



# Aerospace Engineering for Computer Scientists

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Major: Aerospace Engineering

Minors: Computer Science and German

Co-Lead for BLiSS M-HHaPS Project

NASA CALIPSO team member

Former NimblePros junior developer



# Trajectory

1. Spaceflight History
2. Systems Engineering
3. Satellites
4. Manned Spaceflight

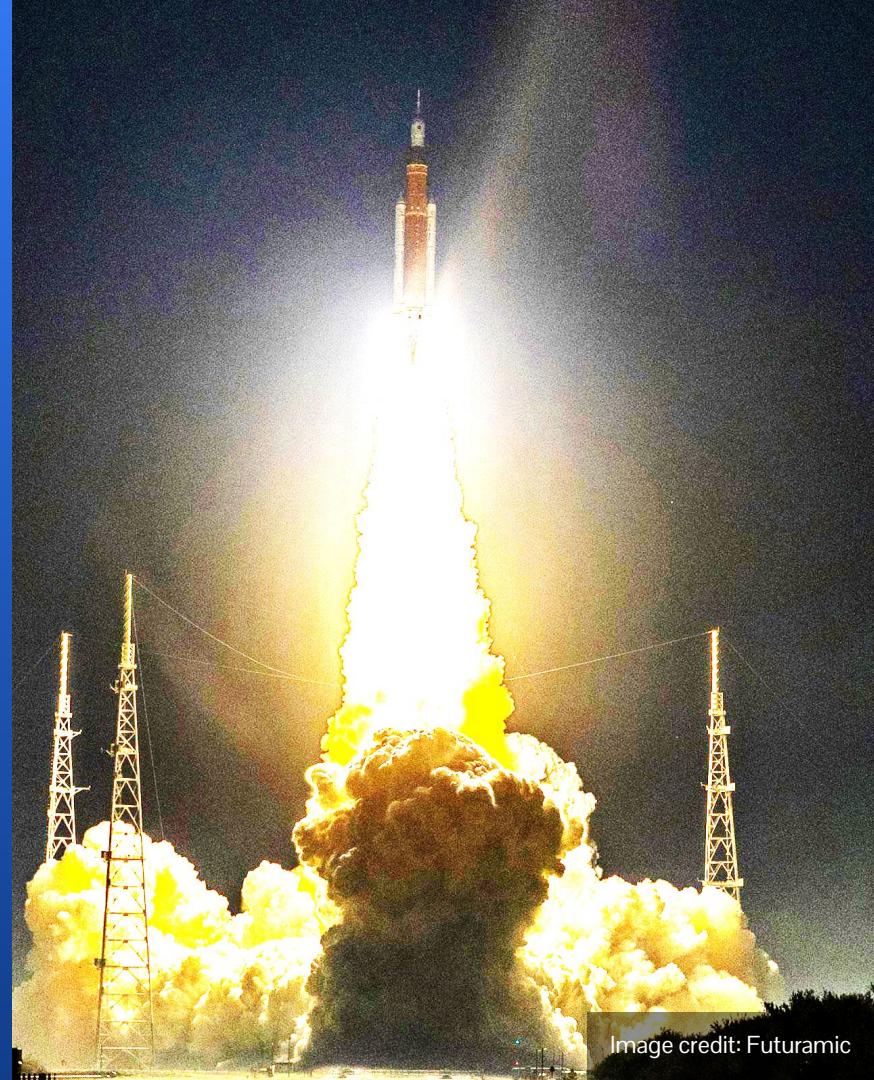


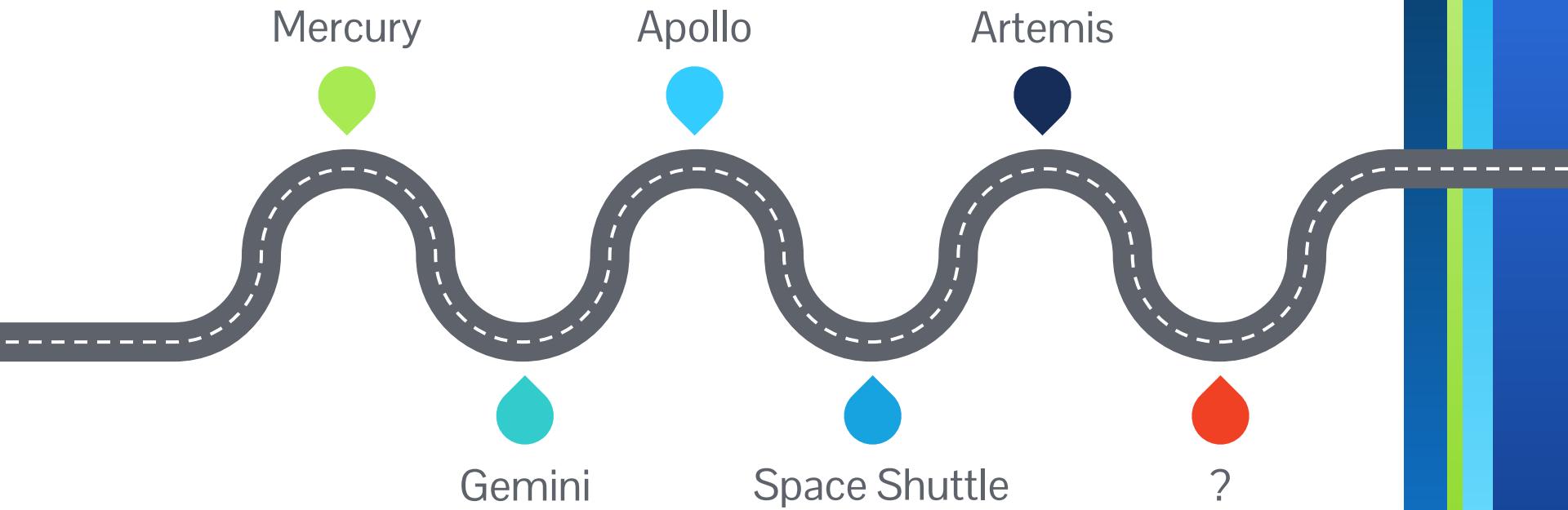
Image credit: Futuramic

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# Spaceflight History for Computer Scientists

An Overview

# American Manned Spaceflight



# American Manned Spaceflight

Mercury



Apollo



Artemis



Gemini

Space Shuttle

Project Mercury: 1958-1963

**First American in Space**

**First American to orbit the Earth**

Image credit: HistoryToday.com



Image credit: Kennedy Space Center

# American Manned Spaceflight

Mercury



Apollo



Artemis



Gemini



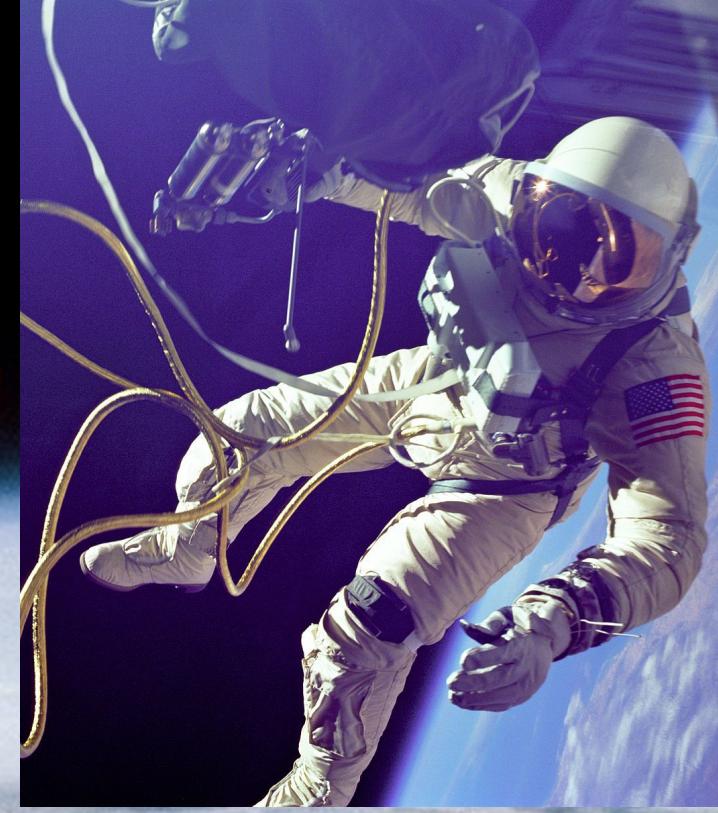
Space Shuttle



?



**Project Gemini: 1964-1966**  
**First American Spacewalk**  
**First Space Rendezvous**  
**First Space Docking**



# American Manned Spaceflight

Mercury



Apollo



Artemis



Gemini



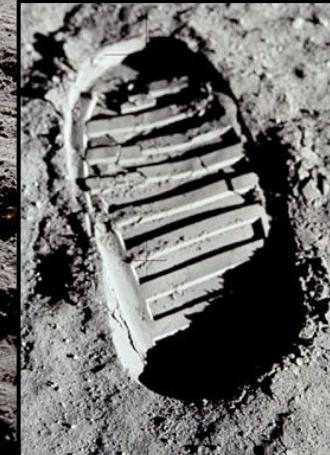
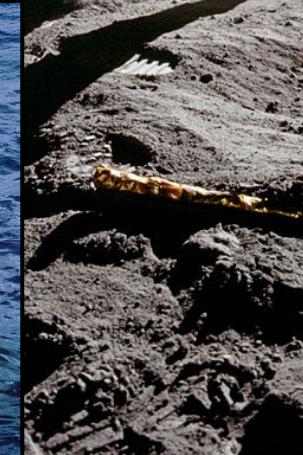
Space Shuttle



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# Project Apollo: 1967-1972 First Man on the Moon



# American Manned Spaceflight

Mercury



Apollo



Artemis



Gemini



Space Shuttle



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# Space Shuttle: 1981-2011 First Reusable Spacecraft



# American Manned Spaceflight

Mercury



Apollo



Artemis



Gemini



Space Shuttle



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# Artemis: 2022-? Return to the Moon



Images credit: NASA.gov

# American Manned Spaceflight

Mercury



Apollo



Artemis



Gemini



Space Shuttle



?

# What's next?



Image credit: Quora



Image credit: IMDB



Image credit: NPR



Image credit: The Aviationist

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# Systems Engineering for Computer Scientists

How did we get to the Moon? And how are we going to get to Mars?

