



## Virtual Labs Experiment Pedagogy

### PROBLEM STATEMENT

Virtual Labs project is a Government of India initiative aimed at developing online virtual experiments consisting of content, images, videos, and interactive animations to enhance student's learning. Data Structures is a very important subject for Computer Science students. Developing a proper conceptual understanding is extremely valuable for a student's foundation in this area. Our goal is to make sure that the student is able to visualize various Data Structures algorithms and be thorough with the concept behind it. All experiments are programming language independent, so as to focus on teaching and testing the students on conceptual understanding only. It is also aimed at facilitating faculty explain the various concepts of Data Structures in a visual way.

### PEDAGOGY PRINCIPLES

Three theories are leveraged on while designing the pedagogy of an experiment:

- Bloom's taxonomy
- Gagne's 9 events of instruction
- Merrill's first principles

#### Learning Object Development

Dr David Merrill's Component Display Theory

Comparing Cognitive Levels Between Merrill and Bloom

Merrill	Bloom	
Remember	Knowledge	Simple to teach and assess
	Comprehension	
Use	Application	Difficult to teach and assess
	Analysis	
	Evaluation	



### EXPERIMENT STRUCTURE

An experiment is structured as a set of learning units. Each learning unit consists of several tasks. The experiment adheres to Gagne's nine events of instruction and Merrill's first principles by ensuring that tasks in each learning unit incorporate following elements:

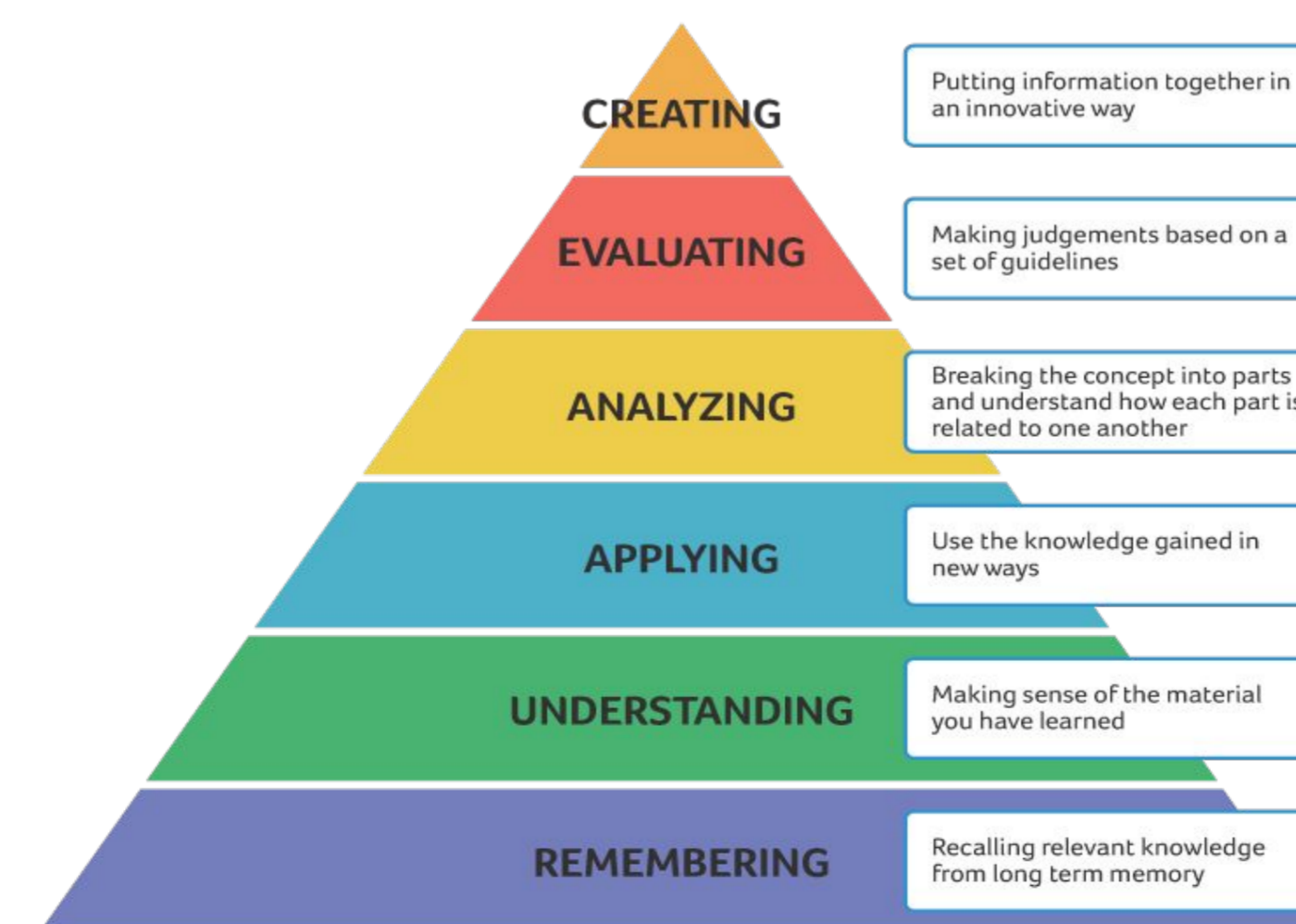
**Define** - Introduce the concept, using text and visual.

**Demonstrate** - Show by giving an example, using animation, images etc

**Practice** - Provide modules to try out the concept through hands-on experience. Supply steps and hints while allowing multiple tries, using animation and interactivity.

**Exercise** - Evaluate on conceptual understanding of the hands-on experience

**Quiz** - Reiterate key concepts, using Multiple Choice Questions



### DEVELOPMENT APPROACH

- **Staged** - Planning, organizing and creation of experiment content
- **Iterative** - Developing and testing modular code
- **Federated** - Integrating frontend and backend to render a final working application.
- Experiment structure is organised and well documented.
- Code is implemented through APIs making it reusable and maintainable.
- Literate style of programming is followed making the code easily understandable.
- Agile development process is followed, with constant feedback from mentors. Each learning unit is designed to be complete in itself, with concept, demonstration, practice, exercise and quiz.

### UNIQUE PERCEIVED BENEFIT

- Beneficial for 1st and 2nd year engineering students as Data Structures and Algorithms are usually taught in these years of study.
- Highly beneficial for tier 2 and tier 3 college students and faculty who can use this experiment to complement their course content.
- Promotes self-learning by being an all-round tool for learning a concept from scratch while assuming very basic prerequisites.
- Caters to many different learning styles, including visual & auditory learners and those who learn by doing and putting in practice; instead of just reading a book.

It is ensured that the learning objectives address the first 3 levels of Bloom's taxonomy: remembering, understanding and applying.

