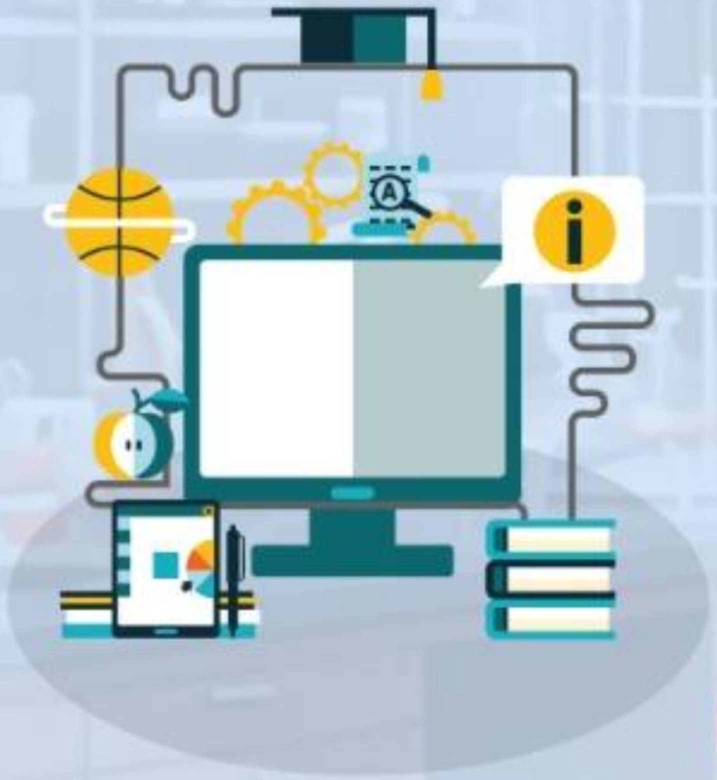
शिक्षा मंत्रालय
MINISTRY OF EDUCATION

Virtual Lab
as a teaching learning tool for Computer Science



Date and Time

5 December, 2024

from 10:00 AM to 11:00 AM, Thursday

Resource Persons

Ms. Shweta Bhardwaj
Technical consultant,
CIET NCERT, New Delhi

Mr. Rahul Verma
Technical consultant,
CIET NCERT, New Delhi

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DIKSHA

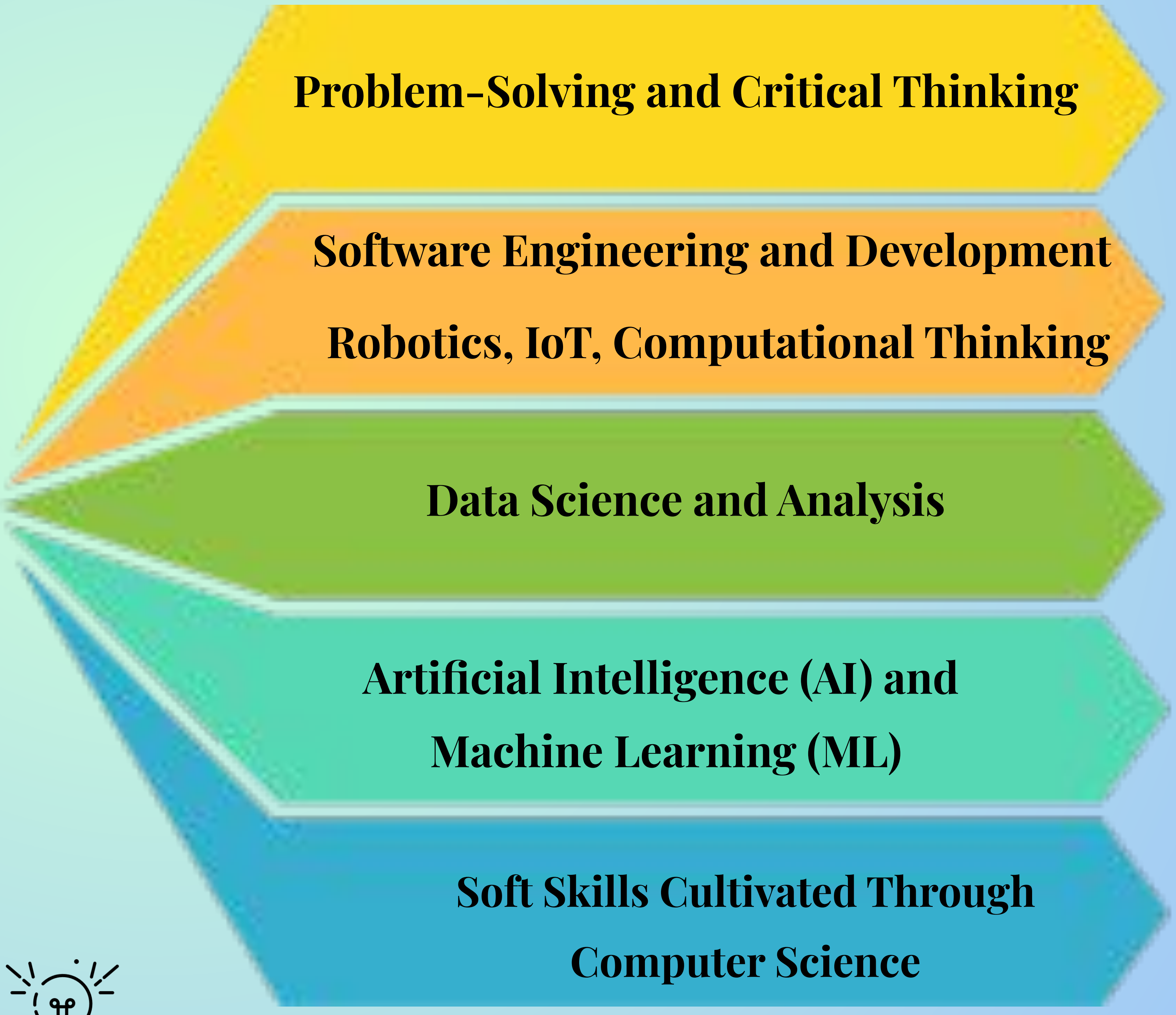
Central Institute of Educational Technology

A Constituent Unit of NCERT

Virtual Labs
as a Teaching-Learning Tool for
Computer Science

Significance of Computer Science in Education

Computer science is a branch of engineering science that studies the technology and the principles of Computer System.



