Lab #1 - Geometry (part 2)

Informática Gráfica

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Before we begin…

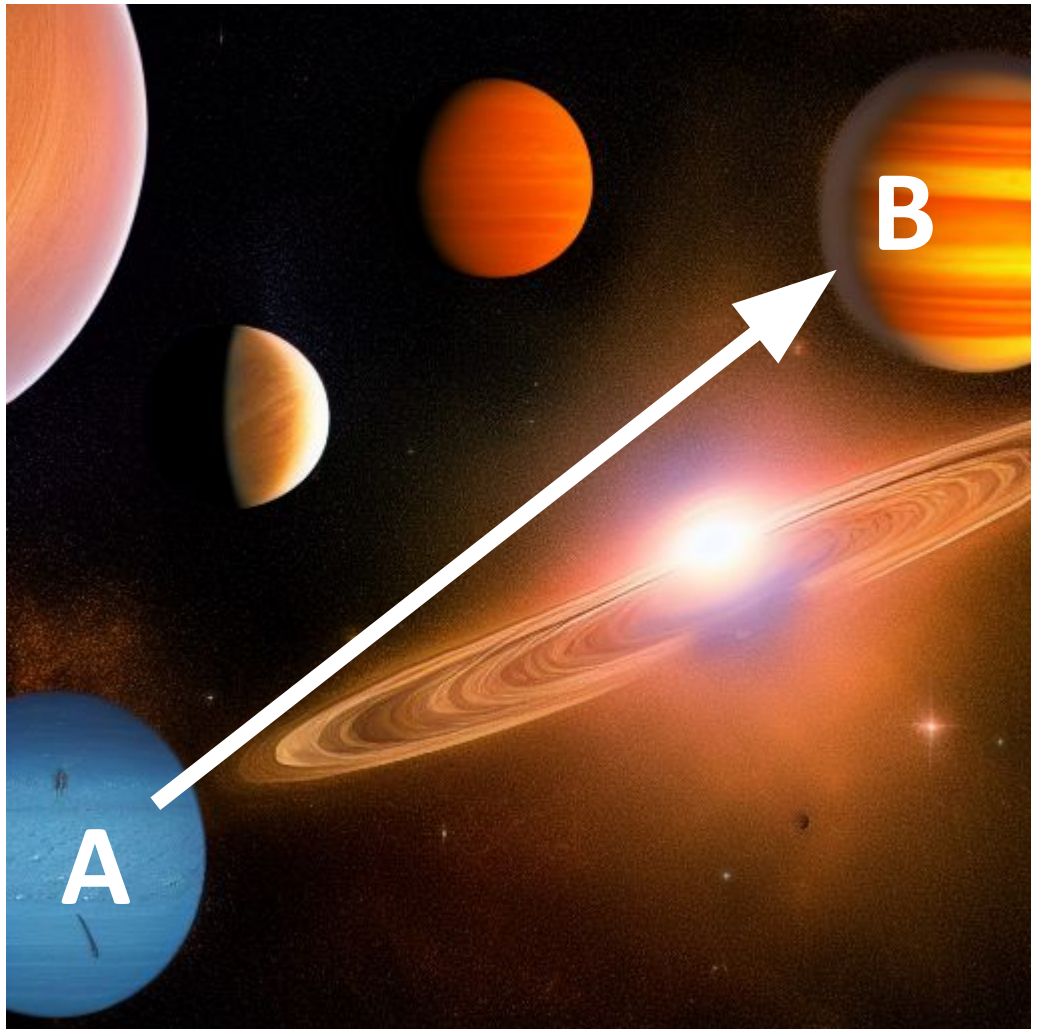
Graphics and Imaging Lab

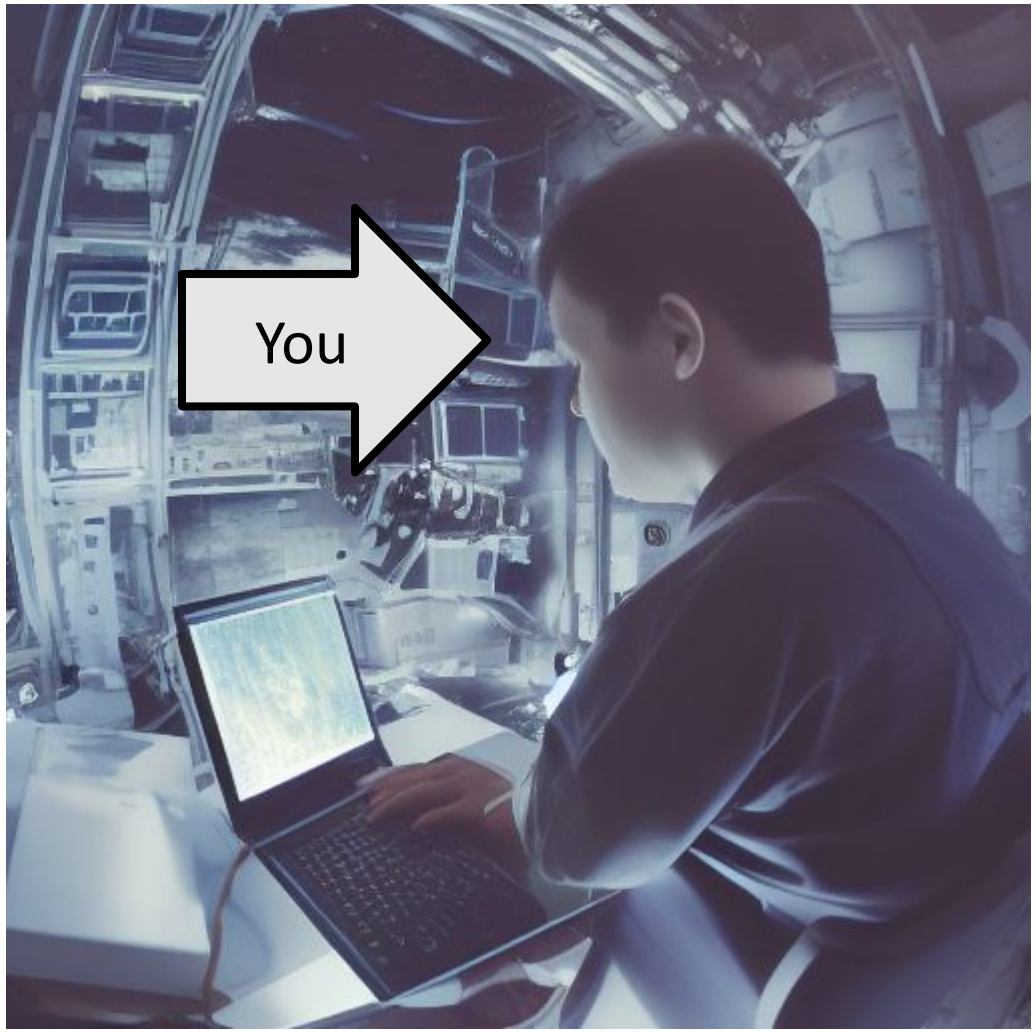
- Practical sessions:
  - Intermediate assignments: no submission required
  - **Highly recommended** to be completed at certain tentative deadlines
    - For the first and second sessions: **September 25th**
  - Your final work will build upon the stuff you'll do here!
    - **80%** of the final grade (including written report)

