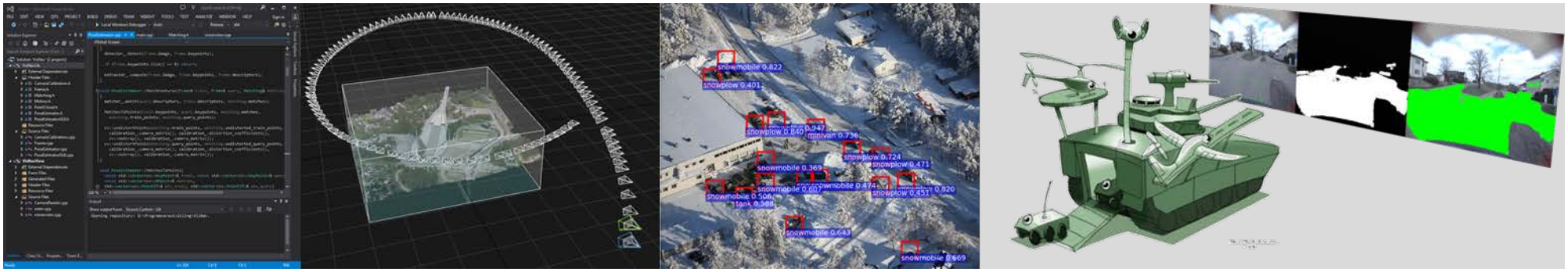


UNIK 4690 – Maskinsyn
Introduction

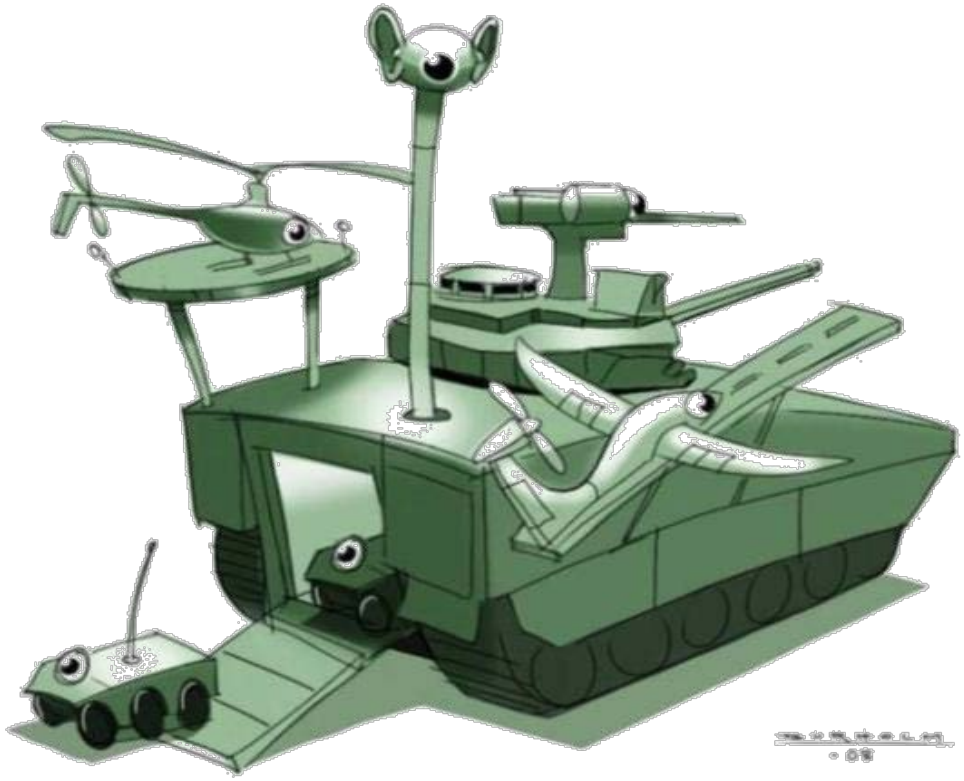
18.01.2018

Trym Vegard Haavardsholm (trym.haavardsholm@its.uio.no)
Idar Dyrdal (idar.dyrdal@its.uio.no)
Thomas Opsahl (thomasoo@its.uio.no)
Ragnar Smestad (ragnar.smestad@ffi.no)

Computer vision

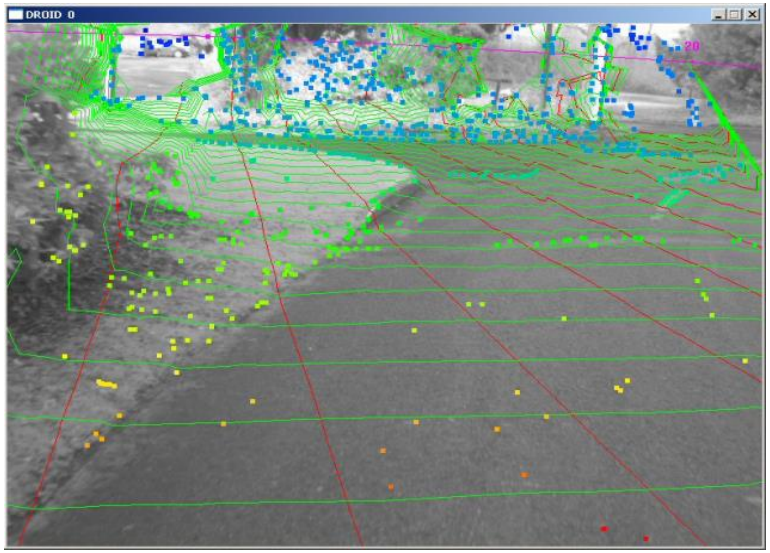
- The study of how a machine can be made to gain high-level understanding from images

  - «Teaching computers how to see»!



