

Teaching Programming and Quantitative Skills to Biologist

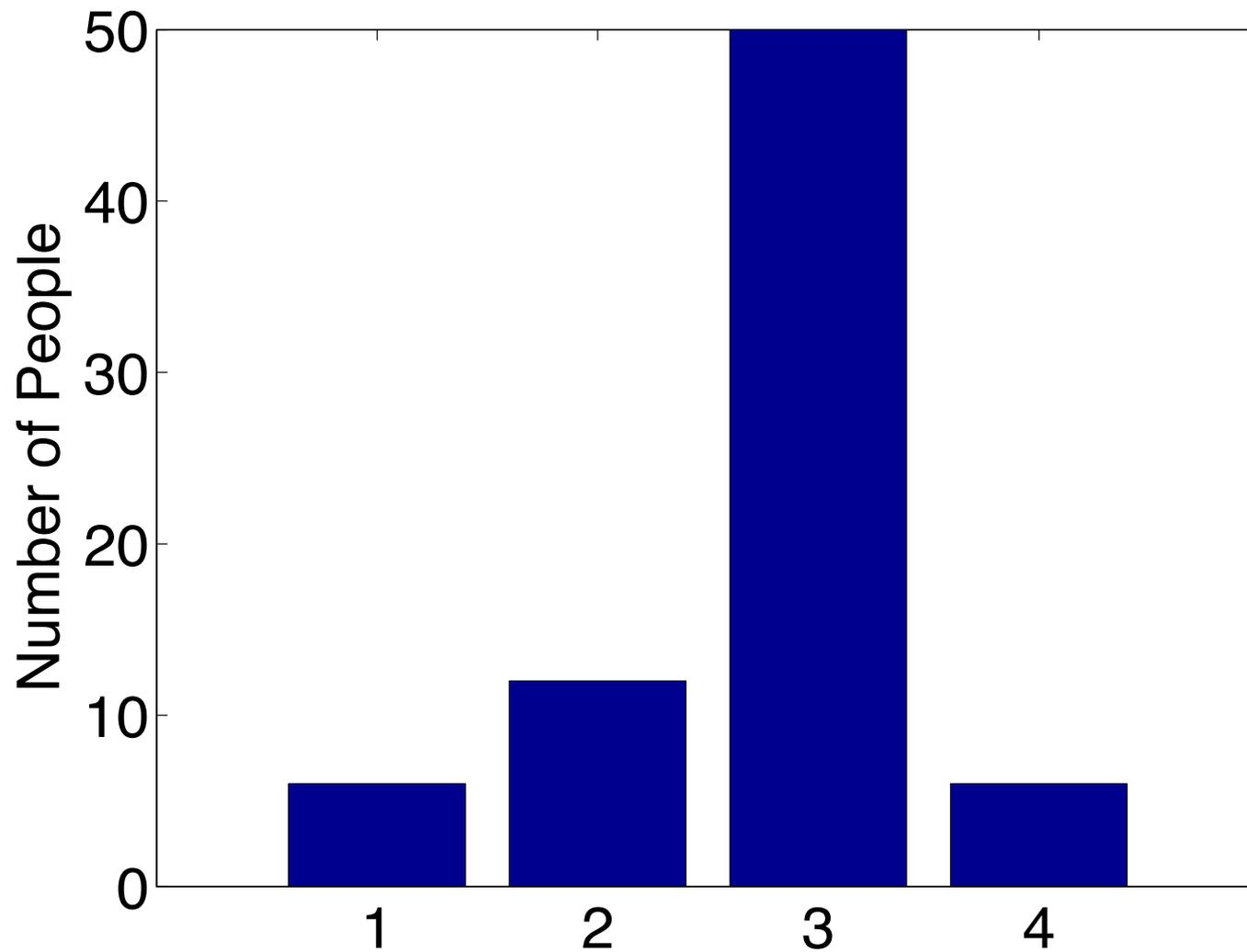
Or how I learned to stop worrying
and love math

Mike Springer
Harvard Medical School

Pick a random number:

- A. 1
- B. 2
- C. 3
- D. 4

Results



Were you random?

