

Artificial Intelligence

Algorithms and Applications with Python

Syllabus



TECHNISCHE
UNIVERSITÄT
DARMSTADT

WIRTSCHAFTS
INFORMATIK



AIAA 1 + 2




Dr. Dominik Jung
dominik.jung42@gmail.com




Syllabus

01



Introduction into Artificial Intelligence

02




Problem-Solving Agents

03




Introduction into AI-Programming with Python

04



Data and Knowledge Engineering

05



Knowledge Reasoning Fundamental Algorithms & Concepts

06




Machine Learning Fundamental Algorithms & Concepts

Workbook Exercises

Code Lectorial
Python


Workbook & Coding Exercises

07




Model Optimization and Selection

08




Artificial Intelligence on Big Data

09



Artificial Neural Networks and Deep Learning

10



Stochastic Modeling and Optimization

11



Building Productive AI-based Information Systems

TU Darmstadt:

Live Coding Sessions

Consultation Hours

Capstone

Workbook & Coding Exercises

Image sources: ↗ [Pixabay](#) (2019) / ↗ [CC0](#)

Exam Structure (preliminary!)

1/3

BASIC CONCEPTS AND THEORETICAL BACKGROUND

- You will have to answer multiple questions related to basic definitions and concepts of the lecture.

1/3

APPLYING THEORY TO PRACTICE

- You will have to show that you understand the algorithms and concepts and that you can use them to solve a business problem.

1/3

PROGRAMMING

- You will have to write, read and understand code examples in the context of business analytics problems.
- Use the exercises and the code examples to prepare!

Note: It may be possible that the point distribution differs in the final exam

Which Content is Relevant for the Exam?

Outline

2 Artificial Intelligence and Information Systems

2.1 Artificial Intelligence Project Management

2.2 Artificial Intelligence Project Lifecycle

2.3 Skills and Roles in Artificial Intelligence Projects

2.4 Types of Artificial Intelligence based Information Systems

► What we will learn:

- How typical AI projects are implemented, and how their life cycle and phases look like
- What skills are needed to implement an AI project
- Why the industry needs AI specialists, and how typical AI jobs look like
- Which types of AI based information systems exists and how they can be used to solve real-world problems



Image source: [Pixabay](#) (2019) / [CC0](#)

► Duration:

- 120 min

► Relevant for Exam:

- 2.1-2.4

Artificial Intelligence: Building AI-Based Information Systems with Python - Dr. Dominik Jung

Exam relevant

- Lecture slides and exercises
- All literature downloads available in GIT (folder literature)
- The referred literature for the business cases in literature
- Teaching material accompanying this lecture (e.g. code, guest lectures etc.)

Note: „the relevant for the exam“ information covers only the slides not the referred literature!

EXPERIENCE

- Today** Data Scientist, After-Sales, *Porsche AG*
- 2016-2019** Research Assistant, *Institute of Information Systems and Marketing (IISM) and Karlsruhe Decision & Design Lab (KD2 Lab), Karlsruhe*

EDUCATION

- 2016-2018** Dr. rer. pol., Business Informatics, *Karlsruhe Institute of Technology (KIT)*
- 2015-2018** M.Sc., Practical Computer Science, *University of Hagen*
- 2013-2015** M.Sc., Information Management and Engineering, *Karlsruhe Institute of Technology (KIT)*
- 2009-2013** B.Sc., Media Economics & B.A., Applied Media and Communication Studies, *Ilmenau University of Technology*

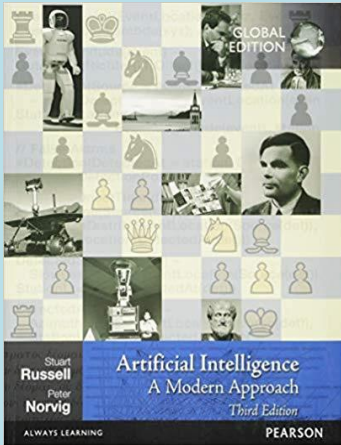
RESEARCH INTERESTS

- Decision Support Systems (e.g. *Robo-Advisors, BPM, Dashboards*)
- Modeling and Analyzing User Behavior with R / Python



