COMPUTATIONAL X: INTEGRATING COMPUTATIONAL THINKING ACROSS DISCIPLINES

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VIRGINIA TECH

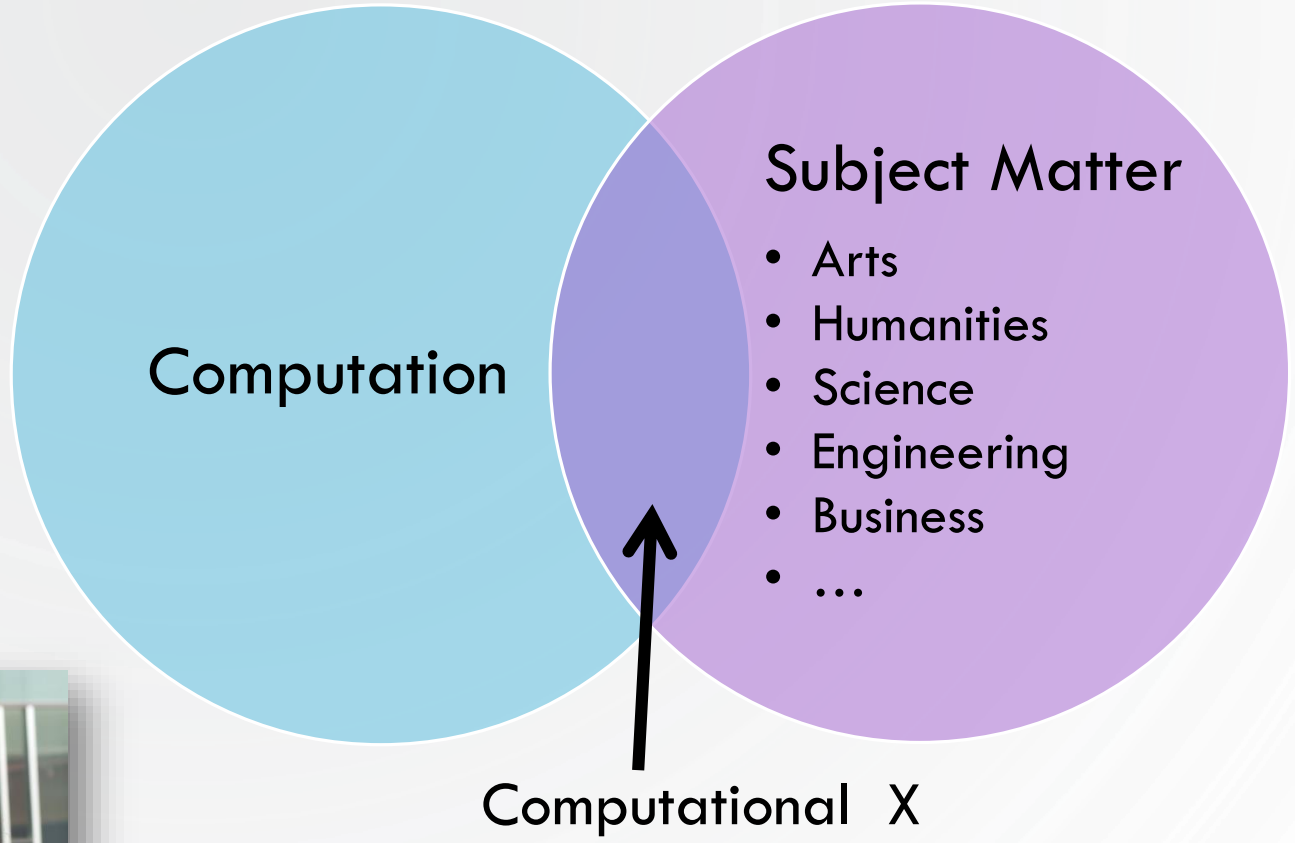
WHO ARE WE?

- Cory Bart
- Dennis Kafura
- Clifford A. Shaffer

WHAT IS IT?

