Machine Learning

– winter term 2016/17 –

Course Mechanics

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Outline

1. Projects!

2. 27.10.

3. Introduction

Food for Thought

Wikification

- Demo should enrich **some** kind of text with Wikipedia
- Live demo!?
- Remember: Choose Wikipedia Category and detect+link key terms
- Training data: Wikipedia (**text + link structure**)
- focus on certain categories?

Gaze Tracking

- steps: camera calibration, landmark detection, normalization, angle estimation
- hardware: webcam? Maybe limit head pose?
- Training phase for user?
- Live Demo!?

Food for Thought

Fish on Kaggle?

- in general, why not?
- Condition: Stick to your **own** approach
- Condition: Live Demo (?)

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Organisatorisches

Prüfungsanmeldung

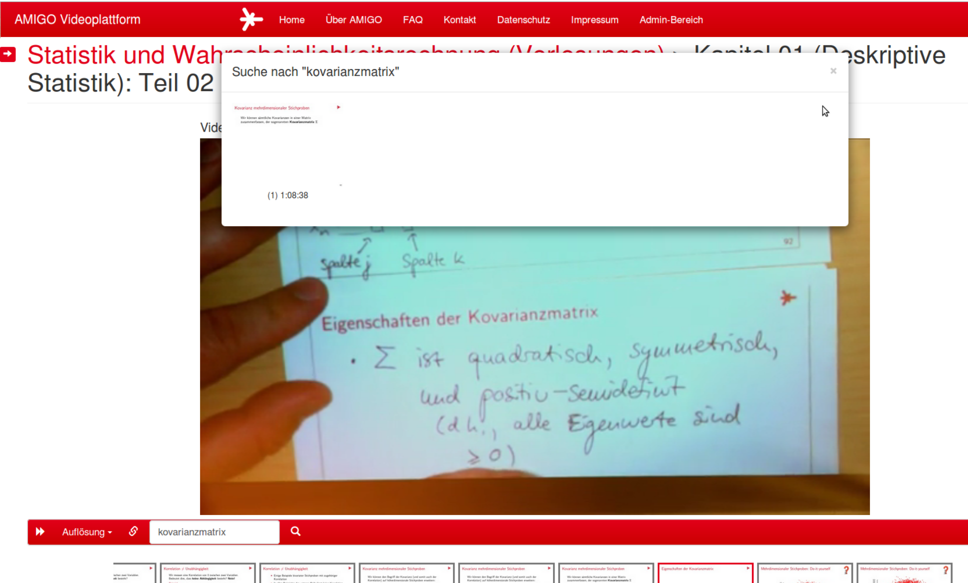
- seeehr analog → Zettel unterschreiben!
- heute (?)

Pause heute

- im zweiten Block (bitte dran erinnern / laut gähnen o.ä.)

http://video.cs.hs-rm.de (AMIGO Video-Plattform)

- Empfohlen: Firefox (mobiler Zugriff möglich).



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Statistik und Wahrscheinlichkeitsrechnung (Vorlesungen) › Kapitel 01 (Deskriptive Statistik): Teil 02

Vide

Suche nach "kovarianzmatrix" ×

Kovarianz mehrdimensionaler Stichproben

Wir können sämtliche Kovarianzen in einer Matrix zusammenfassen, der sogenannten Kovarianzmatrix Σ

(1) 1:08:38

Spalte j Spalte k

92

Eigenschaften der Kovarianzmatrix

- Σ ist quadratisch, symmetrisch, und positiv-Semidefinit (d.h., alle Eigenwerte sind ≥ 0)

Auflösung ▾ | kovarianzmatrix

Korrelation ≠ Unabhängigkeit | Korrelation ≠ Unabhängigkeit | Kovarianz mehrdimensionaler Stichproben | Kovarianz mehrdimensionaler Stichproben | Kovarianz mehrdimensionaler Stichproben | Eigenschaften der Kovarianzmatrix | Mehrdimensionaler Stichproben: Do-it-yourself | Mehrdimensionaler Stichproben: Do-it-yourself

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Videos

- Der Plan ist, diese Vorlesung zu **filmen**
- Der Plan war, die Vorlesungen online zu stellen
- Wie stehen Sie dazu?
- **Problem**: Art 52a UrhG

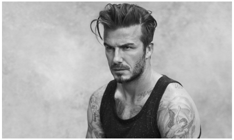
Course Language: English

But Why?