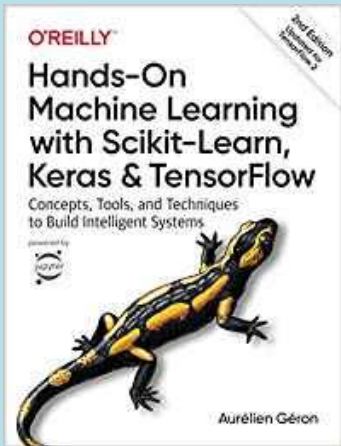
Further Questions?

Please send me an email at dominik.jung42@gmail.com



Russell, S., & Norvig, P. (2016). *Artificial Intelligence: A Modern Approach*. Global Edition.

► Availability: ↗[University Library Darmstadt](#) | ↗[Amazon](#)

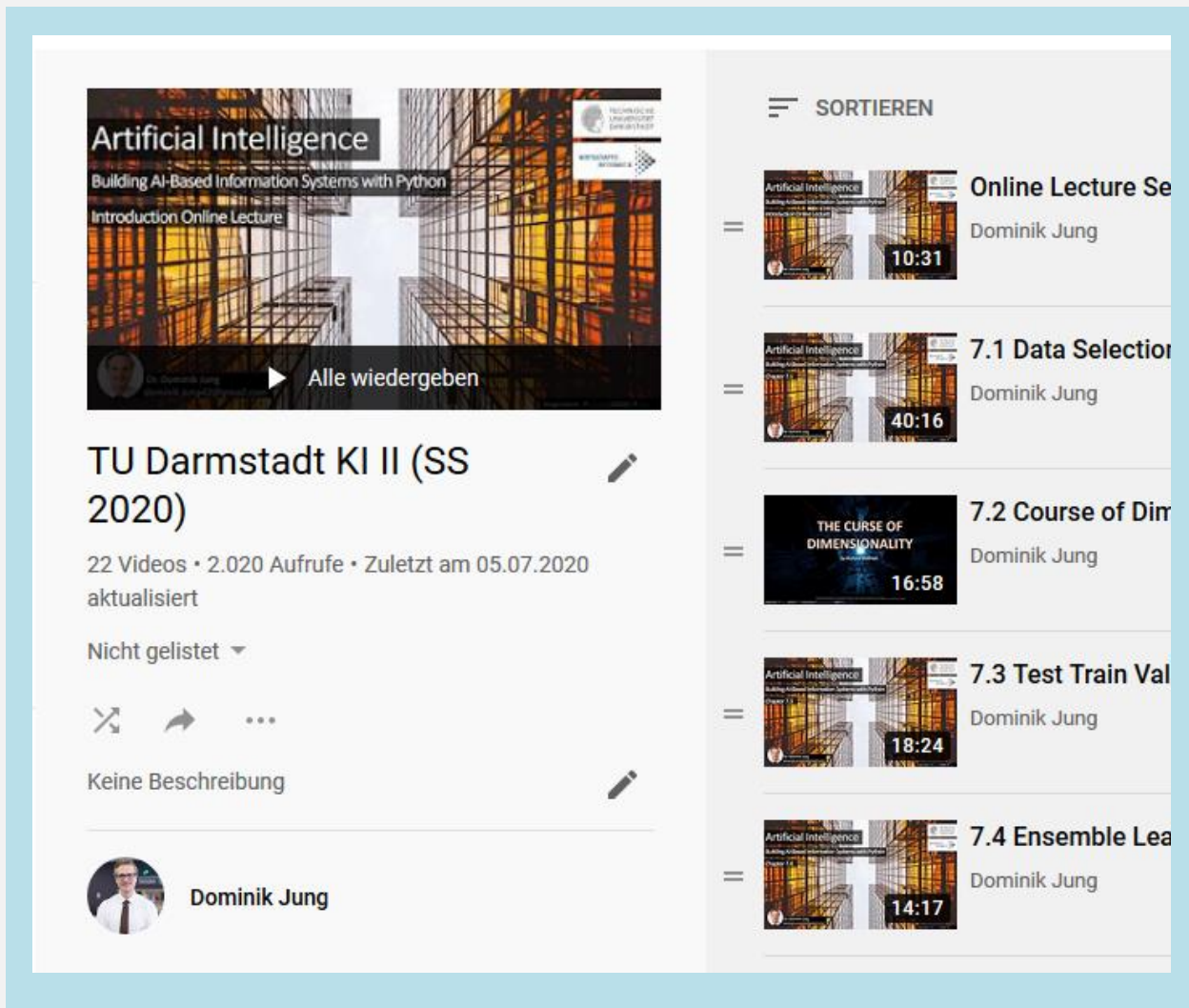


Géron, A. (2017). *Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems*.

► Availability: ↗[University Library Darmstadt](#) | ↗[Amazon](#)

Contact	Description	Distribution
Exam <i>Dr. Dominik Jung</i>	There will be a 60 minutes closed-book/closed-notes exam consisting of short-answer, and analytical questions covering all course material! One third will be general questions, one third related to tools, and the last third will be an overarching case.	60 %
Capstone Project <i>Timo Sturm</i>	Each participant is expected to join a team of max. 4 students to analyze and work on a capstone project. Results should be delivered in a document. Further information will be presented at the capstone introduction.	40 %

- Both elements need to be passed (grade 4.0 or better): Failing (i.e., grade 5.0) the (1) Exam, or the (2) Case Study, or (3) the Exam and the Case Study, results in failing the entire course.
- There is no retake possibility for the Capstone project. Thus, if you fail the Capstone project, you need to retake the course next year!



The screenshot shows a YouTube playlist titled 'Artificial Intelligence: Building AI-Based Information Systems with Python' by Dominik Jung. The playlist includes an introduction lecture and several chapters on data selection, dimensionality, and ensemble learning. The video player shows the 'Introduction Online Lecture' with a duration of 10:31. The playlist list on the right shows the following videos:

