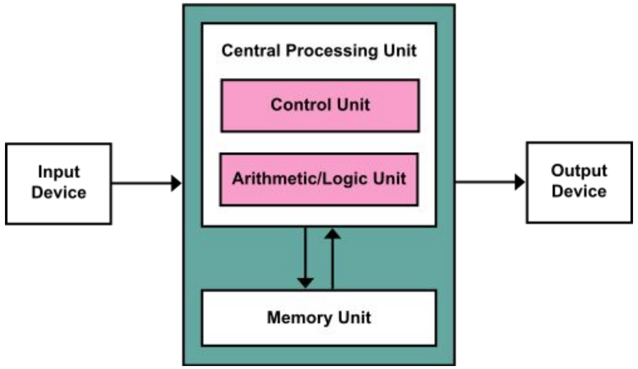
Corso di STATISTICA, INFORMATICA, ELABORAZIONE DELLE INFORMAZIONI

UNIVERSITÀ DEGLI STUDI DELLA BASILICATA

Modulo di Sistemi di Elaborazione delle Informazioni

Input, Elaborazione, Output

Docente:
Domenico Daniele Bloisi



Domenico Daniele Bloisi

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  http://web.unibas.it/bloisi

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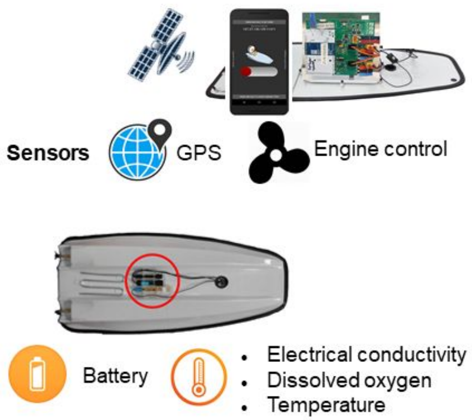
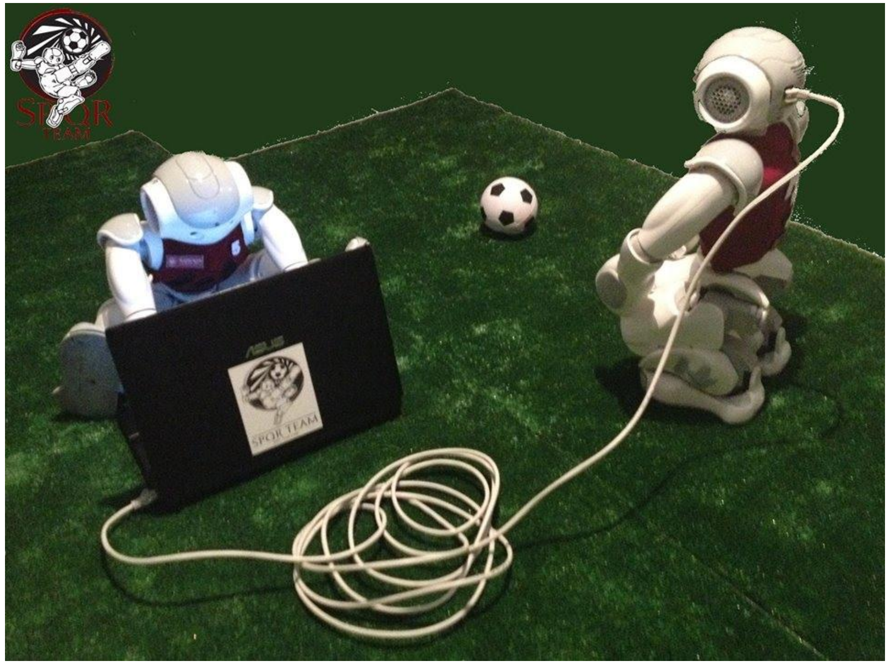
  http://spqr.diag.uniroma1.it





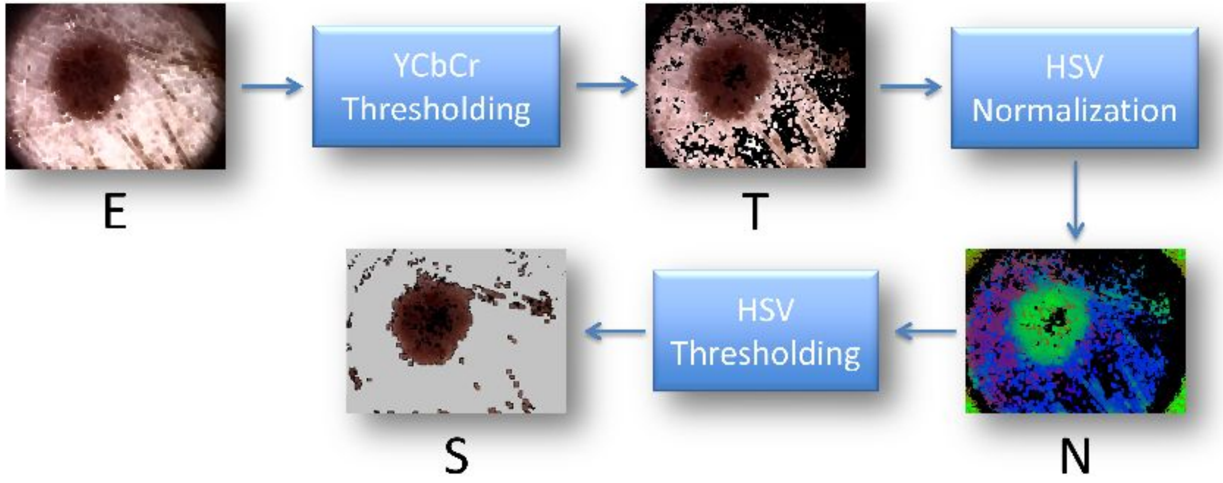
Interessi di ricerca

- Intelligent surveillance
- Robot vision
- Medical image analysis

We annotated 191 images taken from 7 videos for training the net

https://youtu.be/2KHNZX7UIWQ

https://youtu.be/9a70Ucgbi_U



UNIBAS Wolves https://sites.google.com/unibas.it/wolves

- UNIBAS WOLVES is the robot soccer team of the University of Basilicata. Established in 2019, it is focussed on developing software for NAO soccer robots participating in RoboCup competitions.

- UNIBAS WOLVES team is twinned with SPQR Team at Sapienza University of Rome

https://youtu.be/ji0OmkaWh20

Informazioni sul corso

Il corso di STATISTICA, INFORMATICA, ELABORAZIONE DELLE INFORMAZIONI

- include 3 moduli:
  - SISTEMI DI ELABORAZIONE DELLE INFORMAZIONI
    (il martedì - docente: Domenico Bloisi)
  - INFORMATICA
    (il mercoledì - docente: Enzo Veltri)
  - PROBABILITA' E STATISTICA MATEMATICA
    (il giovedì - docente: Antonella Iuliano)

