Sofya Programming Language Version 1.0 User's Guide

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Have fun using Sofya Version 1.0!

Introduction

Welcome to the world of programming! In this manual we assume that this is your first time programming. Thank you for choosing to start programming using Sofya! **Sofya** is a **programming language** that was named after a female mathematician called **Sofya Kovalevskaya**. Sofya was made by **Timothy Oywera** using another programming language called **Python**. Sofya was made to enable people to program computers to solve **mathematical** and **scientific problems**. Before we learn about how to use the Sofya Programming Language, we are going to look at **the life of Sofya Kovalevskaya** and the **basics of programming**.

The Life of Sofya Kovalevskaya

- She was born in **Russia** in a town called **Moscow** in **1850**.
- She became interested in **Mathematics** and **Physics** from an **early age**.
- She taught herself **trigonometry** when she was **fourteen years old**.
- However, her father was not happy with her studying Physics and Mathematics, so he took her textbooks away.
- After she finished high school, she wanted to **continue** her **studies** in **University**.
- However, at that time **Russian Universities** would **not** admit **women** but there was a University in **Switzerland** that admitted women. So Sofya married **Vladimir Kovalevsky** so that she could travel to Switzerland.
- Later she moved to **Germany** to get a **PhD**.
- In **1874**, she presented reports about: **partial differential equations**, **Saturn's rings** and **elliptic integrals**.
- In the report about partial differential equations she had written about a law called **The Cauchy-Kovalevskaya Theorem**.
- Later she returned to **Russia** and she gave birth to her **daughter** in **1878**.
- She **divorced** her **husband** in **1881**.
- She became a **lecturer of Mathematics** in the year **1883** in the **University of Stockholm**.
- In **1890**, she wrote a book called **Memories of Childhood**.
- She **died** in **1891** at the age of **41 years old** because of **influenza**.

- One of her famous quotes was, **"Many who have not studied Mathematics confuse this science with arithmetic and consider it dry and soulless. However, it is a science that requires great imagination."**

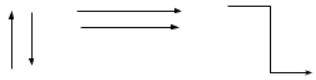
A picture of Sofya Kovalevskaya

The Basics of Programming

Programming is giving instructions to a computer if you want it to do something for you. The instructions that a computer is given are called **programs**. When people are programming computers, they use **programming languages**. The rules of a programming language are called **syntax**. People who program computers are called **Computer Programmers**.

Program Flowcharts

People usually draw **program flowcharts** to help them understand **programs**. In this manual, sometimes we will also use program flowcharts to help you understand programs. Here are the symbols that we will use in the program flowcharts and their meanings:

Symbol	Name	Function
	Terminator	It shows the start or end of a program
	Process	It shows how the computer uses data or how the computer does calculations
	Input or Output	It shows that the person using the computer gives the computer data**(input)** or the computer shows a person something on the screen**(output)**
	On-page Connector	It connects flowcharts that are on the same page
	Off-page Connector	It connects flowcharts that are on different pages
	Decision	It shows that the computer has to make a choice
	Flow Lines	It shows the next step of a program

Programming Using Sofya

Writing Data Types

Sometimes, you might want the computer to **write** something on the screen. This is called **writing**. When you want to write something using Sofya you should use a function called **Write**. On the next page there is a table showing you how to write different data types in Sofya:

Data Type	Example	How to write it using Sofya
String	Hello World	Write “Hello World”
Number	6829	Write 6829
Expression	1+3	Write 1+3
Variable	Energy	Write Variable[Energy]
Constant	Pi	Write Constant[Pi]

Example 1

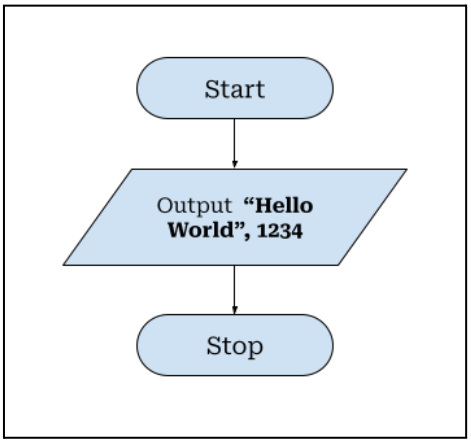
Use Sofya to write **“Hello World”** and the number **1234**.

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:

```
Start
     Write "Hello World"
     Write 1234
Stop
```

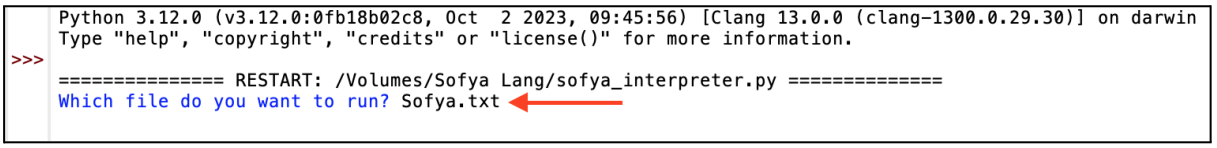
2. Here is a program flowchart for this program:



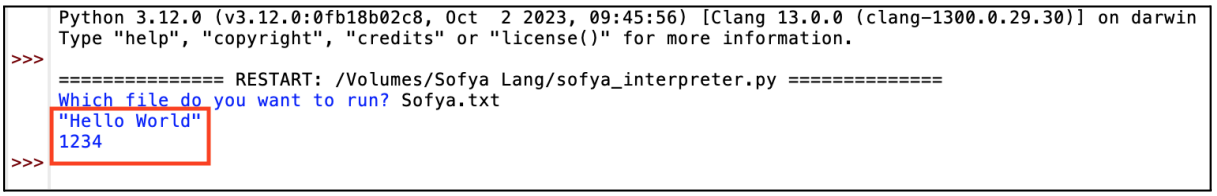
3. Here is an explanation for the program:
   - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **“Start”**).
   - **Line 2:** We are telling the computer to write **“Hello World”**.
   - **Line 3:** We are telling the computer to write **“1234”**.

- **Line 4:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).

4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called "**Sofya.txt**" *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt").*



6. Press **"Enter"** on the keyboard. The computer will write **"Hello World"** and **"1234"**.



Note:

- In Sofya 1.0, when the computer is writing strings on the screen, the strings will **not** have **quotation marks** (**speech marks** [" "]). In this manual, any screenshot that you see that has strings written on the screen with quotation marks is for the older version of Sofya (**Sofya Beta**).
- In Sofya 1.0, when the computer is writing strings on the screen, the strings will be written in capital letters (upper case letters). In this manual, any screenshot that you see that has strings written in small letters (lower case letters) is for the older version of Sofya (**Sofya Beta**).
- Sofya 1.0 is **not case sensitive**.

Using Operations

Sometimes, you might want to do **calculations** using **operations**. Here are the operations that you can use in Sofya:

Name of the operation	How it looks in Sofya	Function	Example
Addition	+	It means that a number is added with another number	1+1 = 2
Subtraction	-	It means that a number is subtracted from another number	2-2 = 0
Multiplication	*	It means that a number is multiplied with another number	3*3 = 9
Division	/	It means that a number is divided with another number	4/4 = 1
Brackets **or** Parentheses	( )	It is used to do some operations first	(8+3)*2 = 22
Exponentiation	Exp	An exponent is a small number that is on top of another number. For example, if you write 2^5, the small 5 that is on top of 2 is an **exponent**	2 Exp 3 = 8
Floor	Floor	Flooring is when you tell a computer to divide a number with another number, but the computer will not show you the remainder	7 Floor 3 = 2
Modulus	Modulus	Modulus is when you tell a computer to divide a number with another number, but the computer will only show you the remainder	7 Modulus 3 = 1

Operator Precedence

Sometimes, when you want to use operations, they can be a lot. For example, let us say that you want Sofya to do this calculation :

10 + 25 * (34 - 4) EXP 6

In that calculation, there are many operators (there is addition, multiplication, subtraction, parentheses and exponentiation). Because of this, Sofya uses something called **operator precedence**, so that Sofya will be able to know how to do calculations that have many operations. Operator precedence helps Sofya to know which operation it should do first.

This is a small chart that is showing us the operator precedence for Sofya :

Parenthesis

↓

Exponentiation

↓

Division or **Floor** or **Modulus**

↓

Multiplication

↓

Addition

↓

Subtraction

Example 2

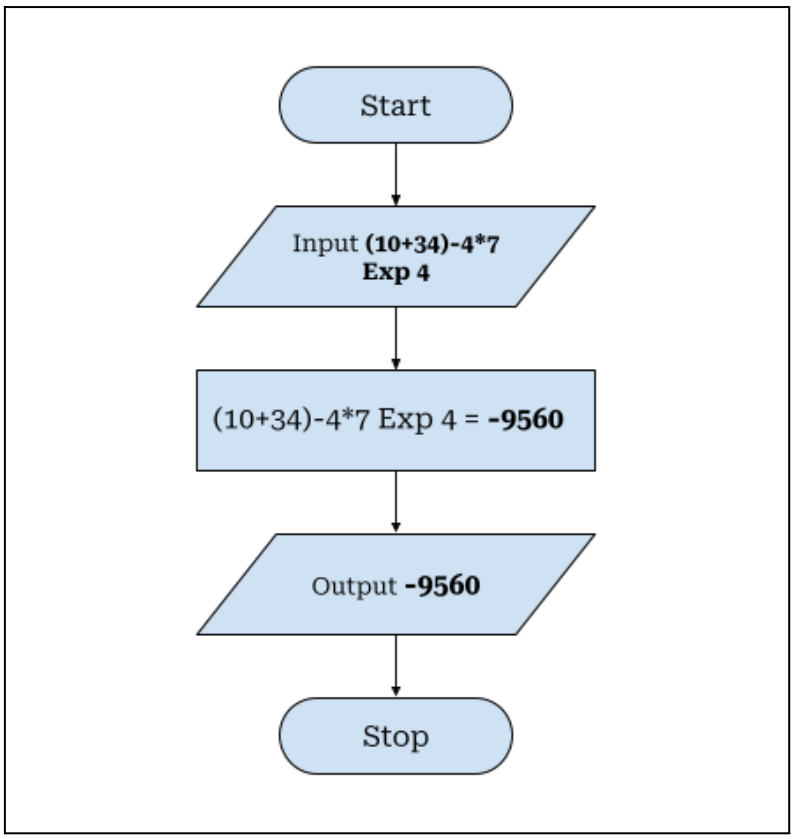
Use Sofya to calculate (**10** + **34**) - **4 x** 7^4.

