Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

Computer Vision Introduction

WS 2019/2020

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University of Hamburg, Germany

Who are we?

Lecturer

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Excercises:

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Group**: Computer Vision:**
https://www.inf.uni-hamburg.de/en/inst/ab/cv.html

Just drop by if you have questions or

contact us by Email:
use the email addresses above, do not write in Stine!

Who are you?

Questionnaire

at the end of the lecture

Outline for today

- What is computer vision?
- Why is computer vision of interest?
- History of computer vision
- Applications of computer vision
- Why is computer vision hard?
- Topics of this lecture
- Organization of course
- Questionnaire

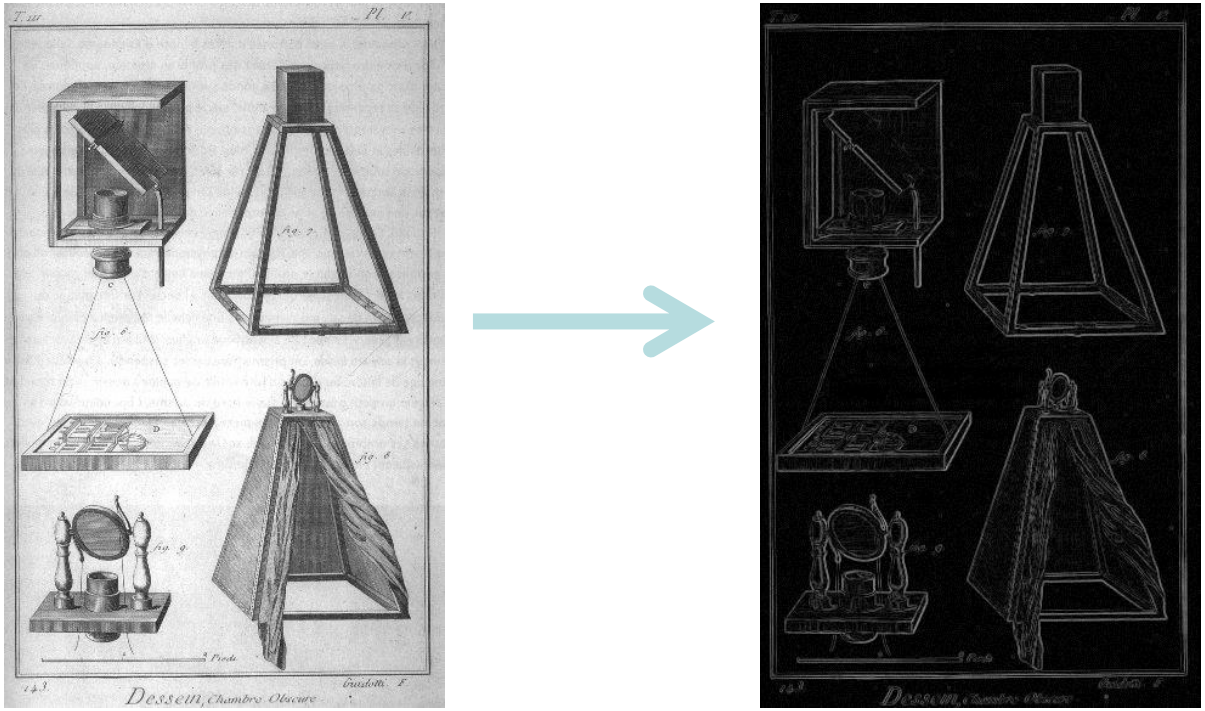
What is Computer Vision?

- Automatic processing of visual signals via algorithms

- Output:
  - A new image (after smoothing, edge detection, etc.), or
  - An image description/interpretation (e.g., “the image shows two faces”)

What is Computer Vision?

- Example for image to image transformation: edge detection



[Wikipedia: Kantendetektion]

What is Computer Vision?

- A bit more fancy: DeepStyle (based on deep learning):

[Wikipedia: Kantendetektion]

What is Computer Vision?

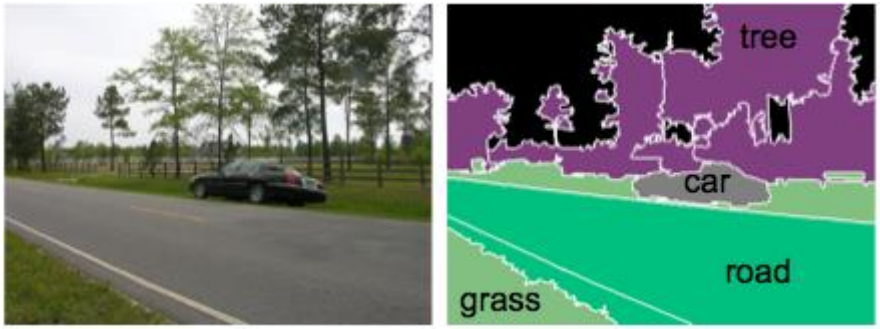
- Example for image to image description

"beach"
"beach with waves and people"

[Wikimedia Commons]

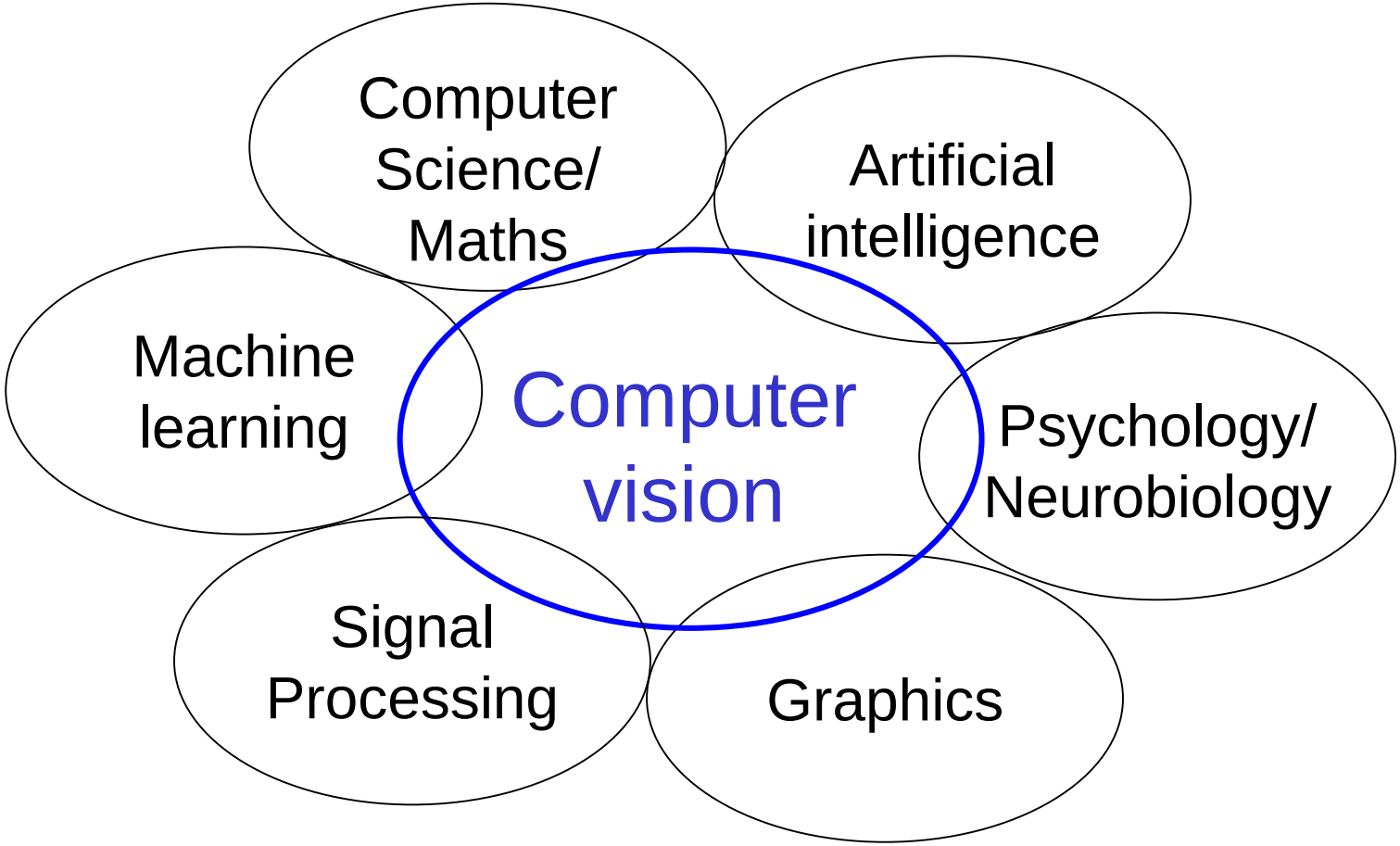
What is Computer Vision?

- A combination of both: output: image with labels



[Wikimedia Commons]

Related Disciplines



Related Vision Fields

- **Computer Vision** (joint term. Process images, videos, and RGB-D data)
- Digital Image Processing (2D images)
- Video Processing (Videos)
- Image Analysis (2D images, focus more on analysis and interpretation than on processing)
- Visual Scene Interpretation (high-level computer vision focusing on interpreting scenes)
- Machine Vision (focus on industrial settings and robot vision)
- Robot Vision (Vision for (usually autonomous) robots)
- Visual computing (all disciplines dealing with images and 3D models, i.e., computer graphics, image processing, visualization, computer vision, virtual and augmented reality, video processing, …)
- Pattern recognition (automatic recognition of patterns in data, often images, but also every other type of data)

The fields are overlapping and there are no clear definitions and boundaries. Differences are sometimes subtle.

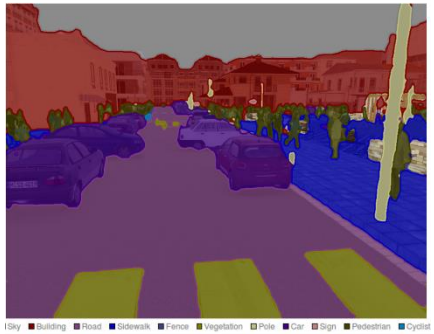
Computer Vision

Low-level

- Smoothing
- Edge detection
- Color processing
- Stereo
- Motion detection
- Etc.

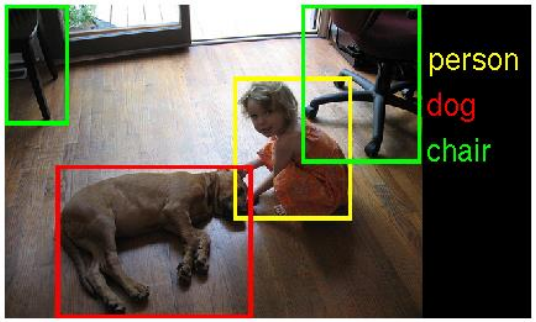
Mid-level

- Segmentation
- Object tracking
- Etc.



