Computational Thinking?

Session-1

Were you able to finish pre-class work for Computational Thinking?
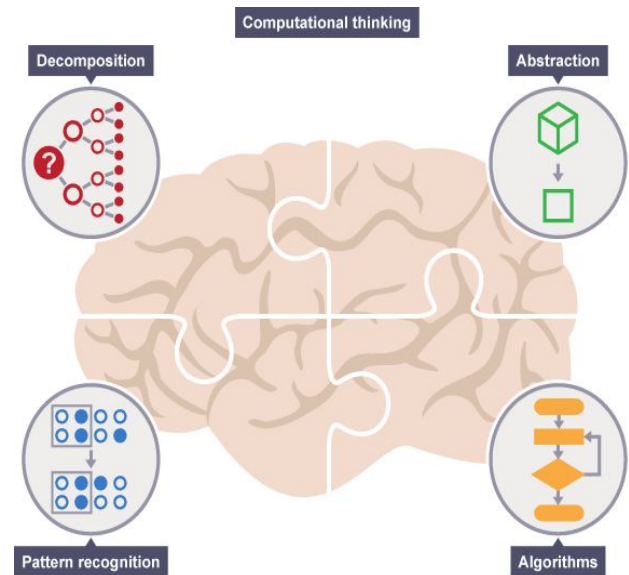
USWAY©
REINVENT YOURSELF

Were you able to finish pre-class work for Computational Thinking?

Today's Topics

- ▸ What is Computational Thinking?
- ▸ Decomposition
- ▸ Pattern Recognition
- ▸ Abstraction
- ▸ Algorithms

CLARUSWAY©
WAY TO REINVENT YOURSELF

What is Computational Thinking?

Let's try to predict and discuss!

REINVENT YOURSELF

5

What is Computational Thinking?

Computational thinking is:

- Logical thinking

- Critical thinking

- Problem solving

If a problem is too hard, what should you try to do?

What is Computational Thinking?

What is Computational Thinking?

Computational thinking is:

- Organising data/information logically (Abstraction)

- Breaking problems into parts (Decomposition)

- Interpreting patterns and models (Pattern Recognition)

- Designing and implementing algorithms (Algorithms)

What is programming?

What is Computational Thinking?

Computational Thinking is the must step between having a problem and having a solution to that problem.

Computational Thinking aims to teach how to form a solution such that can be programmed into a computer.

programming
= algorithms
+ coding

Architects or Bricklayers?

Programming is like bricklaying. You don't have to have an in depth knowledge and thinking to be able to build a wall.

Programming with computational thinking is the architecture.

Architects or Bricklayers

Four pillars of Computational Thinking

- ▶ Decomposition

- ▶ Pattern Recognition

- ▶ Abstraction

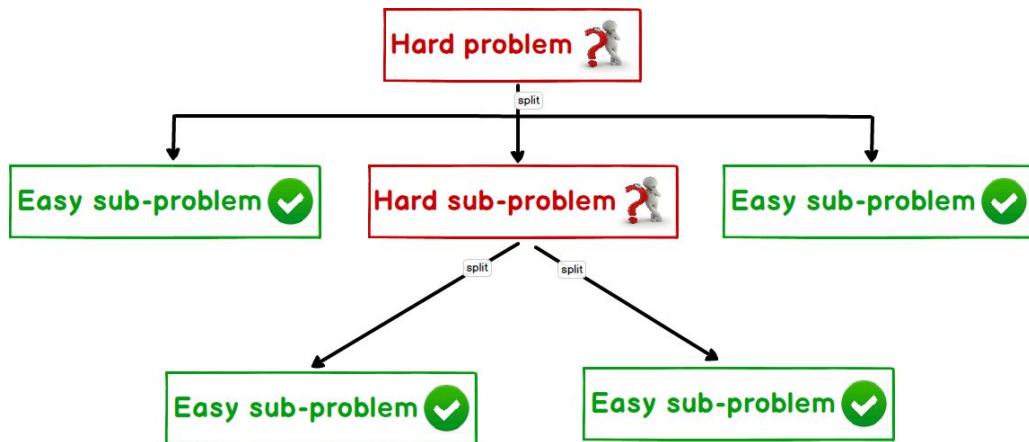- ▶ Algorithm Design

1 Decomposition

Decomposition

Let's discuss and try to predict what does decomposition mean in computational thinking!

Decomposition

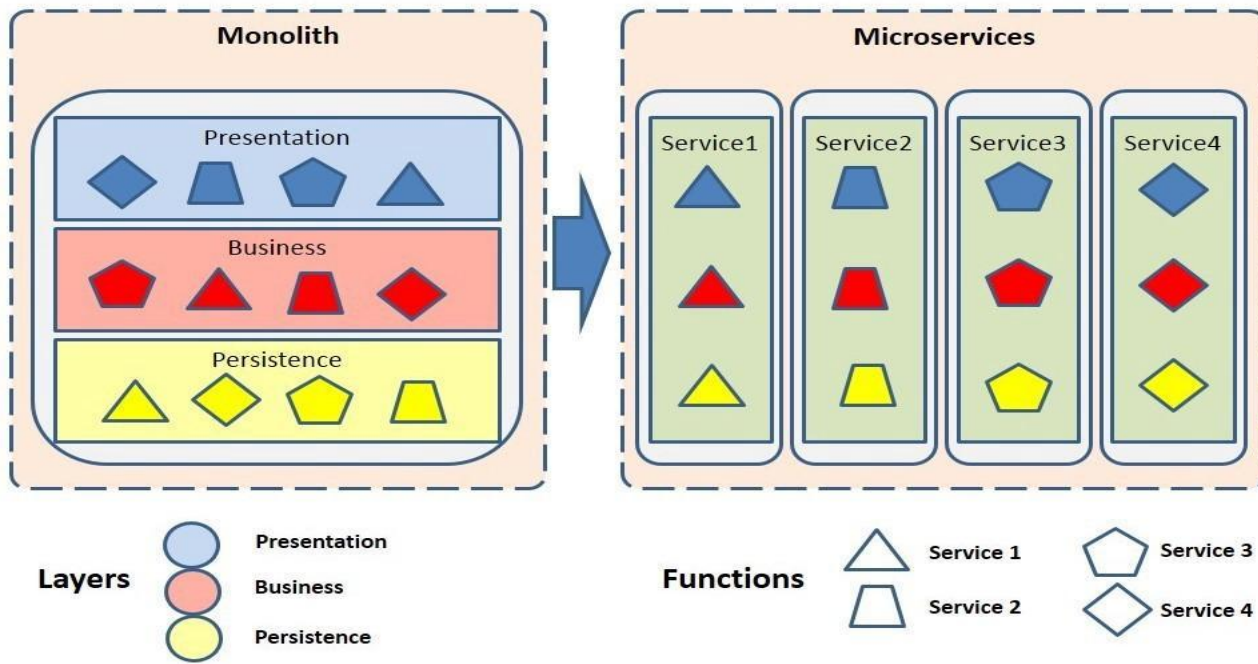It basically means breaking a problem into smaller pieces.

