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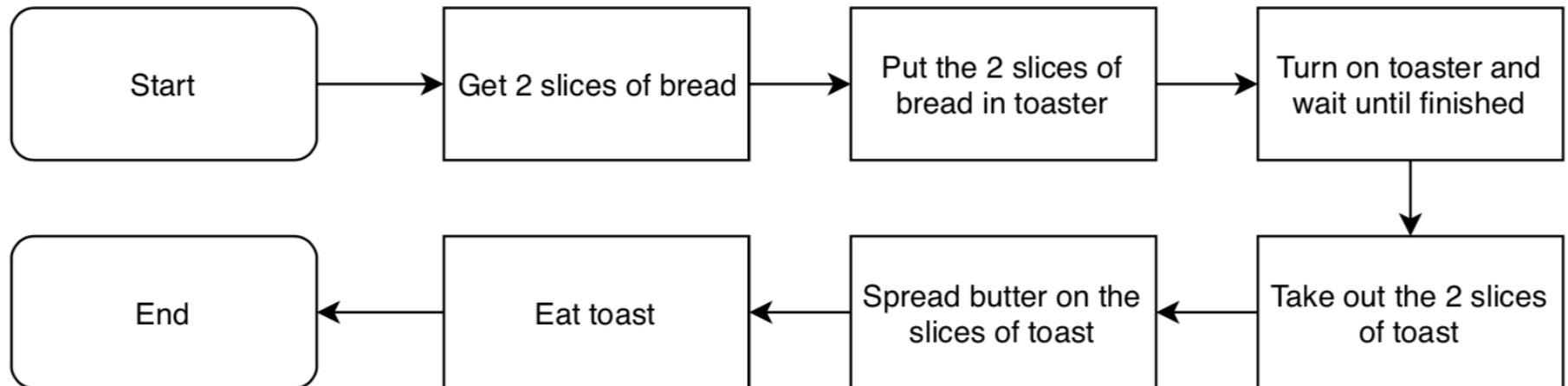
Flowcharts



Algorithms

Algorithms are sets of simple instructions that are done in a certain order to solve a problem.

We use algorithms all the time in everyday life. An example is making and eating toast.

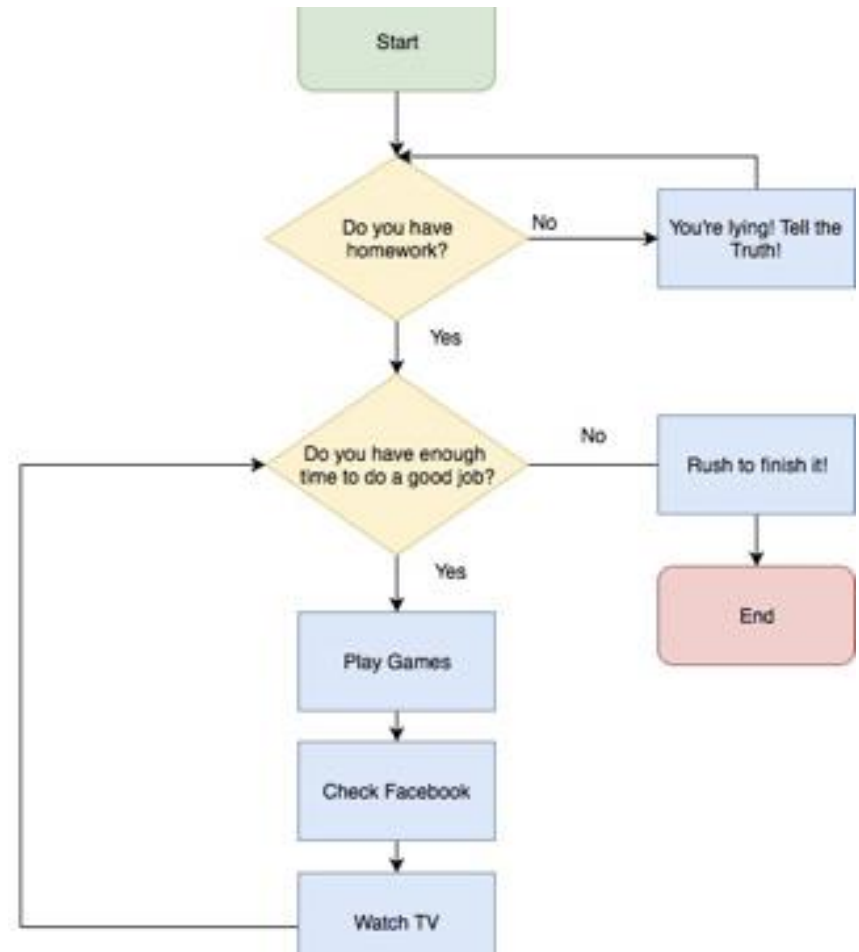


Algorithms

It is important to remember when writing an algorithm to keep instructions:

- Simple
- In the correct order
- Unambiguous
- Relevant to solving the problem at hand

Where do we use algorithms in everyday life?

