



Artificial & Computational Intelligence

AIML CLZG557

M1 Introduction

Indumathi V

Guest Faculty,

BITS - CSIS

BITS Pilani

Pilani Campus

Agenda

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

Course Administration

About the course

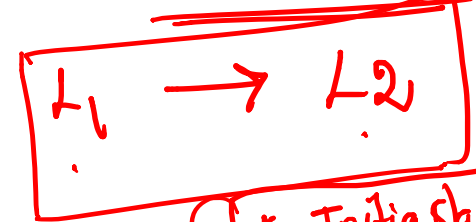
● Focus on

- 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

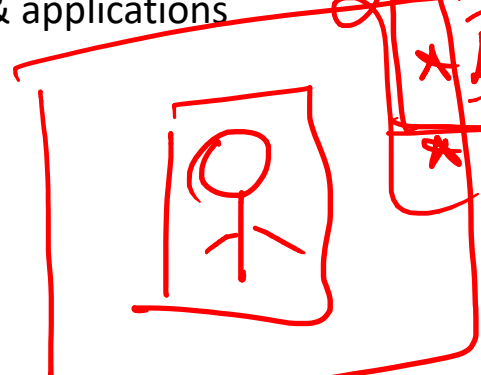
○ Topics not-covered like

- ~~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.

