

Introduction to TEK5030 – Computer Vision

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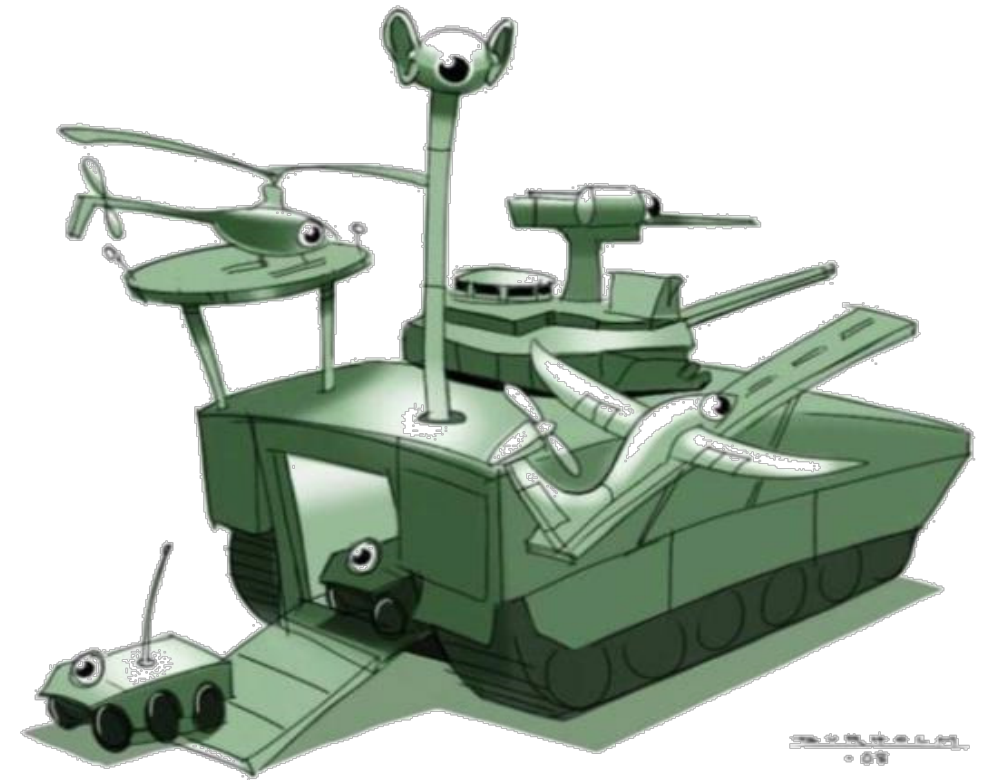
Idar Dyrdal (idar.dyrdal@its.uio.no)

Thomas Opsahl (thomasoo@its.uio.no)



Computer vision

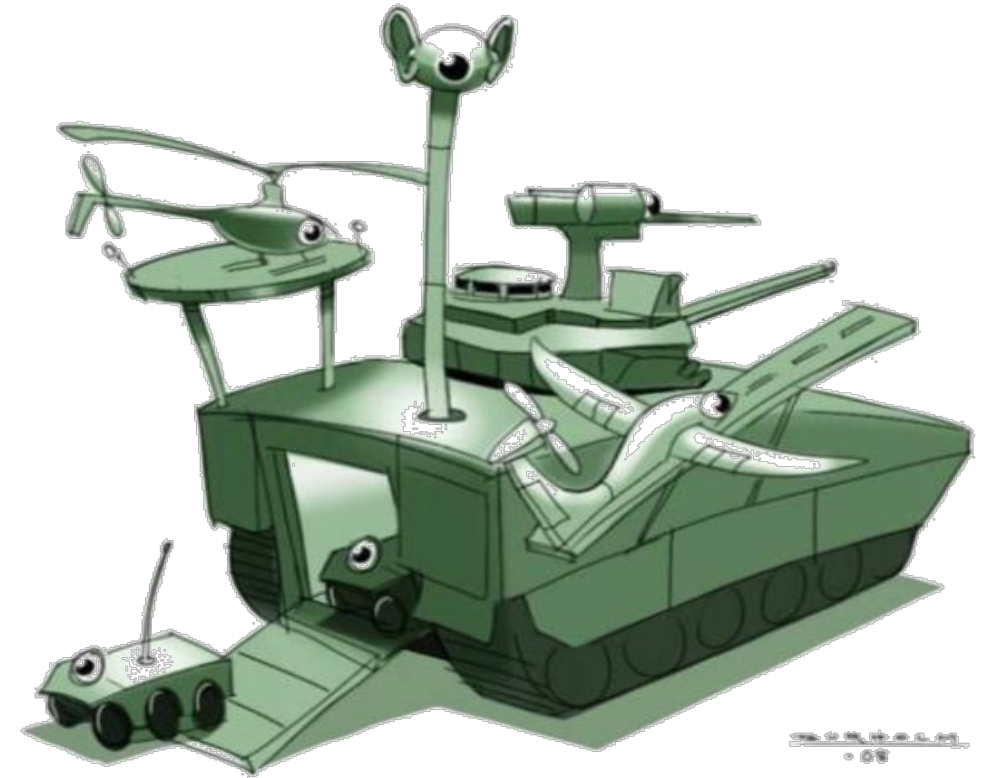
The study of how a machine can interpret and understand its surroundings from images



Computer vision

The study of how a machine can interpret and understand its surroundings from images

- “Enabling computers to see”

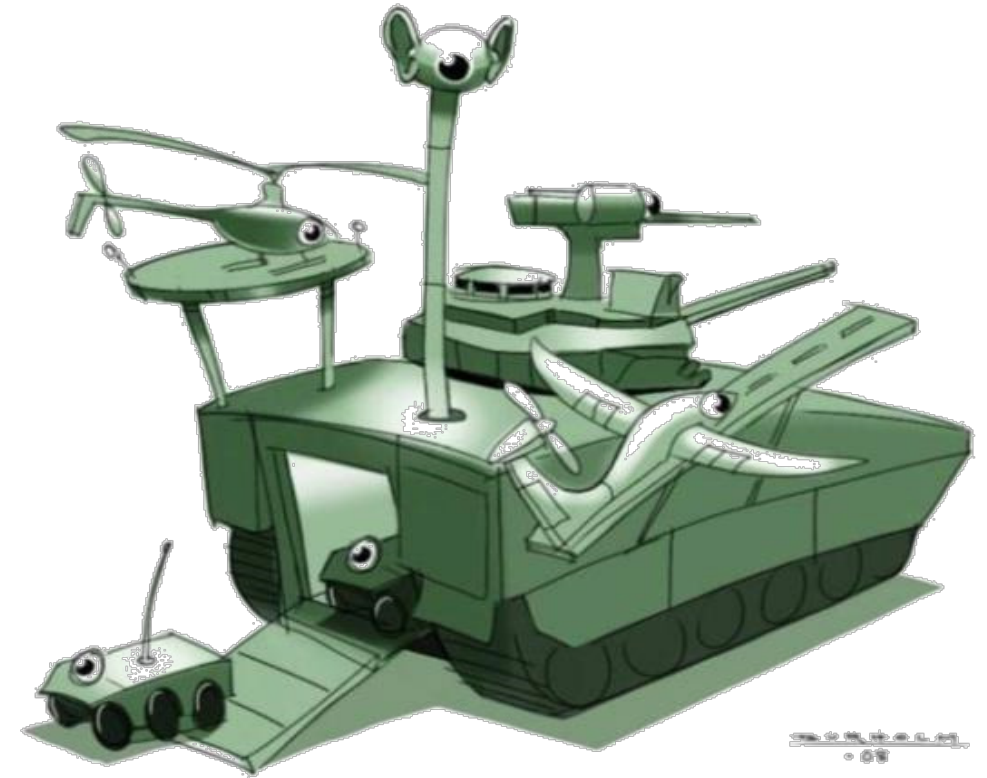


Computer vision

The study of how a machine can interpret and understand its surroundings from images

➤ “Enabling computers to see”

Aka: *Robotic Vision*



Today

- A quick introduction to computer vision
- About the course
- Lab:
 - Processing live video streams with OpenCV!

«An image is worth more than a thousand words»



«An image is worth more than a thousand words»

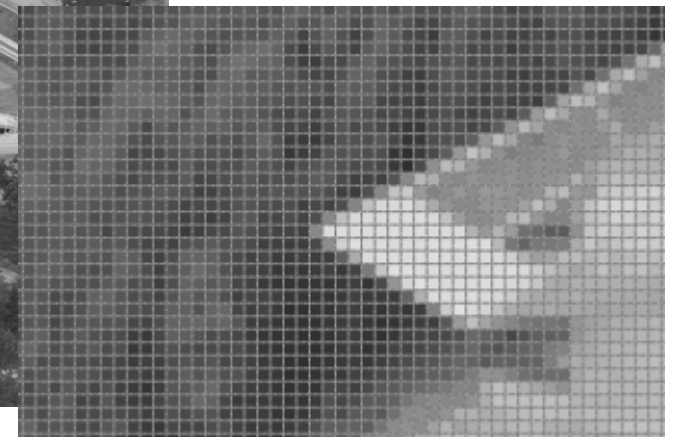
How can we extract
this information?



