AI Concepts, Python, and GitHub

Lecture Outline

- Fundamental Concepts
- Knowledge Representation
- Basics of Logic
  - Syllogistic Logic
- Overview of Reasoning
  - Deductive, Inductive, Abductive
- Learning Python Coding
- Coding Help
- Git and GitHub

Big Picture

- One of the hallmarks of intelligence is the ability to reason
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- Reasoning allows us to solve problems
- If we want to build intelligent machines, we must be able to automate reasoning
- Logic is the study of how we (correctly) reason
- Goals of Logic:
  - Represent knowledge of the world
  - Reason with that knowledge

Knowledge

- Definition of knowledge - ongoing debate among philosophers

- For our purposes, defined as:
  - Statements: Facts, information, descriptions
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- Simple enough, but:
  - Communicating?
  - Manipulating knowledge to draw conclusions and derive new knowledge?

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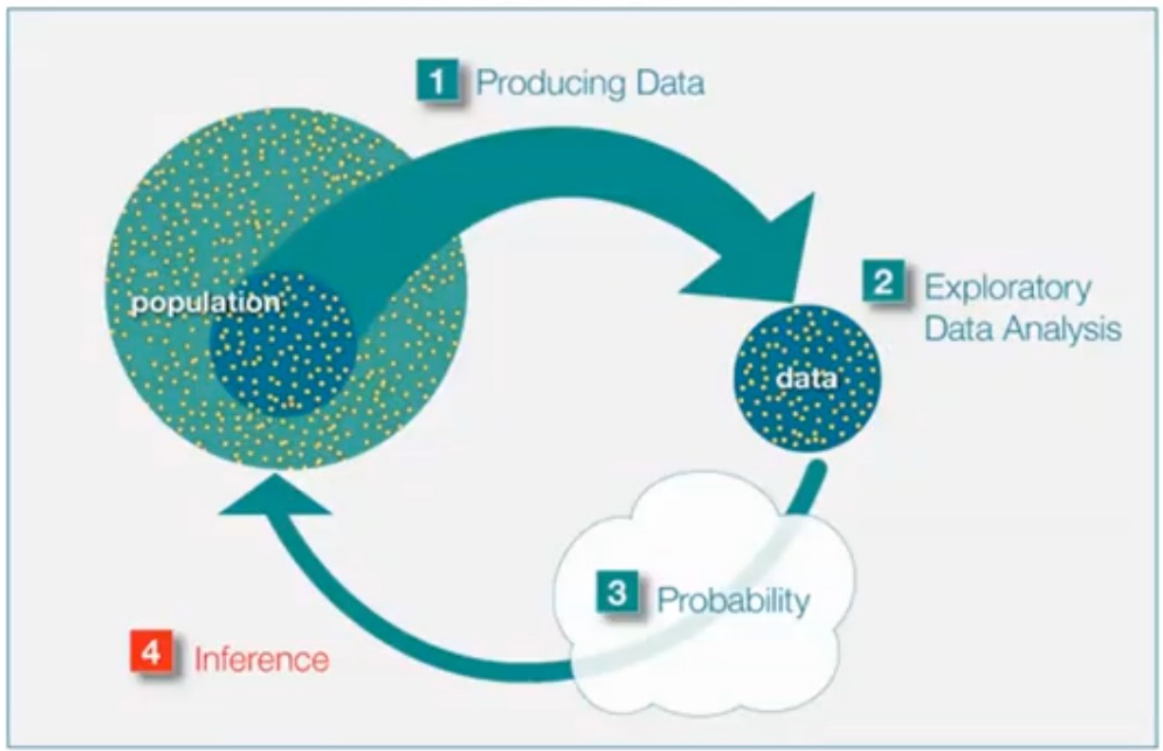
Statistical Inference



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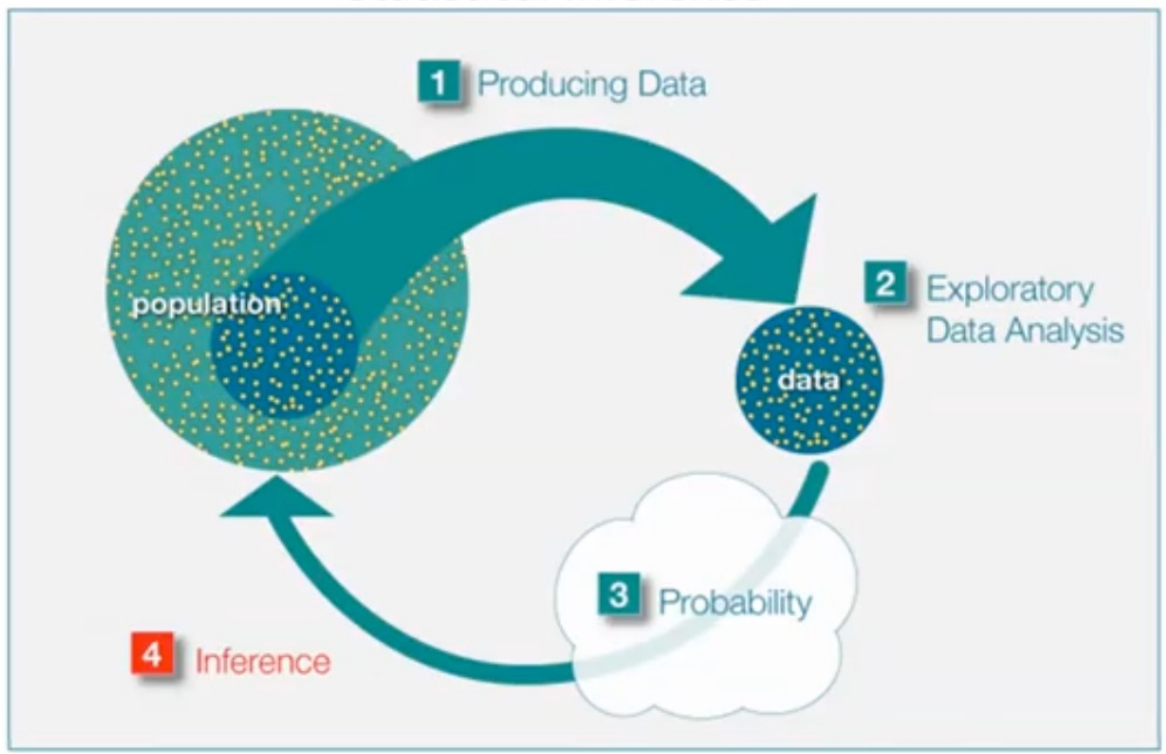

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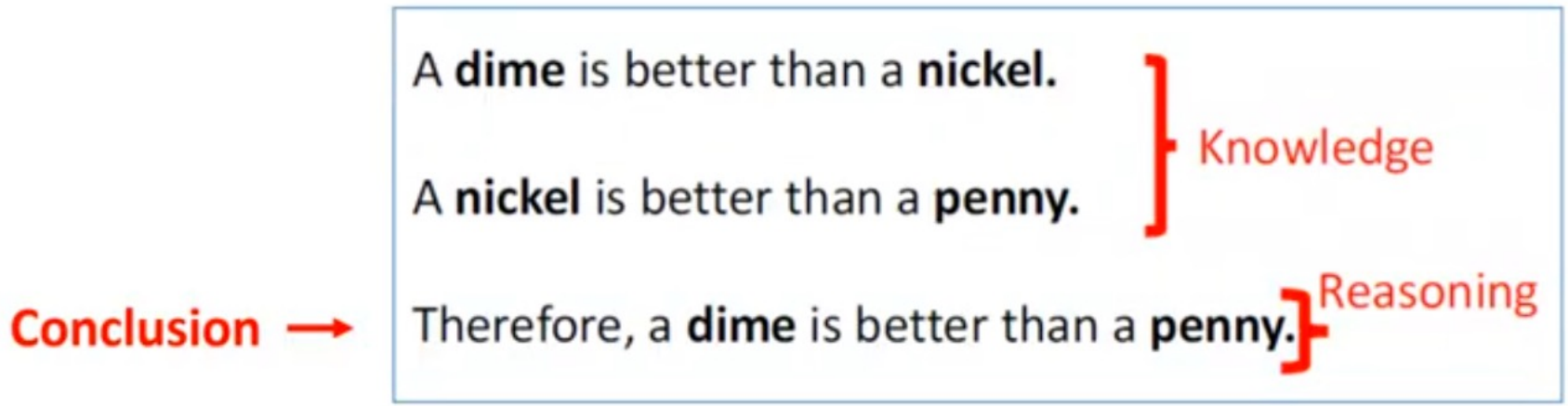

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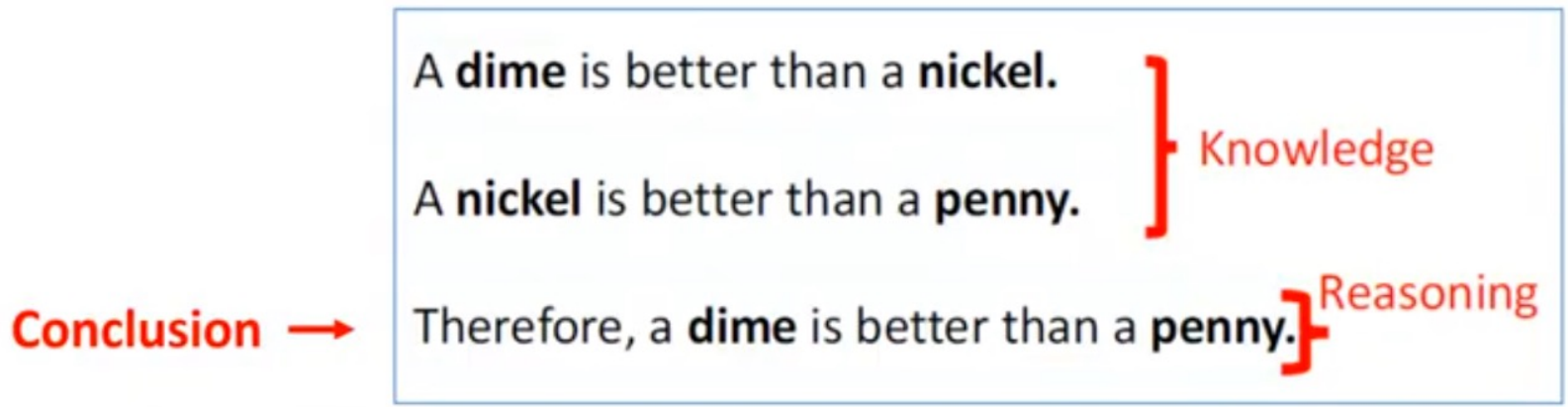