Problem-Solving and Critical Thinking

Software Engineering and Development

Robotics, IoT, Computational Thinking

Data Science and Analysis

Artificial Intelligence (AI) and Machine Learning (ML)

Soft Skills Cultivated Through Computer Science

Experimentation: The Backbone of Learning and Innovation in Computer Science

Bridging Theory and Practicals

Skill Development

Builds Resilience

Understanding complex concepts

Immediate Feedback

Encourage Creativity & Innovation

Computer Science

Understanding

Familiarity with programming language

Visualization

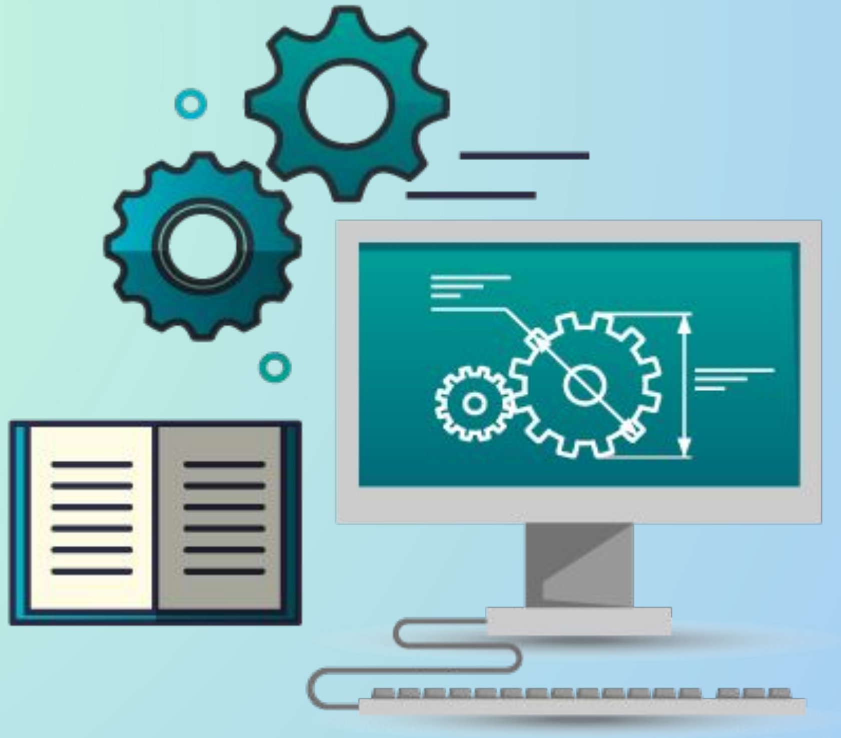
Visualization of concepts using Algorithms and Flowcharts

Real-world Application

Ability to solve problems is the most significant component of computer science

Virtual Labs for Computer Science

Virtual labs are interactive, digital simulations of activities that typically take place in physical laboratory settings.



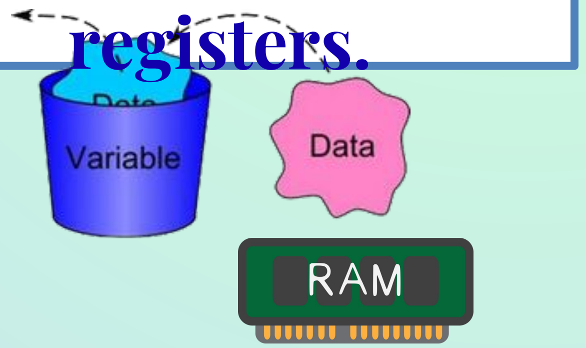
The Significance of Virtual Labs in Computer Science Education

Step-by-Step Code Execution

Provide an interactive environment to understand programming concepts step by step.

Visualizing Variables and Memory

Visual representations of memory allocation, showing how variables are stored in memory or registers.



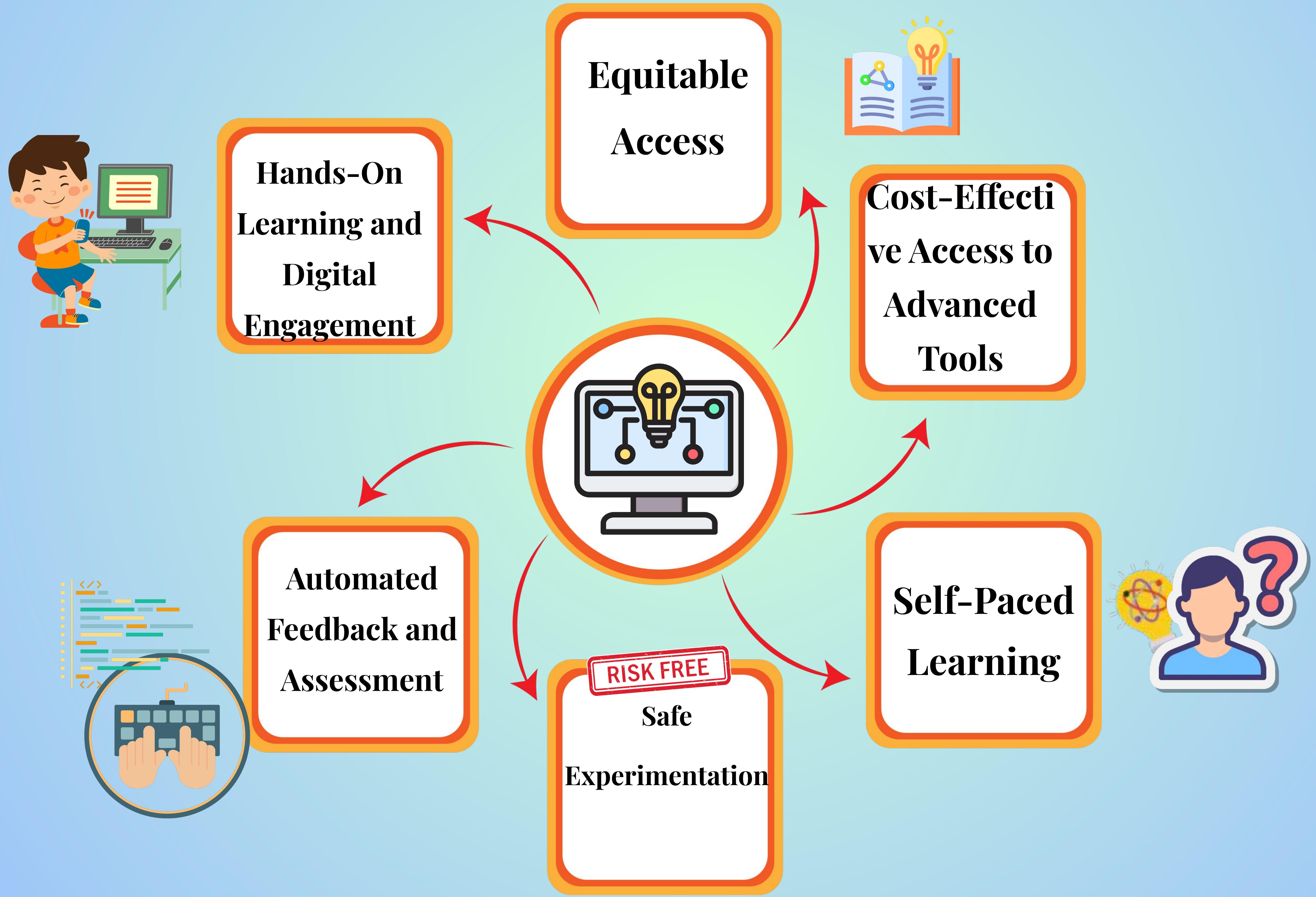
Simulating Hardware Interaction

Simulate lower-level aspects of computation, such as how the CPU processes instructions, how memory is allocated at a hardware level !

Interactive Debugging

Examine the code in real-time. spotting and fixing bugs directly in the development environment

Learning by Doing: Experiential Learning



Hands-On Learning and Digital Engagement

Equitable Access

Cost-Effective Access to Advanced Tools

Self-Paced Learning

RISK FREE

Safe Experimentation

Automated Feedback and Assessment

VIRTUAL LAB SESSIONS

PRE-LAB

Develop familiarity with the necessary instructions, background information, and execution guidelines to prepare the students.