“

*Apollo was much more a management exercise than anything else... the technological challenge, while... impressive, was largely within grasp at the time of the decision. More difficult was ensuring that those technological skills were properly managed and used.*

- James Webb, paraphrased in “Project Apollo: A Retrospective Analysis”

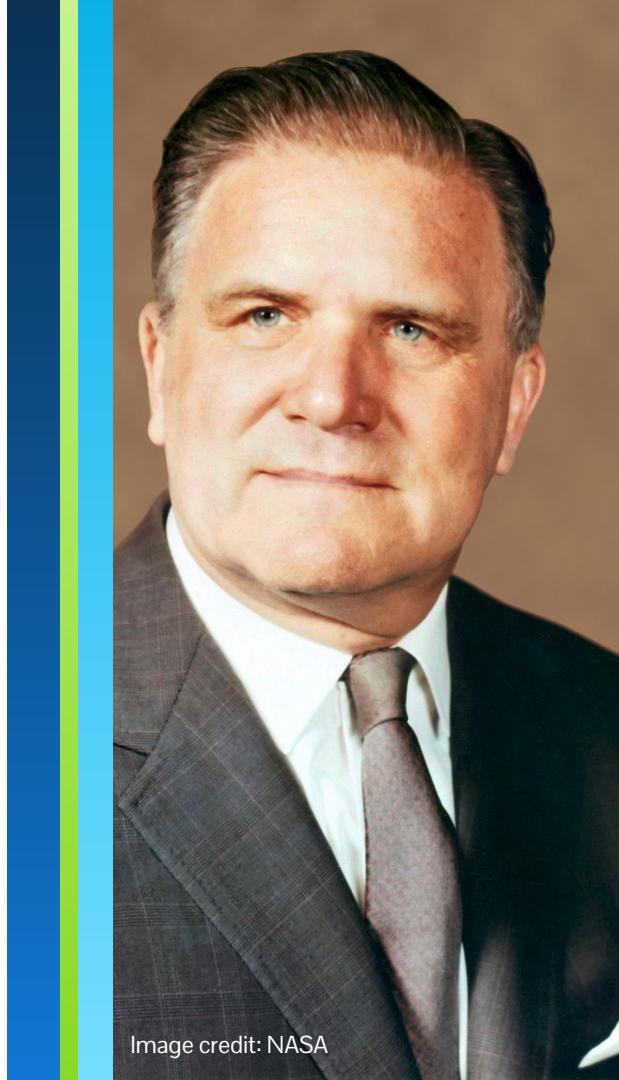
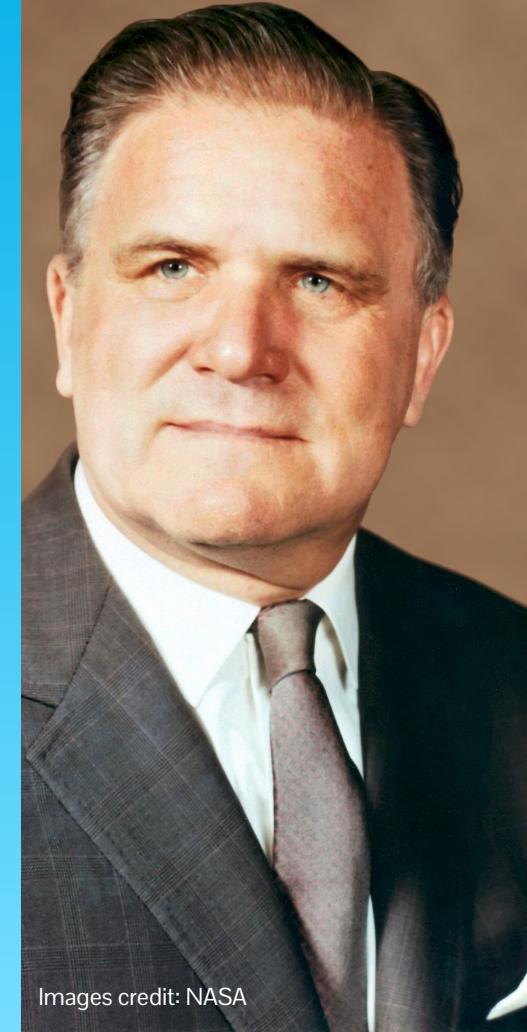


Image credit: NASA



Images credit: NASA



“

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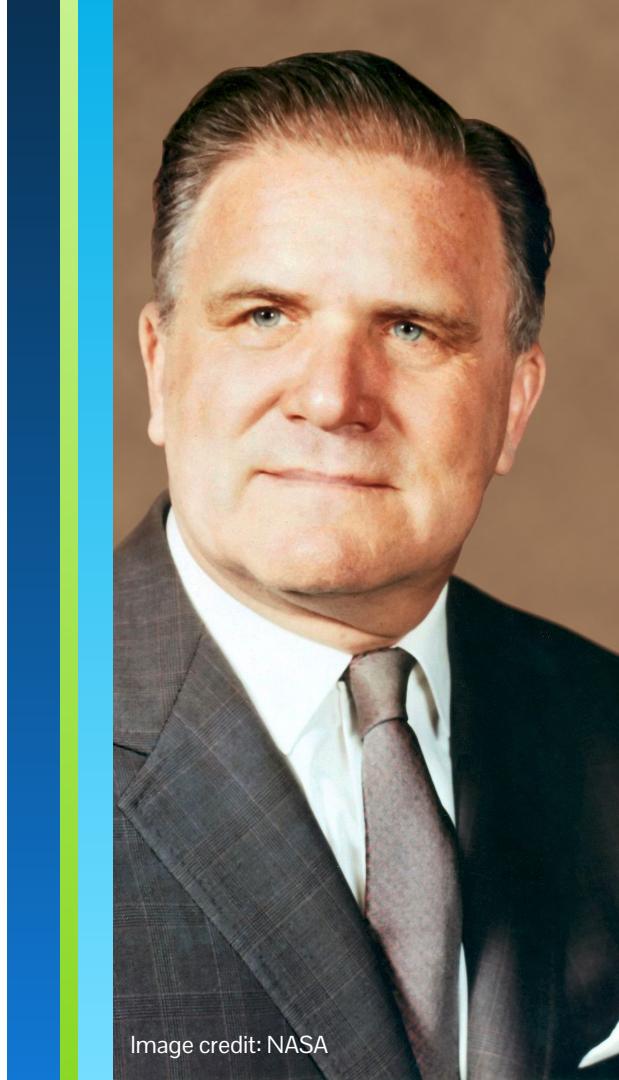
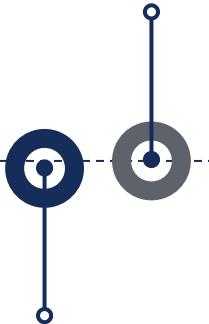


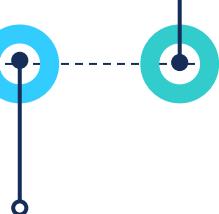
Image credit: NASA

# Project Apollo Timeline

Feb. 1958:  
1st American  
satellite (Explorer 1)



Sept. 1962:  
“We choose to go  
to the Moon”



1969:  
Apollo 11 lands  
on the Moon



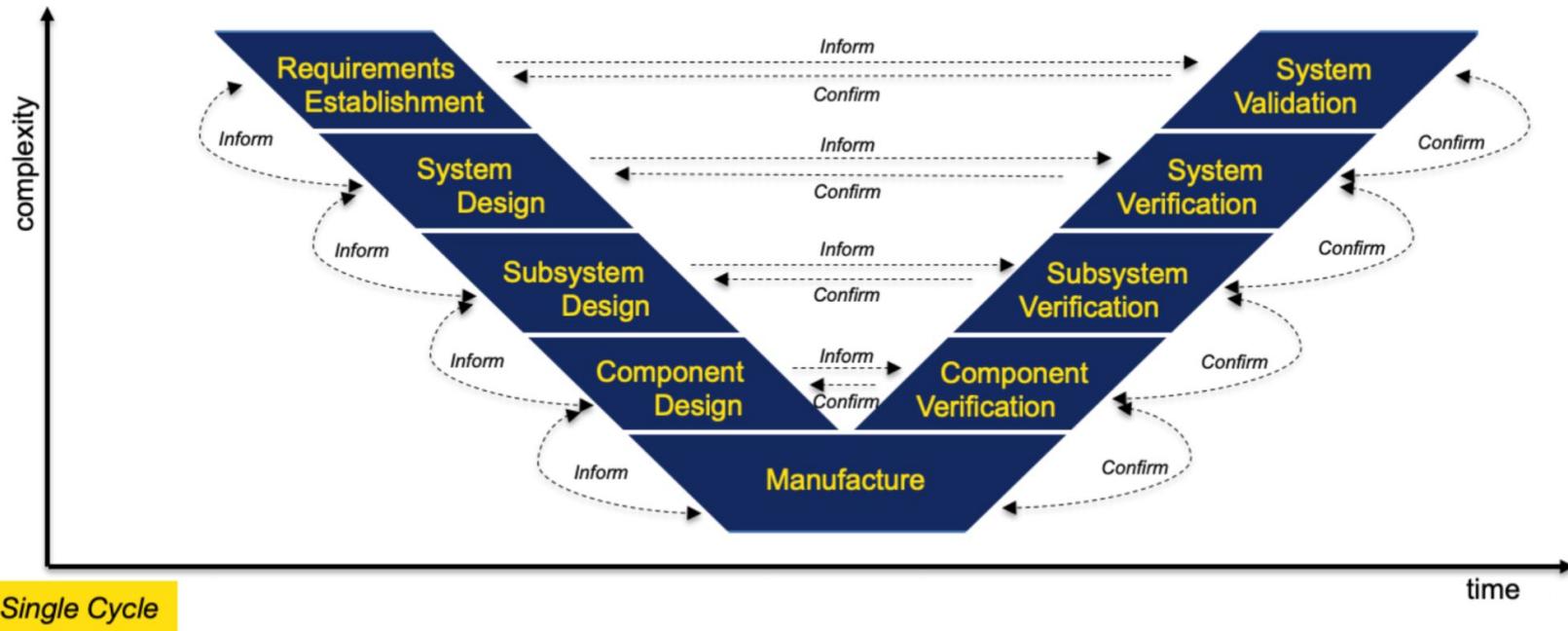
Oct. 1957:  
1st artificial  
satellite  
(Sputnik)