- If you need to find a partner for lab sessions, message us

Your new job at FTL dynamics

Graphics and Imaging Lab



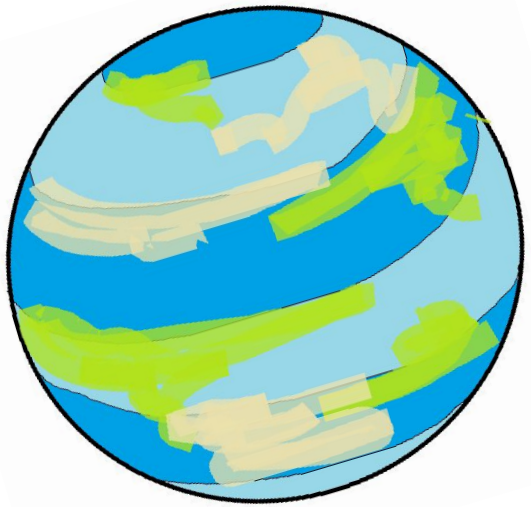


Images generated using Stable Diffusion

Problem statement

Graphics and Imaging Lab

Ideal scenario

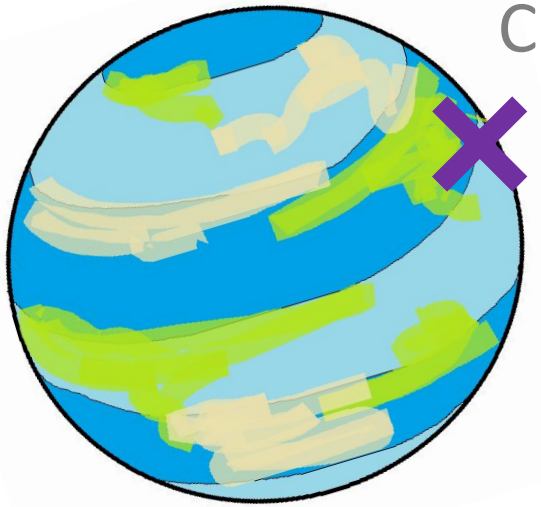


Problem statement

Graphics and Imaging Lab

Ideal scenario

City launcher

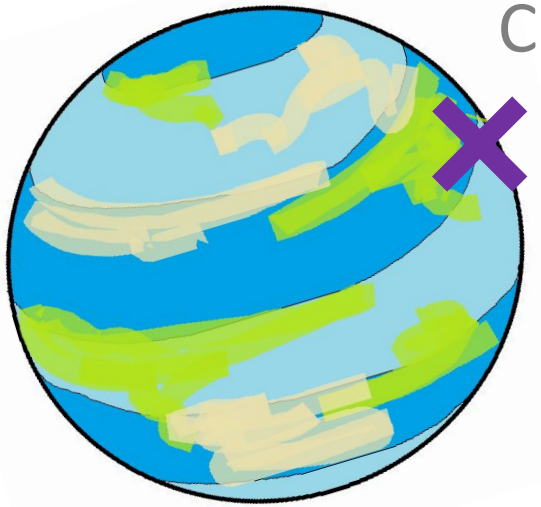


Problem statement

Graphics and Imaging Lab

Ideal scenario

City launcher

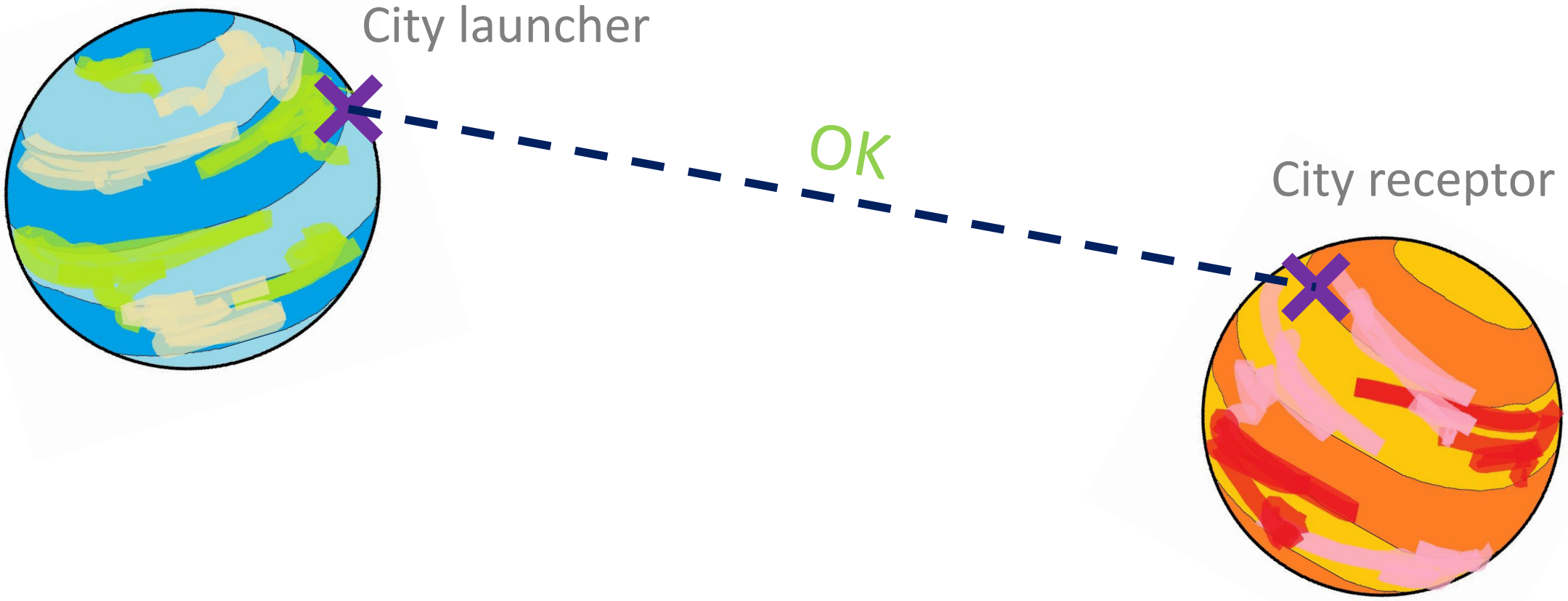


City receptor

Problem statement

Graphics and Imaging Lab

Ideal scenario

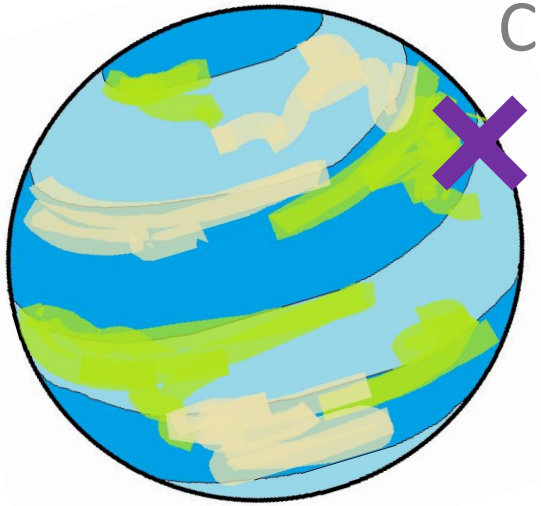


Problem statement

Graphics and Imaging Lab

Fatal scenario (1)