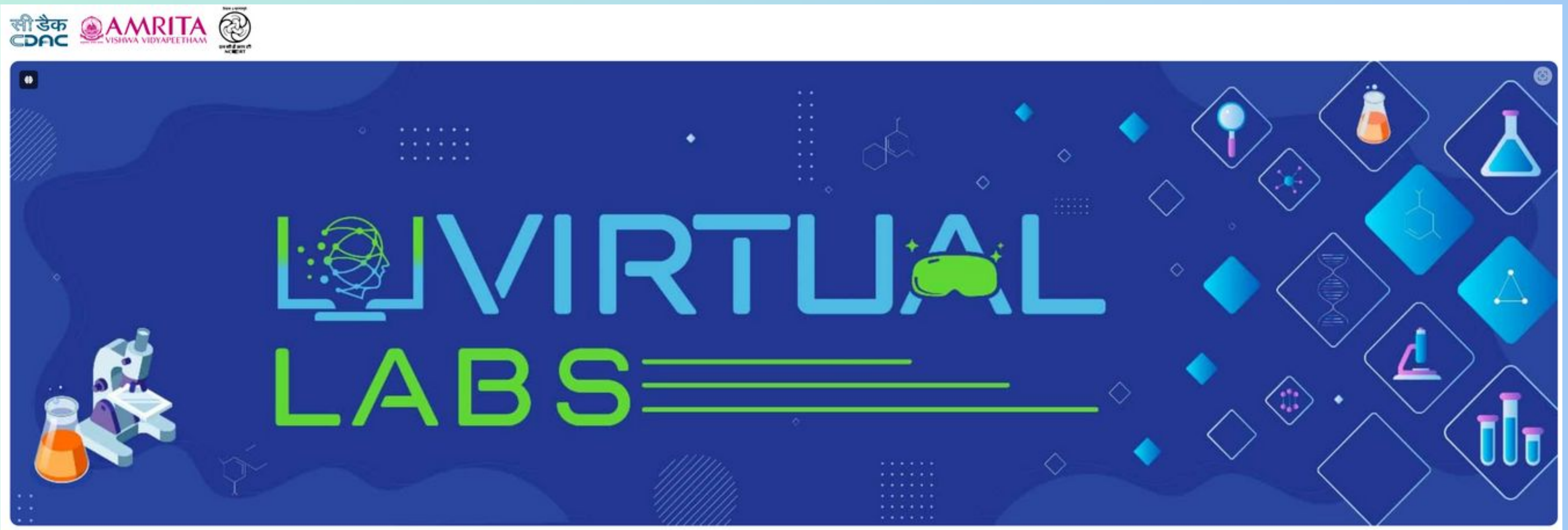
PERFORMANCE-LAB

Allows students to conduct experiments, analyze code, and explore execution process through interactive digital simulations in sandbox environment

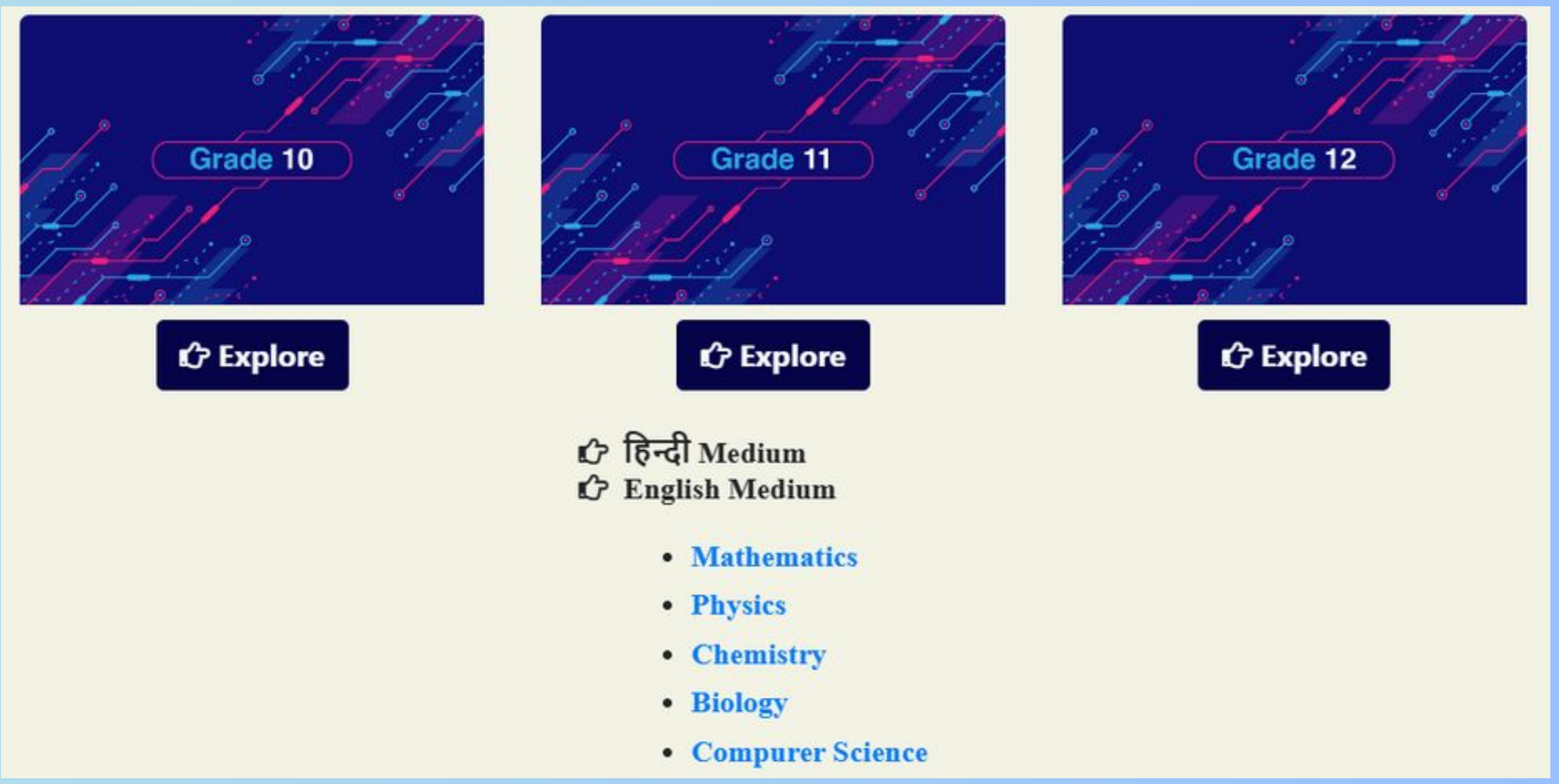
POST-LAB

Involves reviewing output, analyzing results and discussing findings to reinforce learning and draw conclusions from the executed code.

