Chapter 1: Introduction to Intelligent Systems

Tran Dinh Que, PhD. Assoc. Prof.
Mail: quetd@ptit.edu.vn, tdque@yahoo.com
Phone: 0904066883

08.2025

About me

- 1981: Master in Mathematics (Hanoi National University of Education)
- 1998: Master in Software Engineering (Melbourne University, Australia)
- 2000: Ph.D in Computer Science (Vietnam National Academy of Science and Technologies)
- 2001: Invited lecturer at Calgary University, Canada
- **Research Interests**
  - AI General: Knowledge Representation, Uncertainty handling, Reasoning.
  - Complex Networks (Multiagent, Social Networks....): Influence, Trust.
  - Invited speaker at International Conference on Mathematics and Applications, Mahidol University, Bangkok, Thailand 2009, 2011, 2013, 2015, 2019, 2022

    Invited speaker at International Conference on Mathematics and Applications, Nguyen Tat Thanh University, Vietnam 2023, 2024

Publications

- Treextrust: topic-aware computational trust based on interaction experience, reputation of users with similarity and path algebra of graph in social networks, *Journal of Computer Science, Polland, 2025*. Available at: https://journals.agh.edu.pl/csci/issue/view/534
- More publishes: https://scholar.google.com/citations?user=YFw3uwQAAAAJ&hl=vi

Install Guide

1. Access Facebook Group

NO USE GOOGLE COLAB

2. Install

- python 3.11.4 (see Group facebook)
- C:> pip install tensorflow
- C:> pip install notebook
  //jupyterlab seems not stable????
- RUN and CODE!
  C:> jupyter notebook

References

- François Chollet, *Deep Learning with Python*, 2nd Edition, Manning, 2021.
- Wei-Meng Lee, *Python Machine Learning*, Wiley Publishing.
- Online platforms: https://www.geeksforgeeks.org/deep-learning/introduction-deep-learning/
  https://www.geeksforgeeks.org/deep-learning/deep-learning-tutorial/
- Vahid Mirjalili, *Deep Learning: Applications Using Python — Chatbots, Face, Object, and Speech Recognition with TensorFlow and Keras*.
- Stanford Lecture Notes: CS229 (Machine Learning), CS231n (Convolutional Neural Networks).

Assignments - Project

- Complete 5 Assignments with various versions
- Presentation
- Complete Subject Project
- Final Examination: Demo and Presentation/Interview
- Mark scale: 10-20-20-50

Why Intelligent Systems?

- The world is increasingly data-driven and automated.
- Human decision-making is limited by time, memory, and bias.
- Intelligent systems aim to enhance or replace human cognition.
- Examples: autonomous vehicles, personal assistants, medical diagnosis.

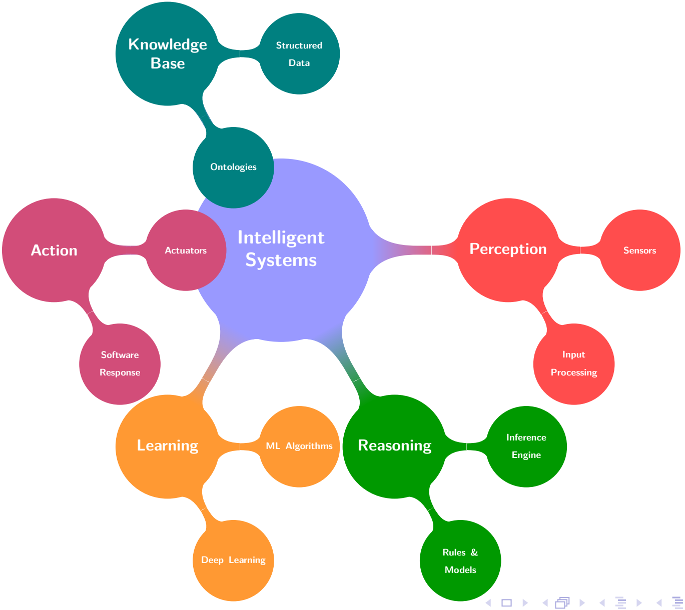
What is an Intelligent System?

- A system that can:
  - Learn from data or experience
  - Reason and make decisions
  - Adapt to changes in the environment
  - Act autonomously or interactively
- Based on Artificial Intelligence (AI), Machine Learning (ML), and data integration.

Core Components of Intelligent Systems

- **Perception:** sensors, input processing
- **Reasoning:** inference engine, rules, models
- **Learning:** ML/DL algorithms
- **Action:** robotic actuators, software responses
- **Knowledge Base:** structured data, ontologies

