



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David



Introduction

Lecture 1: Analysing and Solving Problems (APS)

Trawsnewid Addysg; Trawsnewid Bywydau
Transforming Education; Transforming Lives



www.uwtsd.ac.uk

Today's Lecture

- Overview of Module
- Introduction

Module Aim

To provide students the ability to develop generic solutions to problems using abstract thinking skills.

Module Assessment

- 50% In-class Test
Week 7/8
- 50% Coursework
25th April 2025

The screenshot displays the Moodle LMS interface for the University of Wales. The top navigation bar includes links for Dashboard, My modules, Moodle archives, and Useful links. The left sidebar contains a list of course resources, including Announcements, Programme Handbook, and various assessment briefs. The main content area is divided into two sections: 'ASSESSMENT BRIEFS' and a 'Course Calendar'.

ASSESSMENT BRIEFS

- ACCA4019 Analysing and Solving Problems - Assessment 1 OCT 24 - Specification
- ACCA4019 Analysing and Solving Problems - Assessment 2 OCT 24
- ACCA4019 Analysing and Solving Problems - Assessment 2 JUNE 2024 RESIT
- ACCA4019 Analysing and Solving Problems - Assessment 2 JUNE 2024 REWORK
- ACCA4019 Analysing and Solving Problems - Assessment 2 OCT 23 REWORK
- ACCA4019 Analysing and Solving Problems - Assessment 2 JUNE 23
- EXAM PDF
- Week 6 Mock Test Submissions link - Group 1 (AM)
- Week 6 Mock Test Submissions link - Group 2 (PM)

COURSE CALENDAR

Week	Activity	Submission Link
Sample Test Papers	FINAL SUBMISSION LINK- OCT 2024	DRAFT SUBMISSION LINK- OCT 2024
FINAL SUBMISSION LINK- FEB 2024	DRAFT SUBMISSION LINK- FEB 2024	FINAL SUBMISSION LINK- OCT 2023
DRAFT SUBMISSION LINK- JUNE 2023	Video Recordings	Week 1
Week 4	Week 5	Week 6
Week 7	Week 8 - Exam	

Module Assessment

- 50% In-class Test –
Week 8



- 50% Coursework –
Algorithm



Analysing and Solving Problems

INTRODUCTION



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Abstract Thinking

- Seeing the context and bigger picture surrounding an event or idea
- Abstract thinkers can reflect on events and ideas and think beyond just the “here and now”.
- Opposite of abstract thinking is concrete thinking : take information at face value without thinking beyond or generalizing the information to other meanings or situations.

Abstract Vs Concrete Thinking



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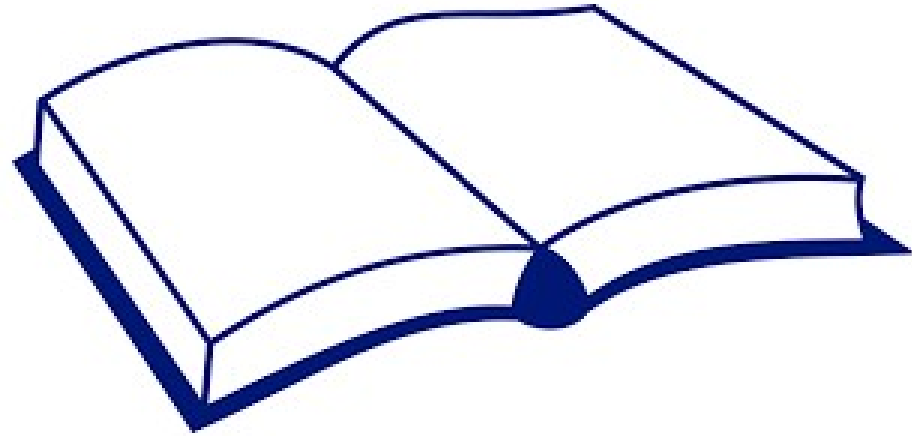
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Abstract Vs Concrete Thinking



A clock doesn't just tell time; it represents the unstoppable flow of time. Each tick of the second hand symbolizes the constant forward movement of life, with no possibility to reverse or pause.

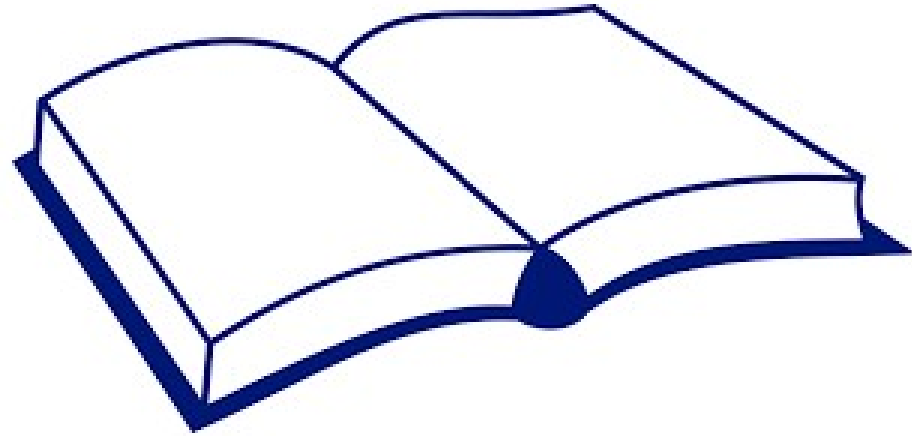
Abstract Vs Concrete Thinking



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Abstract Vs Concrete Thinking



A book doesn't just hold information; it symbolizes wisdom, storytelling, and the accumulation of life experiences..

Abstract Vs Concrete Thinking

Explain/describe the concept of "freedom".



<https://depositphotos.com/photos/freedom.html>

Abstract Vs Concrete Thinking

Explain/describe the concept of "freedom" to your friend.

a) You describe freedom as the ability to make choices, travel wherever you want, and express yourself without restriction.

b) You explain that freedom is like the wind—it can't be touched or seen directly, but it shapes everything around us, giving people space to grow and change.

Abstract Thinking

What do you see?



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Abstract Thinking

You may have thought/said:

- An iPhoneX
 - You know about phones and you are possibly an Apple fan.
- An iPhone
 - It's a phone and you probably recognised the Apple logo
- A Smartphone
 - It's a phone and looks very modern
- A phone
 - Who cares? It can make calls, that's all I need 😊

Abstract Thinking

- What do you see?



- The new iPhone X (very specific)
- An iPhone (slightly less specific)
- A Smartphone (**a bit more abstract**)
- A phone (**more abstract**)
- An object or a thing (**very abstract**)

In computing, we tend to be interested in identifying the “a bit more” and “more” abstract.

Abstract Thinking

- How about **2010**?
- Can you think of specific and abstract thinking examples with regards to **2010**?



Abstract Thinking

- Every object or event in the world can be thought of in many ways.
- Abstract Thinking is the ability to:
 - Filter out the specifics
 - Understand and separate the context from content.
 - Think about things in a way removed from the present time and specific examples
 - Generalise from a set of specific examples
 - Connect the dots i.e. understand the relationships (connections and patterns) between events and objects
 - Understand the meaning behind words, events and situations
- It is an important element of **problem solving**.

Identifying an abstract thinker

- Think about how everything relates to the bigger picture.
- Ask why, not just how
- Look for deeper meanings and underlying patterns
- Understand how everything relates to everything

Concrete vs Abstract



Concrete vs Abstract



"I need to transfer money to my friend. I open the app, enter my details, and press 'Send'. The app transfers the money instantly."

"The mobile app is a tool for transforming how people interact with their finances. It relies on algorithms, encryption, and advanced security measures to allow safe, real-time transactions. This might be reshaping how we perceive and manage money in the future."

4 stages of Abstract thinking



Customers know that specific actions lead to specific results (clicking "Pay" leads to bills being paid)

Customers understand that the app uses encryption to protect data and algorithms for handling transactions

Developers analyze how theories (like user authentication and security) can be applied in practice to make the app functional, secure, and user-friendly.