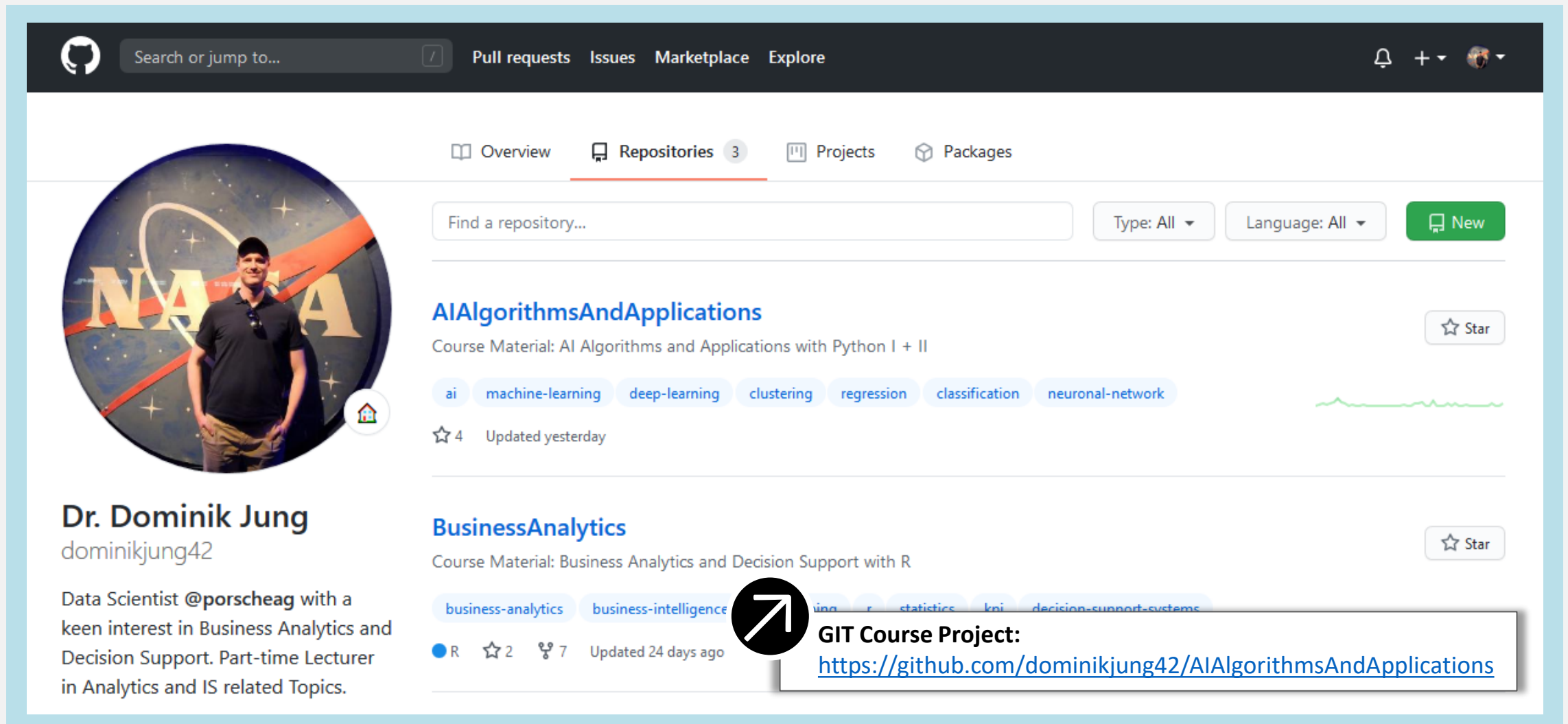
- Online Lecture Se (Dominik Jung, 10:31)
- 7.1 Data Selection (Dominik Jung, 40:16)
- 7.2 Course of Dim (Dominik Jung, 16:58)
- 7.3 Test Train Val (Dominik Jung, 18:24)
- 7.4 Ensemble Lea (Dominik Jung, 14:17)

COVID19 Online Lecture Setup

- Lecture slides and exercises will be online available at Youtube
- Teaching material accompanying this lecture and all literature downloads and course material will be available in GIT
- Please feel free to comment the videos to solve the class room tasks



Youtube: [TU Darmstadt KI I+II \(WS 2020, SS 2021\)](#)



The screenshot shows the GitHub profile of Dr. Dominik Jung. The profile includes a circular avatar with a NASA logo, a bio identifying him as a Data Scientist and Lecturer, and a list of repositories. The 'Repositories' tab is active, showing two repositories: 'AIAgorithmsAndApplications' and 'BusinessAnalytics'. A callout box points to the first repository with the text 'GIT Course Project:' and a URL.

Dr. Dominik Jung
dominikjung42

Data Scientist @porscheag with a keen interest in Business Analytics and Decision Support. Part-time Lecturer in Analytics and IS related Topics.

AIAgorithmsAndApplications
Course Material: AI Algorithms and Applications with Python I + II

ai machine-learning deep-learning clustering regression classification neuronal-network

☆ 4 Updated yesterday

BusinessAnalytics
Course Material: Business Analytics and Decision Support with R

business-analytics business-intelligence ... statistics kni decision-support-systems

● R ☆ 2 🔗 7 Updated 24 days ago

GIT Course Project:
<https://github.com/dominikjung42/AIAgorithmsAndApplications>



Please install

- Anaconda: <https://www.anaconda.com/distribution>
- GIT: <https://git-scm.com/downloads> | <https://gitforwindows.org>

until **next** lecture.

