Hacking for Space

A history of failures – and why we do not do them again

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```
        default='0',
        )
global_scale_setting = FloatProperty(
        name="Scale",
        min=0.01, max=1000.0,
        default=1.0,
        )

def execute(self, context):

    # get the folder
    folder_path = (os.path.dirname(self.filepath))

    # get objects selected in the viewport
    viewport_selection = bpy.context.selected_objects

    # get export objects
    obj_export_list = viewport_selection
    if self.use_selection_setting == False:
        obj_export_list = [i for i in bpy.context.scene.objects]

    # deselect all objects
    bpy.ops.object.select_all(action='DESELECT')

    for item in obj_export_list:
        item.select = True
        if item.type == 'MESH':
            file_path = os.path.join(folder_path, "{}.obj".format(item.name))
            bpy.ops.export_scene.obj(filepath=file_path, use_selection=True,
                                     axis_forward=self.axis_forward_setting,
                                     axis_up=self.axis_up_setting,
                                     use_animation=self.use_animation_setting,
                                     use_mesh_modifiers=self.use_mesh_modifiers_setting,
                                     use_edges=self.use_edges_setting,
                                     use_smooth_groups=self.use_smooth_groups_setting,
                                     use_smooth_groups_bitflags=self.use_smooth_groups_bitflags_setting,
