So you want to become a Data Scientist?

Lecture 1

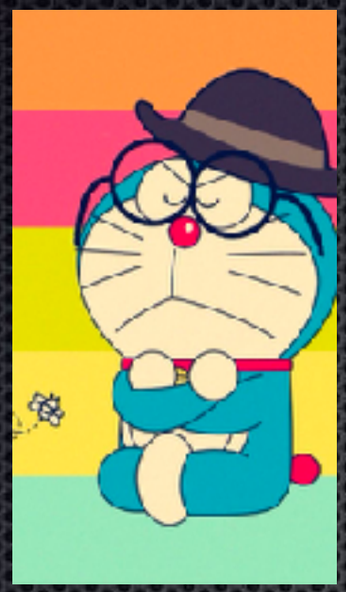
Sep 5, 2018

What is data science?

- Data Science represents a new approach to
  - Acquire knowledge,
  - Collect evidence,
  - Form decisions,
  - Make predictions.
- The end points are:

  knowledge, evidence, decisions and predictions.
- Driven by breakthroughs in technologies.
- Enabling faster solutions to traditional evidence-based practices.
- Creating solutions that would not be otherwise possible.

A simplified data project cycle



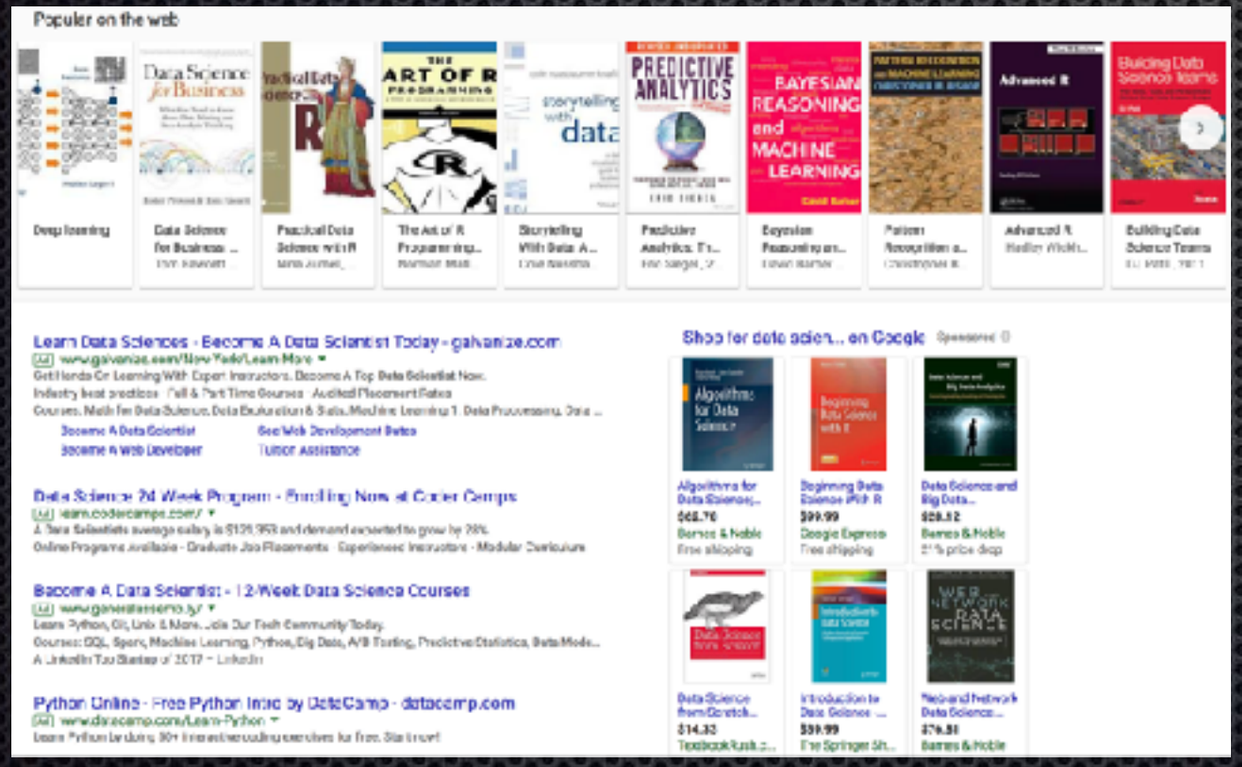
Real world question/ problem

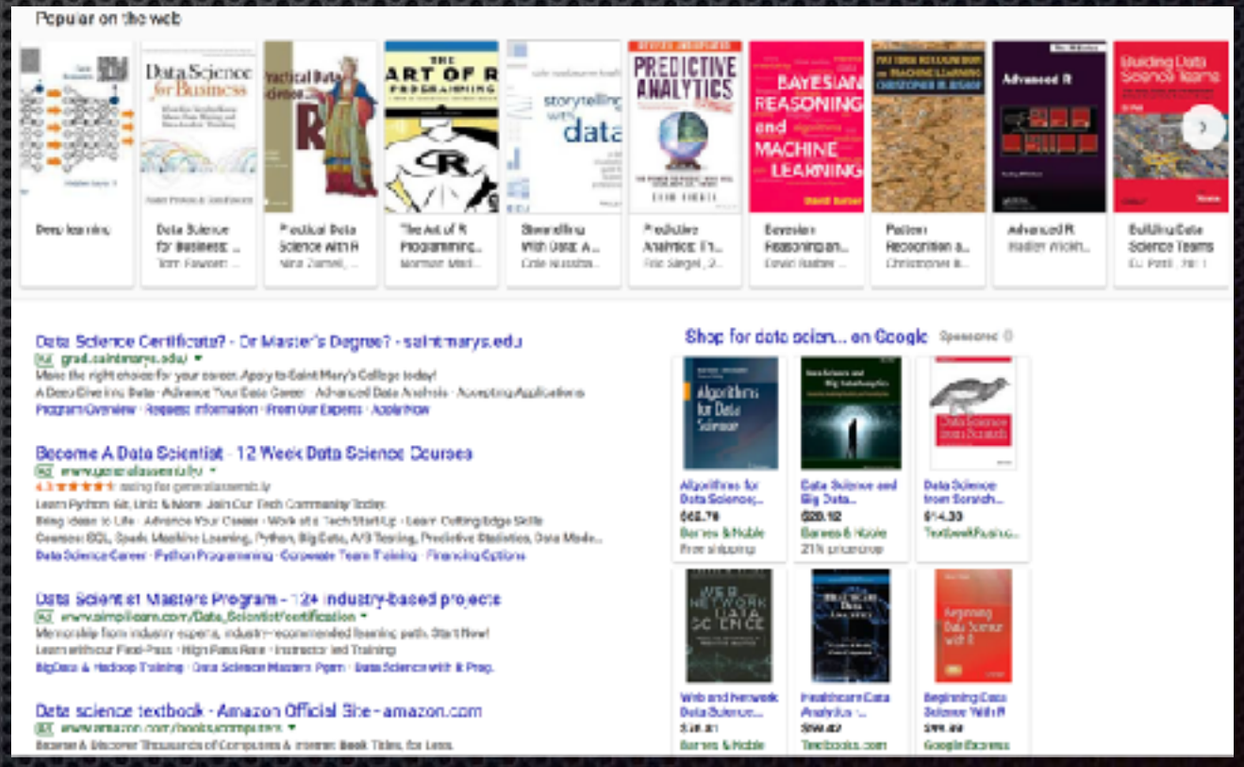
What data/ tools can help?

