PART 1

1- Explain the following concepts: Weak and Strong AI.

Weak AI, which can also be termed as Narrow AI -- focuses on performing a specific, single task. Whereas strong AI can perform a variety of tasks and teach itself, basically doing almost everything a human can do. Examples of Weak AI are all around us, such as chatbots, virtual assistants on phones, speech recognition software, and so on. Strong AI, however, are still a fictional concept as of now.

2- Give a real example to Expert Systems.

An expert system is an interactive decision-making system that uses the data it has to solve complex decision-making problems. It's currently considered at the highest level of human intelligence and expertise. The main purpose of expert systems is to solve the most complex issues in a specific domain. Hence, they're commonly used in the healthcare field, mostly aiding in diagnosis. Some examples of expert systems are -

CaDet: Used to identify cancer at early stages.
PXDES: Used to predict the degree and type of lung cancer.
MYCIN: Used to identify various bacteria that could cause infections.

3- Design an expert system using your imagination. (Only theoretical approach)

Since an expert system requires to solve complex decision-making problems, it must have the following characteristics -

The highest level of expertise.
Flexibility.
Reliability. (Accuracy)
Effective mechanisms.

With the characteristics established, an Expert System consists of the following components -

User Interface: The most crucial part of the expert system software. This component takes the user's query in a readable form and passes it to the inference engine. After that, it displays the results to the user.

Inference Engine: The brain of the expert system. The inference engine contains rules to solve specific problems, it refers to the knowledge from the knowledge base, which helps in deducing the problem and figuring out a solution.

Knowledge Base: A repository of “facts”. It stores all the data about the problem domain. Can be compared to a large container of knowledge that is obtained from different experts of a specific field.

The Inference Engine generally uses two strategies for acquiring knowledge from the Knowledge Base:

Forward Chaining: Forward Chaining is a strategic process used by the Expert System to answer the questions, “What will happen next” This strategy is mostly used for managing tasks like creating a conclusion, result, or effect.

Example: Stock Market trends analysis.

Backward Chaining: Backward Chaining is a storage used by the Expert System to answer the questions, “Why this has happened” This strategy is mostly used to find out the root cause or reason behind it, considering what has already happened.

Example: Most medical diagnoses.

4- What is Fuzzy Logic?

Fuzzy logic is a form of many-valued logic, in which the value of the variables can be any real number between 0 and 1, both inclusive. It is employed to handle the concept of partial truth, where the truth may range between completely true or completely false. (In contrast with Boolean logic.) Mostly representing vagueness or/and imprecise information, which is in turn, based on the observation that people make decisions based on imprecise and non-numerical information.

6- Design a Computer Vision Project using your imagination(Only theoretical approach)

Computer Vision is a compelling AI with many real-world use-case examples. It focuses on creating digital systems that can process, analyze, and make sense of visual data in the same way that humans do. The concept is based on teaching the computers to process an image at a pixel level and understand it.

Most computer vision algorithms today are based on pattern recognition. Machines interpret images as a series of pixels, each with its own set of color values - the data provided as the input to the computer vision algorithm that will be responsible for further analysis and decision making. Most algorithms are based on deep learning.

Deep learning represents a more effective way to do computer vision—it uses a specific algorithm called a neural network. The neural networks are used to extract patterns from provided data samples.

Projects centering around computer vision are usually about around one of the three tasks:

Object classification: The system parses visual content and classifies the object on a photo/video to the defined category. For example, the system can find a dog among all objects in the image.

Object identification: The system parses visual content and identifies a particular object on a photo/video. For example, the system can find a specific dog among the dogs in the image.

Object tracking: The system processes video finds the object (or objects) that match search criteria and track its movement.

Some examples of projects are - Content organization by adding tags to the photos (object classification), facial recognition by comparing to the previously provided data (object identification), augmented reality (object tracking).

8- Challenge Question: Your thoughts about the future of AI and humanity and the Philosophical overview of AI.

(I apologize for the long answer, this topic was very interesting for me and I wanted to delve into detail here, particularly since I would possibly be looking back on these answers to revise the concepts and such.)

AI is already impacting virtually every industry and every human being. However, no matter how remarkable the technology may be, it doesn't come without some major concerns for humanity. Movies like *"Ex Machina", "Transcendence"* and *"Her"* show us the dark side of AI reaching human-level consciousness (which hasn't been possible yet and may not be for decades.)