- Periodo: I semestre ottobre 2022 – gennaio 2023

Informazioni sul modulo

- Home page del modulo:
  https://web.unibas.it/bloisi/corsi/sei.html

- Martedì dalle 11:30 alle 13:30

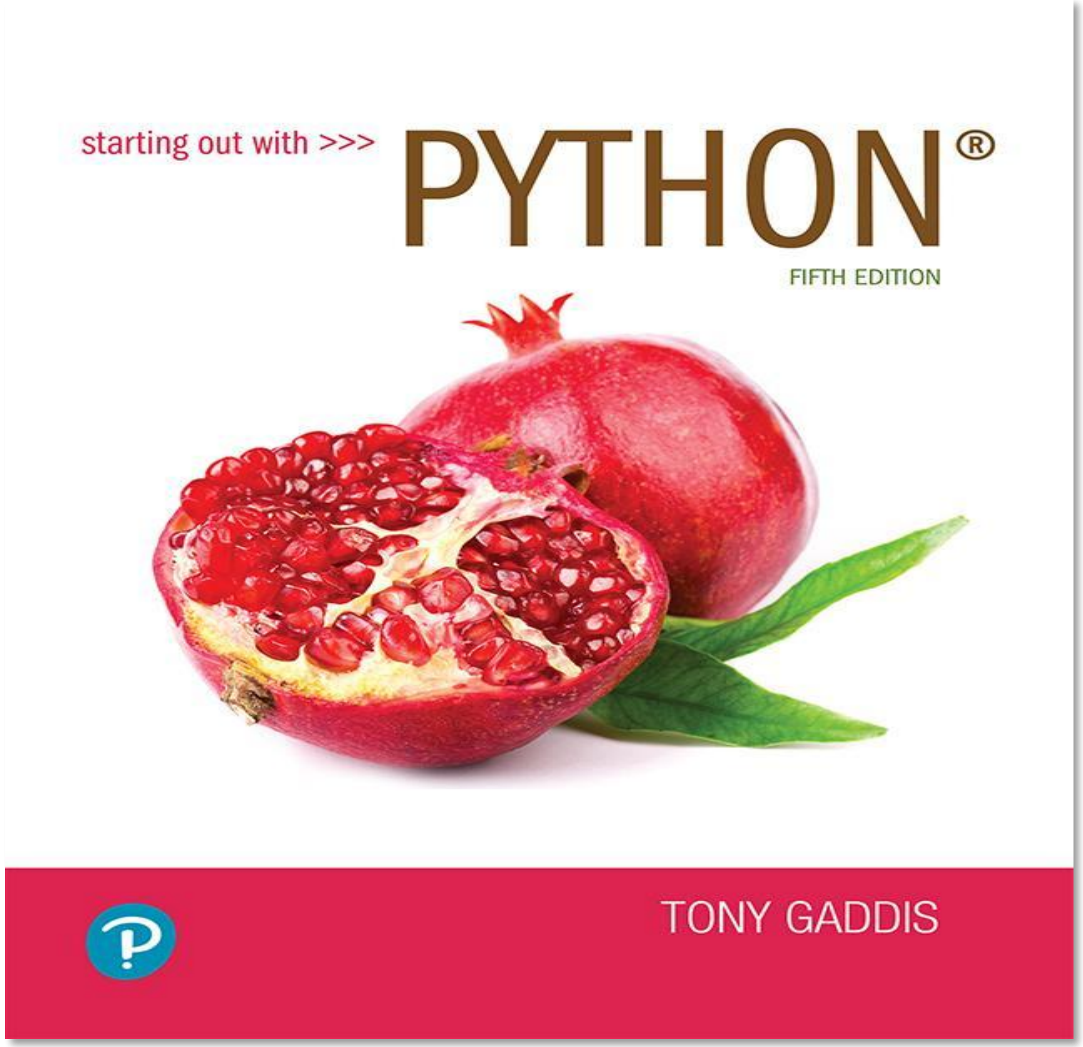
Ricevimento Bloisi

- In presenza, durante il periodo delle lezioni:
  Lunedì dalle 17:00 alle 18:00
  presso Edificio 3D, II piano, stanza 15
  Si invitano gli studenti a controllare regolarmente la bacheca degli avvisi per eventuali variazioni
- Tramite google Meet e al di fuori del periodo delle lezioni:
  da concordare con il docente tramite email

Per prenotare un appuntamento inviare
una email a
domenico.bloisi@unibas.it

Starting out with Python

Fifth Edition



Chapter 2

Input, Processing, and Output

Topics (1 of 2)

- Designing a Program
- Input, Processing, and Output
- Displaying Output with `print` Function
- Comments
- Variables
- Reading Input from the Keyboard
- Performing Calculations
- String Concatenation

Topics (2 of 2)

- More About The `print` Function
- Displaying Formatted Output
- Named Constants
- Introduction to Turtle Graphics

Designing a Program (1 of 3)

- Programs must be designed before they are written
- Program development cycle:
  - Design the program
  - Write the code
  - Correct syntax errors
  - Test the program
  - Correct logic errors

Designing a Program (2 of 3)

- Design is the most important part of the program development cycle
- Understand the task that the program is to perform
  - Work with customer to get a sense what the program is supposed to do
  - Ask questions about program details
  - Create one or more software requirements

Designing a Program (3 of 3)

- Determine the steps that must be taken to perform the task
  - Break down required task into a series of steps
  - Create an algorithm, listing logical steps that must be taken
- Algorithm: set of well-defined logical steps that must be taken to perform a task

Pseudocode

- Pseudocode: fake code
  - Informal language that has no syntax rule
  - Not meant to be compiled or executed
  - Used to create model program
    - No need to worry about syntax errors, can focus on program’s design
    - Can be translated directly into actual code in any programming language

Flowcharts (1 of 2)

- Flowchart: diagram that graphically depicts the steps in a program
  - Ovals are terminal symbols
  - Parallelograms are input and output symbols
  - Rectangles are processing symbols
  - Symbols are connected by arrows that represent the flow of the program

Flowcharts (2 of 2)

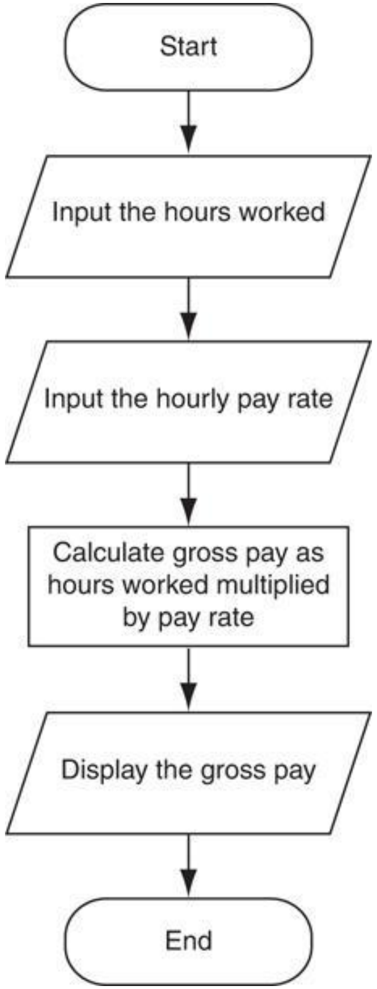

Start
Input the hours worked
Input the hourly pay rate
Calculate gross pay as hours worked multiplied by pay rate
Display the gross pay
End

Figure 2-2 The program development cycle

Input, Processing, and Output

- Typically, computer performs three-step process
  - Receive input
    - Input: any data that the program receives while it is running
  - Perform some process on the input
    - Example: mathematical calculation
  - Produce output

Displaying Output with the `print` Function

- Function: piece of prewritten code that performs an operation
- `print` function: displays output on the screen
- Argument: data given to a function
  - Example: data that is printed to screen
- Statements in a program execute in the order that they appear
  - From top to bottom

Strings and String Literals

- String: sequence of characters that is used as data
- String literal: string that appears in actual code of a program
  - Must be enclosed in single (') or double (") quote marks
  - String literal can be enclosed in triple quotes (''' or " " ")
    - Enclosed string can contain both single and double quotes and can have multiple lines

Comments

- Comments: notes of explanation within a program
  - Ignored by Python interpreter
    - Intended for a person reading the program's code
  - Begin with a # character
- End-line comment: appears at the end of a line of code
  - Typically explains the purpose of that line

Variables

- Variable: name that represents a value stored in the computer memory
  - Used to access and manipulate data stored in memory
  - A variable references the value it represents
- Assignment statement: used to create a variable and make it reference data
  - General format is `variable = expression`
    - Example: `age = 29`
    - Assignment operator: the equal sign (=)

Variables (cont'd.)

- In assignment statement, variable receiving value must be on left side
- A variable can be passed as an argument to a function
  - Variable name should not be enclosed in quote marks
- You can only use a variable if a value is assigned to it

Variable Naming Rules

- Rules for naming variables in Python:
  - Variable name cannot be a Python keyword
  - Variable name cannot contain spaces
  - First character must be a letter or an underscore
  - After first character may use letters, digits, or underscores
  - Variable names are case sensitive
- Variable name should reflect its use

Displaying Multiple Items with the `print` Function

- Python allows one to display multiple items with a single call to `print`
  - Items are separated by commas when passed as arguments
  - Arguments displayed in the order they are passed to the function
  - Items are automatically separated by a space when displayed on screen

Variable Reassignment

- Variables can reference different values while program is running
- Garbage collection: removal of values that are no longer referenced by variables
  - Carried out by Python interpreter
- A variable can refer to item of any type
  - Variable that has been assigned to one type can be reassigned to another type

Numeric Data Types, Literals, and the `str` Data Type

- Data types: categorize value in memory
  - e.g., int for integer, float for real number, str used for storing strings in memory
- Numeric literal: number written in a program
  - No decimal point considered int, otherwise, considered float
- Some operations behave differently depending on data type