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:

```
Start
     Write (10+34)-4*7 Exp 4
Stop
```

2. On the next page there is a program flowchart for this program:



3. Here is an explanation for the program:
    - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).
    - **Line 2:** We are telling the computer to write **"(10+34)-4*7 Exp 4"**. When you tell Sofya to write an expression, the computer will calculate the expression first and then the computer will write the answer of the expression.
    - **Line 3:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).
4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called "Sofya.txt" *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt").*

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: /Volumes/Sofya Lang/sofya_interpreter.py ==========
Which file do you want to run? Sofya.txt
```

Have fun using Sofya Version 1.0!

6. Press **"Enter"** on the keyboard. The computer will write **"-9,560"**.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: /Volumes/Sofya Lang/sofya_interpreter.py
Which file do you want to run? Sofya.txt
-9560
>>>
```

Commenting

Sometimes, you might want to explain to someone what your program does. This is called **commenting**. Comments are **not** part of a program and they do **not** affect how the program works.

Example 3

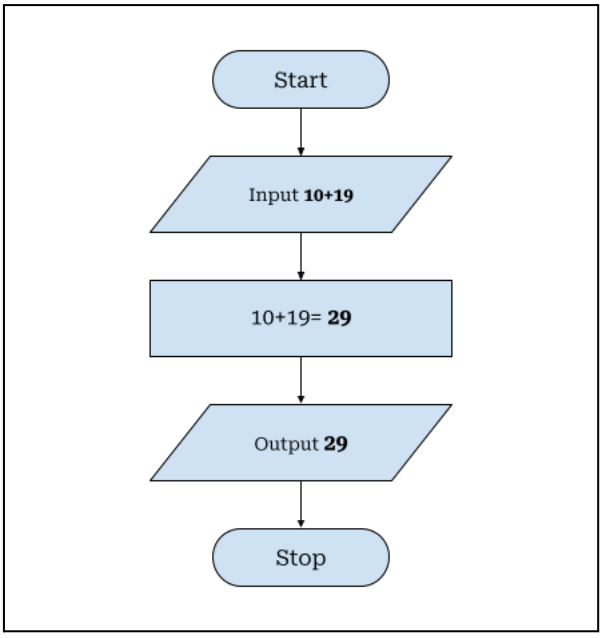
Use Sofya to calculate **10+19** and make a comment that says, **"This program calculates 10+19"**.

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:

```
Start
      Note: This program calculates 10+19;
      Write 10+19
Stop
```

2. Here is a program flowchart for this program:



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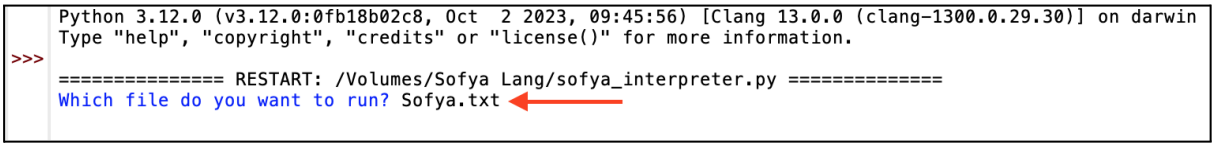
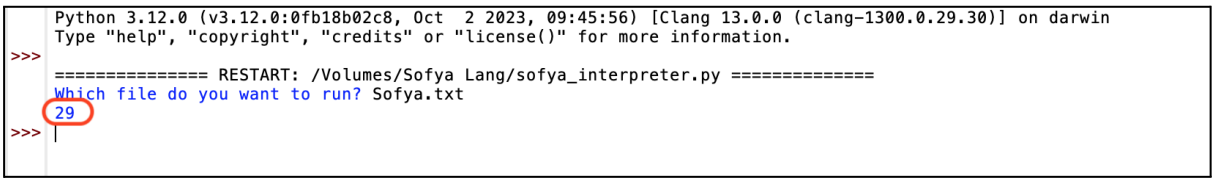
3. Here is an explanation for the program:
    - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).
    - **Line 2:** We are telling the computer that we want to start making a comment (when you want to start making a comment in Sofya, you should say **"NOTE:"** or **"Note:"**). Then we type the comment that we want. Then we tell the computer that we want to stop making a comment (when you want to stop making a comment in Sofya, you should use a semicolon [**";"**]).
    - **Line 3:** We are telling the computer to write **"10+19"**. When you tell Sofya to write an expression, the computer will calculate the expression first and then the computer will write the answer of the expression.
    - **Line 4:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).
4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called "Sofya.txt" *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt").*



6. Press **"Enter"** on the keyboard. The computer will write **"29"**.



Using Variables

A **variable** is something that **stores** things that keep on **changing**. Variables can be used for **calculations**.

Example 4

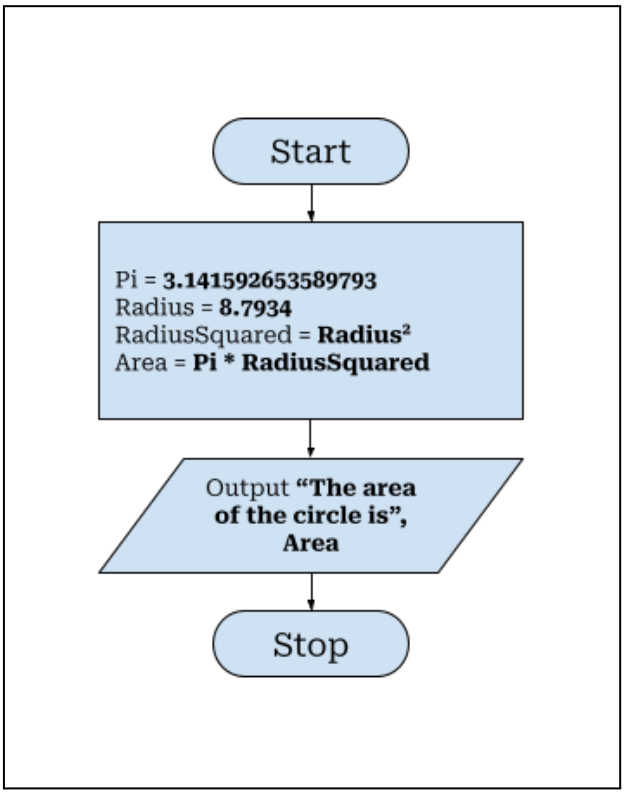
Use Sofya to calculate the **area** of a **circle** that has a radius of **8.7934 cm** (the formula of finding the area of a circle is πr^2. Use Pi[π] as **3.141592653589793**).

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:

```
START
  Variable Pi is 3.141592653589793
  Variable Radius is 8.7934
  Variable RadiusSquared is Variable[Radius] Exp 2
  Variable Area is Variable[Pi] * Variable[RadiusSquared]
  Say "The area of the circle is" also say Variable[Area]
STOP
```

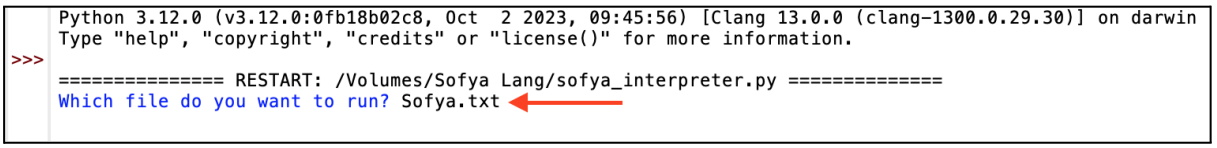
2. Here is a program flowchart for this program:



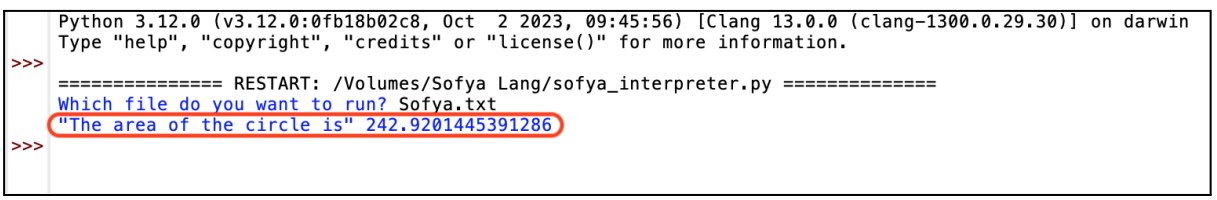
3. Here is an explanation for the program:
   - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say "**START**").

- **Line 2:** We are telling the computer that we are making a **variable** called **Pi** and that Pi is **3.141592653589793**.
- **Line 3:** We are telling the computer that we are making a **variable** called **Radius** and that Radius is **8.7934**.
- **Line 4:** We are reminding the computer that **Radius** is a **variable** and we want the computer to **square** the Radius then store the answer in a **variable** called **RadiusSquared**.
- **Line 5:** We are reminding the computer that **RadiusSquared** and **Pi** are **variables** and we want the computer to **multiply** RadiusSquared and Pi then store the answer in a **variable** called **Area**.
- **Line 6:** We are telling the computer to write **"The area of the circle is"** and what is stored in the variable called **Area**. When you tell Sofya to write a string and a variable at the same time, we use a function called **"Say"** or **"SAY"**. We can also use **"Say"** to write a variable first then a string.
- **Line 7:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"STOP"**).

4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called "Sofya.txt" *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt").*



6. Press **"Enter"** on the keyboard. The computer will write **"The area of the circle is"** and what is stored in the variable called **Area**.



Rules about Variables

1. The name of a variable should **not** have any **spaces** but it **can** have an **underscore** (“_”). For example, it is **not right** to call a variable **Radius Squared** but it is **correct** to call a variable **RadiusSquared** or **Radius_Squared**.
2. The name of a variable should **not** be a **reserved word** — examples of reserved words are **Write**, **Say**, **Variable**, **Exp**, e.t.c.
3. You can store an **expression** and a **variable** inside of another **variable**. If you want to do this, you should type the variable you want to store **first** then the expression. For example, it is **not right** to say **Variable Answer is 2** + **Variable**[**Energy**] but it is **correct** to say **Variable Answer is Variable**[**Energy**] + **2** .
4. You can also store an **expression** and a **constant** inside of another **variable**. If you want to do this, you should type the constant you want to store **first** then the expression. For example, it is **not right** to say **Variable Answer is 2** + **Constant**[**c**] but it is **correct** to say **Variable Answer is Constant**[**c**] + **2** .
5. You can store up to a **maximum** of **2 variables** inside of another **variable** without an **expression**. If you want to do this, you should only use **one operation**. For example, it is **not right** to say **Variable Answer is Variable**[**Mass**] + **Variable**[**Energy**] **Exp 3** but it is **correct** to say **Variable Answer is Variable**[**Mass**] + **Variable**[**Energy**].
6. You can store a **maximum** of **one variable** and **one constant** inside of another **variable**. If you want to do this, you should only use **one operation**. For example, it is **not right** to say **Variable Answer is Constant**[**h**] + **Variable**[**Energy**] **Exp 3** but it is **correct** to say **Variable Answer is Constant**[**h**] + **Variable**[**Energy**].