- There are many ways to reason

- Above is an example of logical deductive reasoning
  - i.e. Syllogism

Knowledge Representation

Reasoning with ‘Natural language’

- Problematic:

A **penny** is better than a **nothing.**

Nothing is better than **world peace.**

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- We need a more consistent, controlled way to represent knowledge to ensure:
  - Our conclusions are valid
  - A computing system can make effective use of knowledge

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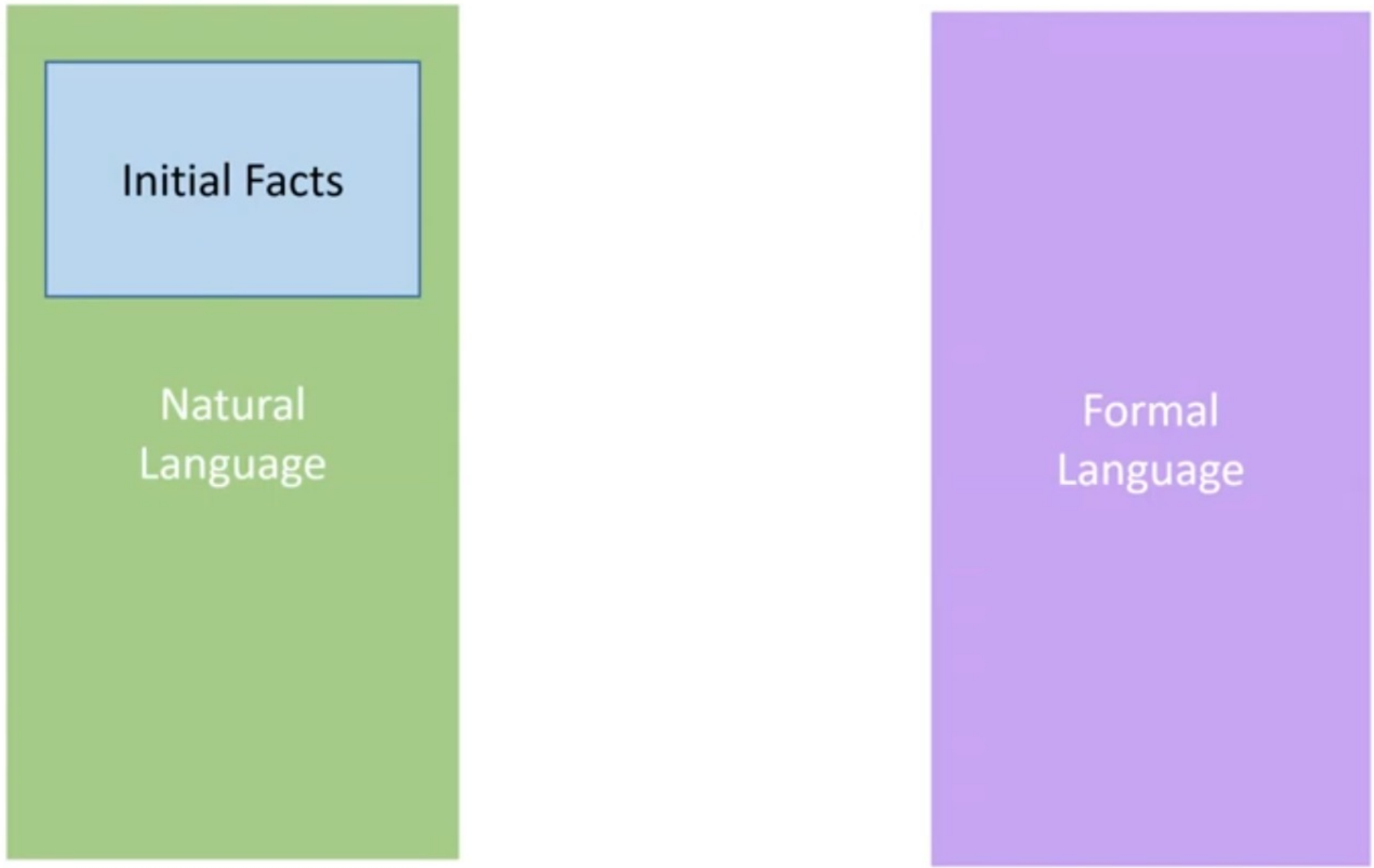
- Consequence:
  - Less flexibility

- *"The intended role of knowledge representation in AI is to reduce problems of intelligent action to search problems."*

– Ginsberg (1993)

Representation and Mappings



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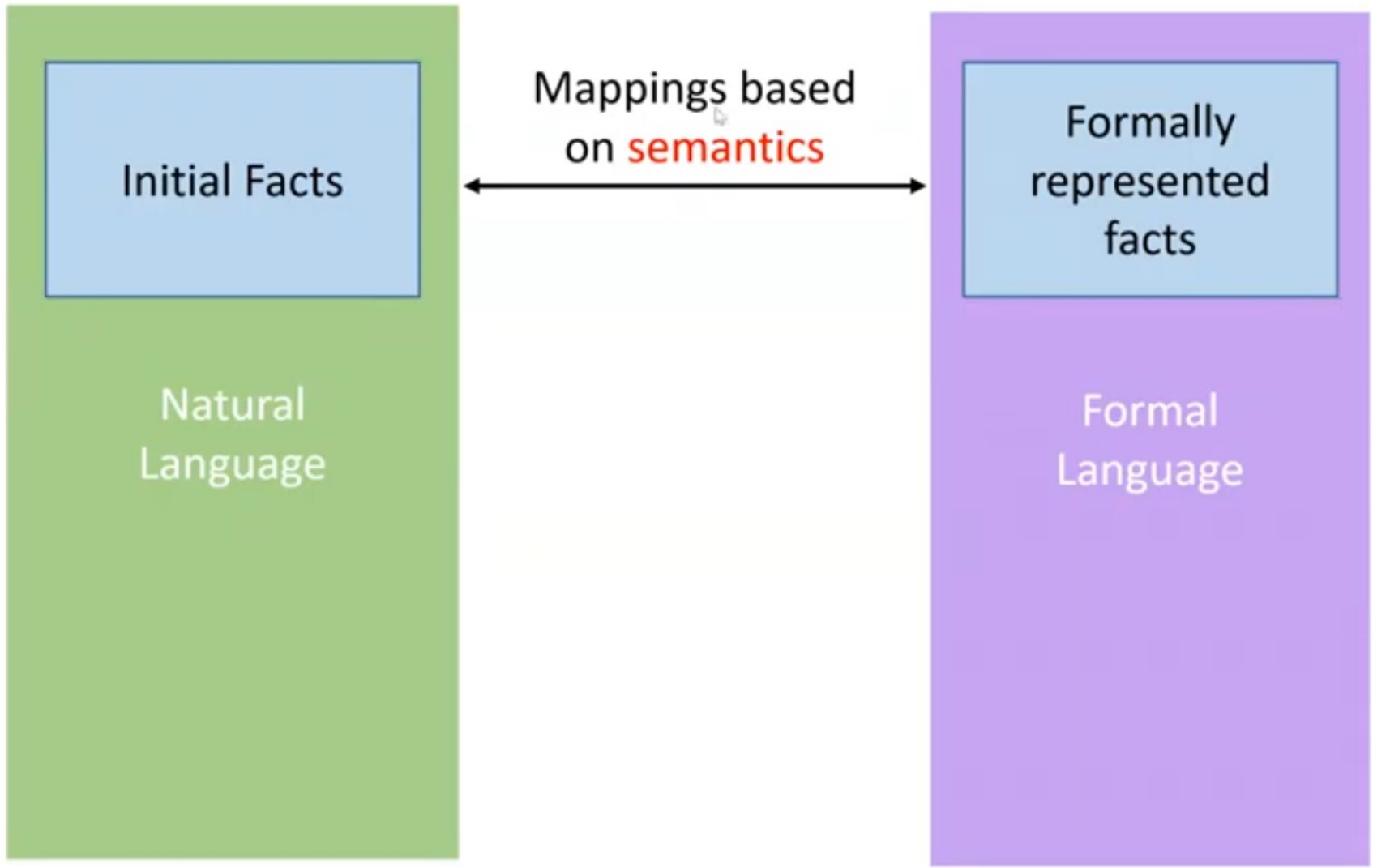

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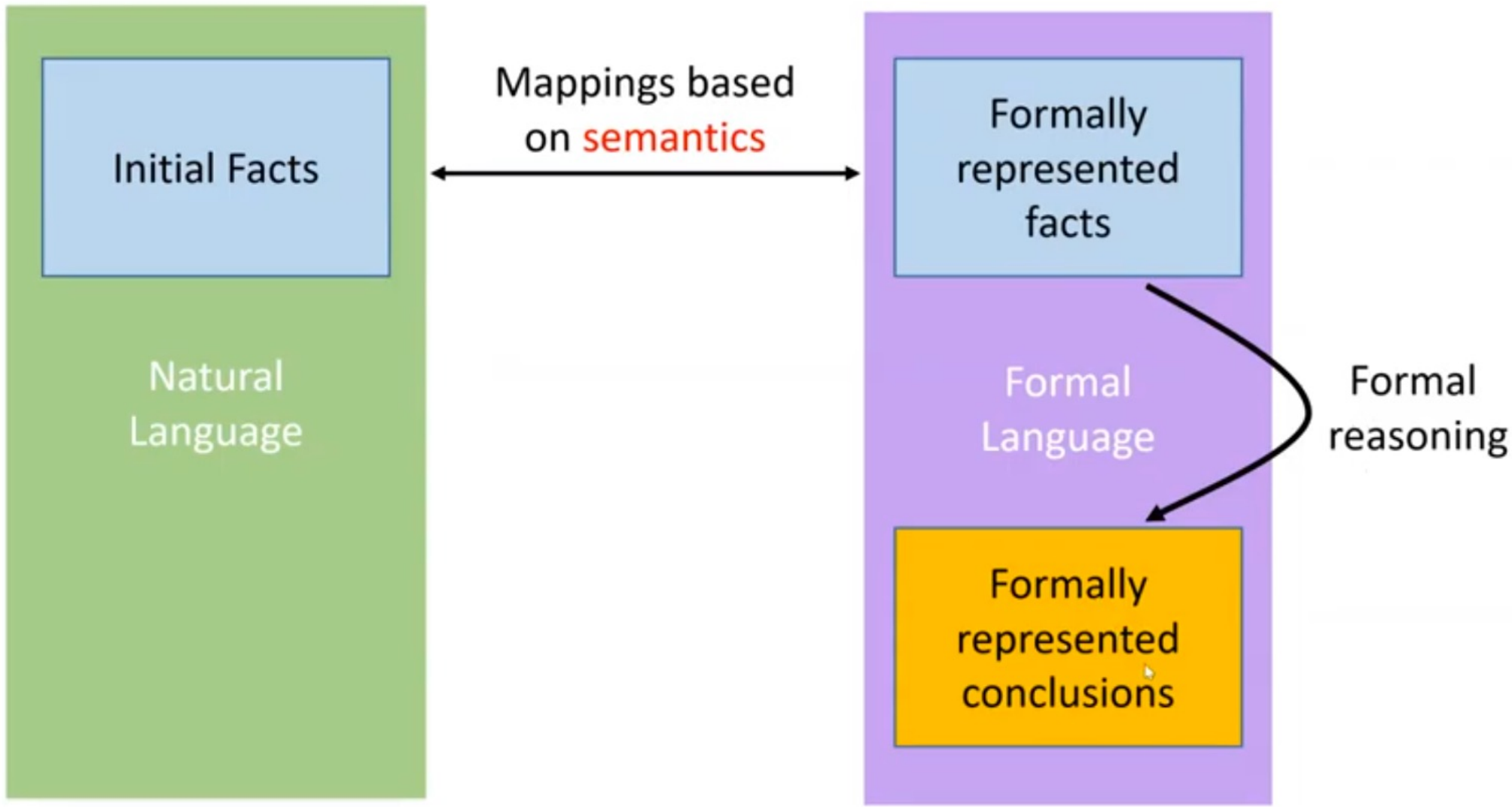

