What is planning?

What is a Plan?

For any planning system, we need the **domain description, action specification**, and **goal description**. A plan is assumed to be a sequence of actions and each action has its own set of preconditions to be satisfied before performing the action and also some effects which can be positive or negative. So, we have Forward State Space Planning (FSSP) and Backward State Space Planning (BSSP) at the basic level.

1. Forward State Space Planning (FSSP)
FSSP behaves in a similar fashion like forward state space search. It says that given a start state S in any domain, we perform certain actions required and acquire a new state S' (which includes some new conditions as well) which is called progress and this proceeds until we reach the goal state. The actions have to be applicable in this case.

- **Disadvantage:** Large branching factor
- **Advantage:** Algorithm is Sound

2. Backward State Space Planning (BSSP)
BSSP behaves in a similar fashion like backward state space search. In this, we move from the goal state g towards sub-goal g' that is finding the previous action to be done to achieve that respective goal. This process is called regression (moving back to the previous goal or sub-goal). These sub-goals have to be checked for consistency as well. The actions have to be relevant in this case.

- **Disadvantage:** Not a sound algorithm (sometimes inconsistency can be found)
- **Advantage:** Small branching factor (very small compared to FSSP)

goal stack planning in ai in short:

Goal stack planning is a planning technique in artificial intelligence that involves breaking down complex tasks into smaller sub-goals or sub-tasks, which are then represented as a stack of goals. The technique works by decomposing the overall goal into sub-goals, and then recursively decomposing each sub-goal into smaller sub-goals until the sub-goals can be achieved using primitive actions. The planner then executes the primitive actions in a bottom-up manner, starting from the lowest level sub-goals and gradually building up to the overall goal. This technique is useful in planning systems where the overall goal is complex and can be broken down into smaller, more manageable tasks.

1. Modularity: The technique allows for the decomposition of complex tasks into smaller, more manageable sub-tasks, making the planning process more modular and easier to manage.
2. Flexibility: The technique is flexible and can be used with a wide range of planning problems and domains.
3. Recursive Planning: The technique allows for recursive planning, where sub-goals can be further broken down into smaller sub-goals, until the planning problem can be solved using primitive actions.
4. Goal Prioritization: The technique allows for the prioritization of goals based on their importance, enabling planners to focus on achieving the most critical goals first.
5. Incremental Planning: The technique supports incremental planning, where the planner can start with a small set of goals and gradually add more goals to the stack as they are achieved.
6. Reusability: The technique allows for the reuse of planning solutions for similar problems, reducing the time and effort required to solve new planning problems.

List out the various planning techniques

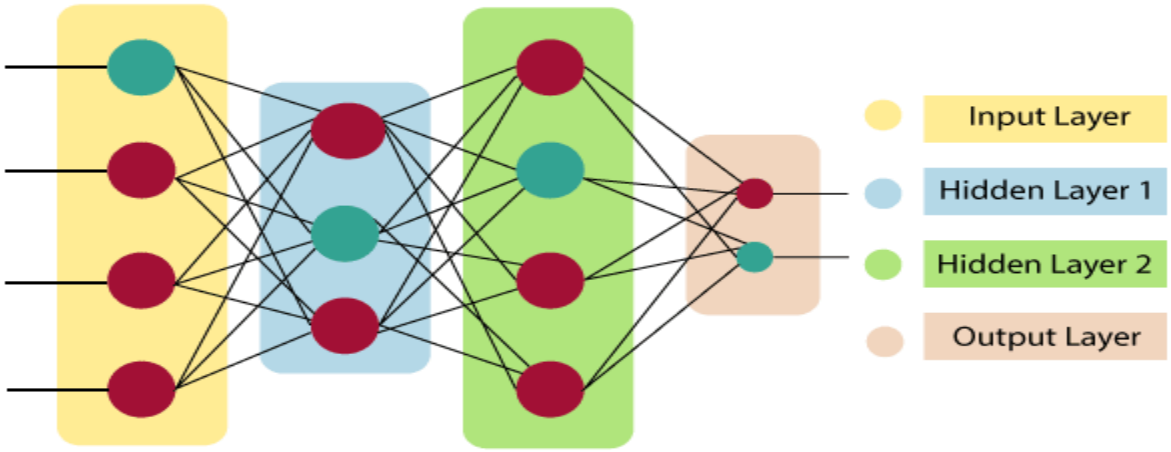
There are several planning techniques used in artificial intelligence and computer science. Here are some of the commonly used planning techniques:

