UNIVERSITY TRANSPORTATION CENTER FOR

RAILWAY SAFETY



Source: pi - top (n.d.).

Day 1

HIGH SCHOOL



UTRio Grande Valley

Housekeeping Rules

Safety and **respect** is our priority, please adhere to the following rules so that we can have a fun and engaging experience.



Must wear designated shirt every day.



Restroom only when accompanied by an adult.



Use of electronic devices is only for instructional purposes.



Be active, engaged, and participate in your group.

Who is Dr. T?

- Dr. Taranweh is an engineering professor at UTRGV with a big mission.
- He teaches college students how machines and technology work, showing them how to solve engineering problems.
- His research helps make trains safer by finding problems before they cause accidents.
- Because of his work, transportation is safer, and he has helped train thousands of future engineers.



Dr. Tarawneh. 2026. Taken by UTCRS Staff



I SEE...

- 30 second silent observation
- What do you see?



I THINK...

- What do you think the focus of this camp is?



I WONDER...

- What do you wonder about what is in store for the week?

Week at a Glance

Monday	Tuesday	Wednesday	Thursday
• Icebreaker • Engineering Design Process • Engineering Design Process • Algorithm Design Process • Intro to Python • Traffic Lights	• Understanding the Sensors Active Sign Creation • Rover Build and Navigation • Rover Speed and Acceleration	• Rover Race Rover Vision Collision Simulation Forklift Assembly Challenge	• Forklift Assembly Challenge • Final Challenge

Today's Agenda

- Ice Breaker (Logic Labyrinth)
- Engineering Design Process
- Algorithm Design Process
- Intro to Variables
- Understanding Logic
- Traffic Lights



Team Building Activity

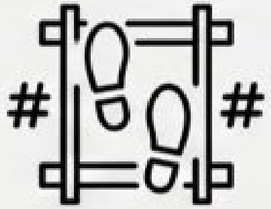
Logic Labyrinth

Ice Breaker: Logic Labyrinth (Thinking like a computer)

- Make teams of 3 - 4 students
- Each team will try to complete a simple task using the functions provided.
- Computers today can perfomr very complex tasks such as driving cars autonomously, or give you the answers to your homework.

Icebreaker (Continued)

Allowed commands for your “robot”:

CONTINUOUS MOTION	MEASURED STEPS	PRECISE TURNING	ACTION & SAFETY
			
Translation	**Steps**	**Rotation**	**Final Action**
Move forward (continuously) Move Back (continuously)	Take # steps forward Take # steps back	Turn right # degrees Turn left # degrees	Stop

Icebreaker (Continued)

- In reality, computers are very dumb, they can only do simple tasks like adding, subtracting, reading and writing data in memory.
- That is it! For the computer to complete the complex tasks AI can do, we need a bunch of operations that all use those 4 actions.
- How do we create complex things like moving a robot?

Reflection Questions

- What was challenging, and how did you address those challenges?
- How important was communication in your team?
- What would you do differently to improve results?

Engineering Design

Adopt an engineer's mindset.

What is Engineering?

