

# Transforming Practices in K-12 Mathematics Education: The Role of Computational Thinking, Data Science, and AI



**Padhu Seshaiyer**

Professor and Director  
George Mason University, USA  
Email: [pseshaiy@gmu.edu](mailto:pseshaiy@gmu.edu)



A Workshop and Webinar Series on  
International Practices in K-12 Mathematics  
Education: The Role of Computational  
Thinking, Data Science, and AI

# Future of Jobs Report 2025

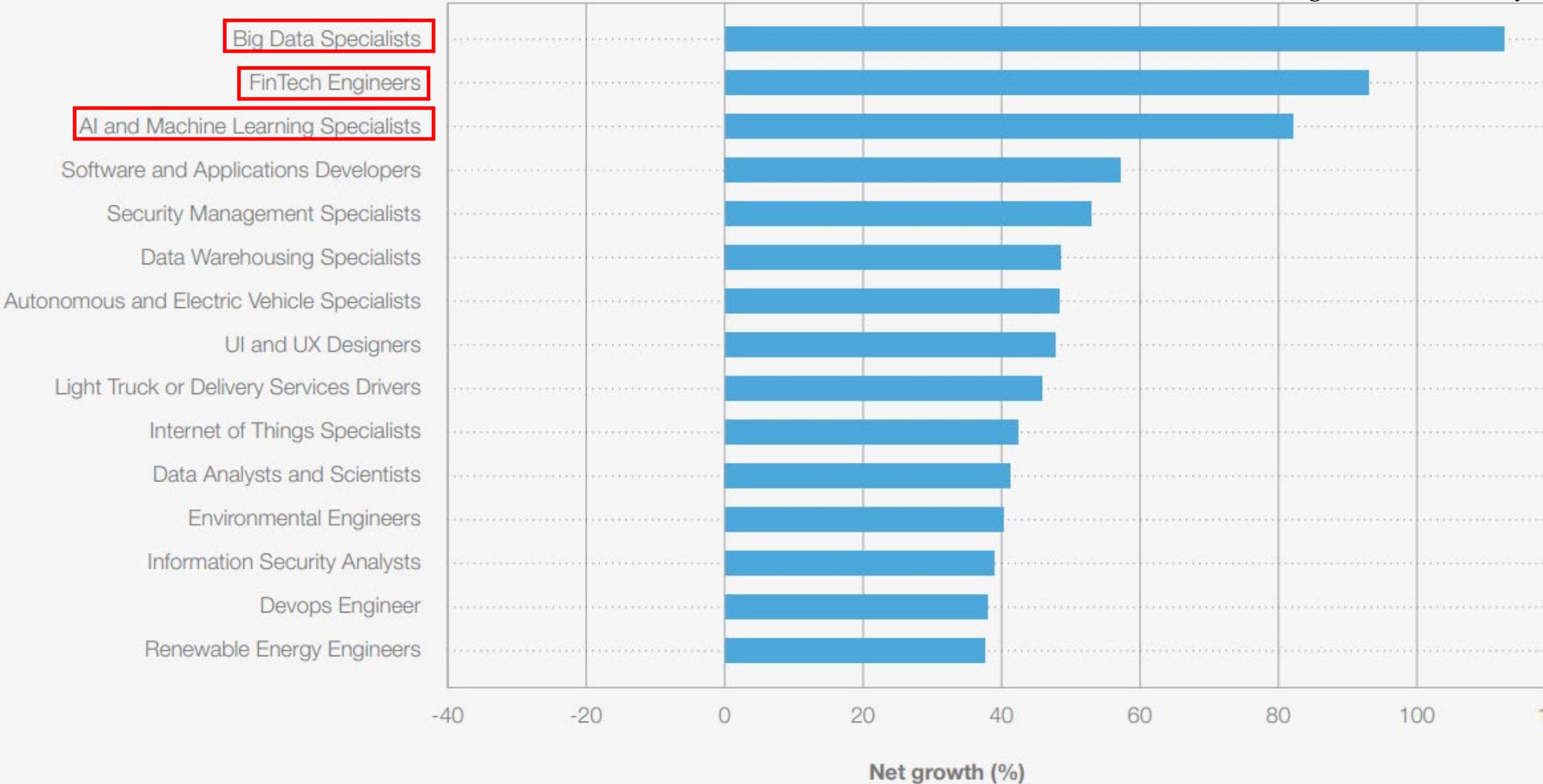
INSIGHT REPORT  
JANUARY 2025

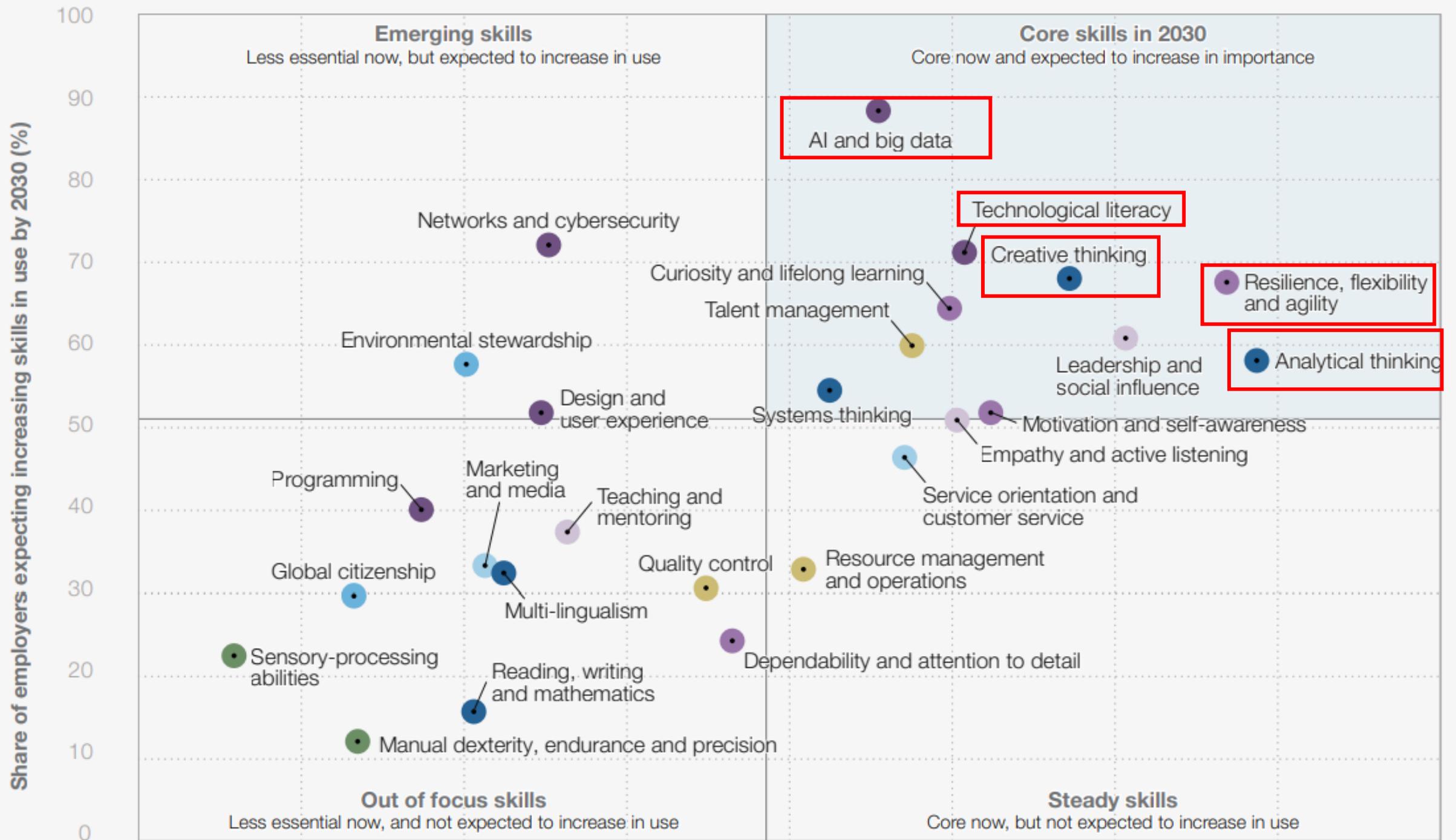
*What do you think are the top fastest growing jobs and the core skills needed by 2030?*