- First think about how you would test whether you are random.
- Now talk for a minute with your neighbor.
- Anyone want to volunteer

Big picture

- Skills – What
- Didactic - How
- Curricular – How/When

Our 'class' – Basic Programming

- Learning Goals:
 - Critical thinking
 - Dissect and analyze data/a big problem
 - Summarize and assess significance of results
 - Evaluate different methods and approaches
 - Synthesis existing tools to create new tools geared to their specific problem
- Programming is just a set of skills to reach these goals.

Our 'class' – ~~Basic Program~~ Quantitative Methods in Biology

- Learning Goals:
 - Critical thinking
 - Dissect and analyze data/a big problem
 - Summarize and assess significance of results
 - Evaluate different methods and approaches
 - Synthesis existing tools to create new tools geared to their specific problem
- Programming is just a set of skills to reach these goals.

What do we do?

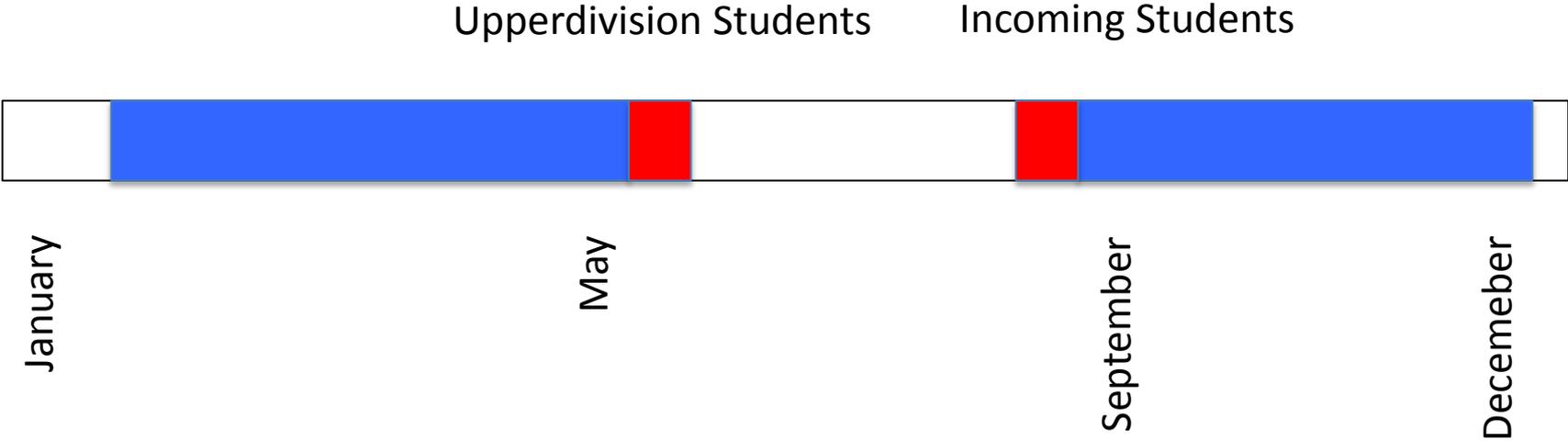
- A five day intensive boot camp



When?



When



What do we cover?

- Basic Programming Skills
- Load and Manipulate Data
- Visualize Data
- How to Analysis Quantitative Data
 - Basic image Analysis
 - Intuitive Approach to Stats (No Math)
 - Bioinformatics/“Modeling”

How are we going to motivate 'people' to learn a programming language?

- Ideally motivate with their own research.
- Quickly get to problems that mirror research questions:
 - Images -> indexing and manipulating arrays, and conditional statements
 - Randn -> data visualization and summary statistics

Class break down

- 1/2 mini-lectures – Socratic style with short examples (<5 minutes)
- 1/4 medium length (15-30 minutes)
- 1/4 long examples (1-1.5 hours)

Challenges

- When - bootcamp
- How to make it interactive?

Active learning – learning catalytics

17. multiple choice

If you only measure a small number of samples, will you usually:

- A. overestimate the standard deviation
- B. underestimate the standard deviation
- C. neither

Round 1



63 responses

A. 75%

B. 13%

C. 13%

Text, graphs, equations, ...

1. word cloud

How are you feeling about this class?

