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# Chapter Contents

- **This chapter covers the following topics:**
  - **What is artificial intelligence (AI)?**
  - **How does AI work?**
  - **Types of AI**
  - **What are examples of AI technology and how is it used today?**
  - **Components of AI**
  - **Objectives of this Course**
  - **Course Contents**
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# What is artificial intelligence (AI)?

- **Artificial intelligence (AI) is the simulation of human intelligence processes by machines, especially computer systems.**
- The advancement of Artificial Intelligence is primarily dependent on the access of available large amounts of data and the evolution of technology allowing the data process and manipulation better than humans.
- **AI can do everything we humans can do, from giving us directions to medical analysis.** Specific applications of AI include expert systems, natural language processing, speech recognition, image recognition, and computer vision.
- **Some further examples of AI today are Amazon's Alexa and Apple Siri** which help us create potential links on what we may want to purchase based on our current searches, being able to recognize spam emails whilst also helping us detect fraud.

# What is artificial intelligence (AI)?

- **In the mid-1950s, John McCarthy is known as the father of Artificial Intelligence for creating the terminology of AI.**
- His definition of AI was “**the science and engineering of making intelligent machines**”.
- Some may know him for creating Lisp, which is a programming language used in robotics for different types of Internet services.
- He started working on self-driving cars to create programs that understand the human brain better and imitate the way humans make decisions.
- Many of us use Cloud computing services, where we can share data between people. This was another of McCarthy’s innovations

# How does AI work?

- AI requires a foundation of specialized hardware and software for writing and training machine learning algorithms.
- No one programming language is synonymous with AI, but a few, including Python, R and Java, are popular.
- **In general, AI systems work by ingesting large amounts of labeled training data, analyzing the data for correlations and patterns, and using these patterns to make predictions about future states.**
- **AI programming focuses on three cognitive skills: learning, reasoning and self-correction.**

# How does AI work?

- **AI programming focuses on three cognitive skills: learning, reasoning and self-correction.**
- **Learning processes:**
  - This aspect of AI programming focuses on **acquiring data and creating rules for how to turn the data into actionable information.** The rules, which are called algorithm, provide computing devices with step-by-step instructions for how to complete a specific task.
- **Reasoning processes:**
  - This aspect of AI programming focuses on **choosing the right algorithm to reach a desired outcome.**
- **Self-correction processes:**
  - This aspect of AI programming is designed to **continually fine-tune algorithms and ensure they provide the most accurate results possible.**

# Types of AI

- There are two broad types of Artificial Intelligence:
  - Narrow AI (Weak AI)
  - General AI (Strong AI)
- **Narrow AI**
  - **Narrow AI, also known as weak AI, is the type of AI system that is designed and trained to complete a specific task.**
  - It's being able to carry out specific tasks that intelligent systems have been taught without being sophisticatedly programmed, this is why it's called Narrow AI.
  - Industrial robots, self-driving cars, voice recognition and virtual personal assistants, such as Apple's Siri, use weak AI.

# Types of AI

- **Narrow AI**

- **Narrow AI is based on machine learning and deep learning.** AI is constructed on a set of algorithms that try to imitate human intelligence. Machine learning is one of these algorithms and deep learning is a sub-skill of a machine learning technique.
- **Machine learning consumes data and uses statistics to better learn the data, in turn improving the ability to solve the task.**
- **Deep learning, also known as deep neural learning, is a type of machine learning technique that tries to imitate the human brain by inputting data through a biological inspired neural network that contains a number of hidden layers.**



# Types of AI

- **Strong AI**
  - **Strong AI, also known as artificial general intelligence (AGI), describes programming that can replicate the cognitive abilities of the human brain.**
  - General AI has a bit more complexity to it and tries to mirror human intellect using its ability to learn and apply the knowledge learnt to solve problems.
  - When presented with an unfamiliar task, **a strong AI system can use fuzzy logic to apply knowledge from one domain to another and find a solution autonomously.**
  - **We are now going through the process of transitioning from Narrow AI to General AI, for example, natural language processing.** In order to achieve this, computer hardware needs to advance in computational power to perform at a better rate.

# Types of AI

- In another way, **AI can be categorized into four types, beginning with the task-specific intelligent systems in wide use today and progressing to sentient (or emotional/sensitive) systems, which do not yet exist.**
- The categories are as follows:
  - Type 1: Reactive machines
  - Type 2: Limited memory
  - Type 3: Theory of mind
  - Type 4: Self-awareness

# Types of AI

- **Type 1: Reactive machines**

- **These AI systems have no memory and are task specific.**
- An example is Deep Blue, the IBM chess program that beat Garry Kasparov in the 1990s. Deep Blue can identify pieces on the chessboard and make predictions, but because it has no memory, it cannot use past experiences to inform future ones.

