

CC-112L

Programming Fundamentals

Laboratory 01

Introduction to Programming, Algorithms and C

Version: 1.0.0

Release Date: 07-02-2025

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Learning Objectives:

- Pseudocode
- Input/Output
- Arithmetic Expressions
- Flowcharts
- C Operators
- Operator Precedence
- C Program Development Environment

Resources Required:

- Desktop Computer or Laptop
- LARP 3.0 Software
- Microsoft ® Visual Studio 2022

General Instructions:

- In this Lab, you are **NOT** allowed to discuss your solution with your colleagues, even not allowed to ask how is s/he doing, this may result in negative marking. You can **ONLY** discuss with your Teaching Assistants (TAs) or Lab Instructor.
- Your TAs will be available in the Lab for your help. Alternatively, you can send your queries via email to one of the followings.

Teachers:		
Course Instructor	Hafiz Anzar Ahmad	anzar@pucit.edu.pk
Teacher Assistants	Manahil	Bitf21m002@pucit.edu.pk

Background and Overview:

What is a Program?

A program is a sequence of instructions to perform a specific task. A computer program is set of instructions given to the computer to perform a particular task. A computer program in its human-readable form is called source code.

What is an Algorithm?

An algorithm is a finite set of instructions used to solve a particular task. Everything we do follows an algorithm. So, computer algorithms are instruction manuals that tells computer how to perform a task.

Pseudocode:

Pseudocode is a of an algorithm in human readable form that does not requires any programming language. It summarizes the flow in which program executes.

Flowchart:

A flowchart is a pictorial representation (diagram / visual representation) of an algorithm, or process in a sequential order.

Microsoft ® Visual Studio:

Microsoft ® Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps.

Microsoft ® Visual Studio supports 36 different programming languages and allows the code editor and debugger to support nearly any programming language, provided a language-specific service exists. Built-in languages include C, C++, C++/CLI, Visual Basic, .NET, C#, F#, JavaScript, TypeScript, XML, XSLT, HTML, and CSS. Support for other languages such as Python, Ruby, Node.js, and M among others is available via plug-ins. Java (and J#) were supported in the past.

© https://en.wikipedia.org/wiki/Microsoft_Visual_Studio

LARP:

LARP is in an acronym. It is a compression of the phrase “**Logics of Algorithms and Resolution of Problems**”. LARP is a programming language for the purpose of rapid prototyping of algorithms.

LARP's main advantage over traditional programming languages is its flexible and semi natural syntax, allowing one to formulate algorithms without the impediments of cryptic languages such as C, C++, Pascal or Java.

© <http://larp.marcolavoie.ca/en/description/description.htm>

Activities:

Pre-Lab Activities:

Microsoft ® Visual Studio 2022 Installation:

- Open Web browser and in search bar, type “**Visual Studio**”, Open the first site or
- Type the URL <https://visualstudio.microsoft.com> in the address bar of the Web browser

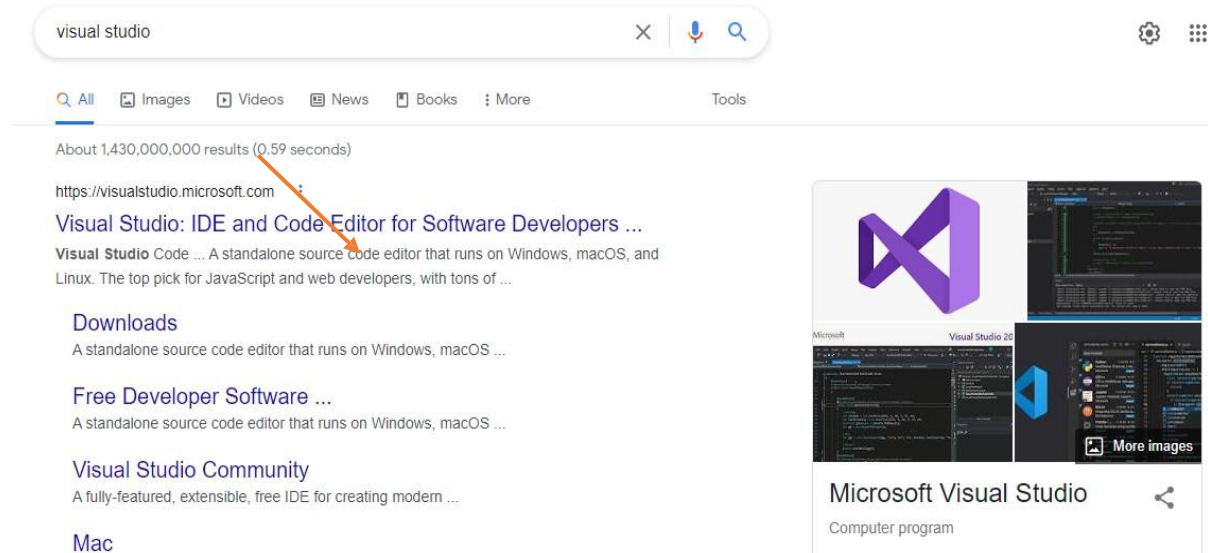


Fig. 01 (Microsoft ® Visual Studio Installation)

Meet the Visual Studio family

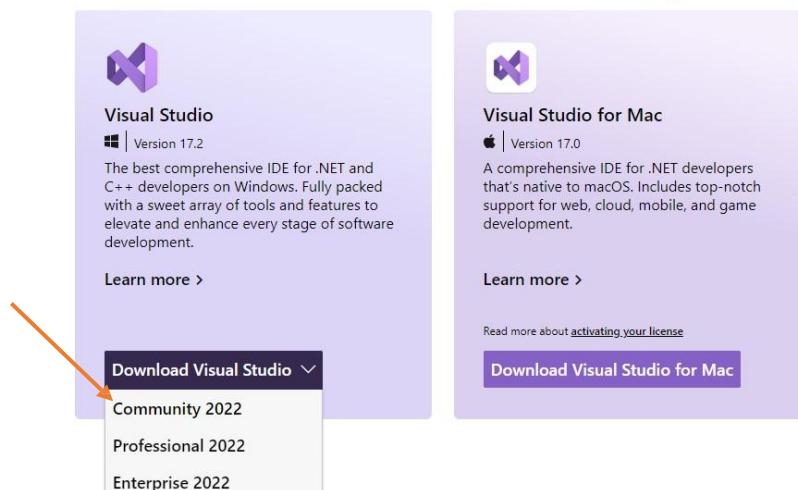


Fig. 02 (Microsoft ® Visual Studio Installation)

- Under “**Meet the Visual Studio family**” heading, click “**Download Visual Studio**” dropdown menu
- Click “**Community 2022**”. The Visual Studio Setup will be downloaded.
- Run the “**Visual Studio Setup**” file. Visual Studio Installer will be downloaded.

Visual Studio Installer

Getting the Visual Studio Installer ready.



Fig. 03 (Microsoft ® Visual Studio Installation)

- Launch “Microsoft ® Visual Studio Installer”
- In “Workloads” tab, under “Desktop & Mobile”, click the checkbox against “Desktop development with C++”
- On bottom right corner, click “Install”

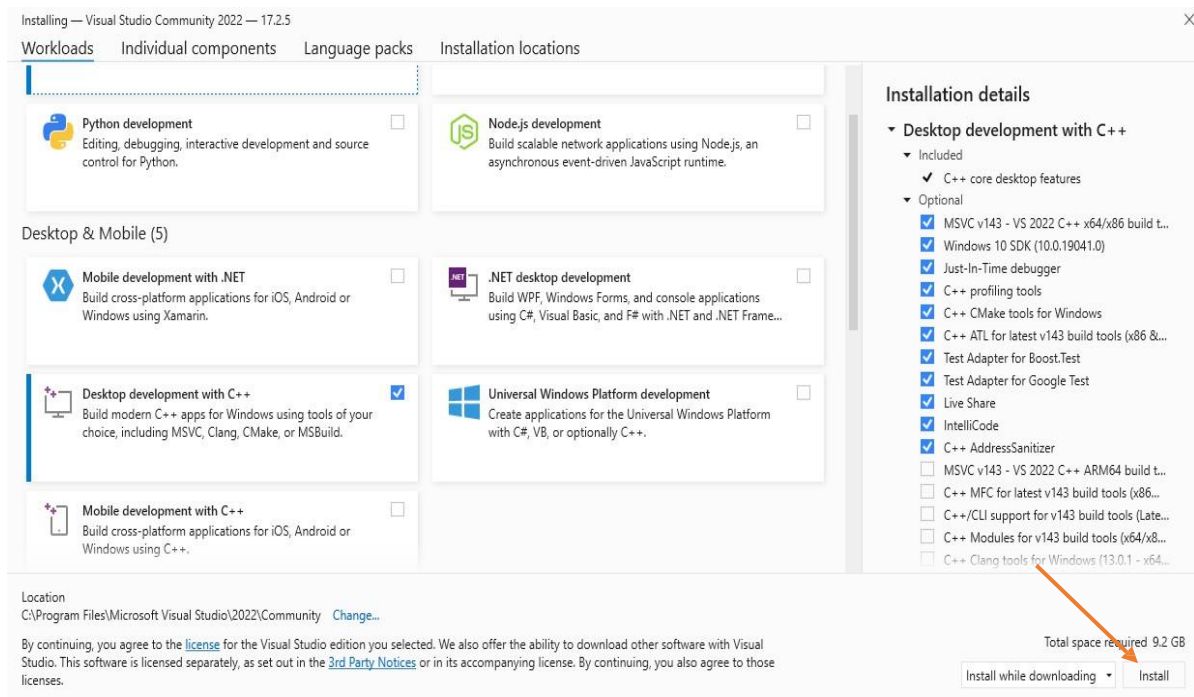


Fig. 04 (Microsoft ® Visual Studio Installation)

The “Microsoft ® Visual Studio 2022” installation starts.

LARP (Logic of Algorithms for Resolution of Problems) Installation:

- Open Web browser
- In search bar, type “LARP Software”. Open the first site or
- Type the URL <https://en.freownloadmanager.org/Windows-PC/LARP.html> in the address bar of the Web browser

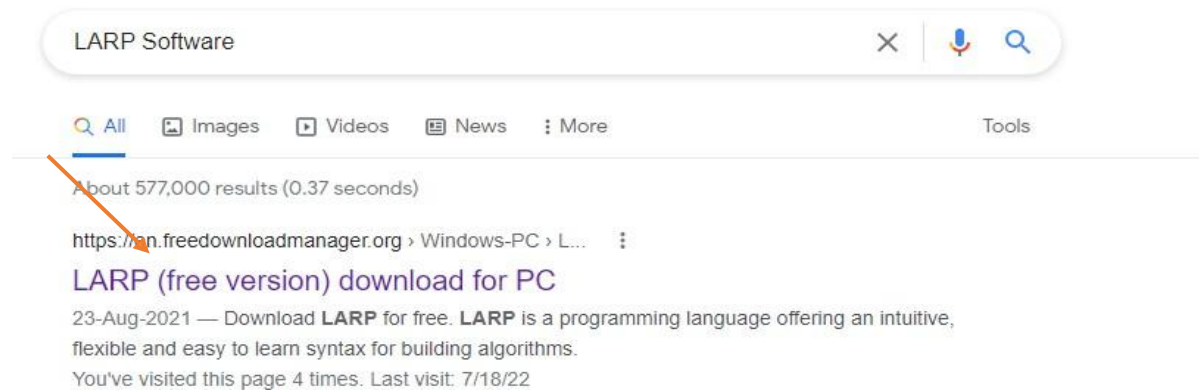


Fig. 05 (LARP Installation)

