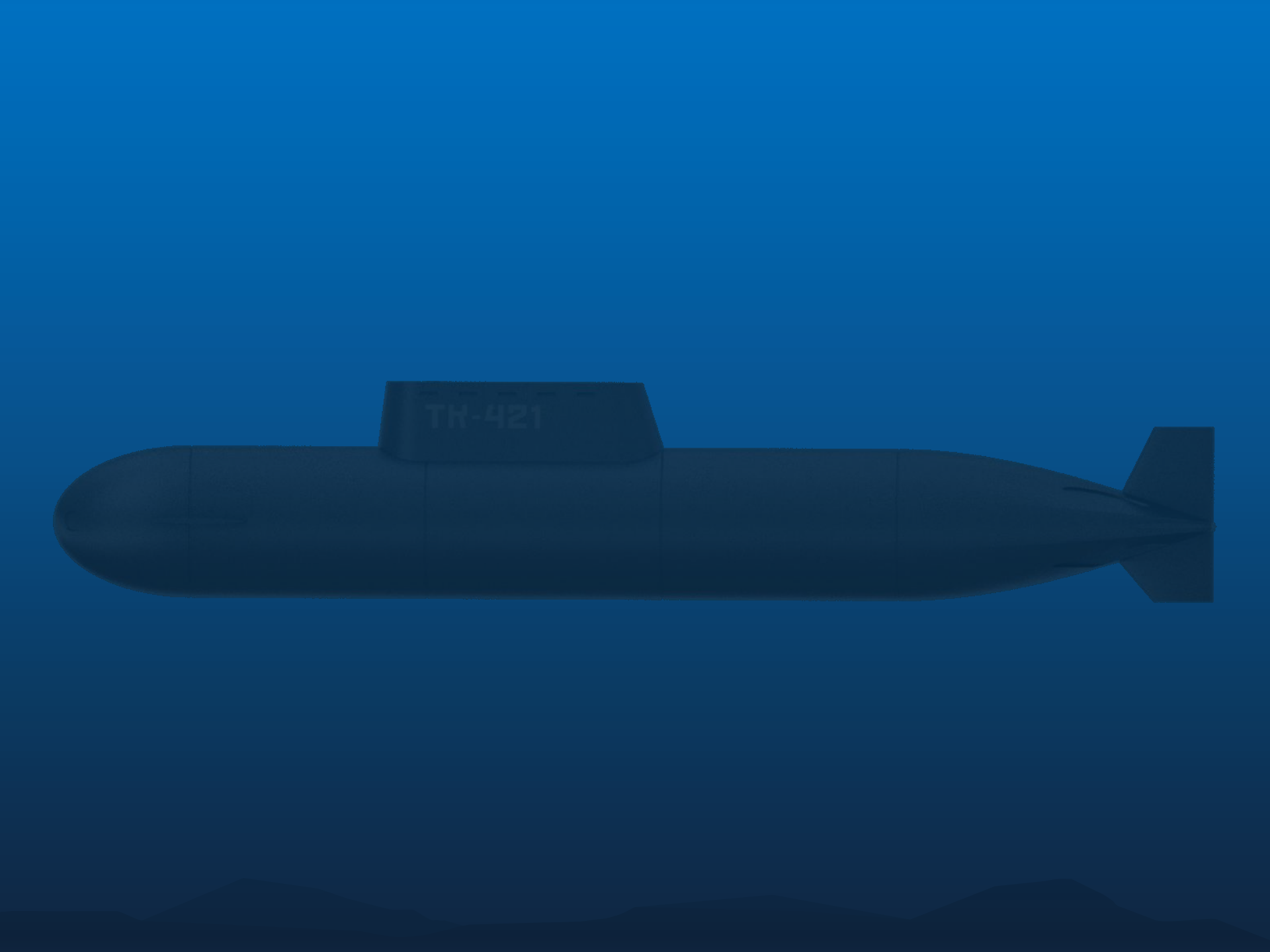
# ОХОТА НА СЭР НИЛЬС ОЛАВ



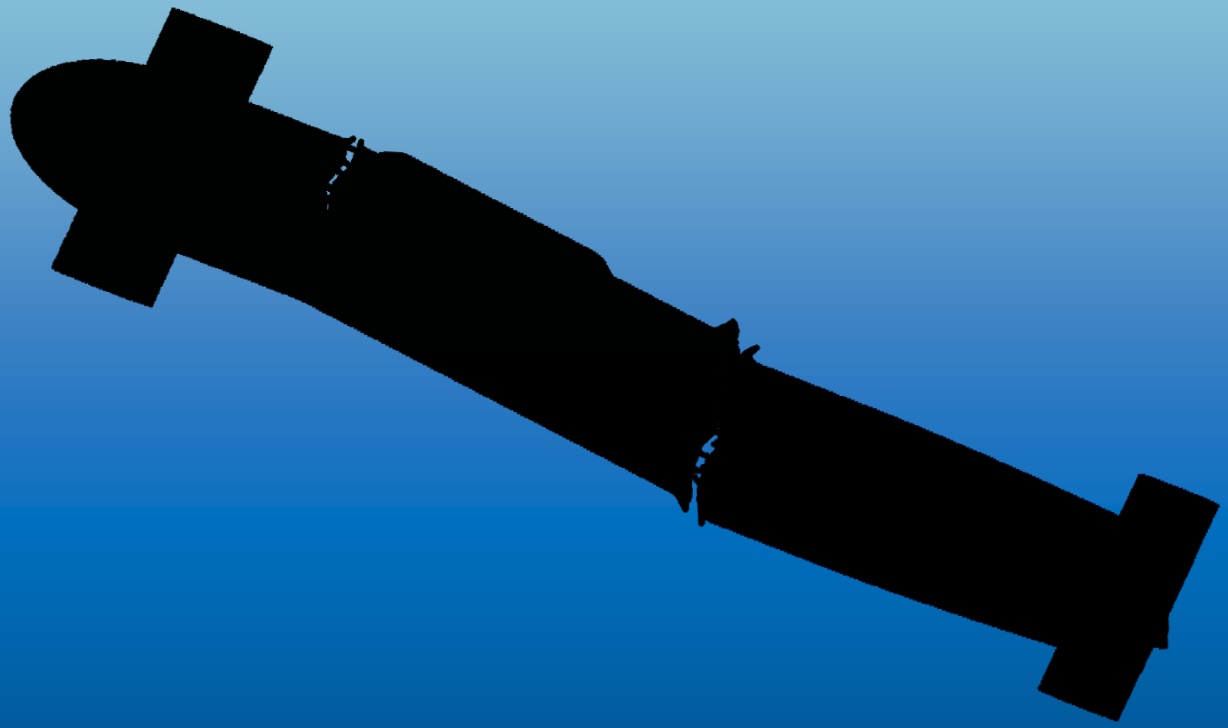

February 28 1977
Makaroff Deep
660 km North East of St. Lucia


KNM *Sir Nils Olav*
Experimental submarine




TR-421


REAKTOR EN
HELT FINT
Å NEI!