1. STRIPS (Stanford Research Institute Problem Solver): STRIPS is a popular planning technique used to solve problems in a restricted domain, using a set of logical rules and goals.
2. PDDL (Planning Domain Definition Language): PDDL is a language used to define planning problems and specify the goals and constraints.
3. HTN (Hierarchical Task Network): HTN is a planning technique that represents plans as a hierarchical structure of tasks, with subtasks decomposed into smaller tasks until they are executable.
4. CSP (Constraint Satisfaction Problem): CSP is a planning technique that models a problem as a set of variables and constraints, with the goal of finding a solution that satisfies all constraints.
5. Decision Trees: Decision trees are a planning technique used for decision-making, with the goal of identifying the best course of action based on a set of inputs or conditions.
6. Monte Carlo Tree Search: Monte Carlo Tree Search is a planning technique that is particularly useful for problems with a large search space, where the goal is to find the optimal sequence of actions.
7. Reinforcement Learning: Reinforcement learning is a planning technique that involves an agent learning to make decisions in an environment, based on rewards and punishments for actions taken.

2.Explain the layers in ANN.

The term "**Artificial Neural Network**" is derived from Biological neural networks that develop the structure of a human brain. Similar to the human brain that has neurons interconnected to one another, artificial neural networks also have neurons that are interconnected to one another in various layers of the networks. These neurons are known as nodes.

The architecture of an artificial neural network:



Input Layer:

As the name suggests, it accepts inputs in several different formats provided by the programmer.

Hidden Layer:

The hidden layer presents in-between input and output layers. It performs all the calculations to find hidden features and patterns.

Output Layer:

The input goes through a series of transformations using the hidden layer, which finally results in output that is conveyed using this layer. **Advantages of Artificial Neural Network (ANN)**

Parallel processing capability:

Artificial neural networks have a numerical value that can perform more than one task simultaneously.

Storing data on the entire network:

Data that is used in traditional programming is stored on the whole network, not on a database. The disappearance of a couple of pieces of data in one place doesn't prevent the network from working.

Capability to work with incomplete knowledge:

After ANN training, the information may produce output even with inadequate data. The loss of performance here relies upon the significance of missing data.

Having a memory distribution:

For ANN is to be able to adapt, it is important to determine the examples and to encourage the network according to the desired output by demonstrating these examples to the network.

Having fault tolerance:

Extortion of one or more cells of ANN does not prohibit it from generating output, and this feature makes the network fault-tolerance.

Disadvantages of Artificial Neural Network:

Assurance of proper network structure:

There is no particular guideline for determining the structure of artificial neural networks. The appropriate network structure is accomplished through experience, trial, and error.

Unrecognized behavior of the network:

It is the most significant issue of ANN. When ANN produces a testing solution, it does not provide insight concerning why and how. It decreases trust in the network.

Hardware dependence:

Artificial neural networks need processors with parallel processing power, as per their structure. Therefore, the realization of the equipment is dependent.

2.Difficulty of showing the issue to the network.

Explain in detail the STRIPS?

The STRIPS system uses a formal language to represent the planning domain and problem. The domain language defines the possible actions that can be taken in the problem, while the problem language specifies the initial state of the problem and the desired goal. The domain and problem language use a first-order predicate calculus notation that allows for the expression of complex logical statements.

The STRIPS system uses a forward-chaining search algorithm to generate a plan of action. The search algorithm works by starting with the initial state of the problem and expanding possible actions that can be taken to achieve the goal state. The system uses a heuristic function to evaluate each state and determine the best action to take next.

One of the key features of the STRIPS system is its ability to use preconditions and effects to represent the conditions under which an action can be taken and the effects of an action. Preconditions are logical statements that must be true before an action can be executed, while effects are logical statements that become true after the action has been executed.

For example, let's say we have a planning problem of moving a box from one location to another location. In STRIPS, we can represent the problem using the following domain and problem languages:

Domain Language:

- Action(move(box, loc1, loc2)) Preconditions: at(box, loc1) Effects: not at(box, loc1), at(box, loc2)

Problem Language:

- at(box, loc1)
- at(agent, loc2)

The domain language defines the action "move" that can move the box from location 1 to location 2. The preconditions state that the box must be at location 1 before the action can be executed, and the effects state that the box will no longer be at location 1 and will be at location 2 after the action is executed.