Receiving Input

Sometimes, you might want to ask the person who is using the computer some **questions** so that you can make a program. This is called **receiving input**.

Example 5

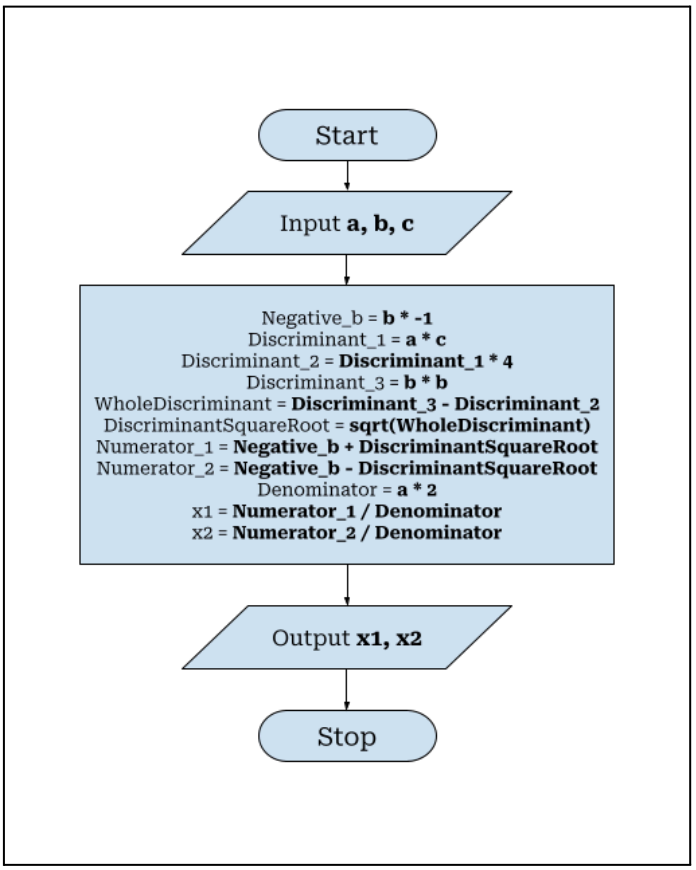
Use Sofya to **solve** the quadratic equation $2x^2 + x - 12 = 0$, using the formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ (This program will only work if **a ≠ 0** and if the **discriminant** [**b^2 - 4ac**] **≥ 0**).

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:
    - **Line 1:** `Start`
    - **Line 2:** `AskComputerUser "Input the value of a" store the answer in Variable[a]`
    - **Line 3:** `AskComputerUser "Input the value of b" store the answer in Variable[b]`
    - **Line 4:** `AskComputerUser "Input the value of c" store the answer in Variable[c]`
    - **Line 5:** `Variable Negative_b is Variable[b] * -1`
    - **Line 6:** `Variable Discriminant_1 is Variable[a] * Variable[c]`
    - **Line 7:** `Variable Discriminant_2 is Variable[Discriminant_1] * 4`
    - **Line 8:** `Variable Discriminant_3 is Variable[b] * Variable[b]`
    - **Line 9:** `Variable WholeDiscriminant is Variable[Discriminant_3] - Variable[Discriminant_2]`
    - **Line 10:** `Variable DiscriminantSquareRoot is Variable[WholeDiscriminant] Exp (1/2)`
    - **Line 11:** `Variable Numerator_1 is Variable[Negative_b] + Variable[DiscriminantSquareRoot]`
    - **Line 12:** `Variable Numerator_2 is Variable[Negative_b] - Variable[DiscriminantSquareRoot]`
    - **Line 13:** `Variable Denominator is Variable[a] * 2`
    - **Line 14:** `Variable x1 is Variable[Numerator_1] / Variable[Denominator]`
    - **Line 15:** `Variable x2 is Variable[Numerator_2] / Variable[Denominator]`

- **Line 16:** `Say "x1 =" also say Variable[x1]`
- **Line 17:** `Say "x2 =" also say Variable[x2]`
- **Line 18:** `Stop`

2. Here is a program flowchart for this program:



3. Here is an explanation for the program:
   - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).
   - **Line 2:** We are telling the computer to ask the person who is using the computer to input the **value** of **"a"** and after the person answers this question, we want the computer to store the person's answer in a **variable** called **"a"**.
   - **Line 3:** We are telling the computer to ask the person who is using the computer to input the **value** of **"b"** and after the person answers this question, we want the computer to store the person's answer in a **variable** called **"b"**.
   - **Line 4:** We are telling the computer to ask the person who is using the computer to input the **value** of **"c"** and after the person answers this

question, we want the computer to store the person's answer in a **variable** called **"c"**.

- **Line 5:** We are telling the computer that we are making a **variable** called **Negative_b** and that it is **b * -1**.
- **Line 6:** We are telling the computer that we are making a **variable** called **Discriminant_1** and that it is **a * c**.
- **Line 7:** We are telling the computer that we are making a **variable** called **Discriminant_2** and that it is **Discriminant_1 * 4**.
- **Line 8:** We are telling the computer that we are making a **variable** called **Discriminant_3** and that it is **b * b** (We can also say **b EXP 2**).
- **Line 9:** We are telling the computer that we are making a **variable** called **WholeDiscriminant** and that it is **Discriminant_3 - Discriminant_2.**
- **Line 10:** We are telling the computer that we are making a **variable** called **DiscriminantSquareRoot** and that it is **WholeDiscriminant** $^{\frac{1}{2}}$ (The normal formula for finding the root of a number is $\sqrt[r]{n}$. **"r"** is the type of **root** that you want to find — for example, **cube root** — and **"n"** is the **number** that you want to find the root of — for example, **number 6**. You can also find the root of a number by doing $n^{\frac{1}{r}}$. For example, if you want to find the cube root of number 8, you should say $8^{\frac{1}{3}}$).
- **Line 11:** We are telling the computer that we are making a **variable** called **Numerator_1** and that it is **Negative_b + DiscriminantSquareRoot**.
- **Line 12:** We are telling the computer that we are making a **variable** called **Numerator_2** and that it is **Negative_b - DiscriminantSquareRoot**.
- **Line 13:** We are telling the computer that we are making a **variable** called **Denominator** and that it is **a * 2**.
- **Line 14:** We are telling the computer that we are making a **variable** called **x1** and that it is **Numerator_1 / Denominator**.
- **Line 15:** We are telling the computer that we are making a **variable** called **x2** and that it is **Numerator_2 / Denominator**.

- **Line 16:** We are telling the computer to write **"x1 ="** and what is stored in the variable called **x1**. When you tell Sofya to write a string and a variable at the same time, we use a function called **"Say"** or **"SAY"**. We can also use **"Say"** to write a variable first then a string.
- **Line 17:** We are telling the computer to write **"x2 ="** and what is stored in the variable called **x2**. When you tell Sofya to write a string and a variable at the same time, we use a function called **"Say"** or **"SAY"**. We can also use **"Say"** to write a variable first then a string.
- **Line 18:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).

4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called "Sofya.txt" *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt")*. Then press **"Enter"** on the keyboard.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: /Volumes/Sofya Lang/sofya_interpreter.py ==========
Which file do you want to run? Sofya.txt
```

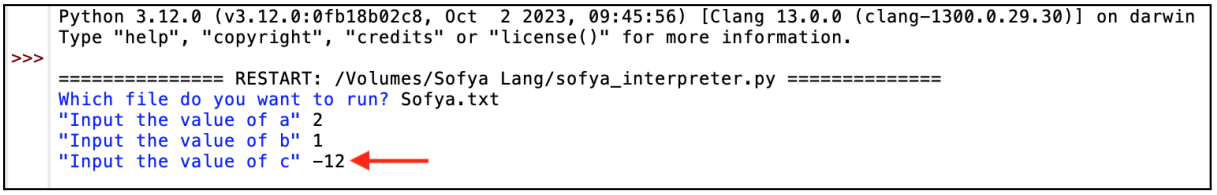
6. The computer will ask you to **"Input the value of a"**. Type the number **"2"** and press **"Enter"** on the keyboard.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: /Volumes/Sofya Lang/sofya_interpreter.py ==========
Which file do you want to run? Sofya.txt
"Input the value of a" 2
```