Round 1



50 responses



38 get it now
x 1 still doesn't get it

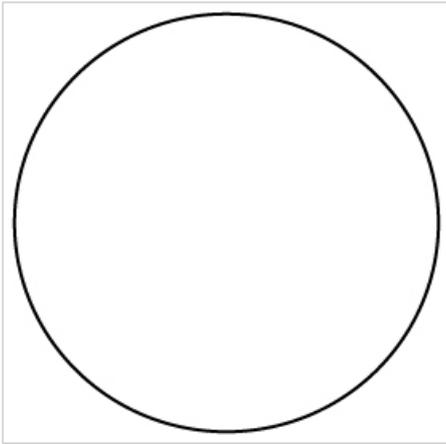
Show 100 entries

Search:

Student	Round 1			
ALEXANDER, TERESSA	I'm feeling pretty great about it! (0.00 points)	↶ Revert to previous attempt	✘ Mark incorrect (0 points)	Comment
Barth-Maroon, Asa	Good (0.00 points)	↶ Revert to previous attempt	✘ Mark incorrect (0 points)	Comment
Baum, Matthew	great! (0.00 points)	↶ Revert to previous attempt	✘ Mark incorrect (0 points)	Comment

Text, graphs, equations, ...

Draw how you are feeling today?



42 responses



Peer-2-peer

What will x equal. Don't use MATLAB to figure this out >> x=3; >> y=x-2; >> x=(x-y*2)^2+1

Round 1

67 responses, 51% correct

1: 3%

2: 51%

3: 3%

5: 16%

10: 1%

17: 22%

48: 1%

Round 2

64 responses, 84% correct

2: 84%

5: 9%

17: 5%

Show 10 entries

Search:

Student	Round 1	Round 2
, Amy	2 Mark as incorrect	2 Mark as incorrect
, Andrew	1 Mark as correct	2 Mark as incorrect
, Annie	2 Mark as incorrect	2 Mark as incorrect
, Jake	10 Mark as correct	2 Mark as incorrect
, Jamie	2 Mark as incorrect	2 Mark as incorrect
, Jeff	17 Mark as correct	2 Mark as incorrect
, Megan	2 Mark as incorrect	2 Mark as incorrect
, Shannon	2 Mark as incorrect	2 Mark as incorrect
, Stefan	2 Mark as incorrect	2 Mark as incorrect
, Youjin	2 Mark as incorrect	2 Mark as incorrect

Showing 1 to 10 of 68 entries



Challenges

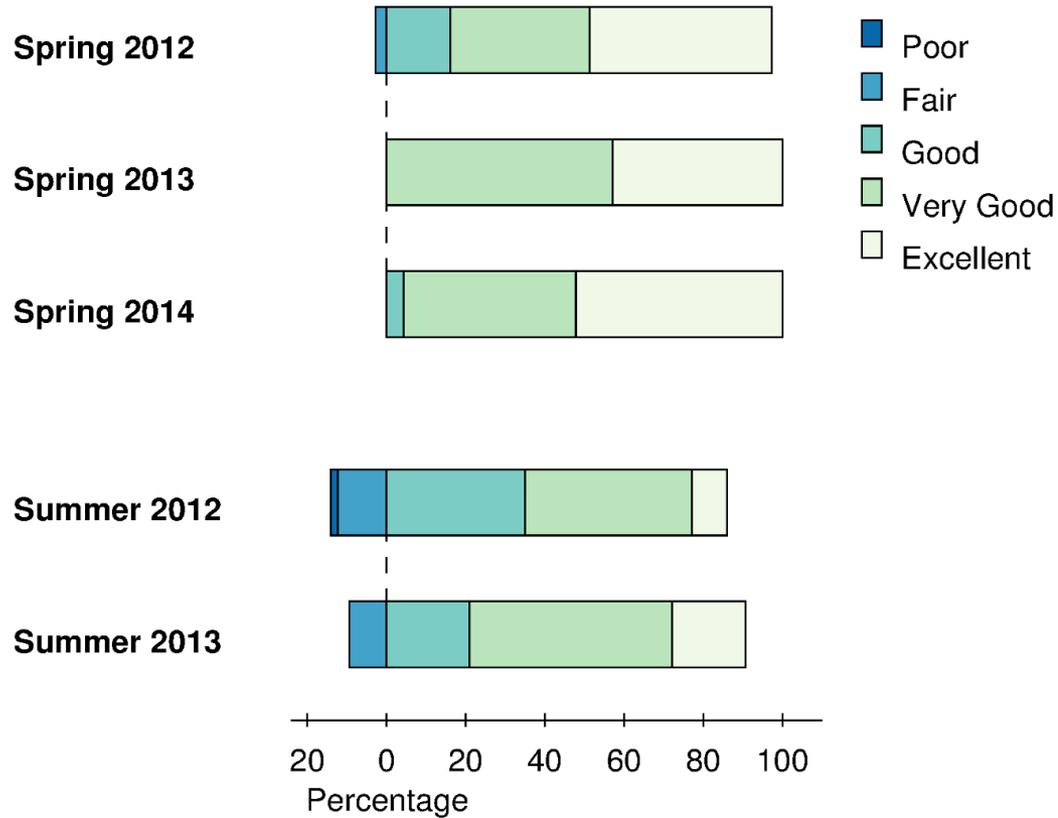
- When - bootcamp
- How to make it interactive? – Learning catalytics, Socratic style, examples
- Scalability – Learning catalytics
- Diverse background and attrition?