City launcher

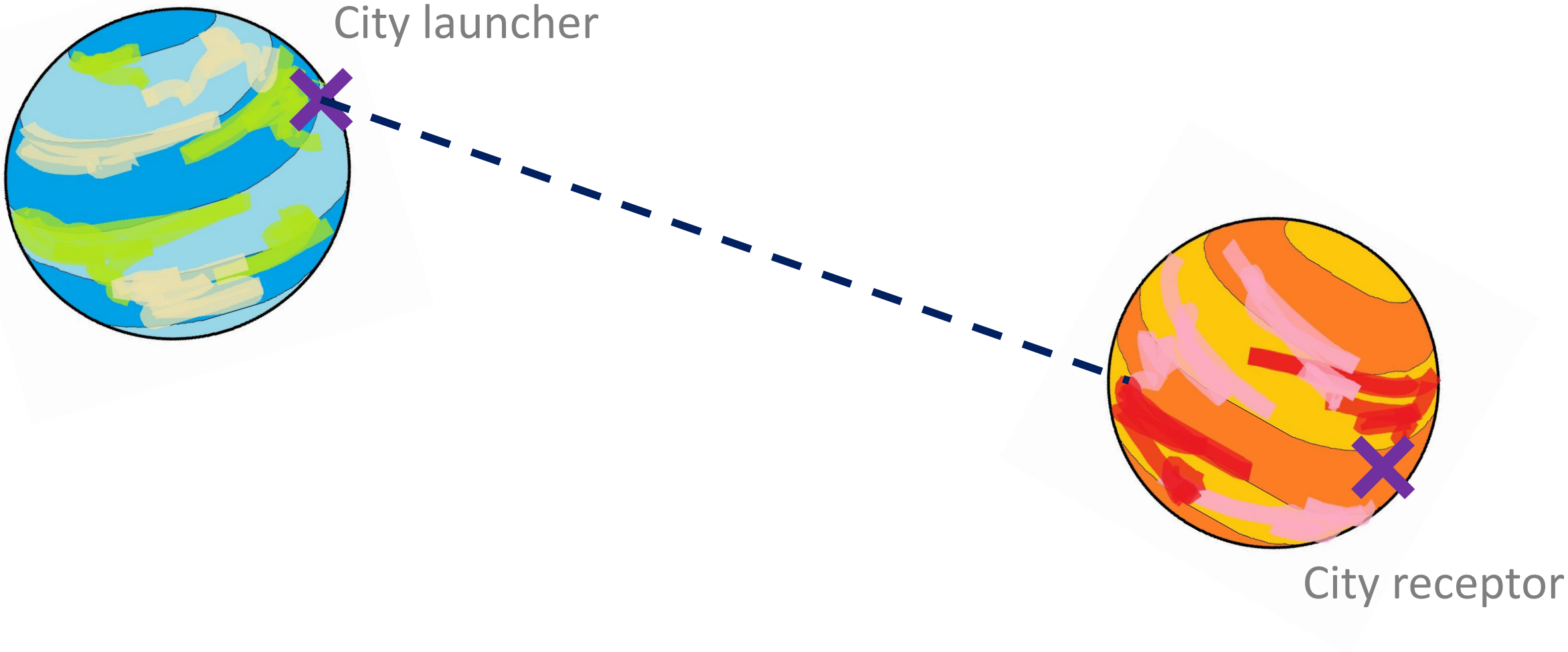


City receptor

Problem statement

Graphics and Imaging Lab

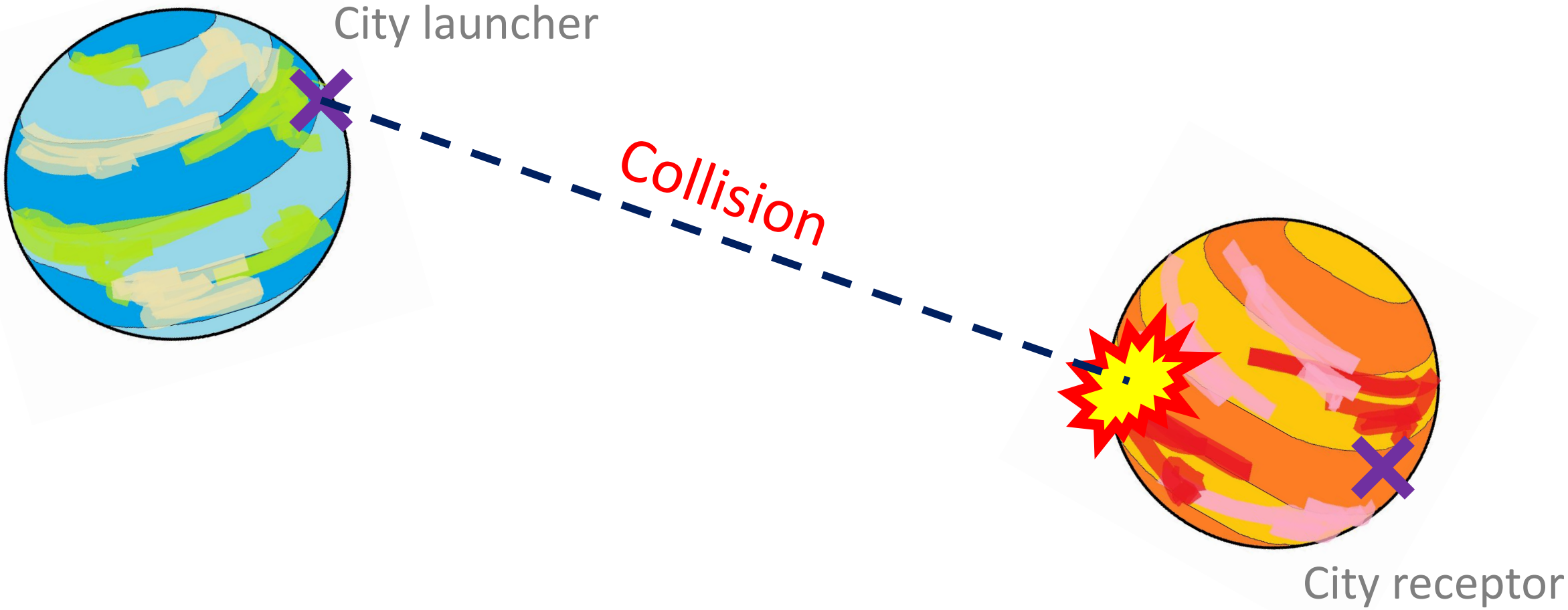
Fatal scenario (1)



Problem statement

Graphics and Imaging Lab

Fatal scenario (1)

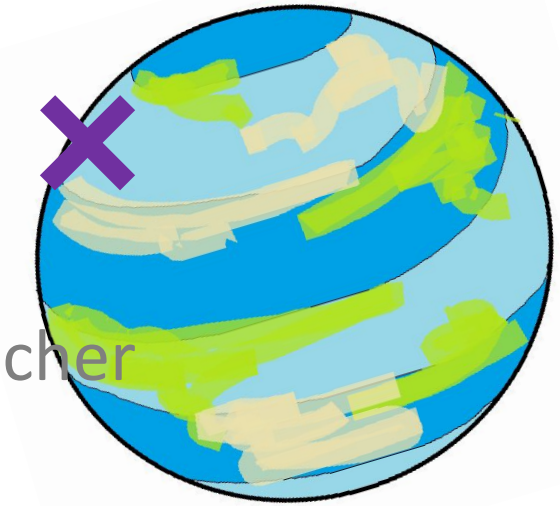


Problem statement

Graphics and Imaging Lab

Fatal scenario (2)

City launcher

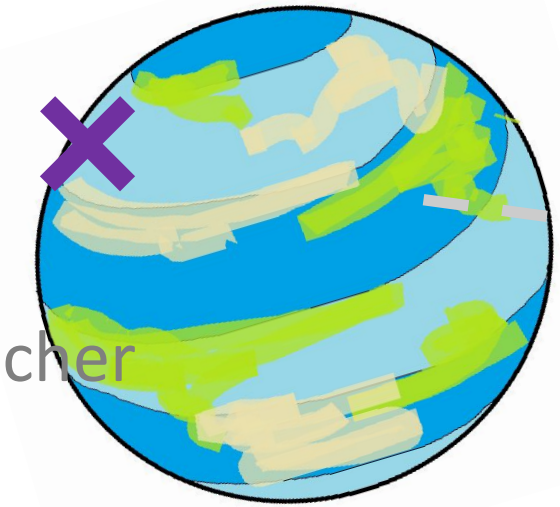


City receptor

Problem statement

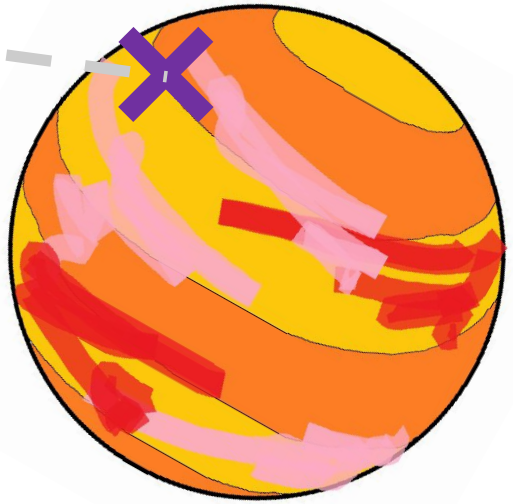
Graphics and Imaging Lab

Fatal scenario (2)