Reassigning a Variable to a Different Type

- A variable in Python can refer to items of any type

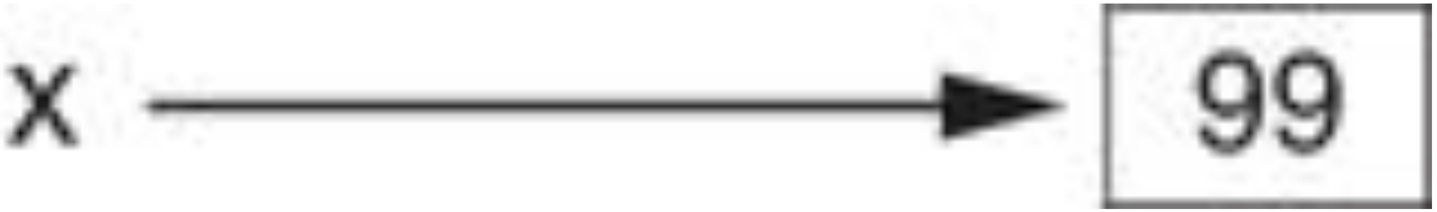


Figure 2-7 The variable x references an integer

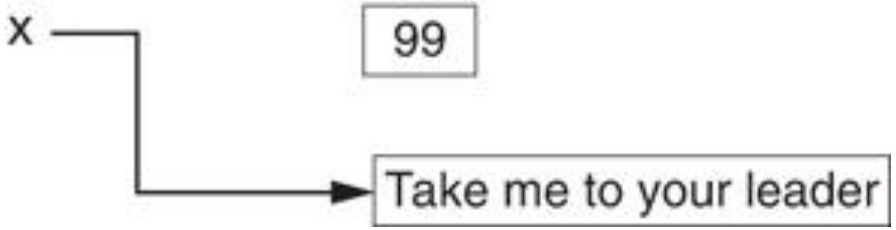


Figure 2-8 The variable x references a string

Reading Input from the Keyboard

- Most programs need to read input from the user
- Built-in `input` function reads input from keyboard
  - Returns the data as a string
  - Format: `variable = input(prompt)`
    - `prompt` is typically a string instructing user to enter a value
  - Does not automatically display a space after the prompt

Reading Numbers with the `input` Function

- `input` function always returns a string
- Built-in functions convert between data types
  - `int(`*`item`*`)` converts *`item`* to an `int`
  - `float(`*`item`*`)` converts *`item`* to a `float`
  - Nested function call: general format:
    `function1``(`*`function2`*`(`*`argument`*`))`
    - value returned by function2 is passed to function1
  - Type conversion only works if item is valid numeric value, otherwise, throws exception

Performing Calculations

- Math expression: performs calculation and gives a value
  - Math operator: tool for performing calculation
  - Operands: values surrounding operator
    - Variables can be used as operands
  - Resulting value typically assigned to variable
- Two types of division:
  - `/` operator performs floating point division
  - `//` operator performs integer division
    - Positive results truncated, negative rounded away from zero

Operator Precedence and Grouping with Parentheses

- Python operator precedence:
  1. Operations enclosed in parentheses
     - Forces operations to be performed before others
  2. Exponentiation (**)
  3. Multiplication (*), division (/ and //), and remainder (%)
  4. Addition (+) and subtraction (-)
- Higher precedence performed first
  - Same precedence operators execute from left to right

The Exponent Operator and the Remainder Operator

- Exponent operator (`**`): Raises a number to a power
  - `x ** y` = x^y
- Remainder operator (`%`): Performs division and returns the remainder
  - a.k.a. modulus operator
  - e.g., `4%2=0, 5%2=1`
  - Typically used to convert times and distances, and to detect odd or even numbers

Converting Math Formulas to Programming Statements

- Operator required for any mathematical operation
- When converting mathematical expression to programming statement:
  - May need to add multiplication operators
  - May need to insert parentheses

Mixed-Type Expressions and Data Type Conversion

- Data type resulting from math operation depends on data types of operands
  - Two `int` values: result is an `int`
  - Two `float` values: result is a `float`
  - `int` and `float`: `int` temporarily converted to `float`, result of the operation is a `float`
    - Mixed-type expression
  - Type conversion of `float` to `int` causes truncation of fractional part

Breaking Long Statements into Multiple Lines (1 of 2)

- Long statements cannot be viewed on screen without scrolling and cannot be printed without cutting off
- Multiline continuation character (\): Allows to break a statement into multiple lines

```
result = var1 * 2 + var2 * 3 + \
         var3 * 4 + var4 * 5
```

Breaking Long Statements into Multiple Lines (2 of 2)

- Any part of a statement that is enclosed in parentheses can be broken without the line continuation character.

```
print("Monday's sales are", monday,
      "and Tuesday's sales are", tuesday,
      "and Wednesday's sales are", Wednesday)

total = (value1 + value2 +
         value3 + value4 +
         value5 + value6)
```

String Concatenation (1 of 2)

- To append one string to the end of another string
- Use the + operator to concatenate strings

```
>>> message = 'Hello ' + 'world'
>>> print(message)
Hello world
>>>
```

String Concatenation (2 of 2)

- You can use string concatenation to break up a long string literal

```
print('Enter the amount of ' +
      'sales for each day and ' +
      'press Enter.')
```

This statement will display the following:

```
Enter the amount of sales for each day and press Enter.
```

Implicit String Literal Concatenation (1 of 2)

- Two or more string literals written adjacent to each other are implicitly concatenated into a single string

```
>>> my_str = 'one' 'two' 'three'
>>> print(my_str)
onetwothree
```

Implicit String Literal Concatenation (2 of 2)

```
print('Enter the amount of '
      'sales for each day and '
      'press Enter.')
```

This statement will display the following:

```
Enter the amount of sales for each day and press Enter.
```

More About The `print` Function (1 of 2)

- `print` function displays line of output
  - Newline character at end of printed data
  - Special argument `end='`*`delimiter`*`'` causes `print` to place *`delimiter`* at end of data instead of newline character
- `print` function uses space as item separator
  - Special argument `sep='`*`delimiter`*`'` causes `print` to use *`delimiter`* as item separator

More About The `print` Function (2 of 2)

- Special characters appearing in string literal
  - Preceded by backslash (`\`)
    - Examples: newline (`\n`), horizontal tab (`\t`)
  - Treated as commands embedded in string

Displaying Formatted Output with F-strings (1 of 8)

- An f-string is a special type of string literal that is prefixed with the letter `f`

```
>>> print(f'Hello world')
Hello world
```

- F-strings support placeholders for variables

```
>>> name = 'Johnny'
>>> print(f'Hello {name}.')
Hello Johnny.
```

Displaying Formatted Output with F-strings (2 of 8)

- Placeholders can also be expressions that are evaluated

```
>>> print(f'The value is {10 + 2}.')
The value is 12.
```

```
>>> val = 10
>>> print(f'The value is {val + 2}.')
The value is 12.
```

Displaying Formatted Output with F-strings (3 of 8)

- Format specifiers can be used with placeholders

```
>> num = 123.456789
>> print(f'{num:.2f}')
123.46
>>>
```

- `.2f` means:
  - round the value to 2 decimal places
  - display the value as a floating-point number

Displaying Formatted Output with F-strings (4 of 8)

- Other examples:

```
>> num = 1000000.00
>> print(f'{num:,.2f}')
1,000,000.00
```

```
>>> discount = 0.5
>>> print(f'{discount:.0%}')
50%
```

Displaying Formatted Output with F-strings (5 of 8)

- Other examples:

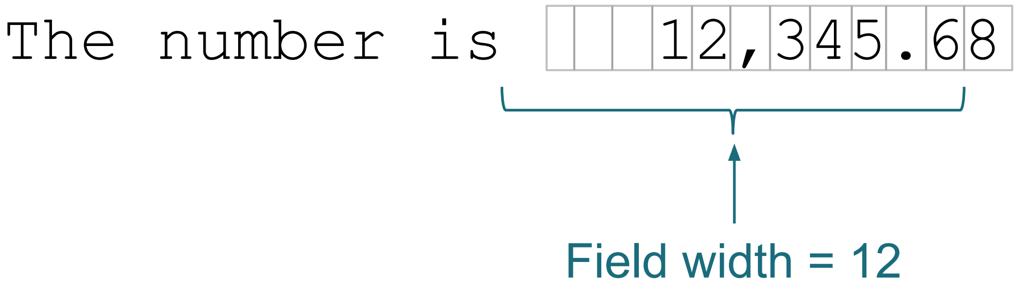
```
>> num = 123456789
>> print(f'{num:,d}')
123,456,789


>>> num = 12345.6789
>>> print(f'{num:.2e}')
1.23e+04
```

Displaying Formatted Output with F-strings (6 of 8)

- Specifying a minimum field width:

```
>>> num = 12345.6789
>>> print(f'The number is {num:12,.2f}')
The number is    12,345.68
```

Field width = 12



```
The number is    12,345.68
```

Field width = 12

Displaying Formatted Output with F-strings (7 of 8)

- Aligning values within a field
  - Use < for left alignment
  - Use > for right alignment
  - Use ^ for center alignment

- Examples:
  - `print(f'{num:<20.2f}')`
  - `print(f'{num:>20.2f}')`
  - `print(f'{num:^20.2f}')`

Displaying Formatted Output with F-strings (8 of 8)

- The order of designators in a format specifier
  - When using multiple designators in a format specifier, write them in this order:

```
[alignment][width][,][.precision][type]
```

- Example:
  - `print(f'{number:^10,.2f}')`

Magic Numbers

- A magic number is an unexplained numeric value that appears in a program’s code. Example:

```
amount = balance * 0.069
```

- What is the value 0.069? An interest rate? A fee percentage? Only the person who wrote the code knows for sure.

