So you want to become a Data Scientist?

Lecture 1

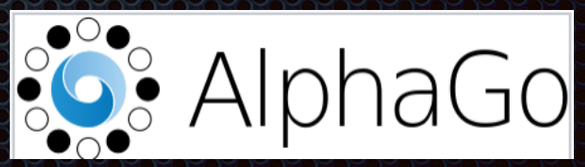
Sep 9, 2020

What is data science?

- Data
  - Large scale
  - Structured v.s. unstructured
- Science
  - Scientific problem

A real example - AlphaGo

- Real world problem - playing Go
- What is the scientific problem?



"The most serious mistakes are not being made as a result of wrong answers. **The true dangerous thing is asking the wrong question.**"

–Peter Drucker

A simplified data project cycle

Scientific problem

Real world question/ problem

What data/ tools can help?

Problem solving

data generating system

Value

Extract

Understand

data

Data Scientists
Human in the loop

results data

Interpret

Engineer

data processin

Design

data mining,
exploratory data analysis,
machine learning,
statistical modeling

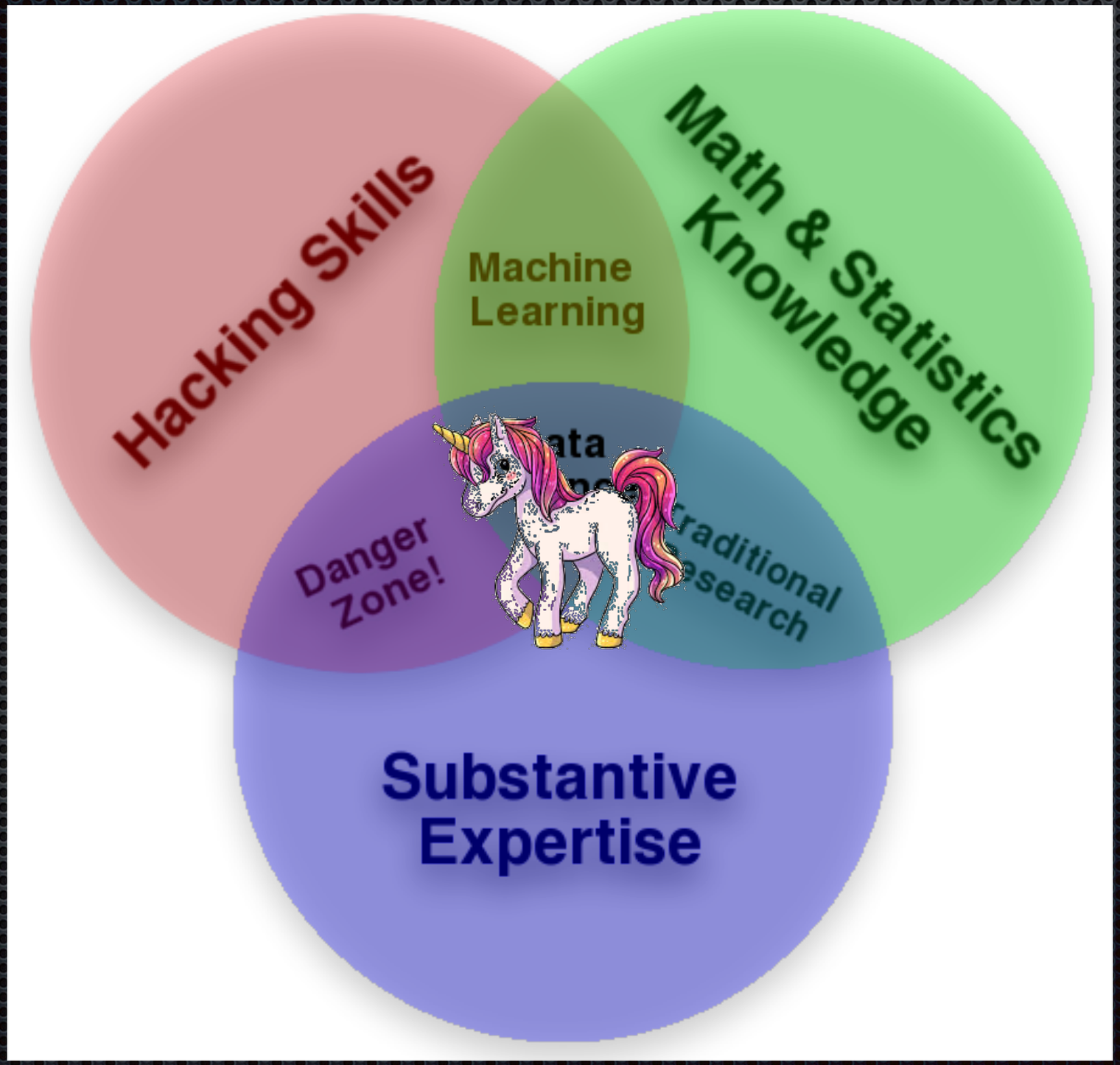
AlphaGo example continued

- What data/tools can help?
- What is the data generating mechanism?

Foundations of data science

- Data engineering
- Software engineering
- Machine learning
- Statistics

Three pillars of data science



Data Science Skill Set

- How to **think** about data versus problem:
  - Mathematics/Statistics/Machine Learning
- How to **handle** data
  - **Technologies: Python, Java, Hadoop, Spark, etc**
- Teamwork and collaboration skills - how to **work with others**.
- How to turn data into business intelligence:
  find **value** in your data
  - Innovation, intellectual curiosity
  - Problem-solving skills
- How to convince others about your data science results
  - Visualization, story telling
  - **Communication** skills

How to fail as a data scientist

- Focusing only on the solution
- Forgetting the basics
- Ineffectively communicating
- More at https://www.techrepublic.com/article/how-to-fail-as-a-data-scientist-3-common-mistakes/

How this course can help

- No formal instruction on statistics/machine learning topics.
- Not intended to be a comprehensive data science bootcamp.
- Project-based course. Learning by doing.

- Project-based learning
  - Problem identification via teamwork and discussion.
  - Problem solving by using existing skills or new skills, learn new things “on the job”, and learn from your peers.
  - Present your codes, your results and your story (try to sell them).
  - There will be things I cannot answer but let’s learn together.

“The course is extremely interesting and allows a very hands-on education in data science concepts. It was especially useful that the projects were deliverables, such that now I have a GitHub with projects I've completed for future employers and for my own reference. I enjoyed watching other groups present and hearing how they tackled similar problems. It was also a huge strength that the course gives students experience working in groups that have different people - this was an education in navigating people as much as technology!”

–Course evaluation

Stay Hungry. Stay Foolish.