Designers and product managers- think the ethical considerations of handling sensitive financial data on a digital platform

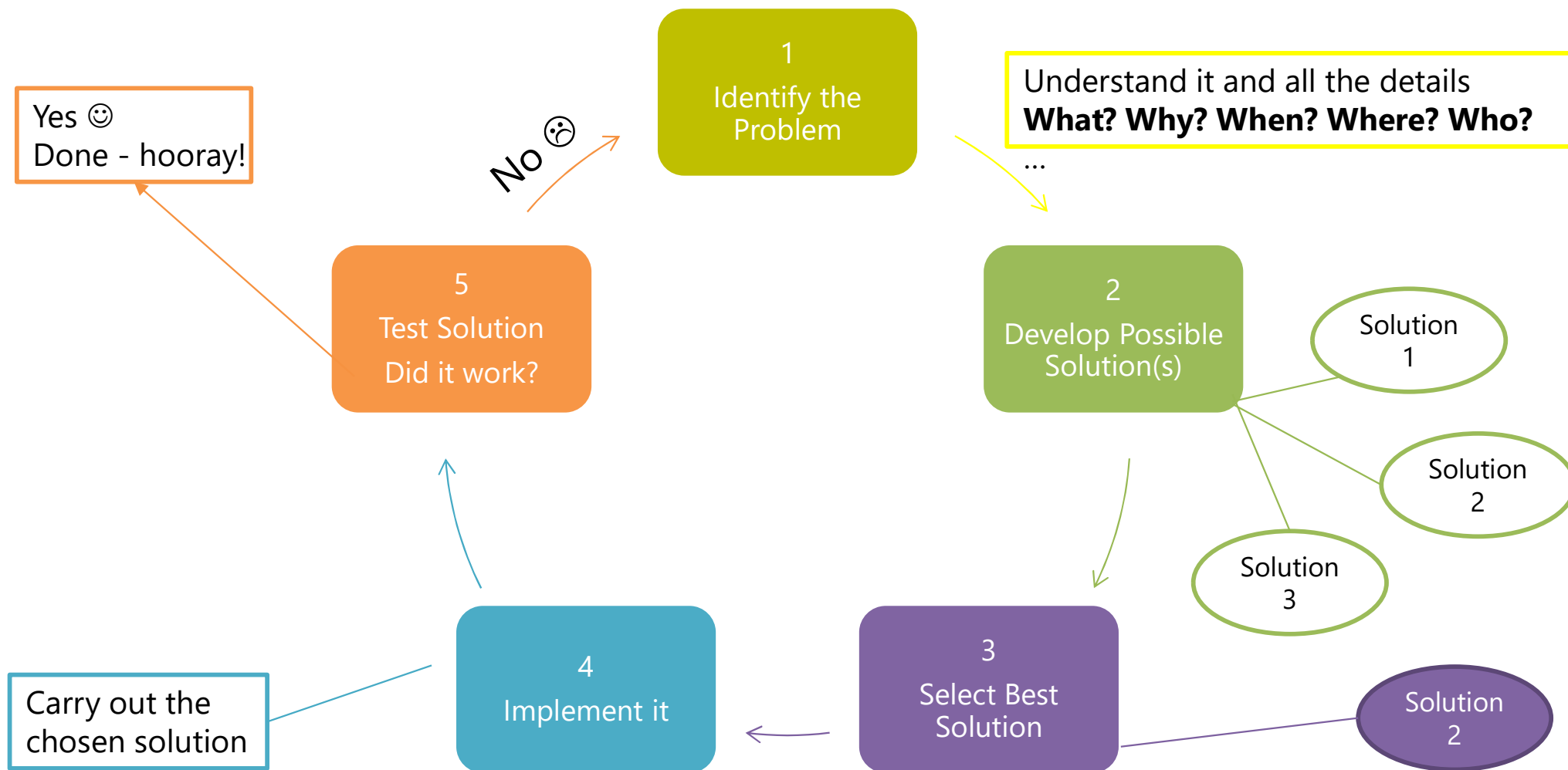
Four Stages of Abstract Thinking

- Shallow Abstract Thinking : Cause – effect relationship, behaviour of objects
- Intermediate Abstract Thinking : cognition of algorithms, theories, and mathematics.
- Intermediate Deep Abstract Thinking Applied methodology, analyses of knowledge in practice.
- Deep Abstract Thinking : philosophical understanding

Problem Solving

- Take a problem (simple or complex)
- Understand what the problem is
- Develop possible solutions
- Present your solution(s) in a way that a computer, a human, or both, can understand.
 - In computing, we are interested in **solutions that both humans and machines can understand.**
 - Humans, i.e. IT and computing personnel and users
 - Computers and systems to help solve or simplify tasks

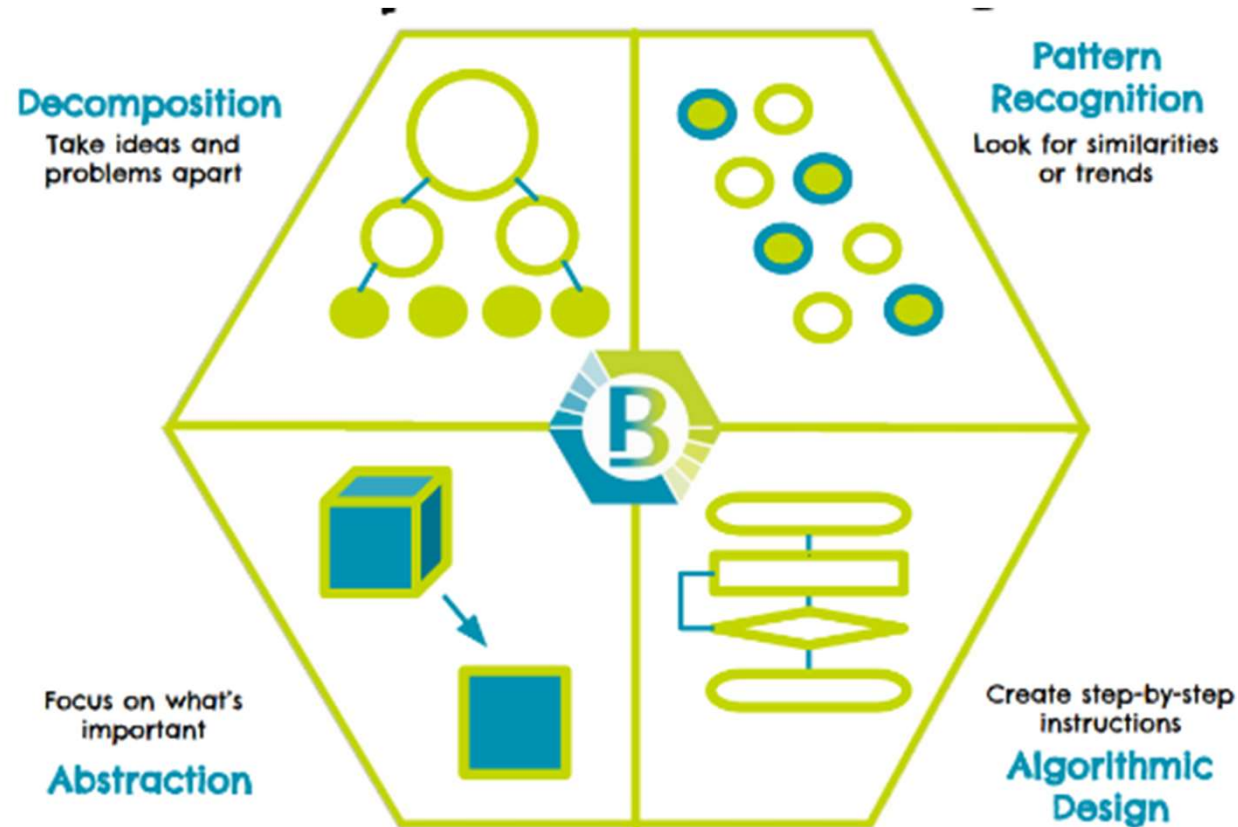
Problem Solving



Computational Thinking

- problem-solving technique that imitates the process computer programmers go through when writing programmes and algorithms.. That is:
 - Formulating a problem (***develop all the details***), and
 - Creating ***solution(s)*** in such a way that a computer or human via a computer system ***can effectively carry it out***.
- Four key techniques to computational thinking:
 - Decomposition
 - Pattern Recognition
 - Abstraction
 - Algorithm Design

Computational Thinking Contd.



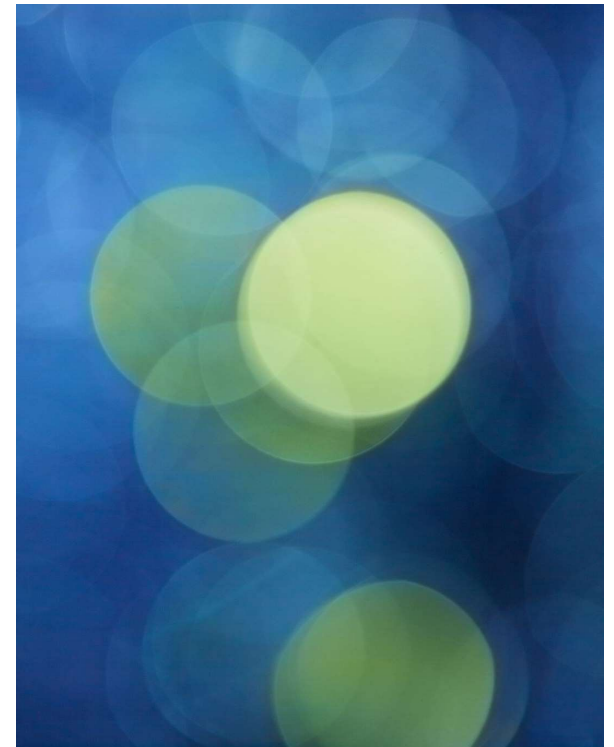
Problem Solving – Elements of Computational Thinking