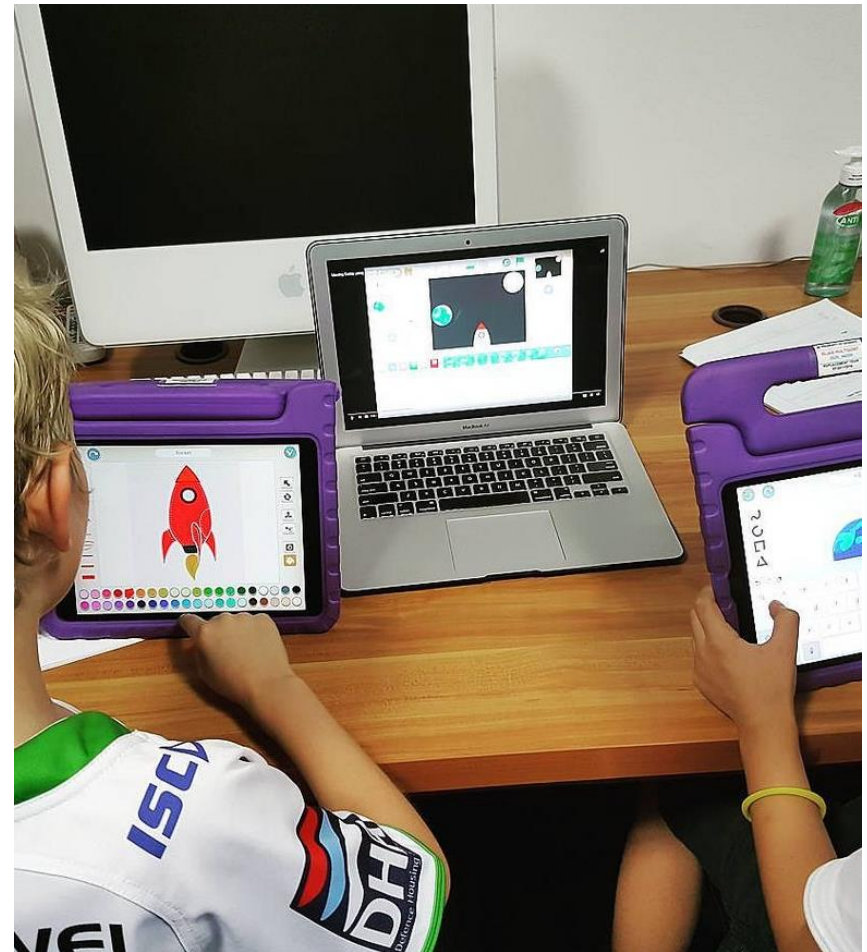


Recap Decomposition

Decomposition is the process of breaking a complex problem down into smaller component parts.

Real world examples of using decomposition include:

- Creating a video game
- Complex maths problems
- Cooking
- Cleaning your room



Recap Abstraction

Abstraction is the process of removing unnecessary detail and simplifying.


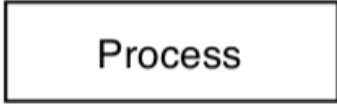
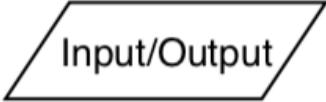

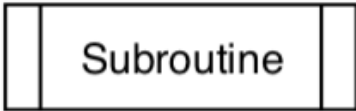

Abstraction is used to remove unnecessary detail from a real-world situation and to model the simplified result in an algorithm or program.





Flowcharts

Flowchart Conventions

Name	Symbol	Usage
Start or Stop/End		Signifies the start or end of a sequence.
Process		An instruction.
Input/Output		Data received or sent by a computer.
Decision		A condition which is either true or false.
Subroutines		Calls a subroutine
Direction of Flow		Connects symbols.

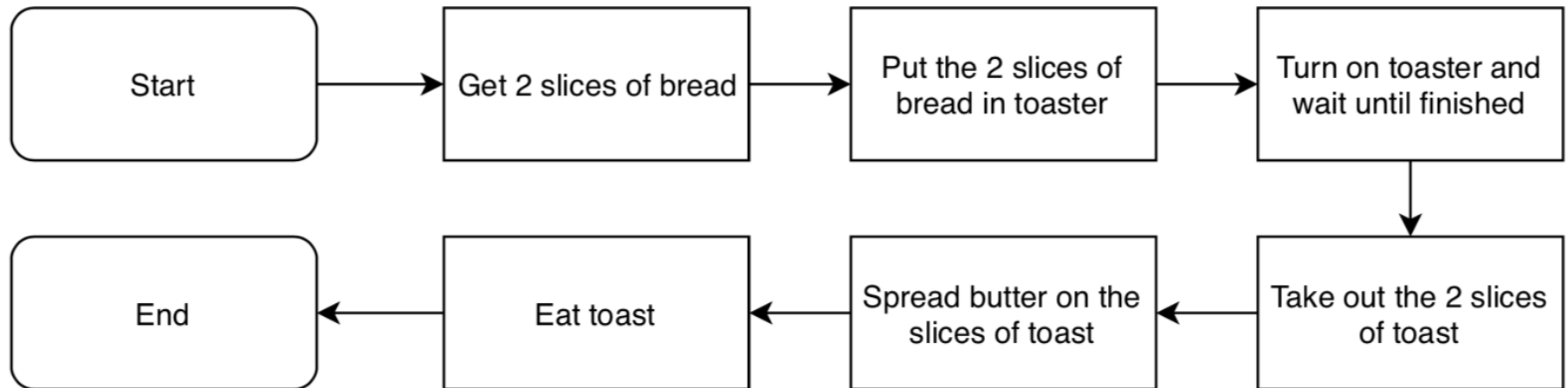


Sequence, Selection, Iteration and Subroutines

Sequence

A **sequence** is an action, or event, which leads to the next ordered action in a predetermined order.

Recall the making and eating toast example:



A Simple Sequence

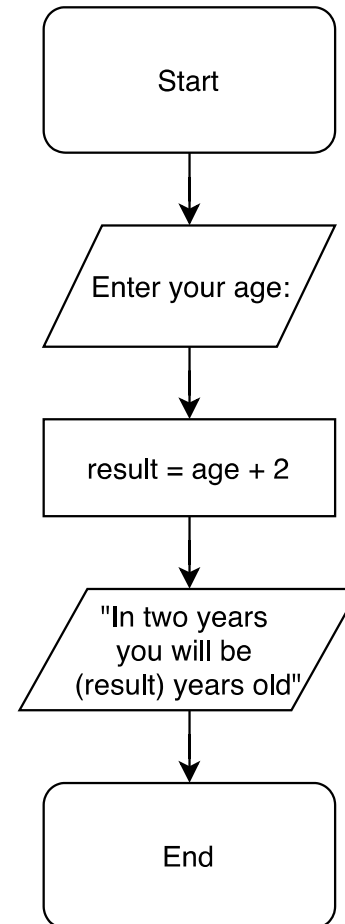
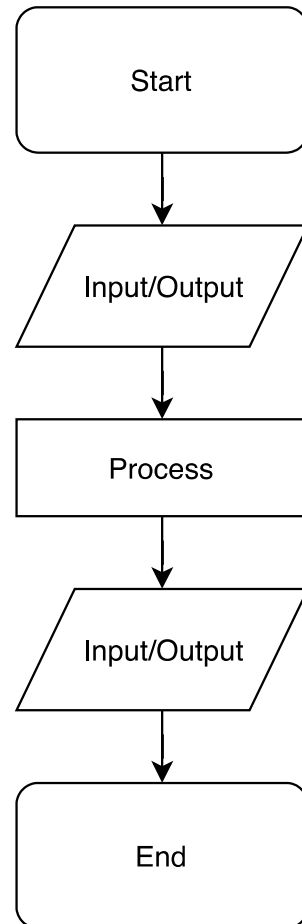
Let's try to create a flowchart for a simple program