-Steve Jobs

Project-Based Learning

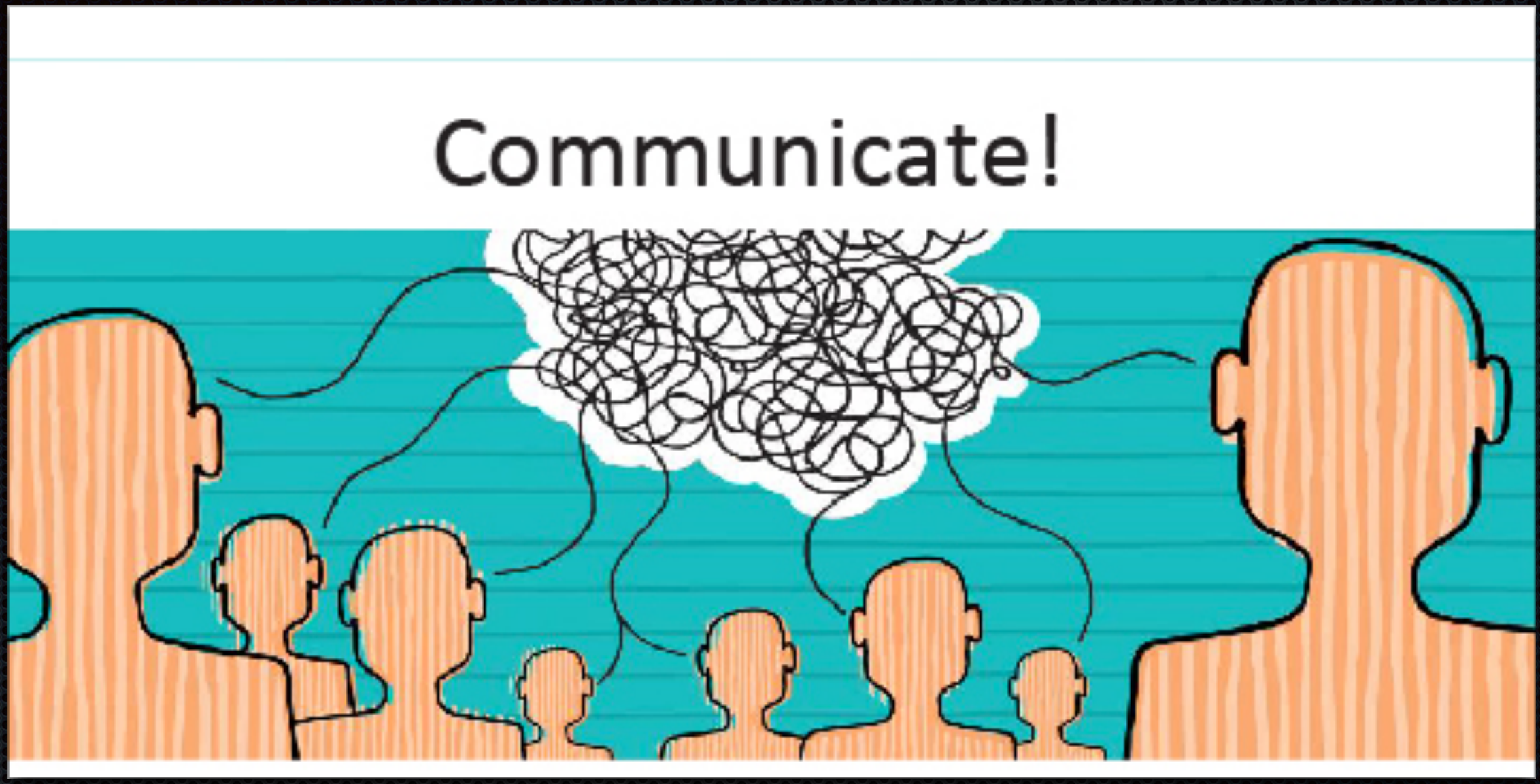
Project-Based Learning Integrating 21st Century Skills

Learning Objectives

- Become self-directed learners
- Develop problem-solving skills
- Teamwork skills: collaboration, reasoning and communication
- Self-assessment skills
- Presentation and critique skills
- “Initial stimulus” and experience for more fun in data science
- Try to become the master of your toolkit

Student-centered Approach

- I am not to lecture here but to facilitate active learning.
- I will design open-ended challenges, each of which focuses on a slightly different area in data science.
- In each challenge,
  - Start with information/knowledge we already have (maybe not you but your teammate) about the problem.
  - Identify knowledge/skills we need to solve the problem.
  - Articulate the above thinking process in a team and implement an inquiry as a team
- I will provide case studies and tutorials to provide guidance on aspects of the above processes.



Communication is everything

Channels of Communication

- During class time
  - Brainstorm
  - Ask questions during tutorial
- Before and after classes
- On Piazza (*show piazza*)
- If you have questions
  - Online Q&A (live or not)
  - Email

Group Projects

Working Together

- You don't have to be in the same room at the same time to work together.
- Here are several ways you will work together in this course
  - Face-to-face brainstorm
  - Online discussion in group forum
  - Online video chat (say, via Google Hangout) with screen share.
  - **GitHub collaboration**
- Learning is not a zero-sum game.

1 - What did you learn - in terms of knowledge, skills, or perspectives - in this course?The answer to this question will generally be available in Vergil.	
Response Rate	11/42 (26.19%)

• teamwork, implement algorithem or apply method from scratch.