- **Type 2: Limited memory**

- **These AI systems have memory, so they can use past experiences to inform future decisions.**
- Some of the decision-making functions in driverless-car are designed this way.

# Types of AI

- **Type 3: Theory of mind**

- **Theory of mind is a psychology term. When applied to AI, it means that the system would have the social intelligence to understand emotions.**
- This type of AI will be able to infer human intentions and predict behavior, a necessary skill for AI systems to become integral members of human teams.

- **Type 4: Self-awareness**

- **In this category, AI systems have a sense of self, which gives them consciousness.**
- Machines with self-awareness understand their own current state. This type of AI does not yet exist.

# What are examples of AI technology and how is it used today?

- AI is incorporated into a variety of different types of technology. Here are some examples:
- **Automation**
  - When paired with AI technologies, automation tools can expand the volume and types of tasks performed. An example is robotic process automation (RPA), a type of software that automates repetitive, rules-based data processing tasks traditionally done by humans.
  - When combined with machine learning and emerging AI tools, RPA can automate bigger portions of enterprise jobs, enabling RPA's tactical bots to pass along intelligence from AI and respond to process changes.
- **Machine learning and deep learning**
  - This is the science of getting a computer to act without programming. Deep learning is a subset of machine learning that, in very simple terms, can be thought of as the automation of predictive analytics.

# What are examples of AI technology and how is it used today?

- **Machine learning and deep learning**
  - Machine learning consumes data and uses statistics to better learn the data, in turn improving the ability to solve the task. Deep learning, also known as deep neural learning, is a type of machine learning technique that tries to imitate the human brain by inputting data through a biological inspired neural network that contains a number of hidden layers.
  - **There are three types of machine learning algorithms:**
    - **Supervised learning.** Data sets are labeled so that patterns can be detected and used to label new data sets.
    - **Unsupervised learning.** Data sets aren't labeled and are sorted according to similarities or differences.
    - **Reinforcement learning.** Data sets aren't labeled but, after performing an action or several actions, the AI system is given feedback.

# What are examples of AI technology and how is it used today?

- **Machine vision/Computer vision**
  - This technology gives a machine the ability to see. Machine vision captures and analyzes visual information using a camera, analog-to-digital conversion and digital signal processing.
  - For example, it is used in a range of applications from signature identification to medical image analysis.
  - **Computer vision, which is focused on machine-based image processing, is often conflated with machine vision.**
- **Natural language processing (NLP)**
  - This is the processing of human language by a computer program. One of the older and best-known examples of NLP is spam detection, which looks at the subject line and text of an email and decides if it's junk.
  - Current approaches to NLP are based on machine learning. NLP tasks include text translation, sentiment analysis and speech recognition.

# What are examples of AI technology and how is it used today?

- **Robotics**

- This field of engineering focuses on the design and manufacturing of robots. Robots are often used to perform tasks that are difficult for humans to perform consistently.
- For example, robots are used in assembly lines for car production or by NASA to move large objects in space.
- Researchers are also using machine learning to build robots that can interact in social settings.

- **Self-driving cars**

- Autonomous vehicles use a combination of computer vision, image recognition and deep learning to build automated skill at piloting a vehicle while staying in a given lane and avoiding unexpected obstructions, such as pedestrians.



# Components of AI

- **Applications**
  - Image recognition
  - Speech recognition
  - Natural language generation
  - Chatbots
  - Sentiment analysis
- **Types of Models**
  - Machine learning
  - Deep learning
  - Neural networks
- **Software/Hardware for training and running models**
  - GPUs
  - Parallel processing tools
  - Cloud data storage and compute platforms
- **Programming languages for building models**
  - Python
  - TensorFlow
  - Prolog
  - Java, C/C++

# Course Objectives

- AI (Artificial Intelligence) is a core course in Computer Science. **The goal is to acquire knowledge on intelligent systems and agents, formalization of knowledge, reasoning with and without uncertainty, machine learning and applications at a basic level.**
- The basic skill that the student is expected to acquire after the successful completion of this course, includes:
  1. Understanding of the historical evolution of Artificial Intelligence.
  2. Explaining artificial intelligence, its characteristics and its application areas.
  3. Identification of the characteristics of an intelligent system/agent.
  4. Formalization of knowledge using the framework of predicate logic. Automatic reasoning in predicate logic using inference rules.
  5. Knowledge and application of basic principles and techniques of intelligent systems and their practical applications.

