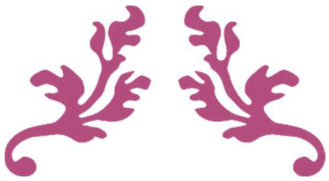


HARVARD UNIVERSITY

ESTD. 1636 CE

HARVARD
UNIVERSITY

INTRODUCTION TO PROGRAMMING WITH PYTHON

DAVID J. MALAN, PROFESSOR HARVARD UNIVERSITY

"Educator Version"

Educators & Faculty

- *Yulia Zhukovets,*
- *Bernie Longboy*
- *Rongxin Lu & Brian Yu*

Documented by

Ravikiran R (CS50AP26031)
Meta Llama 3.2 GPT Model
Ollama x64 Offline GPT Model

"CS50 – Harvard University intellectual enterprises of Computer Science and The Art of Programming" ~ David J. Malan

CS50x India Production & Reference

Final week Reference

....more

Forward Note

Welcome to **CS50 Trimester 2025**, guided by Associative Professor, Ravi Kiran under educators' Quota. This 10-week self-paced course is designed to help you build a strong foundation in computer science. While there are no regular live sessions, weekend guidance is available upon request to support your learning when needed. A detailed syllabus will be provided, outlining all the necessary topics, resources, and practice material to help you stay on track.

At the end of the course, you'll take part in an **interview-based assessment** to evaluate your understanding. You can attempt the interview any time after completing the 10 weeks, with up to two months of extended time and two total attempts allowed. Stay consistent, make the most of the flexibility, and don't hesitate to reach out if you need support along the way. We're excited to see you grow through this journey.

Funny Facts

"Ada Lovelace" wrote the first computer program in the 1800s. She was coding before computers even existed. That's like writing Instagram posts before the internet. Analytical Engine was the first idea of a computer. It was like a steam-powered laptop… just missing the laptop part.

Languages like B, Fortran, Cobol came before C. These are the grandma and grandpa of programming. Old, slow, but still respected. C is not the first, but it's the strict parent. Make one mistake in C, and your computer might explode (okay, not really… but close).

Python and SQLite are built using C. C Language is like the parent. Python is the cool kid who made life easier. SQLite is the nerdy cousin storing everything in memory. C programmers don't show feelings. They don't cry; they just use printf("I'm sad\n");

All SQL dialects look the same but act different. Like how biryani is different in Hyderabad, Kozhikode, Chennai, and Kolkata… but still called biryani. MySQL, SQLite, Oracle, PostgreSQL – all are SQL. It's like having 5 messaging apps… all do the same thing, but everyone argues which is best.

SQL can be a file, a package, a module – whatever. SQL is like a potato. You can boil it, fry it, mash it… still the same potato. Python uses SQLAlchemy, sqlite3, mysql-connector. Python doesn't talk to databases directly - it sends a friend to do the job.

Java uses JDBC and Drive Manager, Java is like a super serious guy in a suit… even to connect to a simple database. JavaScript uses mysql, mssql, pgsql, firebase, JavaScript connects to databases like a kid trying to fix Wi-Fi — randomly pressing buttons and hoping it works.

Firebase is JavaScript's favourite, Because it's easy, flashy, and doesn't ask too many questions. SQLAlchemy (package) is like ordering food online. Writing SQL (actual command) is like cooking it yourself with a blindfold.

SQLite is everyone's backup friend. No server? No problem. SQLite runs quietly in the background like a shy but smart kid.

Index

Sets, Introduction, Iterating over Sets, Growing Sets, Set Operations, Dictionaries, Introduction, Examples, Iterating over Dictionaries, Growing a Dictionary, Mutability, Text Processing, Number of Sentences, Number of Words, Number of Unique Words, Frequent Words, Pangrams and Dictionaries, Dictionary Methods, Dictionaries in Action: LMS, Assignment Model, Submission Model, Grader

Week –6 : Object-Oriented Programming (OOP'S)

Objects and Classes, OOP in Python: An Example, Classes and Objects, self, Class Attributes vs Object Attributes, Inheritance, Concrete Example, Parent-Child Relationship, Method Overriding, Vector: Mathematical Preliminaries, Vector: Specification, Vector: Definition, Collection of Vectors

Week –7 : Glossary & Important Functions

After successfully completing the six weeks of learning, the Glossary and Important Functions section serves as a quick-reference cheat sheet and revision guide. It summarizes key concepts, terms, and commonly used functions in one place, making it easy to recall essential topics and refresh your understanding.

Week –8 : Interview Questions & Logics

The Interview Questions and Logics section includes commonly asked Python questions and logical problems that test your understanding of core concepts. It helps strengthen your problem-solving skills by encouraging you to think critically and write efficient code.

Week –8 : Revision & Et-Cetera

Optionally extend this week learning File Handling with reference of IIT Madras, IIT Bombay & IIT Guwahati.

Introduction to Programming with Python

The Beginning – From Kattappa's Sword to Keyboard Keys!