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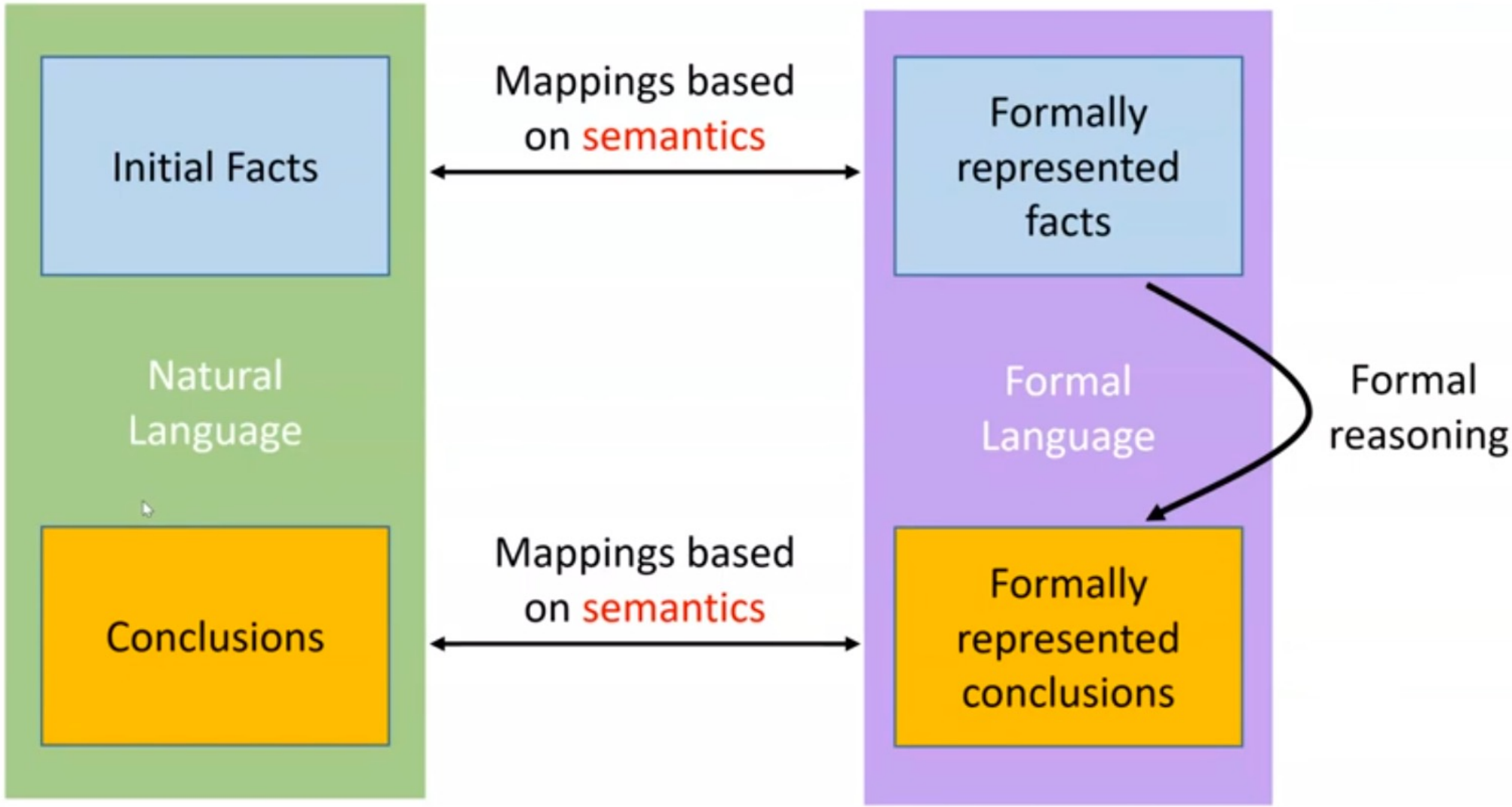

Representation: Symbol Structures

- Knowledge must be represented:
  - Effectively, consistently and in a meaningful way
- Symbol structures - representing bits of knowledge
  - Example:
    - Symbol ‘blue’ denotes a particular color
    - Symbol structure blue(Ryan-car) to denote the fact that my car is blue

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  - Could be any physical medium
  - Computers make this easier
    - Facts: data structures (list, dictionary, array, dataframe)
    - Reasoning: program code

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Programming languages

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- Naturalness:
  - Reasonably natural and easy to use

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- Semantics example:
  - blue(Ryan-car) means, “Ryan’s car is blue”
  - But does not mean (an instruction to), “Paint Ryan’s car blue”
  - Very important for drawing new conclusions

Natural Representation

- Choose names for symbols that are meaningful

- Natural Fact:
  - “If someone has a headache they should take aspirin”

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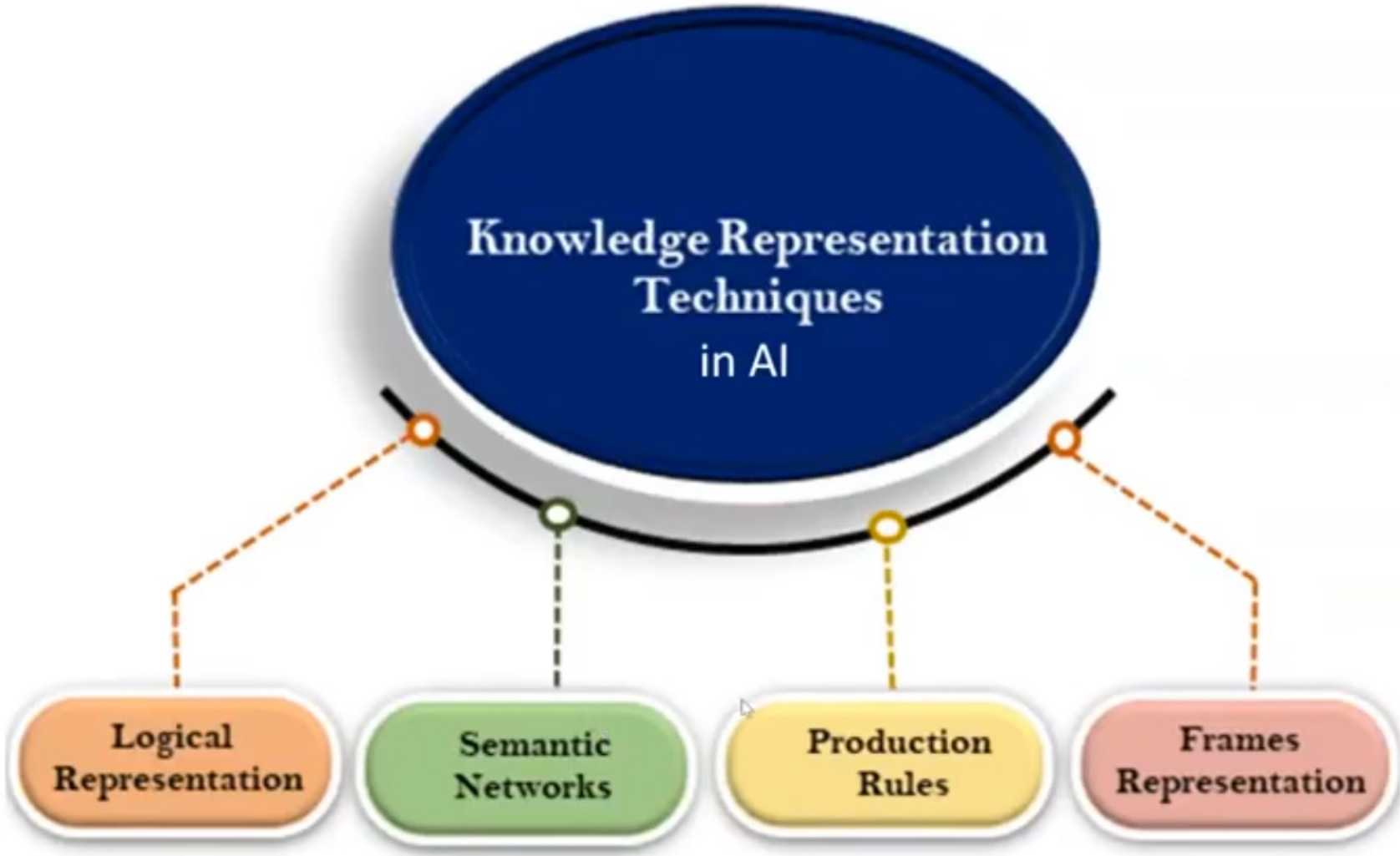
- Choose names for symbols that are meaningful
- Natural Fact:
  - "If someone has a headache they should take aspirin"
- Representation 1: if(x,h,a)
- Representation 2: IF symptom(X, headache) THEN medication(X, aspirin)
- Latter is more readable and easier to deal with

Major Representation Approaches



Basics of Logic

Introducing Logic

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- A logic (almost by definition):
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- Logic studies ways in which humans reason formally through argument
- 'Logic' usually refers to either propositional logic or first order predicate logic

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- How to describe the quality of an argument?