May 1961:  
1<sup>st</sup> American in  
Space



Image credit: NASA

# Systems V





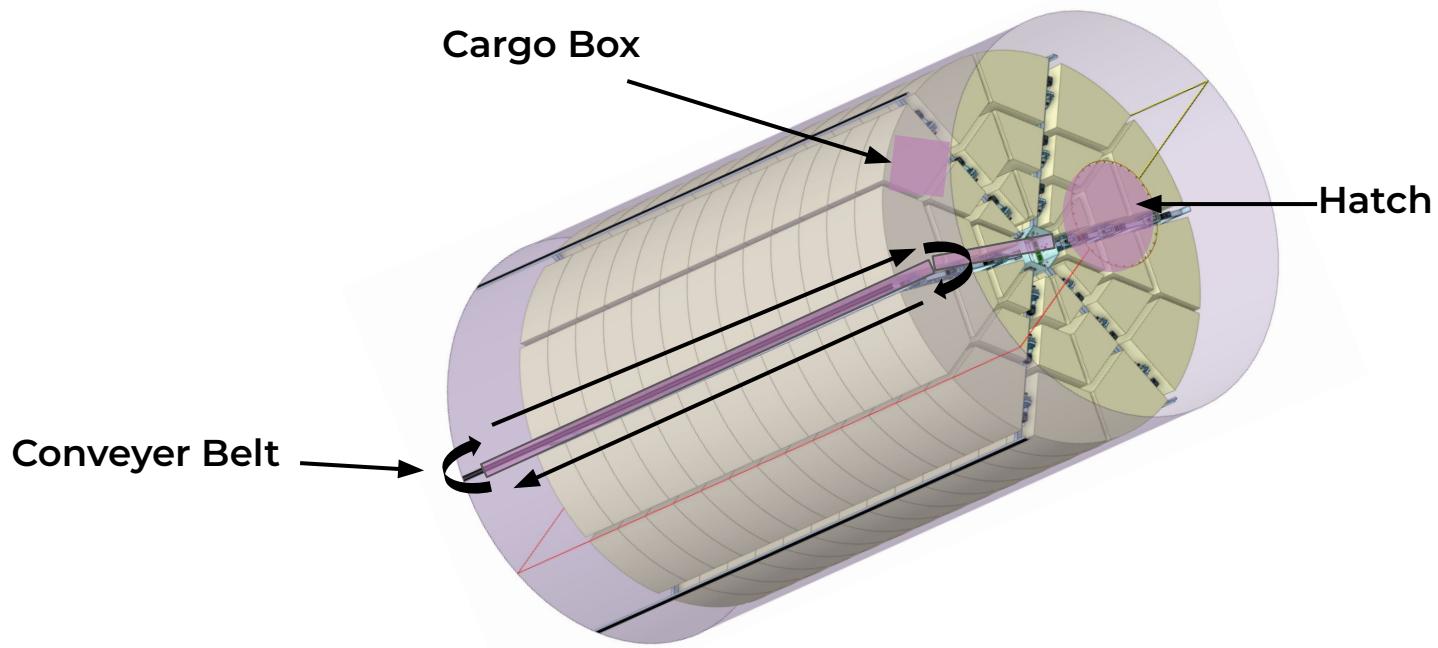
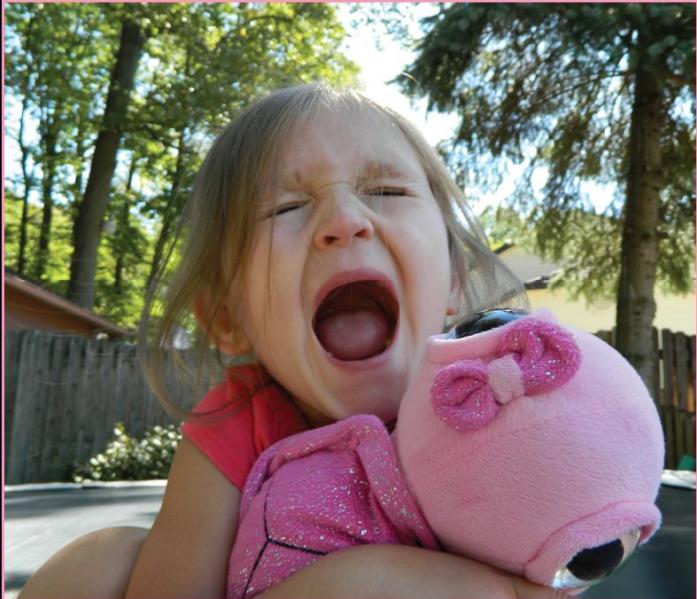




Image credit: BLiSS



## COLLECTIVE CODE OWNERSHIP

That's myYYYYYY code!!!



# Collective Code Ownership



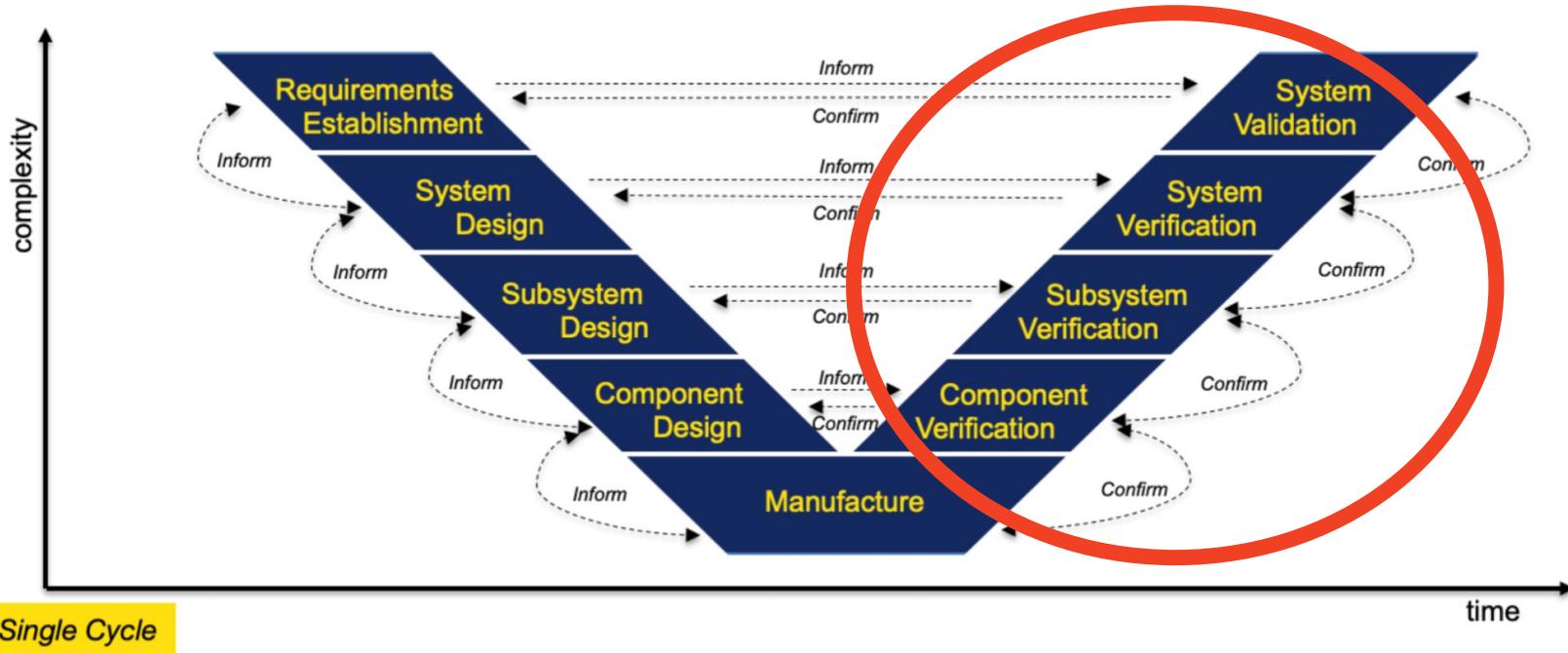
# Bus Factor

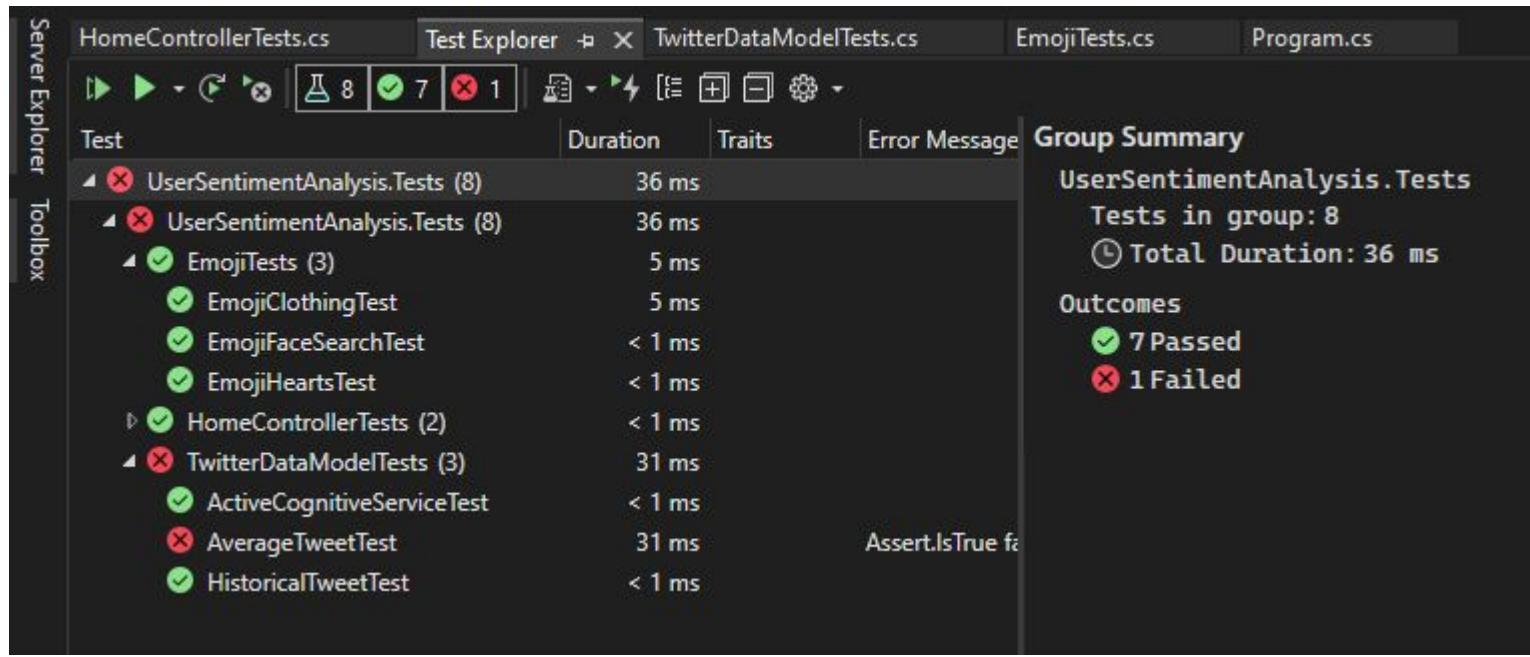


BUS FACTOR

Better cancel Bob's projects...