High-level

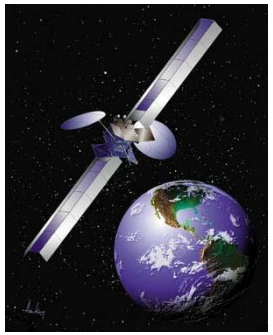
- Detection / classification of
  - Objects
  - Scenes
  - Activities
  - Etc.

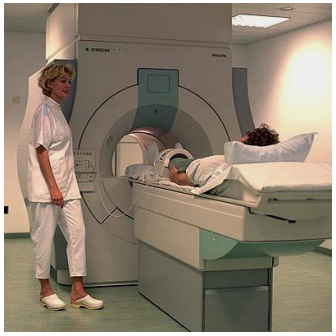


[Forsyth/Ponce]

Why Computer Vision





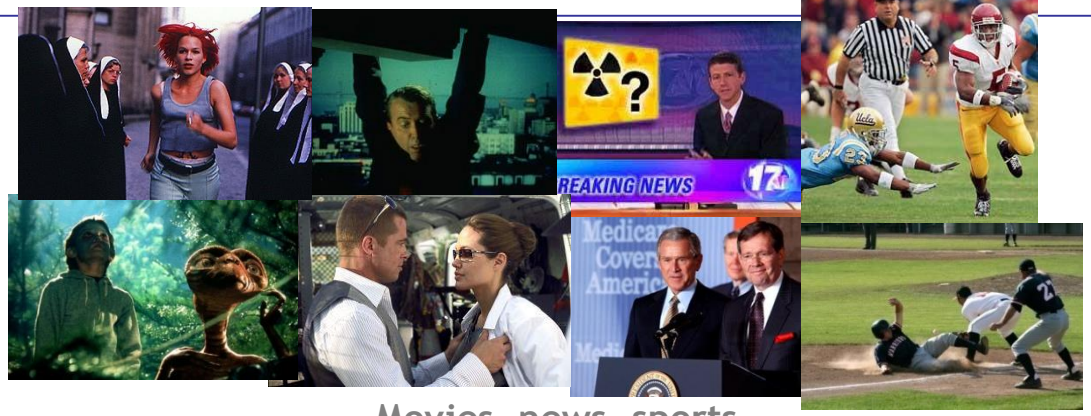
Cameras are everywhere





Images and videos are everywhere..

Personal photo albums



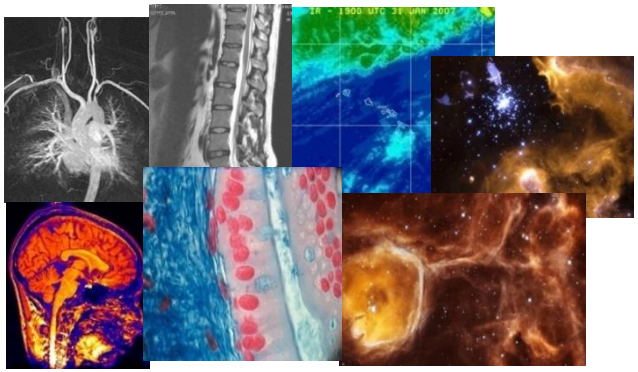
Movies, news, sports

Google Image Search · Picasa · flickr · webshots · picsearch · YouTube Broadcast Yourself · kooaba

Internet services

Surveillance and security

Mobile and consumer applications



Medical and scientific images

Why Computer Vision?

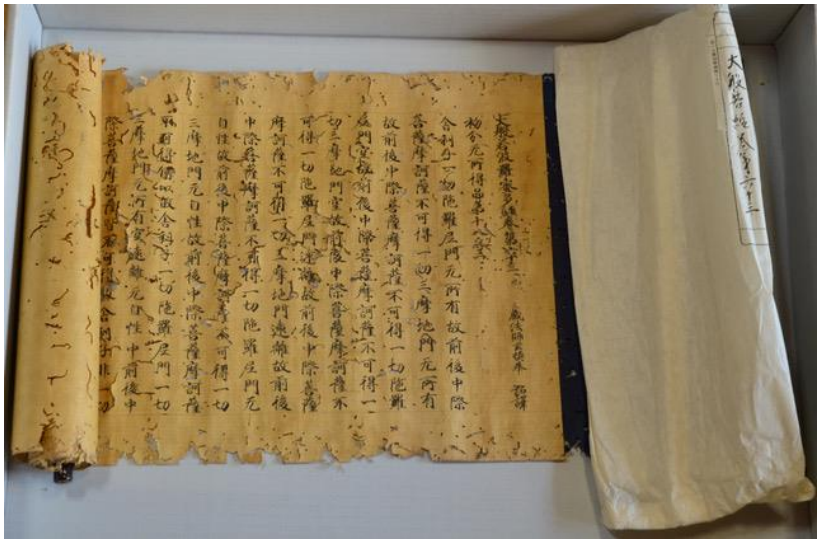
Billions of photos and videos taken every day and shared every day on social media

Organize and search in your private media collection

[AFP/Getty Images]

Why Computer Vision?

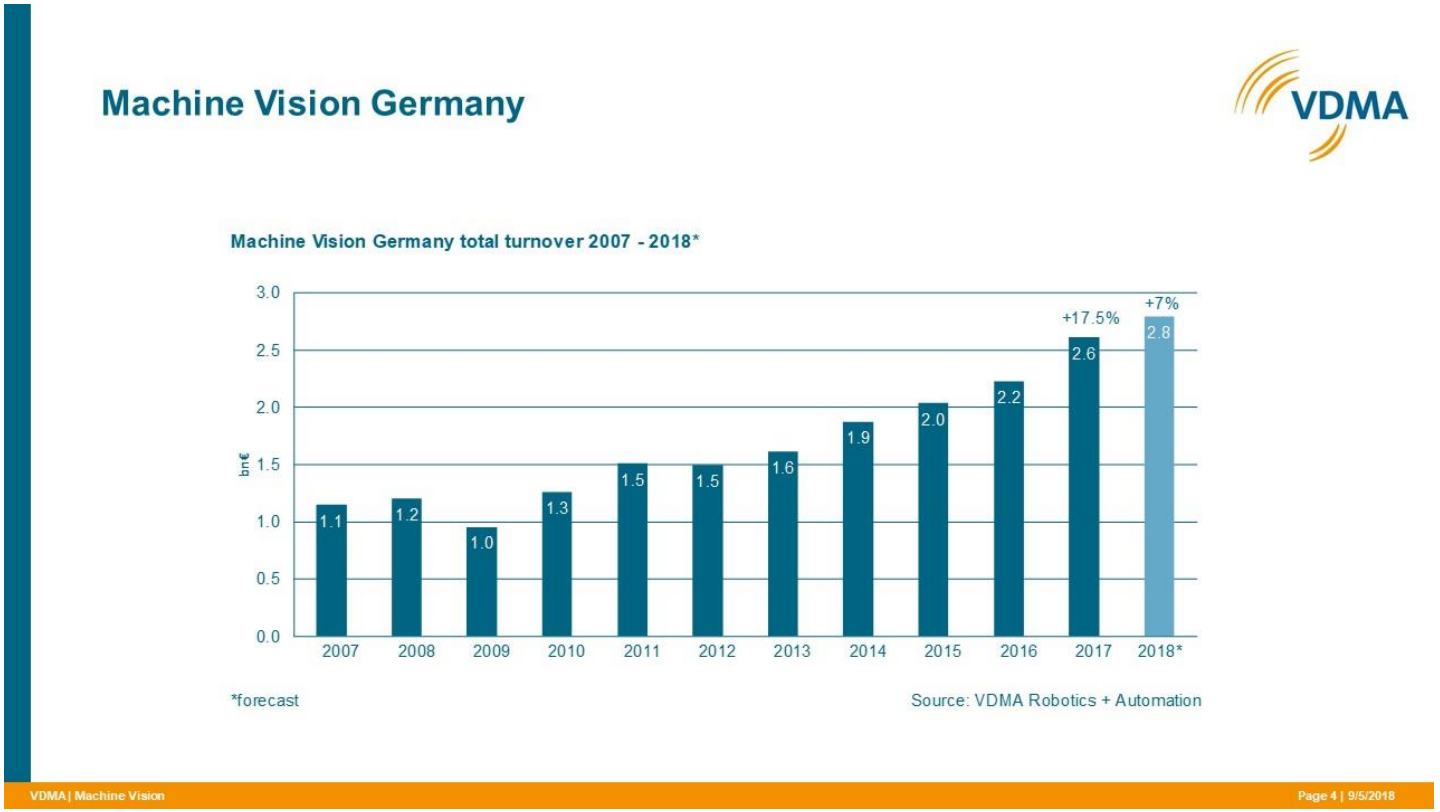
Millions of photos in archives



[Left: Platz der Republik, Berlin, 1926. Source: Bundesarchiv;
Right: manuscript from excellence cluster „Understanding written artifactcs]

Why Computer Vision?

"In 2017, the German machine vision industry achieved record sales of 2.6 billion euros – a rise of 17 percent compared to the previous year."



https://ibv.vdma.org/en/viewer/-/v2article/render/26787213

History

- First digital images in the newspaper industry:
- Pictures send via submarine cable between London and New York

FIGURE 1.1 A digital picture produced in 1921 from a coded tape by a telegraph printer with special typefaces. (McFarlane.) [References in the bibliography at the end of the book are listed in alphabetical order by authors' last names.]