The Problem with Magic Numbers

- It can be difficult to determine the purpose of the number.
- If the magic number is used in multiple places in the program, it can take a lot of effort to change the number in each location, should the need arise.
- You take the risk of making a mistake each time you type the magic number in the program’s code.
  - For example, suppose you intend to type 0.069, but you accidentally type .0069. This mistake will cause mathematical errors that can be difficult to find.

Named Constants

- You should use named constants instead of magic numbers.
- A named constant is a name that represents a value that does not change during the program's execution.
- Example:

```
INTEREST_RATE = 0.069
```

- This creates a named constant named `INTEREST_RATE`, assigned the value 0.069. It can be used instead of the magic number:

```
amount = balance * INTEREST_RATE
```

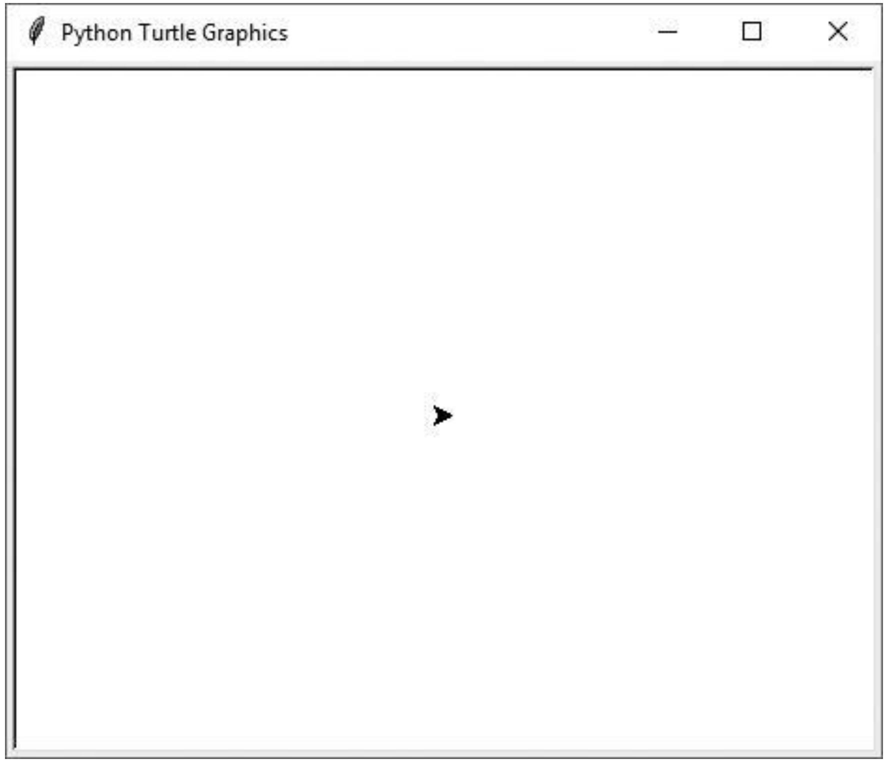
Advantages of Using Named Constants

- Named constants make code self-explanatory (self-documenting)
- Named constants make code easier to maintain (change the value assigned to the constant, and the new value takes effect everywhere the constant is used)
- Named constants help prevent typographical errors that are common when using magic numbers

Introduction to Turtle Graphics (1 of 2)

- Python's turtle graphics system displays a small cursor known as a *turtle*.

- You can use Python statements to move the turtle around the screen, drawing lines and shapes.



Introduction to Turtle Graphics (2 of 2)

- To use the turtle graphics system, you must import the turtle module with this statement:

  ```
  import turtle
  ```

  This loads the turtle module into memory

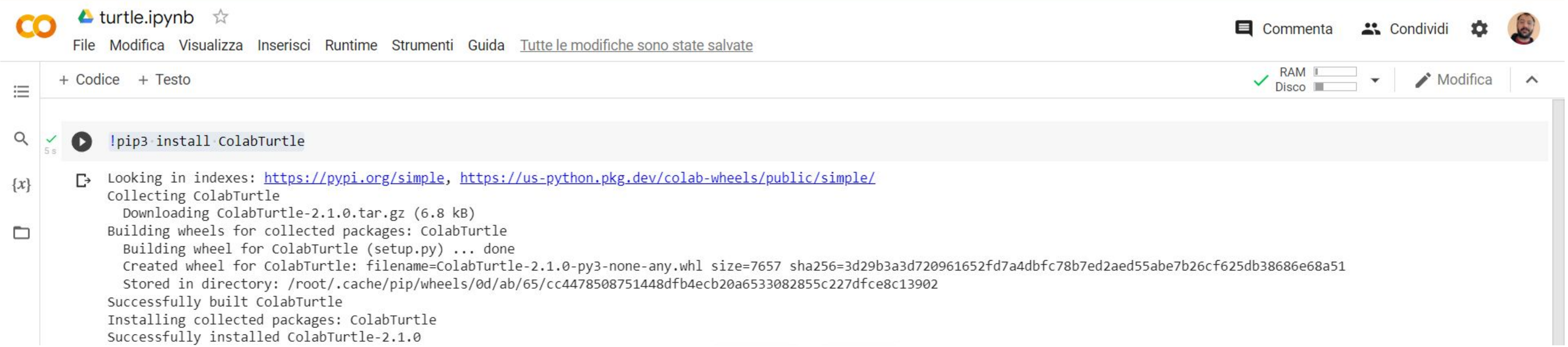
Purtroppo non possiamo (facilmente) usare Turtle in Colab

