

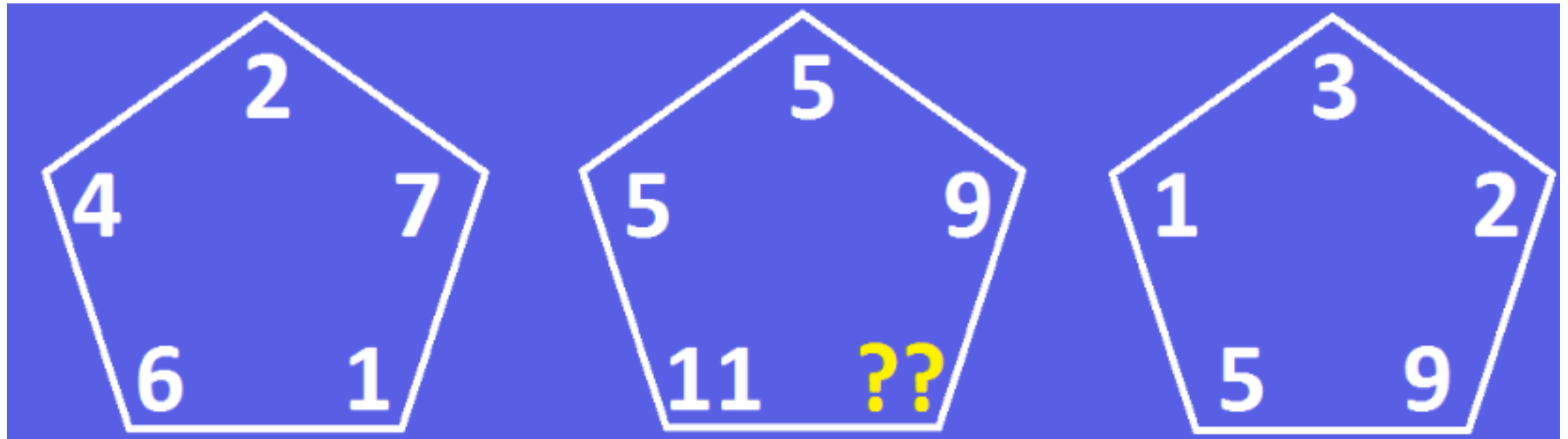


Pattern Recognition

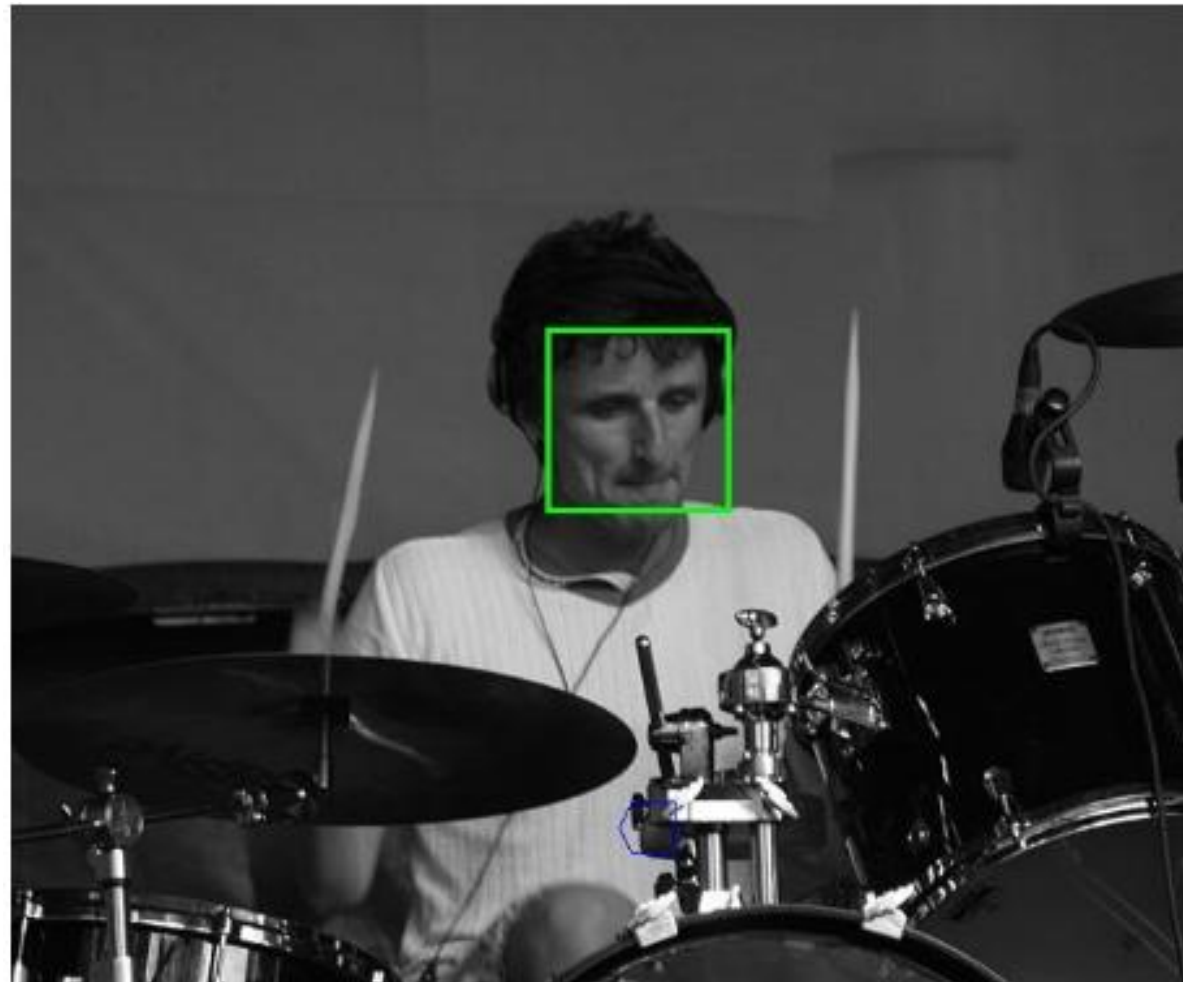
Logic Algorithm

Tri Hadiah Muliawati

Before We Start



Before We Start



Politeknik Elektronika Negeri Surabaya
Logic Algorithm



Objectives:

1. Students able to understand the concept of pattern recognition
2. Students able to find pattern by recognizing shared characteristics and differences in certain problem
3. Students able to implement pattern recognition in algorithm, flowchart, and pseudo code



Subject:

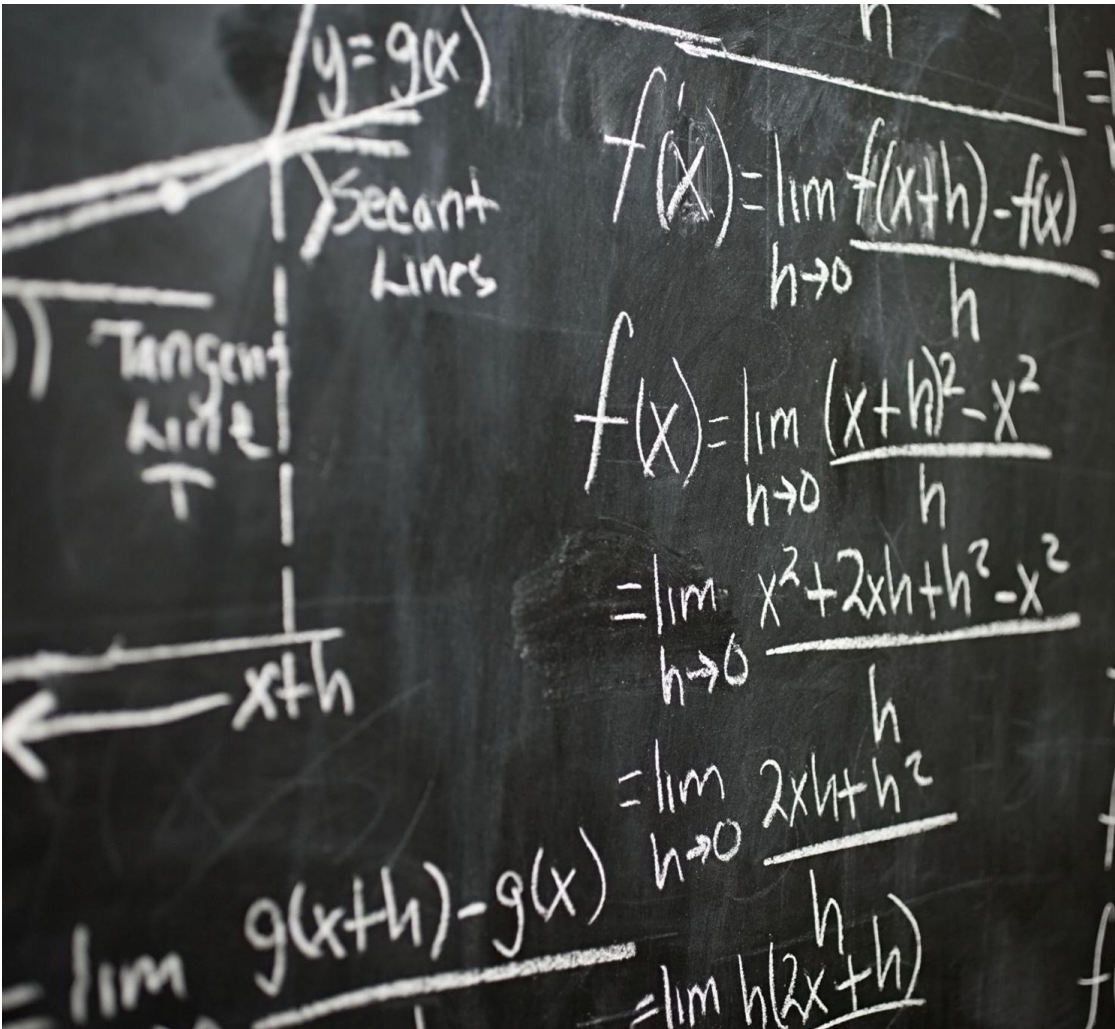
1. Fundamental Pattern Recognition
2. Pattern Recognition in Logic Algorithm



Fundamental Pattern Recognition

Let's Throwback to Computational Thinking

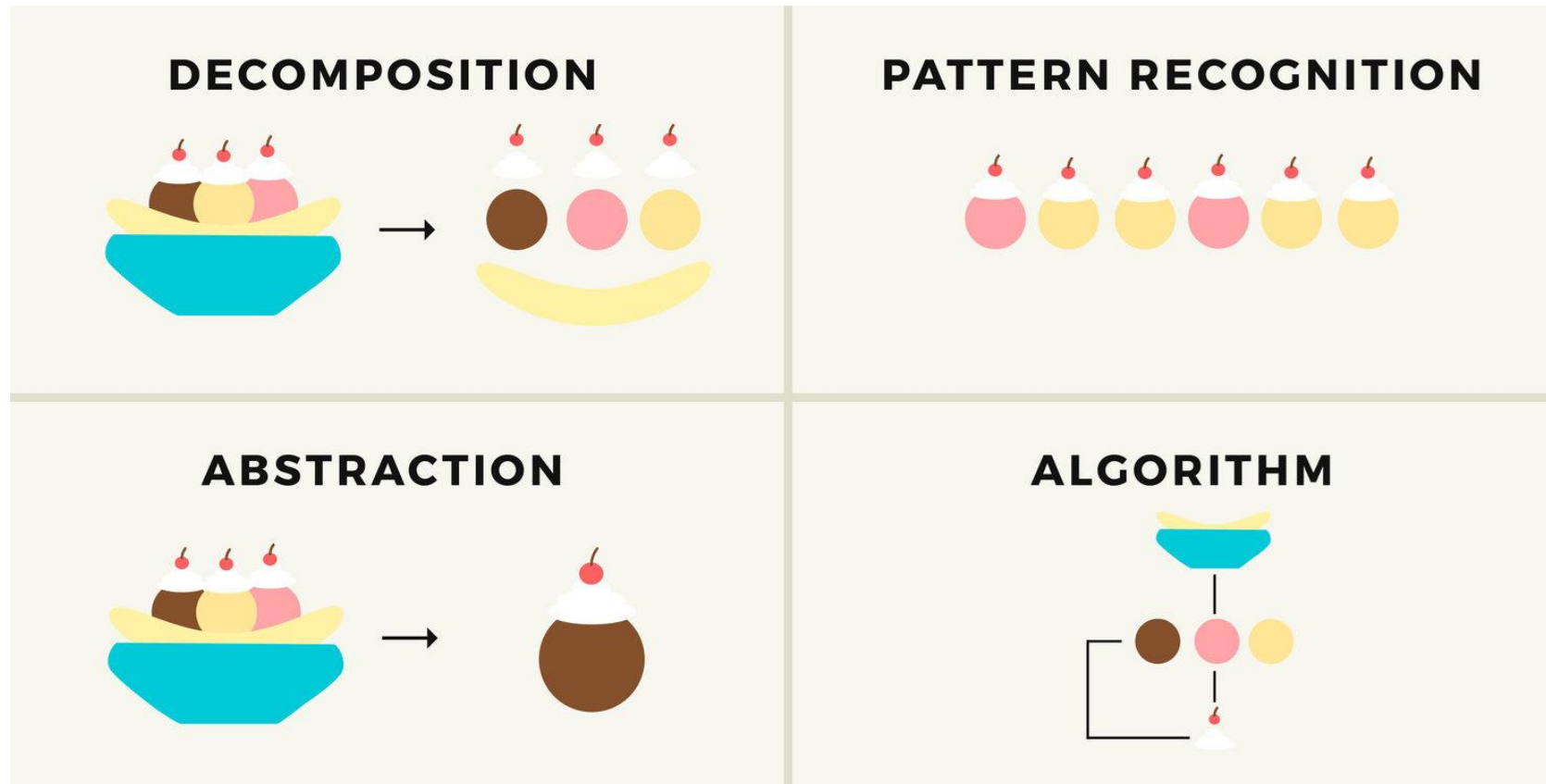
Computational Thinking is the **thought processes involved in formulating problems and their solutions** so that the solutions are represented in a **form that can be effectively carried out** by an information-processing agent



The image shows a chalkboard with handwritten mathematical derivations. On the left, a graph of a function $y = g(x)$ is shown with a secant line and a tangent line. The secant line is labeled "Secant Lines" and the tangent line is labeled "Tangent Line". The x-axis is labeled $x+h$. The derivations on the right are as follows:

