UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Centre de la Imatge i la Tecnologia Multimèdia

Theme 4. Camera Views

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Bachelor's Degree in Video Game Design and Development

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Outline

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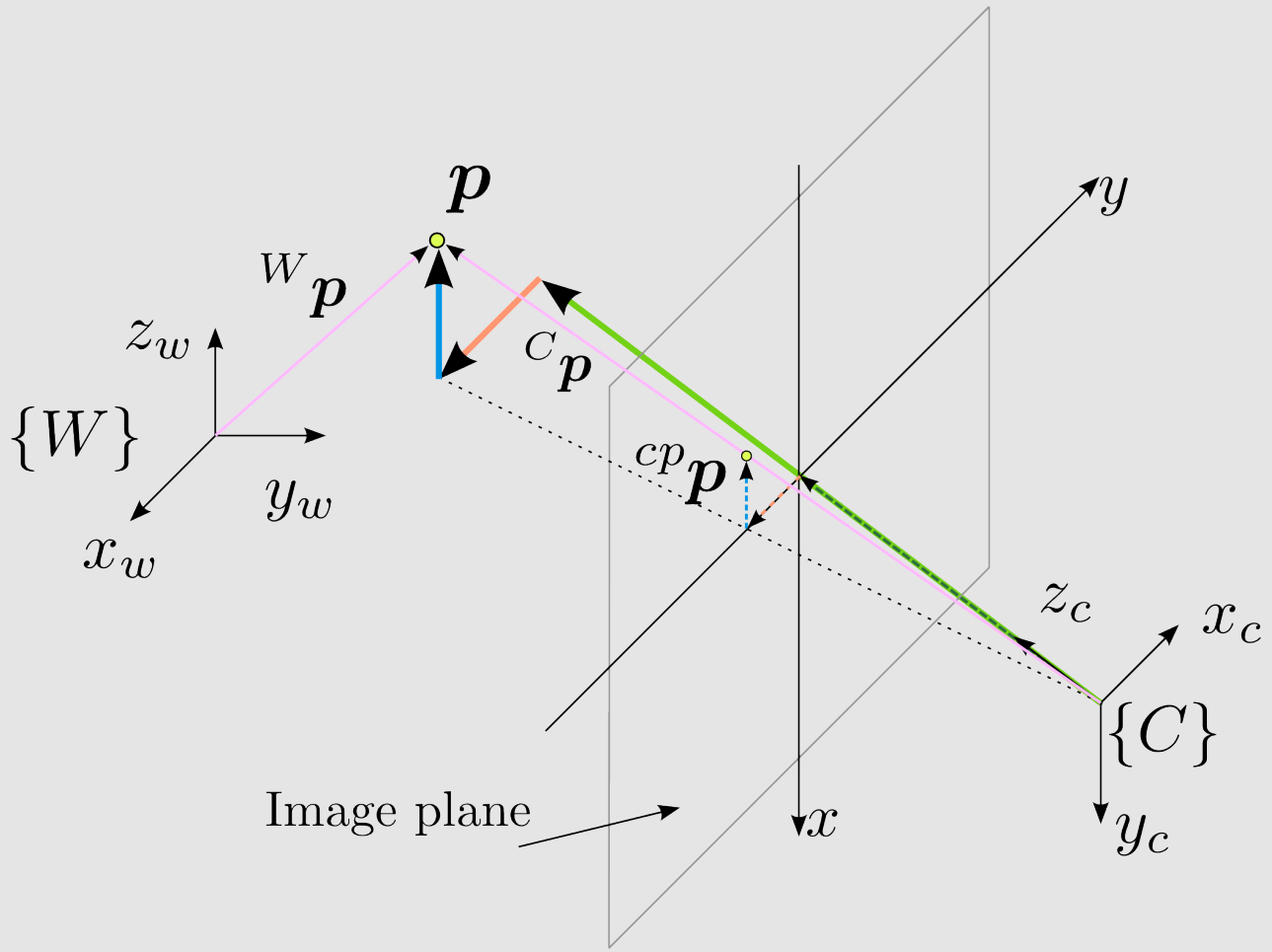
Simple Camera Model

What is the representation of $\boldsymbol{p}$ on the camera plane?