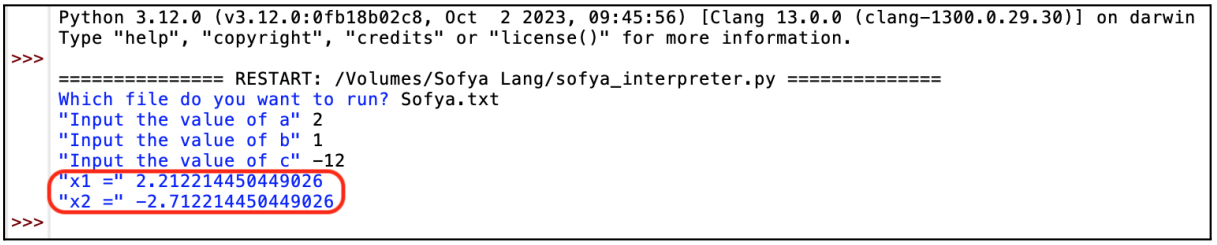
7. The computer will ask you to **"Input the value of b"**. Type the number **"1"** and press **"Enter"** on the keyboard.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: /Volumes/Sofya Lang/sofya_interpreter.py ==========
Which file do you want to run? Sofya.txt
"Input the value of a" 2
"Input the value of b" 1
```

8. The computer will ask you to **"Input the value of c"**. Type the number **"-12"** and press **"Enter"** on the keyboard.



9. The computer will write **"x1 ="**, **"x2 ="** and what is stored in the variables called **x1** and **x2**.



Receiving Special Input

We have already seen how you can input **whole numbers** (**integers**) and **decimal numbers** (**floating point numbers**) in Sofya. Sometimes, you might want to input **special numbers**. In Sofya, the special numbers that you can input are: **numbers in standard** (**or scientific**) **form**, **improper fractions** and **mixed fractions**. This table below explains how you can input special numbers in Sofya.

If you want to input:	Then type it like this using the keyboard
A number in scientific form, for example, 1.024×10^{12}	1.024*10**12
An improper fraction, for example, $\frac{22}{7}$	22/7
A mixed fraction, for example, $3\frac{1}{9}$	28/9 (Change the mixed fraction to an improper fraction)

E-Form

Sometimes, the answer for a calculation can be a very **big number** or a very **small number**. If this happens, Sofya will write the answer in **e-form** (an example of a number written in e-form is **6.022e-23**). If you want to change a number from e-form to standard form, change the **"e"** to $\times 10^{n}$. The **"n"** is the **power**, which is on the **right side** of the **"e"**. For example, the number **9.11e+14** in standard form will be **9.11 x 10^{+14}** or **9.11 x 10^{14}**.

If…Then Statements

Sometimes, you might want a computer to **compare** two things using a **condition** and if the condition is **true**, then the computer **will do** what you told it to do, but if the condition is **false** then the computer **will not do** what you told it to do. This is called an **If...Then statement**.

Comparison Operators

In Sofya, if you want to make a **condition**, you should use **comparison operators**. Here are the comparison operators that you can use in Sofya:

The name of the Comparison operator	How it looks in Sofya	The meaning of the operation	Example
Equal to	=	When you use the equal to operation, it means that a number is the same as another number.	2 = 2
Not Equal to	!=	When you use the not equal to operation, it means that a number is not the same as another number.	10 != 7
Less than	<	When you use the less than operation, it means that a number is smaller than another number.	3 < 5
Greater than	>	When you use the greater than operation, it means that a number is bigger than another number.	5 > 3

Greater than or Equal to	_>_	When you use the greater than or equal to operation, it means that a number can be bigger than another number or that a number can be the same as another number. For example, number 5 is not the same as number 3 but number 5 is bigger than number 3.	5 _>_ 3
Less than or Equal to	_<_	When you use the less than or equal to operation, it means that a number can be smaller than another number or that a number can be the same as another number. For example, number 7 is not the same as number 9 but number 7 is smaller than number 9.	7 _<_ 9

Example 6

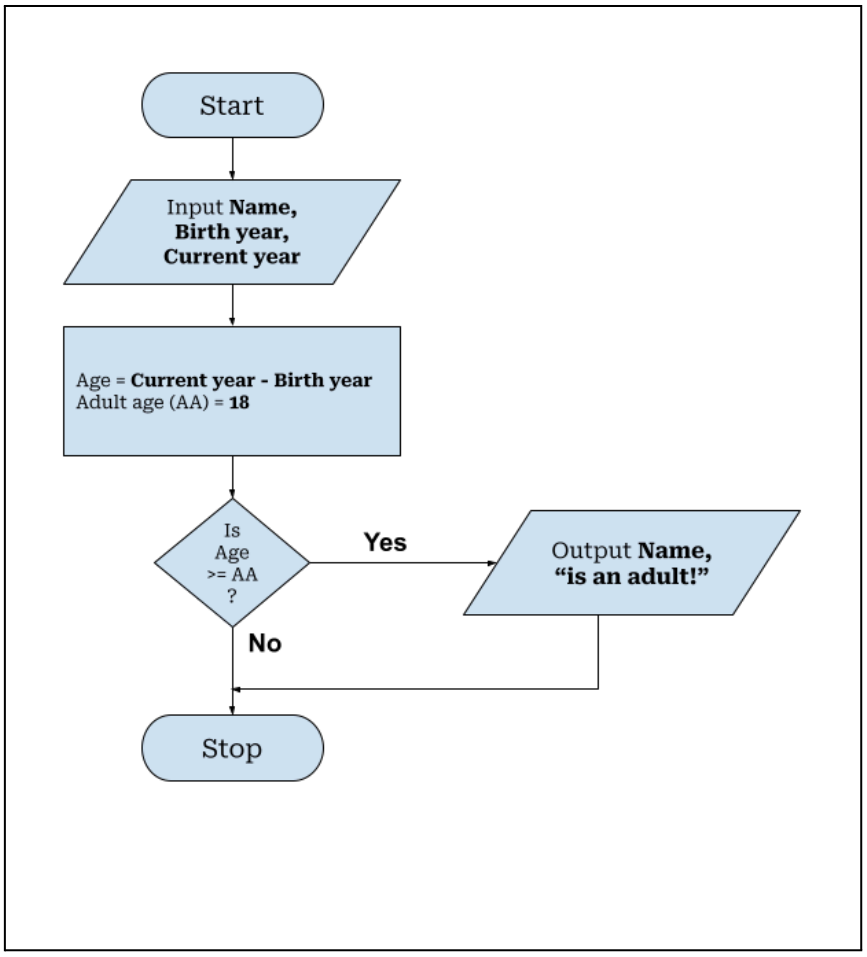
Alexia wanted to program her computer using Sofya, so that the computer could ask someone for their **name**, the **current year** and the **year when they were born** and then the computer could be able to know whether someone is an adult (An adult is 18 years and above). When the computer knows that someone is an adult, the computer will say the **name of the person** and, ***"is an adult!"***. **Angela** (Alexia's friend) was born in **2005**. Use Sofya to help Alexia program her computer (Assume that the current year is **2023**) .

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:
    - **Line 1:** `Start`
    - **Line 2:** `AskComputerUser "What is your name?" store the answer in Variable[Name]`

- **Line 3:** `AskComputerUser "When were you born?" store the answer in Variable[BirthYear]`
- **Line 4:** `AskComputerUser "What is the current year?" store the answer in Variable[CurrentYear]`
- **Line 5:** `Variable Age is Variable[CurrentYear] - Variable[BirthYear]`
- **Line 6:** `Variable AdultAge is 18`
- **Line 7:** `If Variable[Age] _>_ Variable[AdultAge] Then`
- **Line 8:** `Say Variable[Name] also say "is an adult!"`
- **Line 9:** `EndIf`
- **Line 10:** `Stop`

2. Here is a program flowchart for this program:

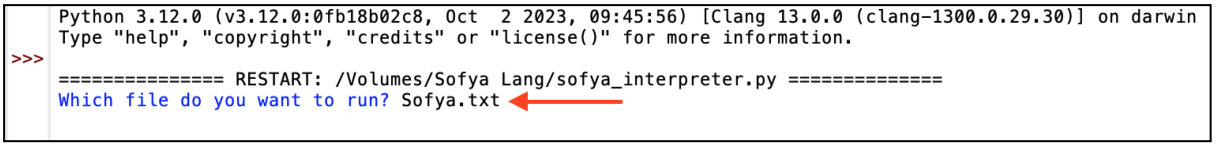


3. Here is an explanation for the program:
   - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).

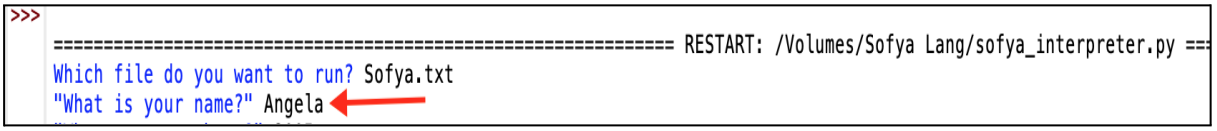
- **Line 2:** We are telling the computer to ask the person who is using it, **"What is your name?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **Name**.
- **Line 3:** We are telling the computer to ask the person who is using it, **"When were you born?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **BirthYear**.
- **Line 4:** We are telling the computer to ask the person who is using it, **"What is the current year?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **CurrentYear**.
- **Line 5:** We are telling the computer that we are making a **variable** called **Age** and that Age is **CurrentYear - BirthYear**.
- **Line 6:** We are telling the computer that we are making a **variable** called **AdultAge** and that AdultAge is **18**.
- **Line 7:** We are telling the computer to check if the **Age** is greater than or equal to the **AdultAge**.
- **Line 8:** We are telling the computer to write what is stored in the variable called **Name** and **"is an adult!"** (This will only happen if the **Age** is greater than or equal to the **AdultAge**). When you tell Sofya to write a string and a variable at the same time, we use a function called "**Say**" or "**SAY**". We can also use **"Say"** to write a variable first then a string.
- **Line 9:** We are telling the computer that we want to stop making the If...Then statement (That is why we put **"EndIf"**).
- **Line 10:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).

4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called "Sofya.txt" *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do*

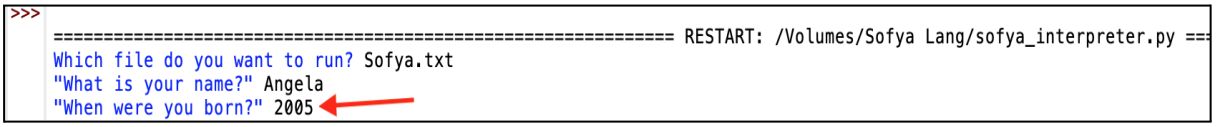
not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt"). Then press **"Enter"** on the keyboard.



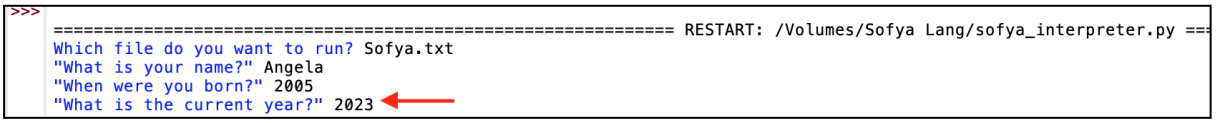
6. The computer will ask you, **"What is your name?"**. Type **"Angela"** and press **"Enter"** on the keyboard.



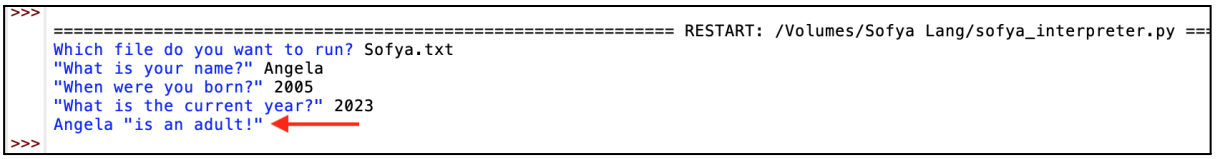
7. The computer will ask you, **"When were you born?"**. Type **"2005"** and press **"Enter"** on the keyboard.



8. The computer will ask you, **"What is the current year?"**. Type **"2023"** and press **"Enter"** on the keyboard.



9. The computer will write what is stored in the variable called **Name** and **"is an adult!"**.



Rules about If…Then Statements

1. If you are not using ranges, the two things that you are comparing in the condition **should** be **variables** — they **cannot** be **strings**, **numbers**, **constants** or **expressions**.
2. If a condition is **false**, the computer will not do what you told it to do in the If…Then statement.

3. At the **end** of an If…Then statement, you should **always** put **"EndIf"** the way we have done in this example.
4. You **cannot** make If…Then statements, If…Then…Else statements or Nested If statements inside of other If…Then statements.
5. You **can** make **Do This…Until Loops** inside of If…Then statements.

Constants

Constants are things that do not change, for example, the speed of light does not change. In Sofya, you can use up to **3 mathematical constants** and **15 scientific constants** for your calculations. This table below shows the list of constants that are in Sofya Version 1.0.

The name of the constant	How it looks in Sofya	The value of the constant
Pi (***π***)	Constant[PI]	3.14159265358979323846
Speed of light in a vacuum (**c**)	Constant[c]	299792458 ms^{-1}
Planck constant (**h**)	Constant[h]	$6.62607015 \times 10^{-34}$ Js