Let's think of some examples of decomposition!

Decomposition

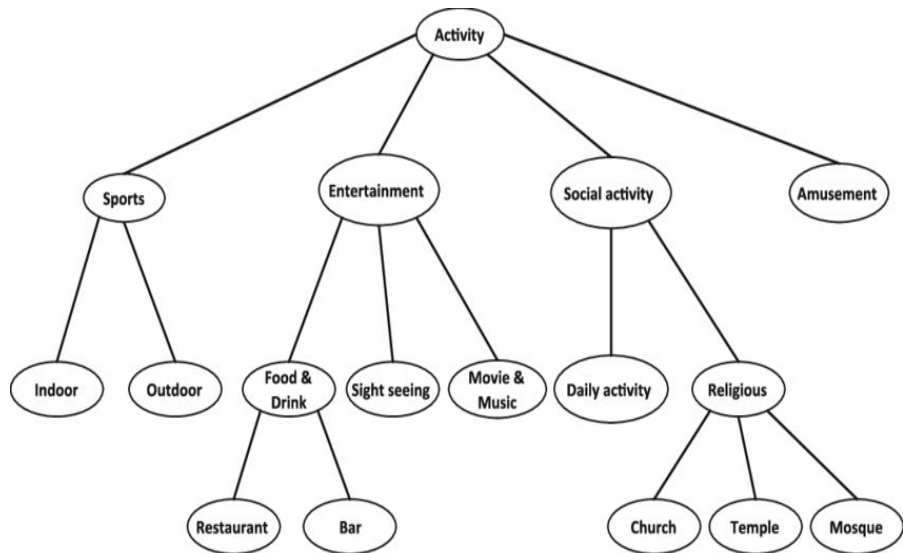Let's think of some examples of decomposition!

Decomposition

We use tree structures to visualize decomposition

- ▸ Tree structures help us decompose problems into sub-problems.
- ▸ It consists of blocks connected by branches.
- ▸ Each block that is connected to its parent block which is above it, represents a sub problem of that block.

Decomposition

Try to break these problems into as much sub problems as possible and represent them with tree structures:
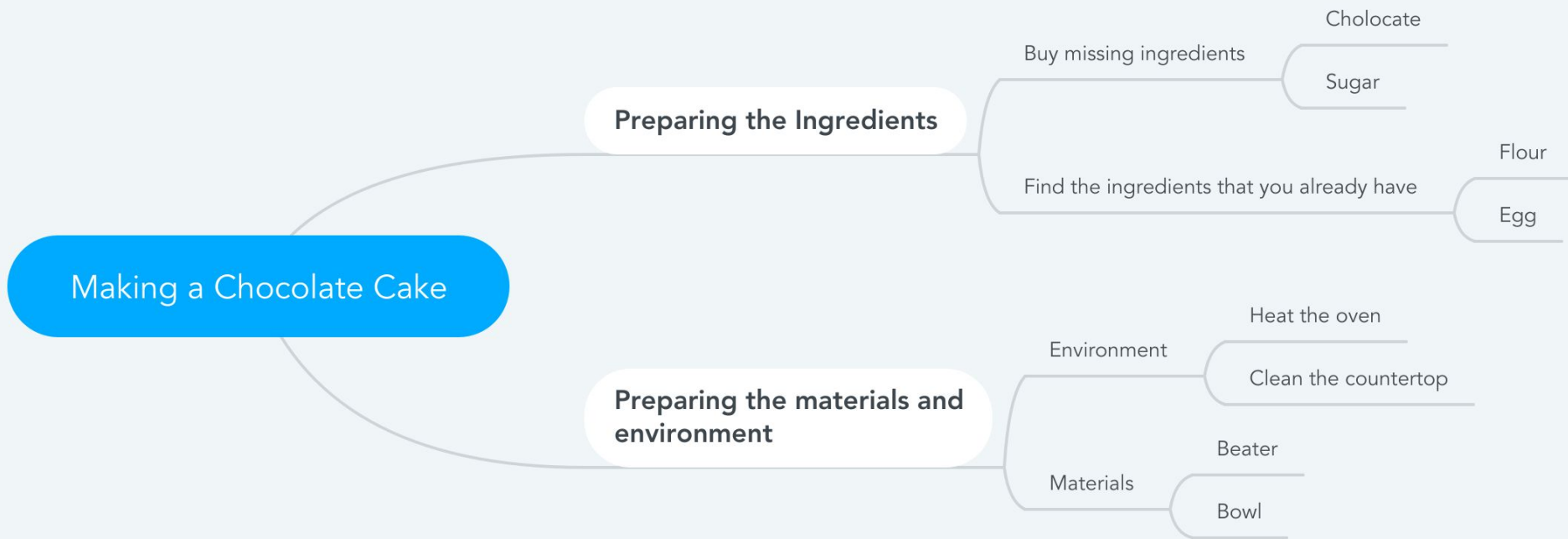
Making a chocolate cake

Parking a car

Preparing to go to work in the morning

Preparing vocation plan

Become IT guy

Making A Chocolate Cake

Making a Chocolate Cake

- **Preparing the Ingredients**
  - Buy missing ingredients
    - Cholocate
    - Sugar
  - Find the ingredients that you already have
    - Flour
    - Egg
- **Preparing the materials and environment**
  - Environment
    - Heat the oven
    - Clean the countertop
  - Materials
    - Beater
    - Bowl

Parking a Car

```
                            Parking a Car
                   /                          \
         Finding a spot                      Parking
         that fits the car              /      |       \
          /          \                 /       |        \
  Take a tour    Stop when       Set the gear  Turn on the   Drive into the
  at the         you find an     to R or D     parking       spot carefully
  parking lot    empty spot                    lights
```

Finding a spot that fits the car
- Take a tour at the parking lot
- Stop when you find an empty spot