Important for humans and machines

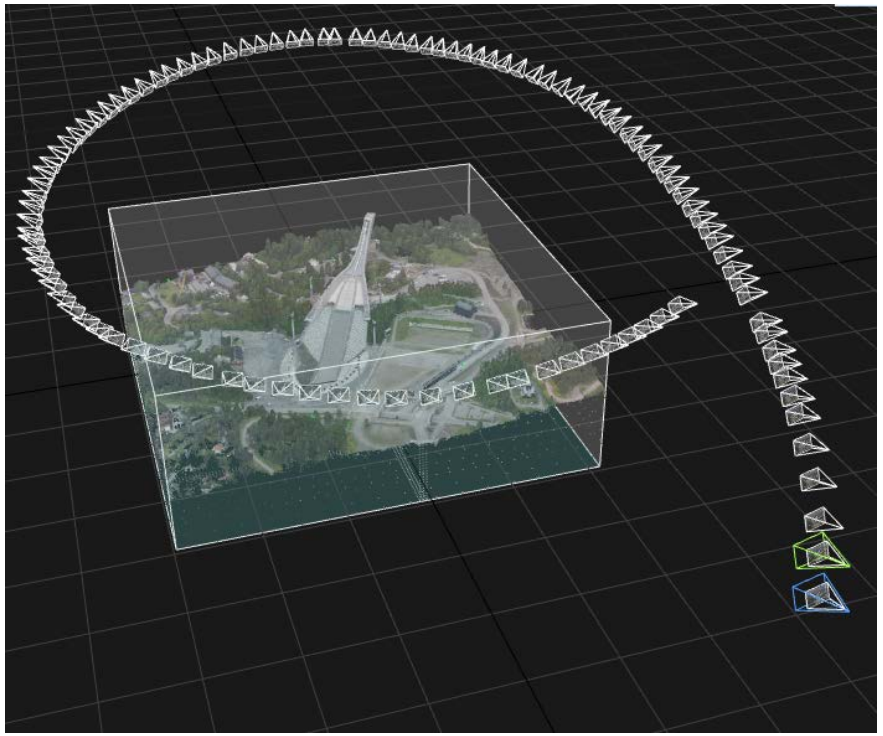
- For humans
  - Find, interpret, fuse



- For robots
  - Understand its own situation!

Quick round of introductions

- Name
- Field of study
- Previous relevant courses
- Motivation for taking this course



Today

- Overview of the course
  - Curriculum
  - Practical information

- Processing live images using OpenCV

Learning outcome

- After completing UNIK4690
  - you have a basic understanding of the field of computer vision
  - you know basic methods and tools within the field
    and you are able to put them into use
  - you understand how some of the important methods and tools work in detail
  - you are able to implement algorithms
    that solve simple computer vision problems
  - you are able to create computer vision applications
    using the software library OpenCV

Learning outcome

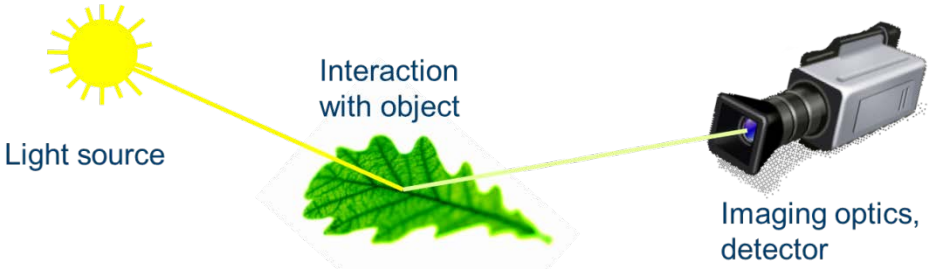
- After completing UNIK9690
  - you have a basic understanding of the field of computer vision
  - you know basic methods and tools within the field
    and you are able to put them into use
  - you understand how some of the important methods and tools work in detail
  - you are able to implement algorithms
    that solve simple computer vision problems
  - you are able to create computer vision applications
    using the software library OpenCV
  - you have a deeper understanding of the methods
    and you are able to pass this on to other students

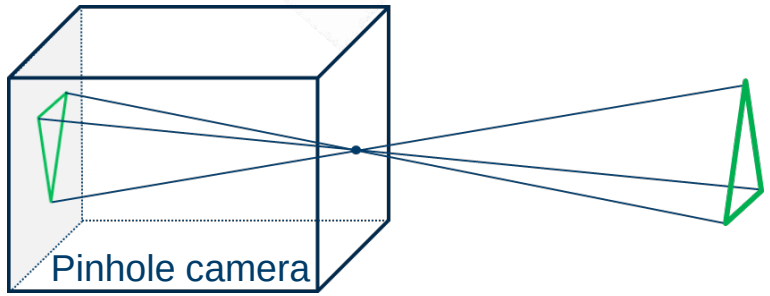
«Flipped classroom»

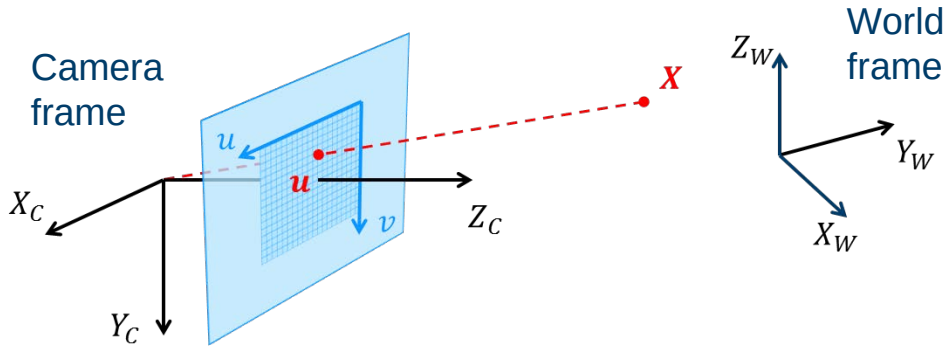
- Purpose
  - To make the most out of your 3 hours at Kjeller per week
- Online
  - Prerecorded video lectures each week
- At Kjeller
  - ~20 minutes summary and Q&A
  - ~2.5 hours programming lab
- Mandatory student project (60%)
  - Large project of your own choosing, preferably in groups of 2-3 students
- Individual oral exam (40%)

Schedule

Part I: Image formation, processing and features	
25.01	**1. Image formation** • Light, cameras, optics and colour • Pose in 2D and 3D • Basic projective geometry • The perspective camera model
01.02	**2. Image Processing** • Image filtering • Image pyramids • Laplace blending
08.02	**3. Feature detection** • Line features • Local keypoint features • Robust estimation with RANSAC
15.02	**4. Feature matching** • From keypoints to feature correspondences • Feature descriptors • Feature matching • Estimating homographies from feature correspondences