Accessing Virtual Labs on Diksha Platform



URL: https://diksha.gov.in/virtuallabs.html



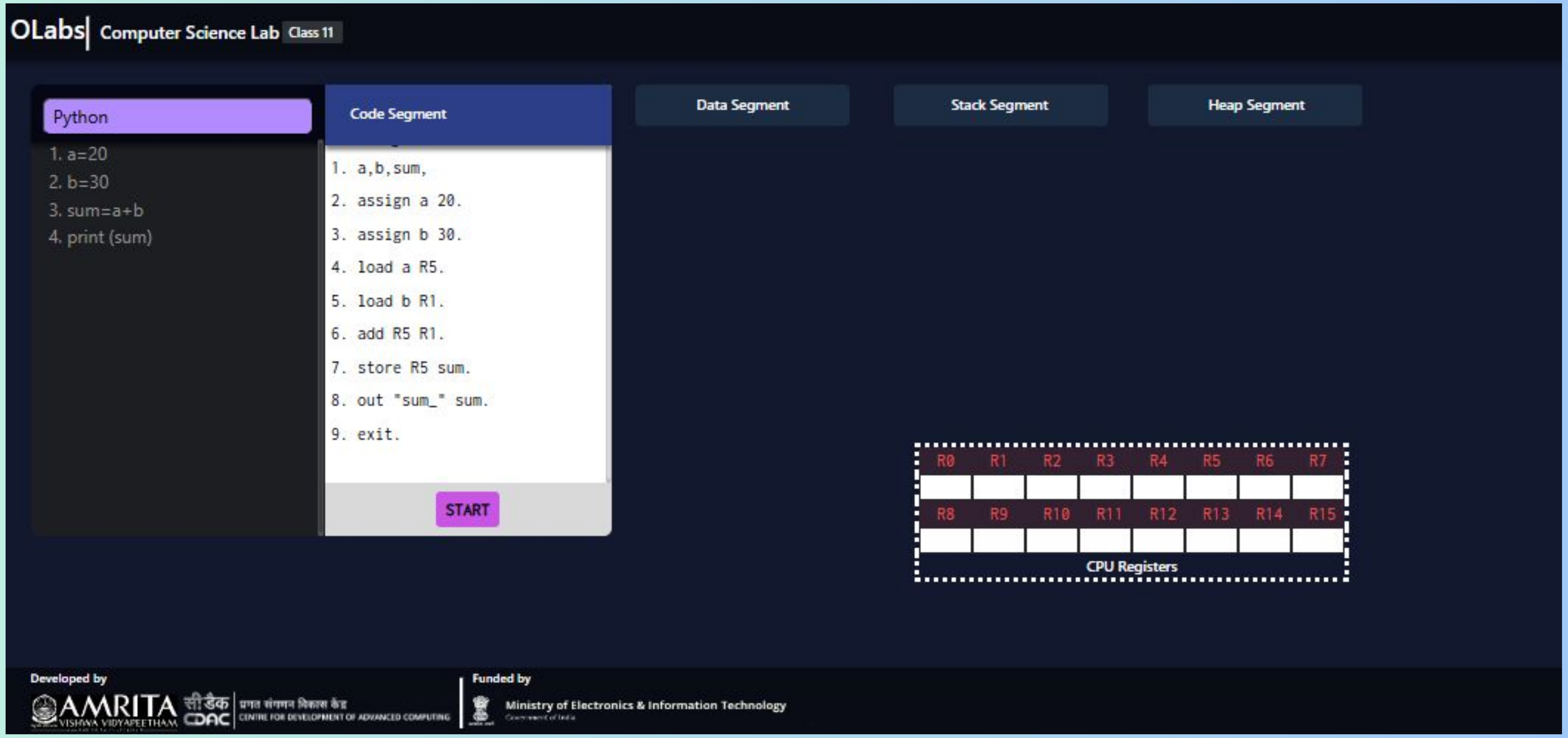
- हिन्दी Medium
- English Medium
  - Mathematics
  - Physics
  - Chemistry
  - Biology
  - Compurer Science

Virtual Lab Experiment

Class XI (Computer Science Lab Manual)

Lab Activity: Add Two Numbers

Aim: -To understand the working of addition of two numbers in python and visualising the output through virtual labs



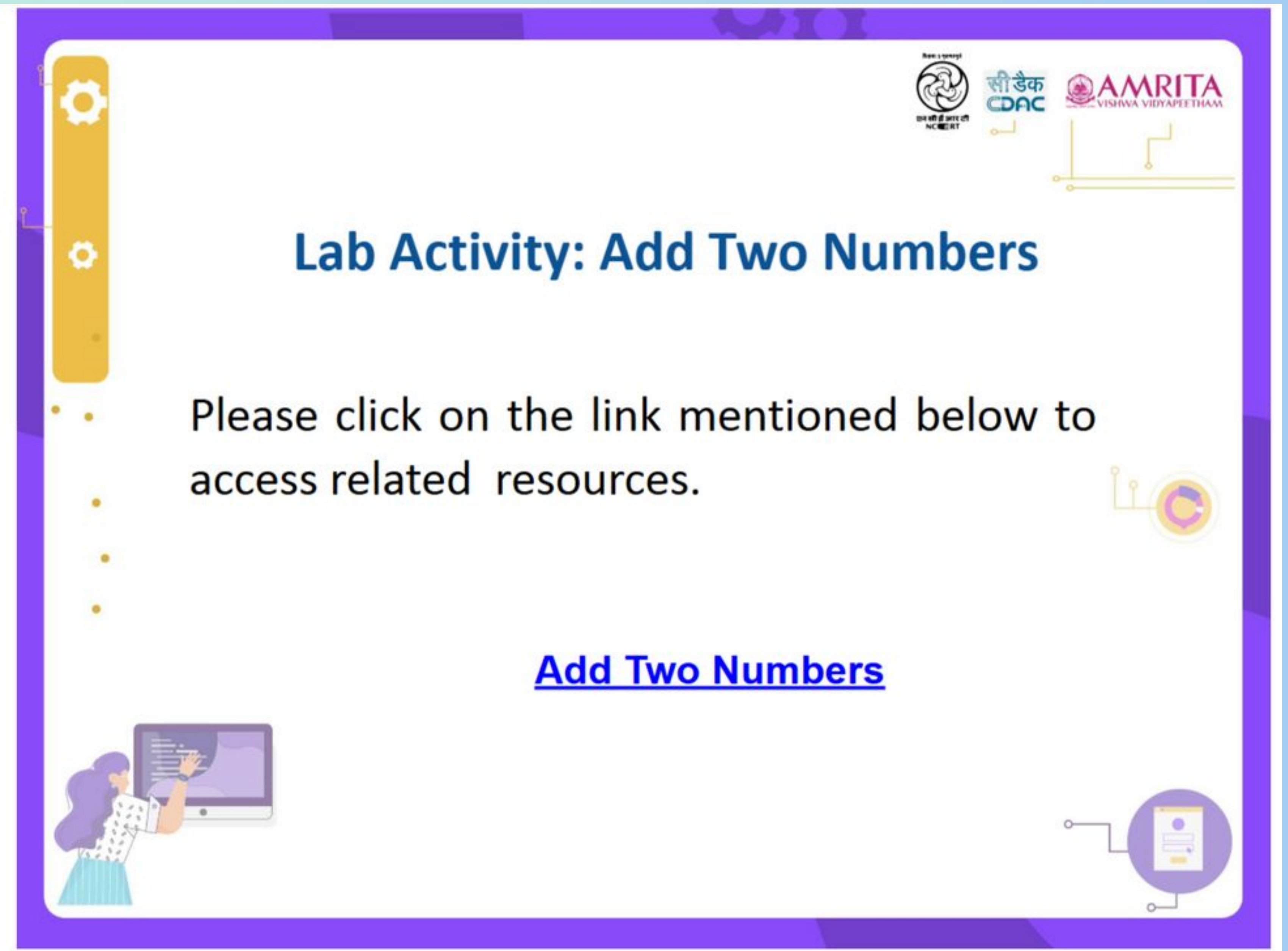
```
a=20
b=30
sum=a+b
print (sum)
```

```
a,b,sum,
assign a 20.
assign b 30.
load a R5.
load b R1.
add R5 R1.
store R5 sum.
out "sum_" sum.
exit.
```

Virtual Lab Experiment

Class XI (Computer Science Lab Manual)

