Artificial & Computational Intelligence

AIML CLZG557

M1 Introduction

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BITS - CSIS

BITS Pilani

Pilani Campus

Agenda

- Course Administration
- Course Overview with example
- Getting Started (Module 1)

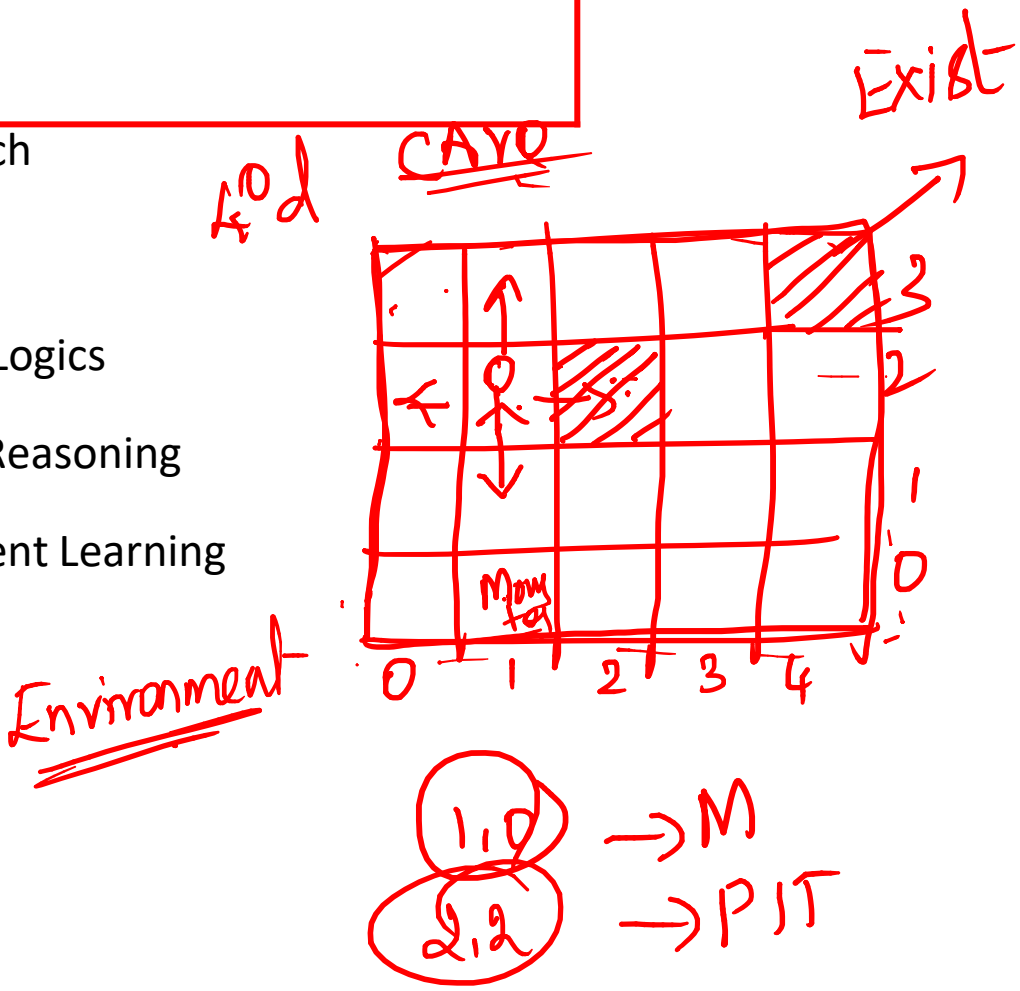
Course Administration

About the course

- Focus on
  - Principles of artificial intelligence
  - Concepts, algorithms involved in building rational agents
  - Topics covered like
    - (informed, uninformed & local) search & optimizations & applications
    - (logical & probabilistic) knowledge representation
    - (logical & probabilistic) Reasoning & applications
  - Topics not-covered like
    - Hardware aspect of the design
    - Formal machine learning & deep learning algorithms, neural networks etc., are covered under next semester courses like : Applied Machine Learning, Deep Learning
    - Deeper applications & algorithms of application of AI in Computer Vision, Natural Language processing etc., are included under next semester courses like Natural Language Processing, Information Retrieval.

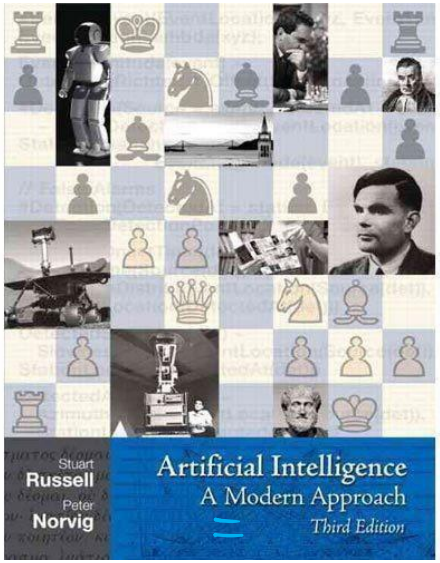
Course Plan

M1	Introduction to AI
M2	Problem Solving Agent using Search
M3	Game Playing
M4	Knowledge Representation using Logics
M5	Probabilistic Representation and Reasoning
M6	Reasoning over time, Reinforcement Learning
M7	Ethics in AI