City launcher

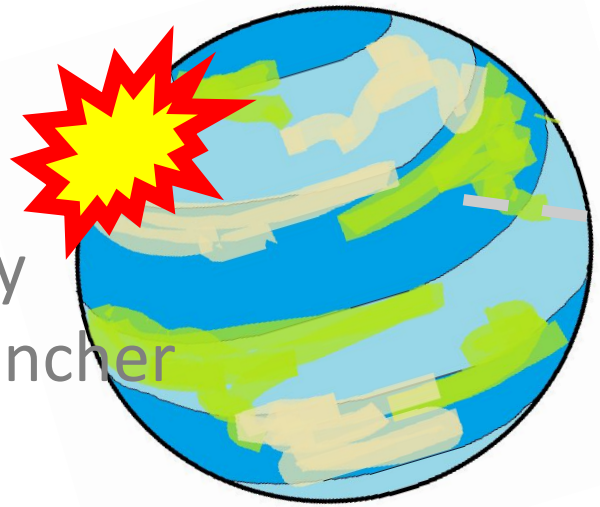
City receptor



Problem statement

Graphics and Imaging Lab

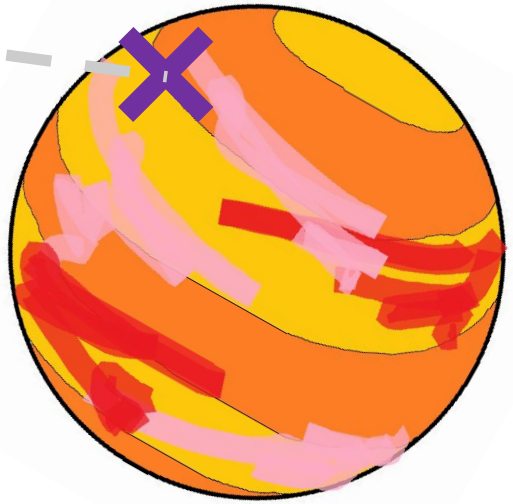
Fatal scenario (2)



City launcher

Collision

City receptor



Basics

Graphics and Imaging Lab

- **Homogeneous coordinates**

Point

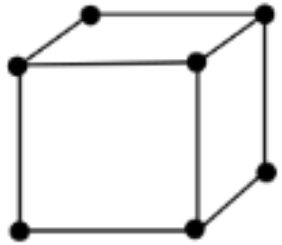
$$\mathbf{p} = \begin{pmatrix} p_x \\ p_y \\ p_z \end{pmatrix} \Rightarrow \mathbf{v} = \begin{pmatrix} p_x \\ p_y \\ p_z \\ 1 \end{pmatrix}$$

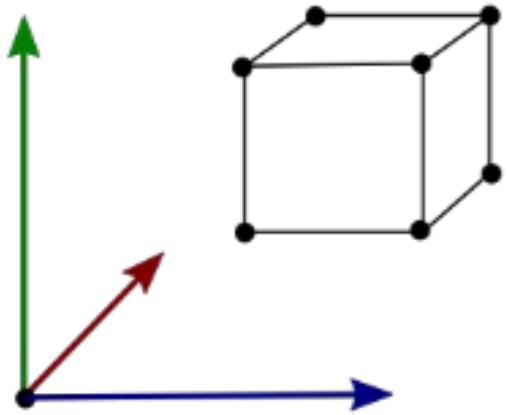
Direction

$$\mathbf{d} = \begin{pmatrix} d_x \\ d_y \\ d_z \end{pmatrix} \Rightarrow \mathbf{v} = \begin{pmatrix} d_x \\ d_y \\ d_z \\ 0 \end{pmatrix}$$

