
Professional Certificate in Artificial Intelligence for Sustainable Marine Engineering

Introduction to Artificial Intelligence

Artificial Intelligence (AI):

Artificial Intelligence (AI) refers to the simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using it), reasoning (using rules to reach approximate or definite conclusions), and self-correction. AI has become an essential part of the technology industry, influencing the development of various sectors, including healthcare, finance, transportation, and more. AI can be categorized as either weak AI, also known as narrow AI, which is designed for a specific task, or strong AI, which aims to replicate human cognitive abilities.

Algorithm:

An algorithm is a set of rules or instructions designed to perform a specific task. In the context of artificial intelligence, algorithms are used to solve problems and make decisions by processing input data and producing an output. Different algorithms are used for various AI tasks, such as machine learning, natural language processing, computer vision, and more.

Backpropagation:

Backpropagation is a key algorithm used in training artificial neural networks. It is a method for adjusting the weights of the connections between neurons in a neural network to minimize the difference between the predicted output and the actual output. Backpropagation involves calculating the gradient of the loss function with respect to the weights and then updating the weights in the opposite direction of the gradient.

Chatbot:

A chatbot is a computer program designed to simulate conversation with human users, especially over the internet. Chatbots are often used in customer service, virtual assistants, and other applications to provide information or assistance to users. Chatbots can be rule-based, using predefined responses based on keywords, or AI-powered, using natural language processing and machine learning to understand and respond to user input.

Data Mining:

Data mining is the process of discovering patterns, trends, and insights in large datasets. In the context of artificial intelligence, data mining is used to extract knowledge from data and make predictions based on that knowledge. Data mining techniques include clustering, classification, regression, association rule mining, and anomaly detection.

Deep Learning:

Deep learning is a subset of machine learning that uses artificial neural networks with multiple layers to

learn from data. Deep learning models can automatically learn to represent and extract features from raw data, making them suitable for tasks such as image recognition, speech recognition, natural language processing, and more. Deep learning has achieved remarkable success in various AI applications, especially in recent years.

Expert System:

An expert system is a computer program that emulates the decision-making ability of a human expert in a specific domain. Expert systems use knowledge representation, inference engines, and a rule-based system to reason and make decisions based on the knowledge stored in their knowledge base. Expert systems are used in various fields, including healthcare, finance, engineering, and more, to provide expert-level advice and solutions.

Genetic Algorithm:

A genetic algorithm is a type of optimization algorithm inspired by the process of natural selection and genetics. Genetic algorithms are used to evolve solutions to optimization and search problems by mimicking the process of natural selection, crossover, mutation, and survival of the fittest. Genetic algorithms are particularly useful for solving complex optimization problems where traditional algorithms may struggle to find an optimal solution.

Heuristic:

A heuristic is a problem-solving approach or technique that uses practical, intuitive rules or strategies to find solutions more efficiently. Heuristics are often used in artificial intelligence to guide search algorithms, make decisions, and solve complex problems where an exhaustive search is not feasible. Heuristics can help AI systems quickly find approximate solutions that are good enough for practical purposes.

Image Recognition:

Image recognition is the process of identifying and detecting objects, patterns, or features in images. In the field of artificial intelligence, image recognition is achieved using computer vision techniques and machine learning algorithms to analyze and classify visual data. Image recognition has applications in various industries, including healthcare, security, automotive, and more, where it is used for tasks such as facial recognition, object detection, and image classification.

Knowledge Base:

A knowledge base is a database or repository that stores knowledge, information, and facts about a specific domain or topic. In the context of artificial intelligence, knowledge bases are used in expert systems, chatbots, and other AI applications to store and retrieve knowledge to make informed decisions or provide answers to user queries. Knowledge bases can be structured in various ways, such as rule-based systems, ontologies, or semantic networks.

Machine Learning:

Machine learning is a subset of artificial intelligence that focuses on developing algorithms and models that

allow computers to learn from data and make predictions or decisions without being explicitly programmed. Machine learning algorithms can analyze and learn from patterns in data to improve their performance over time. Machine learning is used in various applications, including recommendation systems, predictive analytics, fraud detection, and more.