- reduced the time to transport a picture across the Atlantic from more than a week to less than three hours.
- But: no digital computer involved in image creation [Gonzales/Woods]

History

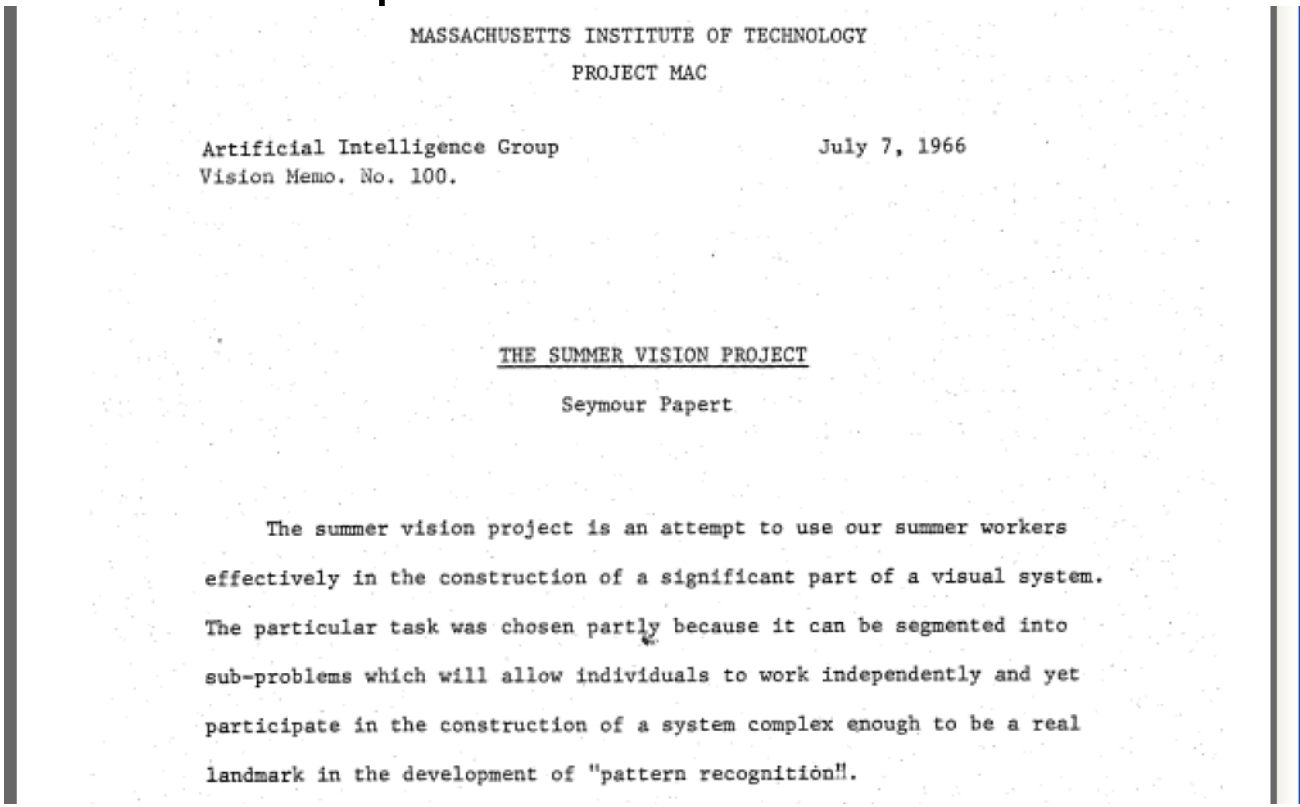
- **1960s:**
  - First computers powerful enough to process images
  - US space program started in the early 1960s: development of image processing for space applications

FIGURE 1.4
The first picture of the moon by a U.S. spacecraft. *Ranger 7* took this image on July 31, 1964 at 9:09 A.M. EDT, about 17 minutes before impacting the lunar surface. (Courtesy of NASA.)

  - satellite imagery, medical image processing, character recognition, astronomy
  - Computer vision as part of AI: endow machines with intelligent behavior and enable them to see. High expectations.

High expectations in the 60s

- 1966: Seymour Papert directs an undergraduate student to solve “the problem of computer vision” as a summer project.



MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PROJECT MAC

Artificial Intelligence Group
Vision Memo. No. 100.

July 7, 1966

THE SUMMER VISION PROJECT

Seymour Papert

The summer vision project is an attempt to use our summer workers effectively in the construction of a significant part of a visual system. The particular task was chosen partly because it can be segmented into sub-problems which will allow individuals to work independently and yet participate in the construction of a system complex enough to be a real landmark in the development of "pattern recognition".

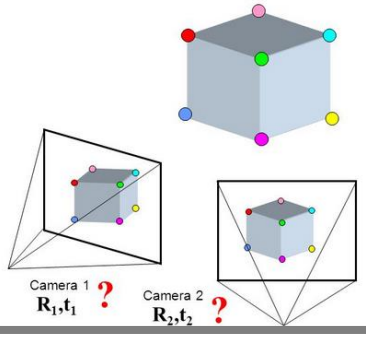
- Obviously, computer vision was too difficult for that…

History

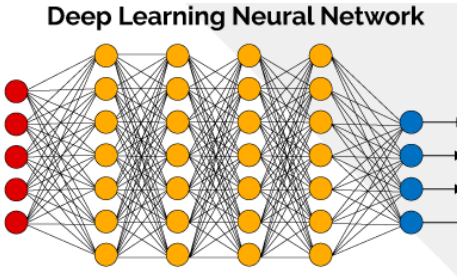
- **1970s:**
  - invention of CT (computerized tomography) led to important advanced in medical image processing.
  - many methods that form the basis of todays algorithms: edge detection, optical flow, motion estimation
- **1980s:** mathematical foundations developed: scale-space theory, shape from X, contour models, Markov random fields
- **1990s:** 3D reconstruction (influences from photogrammetry), stereo vision and multi-view geometry, start of statistical learning methods, first CNNs (neural networks for image processing)
- **2000s:** strong focus on machine learning methods, e.g., Boosting, SVMs, MRFs (NNs considered less powerful and interesting by most researchers)
- **Since 2012:** “Deep learning”, revival of convolutional neural networks

History of CV

1970s:
Edge detection, optical flow, motion estimation



1990s:
3D reconstruction, stereo vision, multi-view geometry



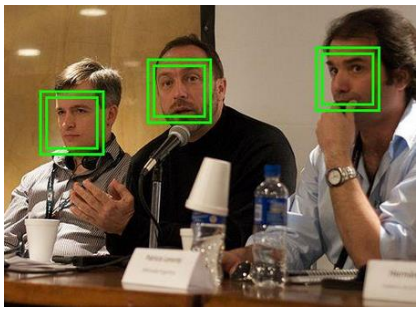
2010s:
"**Deep learning**", revival of convolutional neural networks

1960 1970 1980 1990 2000 2010

1960s:
- **satellite imagery, medical image processing, character recognition,** Computer vision as part of AI: **High expectations**.

1980s:
scale-space theory, shape from X, contour models

2000s:
Machine learning methods, e.g., Boosting, SVMs, MRFs



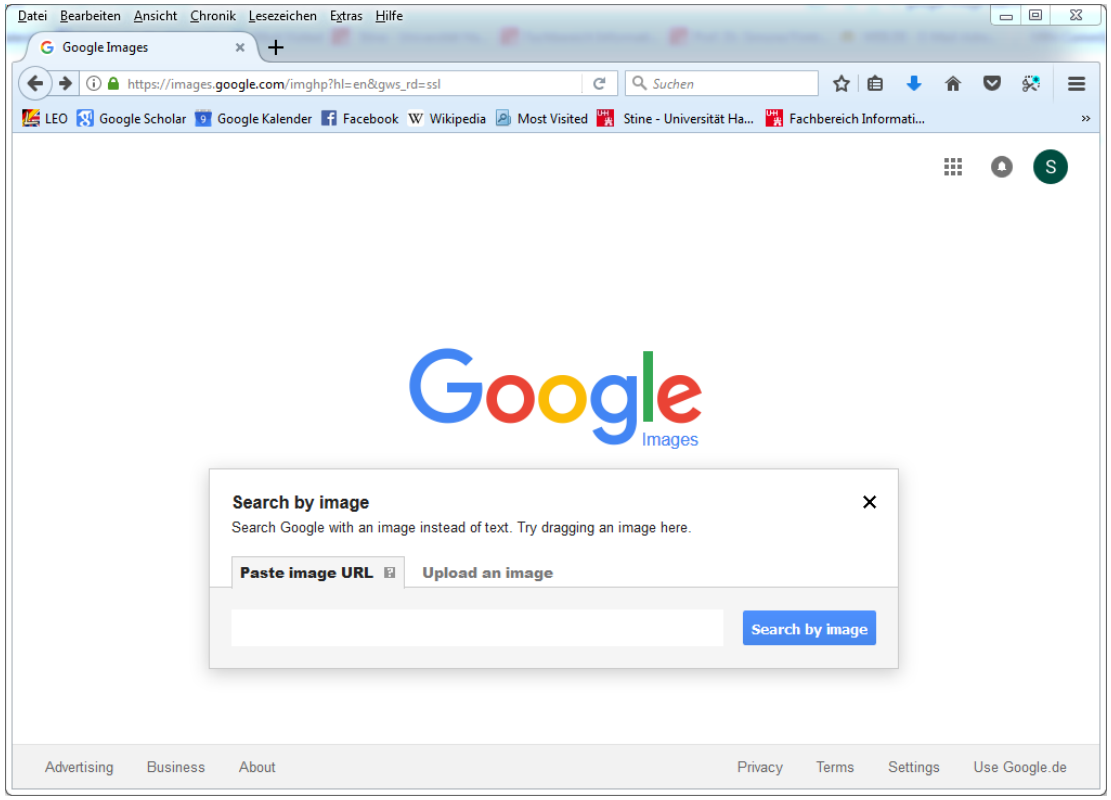
Many Ideas Are Very Old

- Why didn't computer vision work back in the 70s?

- People didn't lack the general ideas…
  but they lacked
  - the algorithms for low-level vision
  - the data
  - the computational power
- Now we have
  - Better low level vision (segmentation, motion estimation, stereo, …)
  - Better learning algorithms
  - A lot more data and hardware and techniques to deal with it

Things Are Starting to Work…

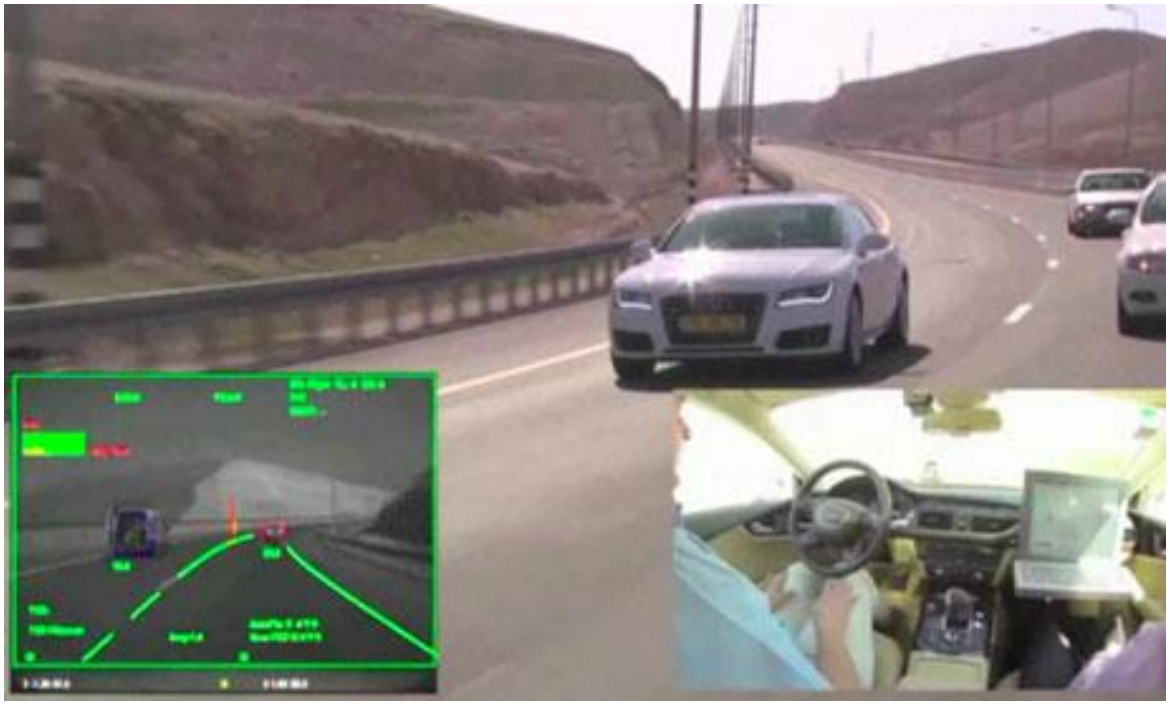
Use images as query…



http://www.6d-vision.com/scene-labeling

Things Are Starting to Work…

Computer Vision in realistic scenarios is becoming feasible!