Lab Activity: Add Two Numbers



Lab Activity: Add Two Numbers

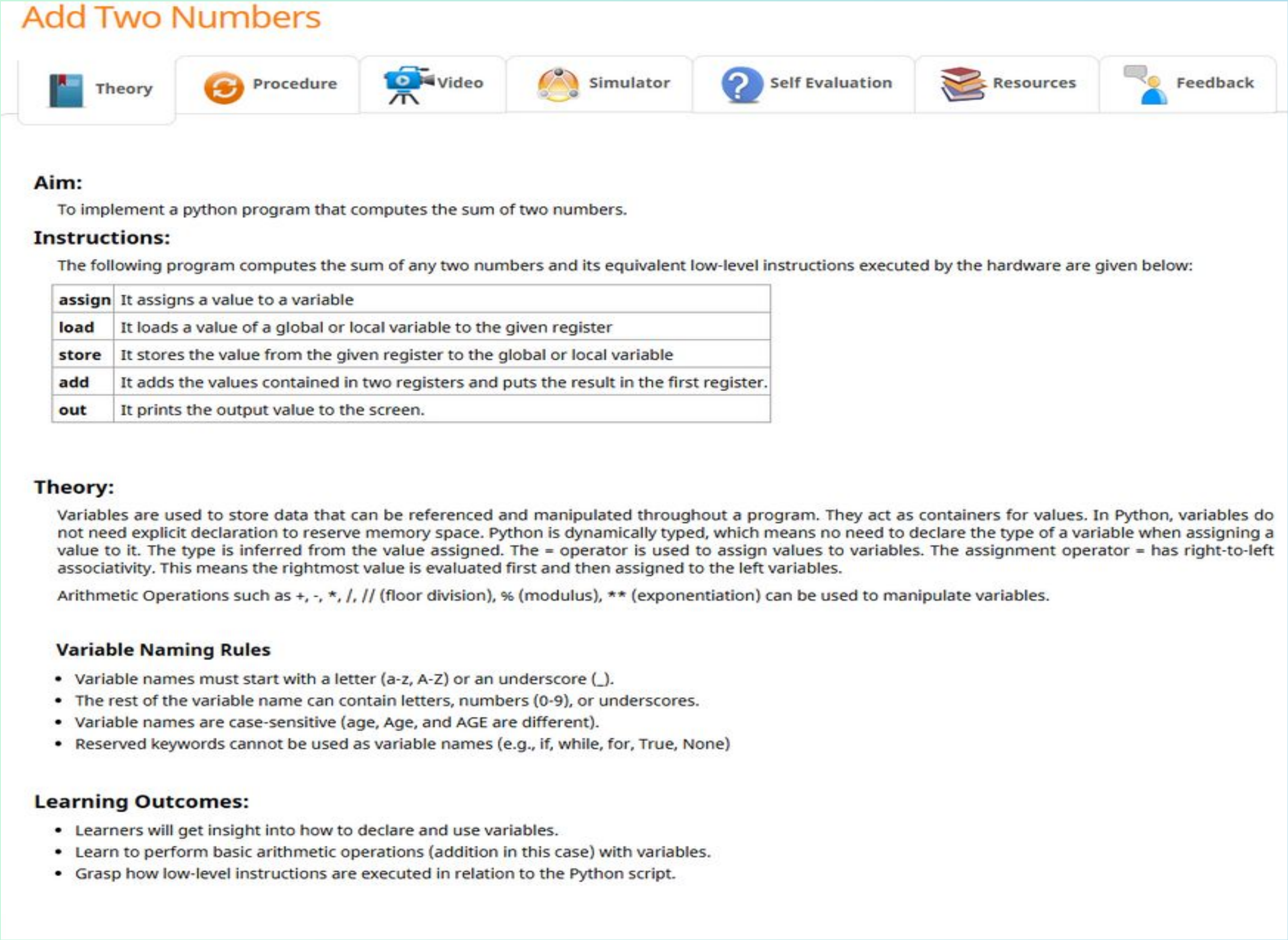
Please click on the link mentioned below to access related resources.

Add Two Numbers

Pre-Lab Session

Theory

Procedure



Add Two Numbers

Aim:

To implement a python program that computes the sum of two numbers.

Instructions:

The following program computes the sum of any two numbers and its equivalent low-level instructions executed by the hardware are given below:

assign	It assigns a value to a variable
load	It loads a value of a global or local variable to the given register
store	It stores the value from the given register to the global or local variable
add	It adds the values contained in two registers and puts the result in the first register.
out	It prints the output value to the screen.

Theory:

Variables are used to store data that can be referenced and manipulated throughout a program. They act as containers for values. In Python, variables do not need explicit declaration to reserve memory space. Python is dynamically typed, which means no need to declare the type of a variable when assigning a value to it. The type is inferred from the value assigned. The = operator is used to assign values to variables. The assignment operator = has right-to-left associativity. This means the rightmost value is evaluated first and then assigned to the left variables.

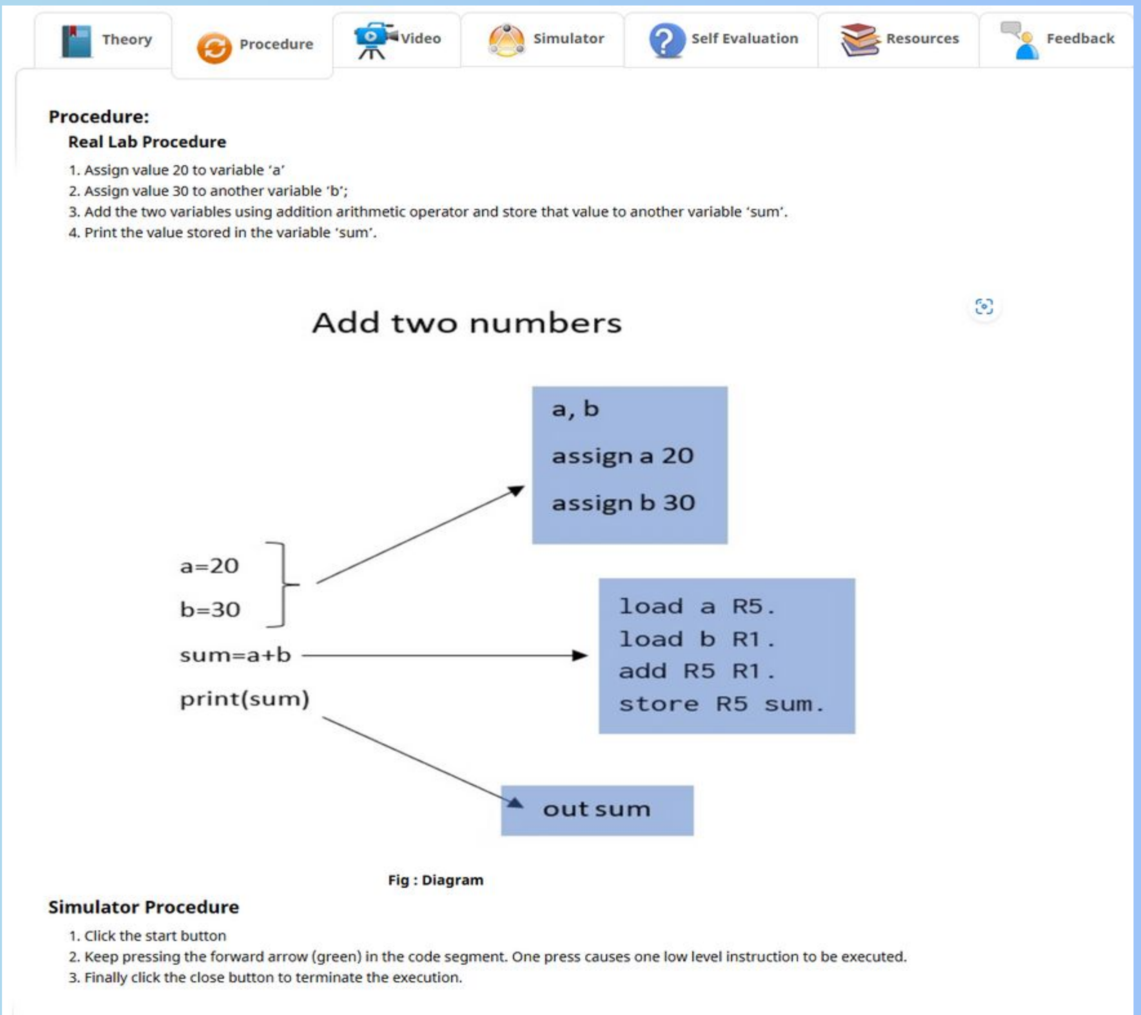
Arithmetic Operations such as +, -, *, /, // (floor division), % (modulus), ** (exponentiation) can be used to manipulate variables.