Parking
- Set the gear to R or D
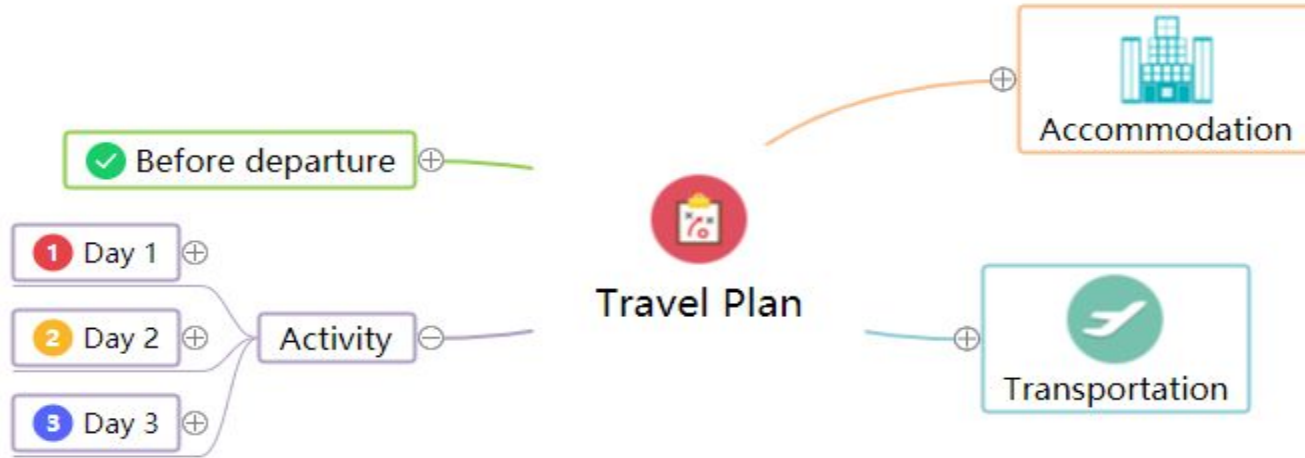- Turn on the parking lights
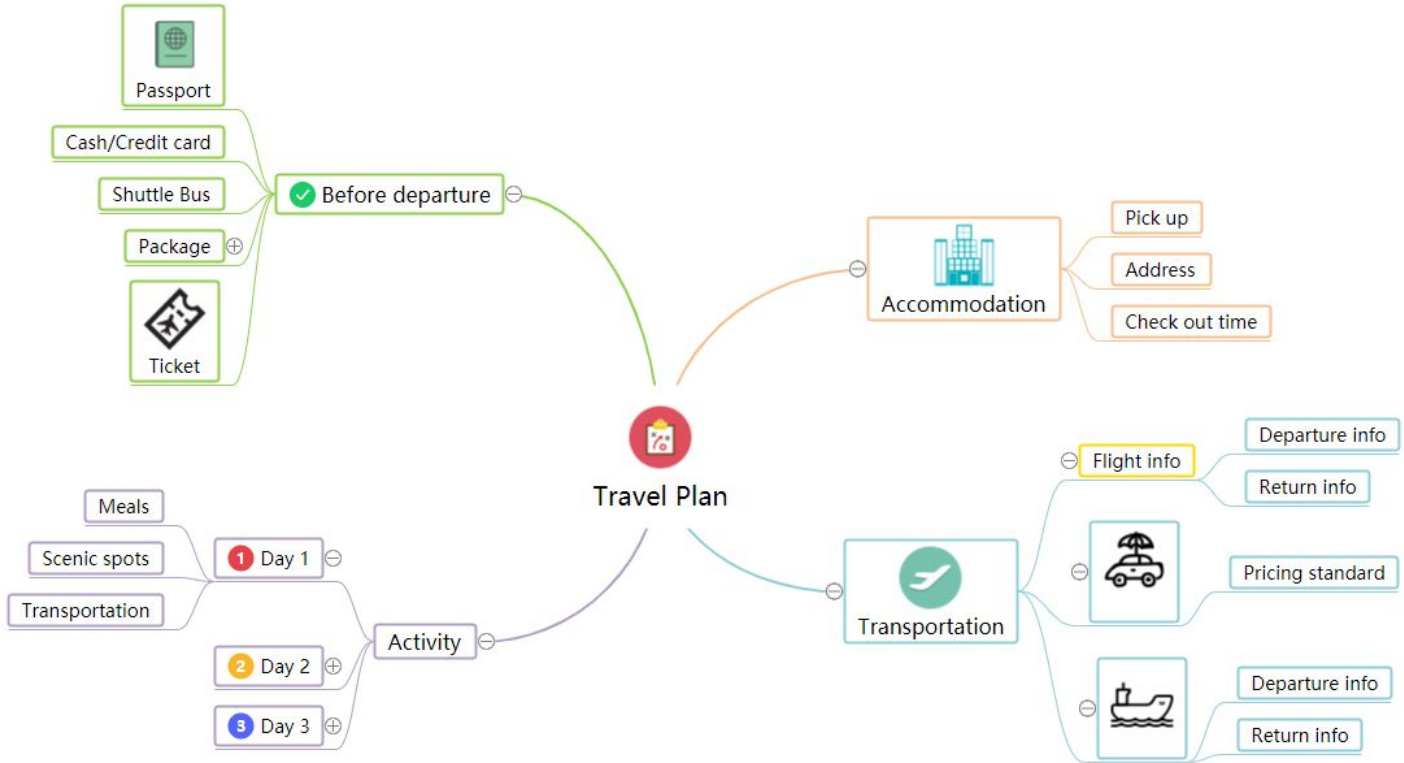- Drive into the spot carefully