"No betrayals or dhokha here, only clean code and clean logic"

Python is not just a programming language — it's that chill friend who never panics during exams and still scores 90+. While other programming languages shout at you with brackets {}, semicolons ;, and *"syntax errors"* like strict tuition teachers, Python just sips chai, pats your back and says, *"Aram se kar bhai, sab ho jaayega."*

Python is simple. So simple, it feels like you're explaining things to your computer in plain English — no shouting, no tantrums, no 3-hour debugging drama. It's like giving instructions to your cousin: *"Do this bhai. Then that. And haan, don't forget this."* And boom — it listens (well… mostly).

Want to build a website? Python. Want to automate boring tasks like renaming 200 files or calculating your relatives' shaadi budget? Python. Want to look smart in front of your crush by building an app? Python. Basically, Python is the *jugaadu dost* that helps you in every subject — without asking for notes in return.

And the best part? You don't need to be a computer science topper or IITian to learn Python. If you can think straight and search stuff on Google without spelling mistakes, *congratulations* — you're already a Python programmer in the making.

So, forget the tension, stop being scared of code, and say *"Hello World!"* to the most beginner-friendly, Indian-mom-approved programming language out there. "*Python*", easy to learn, impossible to hate, and best enjoyed with samosa and stack overflow, *"Chalo, Let's start!"*.

"Baahubali had Kattappa. You've got Python. No backstabbing, just debugging!"

"Python: The Only Language Born from Laughter, Not Logic!"

Python's history isn't like Indian history — no kings, no Mughal invasions, and thankfully, no exams. Just one chilled-out Dutch guy, *Guido van Rossum*, sitting back in 1991 with his laptop in one hand and a British comedy show (*Monty Python's Flying Circus - BBC world*) on the screen. And boom — instead of naming the language something boring like *"SuperCode++ Pro Max,"* he goes, *"Let's call it Python."*

Not because he loved snakes, but because the show made him laugh — imagine creating a whole programming language during a Netflix binge! Guido then became the *"benevolent dictator for life"*, which sounds like a villain from a South Indian film, but he was just the friendly boss of Python (no evil laugh, just clean syntax).

Fast forward 30 years, and Python's still rocking — like that one uncle at every wedding who refuses to age and always knows the DJ. It's built by regular folks like us — not kings, not warriors, just keyboard ninjas with strong Wi-Fi and weak chai. And trust us, it's the only thing in the world that forgives your mistakes with indentation instead of giving *"ek tight slap."*

Python Installation in 3 Easy Steps

"Aram Se, No Tension!"

STEP 1: Visit the Land of Snakes**,** "*No, Not Kerala this time"*

Go to the official Python website,
Link : ***https://www.python.org/downloads***

Click on the big **"*Download Python 3.x.x*"** button.
No research, no confusion — just download like you download memes.

STEP 2: Open File Like a Pro, Not Panic

Double-click the downloaded file.
Tick the box that says *"Add Python to PATH"* — it's tiny but powerful.

Hit *"Install Now"*.
Wait like you're buffering your favourite YouTube video.

STEP 3: Confirm Python's Not Napping

Open **Command Prompt/CMD**
Type: *C:/Users/your_name>* *python*

If you see >>> and Python version info, "*Congrats, Coding ustaad!*"
If not, don't panic. Blame Windows or call cousin tech support.

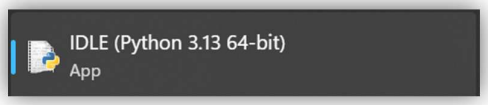
You're Done!
Welcome to the world of Python —
Where the only snake you like is the one that helps you code.

Now go ahead… start typing like a genius!

~~My~~ Your First Program

This is it — your first Python program! It's usually just a simple ***"Hello, World!"***, but don't laugh… it's basically the *namaste* of programming. It tells your computer, "Hey, I've arrived!" No complex logic, no drama — just good vibes and working code. From here, it only gets crazier (and more fun). So, type it like a pro and welcome yourself to the coding duniya!

Here is how you type your first program, *"Not Mine!"*
First find Application in your Laptop, search >>> *"IDLE",* that looks like this



Open IDLE, and you see >>> in the application, you can start typing your first program like,

```
>>> print("Hello, world!")
Hello, world!
```

Explanation:

So, what's happening here?

- `print` – This is Python's way of shouting. Not like your mom when you don't do homework, but politely telling the computer, *"Say this out loud."*
- `"Hello, world!"` – This is your computer's first friendly greeting to the world. It doesn't know much yet, so it just waves and says Hi. No swearing, no bugs — just pure innocence.
- `The brackets ()` – Like tiffin boxes, they carry what's inside. Without them, Python gets confused like us without tea.
- `The quotes ""` – These tell Python, *"Boss, this is a string, not a number or logic."* No quotes, no talk. You can also use single quotes ' ' instead of " ".

Basically, this line means,

> *"Oye Python, please display this line on screen like a good boy!"*
> …and Python happily obeys — no attitude, no debugging drama.

Prompts & Outputs

The Prompt, The Print, and The Python

When you open Python, you'll see something like this on the screen, >>>
Now don't panic — that's not an error, not a warning, not your marks — it's called a prompt.
Just like your blinking cursor in MS Word, it's politely saying,
"Bol na bhai, what should I write?"

```
>>> print("Hello, world!")
```

Then we get,

```
Hello, world!
```

Aree Wah! Your first code is working; Bas one simple line and Python speaks.