Basics

- **Homogeneous coordinates**
- **Transformation matrices**
  - Translation

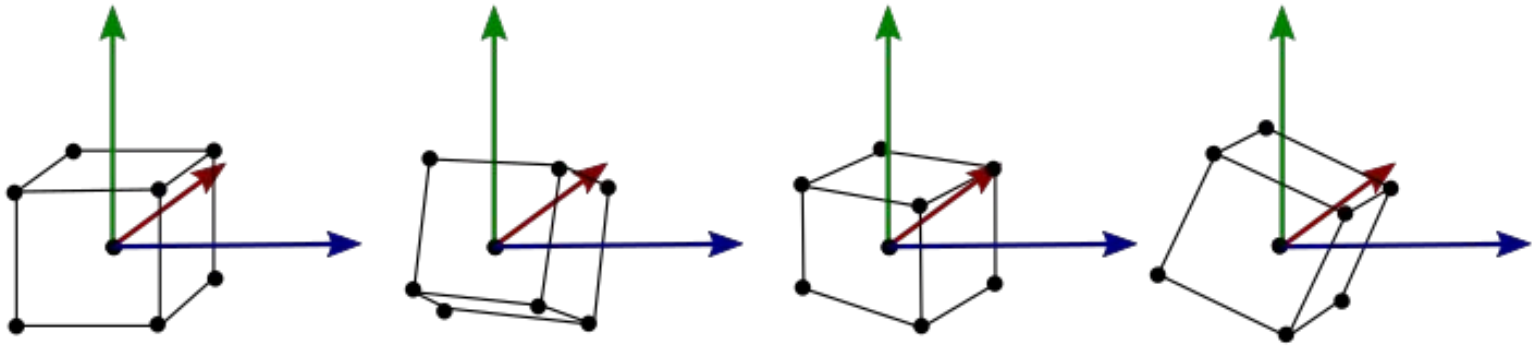




Basics

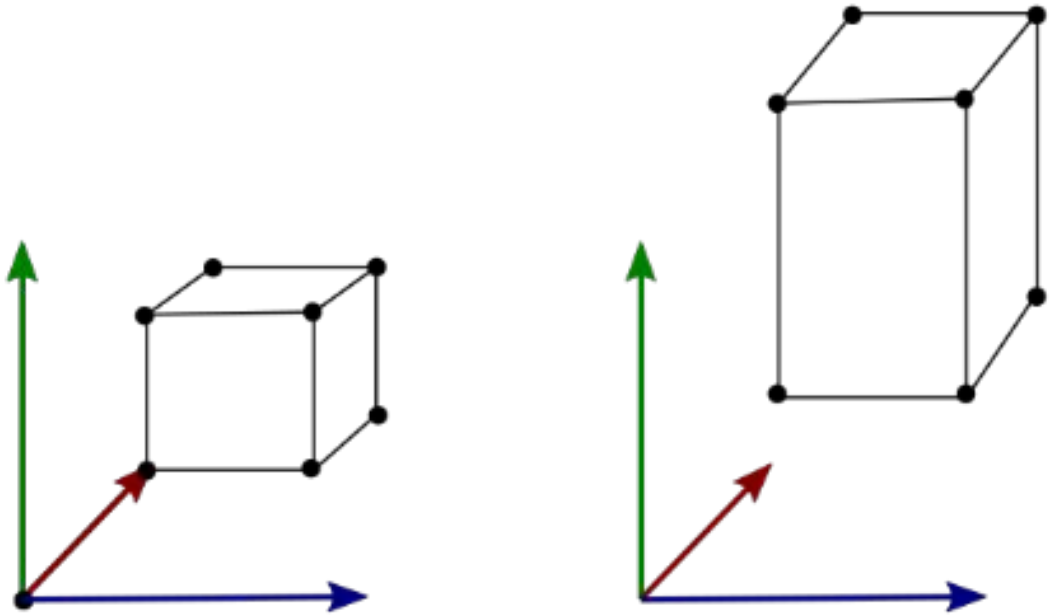
Graphics and Imaging Lab

- **Homogeneous coordinates**
- **Transformation matrices**
  - Translation
  - Rotation



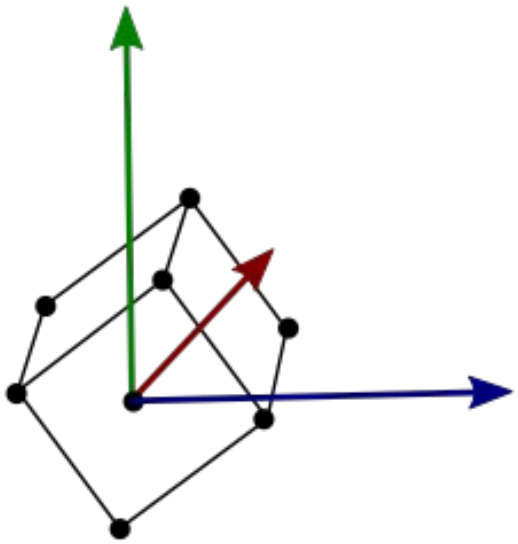