Preparing Vacation Plan

Preparing Vacation Plan
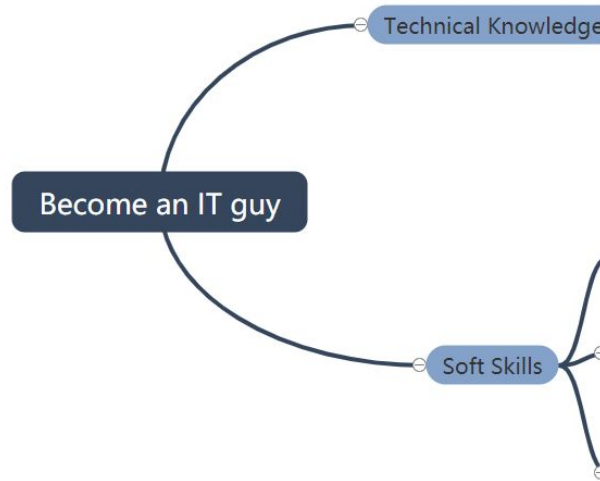
Preparing to Go to Work in the Morning
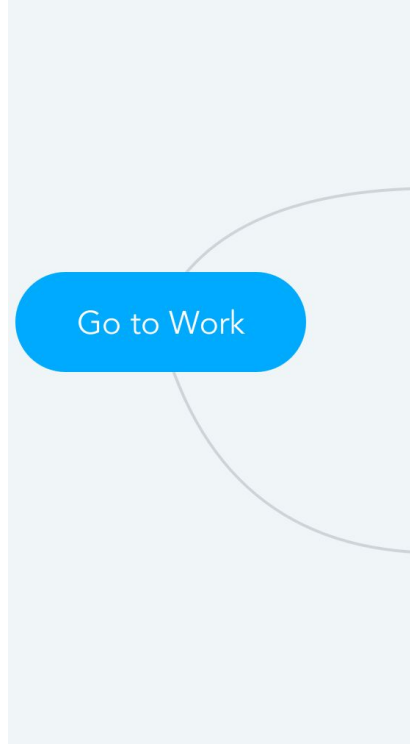
Go to Work

Preparing to Go to Work in the Morning
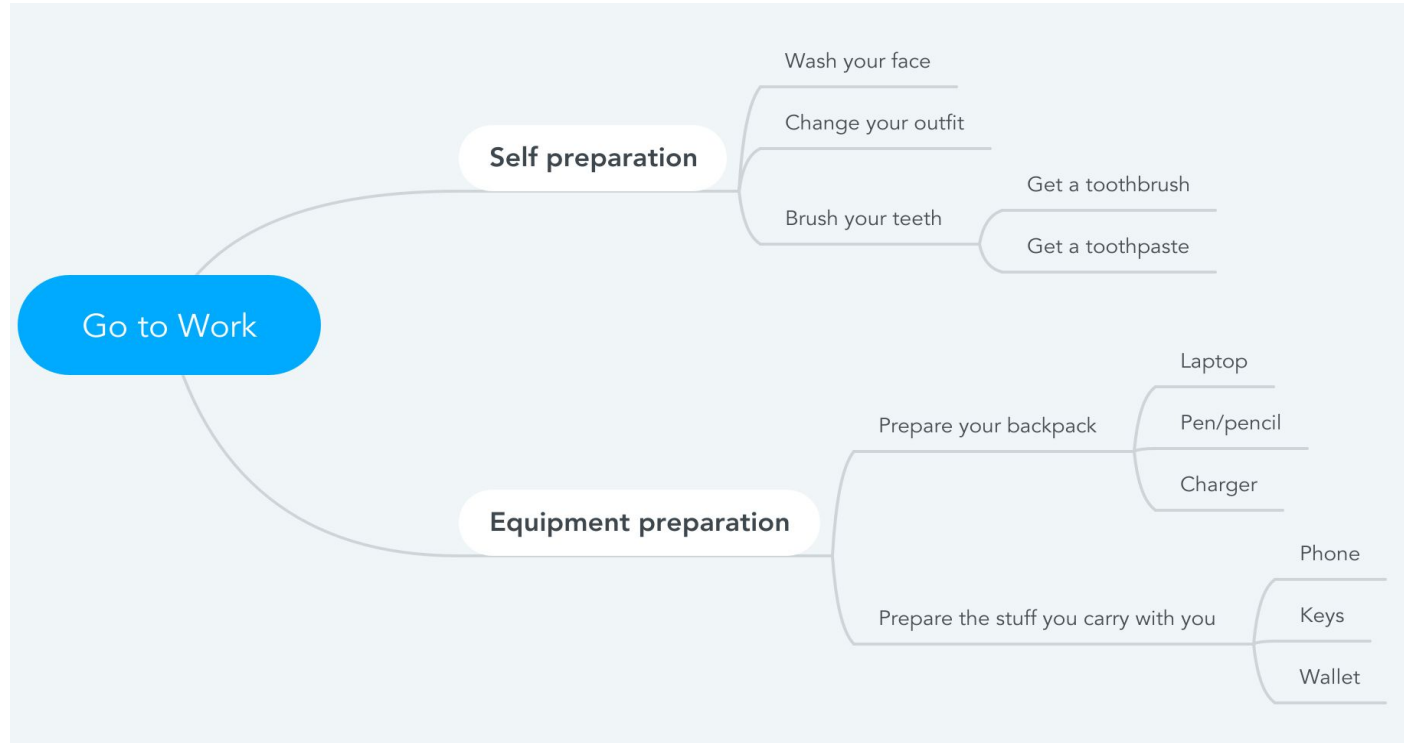
Let's decompose what you're doing right now?

Challenge

A mind map titled "Become an IT guy" with the following structure:

Become an IT guy

- **Technical Knowledge**
  - General Computer Knowledge
    - Hardware
    - Software
    - Operating Systems
  - HTML CSS
    - HTML
    - CSS
  - Linux
  - SDLC Concepts
    - Classic Models
    - Agile
  - Python
    - Python basic
    - Python plus
- **Soft Skills**
  - Communication Skills
  - Interview Skills
    - Mock Speaking Skills
    - English Speaking Skills
    - Flipgrid
  - Leadership Skills
    - Mentoring others
    - Group Study
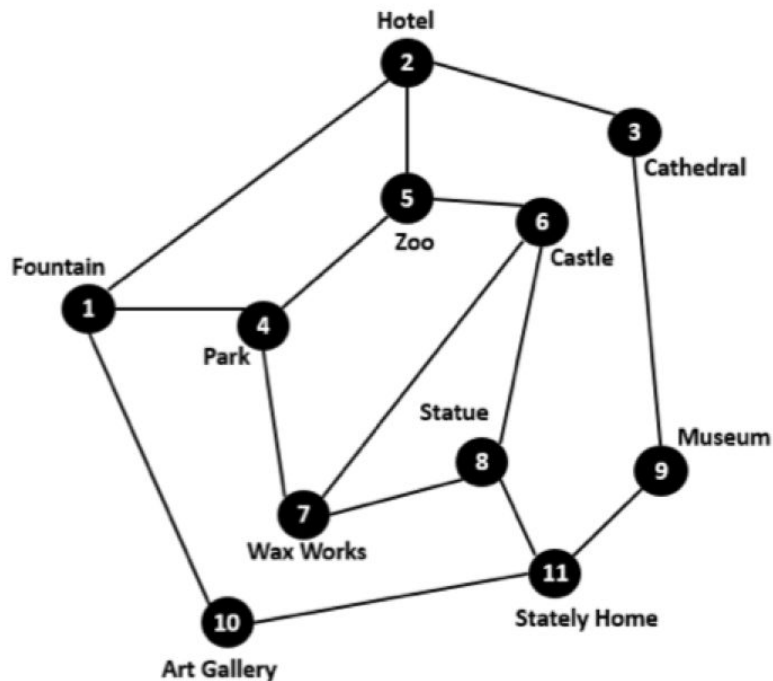
Decomposition Challenge