Permittivity of free space (ε_o)	Constant[Eo]	$8.854187812813 \times 10^{-12}$ Fm^{-1}
Newton's constant of gravitation (**G**)	Constant[G]	$6.6743015 \times 10^{-11}$ $m^3kg^{-1}s^{-2}$
Coulomb constant ($\mathbf{k_e}$)	Constant[Ke]	$8.987551792314 \times 10^9$ Nm^2C^{-2}
Acceleration of gravity on Earth ($\mathbf{g_e}$)	Constant[g_e]	9.80665 ms^{-2}
Earth's atmospheric pressure at sea level (**1 atm**)	Constant[atm]	101,305 Pa
Mass of an electron ($\mathbf{m_e}$)	Constant[m_e]	$9.109383701528 \times 10^{-31}$ kg
Mass of a proton ($\mathbf{m_p}$)	Constant[m_p]	$1.6726219236951 \times 10^{-27}$ kg
Mass of a neutron ($\mathbf{m_n}$)	Constant[m_n]	$1.6749274980495 \times 10^{-27}$ kg

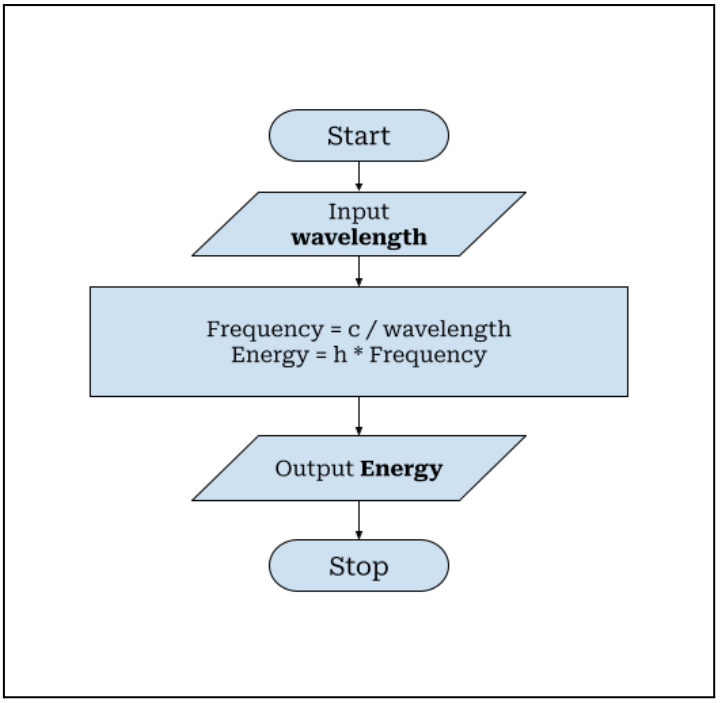
Proton to electron mass ratio ($\mathbf{m_p/m_e}$)	Constant[m_p:m_e]	1,836.1526734311
Avogadro's Number ($\mathbf{N_a}$ or **L**)	Constant[N_a] **or** Constant[L]	$6.02214076 \times 10^{23}$ substances mol^{-1}
Molar gas constant (**R**)	Constant[R]	8.31446261815324 $Jmol^{-1}K^{-1}$
Faraday constant (**F**)	Constant[F]	96,485.3321233100184 $Cmol^{-1}$
Radius of an electron ($\mathbf{r_e}$)	Constant[r_e]	$2.817940326213 \times 10^{-15}$ m
Golden ratio (ϕ)	Constant[Phi]	1.61803398874989484820
Euler's number (e)	Constant[e]	2.71828182845904523536

Example 7

Green light has a wavelength of **5.17 x 10^{-7}m**. Using the formula, $E = h\frac{c}{\lambda}$, use Sofya to create a program to calculate the energy the green light has.

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:
    - **Line 1:** `Start`
    - **Line 2:** `AskComputerUser "What is the wavelength of the green light?" store the answer in Variable[Wavelength]`
    - **Line 3:** `Variable Frequency is Constant[c] / Variable[Wavelength]`
    - **Line 4:** `Variable Energy is Constant[h] * Variable[Frequency]`
    - **Line 5:** `Say "The energy of the green light, in Joules, is" also say Variable[Energy]`
    - **Line 6:** `Stop`
2. Here is a program flowchart for this program:

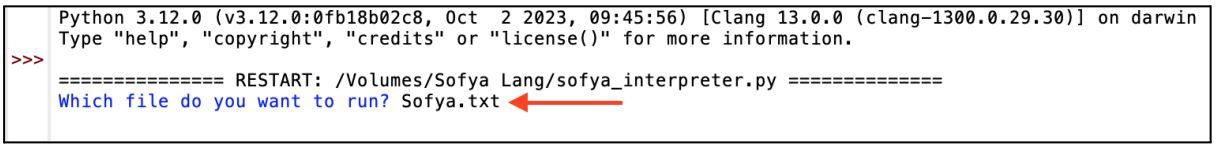


3. Here is an explanation for the program:
    - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).
    - **Line 2:** We are telling the computer to ask the person who is using it, **"What is the wavelength of the green light?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **Wavelength**.
    - **Line 3:** We are telling the computer that we are making a **variable** called **Frequency** and that Frequency is **Constant**[**c**] divided by a variable called **Wavelength** (The reason why we are naming this variable '**Frequency**', is because, in **Physics**, if you do the speed of light divided by the wavelength of the light, you will get the **frequency of the light**).
    - **Line 4:** We are telling the computer that we are making a **variable** called **Energy** and that Energy is **Constant**[**h**] multiplied by a variable called **Frequency**.
    - **Line 5:** We are telling the computer to write what is stored in the variable called **Energy** and **"The energy of the green light, in Joules, is"**. When you tell Sofya to write a string and a variable at the same

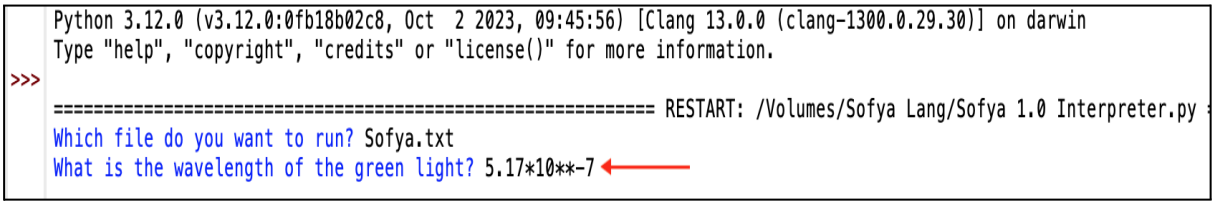
time, we use a function called **"Say"** or **"SAY"**. We can also use **"Say"** to write a variable first then a string.

- **Line 6:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).

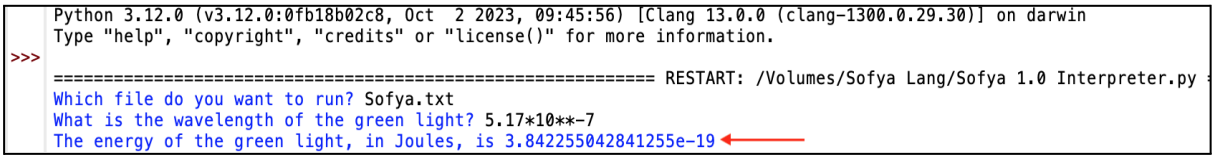
4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called "Sofya.txt" *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt")*. Then press **"Enter"** on the keyboard.



6. The computer will ask you, **"What is the wavelength of the green light?"**. Type **"5.17*10**-7"** and press **"Enter"** on the keyboard.



7. The computer will write what is stored in the variable called **Energy** and **"The energy of the green light, in Joules, is"**.



If…Then…Else Statements

Sometimes, you might want a computer to **compare** two things using a **condition** and if the condition is **true**, then the computer **will do** what you told it to do, but if the condition is **false** then you can tell the computer what to do instead. This is called an **If...Then...Else statement**.

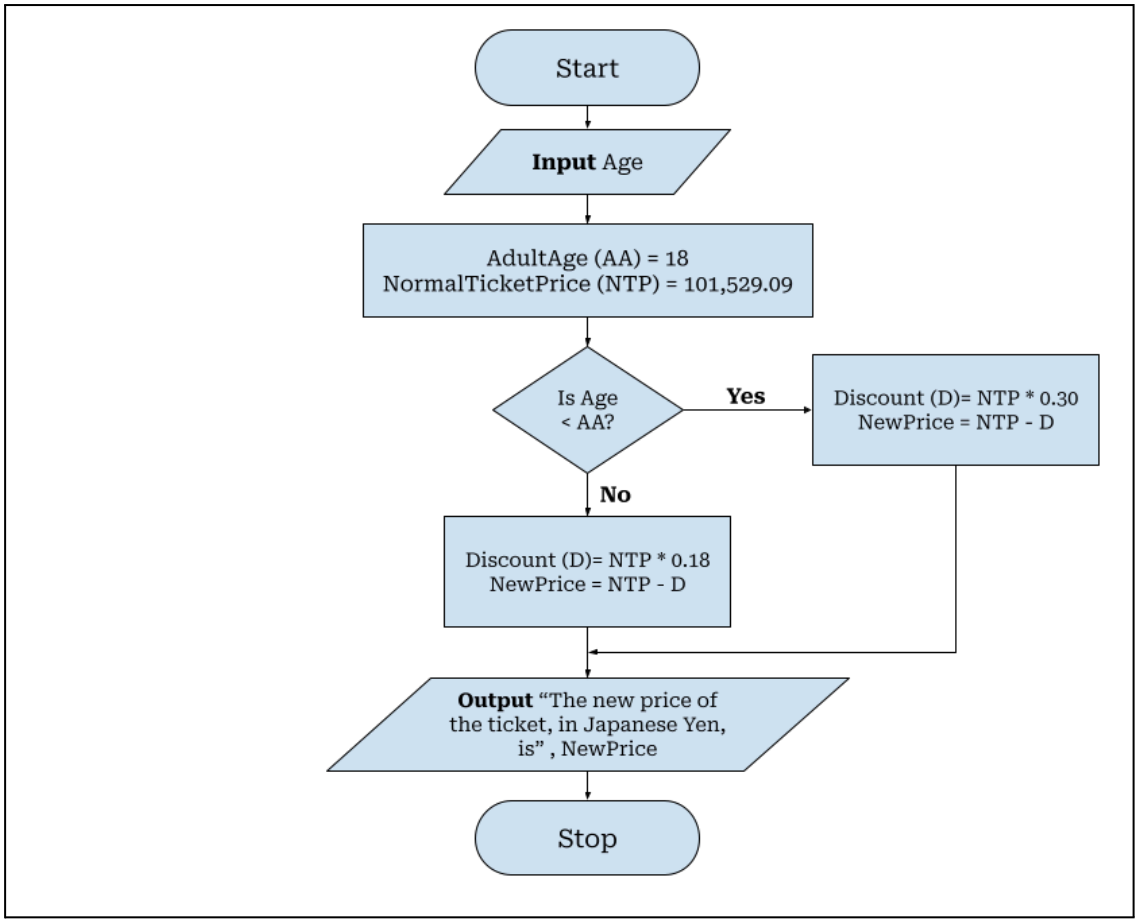
Example 8

Amai Airways is an **airline company** in Japan. On **New Year's Day**, they give discounts on aeroplane tickets depending on a person's age. If a person is 18 years and above (an adult), they get a discount of **18%** on their aeroplane ticket. However, if a person is below 18 years, they get a discount of **30%** on their aeroplane ticket. If, without a discount, an aeroplane ticket costs **101,529.09**￥, use Sofya to create a program to automatically calculate the new price of an aeroplane ticket after someone is given a discount.

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:
    - **Line 1:** `Start`
    - **Line 2:** `AskComputerUser "What is your age?" store the answer in Variable[Age]`
    - **Line 3:** `Variable AdultAge is 18`
    - **Line 4:** `Variable NormalTicketPrice is 101529.09`
    - **Line 5:** `If Variable[Age] _>_ Variable[AdultAge] Then`
    - **Line 6:** `Variable Discount is Variable[NormalTicketPrice] * 0.18`
    - **Line 7:** `Variable NewPrice is Variable[NormalTicketPrice] - Variable[Discount]`
    - **Line 8:** `Otherwise If Variable[Age] is anything else Then`
    - **Line 9:** `Variable Discount is Variable[NormalTicketPrice] * 0.30`
    - **Line 10:** `Variable NewPrice is Variable[NormalTicketPrice] - Variable[Discount]`
    - **Line 11:** `EndIf`
    - **Line 12:** `Say "The new price of the ticket, in Japanese Yen, is" also say Variable[NewPrice]`
    - **Line 13:** `Stop`

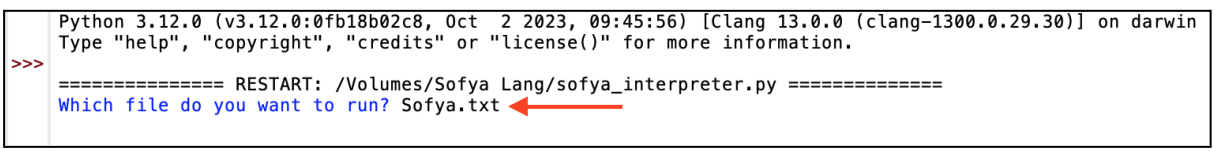
2. Here is a program flowchart for this program:



3. Here is an explanation for the program:
    - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).
    - **Line 2:** We are telling the computer to ask the person who is using it, **"What is your age?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **Age**.
    - **Line 3:** We are telling the computer that we are making a **variable** called **AdultAge** and that AdultAge is **18**.
    - **Line 4:** We are telling the computer that we are making a **variable** called **NormalTicketPrice** and that NormalTicketPrice is **101,529.09**.
    - **Line 5:** We are telling the computer to check if the **Age** is greater than or equal to the **AdultAge**.
    - **Line 6:** We are telling the computer that we are making a **variable** called **Discount** and that Discount is **NewTicketPrice** * **0.18** (This will only happen if the **Age** is greater than or equal to the **AdultAge**).

- **Line 7:** We are telling the computer that we are making a **variable** called **NewPrice** and that NewPrice is **NewTicketPrice - Discount** (This will only happen if the **Age** is greater than or equal to the **AdultAge**).
- **Line 8:** We are telling the computer to check if the **Age** is any other number (which is not greater than or equal to 18).
- **Line 9:** We are telling the computer that we are making a **variable** called **Discount** and that Discount is **NewTicketPrice * 0.30** (This will only happen if the **Age** is less than the **AdultAge**).
- **Line 10:** We are telling the computer that we are making a **variable** called **NewPrice** and that NewPrice is **NewTicketPrice - Discount** (This will only happen if the **Age** is less than the **AdultAge**).
- **Line 11:** We are telling the computer that we want to stop making the If...Then..Else statement (That is why we put **"EndIf"**).
- **Line 12:** We are telling the computer to write what is stored in the variable called **NewPrice** and **"The new price of the ticket, in Japanese Yen, is"**. When you tell Sofya to write a string and a variable at the same time, we use a function called **"Say"** or **"SAY"**. We can also use **"Say"** to write a variable first then a string.
- **Line 13:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).

4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called "Sofya.txt" *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt")*. Then press **"Enter"** on the keyboard.



6. The computer will ask you, **"What is your age?"**. Type **"10"** and press **"Enter"** on the keyboard.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==== RESTART: /Volumes/Sofya Lang/Sofya 1.0 Package/Sofya 1.0 Interpreter.py ===
Which file do you want to run? Sofya.txt
What is your age? 10
```