<5% Attrition

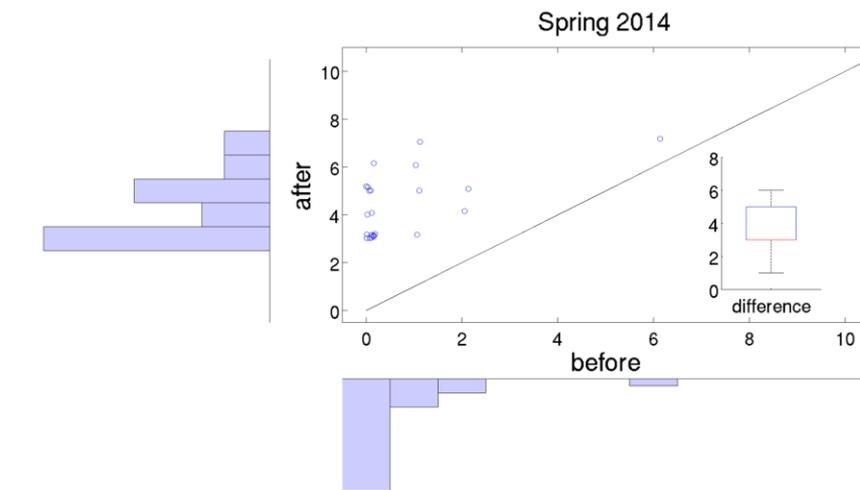
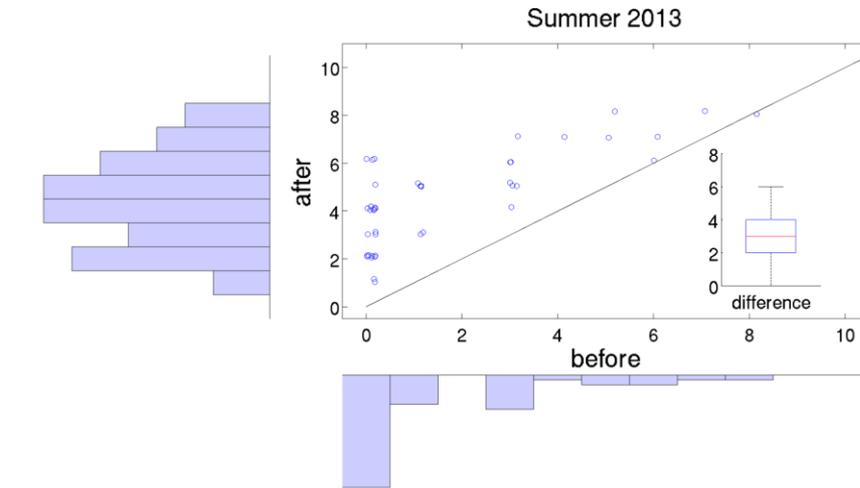
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
		Red	Green	Red	Green	
	Red	Green	Red	Green	Red	

How are we doing?