You are a tour guide. Tourists have booked a tour visiting all the city's attractions starting from the hotel they are staying in. This map shows where the attractions are and roads that connect them. You must work out a route that takes your tour group to **<u>every</u> tourist site. The tourists will not be happy if they pass through the same place twice. They also want to end up back at their hotel that evening.**

Decomposition Challenge

You are a tour guide. Tourists have booked a tour visiting all the city's attractions starting from the hotel they are staying in. This map shows where the attractions are and roads that connect them. You must work out a route that takes your tour group to every tourist site. The tourists will not be happy if they pass through the same place twice. They also want to end up back at their hotel that evening.

2, 3, 9, 11, 10, 1, 4, 7, 8, 6, 5, 2
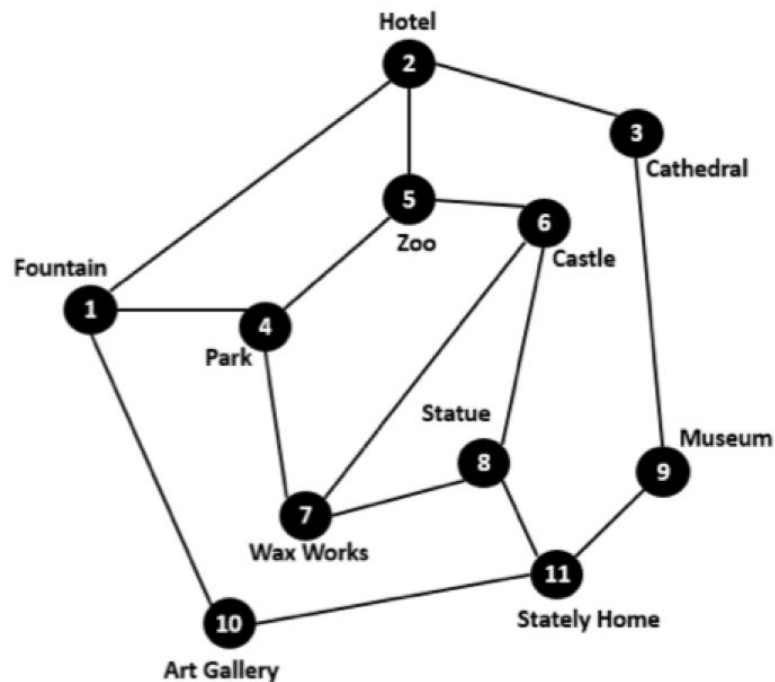
Decomposition Example
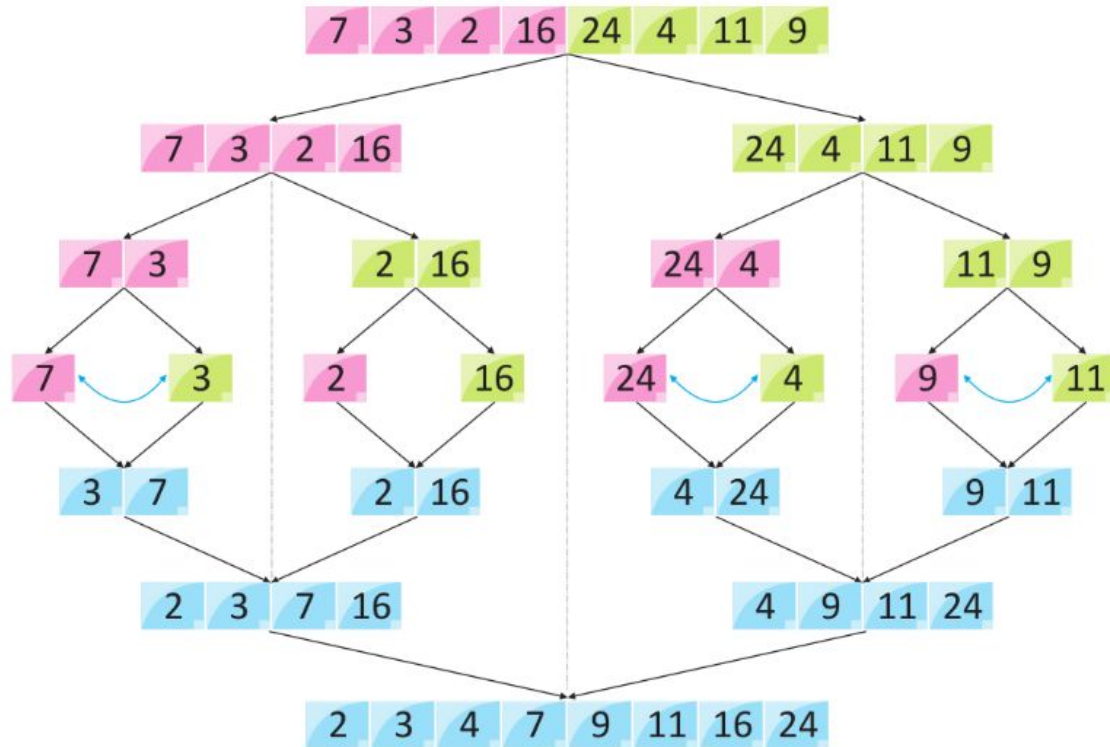
Recap Time

Do you use decomposition in solving your daily problems? if so, what are some examples?

Have you ever used tree structures before? Where did you use them?

2 Pattern Recognition

Some Questions to Think About Before Starting

If you find similarities in lots of solutions to different problems what does that probably tell you?

If you have a problem that is just a little different from a problem that you have a solution for, what would you do?