The problem language specifies that the box is initially at location 1 and the agent is at location 2. The STRIPS system can then use its search algorithm to generate a plan of action to move the box to location 2.

What is Reinforcement Learning?

- Reinforcement Learning is a feedback-based Machine learning technique in which an agent learns to behave in an environment by performing the actions and seeing the results of actions. For each good action, the agent gets positive feedback, and for each bad action, the agent gets negative feedback or penalty.
- In Reinforcement Learning, the agent learns automatically using feedbacks without any labeled data, unlike supervised learning.
- Since there is no labeled data, so the agent is bound to learn by its experience only.
- RL solves a specific type of problem where decision making is sequential, and the goal is long-term, such as **game-playing, robotics**, etc.
- The agent interacts with the environment and explores it by itself. The primary goal of an agent in reinforcement learning is to improve the performance by getting the maximum positive rewards.
- The agent learns with the process of hit and trial, and based on the experience, it learns to perform the task in a better way. Hence, we can say that ***"Reinforcement learning is a type of machine learning method where an intelligent agent (computer program) interacts with the environment and learns to act within that."*** How a Robotic dog learns the movement of his arms is an example of Reinforcement learning.

Types of Reinforcement:

There are two types of Reinforcement:

1. **Positive:** Positive Reinforcement is defined as when an event, occurs due to a particular behavior, increases the strength and the frequency of the behavior. In other words, it has a positive effect on behavior.
   Advantages of reinforcement learning are:
   - Maximizes Performance
   - Sustain Change for a long period of time
   - Too much Reinforcement can lead to an overload of states which can diminish the results
2. **Negative:** Negative Reinforcement is defined as strengthening of behavior because a negative condition is stopped or avoided.
   Advantages of reinforcement learning:
   - Increases Behavior

- Provide defiance to a minimum standard of performance
- It Only provides enough to meet up the minimum behavior

Elements of Reinforcement Learning

Reinforcement learning elements are as follows:

1. Policy
2. Reward function
3. Value function
4. Model of the environment

Advantages and Disadvantages of Reinforcement Learning

Advantages of Reinforcement learning

1. Reinforcement learning can be used to solve very complex problems that cannot be solved by conventional techniques.

2. The model can correct the errors that occurred during the training process.

3. In RL, training data is obtained via the direct interaction of the agent with the environment

4. This is useful in real-world applications where the environment may change over time or is uncertain.

5. Reinforcement learning can be used to solve a wide range of problems, including those that involve decision making, control, and optimization.

6. Reinforcement learning is a flexible approach that can be combined with other machine learning techniques, such as deep learning, to improve performance.

Disadvantages of Reinforcement learning

1. Reinforcement learning is not preferable to use for solving simple problems.

2. Reinforcement learning needs a lot of data and a lot of computation

3. Reinforcement learning is highly dependent on the quality of the reward function. If the reward function is poorly designed, the agent may not learn the desired behavior.

4. Reinforcement learning can be difficult to debug and interpret.

Differentiate Search & planning in ai in table

Search	Planning	
Goal	To find a path or solution from the initial state to the goal state	To generate a sequence of actions that will achieve a specific goal
Input	A problem space defined by an initial state, a set of possible actions, and a goal state	A planning domain defined by a set of possible actions and their effects, an initial state, and a goal state
Output	A solution path or a sequence of actions that leads to the goal state	A plan that consists of a sequence of actions that achieve the goal state
Knowledge	Usually domain-independent and relies on heuristic functions to guide the search process	Domain-specific and includes knowledge about the structure of the problem and the effects of actions
Examples	Pathfinding, puzzle-solving, and game-playing algorithms	Robotics, scheduling, and resource allocation systems

What is Machine Learning?

Machine learning is a subset of AI, which enables the machine to automatically learn from data, improve performance from past experiences, and make predictions. Machine learning contains a set of algorithms that work on a huge amount of data. Data is fed to these algorithms to train them, and on the basis of training, they build the model & perform a specific task.

Let's see the different types of Machine Learning now:

1. Supervised Machine Learning

Imagine a teacher supervising a class. The teacher already knows the correct answers but the learning process doesn't stop until the students learn the answers as well. This is the essence of Supervised Machine Learning Algorithms. Here, the algorithm learns from a training dataset and makes predictions that are compared with the actual output values. If the predictions are not correct, then the algorithm is modified until it is satisfactory. This learning process continues until the algorithm achieves the required level of performance. Then it can provide the desired output values for any new inputs.