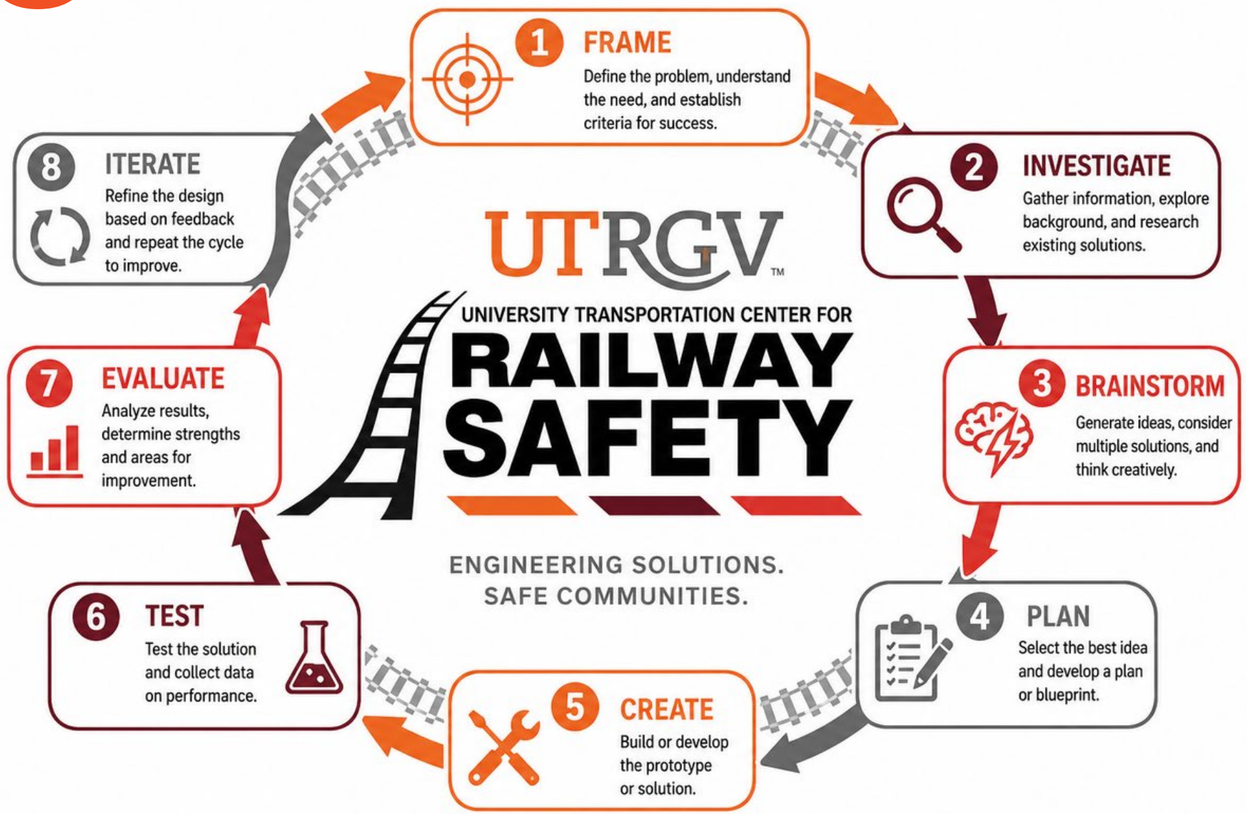
- Engineering is the process of creating technology
- Can you name some examples of technology we use every day?

Characteristics of Engineering

- Strong STEM knowledge
- Creativity
- Effective communication
- Effective Listening Skills
- Team Player
- Problem Solver



Engineering Design



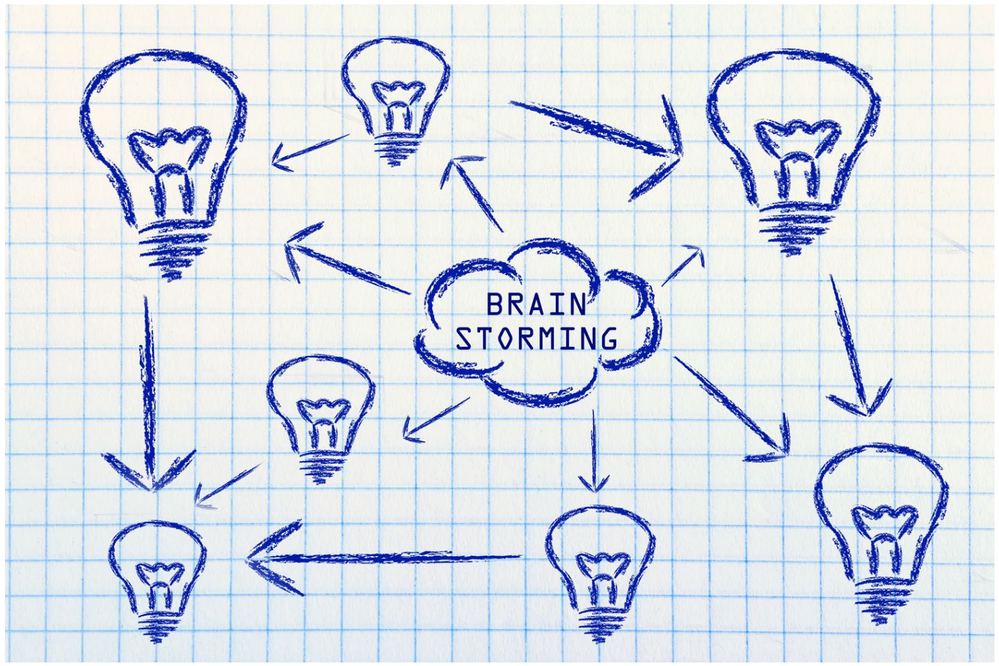
OpenAI. (2026, July 1). Engineering Design Cycle [AI -generated image]. ChatGPT (GPT -5.5). https://chat.openai.com/