# Top fastest growing jobs

*Padmanabhan Seshaiyer  
George Mason University*







**Let's try this together!**

# 21st-Century Skills

**Foundational Literacies**  
How students apply core skills to everyday tasks

-  1. Literacy
-  2. Numeracy
-  3. Scientific literacy
-  4. ICT literacy
-  5. Financial literacy
-  6. Cultural and civic literacy

**Competencies**  
How students approach complex challenges

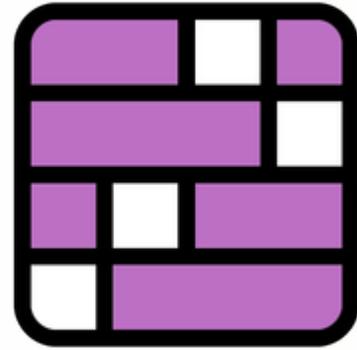
-  7. Critical thinking/ problem-solving
-  8. Creativity
-  9. Communication
-  10. Collaboration

**Character Qualities**  
How students approach their changing environment

-  11. Curiosity
-  12. Initiative
-  13. Persistence/ grit
-  14. Adaptability
-  15. Leadership
-  16. Social and cultural awareness

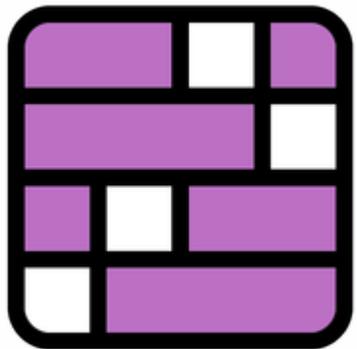
**Lifelong Learning**

# Connections



<b>Pattern Recognition</b>	<b>Claude</b>	<b>ChatGPT</b>	<b>Test</b>
<b>Llama</b>	<b>Train</b>	<b>Visualization</b>	<b>Problem Decomposition</b>
<b>Predict</b>	<b>Algorithmic Thinking</b>	<b>Collection</b>	<b>Gemini</b>
<b>Abstraction</b>	<b>Modeling</b>	<b>Learn</b>	<b>Cleaning</b>

**Popular Large Language Models (LLM)**  
*ChatGPT, Gemini, Llama, Claude*





 Claude

  
ChatGPT

  
Gemini

AI  
COMPARISON  
2026

  
LLaMA

# What is the smallest integer whose square is between 15 and 30?

ChatGPT 4o mini ▾

Log in



To find the smallest integer whose square is between 15 and 30, we can start by finding the square roots of 15 and 30 to approximate the range.

- $\sqrt{15} \approx 3.87$
- $\sqrt{30} \approx 5.48$

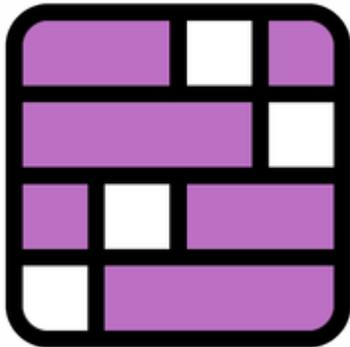
We are looking for an integer whose square is between 15 and 30. The integer must be between 3.87 and 5.48, so the possible candidates are 4 and 5.

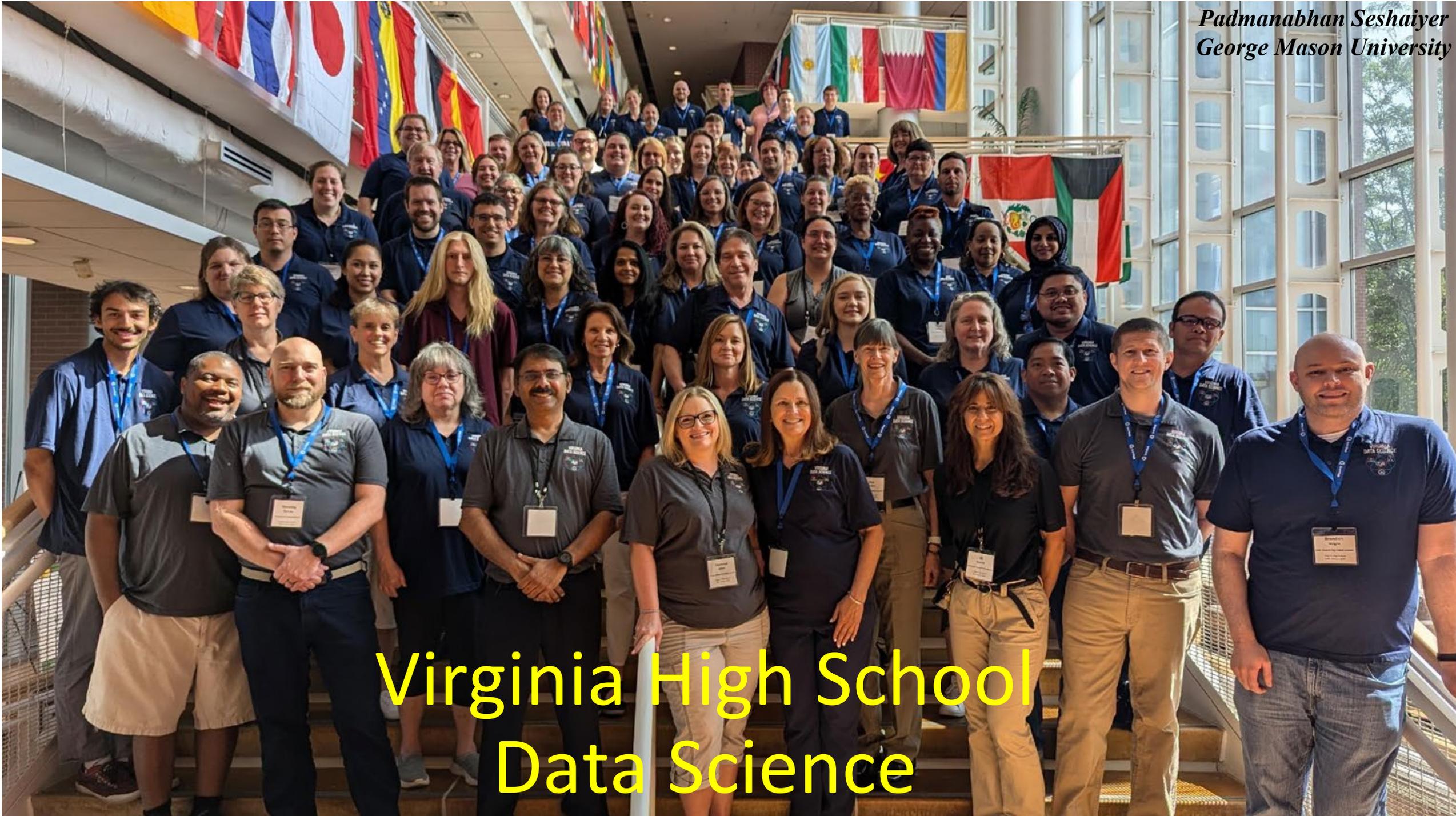
- $4^2 = 16$
- $5^2 = 25$

Since 16 is the smallest square in this range, the  smallest integer whose square is between 15 and 30 is 4.