Variable Naming Rules

- Variable names must start with a letter (a-z, A-Z) or an underscore (_).
- The rest of the variable name can contain letters, numbers (0-9), or underscores.
- Variable names are case-sensitive (age, Age, and AGE are different).
- Reserved keywords cannot be used as variable names (e.g., if, while, for, True, None)

Learning Outcomes:

- Learners will get insight into how to declare and use variables.
- Learn to perform basic arithmetic operations (addition in this case) with variables.
- Grasp how low-level instructions are executed in relation to the Python script.



Procedure:

Real Lab Procedure

1. Assign value 20 to variable ‘a’
2. Assign value 30 to another variable ‘b’;
3. Add the two variables using addition arithmetic operator and store that value to another variable ‘sum’.
4. Print the value stored in the variable ‘sum’.

```
a=20
b=30
sum=a+b
print(sum)
```

```
a, b
assign a 20
assign b 30
```

```
load a R5.
load b R1.
add R5 R1.
store R5 sum.
```

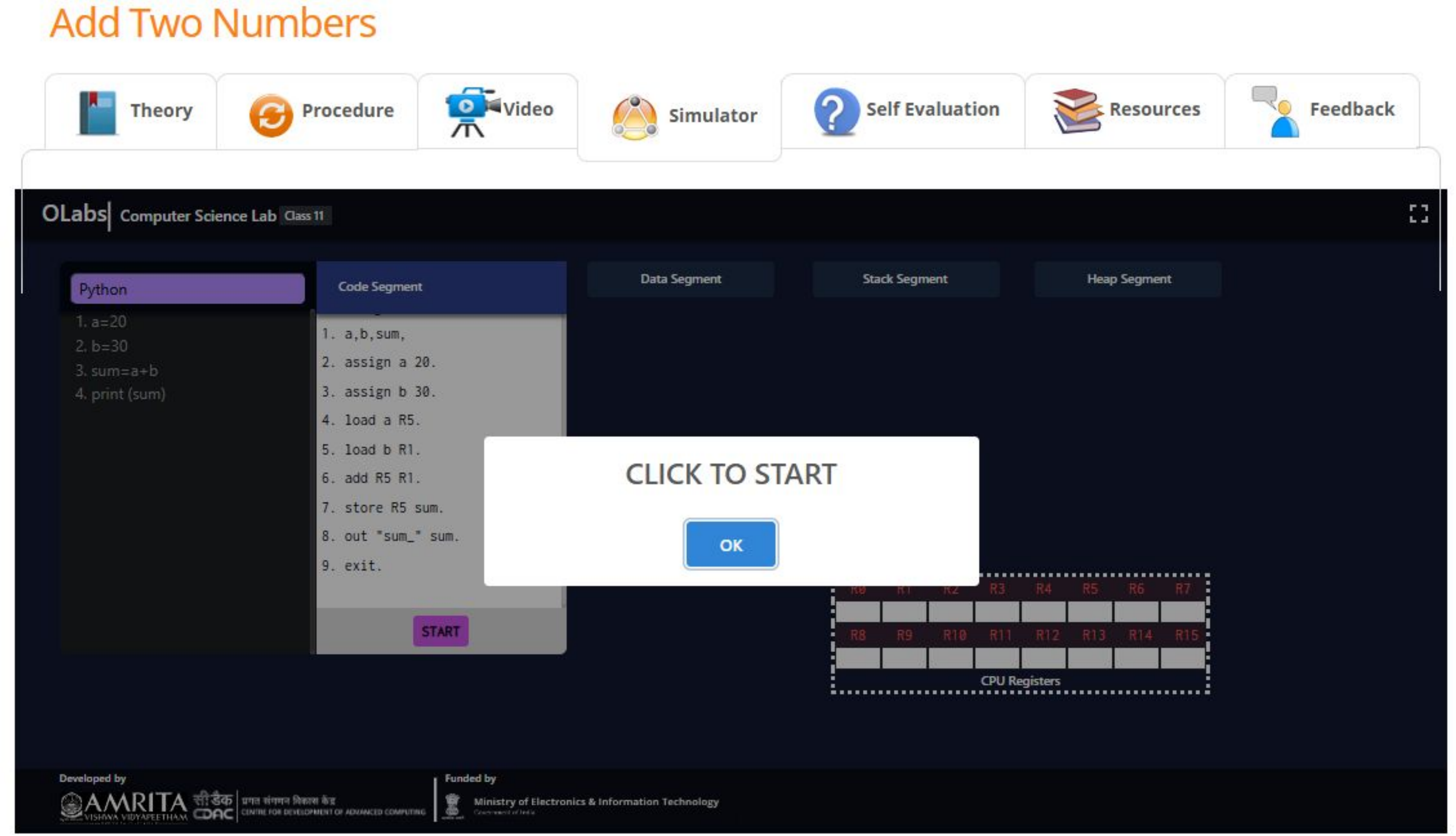
```
out sum
```

Fig : Diagram

Simulator Procedure

1. Click the start button
2. Keep pressing the forward arrow (green) in the code segment. One press causes one low level instruction to be executed.
3. Finally click the close button to terminate the execution.