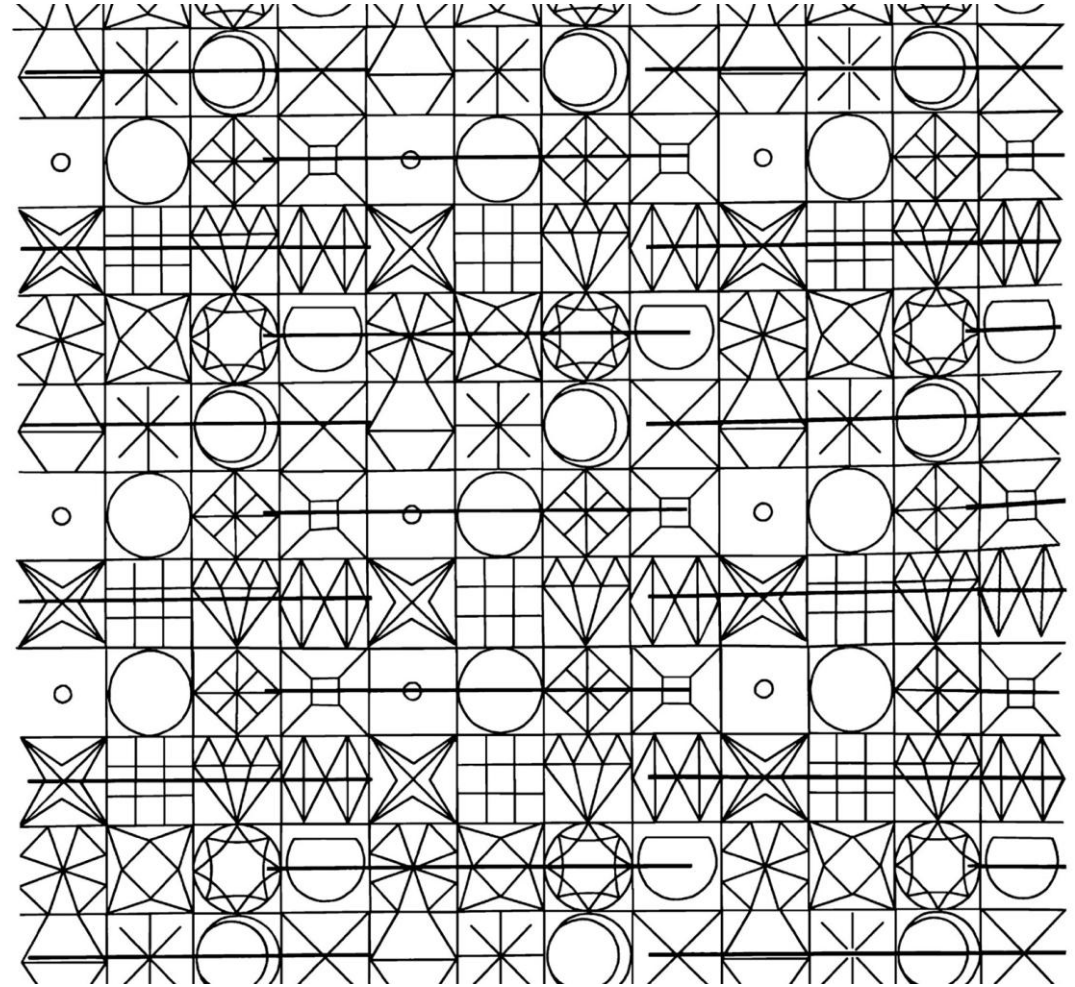
$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$
$$f'(x) = \lim_{h \rightarrow 0} \frac{(x+h)^2 - x^2}{h}$$
$$= \lim_{h \rightarrow 0} \frac{x^2 + 2xh + h^2 - x^2}{h}$$
$$= \lim_{h \rightarrow 0} \frac{2xh + h^2}{h}$$
$$= \lim_{h \rightarrow 0} h(2x + h)$$

Pillars of Computational Thinking



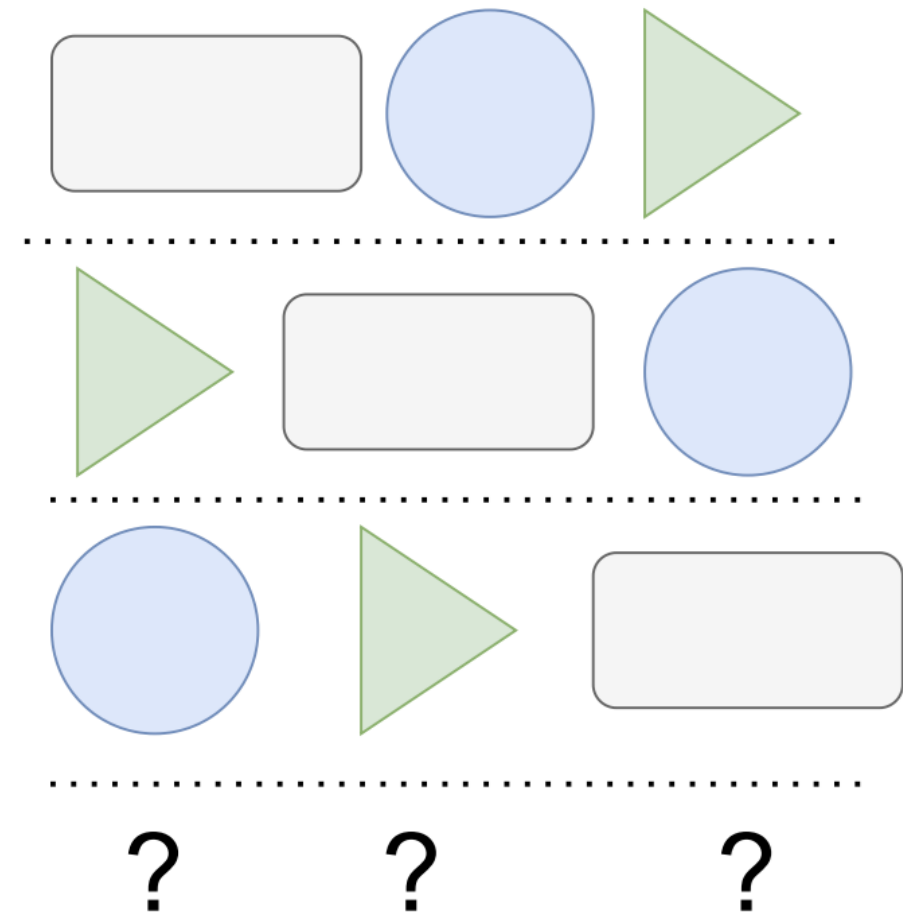
What is Pattern Recognition?

- Pattern recognition is the **skill of recognizing the similarities and differences** between concepts and objects.
- Pattern recognition is the **ability to analyze and identify the shared characteristics** between parts of a decomposed problem.
- Pattern recognition is a core computational thinking skill that **helps in creating shortcuts to solve complex problems.**
- Pattern recognition helps **avoid duplications, and not to reinvent the wheel!**