# Systems V





## Red-Green-Refactor

# Gilded Rose Kata

“Hi and welcome to team  
Gilded Rose!



<https://github.com/ardalis/GildedRoseStarter>

# Gilded Rose Kata

“Hi and welcome to team Gilded Rose!

...

Feel free to make any changes to the UpdateQuality method and add any new code...  
However, do not alter the Item class or Items property as those belong to the goblin in the corner who will insta-rage and one-shot you as he doesn't believe in shared code ownership.”



<https://github.com/ardalis/GildedRoseStarter>

# Gilded Rose Kata

“Hi and welcome to team  
Gilded Rose!



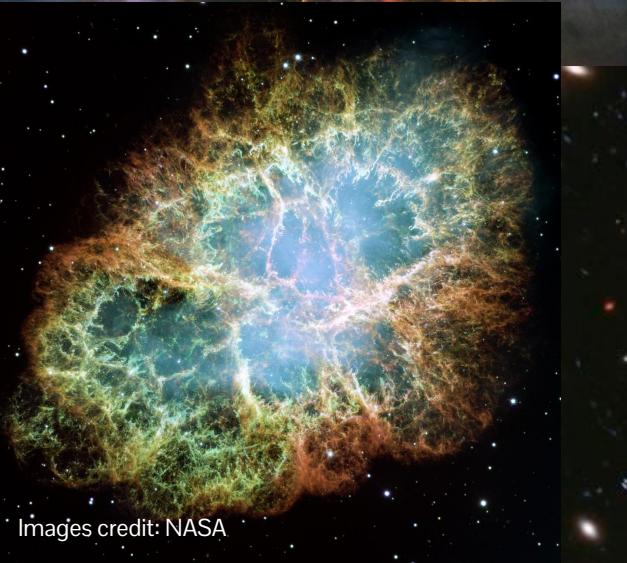
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3

