1. Compare and contrast Expert systems applications with Conventional systems applications. (5 marks)

**Similarities:**

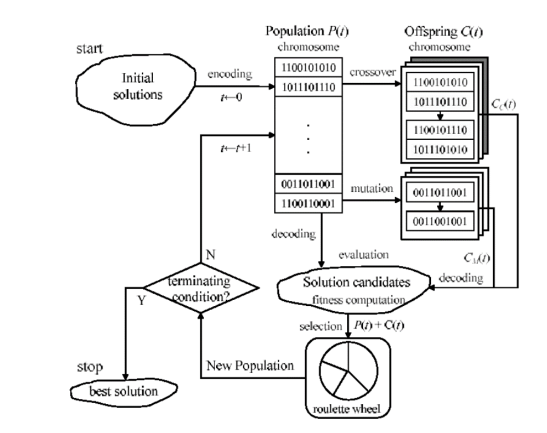
Both expert system and conventional systems applications are developed to address some specific problems in computing. Another similarity is that they are both developed using some programming languages (Tavana & Hajipour, 2019).

**Differences:**

The way problem-related expertise is coded is the primary distinction between expert systems and traditional problem-solving programs. Problem expertise is encoded in both program and data structures in traditional applications. The expert system approach encodes all problem-related expertise in data structures only, not programs. In general, the use of knowledge is critical in expert systems. However, in traditional systems, data is used more efficiently than knowledge (Tavana & Hajipour, 2019). Conventional systems are incapable of explaining a specific solution to a problem. These systems attempt to solve problems in a straightforward manner. Expert systems, on the other hand, can explain how a particular conclusion is reached and why requested information is required during a process. An expert system, on the other hand, solves problems more efficiently than a conventional system. In general, an expert system uses symbolic representations for knowledge, such as rules, different types of networks, frames, scripts, and so on, and performs inference through symbolic computations. However, conventional systems are incapable of expressing these terms.

1. Discuss in detail the process steps involved in developing an expert system. (5 marks)
2. Identification - Before programmers can begin developing an expert system, it is critical that the problem that the system is intended to solve be described as precisely as possible (Tavana & Hajipour, 2019). It is not enough to simply believe that an expert system would be useful in a given situation; coders must identify the precise nature of the problem and state the precise goals that indicate how the expert system is expected to contribute to the solution.
3. Conceptualization - Once the problem for which an expert system is to be developed has been identified, the next stage involves further analyzing the problem to ensure that its specifics as well as generalities are understood (Tavana & Hajipour, 2019). The knowledge engineer frequently creates a diagram of the problem during the conceptualization stage to graphically depict the relationships between the objects and processes in the problem domain.
4. Designing - There has been no attempt in the preceding stages to relate the domain problem to the artificial intelligence technology that may solve it. The emphasis during the identification and formalization stages is entirely on understanding the problem (Tavana & Hajipour, 2019). The problem is now linked to its proposed solution during the formalization stage, and an expert system is supplied by analyzing the relationships depicted in the conceptualization stage.
5. Implementation - During the implementation stage, the formalised concepts are programmed into the computer chosen for system development, and a 'first-pass' (prototype) of the expert system is implemented using the predetermined techniques and tools (Tavana & Hajipour, 2019).
6. Testing - The chances of a prototype expert system working flawlessly the first time it is tested are almost non-existent. A knowledge engineer does not expect the testing process to confirm that the system was built correctly (Tavana & Hajipour, 2019). Rather, testing provides an opportunity to identify flaws in the system's structure and implementation and make necessary changes.

3. Study the Genetic Algorithm structure diagram below. What roles are played by the crossover operator and the mutator. Make sure to mention how the next generation (offspring) is affected, (5 marks)



The crossover operator primarily surveys the information available through the search space, which inadvertently improves the GA's behavior. In addition, mutation is a secondary operator. Its purpose is to change the genes of the offspring (Mirjalili, 2018). The crossover operator and the mutator ensures that the offspring gets to inherit the features of the parents.

1. An Expert System normally has an inference engine to help it make decisions. Using that as context, discuss the difference between forward and backward chaining. (5 marks)

The following table shows the difference between forward and backward chaining:

|  |  |
| --- | --- |
| **Forward Chaining** | **Backward Chaining** |
| When a decision is made based on available data, the process is known as forward chaining. | Backward chaining begins with the goal and works backward to determine what facts must be asserted in order to achieve the goal. |
| Forward chaining is a data-driven technique because we achieve our goal by utilizing the available data (Mirjalili, 2018). | Backward chaining is a goal-driven technique because we begin with the goal and work our way back to the beginning to extract the facts (Mirjalili, 2018). |
| It is a bottom-up model | It is a top-down model |
| The Breadth-First Strategy is used. | The Depth-First Strategy is used |
| The objective of forward chaining is to get the conclusion | The objective of backward chaining is to get probable facts and the required data |

5) Explain the case representation methods in the CBR process. (5 marks)

There are two types of case representation methods: knowledge-intensive approaches and traditional approaches. The first group outnumbers the second. The first methods are ontology-based and improve all CBR processes such as case representation, retrieval, storage, and adaptation (Mirjalili, 2018). The existing methods for case representation based on ontology are studied and evaluated in depth using a proposed set of qualitative metrics. Each of these systems has limitations. No approach outperforms the specified metrics by more than 53%. The survey results explain the current limitations of CBR systems. It demonstrates that ontology usage in case representation requires improvement in order to achieve semantic representation and retrieval in a CBR system.

6) Discuss in detail the approaches to machine learning. Provide examples in your discussions (5 marks)

a. Supervised learning - In this type of machine learning, data scientists provide labeled training data to algorithms and specify which variables they want the algorithm to look for correlations between (Greener et al., 2022). The algorithm's input and output are both specified.

b. Unsupervised learning - Algorithms that train on unlabeled data are used in this type of machine learning. The algorithm scans data sets for any meaningful connections (Greener et al., 2022). The data used to train algorithms, as well as the predictions or recommendations they produce, are predetermined.

c. Semi-supervised learning - This machine learning approach combines the two preceding types. Although data scientists may provide mostly labeled training data to an algorithm, the model is free to explore the data on its own and develop its own understanding of the data set (Greener et al., 2022).

d. Reinforcement learning - Reinforcement learning is typically used by data scientists to teach a machine to complete a multi-step process with clearly defined rules. Data scientists program an algorithm to complete a task and provide it with positive or negative cues as it determines how to complete the task (Greener et al., 2022). However, for the most part, the algorithm decides what steps to take along the way.

7) What are Speech Recognition Systems? What are the uses of SRSs? (3 marks)

Speech recognition systems can use closed captions to translate spoken words into text, allowing people with hearing loss to understand what others are saying. Speech recognition can also help people with limited hand use work with computers by using voice commands instead of typing (Greener et al., 2022). The following are the uses of SRSs; increasing productivity in many areas such healthcare, education among others, capturing speech, helping people with speech and sight problems.

8) Explain what situation exists in a case of reasoning with uncertainty. What approaches can be deployed? (2 marks)

In case of reasoning with uncertainty, the person involved will not be in a position of deriving the actual sense of the message. In this case speech recognition systems are used to derive meanings of a speech.

**References**

Tavana, M. and Hajipour, V. (2019) *A practical review and taxonomy of fuzzy expert systems: methods and applications*.

Mirjalili, S. (2018) *Genetic Algorithm*.

Greener, J. *et al.* (2022) *A guide to machine learning for biologists*.