What is this "print" drama?

So, in Python, print is not like your school printer. It's a built-in function — which basically means Python already knows it, like how we already know pani puri is awesome.

Whenever you use print(), you're telling Python:
"Bhai, display this on screen."

```
>>> print("Telangana's Capital is Hyderabad")
Telangana's Capital is Hyderabad
```

See? It even handles apostrophes like a gentleman.

Quotes ka confusion? Don't worry!

You can use single quotes *'Hello'* or double quotes *"Hello"* — both work the same.
Just don't mix them up like you mix tea and coffee together.

```
>>> print('Hello, world!')
Hello, world!
>>> print("Hello, world!")
Hello, world!
```

But if your sentence has an apostrophe like *Telangana's*, then use double quotes. Why?
Because Python is smart, but not your English teacher — it'll get confused otherwise.

Printing Numbers? Easy Peasy!

```
>>> print(1)
1
>>> print(2.0)
2.0
```

Python handles numbers like a pro — no unit test needed.

Want to print multiple things together?

```
>>> print('Harvard', 'University', 'CS50')
Harvard University CS50
```

Notice the space between the words? Python puts it automatically. Like how aunties leave space in line... okay, maybe not that automatically.

Want silence? Print nothing!

```
>>> print()

>>>
```

Result: Blank line! (Shhh... peace!)

No Brackets? Python will fight back!

If you try to be over-smart and skip the brackets:

```
>>> print 'Hello, world!'
SyntaxError: Missing parentheses in call to 'print'. Did you mean print(...)?
```

Python will get angry and say:

***SyntaxError*:** `Missing parentheses in call to 'print'. Did you mean print('…')?`

See? Even Python is giving *"Did you mean...?"* like Google search. Grammar mistake, boss! In programming, this is called a syntax error — basically, your code's grammar is wrong.

Summary:

- `>>>` → This is Python asking you, *"Bhai, likho kuch!"*
- `print()` → This is you replying *"Suno na Python, display this line!"*.
- Use `''` or `" "`, both are fine — don't be that confused friend in group project.
- Print numbers, words, even blank lines. Python won't complain.
- But always, ALWAYS use brackets — warna Python ka mood kharab ho jaayega!

Literals & Variables

Literals & Variables – Fixed Values and Chalu Boxes!

In Python, when you write things like *'Hello World!', 1, or 2.0*, they are called *Literals*.

No, not "literally" your best friends — they're just fixed values. They don't change; they sit quietly like a topper on the front bench.

Now comes the fun part — variables. Think of variables as containers or boxes where you can keep values. Like your tiffin box — today poha, tomorrow maggi… same box, new item!

In Python, you can create a variable like this:

```
>>> x = 1
>>> print(x)
1
```

Easy na? Here, **x** is your container, and **1** is the thing inside.

Want to store a string?

```
>>> y = 'a string'
>>> print(y)
a string
```

Want to be fancy?

```
>>> foo_bar = 123.456
>>> print(foo_bar)
123.456
```

(Yes, variable names can look like a Wi-Fi password. Just don't start with numbers.)

Now what is that = sign doing? That's not *"equal to"* like in maths — in Python, it's called the *assignment operator*. It means *"Put this thing into that box."*

You can use it in two ways:

1. To create a new box (variable)
   x = 1 → means: *"Put 1 into x."*
2. To update an existing box
   x = x + 1 → means: *"Add 1 to whatever is in x, and put it back in x."*

```
>>> x = 1
>>> x = x + 1
>>> print(x)
2
```

And remember: Python reads this like we read masala dosa — right to left. First it calculates what's on the right side, then puts the result into the left side.

So, bas! That's how variables work. They're flexible, reusable, and unlike relatives, they don't ask too many questions.

More details on variables coming soon in next week— tab tak, keep practicing and *don't forget your = ka asli kaam!*

Basic Data types

Basic Data Types in Python – Meet the Four Main Characters!

In Python, there are 4 basic data types you'll meet again and again. Think of them as the ***main cast*** in your coding movie:

1. Integer – The Whole Number Hero

An **integer** is just a normal number — no decimal, no drama. Like 1, 99, -47, or *how many samosas you ate?* (don't lie).

Want to check if something's an integer?

```
>>> print(1)
1
>>> type(1)
<class 'int'>
```

See? *int = integer = asli number*.

2. Float – The Number with a Decimal Point

A **float** is a number with a dot. Not floating in water, but floating-point — that's coder lingo for decimals.

```
>>> print(1.0)
1.0
>>> type(1.0)
<class 'float'>
```

Even this is valid:

```
>>> print(1.)
1.0
```

So, *1. and 1.0* are same-same — like chai in glass or pot cup, still chai.

3. String – The Chatterbox

A **string** is a bunch of letters, words, or anything inside quotes. Basically, Python's way of letting you gossip.

```
>>> print("string")
string
>>> type('string')
<class 'str'>
```

Single quotes or double quotes — *dono chalega! But no mixing, samjhe*?

4. Boolean – The Yes or No Type

A **boolean** is like your mom during exams: either **True** or **False**, no in-between. Python uses,

```
>>> print(True)
True
>>> type(False)
<class 'bool'>
```

Warning: **Don't write true or false in small letters** — Python will throw tantrums. It only understands **True** and **False** (capital T, capital F — like VIP treatment).