Decomposition

Pattern Recognition

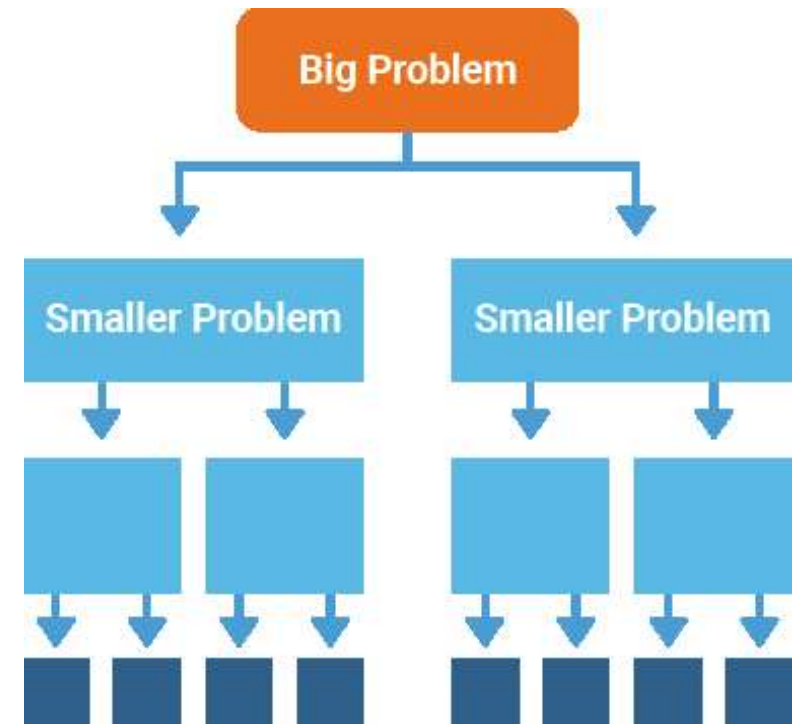
Algorithms

Abstraction



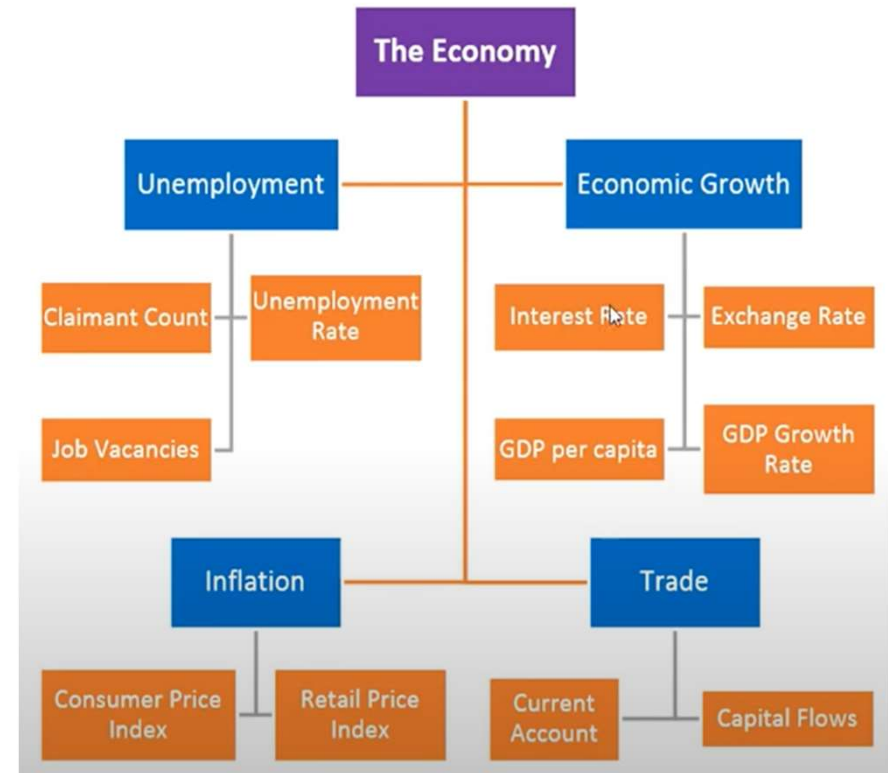
Decomposition

“If you can’t solve a problem, then there is an easier problem you can solve: find it.” - GEORGE PÓLYA



Decomposition = breaking problem to sub problem

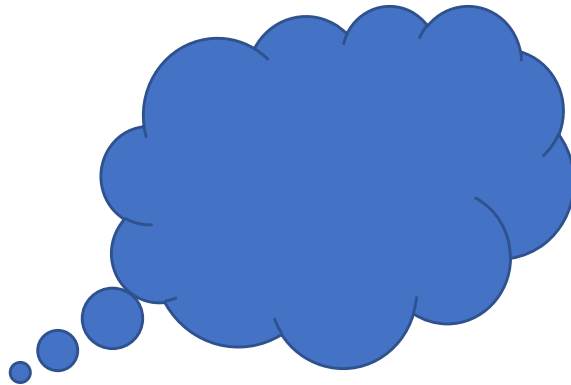
- Sub problem needs to be an identifiable task and can solve independently
- Solutions of sub problem can be combined



Visualising the Problem

a : to see or form a mental image of : envisage trying to visualize the problem.

b : to make (an internal organ or part) visible by radiographic visualization. intransitive verb. : to form a mental visual image



Activity: Visualising – Making a Sandwich

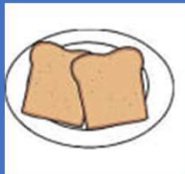
Lay of the slices of cheese and tomatoes on one bread	Slice requirement of tomatoes	Take 2 slices of Bread	Apply spread to the bread slices using knife	Slice requirement amount of cheese	Serve it on a plate and eat it	Put the other slice on top of the other to make a sandwich
		1				

For example - “3 5 1 7 4 6 2” – this is not the correct answer 😊

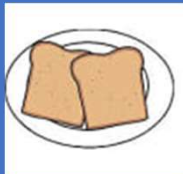
Activity: Visualising – Making a Sandwich

Lay of the slices of cheese and tomatoes on one bread	Slice required amount of tomatoes	Take 2 slices of Bread	Apply spread to the bread slices using knife	Slice required amount of cheese	Serve it on a plate and eat it	Put the other slice on top of the other to make a sandwich
5	4	1	2	3	7	6

Activity: Visualising – Making a Sandwich

						
					1	

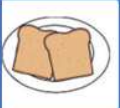
Activity: Visualising – Making a Sandwich

						
2	7	4	6	3	1	5

Reflection: Visualising – Making a Sandwich

Lay of the slices of cheese and tomatoes on one bread	Slice required amount of tomatoes	Take 2 slices of Bread	Apply spread to the bread slices using knife	Slice required amount of cheese	Serve it on a plate and eat it	Put the other slice on top of the other to make a sandwich
5	4	1	2	3	7	6

Which one was easier to order as per the sequence?

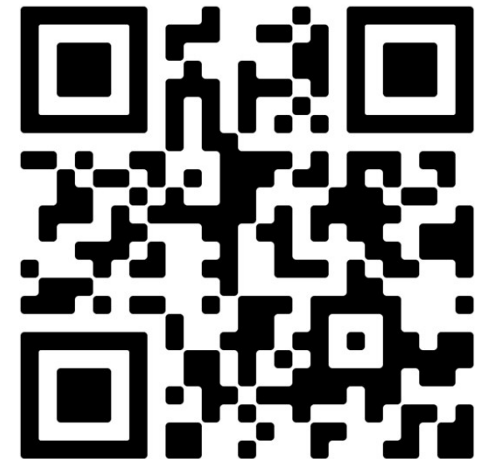
						
2	7	4	6	3	1	5

Why?

Activity: Water Jug Puzzle

You have a 3-liter jug and a 5-liter jug. The jugs have no measurement lines on them either. How could you measure exactly 4 liter using only those jugs and as much extra water as you need?

<https://www.mathsisfun.com/games/jugs-puzzle.html>



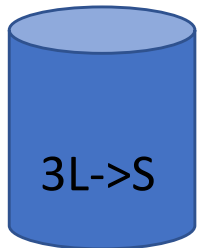
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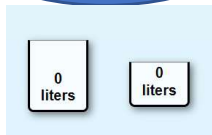
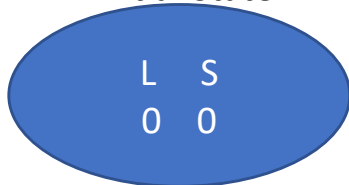
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Activity: Water Jug Puzzle

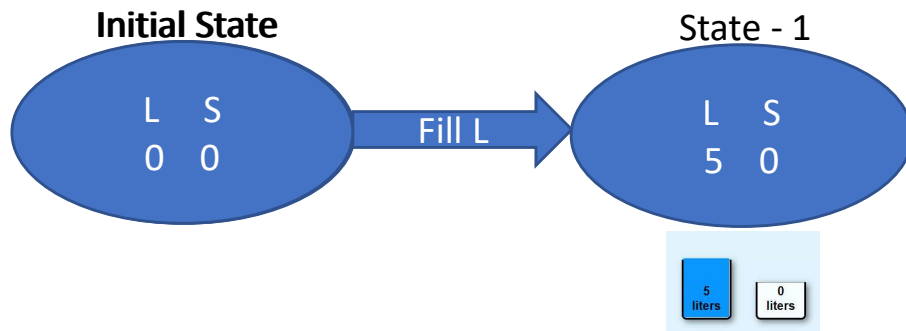
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Initial State