Audi A7

Driver assistance systems and
autonomous driving

Things Are Starting to Work…

Computer Vision in realistic scenarios is becoming feasible!

http://www.6d-vision.com/scene-labeling

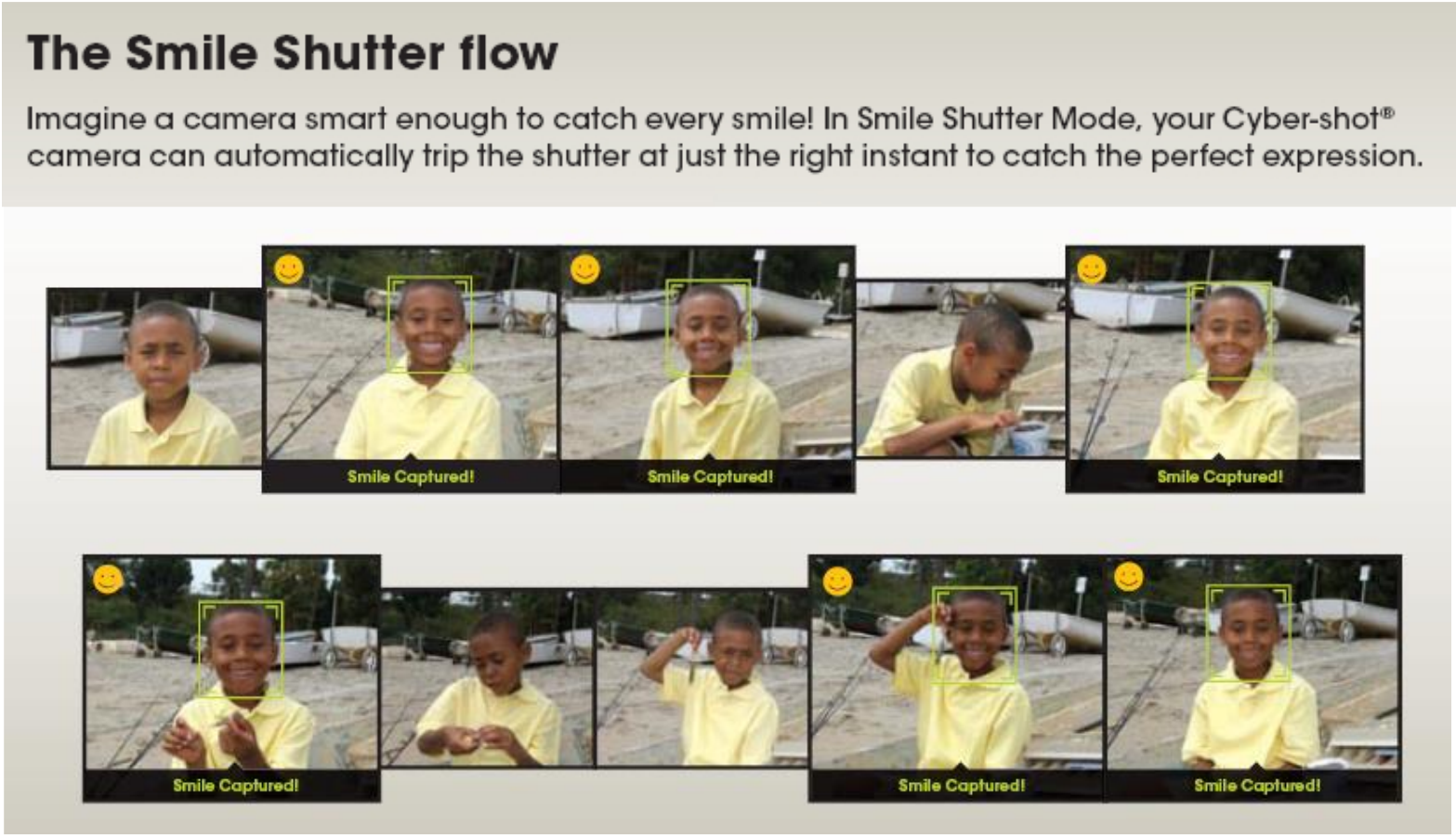
Applications: Faces and Digital Cameras

Setting camera focus via face detection

Camera waits for everyone to smile to take a photo [Canon]

Automatic lighting correction based on face detection

Application: Smile Detection



Sony Cyber-shot® T70 Digital Still Camera

Applications

Image cropping,
resizing,
thumbnailing,
etc.

Photo editing
& picture search

Segmentation

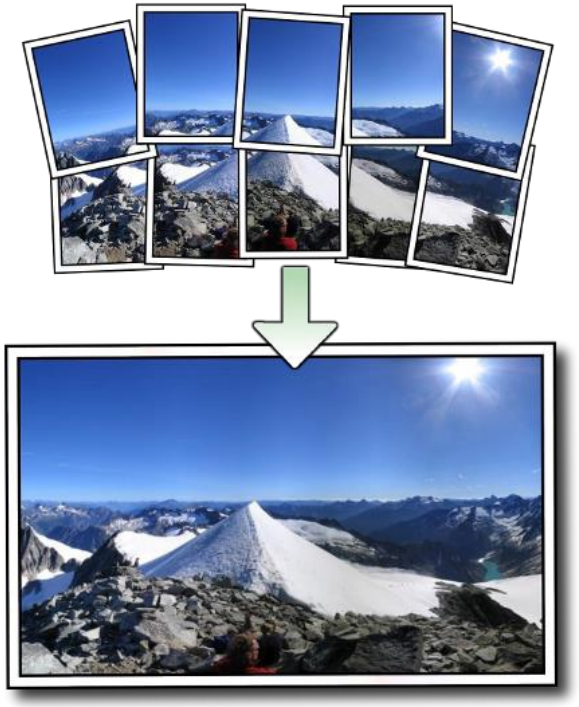
Automatic background removal from images

Functionality is included in Microsoft Office 2010…

Microsoft Office 2010

Panorama Stitching

Stitch your photos together to create panoramas



See lecture on „Features“

AutoStitch is now available in the following commercial products:

- Autopano Pro (Windows, Mac, Linux)
- Serif PanoramaPlus www.serif.com (Windows)
- Calico www.kekus.com (Mac)

http://matthewalunbrown.com/autostitch/autostitch.html [Brown/Lowe 2007]

Applications

Service robots

EU project Squirrel

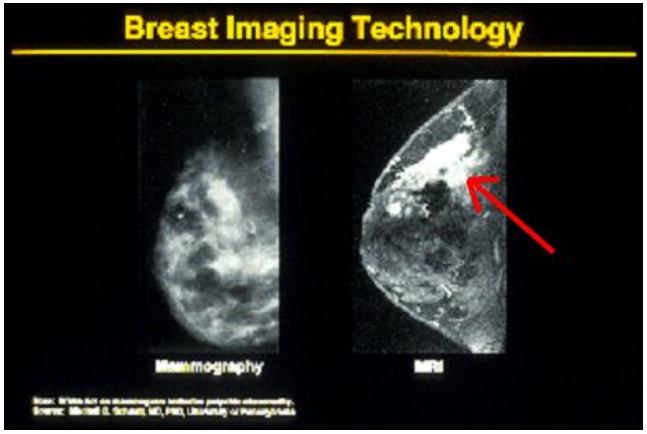
[Uni Bonn, group Behnke]

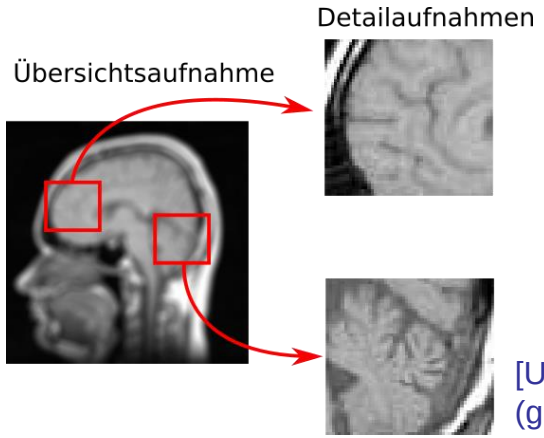
[Uni Hamburg, WTM (group Wermter)]

Care-o-bot 4 http://www.care-o-bot-4.de

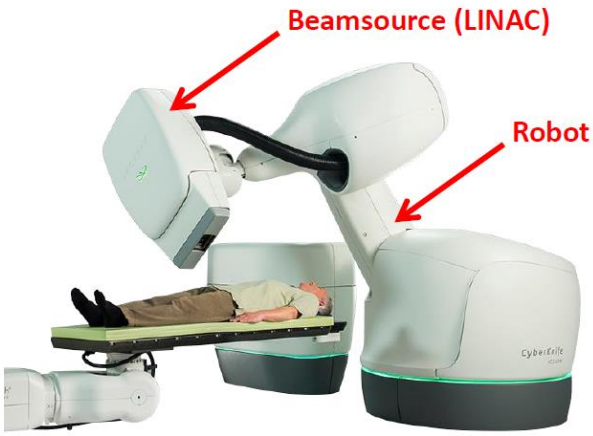
Applications: Medical & Neuroimaging

Image guided surgery
MIT AI Vision Group





[UKE Hamburg (group Knopp)]