Quick Recap,

- `int` = whole numbers (like how many times you hit snooze)
- `float` = numbers with dots (like *petrol price: 100.23*)
- `str` = words in quotes (like *"I love Python"*)
- `bool` = True or False (like *Did you eat the last laddu?*)

Comments

Comments – The Gossip Python Ignores!

In Python, a comment is like that one friend who keeps talking during class — but the teacher (Python) completely ignores them.
You make a comment by starting the line with a # symbol.

```
>>> # This is a comment
>>> # print(1)
>>>
```

See that second line? It has code, but since it starts with #, Python says *"Nope, I didn't see anything."* So, nothing happens. Peace!

You can even put a comment after your code:

```
>>> print(1) # This line printting the values 1
1
>>>
```

Python happily prints 1, and totally ignores the gossip after #. Full focus, no distractions!

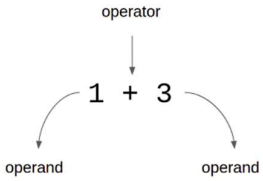
Why use comments?

- To explain your code to yourself (especially when you forget what you wrote 3 days ago)
- To make it readable for others
- To disable code without deleting it (a.k.a. *"temporary break-up"*)

So, remember: #, whispering in Python's ear. It hears nothing, but you remember everything.

Operators

The anatomy of an operation is given below:



Arithmetic Operators – Python's Maths Masala!

Python knows math, and just like us during exams, it also uses operators to do the calculations. These are the special symbols that help Python solve problems — without needing a calculator or tuition!

Here's the math gang in Python,

Operator	What It Does?
+	Addition
-	Subtraction
*	Multiplication
/	Division
//	Floor division
%	Modulus
**	Exponentiation

Let's See Them in Action Like a Maths Movie:

```
>>> 10 + 5 # Addition
15
```

```
>>> 10 - 5 # Subraction
5
```

```
>>> 10 * 5 # Multiplication
50
```

```
>>> 10 / 5 # Division
2.0
```

```
>>> 10 % 5 # Modulus
0
>>> 10 // 5 # Floor Division
2
```

```
>>> 10 ** 5 # Exponentation
100000
```

Wait, Wait! What's This New Stuff?

// → *Floor Division*

Only gives the whole number part of division.

```
>>> 8 // 3
2
```

% → Modulus

Gives the remainder, like how much money is left after buying samosas.

```
>>> 10 % 3
1
```

** → Exponentiation

Like Maths teacher shouting: *"2 to the power of 3!"*

```
>>> 2 ** 3
8
```

What's the Difference Between / and //?

```
>>> 5 / 2
2.5
```

```
>>> 5 // 2
2
```

One gives full result (like your honest friend), the other gives only the integer part (like a friend who keeps the change).

Now Let's Mix in Variables!

```
>>> x = 1
>>> y = x * 5
>>> print(x, y)
1 5
```

Bas! That's how Python does math. Clean, smart, and no calculator required.

So now, maths in Python is no more-scary. It's just another masala dosa of operators — tasty, logical, and fully understandable!

Relational Operators – The Judgy Ones!

Relational operators in Python are like your nosy neighbour auntie — always comparing: *"Beta, who's greater, who's less, who's equal, and who's not?"*

Here's the ***comparison gang*** of Python:

Operator	Kaam (Work)
>	greater than (*Bada kaun hai?*)
<	less than (*Chhota kaun hai?*)
>=	greater than or equal (*Bada ya same*)
<=	less than or equal (*Chhota ya same*)
==	equal to (*Bilkul same!*)
!=	not equal to (*Alag hi scene hai!*)

These are called ***relational*** or ***comparison operators***, and they always answer in **True or False** — like your friend who only replies with *"Haan"* or *"Nahi"*.

Let's Do Some Drama-Free Comparison

```
>>> 10 > 5 # 10 is greater than 5
True
>>> 10 < 5 # 10 us less than 5
False
>>> 10 >= 5 # 10 is greater than or equals to 5
True
>>> 10 <= 5 # 10 is less than or equals to 5
False
>>> 10 == 5 # 10 equals to 5
False
>>> 10 != 5 # 10 not equals to 5
True
```

True or False – That's the Only Answer You Get

These comparisons always return a ***boolean value*** — either **True** or **False**. Python doesn't do *"maybe"* or *"let me think"*. Full clarity.

And yes, you can store this comparison result in a variable:

```
>>> x = 10
>>> y = 5
>>> z = x > y
>>> print(z)
True
```

Now **z** is holding the truth (like a *sanskari hero*).

Don't Mix Up "=" and "=="

- = is used for giving value. (Assignment: *"Lo bhai, ye le."*)
- == is used for checking if values are same. (Comparison: *"Are we twins?"*)

So,

```
x = 5   # Giving 5 to x
x == 5  # Asking: "Is x equal to 5?"
```

Big difference! Don't mix them like salt and sugar in chai.

Final Takeaway – Judging Like a Boss!

