

# Multi-Agent Systems

Lecture 1  
Assignment Project Exam Help

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# Agenda

## 1. Introduction

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## 2. Learning Outcom

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## 3. Student Effort Hours

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## 4. Bibliography.

## 5. Origins and History of Artificial Intelligence.



# Introduction to the course

- Module Coordinator: Professor Gregory O'Hare.
- Lecturer: Dr. Nestor Velasco Bermeo.
- Mode of Delivery: Blended.
- Course Notes: Brightspace [available <https://eduassistpro.github.io/> session].
- Examination: Final Exam Paper [2hrs End of T].
- Sessions: Every Tuesday 14:00 – 15:50 hrs.
- Sessions will begin at 14:05, when joining and during the session it is recommended to mute your audio (unless an activity/question requires your participation).

**\*Sessions will not be recorded in order to promote attendance and participation.\***



# Learning Outcomes of the Module

1. Understand the key concepts that are associated with multi-agent systems, and its associated technologies and techniques.

2. Have an appreciation of how to implement a simple agent system in an appropriate framework.

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3 understand how the approach relates to other approaches to implementing agent-based systems.

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4 Understand the Belief Desire Intention (BDI) model for systems;

5. understand how agent technologies have been applied in various application domains.



# Student Effort Hours

Student Effort Type		
Lectures	<a href="https://eduassistpro.github.io/">https://eduassistpro.github.io/</a>	24
Autonomous Student Learning	Add WeChat edu_assist_pro	100
Total		124



# Recommended Bibliography

- M. Woolridge „An Introduction to Multi-Agent-Systems“, Wiley, 2001
- S. Russell, P. Norvig, „Artificial Intelligence: A Modern Approach“, Prentice-Hall, 1995
- O'Hare, G. M., Jennings, N. R., Jennings, N. (Eds.). (1996). *Foundations of distributed artificial intelligence* (Vol. 9). John Wiley & Sons.

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\* Additional Research articles and complimentary resources.



# Topics to be covered

## • Introduction

- History of A.I. and early efforts.
- Agents and objects
- Agents and Expert Systems

## • Intelligent Agents

- The design of intelligent agents - reasoning agents
- Distributed Artificial Intelligence
- Theories of Agency (Weak vs Strong Agency)
- Reactive vs Intentional Systems
- BDI

## • MultiAgent Systems

- What is Coordination or Cooperation?
- How cooperation occurs – The Prisoner's Dilemma.  
tensions between benevolent  
cooperative distributed problem
- Result Sharing.
- Auctions and voting systems; negotiation.
- Commitments.
- Agent Management.
- Applications of Agent Systems.

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**Originality of**  
**Artificial Intelligence**

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# Lecture I Learning Objectives

❑ To understand the lineage of AI:

❑ To understand **Assignment Project Exam Help** within this journey;  
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❑ To understand the principles around AI;

❑ To understand how MAS differentiates itself from traditional AI;



# The Turing Test

Allan Turing [5] in his classic paper 'Computing Machinery and Intelligence', **Assignment Project Exam Help** circumvented the problem of defining artificial intelligence <https://eduassistpro.github.io/>

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Such a test took the form of a game....the Turing Test.

Born: June 23, 1912, Died: June 7, 1954, Wilmslow,  
United Kingdom



# The Turing Test

The game he describes has three participants, an interrogator, a human and a machine.

The interrogator is physically removed from the other two participants. He can communicate with each of them by way of a tele however, know which participant which is human.

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His task is to establish which one is the machine and which is the human. This became renowned as the 'Turing Test'. A computer could be thought to display intelligence if the interrogator could not distinguish between man and computer.



# Can a computer pass for a human?

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# The Turing Test II

Turing's work did not, however, win universal acceptance. More recently opponents like **Millar** while recognising the merits of his work highlight that it does not yield any insight into the various **institute** intelligence.

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He believed this to be of great importance if any realistic attempt is to be made at constructing a truly intelligent machine.