- Click **“Download now”**. LARP setup will be downloaded

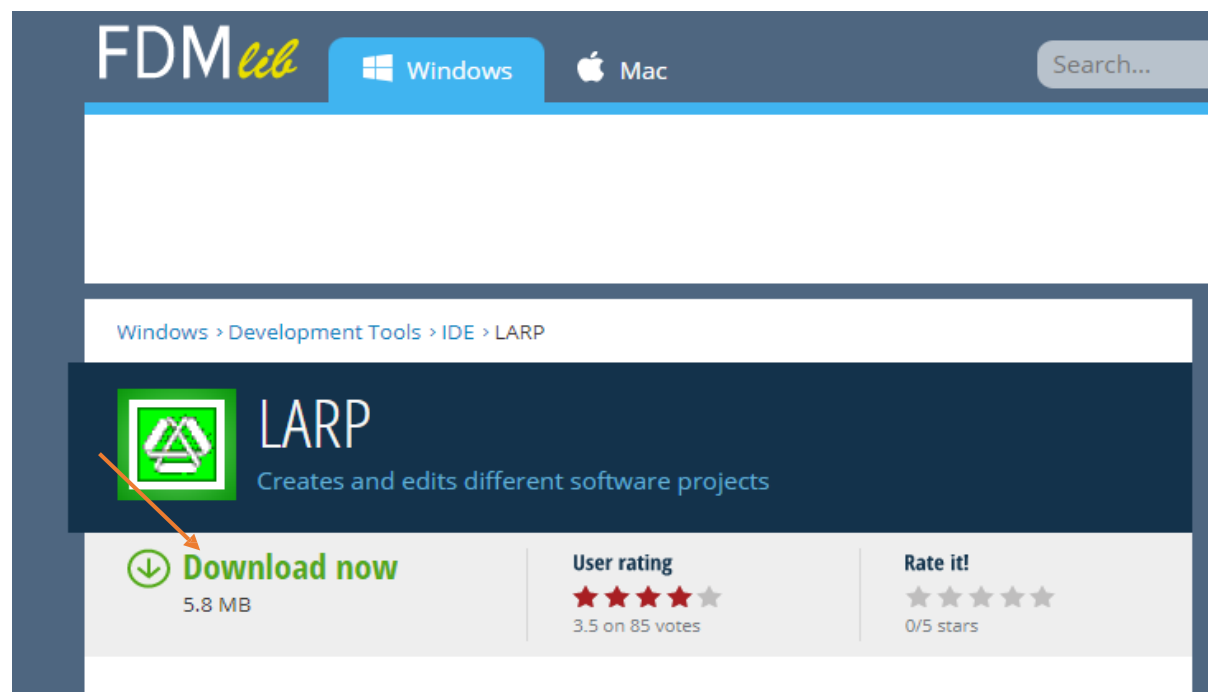


Fig. 06 (LARP Installation)

- Run the LARP setup
- Follow the Setup wizard instructions. LARP will be installed

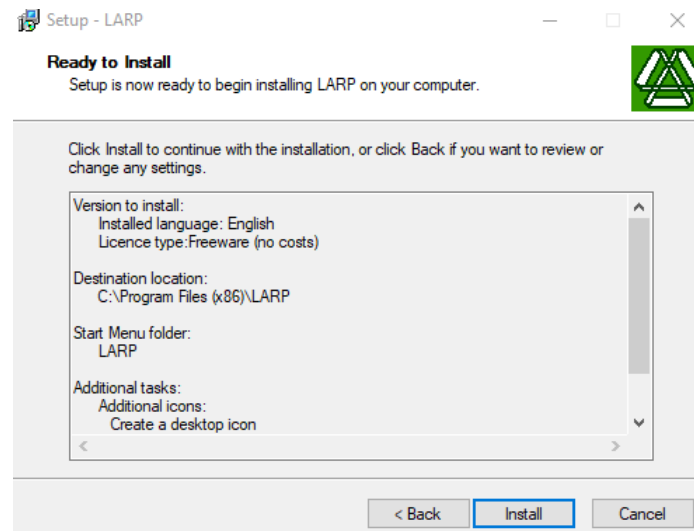


Fig. 07 (LARP Installation)

In-Lab Activities:

Pseudocode

New Project:

- Double Click “**LARP**” application on the Desktop
- Press “**CTRL + N**” on the keyboard OR on the navigation bar, click “**File**”, then click “**New**” from the dropdown

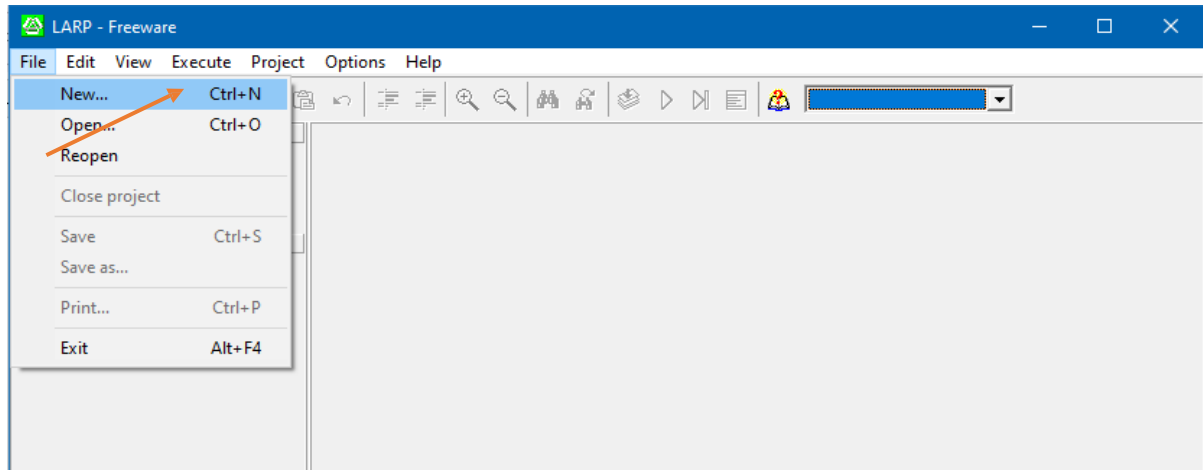


Fig. 08 (LARP New Project)

“New” dialog box opens.

- Under “New project”, click “Pseudo code”
- Click “OK”

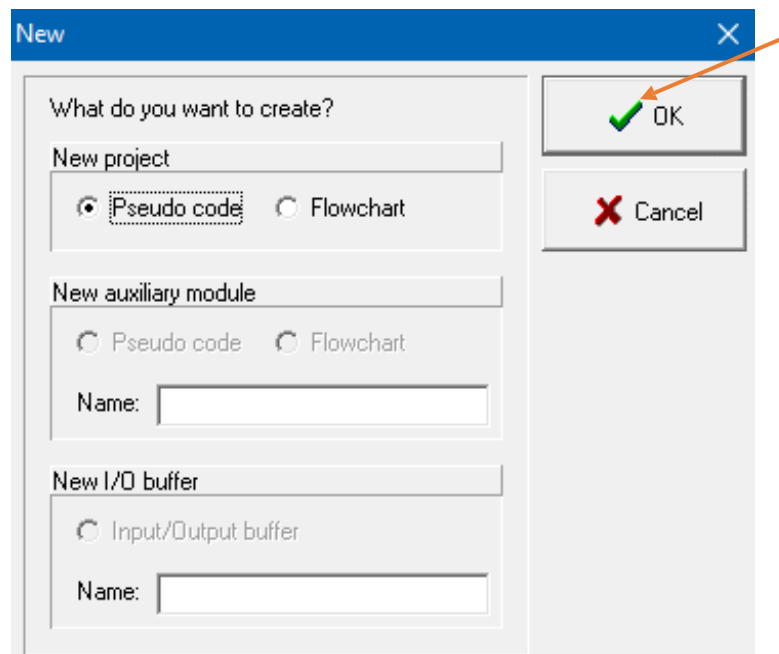


Fig. 09 (LARP New Project)

New Pseudocode project will be created.

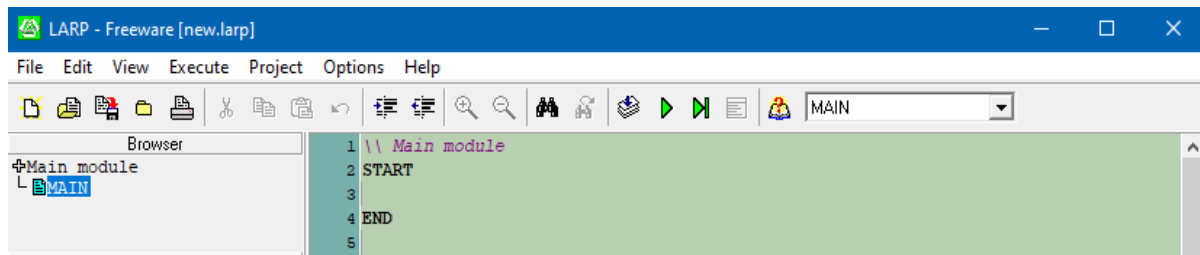


Fig. 10 (Pseudocode in LARP)

Display Output on Console:

- On the text editor in LARP, type “**WRITE {expression}**” OR drag the “**WRITE {expression_list}**” template from the “**Templates**” column
- Replace the expression list with your desired text within inverted commas
- On the ribbon, click the execute button OR press “**F7**” key

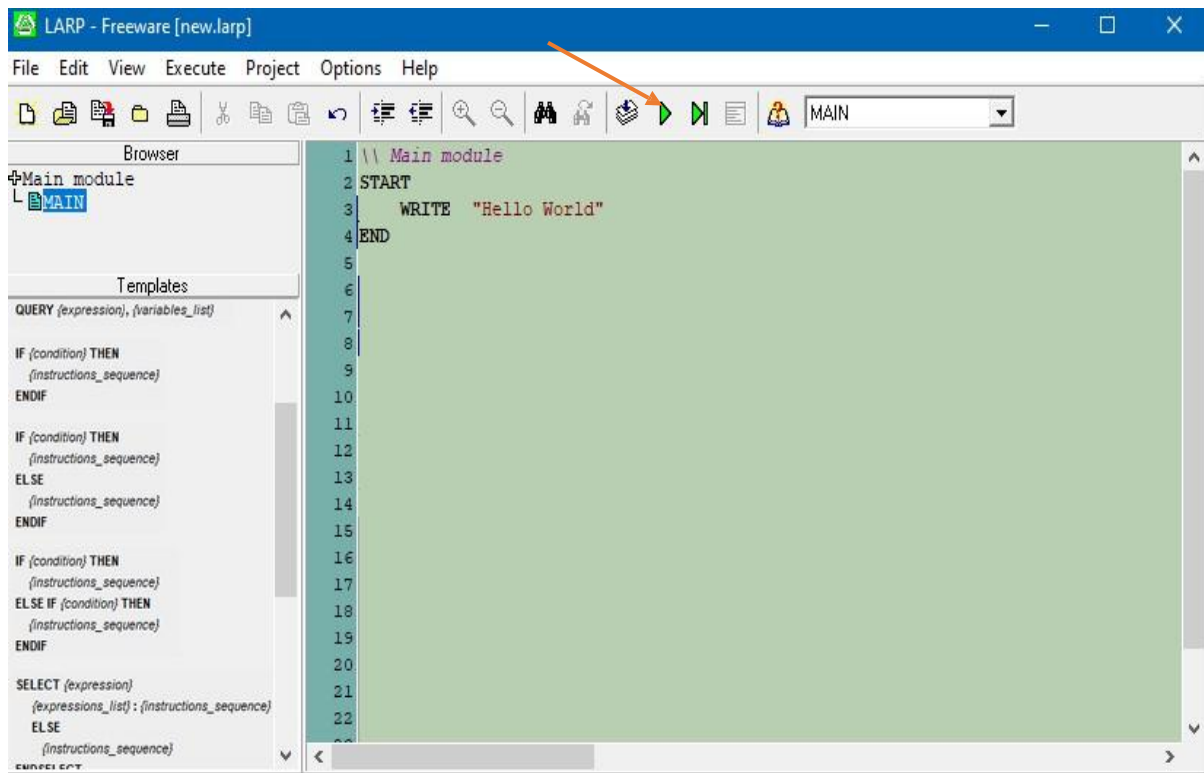


Fig. 11 (Pseudocode in LARP)

Desired output will be displayed on the console.