- Relational operators = **judges** in Python court
- Answer = **True or False only**, no filmy dialogues
- Use == for checking equality, not = (varna Python daant dega)
- Store results in variables like storing secrets in your diary

And boom! You now understand how Python compares values — clean, simple, and no family drama involved.

Logical Operators – The Drama Kings of Python

If relational operators are nosy aunties comparing everything, then **logical operators** are like Indian dads giving life advice:

"Beta, always use logic in life… and in Python!"

Here's the logic squad:

Operator	Work
not	Ulta kar do! (Negation)
and	Both conditions must return True! (Both True = True)
or	At least one condition must return True

`not` – *The Total U-turn*

The not operator flips the truth like a Bollywood plot twist.

True becomes False, and False becomes True. "*Whatever you see is not True and vice-versa"*

```
>>> x = False
>>> y = not x
>>> print(y)
True
```

So basically: *"Python, x is False."*
Python: *"Haan? So, not False = True. Done."*

You can use it with or without brackets — Python doesn't get offended.

```
>>> not True
False
>>> not(False)
True
```

Easy na? It's like saying: *"I'm not hungry" = Yes, you ARE hungry, you liar.*

`and` – *If both works it will happen*

This one's strict like school teachers. If **both** values are True, then only it says *"Okay, fine."*

```
>>> True and True
True
>>> True and False
False
>>> False and False
False
```

"Beta, You get success only when you both work."

So even if **one fails**, the whole thing fails. *Emotional, isn't it?*

`or` – ***At least one must work***

Now this one's chill like your college canteen manager.
If ***at least one*** is True, result is True. Easy-going guy.

```
>>> True or False
True
>>> True or True
True
>>> False or False
False
```

Even if **one** is True, it's like:
"Chalega yaar, I Passed!"

Real Life Logic Example (Desi Edition)

- not hungry = *You're actually full (not True)*
- rains and umbrella = *You'll stay dry (True and True)*
- rains or umbrella = *At least you're safe one way (True or False)*
- rains and no umbrella = *You will be wet! (True and False)*

Recap,

- not = Complete U-turn (True ↔ False)
- and = *If both are True, then results True*
- or = *At least one must be True, to return True*
- Parentheses optional, but use it for typing convention.

And that's how Python does logic — just like us: sometimes smart, sometimes emotional, but always logical!

Convention

Convention! ~ ***Python's Dressing Sense***

Python is pretty chill — it doesn't care if you write:

```
>>> print(1 + 2)
3
>>> print(1+2)
3
```

Both works. Both give 3.

But just like mom says, *"Mowne! T-shirt is vokey, but wear it neatly. Manasillayo?"*

So, in this course — and in good Python culture — we'll keep things ***neat and clean*** with proper spacing:

```
>>> x = 2 ✅ # This looks nice, like school uniform ironed properly
>>> x = 2 ❌ # This is like wearing a tie with a banyan — still allowed, but why?!
```

Why Use Spacing Convention?

- Code looks clean and neat as your Room after mom's cleaning.
- Easier for **you and your future self** to read
- Makes you look like a Python pro, even when you're just starting

So, remember*:* ***space around =, +, -, etc.*** is not for breathing, it's for beauty (and readability)!

Let's write code that not only runs… but also looks good doing it!

Expressions

Expressions – The Maths + Logic Masala of Python

In Python, an **expression** is like a mixture of numbers (literals), boxes (variables) and symbols (operators) — just like a proper Indian masala dosa: a bit of everything!

Example expressions:

```
>>> 1 + 4 / 4 ** 0
... x / y + z * 2.0
... 3 > 4 and 1 < 10
... not True and False
```

Each of these **gives you a final result**, just like a maths sum or your exam marks — and every result has a **type**.

- First two = math mood = float
- Last two = logic mood = bool

Types of Expressions – Only 2 Types Exist:

1. ***Arithmetic Expressions*** → Result: int or float
2. ***Boolean Expressions*** → Result: bool (True ya False, bas!)

Arithmetic Expressions – *Maths Ka Dhamaka*

In school, 1 + 2 = 3, and here too:

```
>>> 1 + 2
3

>>> type(1 + 2)
<class 'int'>
```

Everything is okay... But the moment **float enters**, it takes over like that one cousin who hogs all the biryani.

```
>>> 1.0 + 2
3.0

>>> type(1.0 + 2)
<class 'float'>
```

Moral of the story:
If float and int are in the same room, Python respects float more. Float becomes boss.

Even with other operators:

```
>>> 7.0 * 5
35.0
>>> type(7.0 * 5)
<class 'float'>

>>> 7.0 / 5
1.4
>>> type(7.0 / 5)
<class 'float'>

>>> 7.0 // 5
1.0
>>> type(7.0 // 5)
<class 'float'>

>>> 7.0 % 5
2.0
>>> type(7.0 % 5)
<class 'float'>
```

Conclusion: Float is the *"senior"* in Python's family — always dominates.

Boolean Expressions – Apply Logic , Become Judge!

Whenever you're comparing things or using logical terms like and, or, not, you're creating **Boolean expressions**. Output will be either **True** or **False**. No in-between, no maybe, no confusion.