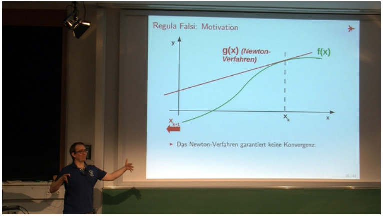
- ML terminology is mostly English anyway
- For the learning experience

But How?

- Lecturer speaks English
- Students speak whatever they like *(English appreciated)*
- Fachgespräch in German *(English terminology where it feels natural)*
- Coursework in German/English
- Presentations in X (?)
- Vocabulary issues ...? *(speak up!)*

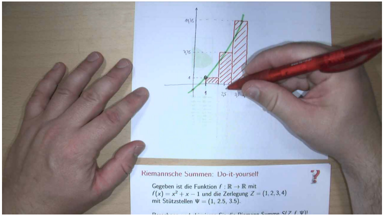


Course Process



Regula Falsi: Motivation

- Das Newton-Verfahren garantiert keine Konvergenz.



Riemannsche Summen: Do-it-yourself

Gegeben ist die Funktion $f : \mathbb{R} \to \mathbb{R}$ mit $f(x) = x^2 + x - 1$ und die Zerlegung $Z = (1, 2, 3, 4)$ mit Stützstellen $\Psi = (1, 2.5, 3.5)$.

Berechnen und skizzieren Sie die Riemann-Summe $S(Z, f, \Psi)$!

Part 01 (7 Weeks)

- **2 blocks** of Lecture-style presentation
- Some interactive parts ("Do-it-yourselfs"), lots of questions
- Writing on some slides → Do print slides beforehand!
- Weekly **coursework**

Part 02 (7 Weeks)

- **Project**: Solving a larger-scale machine learning problem

Time Table (tentative)

20.10.	Lecture 01 Introduction	Lecture 02 Decision trees	exercises
27.10.	Lecture 03 Feature Engineering	Lecture 04 N. Bayes + graph. models	exercises
03.11.	Lecture 05 Instance-based Learning	Lecture 06 Logistic Regression	exercises
10.11.	Lecture 07 Unsupervised Learning I	Lecture 08 Unsupervised Learning II	exercises
17.11.	Lecture 09 Neural Learning I	Lecture 10 Neural Learning II	exercises
24.11.	Lecture 11 Deep Learning	Lecture 12 Deep Learning @ DFKI	exercises
01.12.	Lecture 13 Recommender Systems	exercises	
08.12.	project		
15.12.	project		
22.12.(duh)	project		
12.01.	project		
19.01.	project		
26.01.	project		
02.02.	Project Presentations		

Learning Objectives

After this course, you should …

- … have an algorithmic understanding of the **most common machine learning techniques** (including 9 of the *Top 10 Algorithms in Data Mining*[1])
- … be able to **assess** the benefits and shortcomings of ML algorithms
- … be able to **apply** ML algorithms using state-of-the-art technology *(Python)*
- … have some understanding of the **“dark art” aspects** of ML
- … have gone through an **experimental development cycle** of an ML system.

[1] Wu et al., *Top 10 Algorithms in Data Mining, Knowl. Inf. Syst., 2008.*

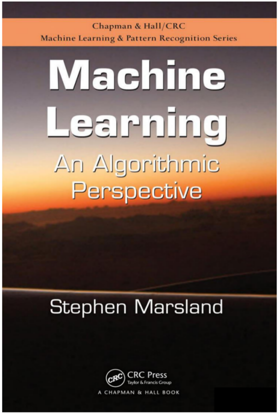
Ressources

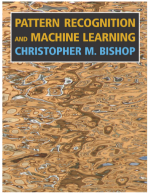
Primary Read

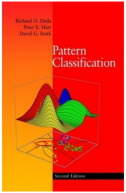
- S. Marsland, *Machine Learning: An Algorithmic Perspective* (Chapman & Hall/CRC).
- Several copies available in the library

Other Good Reads

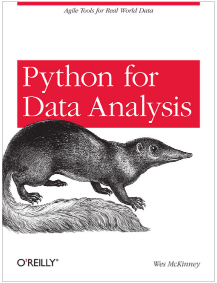
- Bishop: Pattern Recognition and Machine Learning (Springer)
- Duda Hart Stork: Pattern Classification (Wiley Interscience)
- Specific resources per chapter (later)
- Software: R, (matlab), numpy, scipy, matplotlib, scikit-learn







There’s more...