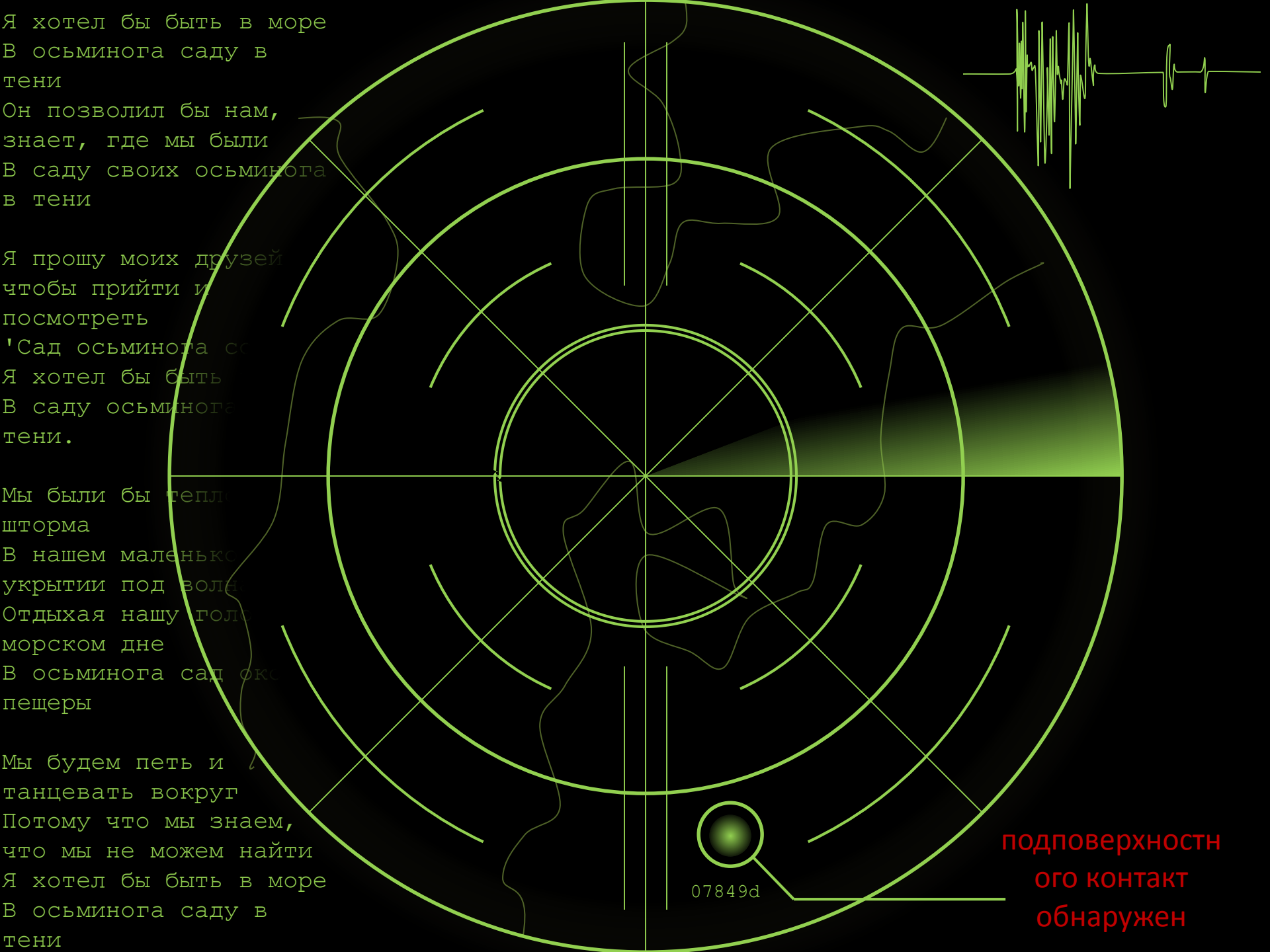

Missile cruiser *Polkovnik Gagarin*
70 km North

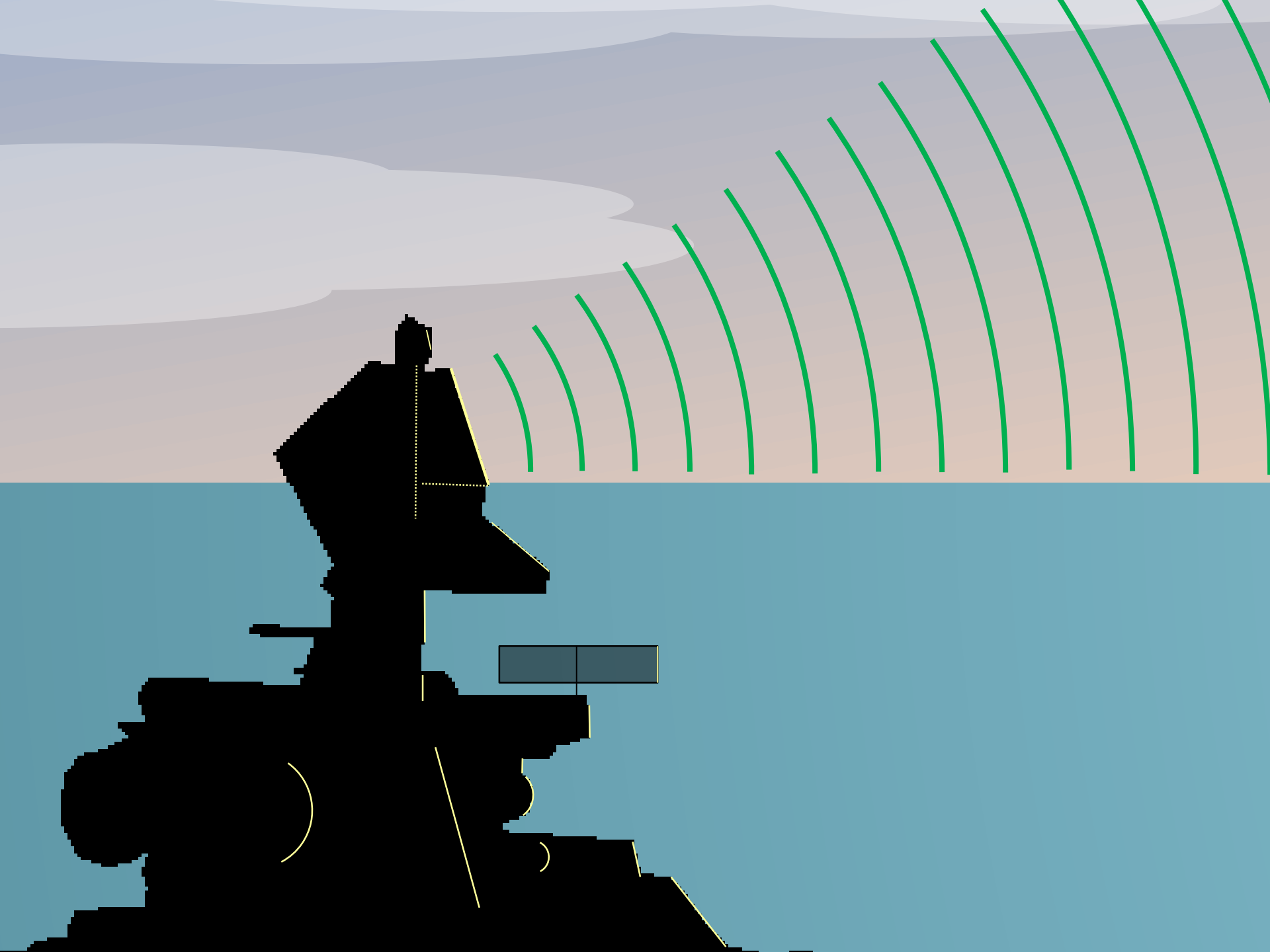
Я хотел бы быть в море
В осьминога саду в
тени
Он позволил бы нам,
знает, где мы были
В саду своих осьминога
в тени

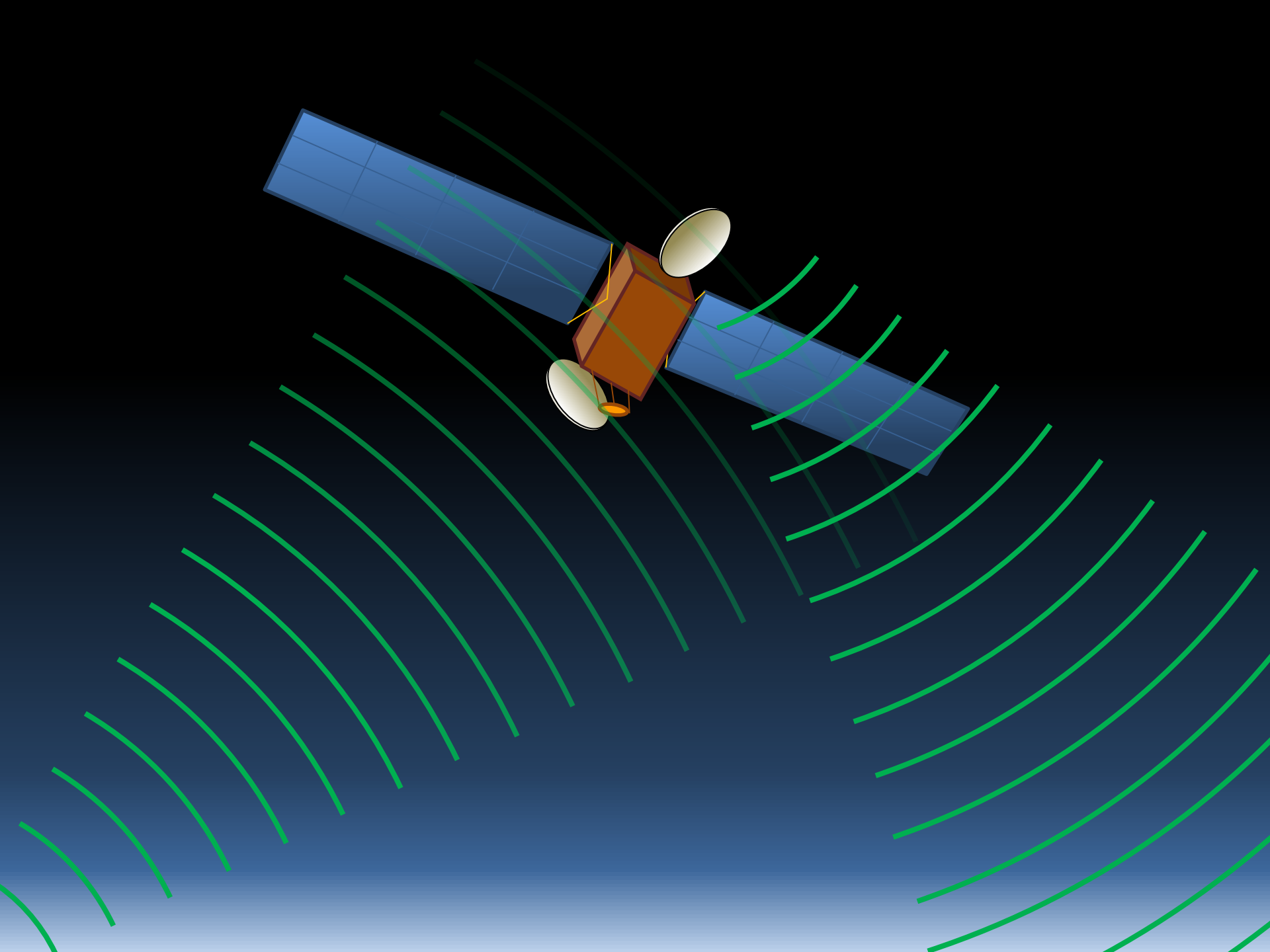
Я прошу моих друзей
чтобы прийти и
посмотреть
'Сад осьминога с
Я хотел бы быть
В саду осьминога
тени.