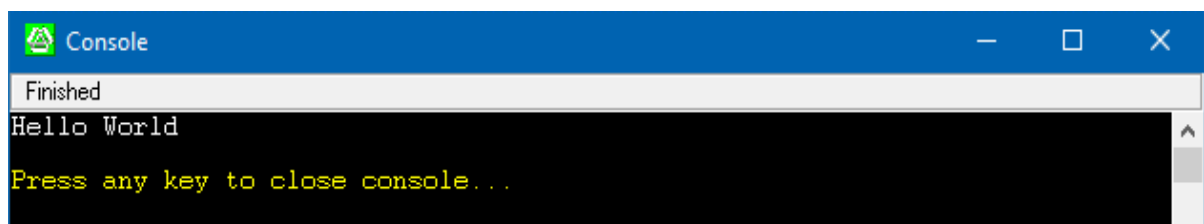


Fig. 12 (LARP Console)

Read & Display Input on Console:

- On the text editor in LARP, type “**READ {variables}**” OR drag the “**READ {variable_list}**” template from the “**Templates**” column
- Replace the variable list with your desired variable name
- On the next line type “**WRITE**” following with an expression and comma separated variable name
- On the ribbon, click the execute button OR press “**F7**” key

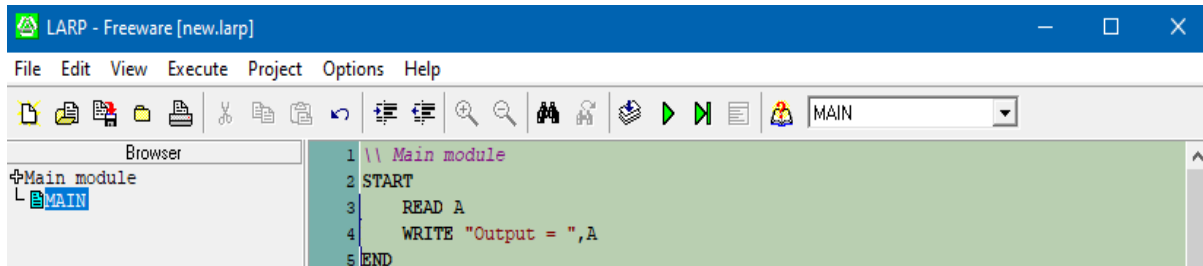


Fig. 13 (Pseudocode in LARP)

- Enter the input value on the console
- Press “**Enter**” key. Output will be displayed

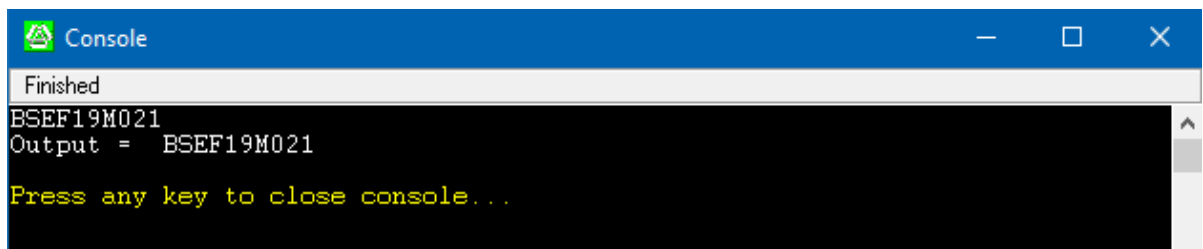


Fig. 14 (LARP Console)

Reading Multiple Inputs:

- On the text editor in LARP, type “**READ {variables}**” OR drag the “**READ {variable_list}**” template from the “**Templates**” column
- Replace the variable list with your desired comma separated variable names
- On the next line type “**WRITE**” following with comma separated variable names
- On the ribbon, click the execute button OR press “**F7**” key

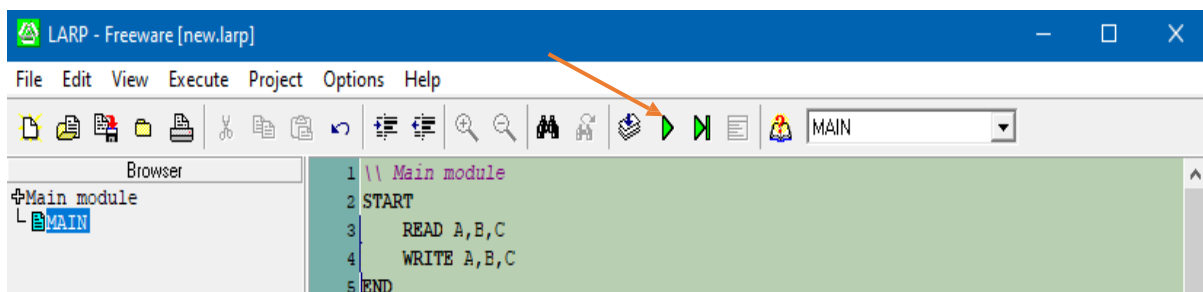


Fig. 15 (Pseudocode in LARP)

- Enter space separated input values on the console
- Press “**Enter**” key. Output will be displayed

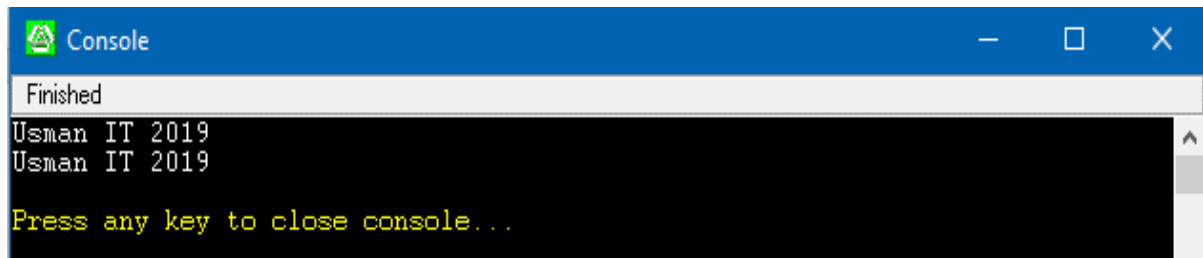


Fig. 16 (LARP Console)

IF ELSE Statement:

The IF/ELSE statement executes a block of code if a specified condition is true. If the condition is false, another block of code can be executed.

- Drag “**IF {condition} THEN {instructions} ELSE IF {condition} THEN {instructions} ENDIF**” on text editor from “**Templates**” column
- Write a code which read a number from user and then prints the number in text form as shown in figure

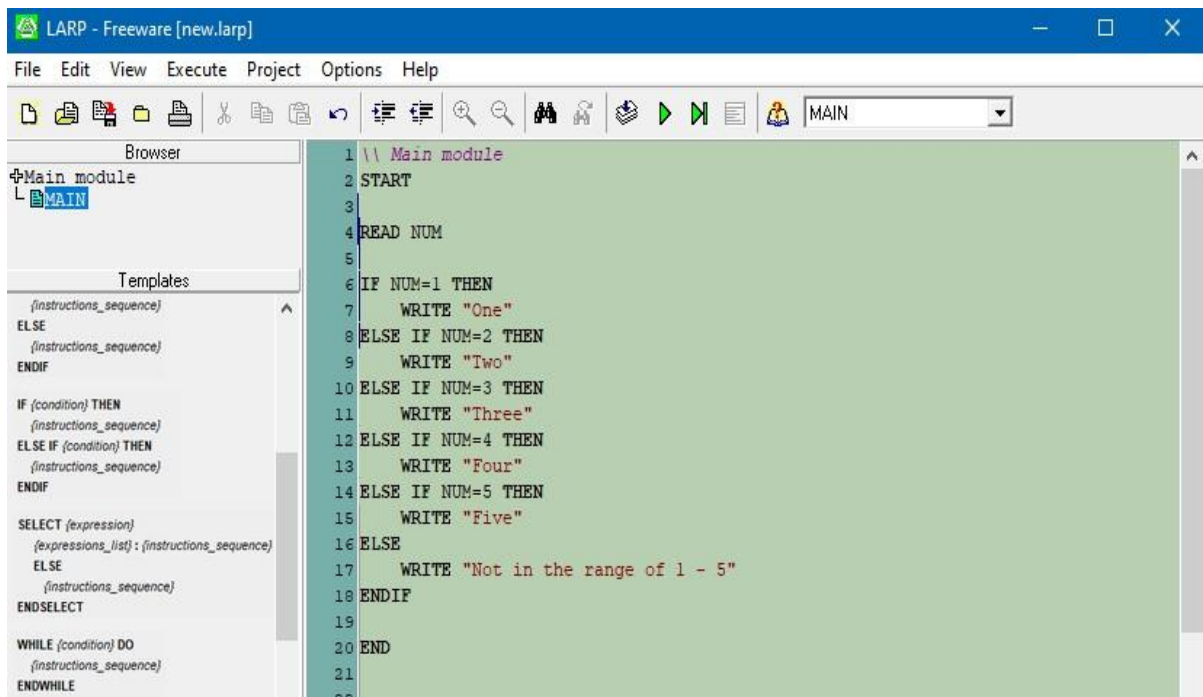


Fig. 17 (Pseudocode in LARP)

- Enter input value on the console
- Press “**Enter**” key. Output will be displayed

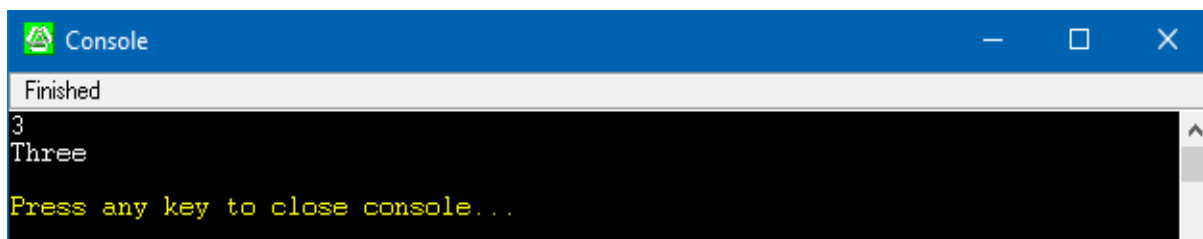


Fig. 18(LARP Console)

Loop Statements:

A Loop executes series of statements repeatedly for a specified number of times or until specified conditions are met.

- Drag “WHILE {condition} DO {instructions} ENDWHILE” on the text editor from the “Templates” box
- Replace the condition & instruction so that console prints numbers from 1 to 5
- Similarly drag “FOR {variable} = {initial value} TO {final value} DO {instructions} ENDFOR”
- Replace the values & instruction so that console prints numbers from 6 to 10

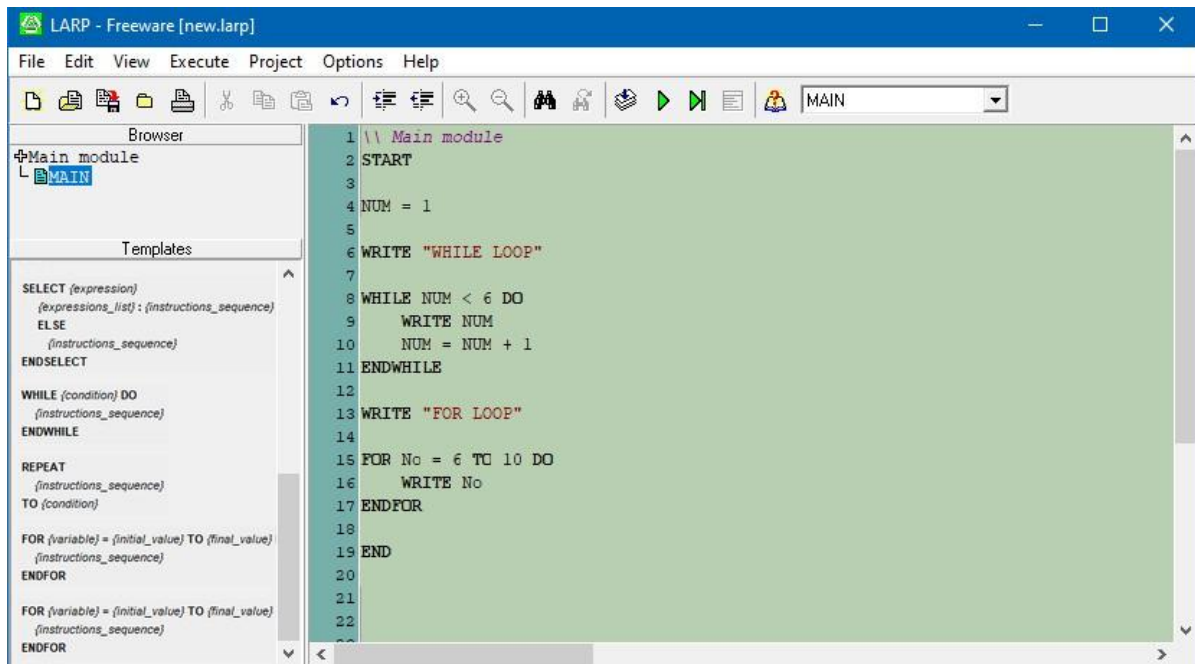


Fig. 19(Pseudocode in LARP)