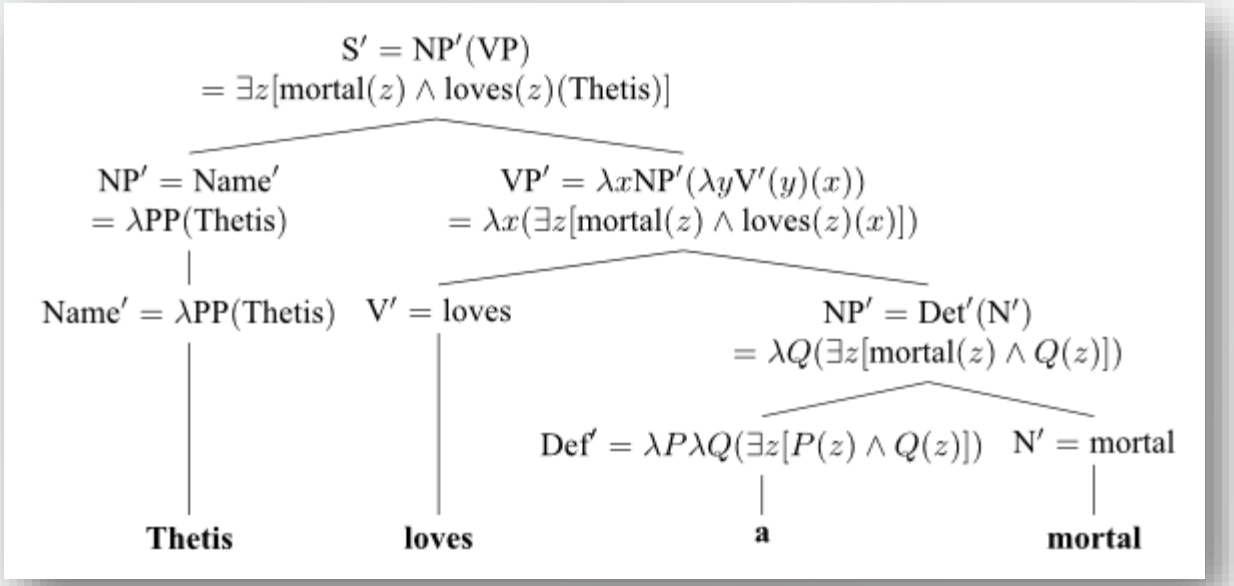
- "Computational Thinking is the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent."

