

Lecture 1 Introduction

Dr. Hanhe Lin

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Contact

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- Consultation Hours: On appointment

Note

- Due to the COVID-19 pandemic, this course will be offered online, therefore, you should
 - Subscribe on ZEuS and ILIAS
 - Use BigBlueButton (BBB) to join lecture and exercise sessions
 - <https://bbb.uni-konstanz.de/b/han-yta-pcy>

About you

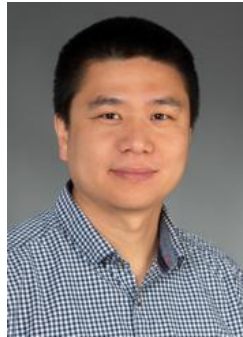
- What is your study background?
- Have you learnt some statistics/machine learning/computer vision courses before?
- Any programming experience (Python, C++, etc.)
- Any special interests in Machine Learning?

MMSP group



Prof. Dr. Dietmar Saupe

With teaching duties:



Dr. Hanhe Lin

With no teaching duties:



Dr. Vlad Hosu



Oliver Wiedemann



Hui Men

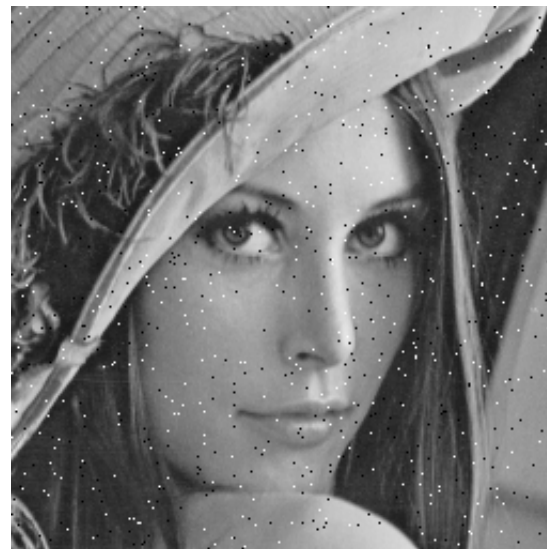
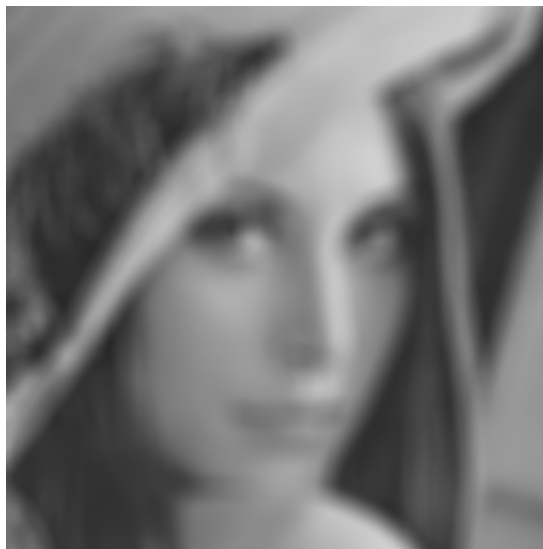
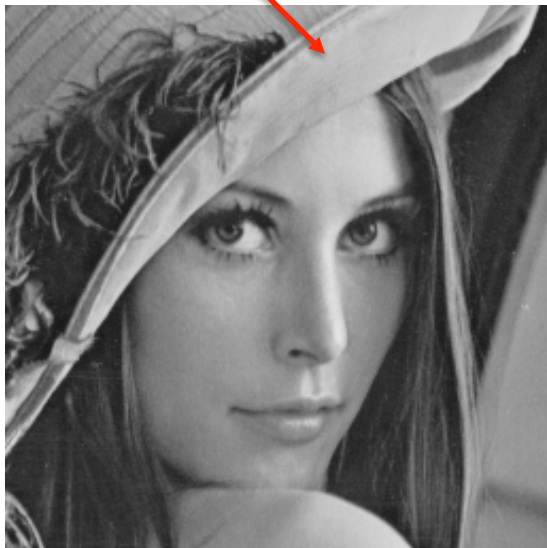
Current research projects