7. The computer will write what is stored in the variable called **NewPrice** and **"The new price of the ticket, in Japanese Yen, is"**.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1300.0.29.30)] on darwin
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==== RESTART: /Volumes/Sofya Lang/Sofya 1.0 Package/Sofya 1.0 Interpreter.py ===
Which file do you want to run? Sofya.txt
What is your age? 10
The new price of the ticket, in Japanese Yen, is 71070.363
```

Rules about If…Then…Else Statements

1. If you are not using ranges, the two things that you are comparing in the condition **should** be **variables** — they **cannot** be **strings**, **numbers**, **constants** or **expressions**.
2. At the **end** of an If…Then…Else statement, you should **always** put **"EndIf"** the way we have done in this example.
3. You **cannot** make If…Then statements, If…Then…Else statements or Nested If statements inside of other If…Then…Else statements.
4. You **can** make **Do This…Until Loops** inside of If…Then…Else statements.

Using Ranges

A range is a group of numbers. Let us say that we have items that have a price range of $10 to $50. If we say that:

- *The price of 5kgs of sugar, for example, is **from $10 to $50***, it means that *the sugar can cost $10 or more but the price of sugar can only go up to $50 but it cannot cost more than $50 (So, we can say that **$10 and $50 are included** in the range)*. If we wanted to make a condition for this in Sofya, it can look like this: ***If Variable[SugarPrice] is From Number[10] to Number[50] Then***.
- *The price of 5kgs of sugar, for example, is **from after $10 to $50***, it means that *the sugar can cost more than $10 but the price of sugar can only go up to $50 but it cannot cost more than $50 (So, we can say that **$10 is not included** in the range but **$50 is included** in the range)*. If we wanted to make a condition for this in Sofya,

it can look like this: ***If Variable[SugarPrice] is From After Number[10] to Number[50] Then***.

- *The price of 5kgs of sugar, for example, is* ***from $10 to before $50***, it means that *the sugar can cost $10 or more but the price of sugar cannot reach $50 and above (So, we can say that* ***$10 is included*** *in the range but* ***$50 is not included*** *in the range)*. If we wanted to make a condition for this in Sofya, it can look like this: ***If Variable[SugarPrice] is From Number[10] to Before Number[50] Then***.
- *The price of 5kgs of sugar, for example, is* ***between $10 and $50***, it means that *the sugar can cost all the prices which are more than $10 but less than $50 (So, we can say that* ***$10 and $50 are not included*** *in the range)*. If we wanted to make a condition for this in Sofya, it can look like this: ***If Variable[SugarPrice] is Between Number[10] and Number[50] Then***.

Nested If Statements

Sometimes, you might want a computer to check **many conditions** (**more** than **two** conditions) and then the computer would only do the condition that is **true**. This is called a **Nested If Statement** or a **Multiple If Statement**.

Example 9

In a computer game, players are ranked based on their points as shown in the table below (points in computer games are also called **experience** or **XP**):

XP	Rank of the Player
0	*Beginner or Noob*
Above 0 to 10,000	*1st Stage Intermediate*
Above 10,000 to 100,000	*2nd Stage Intermediate*
Above 100,000 to 1,000,000	*Pro*
Above 1,000,000 to 10,000,000	*Expert*
Above 10,000,000 to 20,000,000	*Master*

Above 20,000,000 to 50,000,000	*Extraordinary Gamer*
Above 50,000,000	*Gaming Legend*

In this computer game, XP is an **integer** (XP cannot be a decimal or floating point number). Also, in this game if a player is found cheating (hacking the game to get an advantage), their XP will be a **negative number** (below 0 XP) and their rank will be '**Cheater**'. Use Sofya to create a program to rank players using their XP.

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:
    - **Line 1:** `Start`
    - **Line 2:** `AskComputerUser "What is your username in the game?" store the answer in Variable[Username]`
    - **Line 3:** `AskComputerUser "What is your XP in the game?" store the answer in Variable[xp]`
    - **Line 4:** `Variable Zero is 0`
    - **Line 5:** `Variable 50M is 50000000`
    - **Line 6:** `If Variable[xp] = Variable[Zero] Then`
    - **Line 7:** `Say Variable[Username] also say "is a Noob"`
    - **Line 8:** `Otherwise if Variable[xp] is from number[1] to number[10000] Then`
    - **Line 9:** `Say Variable[Username] also say "is a 1st Stage Intermediate"`
    - **Line 10:** `Otherwise if Variable[xp] is from number[10001] to number[100000] Then`
    - **Line 11:** `Say Variable[Username] also say "is a 2nd Stage Intermediate"`
    - **Line 12:** `Otherwise if Variable[xp] is from number[100001] to number[1000000] Then`
    - **Line 13:** `Say Variable[Username] also say "is a Pro"`
    - **Line 14:** `Otherwise if Variable[xp] is from number[1000001] to number[10000000] Then`
    - **Line 15:** `Say Variable[Username] also say "is an Expert"`

- **Line 16:** `Otherwise if Variable[xp] is from number[10000001] to number[20000000] Then`
- **Line 17:** `Say Variable[Username] also say "is a Master"`
- **Line 18:** `Otherwise if Variable[xp] is from number[20000001] to number[50000000] Then`
- **Line 19:** `Say Variable[Username] also say "is an Extraordinary Gamer"`
- **Line 20:** `Otherwise if Variable[xp] > Variable[50M] Then`
- **Line 21:** `Say Variable[Username] also say "is a Gaming Legend"`
- **Line 22:** `Otherwise if Variable[xp] is anything else Then`
- **Line 23:** `Say Variable[Username] also say "is a Cheater"`
- **Line 24:** `EndIf`
- **Line 25:** `Stop`

2. Here is an explanation for the program:
    - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).
    - **Line 2:** We are telling the computer to ask the person who is using it, **"What is your username in the game?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **Username**.
    - **Line 3:** We are telling the computer to ask the person who is using it, **"What is your XP in the game?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **xp**.
    - **Line 4:** We are telling the computer that we are making a **variable** called **Zero** and that Zero is **0**.
    - **Line 5:** We are telling the computer that we are making a **variable** called **50M** and that 50M is 50,000,000.
    - **Line 6 - 23:** We are telling the computer to check the **XP** of a player and the computer will rank a player using their XP.

- **Line 24:** We are telling the computer that we want to stop making the Nested If statement (That is why we put **"EndIf"**).
- **Line 25:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).

3. Go to the Sofya Interpreter and run the program.
4. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called **"Sofya Updates"** *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt")*. Then press **"Enter"** on the keyboard.