ColabTurtle

- Create an empty code cell and type:

```
!pip3 install ColabTurtle
```

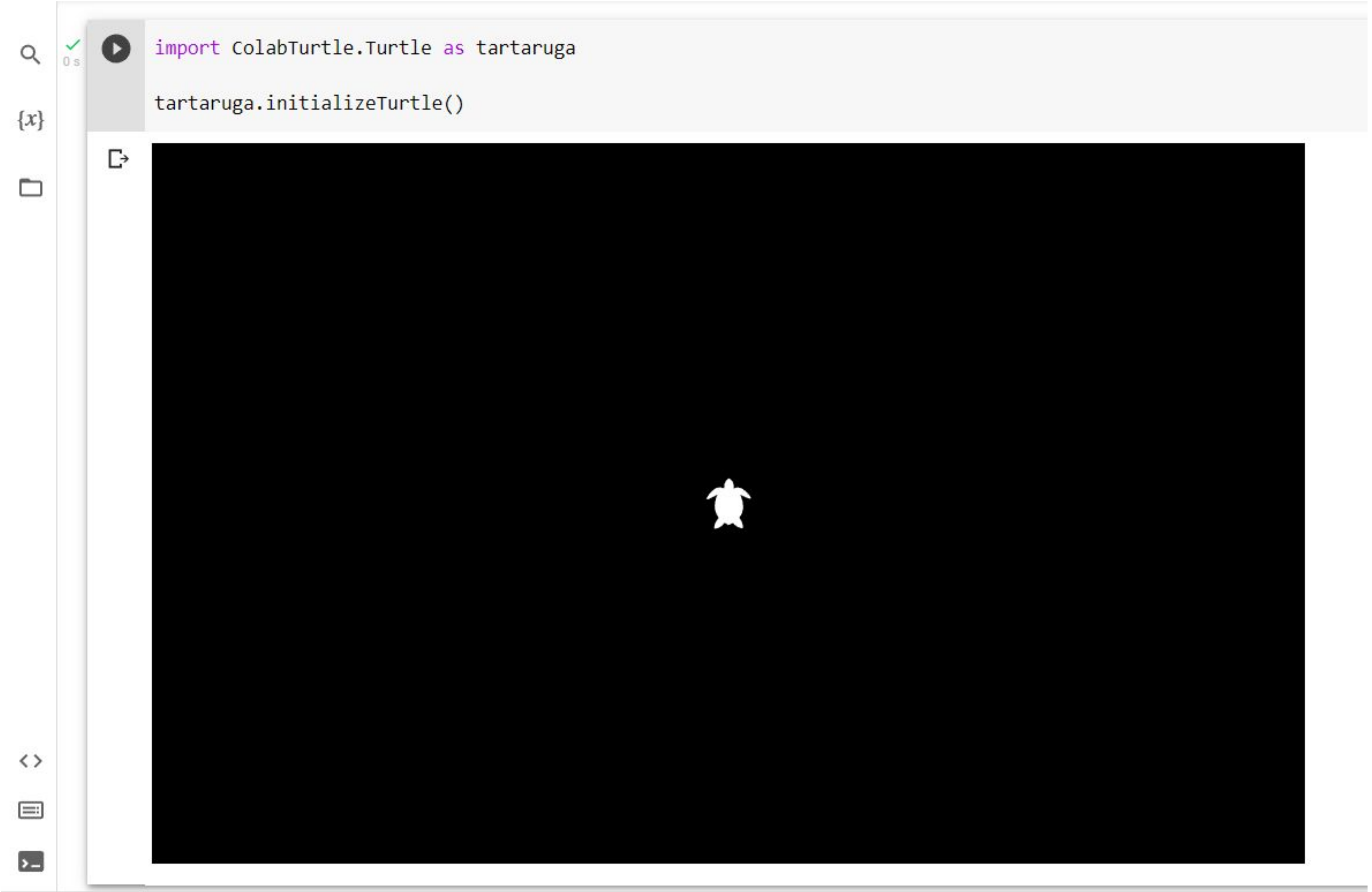
- Run the code cell.



```
!pip3 install ColabTurtle
```

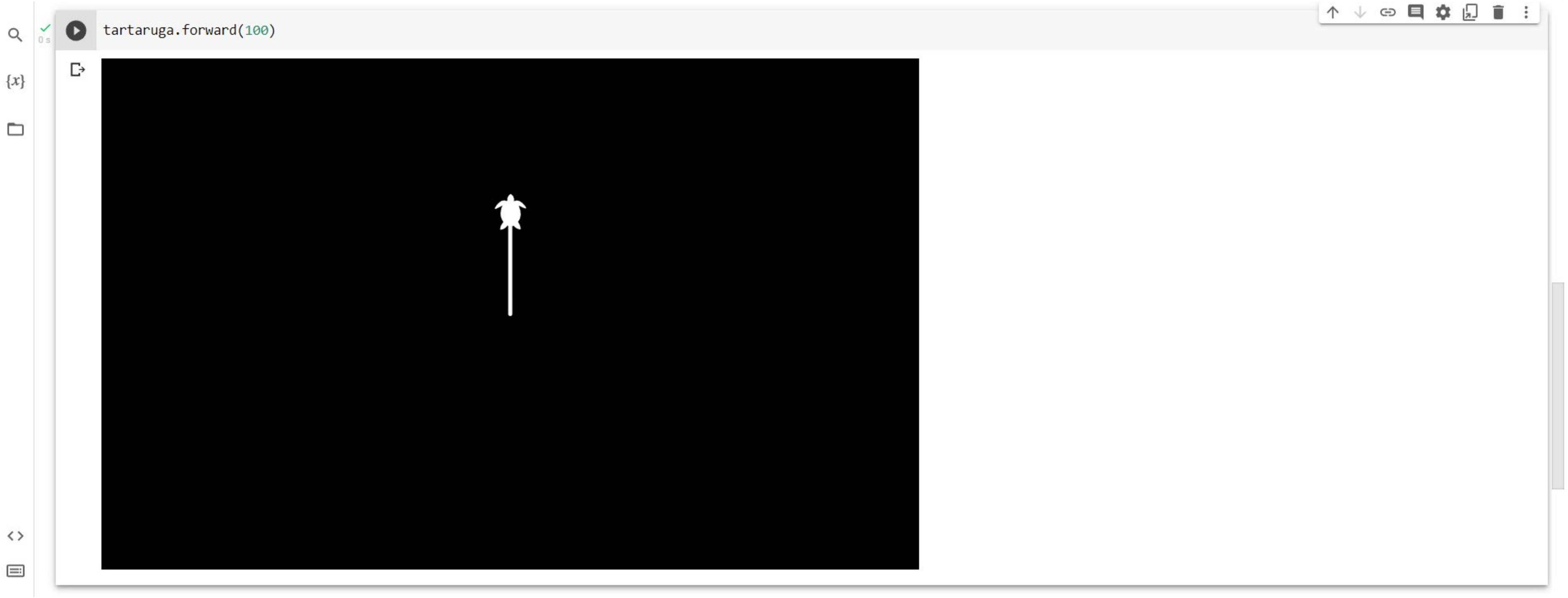
```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Collecting ColabTurtle
  Downloading ColabTurtle-2.1.0.tar.gz (6.8 kB)
Building wheels for collected packages: ColabTurtle
  Building wheel for ColabTurtle (setup.py) ... done
  Created wheel for ColabTurtle: filename=ColabTurtle-2.1.0-py3-none-any.whl size=7657 sha256=3d29b3a3d720961652fd7a4dbfc78b7ed2aed55abe7b26cf625db38686e68a51
  Stored in directory: /root/.cache/pip/wheels/0d/ab/65/cc4478508751448dfb4ecb20a6533082855c227dfce8c13902
Successfully built ColabTurtle
Installing collected packages: ColabTurtle
Successfully installed ColabTurtle-2.1.0
```

InitializeTurtle



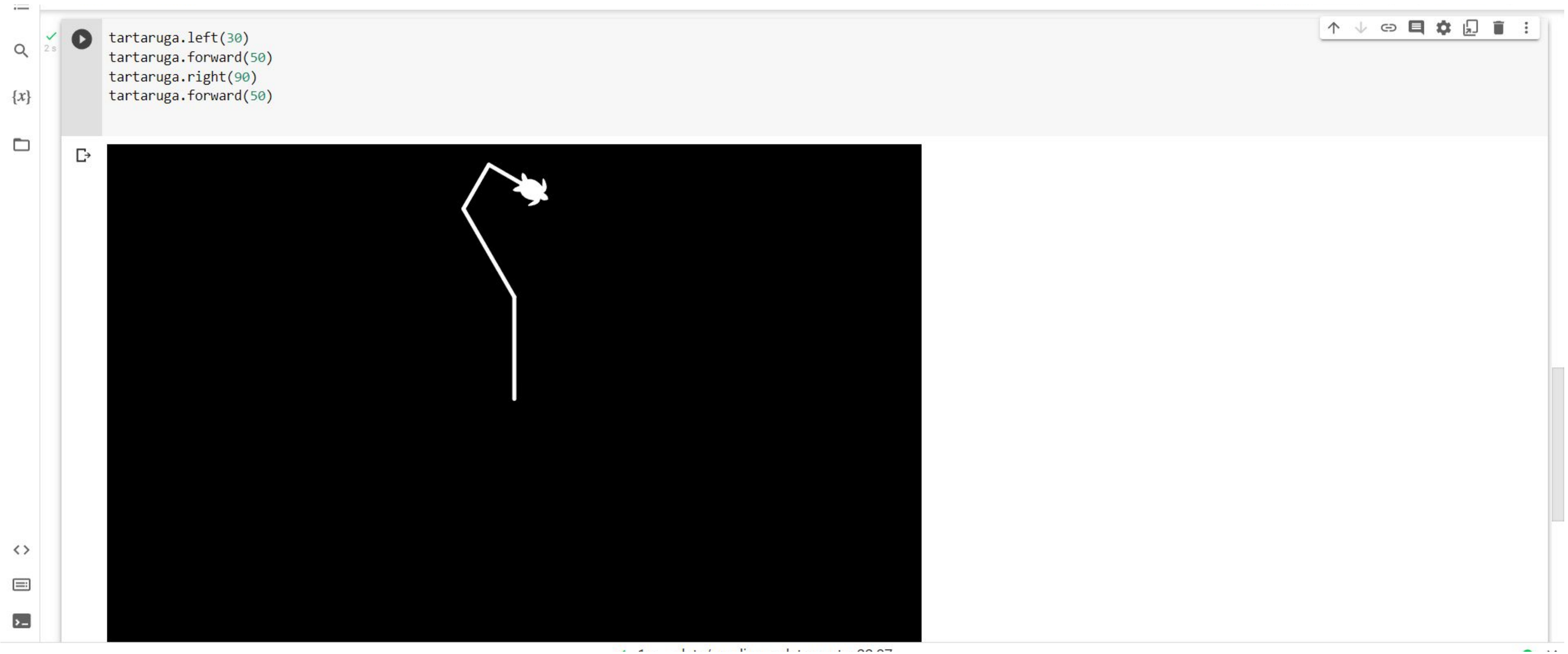
```
import ColabTurtle.Turtle as tartaruga

tartaruga.initializeTurtle()
```