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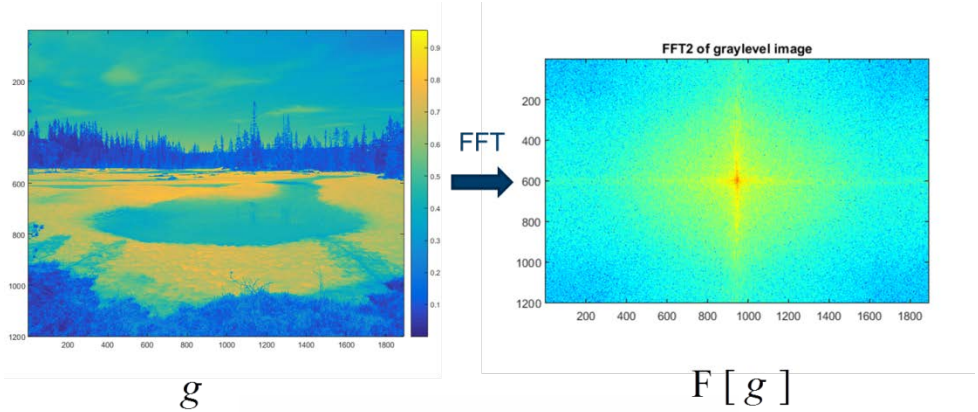

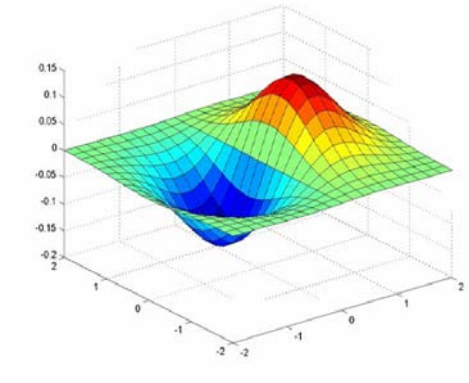

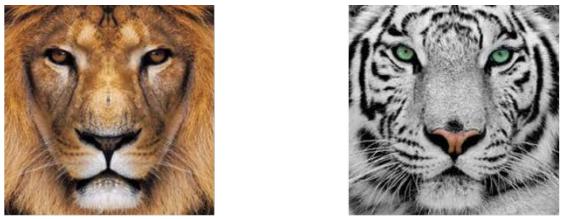

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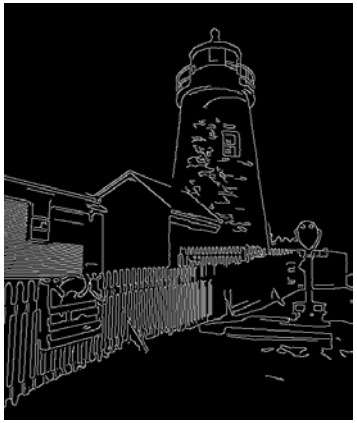