Blind search

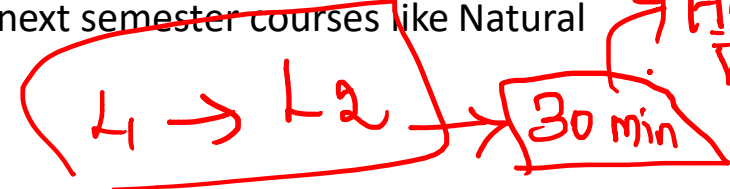


- * Initial state
- * Goal state
- * Environment



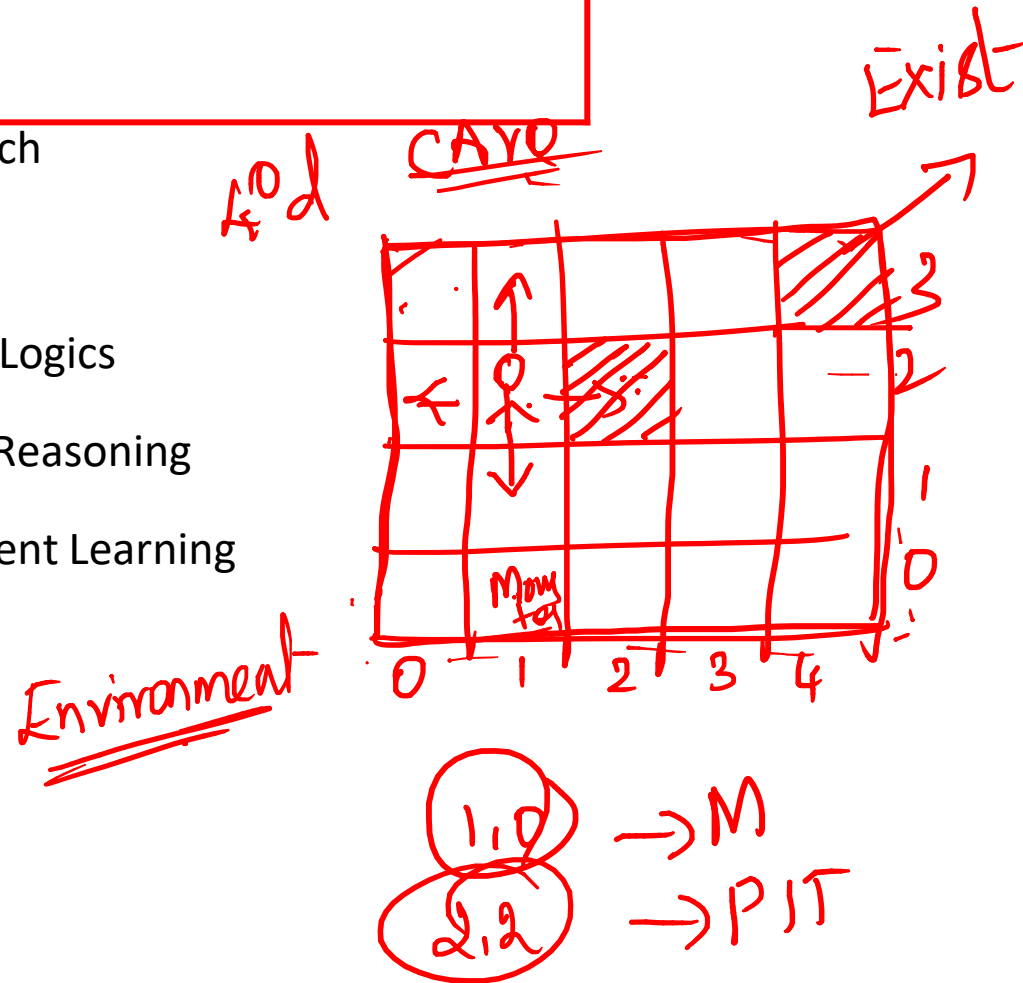
Domain Expert inform

Heuristic Value



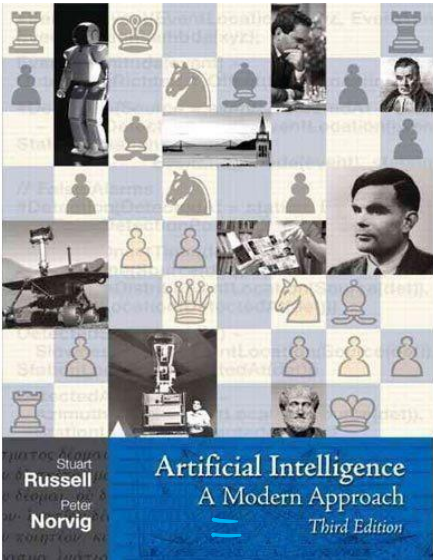
Course Plan

- 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



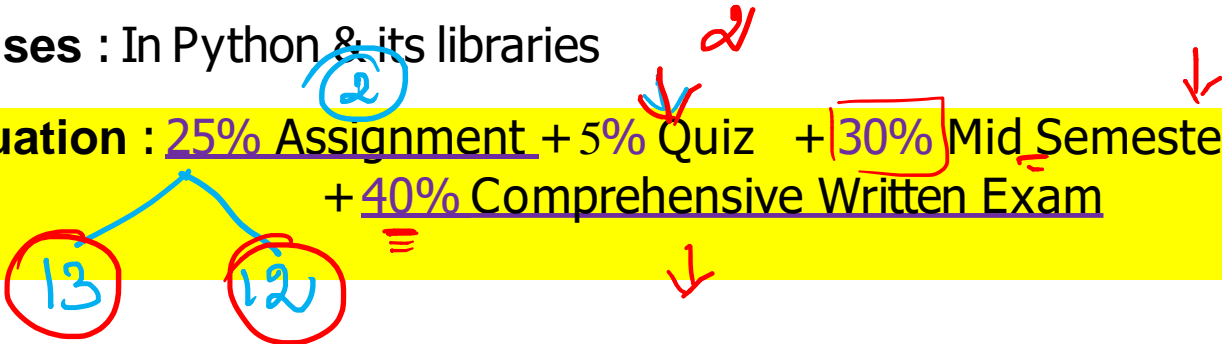
About the course

Text Book






Exercises : In Python & its libraries


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





About Labs





**BITS - Pilani Virtual Lab**


Change Lab


View Slots



Book Slot



Resources





Resources


Home / Artificial Intelligence


 Module - 2 Problem Solving


 Module - 3 Reasoning - Rule Based System


 Module - 4 Introduction To Learning

 Module - 5 Optimization Models

 Module - 6 Application 1 Gaming

 Module - 7 Application 2 Natural Language Proce




 Module - 8 Anatomy Of Building AI Systems





Exercises : In Python & its libraries

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Resources


Home / Artificial Intelligence / Module - 2 Problem Solving

 Exercise 1 - Searching

 Exercise 1.2 - Constraint Satisfaction Problem


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Resources

Home / Artificial Intelligence / Module - 2 Problem Solving / Exercise 1 - Searching

