Outline

- General course information
- What is computer vision?
- Research and applications
- Modelling cameras
General Course Information

- Lectures: $13 \times 2h$.
- Assignments: 5 (mandatory!)
- Exercise sessions: $5 \times 2h$

Exercises are optional! They are intended to be an opportunity to ask questions about the assignments.

Course requirements

- Passing the course: Completed assignments (on time).
- Higher grades (4 or 5): Same as above, written home-exam and oral exam. NOTE: Good solutions to optional exercises in the assignments will give bonus credits for the written home-exam.
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Assignments and Exercises

- 5 assignments, contains both regular exercises and computer exercises.
- You have the opportunity to work with the assignments and ask questions during the computer exercises and regular exercises. The exercise sessions are not mandatory, but the assignments are!
- Reports should be handed in roughly one week after the computer exercise session. Exact dates are written in the assignments.

Some Instructions/Advise

- Feel free to work in groups (as many as you want).
- The reports should be individual. (You should understand and be able to explain the solution you hand in.)
- Ask as many questions as you like.
- Some of the exercises are hard. If you get stuck send a mail to calle@maths.lth.se. I try to answer as fast as I can.
Literature

- Lecture notes. (Posted on the web. Continuously updated.)
- Some additional scientific papers.

Additional Reading

There is no registration during at the lectures anymore!
Registration is done at "Studentportalen".

If you have not signed up for the course or have registration issues contact the administrators: expedition@math.lth.se
What is Computer Vision?

**Computer Graphics**

Generate images from a 3D model.

**Computer Vision**

The inverse problem: Generate 3D model from images.
Main Goal of the Course: Multiview Reconstruction

Given Images

- 4 images out of a sequence with 435 images.

Compute 3D Model
Reconstruction Pipeline

Point Detection and Matching
Detect interesting (descriptive) points in all images.
Match points between images.
Compute 3D-positions of the matched points, position and orientation of the cameras.
Camera Model

The Pinhole Camera

Reinerus Gemma-Frisus camera obscura from 1544.
Camera Model

The Pinhole Camera

- Image plane
- Pinhole
- Virtual image

Diagram showing the pinhole camera model with rays passing through a pinhole and forming an image on a plane.

Carl Olsson
Computer Vision: Lecture 1
2019-01-22
Exercise 1

Compute the image of the cube with corners in $(\pm 1, \pm 1, 2)$ and $(\pm 1, \pm 1, 4)$.
Exercise 2

What is the position of the camera (the coordinates of the camera center) in the global coordinate system? What is the viewing direction in the global coordinate system?
Exercise 3

Compute the projection of $X = (0, 0, 1)$ in the cameras

$\begin{pmatrix}
\frac{1}{\sqrt{2}} & 0 & -\frac{1}{\sqrt{2}} & 0 \\
0 & 1 & 0 & 0 \\
\frac{1}{\sqrt{2}} & 0 & \frac{1}{\sqrt{2}} & 1 \\
\end{pmatrix}$ and 

$\begin{pmatrix}
1 & 0 & -1 & 0 \\
0 & \sqrt{2} & 0 & 0 \\
1 & 0 & 1 & \sqrt{2} \\
\end{pmatrix}$.  \hspace{1cm} (1)
Exercise 4

What is the position (camera center) and viewing direction of the camera
\[ P = K [R \quad t] \]?