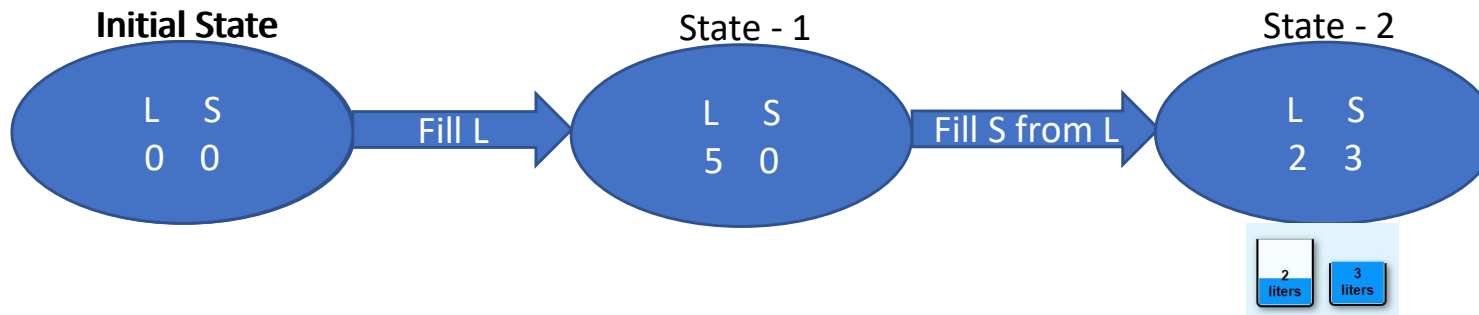
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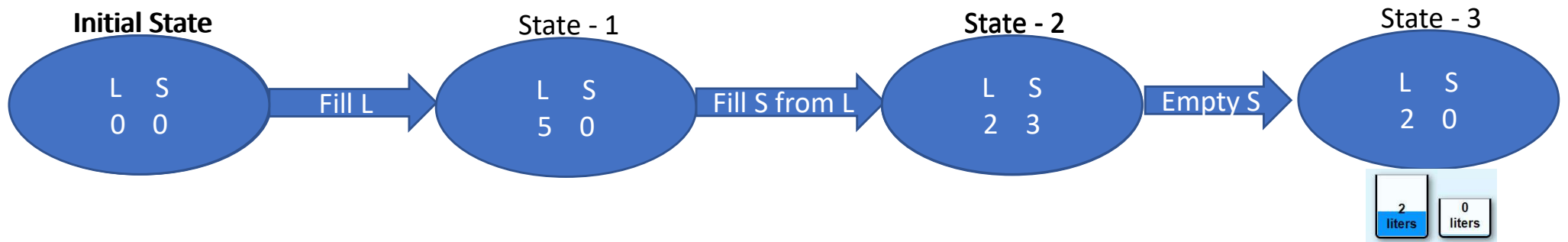
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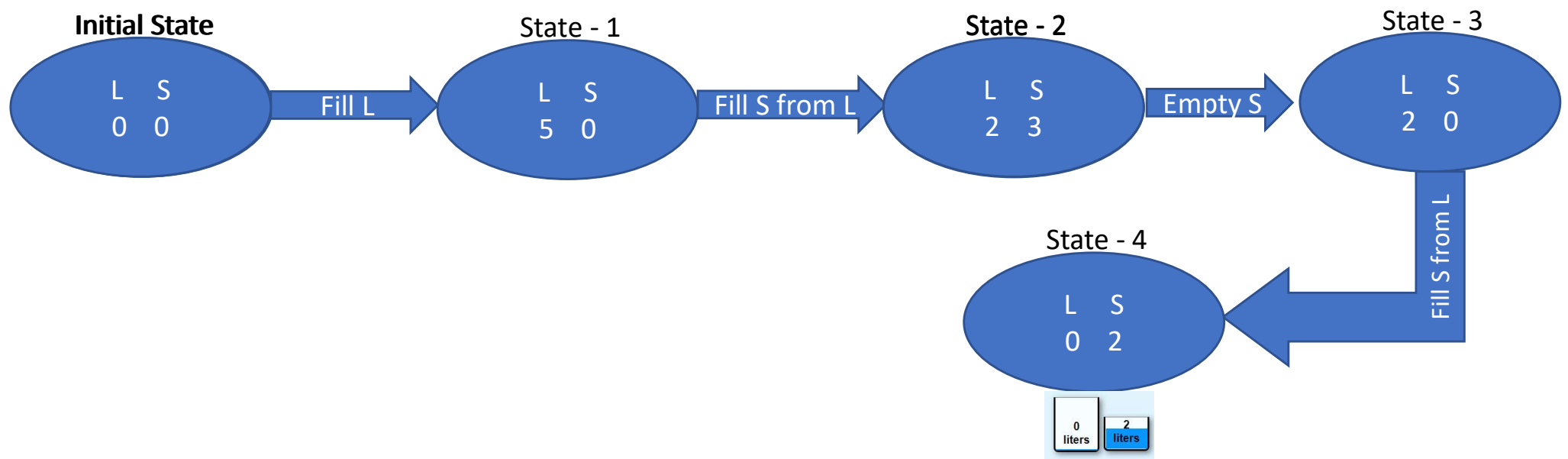
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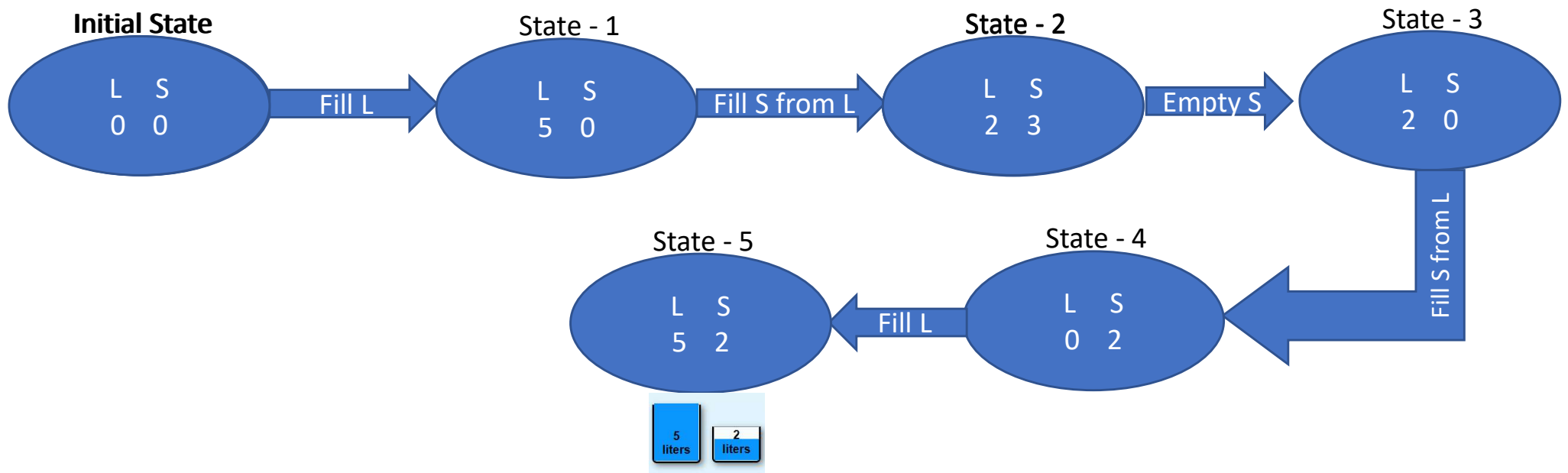
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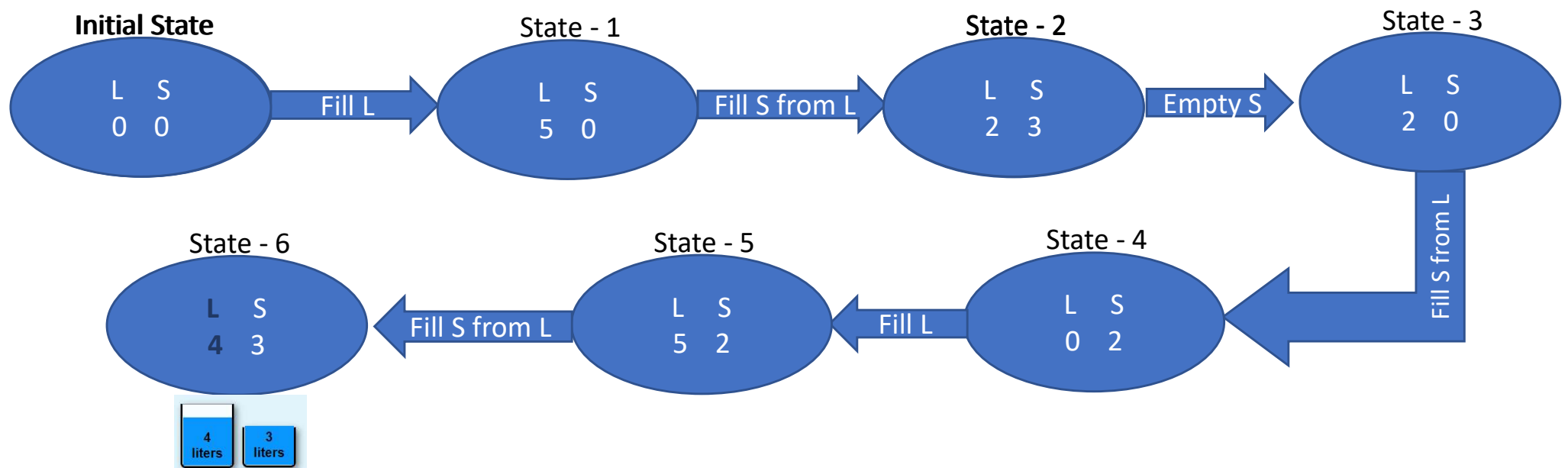
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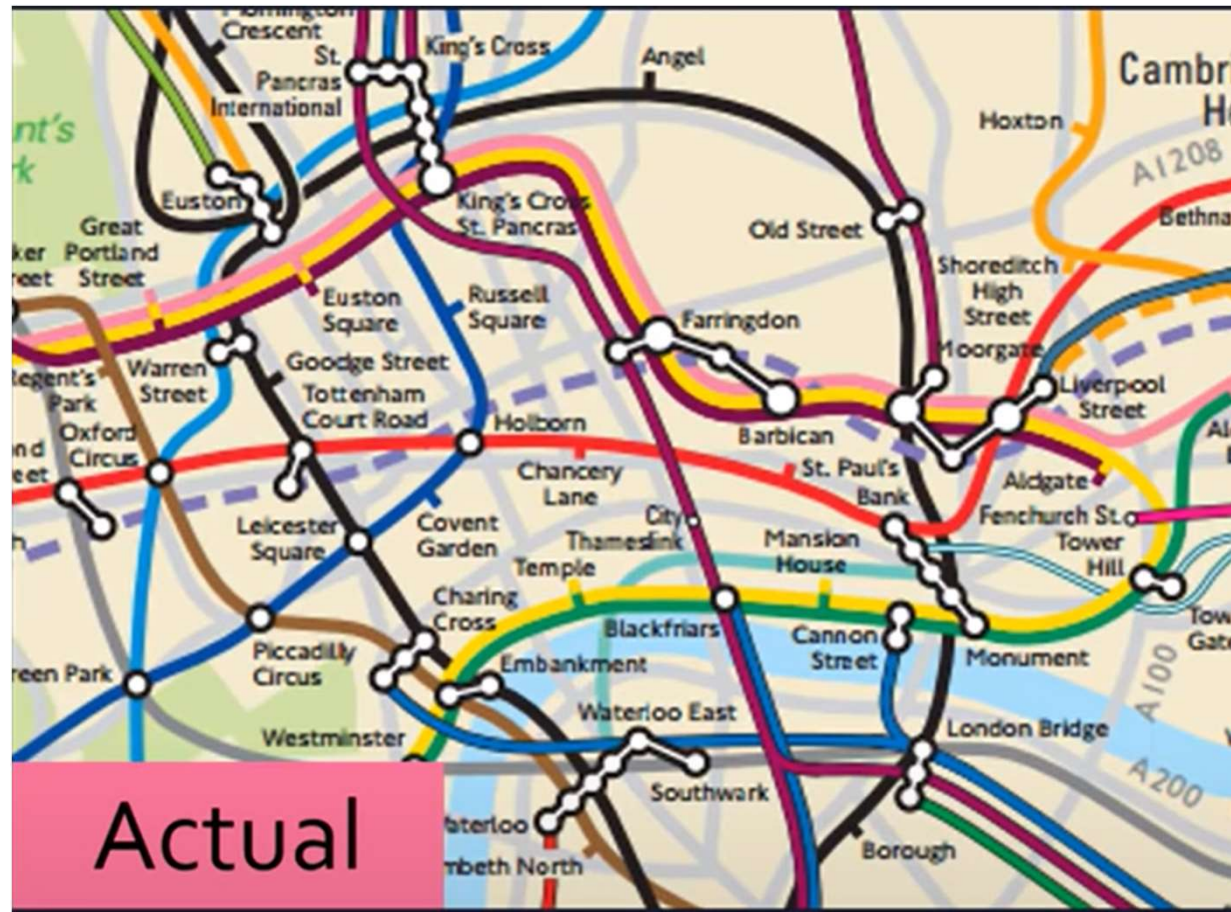