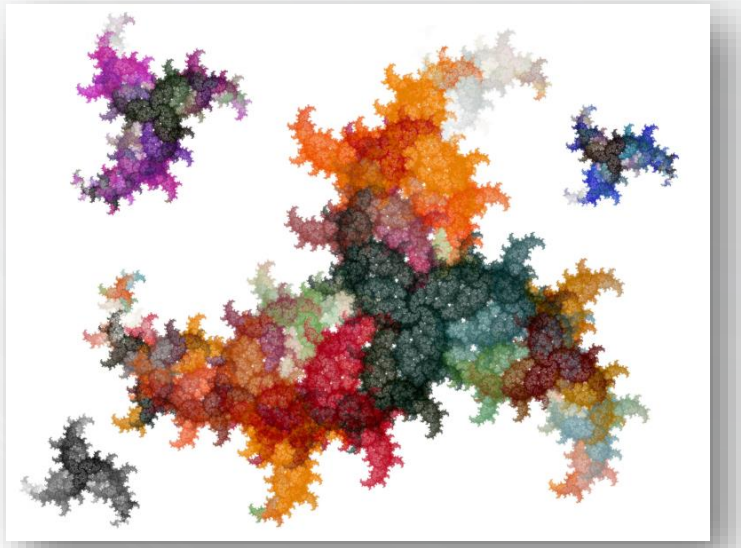
  -Jeanette Wing, 2006

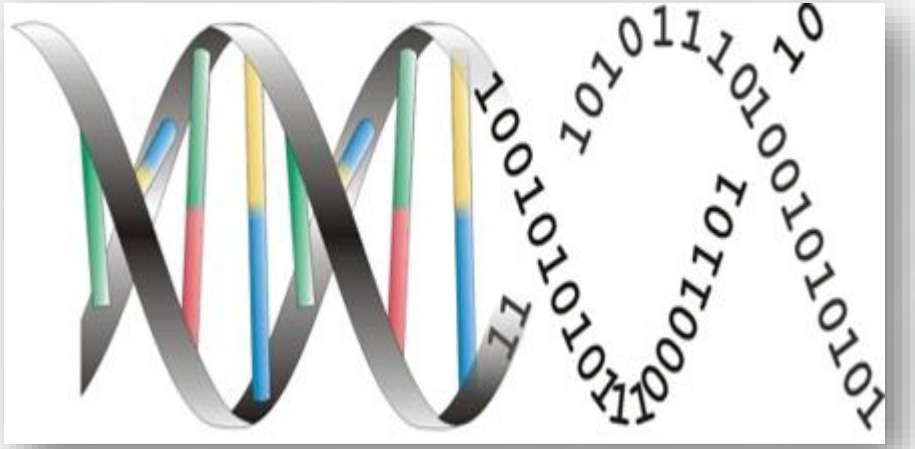


EXAMPLES

- Computational Biology
- Computational Literature
- Computational Art
- …







VIRGINIA TECH

- *To this end, **Virginia Tech will** comprehensively evaluate and **modify the current Curriculum** for Liberal Education to … **incorporate computational thinking** and informatics/digital fluency as basic skills **for all students**, thereby enabling our students to be engaged citizens and life-long learners."*

CRITICAL ELEMENTS OF CT

- Abstraction
- Algorithms
- Social Impacts

ABSTRACTION

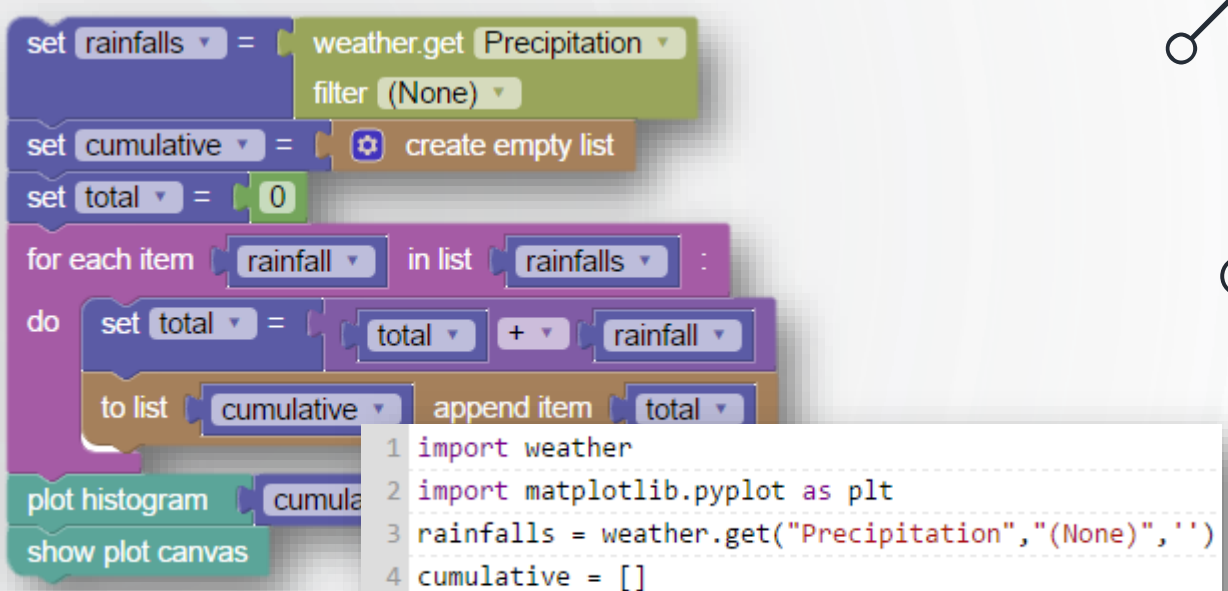
- Representing the real-world with data by removing unnecessary details
  - Spreadsheets
  - Databases
  - Files