• How to effectively complete technical work in teams; how to apply machine learning to practical problems

• It was different way of learning because I learn through each project different implementation approach. I got exposed to data exploration, shinny app development, predictive analytics (Supervised Learning) and algo evaluation.

• Rshiny, text mining, SGD, neural network

• cooperation, how to organize a data project, how to build R ShinyApp and how to tell story using data.

• data preprocessing, data ingegation, modeling

• Practical data analysis skills

• I learn a lot of hands-on experience about data analysis and machine learning.

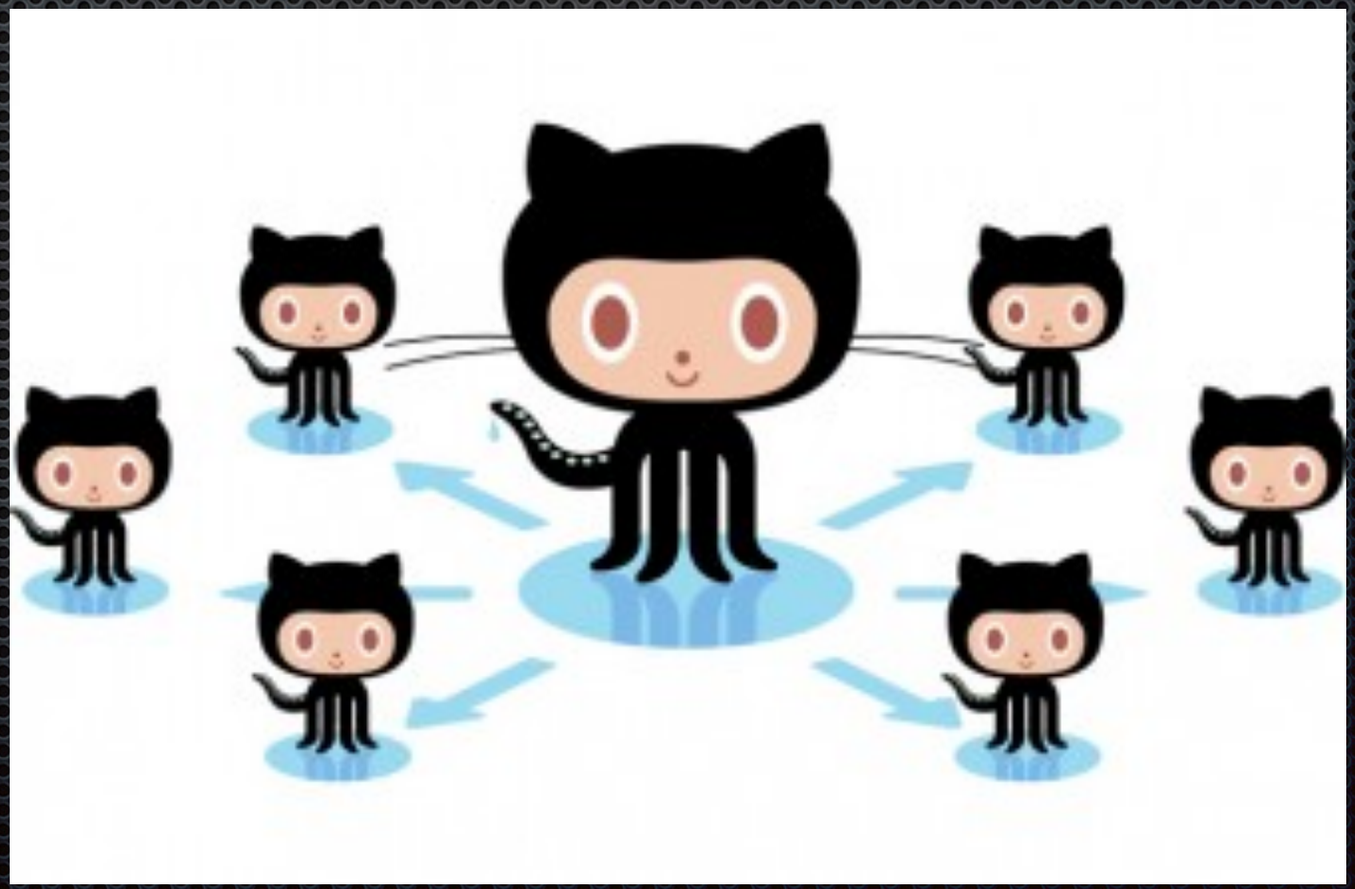
• machine-learning concepts and implementation method for various models