- VQA: visual quality assessment
- Powerbike: performance parameters in road cycling, simulation and data analysis



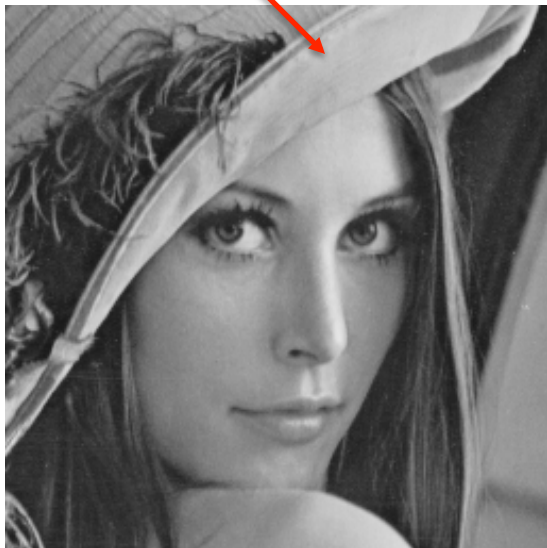
Motivation

Original image



Motivation

Original image



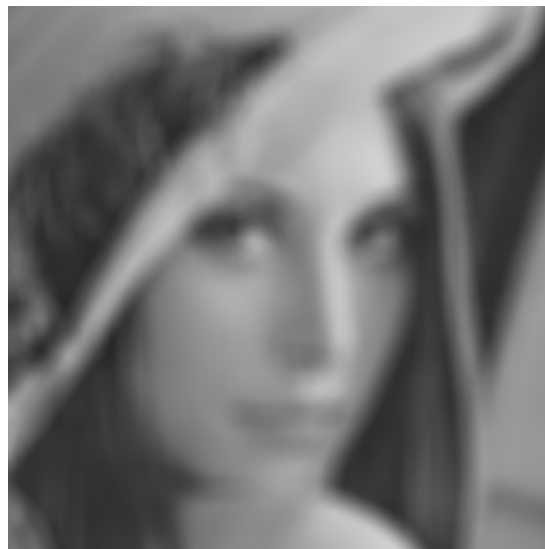
MSE=225



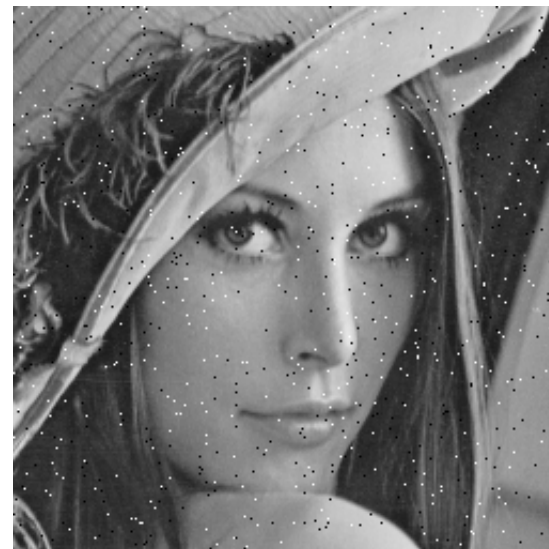
MSE=225



MSE=225



MSE=225



MSE=225

Perceptual Image Processing

Why?

Standard measure (MSE) does not agree with human visual perception



PERCEPTUAL IMAGE PROCESSING



Define Perceptual
IQA Measures



Optimize IP Systems &
Algorithms “Perceptually”



Application Scope: essentially all IP applications

image/video compression, restoration, enhancement,
watermarking, displaying, printing ...