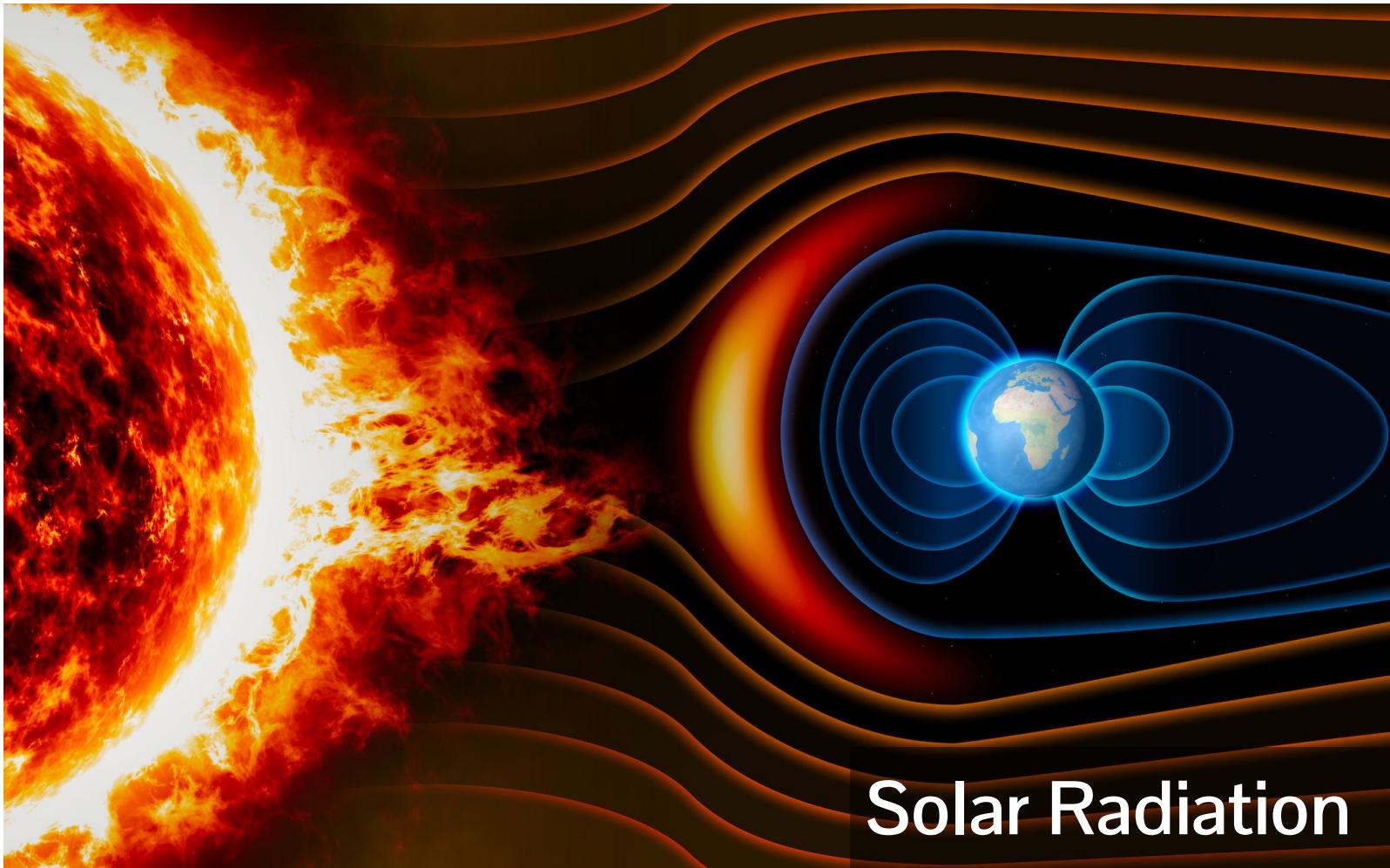
# Satellites for Computer Scientists



Images credit: NASA

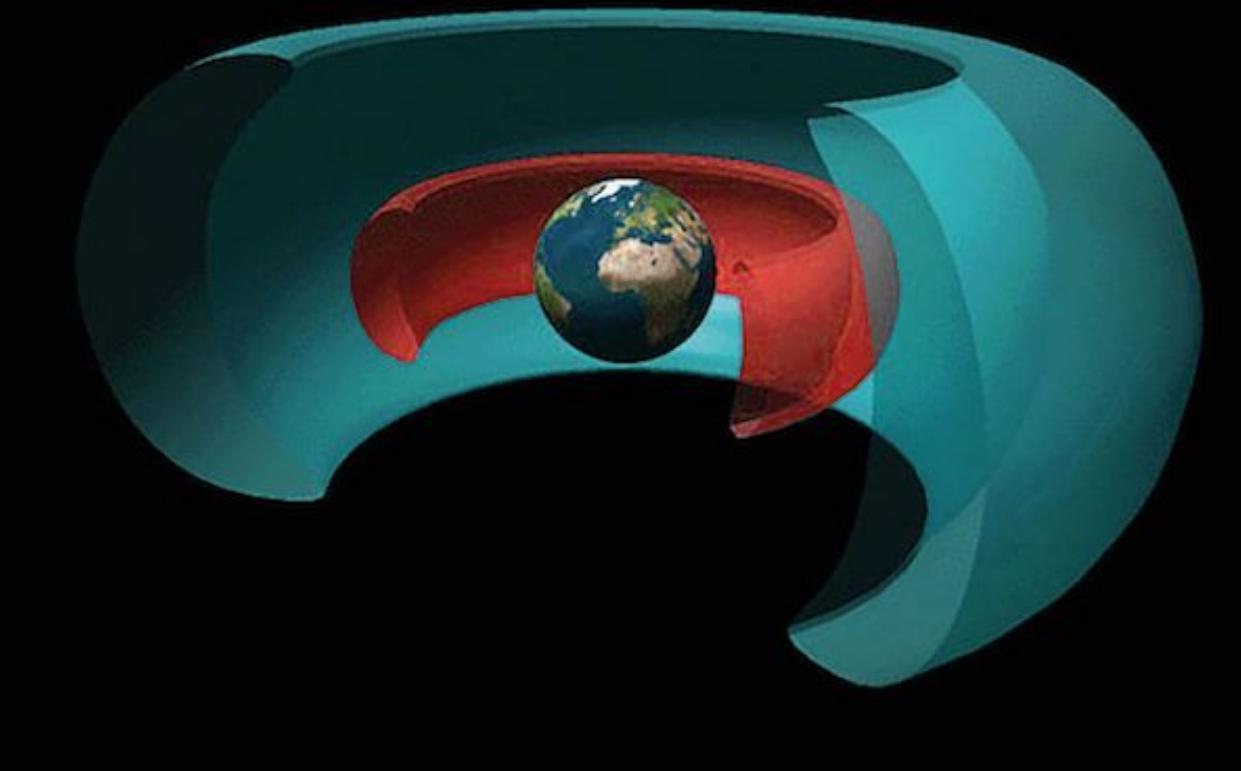


Images credit: NASA

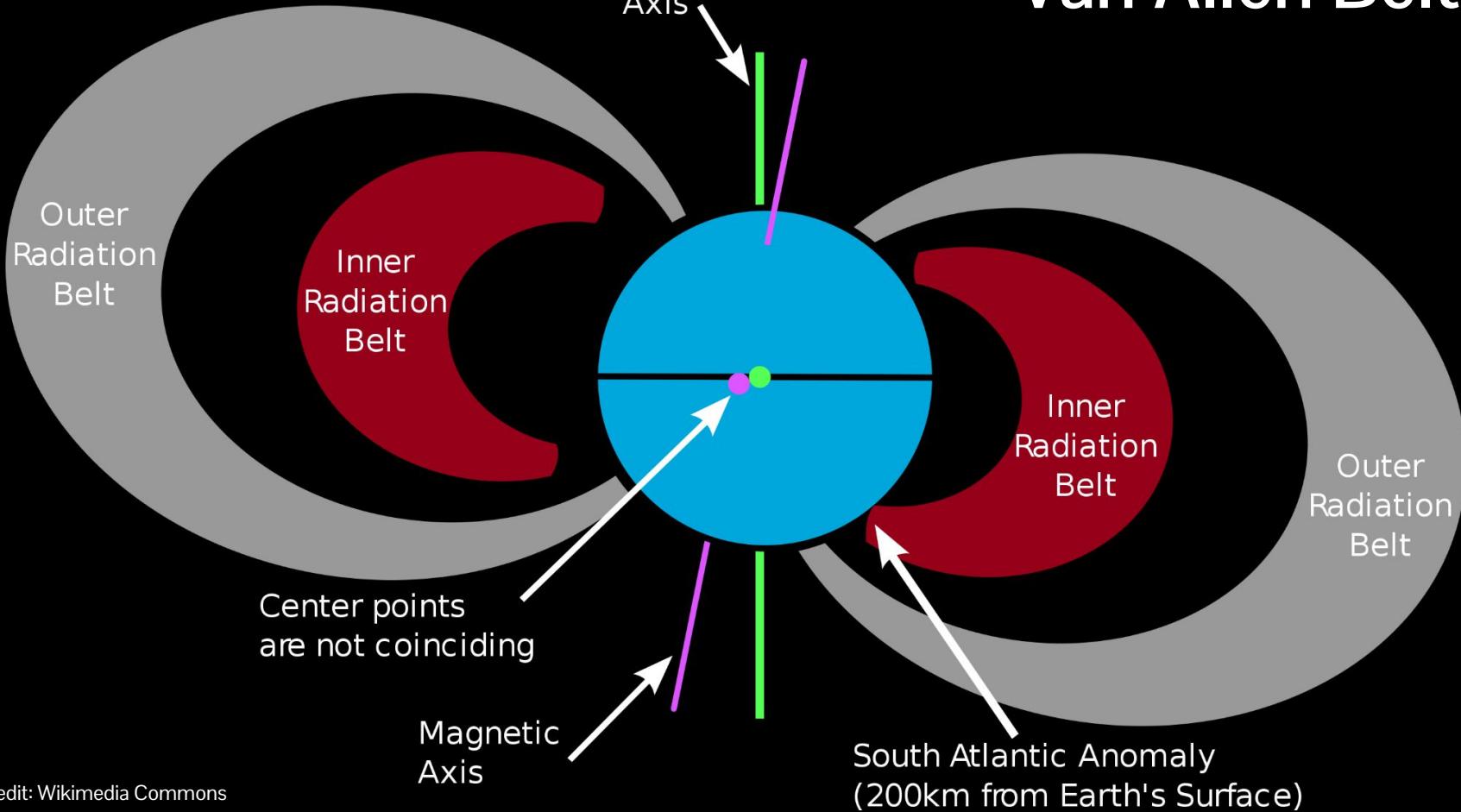


# Solar Radiation

# Van Allen Belts

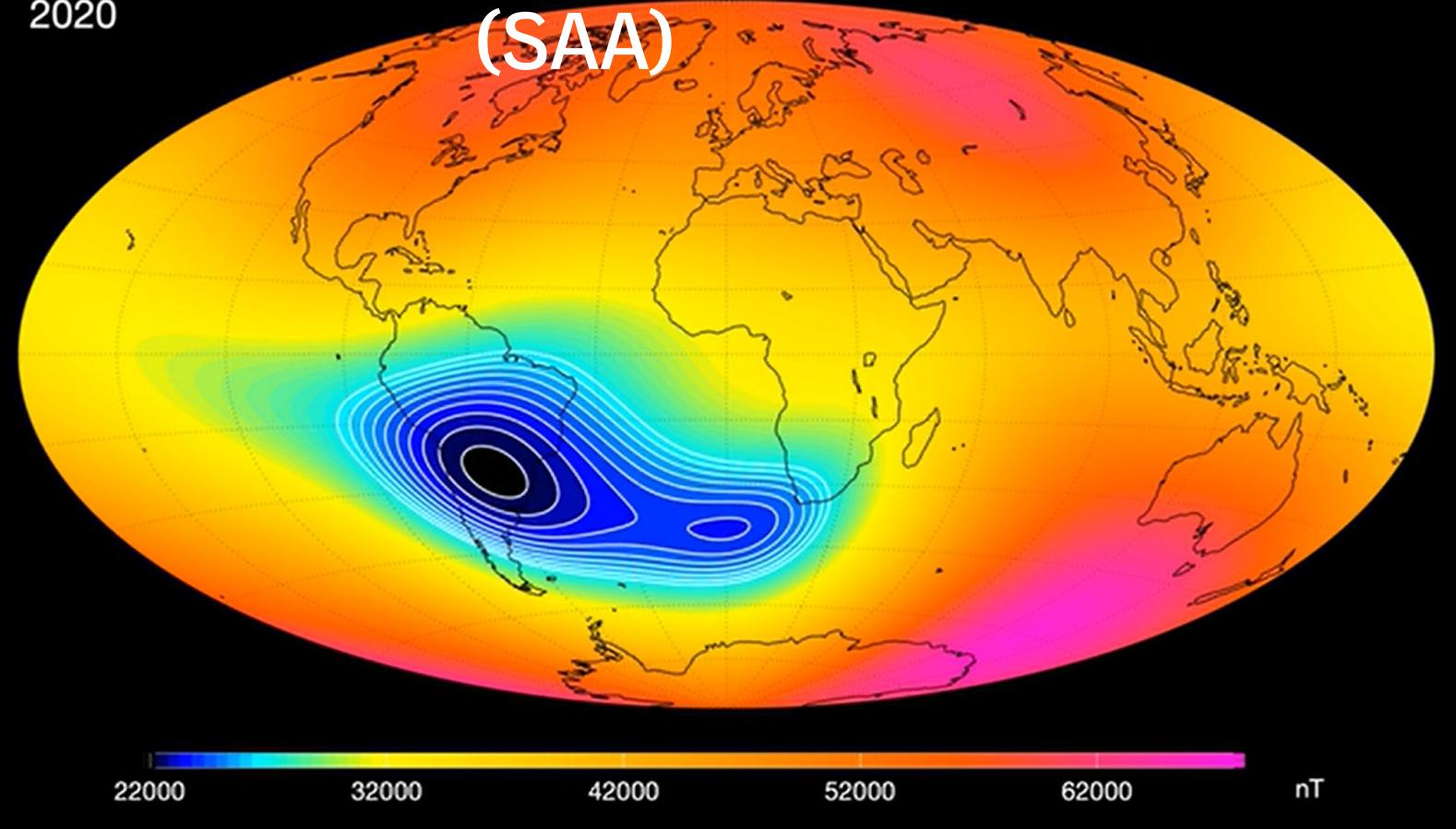


# Van Allen Belts



# South Atlantic Anomaly (SAA)

2020

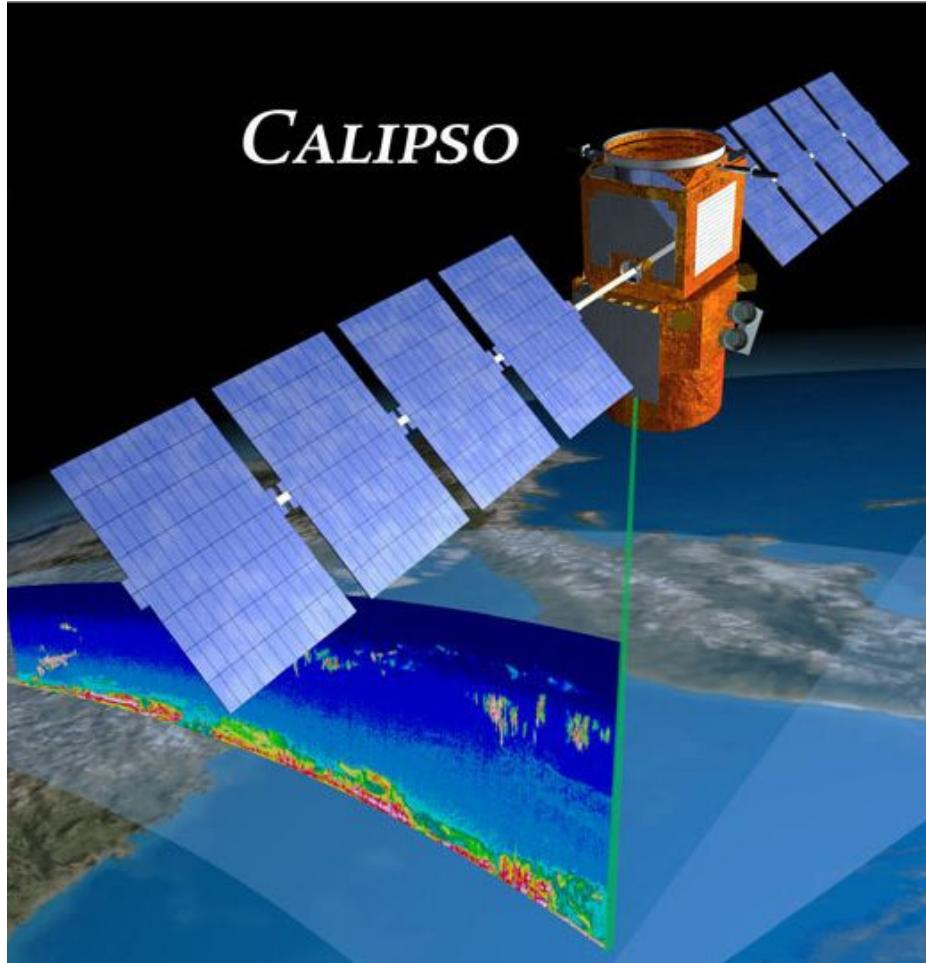




# Hitomi

February-March 2016

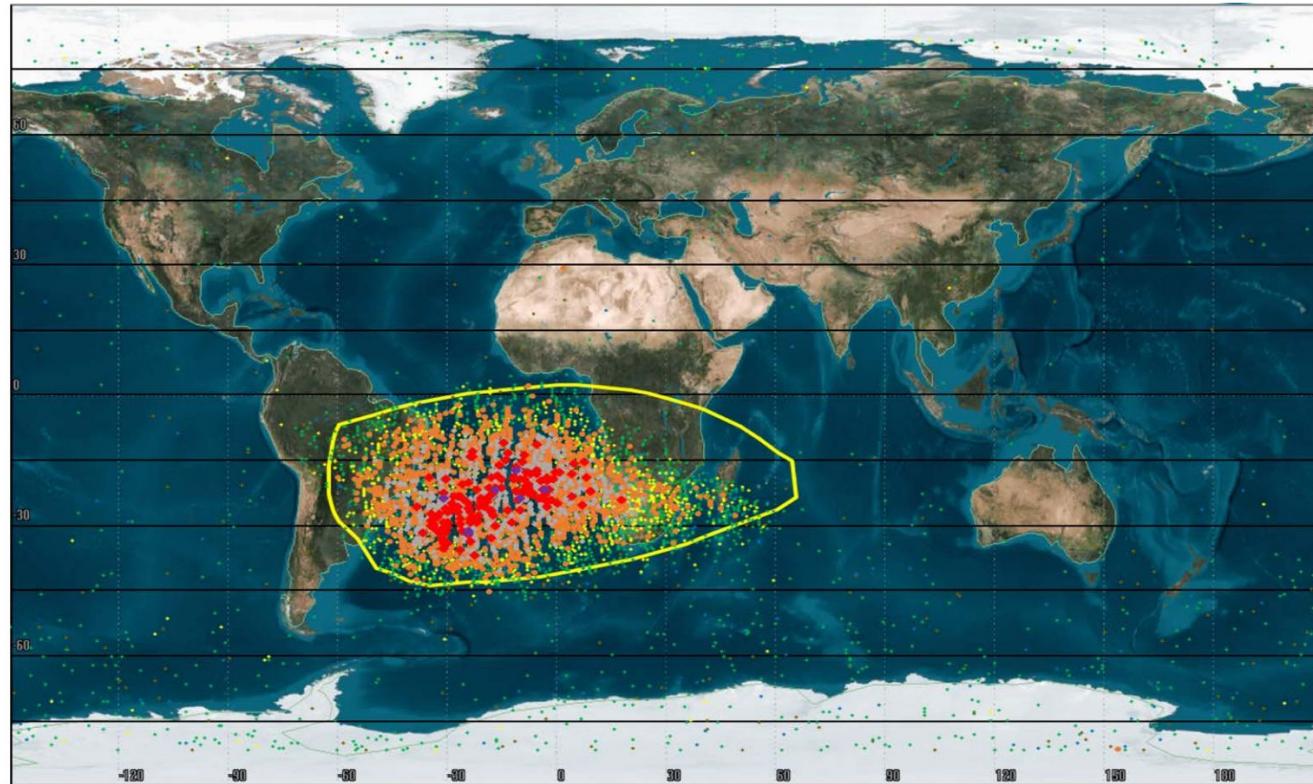
Images credit: JAXA



CALIPSO images credit: NASA



## All Laser Energy Drop Locations August 01 through August 16, 2018



Date Range	Total	$E < 1$ (mJ)	$1 < E < 2$ (mJ)	$2 < E < 5$ (mJ)	$5 < E < 10$ (mJ)	$10 < E < 20$ (mJ)	$20 < E < 30$ (mJ)	$30 < E < 40$ (mJ)	$E > 40$ (mJ)	MAX (mJ)