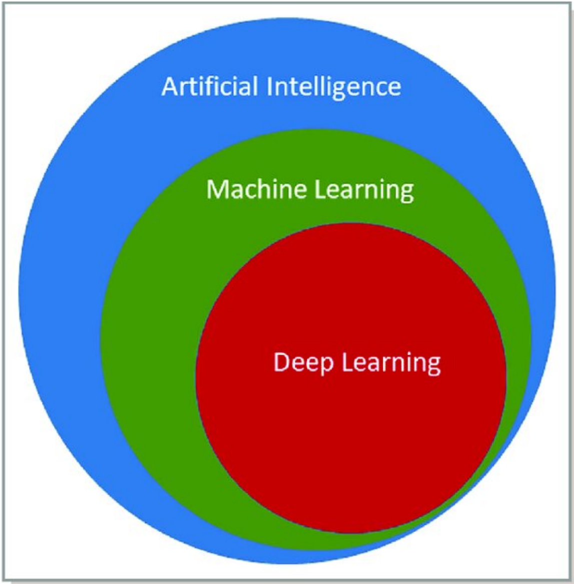
Core Components of Intelligent Systems



Real-World Applications

- **Healthcare:** Disease prediction, medical imaging
- **Finance:** Fraud detection, stock forecasting
- **Smart cities:** Traffic control, energy optimization
- **Retail:** Recommendation systems, dynamic pricing
- **Robotics:** Delivery drones, service robots

AI vs ML vs Deep Learning



Types of Machine Learning

- **Supervised Learning:** labeled data, prediction
- **Unsupervised Learning:** clustering, anomaly detection
- **Reinforcement Learning:** agent-environment interaction

Evolution Timeline

- 1950s: Symbolic AI
- 1980s: Expert systems
- 2000s: Machine Learning
- 2010s: Deep Learning revolution
- 2020s: Foundation models, AGI research

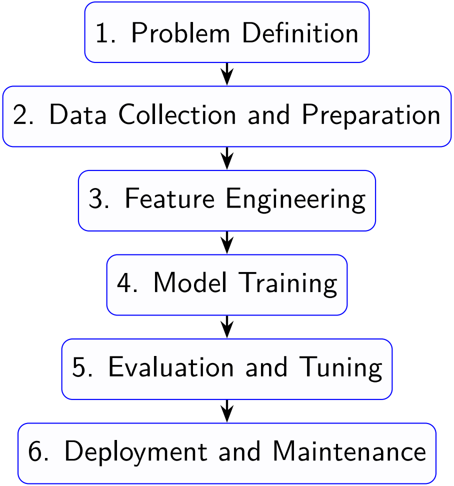
Benefits of Intelligent Systems

- Increased efficiency and productivity
- Reduction of human error
- Scalability in complex environments
- Enables new capabilities and innovation

Challenges and Ethical Concerns

- Bias in data and algorithms
- Lack of transparency (black-box models)
- Data privacy and security
- Job displacement

Phases of Intelligent System Development



1. Problem Definition

2. Data Collection and Preparation

3. Feature Engineering

4. Model Training

5. Evaluation and Tuning

6. Deployment and Maintenance

Course Structure

1. Introduction to Intelligent Systems
2. Fundamentals of Machine Learning
3. Deep Learning Architectures
4. Convolutional Neural Networks (CNNs)
5. Recurrent Neural Networks (RNNs)
6. Reinforcement Learning
7. Data Preprocessing Techniques
8. Model Deployment and Serving
9. Model Evaluation and Tuning
10. Final Project Presentation

Student Requirements

- Proficient in Python or Java
- Completed Software Engineering course
- Understand Data Structures & Algorithms
- Familiar with probability and linear algebra

Learning Outcomes

Upon course completion, students will:

- Distinguish between AI, ML, and DL
- Build and train machine learning models
- Apply models to real-world problems
- Integrate intelligent components into software systems
- Evaluate and improve model performance

Recommended Tools and Platforms

- Python + Libraries: scikit-learn, TensorFlow, keras... (PyTorch)
- Jupyter Notebook
- GitHub for version control
- Streamlit/FastAPI for model deployment

Example Projects

- Face recognition with CNNs
- Chatbot using NLP
- Customer churn prediction
- Analyse user's comments to propose strategy/recommnedation
- Handwritten digit classifier
- Medical image diagnosis...

References

- François Chollet, *Deep Learning with Python*, 2nd Edition, Manning, 2021.
- Wei-Meng Lee, *Python Machine Learning*, Wiley Publishing.
- Vahid Mirjalili, *Deep Learning: Applications Using Python — Chatbots, Face, Object, and Speech Recognition with TensorFlow and Keras*.
- Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, MIT Press.
- Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, O'Reilly, 2nd Edition.
- Stanford Lecture Notes: CS229 (Machine Learning), CS231n (Convolutional Neural Networks).
- Online platforms: Coursera, edX, Kaggle tutorials.

Frontiers of Research

- Explainable AI (XAI)
- Generalization and robustness
- Multi-modal learning (text + image + audio)
- Energy-efficient AI
- Ethical governance frameworks

Traditional vs Intelligent Systems

- Classical: fixed rules with code, limited adaptability
- Intelligent: data-driven, learning-based, adaptable
- Classical → Intelligent: shift from building database and programming to process the data to training DATA for bulding a new model to predicting/classification...From this we can construct chatBot, assistants....

Example Architecture

- Input layer (sensor/data stream)
- Feature extraction (ML pipeline)
- Decision making (neural network / rules)
- Output (actuator / user interface)

Summary of Chapter 1

- Install guide
- Introduced concept and importance of intelligent systems
- Overview of AI/ML/DL and application domains
- Challenges and course layout previewed