Example

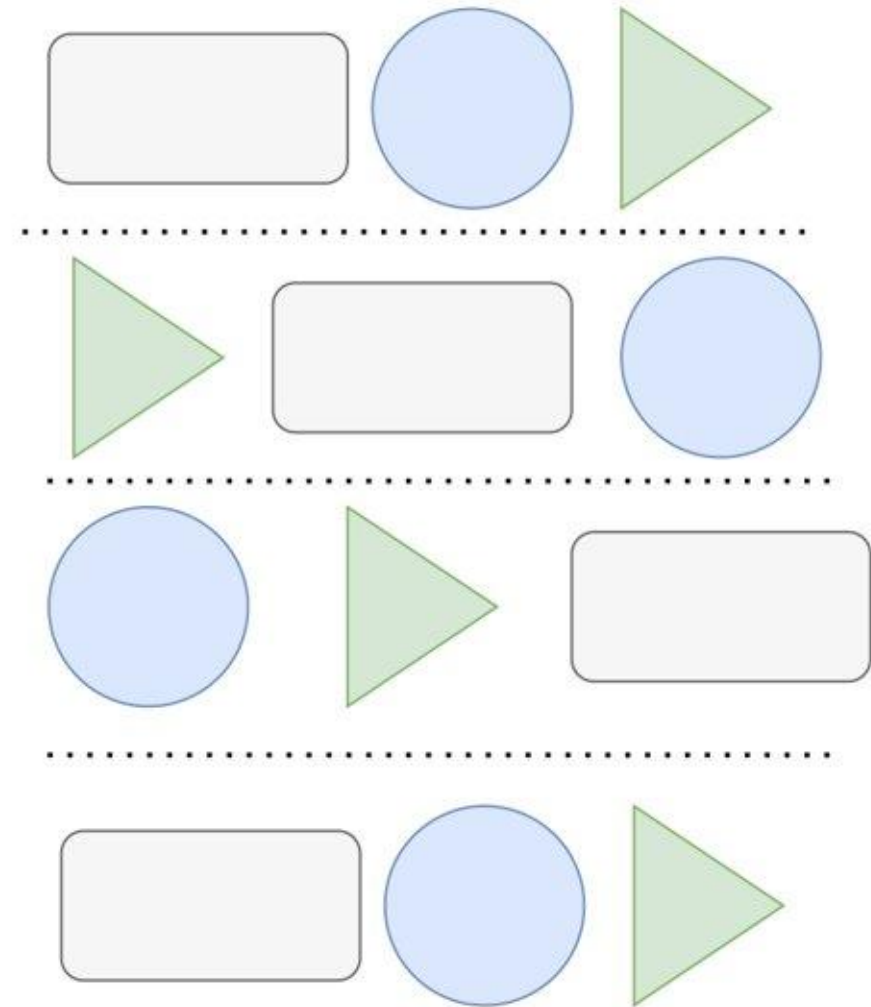
Can you identify a pattern in this picture and predict the arrangement of the shapes in the fourth row?



Answer

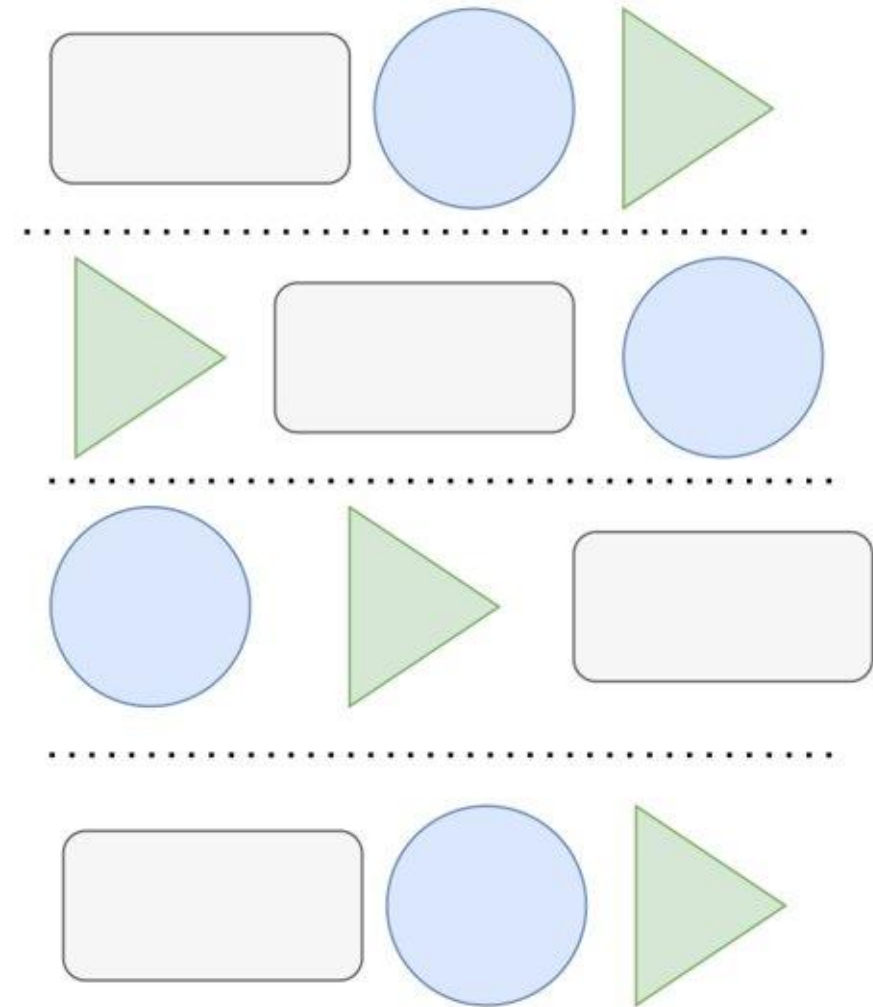
You might have already guessed the right answer!

But, how do you **predict the arrangement?**



Answer

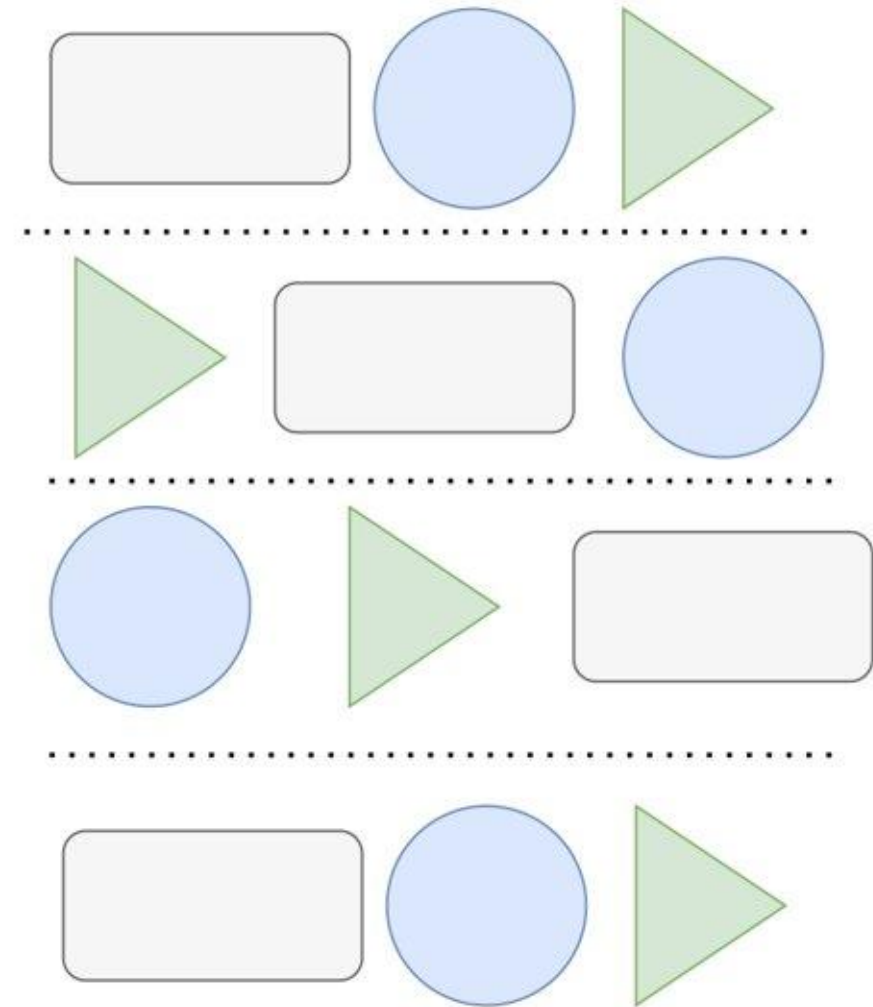
Unconsciously, We observed the **similarities and differences** between the first three rows and predicted the arrangement (solved the problems based on a developed pattern).