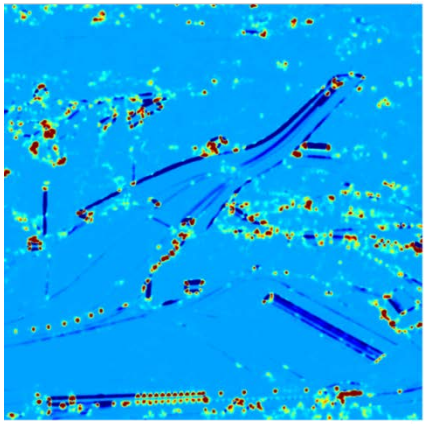

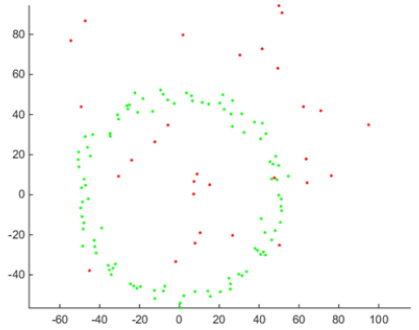

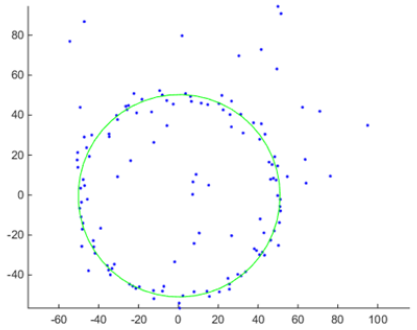

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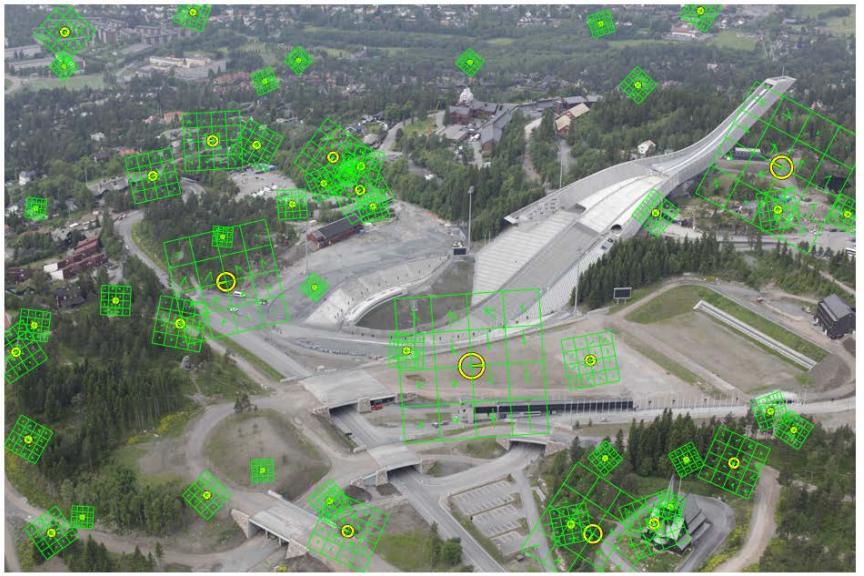
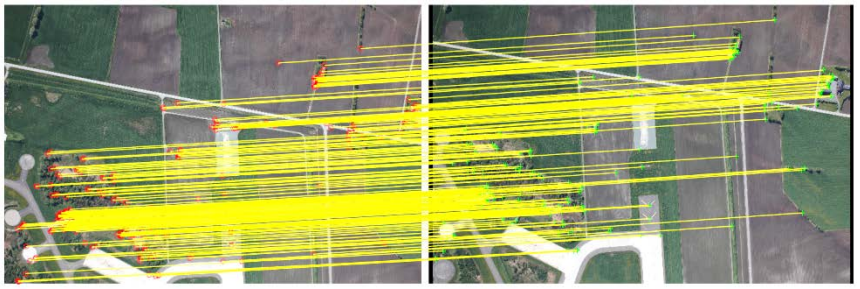
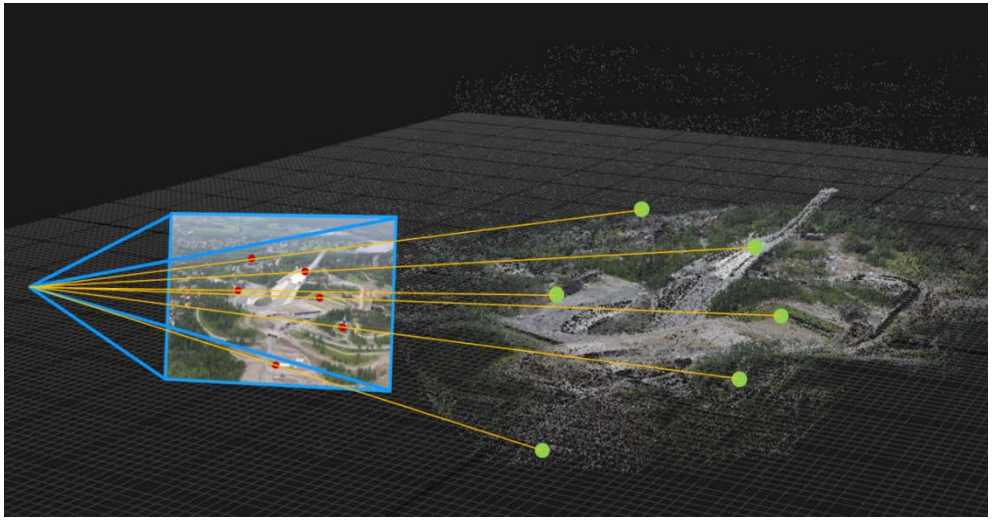
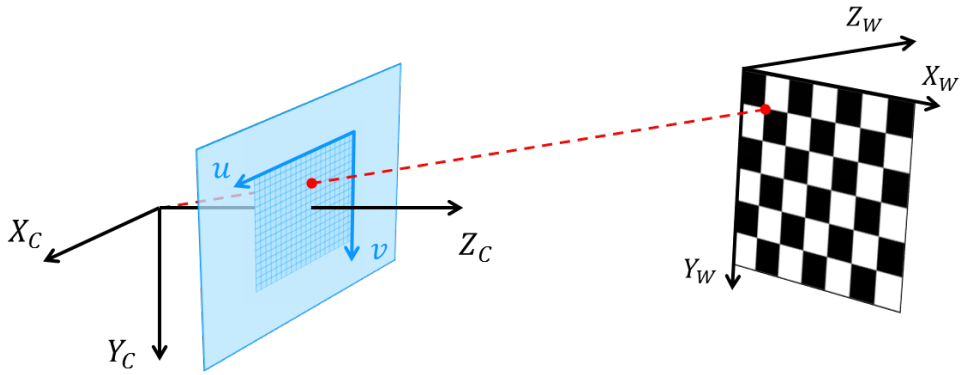




Schedule

Part II: World geometry and 3D	
22.02	**5. Single-view geometry** • The camera matrix P • Pose from known 3D points • Camera calibration
01.03	**6. Stereo imaging** • Basic epipolar geometry • Stereo imaging • Stereo processing
08.03	**7. Two-view geometry** • Epipolar geometry • Triangulation • Pose from epipolar geometry
15.03	**8. Multiple-view geometry** • Multiple-view geometry • Structure from motion • Multiple-view stereo





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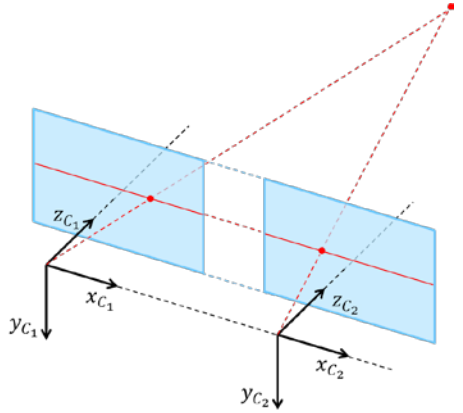

