Algorithms & Data Structures I Week 3 Lecture Note

Notebook:	Algorithms & Data Structures I	
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Cornell Notes	**Topic:** Pseudocode Part 1	Course: BSc Computer Science
		Class: CM1035 Algorithms & Data Structures I [Lecture]
		Date: October 21, 2020

Essential Question:

What is Pseudocode?

Questions/Cues:

- What is pseudocode?
- What is Discretisation?
- What are some common mathematical symbols used in pseudocode?
- What are the logical operators used in pseudocode?
- What is a function?
- What is iteration?
- What are For/while loops?
- What are break and continue operations in loops?
- What is the pseudocode for Euclid's Algorithm look like in a for loop and a while loop?

Notes

- Pseudocode = something between a programming language and descriptive English. Pseudocode uses mathematical symbols alongside some new simple bits of notation.
- Discretisation = Instructions for digital computers work in terms of discrete steps. Discretisation is the process of taking something continuous and turning it into some discrete parts
    - The Assignment symbol is an arrow

Assignment $\leftarrow$
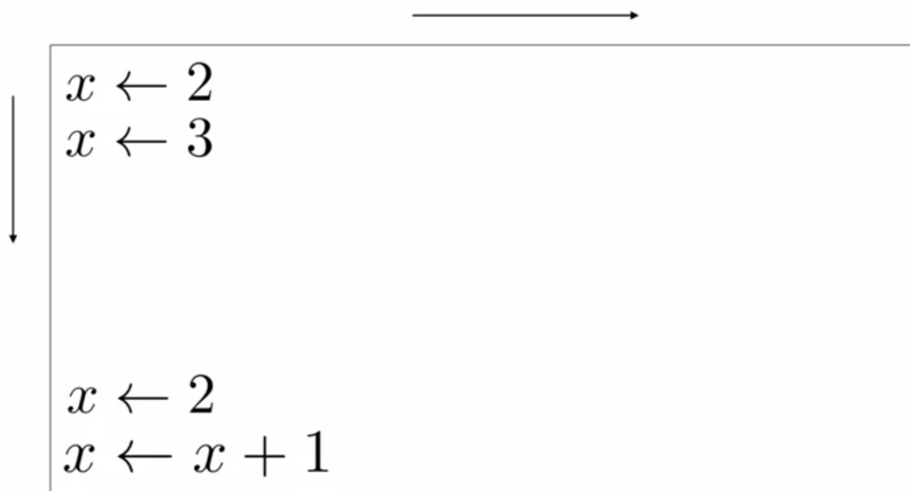
$$x \leftarrow 2$$
$$x \leftarrow \text{TRUE}$$

Names of variables

$Desired\ Temperature \leftarrow 3$ ✕   No

$DesiredTemperature \leftarrow 3$ ✓   Yes

$Desired\_Temperature \leftarrow 3$ ✓   Yes

- o Assignment can be self-referential, that is, once we have initialised the value of x, we can update it to a new value using its old value

$$x \leftarrow 2$$
$$x \leftarrow 3$$

$$x \leftarrow 2$$
$$x \leftarrow x + 1$$

Assignment

$$\leftarrow$$

Arithmetic

$$+ \quad - \quad \times \quad /$$

Comparison

$$= \quad \neq \quad < \quad > \quad \leq \quad \geq$$

NOT ¬

$$\neg \text{TRUE} = \text{FALSE}$$
$$\neg \text{FALSE} = \text{TRUE}$$

AND ∧, OR ∨

$$\text{TRUE} \lor \text{TRUE} = \text{TRUE} \qquad \text{TRUE} \land \text{TRUE} = \text{TRUE}$$
$$\text{TRUE} \lor \text{FALSE} = \text{TRUE} \qquad \text{TRUE} \land \text{FALSE} = \text{FALSE}$$
$$\text{FALSE} \lor \text{TRUE} = \text{TRUE} \qquad \text{FALSE} \land \text{TRUE} = \text{FALSE}$$
$$\text{FALSE} \lor \text{FALSE} = \text{FALSE} \qquad \text{FALSE} \land \text{FALSE} = \text{FALSE}$$