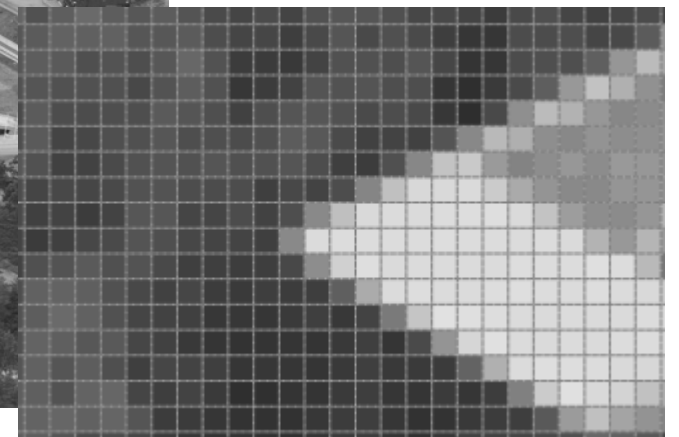
Images and pixels



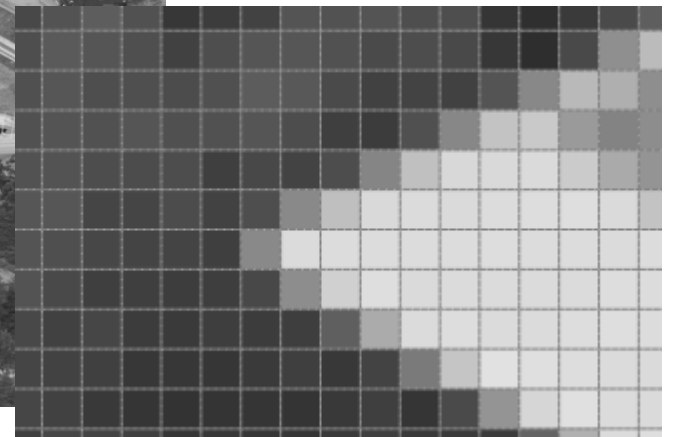
Images and pixels



Images and pixels



Images and pixels



Images and pixels



80	81	85	77	63	60	80	135	191
77	63	72	67	77	133	192	216	217
76	66	78	137	191	217	219	218	220
68	63	137	219	220	220	220	220	220
61	62	72	141	208	222	218	219	219
58	62	60	62	95	171	219	221	219

It is easy to calculate with images!



It is easy to calculate with images!



=



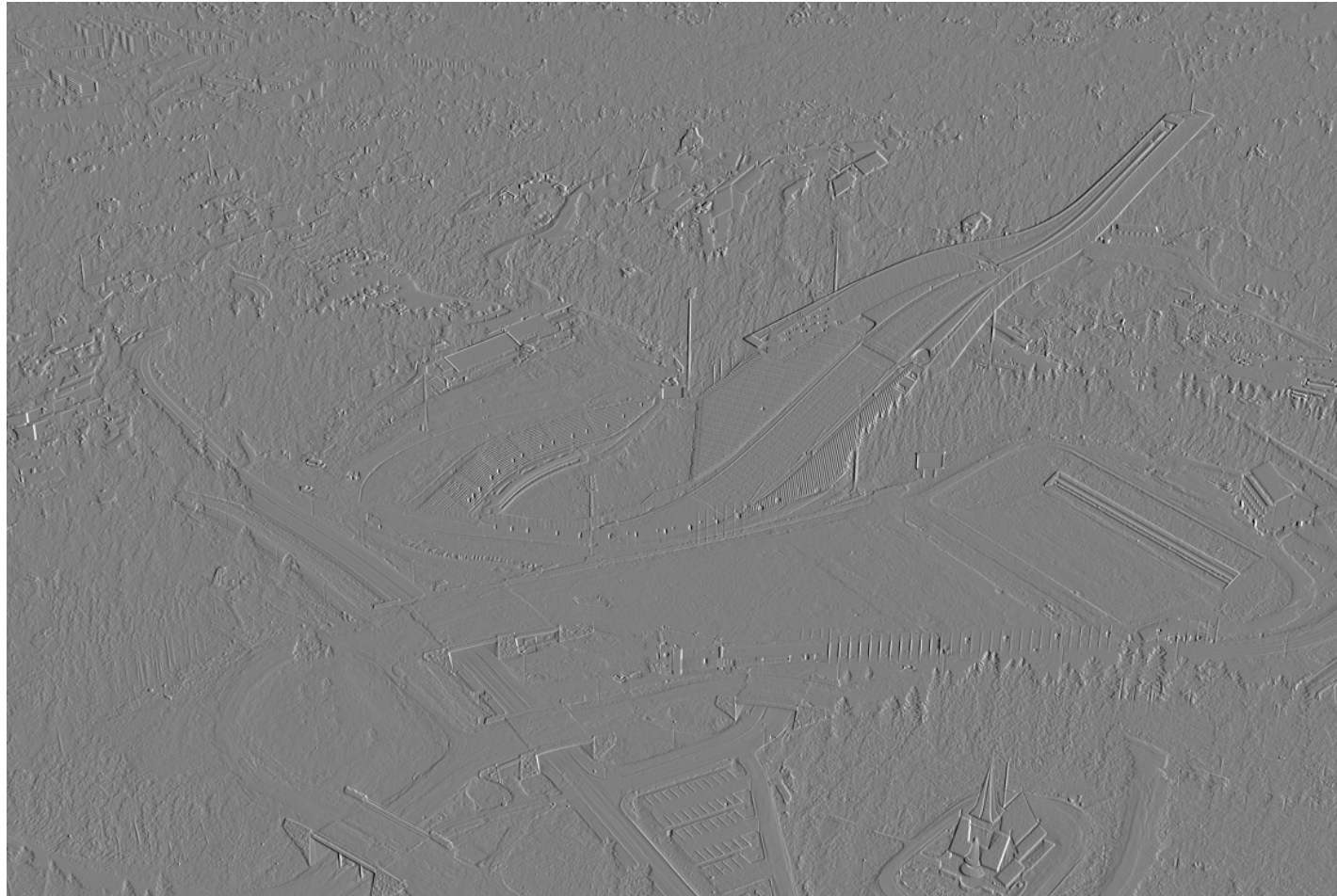
The difference between neighboring pixels



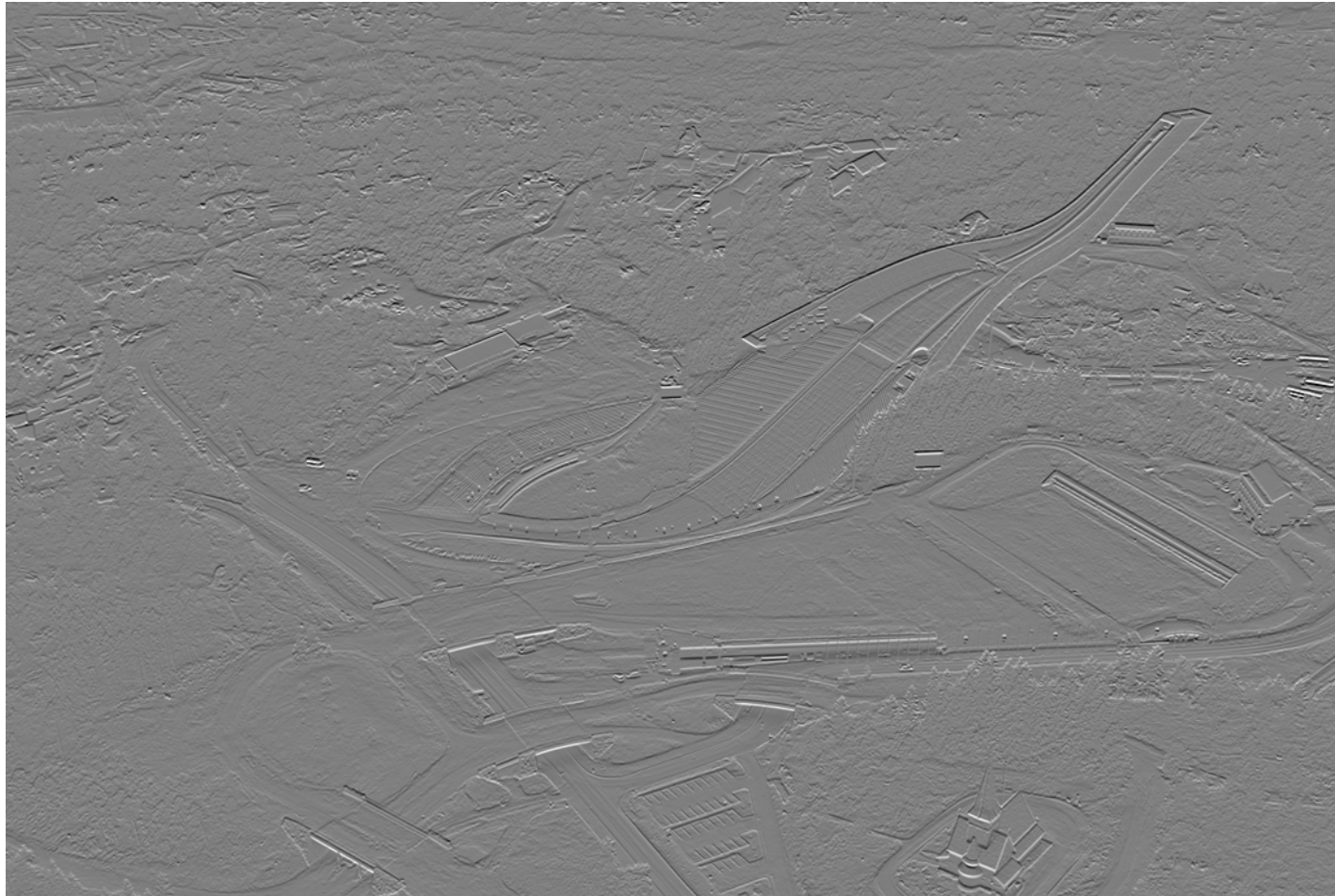
The difference between neighboring pixels