 Lab Exercise 1.Docx



 Lab Reference 1.Docx

 Exercise 1

Exercises : In Python & its libraries


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Resources

Home / Artificial Intelligence / Module - 2 Problem Solving / Exercise 1 - Searching



 Lab Exercise 1.Docx


 Lab Reference 1.Docx

 Exercise 1


Exercises : In Python & its libraries

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View Slots



Book Slot




Resources

You need to book a slot 24 hours in advance

< January 2022 >

Mo	Tu	We	Th	Fr	Sa	Su
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30



Exercises : In Python & its libraries

About Labs



Welcome to Colaboratory - Cola x +

colab.research.google.com/?utm_source=scs-index

Apps ★ Bookmarks BITS RESEARCH COMP ARCH II DBDM LAB ASS REPORT DMDW IEEE Citizen Docs HOME » Other bookmarks Reading list

Welcome to Colaboratory

File Edit View Insert Runtime Tools Help

Table of contents

- Getting started
- Data science
- <> Machine learning
- {x} More resources
- Featured examples
- Section

+ Code + Text Copy to Drive

Connect Editing

Welcome to Colab!

If you're already familiar with Colab, check out this video to learn about interactive tables, the executed code history view and the command palette.

3 Cool Google Colab Features

What is Colab?

Colab, or 'Colaboratory', allows you to write and execute Python in your browser, with

- Zero configuration required
- Free access to GPUs

https://accounts.google.com/ServiceLogin?passive=true&continue=https%3A%2F%2Fcolab.research.google.com%2F%3Futm_source%3Dscs-index&ec=GAZAqQM

Exercises : In Python & its libraries

Course Overview

Artificial Intelligence

4th

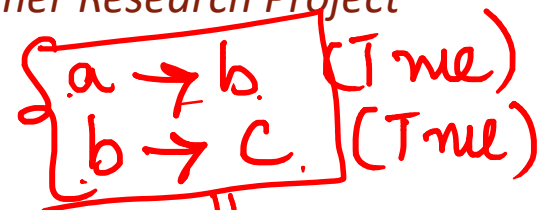
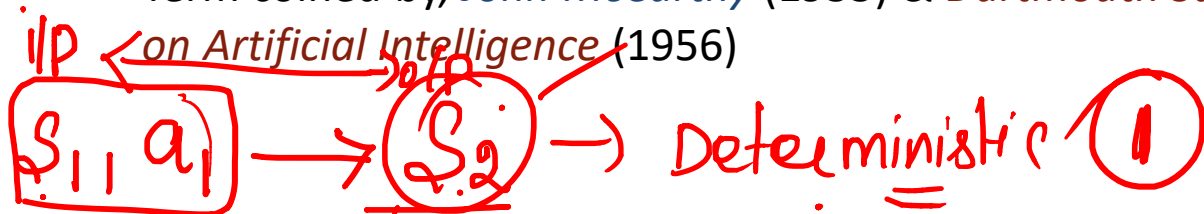
cognitive thinking
 \downarrow logical \Rightarrow reason

innovate

achieve

lead

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



$a \rightarrow c$ (True)

16th \rightarrow Bayes
 Box

Probability

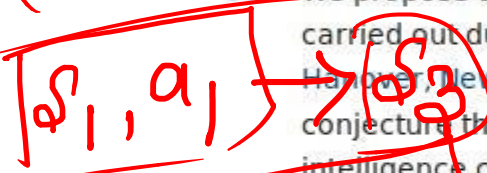
On September 2, 1955, the project was formally proposed by McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon. The proposal is credited with introducing the term 'artificial intelligence'.