Moving the Turtle Forward



```
tartaruga.forward(100)
```

Turning the Turtle

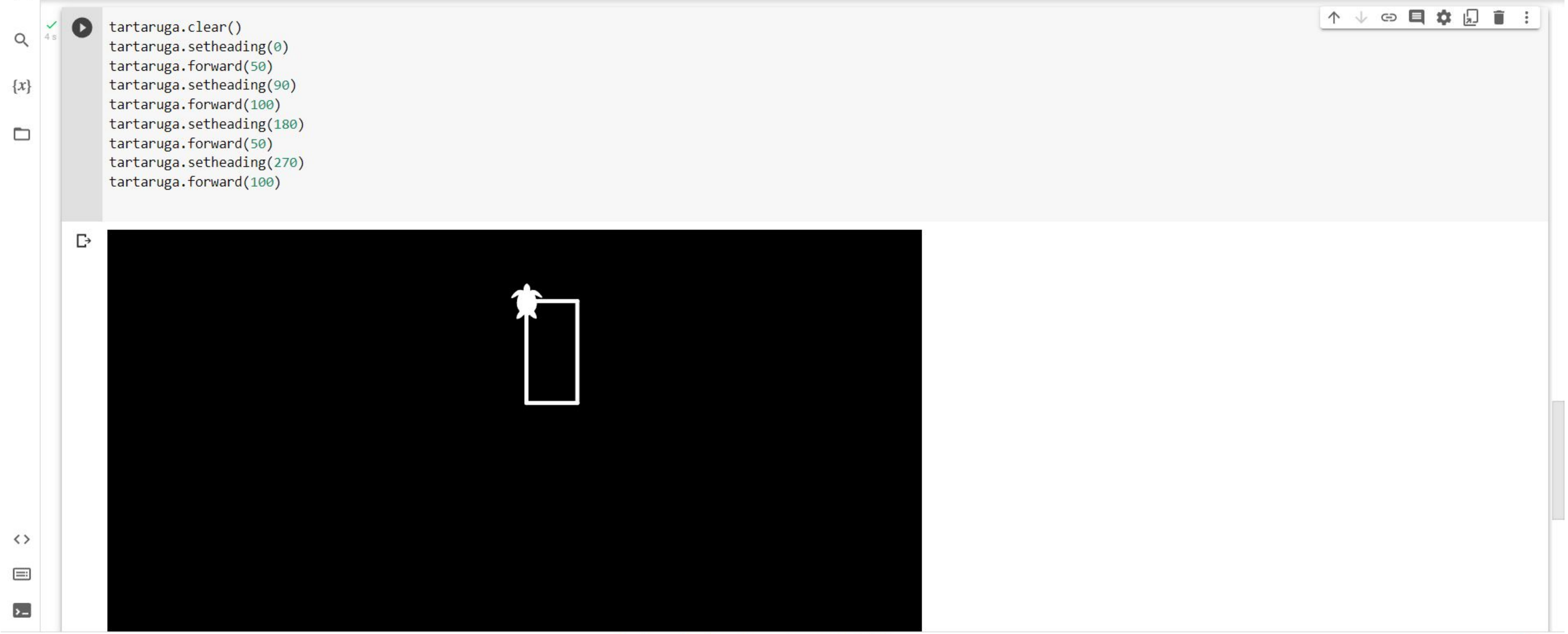


```
tartaruga.left(30)
tartaruga.forward(50)
tartaruga.right(90)
tartaruga.forward(50)
```

Resetting the Turtle’s Window

- The `turtle.clear()` statement:
  - Erases all drawings that currently appear in the graphics window.
  - Does *not* change the turtle's position.
  - Does *not* change the drawing color.
  - Does *not* change the graphics window’s background color.

Setting the Turtle's Heading

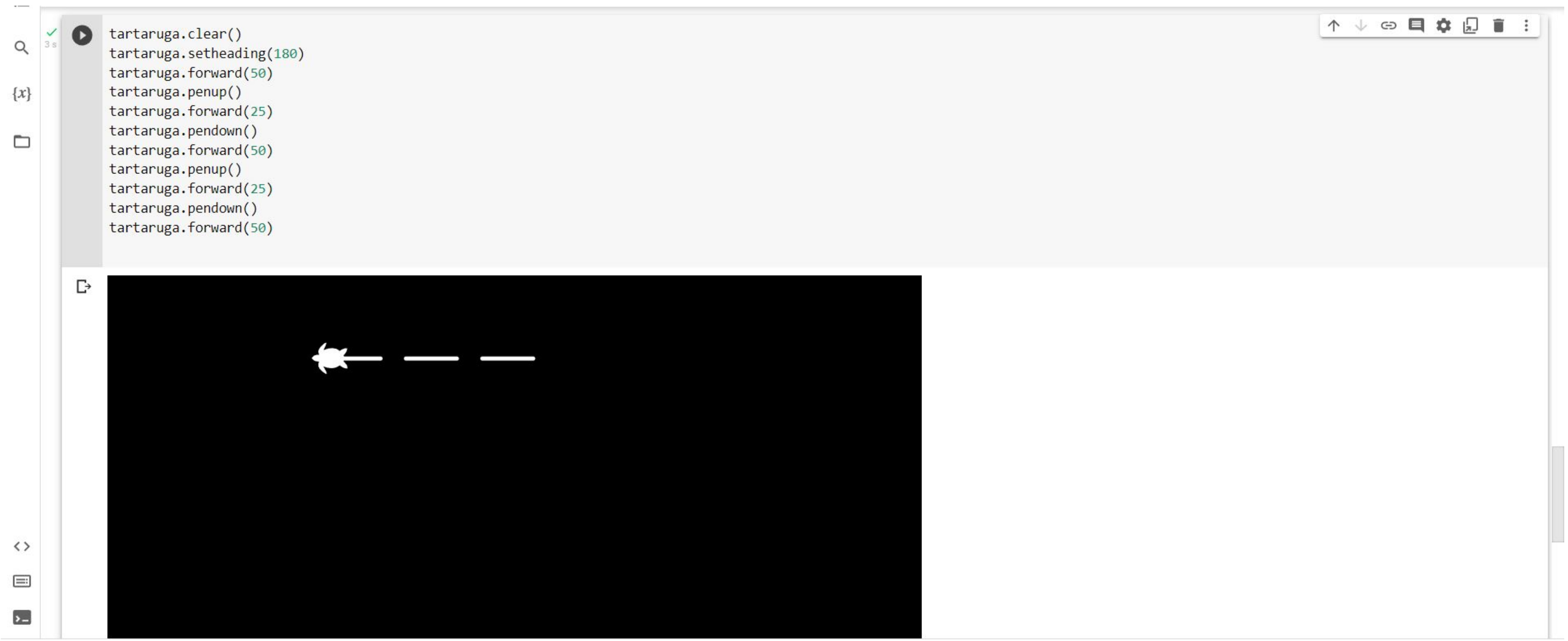


```
tartaruga.clear()
tartaruga.setheading(0)
tartaruga.forward(50)
tartaruga.setheading(90)
tartaruga.forward(100)
tartaruga.setheading(180)
tartaruga.forward(50)
tartaruga.setheading(270)
tartaruga.forward(100)
```

Setting the Pen Up or Down (1 of 2)

- When the turtle's pen is down, the turtle draws a line as it moves. By default, the pen is down.
- When the turtle's pen is up, the turtle does not draw as it moves.
- Use the `turtle.penup()` statement to raise the pen.
- Use the `turtle.pendown()` statement to lower the pen.