Problem solving

A real example - search evaluation

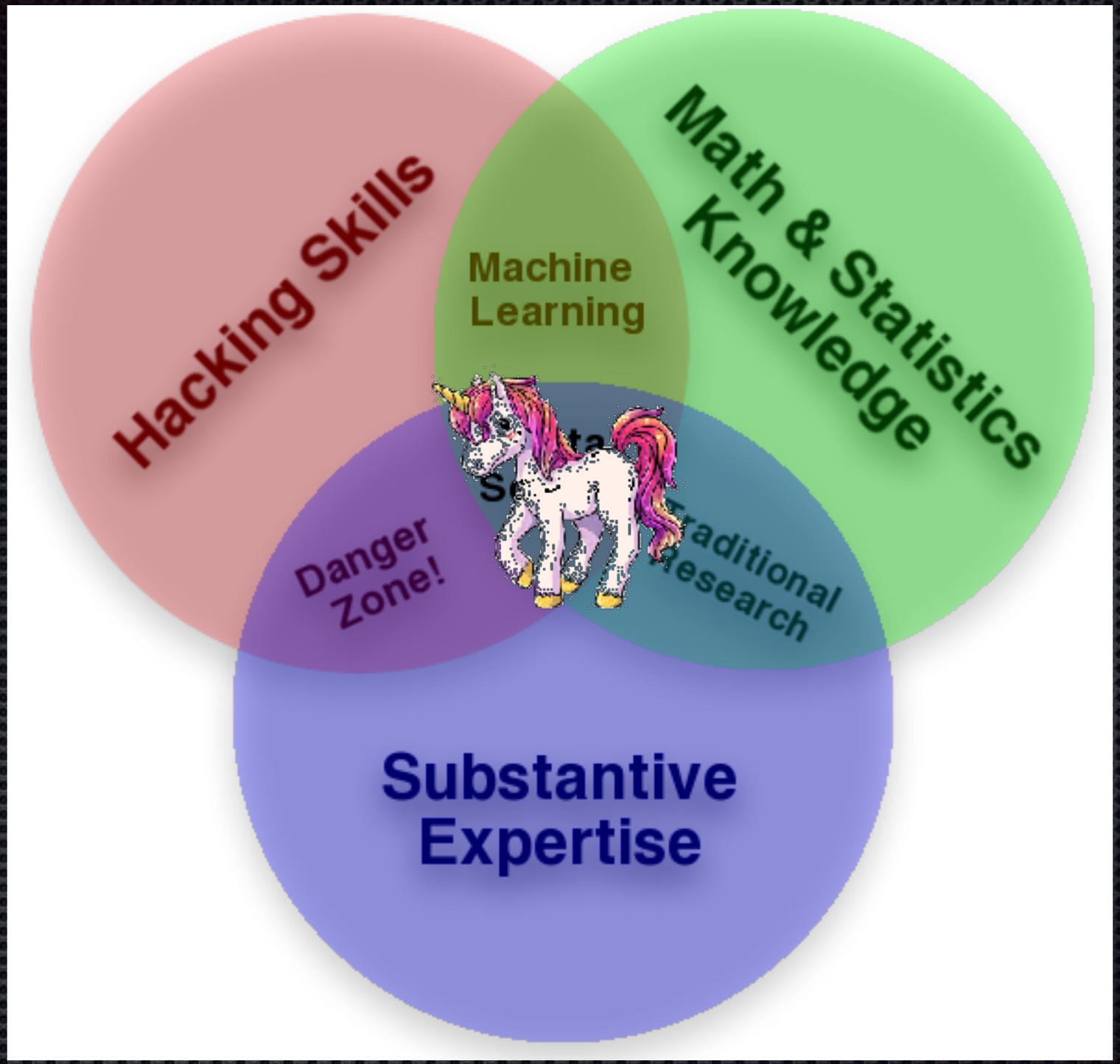
Search results from “data science textbooks”:





Foundations of data science

- Data engineering
- Software engineering
- Machine learning
- Statistics


Hacking Skills
Math & Statistics Knowledge
Machine Learning
Danger Zone!
Traditional Research
Substantive Expertise

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

data generating system

Value

Extract

Understand

data

Data Scientists
Human in the loop

results data

Interpret

Engineer

data processing

Design

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

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.

Stay Hungry. Stay Foolish.