This answer is divided into two groups.

The bright side of the AI future:

1. Precision medicine: AI is currently in use to understand how a person's genetics, environment, and lifestyle can help determine the best approach to prevent or treat a certain disease. Digital therapeutics, custom-designed drugs, and improved diagnosis are already making treatments more affordable, accessible, accurate, and are helping humans live longer and healthier lives.

2. Driverless cars: Deep learning excels at tasks involving pattern recognition, and modern cars will be better than humans when it comes to perception, prediction, and planning on the fly. Fatal driving accidents are projected to drop dramatically as autonomous vehicles become mainstream.

3. Implantables: The wide adoption of brain-machine interfaces will lead to a massive expansion of human intelligence and could allow humans to solve many medical conditions including paralysis, blindness, anxiety, and addiction. Using implantables to reprogram underlying human biology can allow us to augment and upgrade ourselves in a few short years.

For example, a monkey with implants in his brain made by Elon Musk's company, Neuralink, is now able to play Pong using just his thoughts.

The dark side of the AI future:

1. Mass surveillance: The broad use of AI by big technology companies has brought about the destruction of digital privacy.

2. Modern warfare: In the next big war, AI could be the determining factor between winning and losing. With unmanned underwater vehicles, constellations of smart robotic devices, drones, robots, and precision-guided missiles, modern warfare supremacy will be decided by technology.

3. Massive job losses: With AI becoming more mainstream and performing better than humans in most instruction-driven jobs, it is very likely that many humans would lose their jobs to robots. Unfortunately, this technological trend is inevitable, which would likely increase socioeconomic inequality due to the income gap between middle-skill and high-skill labor being enormous.

The philosophical overview of AI.

The relation of AI and philosophy involves many concepts that both subjects include - for example, action, goals, knowledge, belief, and consciousness. However, AI takes what we may call the "designer stance" about these concepts; it asks what kinds of knowledge, belief, consciousness, etc. does a computer system need in order to behave intelligently and how to build them into a computer program.

The most common questions asked when discussing the philosophy of AI are:

1. Can a machine display general intelligence?
2. Can a machine have a mind, consciousness, and mental states?
3. Is thinking a kind of computation?
4. Can a machine have emotions?
5. Can a machine be self-aware?
6. Can a machine be original or creative?
7. Can a machine be hostile?
8. Can a machine imitate all human characteristics?
9. Can a machine have a soul?

These questions, while very interesting, have no particularly decisive answers yet.

(while reading about the philosophy of AI, I stumbled upon this article (research paper?), which, for me, was very interesting!)

PART 2

1- Describe the Steps of a typical Machine Learning Project.

1. Frame the problem: the first step where the objective is defined. Determining which type of machine learning problem (supervised, unsupervised, etc) applies, and adopting appropriate performance metrics.

2. Getting the data: Determine how much data is needed, what type of data is needed, where to get the data, ensure it is appropriately anonymized, make certain of the type of data and convert it into the format required. Create training, validation, and testing sets as warranted.

3. Explore the data: Often referred to as Exploratory Data Analysis (EDA), the goal is to try and gain insights from the data prior to modeling.

4. Prepare the data: Applying data transformations (if needed) or any feature scaling for value standardization and/or normalization.

5. Model the data: Using samples of the full dataset to facilitate training times for preliminary models, models which should cut across a wide spectrum of categories (trees, neural networks, linear, etc) Models should be built, measured, and compared to one another, and types of errors made for each model should be investigated, along with the most significant features for each algorithm used. The best-performing models are short-listed and fine-tuned afterward.

6. Fine-tune the models: The shortlisted models should now have their hyperparameters fine-tuned, and ensemble methods should be investigated.

7. Present the solution: Ensuring proper documentation of technical aspects and visualizing the data, in order to make it easier for the result to be understood.

2- Difference(s) between Supervised and Unsupervised Learning.

Supervised learning:

Algorithms are trained using labeled data.
The model takes direct feedback to check if it's predicting the correct output or not.
Predicts output.
Input data is provided along with the output.
The goal is to train the model so that it can predict the output data when it is given new data.

Unsupervised learning:

Algorithms are trained using unlabeled data.
The model doesn't take any feedback.
Finds the hidden patterns in data.
Only input data is provided.
The goal is to find the hidden patterns and useful insights from the unknown dataset.