Lab Session



Add Two Numbers

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print (sum)
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```
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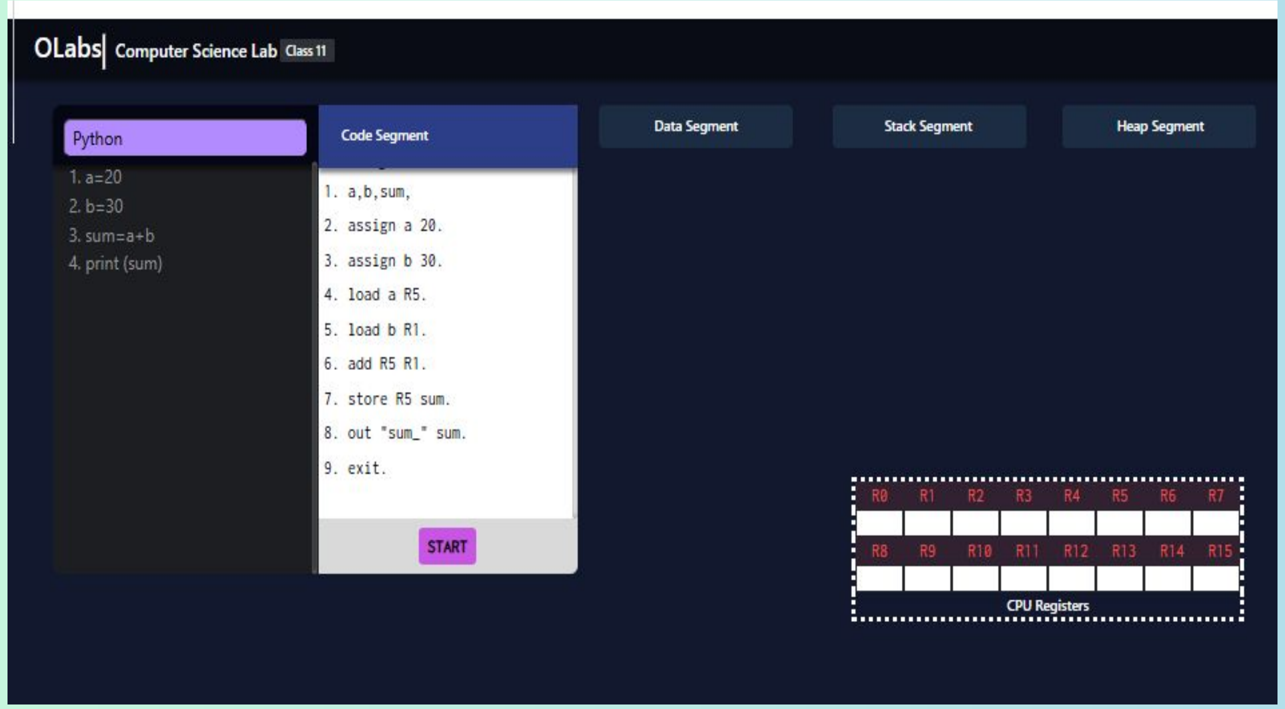
out "sum_" sum.
exit.
```

CLICK TO START

Lab Session

Execution of Python Program



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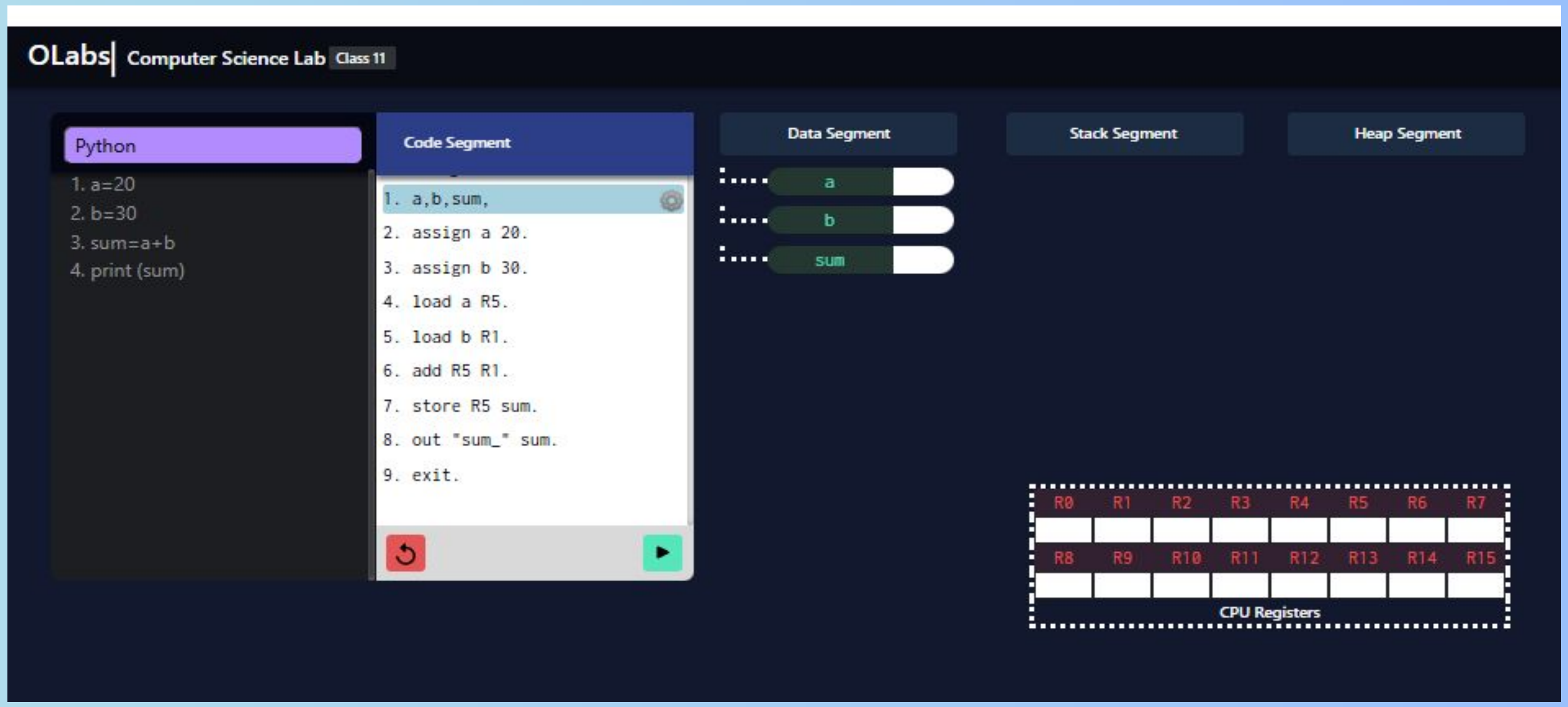

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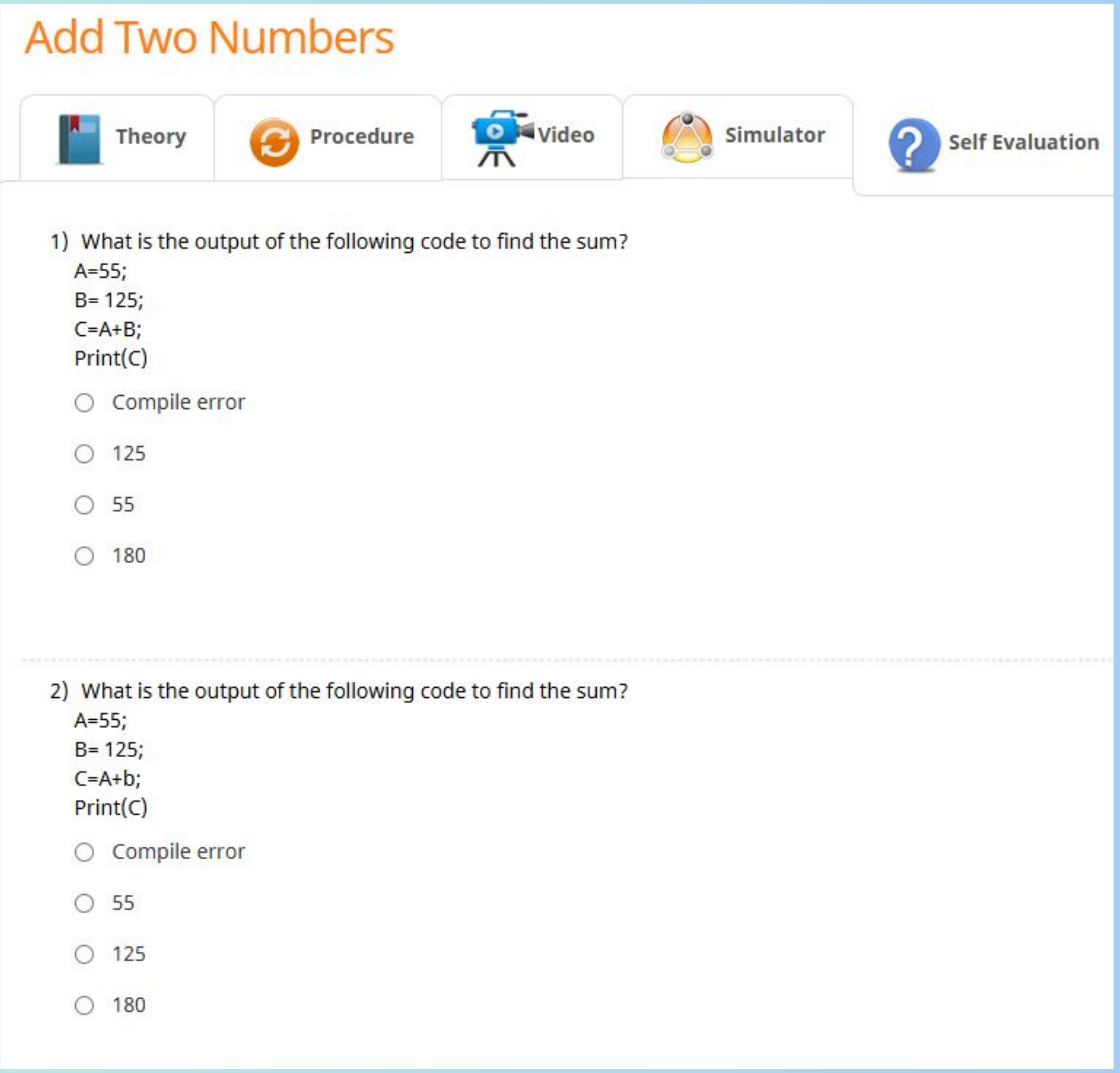
exit.
```