Valid Arguments

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Valid and Sound

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Valid but Unsound

All millionaires eat well.
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Invalid thus Unsound

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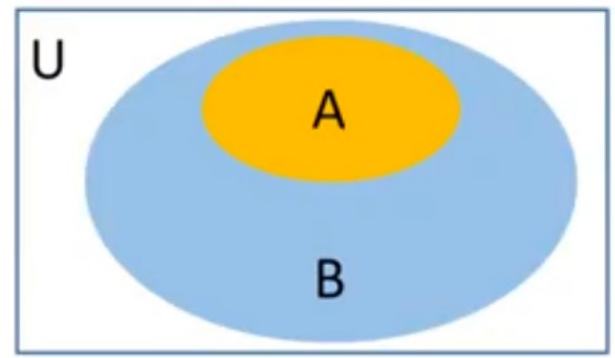

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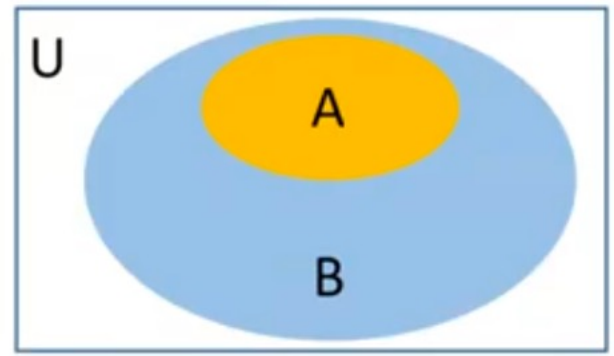

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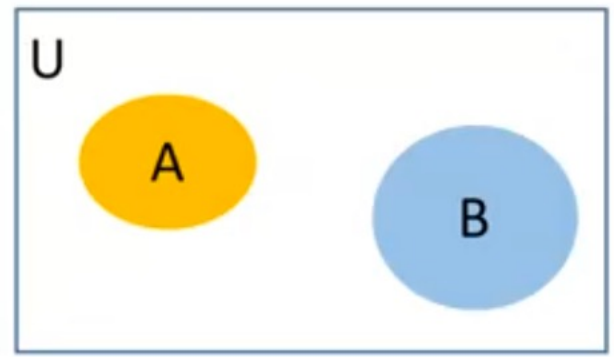

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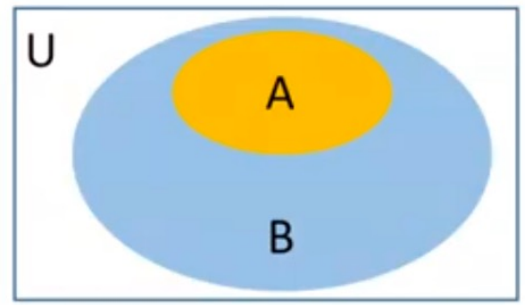

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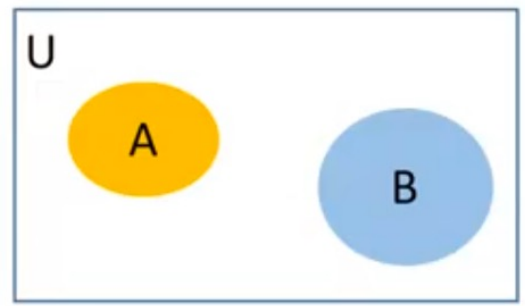
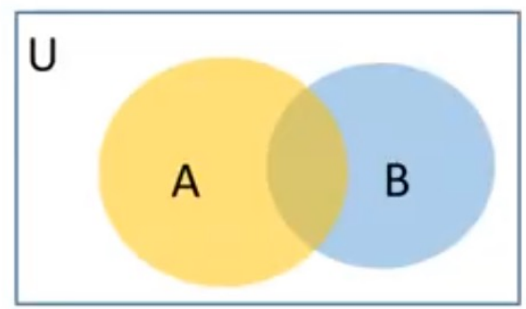


- **Some A is B**



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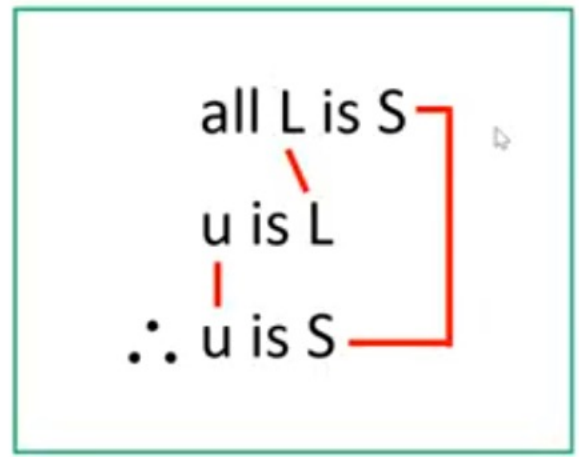

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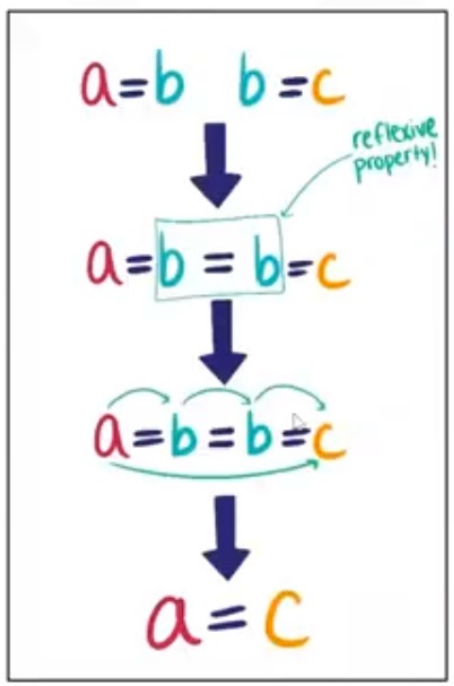
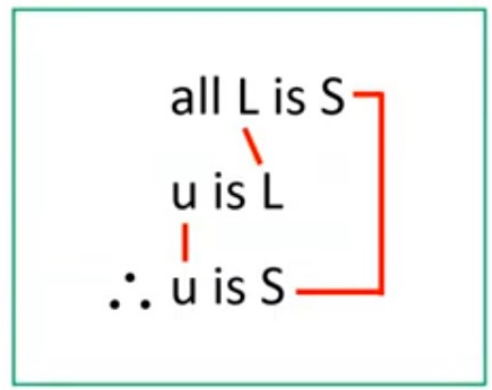
Transitive Property





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  - Syllogism is valid if:
    - Every capital letter is starred exactly once
    - There is exactly one star on the right hand side

all L* is S

u is L

∴ u is S*

Valid

The Star Test

- Gimmick testing a syllogism for validity
- Identify 'distributed' letters:
  - Occurs just after 'all' or anywhere after 'no' or 'not'
  - The first letter after 'all', but not the second
  - Both letters after 'no'
  - Any letter after 'not'

all A is B	some A is B	x is A	x is y
no A is B	some A is not B	x is not A	x is not y

- Star Test:
  - '*' premise letters that are distributed and conclusion letters that aren't
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u is L
∴ u is S*

Valid

no A* is B*
no C* is A*
∴ no C is B

Invalid

The Star Test

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u is L	no C* is A*	some C is B
∴ u is S*	∴ no C is B	∴ some C* is not P
Valid	**Invalid**	**Valid**

Enthymeme

- Argument in which the major premise is left unstated
  - Often a conclusion supported by a single premise

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- Examples:

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  [Conclusion] [Minor Premise]

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Enthymeme

- Argument in which the major premise is left unstated
  - Often a conclusion supported by a single premise

- Examples:

  She must be a good student since she is on the Dean's list

[Conclusion] [Minor Premise]

She must be a good student since she is on the Dean's list

[Implied Major Premise]

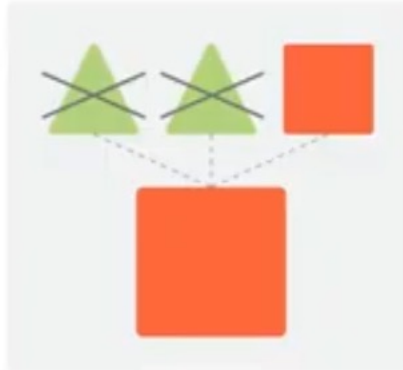
All good students are on the Dean's list

Overview of Reasoning

Types of Reasoning

Deductive	Inductive	Abductive
All men are mortal;	Socrates is a man;	All men are mortal;
Socrates is a man;	Socrates is mortal;	Socrates is mortal;
∴ Socrates is mortal.	∴ All men are mortal.	∴ Socrates is a man.

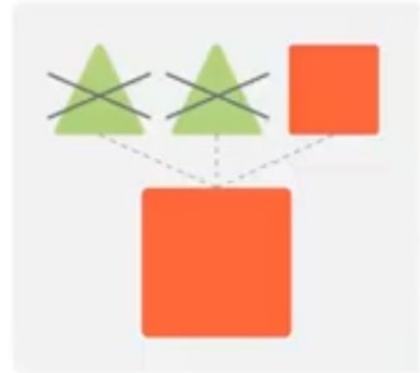
Deductive Reasoning



- General → Specific i.e. “Top-down logic”

- Reasoning from one or more statements to reach a logically certain conclusion

Deductive Reasoning



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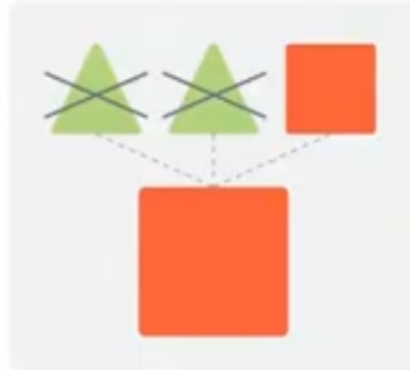

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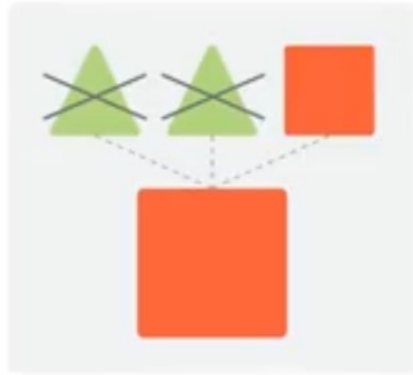
Deductive Reasoning



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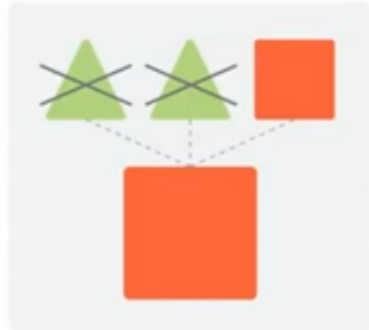
Deductive Reasoning