2. Unsupervised Machine Learning

In this case, there is no teacher for the class and the students are left to learn for themselves! So for Unsupervised Machine Learning Algorithms, there is no specific answer to be learned and there is no teacher. In this way, the algorithm doesn't figure out any output for input but it explores the data. The algorithm is left unsupervised to find the underlying structure in the data in order to learn more and more about the data itself.

3. Semi-Supervised Machine Learning

The students learn both from their teacher and by themselves in Semi-Supervised Machine Learning. And you can guess that from the name itself! This is a combination of Supervised and Unsupervised Machine Learning that uses a little amount of labeled data like Supervised Machine Learning and a larger amount of unlabeled data like Unsupervised Machine Learning to train the algorithms. First, the labeled data is used to partially train the Machine Learning Algorithm, and then this partially trained model is used to pseudo-label the rest of the unlabeled data. Finally, the Machine Learning Algorithm is fully trained using a combination of labeled and pseudo-labeled data.

4. Reinforcement Machine Learning

Well, here are the hypothetical students who learn from their own mistakes over time (that's like life!). So the Reinforcement Machine Learning Algorithms learn optimal actions through trial and error. This means that the algorithm decides the next action by learning behaviors that are based on its current state and that will maximize the reward in the future. This is done using reward feedback that allows the Reinforcement Algorithm to learn which are the best behaviors that lead to maximum reward. This reward feedback is known as a reinforcement signal.

Advantages of Machine Learning :

There are several advantages of using machine learning, including:

1. **Improved accuracy:** Machine learning algorithms can analyze large amounts of data and identify patterns that may not be apparent to humans. This can lead to more accurate predictions and decisions.
2. **Automation**: Machine learning models can automate tasks that would otherwise be done by humans, freeing up time and resources.
3. **Real-time performance:** Machine learning models can analyze data in real time, allowing for quick decision making.
4. **Scalability**: Machine learning models can be easily scaled up or down to handle changes in the amount of data.
5. **Cost-effectiveness:** Machine learning can reduce the need for human labor, which can lead to cost savings over time.
6. **Ability to learn from experience:** Machine learning models can improve over time as they are exposed to more data, which enables them to learn from their mistakes and improve their performance.
7. **Better predictions:** Machine learning models can make predictions with greater accuracy than traditional statistical models.
8. **Predictive Maintenance:** Machine learning models can help identify patterns in sensor data that are indicative of equipment failure, allowing for preventative maintenance to be scheduled before an issue occurs.

Disadvantaged of Machine Learning:

While there are many advantages to using machine learning, there are also some potential disadvantages to consider, including:

1. **Complexity**: Machine learning algorithms can be complex and difficult to understand, which can make it difficult for non-experts to use or interpret the results.
2. **Data requirements:** Machine learning algorithms require large amounts of data to train and be accurate, which can be difficult to collect and preprocess.
3. **Biased data:** Machine learning models are only as good as the data they are trained on, and if the data is biased, the model will also be biased.
4. **Overfitting**: Machine learning algorithms can be overfit to the training data, which means they will not perform well on new, unseen data.
5. **Lack of transparency:** Some machine learning models are considered black boxes, meaning it is difficult or impossible to understand how they arrived at a particular decision.
6. **Privacy concerns**: Machine learning models can process sensitive data that could be used to discriminate or make privacy-intrusive decisions if not used responsibly.

What are K-Strips?

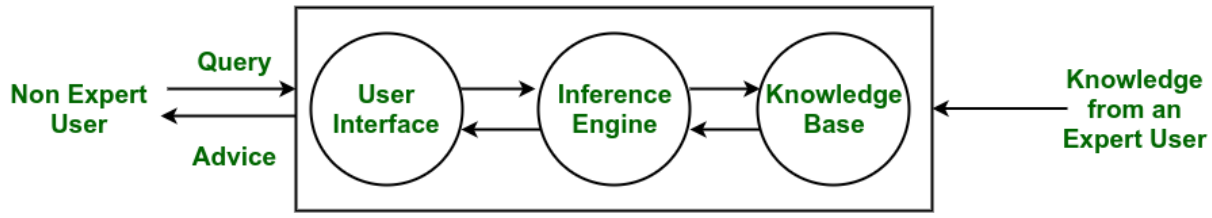
K-Strips is an extension of the STRIPS (Stanford Research Institute Problem Solver) system for automated planning. The K-Strips system is designed to handle uncertainty and incomplete information in planning problems. The "K" in K-Strips stands for knowledge, as the system is based on the use of knowledge representation and reasoning techniques.