Frame and Investigate

- Problem
  - Identify the core issue to be solved.
- Requirements
  - Outline necessary conditions that must be met.
- Constraints
  - Respect the limitations to consider.



Brainstorm



- Students generate solutions and explore various ideas.
- They also investigate what others have accomplished.
- Students generate solutions and explore various ideas while also investigating previous efforts.

Plan

- Students choose two to three of the best ideas from their brainstormed list and sketch possible designs, ultimately choosing a single design to prototype.



Create



- Students build a working model, or prototype, that aligns with design requirements and that is within design constraints.

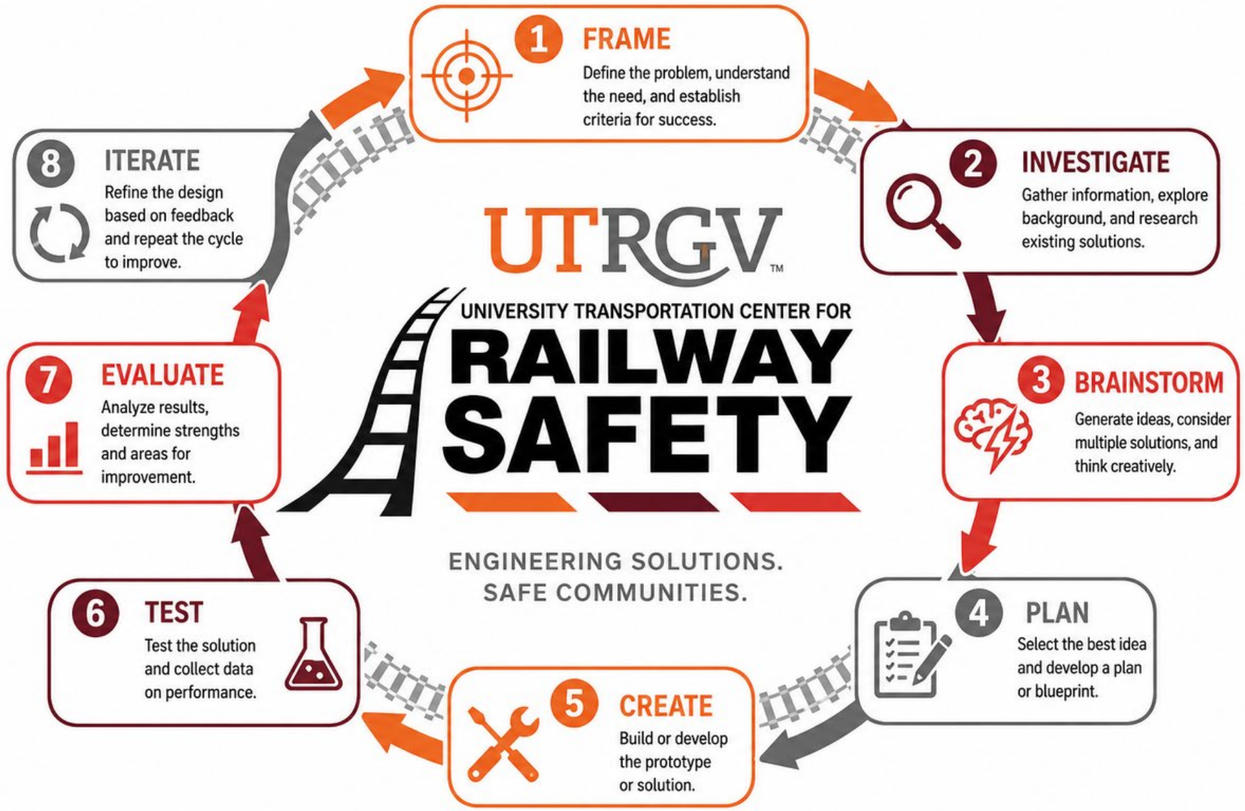