CLARUSWAY©
WAY TO REINVENT YOURSELF
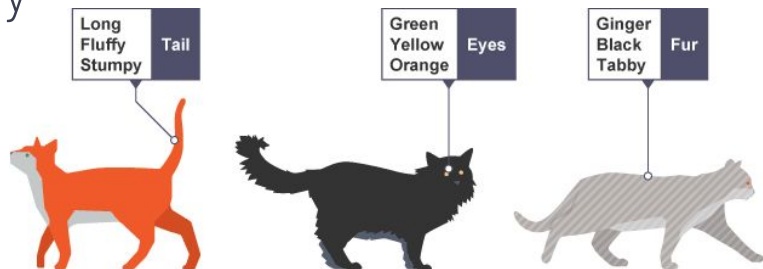
Pattern Recognition

Let's discuss and try to predict what does pattern recognition mean in computational thinking!

34

Pattern Recognition

Pattern recognition is recognising patterns in different things (solutions) and being able to apply these patterns in the solutions of other similar problems.

Pattern recognition is good because we don't have to come up with a new solution each time we encounter the same problem. Instead, we apply the patterns that we have previously recognized.

Long Fluffy Stumpy — Tail

Green Yellow Orange — Eyes

Ginger Black Tabby — Fur

Challenge

add all the numbers from 1 to 200

▸ Big problem?

▸ Did you try?

▸ A lot to do in your head?

Pattern Recognition Exercises

Look at the following number patterns and find the sequence.

1   2   5   10   17   ?

CUSWAY©
REINVENT YOURSELF

Pattern Recognition Exercises

Look at the following number patterns and find the sequence.

1   2   5   10   17   26

Add 1, 3, 5, 7, 9 etc. to previous number

Pattern Recognition Exercises

Look at the following number patterns and find the sequence.

123   117   108   99   ?

Pattern Recognition Exercises

Look at the following number patterns and find the sequence.

123   117   108   99   81

Subtract the sum of previous digits (1 + 2 + 3 = and 123-6 = 117)

Pattern Recognition Exercises

Look at the following number patterns and find the sequence.

12   48   163   26   412   ????

Pattern Recognition Exercises

Look at the following number patterns and find the sequence.

12   48   163   26   412   8

The spaces are incorrectly added, when they are correct it is a simple x 2 pattern

Pattern Recognition Exercises

Look at the following number patterns and find the sequence.

849   352   768   493   527   **?**

RUSWAY®
REINVENT YOURSELF

Pattern Recognition Exercises

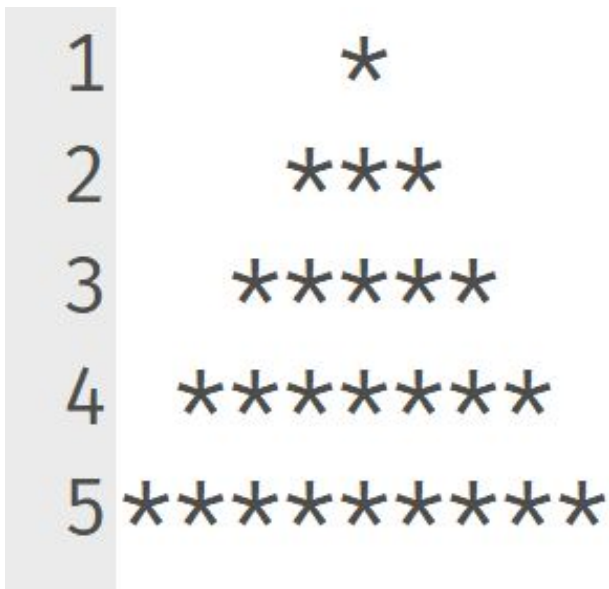Look at the following number patterns and find the sequence.

849   352   768   493   527   684

The numbers are 84935276 repeated and then split into groups of 3 digits

Pattern Recognition Exercises

Look at the following number patterns and find the sequence.

```
1          *
2         ***
3        *****
4       *******
5     *********
```

Students, write your response!

RUSWAY©
REINVENT YOURSELF

Finding The Rules of the Game

Can you find the rules for this game? If so, how did you find the rules?

User Experiences:

I thought of a number in between 0 and 10, someone tried to guess it and sayed 4, I said lower, someone said 2, I said higher, someone said 3. That person won the game.

I thought of a number in between 0 and 10, someone tried to guess it and sayed 10, I said lower, someone said 2, I said higher, someone said 5, I said lower and I won the game.

Finding the Rules of the Game

To find the rules we found a pattern that is repeated in both of the user experiences:

Phrases like "I guess a number in between 0 and 10", "someone tried to guess it and sayed..." and "I said ..." are repeated. So we can use these phrases to be able to play the game. Except, we change the parts like the numbers that we guess and statements about the number that is guessed saying whether it is above or below the number that the player thought of.

Recap Time

What are some patterns that you recognise in your daily life/problems?

So far, we have learned decomposition and pattern recognition. Can you give an example of combining those to in a solution of a problem?

3 Abstraction

Abstraction

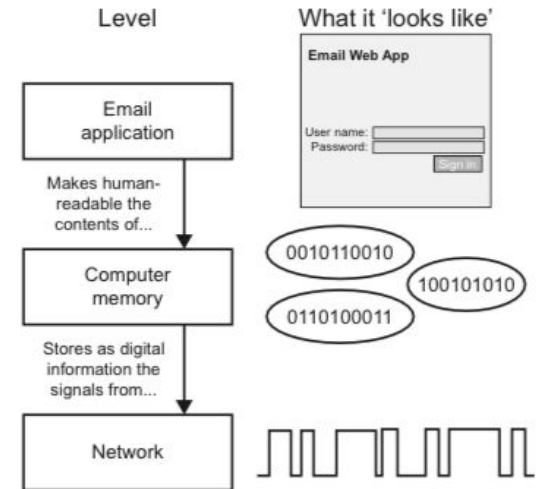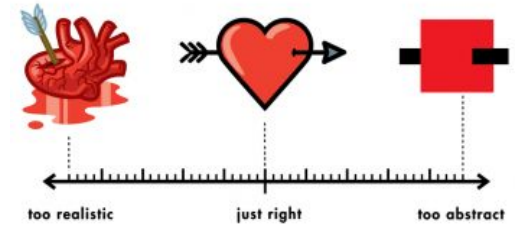Let's discuss and try to predict what does abstraction mean in computational thinking!