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.

uncertainty



$$P(S_2) = 0.8 \quad P(e)$$

$$P(S_3) = 1 - P(S_2) \quad P(ne)$$

$$\Rightarrow 0.2$$

Artificial Intelligence



1943
Small neural n/w
H.O
Conference

1950 - 1956

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

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

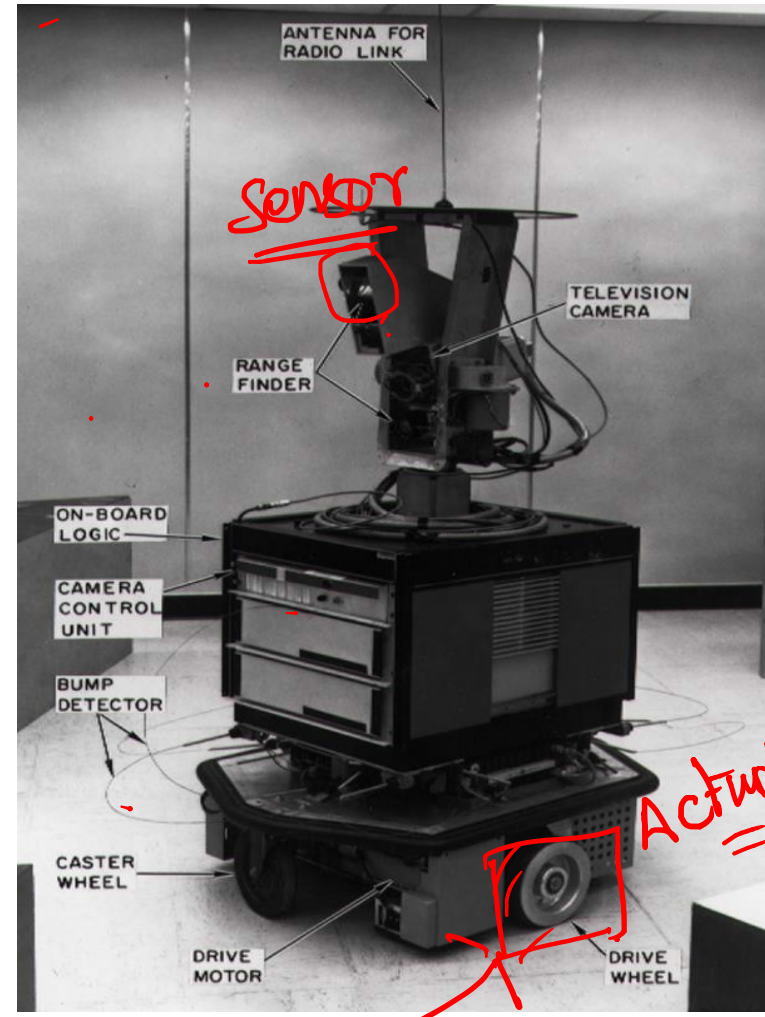
Larger Intent, Dream, Overconfidence ...

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 !!!