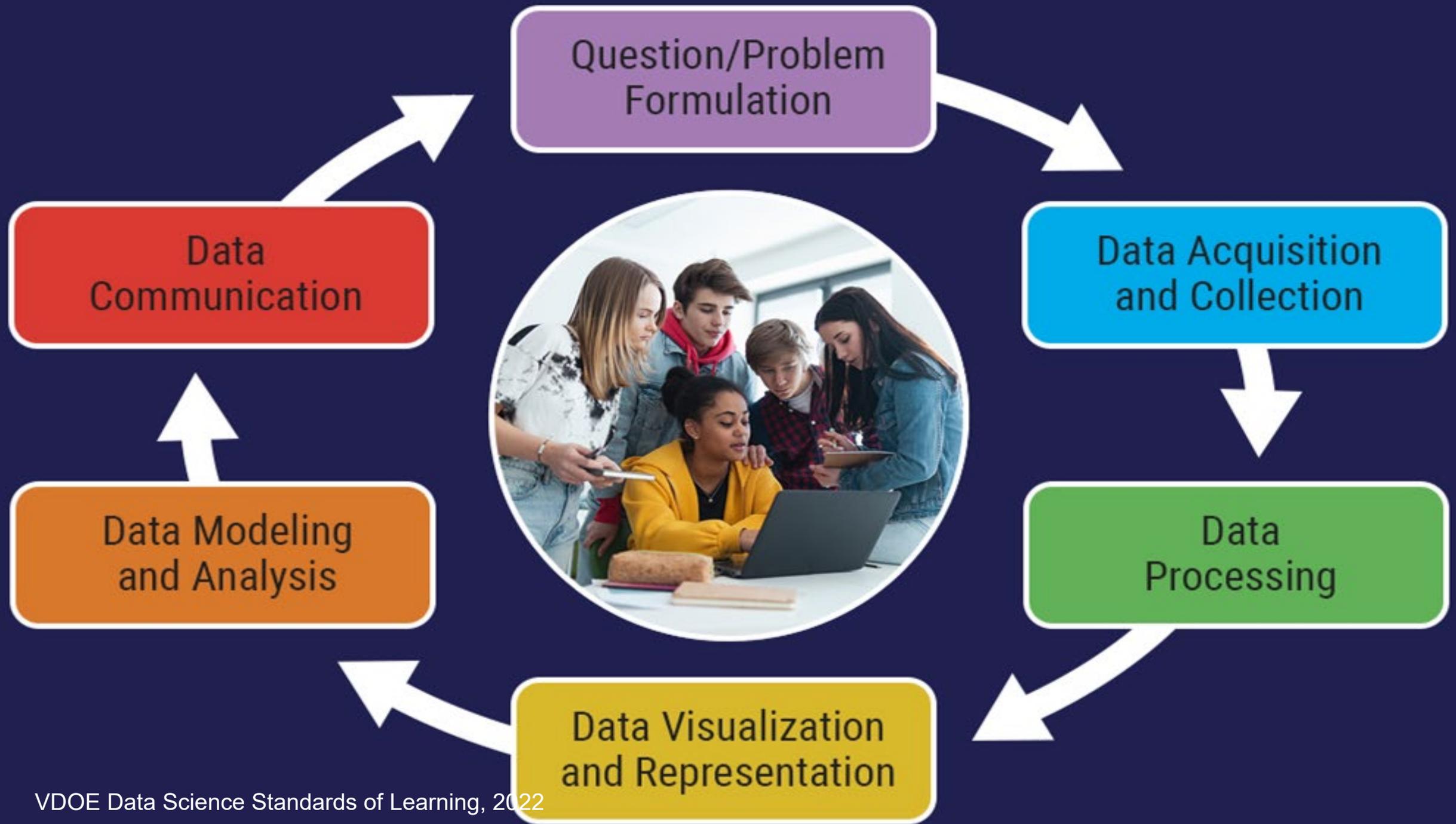
**Popular Large Language Models (LLM)**  
*ChatGPT, Gemini, Llama, Claude*

**Data Science Proficiencies**  
*Collection, Cleaning, Visualization, Modeling*





# Virginia High School Data Science



Question/Problem Formulation

Data Acquisition and Collection

Data Processing

Data Visualization and Representation

Data Modeling and Analysis

Data Communication



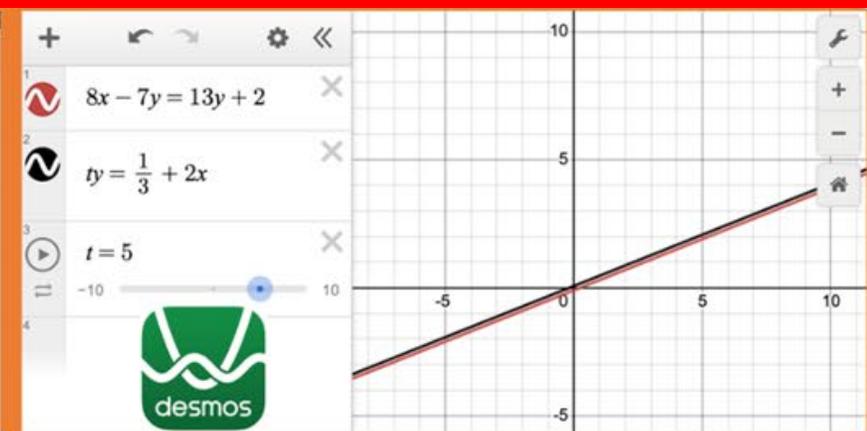
**Common Online Data Analysis Platform (CODAP)**  
Open-source software for dynamic data exploration

For Educators For Developers

CODAP is free educational software for data analysis.

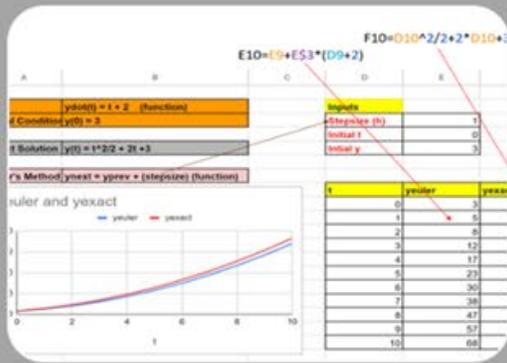
# No-Code

- DESMOS
- CODAP



# Low-Code

- CODAP
- Google Sheets



Animals Dataset - All changes saved to Google Drive

id	name	species	sex	age (years)	thead	legs	weight (lbs)	time to adopt (weeks)
1	Sasha	cat	female	1	false	4	6.6	5
2	Shirley	rabbit	female	2	true	4	5.6	6
3	Miguel	cat	female	2	true	4	7.4	1
4	Sunflower	cat	female	6	true	4	8.1	6
5	Felix	cat	male	16	true	4	9.2	5
6	Shelby	cat	female	7	true	4	6.4	6
7	Bella	small	hermap...	0.5	false	0	0.1	3
8	Snuggles	cat	female	2	true	4	6.6	5
9	Vlad	cat	male	1	false	4	5.2	1
10	Hershey	cat	male	2	false	4	15.4	2
11	Triggie	dog	female	2	true	4	48	1
12	Bon-bon	dog	male	11	true	4	123	24
13	Ernie	dog	male	4	true	4	92	3
14	Midnight	dog	female	5	false	4	70	2
15	Lex	dog	male	1	false	4	18.9	8

Google Sheets IF, AND, OR, IFS formulas with examples

File Edit View Insert Format Data Tools Extensions Help

100% \$ % 0.00 123 Courie... - 12 +

E4 =IF(AND(D1>0,D2>0,D3>0),SUM(B2:B),"Nothing")

Month	Invoices
January	\$5,000.00
February	\$6,000.00
March	\$4,500.00
April	\$7,200.00
May	\$3,800.00
June	\$4,700.00
July	\$5,100.00
August	\$6,300.00
September	\$4,800.00
October	\$5,800.00
November	\$3,200.00
December	\$4,500.00

\$60,900.00

# High-Code

- Python
- R

```

import numpy as np

x_min = 0
x_max = 1
y_min = 0
y_max = 1

def f(x):
    return sqrt(1 - x ** 2)

def monte_carlo(f, n):
    area = (x_max - x_min)*(y_max - y_min) # Area of the rectangle
    s = 0 # Success counter
    for i in range(n):
        rx = np.random.uniform(x_min, x_max)
        ry = np.random.uniform(x_min, y_max)
        if ry <= f(rx):
            s += 1
    return s * area/n
    
```