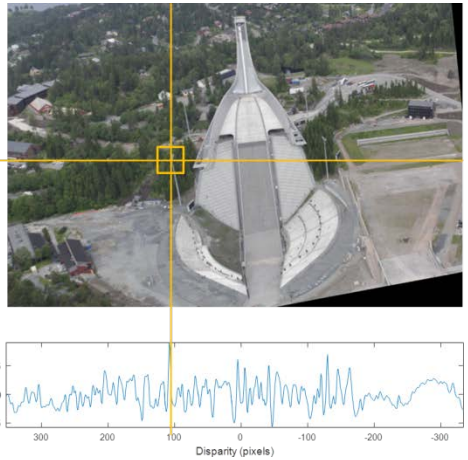

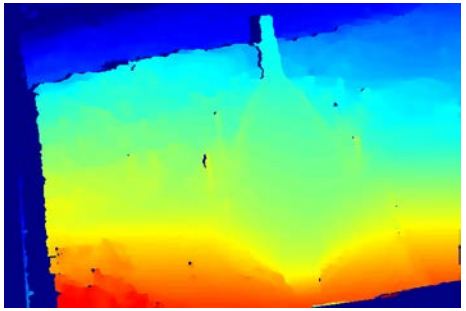

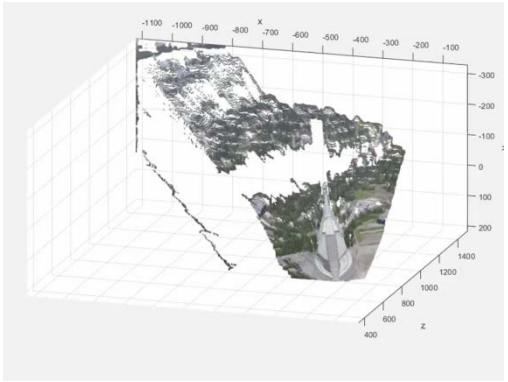

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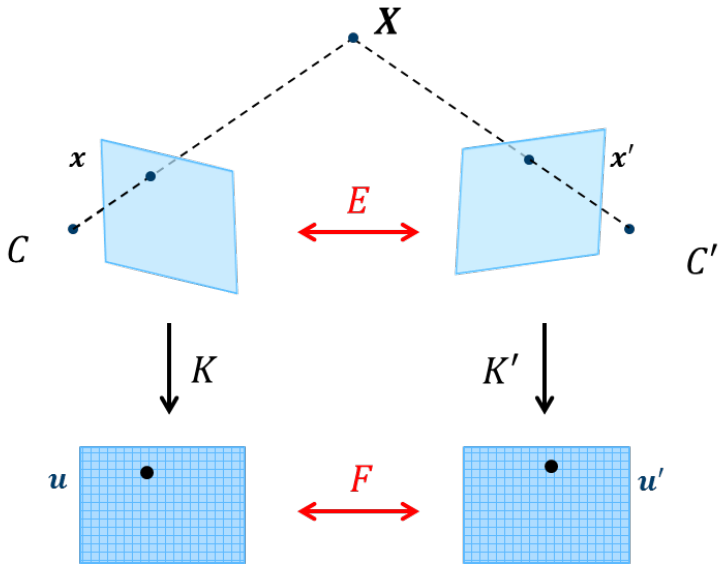

$$\tilde{\boldsymbol{u}}'^{T} F \tilde{\boldsymbol{u}} = 0 \qquad \tilde{\boldsymbol{x}}'^{T} E \tilde{\boldsymbol{x}} = 0$$

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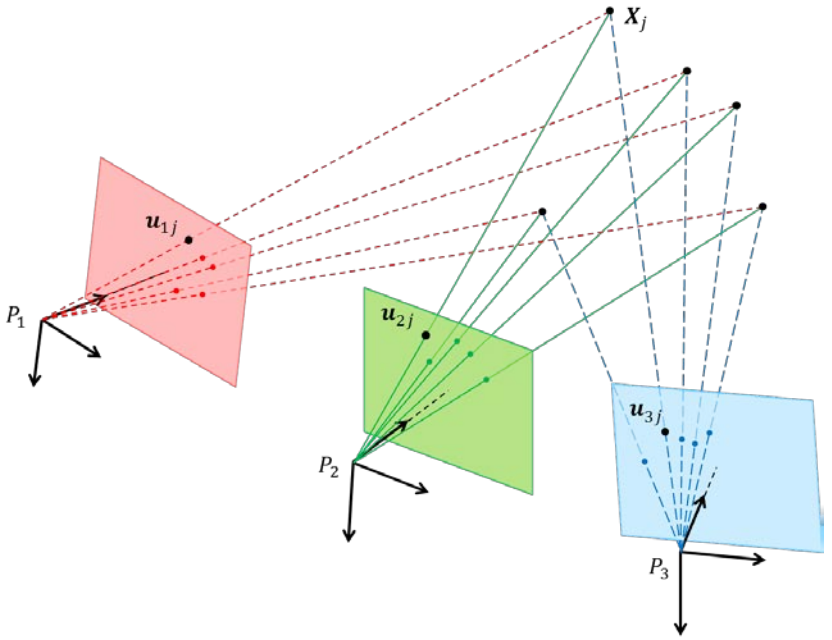
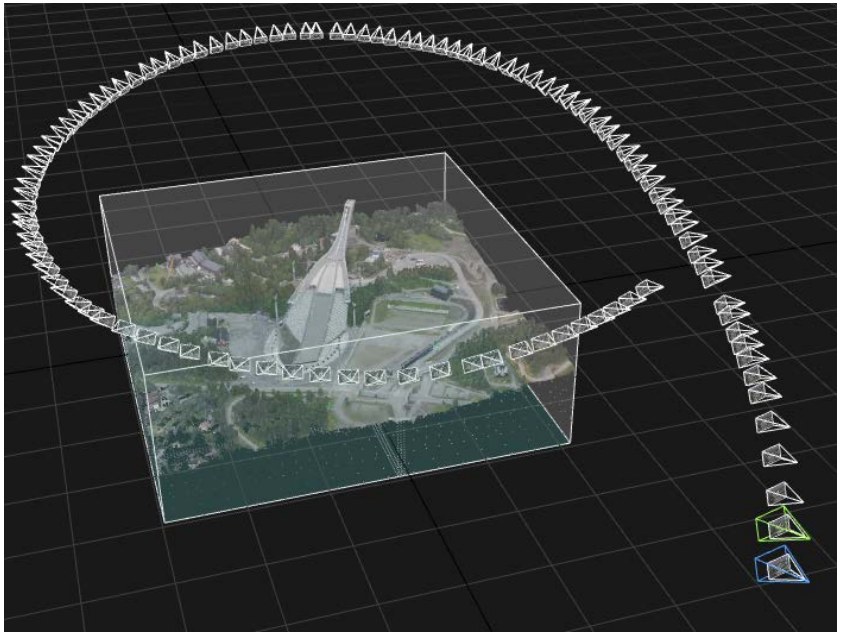
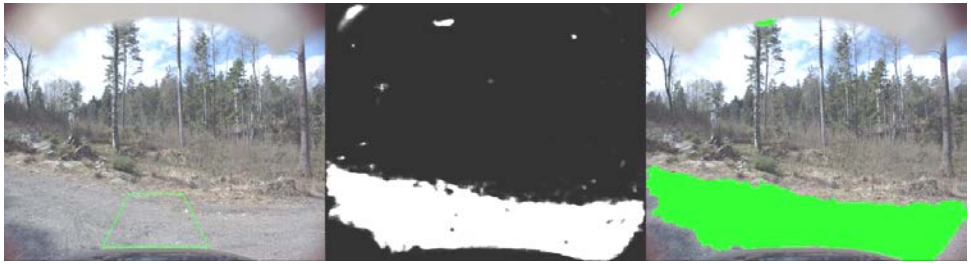