Horizontal differences



Vertical differences



Edges and corners



Significant corners



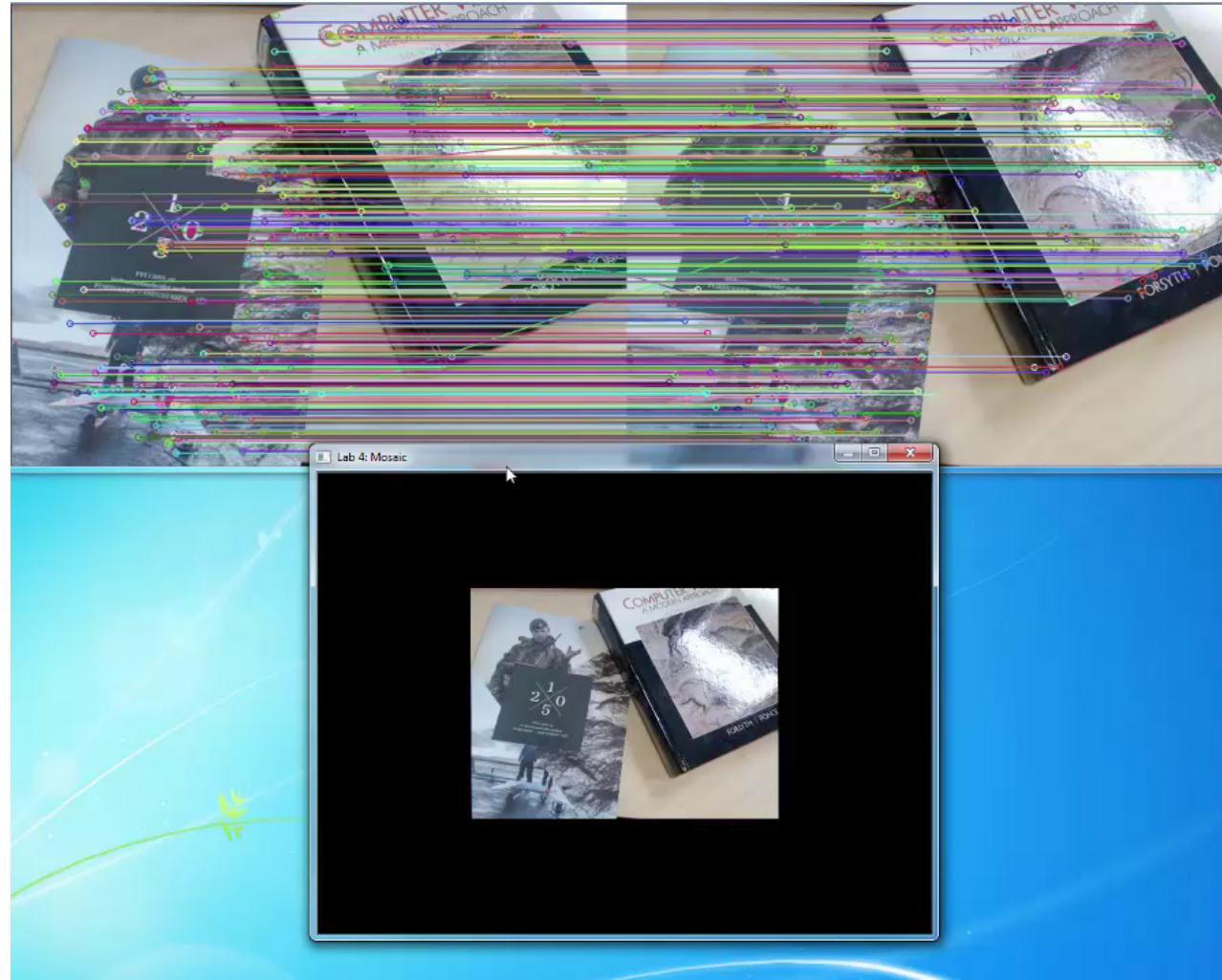
Significant corners



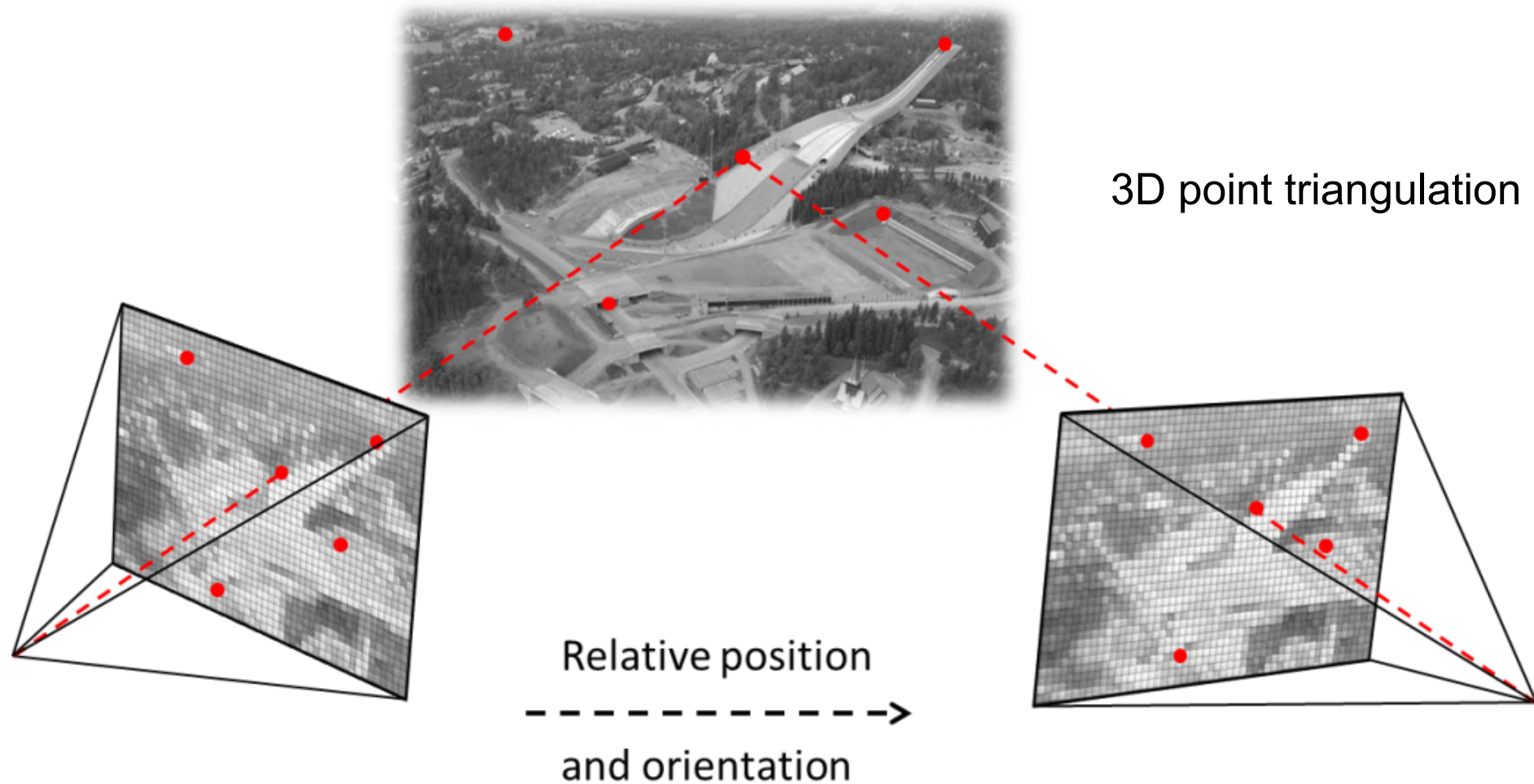
Significant corners



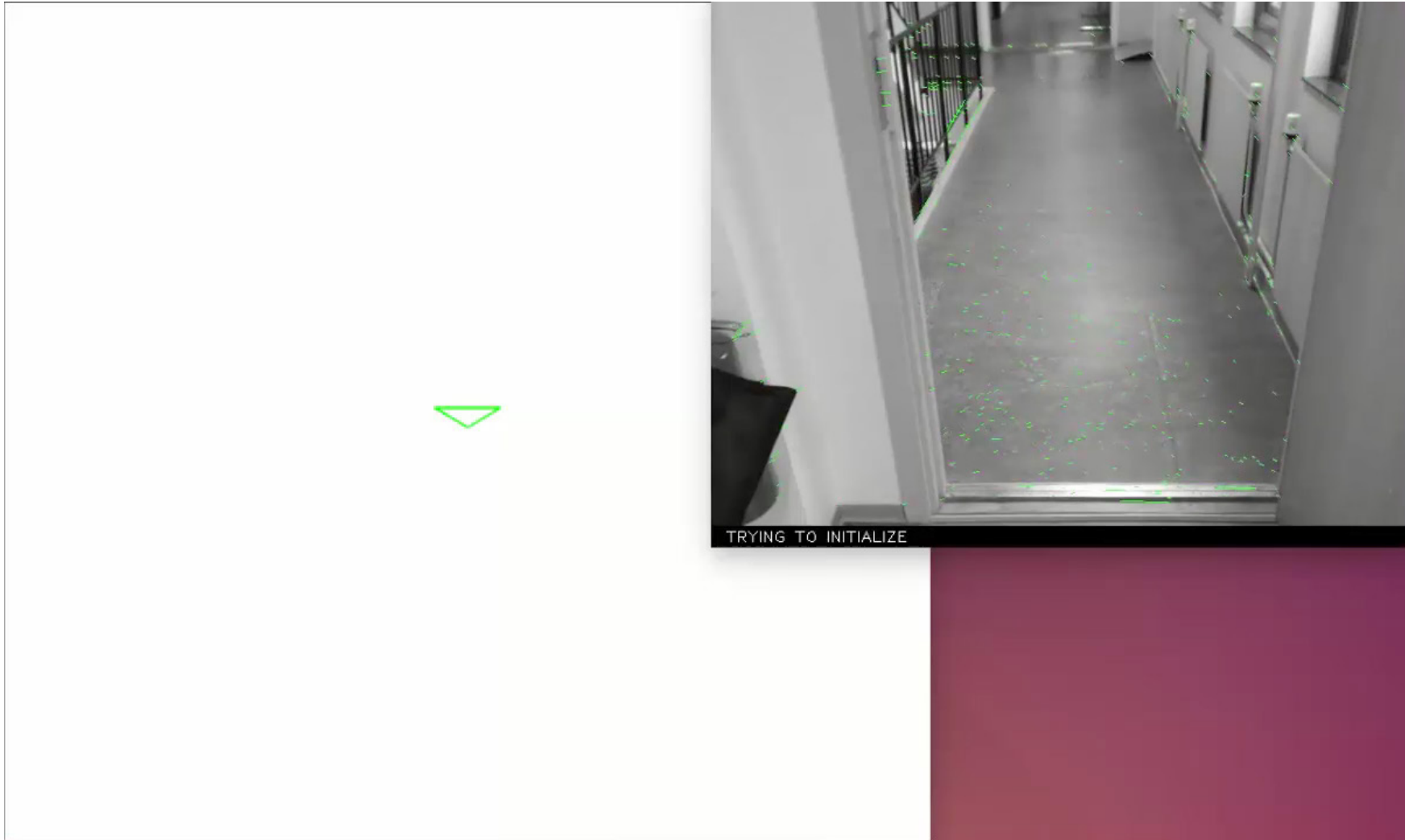
Example: Coregistering images



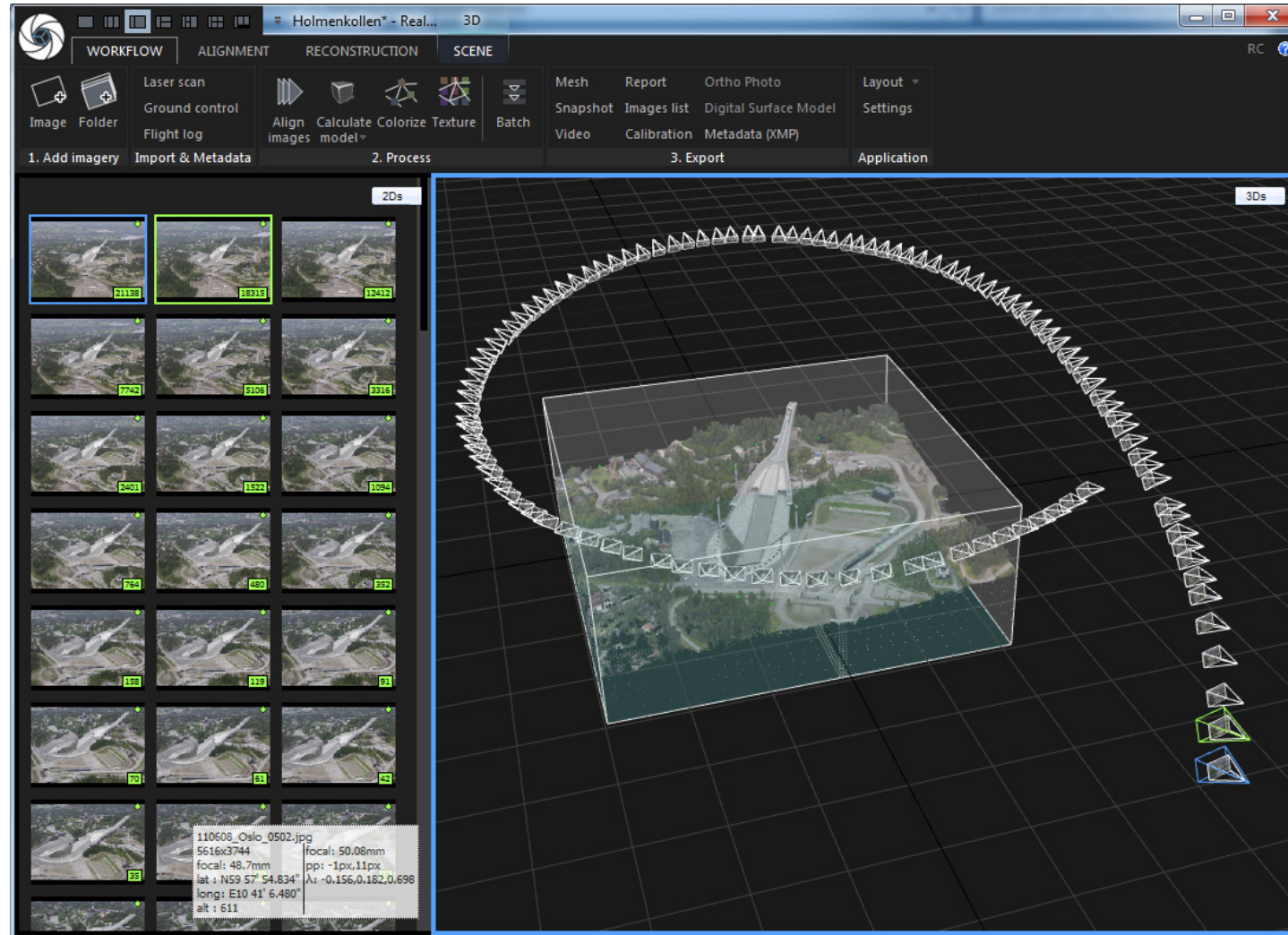
Extracting geometric information from images