```
Python 3.13.7 (tags/v3.13.7:bcee1c3, Aug 14 2
Enter "help" below or click "Help" above for

= RESTART: C:\Users\oywer\OneDrive\Desktop\Sc
Which file do you want to run? Sofya Updates
```

5. The computer will ask you, **"What is your username in the game?"**. You can type **"Bok"** and press **"Enter"** on the keyboard.

```
Python 3.13.7 (tags/v3.13.7:bcee1c3, Aug 14
Enter "help" below or click "Help" above for

= RESTART: C:\Users\oywer\OneDrive\Desktop\S
Which file do you want to run? Sofya Updates
>>> THE PROGRAM HAS STARTED...

WHAT IS YOUR USERNAME IN THE GAME? Bok
```

6. The computer will ask you, **"What is your XP in the game?"**. You can type **"80,000,000"** and press **"Enter"** on the keyboard.

```
Python 3.13.7 (tags/v3.13.7:bcee1c3, Aug 14
Enter "help" below or click "Help" above for

= RESTART: C:\Users\oywer\OneDrive\Desktop\S
Which file do you want to run? Sofya Updates
>>> THE PROGRAM HAS STARTED...

WHAT IS YOUR USERNAME IN THE GAME? Bok
WHAT IS YOUR XP IN THE GAME? 80000000
```

7. The computer will write what is stored in the variable called **Username** and the computer will show you your rank.

```
Python 3.13.7 (tags/v3.13.7:bcee1c3, Aug 14
Enter "help" below or click "Help" above for

= RESTART: C:\Users\oywer\OneDrive\Desktop\S
Which file do you want to run? Sofya Updates
>>> THE PROGRAM HAS STARTED...

WHAT IS YOUR USERNAME IN THE GAME? Bok
WHAT IS YOUR XP IN THE GAME? 80000000
Bok IS A GAMING LEGEND

>>> THE PROGRAM HAS ENDED
```

Rules about Nested If Statements

1. If you are not using ranges, the two things that you are comparing in the condition **should** be **variables** — they **cannot** be **strings**, **numbers**, **constants** or **expressions**.
2. At the **end** of a Nested If statement, you should **always** put **"EndIf"** the way we have done in this example.
3. You **cannot** make If…Then statements, If…Then…Else statements or Nested If statements inside of other Nested If statements.
4. You **can** make **Do This...Until Loops** inside of Nested If statements.

Do This...Until Loops

Sometimes, you might want a computer to **repeat** things using a **condition** and if the condition is **false**, then the computer **will continue** repeating what you told it to do until the condition becomes **true**. This is called a **Do This...Until Loop**.

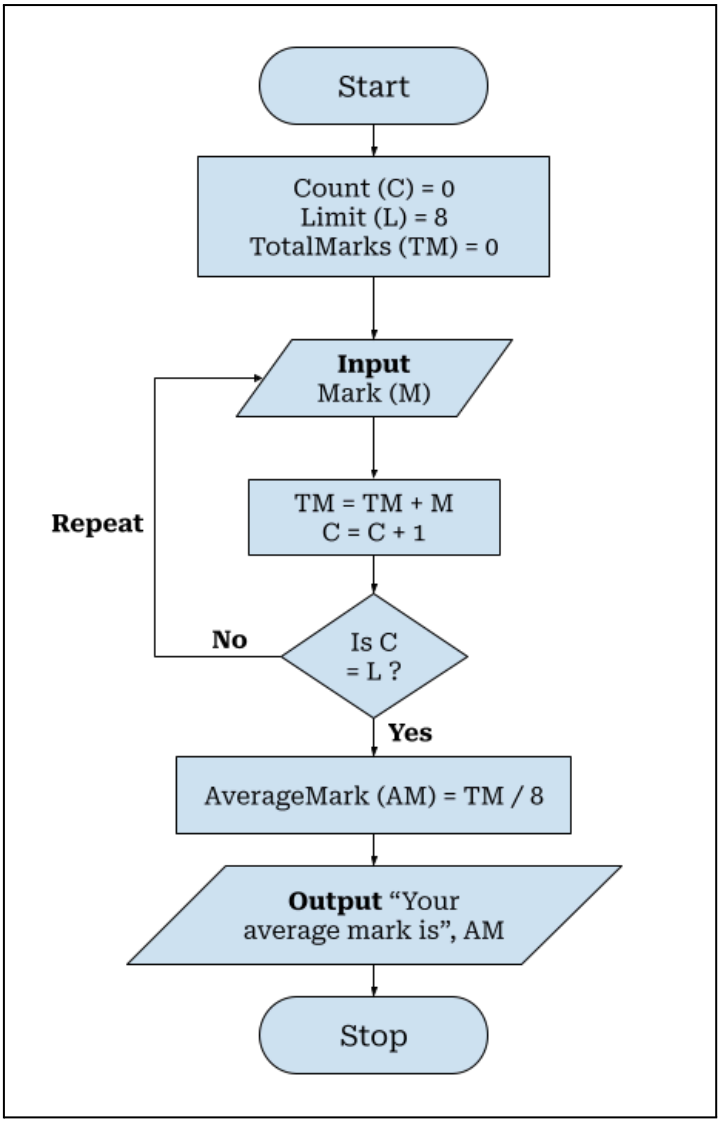
Example 10

Pacifica is a high school student. She did 8 examinations and scored the following marks (out of 100 marks): 50, 49, 67, 89, 92, 41, 73 and 65. Use Sofya to program a computer so that the computer would calculate her average mark.

Solution

1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:
    - **Line 1:** `Start`
    - **Line 2:** `Variable Count is 0`
    - **Line 3:** `Variable Limit is 8`
    - **Line 4:** `Variable TotalMarks is 0`
    - **Line 5:** `Do This`
    - **Line 6:** `{`
    - **Line 7:** `Askcomputeruser "What mark did you score in the examination?" store the answer in Variable[Mark]`
    - **Line 8:** `Variable TotalMarks is Variable[TotalMarks] + Variable[Mark]`
    - **Line 9:** `Variable Count is Variable[Count] + 1`
    - **Line 10:** `}`
    - **Line 11:** `Until Variable[Count] = Variable[Limit]`
    - **Line 12:** `Variable AverageMark is Variable[TotalMarks]/8`
    - **Line 13:** `Say "Your average mark is" also say Variable[AverageMark]`
    - **Line 14:** `Stop`

2. Here is a program flowchart for this program:



3. Here is an explanation for the program:
    - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).
    - **Line 2:** We are telling the computer that we are making a **variable** called **Count** and that Count is **0**.
    - **Line 3:** We are telling the computer that we are making a **variable** called **Limit** and that Limit is **8**.
    - **Line 4:** We are telling the computer that we are making a **variable** called **TotalMarks** and that TotalMarks is **0**.
    - **Line 5 and Line 6:** We are telling the computer that we are making a Do This…Until loop (We are using an opening curly brace [" { "] to tell Sofya which things we want to start repeating).

- **Line 7:** We are telling the computer to ask the person who is using it, **"What mark did you score in the examination?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **Mark** (This line will be repeated if **Count** is not equal to **Limit**).
- **Line 8:** We are telling the computer that we are making a **variable** called **TotalMarks** and that TotalMarks is **TotalMarks** + **Mark** (This means that the computer will keep on adding the marks that someone tells it until it gets the final total mark. This line will be repeated if **Count** is not equal to **Limit**).
- **Line 9:** We are telling the computer that we are making a **variable** called **Count** and that Count is **Count** + **1** (This means that the computer will keep on adding the Count by one every time that someone inputs a mark. This line will be repeated if **Count** is not equal to **Limit**).
- **Line 10:** We are telling the computer where we want to stop repeating things (That is why we have used a closing curly brace [" } "]).
- **Line 11:** We are telling the computer to check if Variable **Count** is equal to Variable **Limit**.
- **Line 12:** We are telling the computer that we are making a **variable** called **AverageMark** and that AverageMark is **TotalMarks** / **8**.
- **Line 13:** We are telling the computer to write what is stored in the variable called **AverageMark** and **"Your average mark is"**. When you tell Sofya to write a string and a variable at the same time, we use a function called **"Say"** or **"SAY"**. We can also use **"Say"** to write a variable first then a string.
- **Line 14:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).

4. Go to the Sofya Interpreter and run the program.
5. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called **"sample.txt"** *(In Sofya 1.0, when you are typing the name of the file that you want to*

run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt"). Then press **"Enter"** on the keyboard.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========================================================= RESTART: /Volumes/Sofya Lang
Which file do you want to run? sample.txt
```