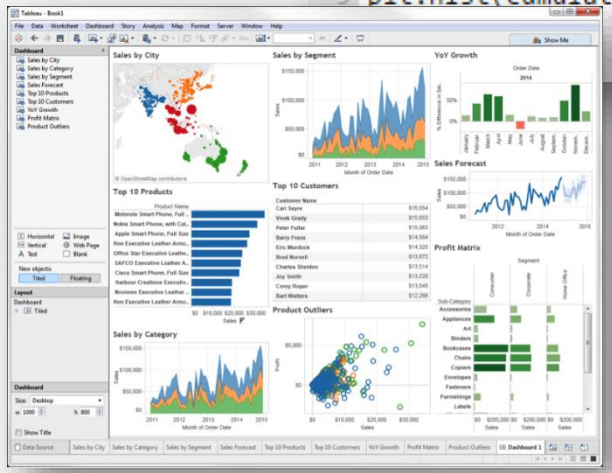
- What data do you have in your field?

Movie			On-Line Customer		
Title (string)	Year (int)	Length (int)	Genre (string)	Format (string)	Price (float)
"Moneyball"	2011	133	"Sports"	"Blueray"	15.00
"Gone With the Wind"	1939	219	"Drama"	"DVD"	10.95
"Jurassic Park"	1993	127	"SciFi"	"DVD"	12.50
"Pirates of the Caribbean"	2003	143	"Comedy"	"Blueray"	17.50
"Sicko"	2007	116	"Documentary"	"Streaming"	11.75

ALGORITHMS

- Manipulating data with concrete instructions to solving problems at scale
  - Programming
  - Software
- What tools do you have in your field?

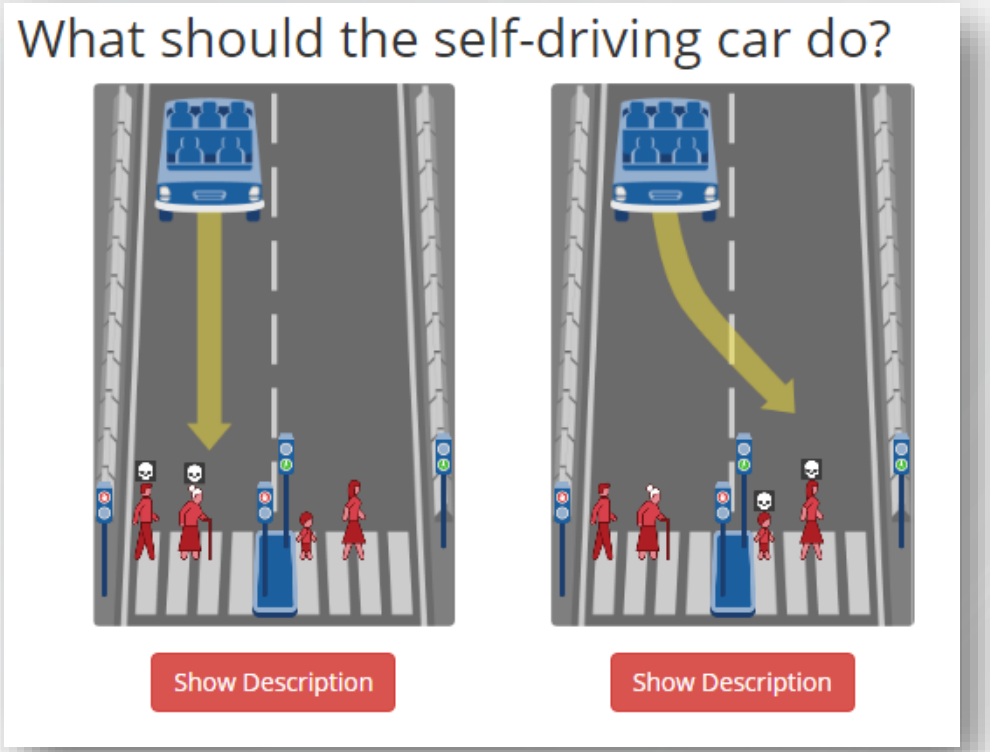




SOCIAL IMPACTS

- Interpreting the meaning of computational results
  - Stakeholders
  - Policy
  - Ethics

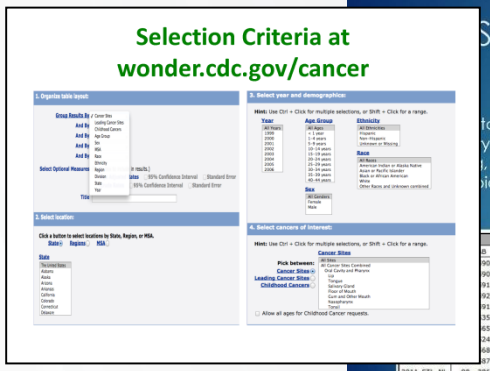
- What are the important questions that need to be answered?