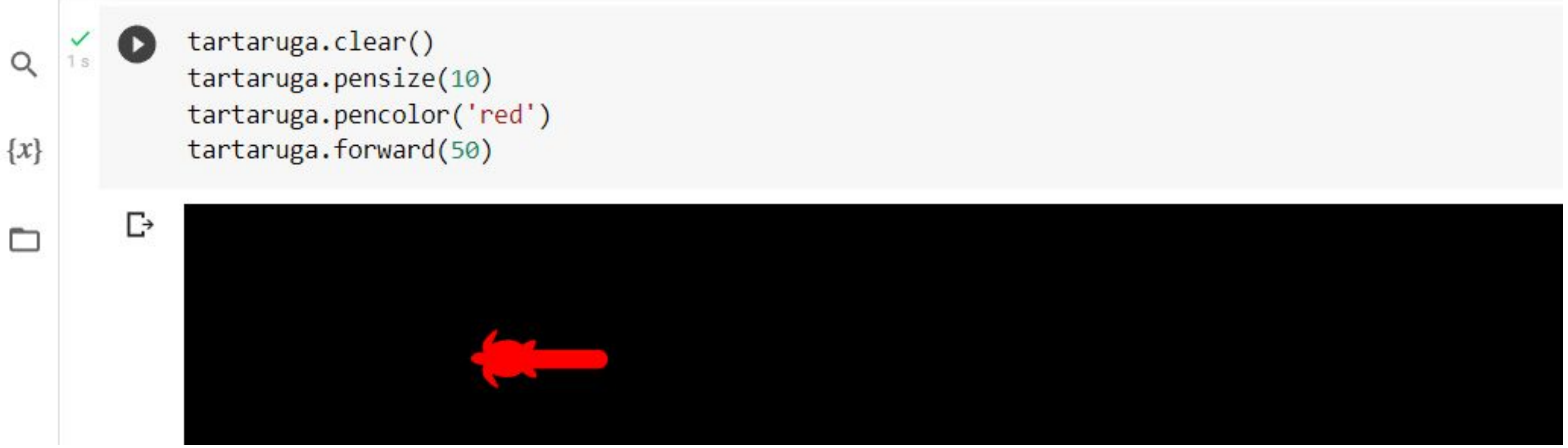
Setting the Pen Up or Down (2 of 2)



```
tartaruga.clear()
tartaruga.setheading(180)
tartaruga.forward(50)
tartaruga.penup()
tartaruga.forward(25)
tartaruga.pendown()
tartaruga.forward(50)
tartaruga.penup()
tartaruga.forward(25)
tartaruga.pendown()
tartaruga.forward(50)
```

Changing the Pen Size and Drawing Color

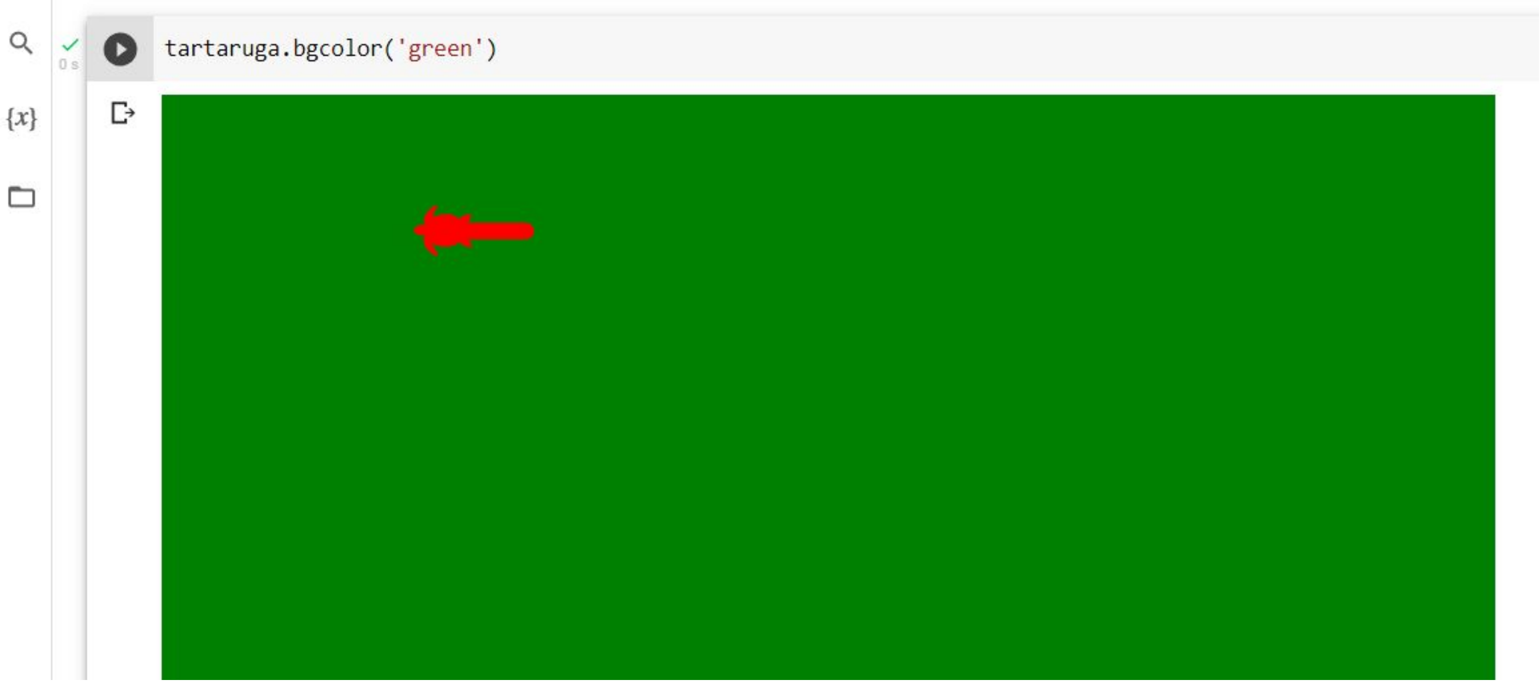
- Use the `turtle.pensize(`*`width`*`)` statement to change the width of the turtle's pen, in pixels.
- Use the `turtle.pencolor(`*`color`*`)` statement to change the turtle's drawing color.
    - *See Appendix D in your textbook for a complete list of colors*.



```
tartaruga.clear()
tartaruga.pensize(10)
tartaruga.pencolor('red')
tartaruga.forward(50)
```

Working with the Turtle's Window

- Use the `turtle.bgcolor(`*`color`*`)` statement to set the window's background color.
  - *See Appendix D in your textbook for a complete list of colors*.