You will need them to solve the exercises in this course!



All tools of this course are available
for Linux, Windows and Apple!



Anaconda 2019.07 for Windows Installer

Python 3.7 version

Download

64-Bit Graphical Installer (486 MB)

32-Bit Graphical Installer (418 MB)

Python 2.7 version

Download

64-Bit Graphical Installer (427 MB)

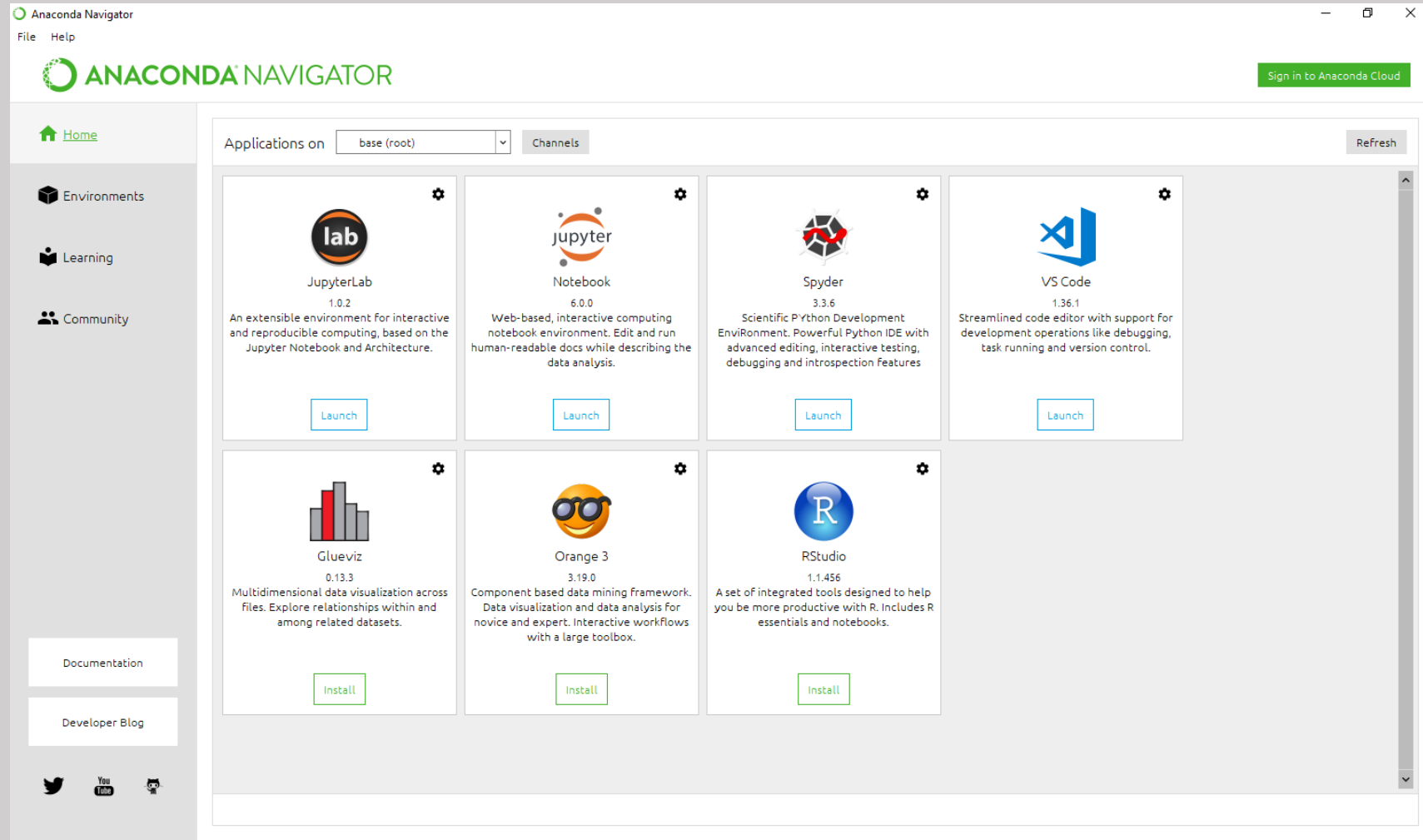
32-Bit Graphical Installer (361 MB)