About the course

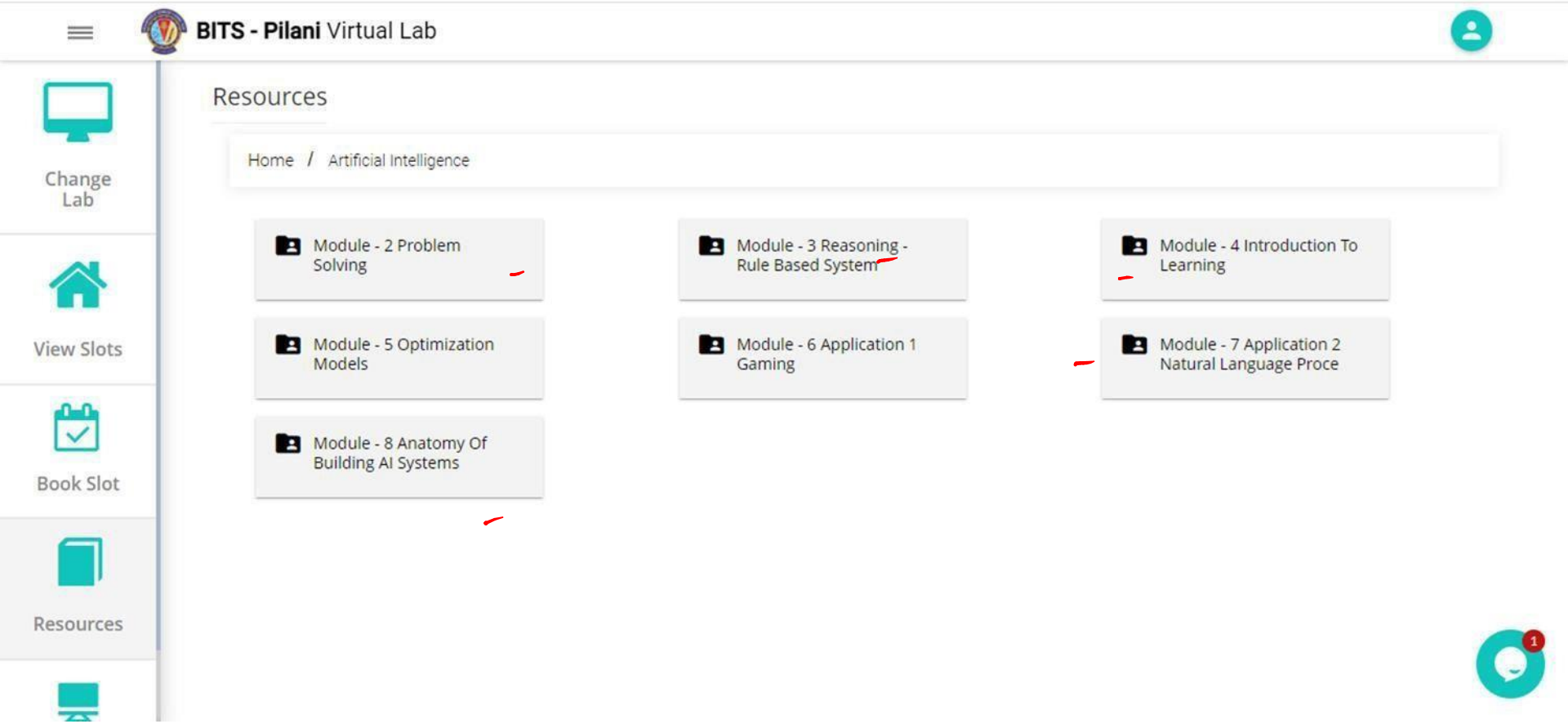
Text Book



Exercises : In Python & its libraries

Evaluation : 25% Assignment + 5% Quiz + 30% Mid Semester Written Exam + 40% Comprehensive Written Exam

About Labs



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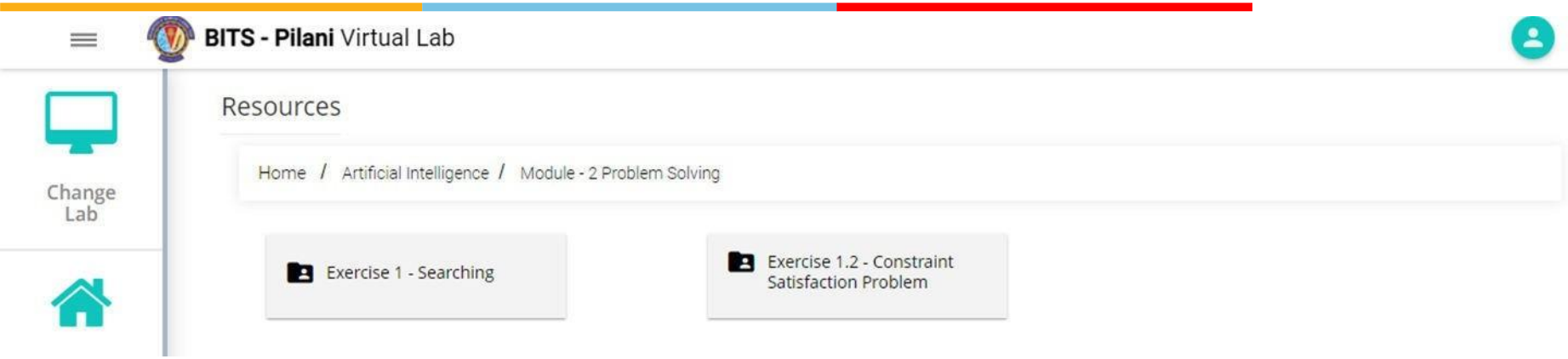