Visual navigation



3D reconstruction from images



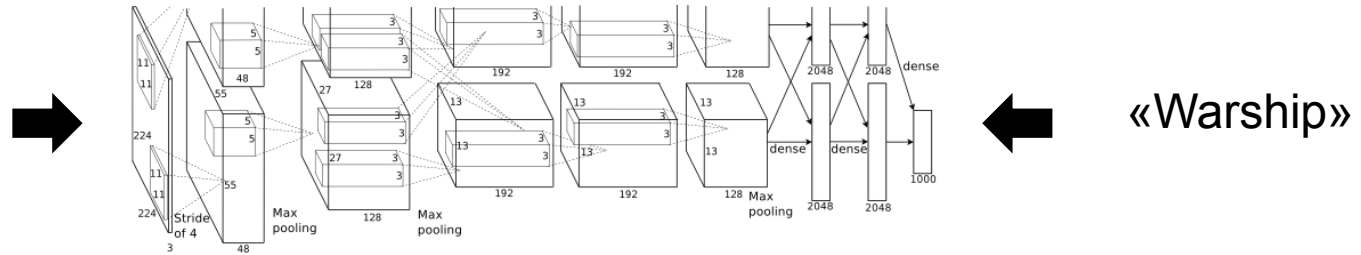
A detailed 3D surface in colors!



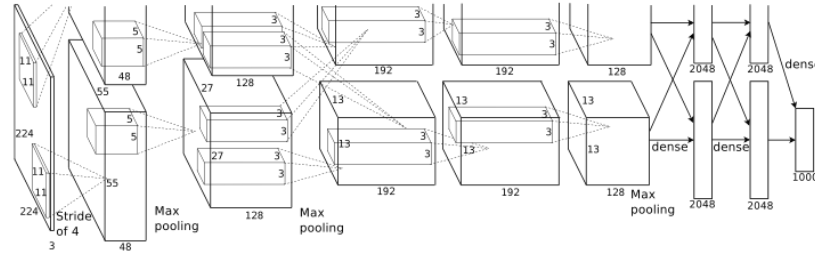
Recognize the shape of a ship



Let the machine learn a better representation itself!

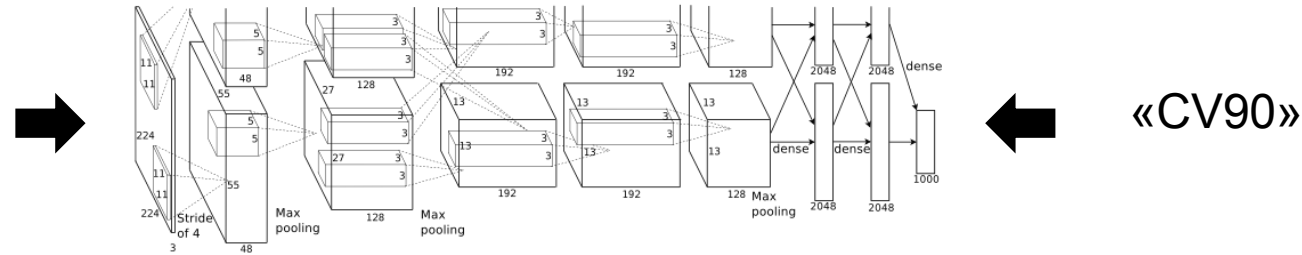


Let the machine learn a better representation itself!