                                     use_normals=self.use_normals_setting,
                                     use_uvs=self.use_uvs_setting,
                                     use_materials_setting,
```

DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

Who am I?

What is DLR

German Aerospace Center

+ NASA = DLR

“German NASA”*

* Not do be taken completely serious


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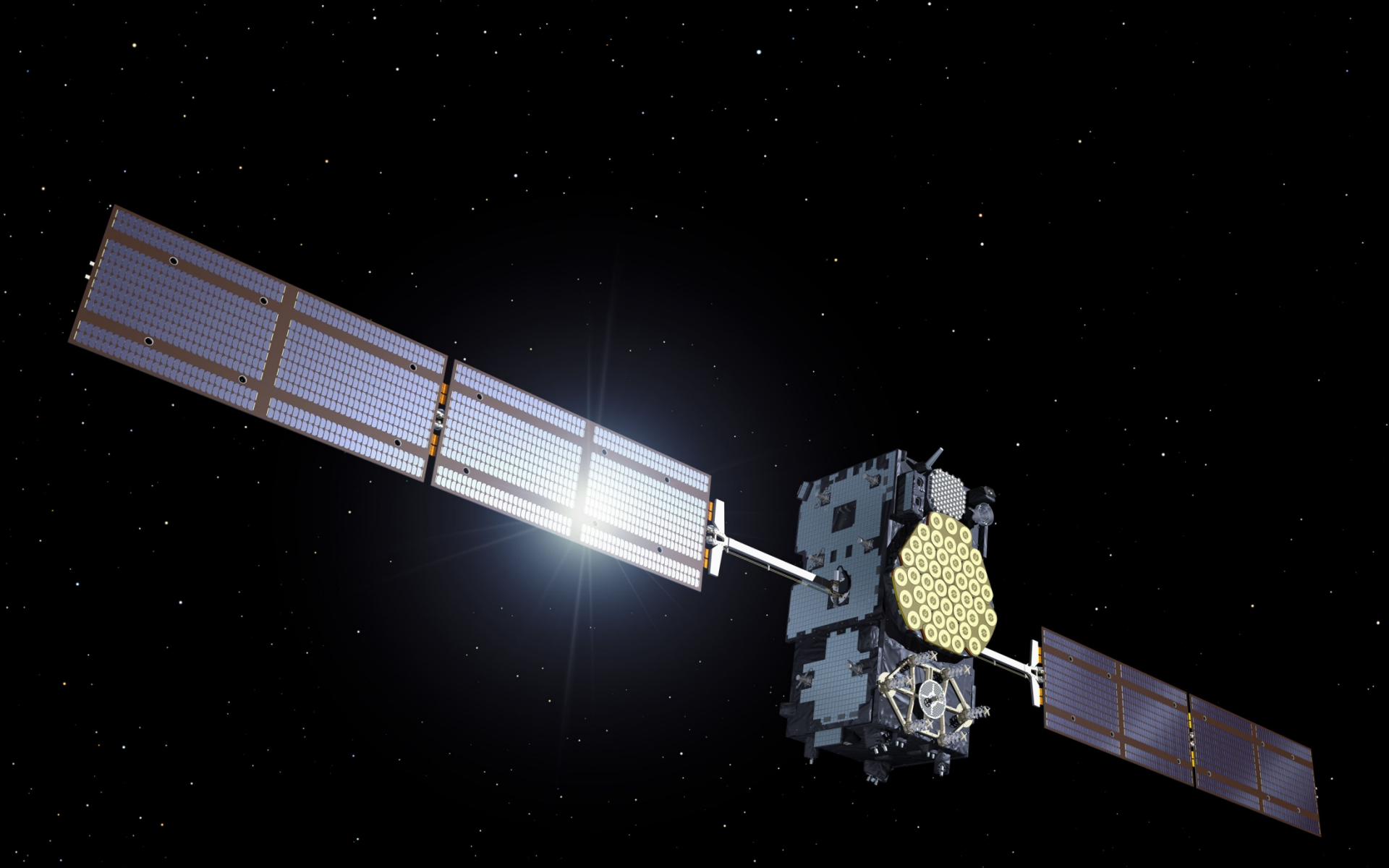
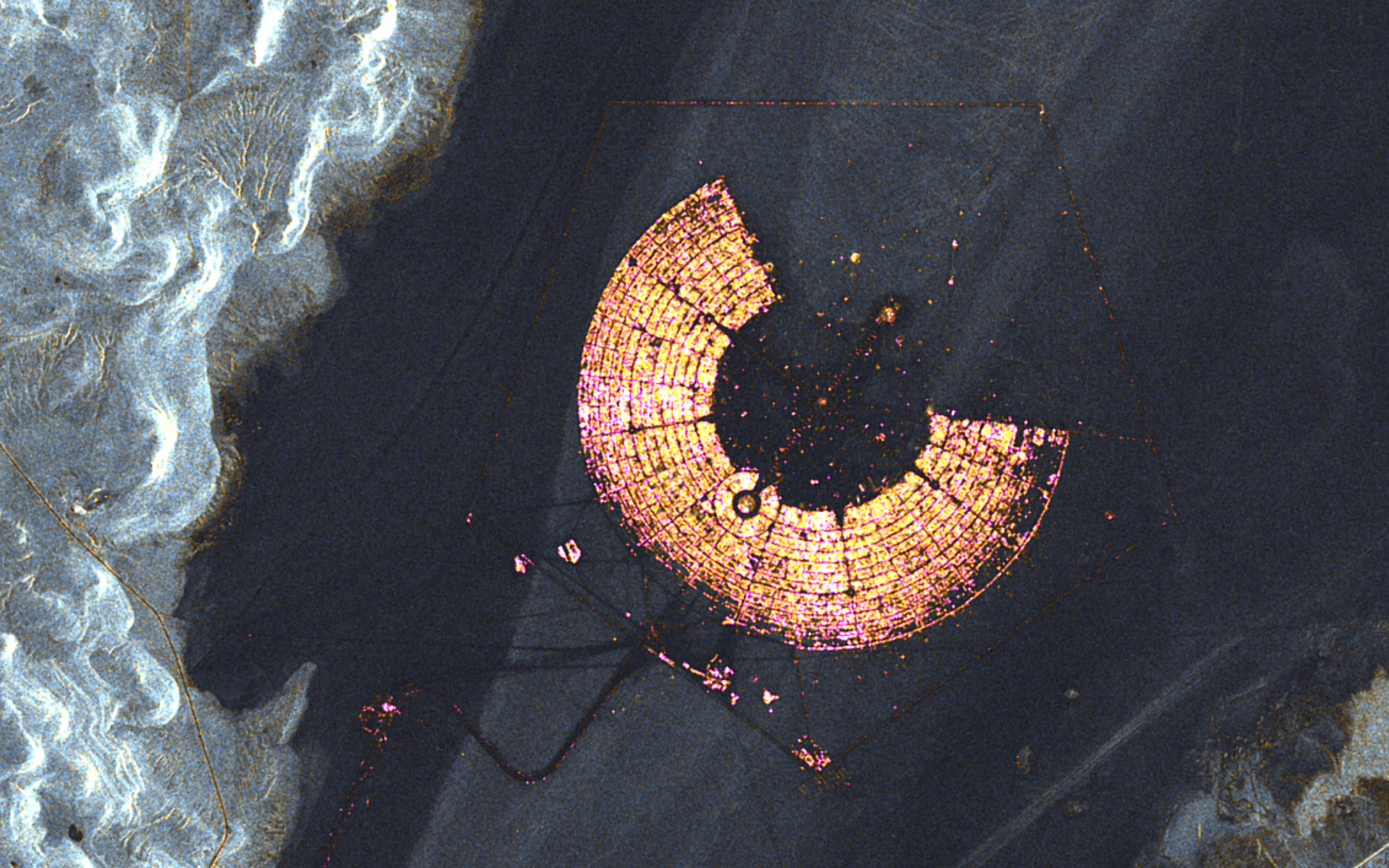


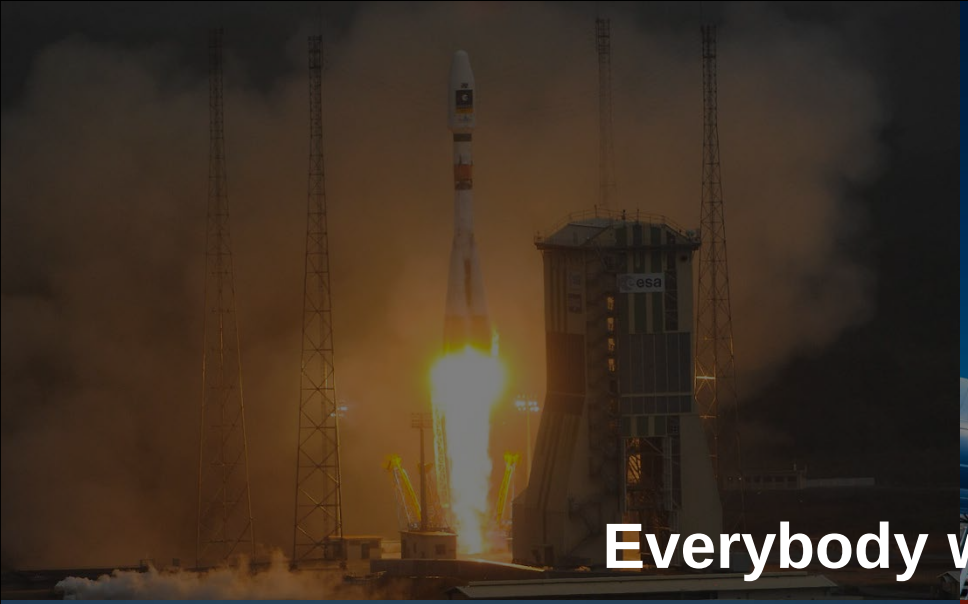


Ca. 8,000 Employees

39 Institutes and Facilities

20 Locations

DLR



Everybody writes code.

Nobody* develops software

* Not do be taken completely serious

The World of Research

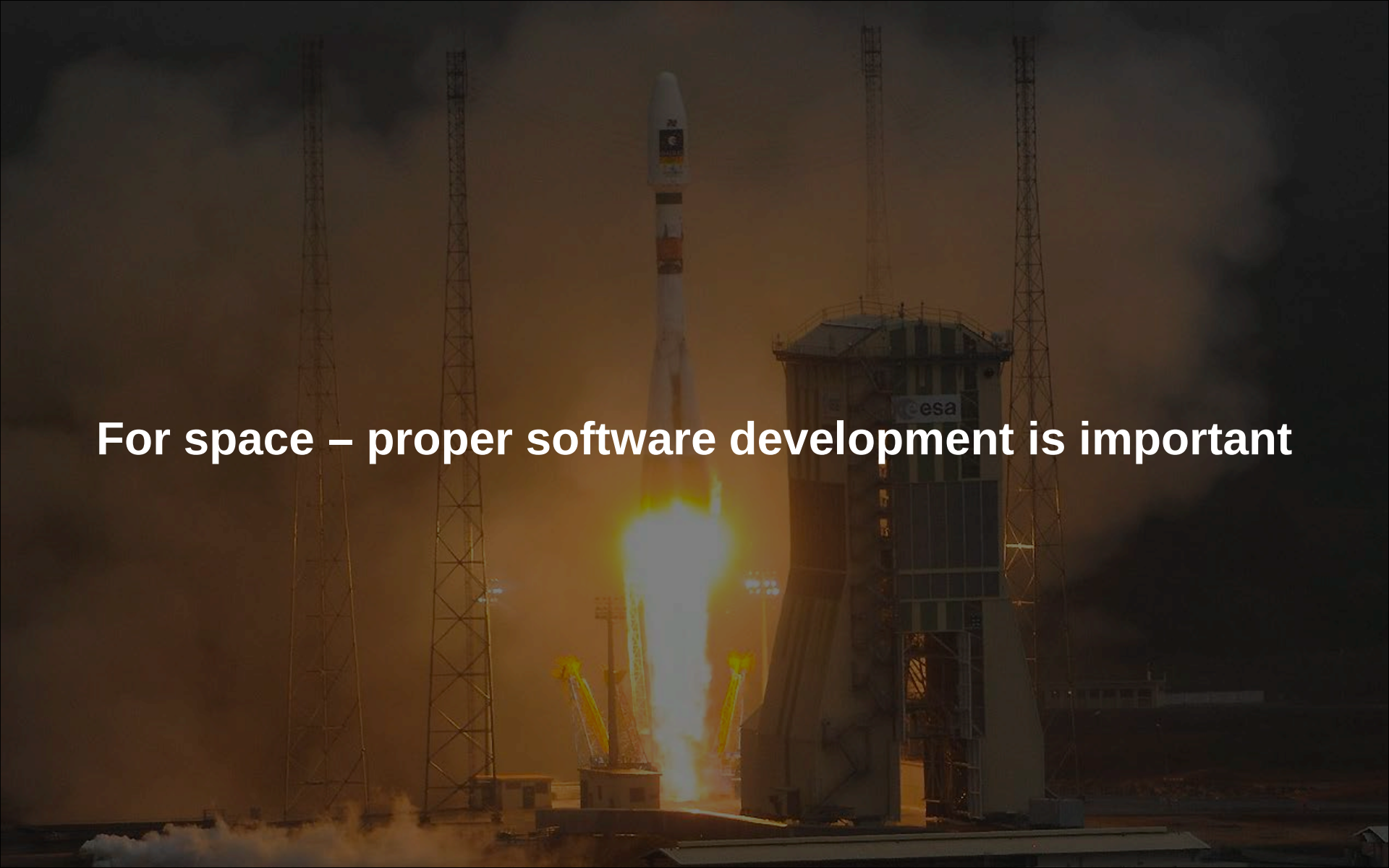
