Università degli Studi di Padova

The pinhole camera model

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DIPARTIMENTO
DI INGEGNERIA
DELL'INFORMAZIONE

- Image formation

- The pinhole camera

- Geometric description of the projection process

- Intrinsic and extrinsic parameters

Slides by Stefano Ghidoni and Alberto Pretto. Reference: Forsyth, Ponce, *Computer vision: a modern approach*

- Today we answer this question:
  How is an image created?

  - What are the main elements of a camera?

  - How can a camera create an image by "looking" at the real world?
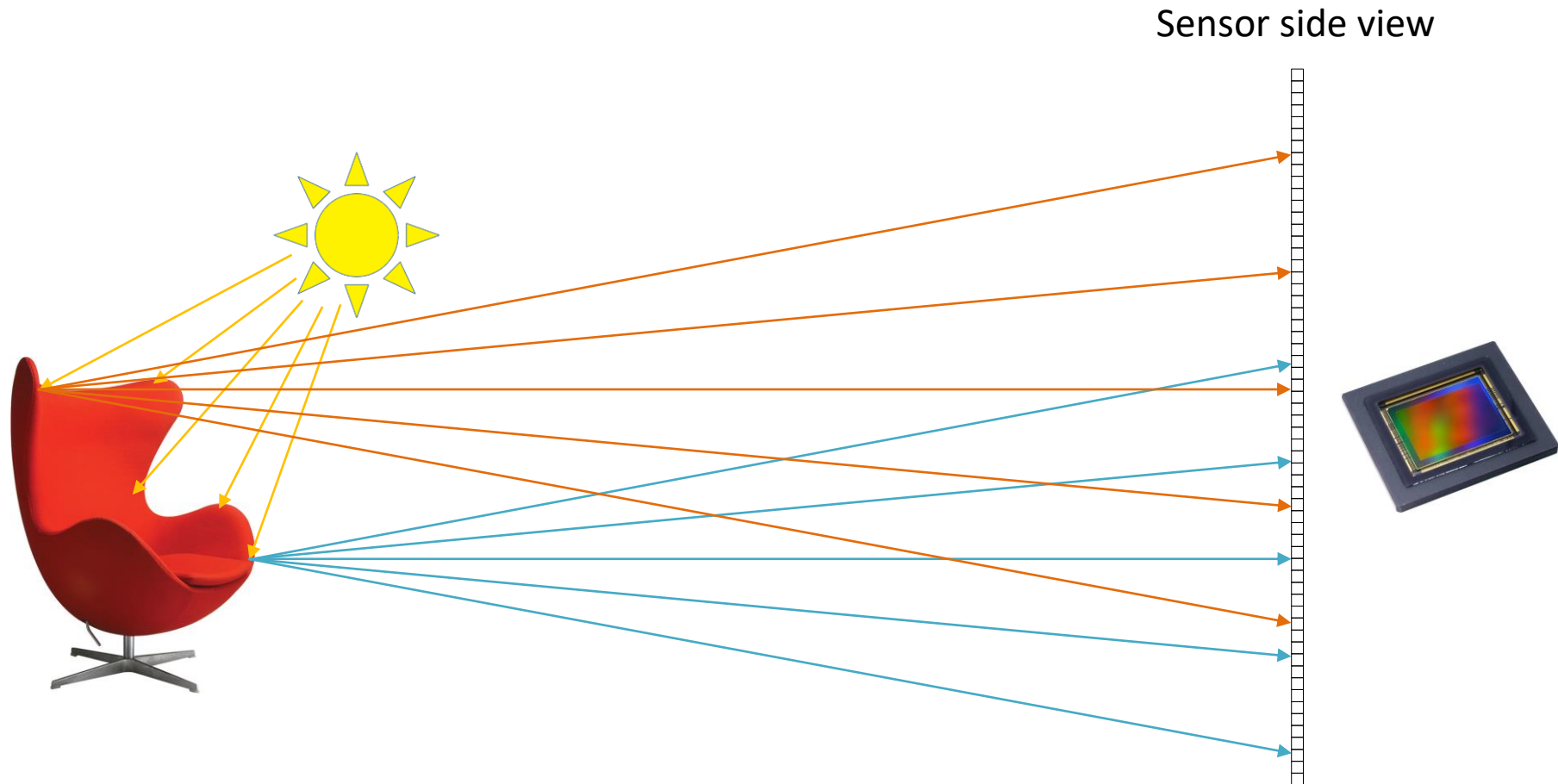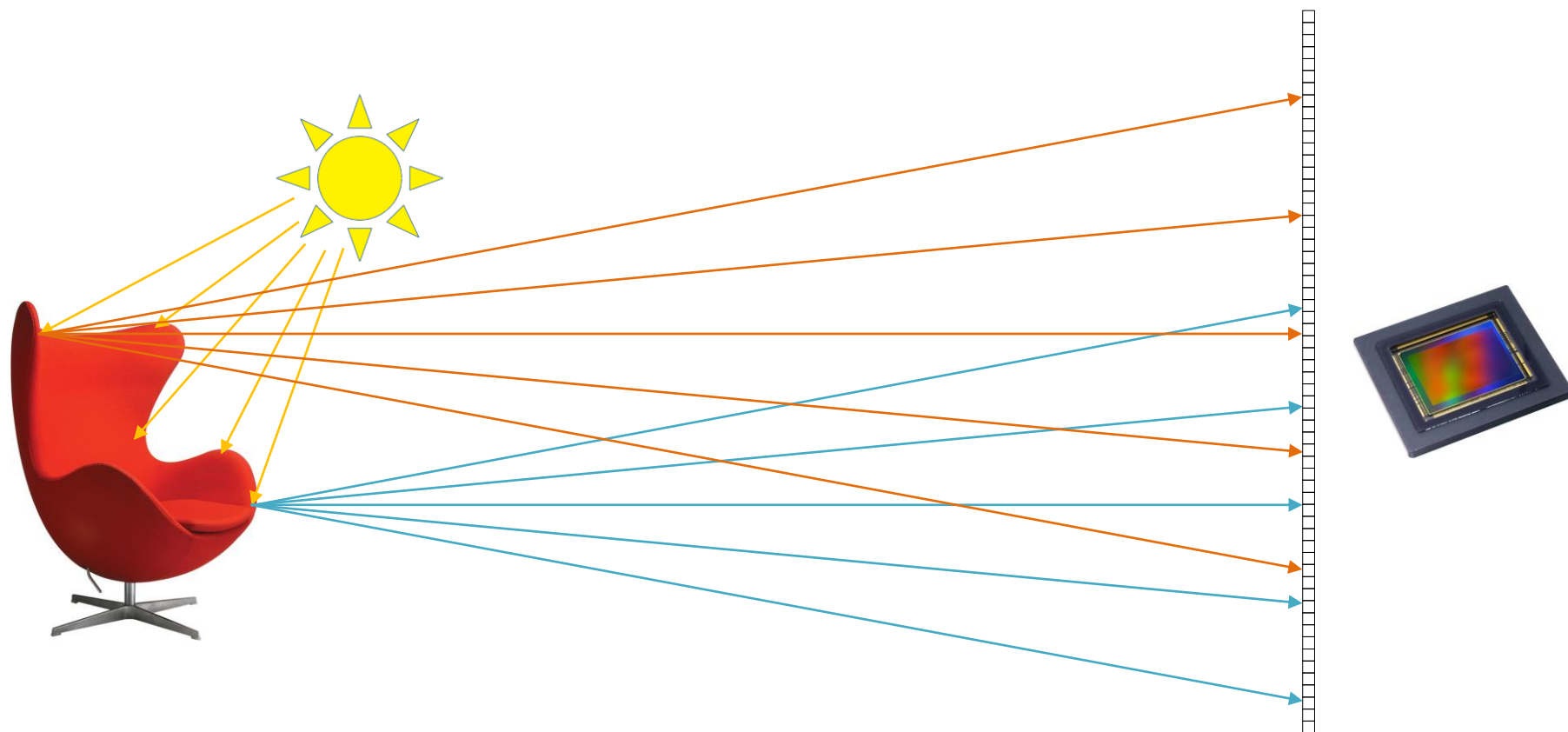
- Anti spoiler ☺
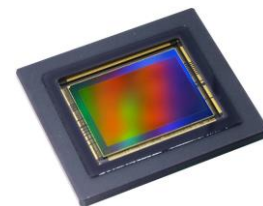
- Object
- Light source
- Sensor