The program should take the user's age as an input, then tell the user how old they will be in two years time

Your flowchart should be language agnostic – anyone should be able to use your flowchart to implement the program in a programming language of their choice



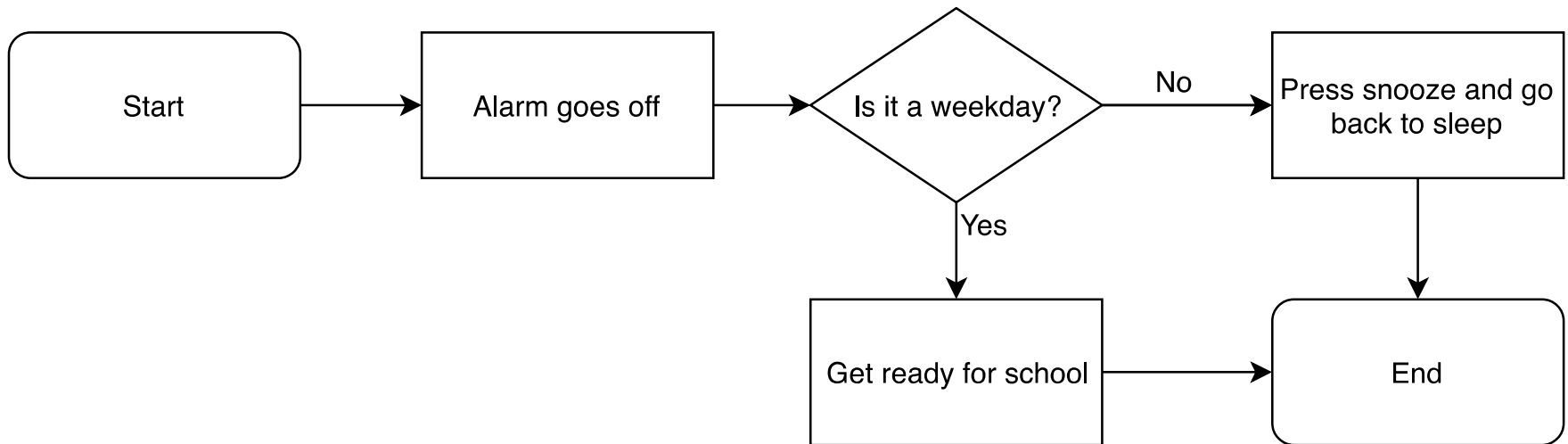
Sequences



Selection

In **selection**, a question is asked and, depending on the answer, the program takes one of the two courses of action.

