Artificial Intelligence Fundamentals

Artificial Intelligence (AI) enables machines to mimic human intelligence.

AI CATEGORIES:

1. Narrow AI (Weak AI)
   - Designed for specific tasks
   - Examples: Siri, Netflix recommendations, chess AI
   - Current state of AI
2. General AI (Strong AI)
   - Human-level intelligence
   - Can perform any intellectual task
   - Theoretical, not yet achieved
3. Super AI
   - Surpasses human intelligence
   - Hypothetical future stage

MACHINE LEARNING (ML):

Subset of AI that learns from data without explicit programming.

Types:

1. Supervised Learning
   - Labeled training data
   - Predicts output for new input
   - Algorithms:
     * Linear Regression (continuous output)
     * Logistic Regression (classification)
     * Decision Trees
     * Random Forest
     * Support Vector Machines (SVM)
     * Neural Networks
2. Unsupervised Learning
   - Unlabeled data
   - Finds patterns and structure
   - Algorithms:
     * K-Means Clustering
     * Hierarchical Clustering
     * Principal Component Analysis (PCA)
     * Apriori Algorithm
3. Reinforcement Learning
   - Learn through trial and error
   - Reward-based learning
   - Applications: Game playing, robotics
   - Algorithms: Q-Learning, Deep Q-Networks

DEEP LEARNING:

Subset of ML using neural networks with multiple layers.

Neural Network Structure:
- Input Layer: Receives data
- Hidden Layers: Process information
- Output Layer: Produces result
Types:
1. Feedforward Neural Networks (FNN)
   - Data flows in one direction
   - Used for classification
2. Convolutional Neural Networks (CNN)
   - Image recognition and processing
   - Uses convolutional layers
   - Applications: Face detection, self-driving cars
3. Recurrent Neural Networks (RNN)
   - Processes sequential data
   - Has memory of previous inputs
   - Applications: Language translation, speech recognition
4. Long Short-Term Memory (LSTM)
   - Special type of RNN
   - Solves vanishing gradient problem
   - Better at long sequences
5. Generative Adversarial Networks (GAN)
   - Two networks compete (Generator vs Discriminator)
   - Creates realistic synthetic data
   - Applications: Image generation, deepfakes
NATURAL LANGUAGE PROCESSING (NLP):
Enables computers to understand human language.
Tasks:
1. Tokenization: Breaking text into words
2. Stemming/Lemmatization: Reducing words to root form
3. Part-of-Speech Tagging: Identifying word types
4. Named Entity Recognition (NER): Identifying names, places
5. Sentiment Analysis: Determining positive/negative tone
6. Machine Translation: Google Translate
7. Text Summarization: Creating summaries
8. Question Answering: Chatbots
COMPUTER VISION:
Enables machines to interpret visual information.
Tasks:
1. Image Classification: Categorizing images
2. Object Detection: Locating objects (YOLO, R-CNN)
3. Image Segmentation: Pixel-level classification
4. Facial Recognition: Identifying faces
5. Optical Character Recognition (OCR): Reading text
AI ALGORITHMS:

1. Search Algorithms
   - Breadth-First Search (BFS)
   - Depth-First Search (DFS)
   - A* Algorithm (heuristic-based)
   - Minimax (game playing)
2. Optimization Algorithms
   - Gradient Descent
   - Genetic Algorithms
   - Particle Swarm Optimization

AI APPLICATIONS:

? Healthcare: Disease diagnosis, drug discovery
? Finance: Fraud detection, algorithmic trading
? Transportation: Self-driving cars, route optimization
? E-commerce: Recommendation systems, chatbots
? Manufacturing: Quality control, predictive maintenance
? Entertainment: Content generation, game AI

ETHICAL CONCERNS:

- Bias in AI models
- Job displacement
- Privacy issues
- Autonomous weapons
- Deepfakes and misinformation
- AI safety and control

POPULAR AI FRAMEWORKS:

- TensorFlow (Google)
- PyTorch (Facebook)
- Keras (High-level API)
- scikit-learn (ML algorithms)
- OpenCV (Computer Vision)
- NLTK/spaCy (NLP)