Natural Language Processing (NLP):

Natural Language Processing (NLP) is a branch of artificial intelligence that focuses on enabling computers to understand, interpret, and generate human language. NLP involves tasks such as text analysis, sentiment analysis, speech recognition, machine translation, and more. NLP techniques are used in chatbots, virtual assistants, search engines, and other applications to process and interact with natural language data.

Optimization:

Optimization is the process of finding the best solution or the optimal outcome to a problem from a set of possible solutions. In the context of artificial intelligence, optimization algorithms are used to improve the performance of AI models, fine-tune parameters, and optimize decision-making processes. Optimization techniques include gradient descent, genetic algorithms, simulated annealing, and more, which are used to find optimal solutions in various AI applications.

Pattern Recognition:

Pattern recognition is the process of identifying and classifying patterns or trends in data based on predefined rules or algorithms. In artificial intelligence, pattern recognition is used to analyze and interpret data, extract meaningful insights, and make predictions based on patterns in the data. Pattern recognition techniques include clustering, classification, regression, anomaly detection, and more, which are used in various AI applications.

Q-Learning:

Q-learning is a reinforcement learning algorithm used to train agents to make sequential decisions in an environment to maximize a cumulative reward. Q-learning is based on the concept of Q-values, which represent the expected cumulative reward of taking a particular action in a specific state. By updating Q-values through trial and error, the agent learns to make optimal decisions in different states of the environment.

Reinforcement Learning:

Reinforcement learning is a type of machine learning that involves training agents to make sequential decisions by interacting with an environment and receiving feedback in the form of rewards or penalties. Reinforcement learning algorithms learn through trial and error to maximize cumulative rewards over time. Reinforcement learning is used in various applications, including game playing, robotics, recommendation systems, and more.

Supervised Learning:

Supervised learning is a type of machine learning that involves training models on labeled data to make

predictions or decisions. In supervised learning, the algorithm learns from examples provided in the form of input-output pairs to generalize and make predictions on new, unseen data. Supervised learning algorithms include regression, classification, and ensemble methods, which are used in various AI applications.

Unsupervised Learning:

Unsupervised learning is a type of machine learning that involves training models on unlabeled data to discover patterns, relationships, or structures in the data. In unsupervised learning, the algorithm learns to represent and cluster data without explicit guidance, making it suitable for tasks such as clustering, dimensionality reduction, and anomaly detection. Unsupervised learning algorithms include k-means clustering, principal component analysis, and autoencoders.

Virtual Assistant:

A virtual assistant is a software program or application that uses artificial intelligence to provide assistance, guidance, and information to users through voice or text interfaces. Virtual assistants can perform tasks such as answering questions, setting reminders, making recommendations, and more, based on natural language processing and machine learning techniques. Virtual assistants are used in various devices and platforms, such as smartphones, smart speakers, and chatbots.

Weak AI:

Weak AI, also known as narrow AI, refers to artificial intelligence systems that are designed for specific tasks or domains and do not possess general human-like intelligence. Weak AI systems excel at performing specific tasks, such as speech recognition, image classification, and game playing, but they lack the broad cognitive abilities of humans. Weak AI is prevalent in various applications and technologies, contributing to advancements in AI research and development.

Neural Network:

A neural network is a computational model inspired by the structure and function of the human brain, composed of interconnected nodes or neurons organized in layers. Neural networks are used in machine learning and deep learning to learn from data, extract features, and make predictions by processing information through layers of neurons. Different types of neural networks include feedforward neural networks, convolutional neural networks, recurrent neural networks, and more, each suited for specific tasks and applications.

Convolutional Neural Network (CNN):

A Convolutional Neural Network (CNN) is a type of neural network designed for processing and analyzing visual data, such as images and videos. CNNs use convolutional layers, pooling layers, and fully connected layers to learn hierarchical representations of features in the input data. CNNs are widely used in image recognition, object detection, facial recognition, and other computer vision tasks, where they have achieved state-of-the-art performance.

LSTM (Long Short-Term Memory):

Long Short-Term Memory (LSTM) is a type of recurrent neural network (RNN) architecture designed to capture long-term dependencies and store information over time. LSTMs use a memory cell, input gate, output gate, and forget gate to learn and update information in sequences of data. LSTMs are used in natural language processing, speech recognition, time series analysis, and other tasks where modeling sequential data is essential.