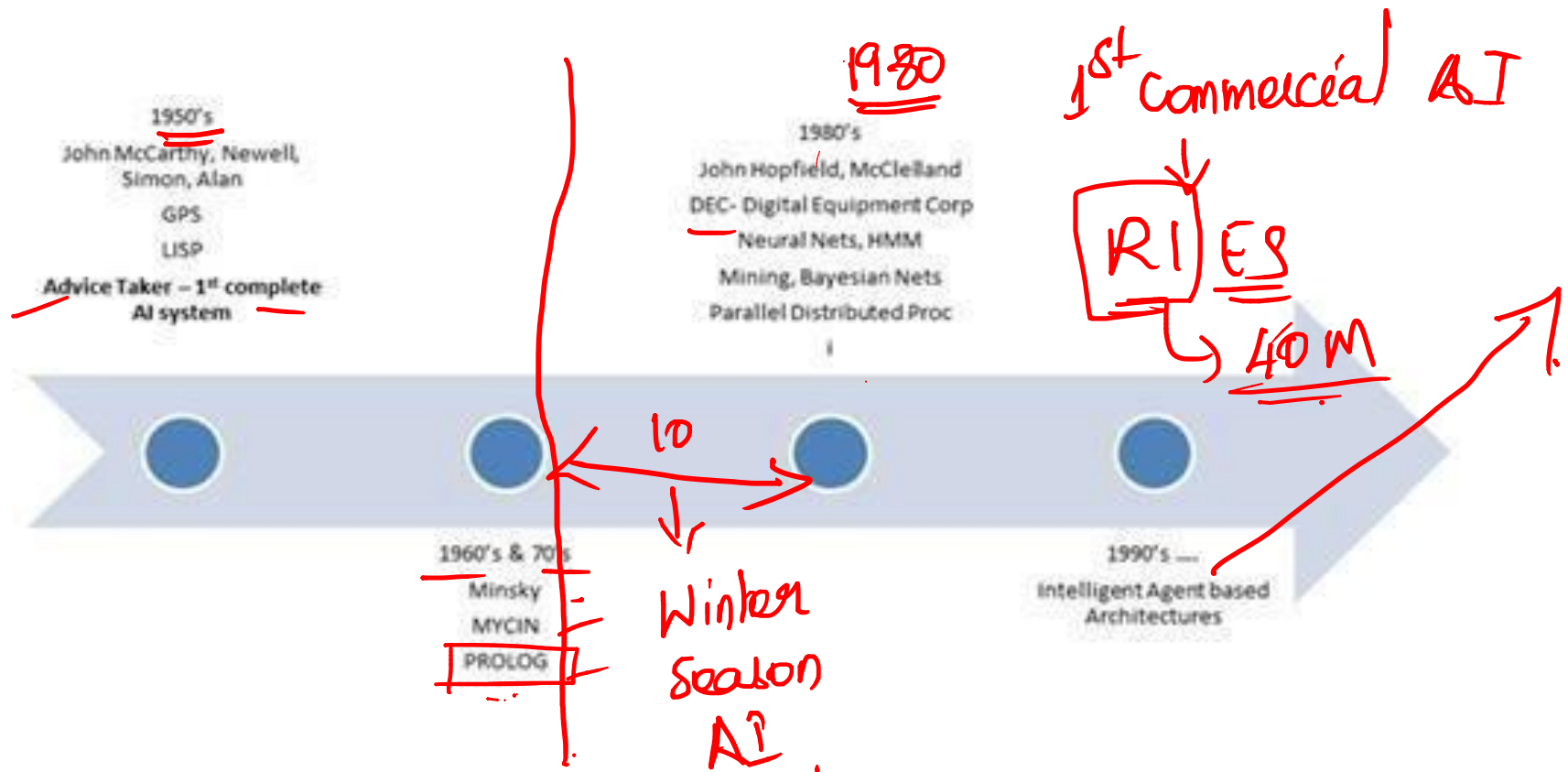
MYCIN → blood related

Rule based system → if then else.