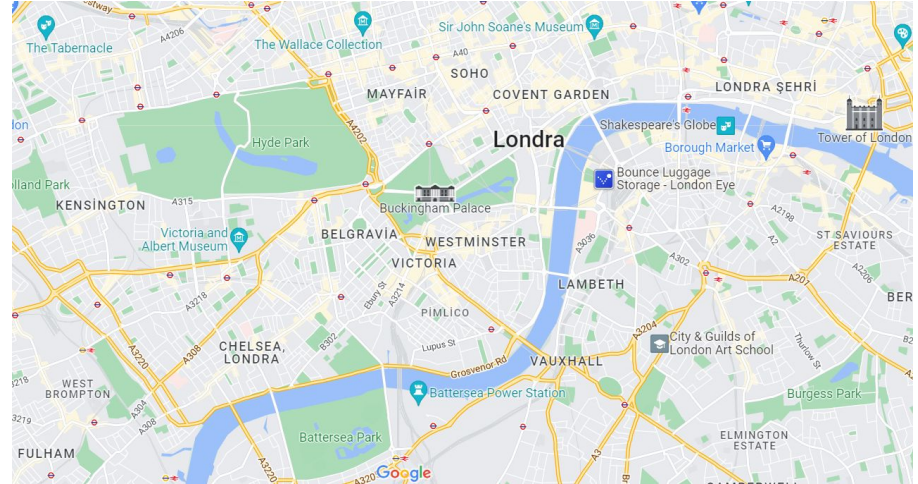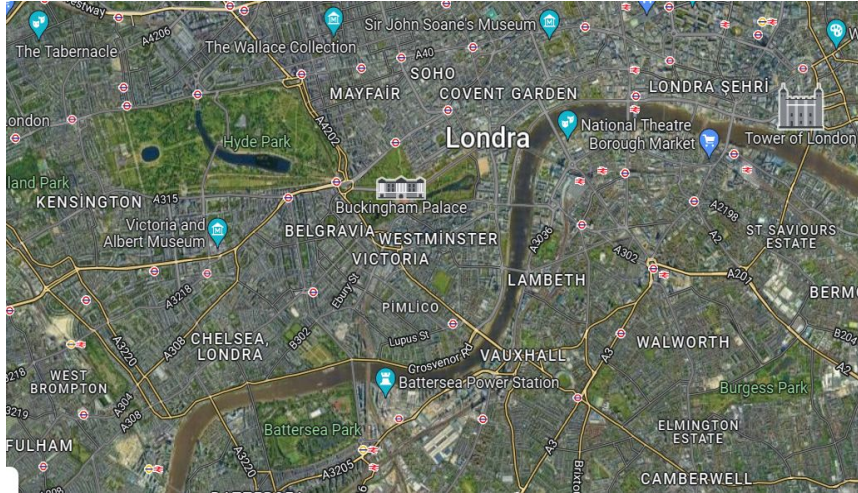Students, write your response!

REINVENT YOURSELF

Abstraction

Abstraction is getting rid of the useless information that is not going to have any contribution to the solution.

Abstraction is the core concept of computer science and computational thinking. To be able to express a real world problem to a computer, the problem has to be abstract.

too realistic   just right   too abstract

Level   What it 'looks like'

Email Web App

Email
application

User name:
Password:
Sign in

Makes human-
readable the
contents of...

0010110010
100101010
0110100011

Computer
memory

Stores as digital
information the
signals from...

Network

CLARUSWAY©
WAY TO REINVENT YOURSELF

Abstraction

Let's abstract stuff!

The key part of abstraction is ignoring the useless aspects of something and including the beneficial aspects. So, find out the useless aspects that are going to be ignored and the beneficial aspects that are going to be considered of the items below. Try going abstract as far as possible. (For example a house is nothing but a shelter for humans when you look abstractly)

Car

Pencil

House

Mobile phone

HINT: Think of what do these objects help solving and which aspects of them wouldn't prevent them from solving that particular problem.

RUSWAY©
REINVENT YOURSELF

Let's Abstract Stuff!

The abstractions should look something like this:

Object	Include	Ignore
Car	Engine, tires, rims, seat	Color, shape, trunk, radio
Pencil	color of the tip, grip	material, brand, type
Mobile phone	speaker, microphone,cellular	color, brand, camera

CLARUSWAY©
WAY TO REINVENT YOURSELF

Let's Abstract Stuff!

Finally, try to describe the objects that you have abstracted, ignoring the parts that you think should be ignored, and including the parts that you think should be included.

Recap Time

What are some examples of abstraction that we encounter in our daily lives?

Do you think that you already abstract stuff? Can you give any examples?

Why do you think abstraction is important for computer science?