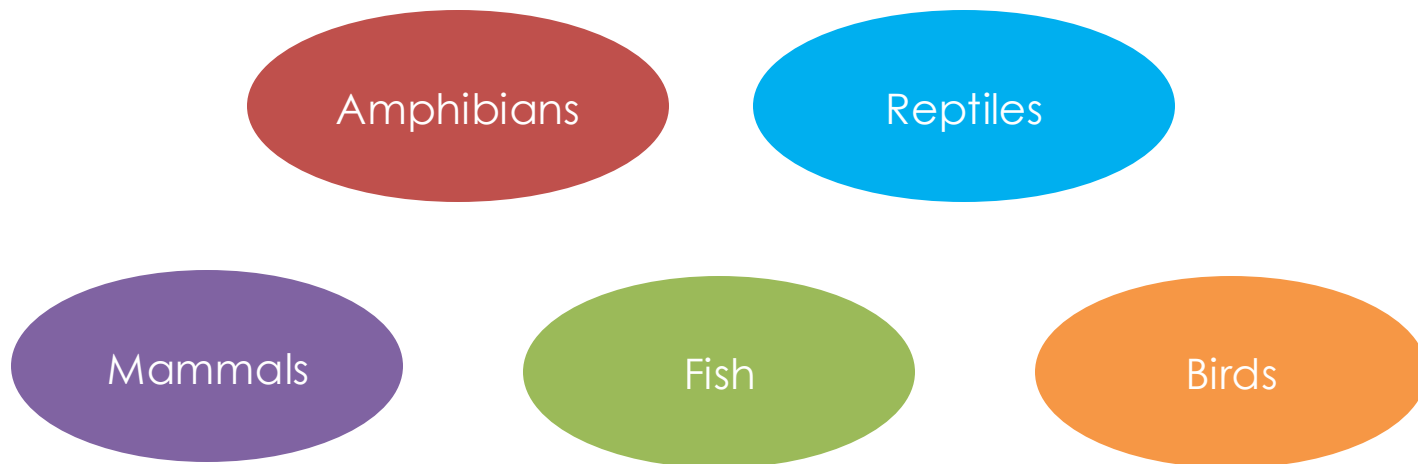
Example: Waking up in the morning



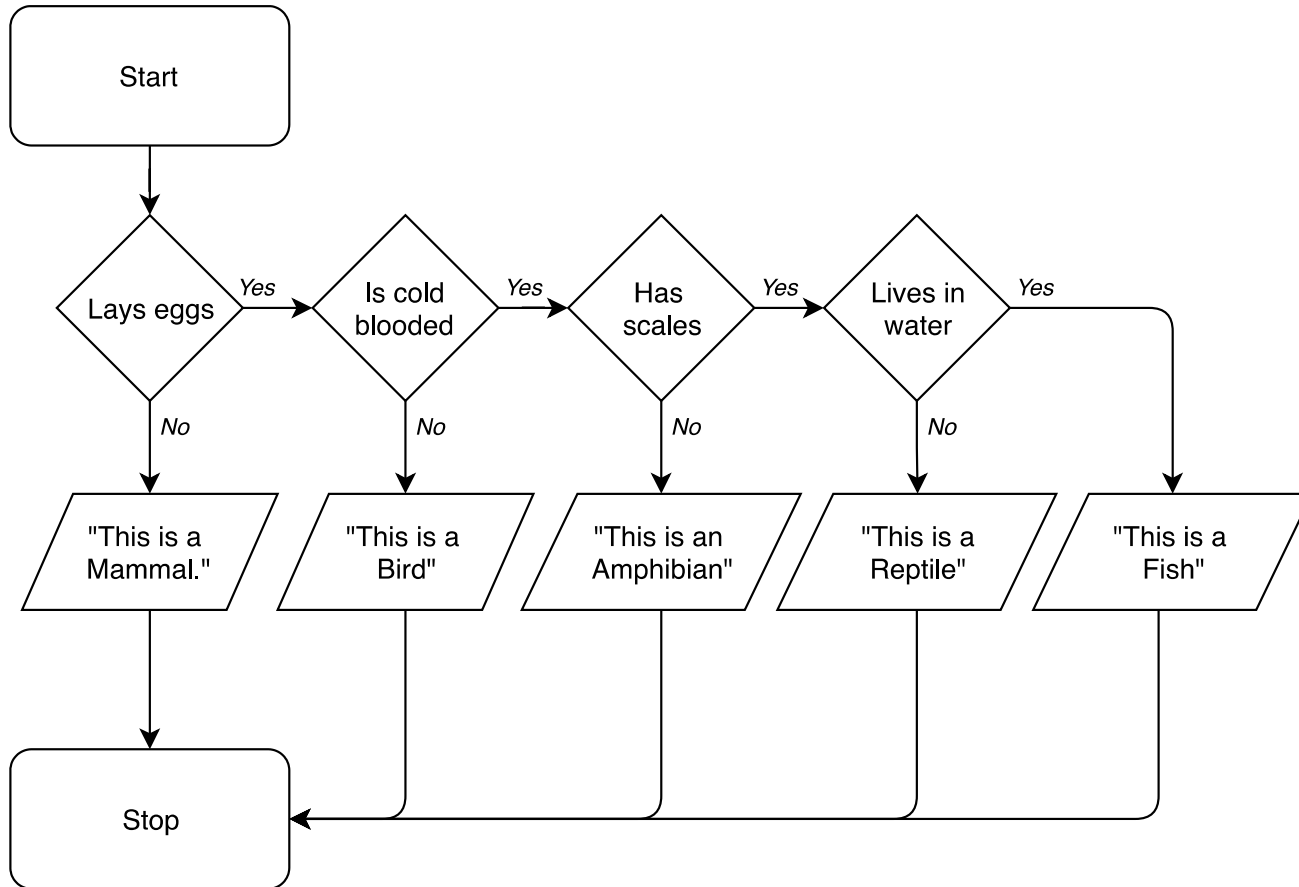
Activity: Vertebrates Flowchart

Write a flowchart with appropriate questions to be able to differentiate between each of the 5 classes of Vertebrates.

Think about what differentiates them and how you would structure your flowchart.