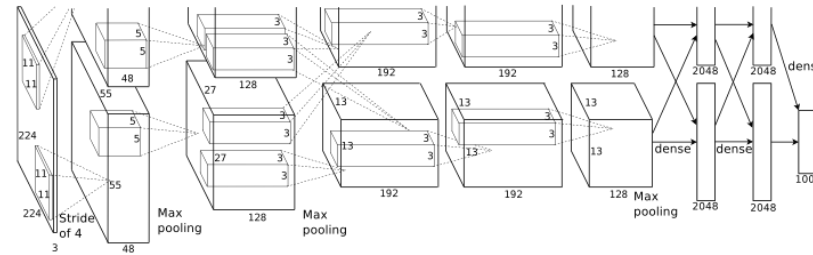
«Warship»

Let the machine learn a better representation itself!



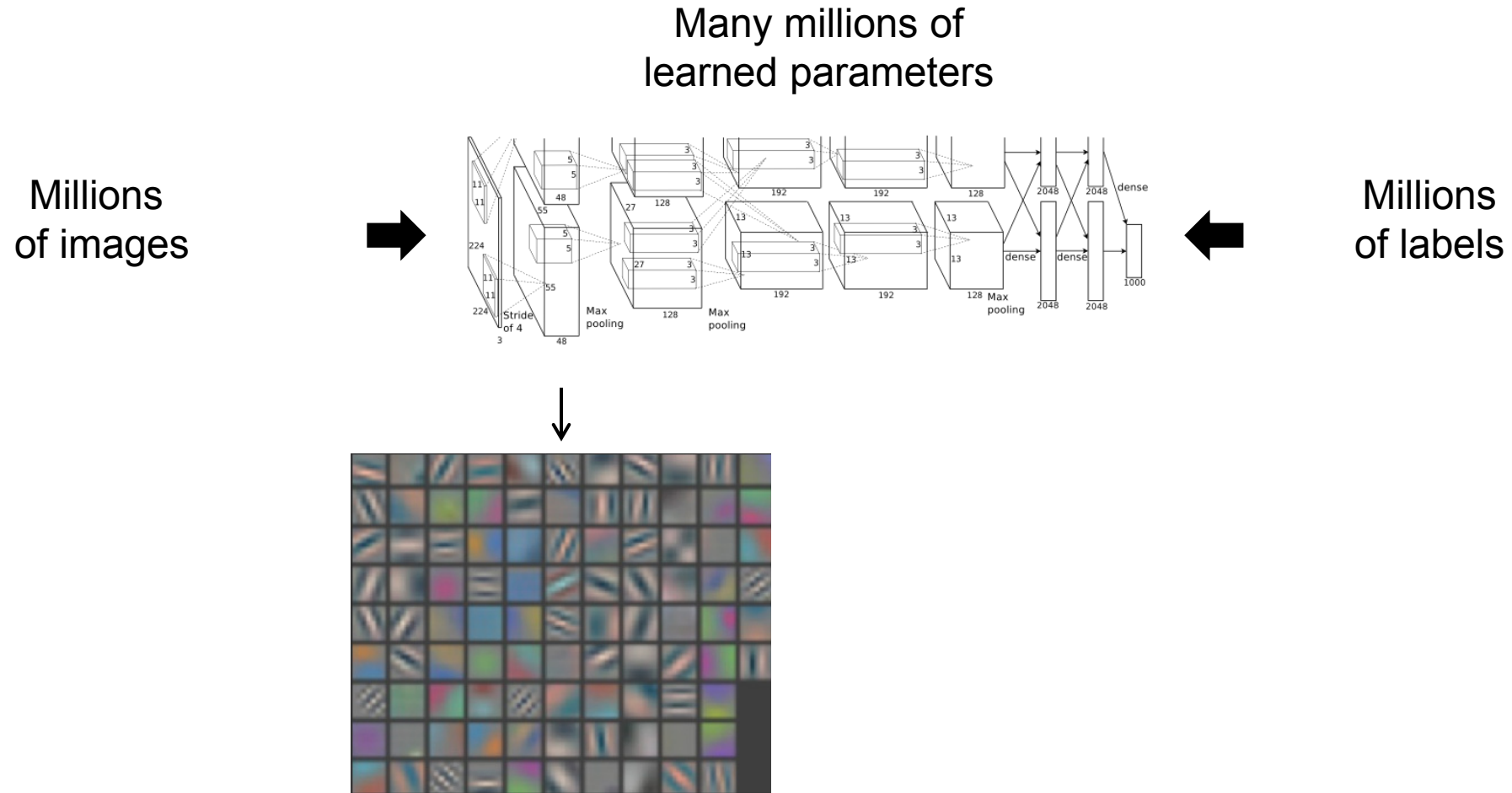
Let the machine learn a better representation itself!

Millions
of images



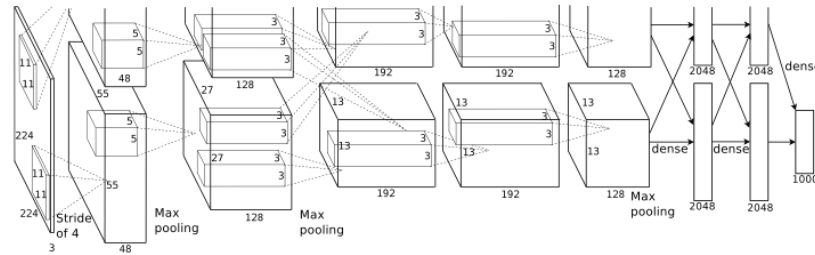
Millions
of labels

Let the machine learn a better representation itself!

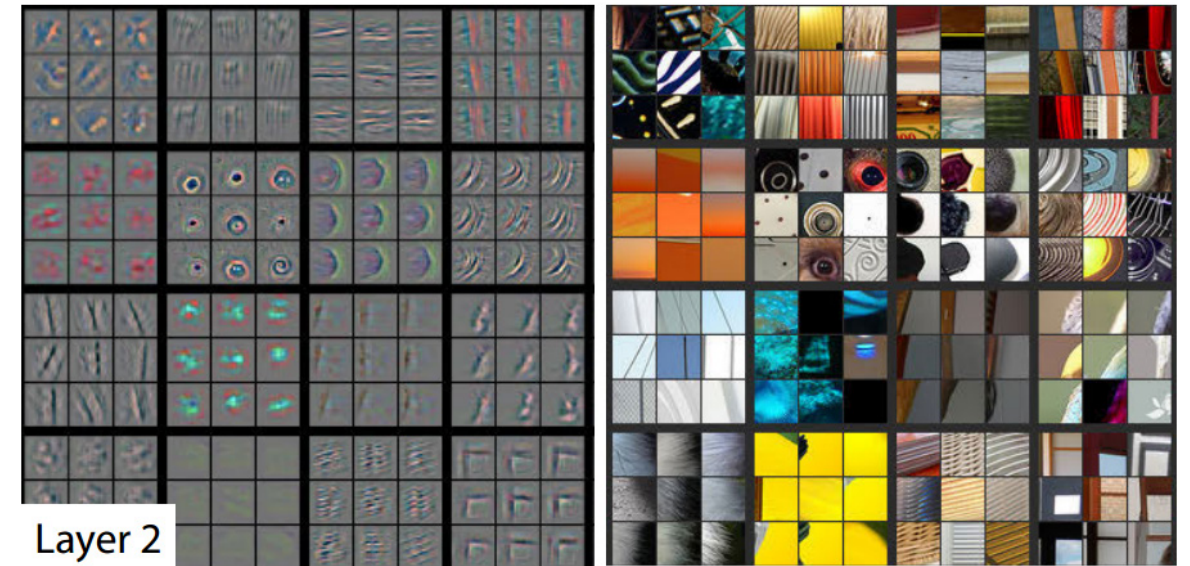


Let the machine learn a better representation itself!

Millions
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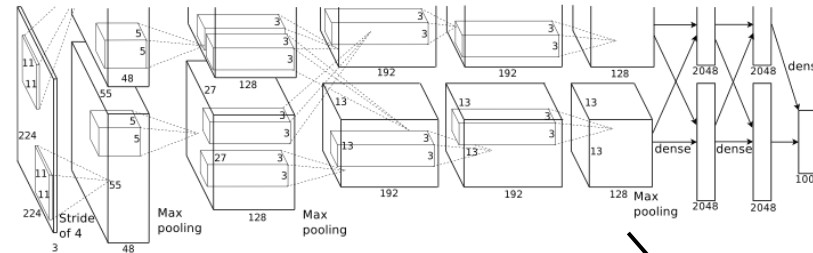


Millions
of labels



Let the machine learn a better representation itself!