Untitled2.ipynb

File Edit View Insert Runtime Tools Help All changes saved

Code Text

```
print("Hello World!")
```

Hello World!

python + colab

R environment

R script

R console

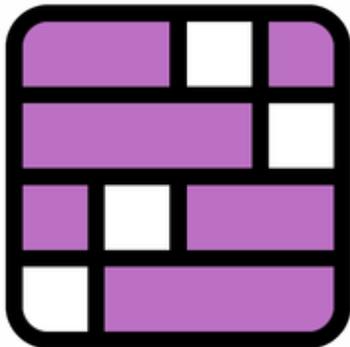
Graphical output

Biomass estimation per plot with different models

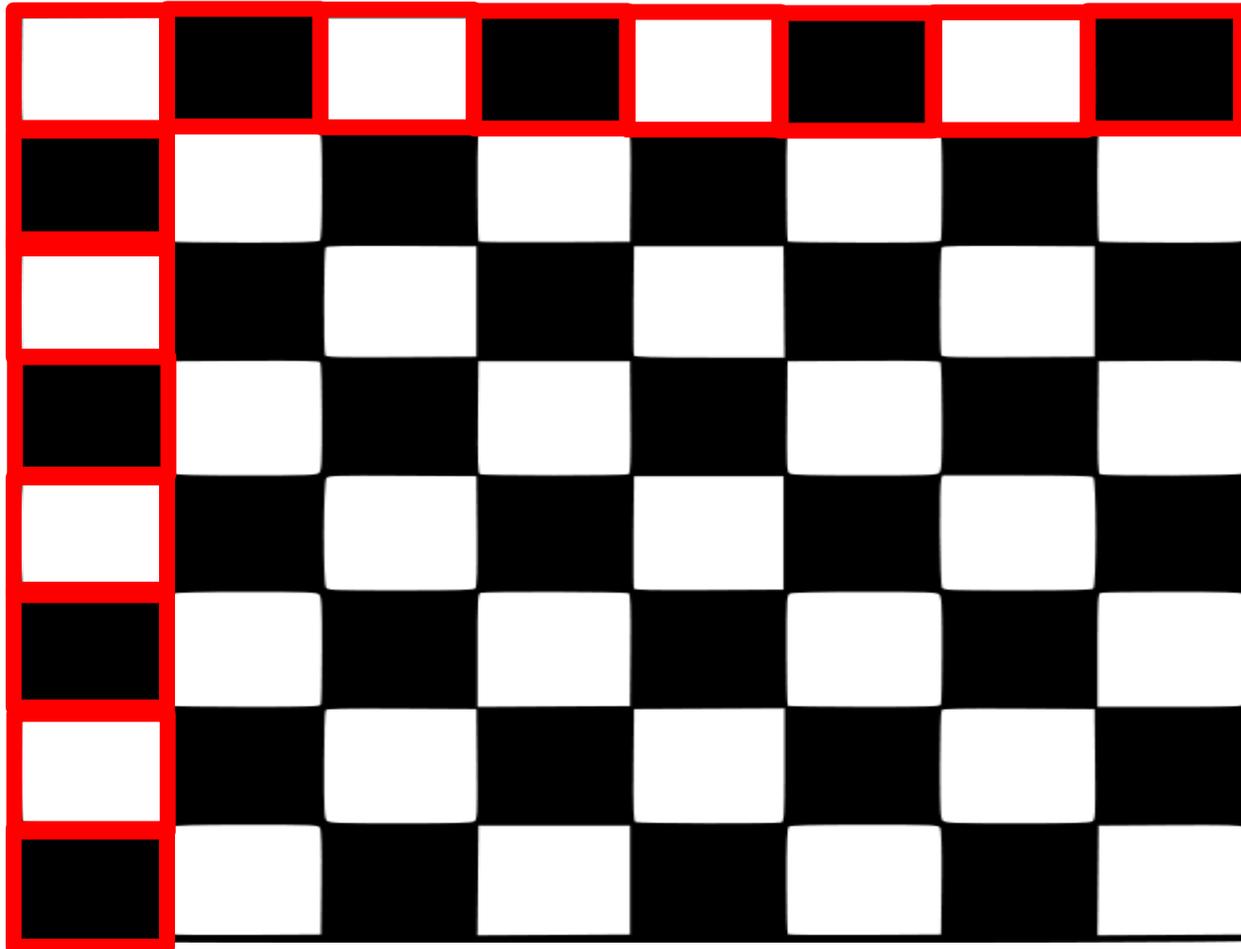
**Popular Large Language Models (LLM)**  
*ChatGPT, Gemini, Llama, Claude*

**Data Science Proficiencies**  
*Collection, Cleaning, Visualization, Modeling*

**Pillars of Computational Thinking**  
*Problem Decomposition, Pattern Recognition, Abstraction,  
Algorithmic Thinking*

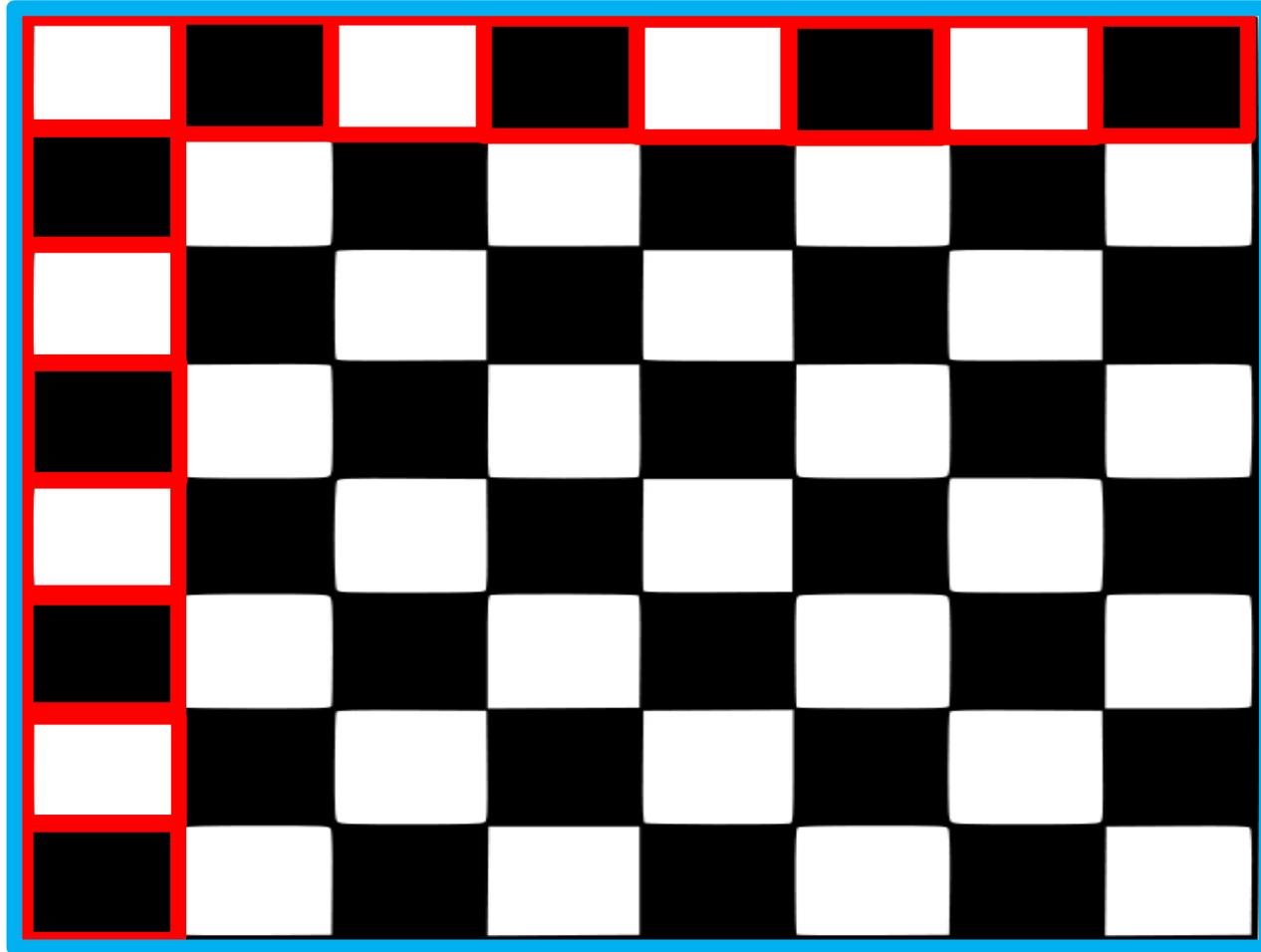


How many squares do you see?