Мы были бы тепл
шторма
В нашем маленьк
укрытии под вол
Отдыхая нашу гол
морском дне
В осьминога сад ок
пещеры

Мы будем петь и
танцевать вокруг
Потому что мы знаем,
что мы не можем найти
Я хотел бы быть в море
В осьминога саду в
тени







The Kremlin, Moscow

Moscow, Union of Soviet Socialist Republics

The hunt for *Sir Nils Olav...* begins

# МЕТР4810
# МЕХАТРОНИКА
# ПРОЕКТ КОМАНДА
# II

Пол Фунты

28 февраль 2017

# METR4810 MECHATRONICS TEAM PROJECT 2

Paul Pounds

28 February 2017

# The HUNT for SIR NILS OLAV

*or*

"One Ping Only"

Paul Pounds

28 February 2017

University of Queensland

# METR4810

- **What**: Mechatronics team project course
- **When**: Starting now, going until week 13
- **Where**: Hawken 50-c404 (mostly)
- **Who**: Cast of thousands
- **How**: Lots of work
- **Why**: Get experience developing complex mechatronic and robotic systems... and

*because it's awesome*

# Specific class objectives

- Explore the trade-offs involved in complex mechatronic/robotic systems
- Gain experience in multi-variable analytical design synthesis
- Exercise practical cyber-electromechanical integration and trouble-shooting techniques
- Build interpersonal skills working in teams

# A quick note on objectives

**Your objective: 7/7 grade**

**My objective: 5/5 SECaT**

**Shared priorities:**

- Meet course objectives
- Reduce unnecessary work
- Have fun!

# What this class is

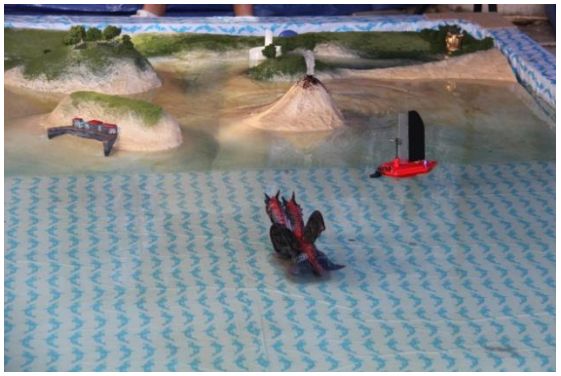
- Taking the safeties off
  - Real challenge, no hand-holding
- Unconstrained design, broad horizons
  - Very few limitations or constraints
- Focus on communication, design process, teamwork

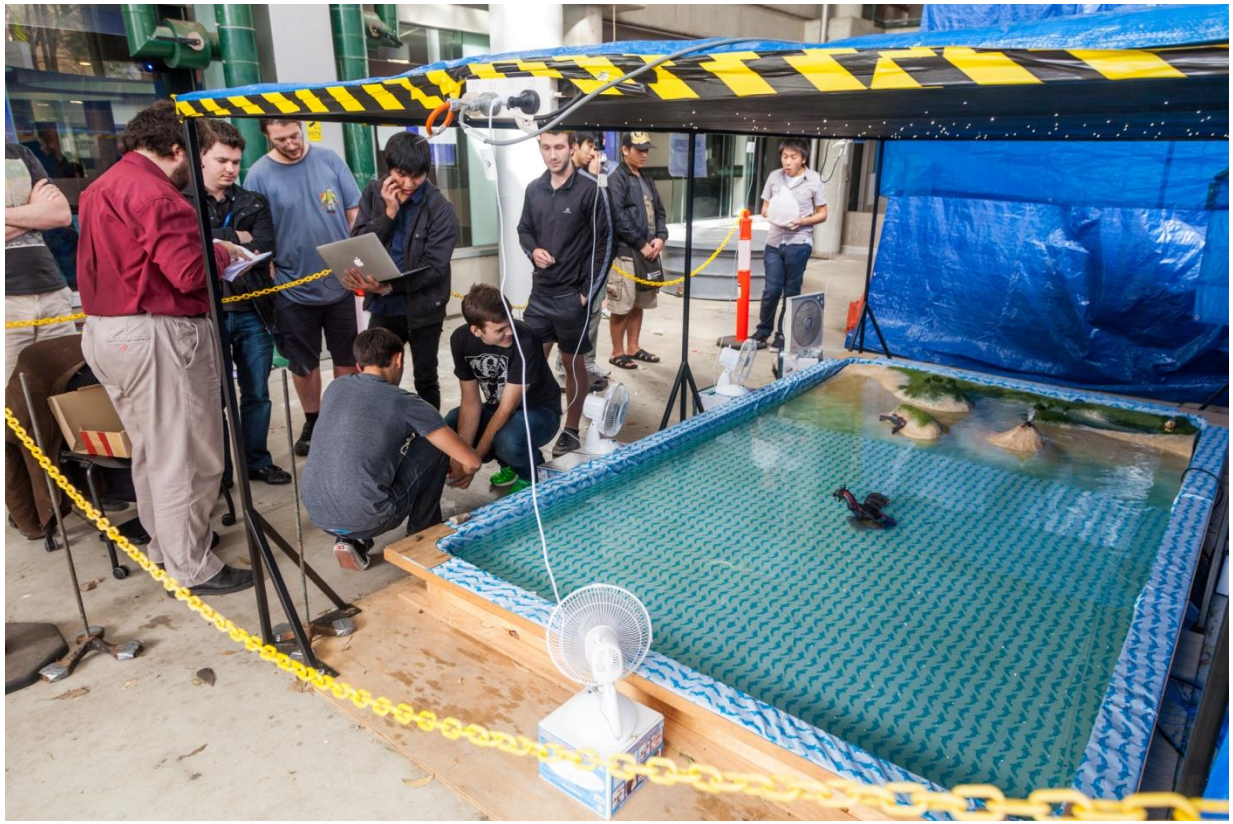
# What this class is not

- Not about the project (not really)
  - It's about how you go about solving it
- Not teaching you technical engineering
  - You already know how to do math, etc.
- Not giving you one single, clear path
  - It's scary out there, and much is unknown

# The Ghost of Projects Past

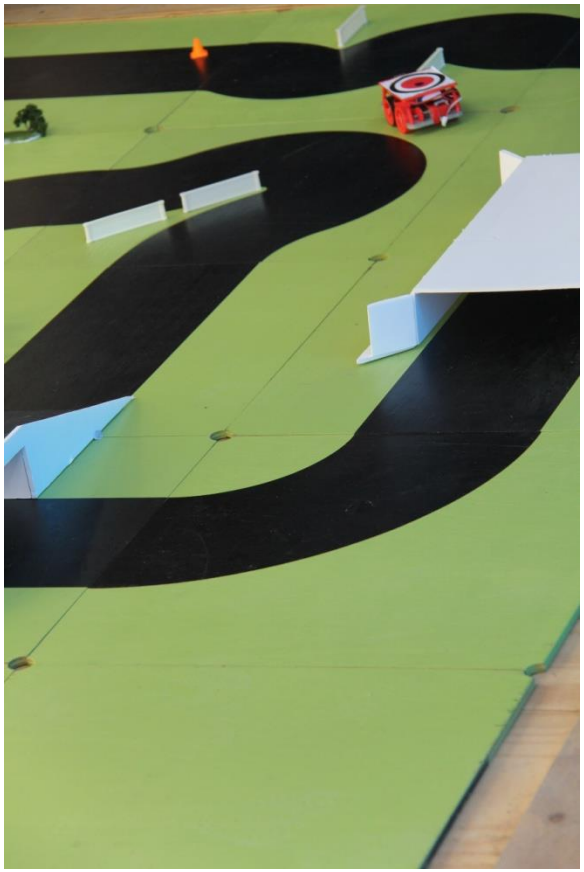
## 2013: Autonomous sailing and navigation