Millions of images



Millions of labels

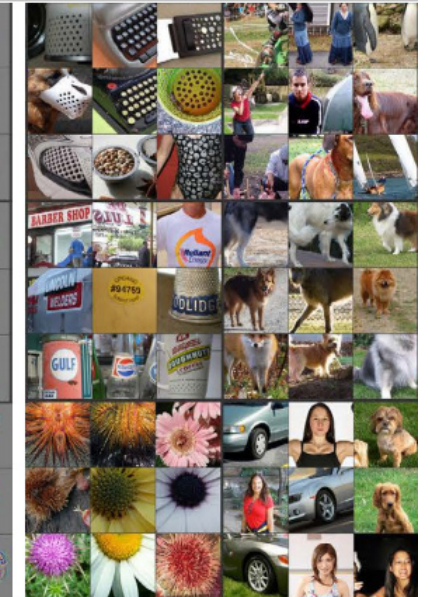
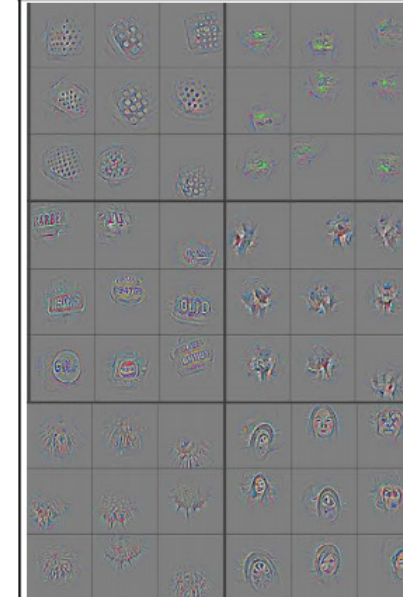
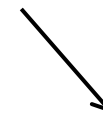


Image search in Google Photo

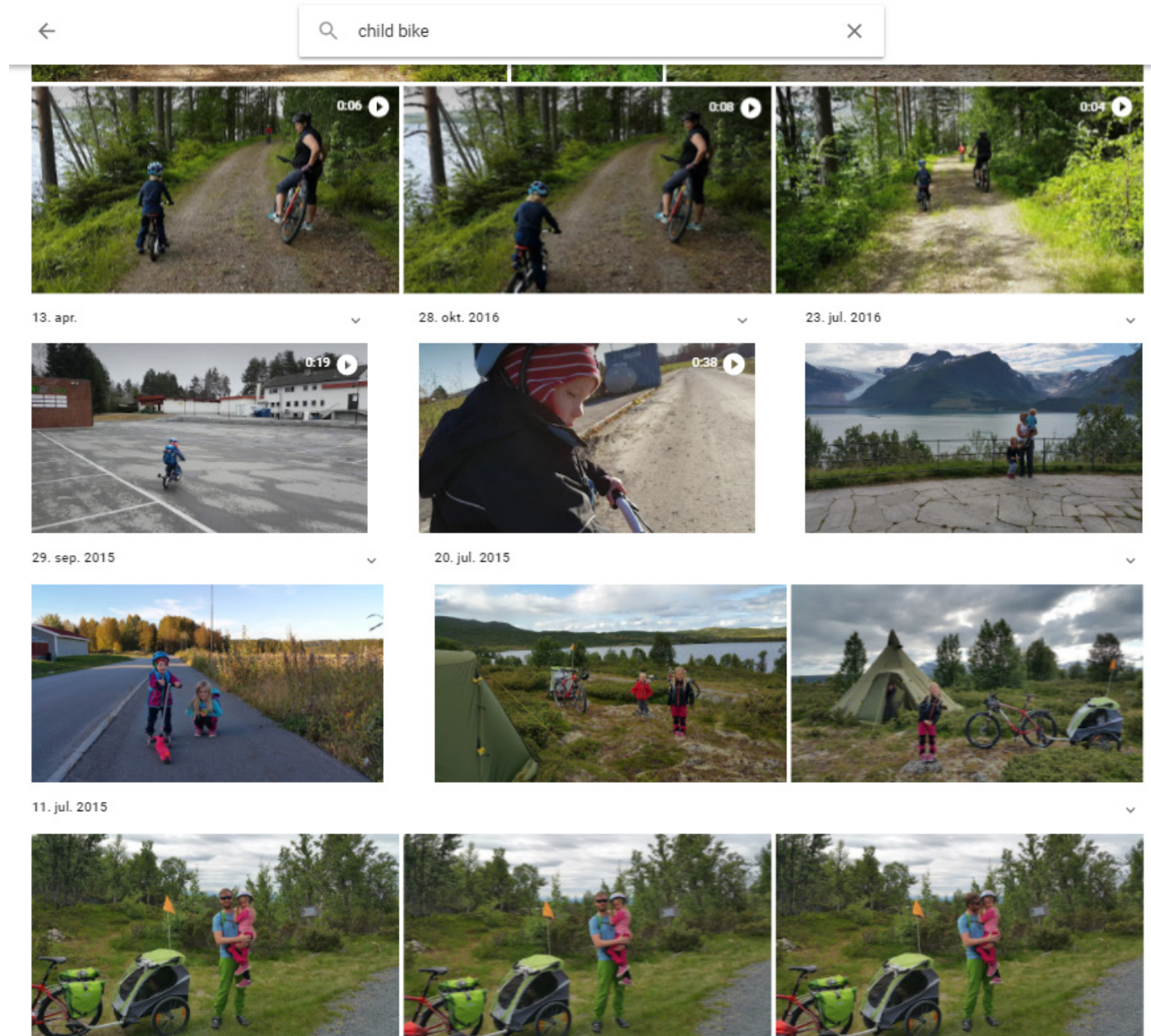
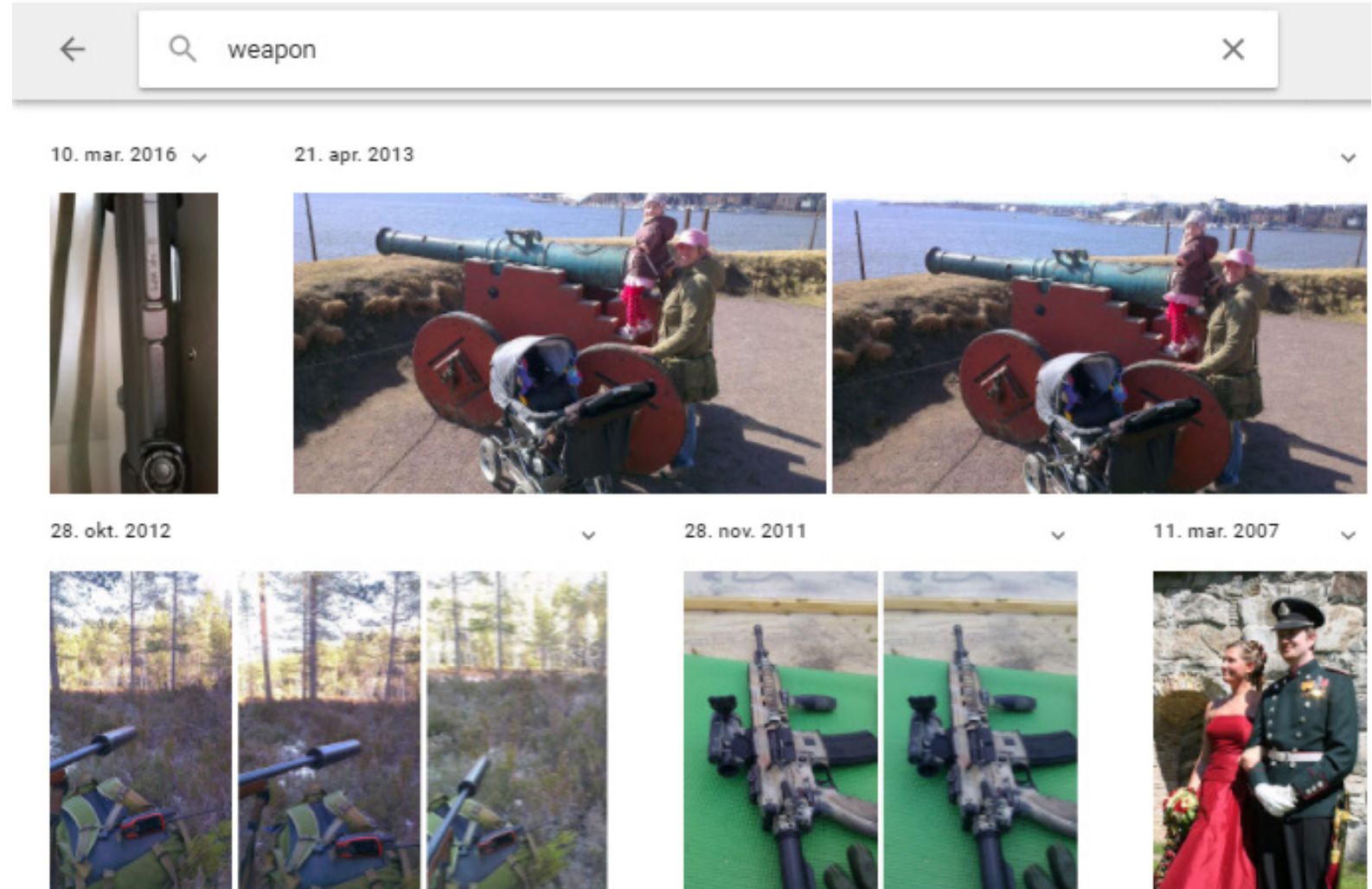
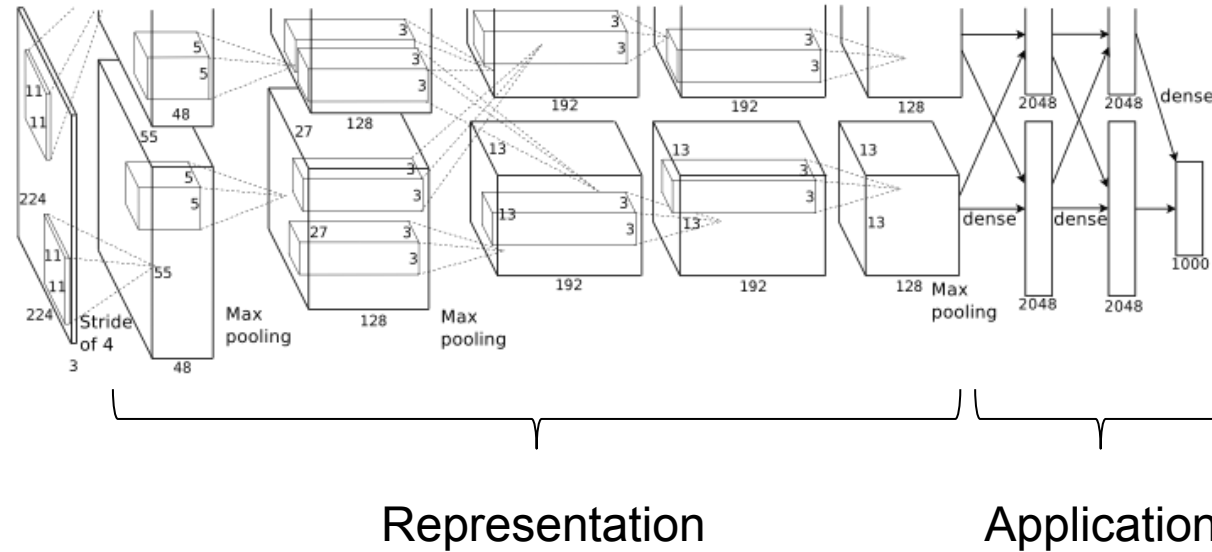