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- Hallmark of expert systems

Inductive Reasoning

- Specific → General i.e. “Bottom-up logic”

- Reasons from evidence about *some* members of a class in order to form a conclusion about *all* members of a class

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- A conclusion derived through inductive reasoning is called a hypothesis
  - Always less certain than evidence itself
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- Machine learning is all about inductive reasoning
  - Using a set of specific instances to find useful generalizations

Inductive Reasoning

- Statistical Syllogism:
  - Correct premise/conclusion link: Strong vs weak
  - True premises: Cogent/reliable vs uncogent/unreliable

Inductive Reasoning

- Statistical Syllogism:
  - Correct premise/conclusion link: Strong vs weak
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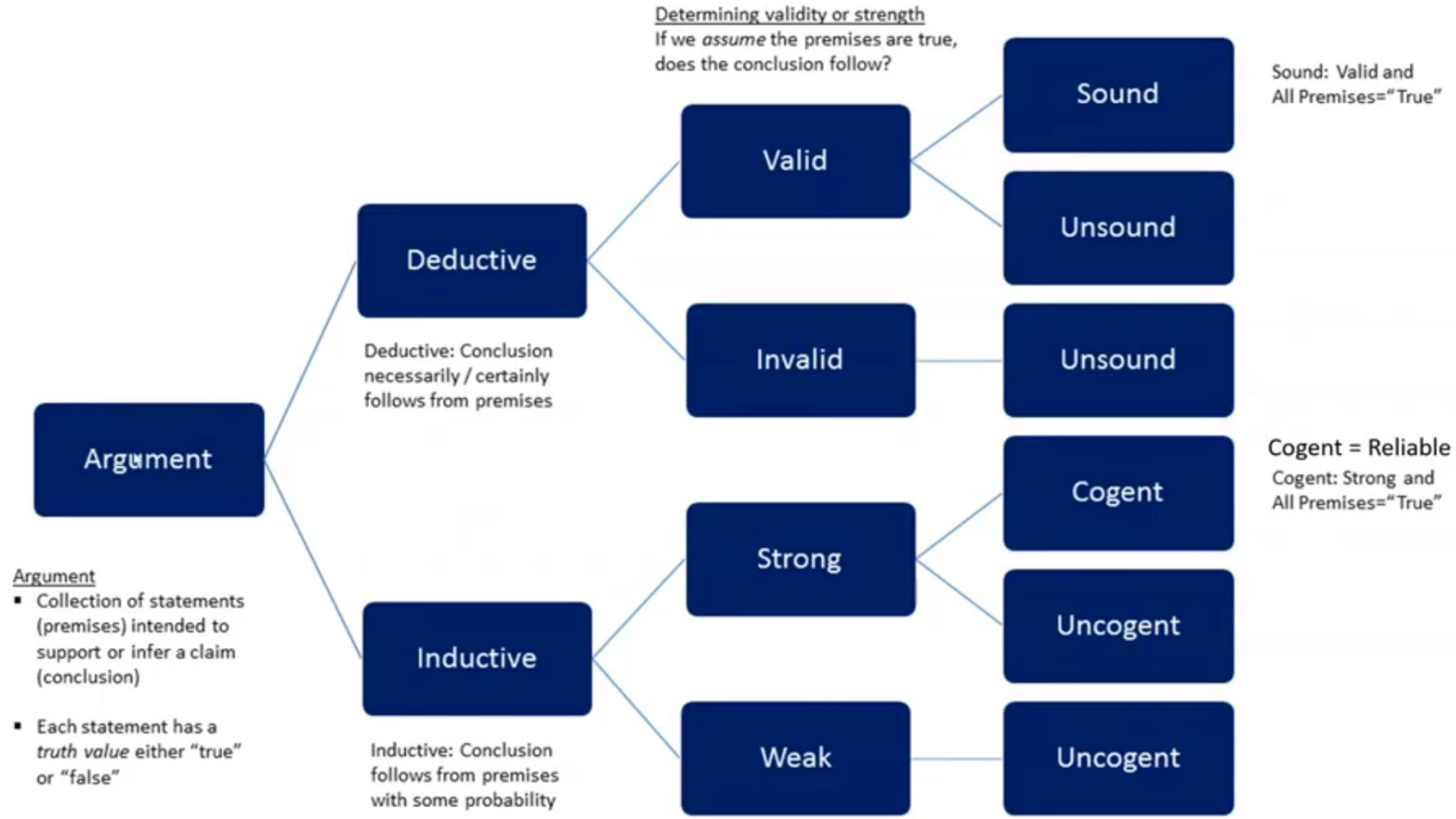
90 percent of AT shelters have water.
Rocky Gap is an AT shelter.
That's all we know about the matter.
∴ It's 90 percent probable that Rocky Gap has water

Quality of Reasoning Arguments



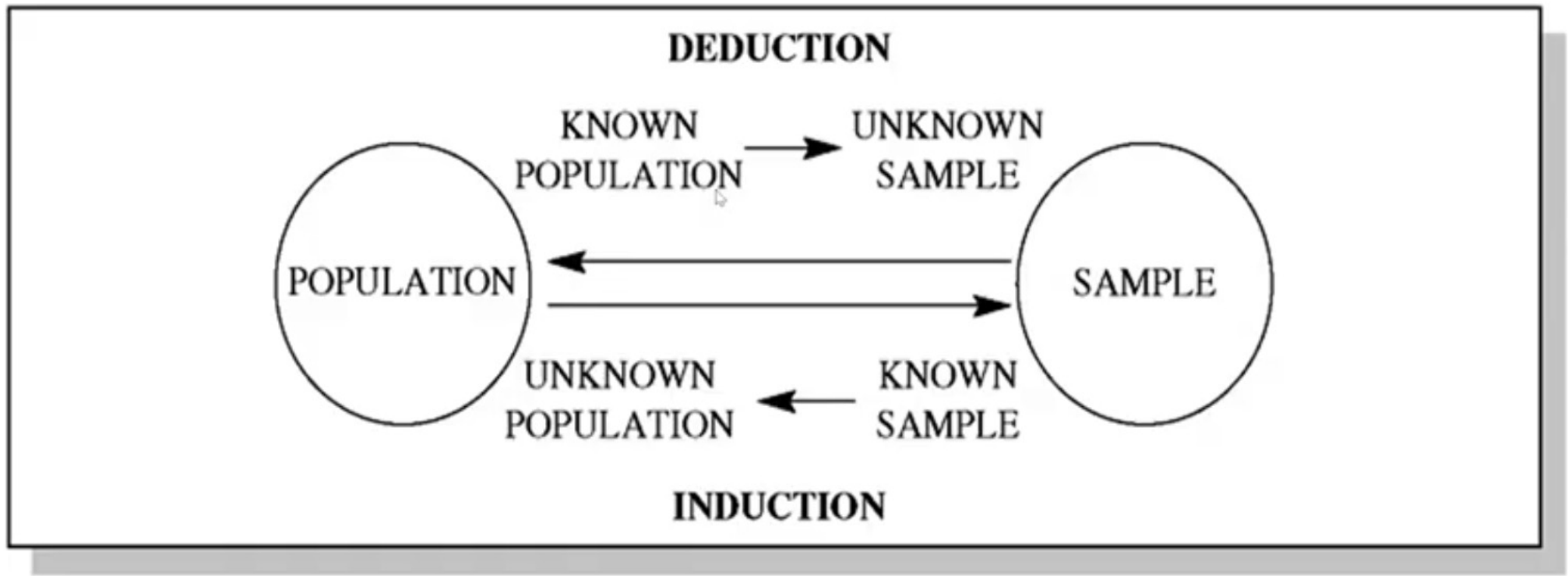
Argument

- Collection of statements (premises) intended to support or infer a claim (conclusion)
- Each statement has a *truth value* either "true" or "false"

Source Information: Patrick J. Hurley "A Concise Introduction to Logic-12th Ed."

Deduction vs Induction

- In context of populations and samples



Deductive vs Inductive Learning

- Deductive learning/instruction:
  - Teacher presents generalization/rule
  - Learner applies this to specific examples or activities

- Inductive learning/instruction:
  - Learners detecting or noticing patterns and working out a ‘rule’ for themselves

Deductive

Generalization (or Rule) ----------> Specific Examples or Activities

Inductive

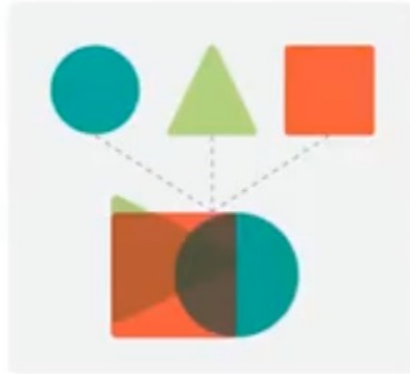
Specific Examples or Activities ----------> Generalization (or Rule)

Abductive Reasoning

- “Inference to the best explanation”

- Starts with an observation or set of observations then seeks to find the simplest and most likely explanation for the observations

Abductive Reasoning



- “Inference to the best explanation”

- Starts with an observation or set of observations then seeks to find the simplest and most likely explanation for the observations

- Yields a plausible conclusion but does not positively verify it - "best available" or "most likely."

Abductive Reasoning

- “Inference to the best explanation”
- Starts with an observation or set of observations then seeks to find the simplest and most likely explanation for the observations
- Yields a plausible conclusion but does not positively verify it - "best available" or "most likely."
- Sometimes used by diagnostic expert systems

Learning Python Coding

Python Coding: Editors and IDEs

- Editor (i.e. text editor):
  - Simply a place where text and code can be written and edited.

- Integrated development environment (IDE):
  - A software application that provides comprehensive facilities to computer programmers for software development.
    - Source code editor
    - Build automation tools
    - Debugger.