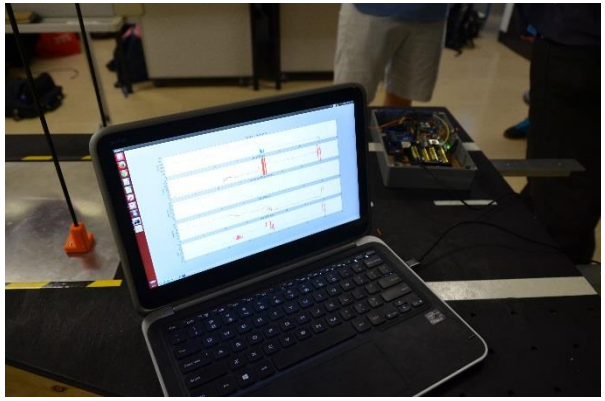
# The Ghost of Projects Past

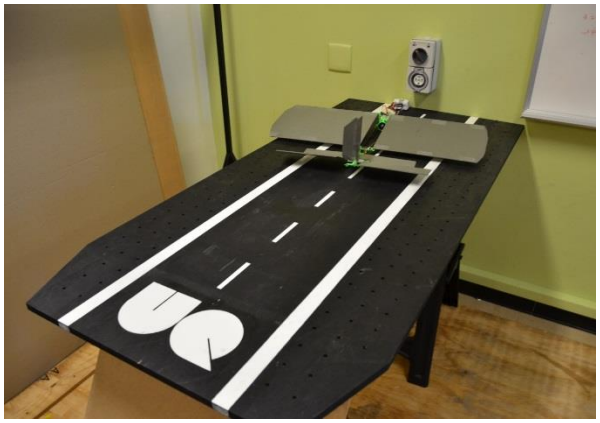
## 2014: Autonomous race car challenge



# The Ghost of Projects Past

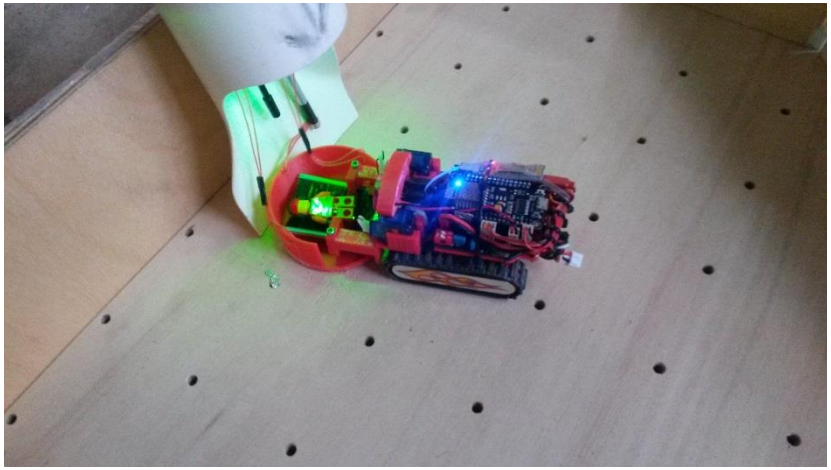
## 2015: Autonomous Carrier Operations

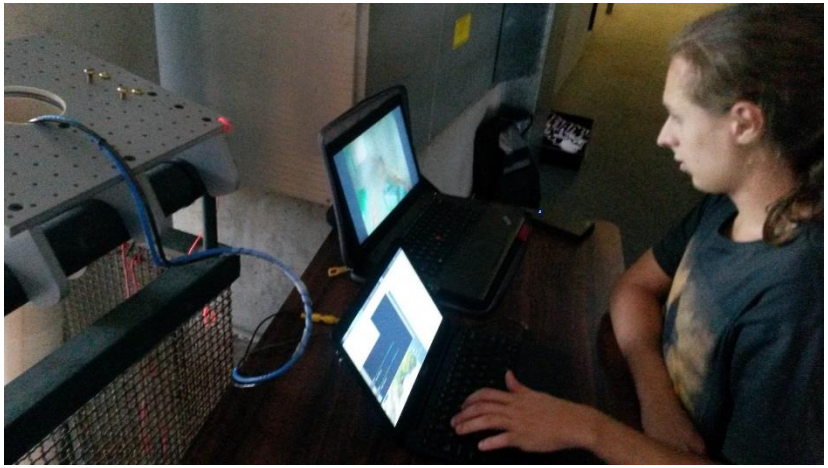




# The Ghost of Projects Past

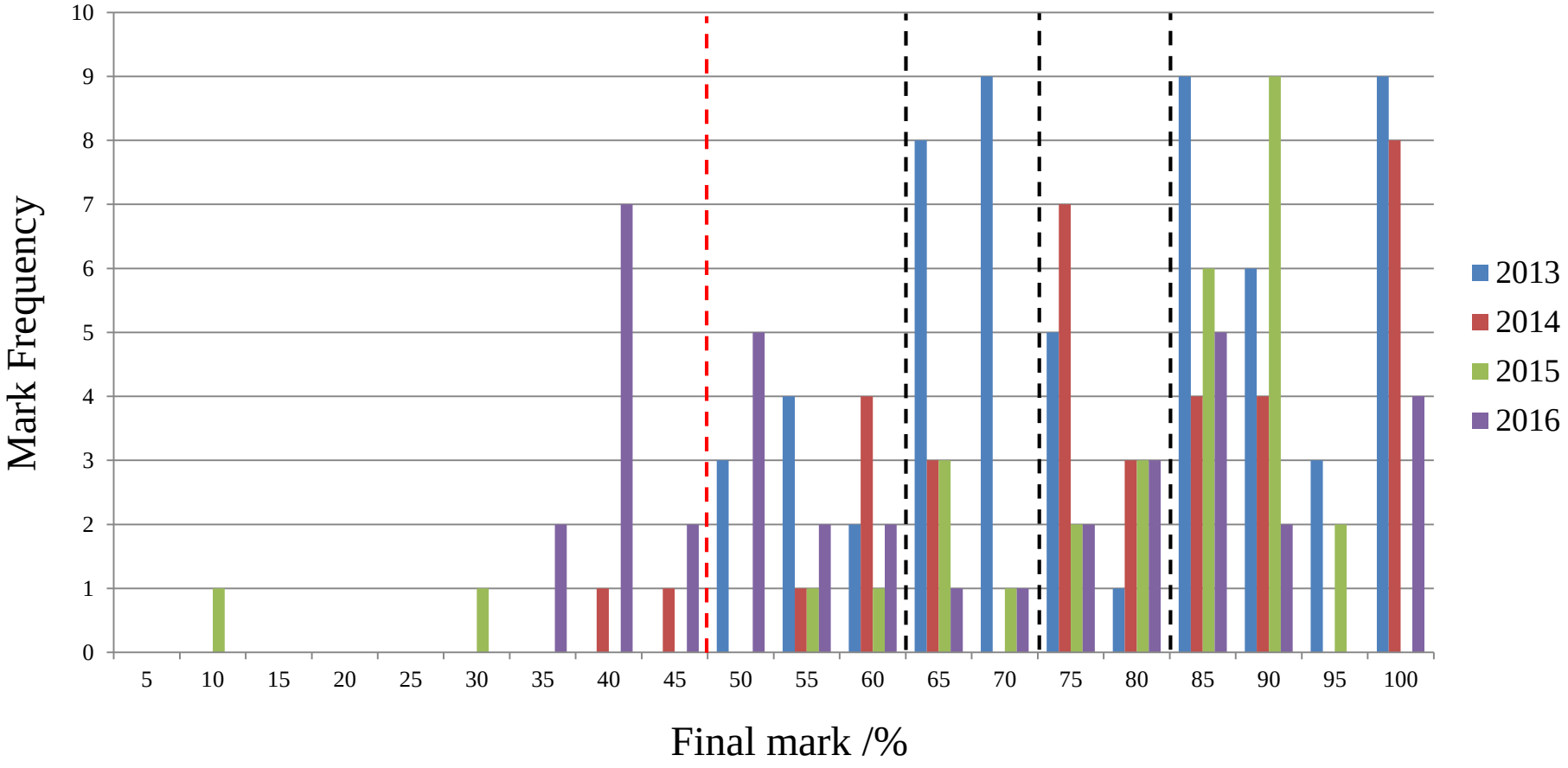