Example:

```
>>> 2 > 1
True
```

```
>>> type(2 > 1)
<class 'bool'>
```

Another example using logical operator:

```
>>> True and False
False
```

```
>>> type(True and False)
<class 'bool'>
```

Truth Table – Python's Inner Panchayat

You can see these truth tables if you had studied your boring semi-conductor's chapter in 12th Standard, you may also find NAND, NOR, XOR and many more truth tables.

Let's say you have two variables: X and Y, both can be True or False. Let's judge the result of **X or Y** using a **truth table** (basically, Python ka "What if?" list),

X	Y	X or Y
True	True	True
True	False	True
False	True	True
False	False	False

Logic: *If even one is telling the truth, we believe them. Only if both are lying, we say False.*

Same you can do with **and**:

X	Y	X and Y
True	True	True
True	False	False
False	True	False
False	False	False

Logic: *Both have to be honest for result to be True. One lies = Fail.*

Summary Time – Learn Like a Pro

- **Expression = combo meal** of values, operators, and maybe variables
- If it's doing maths → **Arithmetic expression** *(int or float*)
- If it's doing comparison or logic → **Boolean expression** (*True or False*)
- **float** always wins over **int data type.**
- **not** operator flips result like a plot twist, (movie climax)
- Truth tables = logical cheat codes!

Arithmetic Expressions

Operator Precedence

Think of operators as kids in a lunch line. Some push to the front (*high precedence*), others just stand in the back (*low precedence*).

- ** (power) is like the class topper — always goes first.
- *, /, //, % — they come next, like middle school prefects.
- +, - are chill, waiting at the end of the line.

Example:

Expression: `3 ** 2 * 4 - 4`

Python solves it like:

Power first → Multiply → Then Subtract → Like a good student.

In the given diagram, you can see how operators are prioritized based on their utility and associativity.

Operators	Operation
`**`	exponentiation
`+x, -x`	unary +, unary - (positive sign), (negative sign)
`*, /, //, %`	multiplication, division, floor division, modulus
`+, -`	addition, subtraction

Order of Evaluation

Not all operators follow the same direction.

- Most operators go left to right.
- Only ** (power) and = (assignment) go right to left — they're the rebels.

Example:

```
2 ** 3 ** 0 # Power operator goes right to left!
```

Python thinks: *"Let me do 3 ** 0 first… then raise 2 to that."*

Addition and Subtraction – Best Friends

`3 - 2 + 1` ➔ `(3 - 2) + 1 = 2`

Python goes from left to right. No fights, no confusion.

But if you *guess the brackets wrong*, you'll get a completely different number.

Beware of Float!

Floating point numbers (like 0.1) are sneaky.

- They look innocent, but behave weirdly because computers can't store them *exactly*.
- It's like trying to fit a long number into a tiny box — some bits fall out.

Examples:

```
0.1 * 3 == 0.3   # False  (Scary)
0.1 ** 1000 == 0.0   # True  (Injustice)
```

Computers: *"Sorry, close enough is good enough."*

Boolean Expressions

These are just True or False stories.

```
3 < 3.14 < 4 # True
```

Python reads it like a sentence: *3 is less than 3.14 and 3.14 is less than 4* — all good!

You can also mix them:

```
10 > 20 or True # True, because 'or' only needs one truth!
```

Logical Operator Precedence

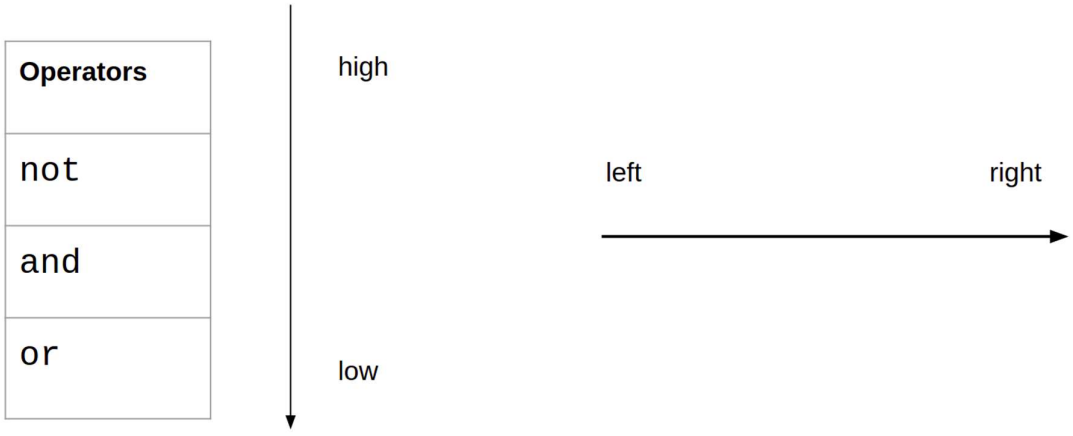
Just like arithmetic, logical operators also have rules.

- **not** is bossy → comes first.
- Then **and** → does teamwork.
- Then **or** → laid-back, takes anything.

Example:

```
not True and False # False
```

Python goes: *"not True → False, then False and False → still False"*



Short Circuit Evaluation

Python is lazy but smart.

- If it already knows the answer, it skips the rest.