Test and Evaluate

- Evaluate the solution through testing; collect and analyze data; summarize strengths and weaknesses of the design that were revealed during testing.



Iterate

- Based on the results of the tests, make improvements on the design. Identify changes needed and justify revisions.

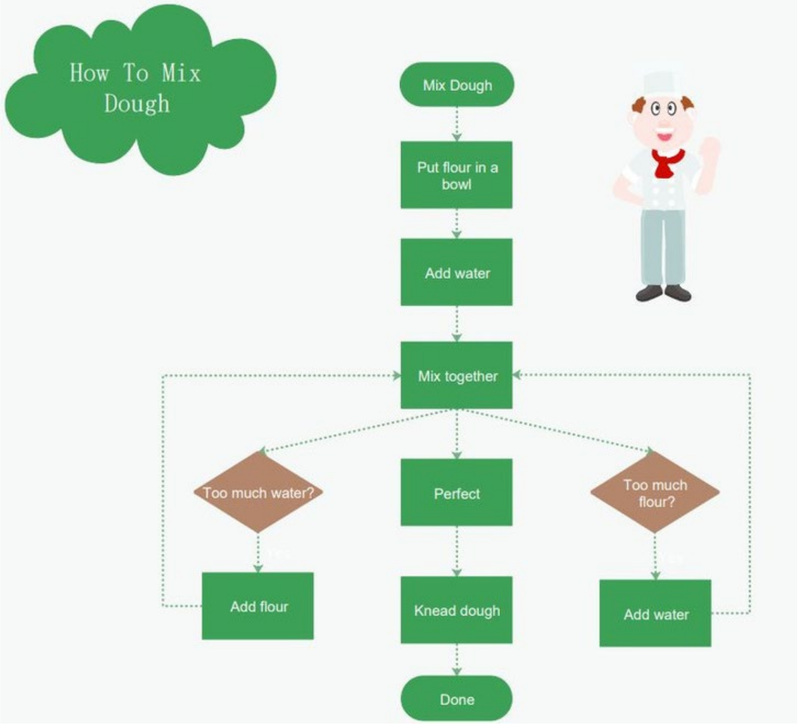


OpenAI. (2026, July 1). Engineering Design Cycle [AI -generated image]. ChatGPT (GPT -5.5). https://chat.openai.com/

Algorithms and Pseudocode

Algorithms

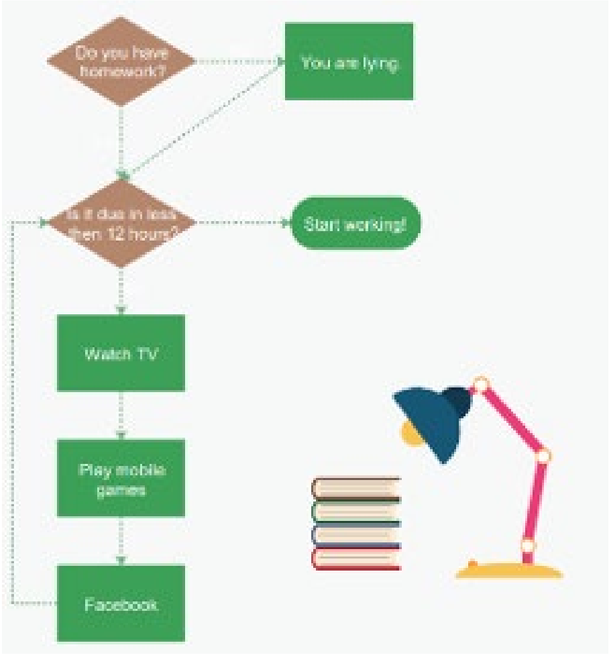
- An algorithm is a set of instructions for solving a problem or accomplishing a task.
- One common example of an algorithm is a recipe, which consists of specific instructions for preparing a dish or meal.