08/01-08/16/18	6832	367	261	2555	1344	1544	616	138	7	45.3

Images credit: NASA



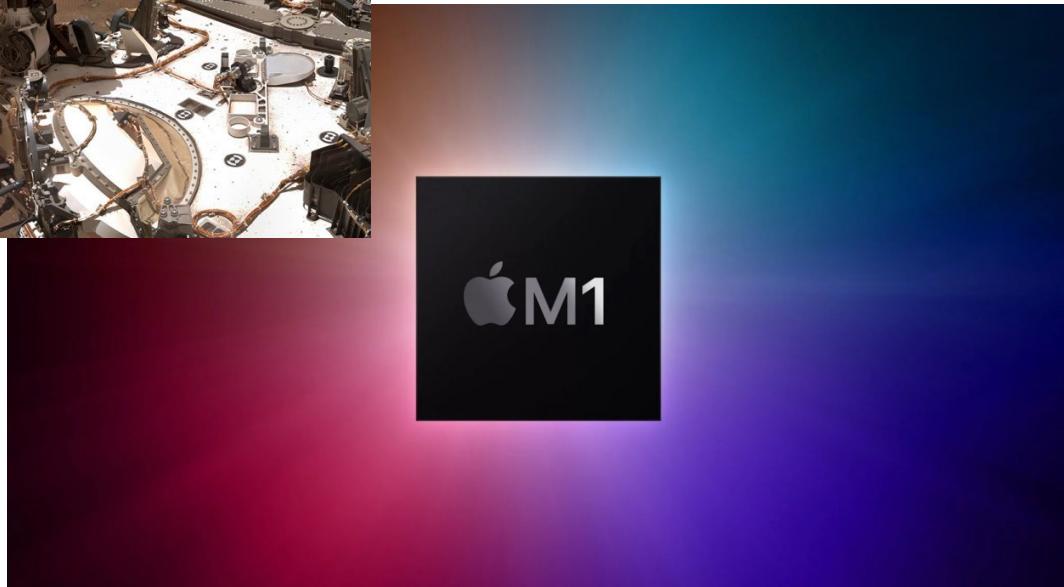
# Mitigation

Image credit: League of Women Voters

Perseverance Feature Size: 200 nm



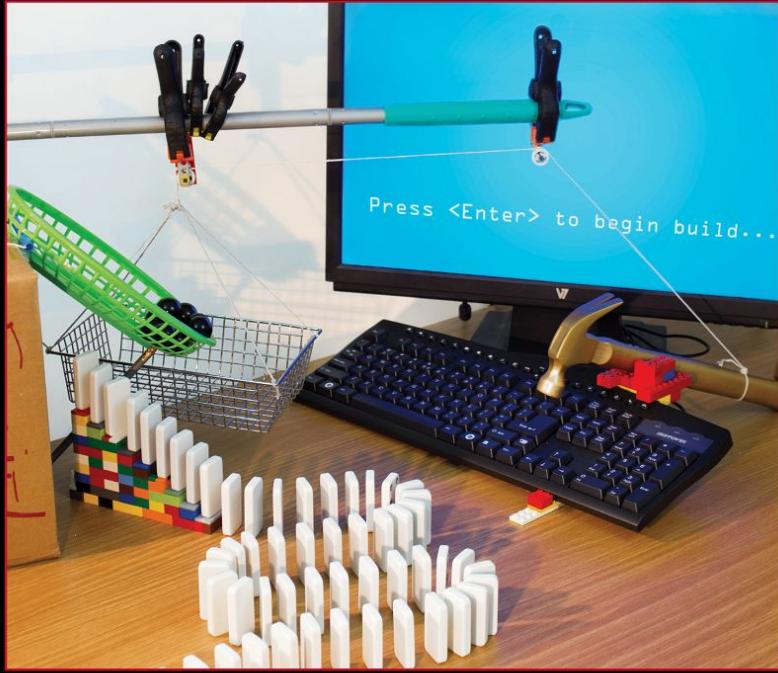
M1 Processor Feature Size: 5 nm



## Mitigation

Image credit: NASA

Image credit: PCMag



## KEEP IT SIMPLE

If only there were an easier way.



# Keep it Simple (KISS)



Image credit: NASA

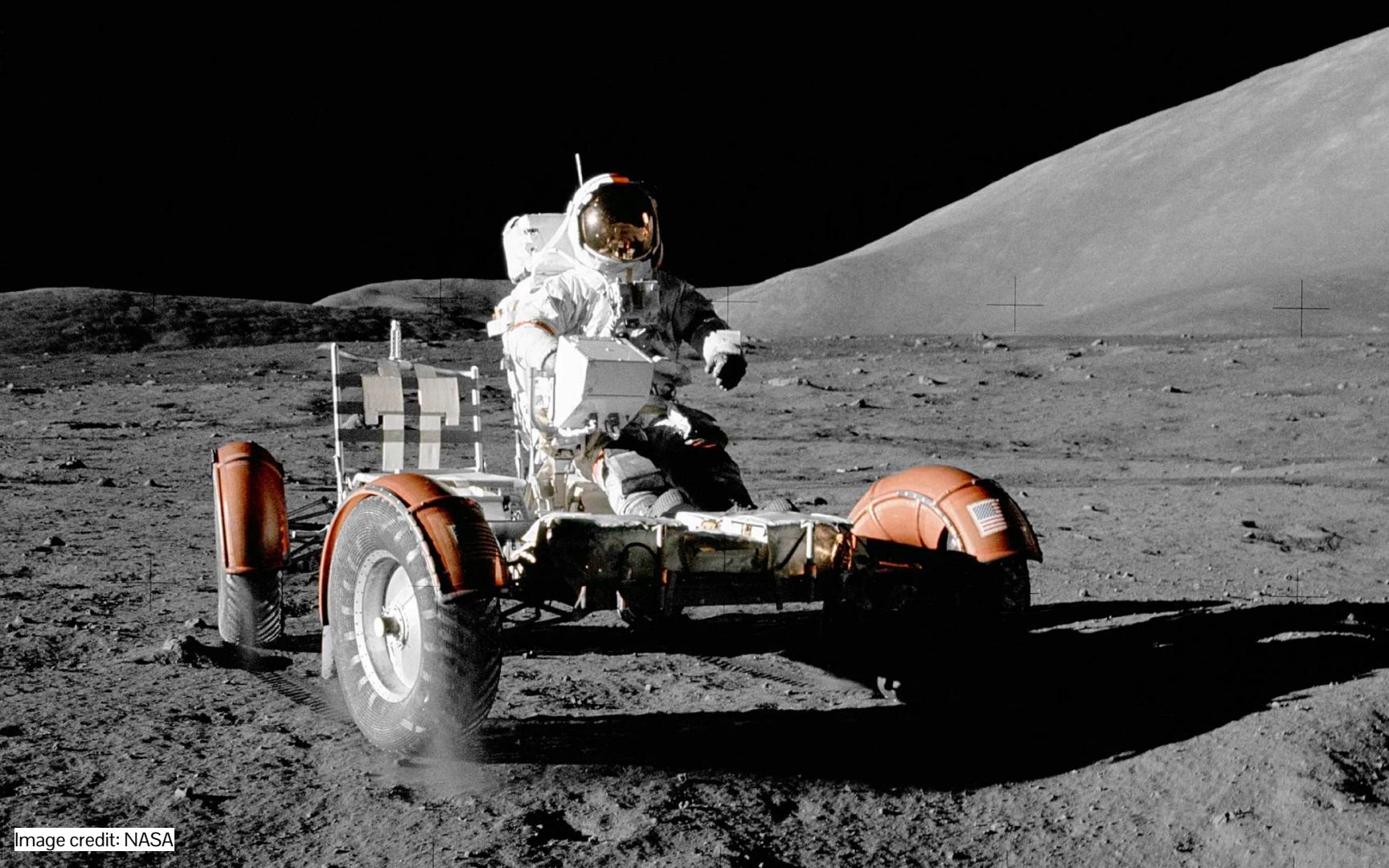


Image credit: NASA

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# Manned Spaceflight for Computer Scientists