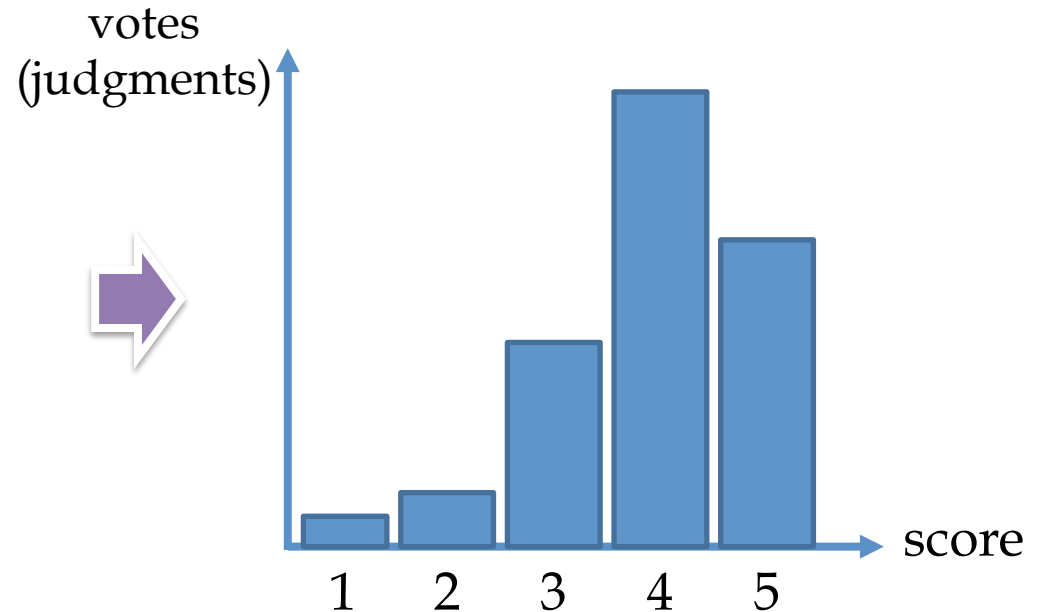
Quantifying image quality



What is the technical quality of the image? (required)

Bad	Poor	Fair	Good	Excellent
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1	2	3	4	5

Collecting subjective ratings

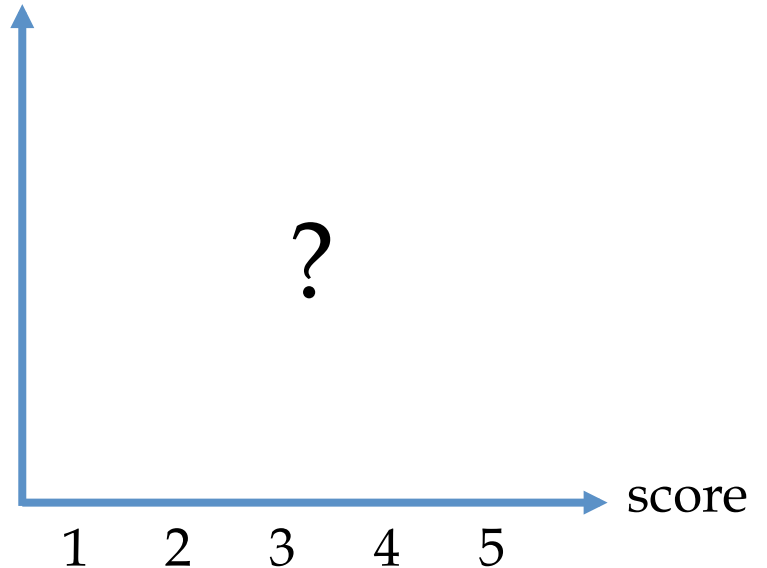


Mean opinion score (MOS) = 4.1

Learning task



votes
(judgments)



Mean opinion score (MOS) = ?

IQA



Given image



What is the image quality?

Subjective



IQA methods

Objective

IQA



Given image



What is the image quality?

Subjective



IQA methods

Objective



Ground-truth
IQA database?

Subjective IQA study

- Conventional way: lab study



Time-consuming and expensive!

Subjective IQA

- Our solution: crowdsourcing study



Convenient and cheap, but less reliable!