6. The computer will ask you, **"What mark did you score in the examination?"**. Type **"50"** and press **"Enter"** on the keyboard.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========================================================= RESTART: /Volumes/Sofya Lang
Which file do you want to run? sample.txt
What mark did you score in the examination? 50
```

7. The computer will keep on asking you, **"What mark did you score in the examination?"**, seven more times. Type **"49"**, **"67"**, **"89"**, **"92"**, **"41"**, **"73"** and **"65"** respectively, and press **"Enter"** on the keyboard after you have told the computer a mark scored by Pacifica.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========================================================= RESTART: /Volumes/Sofya Lang
Which file do you want to run? sample.txt
What mark did you score in the examination? 50
What mark did you score in the examination? 49
What mark did you score in the examination? 67
What mark did you score in the examination? 89
What mark did you score in the examination? 92
What mark did you score in the examination? 41
What mark did you score in the examination? 73
What mark did you score in the examination? 65
```

8. The computer will write what is stored in the variable called **AverageMark** and **"Your average mark is"**.

```
Python 3.12.0 (v3.12.0:0fb18b02c8, Oct  2 2023, 09:45:56) [Clang 13.0.0 (clang-1
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========================================================= RESTART: /Volumes/Sofya Lang
Which file do you want to run? sample.txt
What mark did you score in the examination? 50
What mark did you score in the examination? 49
What mark did you score in the examination? 67
What mark did you score in the examination? 89
What mark did you score in the examination? 92
What mark did you score in the examination? 41
What mark did you score in the examination? 73
What mark did you score in the examination? 65
Your average mark is 65.75
```

Rules about Do This...Until Loops

1. The two things that you are comparing in the condition of the loop **should** be **variables** — they **cannot** be **strings**, **numbers**, **constants** or **expressions**.
2. If a condition is **true**, the computer will not repeat what you told it to repeat in the curly braces ("{ }").
3. You **cannot** make Do This...Until Loops inside of other Do This...Until Loops.
4. You **can** make **If...Then statements**, **If...Then...Else statements** or **Nested If statements** inside of Do This...Until Loops.

Breaking Loops

Sometimes, you might want to **get out** of a loop (end a loop) before the looping condition in the Do This...Until loop becomes **true**. This is called **breaking a loop**.

Example 11

In a computer game, a player is required to guess a winning number. If the number guessed is 10, the player is declared a winner and the game ends. If the number guessed is not 10, the player is notified to try again. When the number of trials exceeds 4, the game ends and the player loses. Write a Sofya program to represent the algorithm of this game.

Solution

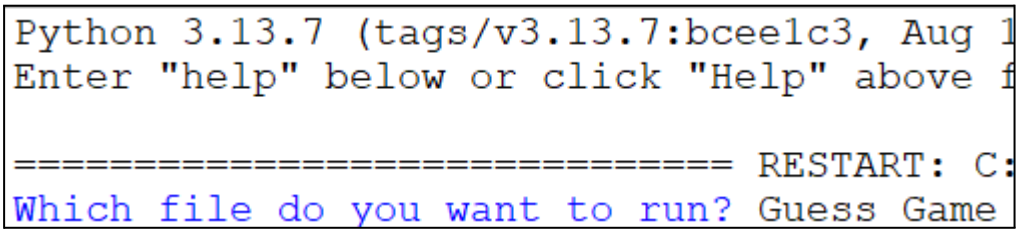
1. Open a blank plain text file, like notepad (for Windows) or text editor (for Macintosh), and type the following program:
    - **Line 1:** `Start`
    - **Line 2:** `Variable Correct is 10`
    - **Line 3:** `Variable Limit is 4`
    - **Line 4:** `Variable Chance is 0`
    - **Line 5:** `Do this`
    - **Line 6:** `{`
    - **Line 7:** `AskComputerUser "What is your guess?" store the answer in Variable[Guess]`
    - **Line 8:** `If Variable[Guess] = Variable[Correct] Then`
    - **Line 9:** `Write "Your answer is correct!"`

- **Line 10:** `Break the loop`
- **Line 11:** `Otherwise If Variable[Guess] is anything else Then`
- **Line 12:** `Write "You are wrong!"`
- **Line 13:** `Variable Chance is Variable[Chance] + 1`
- **Line 14:** `EndIf`
- **Line 15:** `}`
- **Line 16:** `Until Variable[Chance] = Variable[Limit]`
- **Line 17:** `Stop`

2. Here is an explanation for the program:
    - **Line 1:** We are telling the computer that we want to start programming (SOMETIMES, the program will NOT work if you do NOT say **"Start"**).
    - **Line 2:** We are telling the computer that we are making a **variable** called **Correct** and that Correct is **10**.
    - **Line 3:** We are telling the computer that we are making a **variable** called **Limit** and that Limit is **4**.
    - **Line 4:** We are telling the computer that we are making a **variable** called **Chance** and that Chance is **0**.
    - **Line 5 - 6:** We are telling the computer that we are making a Do This…Until loop (We are using an opening curly brace [" { "] to tell Sofya which things we want to start repeating).
    - **Line 7:** We are telling the computer to ask the person who is using it, **"What is your guess?"**, and after the person answers this question, we want the computer to store the person's answer in a **variable** called **Guess**.
    - **Line 8:** We are telling the computer to check if the **Guess** is equal to **Correct**.
    - **Line 9:** We are telling the computer to write **"Your answer is correct!"** on the screen (This will only happen if the **Guess** is equal to **Correct**).
    - **Line 10:** We are telling the computer to break the loop (This will only happen if the **Guess** is equal to **Correct**).

- **Line 11:** We are telling the computer to check if the **Guess** is anything else (which is not the correct guess).
- **Line 12:** We are telling the computer to write **"You are wrong!"** on the screen (This will only happen if the **Guess** is not equal to **Correct**).
- **Line 13:** We are telling the computer that we are making a **variable** called **Chance** and that Chance is **Chance** + **1** (This means that the computer will keep on adding the Chance by one every time that someone inputs a wrong guess).
- **Line 14:** We are telling the computer that we want to stop making the If…Then…Else statement (That is why we put **"EndIf"**).
- **Line 15:** We are telling the computer where we want to stop repeating things (That is why we have used a closing curly brace [" } "]).
- **Line 16:** We are telling the computer to check if Variable **Chance** is equal to Variable **Limit**.
- **Line 17:** We are telling the computer that we want to stop programming (SOMETIMES, the program will NOT work if you do NOT say **"Stop"**).

3. Go to the Sofya Interpreter and run the program.
4. The computer will ask you, **"Which file do you want to run?"**. Type the name of the file. In this manual, the name of the file we used was called **"Guess Game"** *(In Sofya 1.0, when you are typing the name of the file that you want to run, you do not have to type the file extension, for example, if you want to run a file that is called "Sofya" you can just type the file name as "Sofya" and not "Sofya.txt")*. Then press **"Enter"** on the keyboard.



5. The computer will ask you, **"What is your guess?"**. You can type **"7"** and press **"Enter"** on the keyboard.

```
Python 3.13.7 (tags/v3.13.7:bcee1c3, Aug 1
Enter "help" below or click "Help" above f

============================== RESTART: C:
Which file do you want to run? Guess Game
>>> THE PROGRAM HAS STARTED...

WHAT IS YOUR GUESS? 7
```

6. The computer will write **"You are wrong!"** on the screen then the computer will ask you, **"What is your guess?"**. You can type **"10"** and press **"Enter"** on the keyboard.

```
Python 3.13.7 (tags/v3.13.7:bcee1c3, Aug 1
Enter "help" below or click "Help" above f

============================== RESTART: C:
Which file do you want to run? Guess Game
>>> THE PROGRAM HAS STARTED...

WHAT IS YOUR GUESS? 7
YOU ARE WRONG!
WHAT IS YOUR GUESS? 10
```

7. The computer will write **"Your answer is correct!"** on the screen then the program will end.

```
Python 3.13.7 (tags/v3.13.7:bcee1c3, Aug 1
Enter "help" below or click "Help" above f

============================== RESTART: C:
Which file do you want to run? Guess Game
>>> THE PROGRAM HAS STARTED...

WHAT IS YOUR GUESS? 7
YOU ARE WRONG!
WHAT IS YOUR GUESS? 10
YOUR ANSWER IS CORRECT!

>>> THE PROGRAM HAS ENDED
```

Program Errors in Sofya

The table on the next page shows the **names**, **causes**, **solutions** and **examples** of program errors that you can find in Sofya Version 1.0:

Name of the error	Cause of the error	Solution to the error	Example of the error
Variable Error	You have told Sofya to do something with a variable that does not exist	Make the variable first and then you can tell Sofya what to do with the variable	You might want Sofya to write a variable called **'Pi'** but you did not tell Sofya what to store in the variable called 'Pi'
File Not Found Error	Sofya was not able to find the file you are trying to run because it might not exist or you might have typed the file name wrongly	• Make sure that the file that you are trying to run is in the same folder as the Sofya Interpreter. • Make sure that you have typed the file name correctly.	You might have wanted to run a file called **'equation'** but you typed the file name as **'Equation'**
Syntax Error	In the Sofya program, you have used something that does not follow the rules of Sofya	Make sure that your Sofya program follows the rules of Sofya	You might tell the computer to write **'hello world'** by saying, **cout>> hello world**
Division by Zero Error	There is a place in the Sofya program where a number is divided by zero	Make sure that your Sofya program does not have a place where a number is divided by zero	You might tell the computer to do, **Variable Answer is 3/0**
Program Run Error	You might have not put 'Start' or 'Stop' in your program	Make sure that your program has 'Start' and 'Stop'	At the beginning of the program, you might have not said 'Start' or at the end of the program, you might have not said 'Stop'

Conclusion

Thank you for reading this manual! I hope you found it useful. If you have any questions, please send an email to oyweraa@gmail.com. I will be happy to help. Have fun using Sofya!