Basics

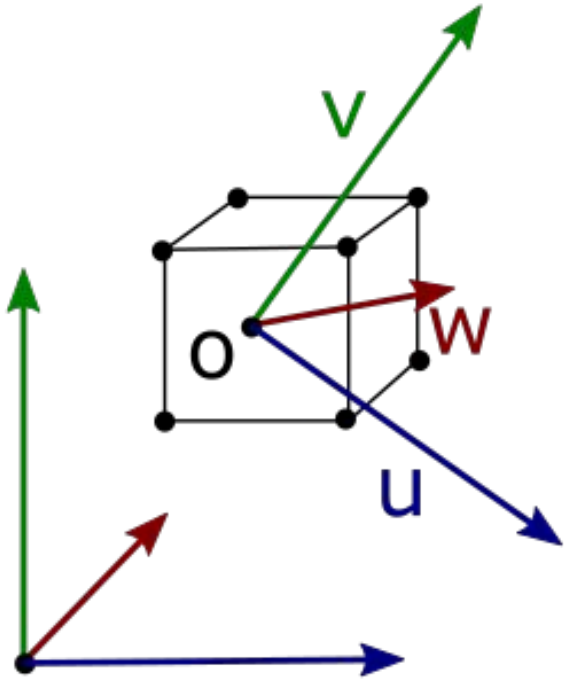
- **Homogeneous coordinates**
- **Transformation matrices**
  - Translation
  - Rotation
  - Scale



Basics

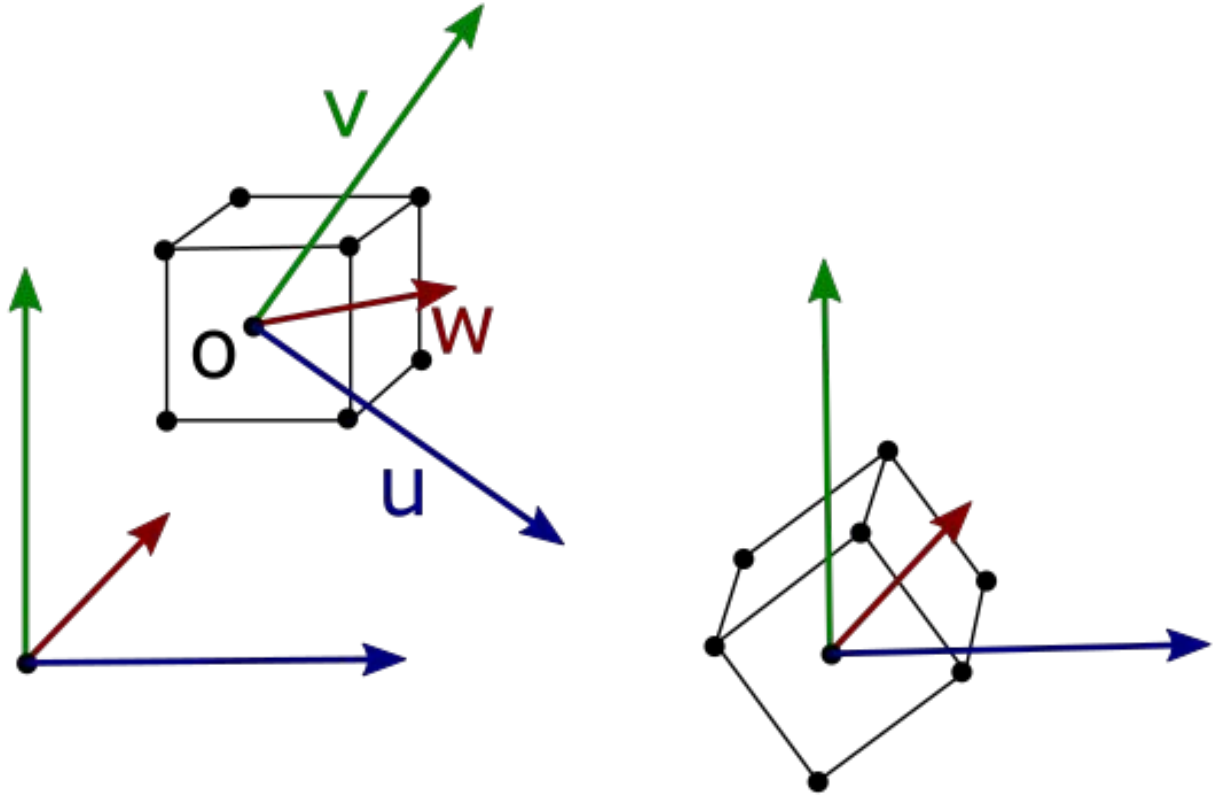
- **Homogeneous coordinates**
- **Transformation matrices**
  - Translation
  - Rotation
  - Scale
  - Change of base