In K-Strips, the knowledge base is represented using a logic-based formalism that allows for the representation of incomplete and uncertain information. The system uses a reasoning engine to manipulate the knowledge base and generate a plan of action. The reasoning engine uses a variety of techniques, including rule-based reasoning, fuzzy logic, and probabilistic reasoning, to handle uncertainty and incomplete information.

One of the key features of K-Strips is its ability to represent and reason about alternative plans. The system can generate multiple plans that achieve the same goal and evaluate them based on various criteria, such as efficiency, safety, and cost.

Expert Systems

Artificial Intelligence is a piece of software that simulates the behaviour and judgement of a human or an organization that has experts in a particular domain is known as an expert system. It does this by acquiring relevant knowledge from its knowledge base and interpreting it according to the user's problem. The data in the knowledge base is added by humans that are expert in a particular domain and this software is used by a non-expert user to acquire some information. It is widely used in many areas such as medical diagnosis, accounting, coding, games etc.



Characteristics of an Expert System :

- Human experts are perishable, but an expert system is permanent.
- It helps to distribute the expertise of a human.
- One expert system may contain knowledge from more than one human experts thus making the solutions more efficient.
- It decreases the cost of consulting an expert for various domains such as medical diagnosis.
- They use a knowledge base and inference engine.
- Expert systems can solve complex problems by deducing new facts through existing facts of knowledge, represented mostly as if-then rules rather than through conventional procedural code.
- Expert systems were among the first truly successful forms of artificial intelligence (AI) software.

Limitations :

- Do not have human-like decision-making power.
- Cannot possess human capabilities.
- Cannot produce correct result from less amount of knowledge.
- Requires excessive training.

Advantages :

- Low accessibility cost.
- Fast response.
- Not affected by emotions, unlike humans.
- Low error rate.
- Capable of explaining how they reached a solution.

Disadvantages :

- The expert system has no emotions.
- Common sense is the main issue of the expert system.
- It is developed for a specific domain.
- It needs to be updated manually. It does not learn itself.
- Not capable to explain the logic behind the decision.

Applications :

The application of an expert system can be found in almost all areas of business or government. They include areas such as –

- Different types of medical diagnosis like internal medicine, blood diseases and show on.
- Diagnosis of the complex electronic and electromechanical system.
- Diagnosis of a software development project.
- Planning experiment in biology, chemistry and molecular genetics.
- Forecasting crop damage.
- Diagnosis of the diesel-electric locomotive system.
- Identification of chemical compound structure.
- Scheduling of customer order, computer resources and various manufacturing task.
- Assessment of geologic structure from dip meter logs.
- Assessment of space structure through satellite and robot.
- The design of VLSI system.
- Teaching students specialize task.
- Assessment of log including civil case evaluation, product liability etc.

What are frame based expert systems?

A frame-based expert system is a type of rule-based expert system that represents knowledge using frames, which are hierarchical data structures that organize information in a structured and modular way. Frames provide a way to represent objects, concepts, and their attributes and relationships.

Expert systems are computer-based systems that mimic the decision-making ability of a human expert in a particular domain. Here are some of the benefits of expert systems:

1. Improved decision-making: Expert systems can provide accurate and consistent advice and recommendations, based on the knowledge and expertise of human experts. They can analyze complex data and provide insights that may not be apparent to human experts.
2. Cost savings: Expert systems can automate tasks that would otherwise require the time and effort of human experts. This can lead to significant cost savings for organizations.
3. Increased efficiency: Expert systems can work around the clock without getting tired or making mistakes, which can increase productivity and efficiency.
4. Knowledge retention: Expert systems can capture the knowledge and expertise of human experts, even after they retire or leave the organization. This knowledge can be preserved and shared with others, improving organizational knowledge management.
5. Improved training: Expert systems can be used to train new employees, providing them with access to the expertise of experienced professionals.
6. Scalability: Expert systems can be scaled to handle large amounts of data and complex problems, making them suitable for use in a variety of domains and applications.
7. Improved consistency: Expert systems can provide consistent advice and recommendations, reducing the potential for errors or inconsistencies in decision-making.
8. Reduced risk: Expert systems can help to reduce the risk of errors and mistakes, particularly in domains where the consequences of errors can be significant, such as medicine or finance.