Current available Ba+Ma projects on VQA

- Eye-tracking just noticeable differences
- Perceptually guided image enhancement
- Removing biases from subjective quality scores
- Adaptive sampling techniques for scale value reconstruction
- Machine learning on VQA

Course details

- 2+2, 6 ECTS
- Lecture: Wed. 13:30 – 15:00 (13 weeks)
- Exercise: Fri. 13:30 – 15:00 (13 weeks)
- Topics:
 - Linear regression
 - Logistic regression
 - Support vector machine
 - Neural networks
 - Dimensionality reduction
 - Clustering
 - Anomaly detection

Course details (cont.)

- Grading
 - Practical participation (20%)
 - Presentation of your project (30%)
 - Report containing technical details (50%)

Practical

- Goal:
 - Participation of lecture and exercise sessions
 - Discussion of exercises
 - Discussion of open questions
 - Requirement for project participation
- Exercise
 - 4 programming + 4 exercise sheets
 - Hand out every week
 - Hand over on individual basis
 - Hand over through ILIAS before deadline
 - Minimum requirement needed to participate in final project

Presentation & Report

- Content in presentation
 - Motivation
 - Data collection and analysis
 - Designed framework
 - 30 minutes talk plus 10 minutes Q & A
- Content in report
 - The implemented detail of your framework
 - Experimental result
 - Up to 4 pages including references

Project

- (Generally) Team of up to 2 students
- Presentation date: TBD
- Report deadline: TBD
- Example topics from previous years:
 - Predicting Changes in Conflict in a Country Using Socioeconomic Data
 - Human Step Recognition Using Smartphone Sensor Data
 - Predicting the speed and movement direction of a vehicle

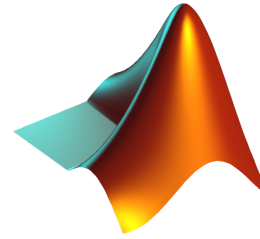
Other information

- Exam:
 - No exam
 - But do register on ZEuS
- Practical:
 - Please DO NOT plagiarize
 - Do discuss approaches to problems
- Reading materials:
 - Publish on ILIAS

Literature

- Christopher Bishop. Pattern recognition and machine learning. Springer.
- Ethem Alpaydin. Introduction to machine learning. MIT press.
- Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep learning. MIT press.

MATLAB



- MATLAB is a multi-paradigm programming language and numerical computing environment.
- University of Konstanz is a member of the state-wide MATLAB agreement, you can use it for free.

Learning objective

- You will
 - Have an insight of the fundamentals of Machine Learning
 - Have the ability to design your own machine learning algorithm to solve some specific problems with MATLAB
 - Know how to improve your model using training data

What is Machine Learning?

Introduction

- Machine Learning
 - Grew out of work in AI
 - An interdisciplinary research, e.g., statistics, biology, ...
 - New capability for computers
 - Machine learning is everywhere
- Examples:
 - Face detection/recognition, image analysis, self-driving car, AlphaGo, ...

Machine Learning Definition

- Field of study that gives computers the ability to learn without being explicitly programmed (Arthur Samuel, 1959).
- Well-posed Learning Problem: A computer program is said to learn from experience E with respect to some task T and some performance measure P , if its performance on T , as measured by P , improves with experience E (Tom Mitchell, 1998).