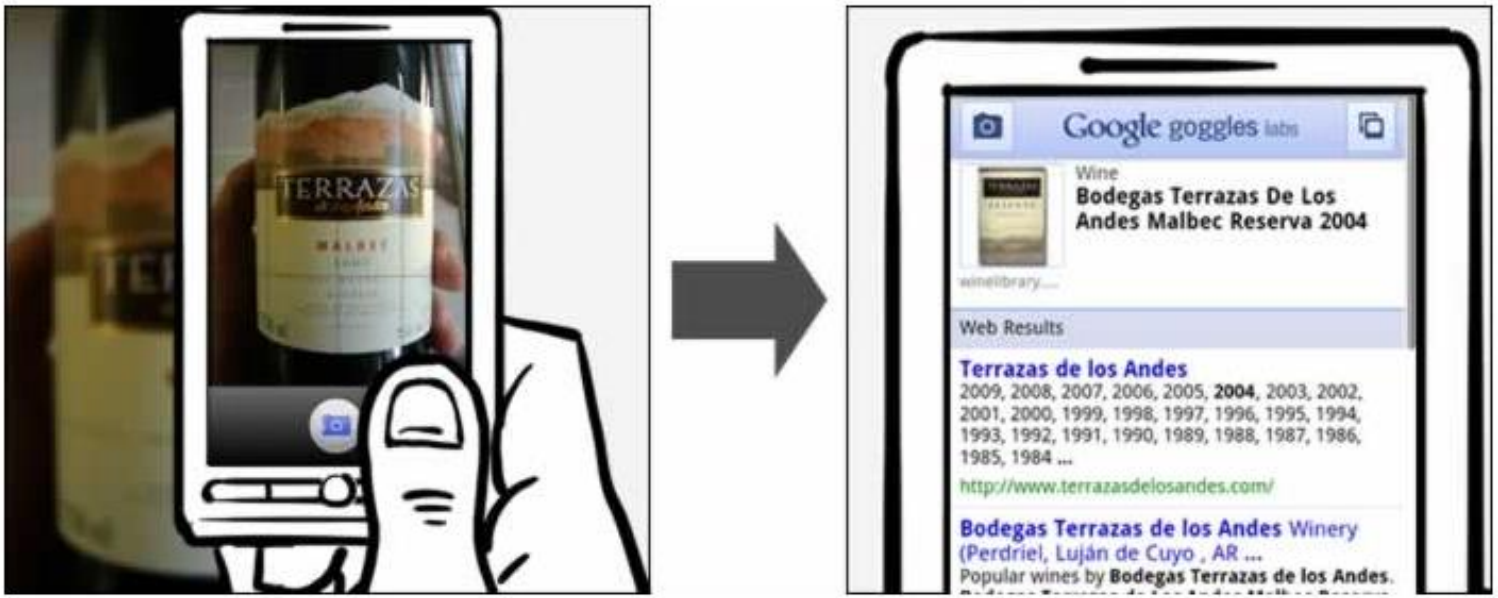


[TUHH (group Schlaefer)]

Applications: Vision-based Interfaces

Games
(Microsoft Kinect)

Applications: Vision for Mobile Phones



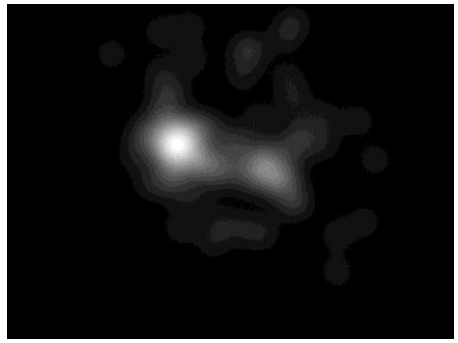
Take photos of objects as queries for visual search

Research in our group

Saliency computation: find regions that automatically attract human attention

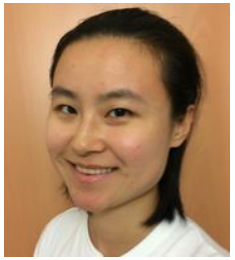
Input image

Output:
Saliency map



AIM [Bruce/Tsotsos 2009]

VOCUS2 [Frintrop et al. 2015]



Research in our group

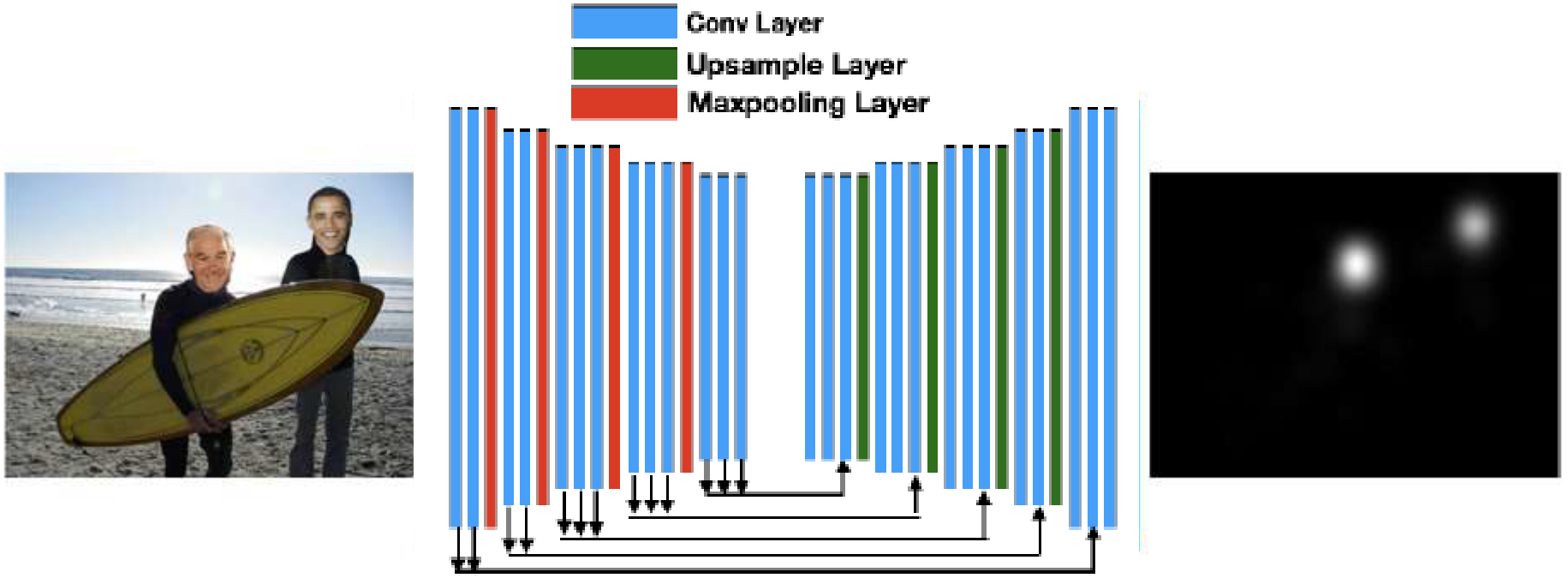
With Ge Gao:

- Attentive Trixie: attend to salient regions

- Cooperation with group of Prof. Jianwei Zhang (TAMS, UHH)

Research in our group

Deep Learning Saliency Model: simulate eye fixations with encoder-decoder architecture (work of Faiz Ul Wahab):



[Ul Wahab 2018]

Research in our group

Cooperation with Adobe Research, Hamburg:

- Image enhancement with saliency
- Train a GAN network by using saliency to compute the loss

(a) Original [fli].

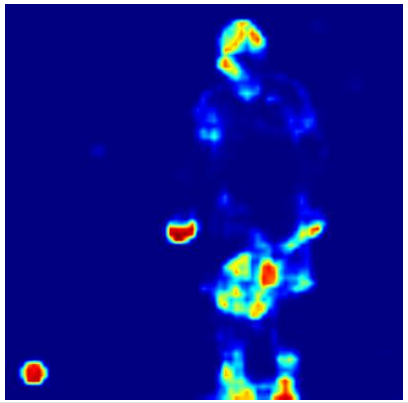
(b) Enhanced.

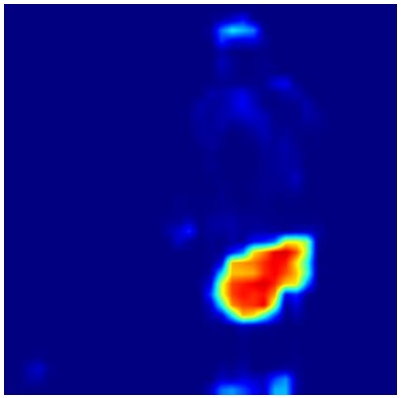
[Soroka 2018]

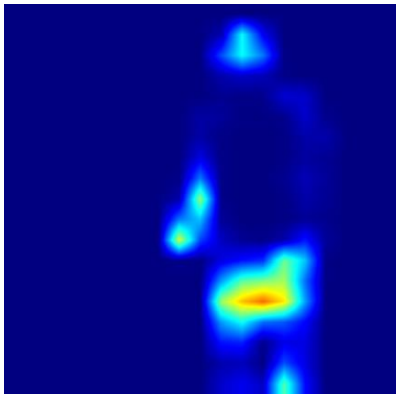
Research in our group

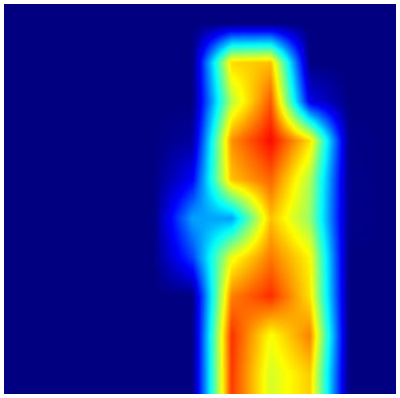
AttentionMask [Wilms/Frintrop 2018]

- Object proposal detection: find promising object candidates in images
- Scale-based attention focuses processing on promising parts of the image