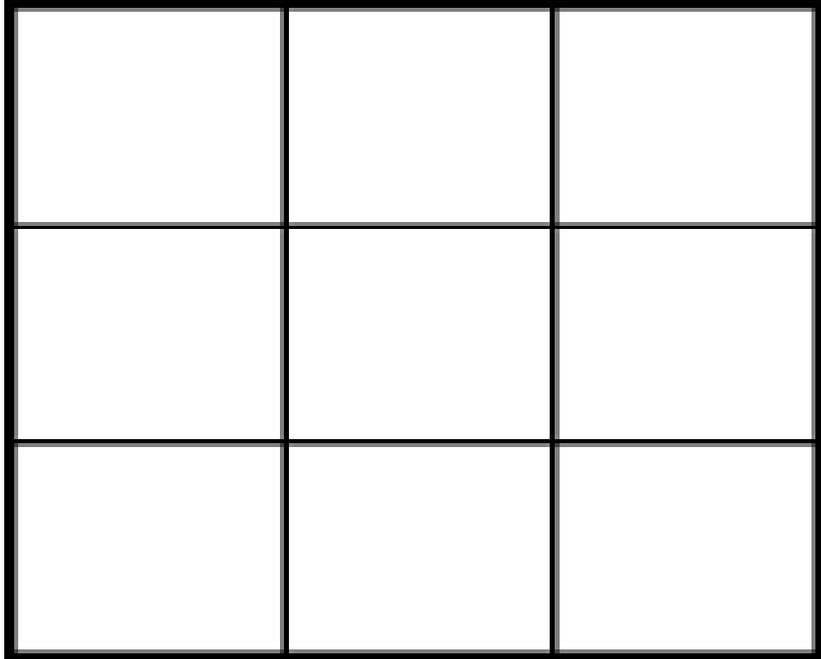
**Pattern  
Recognition**

How many squares do you see?



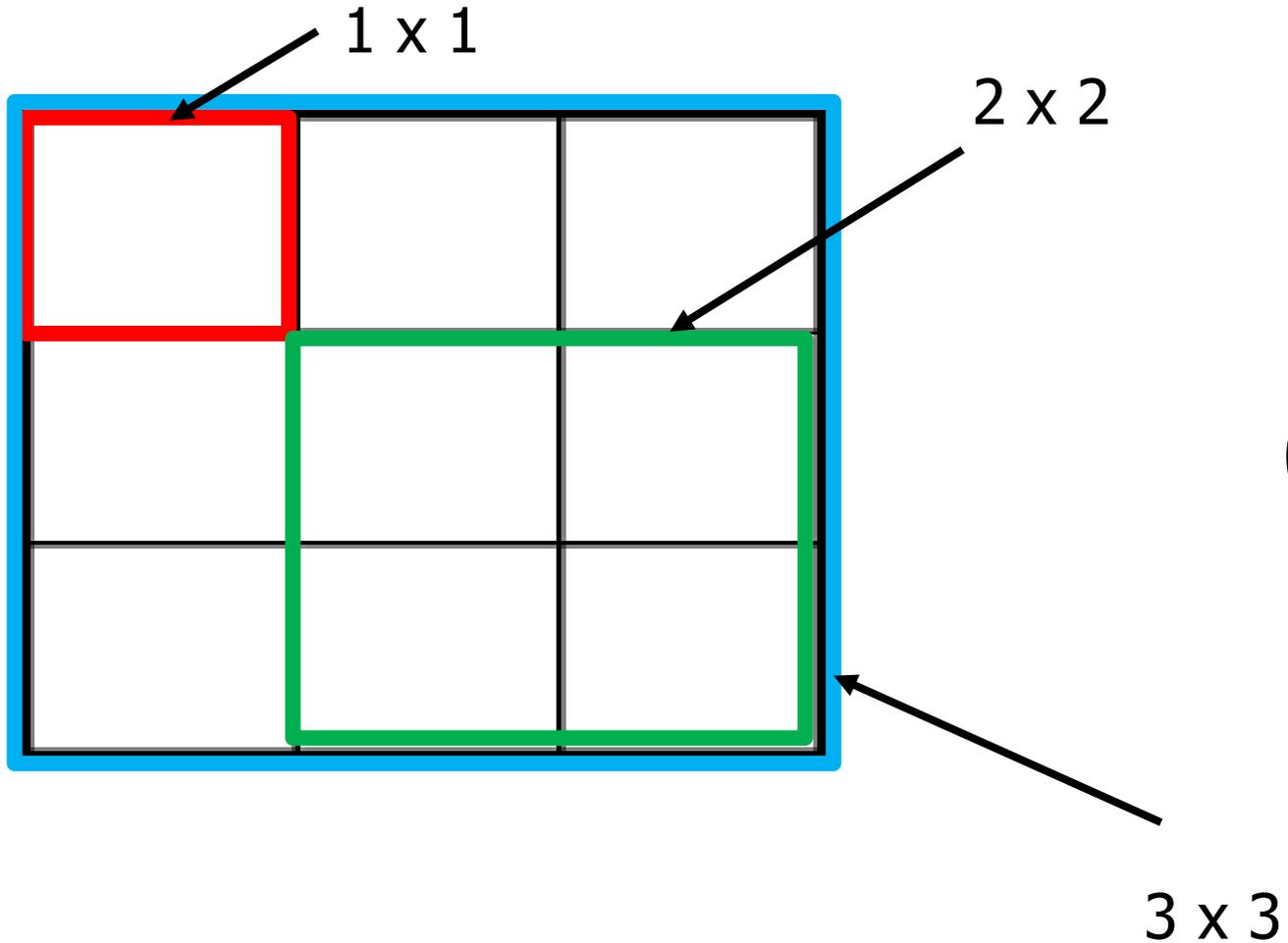
**Critical  
Thinking**

How many squares do you see?