- Press “F7” key. Output will be displayed on the console

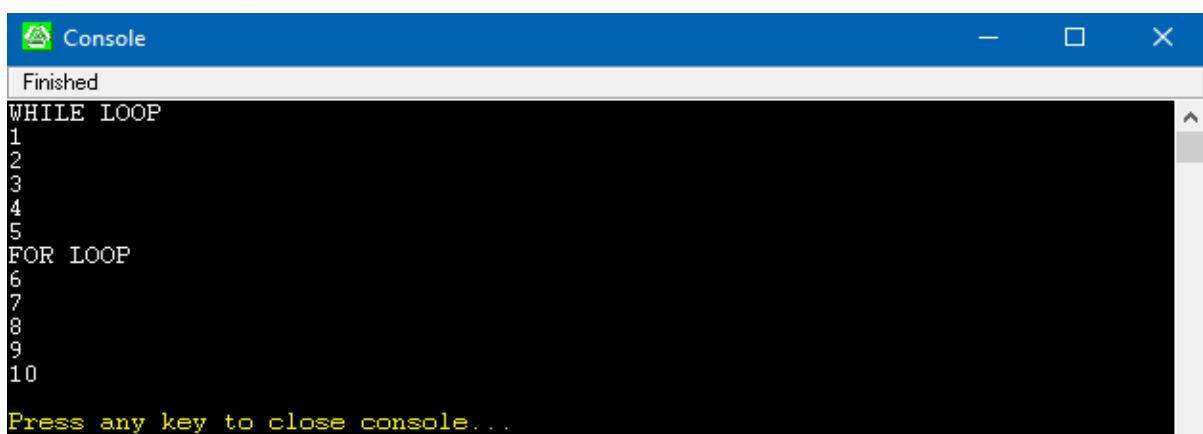



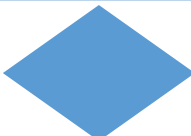



Fig. 20 (LARP Console)

Flowchart

Symbol	Name	Function
	Start/End	Oval represents a Starting or Ending point
	Process	A rectangle represents a process
	Input/Output	A parallelogram represents an input or output
	Decision	A diamond represents a decision
	Arrow	Arrow shows a relationship between representative shapes

Input / Output:

- Open flowchart project in LARP
- Drag **“Parallelogram”** from the **“Templates”** box and drop it on the connector (where arrow is pointing in the figure)

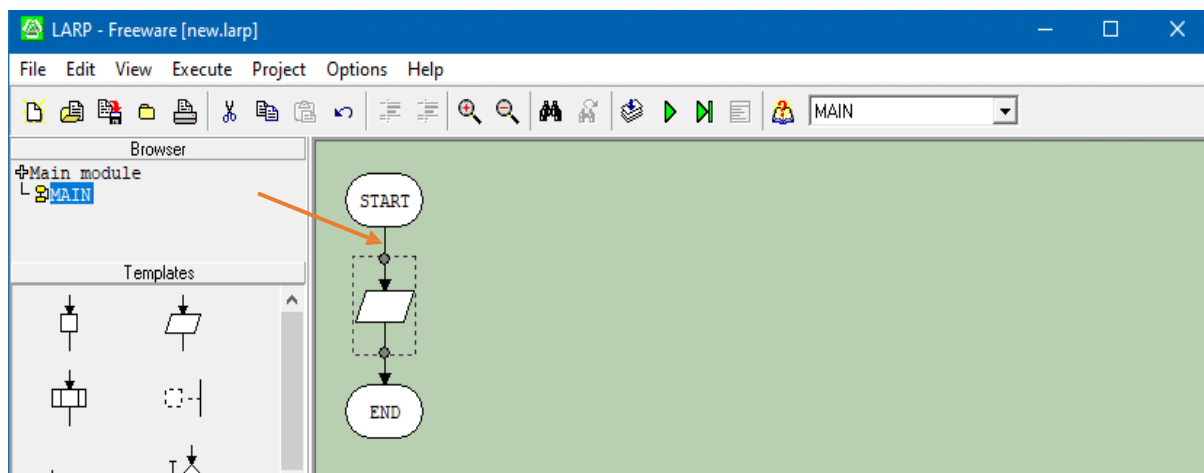


Fig. 21 (LARP Flowchart)

- Double click the parallelogram
- Edit dialog will open. Type **“Num”** under **“Read”** column
- Click **“OK”**

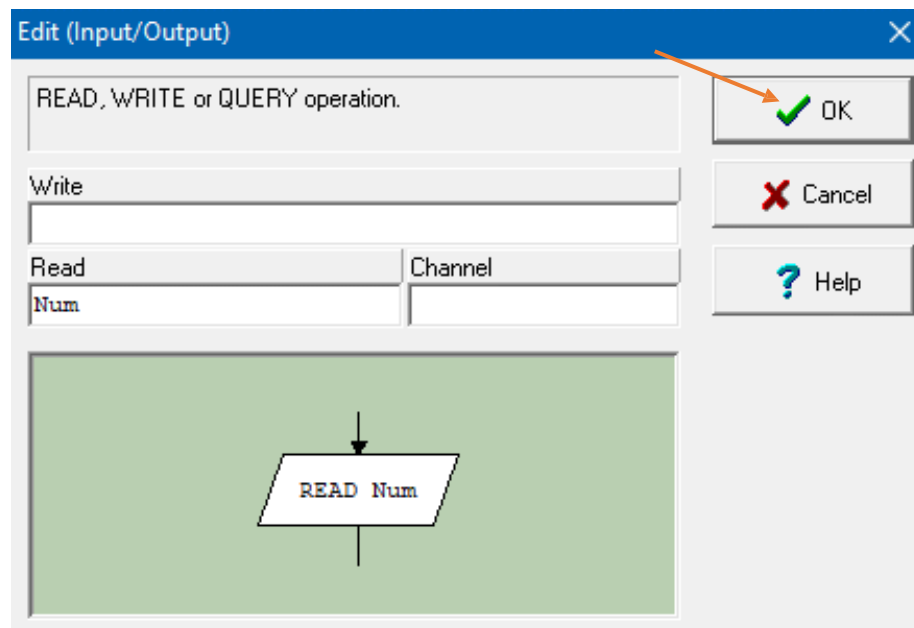


Fig. 22 (LARP Flowchart)

- Drag & drop another parallelogram
- Double click on it
- Type **"Output = ", Num** under **"Write"** column
- Click **"OK"**

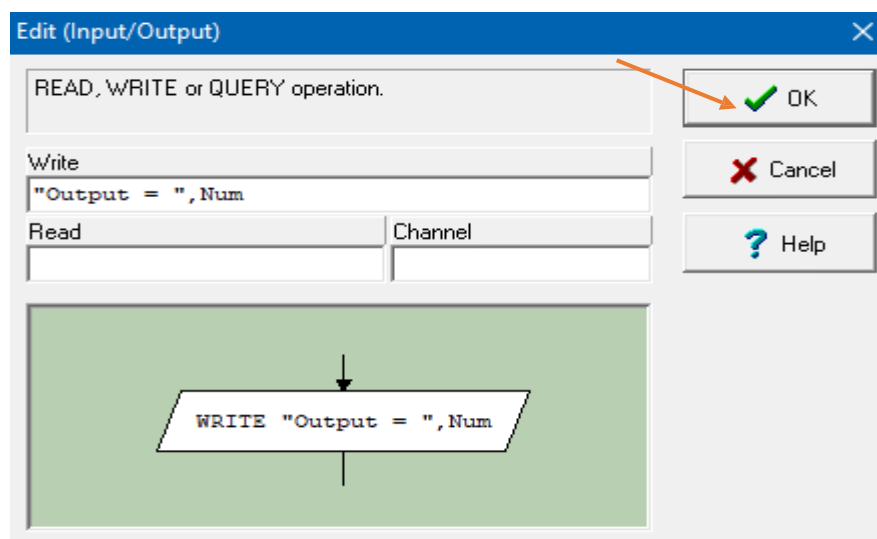


Fig. 23 (LARP Flowchart)

- On the ribbon, click the execute button OR press **"F7"** key

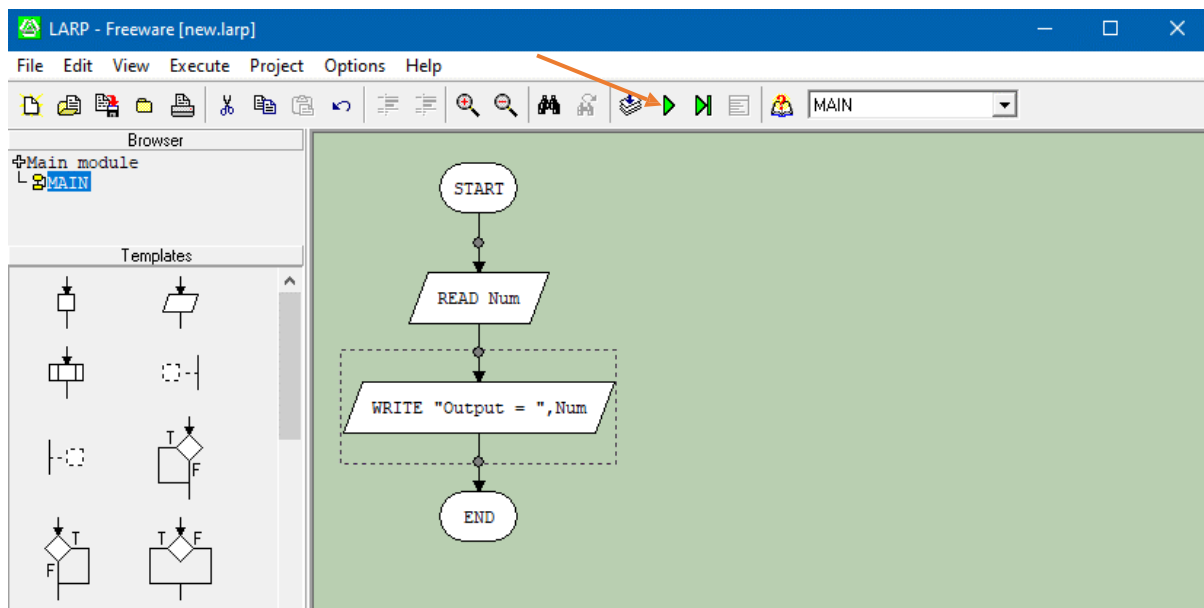


Fig. 24 (LARP Flowchart)

- Enter the input value on console
- Press “**Enter**” key

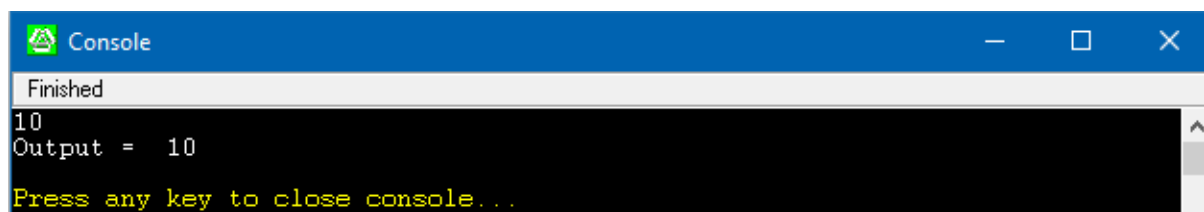


Fig. 25 (LARP Console)

Decision

Decision symbol is used to make decisions. It can be used for IF ELSE conditional, WHILE Loop, FOR loop etc. In LARP different decision templates are provided under “**Templates**” box.