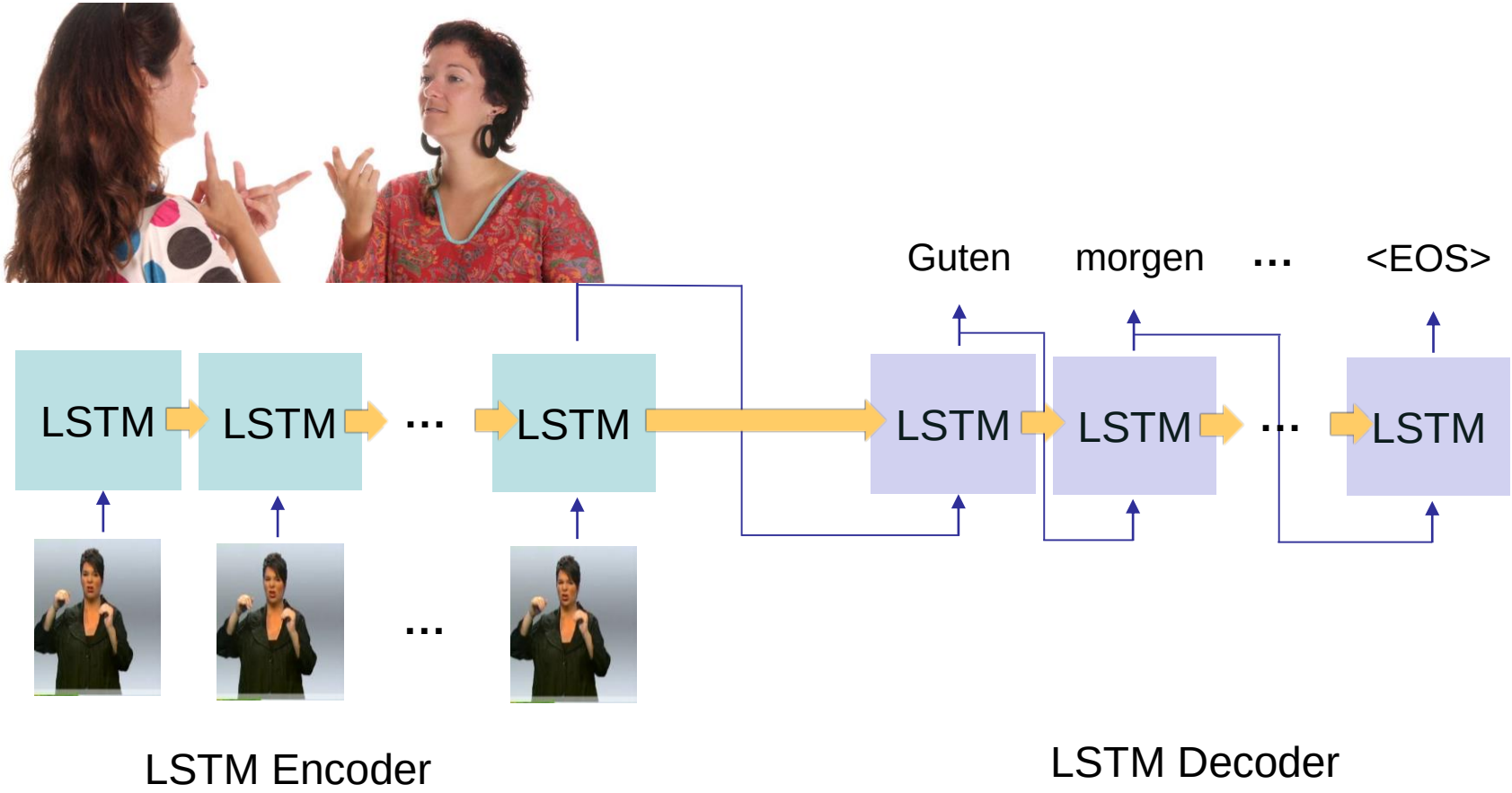






Research in our group

Sign language recognition (with Noha Sarhan)



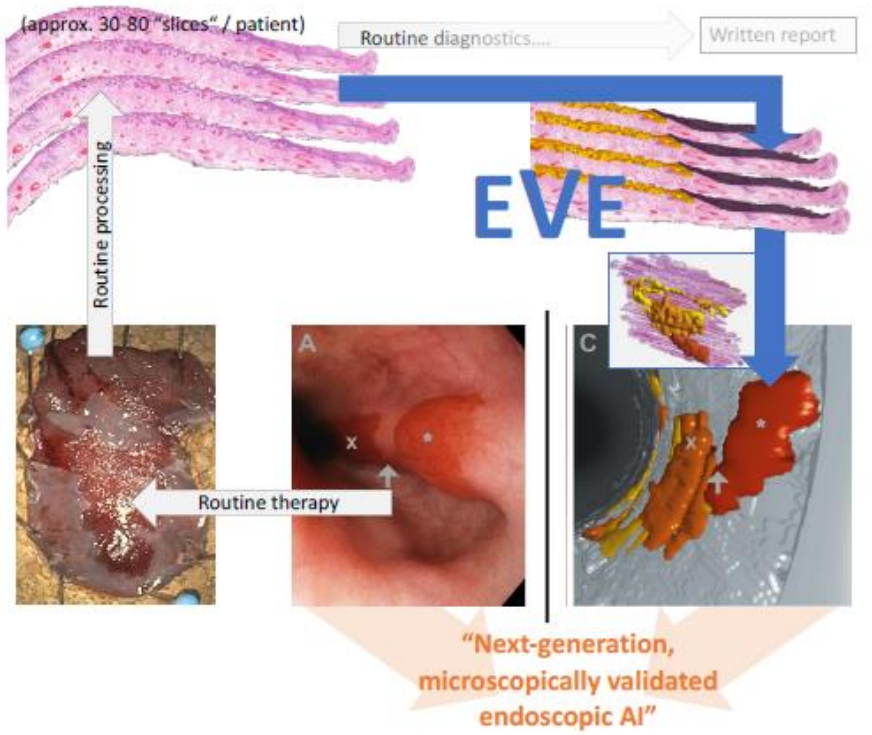
Research in our group

- Cooperation with ZeroG (Lufthansa Spin off)
  (with Christian Wilms & Rafael Heid)
- Detect & recognize plane logos in smartphone images

Abbildung 4.4: Beispielbilder, der 13, am Hamburger Flughafen aufgenommenen, Airlines aus dem HAM-AirLogo Datensatz.

Medical image processing

Starting cooperation with UKE (Rüdiger Schmitz, PD Dr. Rene Werner, Prof. Rösch)
Tumor detection in endoscopic images of oesophagus



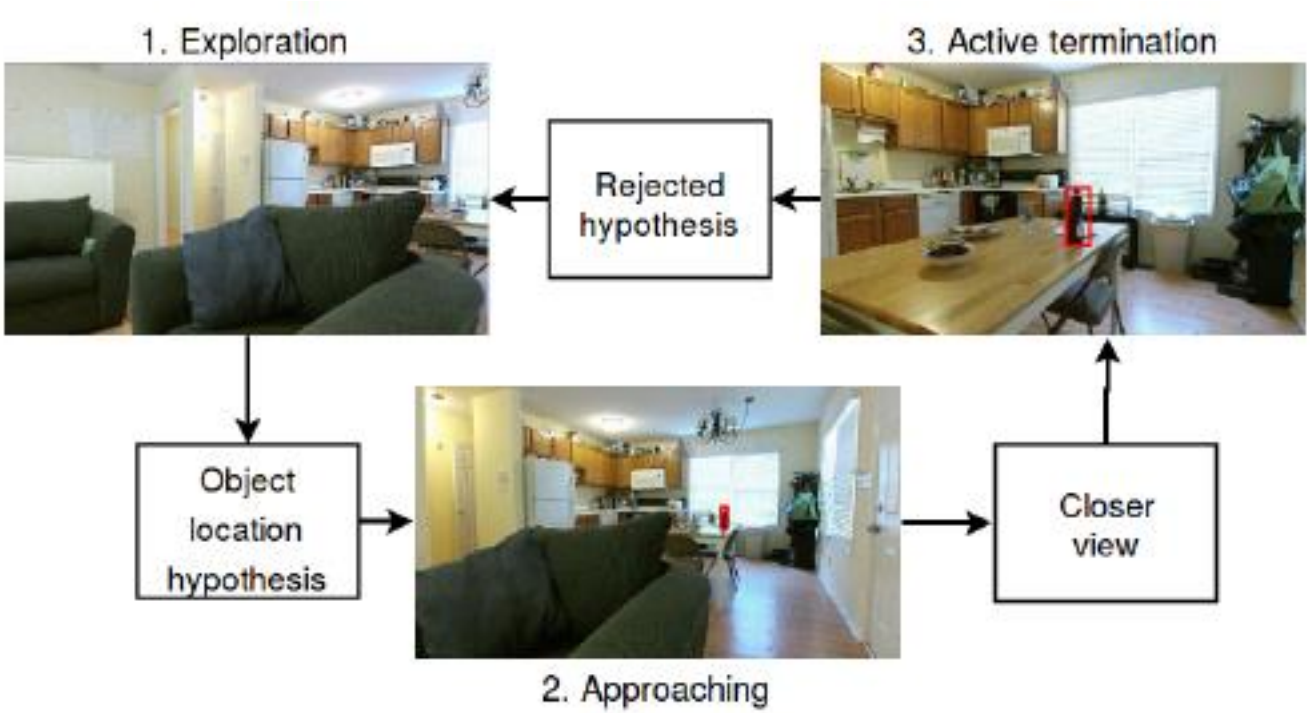
Active Perception

How to guide attention to increase information gain?

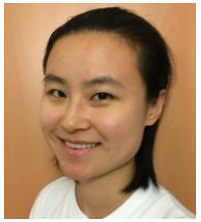
Current work: estimating next best view (with Mikko Lauri)

Active Visual Object Search

(with Jan Fabian Schmid)

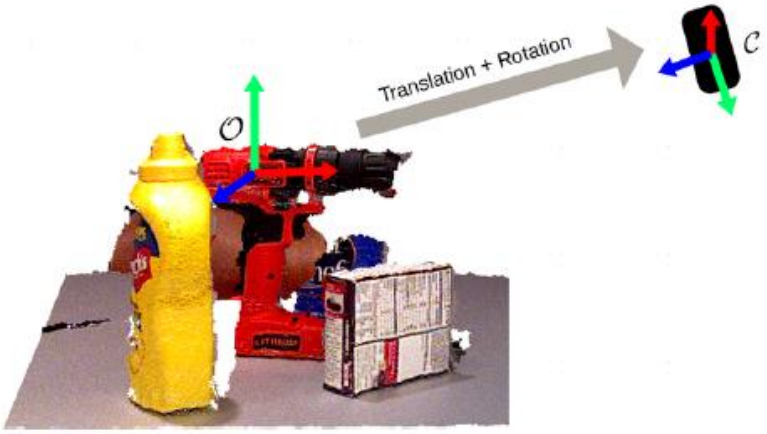


Jan Fabian Schmid, Mikko Lauri, Simone Frintrop: **Explore, Approach and Terminate: Evaluating Subtasks in Active Visual Object Search Based on Deep Reinforcement Learning**, in IEEE/RSJ Int'l Conf. on Intelligent Robots and Systems (IROS), 2019

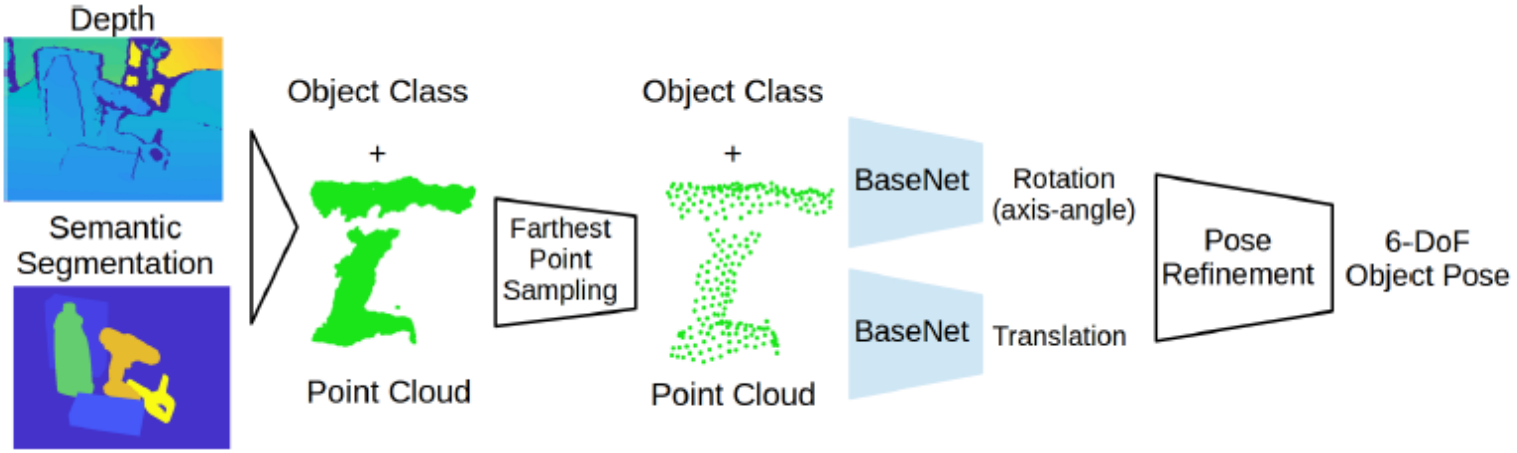


6DoF Object Pose Estimation

Estimate 6D Pose directly from Point Clouds: [Gao et al, 2018]

