Module 1: AI Foundations — 12 Lessons

Lesson 1: What Is AI?

Understanding Artificial Intelligence and Its Core Concepts
In this lesson, you will explore what Artificial Intelligence (AI) truly means. AI refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning, reasoning, problem-solving, perception, and language understanding. AI has become a central part of modern technology, automating tasks that traditionally required human intelligence, such as understanding speech or recognizing images.

Key terms: Agent, Environment, Rationality, Symbolic vs. Statistical AI

Lesson 2: Turing Test: Testing Artificial Intelligence

What Is the Turing Test?
Proposed by Alan Turing in 1950, the Turing Test evaluates whether a machine can exhibit intelligent behavior indistinguishable from human behavior. It focuses on interaction via conversation—if a human cannot tell whether they are speaking to a machine or a human, then the machine has passed the test.

Key terms: Turing Test, Imitation Game, Indistinguishability, Natural language

Lesson 3: History of Artificial Intelligence: From Expert Systems to Deep Learning

Evolution of AI from Expert Systems to Deep Learning
AI development dates back to the 1950s when early AI systems like expert systems were developed to solve problems based on human knowledge and skills. Over time, machine learning and deep learning evolved, enabling machines to learn from data and make decisions using complex neural networks. Today, deep learning powers technologies such as facial recognition and self-driving cars.

Key terms: Expert systems, AI winters, Machine learning, Deep learning

Lesson 4: Categories of AI

Narrow AI, General AI, and Superintelligence
In this lesson, we will explore the distinctions between Narrow AI, which performs specific tasks (e.g., Siri, Google Assistant), General AI that matches human cognitive abilities across a broad range of tasks, and Superintelligence, a theoretical AI that surpasses human intelligence in all areas.

Key terms: Narrow AI (ANI), General AI (AGI), Superintelligence (ASI)

Lesson 5: Introduction to Basic Logic and Search Algorithms

Logic in AI and Search Algorithms

Logic is essential for AI decision-making and problem-solving. AI systems use logic to think in structured ways and perform reasoning. Search algorithms help AI find solutions to complex problems, such as solving puzzles like Sudoku. The Depth-First Search (DFS) and Breadth-First Search (BFS) algorithms are examples of search techniques used to explore various paths in problem-solving.

Key terms: Propositional logic, DFS, BFS, Optimality, Completeness, Path cost

Lesson 6: Using JavaScript for Small Demonstrations

Tic-Tac-Toe AI and Pathfinding Visualization

This lesson demonstrates how basic search algorithms can be applied in AI. First, we create a Tic-Tac-Toe AI using simple search algorithms to make decisions based on the current game state. Next, we explore pathfinding using the A* algorithm, showing how it finds the best path from start to finish in a grid.

Key terms: Minimax, Heuristic, A* (A-star), Nodes & edges

Lesson 7: Data, Features, and Labels

What Data Looks Like in ML and How It Flows

In machine learning, data consists of three core elements: features (inputs), labels (targets), and examples (rows). Data flows through a typical workflow: collect, clean, split (train/validation/test), train, evaluate, and iterate. For images, features are pixels, and labels could be classes; for text, features could be tokens or embeddings, and labels might be intents.

Key terms: Features, Labels, Train/Val/Test split, Leakage

Lesson 8: Learning Paradigms

Supervised, Unsupervised, and Reinforcement Learning

Supervised learning uses labeled input-output pairs (classification or regression). Unsupervised learning finds hidden structures in unlabeled data (clustering, dimensionality reduction). Reinforcement learning is about optimizing actions through rewards.

Key terms: Supervised, Unsupervised, Reinforcement, Clustering, Policy, Reward

Lesson 9: Model Evaluation

Accuracy, Precision, Recall, F1, and ROC-AUC

When evaluating models, accuracy may not always give the best insight, especially with imbalanced data. Instead, metrics like precision, recall, F1, and ROC-AUC offer a more detailed view of model performance.

Key terms: Confusion matrix, Threshold, PR curve, ROC curve

Lesson 10: Overfitting and Generalization

Bias-Variance, Regularization, and Validation Strategies
Overfitting occurs when a model memorizes noise in the training data, leading to poor generalization. Regularization techniques, such as L1/L2, dropout, early stopping, and data augmentation, help prevent overfitting. Cross-validation techniques, such as k-fold validation, help ensure that the model generalizes well to unseen data.