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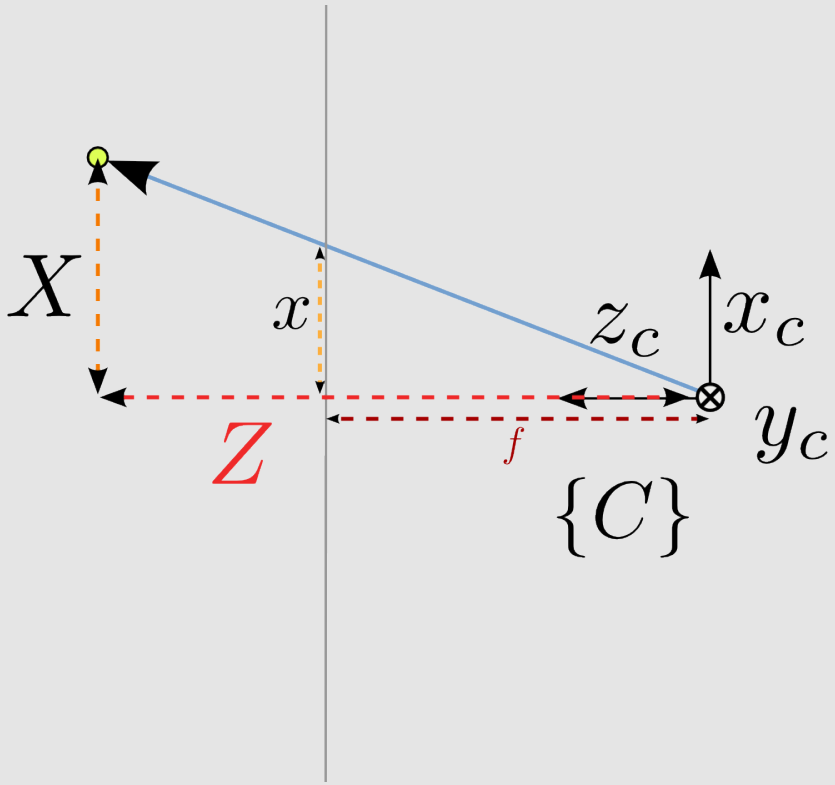