# The Turing Test

*"The isolated man does not develop any intellectual power. It is necessary for him to be immersed in an environment of other men. In this environment he absorbs techniques he absorbs during the first two years of his life. He may then perhaps do a little research on his own and make a very few discoveries which are passed on to other men."*

— Alan Turing



# Searle's Chinese Room (1980)

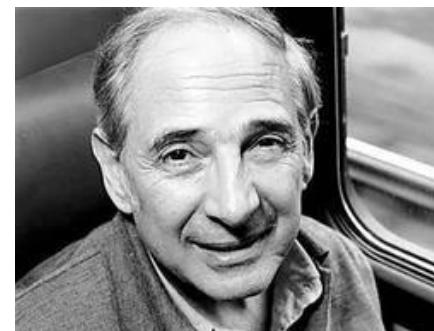
- Strong AI Advocates believe:
  - The appropriately programmed computer with the right inputs and outputs would thereby have a mind in exactly the same sense human beings have minds.
- Postulated by John Searle in his paper "*Minds, Brains and Programs*", published in *Behavioral Sciences* in 1980. It was a thought experiment.
  - A human enters a locked room and receives Chinese characters (written or spoken).
  - He is given a set of rules (in English) that define a mapping between sets of symbols (Chinese characters).
  - These rules allow him to respond to inputs (written in Chinese) with outputs (also written in Chinese)...
  - Does the machine literally "understand" Chinese? Or is it merely simulating the ability to understand Chinese?]

"**strong AI**" and the latter "**weak AI**"

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# The Turing Test (cont.)

If I may paraphrase Leonardo da Vinci (1452-1519), he in a similar vein suggested that.....

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*“when man understands the natural flight of the bird, man will be able to build a flying machine.”*

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# A Working Definition

So with artificial intelligence, the definition we shall employ is that

volunteered by Marvin Minsky

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*“Artificial intelligence is that part of making machines do things that would require intelligence if done by man.”*

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***Learn, reason, -self-correct***

Marvin Minsky

Born August 9, 1927, New York City,

Died: January 24, 2016, Boston, Massachusetts



# Useless Machine?

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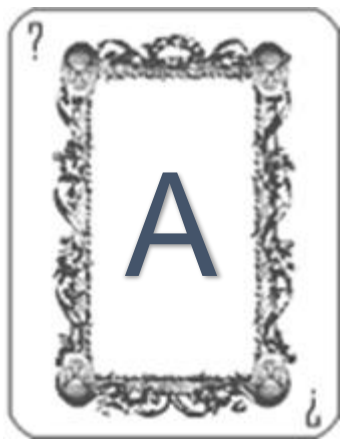
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**How it was Invented**

**Useless Machine operating**

# A Simple Example



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*"If there is a vowel on one side of a card then there will be an even number on the other side"*

Which card(s) must be turned over in order to determine whether or not the rule has been followed

# Wason's four-card problem



46%



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7%



33%



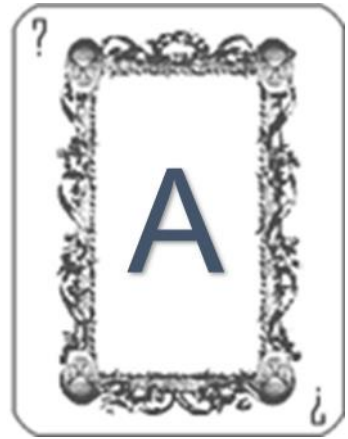
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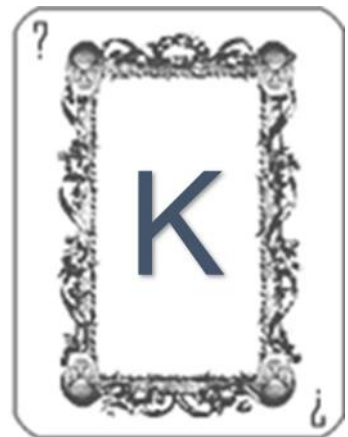
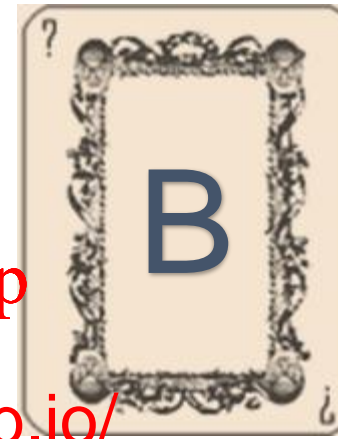
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# Which Cards should be turned? (If-then)