Activity: Water Jug Puzzle

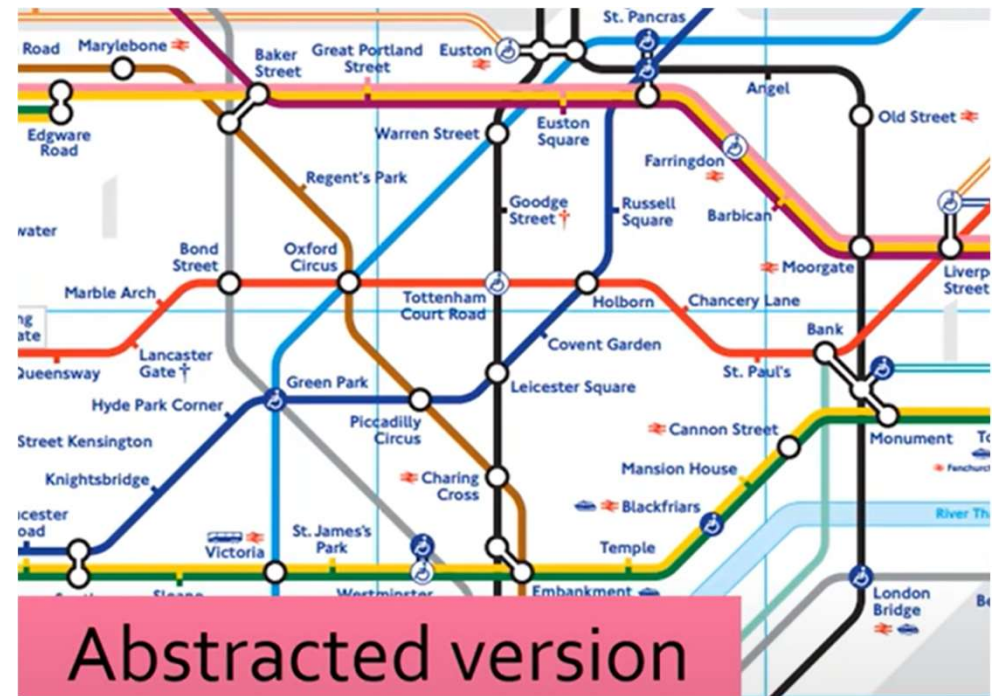
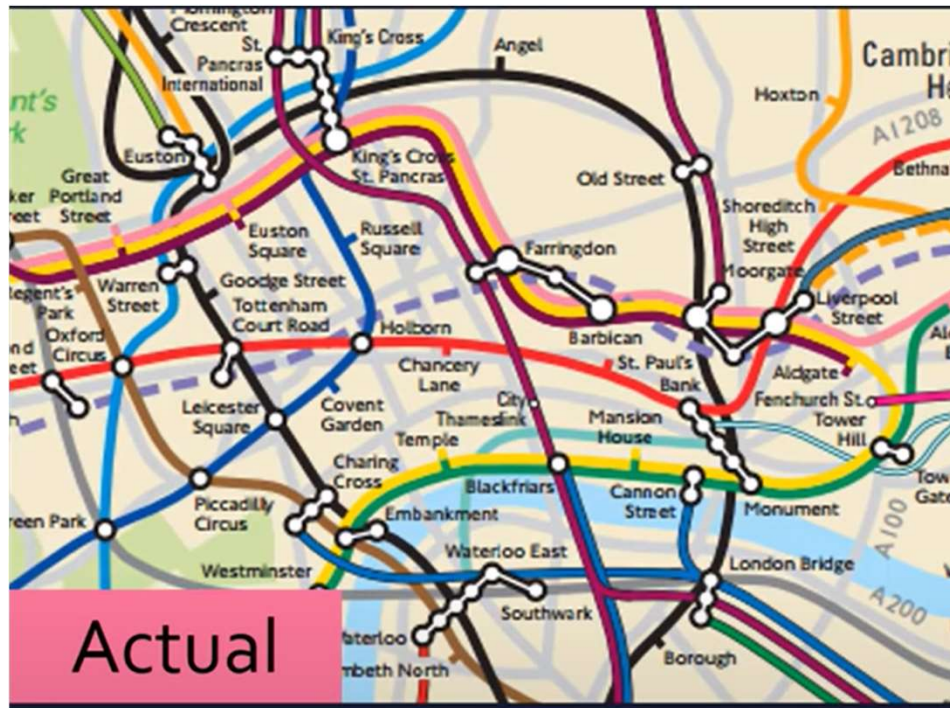
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Abstraction = removing unnecessary detail from a problem



Abstraction = removing unnecessary detail from a problem



Abstraction

- Why we need abstraction ? It simplifies a problem
 - Example: When designing , disregard implementation details
- A model is an abstraction : generalized version

Algorithm Design

- Informally: “An algorithm is a set of steps that define how a task is performed.”
- Formally: “An algorithm is an ordered set of unambiguous executable steps, defining a terminating process.”
 - Ordered set of steps: structure!
 - Executable steps: doable!
 - Unambiguous steps: Well defined instructions!
 - Terminating: must have an end!