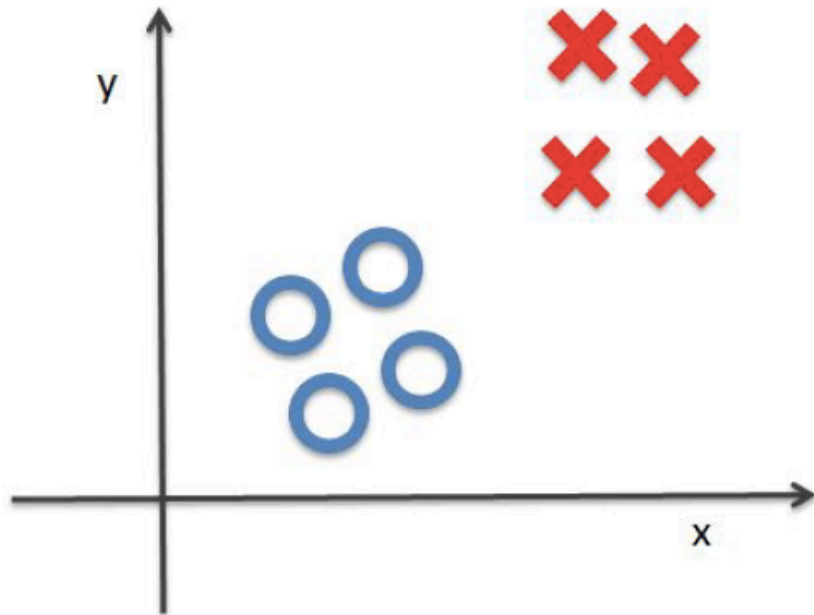
Question

- Suppose your email program watches which emails you do or do not mark as spam, and based on that learns how to better filter spam. What is its experience E , task T , and performance P ?
 - Classifying emails as spam or not spam
 - Watching your labeled emails as spam or not spam
 - The number of emails correctly classified as spam/not spam

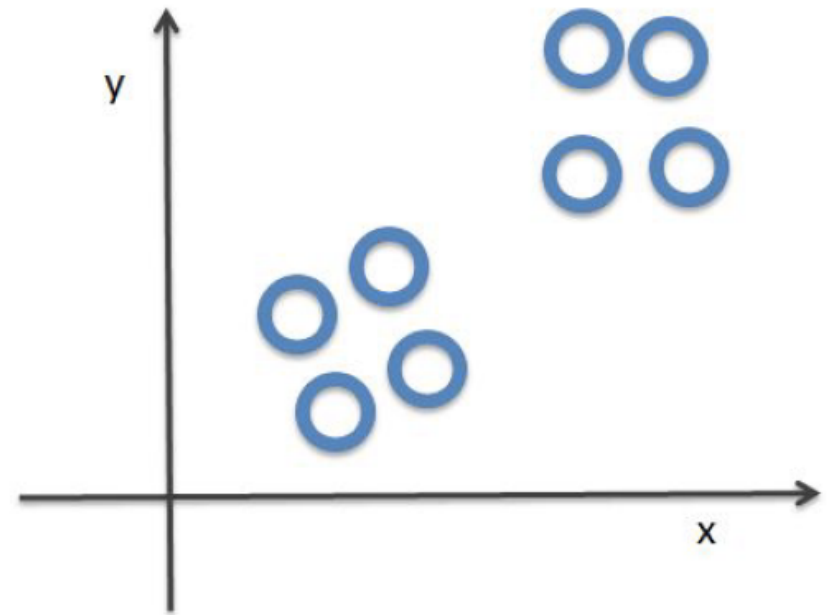
Question

- Suppose your email program watches which emails you do or do not mark as spam, and based on that learns how to better filter spam. What is its experience E , task T , and performance P ?
 - Classifying emails as spam or not spam T
 - Watching your labeled emails as spam or not spam E
 - The number of emails correctly classified as spam/not spam P

Supervised learning vs. Unsupervised learning



Supervised learning



Unsupervised learning

Supervised learning

- Right answers, or ground truth, are given.
- Two kinds in terms of outputs:
 - Regression: predict continuous valued output
 - Classification: predict discrete valued output
- Applications: face recognition, object detection, ...

Question

- You're running a company, and you want to develop learning algorithms to address each of two problems.
 - Problem 1: you have a large inventory of identical items. You want to predict how many of these items will sell over the next 3 months.
 - Problem 2: you'd like software to examine individual customer accounts, and for each account decide if it has been hacked/compromised.