Post-Lab Session

Assessment of Conceptual Understanding of learners



Add Two Numbers

1) What is the output of the following code to find the sum?

```
A=55;
B= 125;
C=A+B;
Print(C)
```

○ Compile error

○ 125

○ 55

○ 180

2) What is the output of the following code to find the sum?

```
A=55;
B= 125;
C=A+b;
Print(C)
```

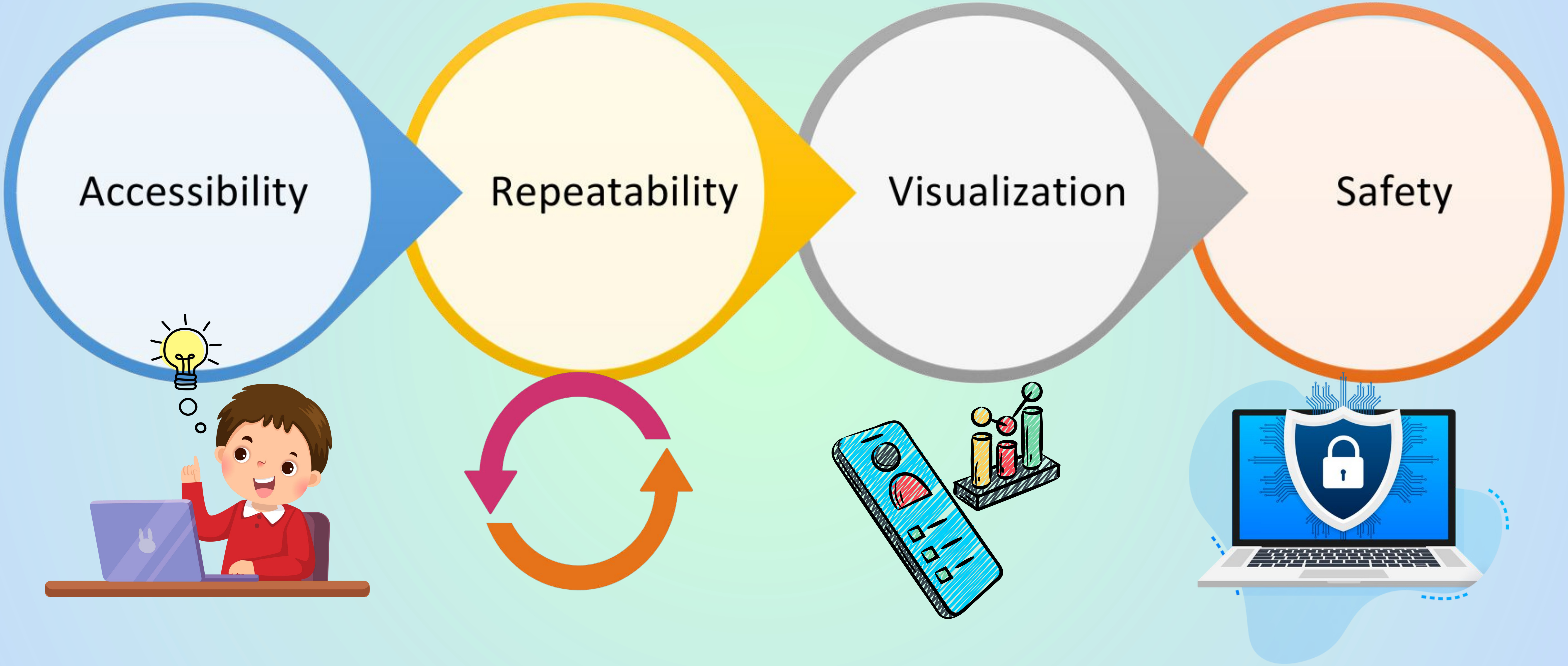
○ Compile error

○ 55

○ 125

○ 180

Benefits of Virtual Lab



Accessibility

Repeatability

Visualization

Safety

Enhancing Critical Thinking and Problem-Solving

Program Structure

Encourage Logical Thinking about the structure of program, considering the appropriate variables, controls, and data collection methods.

Data Analysis

Analysis of collected data , identifying patterns, and drawing conclusion honing their problem-solving and analytical skills.

Concept Application

Application of Computational Knowledge to solve real-world problems, fostering their ability to think critically and creatively.

Assessment with Virtual Simulations

DIAGNOSTIC

IDENTIFY MISCONCEPTION

Virtual lab diagnostic can pinpoint specific areas where students struggle, allowing teachers to address misconception

PERSONALISED FEEDBACK

Diagnostic assessment in virtual labs can provide tailored feedback to students, guiding them towards mastery

DATA DRIVEN INTERVENTION

Insights from virtual lab diagnostic can inform targeted interventions and personalized learning plans

FORMATIVE

INTERACTIVITY

Virtual simulations allow students to actively execute the code, providing real-time feedback and opportunities for experimentation.

DATA COLLECTION

Virtual labs can capture detailed performance data, enabling teachers to track student progress and identify areas for improvement.

ADAPTIVE FEEDBACK

Simulations can adapt to student actions, providing personalized guidance and scaffolding to support learning.

The Role of Teachers in Virtual Lab Assessment

1. Guiding and Facilitating Learning
2. Blending Virtual and Physical Lab Activities
3. Monitoring and Assessing Progress
4. Supporting Self-Paced Learning
5. Developing Assessment Strategies