The reality

Research is the goal – not software

Coding is a tool

Every language gets used

Python was a game changer



For space – proper software development is important

Proper Software

What you need to do to get there

Clean Code

Tests

Unit Tests

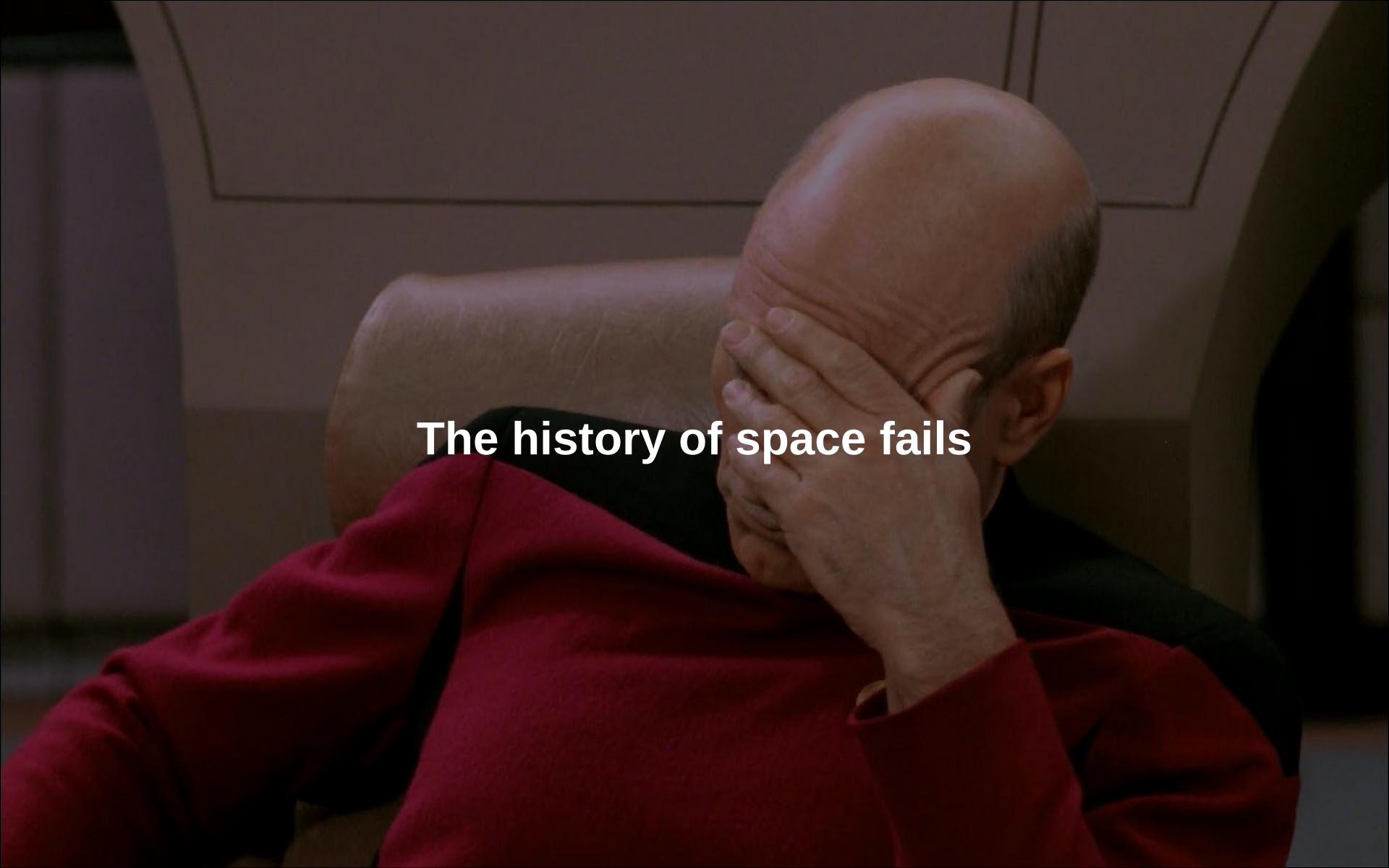
Integration Tests

System Tests

A development process

…

=> Software Engineering


The history of space fails

Mariner 1 (1962)
Tests? Which tests?

Goal: Flyby of Venus

Error

- Transcriber oversees overbar in written specification of guidance program – incorrect formula (FORTRAN)

Consequences

- Deviation from trajectory
- Loss of control
- Self destruction after 294.5 seconds (6 before separation – launch vehicle could not have been destroyed after)

Cost: US $ 18.5 million