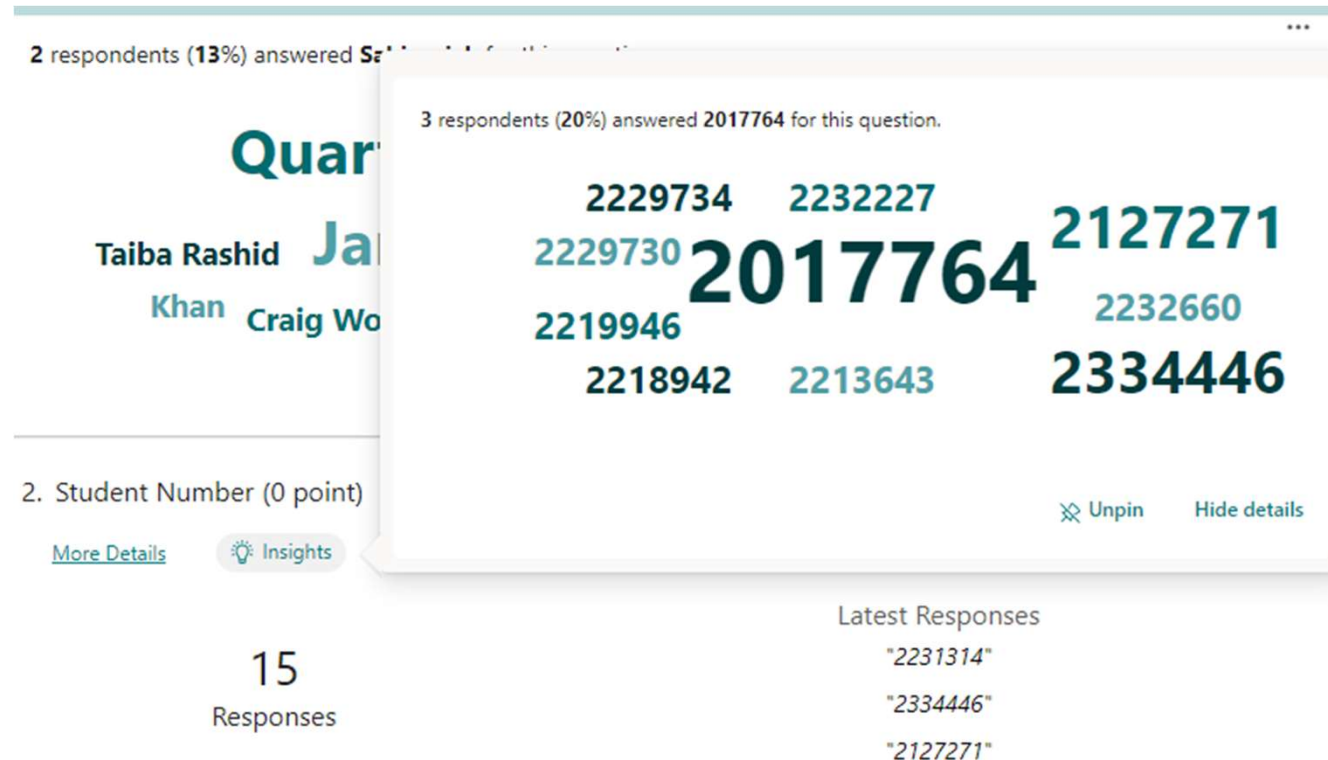
Outline

- Elements of Computational thinking
- Labeled State Transition Diagram
- Pattern Recognition
- Algorithms

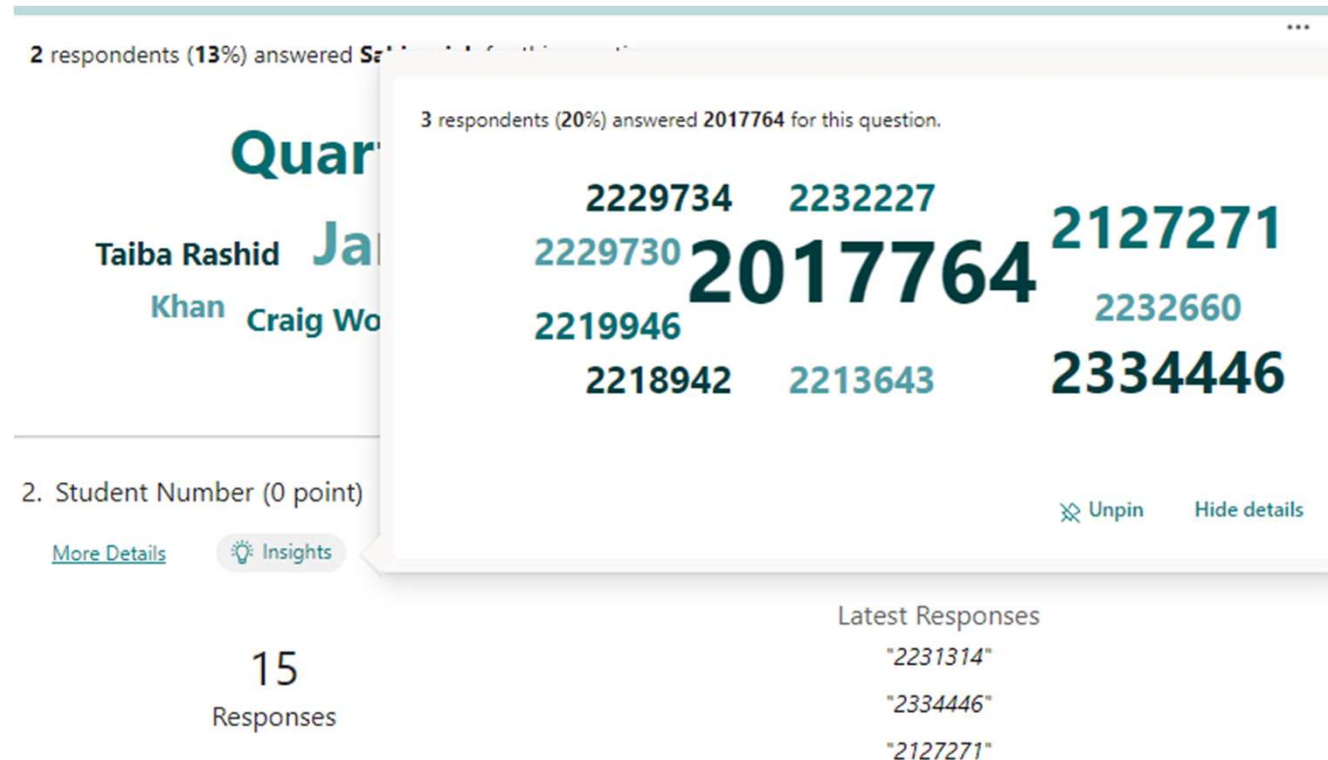
Assignment: Three Thieves Problem

- Three Thieves need to cross a river. Each thief has certain amount of stolen gold coins kept in his bag.
Thief A has 1000 gold coins
Thief B has 700 gold coins
Thief C has 300 gold coins
- To cross the river there is a boat which can carry a maximum of two objects at a time that means either a maximum of two thieves can cross the river or a thief with a bag can cross the river. The problem is that in this process of crossing the river if a thief is left with total number of coins more than his own then he will run away with that. The same rule applies for two thieves, if they are left with a total of more than their cumulative gold coins then they will run away with that money. What strategy will ensure that they all cross the river properly ?
- Hint: Use visualization, abstraction and labelled transition