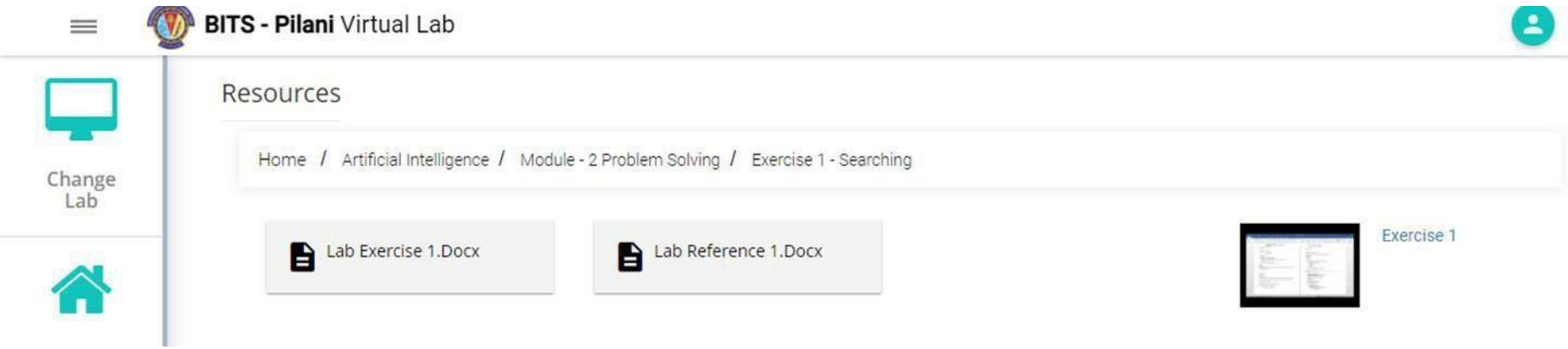

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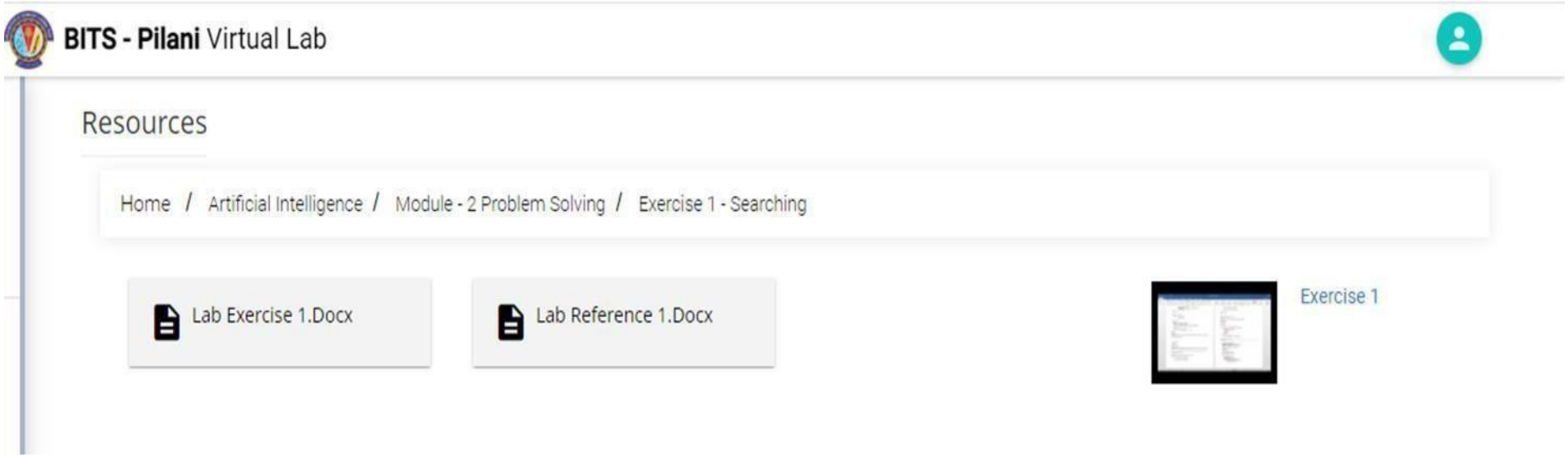