-Steve Jobs

Project-Based Learning

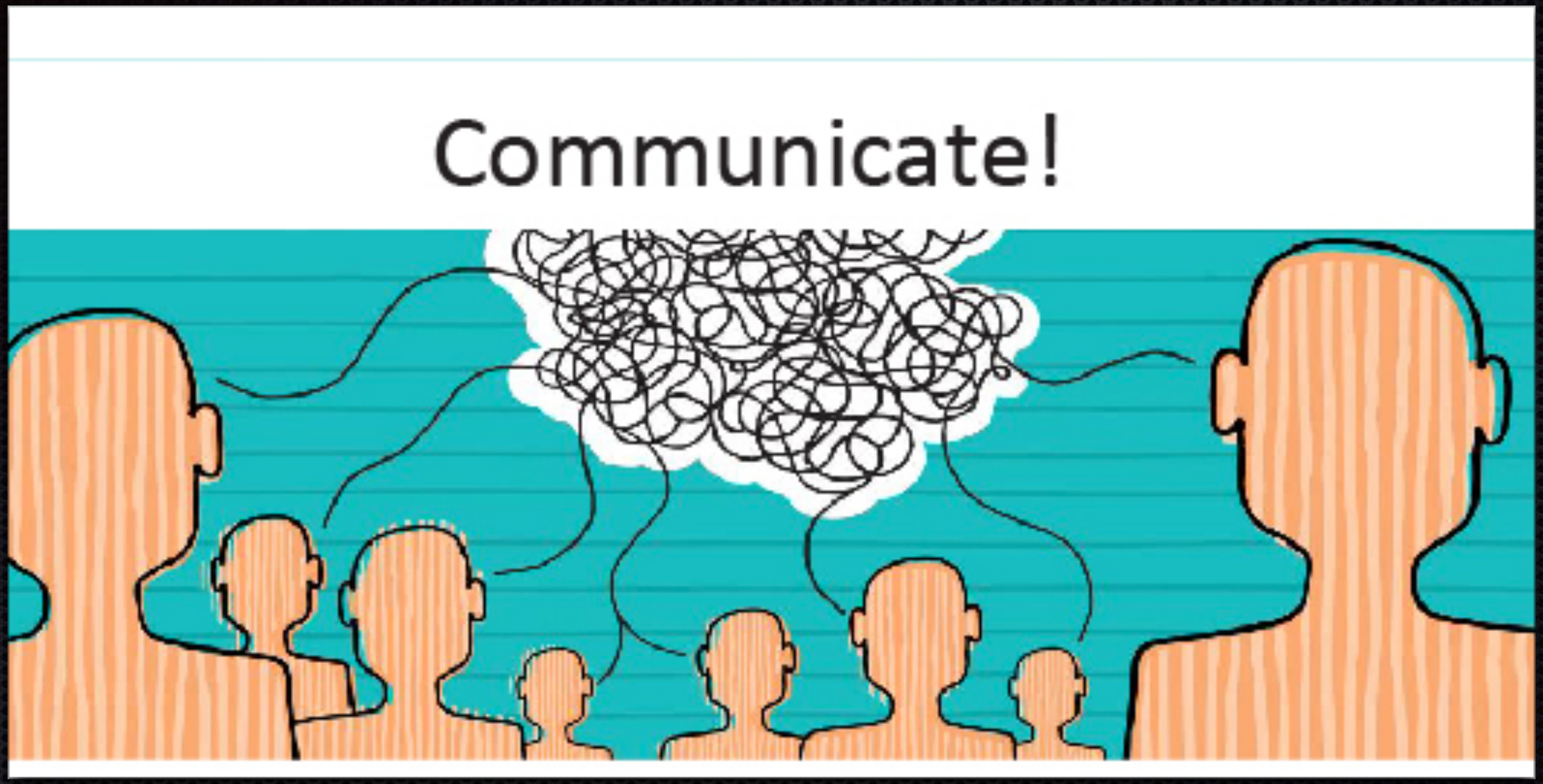
Project-Based Learning Integrating 21st Century Skills