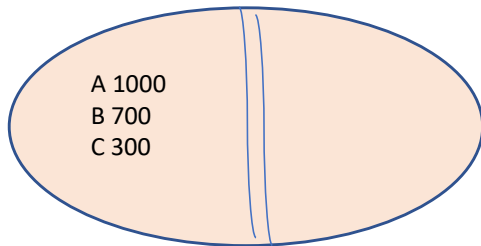
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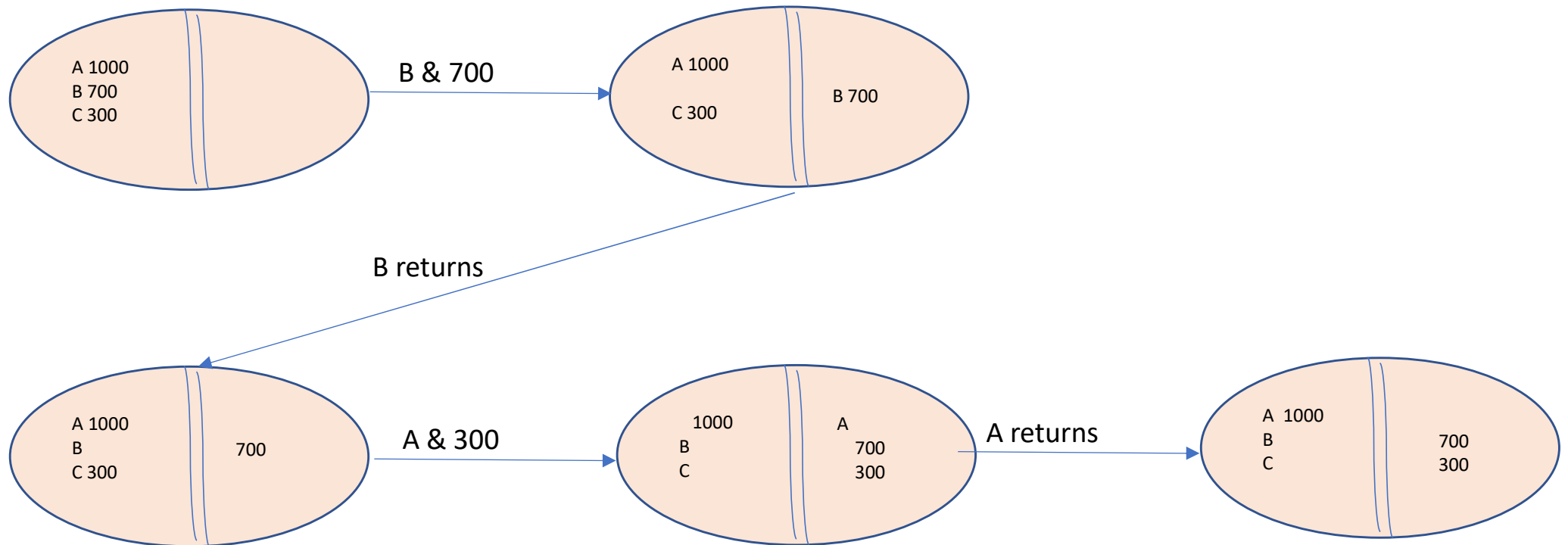


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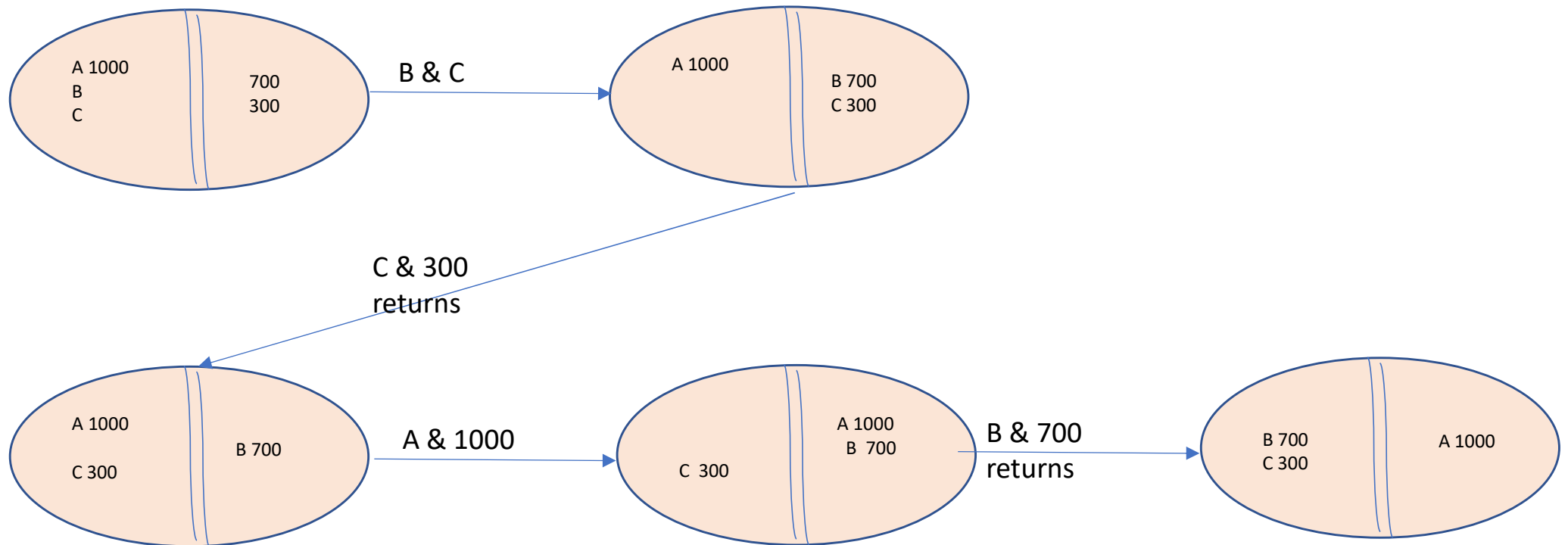


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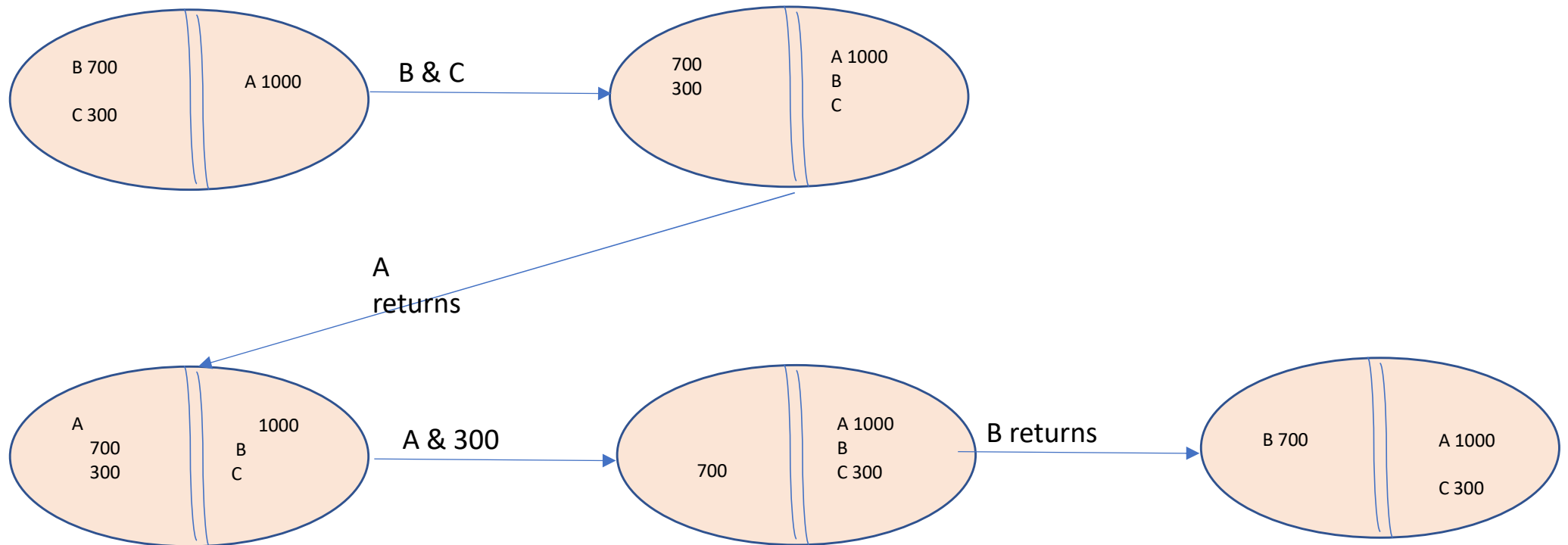
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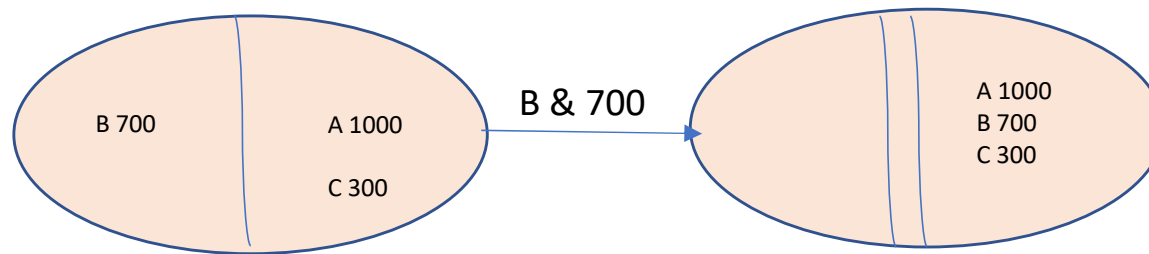
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Assignment: Three Thieves Problem