IF ELSE Conditional:

- Read a number from user with variable name “**Num**” using Input/Output symbol
- Drag IF ELSE Conditional from the “**Templates**” box

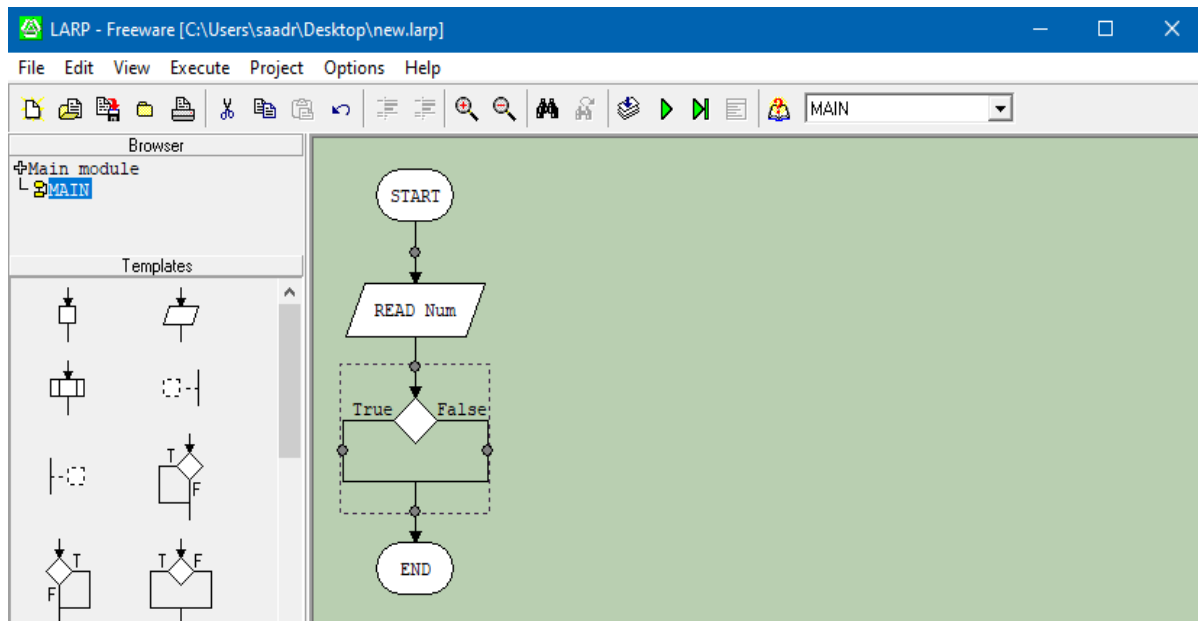


Fig. 26 (LARP Flowchart)

- Double click it. Edit dialog will open
- Type “Num > 5” under “Condition” column
- Click “OK”

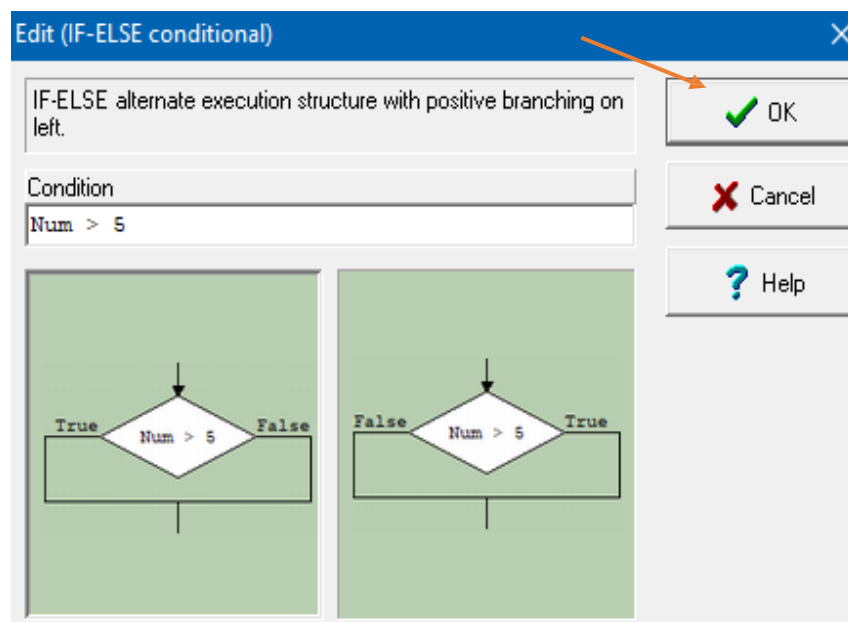


Fig. 27 (LARP Flowchart)

- Display “**Greater than 5**” if the condition is true else display “**Less than or equal to 5**”

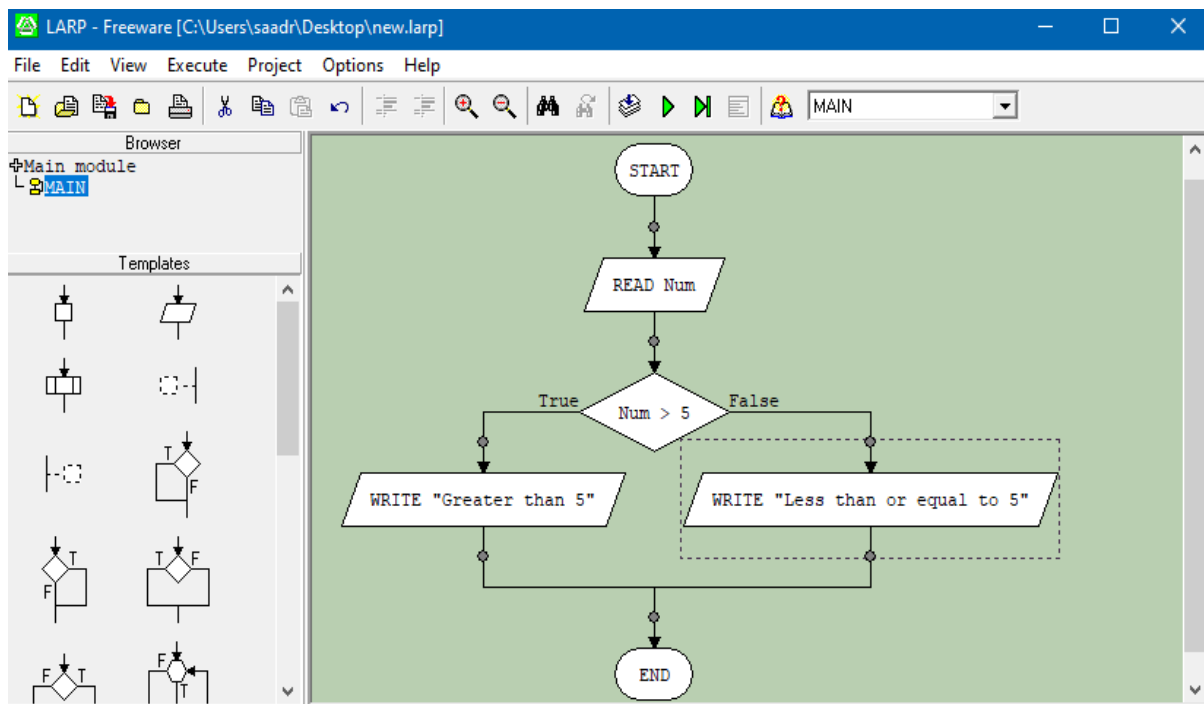


Fig. 28 (LARP Flowchart)

- Press “F7” key
- Enter the input value on console
- Press “Enter” key

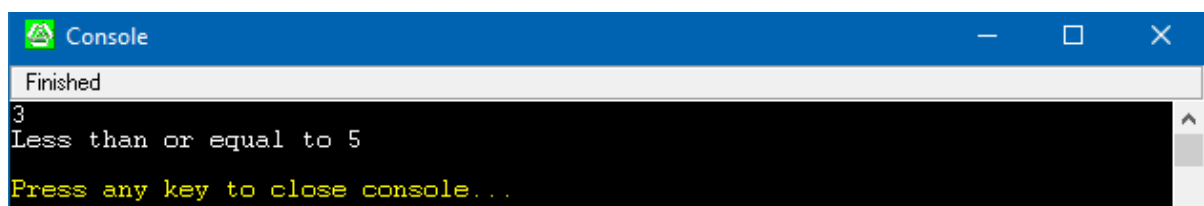


Fig. 29 (LARP Console)

FOR Loop:

A FOR Loop is a statement for specifying iteration, which allows the code to be executed repeatedly.

- Drag FOR Loop template from the “**Templates**” box

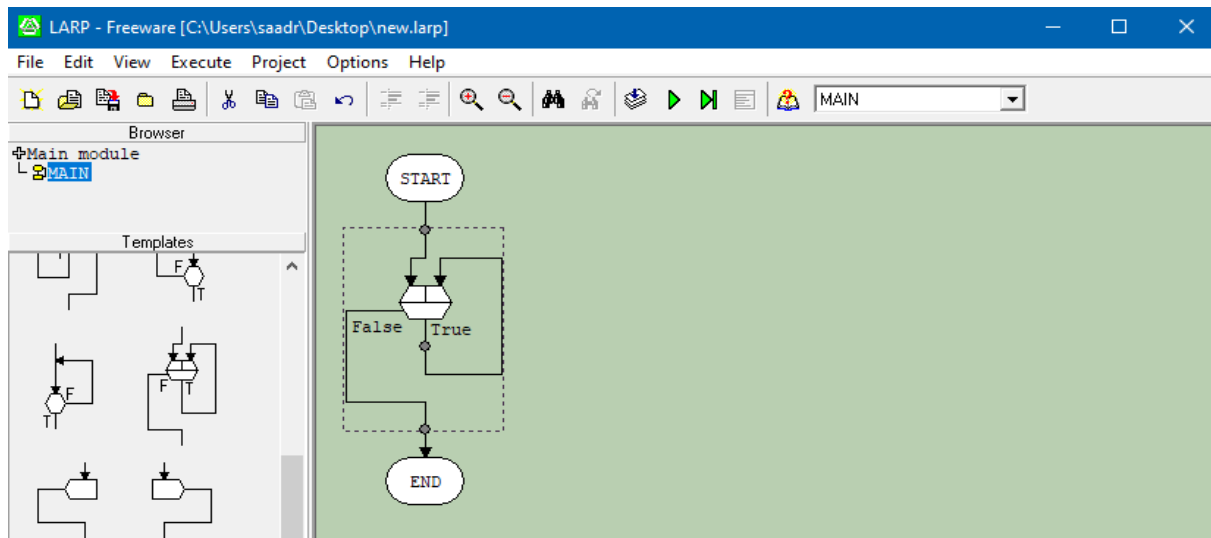


Fig. 30 (LARP Flowchart)

- Double click it. Edit dialog will open
- Type “**Num**” under “**Variable**” column
- Type “**2**” under “**Increment**” column
- Type “**1**” under “**Initial value**” column
- Type “**10**” under “**Final value**” column
- Click “**OK**”

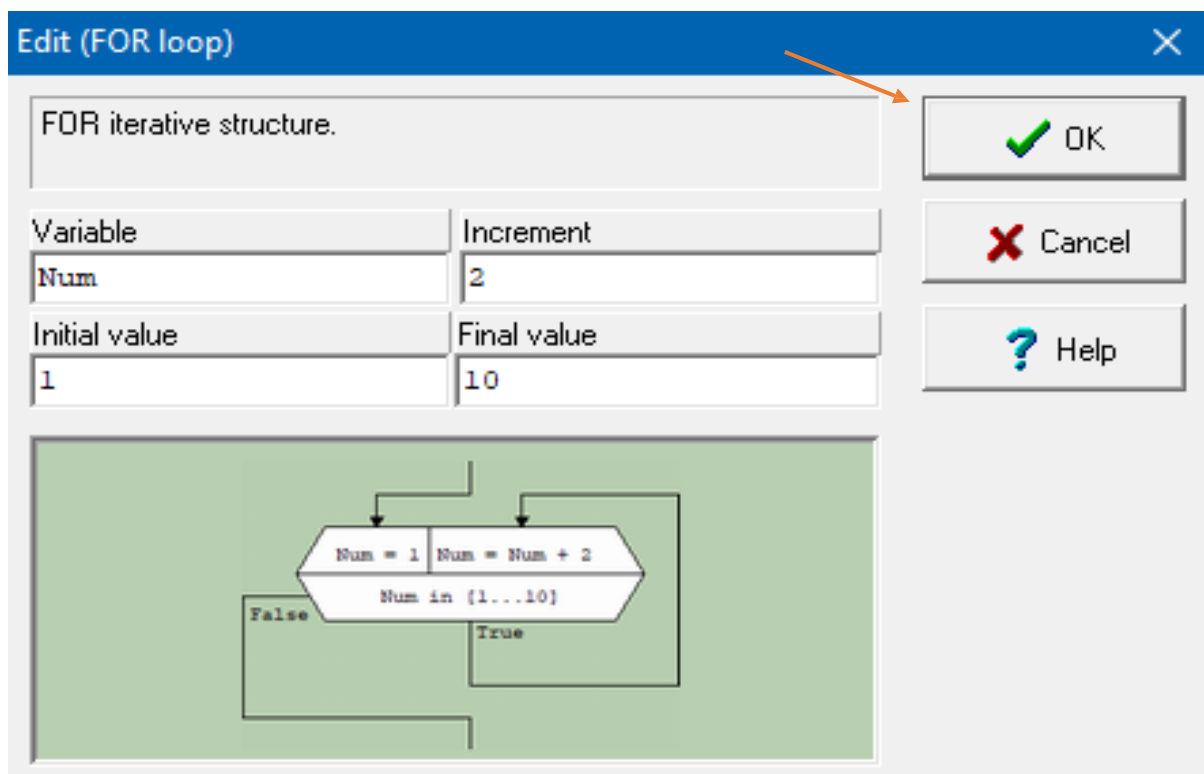


Fig. 31 (LARP Flowchart)