Vertebrates Solution

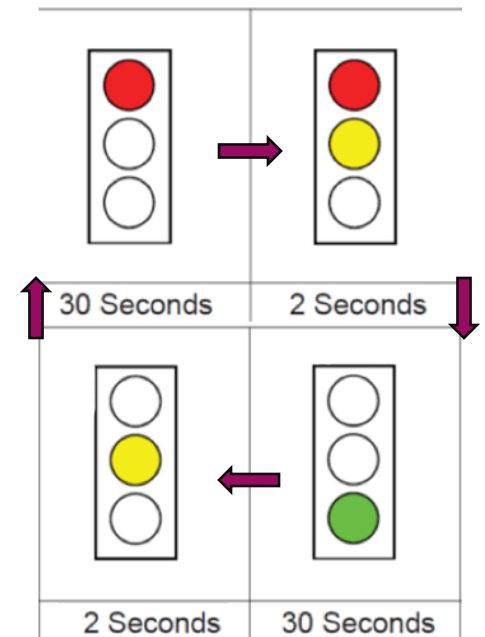


Iteration

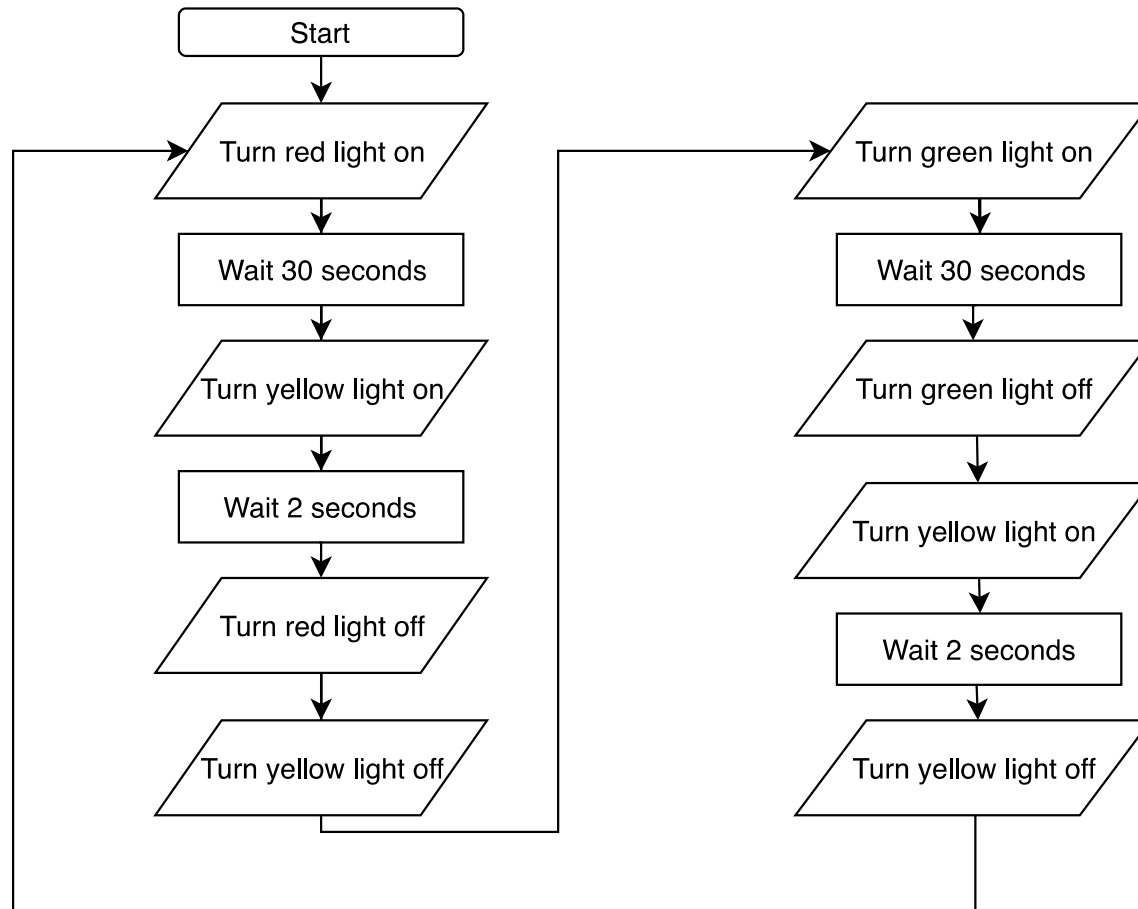
An **iteration** is a single pass through a set of instructions. Most programs contain a set of instructions that are executed over and over again. We can simplify this using a loop. The computer iterates through the instructions and loops back to the start.

A simple traffic light example:

- What instructions would you use?
- What needs to be iterated?
- How could you show that in a flowchart?
- Does this process ever end?