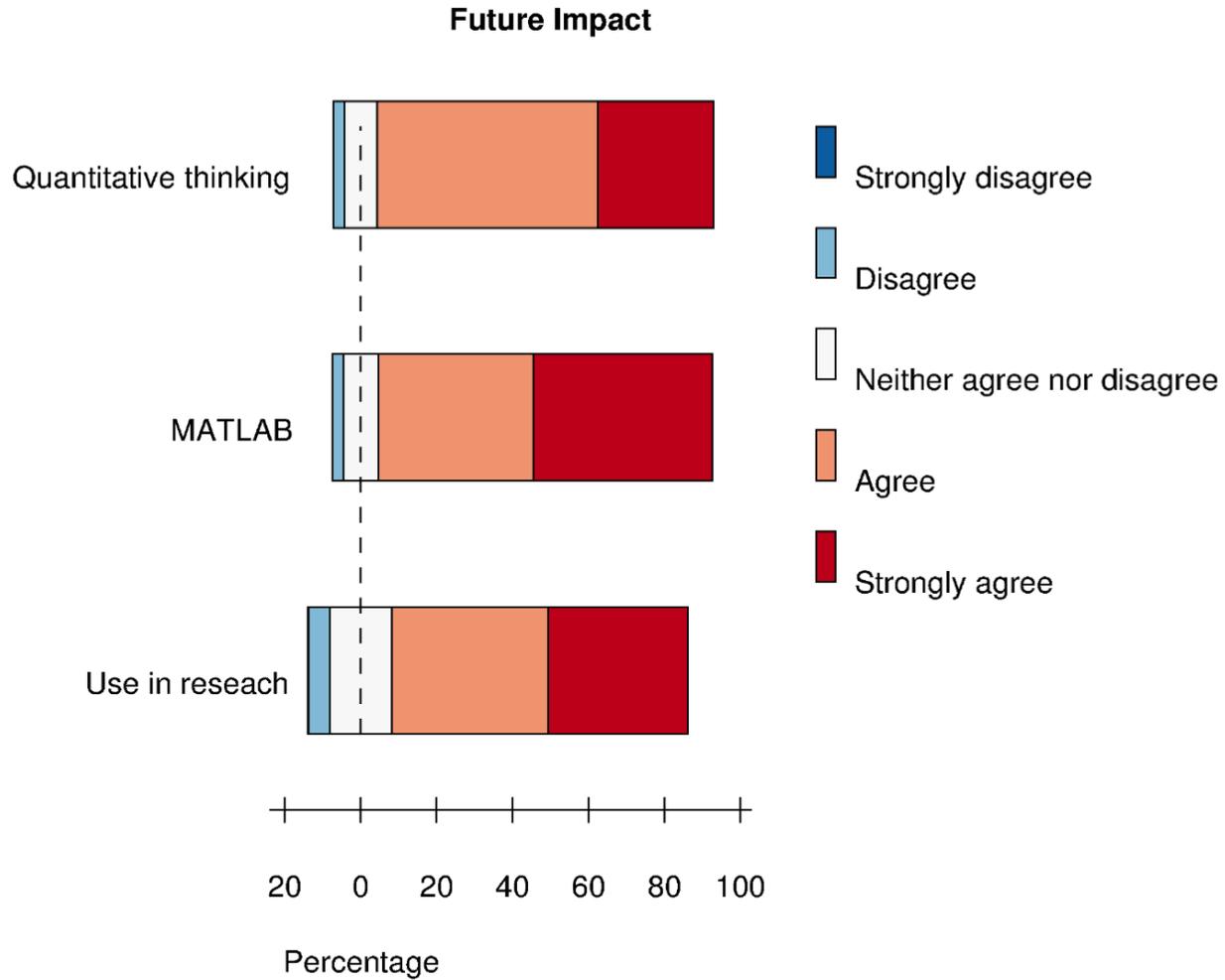
Please rate the course overall



How are we doing?



How are we doing?



How are we doing?

- In some ways we are a failure ...

A second didactic rant

- Moving from standard lectures to active learning approaches

Learning tools versus learning to use tools

- A ship is carrying 10 sheep and 16 goats.
- How old is the captain?

It is very important that you learn about traxoline.

Traxoline is a new form of zionter. It is montilled in Ceristanna. The Ceristannians gristerlate large amounts of fevon and then brachter it to quasel traxoline. Traxoline may well be one of our most lukized snezlaus in the future because of our zionter lescelidge.

Directions: Answer the following questions in complete sentences.

1. What is traxoline?
2. Where is traxoline montilled?
3. How is traxoline quaselled?
4. Why is it important to know about traxoline?

---Judy Lanier

Did you “Learn” Anything?