Example:

```
True or (1 / 0)
```

Python: *"Hmm, left is True… no need to check right. Skip that scary division."*

Another one:

```
False and (10 / 0)
```

Left is False, so the answer is False, no matter what the right side says. Boom! No error.

Example :

```
(not((3 > 2) or (5 / 0))) and (10 / 0)
```

 # *Output:* *False*

Wait — why no error from 5 / 0 or 10 / 0?

Python is smart. It doesn't do extra work if it already knows the answer — this trick is called short circuit evaluation.

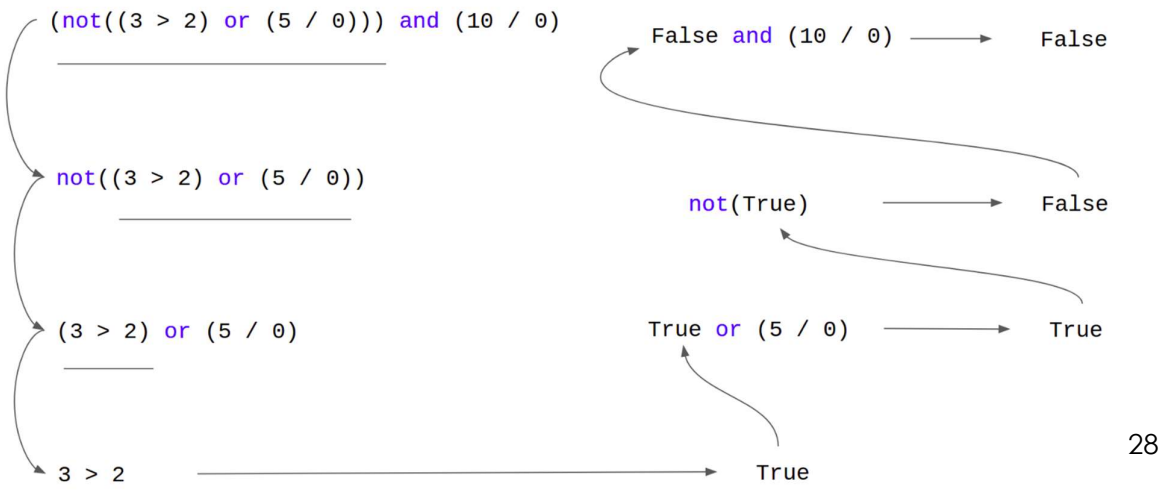
Let's break it down:

1. 3 > 2 → True
2. (3 > 2) or (5 / 0) → Since the left is already True, Python skips (5 / 0)
3. So now: not(True) → False
4. Now Python checks: False and (10 / 0) → Since the left is False, Python skips (10 / 0)
5. Final result: False

No division errors! Because Python *didn't even look at the dangerous parts.*

Think of it like this,

- Python sees something is already True in an or, or already False in an and, and goes: ➤ *"I've seen enough. I'm out!"*



DO THIS or DO THEM! *("Your wish, but do Something")*

Note: *Don't take it easy, they may change your course fate!*

1. What is the output of: 2 + 3 * 2 ** 2 // 2

a) 8 b) 10 c) 7 d) 6

Hint: Power > Multiply/Divide > Add

2. Evaluate: 10 - 2 + 3 * 2 % 4

a) 12 b) 8 c) 10 d) 11

Hint: % has same precedence as * and / — evaluate left to right.

3. What is the result of: 16 / 4 // 2 * 3

a) 6.0 b) 6 c) 1.5 d) 3.0

Hint: / gives float, but // gives int. Be careful**.**

4. Predict the output: 5 ** 2 % 3 * 4

a) 4 b) 8 c) 1 d) 2

Hint: Evaluate ** first, then %, then *.

5. What does this return? 2 + 3 * 4 - 2 ** 2

a) 12 b) 10 c) 16 d) 14

Hint: Power first, then multiply, then add/subtract.

Boolean Expression Questions

6. What is the result? not True or False and True

a) False b) True c) Syntax Error d) None

Hint: not > and > or

7. Evaluate: 3 > 2 or 5 / 0 == 1

a) True b) False c) Error d) None

Hint: Short-circuit alert! Does Python evaluate 5 / 0?

8. Find the output: (3 > 2 and False) or (4 < 2 or True)

a) False b) True c) Error d) None

Hint: Parentheses first, then short-circuit applies.

9. What is the result of: not(3 < 2) and 2 == 2 or 5 > 10

a) True b) False c) Syntax Error d) None

Hint: Use a step-by-step breakdown.

10. Will this cause an error? False and (10 / 0) or True

a) Error b) True c) False d) None

Hint: Watch the short-circuit behaviour of operator **and** & **or**.

Final Wisdom in Funny One-Liners (Summary)

- Operator fights are solved by math teachers, not lawyers.
- Power comes first, like always. Even in Python.
- Floats lie. 0.1 * 3 is *almost* 0.3, but not really.
- Python skips unnecessary work like a lazy student with perfect logic.
- **"or"** is happy if just one friend is True. **"and"** wants all friends to be True.
- Use brackets — Python won't judge you, but it'll sure get confused if you don't.

Strings

Strings, The Comedy Show of Python

Strings are like pizzas — made of characters instead of cheese. And Python? It lets you slice, compare, and even replicate them. Let's dive in like hungry coders at a midnight hackathon!