if Sy1 & Sy2
Dis 1

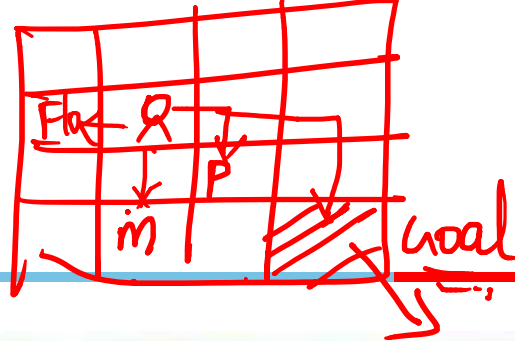
else Dis 2

A brief history of AI

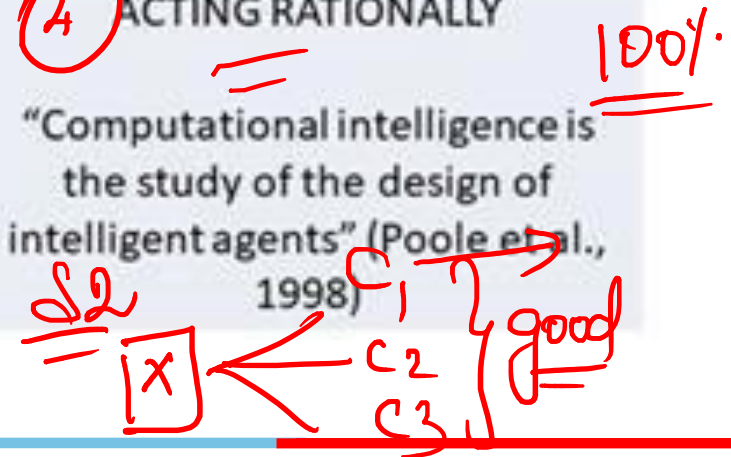
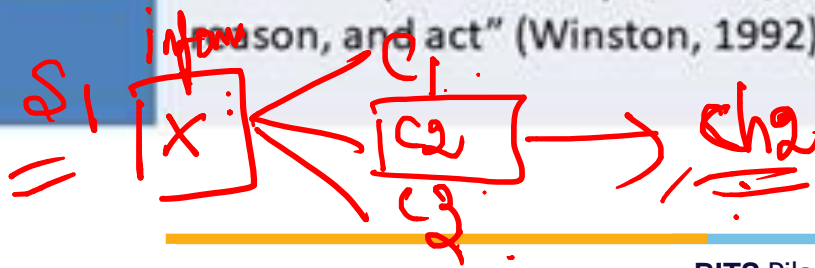


Perspectives of AI

Definitions



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



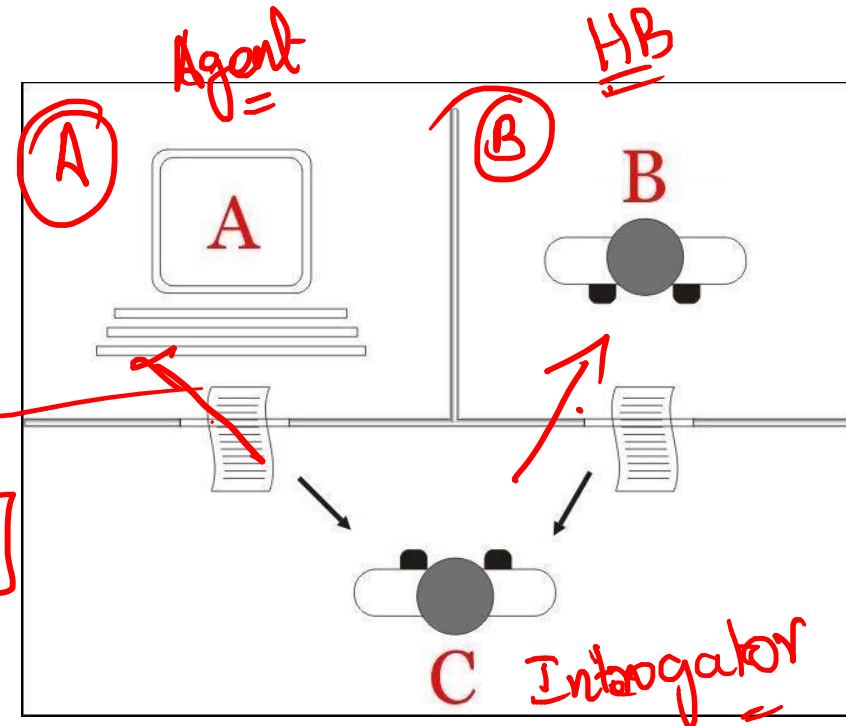
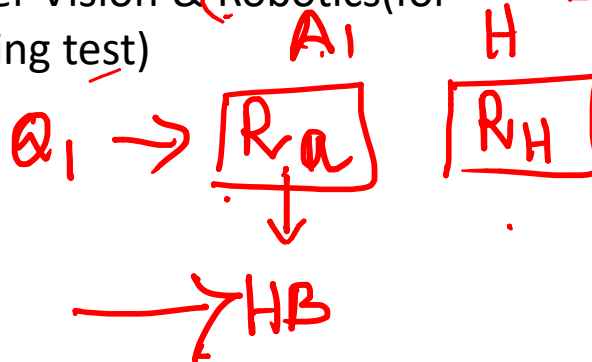
Acting Humanly