Sensor side view

- ## Any problems?

Sensor side view

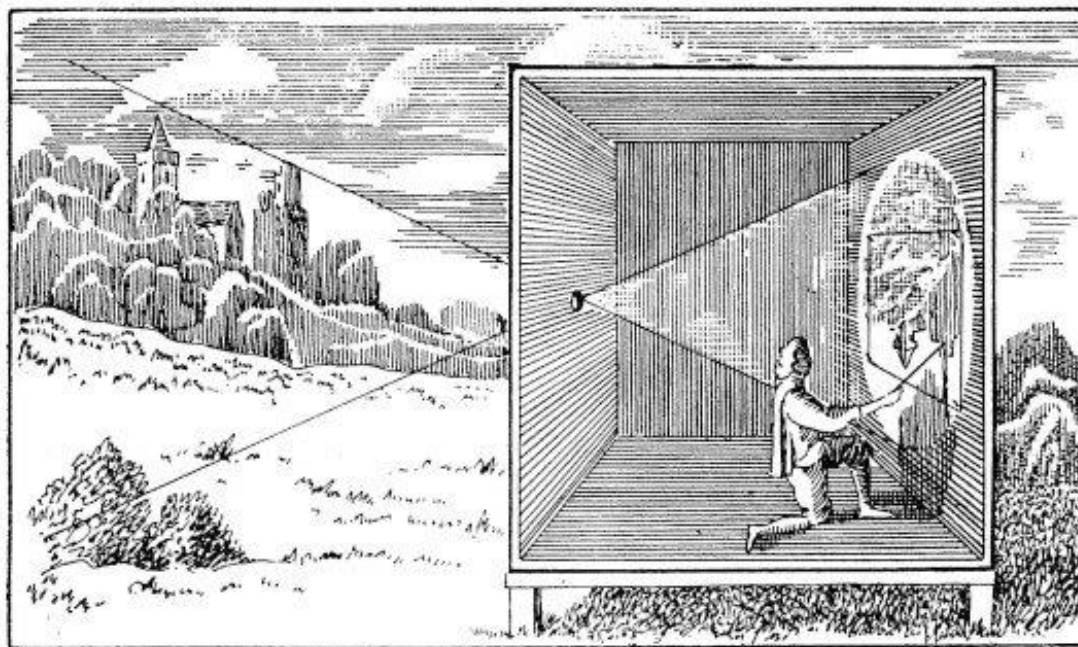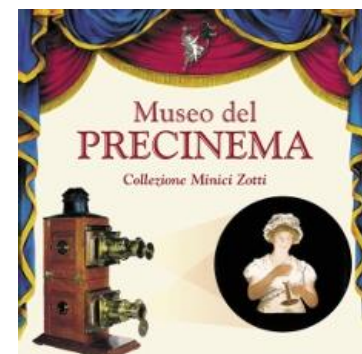Sensor