- *Science is built up of facts, as a house is with stones. But a collection of facts is no more a science than a heap of stones is a house. -- Poincare*

Assessment should cover a range of levels

Bloom's Taxonomy is a guide to levels of assessment

Evaluation: Assess or judge quality, evaluate, criticize

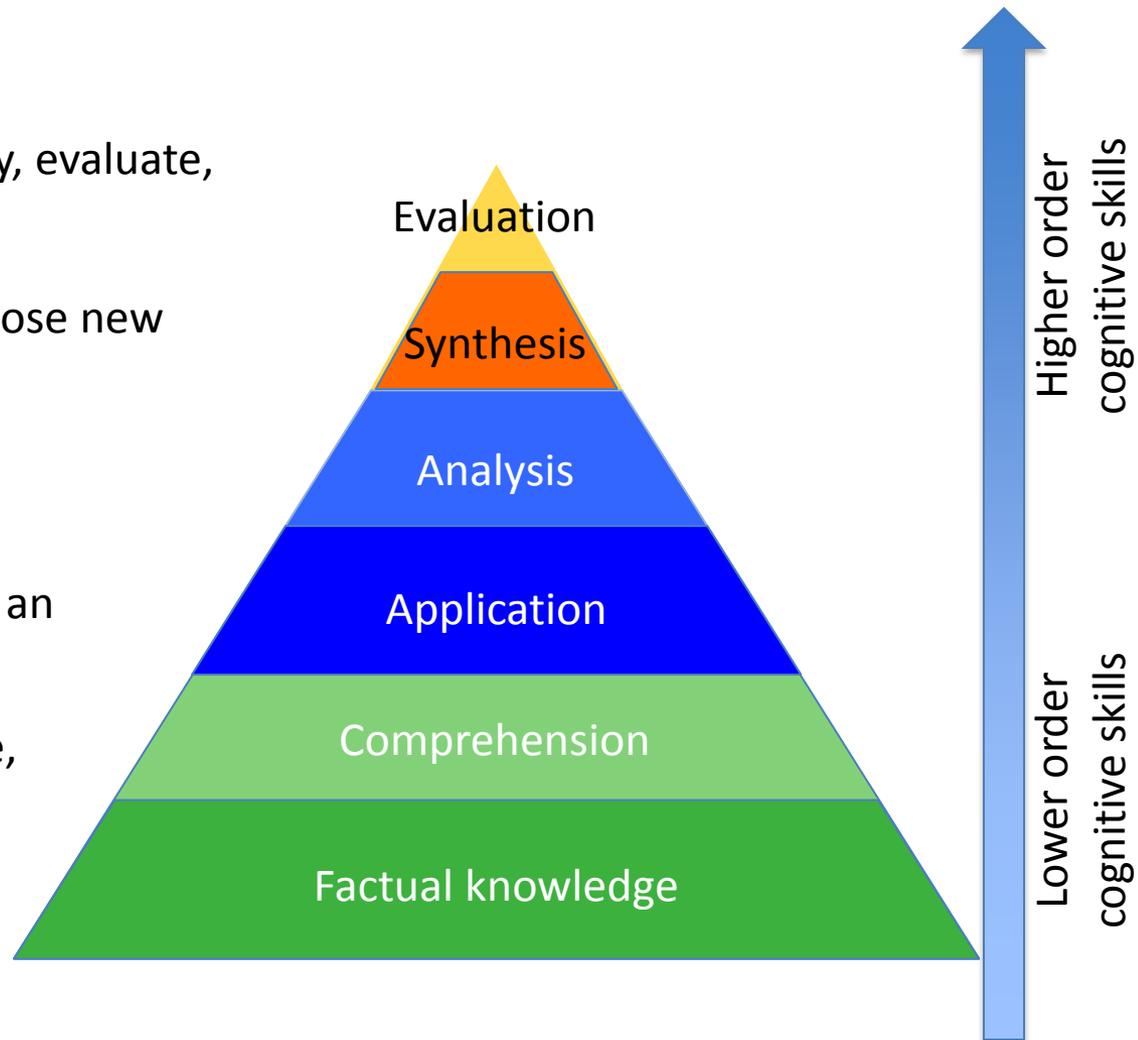
Synthesis: Create new ideas, propose new experiment

Analysis: Analyze, compare and contrast, predict

Application: Apply information to an unfamiliar situation, solve, predict

Comprehension: Explain, describe, summarize

Factual knowledge: Define, Recall, Identify



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