## 2016: Subterranean Mine Rescue





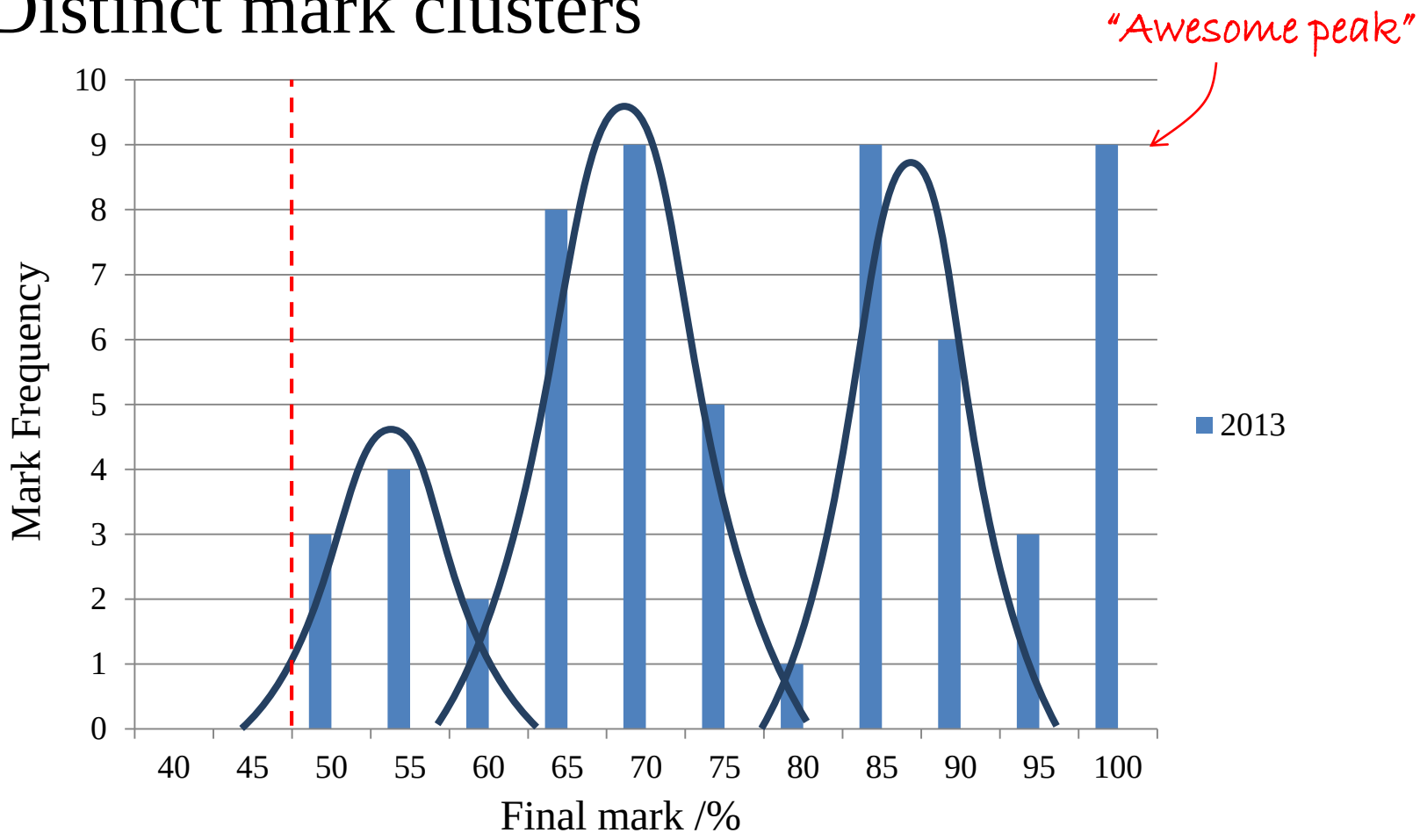
# Assessment results

- Atypical mark spread: not a real bell curve



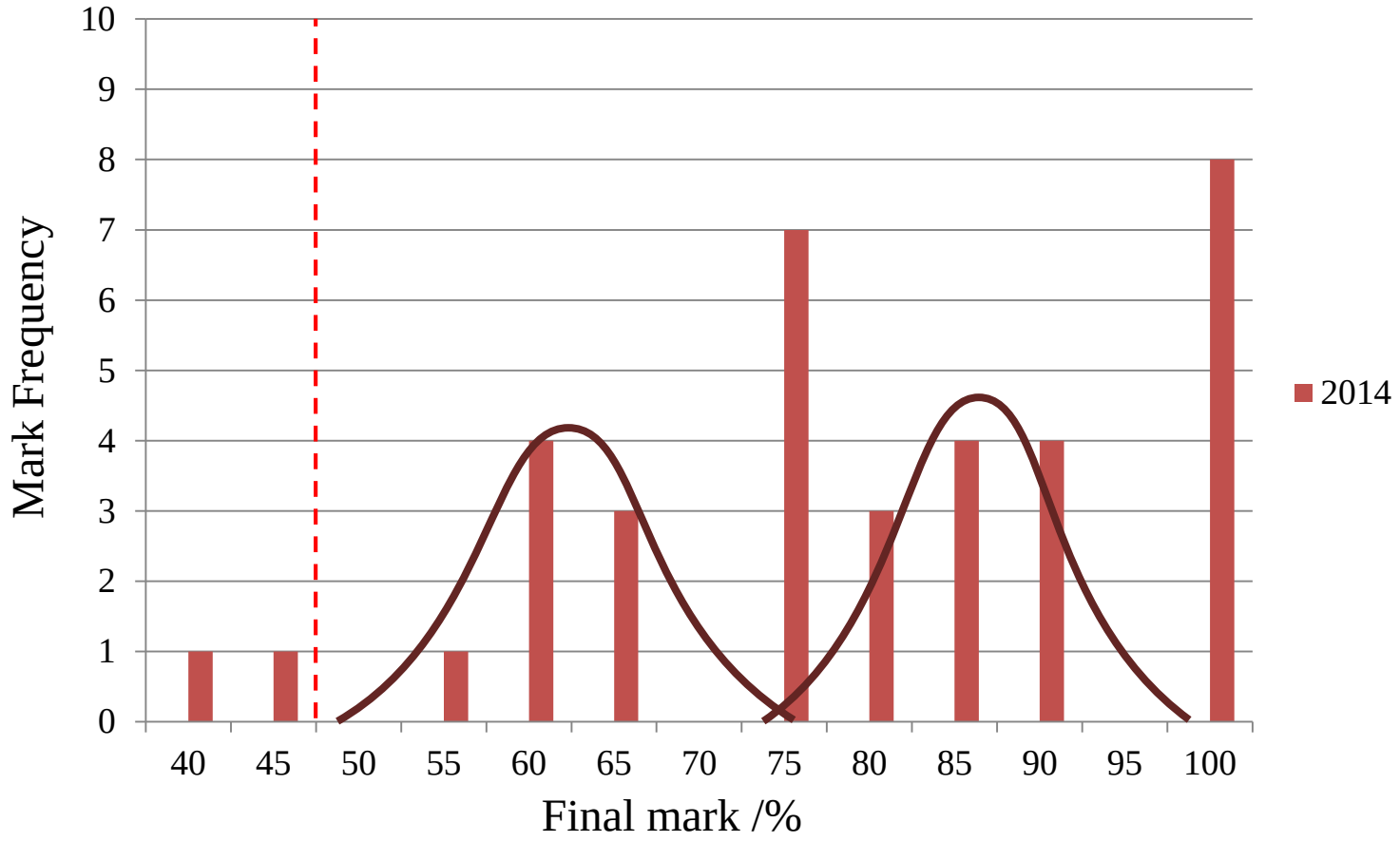
# Assessment results

- Distinct mark clusters



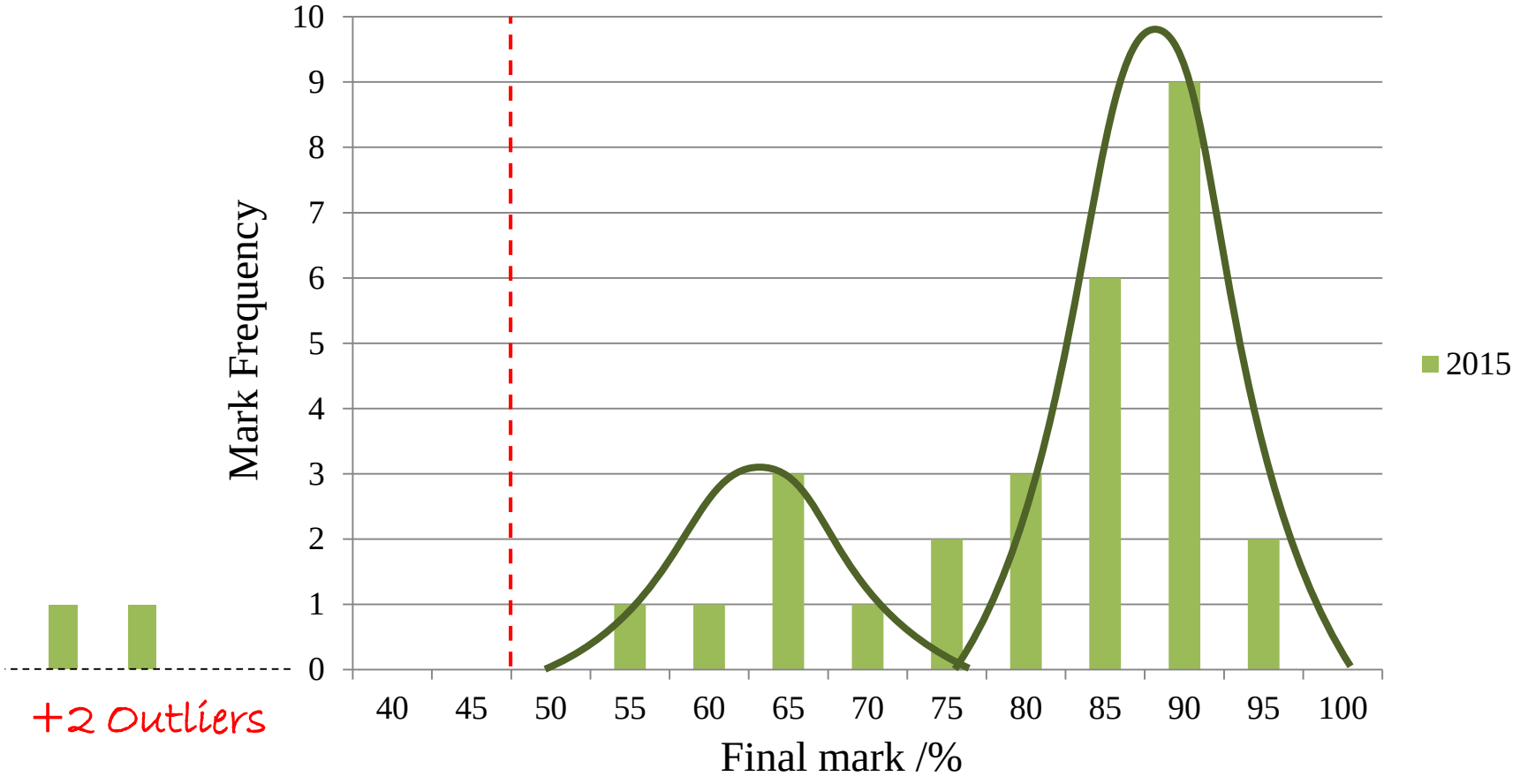
# Assessment results

- Mark clusters move over time:



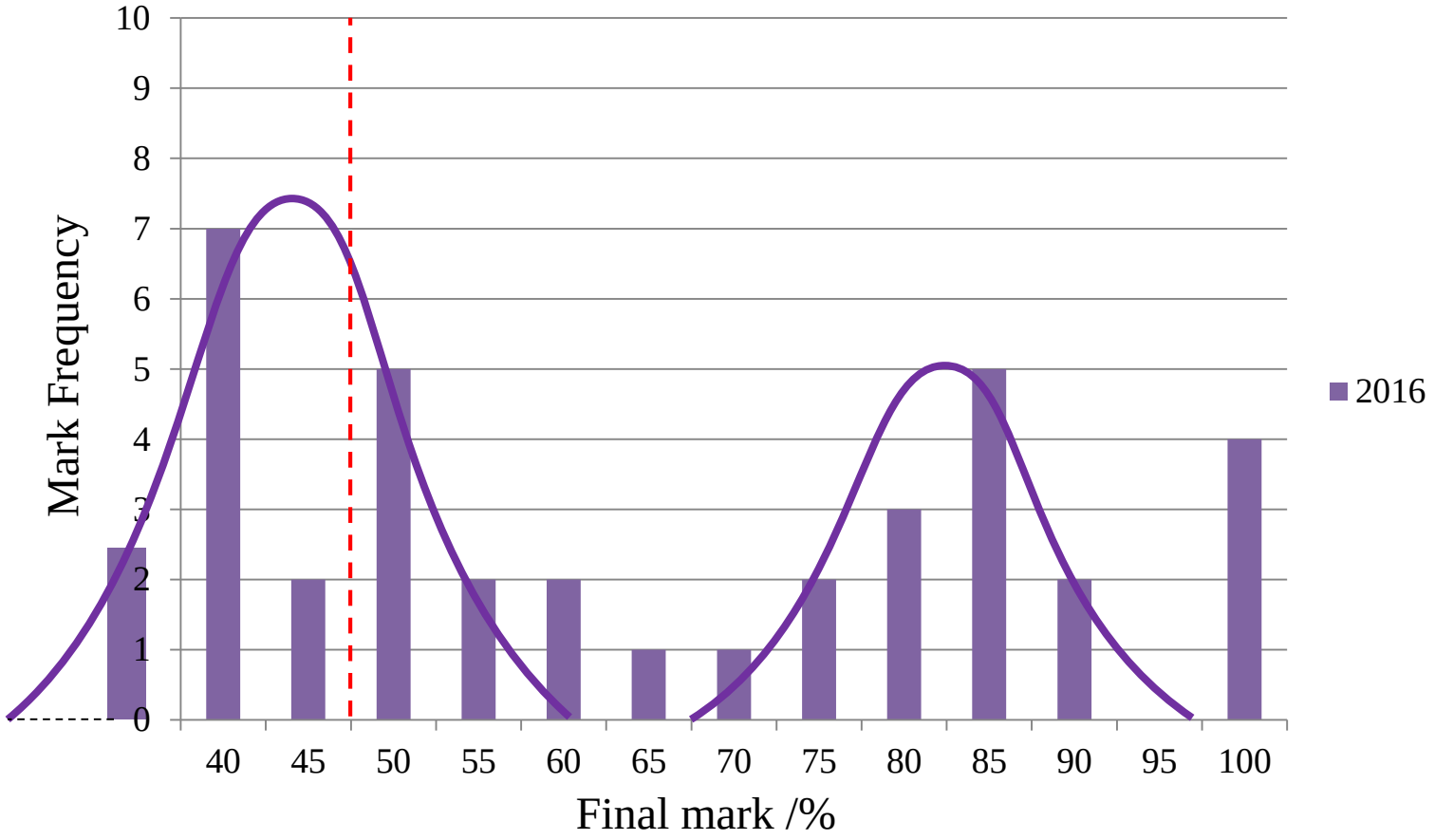
# Assessment results

- Increasing performance, but more failures



# Assessment results

- Strong successes but higher failure rate, still



# Assessment results

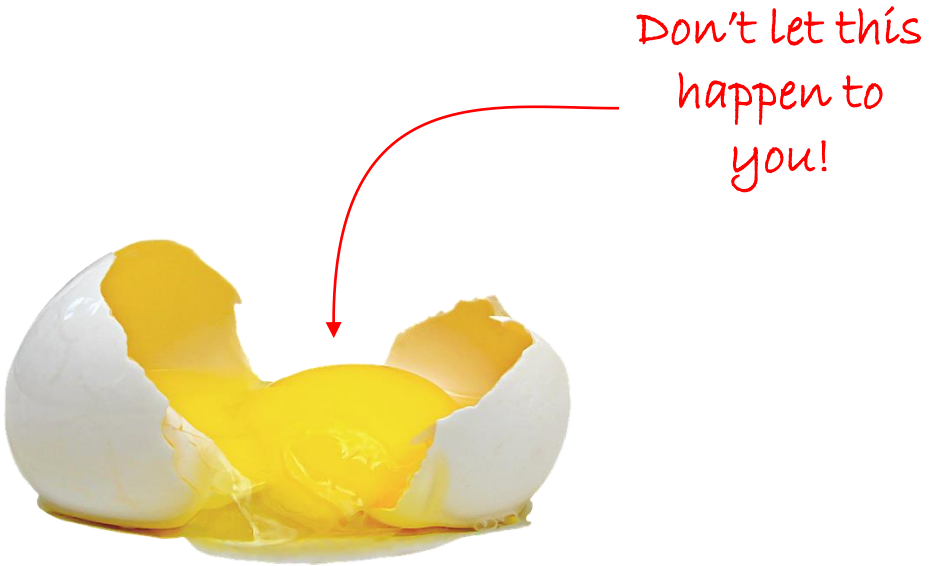
- Or, put another way:

| | Percentage of class | | | | | |
|---|---|---|---|---|---|---|
| | **≤3** | **4** | **5** | **6** | **7** | **Avg** |
| **2011** | 0 | 19 | 26 | 22 | 33 | 5.69 |
| **2013** | **0** | 25 | 24 | **19** | **32** | 5.58 |
| **2014** | **6** | 14 | 8 | **28** | **44** | 5.90 |
| **2015** | **7** | 16 | 10 | **30** | **37** | 5.66 |
| **2016** | **29** | 24 | 5 | **21** | **21** | 4.52 |

# Welcome back, frequent fliers

# This course breaks eggs

- You are probably going to find this course technically or socially challenging (or both!)
  - This is intentional



# Typical student outcomes

Student tend to fall into two broad groups:

The **Gets-its** and the **Don’t-Gets-its**

- The Gets-its work as a team, deconstruct the task rationally, try to understand the real problem, and implement a solution well
- The Don’t-Gets-its... don’t

# How to pass this course

- Work as a team
- Get started early
- Deconstruct the task logically
- Understand the *real* problem
- Implement a solution well

# How to fail this course

- Don’t contribute to your team
- Do it all at the last minute
- Don’t play nice with others
- Fixate on your pet approach
- Do lazy, effortless hacking