Simple Traffic Lights



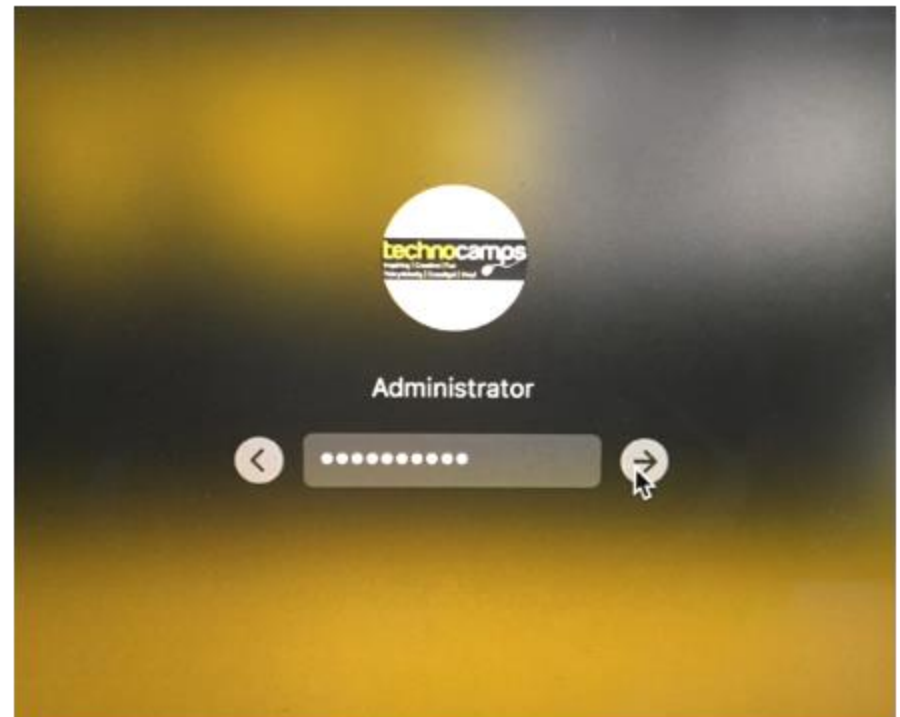


Activity: Login System in Python

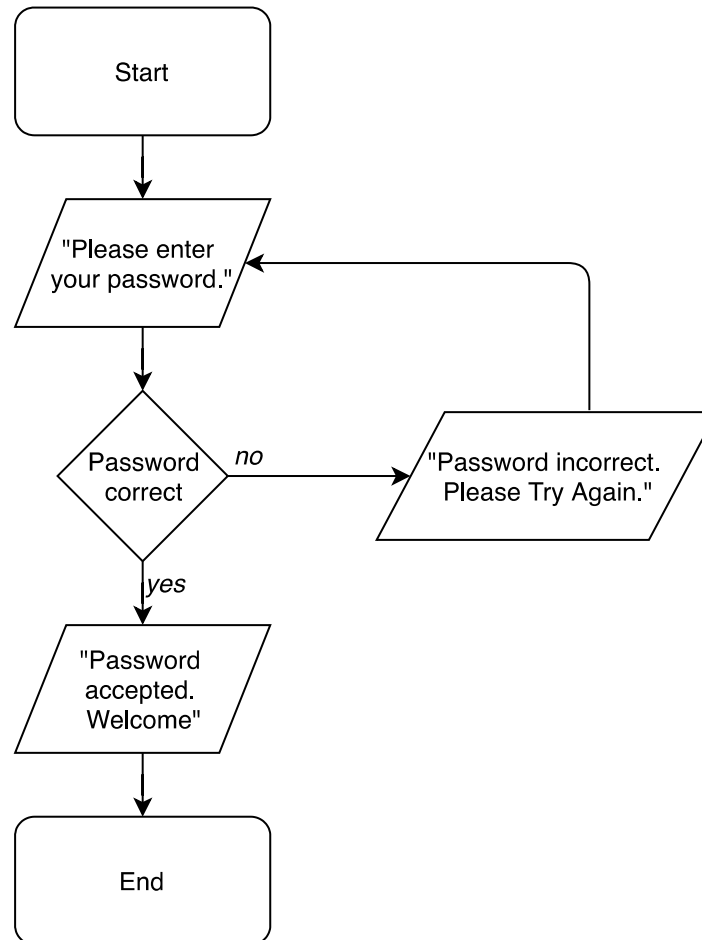
Activity: Login System Flowchart

Create a flowchart for a program which asks a user for a password:

- If the password is incorrect it should output the message **“Password incorrect. Please Try Again.”** and take the user back to the log in screen
- Otherwise it should say **“Password accepted. Welcome!”** and end the program

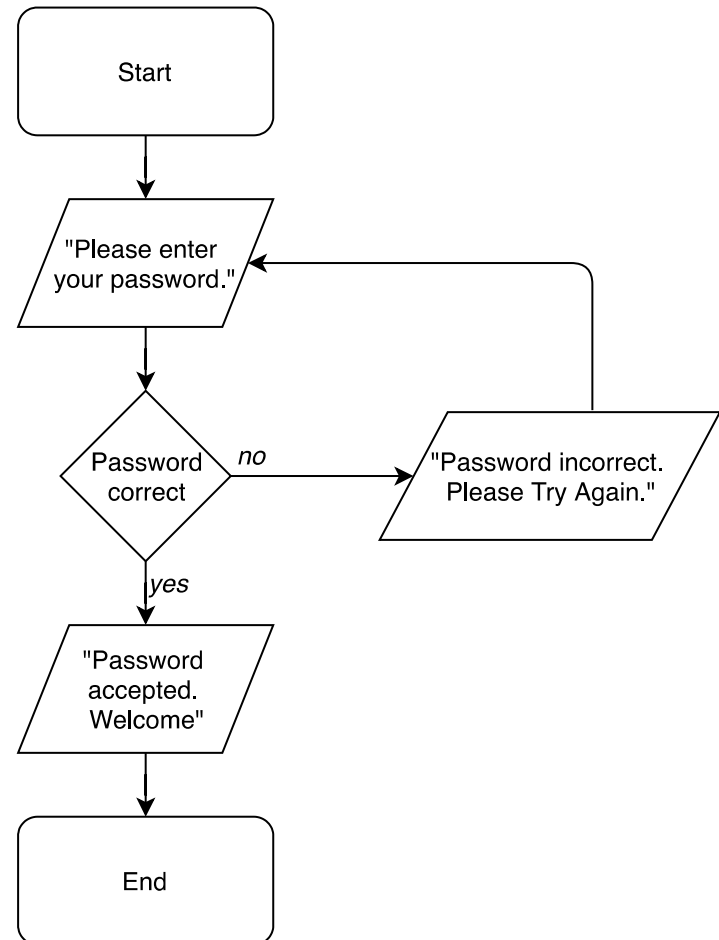


Login System Solution



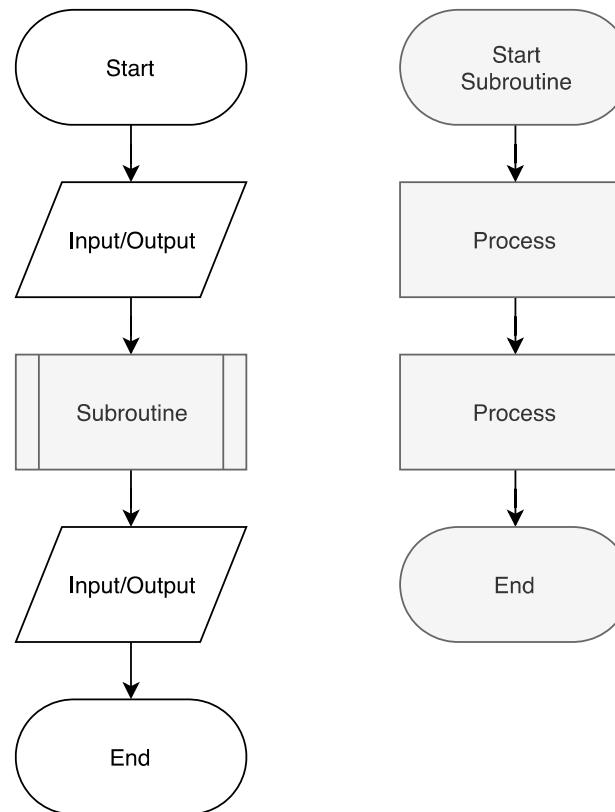
Activity: Login System in Python

Using the flowchart, write a python program for the login system.



Subroutines

Subroutines are a sequence of instructions that perform a specific task.