Answer

What are the observed similarities and differences?

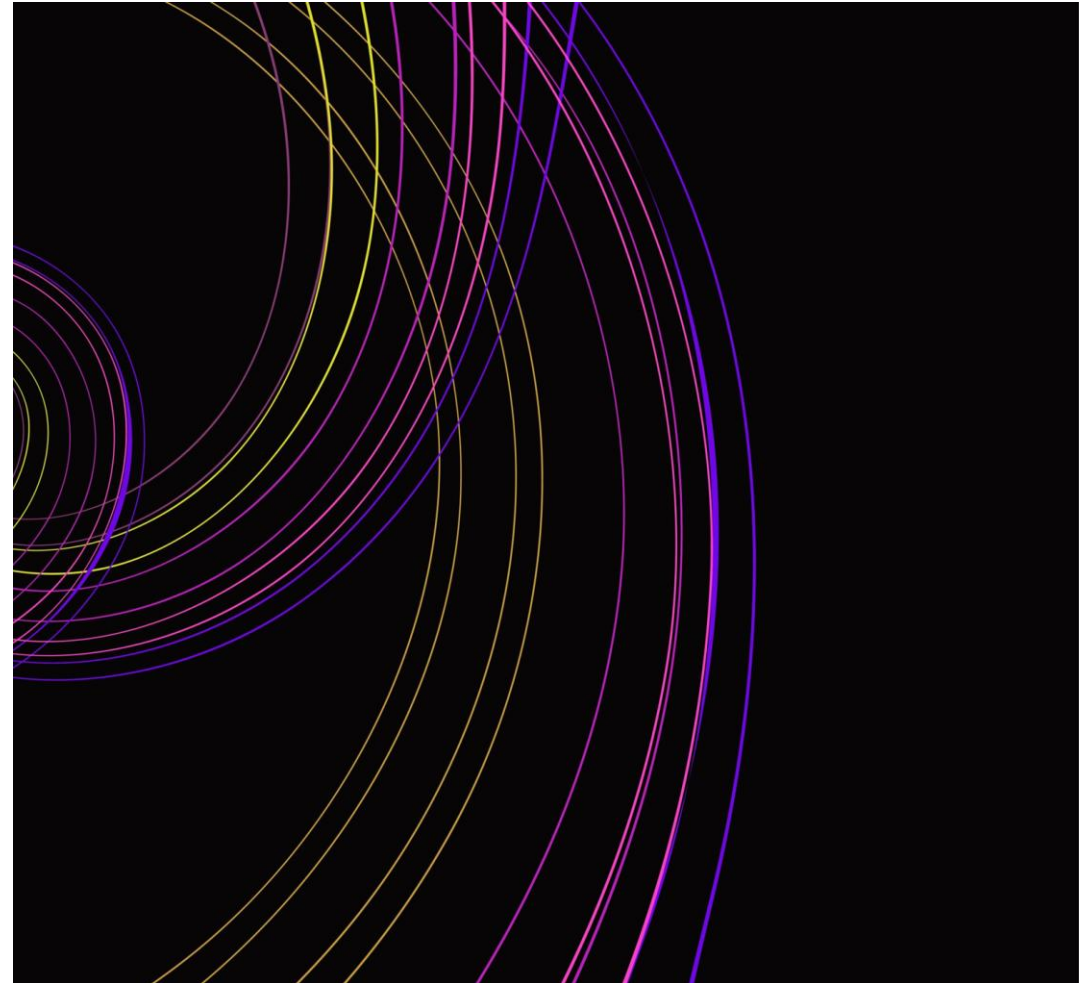
- **Similarity:**
The unique shapes and colors and direction of the shift (right shift in shapes of every row)
- **Difference:**
The position of shapes in each row



Pattern recognition in **problem solving is key to determine appropriate solutions** to problems and knowing how to solve certain types of problems. **Recognizing a pattern, or similar characteristics helps break down the problem and also build a construct as a path for the solution.** Ever find yourself saying, 'where have I seen this before', could be a significant step in computational thinking.

Pattern Recognition in Computational Thinking

- Patterns help in creating an abstraction of a concept that can be used over and over again without being similar in every instance of the application.
- We may conclude that pattern recognition goes hand in hand with **abstraction** (creating an abstraction of the problem and solution to be applied in similar problems/domains in the future).



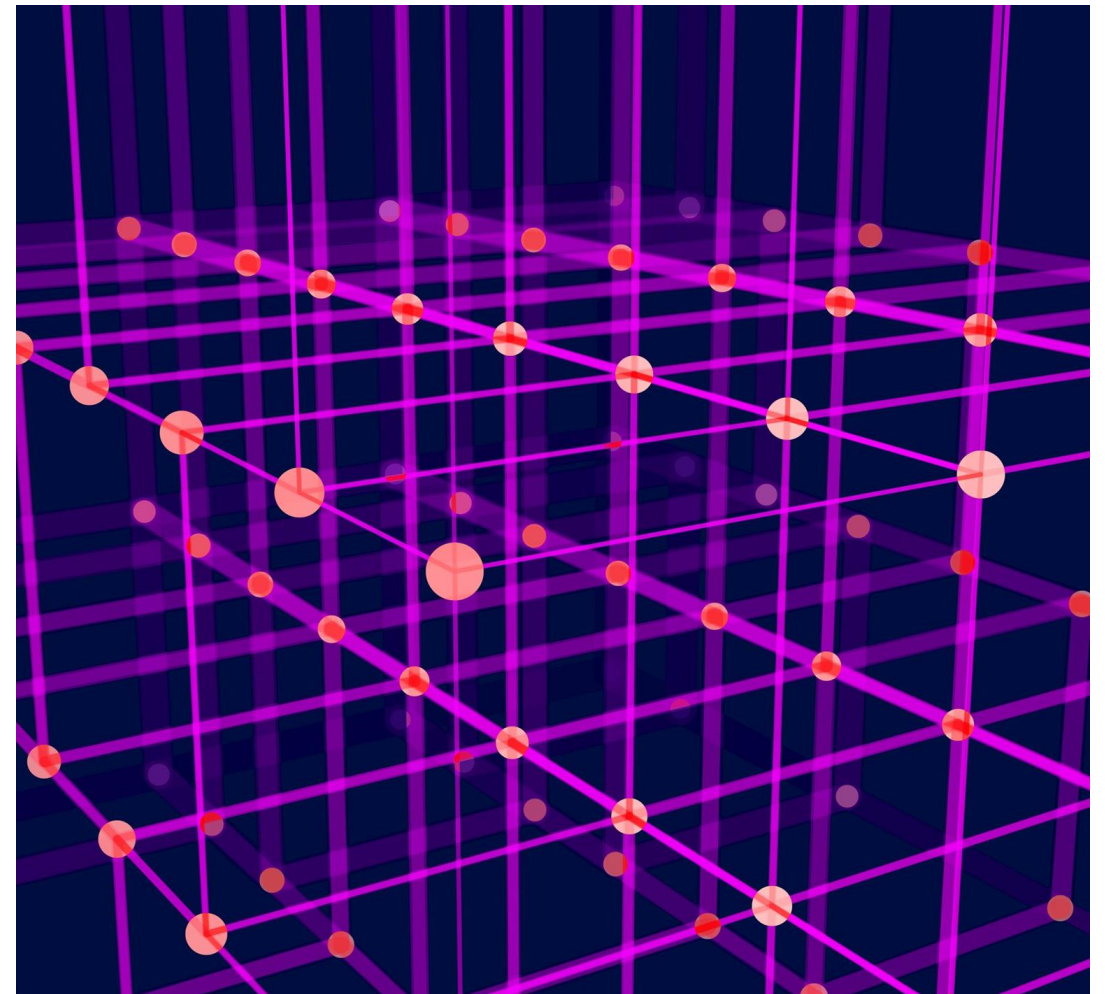
Pattern Recognition on Computer Science

- Pattern recognition helps us **solve computing problems easily and develop advanced algorithms** for complex problems.
- For example, in programming and software development we **create patterns based on the best practices and replicate the style of their architecture** for other applications in the same domain (-- design patterns and domain-specific software architecture design).