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

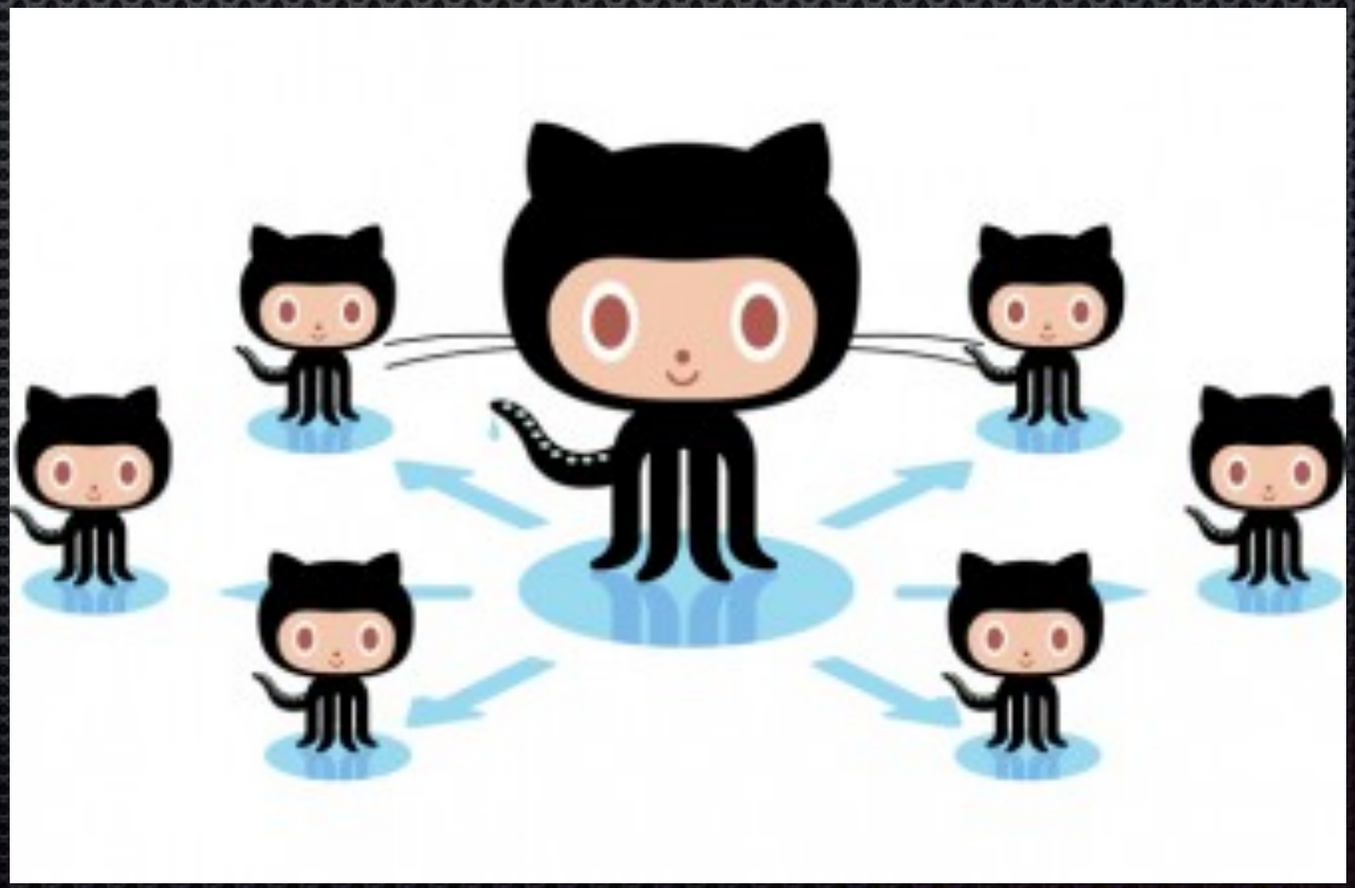
Group Projects

Working Together

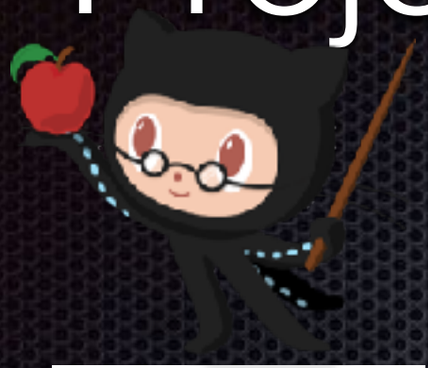
- You don't have to be in the same room at the same time to work together.
- Here are several ways you will work together in this course
  - Face-to-face brainstorm
  - Online discussion in group forum
  - Online video chat (say, via Google Hangout) with screen share.
  - **GitHub collaboration**
- Learning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

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 GiT for version control

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