Anaconda Platform:

<https://www.anaconda.com/distribution>

Setup Anaconda





git

Search entire site...

About
Documentation
Downloads
GUI Clients
Logos
Community

The entire **Pro Git book** written by Scott Chacon and Ben Straub is available to [read online for free](#). Dead tree versions are available on [Amazon.com](#).

Downloads

Mac OS X Windows Linux/Unix

Older releases are available and the [Git source repository](#) is on GitHub.

Latest source Release
2.23.0
[Release Notes](#) (2019-08-16)
[Download Source Code](#)

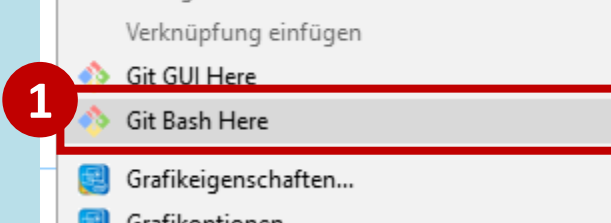
GUI Clients
Git comes with built-in GUI tools ([git-gui](#), ...)

Logos
Various Git logos in ...

Git:
<https://git-scm.com/downloads>

Setup GIT - Download the Course Material

Console

- Register @git
- Make a new folder and make a right-click, choose "Git Bash Here"

- Run the following lines of code in your Git Bash to setup your repository

```
git init
git config --global user.name "YOUR NAME"
git config --global user.email "YOUR EMAIL"
git clone "https://github.com/dominikjung42/AIAlgorithmsAndApplications.git"
```

- During the course, run the following lines of code to update your repository

```
git pull origin master
```



No reason to panic! If you have trouble contact me, I will help you to setup your repository!

Teaching Material Icons



Important note



Definition



Referenced package/library



Referenced handout



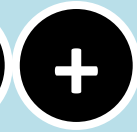
Information about self-studying or other lectures (not explicitly exam relevant if not said otherwise)



Classroom question or task



Problem / Solution



Pro / Contra



Weblink or external resource

Types of Tasks and Exercises

Classroom Task



Classroom task

Your turn!

Task Please use the `str()` function to investigate the `cars` dataset. How many rows and columns does it have. Use the `isnumeric` function, if you are not sure how to use the commands.

Task Please, try to retrieve the following values from the `cars` dataset:

- Return observations where the speed is bigger than 20
- Exclude observations 10-13 from the dataset
- Return only observations with speed bigger than 10 and smaller than 20

Decision Support Systems and Business Analytics
with R by Dominik Jung

- Short tasks, workload should be about 5 minutes
- Solved during lecture
- Use it for exam preparation

Classroom Case



Business Case

Task The *Junglvet Whisky Company* is interested in the geographical and spatial distribution of the Whisky market in Scotland. They plan to put the new 10 years Junglvet on the market. He is very body and smoky. For that purpose cluster the whiskies and find the most body and smoky group of whiskies. And plot them with ggplot on a map of Scotland to support the marketing and sales team. Try to structure your work according to the process model from the lecture. Before you build the cluster, try to understand the data. Please take a look if it is true that the most smoky and body Whisky distilleries are from Islay. Use the `whiskies.csv` file for your analysis.