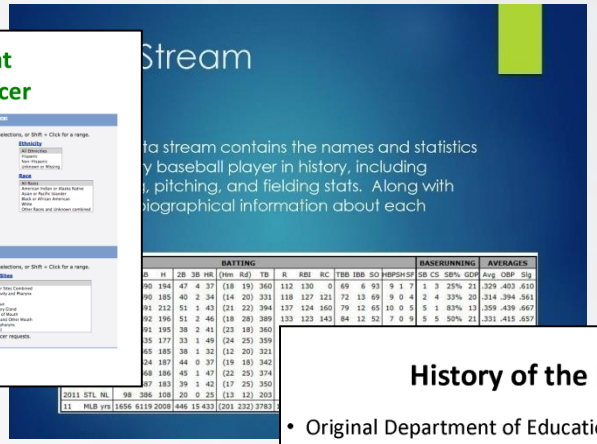


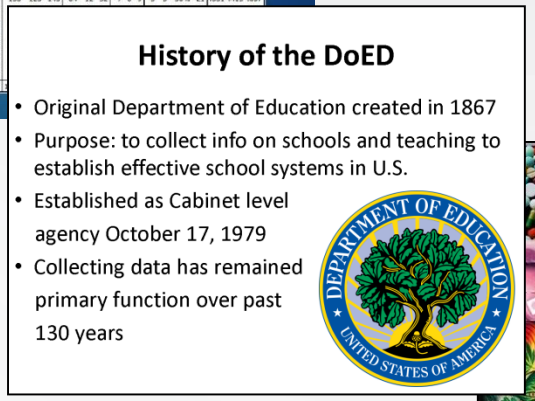
“INTRODUCTION TO COMPUTATIONAL THINKING”

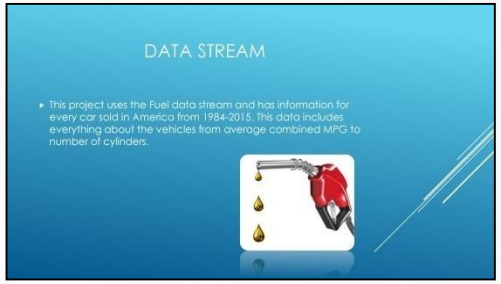
- Area 5
- For non-CS major students
- Data Science context
- Modern pedagogy (more on that soon)