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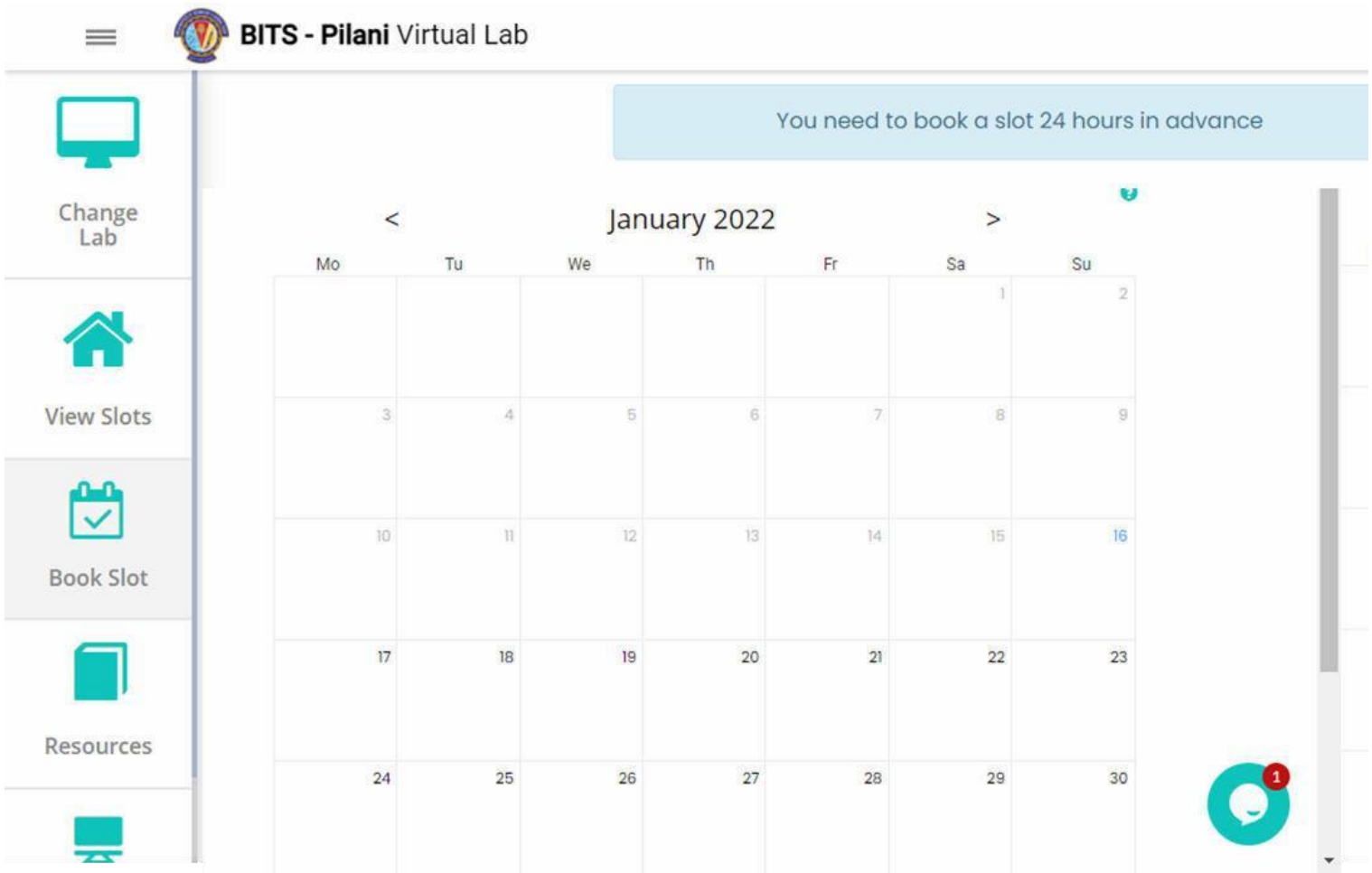

