CS101
Data Structures and Algorithms

Lecture 04

Thinking Algorithmically

The Robot Potato Race Problem

- Description
  - There are three stations A, B, C along a straight line with a 20m separation between successive stations.
  - Station A has 5 potatoes, and none in B and C
  - The potatoes has to be transferred one by one from Station to A to B entirely and then from B to C
  - At a run only one potato can be transferred
  - Among the participating Robots whichever finishes first is awarded

The Robot Potato Race Solution

- The basic Robot commands are:- Pick (potato), Turn, Move to next station, Place(potato)
- Initialization (Robot is placed facing Station A having 5 potatoes)
- The following command sequence transfers the 5 potatoes from A to B
- Note the missing Turn/Move in the last set.
- Where is the Robot at the end?

Pick	Pick	Pick	Pick	Pick
Turn	Turn	Turn	Turn	Turn
Move	Move	Move	Move	Move
Place	Place	Place	Place	Place
Turn	Turn	Turn	Turn	
Move	Move	Move	Move	

The Robot Potato Race Solution Improvement

- Let cp be the count of potatoes in Station A at the start.
- We need a repeat/loop construct that repeats the set of commands for a determined number of times.
- Solution: While-End While

```
While (condn)
   Loop body / Instructions to be repeated
End While
```

- So long the condn evaluates to TRUE Loop body will be evaluated
- When the condn evaluates to False the code after End While will be executed, that is the loop body will be exited.

The Robot Potato Race Solution Improvement

- The series of repeated commands becomes,

Pick	Pick	Pick	Pick	Pick
Turn	Turn	Turn	Turn	Turn
Move	Move	Move	Move	Move
Place	Place	Place	Place	Place
Turn	Turn	Turn	Turn	
Move	Move	Move	Move	

```
Initialize # Robot is placed A, facing A
CP = 5 # Potato Count
Pick, Turn, Move, Place
CP = CP-1
While (CP > 0)
   Turn, Move, Pick, Turn,  Move, Place
   CP = CP-1
End While
# Robot is now in B
```

The Robot Potato Race: More stations

- For more than two stations, in order to transport all the potatoes to the last station, we need to setup nested loops as below

```
Initialize # Robot is placed A, facing A
NS=3
While (NS>1)
    CP = 5 # Potato Count
    Pick, Turn, Move, Place
    CP = CP-1
    While (CP > 0)
      Turn, Move, Pick, Turn,  Move, Place
      CP = CP-1
    End While
    NS=NS-1
End While
```

The Robot Potato Race: More stations, Another way

- For more than two stations, in order to transport all the potatoes to the last station, we need to setup nested loops for sure but this can be achieved indirectly using functions

```
def TransportPotatoes( CP )
    Pick, Turn, Move, Place
    CP = CP-1
    While (CP > 0)
      Turn, Move, Pick, Turn,  Move, Place
      CP = CP-1
    End While
```

```
Initialize # Robot is placed A, facing A
NS=3
While (NS > 1)
    TransportPotatoes(CP=5)
    NS = NS -1
End While
```

Amazing Robot: Assignment