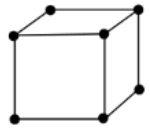
Basics

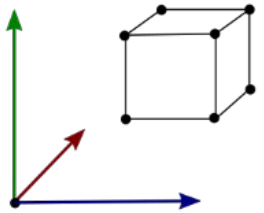
- **Homogeneous coordinates**
- **Transformation matrices**
  - Translation
  - Rotation
  - Scale
  - Change of base
  - Inverse transform

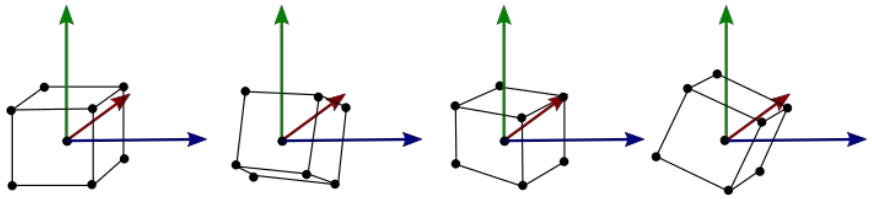


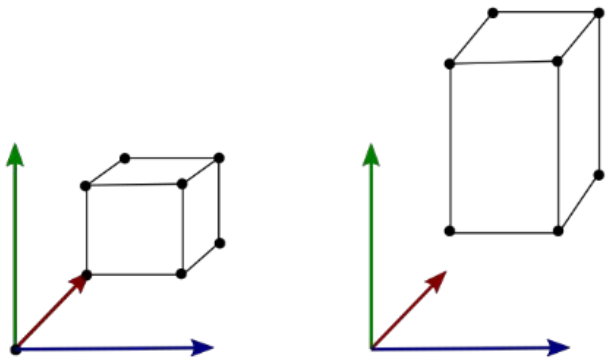
Basics

- **Homogeneous coordinates**
- **Transformation matrices**
  - Translation
  - Rotation
  - Scale
  - Change of base
  - Inverse transform
- **Combine transform matrices**









Basics

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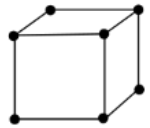
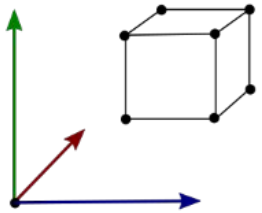
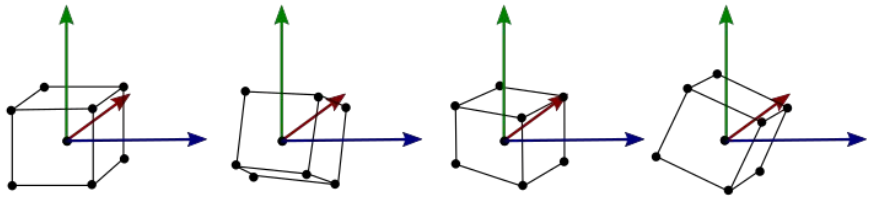
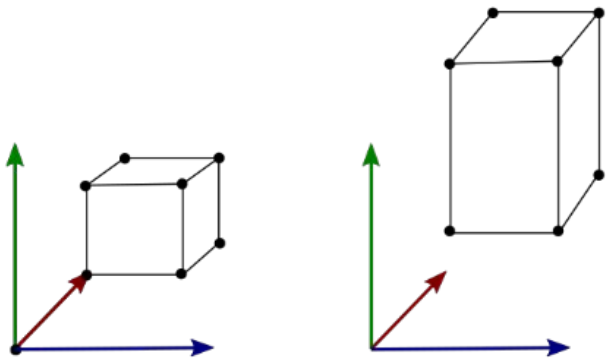
- **Combine transform matrices**





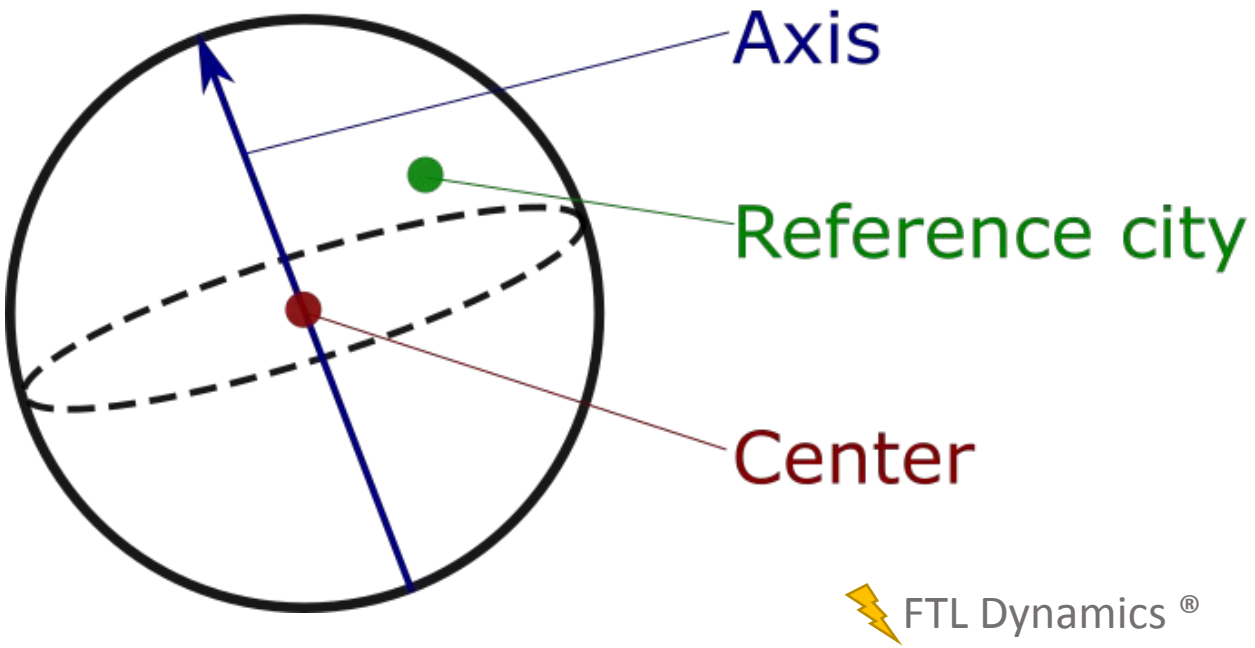


```
std::cout << matrix << std::endl;
 / 1.0  0.0  0.0  0.0 \
 | 0.0  1.0  0.0  0.0 |
 | 0.0  0.0  1.0  0.0 |
 \ 0.0  0.0  0.0  1.0 /
```