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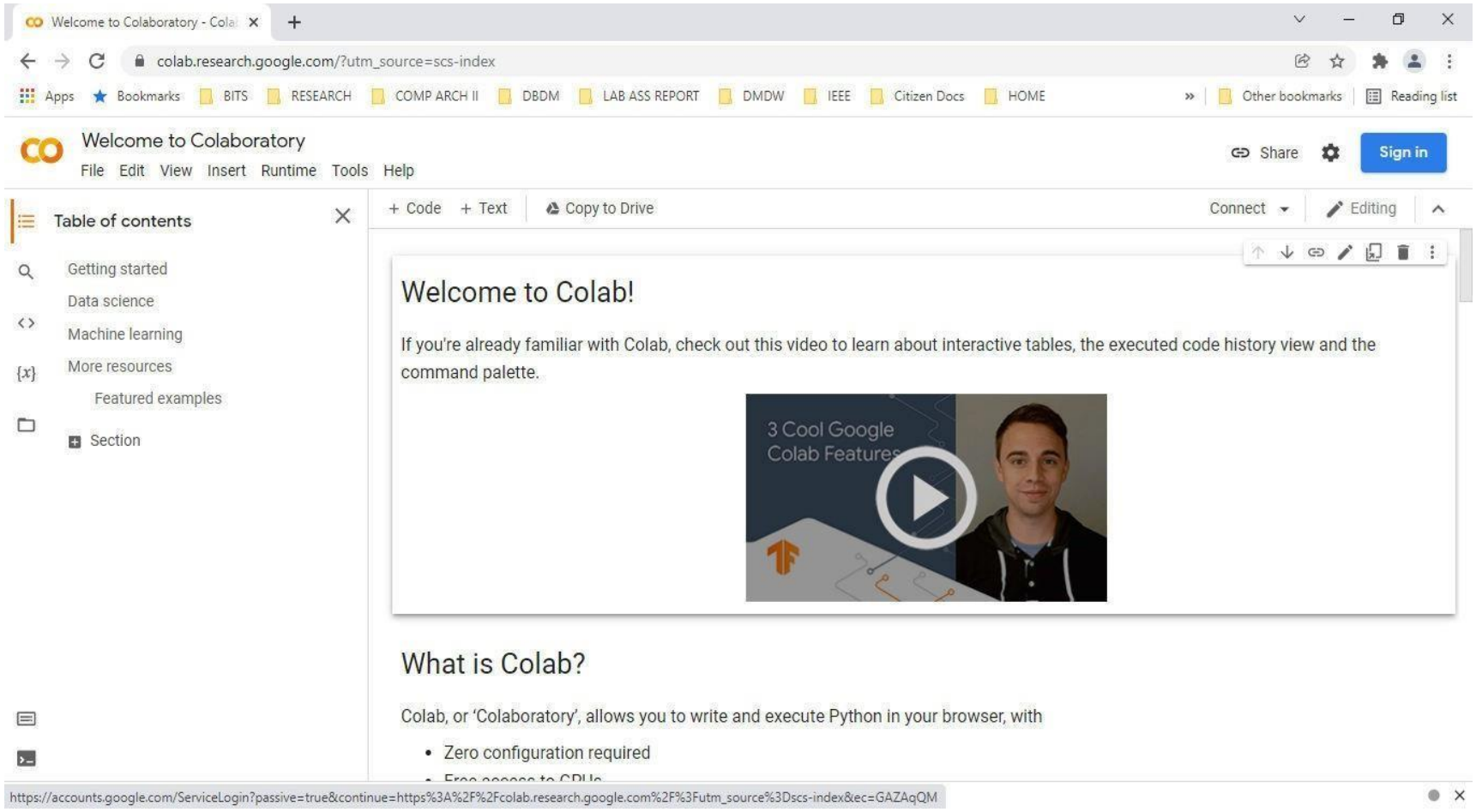

Exercises : In Python & its libraries

Course Overview

Artificial Intelligence

- Term coined by, *John McCarthy* (1955) & *Dartmouth Summer Research Project on Artificial Intelligence* (1956)

On September 2, 1955, the project was formally proposed by McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon. The proposal is credited with introducing the term 'artificial intelligence'.

The Proposal states[7]

> We propose that a 2-month, 10-man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

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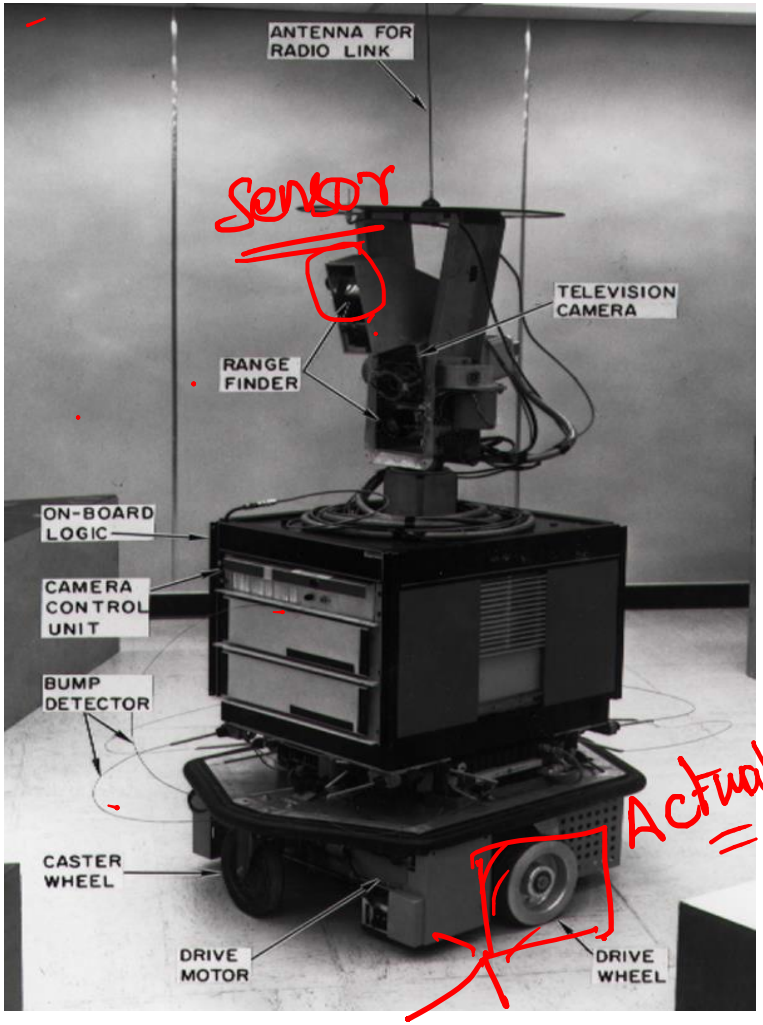
https://en.wikipedia.org/wiki/Dartmouth_workshop [01 June, 2019]

Larger Intent, Dream, Overconfidence …

Some Early successes of Dartmouth

Many key projects were initiated after Dartmouth summer project.