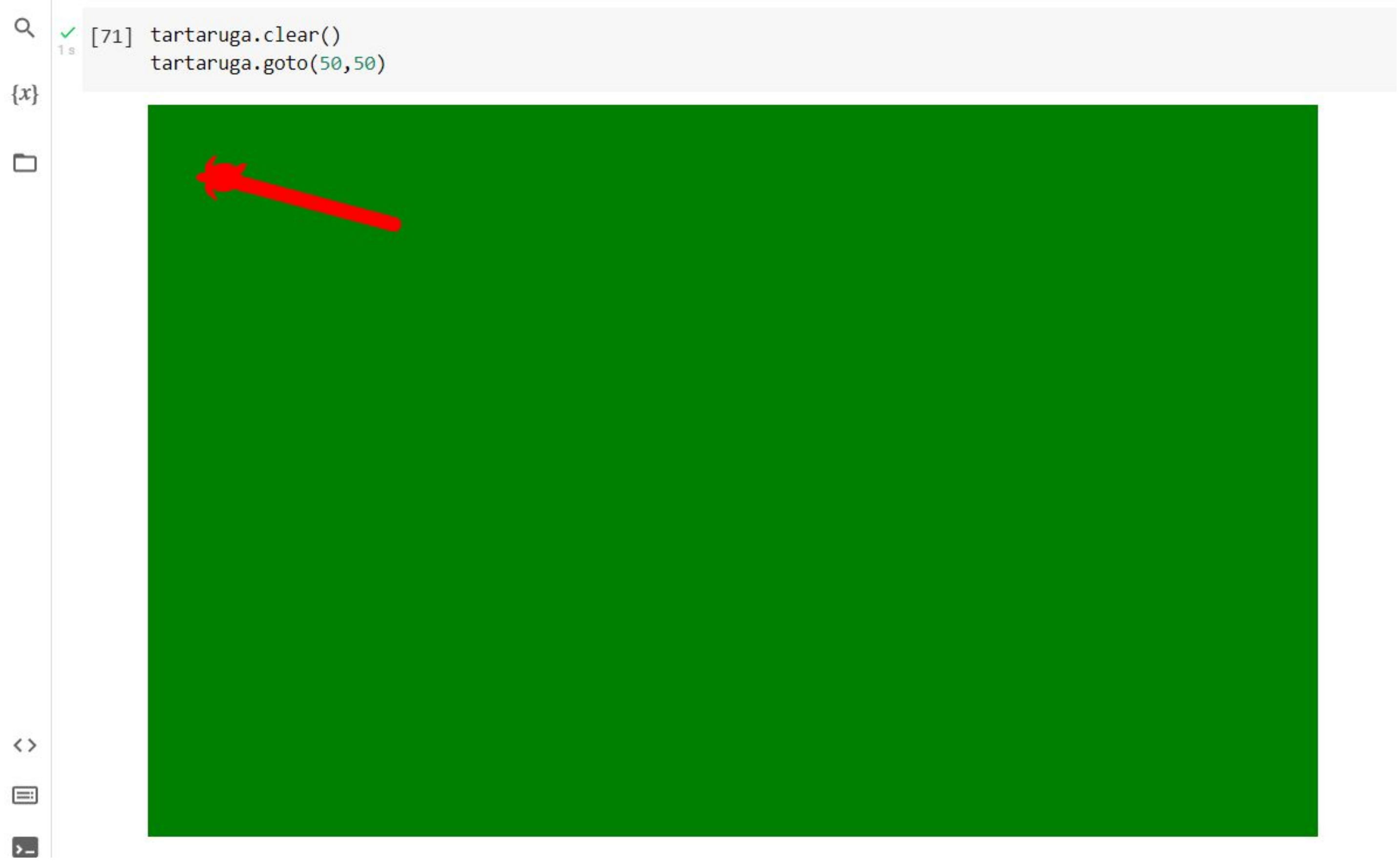
```
tartaruga.bgcolor('green')
```

Resetting the Turtle’s Window (3 of 3)

- The `turtle.clearscreen()` statement:
  - Erases all drawings that currently appear in the graphics window.
  - Resets the drawing color to black.
  - Resets the turtle to its original position in the center of the screen.
  - Resets the graphics window’s background color to white.

Moving the Turtle to a Specific Location

- Use the `turtle.goto(x, y)` statement to move the turtle to a specific location.



```
tartaruga.clear()
tartaruga.goto(50,50)
```

Animation Speed

- Use the `turtle.speed(speed)` command to change the speed at which the turtle moves.
  - The *`speed`* argument is a number in the range of 0 through 10.
  - If you specify 0, then the turtle will make all of its moves instantly (animation is disabled).

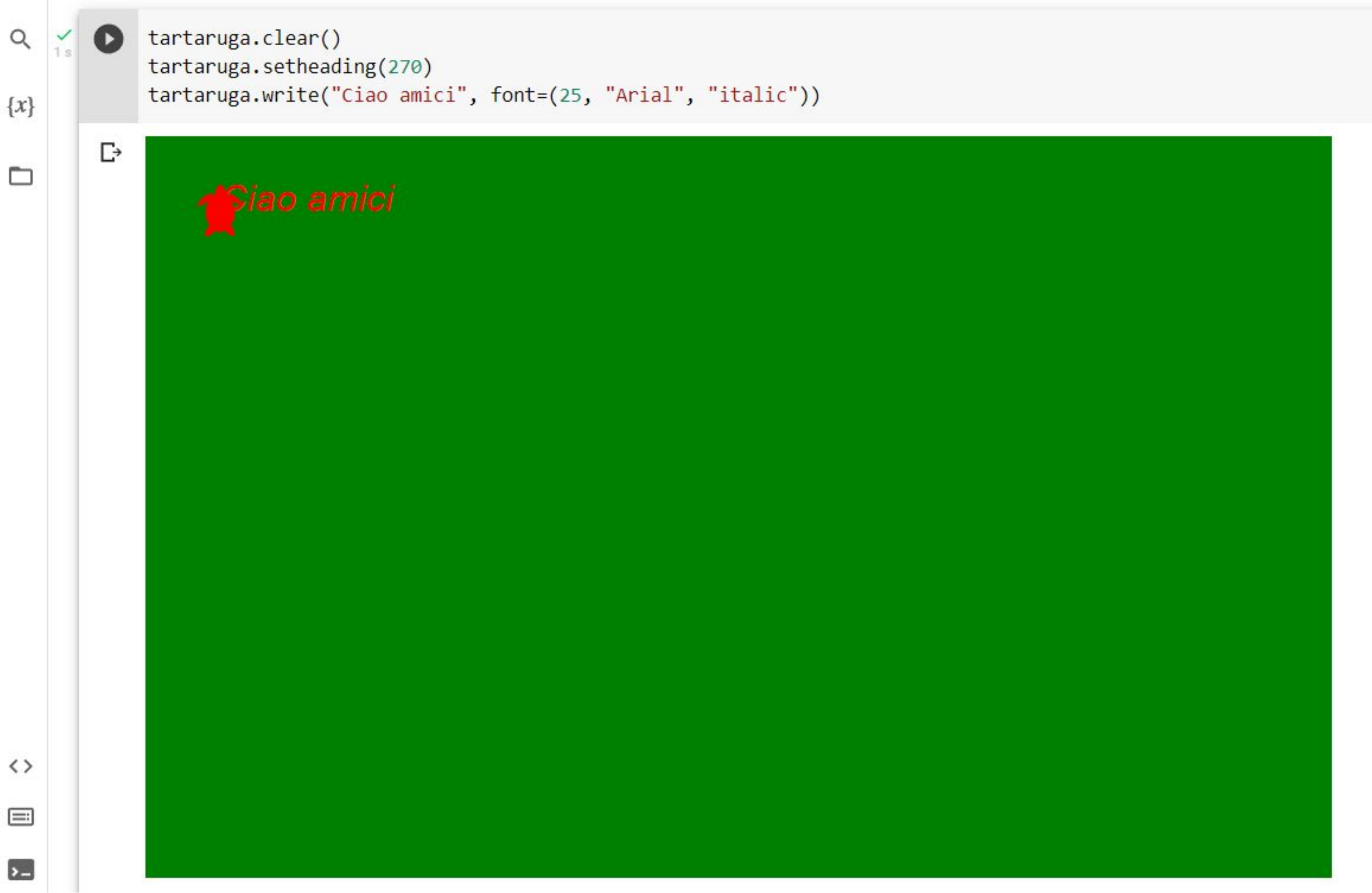
Hiding and Displaying the Turtle

- Use the `turtle.hideturtle()` command to hide the turtle.
  - This command does not change the way graphics are drawn, it simply hides the turtle icon.
- Use the `turtle.showturtle()` command to display the turtle.

Displaying Text (1 of 2)

- Use the `turtle.write(`*`text`*`)` statement to display text in the turtle's graphics window.
  - The *`text`* argument is a string that you want to display.
  - The lower-left corner of the first character will be positioned at the turtle’s *X* and *Y* coordinates.

Displaying Text (2 of 2)



```
tartaruga.clear()
tartaruga.setheading(270)
tartaruga.write("Ciao amici", font=(25, "Arial", "italic"))
```

Summary

- This chapter covered:
  - The program development cycle, tools for program design, and the design process
  - Ways in which programs can receive input, particularly from the keyboard
  - Ways in which programs can present and format output
  - Use of comments in programs
  - Uses of variables and named constants
  - Tools for performing calculations in programs
  - The turtle graphics system

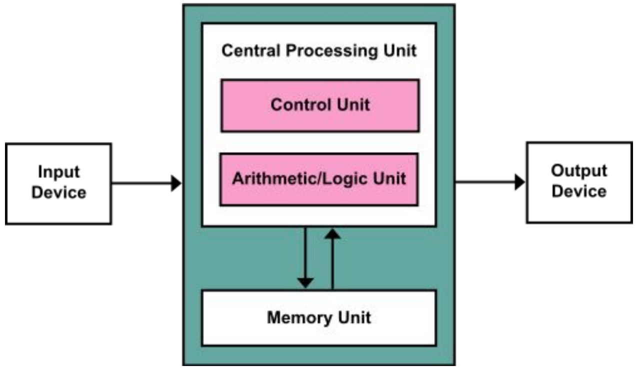
Corso di STATISTICA, INFORMATICA, ELABORAZIONE DELLE INFORMAZIONI

UNIVERSITÀ DEGLI STUDI DELLA BASILICATA

Modulo di Sistemi di Elaborazione delle Informazioni

Input, Elaborazione, Output

Docente:
Domenico Daniele Bloisi


Central Processing Unit
Control Unit
Arithmetic/Logic Unit
Memory Unit
Input Device
Output Device