side view
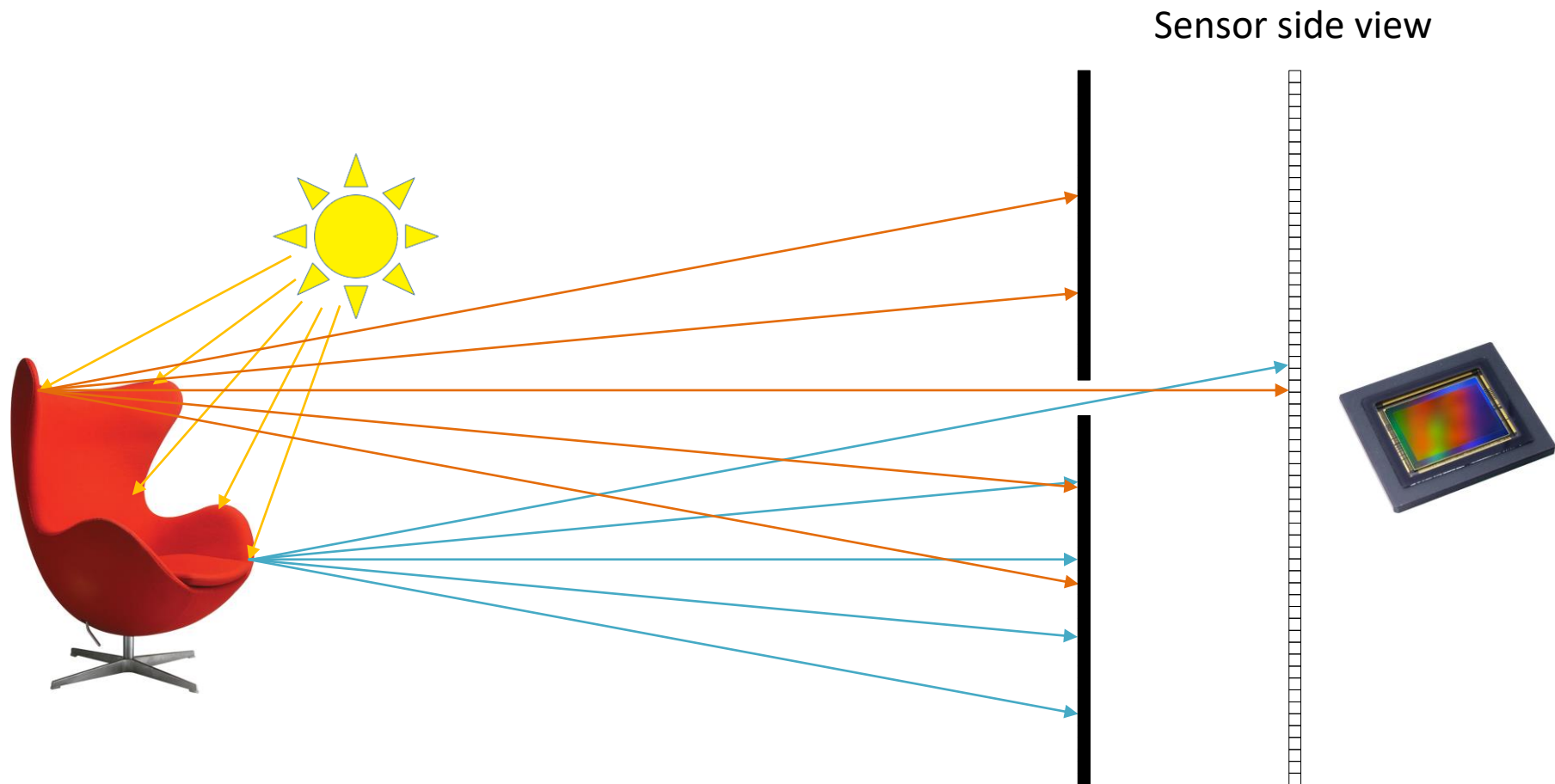
- The selection of rays depends on the size of the hole