Shakey robot - First mobile robot to perceive environment & reason about surroundings, actions - Introduced A* algorithm to find paths - Hough Transform for image analysis - Used Lisp for programming - visibility graph used for finding shortest paths in the presence of obstacles...



Some Early successes of Dartmouth

DENDRAL -

Attempted to encode the domain expertise in molecular biology as an expert system

Led to the creation of expert systems for various other domain, including medical.

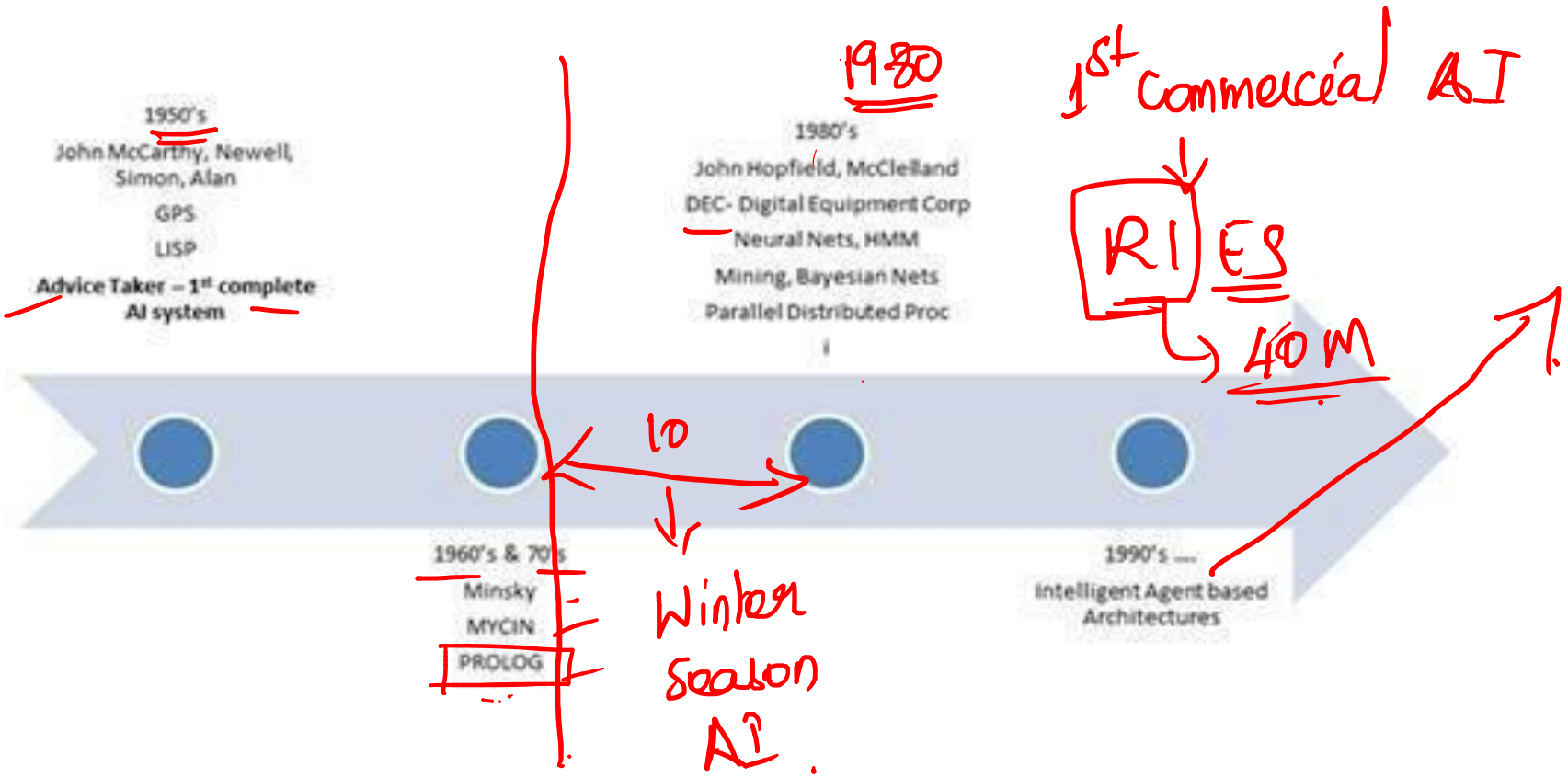
A milestone worship in the history of AI !!!

MYCIN → blood related

Rule based System → if then else.