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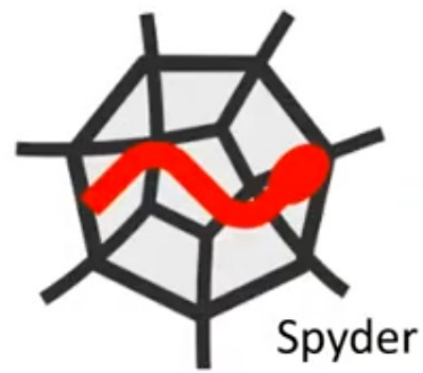
- General Editors and IDEs with Python Support
  - Eclipse + PyDev
  - Sublime Text
  - Atom
  - GNU Emacs
  - Vi / Vim
  - Visual Studio
  - Visual Studio Code
  - Jupyter Notebook

- Python specific IDEs:
  - PyCharm
  - Spyder
  - Thonny
  - IDLE

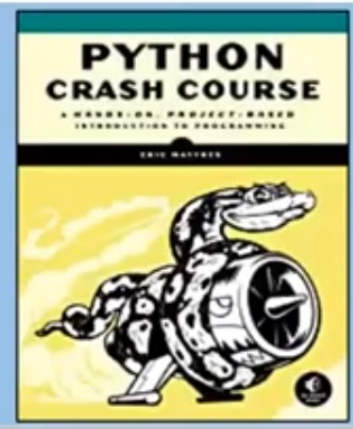


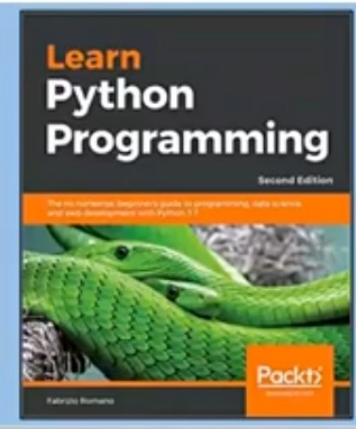
Introductory Tutorials on Python Coding

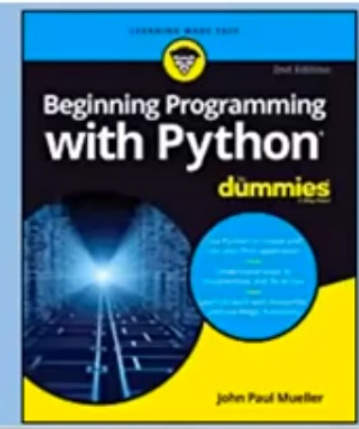
- Self-Guided 'Basics':
  - https://www.learnpython.org/
- Video (Basics):
  - Link: Python Tutorials by Corey Schafer
- Pandas (Data Science):
  - Link: Pandas Tutorial
- Scikit-Learn (Machine Learning):
  - Scikit-learn Tutorial
- Course:
  - BMIN 525 – Introduction to Python Programming (Fall)

Python Books

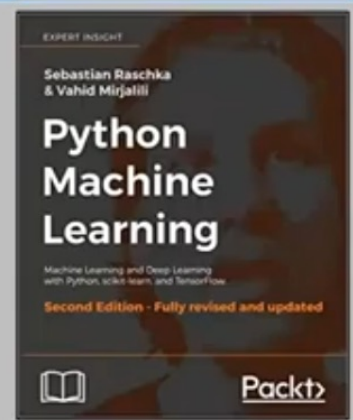
- Python Basics:

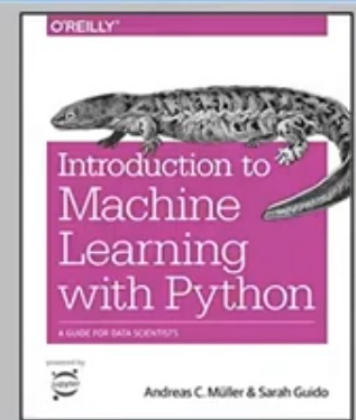




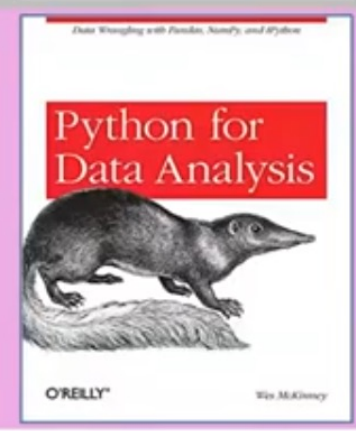


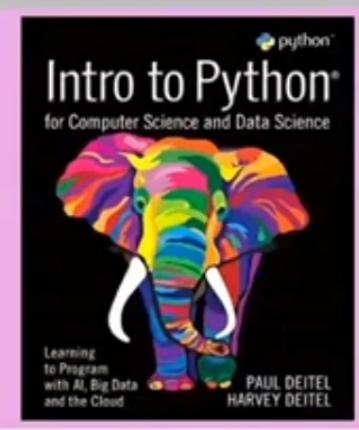
- Python Machine Learning:





- Python Data Science:





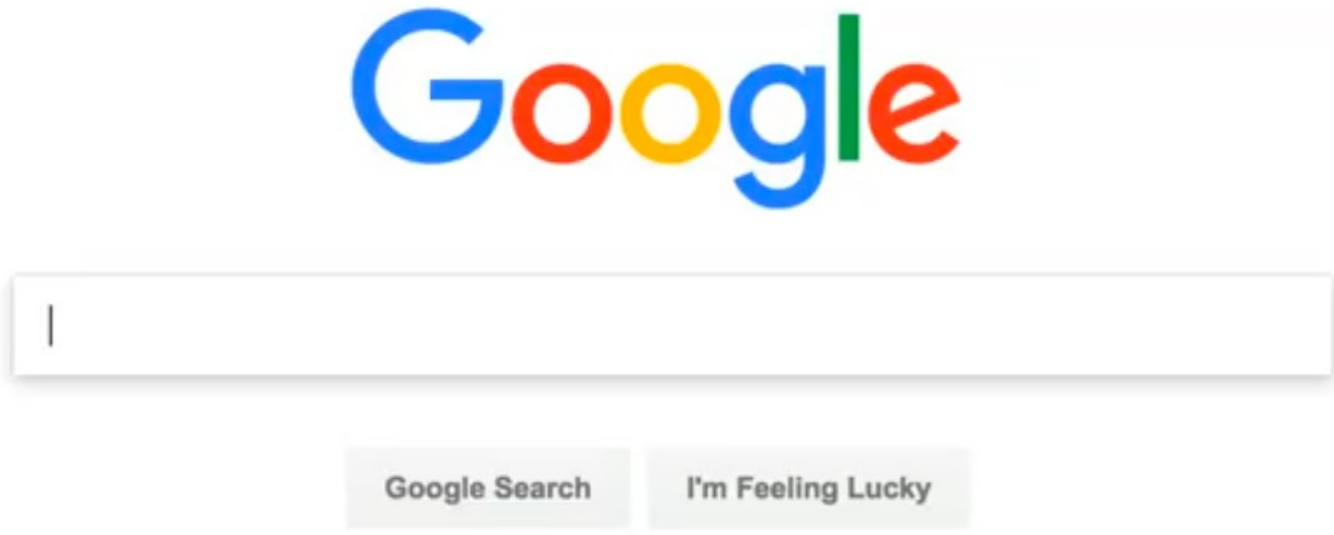
Coding Help

Getting Help with Coding

- Being a data scientist includes being able to be able to seek answers on your own
  - Put some effort into it
  - Don’t be afraid of data/errors
  - Admission of not knowing something is OK

- Most questions you have have already been answered on the web

Where to Get Help



- Hardest part can be figuring out what to search for

Where Else to Get Help Coding/Debugging

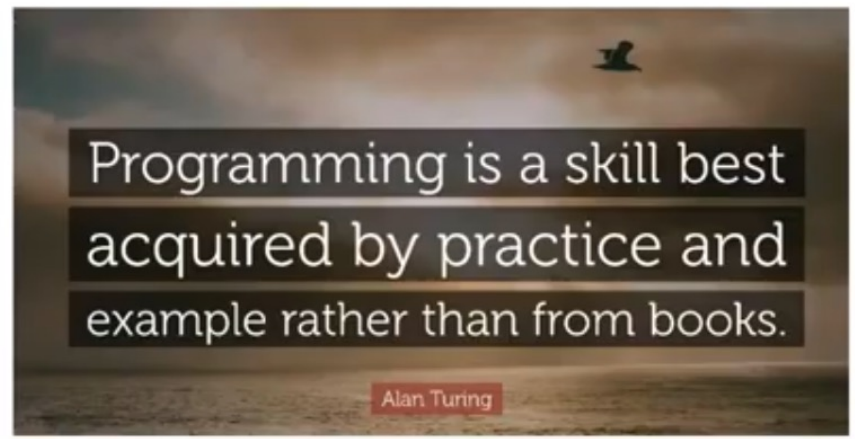
- http://stackoverflow.com

- https://www.geeksforgeeks.org/

GeeksforGeeks
A computer science portal for geeks

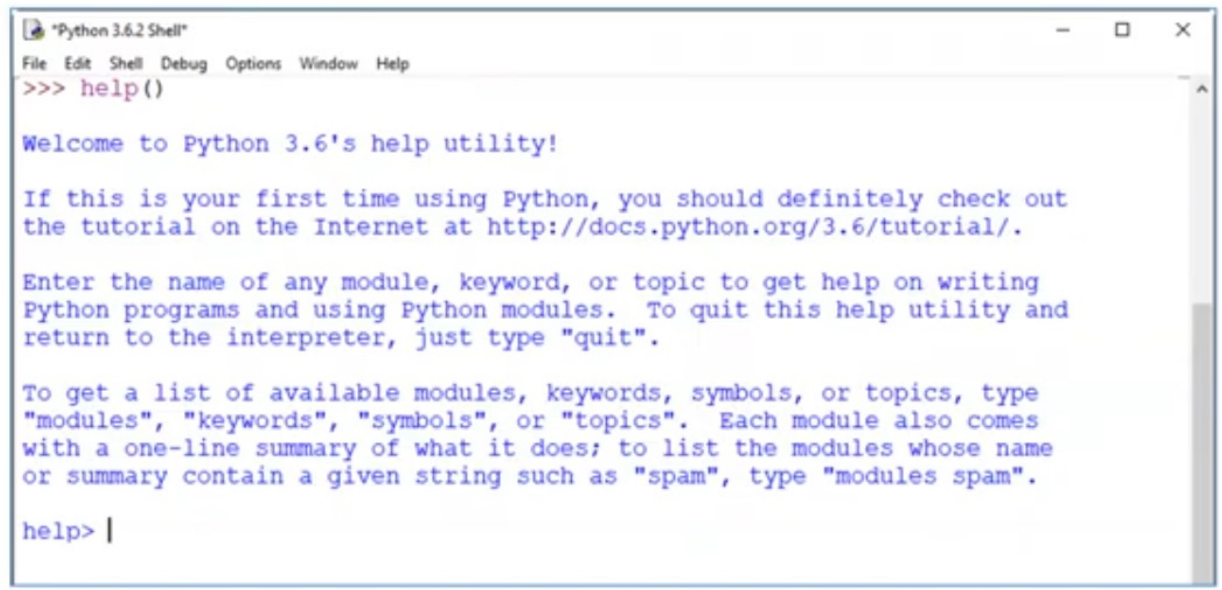
- https://python-forum.io/index.php

- https://www.quora.com/



Describing a Problem

- Give details of question, but be brief!
  - Language (Python)
  - Environment (version, package name, etc)
  - Code you tried
  - Error message
  - Try different ways of explaining what you are trying to do