- We get a perfect definition if only one ray per point reaches the sensor

- This happens if the hole is just a point
 - **Pinhole camera model**

image plane

pinhole

virtual image
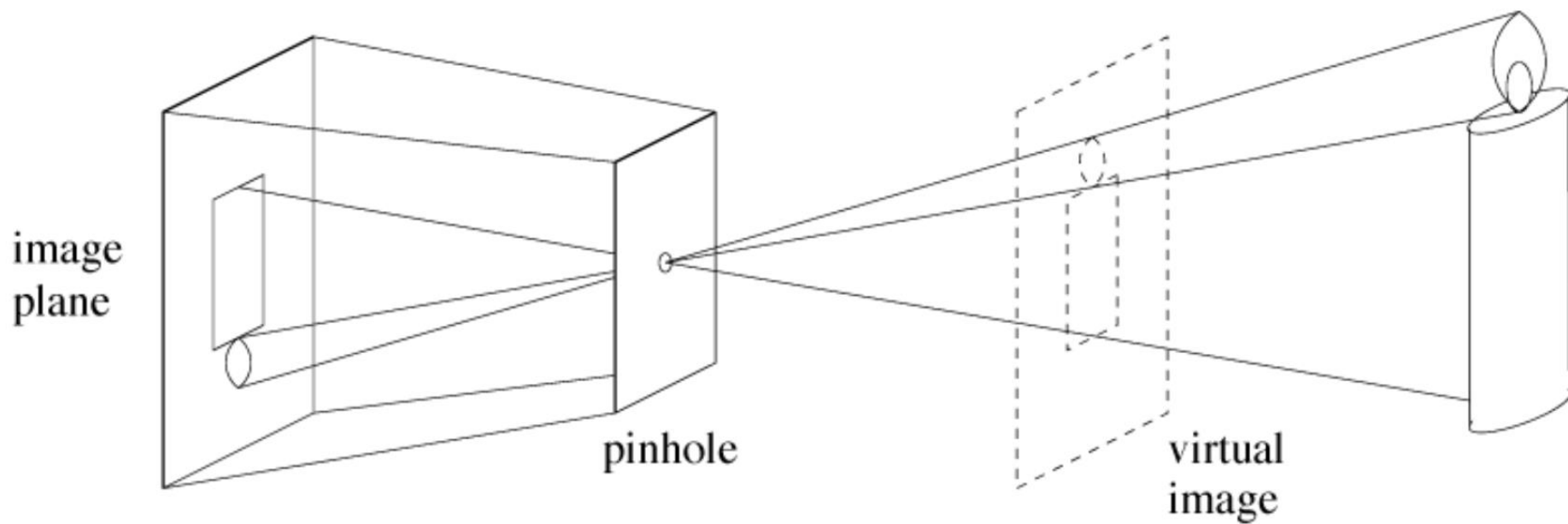
- A model used since many years…
- One is available in Padova
 - Museo del precinema, Prato della Valle