A Simple Subroutine

Let's try to create a flowchart that includes a subroutine

The flowchart should represent a simple program for calculating the area of a square

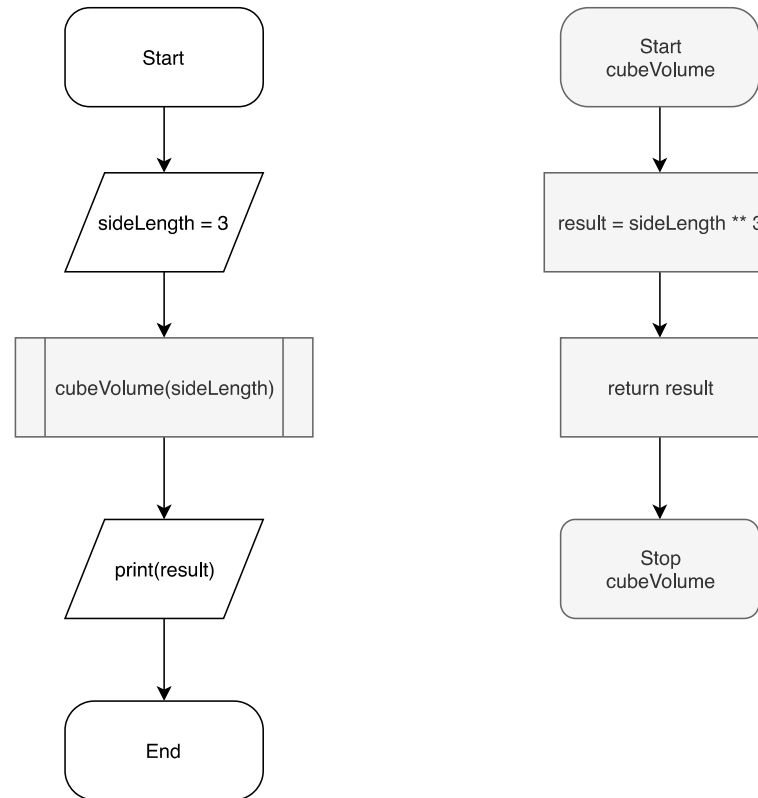
The program should take the length of a square's side as input from the user. Next, it should calculate the area of the square, then inform the user.

Consider where to include your subroutine



Subroutines

For example, we could have a subroutine that calculates the volume of a cube when given the length of one side.



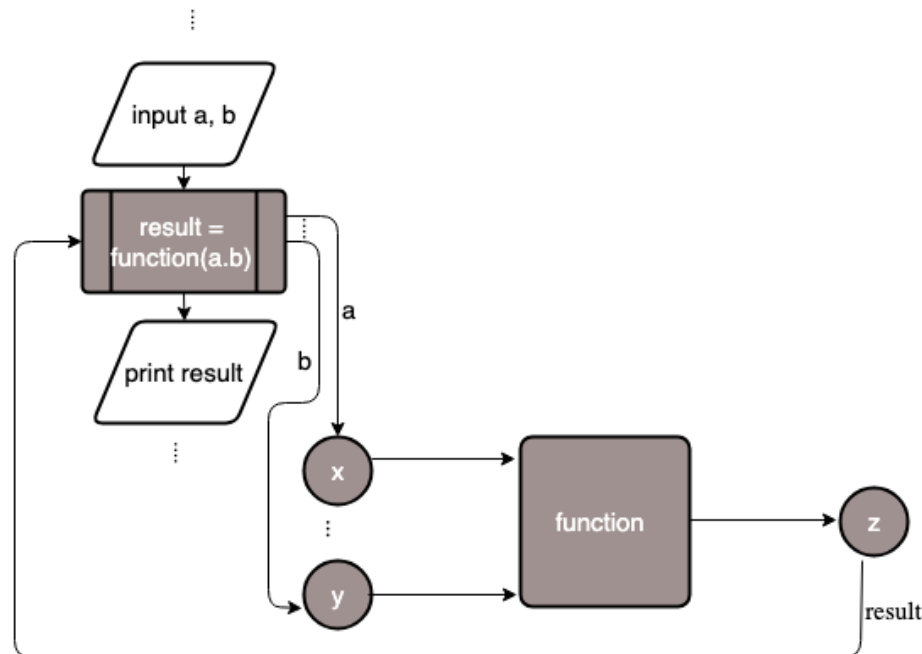


Subroutines in Python

Functions in Python

Subroutines are implemented as functions in Python.

A function is a subroutine that **usually takes in one or more values** from the program and then **returns a value back**.



Functions in Python - Example

```
#Functions in Python
```

```
def cubeVolume(side):
```

```
    vol = side ** 3
```

```
    return vol
```

```
sideLength = int(input("Enter side length of a cube: "))
```

```
result = cubeVolume(sideLength)
```

```
print ("The cube's volume is: ", result)
```

Functions in Python - Example

```
#Functions in Python
```

```
def cubeVolume(side):  
    vol = side ** 3  
    return vol
```

```
sideLength = int(input("Enter side length of a cube: "))  
result = cubeVolume(sideLength)  
print ("The cube's volume is: ", result)
```

Functions in Python - Example

```
#Functions in Python
```


```
def cubeVolume(side):  
    vol = side ** 3  
    return vol
```

```
sideLength = int(input("Enter side length of a cube: ")) ← 1  
result = cubeVolume(sideLength) ← 2  
print ("The cube's volume is: ", result)
```



Functions in Python - Example

```
#Functions in Python
```

```
def cubeVolume(side):  
    vol = side ** 3  
    return vol
```



```
sideLength = int(input("Enter side length of a cube: "))  
result = cubeVolume(sideLength)  
print ("The cube's volume is: ", result)
```



Functions in Python - Example

#Functions in Python

```
def cubeVolume(side):  
    vol = side ** 3  
    return vol
```

← 3 side = value of sideLength

```
sideLength = int(input("Enter side length of a cube: "))  
result = cubeVolume(sideLength)  
print ("The cube's volume is: ", result)
```

← 1

← 2

Functions in Python - Example

#Functions in Python

```
def cubeVolume(side):  
    vol = side ** 3  
    return vol
```

← 3 side = value of sideLength
← 4

```
sideLength = int(input("Enter side length of a cube: "))  
result = cubeVolume(sideLength)  
print ("The cube's volume is: ", result)
```

← 1
← 2

Functions in Python - Example

#Functions in Python

```
def cubeVolume(side):  
    vol = side ** 3  
    return vol
```

← 3 side = value of sideLength
← 4
← 5

```
sideLength = int(input("Enter side length of a cube: "))  
result = cubeVolume(sideLength)  
print ("The cube's volume is: ", result)
```