Machine Vision:

Machine vision is a field of artificial intelligence that focuses on enabling machines to see, interpret, and understand visual information from the environment. Machine vision combines computer vision techniques, image processing, and machine learning algorithms to analyze and extract meaningful insights from images or videos. Machine vision has applications in autonomous vehicles, robotics, quality control, surveillance, and more, where visual perception is crucial for decision-making.

Perceptron:

A perceptron is the simplest form of an artificial neural network, consisting of a single layer of neurons with weighted connections to produce an output. Perceptrons are used in linear classification tasks to learn decision boundaries between classes based on input features. Although perceptrons are limited to linearly separable problems, they serve as the building blocks for more complex neural network architectures, such as multi-layer perceptrons and deep neural networks.

Recurrent Neural Network (RNN):

A Recurrent Neural Network (RNN) is a type of neural network designed to process sequential data by maintaining a hidden state that captures dependencies across time steps. RNNs use feedback loops to pass information from one time step to the next, allowing them to model temporal patterns and sequences. RNNs are used in natural language processing, speech recognition, time series analysis, and other tasks where sequential data processing is required.

Rule-Based System:

A rule-based system is a type of artificial intelligence system that uses a set of logical rules to make decisions or draw conclusions based on input data. Rule-based systems encode knowledge in the form of if-then rules, where specific conditions trigger actions or responses. Rule-based systems are used in expert systems, chatbots, recommendation systems, and other applications to model decision-making processes and provide automated reasoning based on predefined rules.

Self-Driving Car:

A self-driving car, also known as an autonomous vehicle, is a vehicle equipped with artificial intelligence and sensors to navigate and operate without human intervention. Self-driving cars use computer vision, machine learning, sensor fusion, and control systems to perceive the environment, make decisions, and drive safely. Self-driving cars have the potential to revolutionize transportation, reduce accidents, and improve efficiency in urban mobility.

Speech Recognition:

Speech recognition is the process of converting spoken language into text or commands by a computer system using natural language processing and machine learning algorithms. Speech recognition systems analyze audio input, identify speech patterns, and transcribe spoken words into text. Speech recognition is used in virtual assistants, dictation software, voice-controlled devices, and other applications to enable hands-free interaction with computers and devices.

TensorFlow:

TensorFlow is an open-source machine learning framework developed by Google for building and training deep learning models. TensorFlow provides a flexible and scalable platform for developing a wide range of machine learning applications, including image recognition, natural language processing, reinforcement learning, and more. TensorFlow supports both high-level APIs for quick prototyping and low-level APIs for fine-tuning and customization of neural network architectures.

Unstructured Data:

Unstructured data refers to data that does not have a predefined format or organization, making it challenging to analyze and process using traditional methods. Unstructured data includes text, images, videos, audio, social media posts, and other forms of content that do not fit neatly into rows and columns of a database. Artificial intelligence techniques, such as natural language processing and computer vision, are used to extract insights from unstructured data and make sense of the information.

Voice Assistant:

A voice assistant is a virtual assistant that uses speech recognition and natural language processing to interact with users through voice commands. Voice assistants can perform tasks such as answering questions, playing music, setting reminders, and controlling smart home devices using spoken instructions. Voice assistants, such as Amazon Alexa, Apple Siri, Google Assistant, and Microsoft Cortana, are integrated into various devices and platforms to provide hands-free and intuitive user experiences.

Weak Supervision:

Weak supervision is a machine learning technique that involves training models using noisy, incomplete, or imperfect labels instead of manually annotated data. Weak supervision leverages heuristics, rules, or existing knowledge to generate training data at scale, allowing models to learn from diverse sources of information. Weak supervision is used to tackle data labeling challenges in large datasets where obtaining accurate labels is time-consuming or costly.

Zero-Shot Learning:

Zero-shot learning is a machine learning paradigm that enables models to generalize and make predictions on unseen classes without explicit training examples. Zero-shot learning leverages semantic relationships, attributes, or textual descriptions of classes to infer similarities and make predictions on novel classes. Zero-shot learning is used in image recognition, natural language processing, and other tasks where models need to adapt to new concepts or categories with limited labeled data.