Git and GitHub

git : Version Control

- Version Control:
  - Allows tracking/restoring of files over time
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  - Great for projects with multiple contributors

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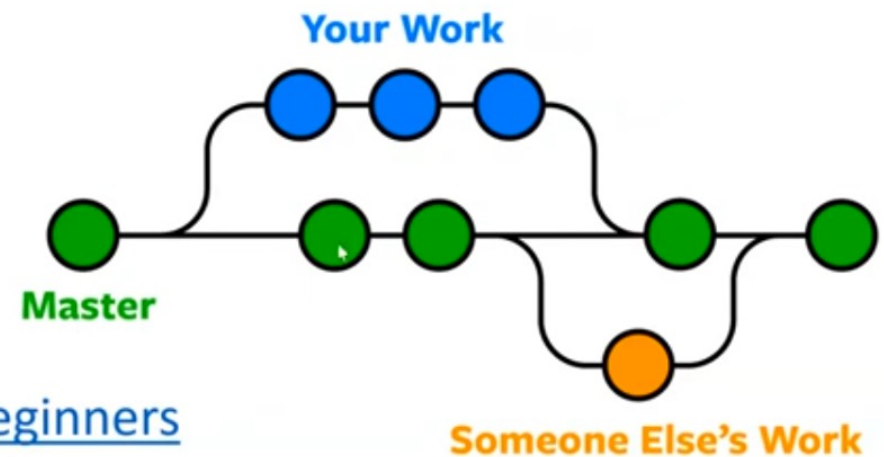
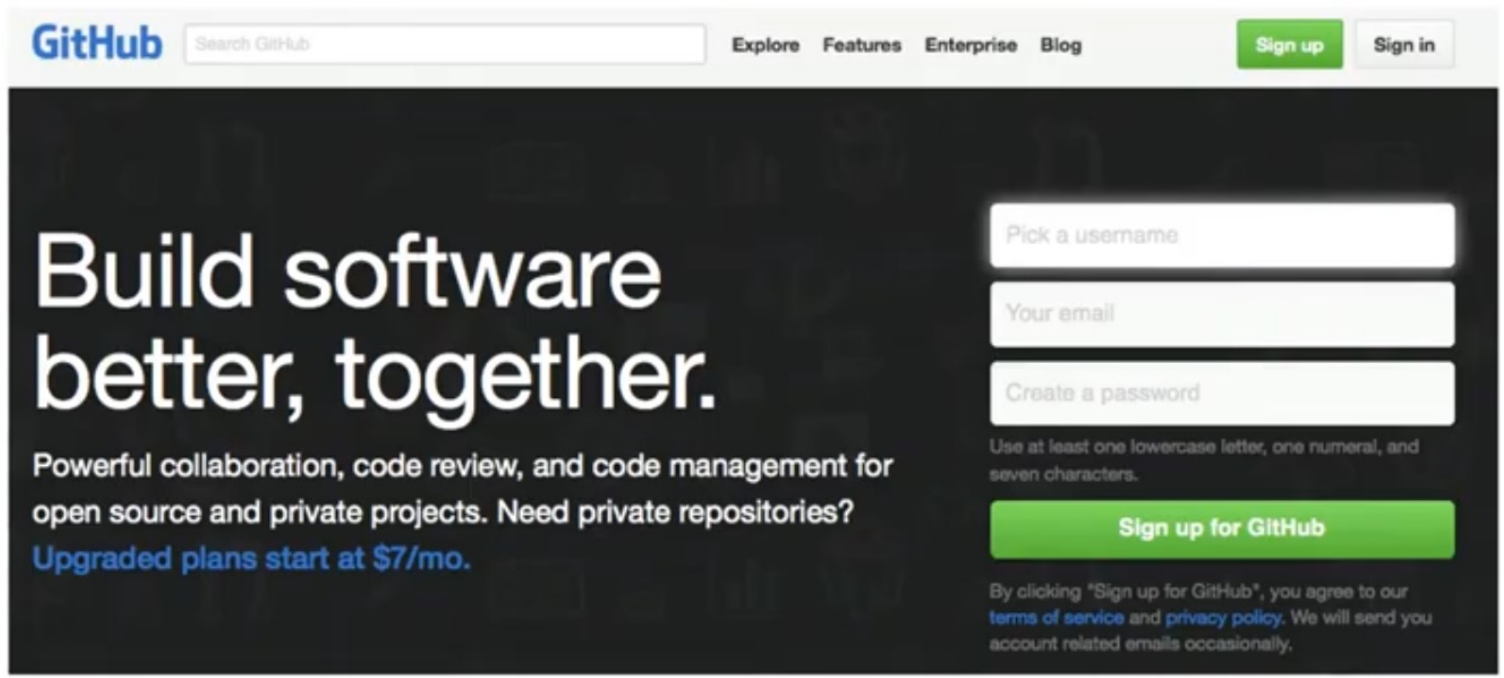


Link: An Introduction to Git and GitHub for Beginners

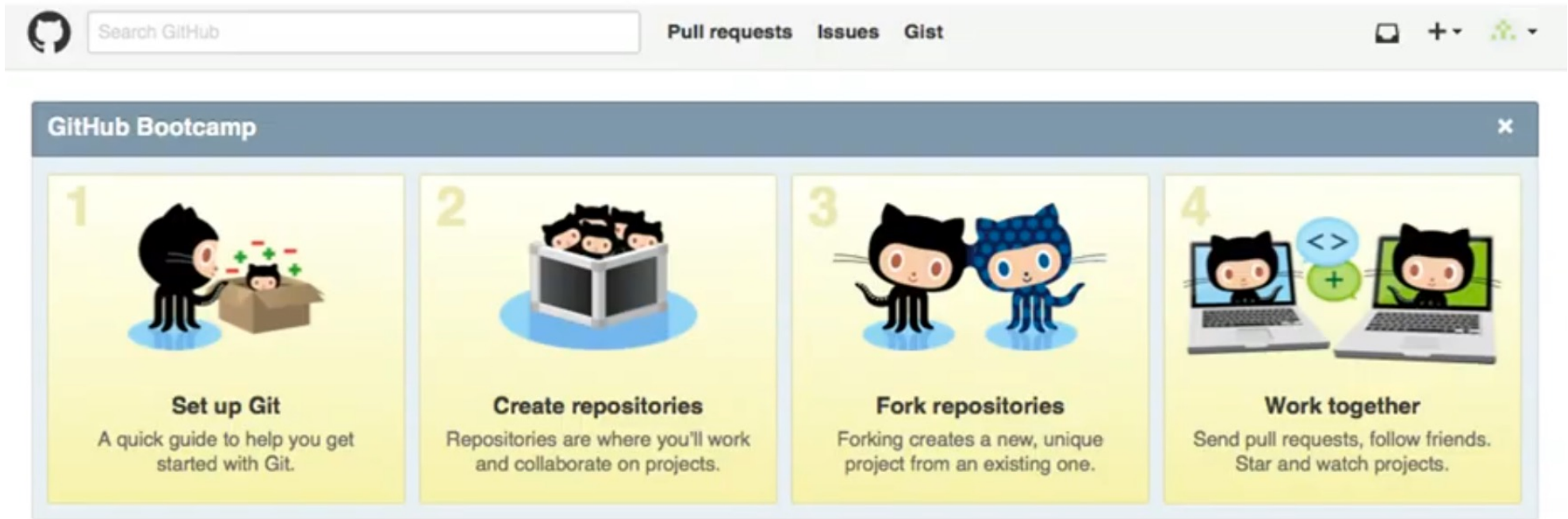
GitHub

- Web-based platform that hosts projects using Git for version control
- Can share code with others and access others' code
- Repositories (i.e. 'repos') are folders which contain intentional snapshots of progress called 'commits