Phobos 1 (1988)

I don’t have time for this!

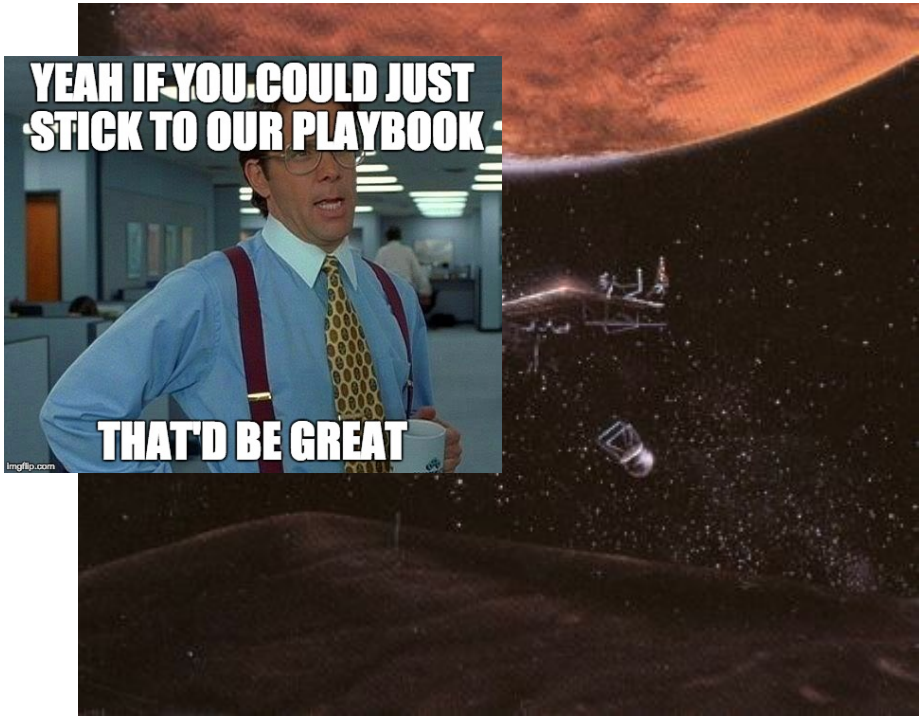
Goal: Explore Mars, Phobos, and Deimos

Error

- Technician leaves out hyphen (“-”) in key-command
- Computer that checks the code malfunctions
- Technician sends the command without check

Consequences

- End-of-mission command run
- All systems shut down
- No communication or control possible



Ariane 5 Flight 501 (1996)

This wouldn‘t have happened with Python

Goal: Transport satellites into Earth’s magnetosphere

Error

- Cast from 64-bit floating point to 16-bin signed integer

Consequences

- Correction of flight path
- Rapid change of altitude
- Launcher disintegrated 39 sec after start

Cost: US $ 370 million

Mars Climate Orbiter (1998)

Metric system? SI units?