Image search in Google Photo



Reuse of learned representations

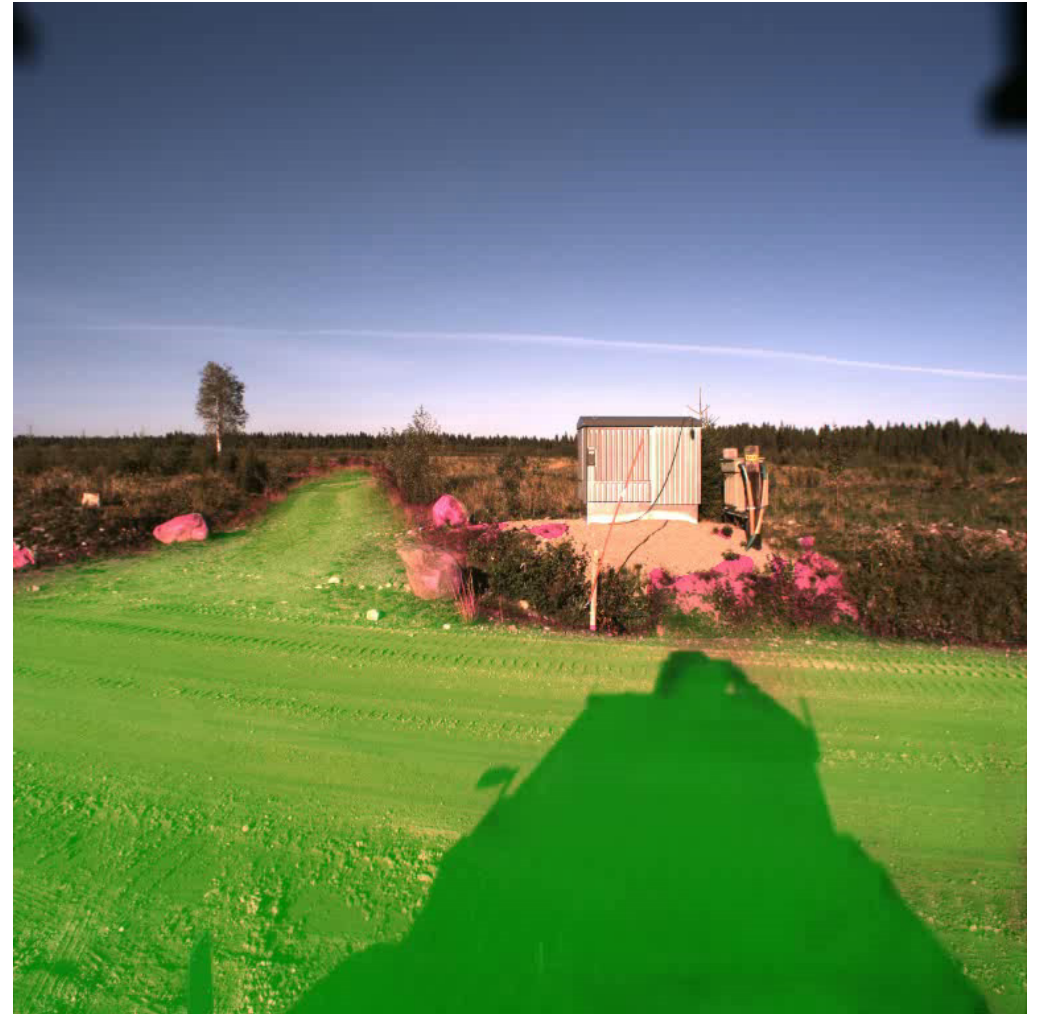
Download a model learned from millions of examples



Reuse of learned representations in new applications



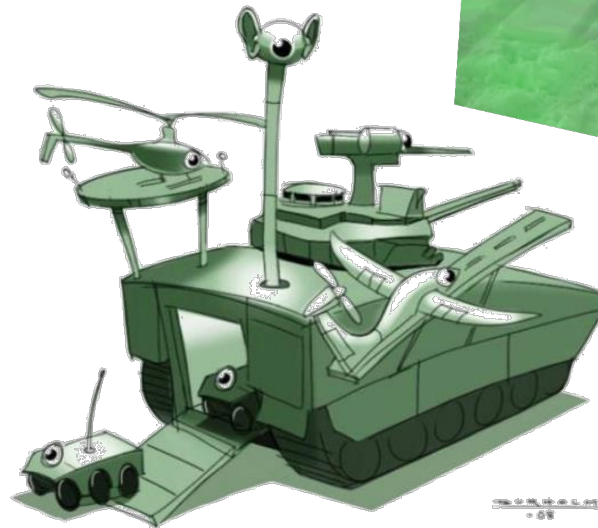
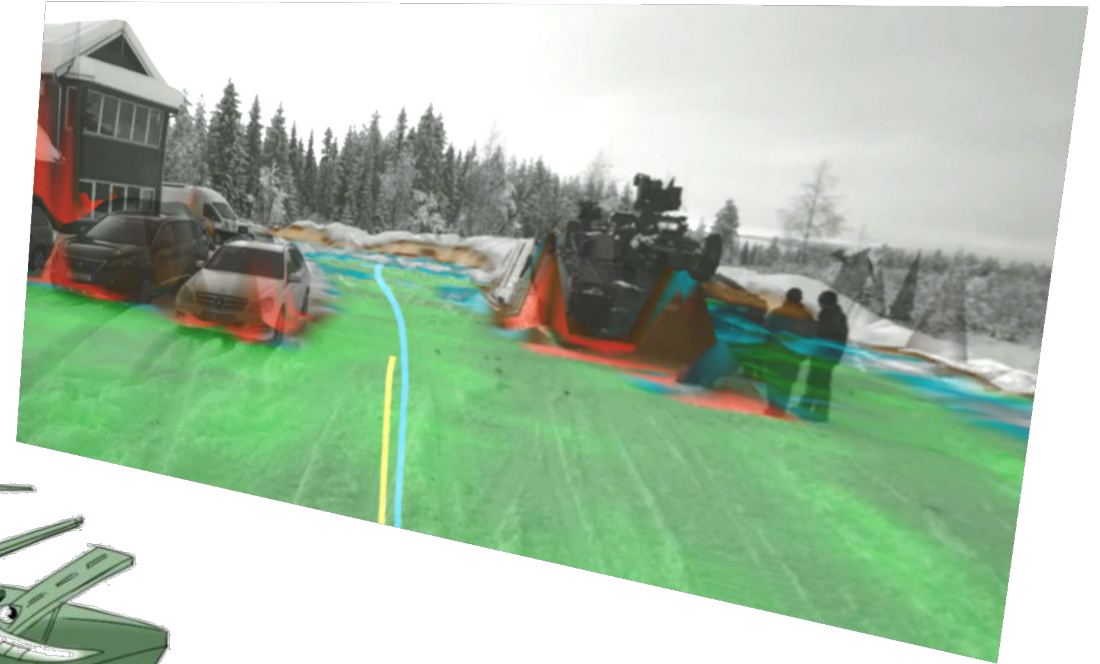
Reuse of learned representations in new applications



About the course

A quick round of presentations

- Full name
- Study
- Relevant background?
- Why take the course?



TEK5030

Learning outcome

After completing TEK5030:

- you will have a fundamental overview of the field of computer vision.
- you will know about, and understand how you can apply fundamental computer vision tools and methods.
- you will understand how some important tools and methods work in detail.
- you will be able to implement algorithms that solves basic computer vision problems.
- you will have experience with using the OpenCV library to build computer vision systems.