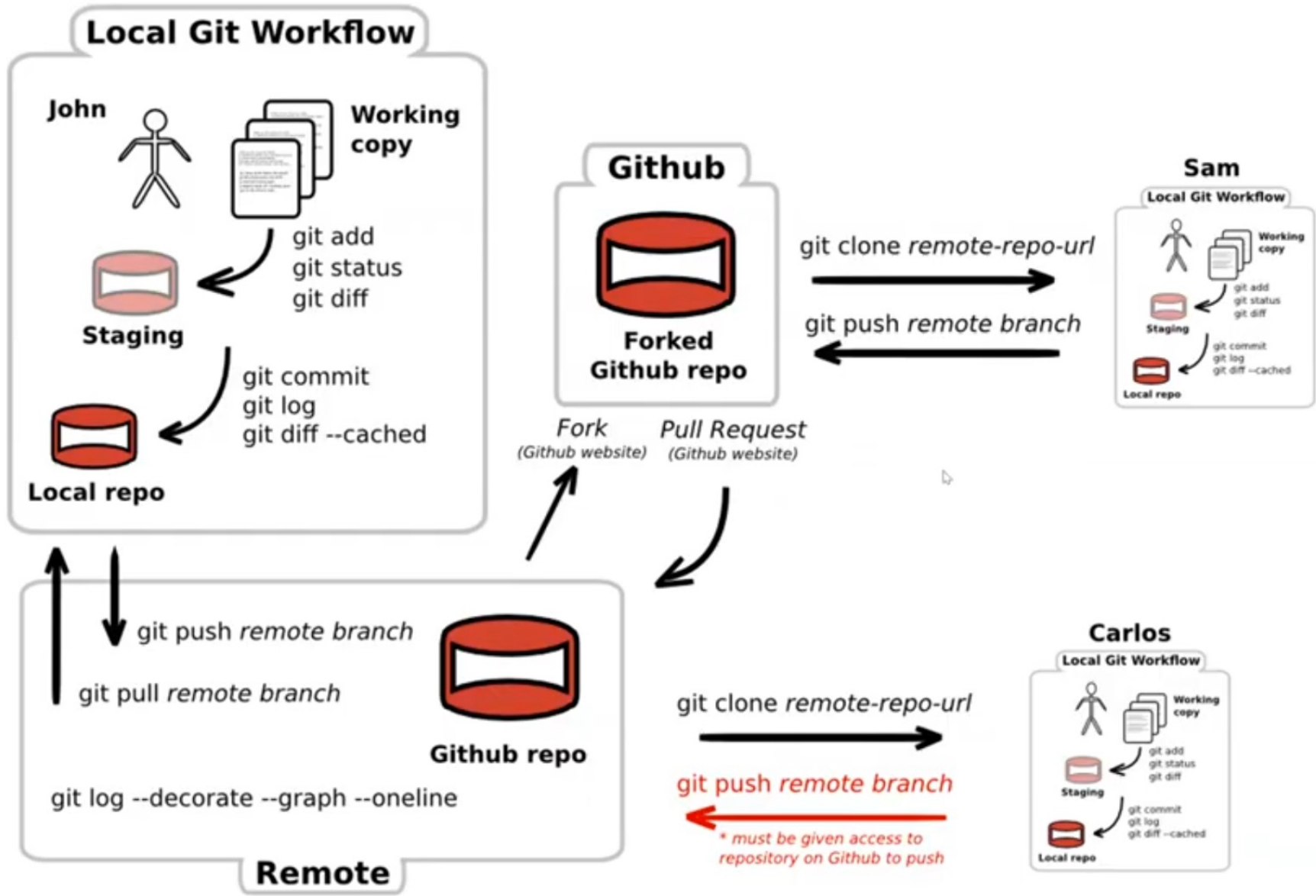


Creating GitHub Repos

- Create:
  - A new one (from scratch)
  - Fork: Copy another user's repository

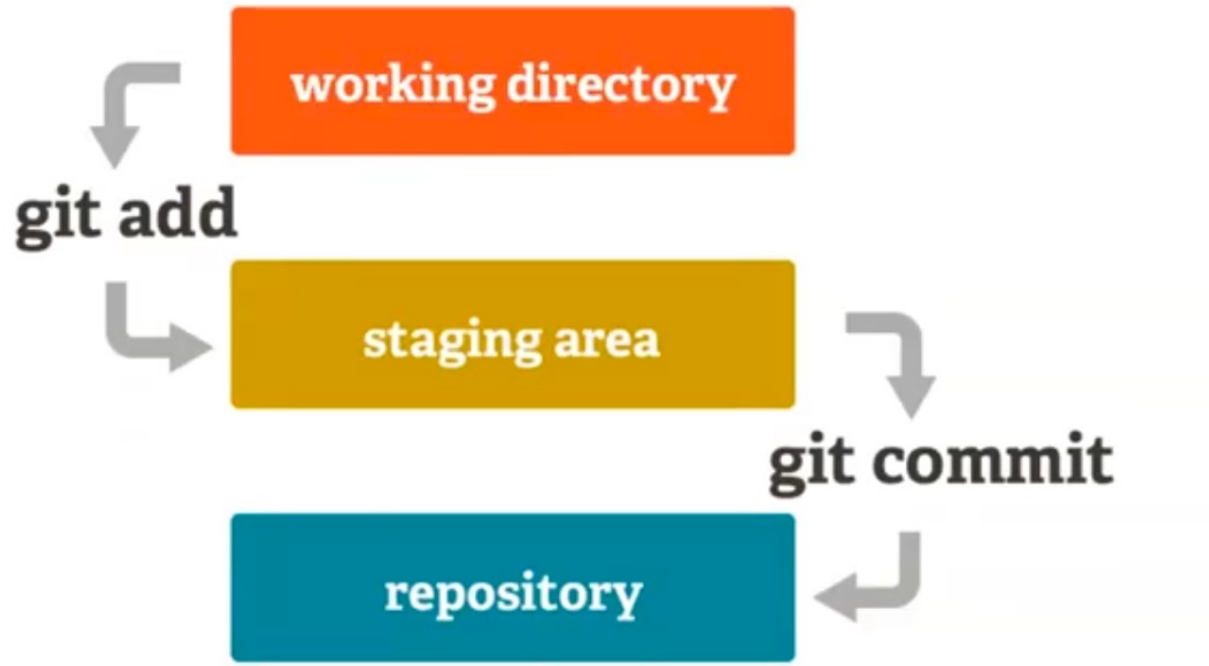


Git/GitHub Workflow Overview



Git Local Commands

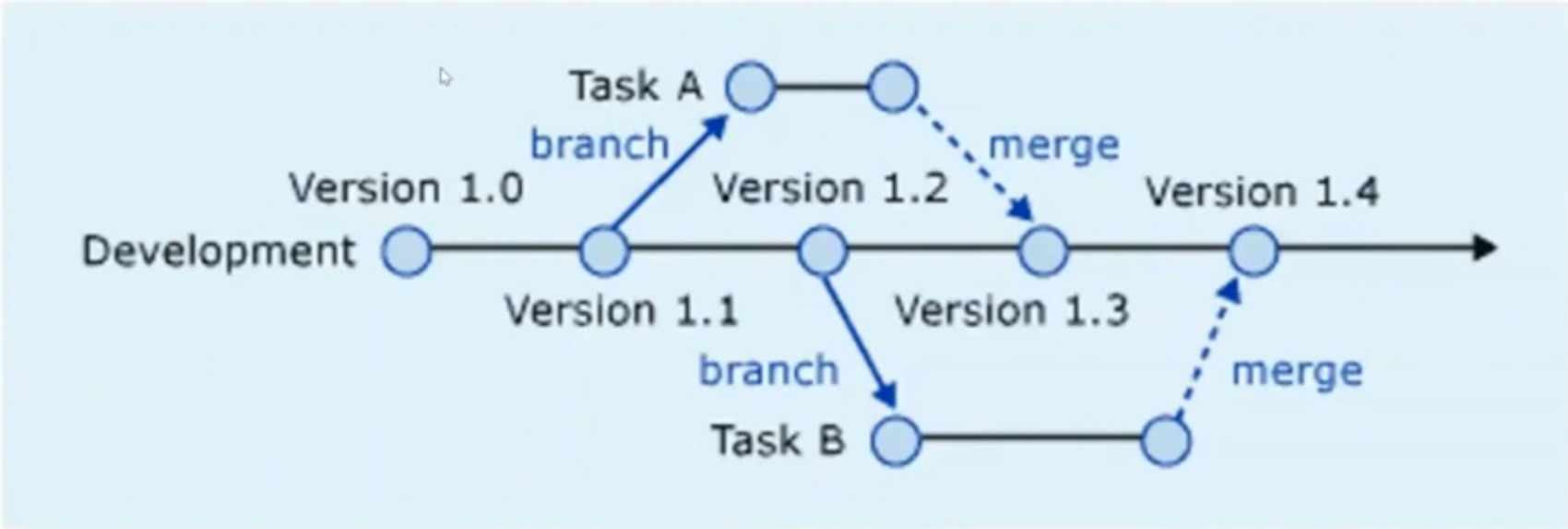
- Making and documenting code updates
  - Add:
    - Select the changes that will be staged for the next commit
  - Commit:
    - Create a snapshot of the staged changes along a timeline of a Git projects history.



Git Version Control Commands

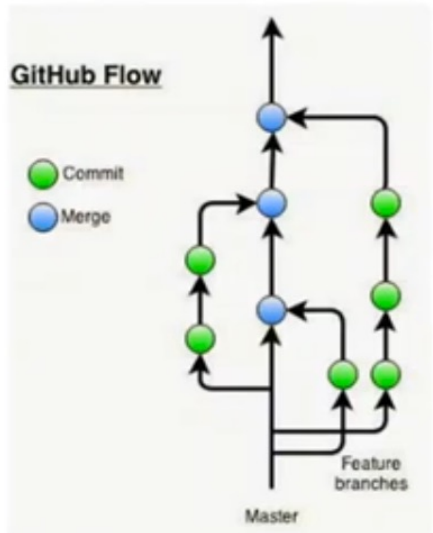
- Branch: create, list, rename, and delete branches

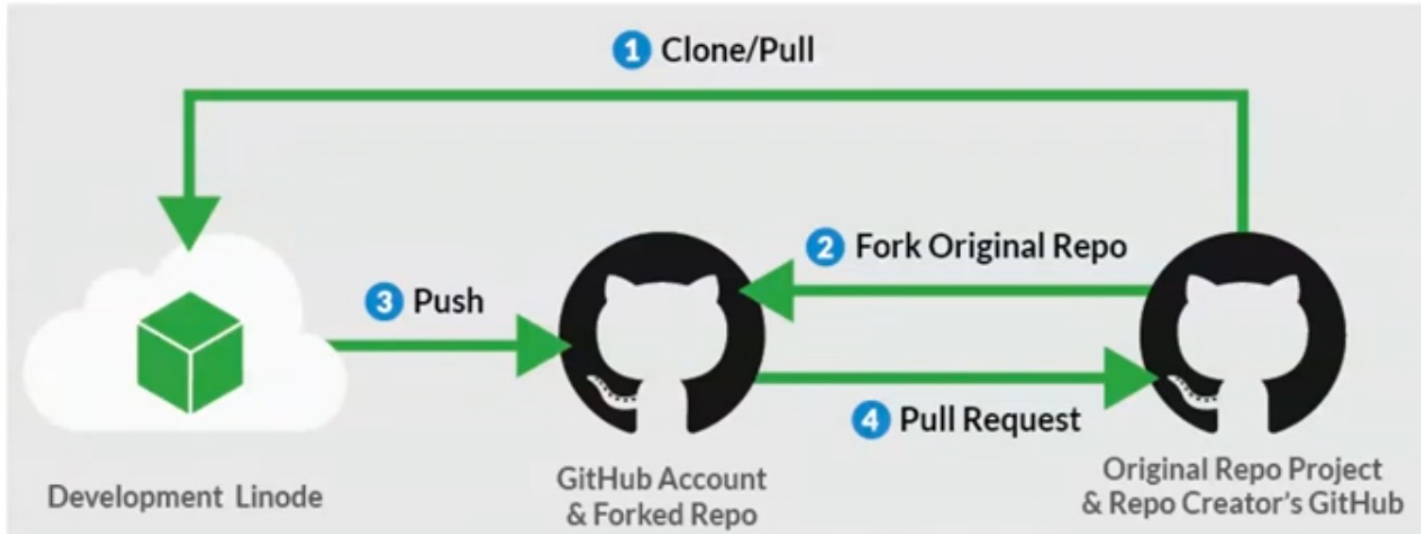
- Merge: Take the independent lines of development created by git branch and integrate them into a single branch



Git Network Commands

- Clone: Target an existing repository and create a clone, or copy of the target repository
- Pull: Update the local version of a repository from a remote
  - Pull request: Asking the owner to pull updated code you provide
- Push: Upload local repository content to a remote repository. Pushing is how you transfer commits from your local repository to a remote repo. It's the counterpart to 'fetch'
- Fetch: Download contents from a remote repository





Assignments

- Reminder: Assignment 1

- Goals:
  - Get your computer set up (and equipped) with the tools needed for using Python and available packages
  - Understand the difference between Anaconda, MiniConda, and Conda
  - Understand how to access Python through your terminal (MacOS) or command line (Windows, Linux)
  - Learn how to use Git and GitHub
  - Learn basics of Python programming