← 1
← 2

Functions in Python - Example

#Functions in Python

```
def cubeVolume(side):  
    vol = side ** 3  
    return vol
```

← 3 side = value of sideLength
← 4
← 5

```
sideLength = int(input("Enter side length of a cube: "))  
result = cubeVolume(sideLength)  
print("The cube's volume is: ", result)
```

← 1
← 2 ← 6

Functions in Python - Example

#Functions in Python

```
def cubeVolume(side):
    vol = side ** 3
    return vol
```

← 3 side = value of sideLength
← 4
← 5

```
sideLength = int(input("Enter side length of a cube: "))
result = cubeVolume(sideLength)
print("The cube's volume is: ", result)
```

← 1
← 2 ← 6 result = vol

Functions in Python - Example

#Functions in Python

```
def cubeVolume(side):
    vol = side ** 3
    return vol
```

← 3 side = value of sideLength
← 4
← 5

```
sideLength = int(input("Enter side length of a cube: "))
result = cubeVolume(sideLength)
print("The cube's volume is: ", result)
```

← 1
← 2 ← 6 result = vol
← 7

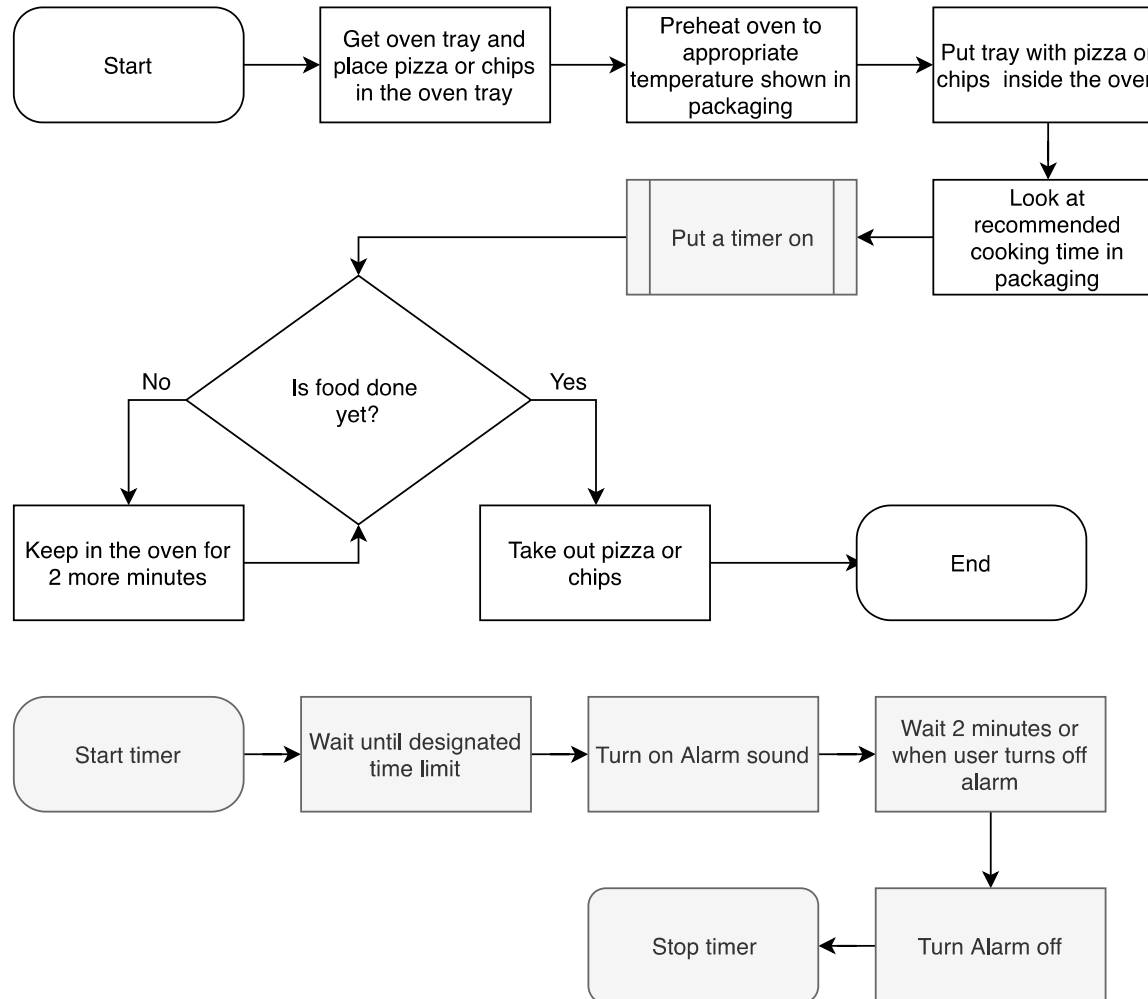
Activity: Pizza Flowchart

Create a flowchart on cooking pizza or chips in the oven. Try to make use of all of the flowchart components we have talked about:

- Sequences
- Selection
- Iteration
- Subroutines

For example, you could try using a timer subroutine that sets an alarm for the cooking time.

Pizza Flowchart Solution




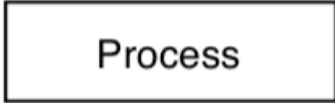
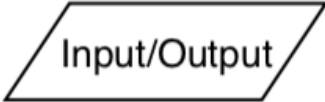

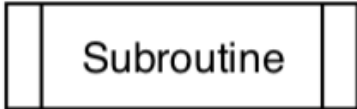

A Not So Simple Flowchart

Expand your 'area of a square' flowchart for a program that includes the following features:

- The user should be able to enter the height and width of their shape
- The program should be able to calculate the area of any rectangle, triangle or ellipse
- The user should be able to select which calculation they would like performed
- The program should keep running until the user decides to quit

When you are happy, attempt to implement your flowchart in Python

Flowchart Shape Recap

Name	Symbol	Usage
Start or Stop/End		Signifies the start or end of a sequence.
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