# Enough about other people…

Now it’s your turn

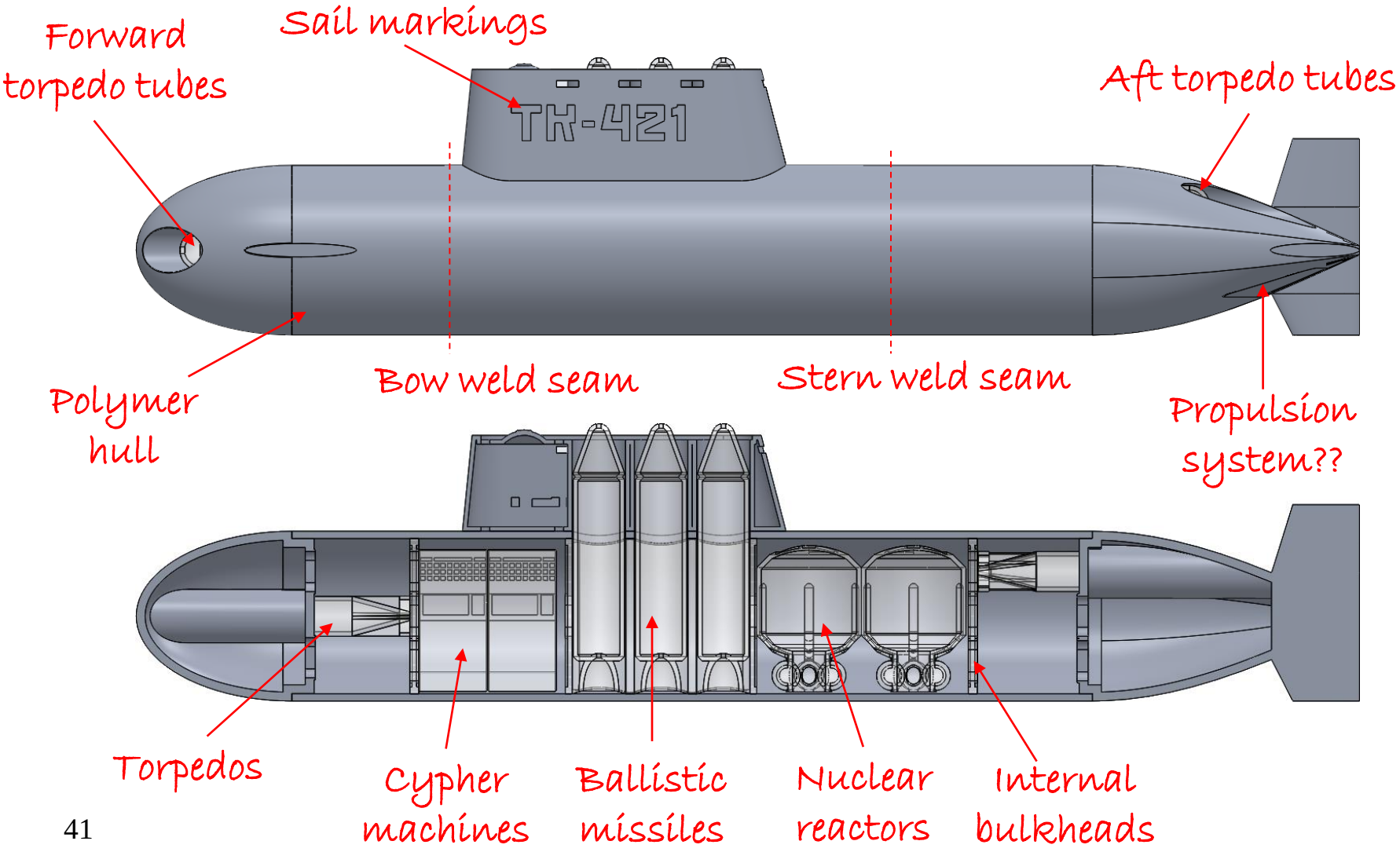
# PART 1

## The Project

# The task

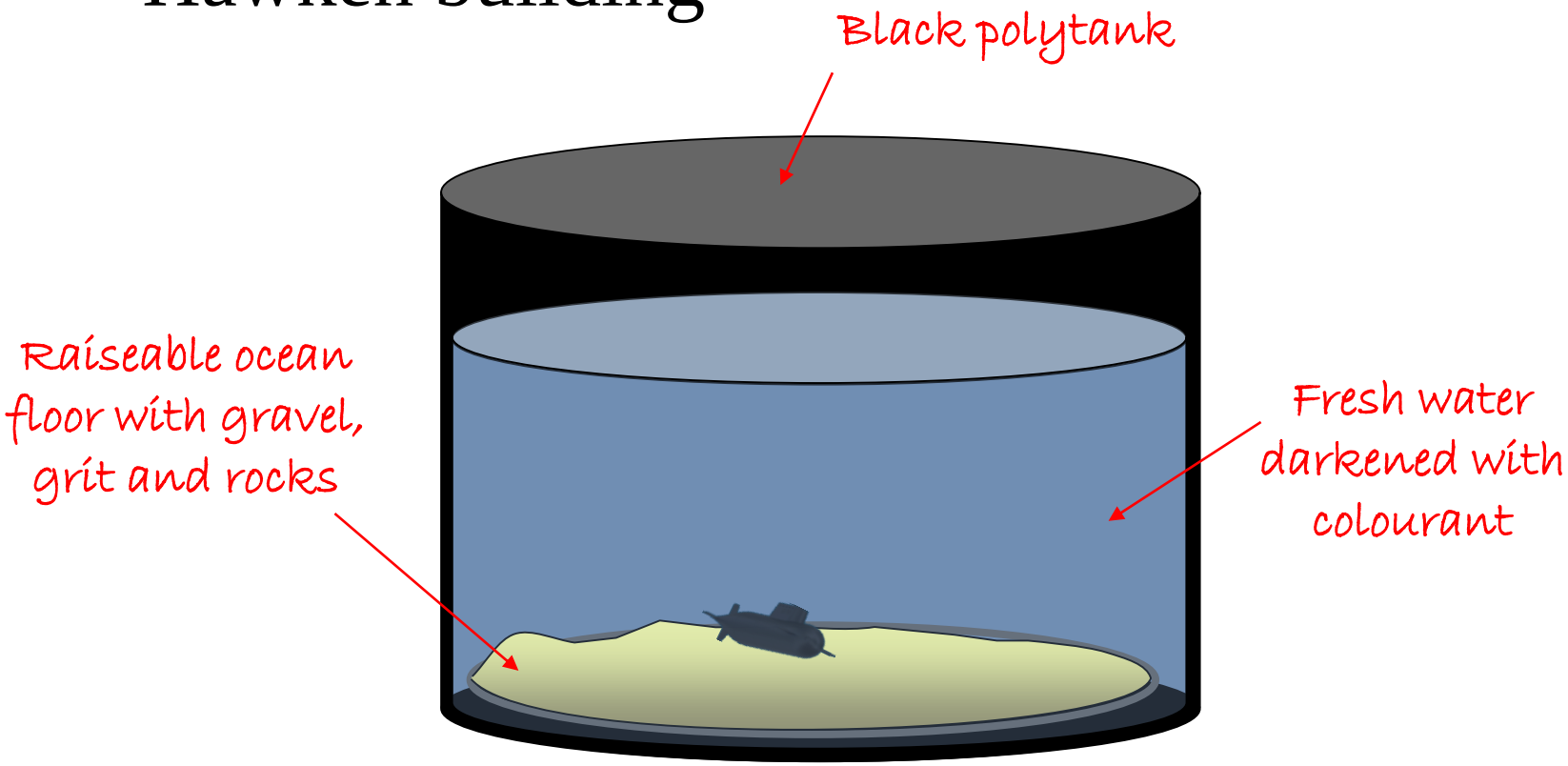
Build a system for recovering a sunken (miniature) submarine wreck from the (miniature) ocean floor

# Intelligence brief: The *Sir Nils Olav*



# Testing tank

- 2m x 2m converted rainwater tank near Hawken building



# Here are some numbers

There are a few parameters:

- Recovery time available: 25 minutes
- *Sir Nils Olav* length: 275 mm
- *Sir Nils Olav* weight: 300 – 500 g estimated
- Water depth: 1.5 – 1.75 m

Full details on restrictions and constraints are in the task specification document

# Key points

- Unlike previous years, you are not being asked to build something fully autonomous
  - Much like an open-book exam, the expectations will be correspondingly higher
- This task is intended to be *challenging*
  - Focus on getting readily achievable marks first
  - Don’t underestimate the effects of variability
  - Consider limitations on testing availability

# Scoring

- Performance will be measured with a point system for demonstrated functionality
- Points will be awarded during scheduled demonstration sessions in week 13
  - 30 minute total time for set up and test
  - Last 5 minutes reserved for pack-down/marking

See rules and description document for full details

# Functionality and scoring

| **Basic Functionality** | **25/25 Points** |
|---|---|
| Return images of the sea floor to surface | 10 |
| Locate the wreck of *Sir Nils Olav* | 10 |
| Return image of sail markings to surface | 5 |

| **Recovered items** | **30/30 Points** |
|---|---|
| Torpedo | 2 each |
| ICBM | 2 each |
| Reactor module | 4 each |
| Code cipher machine | 2 each |

| **Recovered hull sections** | **35/35 Points** |
|---|---|
| One separate section | 10 |
| Two separate sections | 15 |
| Three separate sections | 20 |
| Two joined sections | 25 |
| Two joined sections, one separate section | 30 |
| Entire submarine intact | 35 |

| **Bonus Functionality** | **10/10 Points** |
|---|---|
| TBA | |

Protip: Passing the class pretty much requires you to be able to do this

# The low energy solution

- There is often a simple, elegant low-energy solution to an engineering challenge
  - There is no ‘right’ way to solve any problem
  - Some people spend much energy on a complex solution, only to get frustrated when someone else finds a much simpler way
  - The simpler way is **more correct**; if you are struggling with your approach, maybe you need to rethink your assumptions?

# PART 2

# Assessment

# My philosophy

- Engineering is the highest, purest and most noble pursuit of the human experience
  - All else is artifice or drudgery
- You are training to be engineers, and this is a chance to actually practice engineering
- You are not your grade*
- There will be second chances

* They make me assign you a grade

# What to expect

- Expect to learn new things on your own
  - You need will need to know *more* than just what you've been taught at university thus far
- Expect to apply real effort
  - This course **actively** punishes freeloaders
- Expect to be involved
  - Lots of peer assessment; PAFs can be ***vicious***
- Expect change
  - The specifications will change (intentionally)

# A common theme

- Present analysis to justify design decisions
  - Motor torque/power calculations
  - Chassis structural load simulations
  - Clearance and tolerance of components
  - Microcontroller control cycle overhead
  - Decision matrices... and such!

If you can’t back up it up with numbers, you‘re really just **guessing**

# Deliverables

- Problem analysis – 10%
- Progress Review 1 – pass/fail†
- Progress Seminar* – 10%
- Progress Review 2 – pass/fail†
- Preliminary Report – pass/fail†
- Final Product Demo* – 60%
- Final Project Report – 20%

* Team assessment with peer and tutor weightings

† More on this later

# Problem analysis

Due March 10th – 10% (2 pages max)

- Break down the design problem, determine its scope, requirements and constraints.
- Describe the key underlying engineering design challenges – what makes this hard?
- Present a candidate solution, and explain how your approach addresses the problem.
  - Analysis is golden.