Decision Support Systems and Business Analytics
with R by Dominik Jung

- Simplified, real-world business-problems and cases
- Workload between 30-60 minutes
- Read and Discuss
- Use it to deepen your applied skills

Challenge



Case Challenge

Case The sinking of the RMS Titanic is one of the most infamous shipwrecks in history. On April 15, 1912, during her maiden voyage, the Titanic sank after colliding with an iceberg, killing 1502 out of 2204 passengers and crew. This sensational tragedy shocked the international community and led to better safety regulations for ships. One of the reasons that the shipwreck led to such loss of life was that there were not enough lifeboats for the passengers and crew. Although there was some element of luck involved in surviving the sinking, some groups of people were more likely to survive than others, such as women, children, and the upper-class. In this challenge, we ask you to complete the analysis of what sorts of people were likely to survive. In particular, we ask you to apply the tools of machine learning to predict which passengers survived the tragedy.

Spruce Cartoons

- General task with a wide focus on the different topics of the course
- Workload to pass is about 6-8 hours

Business Case



Business Case: Sentinel Program

01 Executive Summary
Virtual Case File for VCT with a software application developed by the FBI between 2000 and 2005. The project was not close to completion when it was officially abandoned in January 2005, having turned into a complete mess for the FBI. In addition to wasting at least \$100 million, the Sentinel Program introduced numerous problems to the Bureau and its clients. Robert J. Mueller Jr. Finally, \$100 million dollars were wasted on the first two attempts of the project VCT + Sentinel with a similar end goal.

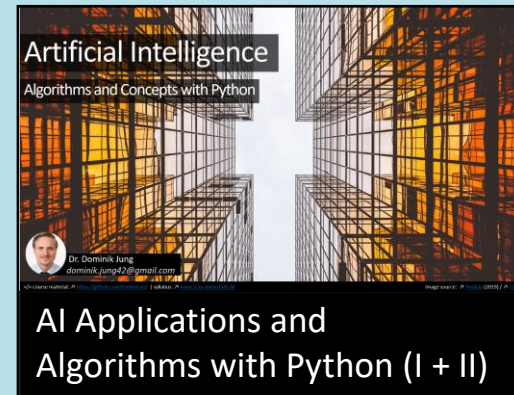
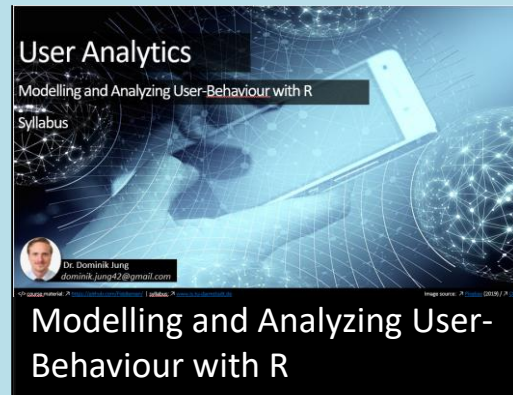
02 Solution
• Scrum Team was set up near the product owner in the basement of the Tower Building
• Staff reduced from 400 to 40, and in 1 year and 200 million, they were code complete. At a cost savings of more than 90 percent.

03 Introduction
• All project management gets things done
• Agile development is cheaper

Take Action

- Typical business case
- Discussed together

Data Science Lectures



Data Science Seminars



Check out my git repository for course material and more information!

Main literature

1. Rusell, S., & Norvig, P. (2016). *Artificial Intelligence: A Modern Approach*. Global Edition
2. Géron, A. (2017). *Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems*.

Further reading

- I strongly recommend to take a look at the free available online version of the *Pro Git book*, written by Scott Chacon and Ben Straub and published by Apress, it is available online as pdf, epub and mobi (↗ git-scm.com)
- *Rogerdudler Git Tutorial* (↗ <https://rogerdudler.github.io/git-guide/>) gives an excellent introduction for getting started with git and no deep shit ;)
- I also can recommend to take a look at the GIT guide from *kbroman* (↗ kbroman.org)