https://www.edrawsoft.com/templates/pdf/daily-life-flowchart.pdf

Pseudocode

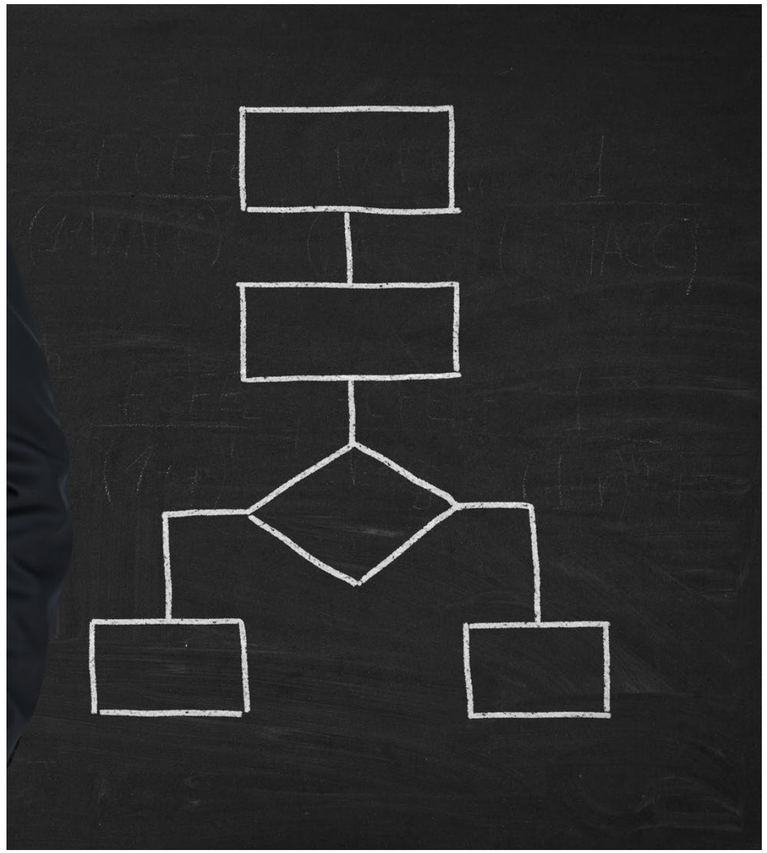
- Pseudocode looks almost like real code, but it does not follow any specific syntax for any language,
- Instead, it is meant to be written almost in plain English to break down steps in a set of instructions.



https://www.edrawsoft.com/templates/pdf/daily-life-flowchart.pdf

Pseudocode Example

- Pseudocode for deciding when to do your homework:
  - If it is due in less than 12 hours?
    - then start working
    - else
      - do procrastination script
    - else you are lying
      - then go back and check if you have homework



Algorithm Example



What is Python?



Further Course: Intro to Variables

- What is a Variable
- Naming Variables
- Rules for Variables



What is a Variable?

- Variables are declarations or names written close to the top of the script.
- They are used to store and manipulate pieces of information.
- Variables allow us to assign values, declare what ports or pins are used, use calculations, etc.