# Course Objectives

- The basic skill that the student is expected to acquire after the successful completion of this course, includes:
  6. Identify the type of search strategy (blind/heuristic/adversarial) that is more appropriate to address a particular problem and implement the selected strategy.
  7. Identify the type of learning process (supervised, unsupervised, reinforcement learning) is more appropriate to address a given problem. Identify and implement appropriate learning strategies.
  8. Formalization of AI skills in machine learning, bot development, robotic process automation, and cognitive computing
  9. Formalize and design solutions to practical problems of current interest using the strategies introduced during the course.
  10. Analyze the implications of applying AI systems to organizations and future of work.

# Course Objectives

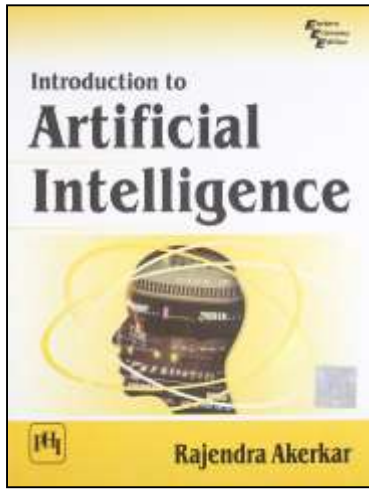
- **AI Lab Course Objectives:**
- The basic skill that the student is expected to acquire after the successful completion of this AI lab course, includes:
  1. To study the applications of AI and agent-based approach to AI.
  2. To study first-order predicate calculus, logical reasoning and problem solving using LISP and Prolog languages.
  3. To study and discuss various techniques and algorithms of AI used in general problem solving, optimization problems, constraint satisfaction problems, and game programming.
  4. To familiarize students with various sub-areas of AI, such as expert systems, natural language processing and machine learning.

# Course Contents

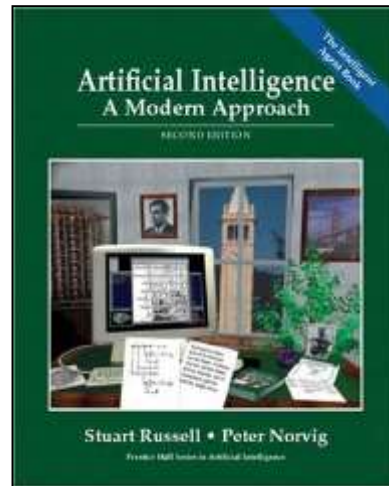
- **CSE 421 (Artificial Intelligence)      Credit: 3.0**
  - Overview and foundations of AI; History, types of AI, AI models, and applications of AI, Intelligent agents and their characteristics; General Concept of Knowledge, knowledge representation, and knowledge model.
  - Problem solving by searching: formulating problems, uninformed and informed search strategies, local search, evaluation of behavior and estimated cost, applications; Constraint satisfaction: formulating problems as CSP, backtracking and constraint propagation, applications; Games and adversarial search : minimax algorithm and Alpha-Beta? pruning, applications
  - Propositional logic: representing knowledge in PL, inference and reasoning, applications; First-order logic: representing knowledge in FOL, inference and reasoning, forward and backward chaining, rule-based systems, applications
  - Planning: languages of planning problems, search methods, planning graphs, hierarchical planning, extensions, applications
  - Expert systems, and natural language processing; AI, philosophy and ethics: can machines act intelligently, can machines really think, ethics and risks of AI, future of AI.
  - Languages and Programming Techniques for AI: Introduction to LISP and PROLOG.
- **CSE 422 (Artificial Intelligence Lab)      Credit: 1.5**
  - Laboratory works based on CSE 421

# Recommended Books

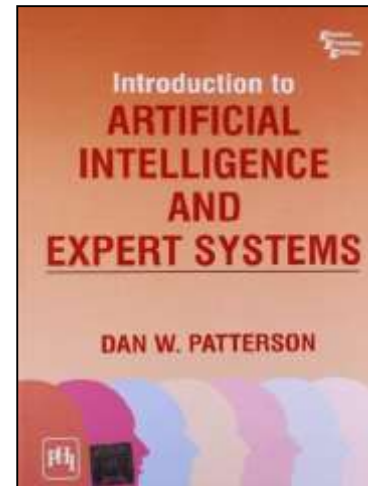
- **CSE 421 (Artificial Intelligence) Credit: 3.0**
- **CSE 422 (Artificial Intelligence Lab) Credit: 1.5**



