Seminar:
Multimediale Datenverarbeitung

Wintersemester 2016/17

General Information

Learning Objectives

- Requirements:
  - Formally: None
  - Interest in Multimedia Computing and/or Machine Learning
  - Recommended from the 3rd semester

- Over the course of the seminary you should learn…
  - … to independently familiarize yourself with new concepts
  - … to distinguish between important and unimportant information
  - … to present a topic to an audience of non-experts
  - … to write a clear and concise summary of the topic
  - … to communicate and recieve criticism

Modalities

- Credits: 4 LPs
- Presentations
  - Location: Room 1021 N
  - Time: Proposal:
    03.02.2017
    Attendance is mandatory!
  - Approx. length: 25 Minutes + Questions
- Term papers
  - Approx. length: 10 pages
  - Due date: 18.02.2017
  - Language: German or English
  - Latex template can be found in Digicampus

Schedule

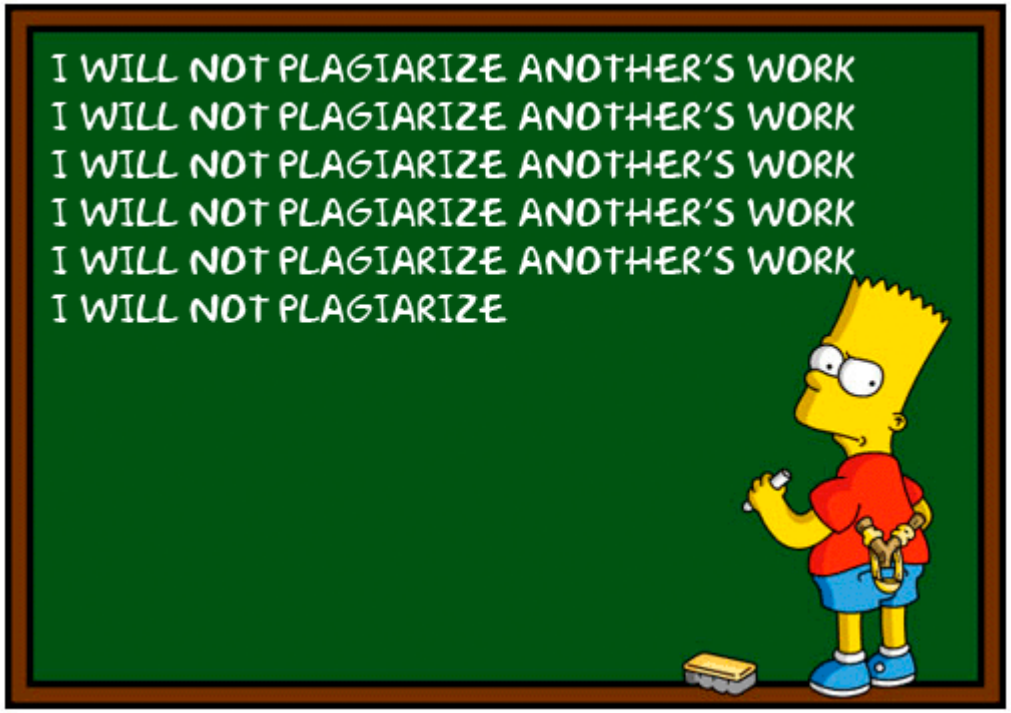
Phase	Last date
Introduction	Today
Topic Assignment	Mo 07.11.2017
Outline review	Mo 09.01.2017
First Draft	Mo 23.01.2017
Feedback	Fr 27.01.2017
Presentation	Fr 03.02.2017
Final Paper Submission	So 18.02.2017

Some unasked-for but nevertheless good advice

- Do not underestimate the workload
  - Understanding takes time
  - Articles are often hard to read
  - You will often need to read multiple sources
- Presentations:
  - Find the right level of detail
  - Keep in mind: Most audience members do not know the topic
  - If necessary: Practice in advance
    - Check your timining
    - Prepare verbalization
- Papers:
  - Limit yourself to key aspects
  - Explain those aspects clearly and in detail
  - Should follow a train of thought

This should go without saying…

… unfortunately it still seems necessary



Source: http://cebusocsci11.wordpress.com/

Available Topics

Scale-invariant Feature Transform (SIFT)

- Motivation
- Requirements of good image features
- The concept of scale-space
- Keypoint detection and refinement
- Estimation of keypoint orientation
- Feature-Descriptor
  - What is recorded?
  - How is it constructed?

Source: [1]

Literature:
[1] Distinctive Image Features from Scale-Invariant Keypoints, D. Lowe, International Journal of Computer Vision, 2004, Vol 60, pp. 91-110

Superpixels with SLIC

- Motivation: Superpixels and potential applications
- What are „good“ superpixels?
- Under- and Oversegmentation
- K-Means: Algorithm description
- Application of K-Means in SLIC
- Computational complexity

Source: https://infoscience.epfl.ch/record/149300/files/SLIC_Superpixels_TR_2.pdf

Literature:
[1] SLIC Superpixels, A. Radhakrishna, A. Shaji, K. Smith, A. Lucchi, P. Fua, S. Süsstrunk, EPFL Technical Report No. 149300, June 2010

Outlier Detection with RANSAC

- Problem definition: What is the problem fitting least-squares models using noisy data?
- What is RANSAC and how can it help to overcome these problems?
- Possible applications