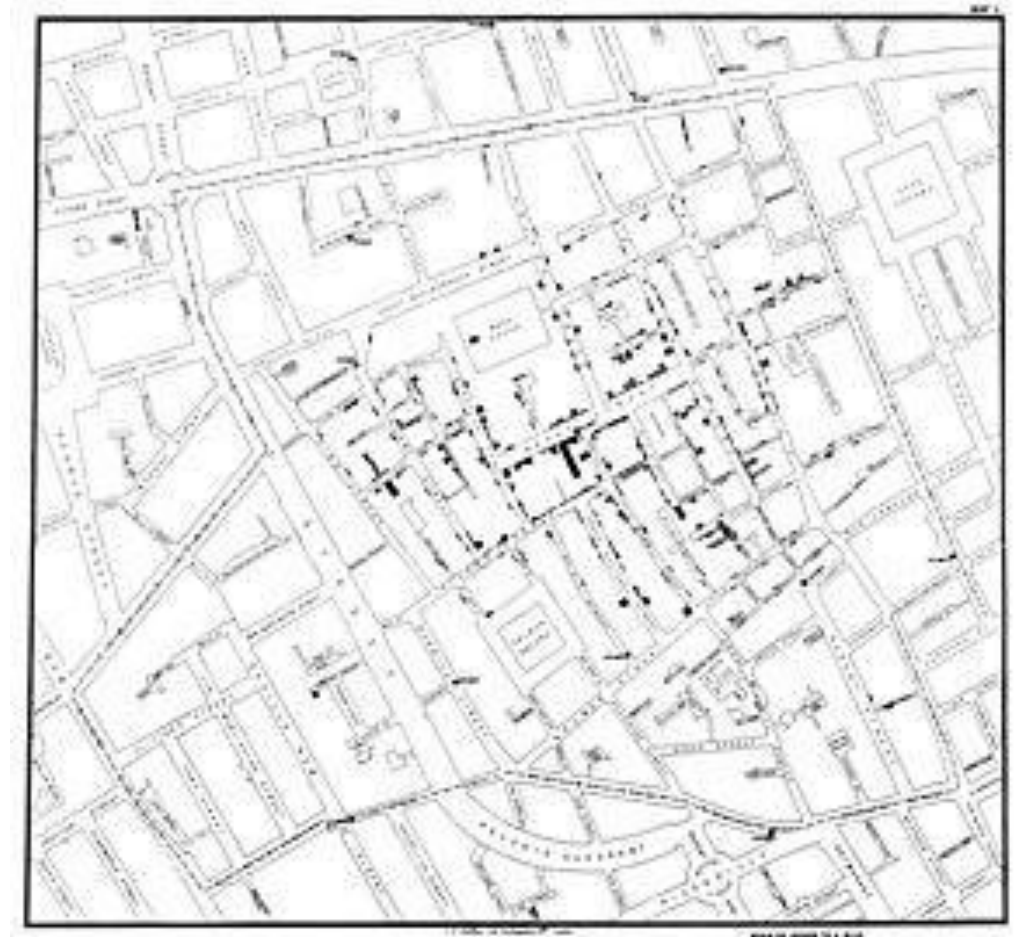
Pattern Recognition on Data Analysis

- In artificial intelligence, we use **pattern recognition to analyze data and identify similarities** to recommend an object or content to the end user.
- For example, Amazon, Netflix, or Facebook recommend items, movies, and friends or events from the patterns they develop based on your interaction history with these systems.



Example of Pattern Recognition

- At the time, germs were not yet understood and Cholera was thought to spread through the air but there was one man named **Dr. John Snow** who stopped the outbreak with the help of pattern recognition
- He (and some other scientist and physicians) thought that drinking water might be the source
- **But not everyone was convinced of this**
- He mapped the homes of cholera victims and common water sources (wells)





Pattern Recognition in Logic Algorithm

Overview

- When solving a problem, try to recognize a similar / shared characteristics and differences (if any).
- Construct a pattern using found shared characteristics and differences (if any). Recognized pattern can be implemented using loop / repetition.

Example

Problem:

Print 5-seconds countdown before firing a “Happy New Year” firework.

Expected output:

5 s left

4 s left

3 s left

2 s left

1 s left

Happy New Year

Algorithm:

1. Print “5 s left”
2. Print “4 s left”
3. Print “3 s left”
4. Print “2 s left”
5. Print “1 s left”
6. Print “Happy New Year”

Try to optimize the algorithm by finding the shared characteristics and differences from this problem!

Answer

Problem:

Print 5-seconds countdown before firing a “Happy New Year” firework.

Expected output:

5 s left

4 s left

3 s left

2 s left

1 s left

Happy New Year

Similarities:

- Line 1 to 5 print “s left” after the *remaining time*
- The *remaining time* is decreased by 1 each time

Difference:

- The displayed *remaining time* is different from line 1 to 5

Answer

Problem:

Print 5-seconds countdown before firing a “Happy New Year” firework.

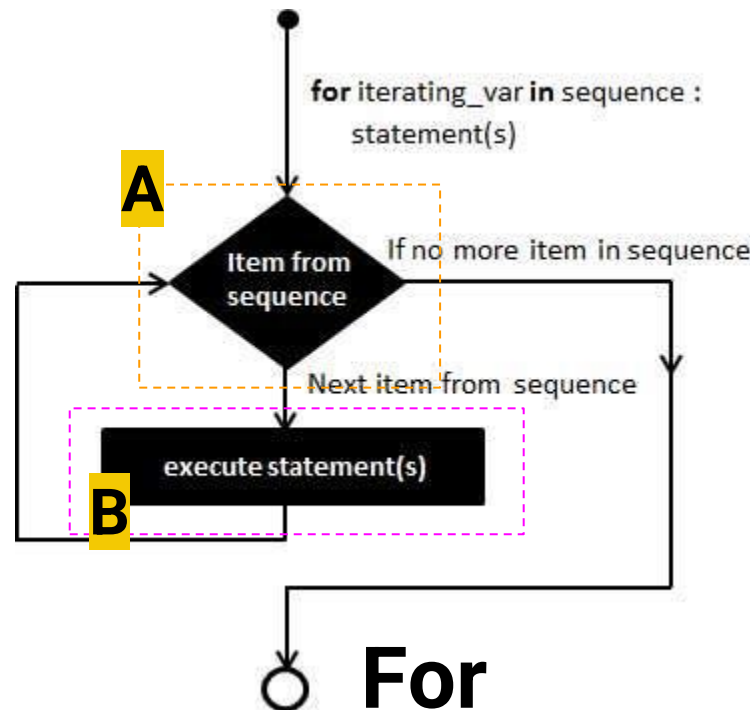
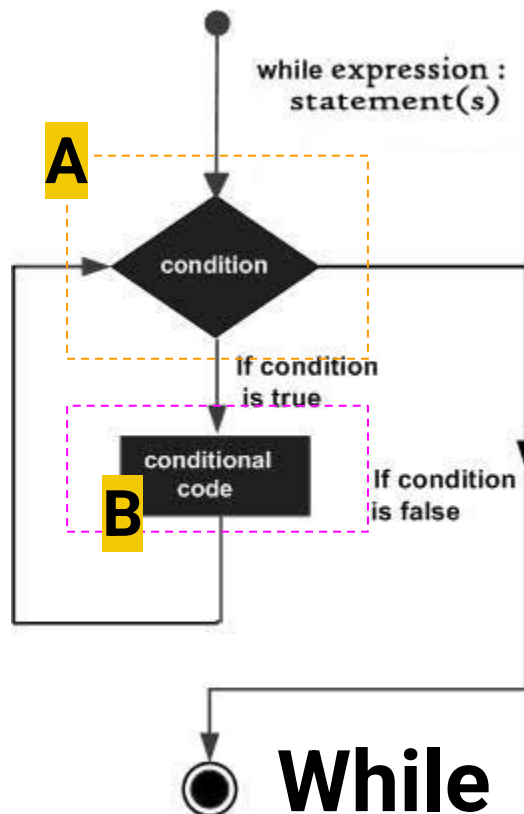
Algorithm:

1. Print “5 s left”
2. Print “4 s left”
3. Print “3 s left”
4. Print “2 s left”
5. Print “1 s left”
6. Print “Happy New Year”

Optimized Algorithm:

1. Initialize time to 5
2. While time is more than 0,
print time + “s left” and
decrease time by 1
3. Print “Happy new year”

Pattern Recognition in Flowchart



In flowchart, loop or repetition is visualized using a closed loop. It is started from decision (**A**) to evaluate the condition and followed by process(es) which depicts loop body (**B**). After executing loop body, it will return to the beginning of the loop. Loop body will be executed as long as the condition equals to True.

Example

Problem:

Print 5-seconds countdown before firing a “Happy New Year” firework.

Optimized Algorithm:

1. Initialize time to 5
2. While time is more than 0,
print time + “s left” and decrease time by 1
3. Print “Happy new year”

Try to visualize the
algorithm using
flowchart!

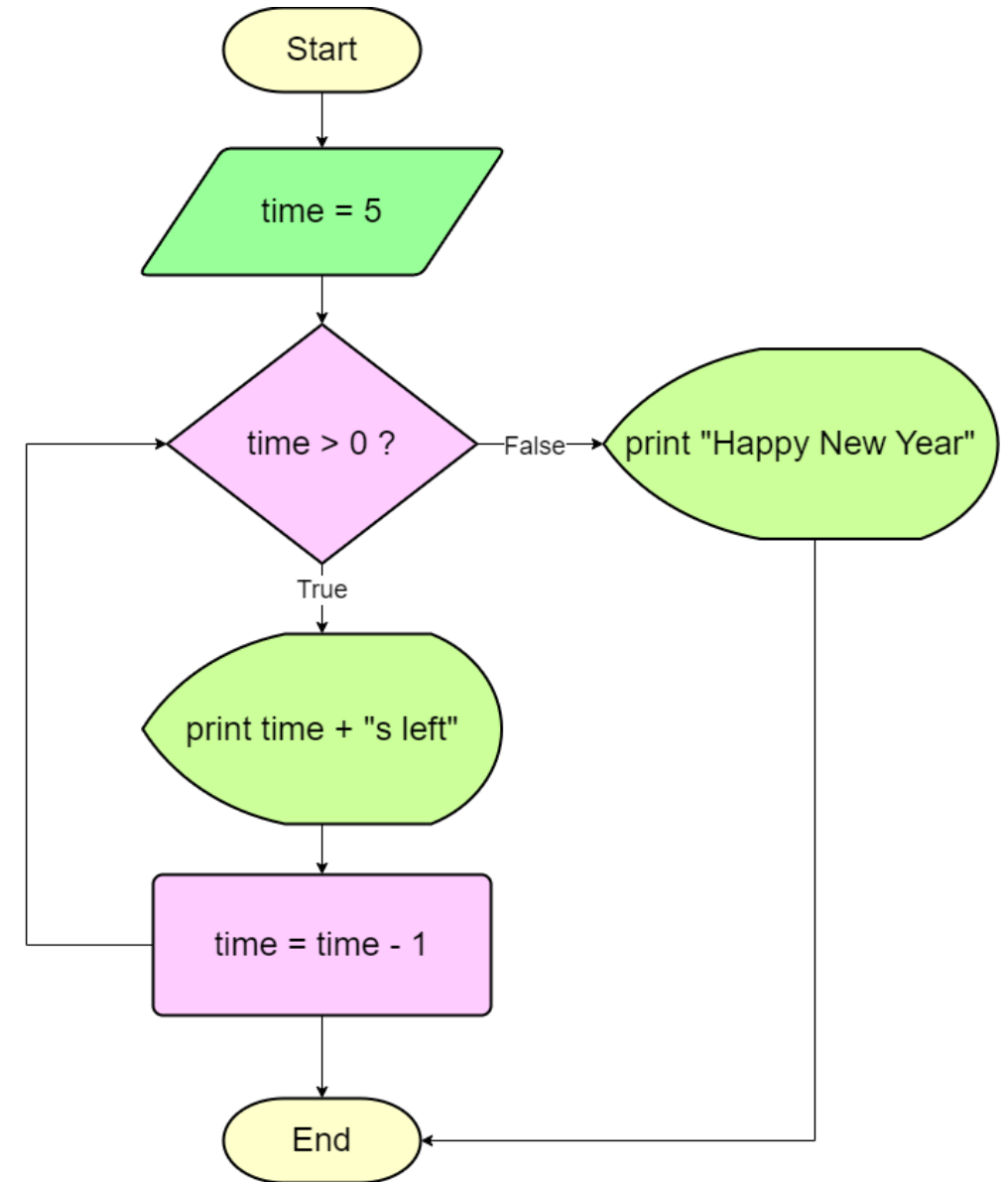
Answer

Problem:

Print 5-seconds countdown before firing a “Happy New Year” firework.