Sample Program with Variables

```
1  from signal import pause
2
3  #------- Variables --------
4  yellow_led = LED("D0")
5  red_led = LED("D1")
6  green_led = LED("D2")
7  button = Button("D3")
8
9  #Section 2; defines a 'red light' function
10 def red_light():
11     yellow_led_.on()
12     red_led.off()
13     green_led.off()
14     print("WAIT")
15     sleep(3)
16     yellow_led_.off()
17     red_led.on()
18     print("STOP")
19
20 # Section 3 defines a 'green light' function
21 def green_light():
22     yellow_led_.off()
23     red_led.off()
```

Variables in sample code

Further | Interactive Learning Platform. (2026). GetPiTop. https://further.pi-top.com/

Naming Variables

- To create a variable, it must be given a name and value (or some type of “defining” information).
- For example, speed = 120.
- The variable is named speed, with an integer value of 120.

Variable Examples

```
#-------- Variables ------------
redLED = LED("D4")
#yellowLED = LED()
button = Button("D7")
```

```
button1 = Button("D4")
button2 = Button("D7")
playerpos = mc.player.getPos()
```

```
game_width = 1000
game_height = 800
```

```
x = 5
y = 12
```

Further | Interactive Learning Platform. (2026). GetPiTop. https://further.pi top.com/

Rules for Variables

- Variables can contain words, letters, underscores, and numbers but it is best to use a word or letter to start it off.

```
 8 #------- Variables --------------------
 9 miniscreen = Miniscreen()
10 rocket = Image.open("/usr/lib/python3/dist-
   packages/pitop/miniscreen/images/rocket.gif")
11 select_button = miniscreen.select_button
12 red_led = LED("D3")
```

Further | Interactive Learning Platform. (2026). GetPiTop. https://further.pitop.com/

Rules for Variables

- Python code is case sensitive. Thus, if capital letters are used, they must always be written the same way throughout the script.
  - For instance, Walk and walk are different variable names. Symbols: - / # @ are not to be used when naming variables. Avoid using python commands, like import or print.

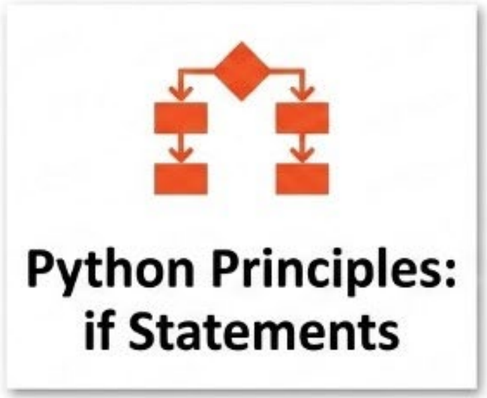
Reflection Questions

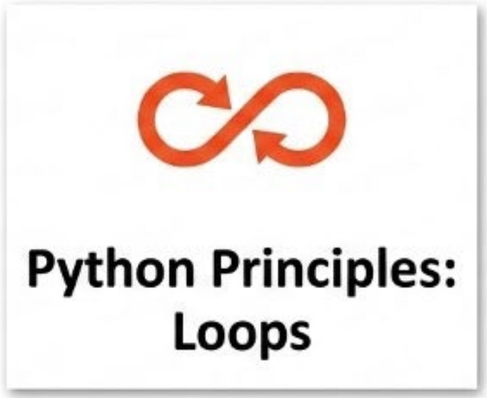
- Why should programmers be specific when writing code?
- How do import statements work?
- How can we teach the computer what each Pi accessory is and how to control it?



- top

Further Course: Understanding Logic







Google Gemini (2026, July 1). Slide Enhancement [AI -generated image]. Gemini (3.8 Flash). https://gemini.google.com/

Python Principles: if Statements

What are if statements?

- Conditionals, such as if and else, are used for decision making operations and in branching.
- If statements are used when programmers want to give the computer a condition to evaluate before activating and to activate any code.

```
1 if button.is_pressed:
2     print("pressed")
```