Goal: Explore Mars, communication relay

Error

- pound-force (lbf), instead of newtons (N)

Consequences

- Wrong trajectory
- Disintegrate in upper atmosphere

Cost: US $327.6 million

Schiaparelli (2016)
Endless possibilities

Goal: Land on Mars

Error

- Unexpected negative value

Consequences

- Premature release of parachute and back shell
- Braking thrusters fired for 3 instead of 30 sec
- Crashed into Mars from 3.7km

Soyuz 2.1b (2017)
Where are we?

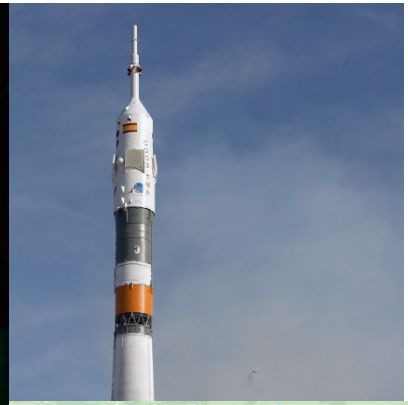
Goal: Bring 19 satellites into orbit

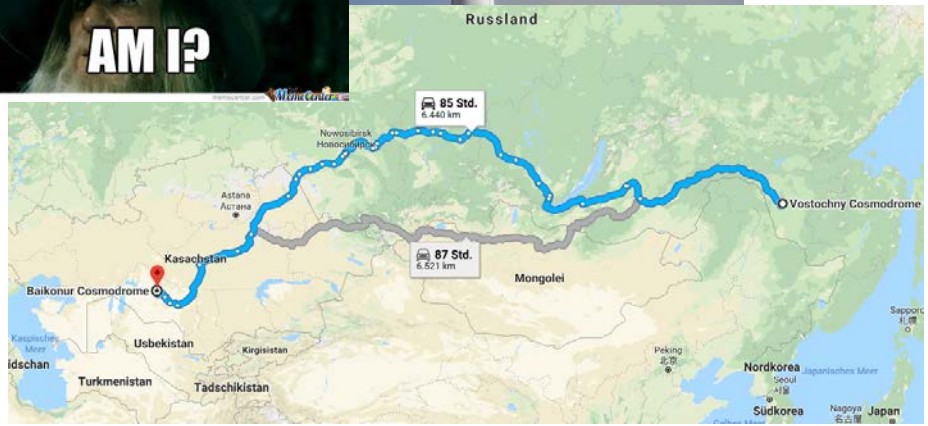
Error

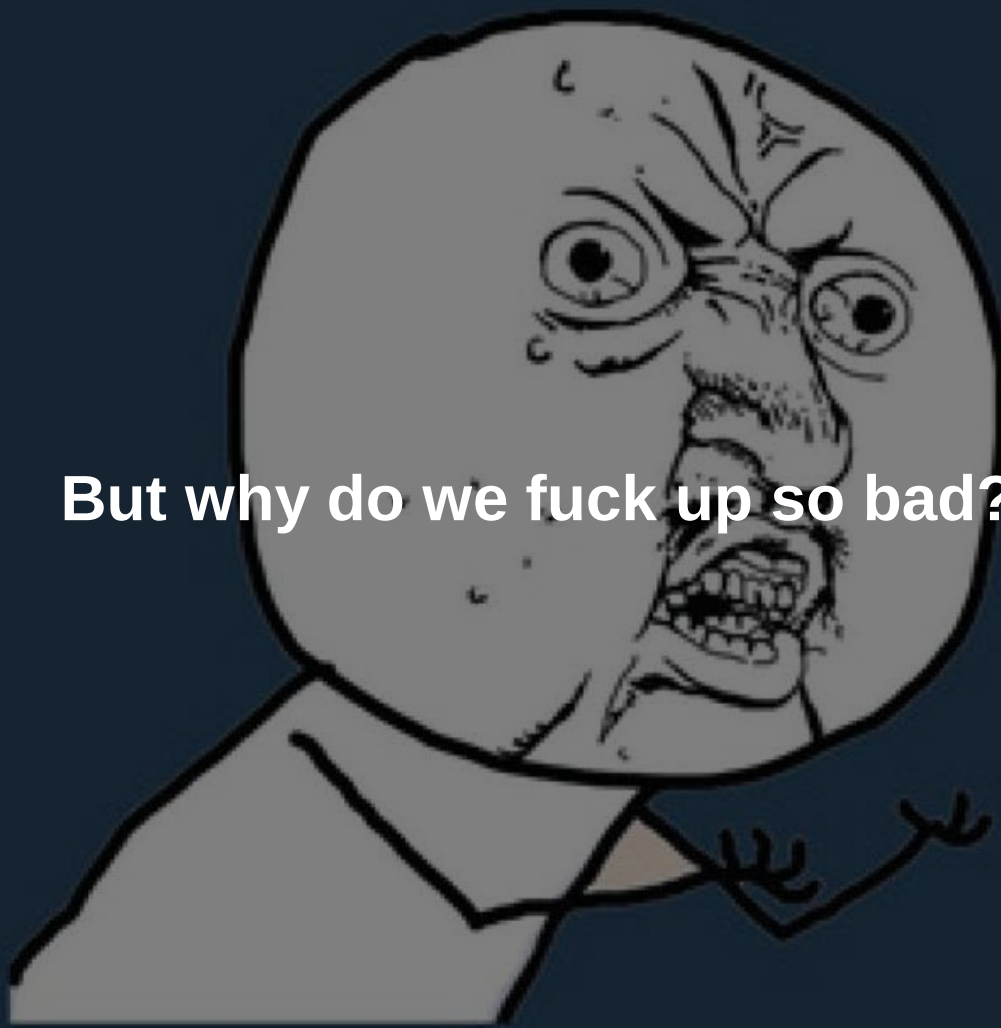
- Wrong location
- Vostochny != Baikonur

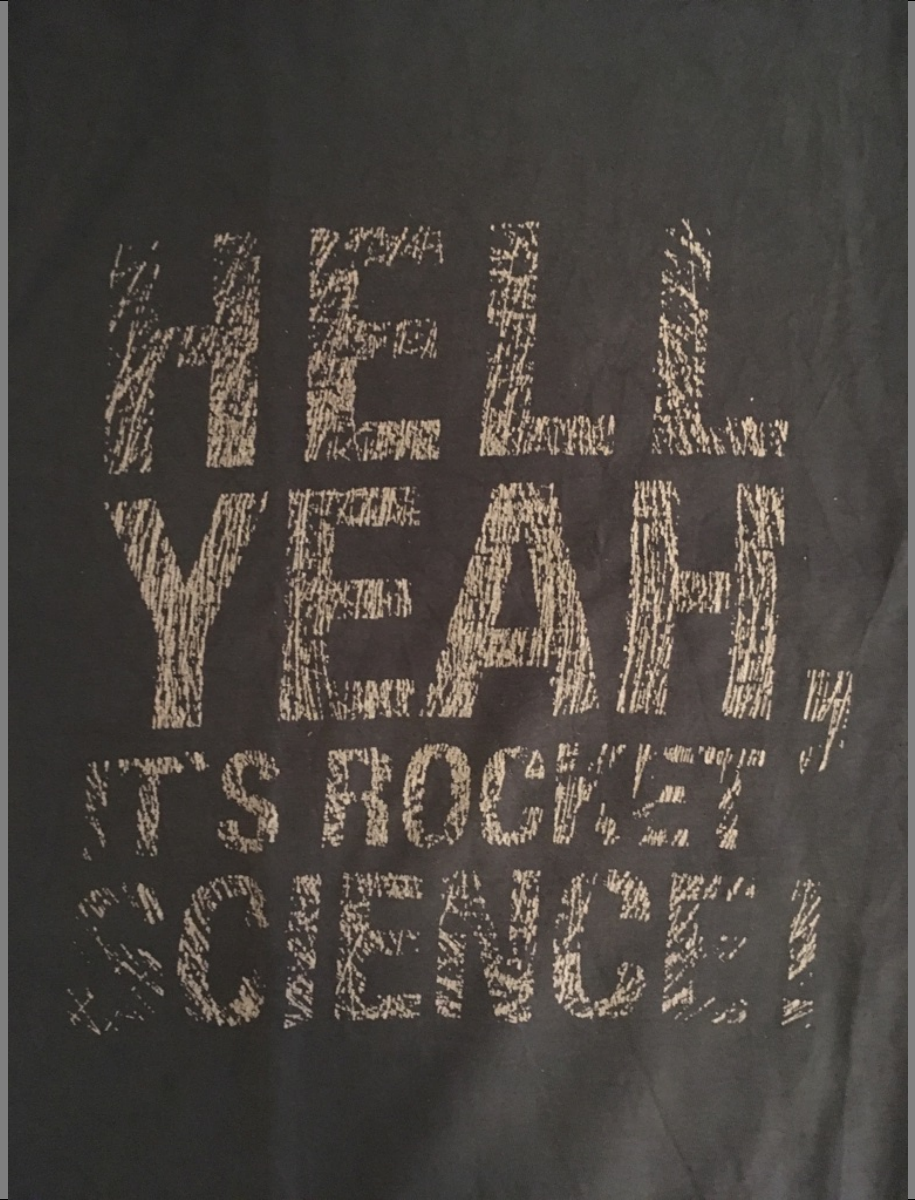
Consequences

- Upper stage could not orient itself
- Fired in wrong direction – towards earth
- Burned up in Earth‘s atmosphere

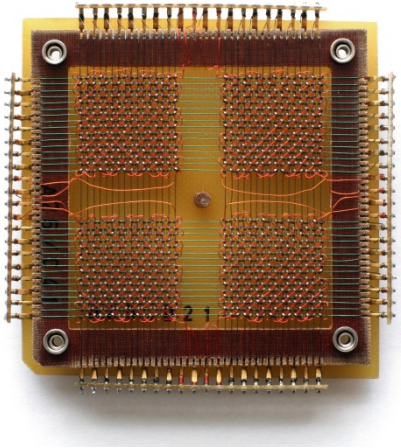





But why do we fuck up so bad?


HELL
YEAH,
IT'S ROCKET
SCIENCE!

But why did we fuck up so bad?
The reasons