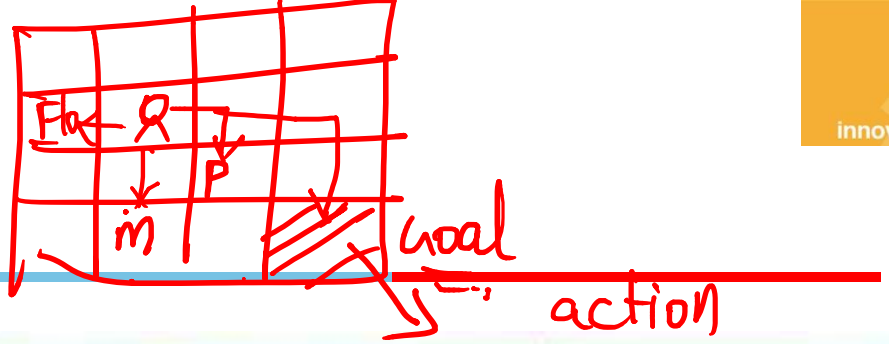
if Sy1 & Sy2
Dis 1
else
Dis 2

A brief history of AI



Perspectives of AI

Definitions



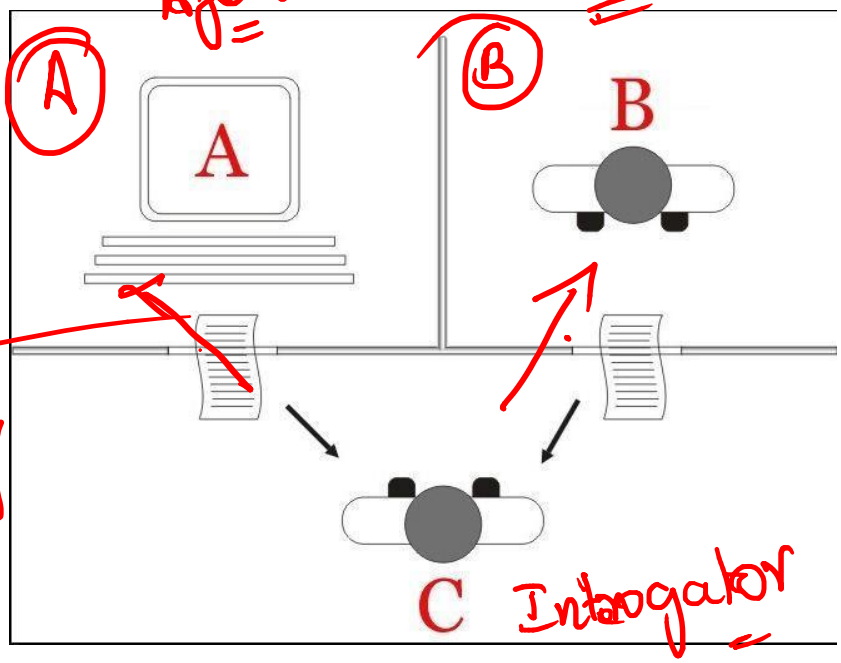
	Thought / Reasoning	Acting
Human Performance	(1) THINKING HUMANLY "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning, ... " (Bellman, 1978)	(2) ACTING HUMANLY "The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990)
Rational Performance	(3) THINKING RATIONALLY "The study of computations that make it possible to perceive, reason, and act" (Winston, 1992)	(4) ACTING RATIONALLY "Computational intelligence is the study of the design of intelligent agents" (Poole et al., 1998)

Acting Humanly

Turing Test Approach

- *Turing Test* & *Total Turing test* (operational test to determine an entity is intelligent / not) [50's]

- Skills necessary to pass these tests
  - NLP, Knowledge Representation, Automated Reasoning, ML + Computer Vision & Robotics(for total turing test)



Pictorial Representation of Turing Test from https://en.wikipedia.org/wiki/Turing_test

Passing the Turing Test

- 2014 - Royal Society (London) - Sixteenth Anniversary of Alan Turing -
- Chabot - Eugene Goostman - Pretended to be a thirteen-year-old Ukrainian boy
  - Passed the turing test for the first time
  - 10/30 Judges believed the response is from human
- *Turing predicted in 50 years time, computers can be programmed to play imitation game in which an average interrogator fails to identify the machine 70% time in a 5 mins questioning*

Passing the Turing Test

Transcript of a chat

EUGINE - a thirteen-year-old Ukrainian boy, chats

JUDGE: Hello.

EUGENE: Hello, I'm really glad to have the chance to chat with you! My guinea pig Bill sends his regards too!

JUDGE: Is Bill a male or a female?

EUGENE: Ask Bill personally, please.

JUDGE: Well I'd rather talk to you. What is your name?

EUGENE: Call me Eugene. I am glad to talk to you!

JUDGE: My name is Jane and I am female. How about you? What's your gender?

EUGENE: I'm a male. A “guy’ I'd say.

JUDGE: Pleased to meet you Eugene. What's the weather like where you are?

EUGENE: Let's get on with our conversation!

JUDGE: Don't you like talking about the weather?

EUGENE: All these talks about weather is a waste of time.

JUDGE: What would you like to discuss?