40+ DATASETS IN ARTS, SCIENCES, HUMANITIES, BUSINESS, AND MORE



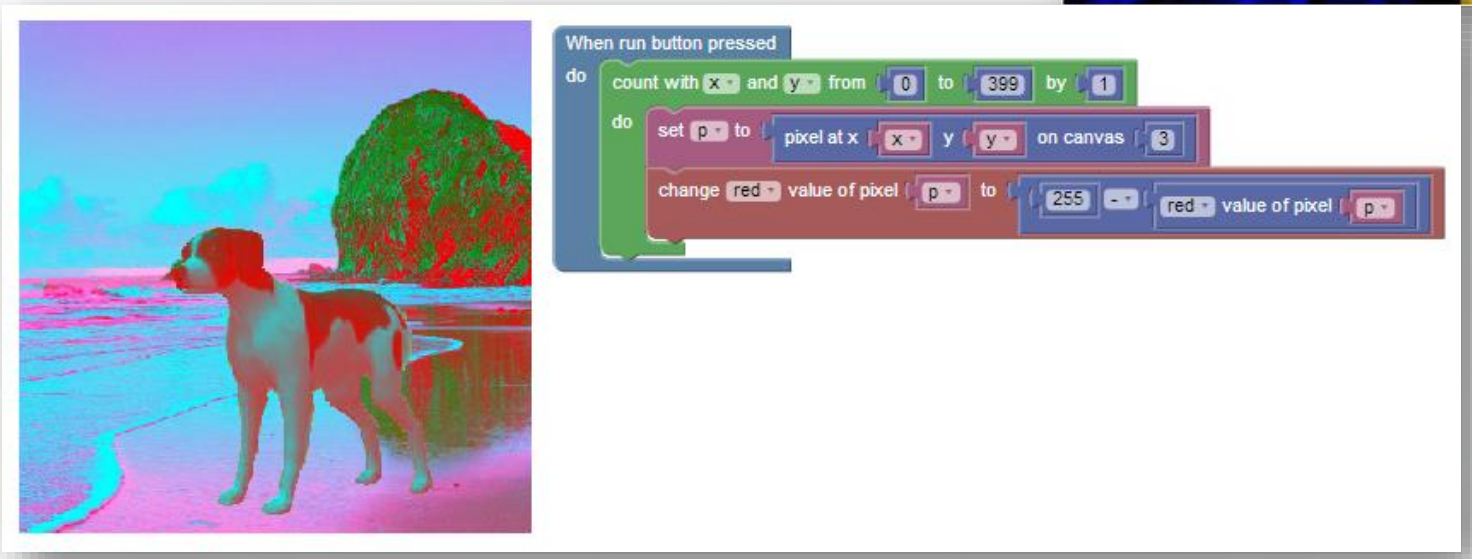






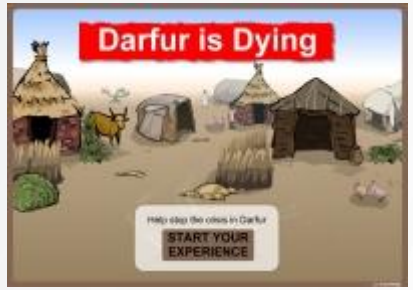
MEDIA COMPUTATION

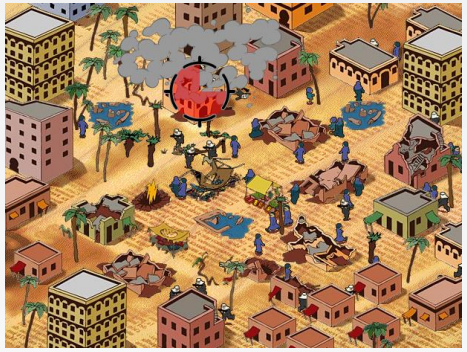
- Using computation to create art and sound