4 Algorithm

Algorithm

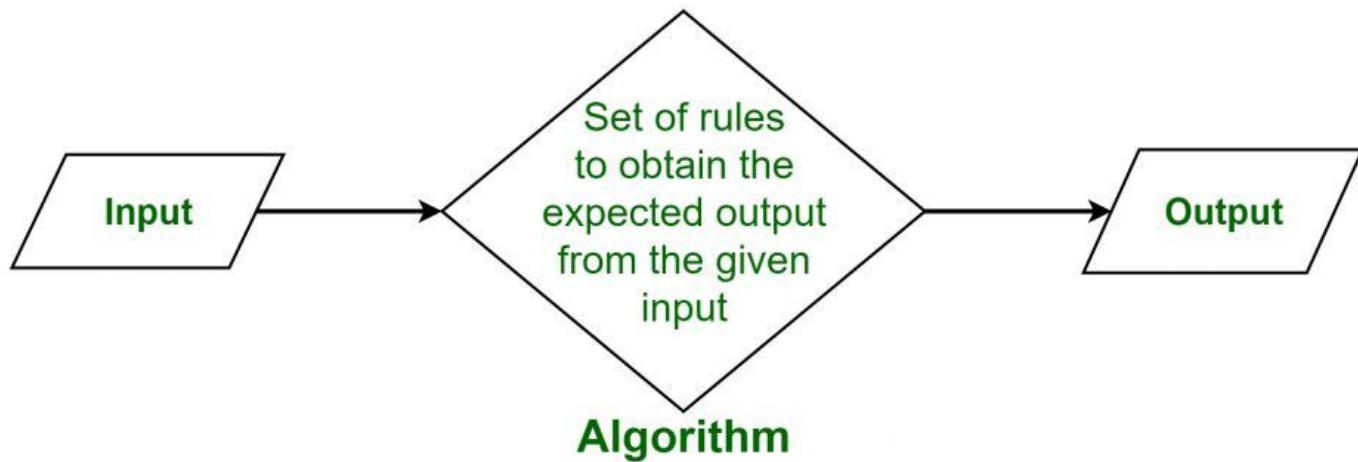- ▶ Algorithm

- ▶ Pseudocode

- ▶ Flowchart

Algorithm

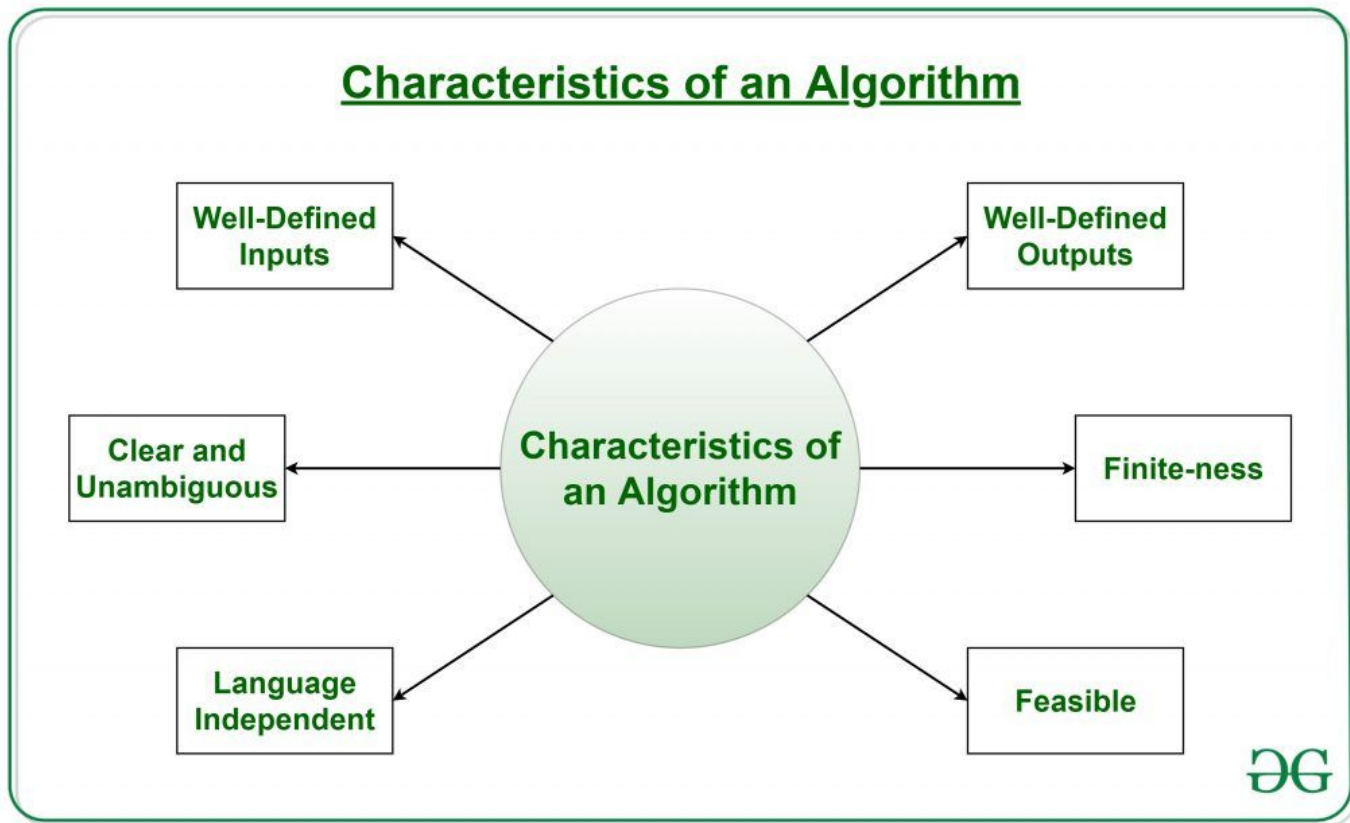Let's discuss and try to predict what does algorithm design mean in computational thinking!

What is Algorithm

What is Algorithm

Characteristics of an Algorithm

Well-Defined Inputs

Well-Defined Outputs

Clear and Unambiguous

Characteristics of an Algorithm

Finite-ness

Language Independent

Feasible

Brief Explanation of Algorithm

▸ An algorithm is a sequence of clearly defined steps to describe a process.

▸ Algorithms are useful when we wish to explain someone else or a computer how to carry out steps.

▸ Algorithms are important for programming because a correct algorithm is the ultimate basis of any computer-based solution.

What is Computational Thinking?

Exact Instructions

Let's brew a coffee

?

Let's brew coffee

- Prepare ingredients
- Make coffee
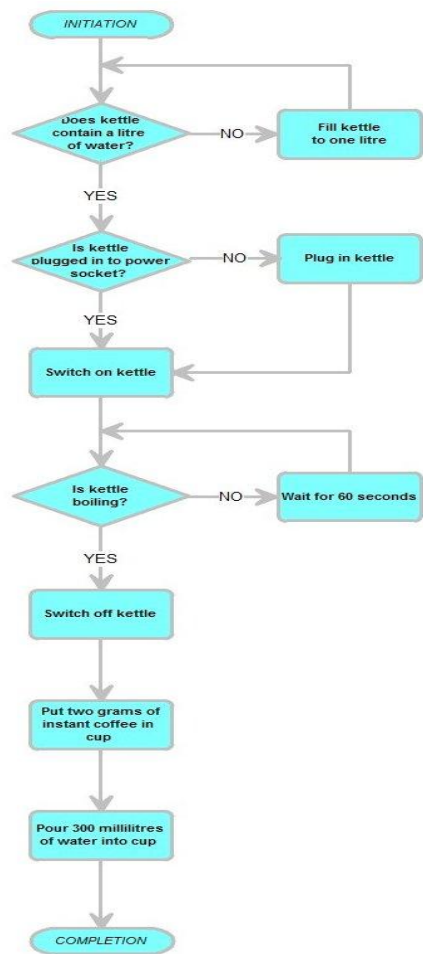- Prepare serving
- Enjoy

Let's brew a coffee

- START

- Fetch a tea cup

- Boil some water

- Place a tea bag into the cup

- Pour on boiling water

- Stir tea bag

- Remove tea bag

- END

Let's brew a coffee

- 1-START

- 2-Does kettle contain a litre of water

- No—go to the line 2

- Yes ---continue

- 3.Is kettle plugged in to power socket

- No—plug in kettle

- Yes ---continue

- 4.Is kettle boiling?

- No—wait for 60 seconds

- Yes --- continue

- 5. Switch off kettle

- 6.Put two grams of instant coffee in cup

- 7.Pour 300 milliliters of water into cup

- 8-FINISH

THANKS!

Any questions?