$$^{C}\boldsymbol{p} = \begin{pmatrix} X \\ Y \\ Z \end{pmatrix}$$

$$^{cp}\boldsymbol{p} = \begin{pmatrix} x \\ y \end{pmatrix}$$

f is the focal length: distance between the image plane and the camera

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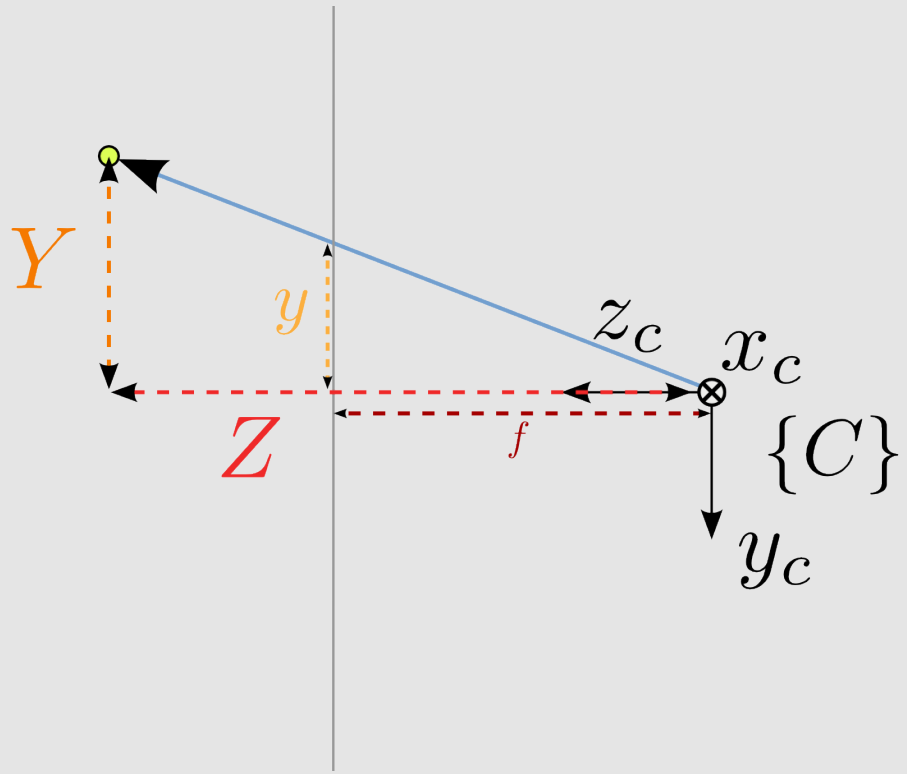

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Simple Camera Model

What is the representation of $\boldsymbol{p}$ on the camera plane?

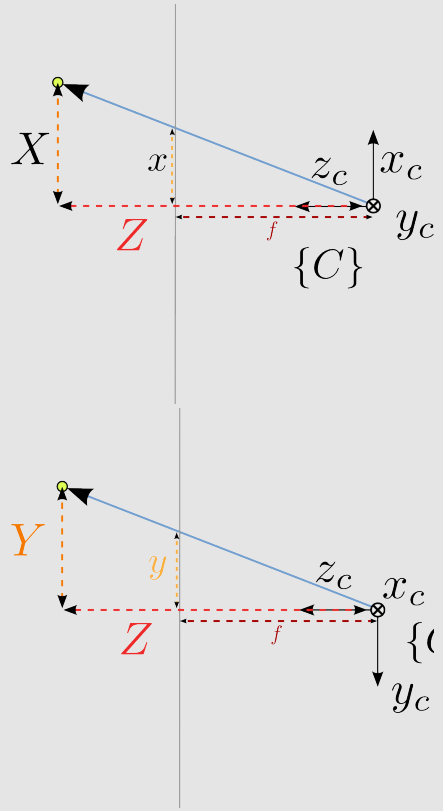
Thales Theorem about similar triangles establishes

$$\frac{X}{Z} = \frac{x}{f}$$

$$\frac{Y}{Z} = \frac{y}{f}$$

which implies that

$${}^{cp}\boldsymbol{p} = \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} \frac{X}{Z} f \\ \frac{Y}{Z} f \end{pmatrix}$$



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Perspective Transformation

$$ {}^{cp}\boldsymbol{p} = \begin{pmatrix} \frac{X}{Z} f \\ \\ \frac{Y}{Z} f \end{pmatrix} $$

is a transformation, known as Perspective Transformation, with the properties

- It Is a mapping from 3-dimensional space to 2-dimensional space.
- Straight lines in the world are projected to straight lines in the camera plane.
- Parallel lines in the world are translated to lines that intersect at a vanishing point.

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Perspective Transformation

- Conics (circles, ellipses, parabolas and hyperbolas) are translated to other conics.
- The transformation does not preserve angles between lines.
- The mapping in general has not a unique inverse: any point

$$ {}^{c}\boldsymbol{p} = \begin{pmatrix} \lambda X \\ \lambda Y \\ \lambda Z \end{pmatrix} , \forall \lambda $$

is mapped to the same point ${}^{cp}\boldsymbol{p}$ on the camera

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Homework

Camera Views

Exercises

- Mock exam: Exercise 4
- Re-evauation exam: Exercise 5