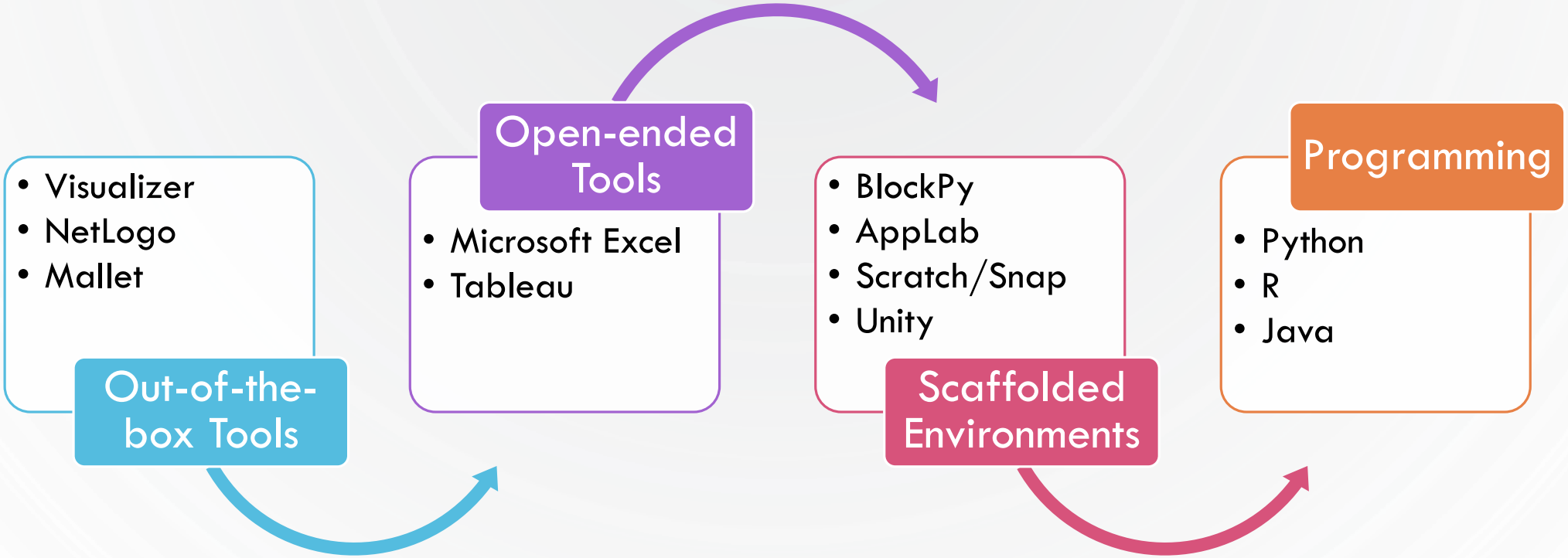
WEB/GAMES/APP DEVELOPMENT

- Actually make games, interactive websites, mobile applications
- For some purpose (to solve a real-world problem)
  - Games for change
  - Educational Games
  - Charitable websites





TOOLS FOR TEACHING CT



DISCUSSION QUESTIONS

TEACHING STRATEGIES

- Peer learning
- Active Learning
- Flipped Classroom
- Situated experience
- Project-based learning

MOTIVATION

- Provide support, reassurances
- Have plans for how students get help
- Leverage social learning
- Get computing allies
- Set expectations reasonably
- Sell the experience

CT PROFESSIONAL DEVELOPMENT

- Read online books (How to Think like a Computer Scientist)
- Try out CodeCademy
- Start a project
- Take a MOOC

ASSESSMENT IDEAS

- Correctness of algorithms
- Usefulness of abstractions
- Value of interpretations

- Rubrics
- Unit tests

WHAT'S NEXT?

- You probably already do many of these things
- Push it a bit farther
  - More computational assignments
  - Computational component to a project
- Use our course as a pre-requisite

COMPUTATIONAL THINKING

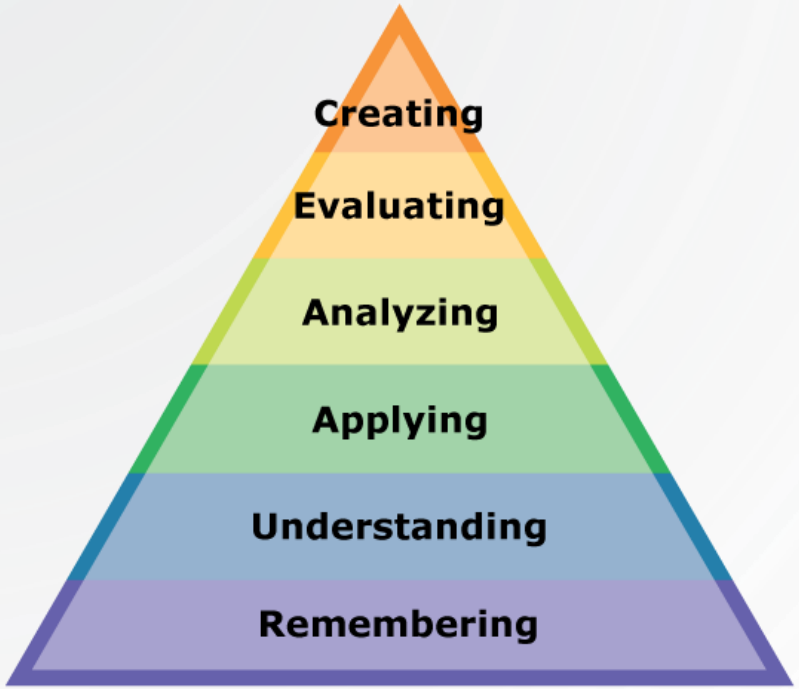
- What is it?
- How do we teach it?
- How do we know if they learned it?