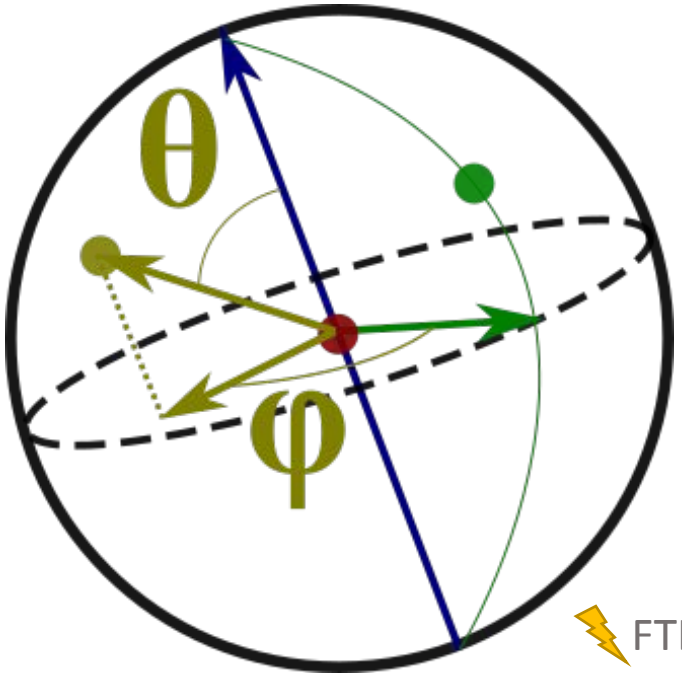
Planetary stations

- **How to define a planet**



Planetary stations

- **How to define a planet**
- **How to define a city**

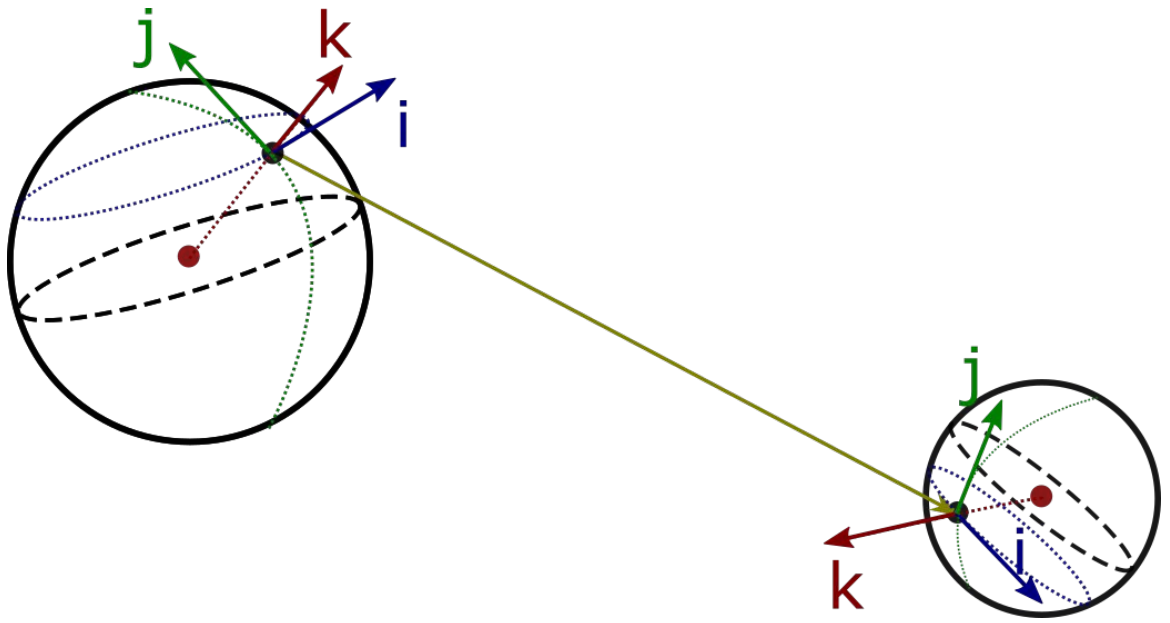


FTL Dynamics ®

Planetary stations

Graphics and Imaging Lab

- **How to define a planet**
- **How to define a city**
- **Interplanetary connections**



FTL Dynamics ®

Questions

Graphics and Imaging Lab

DO ASK questions, either now or after the lab

But be reasonable, please :)

pluesia@unizar.es | dsubias@unizar.es | o.pueyo@unizar.es

What to expect from this session

Graphics and Imaging Lab

In the programming language of your choice, implement:

- **Data basics:** Matrices, homogeneous coordinates
- **Transformation matrices**:
  - Translation, rotation, scale
  - Change of basis, inverse transformation, combine transform matrices
  - Pretty stdout operator
- Use your new math powers on your job at FTL dynamics
- Recommended deadline: September 25th. Do you have **extra time**?
  - Go home and rest :)
  - Next session: read/write PPM images, tonemapping
  - Try programming ray-sphere intersections, test it with planetary stations