- Display “**Num**” if the condition is true. It will display odd numbers up to 10

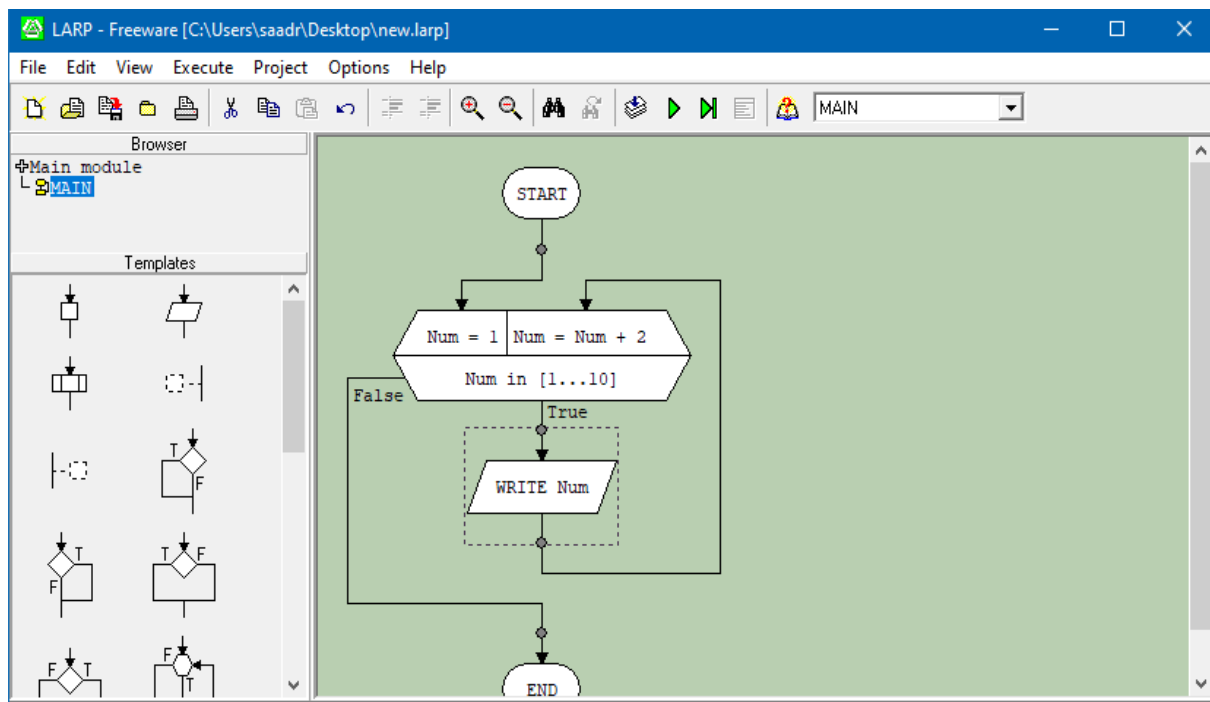


Fig. 32 (LARP Flowchart)

- Press “F7” key. Output will be displayed

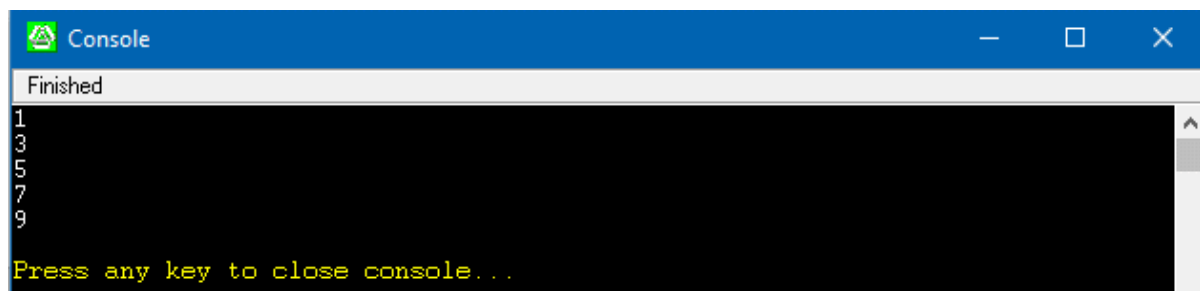


Fig. 33 (LARP Console)

Saving a file in LARP:

- On the ribbon, click Save button OR Press “CTRL + S”

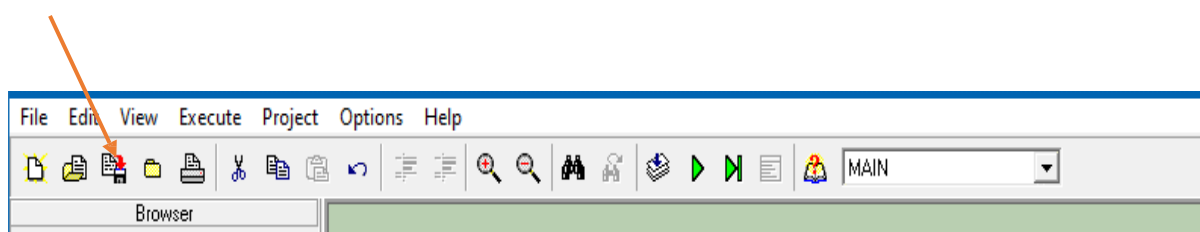


Fig. 34 (Save LARP File)

- Save dialog will open. Choose your desired path
- Click “Save”

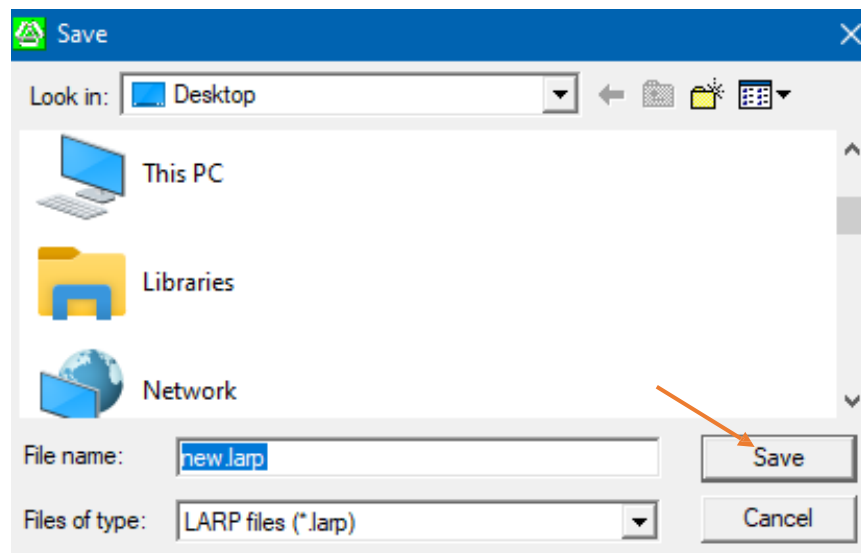


Fig. 35 (Save LARP File)

C program in Microsoft ® Visual Studio 2022:

- Open Microsoft ® Visual Studio 2022
- Click on “Create a new project”

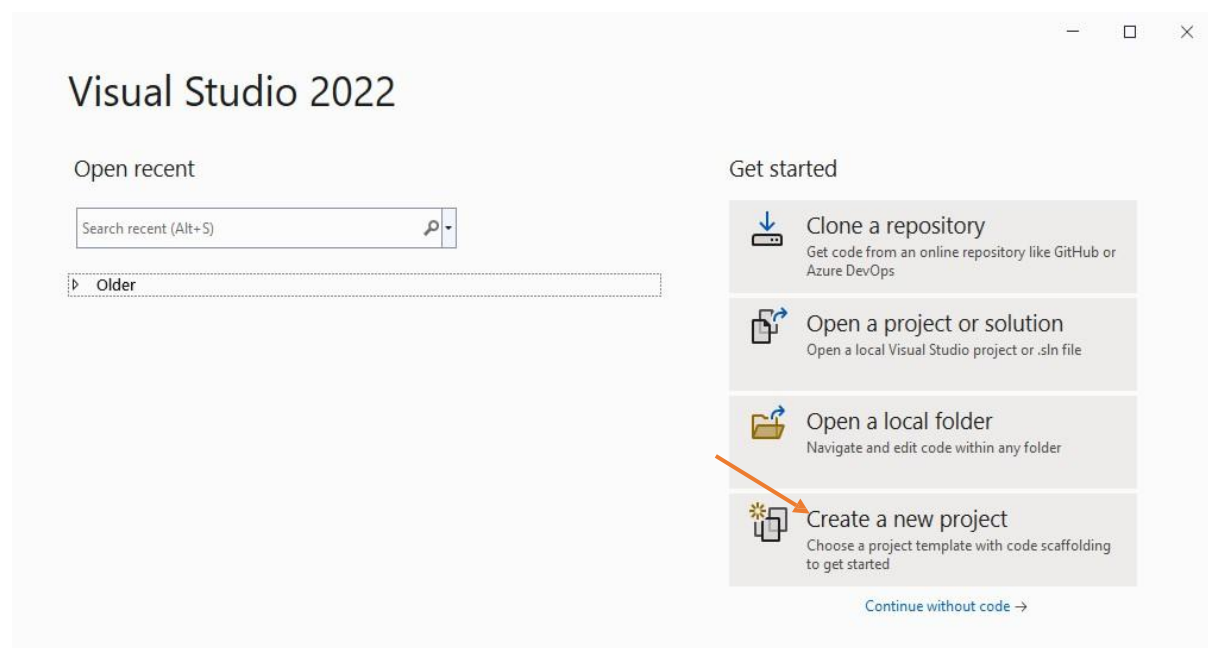


Fig. 36 (Microsoft ® Visual Studio 2022)

- Select the “Empty Project”
- Click “Next”

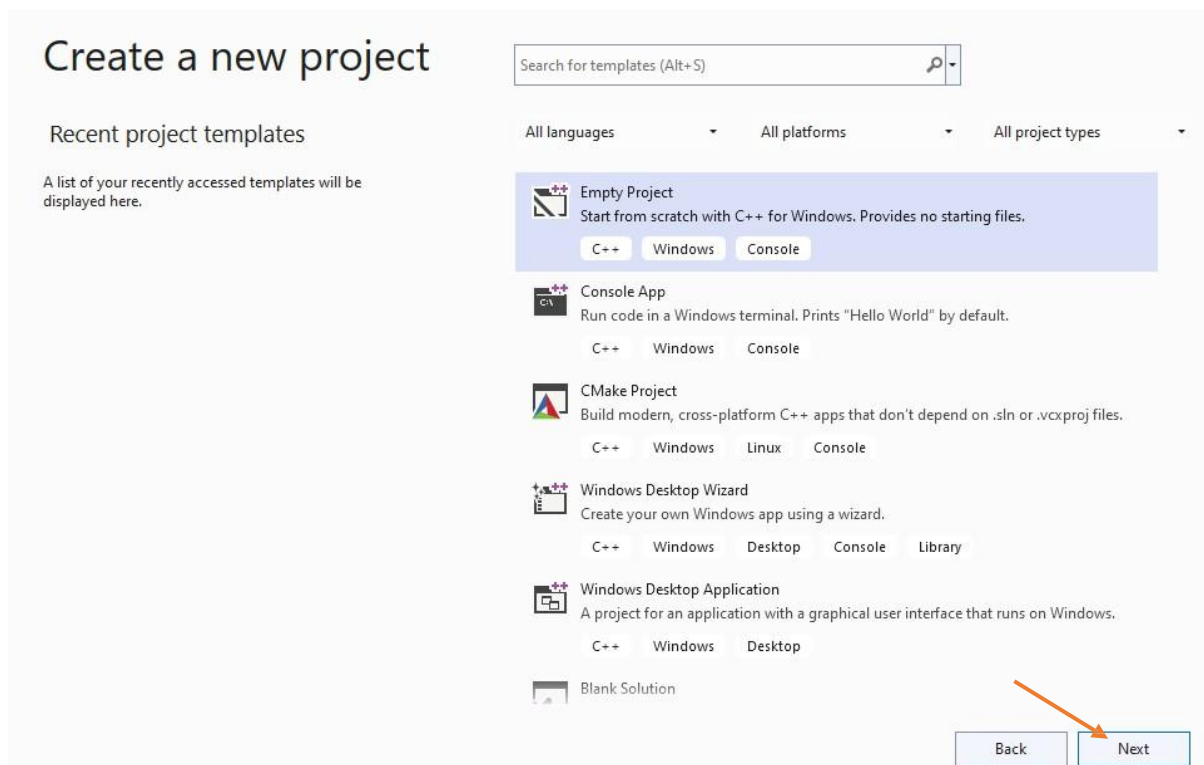


Fig. 37 (Microsoft ® Visual Studio 2022)