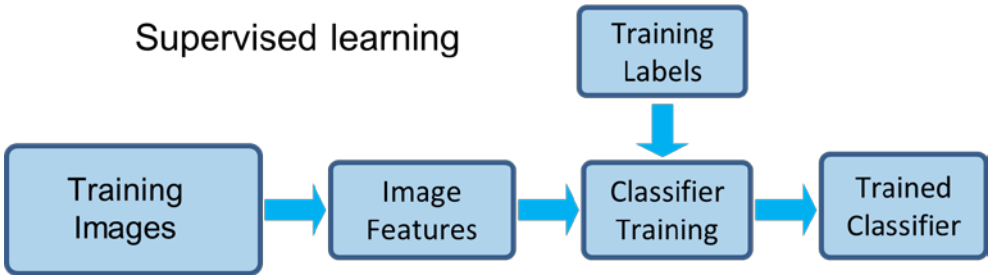


Schedule

Part III: Scene analysis	
22.03	**9. Image analysis** • Image segmentation • Image feature extraction • Introduction to machine learning
05.04	**10. Object detection** • Descriptor-based detection • Introduction to deep learning with CNNs
12.04	**11. Image retrieval and place recognition** • Image retrieval • Visual place recognition



$$\vec{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ \dots \\ x_d \end{bmatrix}$$



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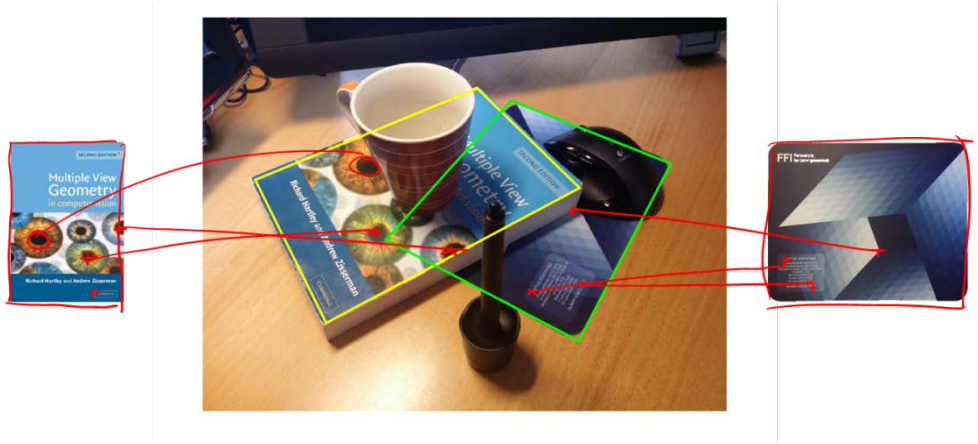

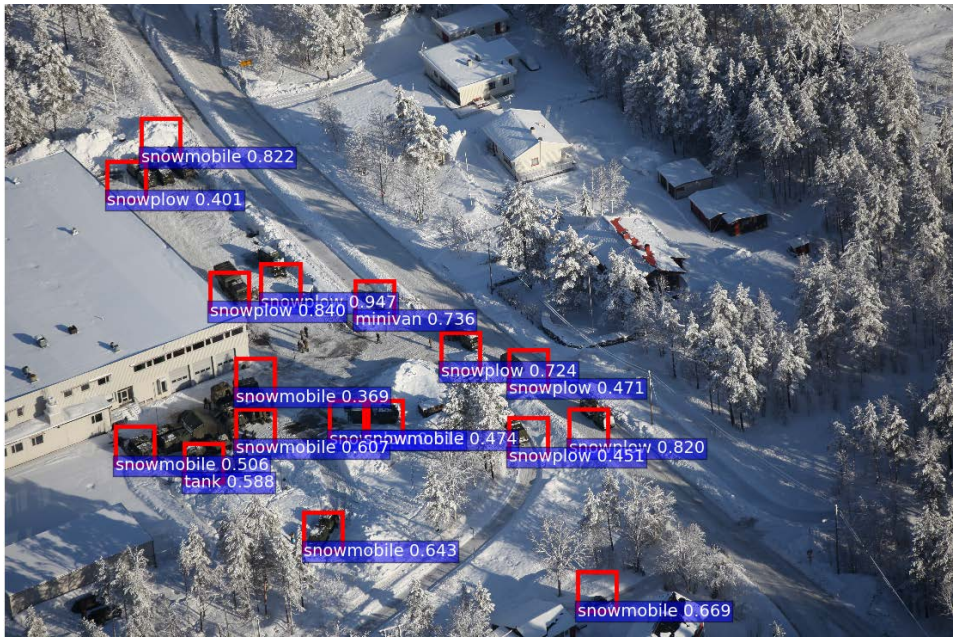

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Schedule

Part IV: Student project	
12.04	Student project proposals
19.04	Student project feedback
26.04	Teachers available for support 9:15-12:00
03.05	Teachers available for support 9:15-12:00
10.05	Holiday
17.05	Holiday
24.05	Teachers available for support 9:15-12:00
27.05	Project report deadline
31.05	Project presentations

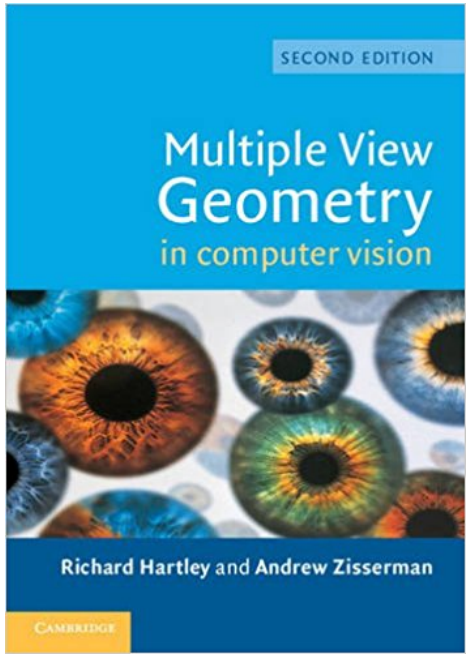
Textbook

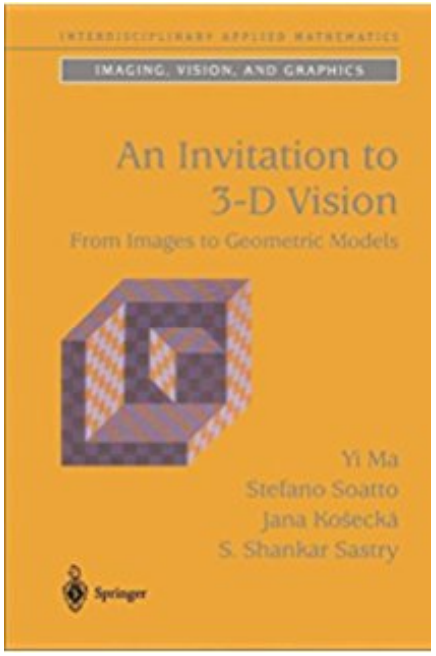
Computer Vision: Algorithms and Applications