# Progress Reviews 1 and 2

Due 20 – 24 March and 8 – 12 May

- Tutor-mediated meetings
- Demonstrate your progress in the preceding period with tangible **evidence** of your contributions – eg. prototypes, code, etc
- Pass/fail mark based on quality of work and relative progress towards the goal

**EXPECT NO MERCY.**

# Statement of roles

New this year:

- At Progress Review 1, your team will be required to present a statement of team member roles signed by the whole team.
- Roles must be clearly defined
- You will be expected to account for your responsibilities at subsequent reviews

# Progress Seminar

Due 10 – 14 April (team assessment) – 10%

- Provide a 10 minute seminar outlining progress towards developing a solution to the problem.
  - Focus on the progress, not the approach
  - Each student presents for roughly equal time
- Assessed by course coordinator and tutors

# Preliminary Report

Due 19 May

- Describes the methodical analytical approach to solving your subtask, how it relates to the other subsystems within the project and the analytical process that was used in developing the solution.
- Show the formal, disciplined, quantitative engineering process followed, demonstrating the feasibility of the approach taken.

# Final Product Demo

Due week 13 (team assessment) – 60%

- The Main Event – show your system works!
- Marks awarded for functionality, achievements and build quality.
- Hand in everything needed to make your system work, including documentation and printouts of design schematics.

**Above all: Convince me you can *engineer*.**

# Final Report

Due 2 June – 20 %

- Identical to the preliminary report, but incorporating corrections and reflecting any changes from the final two weeks.
- Preliminary report will be returned with comments so that you have an opportunity to revise your work and improve upon it,

*Just like in real life!*

# Incremental demos

- Spontaneous night-before failure of hardware systems is **brutal** and **unfair***.

  *Just like real life!*

- If your system is sort-of working early, you can have it tested in an incremental demo.
  - If the final demo mark is less than what was scored in an incremental demo, you will be awarded the incremental demo mark.

# Incremental demos

- Scored just like the final demo, but the mark is capped according to time left in semester
  - Week 7: 25%
  - Week 9: 50%
  - Week 11: 75%
- Incremental demos are by appointment only*

* Do not attempt a demo with an obviously non-functional system or you may forfeit future incremental demo privileges

# Pass/fail penalties

- Subpar (or absent) pass/fail submissions incur a deduction from your final grade
  - Project reviews: 5% each
  - Preliminary report: 10%
- These deductions are *cumulative*
  - If you were to fail all of them, your maximum achievable grade for the course would be 80%

# PAF and TAF

- A substantial fraction of assessment is peer-moderated; others are tutor-moderated
  - Regularly adjusts results by up to **2 grades**
- It's vital your team recognises your efforts
  - A bitter or frustrated team means a low PAF!
- Ultimately, peer and tutor weighting is mediated by the course coordinator

# Peer assessment

- At progress reviews, progress seminar and final demo, you will fill out PAFs
- Your demo mark will be scaled by all of the PAFs, according to a weighting scheme:
  - Progress review 1: 10%
  - Progress seminar: 20%
  - Progress review 2: 30%
  - Final demo: 40%

# Calendar at a glance

You are here

Teams assigned here

| 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 | PCB design tips | 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 | |
| Break | 17/4 – 21/4 | | | | |
| 8 | 24/4 – 28/4 | Switch to Q and A sessions | | | |
| 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 |

Try to work ☺

Madness week

# PART 3

# Class Organisation

# Blackboard and splashy website

- This class has a Blackboard page and a "splashy" outwards-facing website
  - If the two ever differ (which they won't), the Blackboard page is considered authoritative

Blackboard: learn.uq.edu.au/

Splashy: robotics.itee.uq.edu.au/~metr4810/

# Weekly schedule

- Lectures – 2 hours once per week
  - Professional topics and Q&A sessions
- Practicals – 2 hours twice per week
  - Tutors available in lab (but 24/7 access)
- "Contact" – 2 hours twice per week
  - Time set aside for meetings, demos, etc.

Your team should meet and interact continuously outside of class – *at least* once per week

# Class clashes

I am aware of some clashes with other classes

- Most notably METR4900 and COMP4702
  - This will ruin your life – plan accordingly
- Any others I've missed?

All lecture content will be online

Major announcements go out via Blackboard

… but you'll hear it first in class

# Lectures

- Boring, useless lectures help *nobody*
- I will endeavour to provide lectures that are educational, useful and (sort of) entertaining
- Lectures will be student-driven: you tell me what you want to learn about and I'll teach it

# Lectures

- Lecture 1: Introduction to the project
- Lecture 2: Principles of mechatronics system design
- Lecture 3: Professional engineering topics
- Lecture 4: PCB design tips
- Lecture 5: Your soldering is terrible (probably)

Topics may be nominated by emailing me, and then voted for on a doodle poll

# Lectures

- No, you don't *have* to attend lectures, but if you don't you're really missing out
  - Protip: Students who attend lectures historically do better than those who don't!
- Lectures are the first and most immediate way of hearing about what's happening and getting your questions answered
  - Note: recordings aren't interactive

# Some suggested topics

- Principles of teleoperation control
- Vehicle dynamics
- Digital control
- Electromechanical devices
- Computer vision
- Sensor-fusion and filtering
- Localisation
- Schopenhauer and philosophical pessimism

# Teams

- Teams will each consist of four people
  - Except for when they don't
- Teams will each be assigned a tool kit
  - Complete kit must be returned ***or else***
- Work together! Contact sessions are set aside for team meetings and collaboration

# Teams

- You will have to work with people you hate*

  *Just like in real life!*

- You may email me and request one person with whom you do not want to work
  - Exclusion requests must be in by Friday
- Otherwise, teams will be allocated by *magic*
  - Teams will be assigned in week 2

*If you don't hate them now, you will by the time you're done

# Laboratory space

- Far more students this year (new friends!)
  - The lab space is really going to suck ... I think
- Consequence: be neighbourly
  - New (smaller) lockers for project work
  - Shared space and resources
  - Get started early; consider how you can work most effectively in the final two crunch weeks

# <eyeofsauron>

# Laboratory space

- The laboratories are governed by the UQ risk management policy
- To work in the lab:
  - You **MUST** have completed the induction
  - You **MUST** have read the lab risk assessment
  - You **MUST** wear appropriate footwear
  - You **MUST** abide by all safety requirements
- If you do not follow the guidelines you will be barred from the lab

# Laboratory space

- Just in case you forgot:
  - No eating/drinking in the lab
  - No sleeping in the lab
  - No non-METR4810 students in the lab
  - The lab is not for facebook/tindr/grindr/gaming/ socialising/having a life etc.
  - I am held personally responsible for the safety and condition of the lab and I get ***very*** grumpy.

So don’t say you weren’t told.

# Laboratory space

- Keep the lab clean and orderly
- Cleanliness "warning light" system in effect
  - Status noted on Blackboard/class website

Green: Full speed ahead

Yellow: Clean up needed

Red: *Danger, Will Robinson!**

**Black**: "*Uh oh.*"**

*Lab will go to limited hours until cleaned.

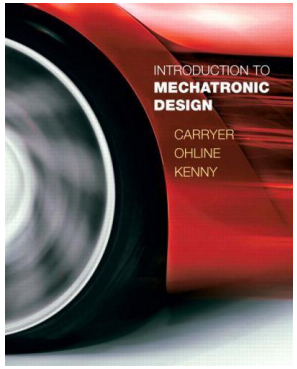
**Lab will be locked until further notice.

# </eyeofsauron>

Keeping the lab tidy makes for a nicer place to work and makes it easier to get stuff done

# Resources

- Website
  - Everything will be posted on the Blackboard class website: (learn.uq.edu.au)
  - Better-looking class website will mirror course materials: (robotics.itee.uq.edu.au/~metr4810)
- Textbook
  - "Introduction to Mechatronic Design" by Carryer, Ohline and Kenny




(recommended but not required)

# Knowledgeable people

- Course Coordinator and Chief Conspirator:
  - Paul Pounds
- Technical Staff
  - Peter Bleakley
  - Ray White
  - Dejan Subaric
  - Grant Tayles
  - Doug Malcolm
- Tutors:
  - William Deer
  - Iain Rudge
- Emergency Auxiliary Temporary Back-Up Replacement Stand-in Teaching Faculty
  - Dr. Surya Singh
  - Dr. Michael Kearny

# Contact info

If anything is bothering you, bring it up *early*

- Rules questions
- Technical issues
- Ordering
- Assessments
- Group problems
- Enrolment
- Disenfranchisment with the sociopolitical gestalt

➢ Serious? Email first to arrange a meeting

➢ No? Just stop on by! (but email is good too)

# On that topic…

- I often get comments in the SECaTs about things that *could* have been addressed during the semester if I'd been told about it
- Don't wait until you're angry in week 13
  - Tell me about it as soon as it comes up so I can explain it/solve it/fix it/find it/sort it right away
- I'm always happy to help! ☺

# Contact info

Who: Me!

Why: Questions, issues, concerns, ennui!

Where: GPS 78-529 or Wordsmiths

When: 10ish to 4ish – by appointment (or drop in)

What: Coffee or coke (either kind)

How: paul.pounds@uq.edu.au

# What happens next?

- Send me group exclusion requests
  - Email me ASAP!
  - Groups will be posted next week
- Attend the afternoon practical session in Hawken c404 Thursday 9th March
  - Toolbox handouts
  - Room induction, 3D printer induction

And start thinking about solutions!

# Tune-in next time for…

Principles of Mechatronic Systems Design

*or*

"Striking a Balance is Making Everybody Equally Unhappy"

Fun fact: Brigadier Sir Nils Olav III is the most senior member and colonel-in-chief of the Norwegian King's Guard.

# Questions?

?