5   
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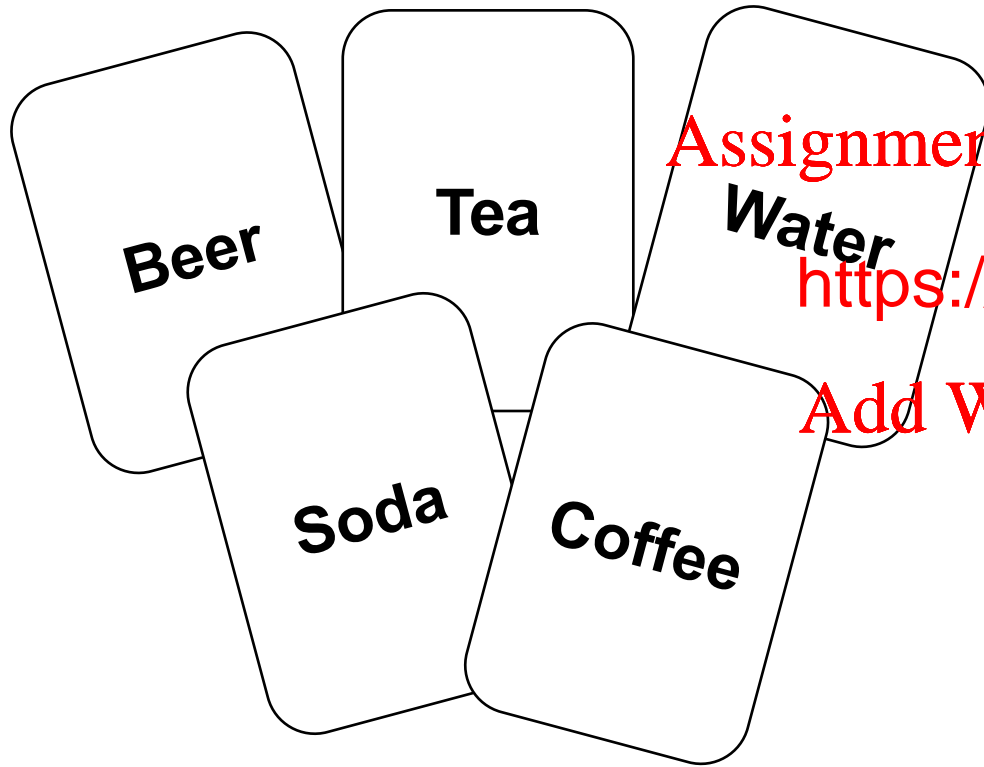


Inductive Reasoning vs Deductive Reasoning



# Each card represents a person...

**Drinks on one side**



**Age on the other side**



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# Let's try Again...

**Beer**

**Water**

**25**

**16**

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*"If a person is drinking alcohol, then they must be 18 years or older"*

Which card(s) must be turned over in order to determine whether or not the rule has been followed

Knowledge Representation

*\*Wason's four-card problem*



# A Short History of AI

- The term **Artificial Intelligence** is normally attributed to **John McCarthy**.
- In 1956 he organised a conference which was to enable researchers in the field  
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- As a consequence of his actions the field of **AI** was founded.  
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- Some attendees namely, Allan Newell, Herbert Simon and Marvin Minsky himself, are now without question the leading researchers in the field.





# A Short History of AI

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# The History of AI 2

At the conference Newell & Simon detailed work on the theorem prover which had been performed at Carnegie.

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This is commonly regarded <https://eduassistpro.github.io/>  
**first AI program as such.** [Add WeChat edu\\_assist\\_pro](#)

The Logic Theorist was written in IPL  
**(Information Processing Language)**  
the first language which permitted  
computers to process concepts as  
opposed to numerical quantities.



# Inaugural AI Conference in 1956

## Alan Newell & Herb Simon: Logic Theorist

- Proved 38 out of 52 theorems from Chapter 2 (The Theory of Logical Types) of Principia Mathematica.
- Based on logic
- Reasoning as Search
- Use of Heuristics
- Information Processing Language (Cursor to Lisp)
- Widely accepted as the first AI prog

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You can find the paper in the following link (with the complete program included)

[The Logic Theory Machine. A Complex Information Processing System](#)



# The History of AI 3

- Minsky & McCarthy founded the MIT AI Laboratory.
- McCarthy is renowned as the inventor of LISP while Minsky proposed the Frame concept for Knowledge Representation.
- In this early stage efforts  
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  - **Game Playing:** equipping a computer to play a particular game.
  - **Theorem Proving:** equipping a computer to show that some statement follows logically from a set of known truths called axioms.