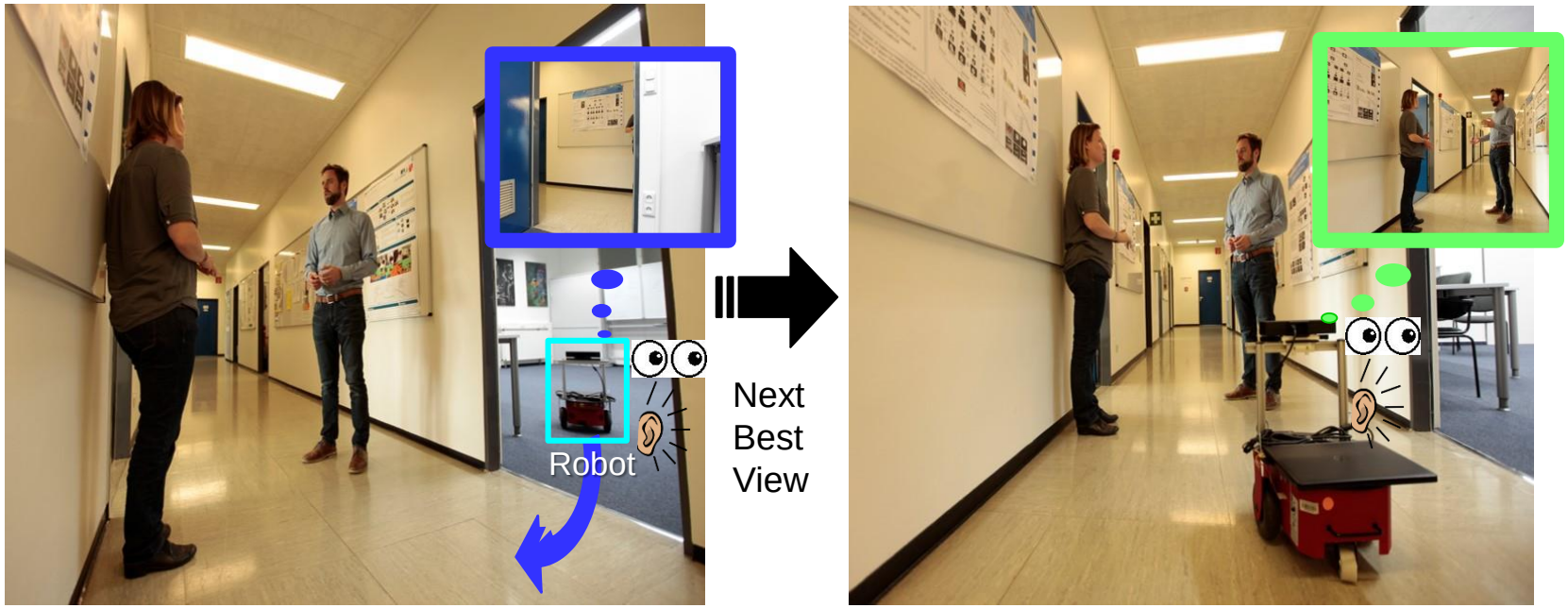


Network architecture:



Research in our group

Ahoi.digital project: **Adaptive crossmodale Sensordatenerfassung**
(with Prof. Gerkmann, Prof. Knopp (TUHH) and Prof. Schlaefer (TUHH))



Is Everything Solved Now?

- No!
- Image analysis and interpretation still far from human performance

Octavia Camps (Prof. at Northeastern University, Boston):

"We're doing such great things here at the conference, everything is getting flashier and better, but when you try to apply that to real world problems with poor quality video from surveillance cameras, it doesn't work as much." (ECCV Daily Magazine, Oct. 2016)

Jitendra Malik (Prof. at UC Berkeley):

"In the context of computer vision, I think one of the key problems that we have not yet solved is prediction: given a certain situation, what will happen next.

Usually, the benefits of perception are in guiding action. One of the ways in which it comes about is that in any situation we know what is likely to happen next. If we see a tiger moving, we kind of know that it is going to jump at us or whatever… or cars moving." (ECCV Daily Magazine, Oct. 2016)

Is Everything Solved Now?

Danica Kragic (Prof. at KTH, Stockholm):

"In early 1980, David Marr stated that “in the 1960s, almost no one realized that machine vision was difficult. The reason for this misperception is that we humans are ourselves so good at vision” (2). Most of us will agree that Marr made an important point, given that we still do not have artificial vision systems that demonstrate the flexibility, scalability, and adaptability of the human visual system."

Sünderhauf et al. (IJRR 2018):

"-- successful algorithm must generalize to numerous novel settings, which shifts the emphasis away from a singular focus on computing the best summary statistic (e.g. average accuracy, area under the curve, precision, recall) over a canned dataset. Recent catastrophic failures of autonomous vehicles relying on convolutional neural networks (Lohr, 2016) highlight this disconnect: when a summary statistic indicates that a dataset has been solved, it does not necessarily mean that the problem itself has been solved. The consequences of this observation are potentially far reaching if algorithms are deployed without a thorough understanding of their strengths and weaknesses"

(“The limits and potentials of deep learning in robotics”

http://journals.sagepub.com/doi/abs/10.1177/0278364918770733)

Why is Computer Vision hard?

What we see

39	24	9	15	19	27	36	37	32	27	26	36	36	35	34	36	41	50	57	50	47
51	40	19	12	16	26	36	38	34	31	31	39	34	33	41	53	60	57	51	61	56
48	48	39	13	17	25	33	35	32	31	34	36	33	34	45	59	64	56	46	64	61
35	45	50	18	20	25	31	31	28	29	33	31	34	39	46	51	52	50	48	59	59
19	36	61	35	17	19	35	37	32	31	33	25	41	50	46	46	52	51	43	61	53
24	28	38	79	51	23	26	49	59	42	21	41	53	58	48	40	46	57	64	68	75
42	37	34	71	60	32	27	60	77	56	33	43	52	62	68	70	77	90	101	107	114
34	29	20	22	45	42	35	52	54	42	45	86	80	81	93	103	106	107	110	99	117
52	52	46	39	65	73	76	88	84	86	112	99	87	81	91	103	111	120	130	163	162
86	85	80	88	81	68	69	76	67	65	84	96	100	112	128	140	151	169	185	212	210
88	82	77	81	70	71	91	110	117	126	139	163	175	190	200	203	205	210	216	232	224
106	109	110	132	137	159	179	182	183	192	200	214	215	215	214	216	218	217	214	222	223
169	190	190	201	203	210	215	214	209	207	209	210	217	215	213	215	213	211	218	225	225
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212	210	208	205	210	214	215	212	210	211	213	220	220	220	218	215	216	220	224	225	227

What the computer sees

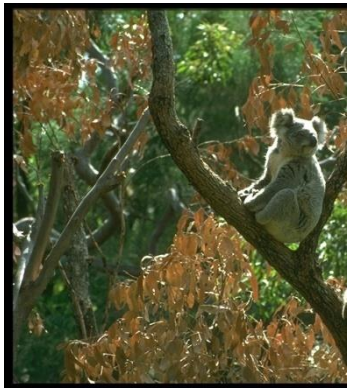
[WikiImages]

Why is Computer Vision hard?

Illumination

Object pose

Occlusions

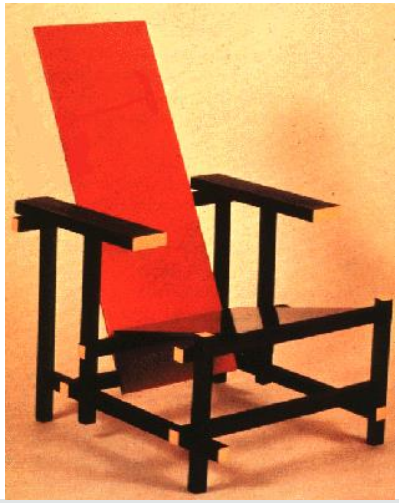


Clutter

Viewpoint

Why is Computer Vision hard?

Challenges: Intra-Category Variation



Slide credit: Fergus, FeiFei, Torralba

Computer Vision: Good or evil?

On the one hand…

- Support disabled and elderly
- Make live easier and more fun

On the other hand…

- Spying everywhere?
- No data privacy?
- What about military applications?

facebook

The lecture is about algorithms, not applications.
But don't forget to think critically about possible applications…

BEST OF ICCV

Cristian Canton - Facebook
Computer Vision News

Cristian Canton Ferrer is an Engineering Lead from Catalonia working at Facebook building a team to address video and image understanding for protection and care against child pornography, violence, terrorism and, in general, harmful content..

Cristian, what is your current work?

Currently, I am working between two roles in Facebook. I do machine learning for AR (augmented reality). I was leading a team there. I am transitioning to a position where I am building up a team to do video and image understanding for protection and care. Essentially, this is trying to use the state of the art or machine learning to prevent child pornography, anti-terrorism, extortion, bullying... all of these kinds of nasty things that happen in the era of internet.

How did you arrive to this position? Was it an idea from Facebook or did you offer your skills to solve these kinds of problems?

That's a good question. In my previous life, before Facebook, when I was working at Microsoft, I did some work for Microsoft in this domain trying to find missing children. I tried to find children who had been abducted and sexually assaulted for favors on the internet. We were doing some projects. That was something I became very interested in, trying to fix the world through machine learning.

What drives you to do this kind of work?

I think every big corporation has some people working on these hard problems because, even if you are focused on cloud or social networks, you always have to keep in mind that the bad guys are going to be using your tools. Every big corporation has a division working on these kinds of problems. I just came across the right person who said, *"Hey, I need an expert on machine learning to help me solve that."* That's how I got into these problems. Very recently, I just found out that Facebook was looking for a leadership position for this so I said, *"Okay, I'm going to make a change in my career."* I've been doing machine learning and geometry for 15 years. I was like, *"Hey, I can help you there with my background. I can try to help."* It was like a revelation. That's the moment when I decided to take a detour in my career and try to work more in this domain.

Did you have any particular interest in these kind of issues before taking the job?