- Let's try to model a real camera using a pinhole model
  - Some effects are neglected
  - A first, simplified model to start studying the geometric projection
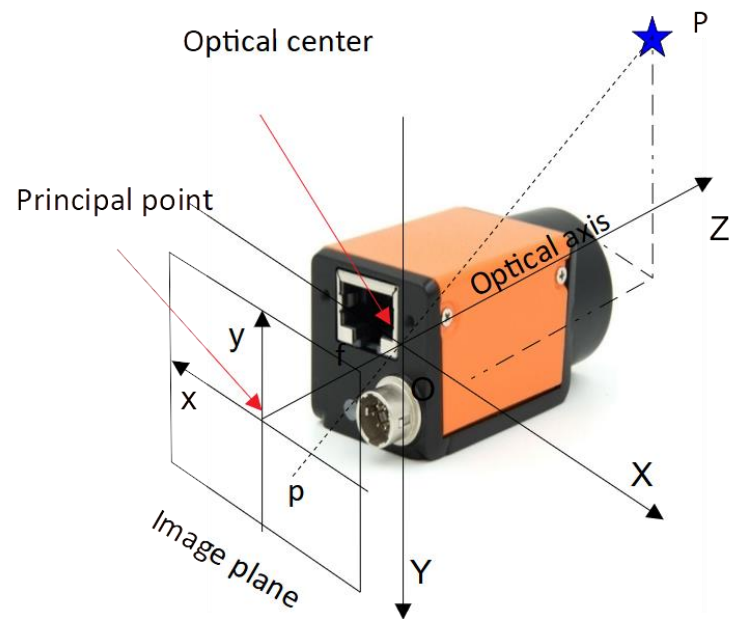
- ## Main elements
  - Optical center O
    - Location of the pinhole
  - Image plane Π
  - Optical axis Z
    - Perpendicular to image plane
   - Passing through the optical center
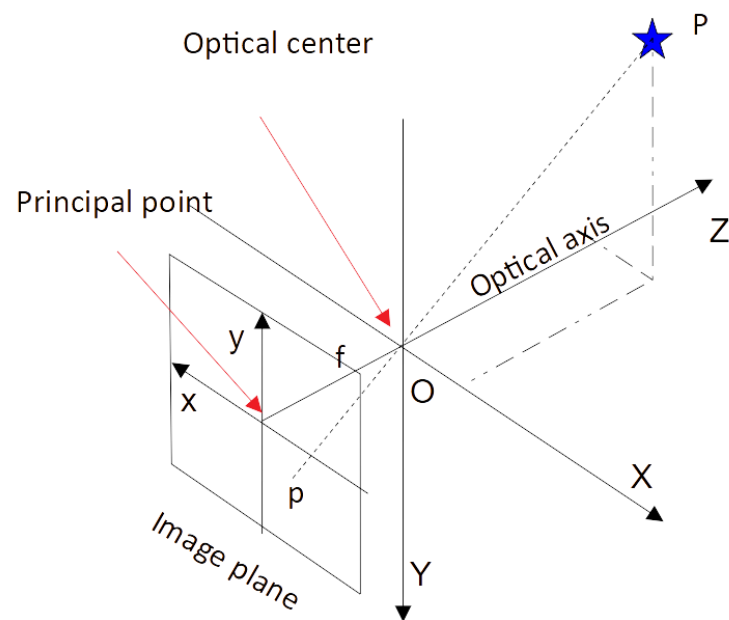
- # Main elements
  - ## Principal point
    - Intersection of image plane and optical axis
  - ## Focal length f
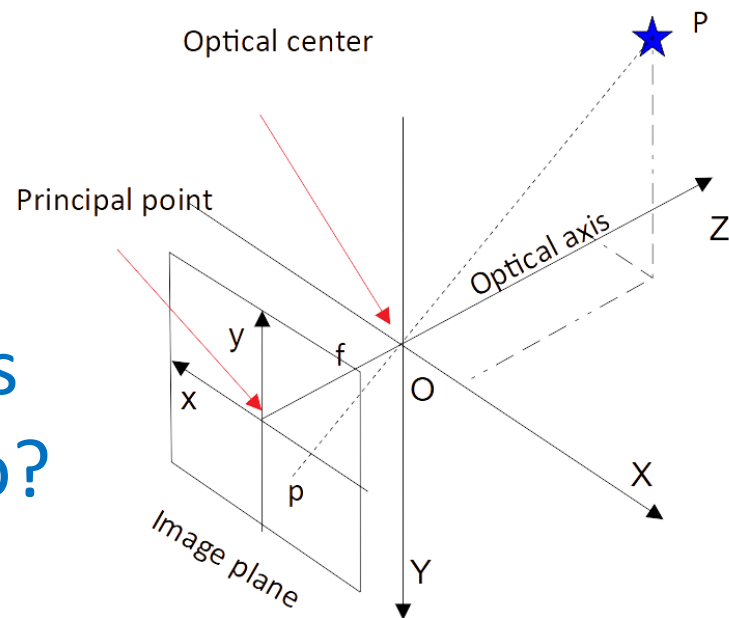   - Distance between optical center and image plane
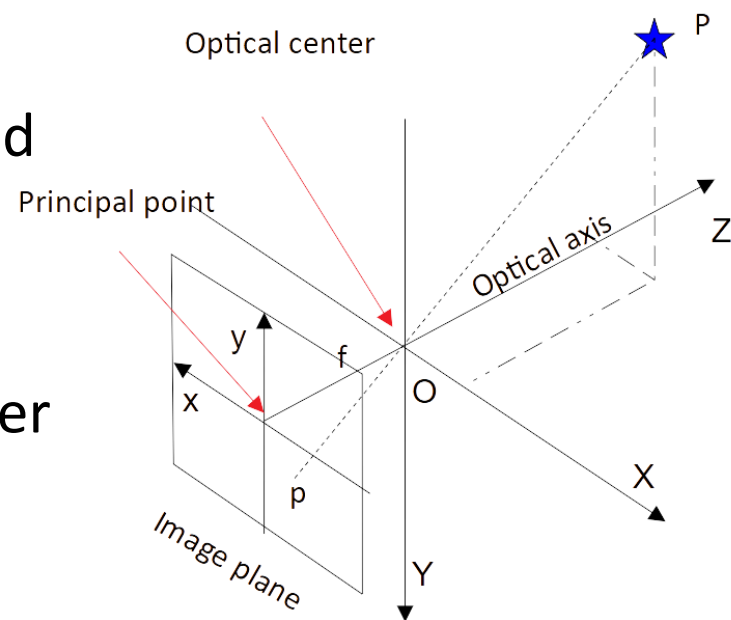
UPPERCASE-> 3d world
LOWERCASE-> camera reference system