If... then

if $x = y$ **then**
$$x \leftarrow y$$
end if

if $x = y$ **then**
$$x \leftarrow y$$
else
$$x \leftarrow 1$$
end if

$$t \leftarrow 18$$
$$T \leftarrow 20$$
if $t < T$ **then**
$$t \leftarrow t + 0.5$$
end if
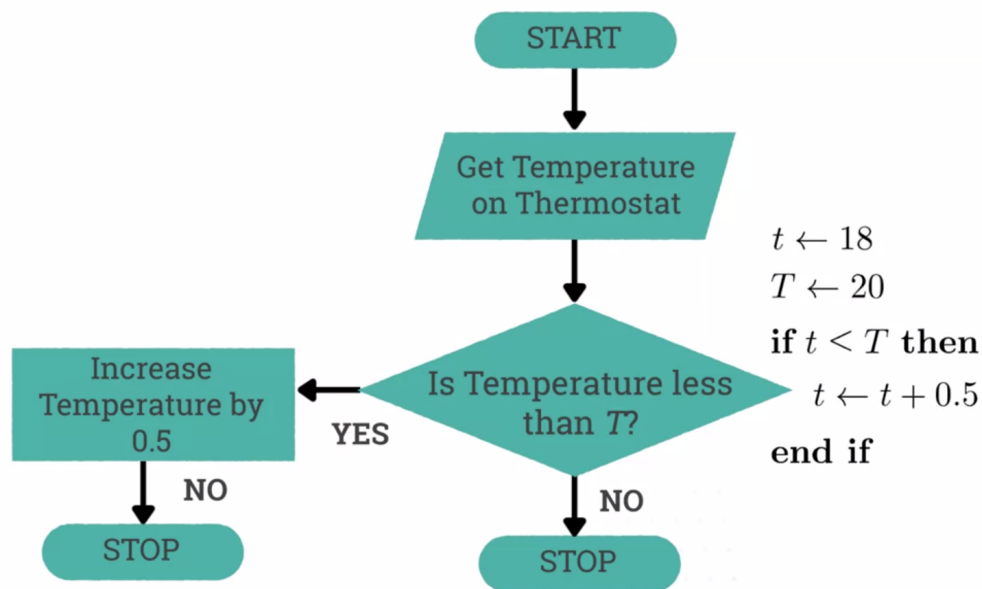
- Function = take inputs and give back outputs. Recall that a problem some relevant input and asks a question about it. A function is a method for going from that input to an answer to that question. When the answer to the input is achieved or some output is returned, the function terminates.

```
function EVEN(n)
        if n mod 2 = 0
                return TRUE
        else
                return FALSE
        end if
end function
```
(body)

- Iteration = idea of repeating something multiple times, but with a different set of parameters each time the loop is done. Iteration is often refer to as looping. In loops, there is a variable that is changing its value, typically not exclusively it's an integer which is increasing its value by one for each iteration.
    - In For loops, we initiate a variable, let's say i for some value like 2 and then we increase its value by one for each iteration until it reaches a target value such as 10. For loops are great for repeating something a desired number of times.
    - The basic concept of a while loop is that something should be implemented as long as something else is true.

$$x \leftarrow 1$$

for $2 \leq i \leq 10$ **do**

$$x \leftarrow x + i$$ } body

end for

$$x \leftarrow 2$$

for $0 \leq i \leq 2$ **do**

$$x \leftarrow x \times 2$$

end for

$$x \leftarrow 1$$

$$y \leftarrow 0$$

condition

while $x < 11$ **do**

$$y \leftarrow x + y$$

$$x \leftarrow x + 1$$ } body

end while

If $x^2 = n$, is x an integer?

function IsXInteger(n)
    $y \leftarrow$ FALSE
    for $1 \leq i \leq n$ **do**
        if $i^2 = n$ **then**
            $y \leftarrow$ TRUE
        end if
    end for
    return y
end function

If $x^2 = n$, is x an integer?

function IsXInteger(n)
    $y \leftarrow$ FALSE
    $i \leftarrow 1$
    while $i^2 \leq n$ **then**
        if $i^2 = n$ **then**
            $y \leftarrow$ TRUE
        end if
    $i \leftarrow i + 1$
    end while
    return y
end function

- Break operation = stops a loop altogether and no more iterations will be completed.
- Continue operation = just skips the rest of the body of the loop and goes to the next iteration of a loop

$x \leftarrow 1$
$y \leftarrow 0$
while $x < 11$ **do**
    $y \leftarrow x + y$
    $x \leftarrow x + 1$
    break
end while

$x \leftarrow 2$
for $0 \leq i \leq 2$ **do**
    $x \leftarrow x \times 2$
    continue
end for

function GreatestCommonDivisor(a, b)
    $x \leftarrow a$
    $y \leftarrow b$
    for $0 \leq i \leq x + y$ **do**
        if $a = b$ **then**
            break
        end if
        if $a > b$ **then**
            $a \leftarrow a - b$
        else
            $b \leftarrow b - a$
        end if
    end for
    return a
end function

function GreatestCommonDivisor(a, b)

    while $a \neq b$ **do**

        if $a > b$ **then**

            $a \leftarrow a - b$

        else

            $b \leftarrow b - a$

        end if

    end while

    return a

end function

Summary

In this week, we learned about Pseudocode is, what is Discretisation is, common symbols/operators in pseudocode, what a function is, what iteration is, what for and while loops are, what the break and continue operations in loops and finally we explore the pseudocode for Euclid's Algorithm.