- Enter **“First Program”** in Project Name
- Click **“Create”**

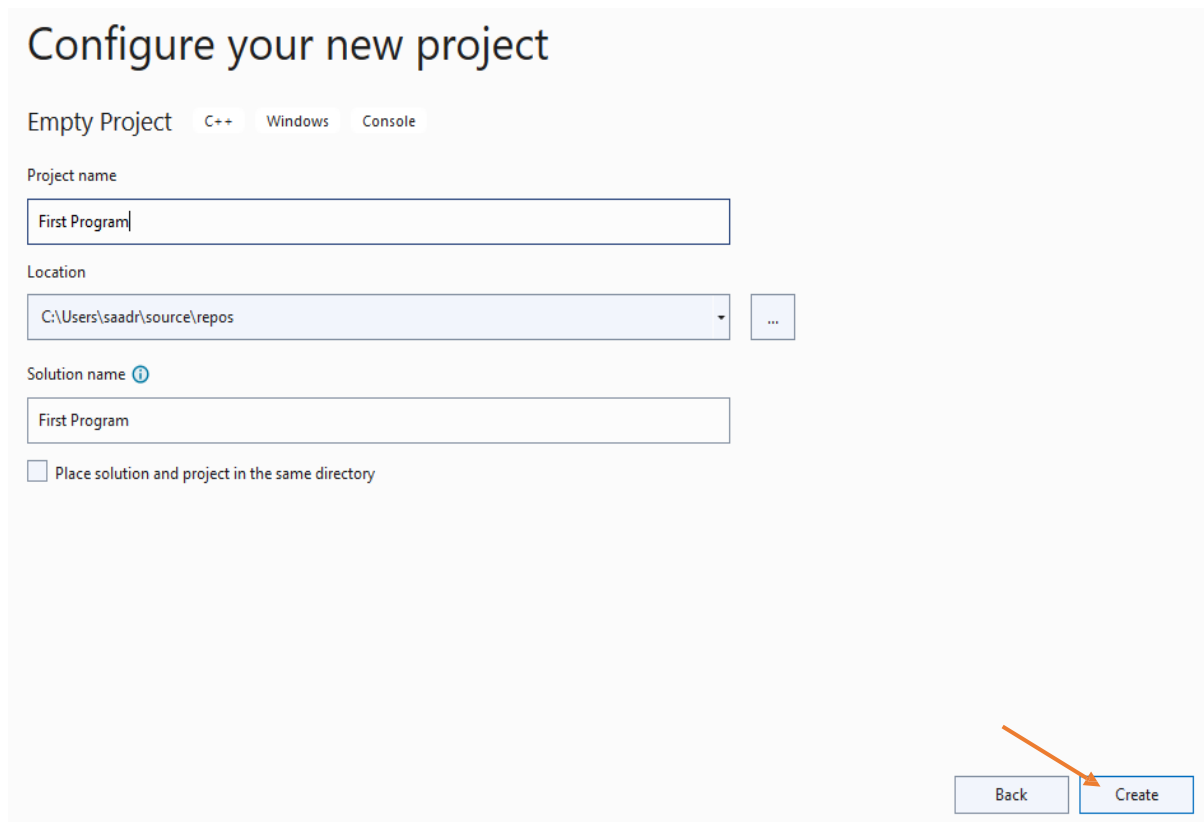


Fig. 38 (Microsoft ® Visual Studio 2022)

- On right side, Under “**Solution Explorer**”
- Right click “**Source Files**”
- Select “**Add**”
- Click “**New Item**”

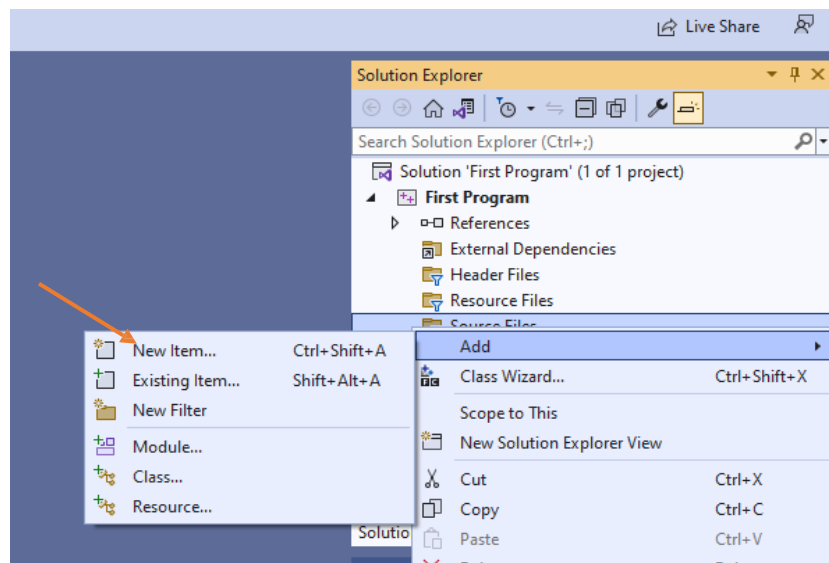


Fig. 39 (Microsoft ® Visual Studio 2022)

- Select “**C++ File (.cpp)**”
- Name it “**Source.c**”
- Click “**Add**”

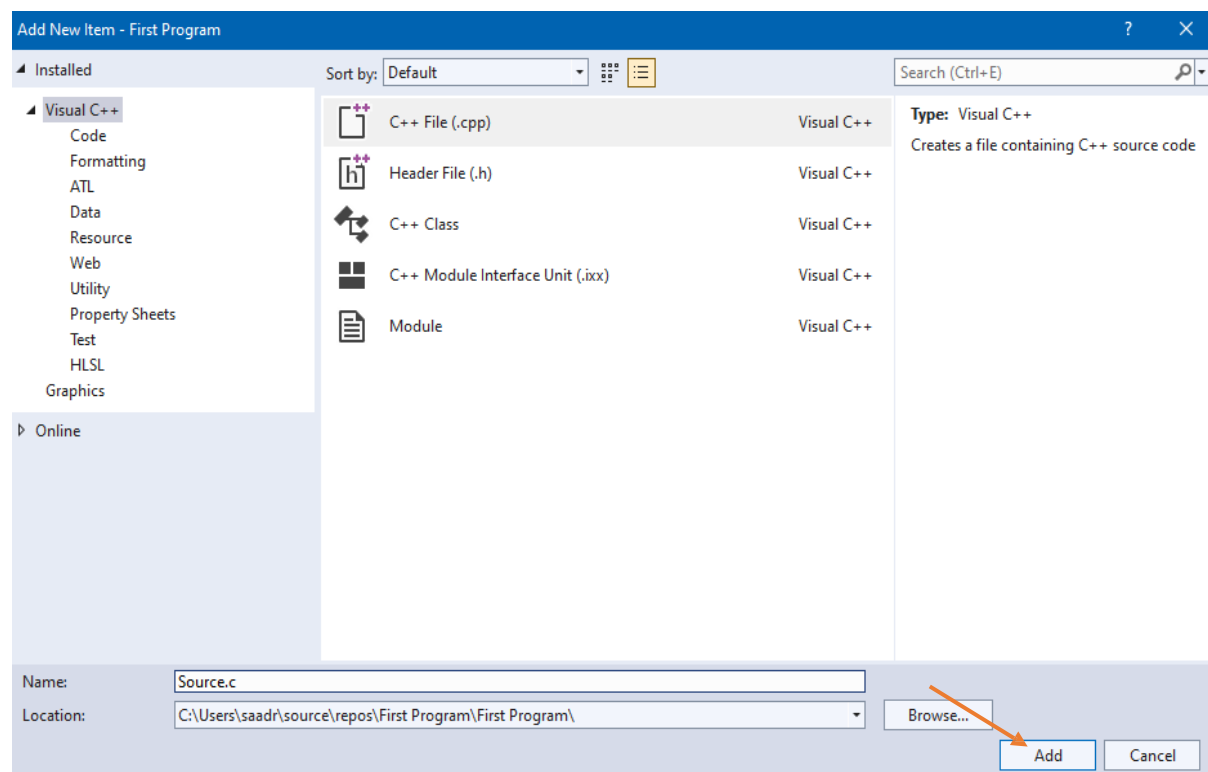


Fig. 40 (Microsoft ® Visual Studio 2022)

- Write a C program to display “**Hello World**”

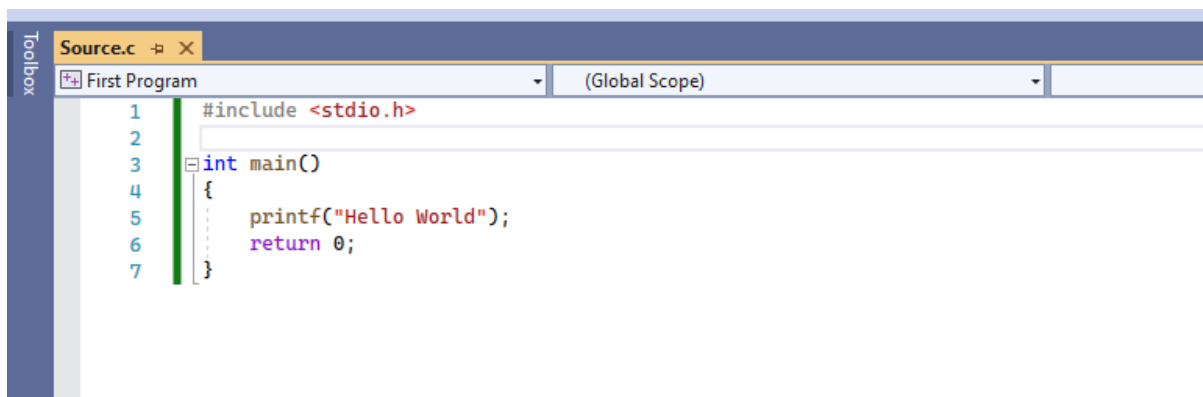


Fig. 41 (Microsoft ® Visual Studio 2022)

- On the menu bar select “**Debug**”
- Click “**Start Without Debugging**” OR Press “**CTRL + F5**”

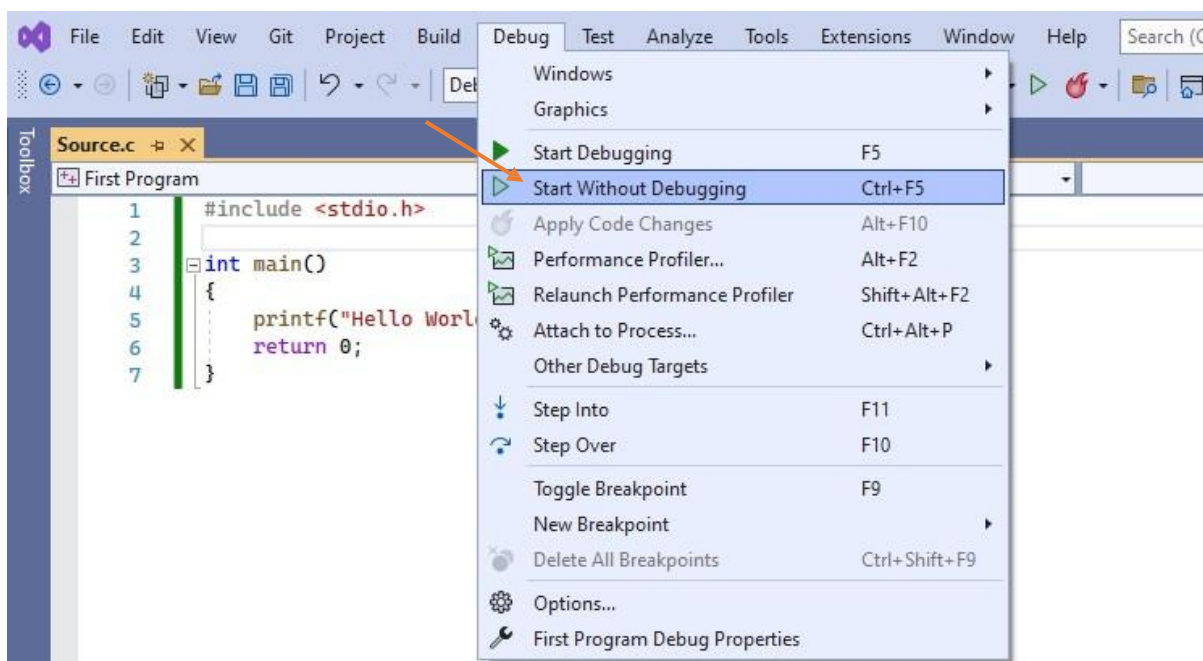


Fig. 42 (Microsoft ® Visual Studio 2022)

Output will be displayed on the console.