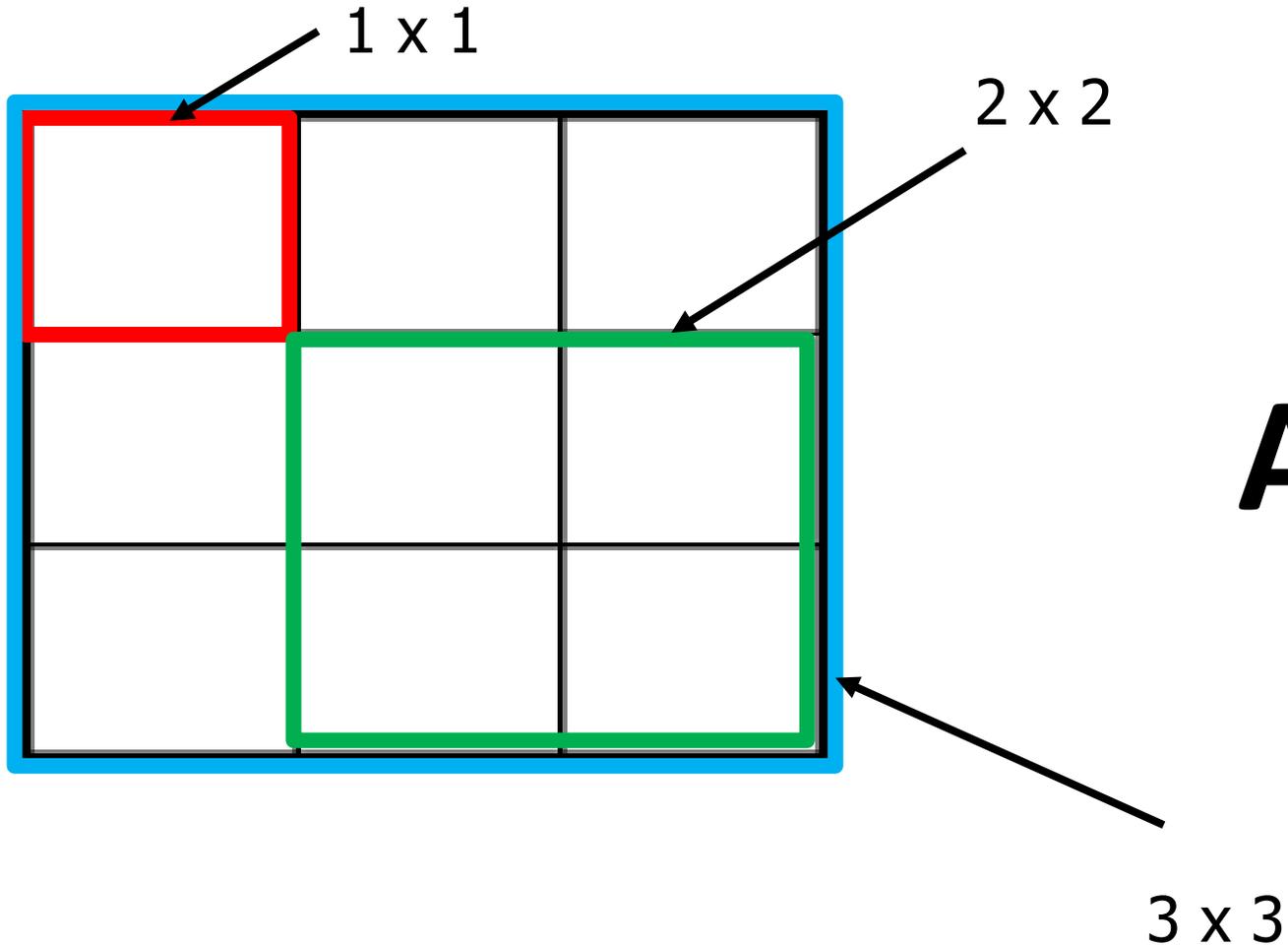
**Problem  
Decomposition**

# How many squares do you see?



# Creativity

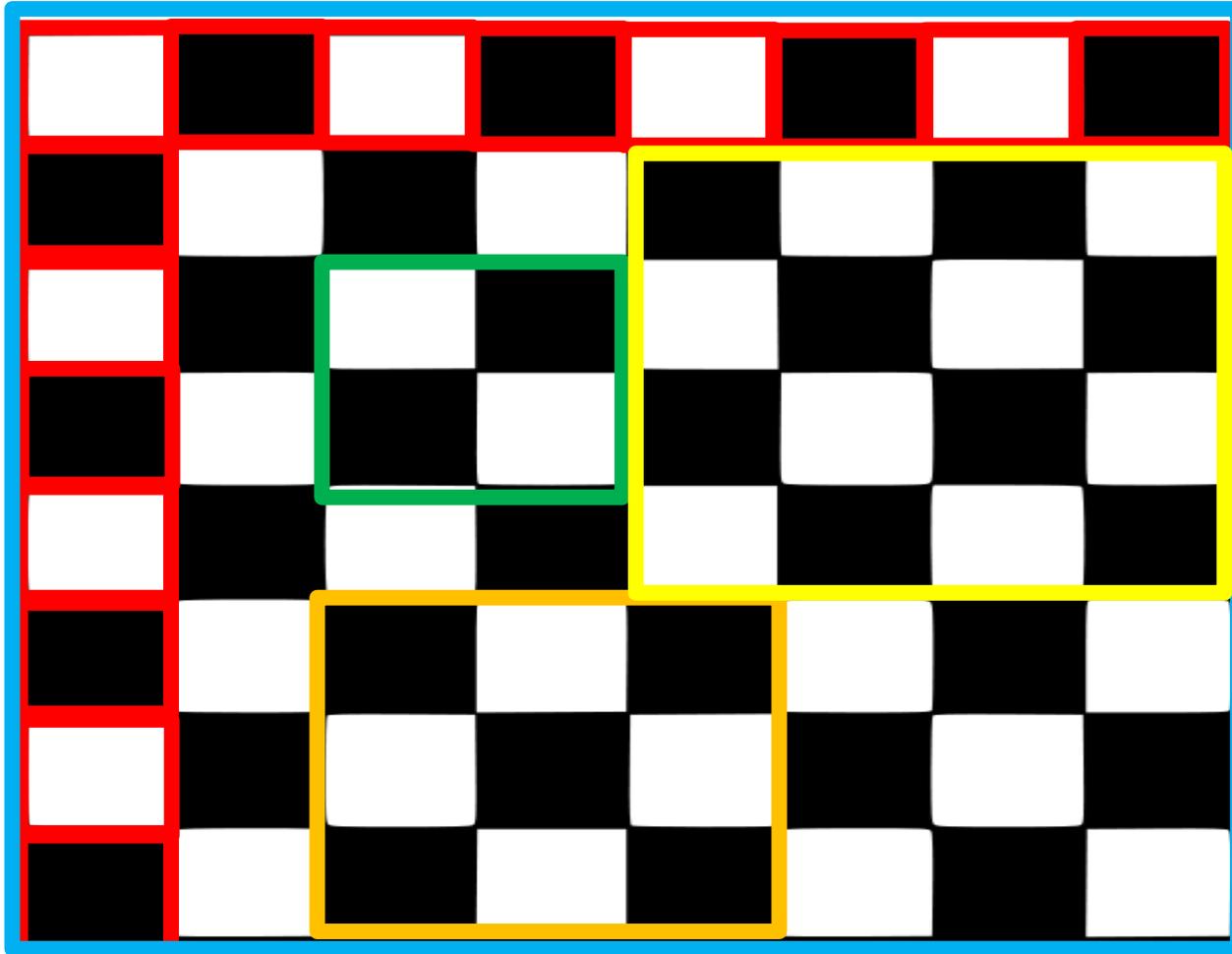
# How many squares do you see?



## Algorithms

$$1^2 + 2^2 + 3^2$$

How many squares do you see?

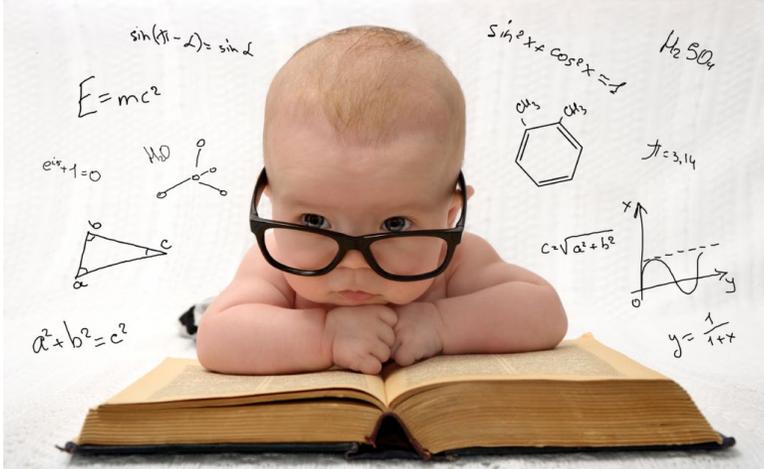


**Abstraction**

# How many squares do you see?

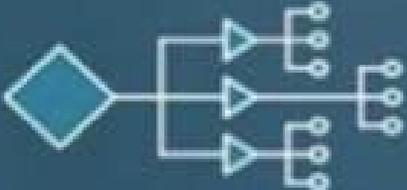


$$1^2 + 2^2 + 3^2 + \dots + n^2 = \frac{n(n+1)(2n+1)}{6}$$



# Computational Thinking

**Decomposing**



**Abstraction**



**Pattern recognition**



**Algorithms**

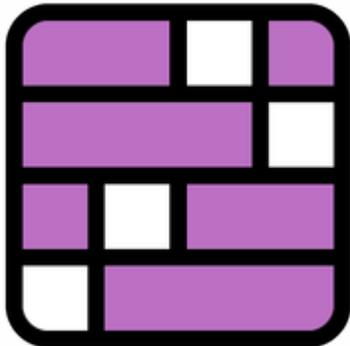


**Popular Large Language Models (LLM)**  
*ChatGPT, Gemini, Llama, Claude*

**Data Science Proficiencies**  
*Collection, Cleaning, Visualization, Modeling*

**Pillars of Computational Thinking**  
*Problem Decomposition, Pattern Recognition, Abstraction,  
Algorithmic Thinking*