Key terms: Bias-variance, L1/L2 (weight decay), Early stopping, Cross-validation, Data augmentation

Lesson 11: Ethics and Responsible AI

Fairness, Privacy, Transparency, and Safety
Responsible AI development goes beyond technical performance; it must also consider fairness, privacy, transparency, and safety. AI systems must be fair, unbiased, transparent in their decision-making, and safe for users. Addressing issues such as consent, purpose limitation, and model explainability ensures ethical AI development.

Key terms: Fairness, Bias, Privacy, Transparency, Accountability

Module Summary

By the end of this module, you can explain AI's core concepts, understand the Turing Test and its limitations, and differentiate between Narrow AI, AGI, and Superintelligence. You'll also be able to structure data properly for machine learning, understand key learning paradigms (supervised, unsupervised, and reinforcement learning), evaluate models with precision, recall, F1, and ROC-AUC, and apply regularization techniques to avoid overfitting. Responsible AI practices, including fairness, privacy, and transparency, are also emphasized throughout.

Next Steps:

Explore the Machine Learning module to dive deeper into algorithms, model training, and performance evaluation. Then, practice applying AI techniques through small projects or experiments.

Lesson Quick Check

Lesson 1: What Is AI?

What statement best defines Artificial Intelligence?

A. Only data compression

B. Systems that perceive, reason, learn and act toward goals

C. Only visual design

D. Only faster hardware

Answer: Systems that perceive, reason, learn and act toward goals

Lesson 2: Turing Test: Testing Artificial Intelligence

What does the Turing Test evaluate?

A. Training dataset size

B. Image resolution

C. GPU clock speed

D. Whether a machine can converse indistinguishably from a human

Answer: Whether a machine can converse indistinguishably from a human

Lesson 3: History of Artificial Intelligence: From Expert Systems to Deep Learning

Which classic AI approach relied on hand-crafted rules and domain expertise?

A. Self-supervised transformers

B. Expert systems

C. Convolutional neural networks

D. Reinforcement learning

Answer: Expert systems

Lesson 4: Categories of AI

Which option best describes Narrow AI?

A. A rule that prevents overfitting

B. AI that surpasses humans in every domain

C. AI that matches human general intelligence in all tasks

D. AI designed for specific tasks with limited scope

Answer: AI designed for specific tasks with limited scope

Lesson 5: Introduction to Basic Logic and Search Algorithms

BFS (Breadth-First Search) is guaranteed to find:

A. The longest path

B. The most memory-efficient path

C. The shortest path in unweighted graphs

D. A global optimum in any search space

Answer: The shortest path in unweighted graphs

Lesson 6: Using JavaScript for Small Demonstrations

Which algorithm is commonly used to find the shortest path on a grid?

A. Gradient Descent

B. A* (A-star)

C. K-Means

D. Backpropagation

Answer: A* (A-star)

Lesson 7: Data, Features, and Labels

In a typical ML dataset, the label refers to:

A. A model hyperparameter

B. The target variable to predict

C. A unique row identifier

D. An input feature

Answer: The target variable to predict

Lesson 8: Learning Paradigms

Which is an unsupervised algorithm?

A. Q-learning

B. Random forest

C. K-Means clustering

D. Logistic regression

Answer: K-Means clustering

Lesson 9: Model Evaluation

Precision is defined as:

A. (TP + TN) / (All)

B. TP / (TP + FN)

C. TP / (TP + FP)

D. FP / (FP + TN)

Answer: TP / (TP + FP)

Lesson 10: Overfitting and Generalization

Overfitting best describes a model that:

A. Performs poorly on both train and test

B. Is always linear

C. Has too few parameters

D. Performs well on training but poorly on unseen data

Answer: Performs well on training but poorly on unseen data

Lesson 11: Ethics and Responsible AI

Which practice best supports Responsible AI?

A. Using model cards and monitoring for bias

B. Collecting more personal data without consent

C. Hiding model limitations from users

D. Maximizing accuracy at any cost

Answer: Using model cards and monitoring for bias