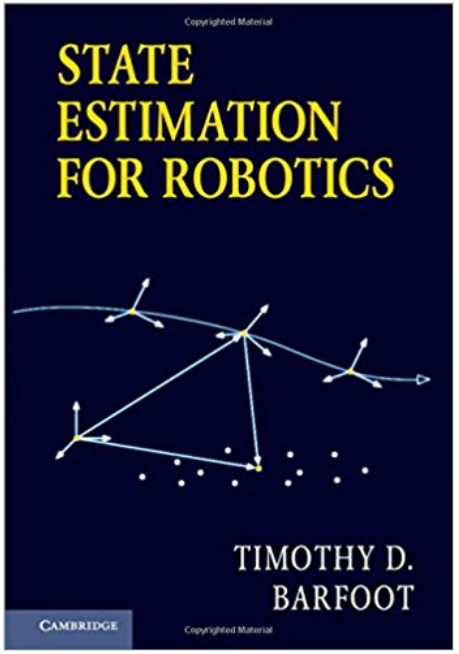
© 2010 Richard Szeliski, Microsoft Research

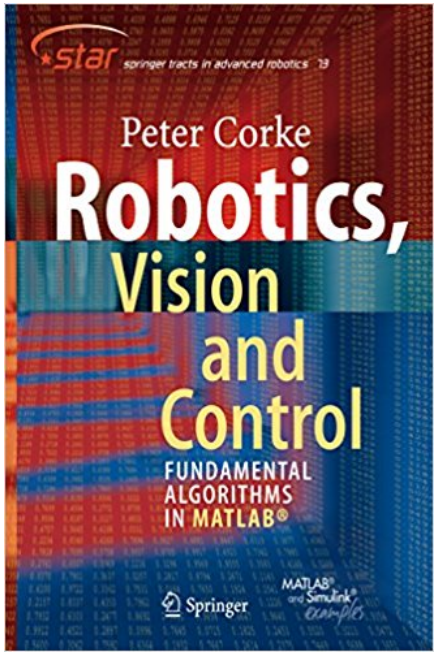
Free version online: http://szeliski.org/Book/

Supplementary resources









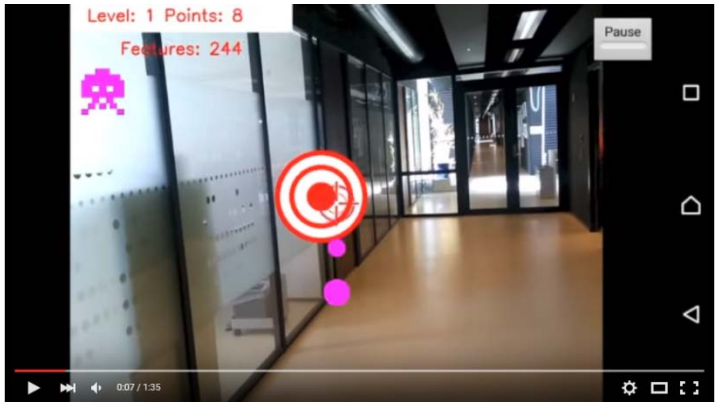
Lecture weeks

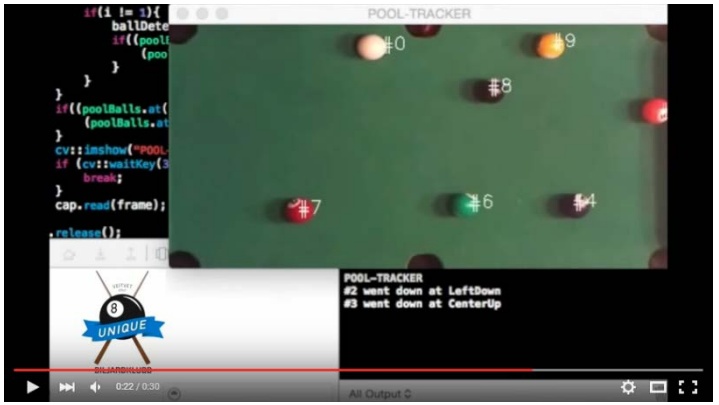
- Friday afternoon/evening the week before
  - Lectures are made available online
  - 3-4 videos (~20 minutes each)
- Read the chapters in the textbook
- Q&A, discussions on Piazza
- Thursdays 09:15
  - Brief summary with room for questions
- Thursdays ~09:35-12:00
  - Programming lab
  - Supervised by lecturers and lab assistant

The student project

- Develop a functioning computer vision system that does something interesting
  - Large: More than a month
  - Mandatory: 60% of the grade

- Students propose their own projects
- Preferably groups of 2-3 students





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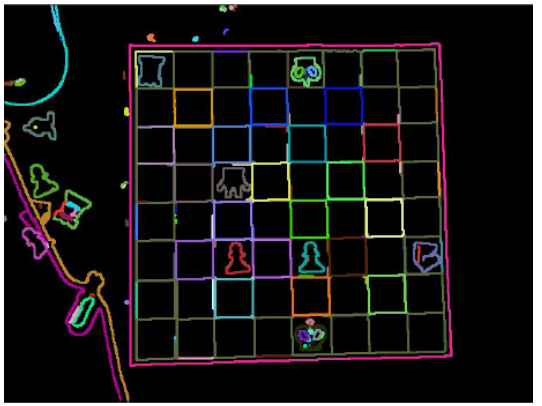
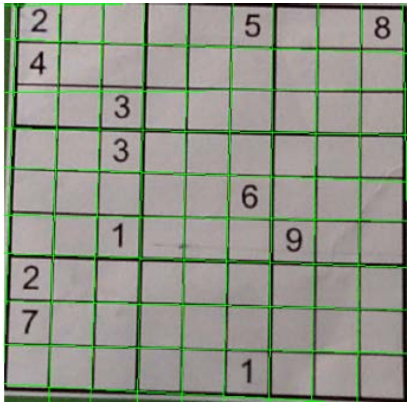