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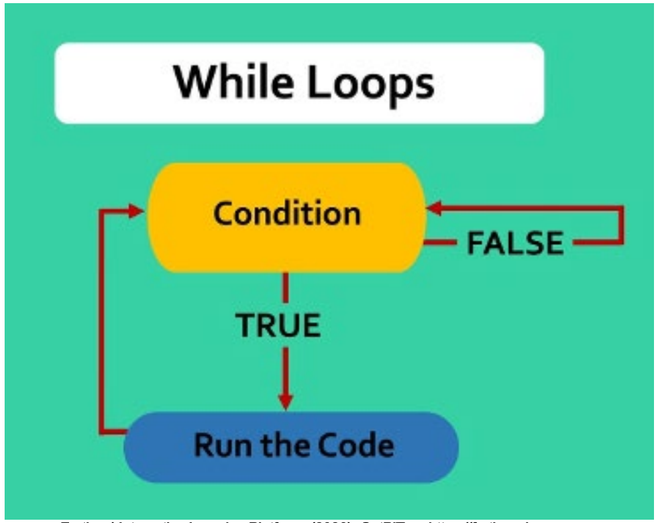
Python Principles: Loops

- Loops are used when programmers want to execute repetitive code when a program runs. A loop with run the same set of codes over and over again when written in a program.
- Think of this as a place where you would put the ongoing actions that a game character would need to have. If they should take more than one step when a button is pressed, then it is most convenient when in a loop.

Python Principles: Infinite Loops

While Loops (Infinite Loops)

- What happens when a programmer isn't sure how many times to run the code? Or if they want to make it run repeatedly until they press stop?
- In this type of situation, a while loop is used.
  - While loops are loops that will run if and when a condition is met.
  - It is a type of Boolean expression - meaning the condition can only be true or false.



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```
1 while True:
2     x += 1
3     print(x)
4     sleep(0.5)
```

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Python Principles: For Loops

- When the programmer wants a section of code to happen a set number of times, the for loop is used. The amount of times is known as an iteration.
- For loops iterate over a given sequence, or run the same block of code over and over until the sequence ends.
- They basically will run a body of code for a specified amount of time or only as long as the code that is written needs to run. Complete exercise 6 below to practice this concept.

```
15 #Rocket Function ----------------------
16 def rocket_launch():
17     for text in ["5", "4", "3", "2", "1"]:
18         miniscreen.display_multiline_text(text)
19         red_led.on()
20         sleep(0.5)
21         red_led.off()
22         sleep(0.5)
23
```

Further | Interactive Learning Platform. (2026). GetPiTop. https://further.pi top.com/

Python Principles: Nested Loops

- Python allows us to use a loop inside of another loop. Yes, there may be times that for loops need to be written inside of other loops.
- While loops or infinite loops can also contain for loops, depending on what the programmer wants to happen.
- This is easy to do, but always make sure that the lines are indented properly.

```
1 for x in range(5):
2     for y in range(2):
3         print(x,y)
```

Further | Interactive Learning Platform. (2026). GetPiTop. https://further.pi top.com/

Reflection Questions

- What is an “if statement”, and why is it used?
- Describe what happens when a condition is true vs. false.
- How do different loops change and why use them with sensors?

Tutorial: Mini Screen

- The Pi Top comes included with a Mini screen we can use to display messages or get information the robot is processing.
- In this tutorial you will learn how to use it to display simple messages, and construct a counting game.



Source: CAProjects (2021), pi - top Forum.

Further Course: Programming Hardware





Google Gemini (2026, July 1). Slide Enhancement [AI -generated image]. Gemini (3.8 Flash). https://gemini.google.com/

Traffic Lights

Belisha Beacon

- Is a flashing amber globe lamp mounted on a tall, black-and-white striped pole that marks pedestrian zebra crossings, in the UK and other countries.

Requirements of build:

- Must be free standing
- Must alternate blink forever



Traffic Lights

- Traffic lights normally consist of three signals, transmitting meaningful information to road users through colors and symbols, including arrows and bicycles.



Traffic Lights

What other traffic lights do you know?

Can you recreate it?

Build a traffic light system for pedestrians

- Use 3 LEDs (red, green, yellow) and 1 button
- Must be freestanding
- When you press the button turn the red light, when you release it turn the green light



Reflection Questions

- How do traffic signals improve safety?
- How does your model compare to real - world systems?
- Why are loops important for programs mimicking safety signals?

Housekeeping

Clean up and put any loose pieces back in your box.