FORMAL LEARNING OBJECTIVES

1. Explain the application of computational or quantitative thinking across multiple knowledge domains.
2. Apply the foundational principles of computational or quantitative thinking to frame a question and devise a solution in a particular field of study.
3. Construct a model based on computational methods to analyze complex or large-scale phenomenon.
4. Identify the impacts of computing and information technology on humanity.

COURSE INTEGRATION

- Open-ended projects
- Solving practice problems
- Learning how to use a tool
- Learning relevant terminology



HISTORY

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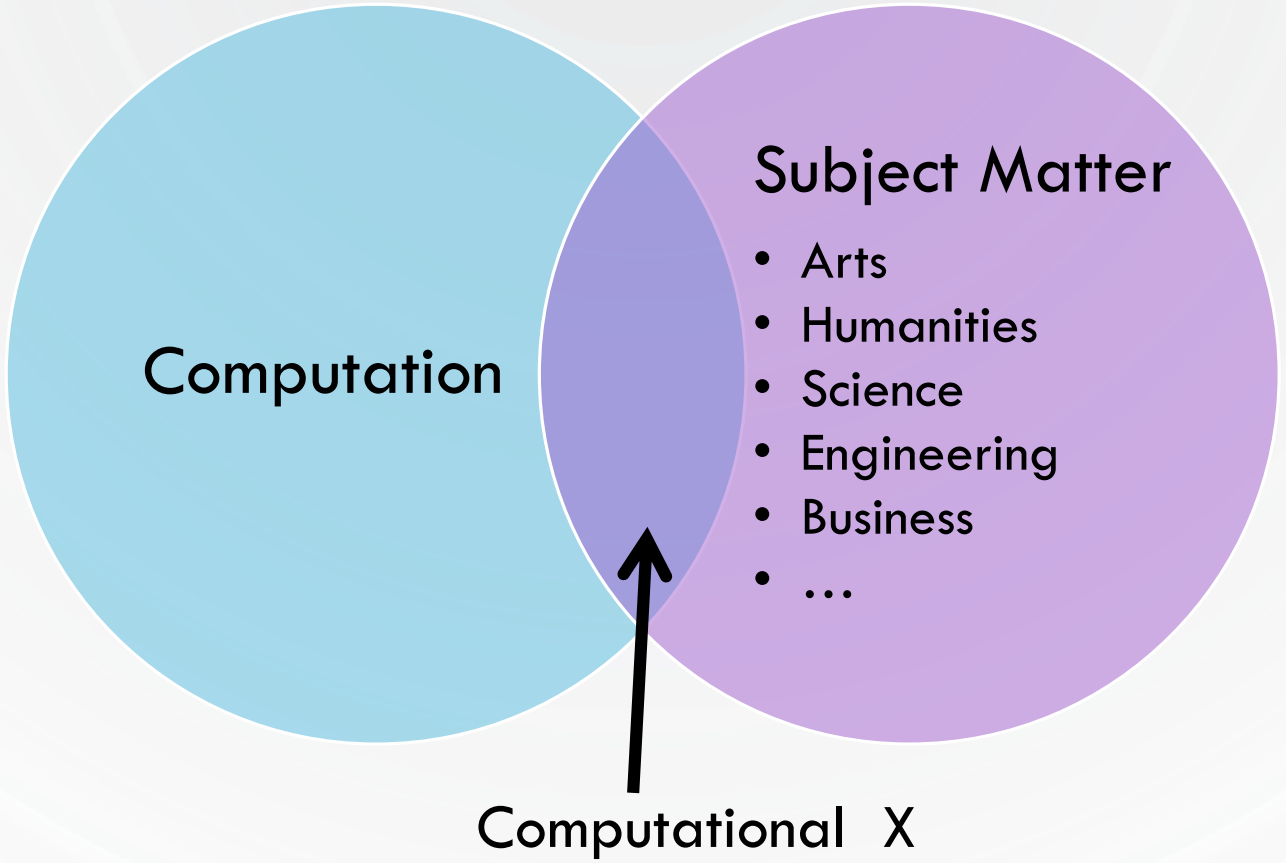
COMPUTATIONAL X



GLOBAL DEMAND

- End-user programmers are growing!
- More and more jobs involve computation

- *Need a compelling quote here*

FINAL PROJECT: OPEN-ENDED DATA SCIENCE