**Components of Machine Learning**  
*Train, Learn, Test, Predict*



# WHAT IS ARTIFICIAL INTELLIGENCE?

## Machine Learning

Using sample data to train computer programs to recognize patterns based on algorithms.



## Neural Networks

Computer systems designed to imitate the neurons in a brain.



## Natural Language Processing

The ability to understand speech, as well as understand and analyze documents.

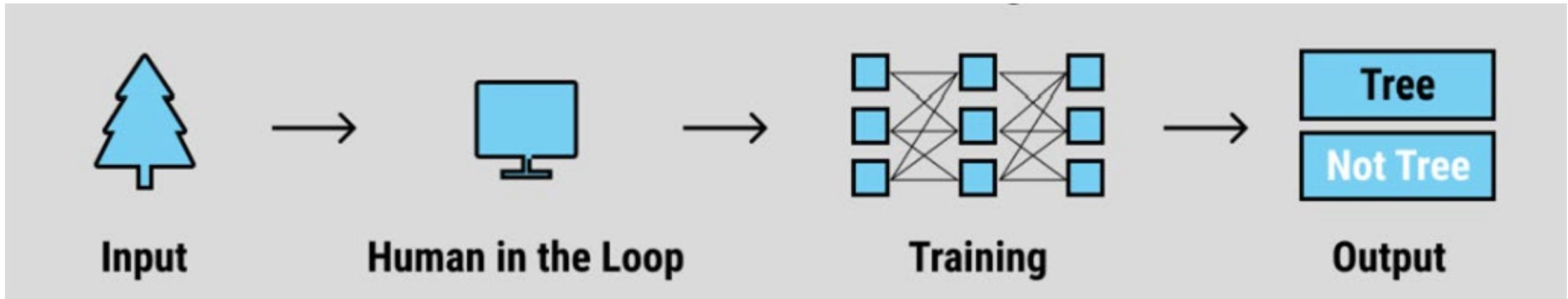


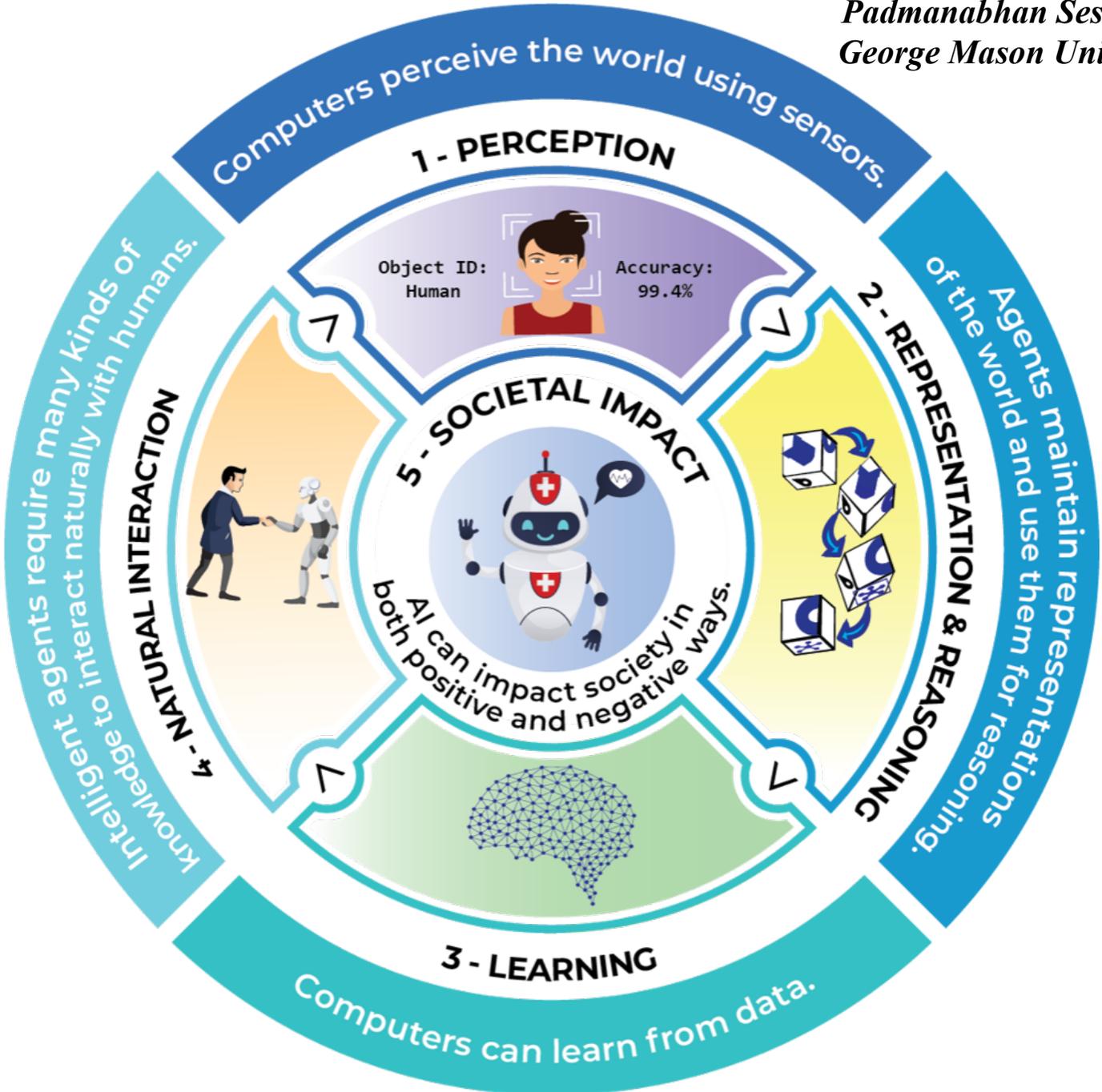
## Robotics

Machines that can assist people without actual human involvement.