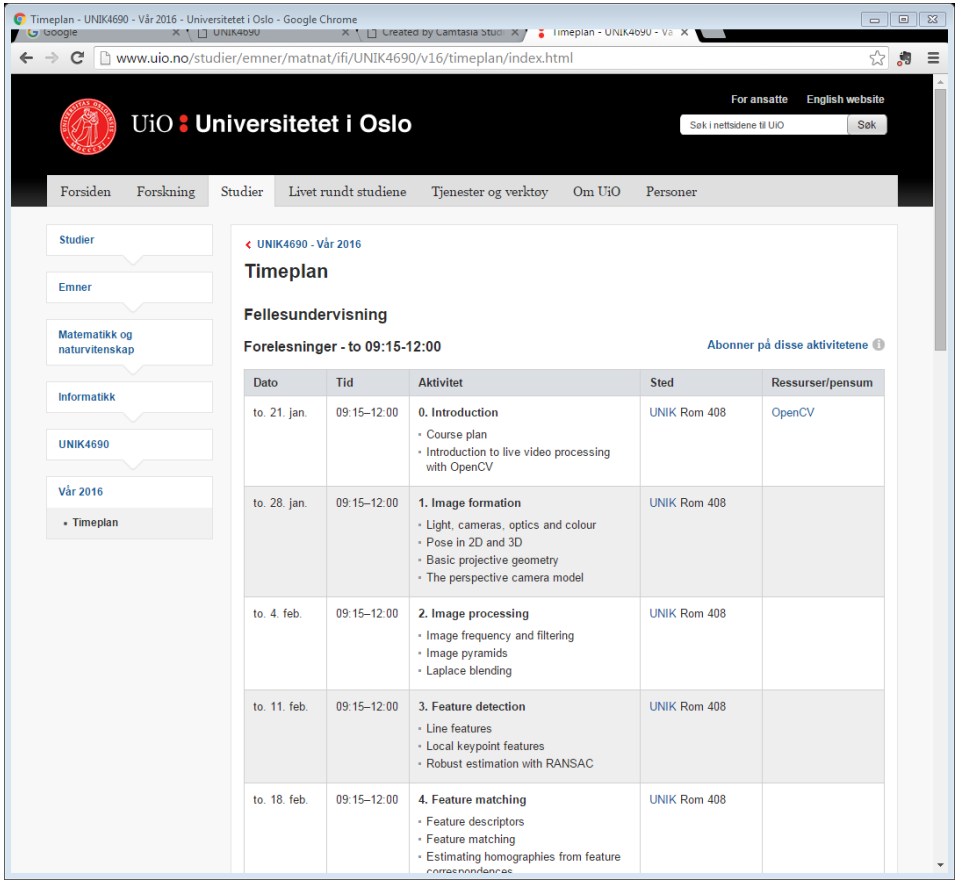


The student project

- Freedom of choice
  - Platform, programing language, tools,…
- Important dates
  - 12.04: Hand in written project proposal
  - 19.04: Oral feedback on the project proposals
  - 28.05: Hand in project report
  - 31.05: Project presentations
- During the project period we will be available for project support here at Kjeller on Thursdays 09:15-12:00
- The lab will in general be available to you (at least within office hours)

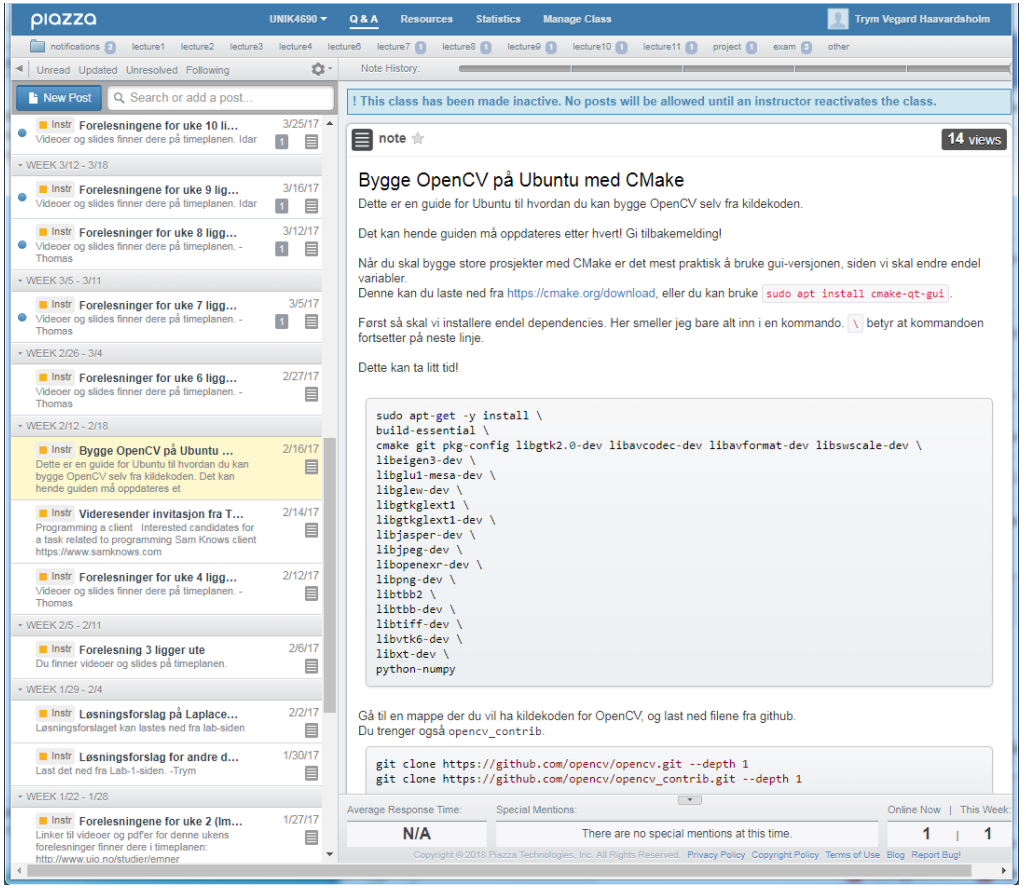
Webpage

- http://www.uio.no/studier/emner/matnat/its/UNIK4690/v18/timeplan/index.html
- Schedule
- Resources
  - Lectures as video
  - Lectures as pdf
  - Lab tutorials and exercises



Piazza

- https://piazza.com/uio.no/spring2018/unik4690/home
- Messages
- Questions
  - Open or private
- Discussions



Feedback

- We encourage feedback during the course
  - We are open for making adjustments

- We encourage you to participate in the course evaluation

- Any questions?