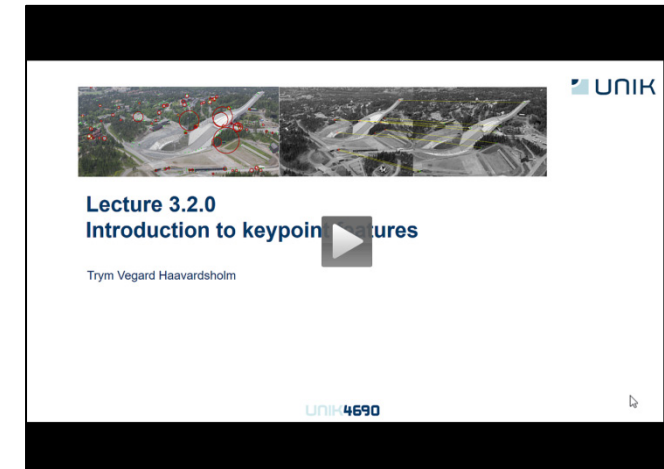
Learning outcome

After completing TEK9030:

- you will have a fundamental overview of the field of computer vision.
- you will know about, and understand how you can apply fundamental computer vision tools and methods.
- you will understand how some important tools and methods work in detail.
- you will be able to implement algorithms that solves basic computer vision problems.
- you will have experience with using the OpenCV library to build computer vision systems.
- you will have a deeper understanding of selected topics.

«Flipped classroom»

- Purpose
 - Get as much as possible out of a day at Kjeller
- Online
 - Prerecorded lectures each week
- Thursdays 09:15-12:00
 - ~20 min lecture summary and questions
 - ~2.5 hours programming lab
- Mandatory student project (Approved/not approved)
 - Big project of you own choice, preferably in groups
- 4 hour written examination



```
1 #include "opencv2/highgui.hpp"
2 #include <iostream>
3
4 int main()
5 {
6     cv::VideoCapture input_stream(0);
7
8     if (!input_stream.isOpened())
9     {
10         std::cerr << "Could not open camera\n";
11         return EXIT_FAILURE;
12     }
13
14     const std::string window_title = "Lab 0: Introduction to OpenCV";
15     cv::namedWindow(window_title, cv::WINDOW_NORMAL);
16
17     cv::Mat frame;
18
19     while(true)
20     {
21         input_stream >> frame;
22
23         if (frame.empty())
24             { break; }
25
26         cv::imshow("cam", frame);
27
28         if (cv::waitKey(15) >= 0)
29             { break; }
30     }
31
32     return EXIT_SUCCESS;
33 }
34
```

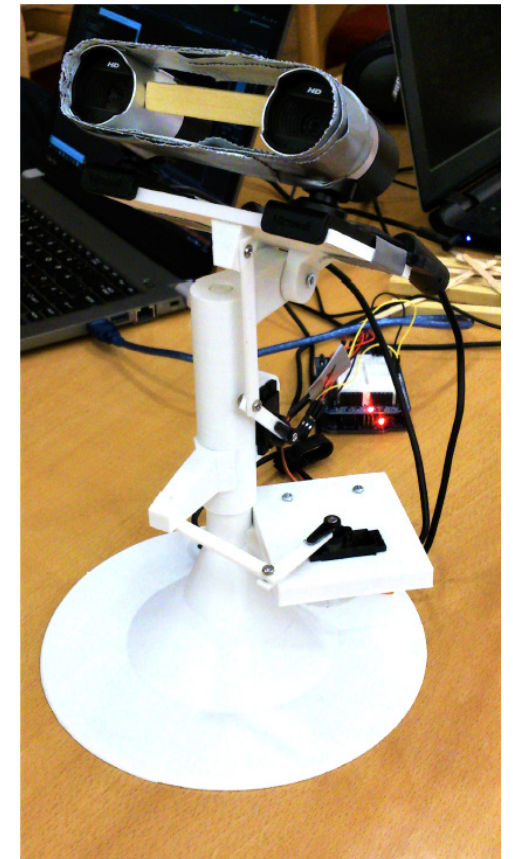
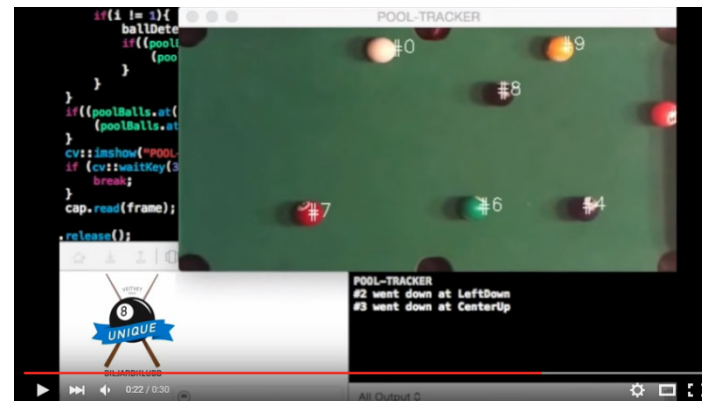
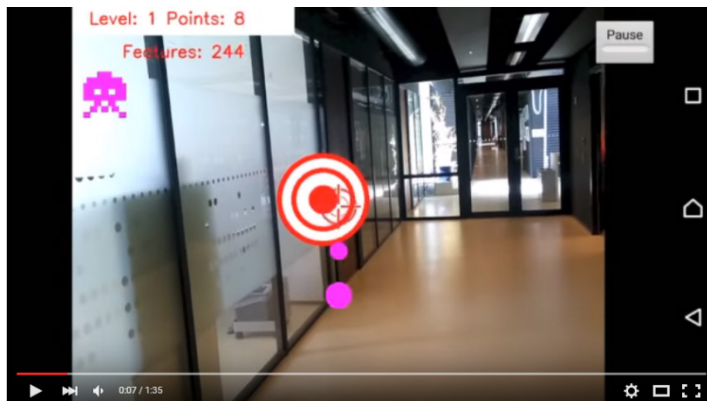
Course information

- We use canvas: <https://canvas.uio.no/>
- Course plan
- Teaching materials
 - Lecture videos
 - Lecture slides
 - Lab exercises
- Questions and discussions
- Project deliveries

The screenshot shows the Canvas LMS interface for the course TEK5030 19V Maskinsyn. The page is titled "2019 VÅR" and "TEK5030 19V Maskinsyn". The main content area features the Uio logo and the text "Uio : Institutt for teknologisystemer Det matematisk-naturvitenskapelige fakultet". Below this, the course title "TEK5030: Maskinsyn - Våren 2019" is displayed. A large image shows a green and black tracked vehicle in a snowy environment. Below the image, the text "Tid og sted" is followed by "Torsdager 09:15-12:00 på rom 402, ITS, Kjeller". The left sidebar contains navigation options: Konto, Dashboard, Emner, Kalender, Innboks, and Hjelp. The right sidebar shows a "Se emnesstrøm" button, a "Vis emnekalender" button, and a list of "Å gjøre" tasks: "Da er vi snart i gang med TEK5030!" (16. jan. i 20:09), "Project proposal" (18. april i 12:00), "Project report" (19. mai i 23:59), and "Project presentation" (23. mai i 23:59).

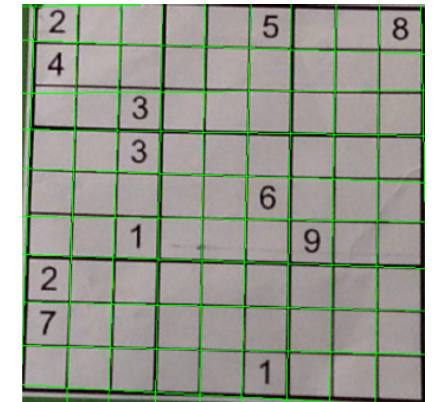
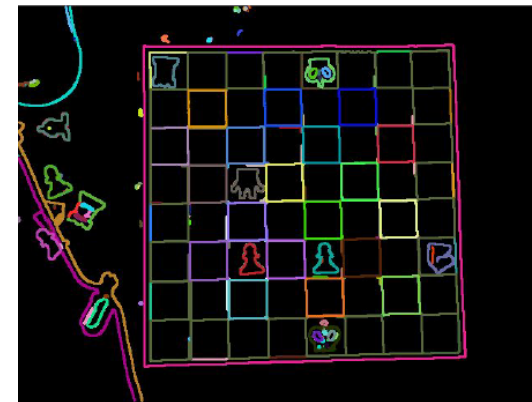
Student projects

- Develop a working computer vision system that does something interesting
 - Big: More than a month
 - Approved/Not approved
- Project topic of your own choice
- Preferably in groups of up to 3 persons



Student projects

- Develop a working computer vision system that does something interesting
 - Big: More than a month
 - Approved/Not approved
- Project topic of your own choice
- Preferably in groups of up to 3 persons



Student projects

- Great freedom of choice
 - Platform, programming language, tools, ...
- Project period:
 - 19.04: Submission of written project proposals
 - 23.04: Feedback on project proposals
 - 28.05: Project presentations
 - 29.05: Submission of project report
- We will be present to guide the projects during the lecture days
- The lecture room will be available the rest of the weeks as well

Course feedback

- Give us feedback along the way!
 - We are open to adjusting the plans
- Please fill out and deliver the course evaluation form after the course!
- Questions?