Space is cool and humans are hard



Images credit: NASA

# Antipattern

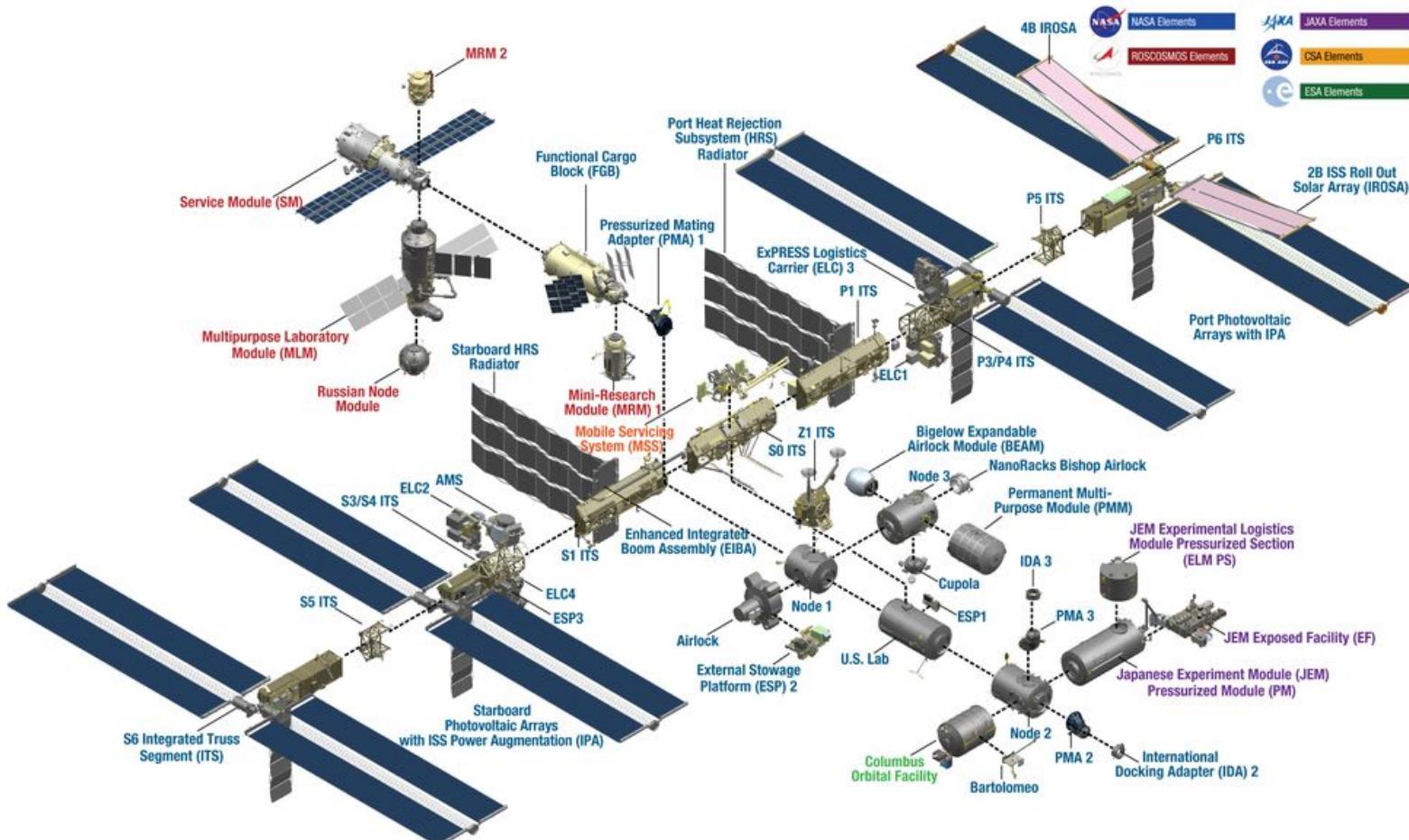


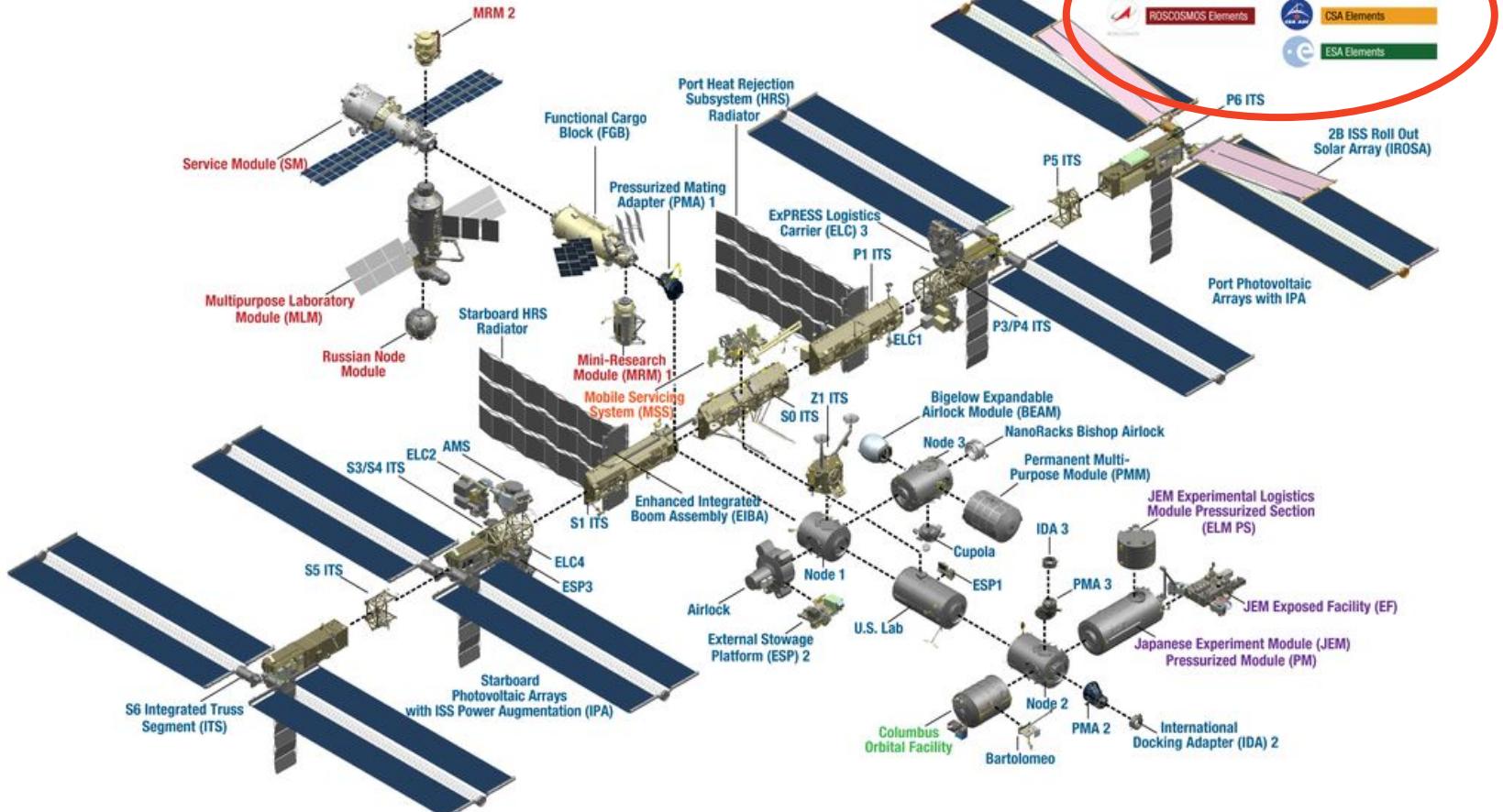
## SPAGHETTI CODE

Maintenance is easy with everything in one place.



Image credit: NASA







## SEPARATION OF CONCERNSS

Don't let your plumbing code pollute your software.