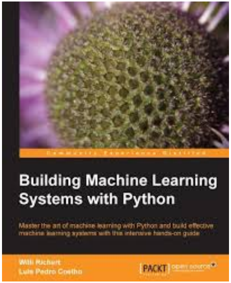


Agile Tools for Real World Data

Python for Data Analysis

O’REILLY®

Wes McKinney



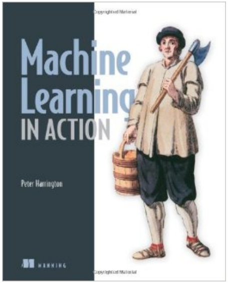
Community Experience Distilled

Building Machine Learning Systems with Python

Master the art of machine learning with Python and build effective machine learning systems with this intensive hands-on guide

Willi Richert
Luis Pedro Coelho

PACKT open source



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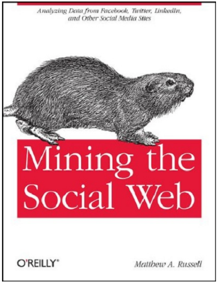
Machine Learning IN ACTION

Peter Harrington

MANNING

Copyrighted Material

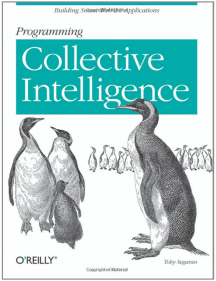


Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites

Mining the Social Web

O’REILLY®

Matthew A. Russell



Building Smart Web 2.0 Applications

Programming

Collective Intelligence

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Toby Segaran

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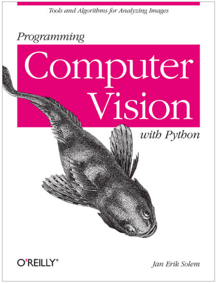


Tools and Algorithms for Analyzing Images

Programming

Computer Vision

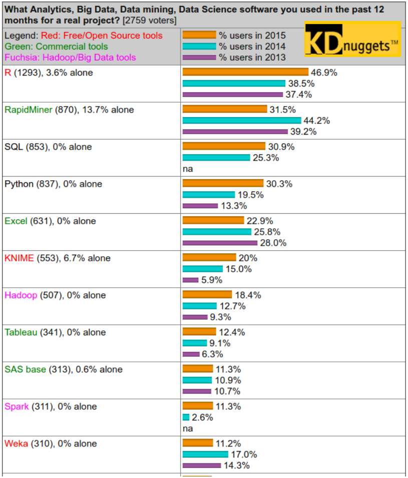
with Python

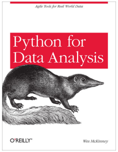
O’REILLY®

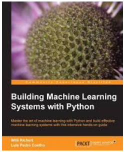
Jan Erik Solem

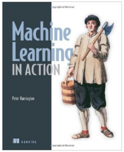
Python: Why?

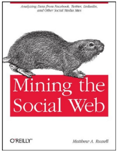
- OO scripting language with functional elements
- easy to learn *("pseudo-code that runs")*, powerful data structures + libraries
- widely used: most popular general-purpose scripting language *(rank 5 in the TIOBE Top Ten*[2]*)*
- very popular for data analysis

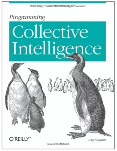


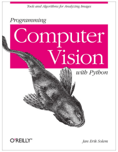












[2] `http://www.tiobe.com/index.php/content/paperinfo/tpci/index.html`

The Python ML Ecosystem

Numpy

- working with vectors + matrices
- array operations for compact code
- numerical algorithms wrapped

Scikit-Learn (sklearn)

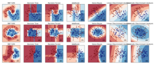
- machine learning algorithms!!!