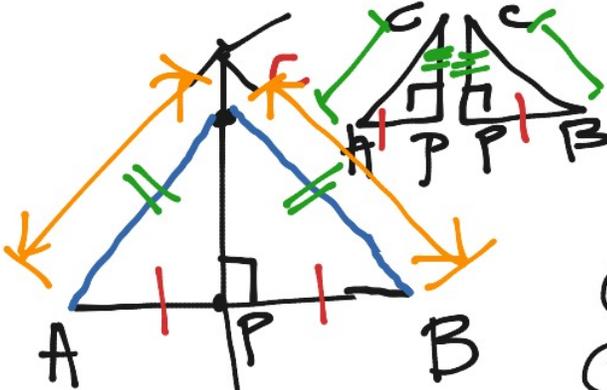


# Foundations of Machine Learning





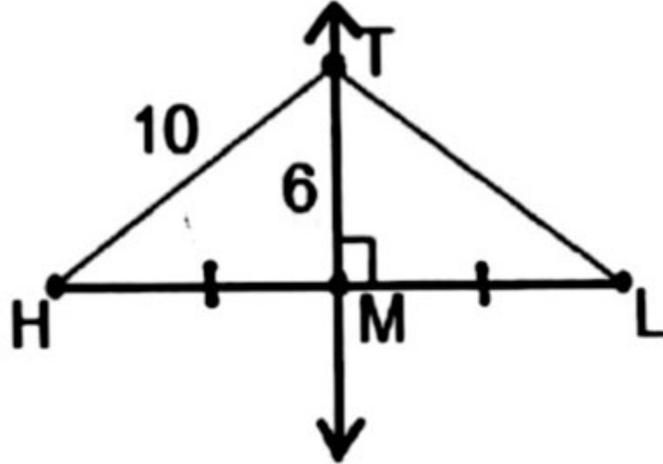
# Remember from High School Geometry



Given:  $\overleftrightarrow{CP}$  is  $\perp$  bisector of  $\overline{AB}$

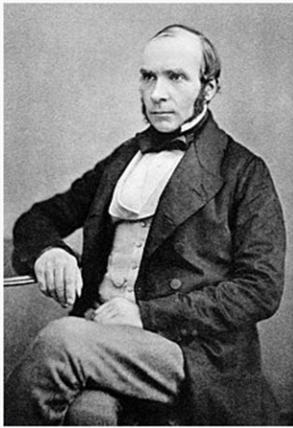
Prove:  $\overline{CA} = \overline{CB}$

S	R
① $\overleftrightarrow{CP}$ is $\perp$ bisector of $\overline{AB}$	given
② $\angle P = \angle P$	right $\angle$ 's
③ $\overline{AP} \cong \overline{BP}$	defn of $\perp$ bisector
④ $\overline{CP} \cong \overline{CP}$	reflexive
⑤ $\triangle APC \cong \triangle BPC$	SAS
⑥ $\overline{AC} \cong \overline{BC}$	c.p.c.t.

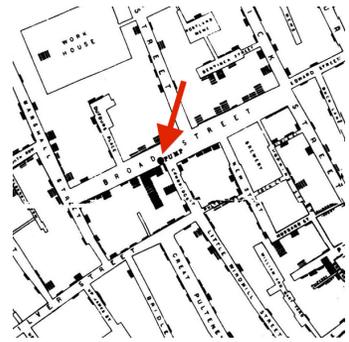
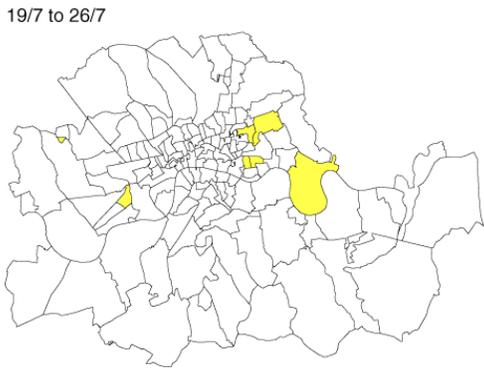
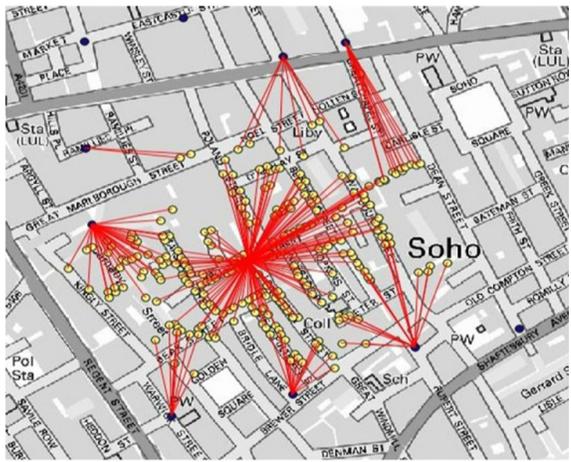
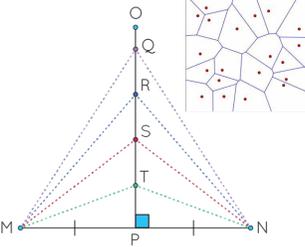
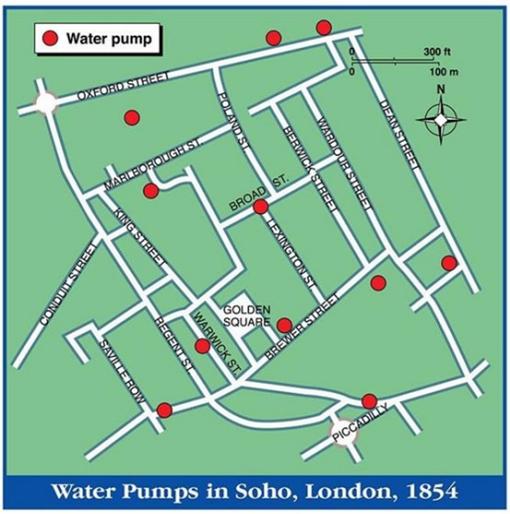
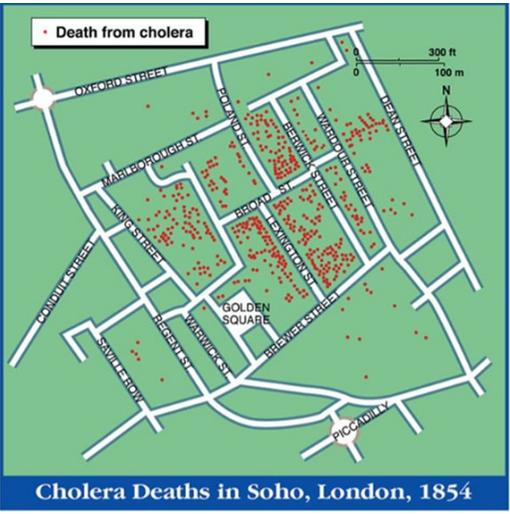
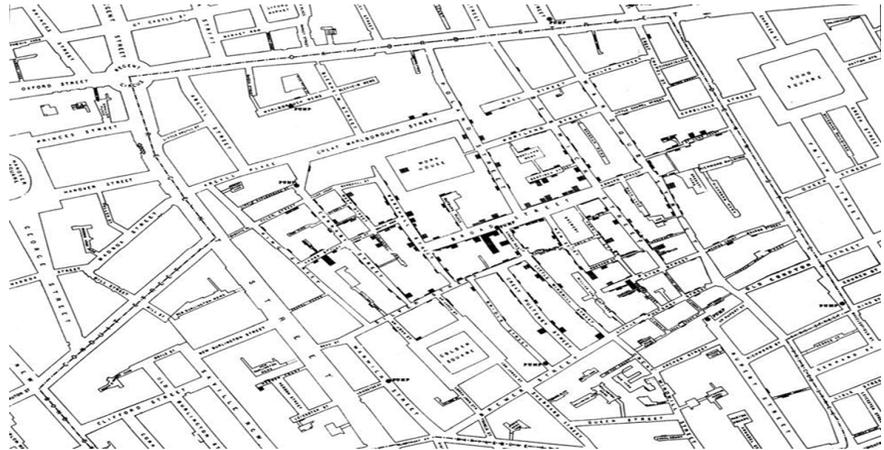


Find:  
 $TL =$   
 $HM =$   
 $ML =$

# A Data Story



Born 15 March 1813  
York, England  
Died 16 June 1858 (aged 45)  
London, England



# Contact



Padmanabhan (**Padhu**) Seshaiyer

Email: [pseshaiy@gmu.edu](mailto:pseshaiy@gmu.edu)

Twitter: [@padhuseshaiyer](https://twitter.com/padhuseshaiyer)

Linked In: <https://www.linkedin.com/in/padhuseshaiyer/>

Phone: +1 (806) 239 8738

Web: <https://science.gmu.edu/directory/padmanabhan-seshaiyer>



<https://www.youtube.com/watch?v=Ybxnfv2O3k4>