• This course allows students to experience completing real world data science projects. On top of learning technical data science skills, you learn how to work with a team, use time management, and how to present a data science project.

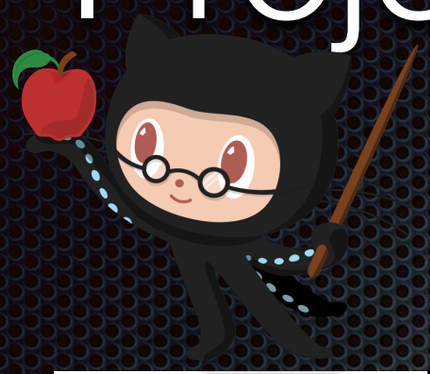
• Using R/Python for various data science topics such as prediction, classification, matrix factorization, making simple apps with R Shiny,etc

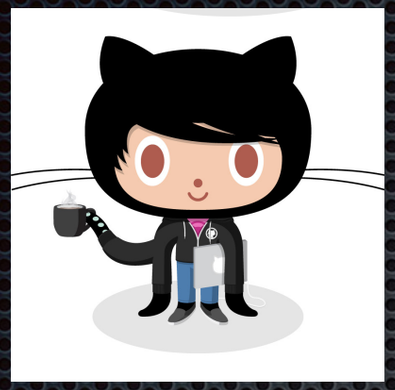
Learning on GitHUB

- This semester we will use Classroom for GitHub
- It allows the instructor to create parallel private repositories for groups to collaborate.



Project Assignment





starter repo → assignment → Invitation

private

starter repo

private

starter repo

Project Assignment

- Teacher creates starter code folder
- Teacher creates groups with group numbers (off GitHub)
- Teacher shares the group info with students (especially group number) on Piazza
- Teacher create assignments (private) and set the option for “new set of groups”
- Send invitation link to students with instruction
    - First, check whether your teammate already created a team for your group from the “Join an existing group”.
    - If you cannot find your group’s name (as assigned in the Excel name), please create the team using precisely the name specified in the Excel file.
- The Project name and membership can be managed later but the most important part is we get all the teams/groups set up automatically.
- Everyone from your team should install Git, GitHub Desktop and use Git with Rstudio.

Applied Data Science

Tutorial 1: reproducible data analysis

Improve Reproducibility

- Setup project folder
- Documentation
- Project history and source control

Project Setup

- Rstudio really makes it easy to keep track of a project.
  - First, identify a working folder.
  - Inside the working folder, create the following subfolders.
    - data: data used in the analysis. Read only
    - doc: the report or presentation files
    - figs: contains the figures. only contains generated files. Images used for report should be put in a separate image folder under doc.
    - lib: various files with function definitions and code.
    - output: analysis output, processed datasets, logs, or other processed things. only contains generated files.

Use knitr for reproducible data analysis

- knitr is an R package that processes R markdown files.
- An R markdown file follows the markdown syntax and contains R code blocks.
- An R markdown file can be “knitted” into either a html page or PDF document that reproduces a data analysis.
- It shows both the code *chunk*s and the results produced.
- One can also include seamlessly project discussion, method section (with LaTeX support) and results discussion.
- It should be viewed as a data analysis documentation, rather than a report though, as the analysis needs to presented in a chronological order.

DPLYR

- Data manipulation using five key verbs
  - filter
  - select
  - mutate
  - arrange
  - summarise
- along with "by group" adverb.

Now lets Look at Project 1