Support Vector Machine Algorithm

Support Vector Machine (SVM) is a supervised machine learning algorithm that is widely used for classification and regression analysis. The main goal of SVM is to find the best boundary or hyperplane that separates the data into different classes.

In a binary classification problem, SVM tries to find the hyperplane that maximizes the margin between the two classes. The margin is defined as the distance between the hyperplane and the closest data points of the two classes. The hyperplane that maximizes the margin is considered the best decision boundary, as it is expected to generalize well to unseen data.

SVM can also be used for multi-class classification by dividing the problem into multiple binary classification problems, using one-vs-all or one-vs-one techniques. In regression analysis, SVM tries to find the best fit line or hyperplane that minimizes the error between the predicted values and the actual values.

The key features of SVM are:

1. Kernel function: SVM uses a kernel function to transform the input data into a higher-dimensional feature space, where it becomes easier to find a linear hyperplane that separates the data. The most commonly used kernel functions are linear, polynomial, and radial basis function (RBF).
2. Margin: SVM tries to maximize the margin between the decision boundary and the closest data points of the two classes. This helps to reduce the risk of overfitting and improve the generalization of the model.
3. Support vectors: The data points that are closest to the decision boundary are called support vectors. These are the most important data points for defining the decision boundary and determining the margin.
4. Regularization: SVM uses a regularization parameter, C, to control the balance between maximizing the margin and minimizing the classification error. A smaller value of C will lead to a wider margin, but may result in more misclassifications, while a larger value of C will lead to a narrower margin, but may result in overfitting.

Advantages of SVM

- Effective in high-dimensional cases.
- Its memory is efficient as it uses a subset of training points in the decision function called support vectors.

- Different kernel functions can be specified for the decision functions and its possible to specify custom kernels.

Overall, SVM is a powerful algorithm that can handle both linear and non-linear data, and has been successfully applied in various domains such as image classification, text classification, and bioinformatics.

Write in detail about the process of information extraction and Machine translation?

Information Extraction (IE) and Machine Translation (MT) are two related fields in Natural Language Processing (NLP) that involve automatically processing and transforming natural language text into structured or translated information.

Information Extraction:

Information Extraction is the process of automatically extracting structured information from unstructured or semi-structured natural language text. The goal of IE is to identify and extract relevant information from text, such as entities, relationships, events, and attributes. The main steps in the IE process include:

1. Pre-processing: The text is first pre-processed by tokenizing, segmenting, and tagging the words to identify their parts of speech and syntactic structure.
2. Named Entity Recognition (NER): NER is used to identify and extract named entities, such as people, organizations, locations, and dates, from the text.
3. Relation Extraction: Once the named entities have been identified, relation extraction techniques are used to identify the relationships between them, such as the fact that a person works for an organization.
4. Event Extraction: Event extraction involves identifying events or actions that occur in the text, such as a company announcing a new product launch.
5. Output: The final output of the IE process is a structured representation of the relevant information extracted from the text, such as a database or knowledge graph.

Machine Translation:

Machine Translation is the process of automatically translating text from one language to another. The goal of MT is to produce translations that are accurate, fluent, and natural-sounding. The main steps in the MT process include:

1. Pre-processing: The source text is pre-processed by tokenizing, segmenting, and tagging the words to identify their parts of speech and syntactic structure.
2. Translation Model: The translation model is used to generate a set of possible translations for each input sentence. This model can be based on statistical methods or neural network models, such as the sequence-to-sequence model.
3. Decoding: Decoding is the process of selecting the best translation from the set of possible translations generated by the translation model. This is typically done using a scoring function that takes into account factors such as the fluency, accuracy, and relevance of the translation.
4. Output: The final output of the MT process is the translated text in the target language.

Both IE and MT have their own challenges and limitations. IE can be challenging due to the complexity of natural language and the need to deal with ambiguous and context-dependent expressions. MT can be challenging due to the differences in syntax, grammar, and cultural nuances between languages, as well as the need to deal with idiomatic expressions and rare words.