- Hot topics: Line fitting, least squares, termination criterion

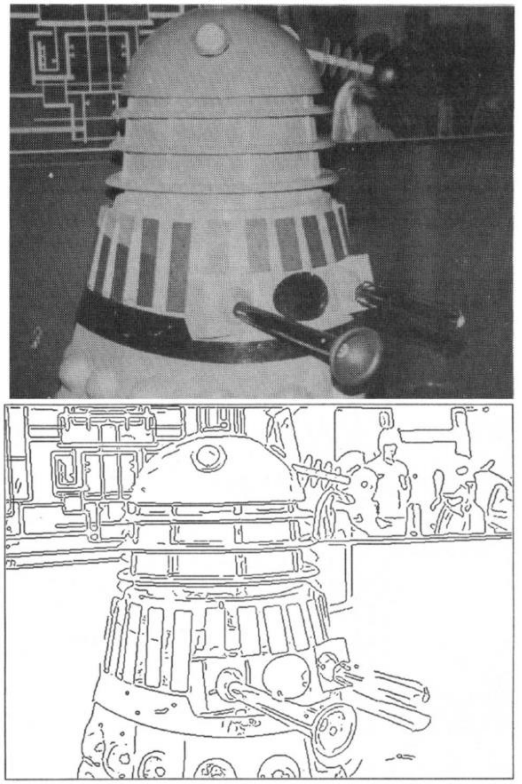
Source: http://www.multimedia-computing.de/

Literature:
[1] Random Sample Consensus: A paradigm for Model Fitting with Applications to Image Analysis and Automated Cartography, M.A. Fischler, R.C. Bolles, 1981
[1] Computer Vision: Algorithm and Applications, R. Szeliski, Springer, 2011, ISBN 978-1848829343

Edge Detection with Canny

- Describe applications of Edge Detectors in general
- What are some of the challenges/problems when detecting edges
- Explain mathematically and in your own words the canny edge detection algorithm
- Explain in detail how the canny edge detector can be improved.

- Hot topics: noise reduction, gradients, hysteresis thresholding



Source: [1]

Literature:
[1] A Computational Approach to Edge Detection, J. Canny, 1986, IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 8, Issue 6, pp. 679-698

Hough Transform for Shape Detection

- What is a Hough transform?
- Explain the theory of hough transforms mathematically and illustratively
- Focus on the detection of lines and circles
  - Possible Parametrizations
  - Advantages/Disadvantages
- Explain the Randomized Hough Transform mathematically and with your own words
- Hot topics: hough spaces, hesse normal form, randomized hough transform

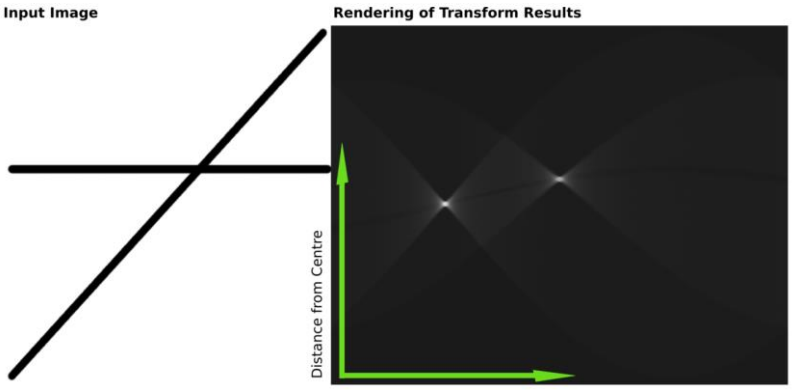
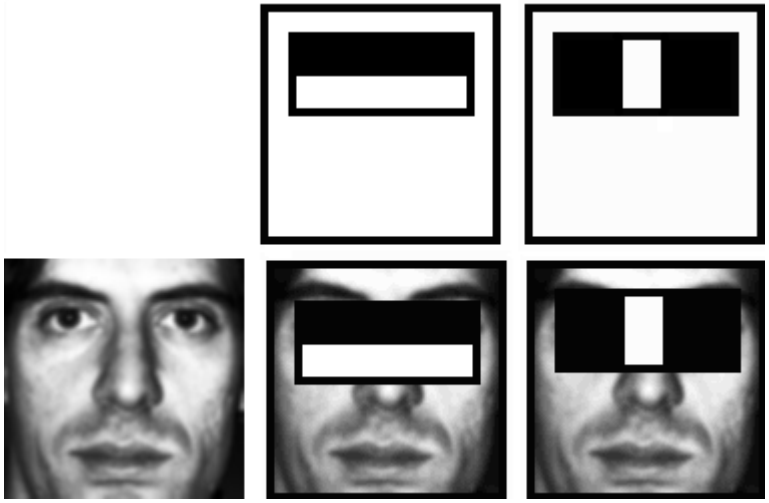


Image source
https://en.wikipedia.org/wiki/Hough_transform

References:
[1] Duda, R. O. and P. E. Hart, "Use of the Hough Transformation to Detect Lines and Curves in Pictures," *Comm. ACM, Vol. 15*, pp. 11–15 (January, 1972)
[2] D.H. Ballard, "Generalizing the Hough Transform to Detect Arbitrary Shapes", Pattern Recognition, Vol.13, No.2, p.111-122, 1981

Face Detection with AdaBoost

- Motivation and basic idea of boosting
- Cascading Classifiers
- Algorithm Description: AdaBoost
- Application: Face Detection
  - Weak classifiers and Haar-Like Features
  - Efficient computation
- Hot topics: Image pyramid, integral images, boosting



Source: http://siret.ms.mff.cuni.cz/facereco/method/

Literature:

[1] Rapid Object Detection using a Boosted Cascade of Simple Features, P. Viola, M. Jones, CVPR 2001

[2] An extended set of Haar-like Features for Rapid Object Detection, R. Lienhart, J. Maydt, CVPR 2002

Additional Literature

The following sources might provide additional information:

Topics:

- Image Features & Algorithms: VLFeat
  http://www.vlfeat.org
- Machine Learning: Scikit learn
  http://www.scikit-learn.org

Questions?