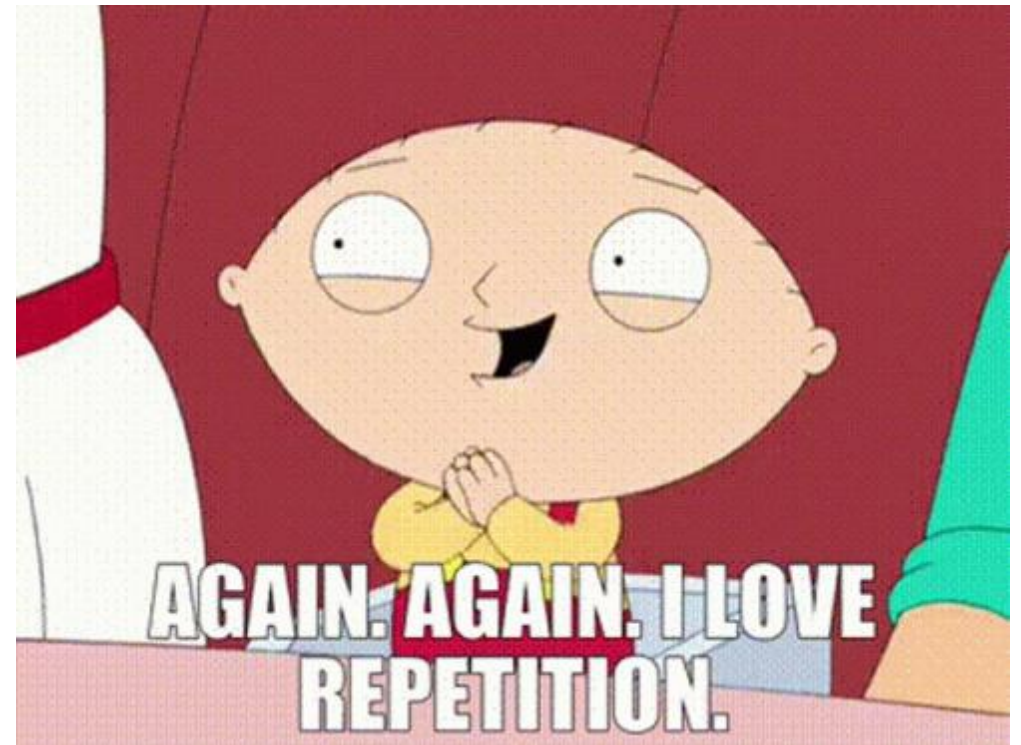
Optimized Algorithm:

1. Initialize time to 5
2. While time is more than 0,
print time + “s left” and decrease time by 1
3. Print “Happy new year”



Pattern Recognition in Pseudocode

Loop or repetition in pseudo code is characterized by **WHILE** or **FOR** and followed by condition to evaluate. The following statements are indented to represent loop body which will be executed if the condition equals to True.



Answer

Problem:

Print 5-seconds countdown before firing a “Happy New Year” firework.

Optimized Algorithm:

1. Initialize time to 5
2. While time is more than 0,
 print time + “s left” and decrease time by 1
3. Print “Happy new year”

Line 3 and 4 in pseudo code are loop body. They will be executed if only condition in line 2 equals to True.

Pseudo code:

1. $time \leftarrow 5$
2. WHILE $time > 0$ THEN
3. PRINT $time + \text{“s left”}$
4. $time \leftarrow time - 1$
5. PRINT “Happy New Year”

Summary

- Pattern recognition is the **ability to analyze and identify the shared characteristics** between parts of a decomposed problem.
- Recognizing a pattern, or similar characteristics helps break down the problem and also build a construct as a path for the solution

Task

1. Consider the following sequence:

2, 6, 12, 20, 30, 42, ...

- a) Determine the pattern of the sequence.
- b) Calculate the 8th element in the sequence.
- c) Write an algorithm in pseudocode to display the first n elements of the sequence.

Task

1. Consider the following sequence:

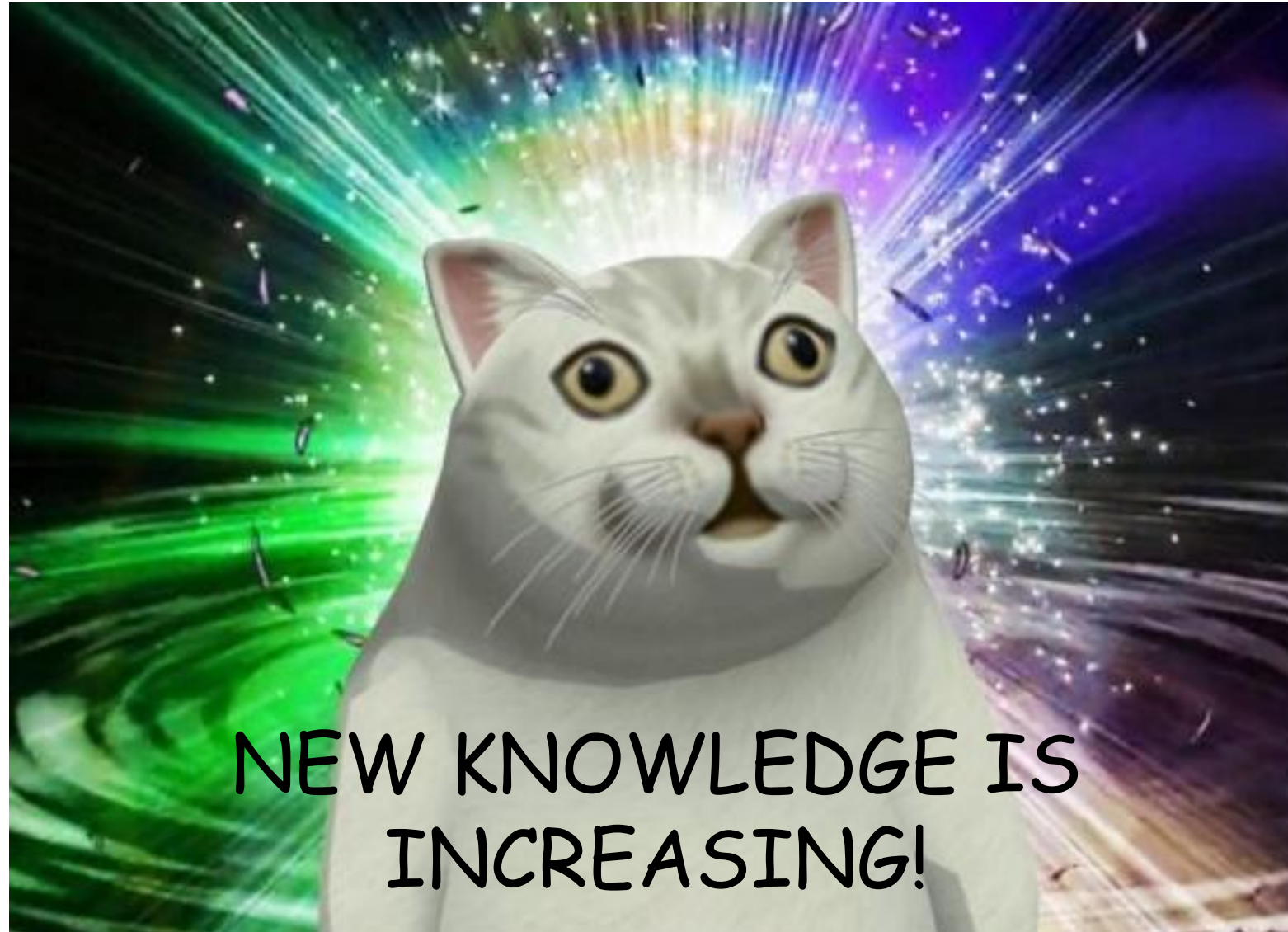
2, 6, 12, 20, 30, 42, ...

- a) Determine the pattern of the sequence.
- b) Calculate the 8th element in the sequence.
- c) Write an algorithm in pseudocode to display the first n elements of the sequence.

Task

2. Look at the following sequence of images. Each image consists of colored squares that change position and number according to a specific pattern. Choose the image that should replace the question mark (?) in the last sequence.





NEW KNOWLEDGE IS
INCREASING!

Reference

- Karl, Beecher. "Computational Thinking: A Beginner's Guide to Problem-Solving and Programming." Swindon, UK: BCS, The Chartered Institute for IT (2017).
- CSE 1300 - Introduction to Computing Principles, Kennesaw State University
- Computer Science (CS) and Computational Thinking (CT) : Pattern Recognition in the AYA curriculum, Miami University

Next week

- We will learn about **list** . Please read references about it.
- **It is strongly encouraged to do self study and self-paced practicum.**





THANK YOU!