1950 Alan Turing



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*

Aq
→ TT

Passing the Turing Test



Transcript of a chat

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

→ **JUDGE**: Hello.

13

→ **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)

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



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)

“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: $[f: P^* \rightarrow A]$
- 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

No info \rightarrow Random



Traveller's Problem

Envir

Destination



Destination - Fixed Goal

Dead end

learned info \rightarrow Knowledge

negative 100 customers

Source

Penalty Rewards } Feedback Source

$R_1 \rightarrow MR \mid F$

$T_{10} \rightarrow R_1 \rightarrow \dots$

KB

4 possible path

$P_1 P_2 P_3 P_4 \rightarrow \text{Soln} \rightarrow P_4$

Traveller's Problem

Road \rightarrow 2 days

Numerical measures \rightarrow Utility



Destination - Fixed Goal

Road blocked

$P_1 P_2 P_3$

Path 2

Source

P_4

P_2

- ① mindis
- ② Fuel effr

Dis + time fcos

Single

$P_4 \rightarrow \text{Best} \rightarrow \text{invalidated}$
 $\rightarrow \text{least weighted}$

Traveller's Problem



Sensors → Environment → Actuators

Sketch the problem

Computer Vision

Searching Technique

Path Finding

Planning - Constraint

Derive Solution/s

Automated Reasoning

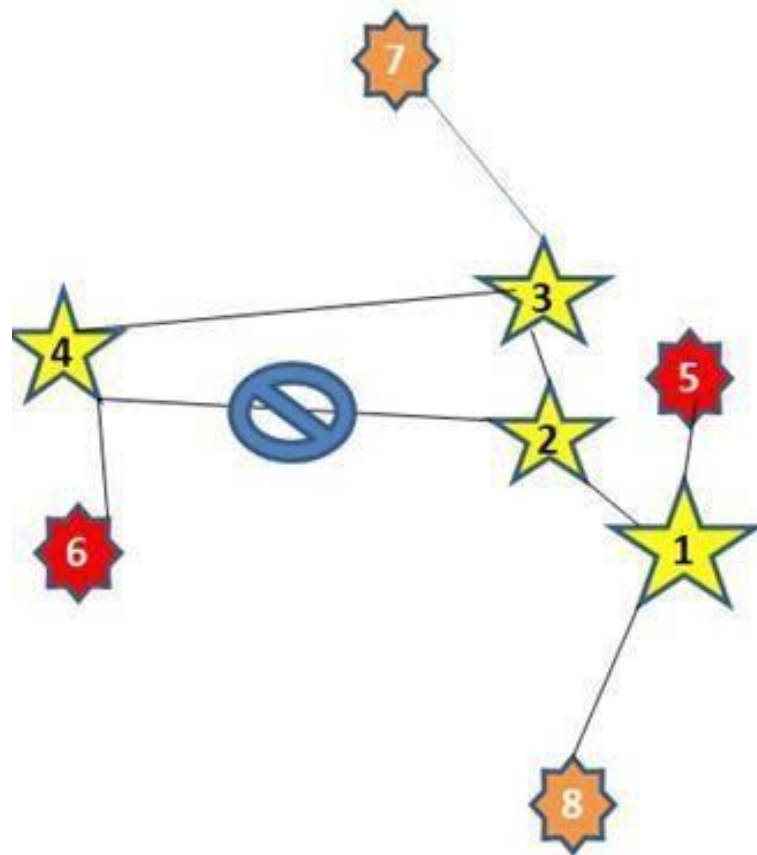
Improve Solution

Optimization Problems

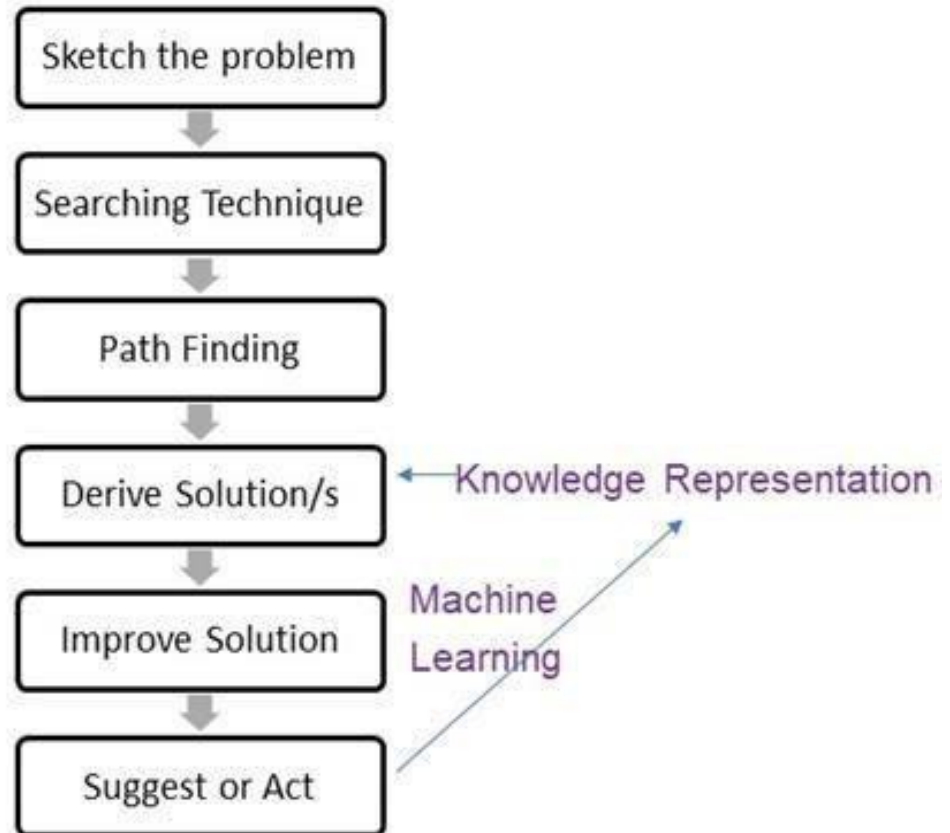
Suggest or Act

Natural Language Processing / Robotics

Traveller's Problem



Sensors → Environment → Actuators



AI in HealthCare



Lyrebird's Project Re-Voice



AI in Culinary Field



Spyce

AI in Transportation



AI in NLS

IBM Watson



Wimbledon AI Highlights

IBM



Women's Final: Caroline Wozniacki vs. Venus Williams
Sat 8:00 PM EDT. Wozniacki wins the match with a hard-fought victory.



0.87

R. Federer vs. M. Cilic

Sat 7:00 PM EDT. Federer wins the match with a hard-fought victory.



0.79

D. Murray vs. S. Querrey

Sat 7:00 PM EDT. Murray wins the match with a hard-fought victory.



0.76

D. Murray vs. S. Querrey

Sat 7:00 PM EDT. Murray wins the match with a hard-fought victory.



0.63

Murray/Murray vs. Wozniacki/Williams

Sat 8:00 PM EDT. Murray/Murray wins the match with a hard-fought victory.

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