Nobody know what to expect

Testing for space is hard

The early days

The “wrong”* persons are doing it

Old (but reliable) technology

It’s not failing, it’s learning!

* Not do be taken completely serious

We gonna change!

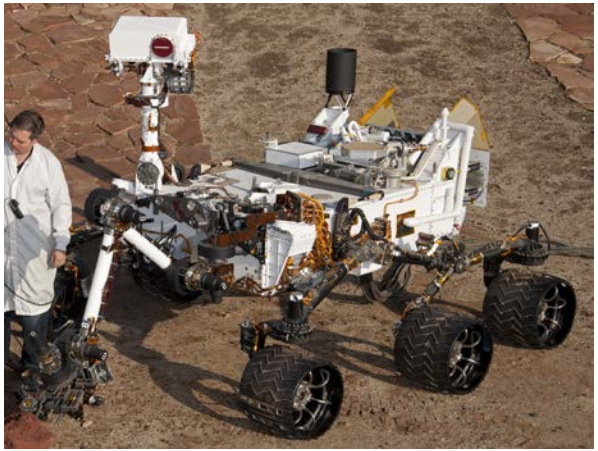
We really try!

Teaching Software Engineering skills to researchers

RSEs helping out

Creating standards (ECSS)

We cheat



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Curios? Talk to me!

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