Length `len()`: Counting the guests at the party

```
>>> word = "Python"
>>> length = len(word)
>>> print(length)
6
```

Even though it *feels* like len is checking vibes, it's just counting how many characters are in the string. Including spaces, punctuation, and that invisible newline too!

Concatenation: When strings fall in love!

```
>>> greet = "Hello"
>>> name = "Oggy"
>>> print(greet + " " + name)
Hello Oggy
```

The + operator is basically Cupid for strings — it brings them together. But don't expect it to add numbers unless they're strings too.

`print("10" + "20")` *# Outputs 1020. No math, just string drama.*

Replication: When strings become rabbits.

```
>>> laugh = "Ha"
>>> print(laugh * 3)
HaHaHa
```

Yes, you can clone strings like sheep in a lab.

Comparison: String Showdown

*Strings are compared alphabetically — like in a dictionary, except Python doesn't care about your handwriting***.**

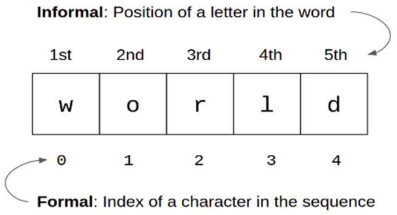
```
>>> print("apple" > "banana")
False
>>> print("abc" == "ABC")
False
```

Indexing: Your String, Your Playground

Imagine**, word =** *"world"* is like seats in a theatre**:**

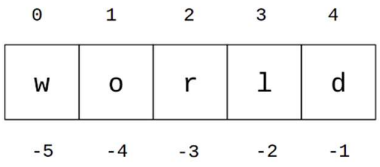
Index: 0 1 2 3 4

Letter: w o r l d



Front-door Indexing:

```
print(word[0])  # 'w'
print(word[4])  # 'd'
```



Back-door Indexing *(Negative Indexing)*

```
print(word[-1])  # 'd'
print(word[-5])  # 'w'
```

Like ghosts from the past, negative indices rise from the end.

 # But go beyond the ghost range? Python screams**!**

```
print(word[5])   # Index Error
print(word[-6])  # Also Index Error
```

They give error because the given index is out of range or doesn't exist as index.

Slicing: String Butchering 101

Index: *0123456789....*

String: *'CS_10_014@kl.cgg.gov.in'*

email = *'CS_10_014@tg.cgg.gov.in'*

```
branch = email[0:2]
year = email[3:5]
roll = email[6:9]
state = email[10:14]
print(branch, year, roll, college)
# Output: CS 10 014 kl
```

You can also leave starting index and just give ending index; string automatically starts from starting index.

```
print(email[:9])  # 'CS_10_014'
```

Python automatically finds out end index if only starting index is given, eventually ending index is the last character of the string.

```
print(email[10:])  # kl.cgg.gov.in'
```

Negative indexing : This is a ninja technique that string indexed from last character to first character.

```
print(email[-10:])  # kl.cgg.gov.in
```

Mind-bending examples

word = 'world'

print(word[-4:3]) # 'or'

print(word[1:-2]) # 'or'

Immutability: *Frozen like Elsa*

word = 'some string'

word[0] = 'S'

Boom: *Type Error: 'str' object does not support item assignment*

You cannot assign string directly, because strings are immutable, which means they're like your phone's lock screen — can't change a part, just replace the whole.

word = 'Some string' # New string, new binding. Old one still in memory.

String Methods: Tools in Your Belt (Operations that can be done on a String)

capitalize(): The method that capitalises the first character of the string.

sentence = "this is fun!"

print(sentence.capitalize()) # 'This is fun!'

Only the first character gets the crown. The rest stay peasants. When *capitalize()* is used only character at first index get capitalised.

isalpha(): Checking Alphabets in the string

```
name = "Alice"
print(name.isalpha())  # True

name2 = "Bob123"
print(name2.isalpha())  # False
```

If it's not A-Z or a-z all the way — even one digit, it fails like a bad password. *isalpha()* used it checks each index for the alphabets, if there is even single character other than alphabets returns False. Basically, we use it for checking alphabets in the string.

Strings Cheat Sheet

Concept	Example	Output / Note
len()	*len("hi")*	*2*
+	*"hi" + "bye"*	*hibye*
***	*"ha"*3*	*hahaha*
word[i]	*"hi"[0]*	*h*
Negative Index	*"hi"[-1]*	*i*
Slice	*"hello"[1:4]*	*ell*
capitalize()	*"hello".capitalize()*	*Hello*
isalpha()	*"name".isalpha()*	*True*
Immutable	*"hi"[0] = "H"*	*Error*

Refer this link for more and important string methods : Python String Methods

Important String Methods Glossary : *capitalize(), count(), endswith(), find(), format(), index(), isalnum(), isalpha(), isdigit(), islower(), isnumeric(), isspace(), istitle(), isupper(), join(), lower(), lstrip(), partition(), replace(), rsplit(), rstrip(), split(), splitlines(), startswith(), strip(), swapcase(), title(), upper()*

Examples and extensive explanation for these functions will be available from Week-1 Continuation! That's it for Week -0!