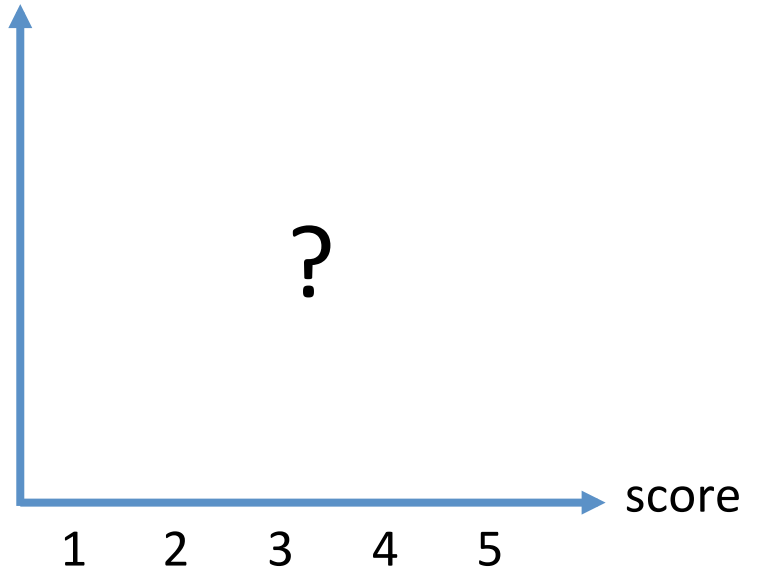
Question

- You're running a company, and you want to develop learning algorithms to address each of two problems.
 - Problem 1: you have a large inventory of identical items. You want to predict how many of these items will sell over the next 3 months. **Regression**
 - Problem 2: you'd like software to examine individual customer accounts, and for each account decide if it has been hacked/compromised. **Classification**

IQA: regression or classification?



votes
(judgments)



Mean opinion score (MOS) = ?

IQA: regression or classification?

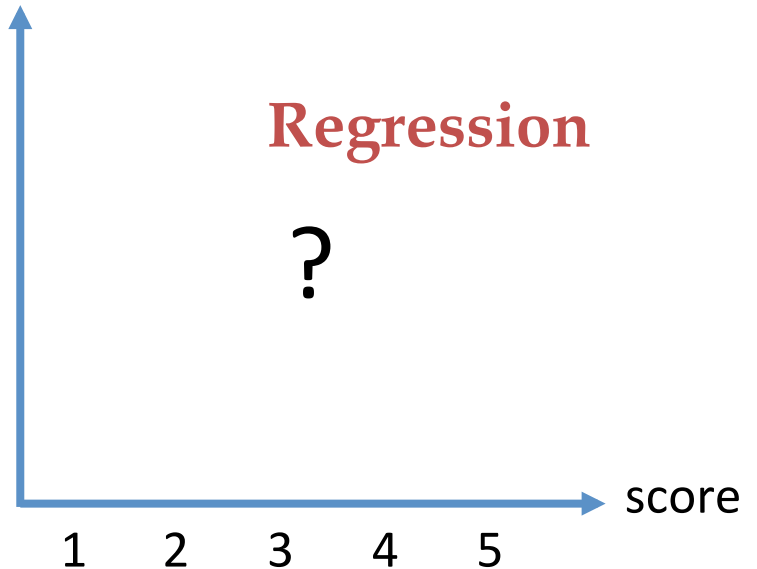


votes
(judgments)



Regression

?



Mean opinion score (MOS) = ?

Unsupervised learning

- We can't give right answer to all data as the data increase exponentially with the development of technology
- Unsupervised learning is proposed to handle the unlabeled data.
- Examples: Google, Facebook,...

Question

- Which would you address using an unsupervised learning algorithm?
 - Given email labeled as spam/not spam, learn a spam filter.
 - Given a set of news articles found on the web, group them into set of articles about the same story.
 - Given a database of customer data, automatically discover market segments and group customers into different market segments.
 - Given a dataset of patients diagnosed as either having diabetes or not, learn to classify new patients as having diabetes or not.

Question

- Which would you address using an unsupervised learning algorithm?
 - Given email labeled as spam/not spam, learn a spam filter.
 - Given a set of news articles found on the web, group them into set of articles about the same story. **Unsupervised**
 - Given a database of customer data, automatically discover market segments and group customers into different market segments. **Unsupervised**
 - Given a dataset of patients diagnosed as either having diabetes or not, learn to classify new patients as having diabetes or not.

Machine Learning algorithms

- Supervised learning
 - Linear regression
 - Logistic regression
 - Neural network
 - Support vector machine
 - ...
- Unsupervised learning
 - K-means
 - Gaussian mixture models
 - PCA
 - ...