EUGENE: I don't know. Better tell me more about yourself!

Acting Humanly

Turing Test Approach

Some Definitions of AI:

"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990)

"The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)

Thinking Humanly

Cognitive Modelling Approach

- How do we capture human thinking to implement?
  - Introspection
  - Psychological Experiments
  - Brain Imaging

- System : *"General Problem Solver"* (*Newell and Simon, 1961*)
  - Designed to work as a universal problem solver
  - Problems represented by horn clauses
  - First AI Machine which has KB + Inference separation
  - Authors focus on this is on comparing the trace of its reasoning steps to traces of human subjects solving the same problems

- Growth of Cognitive science and AI supports each other

Thinking Humanly

Cognitive Modelling Approach

Some Definitions of AI:

"The exciting new effort to make computers think . . . machines with minds, in the full and literal sense." (Haugeland, 1985)

"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)

Thinking Rationally

"Laws of Thought" Approach

- Invention of Formal Logic, Greek Philosopher **Aristotle**, Third century BC.
- Introduced syllogisms, providing argument structures

In all boring classes, students sleep It

is a boring class

Students sleep in this class [Are you ?
]

- Field of Logics gave rise to codifying rational thinking
    - When elements are '*things*', we reason about things

Hurdles to the idea :
(1) Not everything can be logically coded
(2) no provably correct action at a moment
(3) Exhaustive computational resources

Acting Rationally

The Rational Agent Approach

- An agent is an entity that perceives and acts

This course is about designing rational agents

- Abstractly, an agent is a function from percept histories to actions: [f: P* → A]
- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance
- Computational limitations make perfect rationality unachievable
- Design best program for given machine resources

Acting Rationally

The Rational Agent Approach

- Rational behaviour: doing the *right thing*
- The *right thing:* that which is expected to maximize goal achievement, given the available information
- Rational behaviour is not just about correct inference / thinking, skills needed to pass turing test etc.

(adv) : More General - Correct inference is just a thing

(adv) : More amenable for scientific developments, as the rational behaviour is better defined than human thinking and behaviour

Traveller's Problem

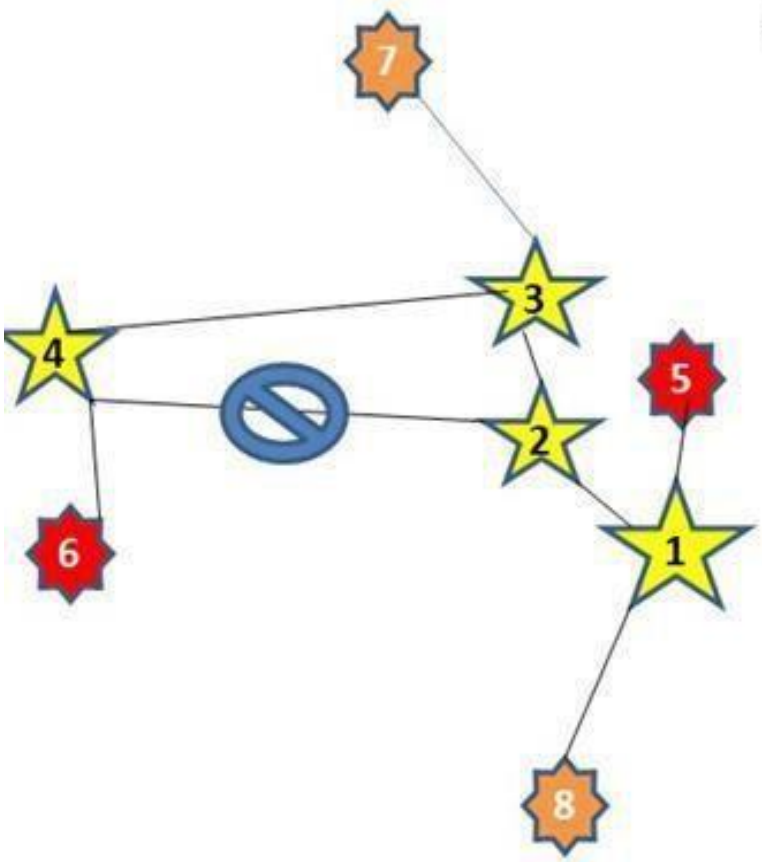
Traveller's Problem

Traveller's Problem

Sensors → Environment → Actuators

Sketch the problem	Computer Vision
Searching Technique	
Path Finding	Planning - Constraint
Derive Solution/s	Automated Reasoning
Improve Solution	Optimization Problems
Suggest or Act	Natural Language Processing / Robotics

Traveller's Problem



Sensors → Environment → Actuators

Sketch the problem

Searching Technique

Path Finding

Derive Solution/s ← Knowledge Representation

Improve Solution

Suggest or Act

Machine Learning

AI in HealthCare

Lyrebird's Project Re-Voice

AI in Culinary Field

Spyce

AI in Transportation

AI in NLS

IBM Watson

Computer Vision
NLP
ML
Speech Recognition
Automation

Required Reading: AIMA - Chapter #1

Thank You for all your Attention

Note : Some of the slides are adopted from AIMA TB materials