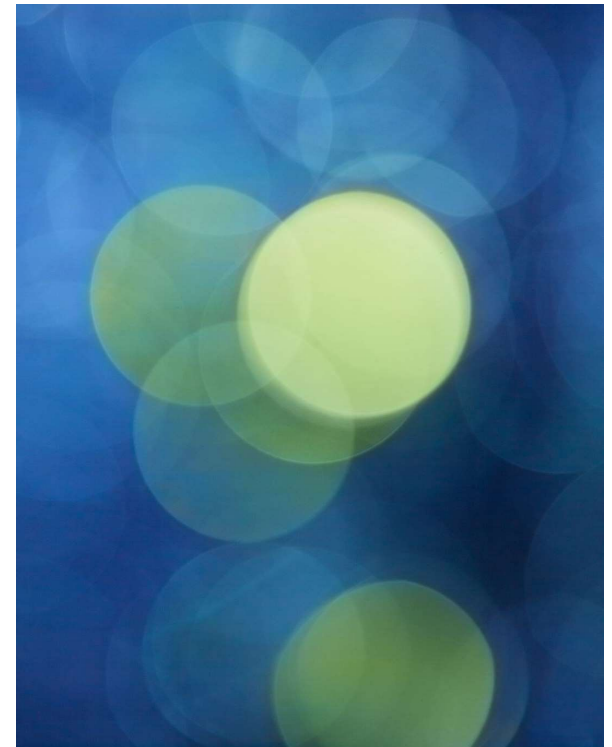
Problem – Elements of Computational Thinking

Decomposition

Pattern Recognition

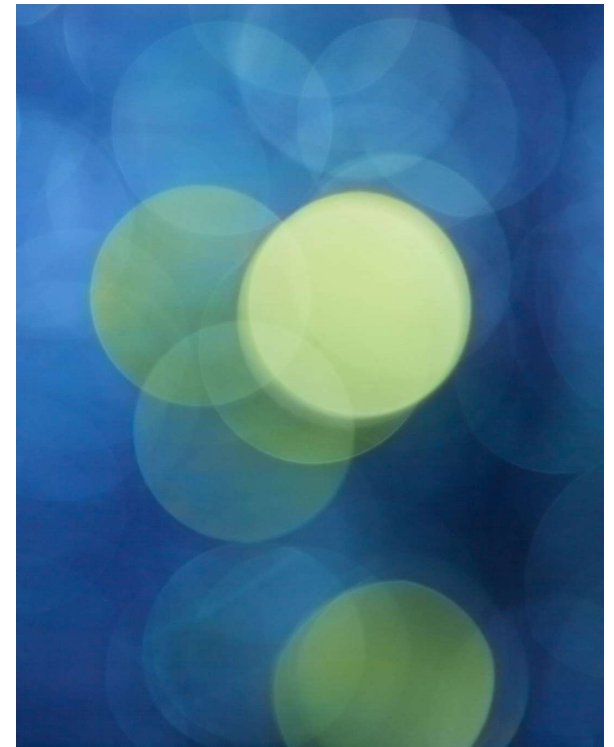
Algorithms

Abstraction



Problem – Elements of Computational Thinking

Pattern Recognition



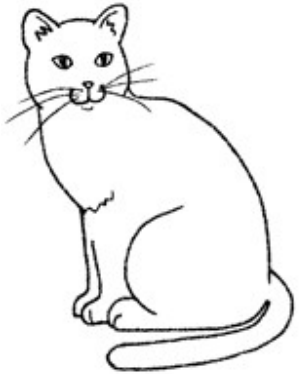
Pattern Recognition (let us get arty...)

- Draw a cat

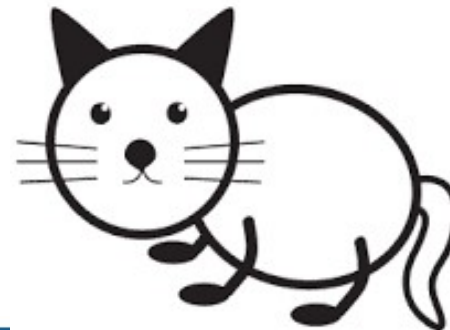
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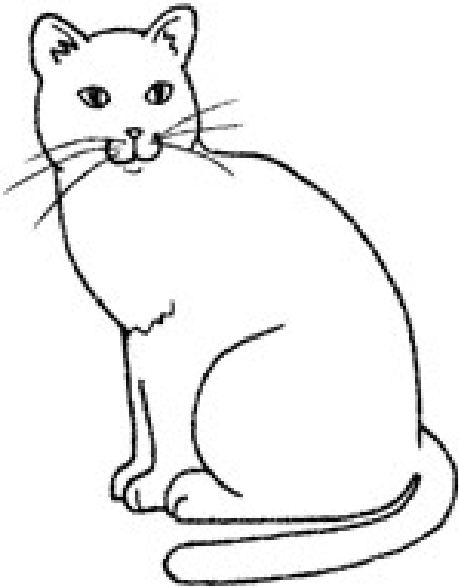
Pattern Recognition



What do all of these drawings have in common?

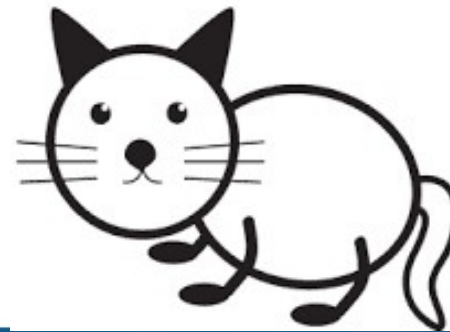


Pattern Recognition



The only things that are different are the specifics:

- one cat may have green **eyes**, a long **tail** and black **fur**
- another cat may have yellow **eyes**, a short **tail** and striped **fur**

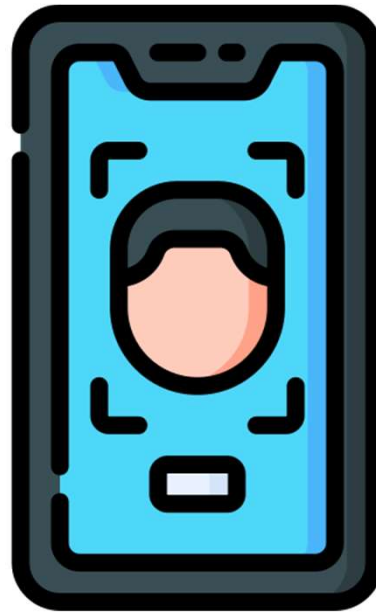


Pattern Recognition - Examples

Computer aided diagnosis

Speech Recognition

Image Recognition



Pattern Recognition - Activity

1,2,3,4,5, __, __, __

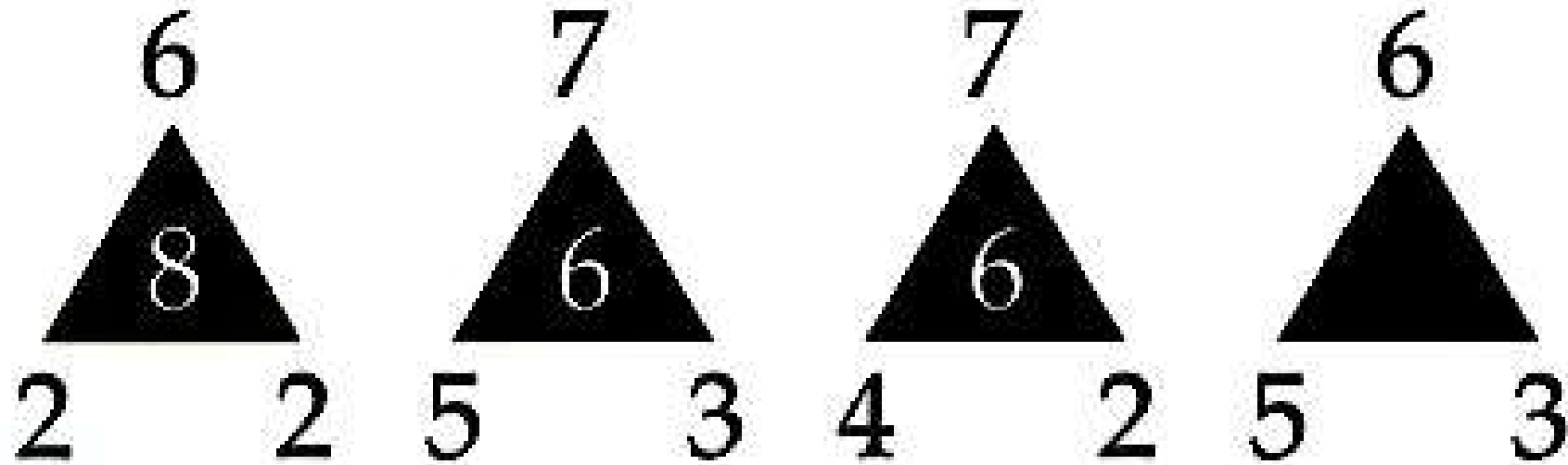
2,4,6,8,10, __, __, __

8,4,0,-4, -8, __, __, __

1,2,4,7,11,16,22, __, __, __

1,1,2,3,5,8,13,21,34, __, __

Pattern Recognition - Activity



Pattern recognition- activity



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