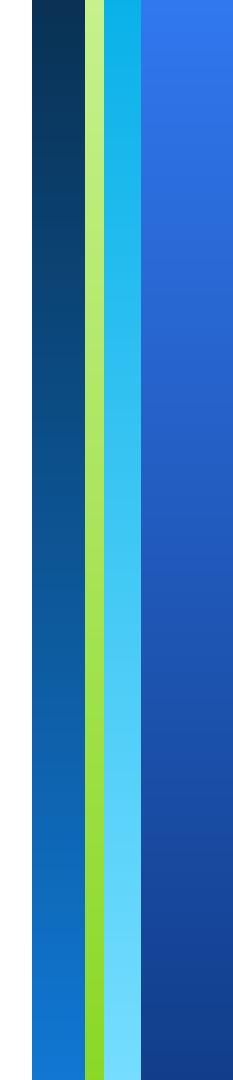


# Separation of Concerns



# Dependency Inversion





# Exercise

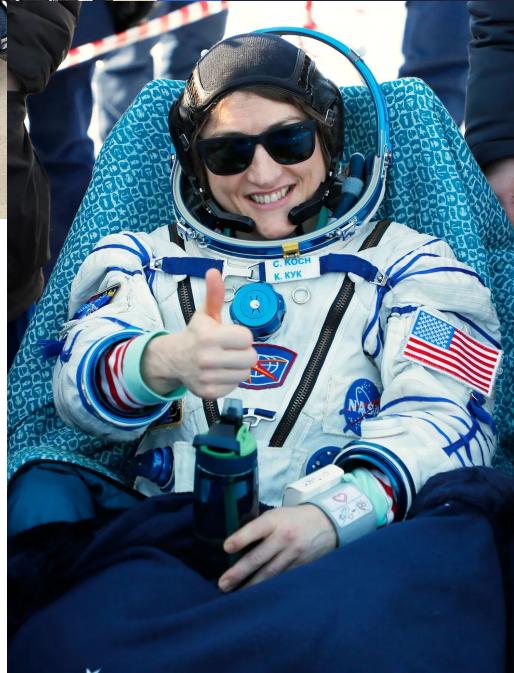


Image credit: NASA

Image credit: AP

# Fluid Redistribution

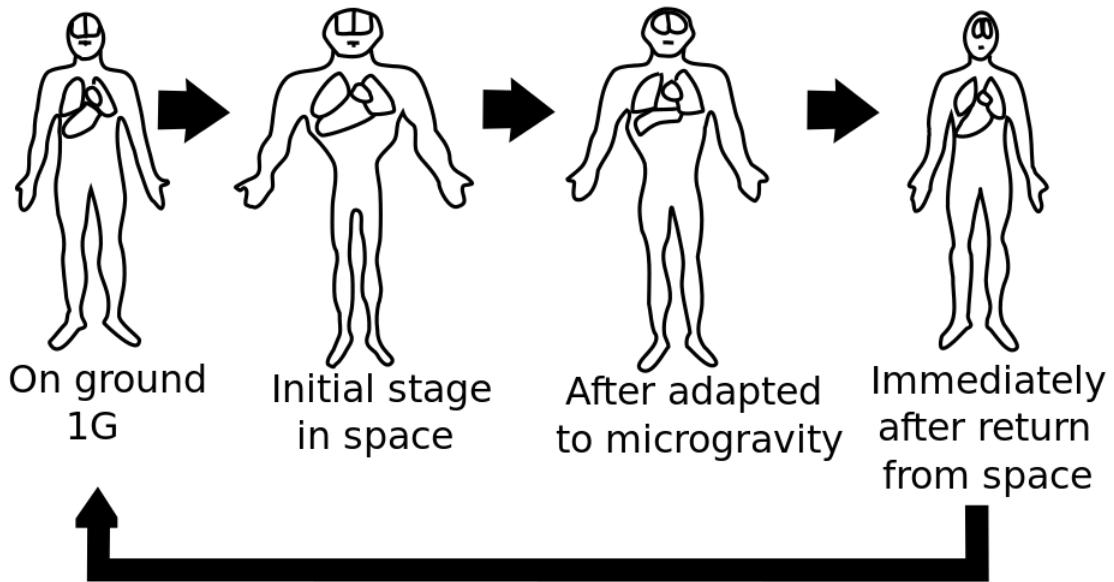


Image credit: Wikimedia Commons



Image credit: AP

# Atmosphere

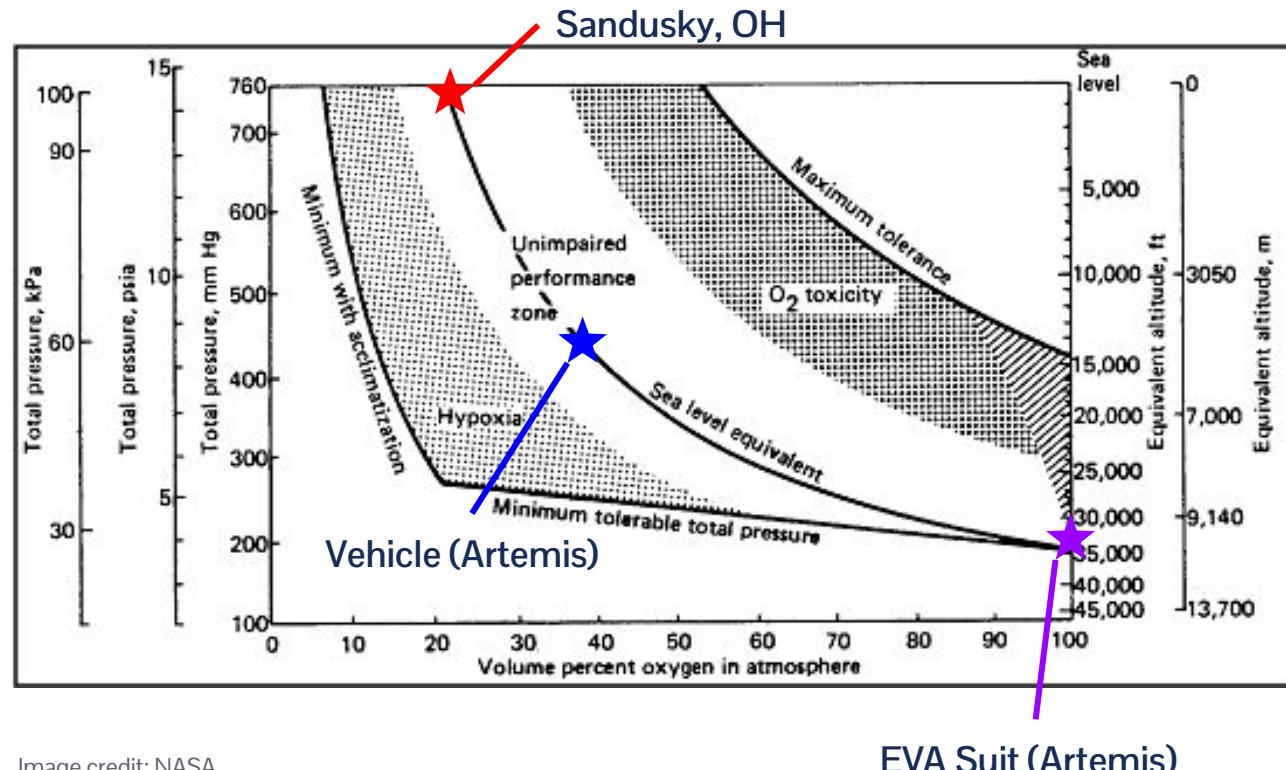




Image credit: NASA



Image credit: NASA



Image credit: PADI

KEEP IN MIND THAT I'M SELF-TAUGHT, SO MY CODE MAY BE A LITTLE MESSY.

LEMMIE SEE-  
I'M SURE  
IT'S FINE.



...WOW.  
THIS IS LIKE BEING IN A HOUSE BUILT BY A CHILD USING NOTHING BUT A HATCHET AND A PICTURE OF A HOUSE.



IT'S LIKE A SALAD RECIPE WRITTEN BY A CORPORATE LAWYER USING A PHONE AUTOCORRECT THAT ONLY KNEW EXCEL FORMULAS.



IT'S LIKE SOMEONE TOOK A TRANSCRIPT OF A COUPLE ARGUING AT IKEA AND MADE RANDOM EDITS UNTIL IT COMPILED WITHOUT ERRORS.

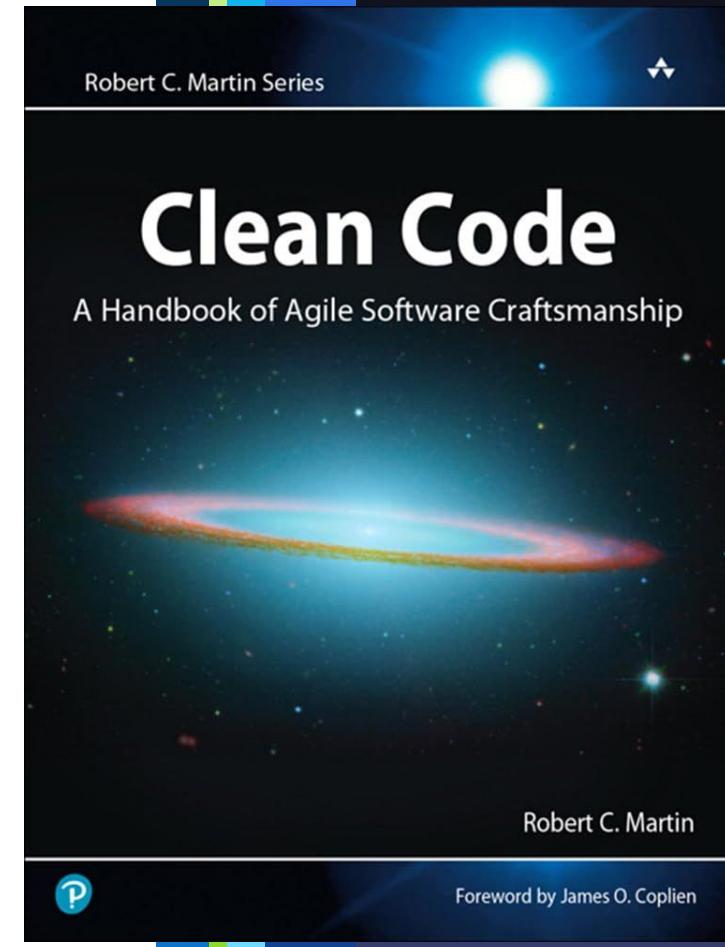
OKAY, I'LL READ A STYLE GUIDE.



“

*You should name a variable using the same care with which you name a first-born child.*

- *Robert C. Martin,  
Clean Code*



“

*The ratio of time spent reading versus writing is well over 10 to 1...  
Making it easy to read makes it easier to write.*

- *Robert C. Martin,  
Clean Code*

Robert C. Martin Series

# Clean Code

A Handbook of Agile Software Craftsmanship

Robert C. Martin



Foreword by James O. Coplien



# Code Readability

# CODE READABILITY

Well written code speaks for itself.



## CODE READABILITY

Well written code speaks for itself.



## COLLECTIVE CODE OWNERSHIP

That's myYYYYYY code!!!



## KEEP IT SIMPLE

If only there were an easier way.



## SEPARATION OF CONCERNS

Don't let your plumbing code pollute your software.



## DEPENDENCY INVERSION

Would you solder a lamp directly to the electrical wiring in a wall?

# Thank You!

## Any questions?



LinkedIn



Blog



Image credit: NASA Apollo Image Archive