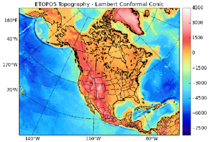
Tensorflow

- neural networks + deep learning
- scalable, portable, GPU support
- Alternatives: Caffe, Theano

Matplotlib

- visualization





Pandas

- 'excel perspective'
- feature engineering

Jupyter Notebook

- run experiments in a Wiki
- demo

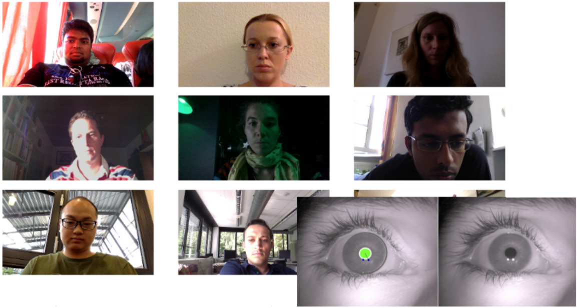
Projects

You Will...

- ... work in teams of 2 *(for the whole course, actually)*
- ... solve a machine learning challenge
- ... present your results in a talk *(last week)*
- ... honor the **ground rule** *(do not train on the testing data)*

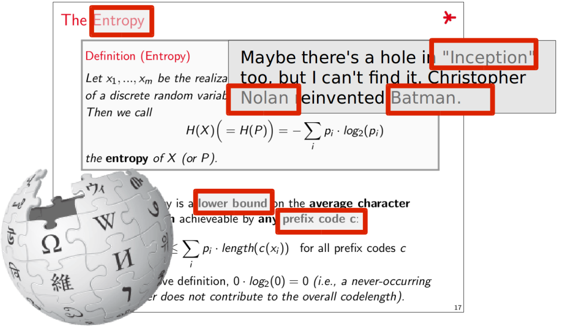
Challenge 1: Gaze Tracking

- Build a system that detects where on a computer screen the **user is looking**
- eye detection → pupil tracking → estimating gaze direction
- optionally: adapt to a specific user
- build a demo system
- Technology: Deep CNNs, Tensorflow



Challenge 2: Wikification

- Vision: Enrich any piece of text with **Wikipedia**
- Step 1: Sort text into the Wikipedia category tree
- Step 2: Detect keywords and link them to Wikipedia articles
- build a demo system
- Training data: Wikipedia (**text + link structure**)
- Technology: free of choice (NLTK recommended)



The Entropy

Definition (Entropy)

Let $x_1, \ldots, x_m$ be the realiza
of a discrete random variab
Then we call

$$H(X)\Big(=H(P)\Big) = -\sum_i p_i \cdot log_2(p_i)$$

the **entropy** *of X (or P).*

Maybe there's a hole in "Inception" too, but I can't find it. Christopher Nolan reinvented Batman.

y is a lower bound on the **average character**
h achieveable by **any** prefix code c:

$\leq \sum_i p_i \cdot length(c(x_i))$ for all prefix codes *c*

ve definition, $0 \cdot log_2(0) = 0$ (*i.e., a never-occurring*
r does not contribute to the overall codelength).

17

Grading

- Grading for this course will adhere to the rules of **Praktische Tätigkeit und Fachgespräch**
- Remember to sign in early on QIS!
- Attendance to “Praktikum” will be recorded *(do not miss more than 3!)*
- **Final grade**: 30% weekly coursework, 40% project, 30% Fachgespräch

1. Weekly Coursework

- Before the project phase, there will be weekly (mostly programming) exercises
- Grading based on brief “weeklies”
  - general progress
  - brief demo / results
  - code walk-through

Grading (cont'd)

2. Project

- Main deliverable: **project presentation** *(experiments+reading done, motivation for investigative path, scientific standard)*
- Do record results **while** working on the project!
- I will also check code *(should be able to install and run)*
- Please create a Gitlab repo

3. Fachgespräch

- Will use your project work as basis, but also include questions from lecture/exercises
- Prepare like for an **oral exam**!