1. **Neural Networks in Artificial Intelligence**:
   * **Definition**: A **neural network** is a machine learning model that mimics the structure and function of the human brain. It consists of interconnected nodes (artificial neurons) organized into layers: an input layer, one or more hidden layers, and an output layer.
   * **How They Work**:
     + Each node receives input data, applies weights to it, and passes the result through an activation function.
     + The weights determine the importance of each input feature, and the activation function introduces non-linearity.
     + By adjusting weights during training, neural networks learn to make accurate predictions.
   * **Differences from Traditional ML Algorithms**:
     + Neural networks are more flexible and can handle complex relationships in data.
     + Unlike traditional algorithms (e.g., linear regression), neural networks can learn from unstructured data (e.g., images, text).
   * **Advantages**:
     + **Pattern Recognition**: Neural networks excel at recognizing patterns in data, making them ideal for tasks like image recognition and speech processing.
     + **Non-Linearity**: They capture non-linear relationships, which traditional models struggle with.
     + **Parallel Processing**: Neural networks can process data in parallel, speeding up computations.
     + **Adaptability**: They adapt to new data without reprogramming.
2. **Weak AI vs. Strong AI**:
   * **Weak AI (Narrow AI)**:
     + Focuses on specific tasks (e.g., virtual assistants, image recognition).
     + Cannot reason beyond its designated function.
     + Examples: Siri, chatbots, recommendation systems.
     + **Limitations**: Lacks general intelligence, limited context awareness.
   * **Strong AI (General AI)**:
     + Aims to replicate human intelligence across various domains.
     + Thinks and behaves like humans.
     + **Challenges and Risks**:
       - Ethical concerns: Privacy, bias, job displacement.
       - Safety: Ensuring AI aligns with human values.
   * **Potential Impact on Society**:
     + Revolutionize industries (medicine, transportation, etc.).
     + Address complex global challenges.
     + Requires robust ethical guidelines.
3. **Role of Natural Language Processing (NLP)**:
   * **Definition**: NLP combines computational linguistics with machine learning to enable computers to understand, generate, and process human language.
   * **Challenges and Limitations**:
     + **Ambiguity**: Words with multiple meanings (e.g., “bank”).
     + **Context**: Understanding context-dependent language.
     + **Idioms and Sarcasm**: Handling non-literal expressions.
   * **NLP Tasks**:
     + **Speech Recognition**: Converts voice data to text (e.g., voice-operated GPS).
     + **Part of Speech Tagging**: Identifies word roles (e.g., verb, noun).
     + **Word Sense Disambiguation**: Selects the correct meaning of a word based on context.
   * **Applications**:
     + **Chatbots**: Customer service, virtual assistants.
     + **Sentiment Analysis**: Assessing emotions in text.
     + **Language Translation**: Google Translate, language models.