Introduction to  
Artificial Intelligence  
*By Rajendra Akerkar*

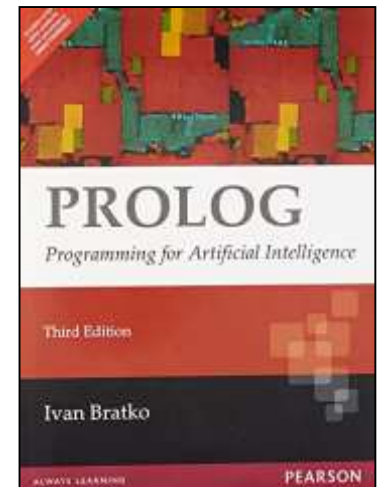


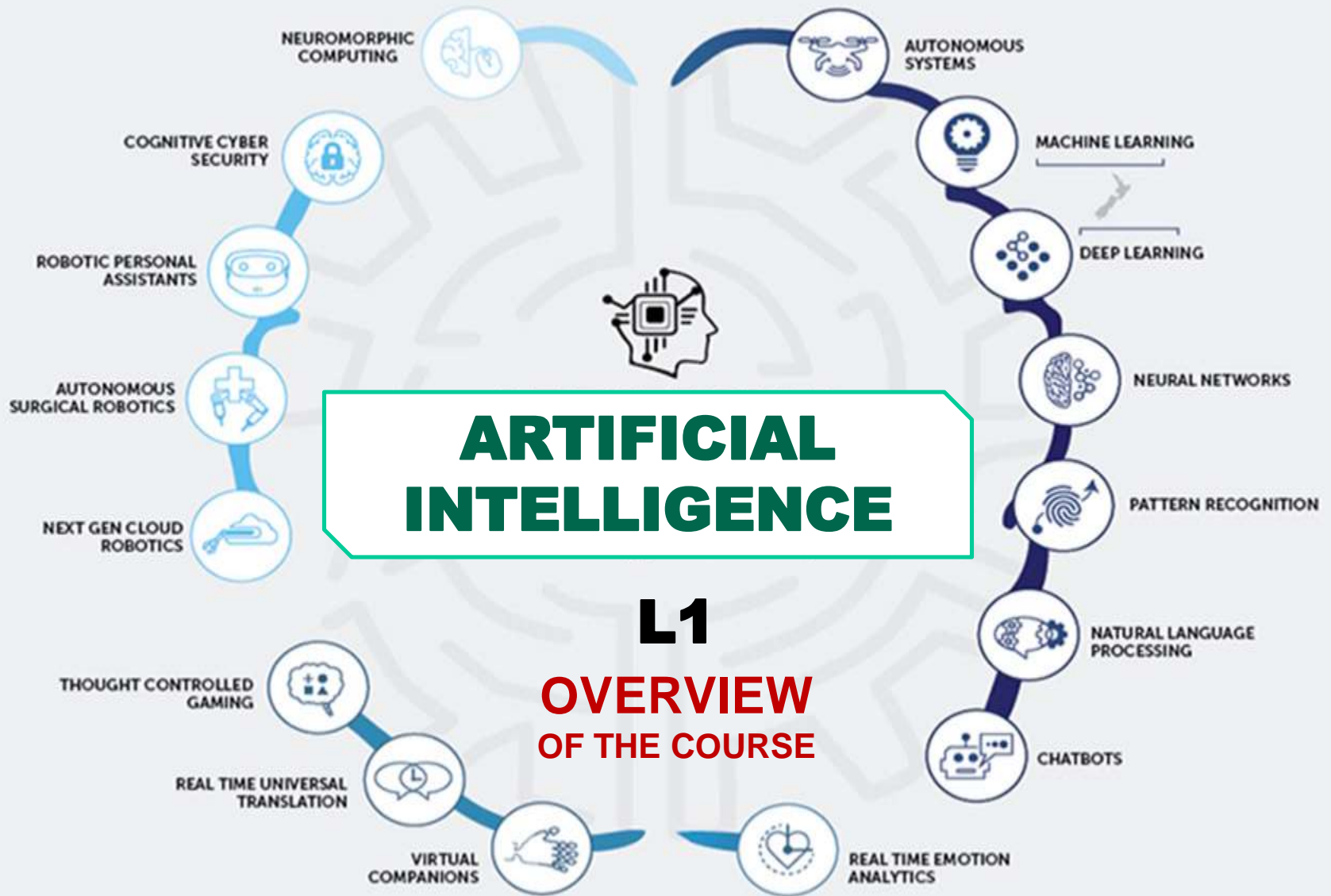
Artificial Intelligence  
A Modern Approach  
*By Stuart Russel & Peter Norvig*



Introduction to  
Artificial Intelligence  
and Expert System  
*By Dan W Patterson*

PROLOG  
Programming for  
Artificial Intelligence  
*By Ivan Bratko*





**The End**