- ## Main elements
  - – Reference systems
    - One describes the camera
    - One describes the image plane

- ## Remember the orientation
  - – Right-hand rule
    - Remember? Try!
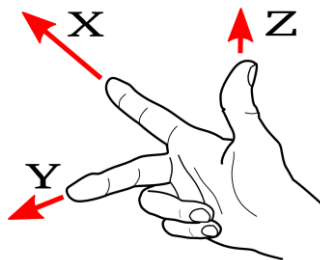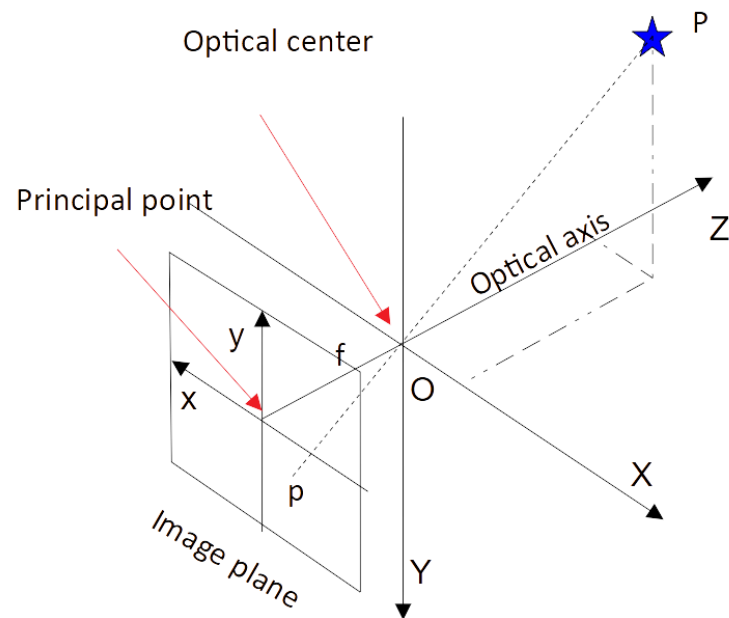
- Consider when
  - We find a keypoint
  - We detect an edge
  - We detect a line or a blob
- In which reference system is given the output of the algo?
- Did we use any other reference system?

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