I think it's more of an ethical mindset that I've grown over the years. As you come to this conference and see so much talent. They are very interesting problems. Then you think how you could apply this wealth of knowledge to do things that are ethically relevant or to make this world a better place. I grew this consciousness and said that's something I may try to do. I have a funny story from just a month ago. I was flying to Mexico City, and I was chatting with one of the attendants. She asked me where I work and I said, *"I work at Facebook!"* She looked at me very sternly. So I asked, *"Is something wrong with Facebook?"* She said, *"Well, the other hostess that operates this flight lost her son last week. He committed suicide because there were some kids bullying him through social networks. You guys and all the people that work in social media should work harder."* I was really touched by that. Yes, we have to do something more. That developed rapidly within myself. With all of the machine learning problems that we try to solve, even simple machine learning problems that have to be addressed, they cannot be overlooked. We have to fix them. I find that it was a calling to help there.

Bullying was not born because of Facebook. If it didn't happen on Facebook, it might happen in other places. What impact can Facebook have on solving the problem of bullying?

I don't think Facebook will solve the problem of bullying generally. We can help to solve some of the cases that happen on our platform. I think Facebook as a corporation has like 2 billion users. We work hard to try to fix these problems. We know that these problems may happen as a spontaneous thing due to the social graph. Not only good interactions happen. Bad interactions also happen. It's our duty to find those and really understand how to prevent these kinds of things.

Where have you already had success?

In preventing child pornography on Facebook. That's something that we have done. You will not see much of this content. It's almost impossible to get it public on the web. That's a good question, I mean, it's hard to tell. We've succeeded in image classification to prevent showing nudity, porn, and all of these kind of things. We've had a lot of success there.

Where do you see future opportunities?

I think transferring all of the state of the art in classification and cutting edge technologies, to apply more particularly to these kind of problems

and getting better systems. That's where I see us trying to improve our path even more. Live video, like trying to do things as fast as possible and to intervene if something wrong is being aired.

Do you think you'll solve the issues enough that you will not have any more problems to fix?

That's impossible. One of the paradigms in every system is that, even if you do your best, the bad guys are going to try to outsmart you. They will find ways to beat the system. Even if you get the best system out, someone is going to get to the next step to beat the system and do something wrong. There is no way that we can solve the problem for sure.

Is it like a game of cat and mouse?

Even the cat and the mouse are getting cleverer and cleverer. This is why you have to come to these conferences in order to catch up with the state of the art to understand how this technology can be used for good things and for bad things. If you were to use them for bad things, how can I prevent that?

You suspect that there are dark scientists working in computer vision and artificial intelligence?

I wouldn't say that they are dark scientists. That would be really bad if someone devoted their career to bad things.

Well, the things that you mentioned before are quite bad. We can agree on that.

I just think that the bad guys are getting cleverer and cleverer. With the massive access to any technology and research, you may end up finding people that may learn from these kind of papers or state of the art to do bad things. I don't think that there are scientists working on these domains. The fact that everyone has access to the latest in cutting edge and deep learning technologies empowers people to have tools to do bad things. That's a sound assumption that we

But you do not have any precise knowledge about it?

No, it's just an assumption. I think it's a valid assumption.

What could an everyday person do to help? Also, what could people in this community of highly educated scientists do to help?

The first question of how normal users of any platform, not Facebook in particular, can try to help make things better is whenever you see something wrong in the platform, something that should not be there, report it.

That's how we learn. You just reinforce the system. If you say that this picture should not be here then we can understand why. These kinds of false negatives go through so that we can fix that. We can understand why that case happened, and we can try to address that. What scientists and highly educated people in this field can do is to make it a better, safer place is thinking ethically about technology. Usually, you may think that technologies are harmless, but you should sit down and consider how someone with bad intentions would use the technology. In some cases, it's nothing. Some of the cases can be interesting, for instance, generative adversarial networks (GANs).

"You have to become doubtful of what you see. Keep the ethical implications in mind when you are writing data or doing research."

You can start generating information like images and videos. I'm sure in the next five years, there will be a lot of research in this field. You can start using that to generate information that is not true, but looks plausible to your eyes. That's something that you have to keep in mind. You have to become doubtful of what you see. Keep the ethical implications in mind when you are writing data or doing research. It's not something that you have to highlight in your paper, but it's something to keep in mind. If you want to contribute to these kinds of causes, just get in touch. There are a lot of NGOs or even big corporations that are putting a lot of efforts to use technology for good. You can go and help.

"Every year Facebook organizes a child safety hackathon. We have a lot of people come. Last year, we had Facebook, Microsoft, Google, Amazon"

You sort of hinted that other internet platforms are also sensitive to this issue. Can you name any that are cooperating with you in some way or another?

Good question - For instance, every year Facebook organizes a child safety hackathon. That's, by the way, how I moved from Microsoft to Facebook. We have a lot of people come. Last year, we had Facebook, Microsoft, Google, Amazon, and a huge collection of startups coming together. Usually, that happens in May. We sit down and discuss how we can make this world a better place and a safer place for kids. We get a lot of ideas, and we start collaborating and share code. We say, *"Let's meet next year and see how we can keep moving these kinds of things forward."* There are always volunteers from big corporations to work together on some of these very sensitive topics.

Are the proceedings of these meetings public?

It's not a conference like this one. It's like a workshop. You sit down together and talk about the problems we have right now. It's public. It's more like a get-together, and it's open to anyone. Every bit of help is welcome.

More on Computer Vision

Interested in computer vision topics? Here you get more:

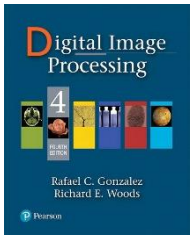
- **Mailing list at Informatikum:** announces talks on computer vision topics
  subscribe here:
  https://mailhost.informatik.uni-hamburg.de/mailman/listinfo/cv-talks
- **Computer Vision News** – the magazine of the algorithm community
  subscribe here:
  http://www.rsipvision.com/computer-vision-news/
- **Imageworld-digest:** International Mailing list announces worldwide events (conferences/workshops) and open jobs in computer vision. Subscribe here (in case you are interested in PhD positions):
  https://list.ku.dk/listinfo/sci-diku-imageworld
- **Initiative Bildverarbeitung e.V.** in Hamburg und Schleswig-Holstein (if you are looking for local job opportunities):
  http://www.initiative-bildverarbeitung.de/home/

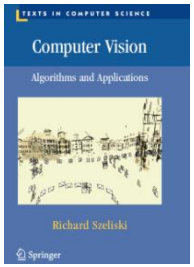
Course Outline

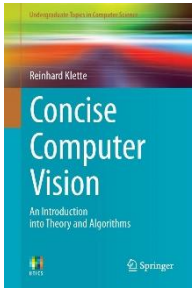
- Human Vision (very short, more next semester)
- Image Processing Basics
- Digital Filters (spatial and frequency domain)
- Edge Detection
- Model Fitting (e.g., line and circle detection)
- Features & Matching
- Segmentation
- Object Recognition and Categorization – Deep Learning in Computer Vision (Convolutional Neural Networks)

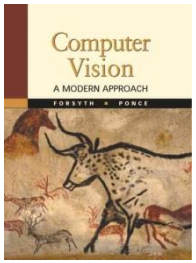
Literature

- Some textbooks:
  - Rafael C. Gonzalez and Richard E. Woods: Digital Image Processing, Addison-Wesley Publishing Company, 4th edition: 2017.
  - Computer Vision: Algorithms and Applications, Richard Szeliski, Microsoft Research, 2010 (also online: szeliski.org/Book)
  - R. Klette: Concise Computer Vision: An Introduction into Theory and Algorithms, Springer 2014
  - D.A. Forsyth, J. Ponce: Computer Vision, A Modern Approach (2nd edition), Prentice-Hall 2012









- Computer vision is a very active field. Many topics have not yet found their way to textbooks, you have to read papers.
  → Literature for the individual topics during the lecture:
  See last slides of each lecture for references
  (Primary literature: directly related. Read for deeper understanding of lecture content (reading slides is NOT sufficient).
  Secondary literature: references and additional reading)

Rate your readings

Very good Journals in Computer Vision:

- PAMI: IEEE Transactions on Pattern Analysis and Machine Intelligence
- TIP: IEEE Transactions on Image Processing
- IJCV: International Journal of Computer Vision

Good Journals in Computer Vision (Selection):

- CVIU: Computer Vision and Image Understanding (Elsevier)
- Imavis: Image and Vision Computing (Elsevier)
- …

- Determine quality of other journals:
  SCImago Journal and Country rank: http://www.scimagojr.com
  ("Journal Search" or "Journal Rankings")

  http://www.scimagojr.com/journalrank.php?category=1707

Rate your readings

Very good Conferences Computer Vision:

- ICCV (International Conference on Computer Vision)
- ECCV (European Conference on Computer Vision)
- CVPR (International Conf. on Comp. Vision and Pattern Recognition)

Good Conferences Computer Vision (Selection):

- ICIP (International Conference on Image Processing)
- ICPR (International Conference on Pattern Recognition)
- ACCV (Asian Conference on Computer Vision)
- GCPR (German Conference on Pattern Recognition)
- BMVC (British Machine Vision Conference)
- ICVS (International Conference on Computer Vision Systems)

Slide Credits

The computer vision community shares slides frequently.

For this course, some slides are taken or adapted from:

- Bernd Neumann/Siegfried Stiehl/Benjamin Seppke (Uni HH): Image Processing
- Bastian Leibe (RWTH Aachen): Computer Vision
- Jürgen Gall (Uni Bonn): Computer Vision
- Kristen Graumann (Uni of Texas at Austin): Computer Vision
- Svetlana Lazebnic (Uni Illinois): Computer Vision
- Fei Fei Li and Andrej Karpathy (Stanford): Convolutional Neural Networks for Visual Recognition)

and others…

Thanks to everybody for providing the slides!

Slide credit is given at bottom of each slide.

Stine and Moodle

- We will use Stine and Moodle

- Stine only for grades, times, rooms

- Moodle: platform to collaborate online
- For emails, sharing material, discussion. Please register!
- Course name: "**Computer Vision I WS2019-2020**"
- Enrollment Key: CV1-2019

- You will find the slides on Moodle: before the lecture a draft, after the lecture the final version. So make sure to update your slides later!

Exercises

Exercises:

- Theoretical assignments during class and homework
- Practical assignments in Python

Given by Dr. Mikko Lauri and Quan Nguyen at

Thursdays, 12:00 – 14:00

Fridays, 12:00 – 14:00

in room D-010

Organization

- Pass the exercise class:
  - Solve at least 50% of the pen and paper assignments and be able to present them in class
  - Solve at least 50% of the programming homework assignments and be able to present them in class
- Test at Jan. 17th (during lecture slot): optional test to prepare for exam. Use it to get feedback on your knowledge!
- Exams: written exam
  1. exam date: (Stine date will most likely be changed)
  2. exam date: Thu 19 Mar 2020, 9.30-11.30 (D-125/129)
- You can take the exam even if you did not pass the exercise class, but you can not finish the module then. You will have to repeat the exercise class later.

Who are you?

Questionnaire