# Expert Systems: SHRDLU 1968-70

- A program that understands a subset of English and can manipulate some wooden blocks.
  - Implemented using ~~Micro Planner~~ **Assignment Project Exam Help** (Carl Hewitt, 1969) & Lisp (McCarthy, 1958)  
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  - Micro Planner (precursor) **Add WeChat edu\_assist5pro** a logical reasoning engine based on Resolution (Robi ed\_5)pro
  - Lisp provided support for procedural code.
- Users interact with Shrdlu via a command line.
  - Shrdlu parses the user input and responds appropriately.
  - This can involve manipulating the blocks or responding to some user query...



# Expert Systems: Shrdlu 1968-70

- **Person:** Pick up a big red block.
- **Computer:** OK.
- **Person:** Grasp the pyramid.
- **Computer:** I don't understand which pyramid you mean.
- **Person** (changing their mind): Find which is taller than the one you are and put it into the box.
- **Computer:** By "it", I assume you mean the block which is taller than the one I am holding.
- **Computer:** OK.

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# The History of AI 4

Early efforts employed a technique known as **State Space Search** involving essentially several components ...

(a) an initial stage

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(b) a final state

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(c) an ability to detect final state

(d) a set of legal operations that can be applied to each state.

Such an approach can often be understood better by conceptually regarding states as nodes and operations as arcs.

# The History of AI 5

By way of example in a chess game:

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(a) initial state: initial st

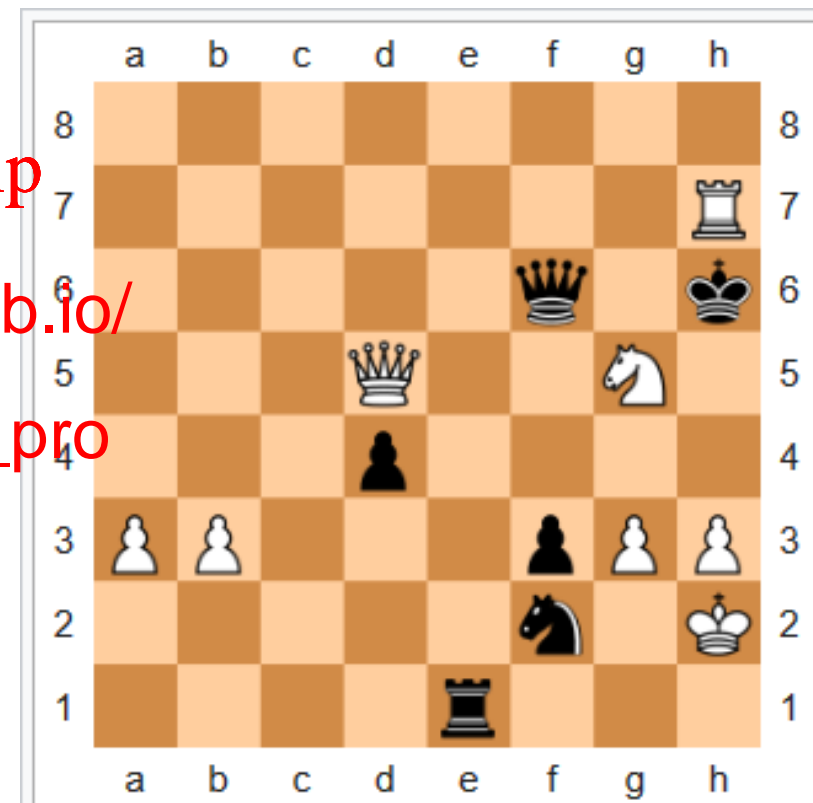
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(b) final state: checkmate

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(c) ability to detect final state: ability to detect checkmate.

(d) set of legal operations: legal moves of chess.







# Generate & Test 1

The simplest form of state space search is that of **Generate & Test**.

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Such an approach involves generating, those of ...

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(a) Generating a possible solution of a new state.

(b) Ascertaining whether the new state is indeed the final state.

(c) If new state is the final state terminate, otherwise repeat steps a, b and c.



# Generate & Test 2

- Two forms of generate and test exist: Depth-first Search & Breadth-first Search.
- Both fall foul of the ‘combinatorial explosion’ caused by the exponential growth of the nodes irres <https://eduassistpro.github.io/> generation.
- Consequently exhaustive search is onl <https://eduassistpro.github.io/> when the search space is very small.
- For larger spaces the search needs to be guided.
- Guided searches are normally referred to as **Heuristic Searches**.
- Searches of this nature utilise domain specific knowledge called heuristics.