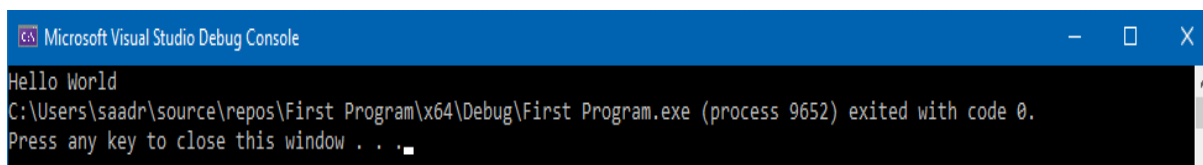


Fig. 43 (Microsoft ® Visual Studio Console)

Operators in C:

Operator Type	Name	Operator
Unary Operators	Increment	++
	Decrement	--
Arithmetic Operators	Addition	+
	Subtraction	-
	Multiplication	*
	Division	/
	Modulus	%
Logical Operators	AND	&&
	OR	
	NOT	!
Relational Operators	Less than	<
	Greater than	>
	Less than Equal to	<=
	Greater than Equal to	>=
	Equal to	==
	Not Equal to	!=
Bitwise Operators	Bitwise AND	&
	Bitwise OR	
	Bitwise XOR	^
	Bitwise Complement	~
	Shift left	<<
	Shift right	>>
Ternary Operators	Conditional	?:

Operator Precedence in C:

Operator precedence determines the grouping of terms in an expression and decides how an expression is evaluated. Operators with highest precedence appear at the top of the table, those with lowest appear at the bottom.

Operator Type	Operators
Postfix	(), [], ->, ++, --
Unary	+, -, !, ~, ++, --
Multiplicative	*, /, %
Additive	+, -
Shift	<<, >>
Relational	<, <=, >, >=
Equality	==, !=
Bitwise AND	&
Bitwise XOR	^
Bitwise OR	
Logical AND	&&
Logical OR	
Conditional	?:

Integer Division:

Division in which the fractional part is discarded is called Integer Division. For example

$11/2 = 5 + \frac{1}{2}$. In Integer Division, $11/2 = 5$. Demonstration in C programming is shown below.

- Open Web browser
- In search bar type, “**Online C compiler**”
- Open first site

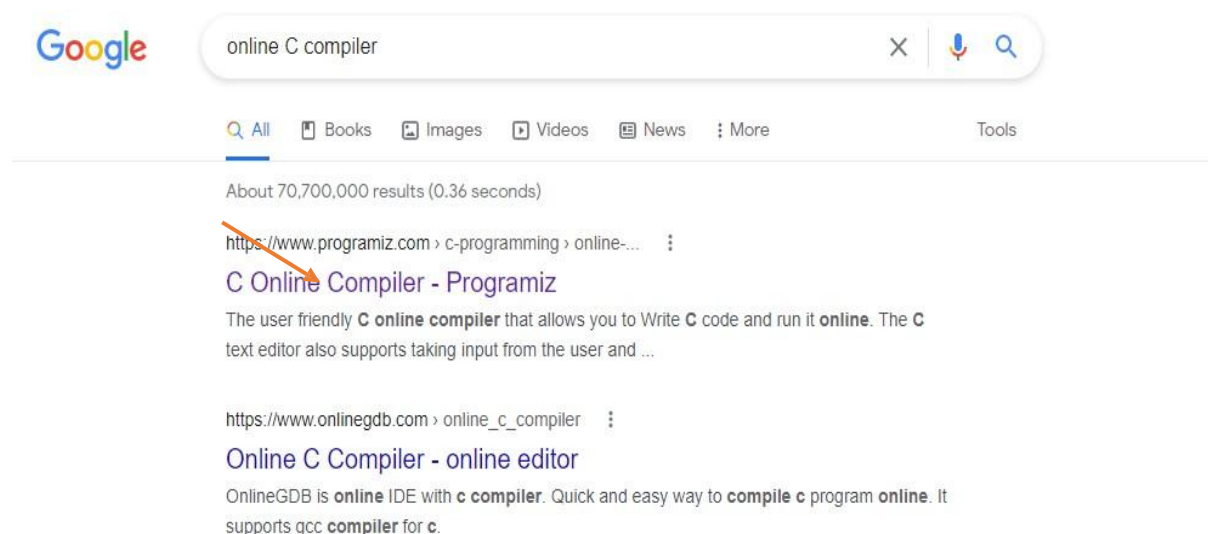
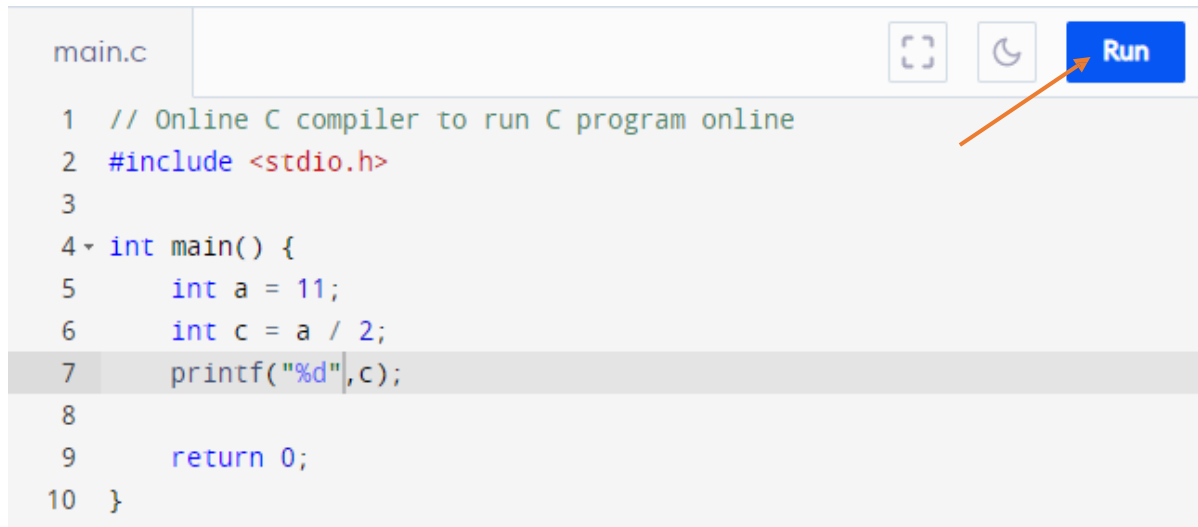


Fig. 44 (Online Compiler)

- Write a simple program which divides an odd integer by 2 as shown in figure
- Click the **“Run”** button

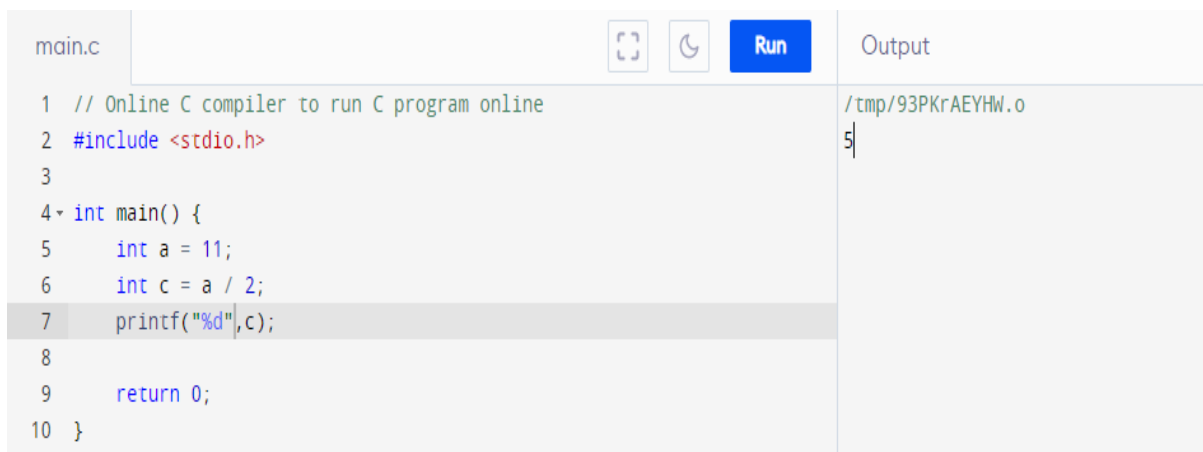


The screenshot shows an online C compiler interface. At the top, there is a tab labeled 'main.c'. To the right of the tab are three icons: a square with a circle inside, a circular arrow, and a blue button labeled 'Run'. An orange arrow points from the 'Run' button towards the bottom right. Below the tab, the C code is displayed in a monospaced font with syntax highlighting. The code is as follows:

```
1 // Online C compiler to run C program online
2 #include <stdio.h>
3
4 int main() {
5     int a = 11;
6     int c = a / 2;
7     printf("%d",c);
8
9     return 0;
10 }
```

Fig. 45 (Online Compiler)

Output will be shown next to the editor screen.



The screenshot shows the same online C compiler interface as Fig. 45, but now with an 'Output' panel on the right. The 'Run' button has been clicked, and the output of the program is displayed in the 'Output' panel. The output is the number '5'. The C code is the same as in Fig. 45.

```
1 // Online C compiler to run C program online
2 #include <stdio.h>
3
4 int main() {
5     int a = 11;
6     int c = a / 2;
7     printf("%d",c);
8
9     return 0;
10 }
```

Output: /tmp/93PKrAEYHW.o
5

Fig. 46 (Online Compiler)

IN-LAB TASKS

Task 1

Design a pseudocode to find the largest of three numbers and represent the logic using a flowchart in LARP.

Input:

Enter first number: 12
Enter second number: 25
Enter third number: 9

Output:

The largest number is 25

Task 2

Write a pseudocode and draw a flowchart to check whether a given year is a leap year.

Input 1:

Enter a year: 2024

Output 1:

2024 is a leap year.

Input 2:

Enter a year: 2023

Output 2:

2023 is not a leap year.

Task 3

Calculate Square: Write a pseudocode to compute the square of a given number and represent it in a flowchart.

Input:

Enter a number: 5

Output:

Square of 5 is 25.

Task 4

Simple Calculator: Write a pseudocode for a calculator that takes two numbers and performs a user-selected operation (addition, subtraction, multiplication, division).

Input 1 (Addition):

Enter first number: 8

Enter second number: 4

Enter operation (+, -, *, /): +

Output 1:

Result: 12

Input 2 (Division):

Enter first number: 10

Enter second number: 2

Enter operation (+, -, *, /): /

Output 2:

Result: 5

Input 3 (Invalid operation):

Enter first number: 10

Enter second number: 5

Enter operation (+, -, *, /): %

Output 3:

Invalid operation.

Task 5

Simple Login: Write a pseudocode to check if a user's input matches a hardcoded username and password and display success or error messages accordingly.

Input 1 (Correct credentials):

Enter username: admin

Enter password: 1234

Output 1:

Login successful!

Input 2 (Incorrect password):

Enter username: admin

Enter password: 0000

Output 2:

Incorrect username or password.

Task 6

Convert Minutes to Seconds: Create a flowchart that converts a given number of minutes into seconds.

Input:

Enter minutes: 3

Output:

3 minutes is equal to 180 seconds.

Submissions:

- For In-Lab Activity: Save the files on your PC. TA's will evaluate the tasks offline.
- For Post-Lab Activity: Submit the .larp file on Google Classroom and name it to your roll no.

References and Additional Material:

- Microsoft ® Visual Studio 2022 Installation
<https://visualstudio.microsoft.com/>
- LARP 3.0 Installation
<https://en.freownloadmanager.org/Windows-PC/LARP.html>
- Microsoft ® Visual Studio Documentation
<https://docs.microsoft.com/en-us/visualstudio/windows/?view=vs-2022>
- LARP Documentation
<http://larp.marcolavoie.ca/en/documentation/documentation.htm>