3- Difference(s) between Regression and Classification.

The main difference between regression and classification algorithms is that regression algorithms are used to predict the continuous values, while classification algorithms are used to predict/classify the discrete values.

Classification is the process of finding a function that helps in dividing the dataset based on different parameters. In classification, a computer program is trained on the training dataset, and based on that training, it categorizes the data into different classes.

The task of a classification algorithm is to find the mapping function to map the input(x) to the discrete output (y)

Regression is the process of finding the correlations between dependent and independent variables.

The task of the Regression algorithm is to find the mapping function to map the input variable(x) to the continuous output variable(y).

4- What is AlexNet?

AlexNet is a convolutional neural network (CNN) GPU-based architecture, designed by Alex Krizhevsky in collaboration with Ilya Sutskever and Geoffrey Hinton. In 2012, AlexNet competed in the ImageNet Large Scale Visual Recognition Challenge and achieved a top-5 error of 15.3%.

AlexNet's architecture consists of eight layers: five convolutional layers and three fully connected layers. But this isn't what makes AlexNet special; these are some of the features used that are new approaches to convolutional neural networks:

Multiple GPUs: AlexNet allows for multi-GPU training by putting half of the model's neurons on one GPU and the other half on another GPU. Not only does this mean that a bigger model can be trained, but it also cuts down on the training time.

Overlapping Pooling. CNNs traditionally "pool" outputs of neighboring groups of neurons with no overlapping. However, when the overlap was introduced, there was a reduction in error by about 0.5% and it was found that models with overlapping pooling generally find it harder to overfit.

This leads to one of the major issues of AlexNet, overfitting. AlexNet had 60 million parameters, a major issue in terms of overfitting. Two methods were employed to reduce overfitting:

Data Augmentation: Usage of label-preserving transformation to make data more varied. Specifically, generating image translations and horizontal reflections, along with using Principle Component Analysis (PCA) on the RGB pixel values to change the intensities of RGB channels, which reduced the top-1 error rate by more than 1%.

Dropout: This technique consists of “turning off” neurons with a predetermined probability (e.g. 50%). This means that every iteration uses a different sample of the model’s parameters, which forces each neuron to have more robust features that can be used with other random neurons. However, dropout also increases the training time needed for the model’s convergence.

The Result: On the 2010 version of the ImageNet competition, the best model achieved 47.1% top-1 error and 28.2% top-5 error. AlexNet vastly outpaced this with a 37.5% top-1 error and a 17.0% top-5 error. AlexNet is able to recognize off-center objects and most of its top five classes for each image are reasonable. AlexNet won the 2012 ImageNet competition with a top-5 error rate of 15.3%, compared to the second place top-5 error rate of 26.2%.

Source.

5- Describe a situation where you may use GAN’s.

GAN - A generative adversarial network, is a type of neural network architecture for generative modeling. It is trained using two network models, one called the “generator” model that learns to generate new plausible samples. The other model is called the “discriminator”, which learns to differentiate generated examples from real examples.

The two models are set up in a contest where the generator model seeks to fool the discriminator model, and the discriminator is provided with both examples of real and generated examples. After training, the generative model can then be used to create new plausible samples on demand.

There are many examples of GANs that have been used in media, including but not limited to -

Generating examples for image datasets.
Image-to-Image translation
Text-to-Image translation
Generating photographs of human faces
Generating realistic photos

Real-world applications of GANs include the usage of “DeepFakes” to bring paintings/pictures to life by adding the ability to morph them into different expressions, creating portraits from scratch, photo manipulation, and so on.

6- Difference(s) between Recurrent Neural Network and Convolutional Neural Network.

Convolution Neural Networks (CNNs) are a class of deep neural networks, most commonly applied to analyzing visual imagery and suitable for spatial data like images, while Recurrent Neural Networks (RNNs) are a class of artificial neural networks where connections between nodes form a directed graph along a temporal sequence.

CNNs:

Ideal for images and video processing.
Take input of fixed sizes and generate fixed-size outputs.
Applications include Image Recognition, Image Classification, Medical Image Analysis, Face Detection, and Computer Vision.

RNNs:

Ideal for text and speech analysis.
Can handle arbitrary input/output lengths.
Applications include Text Translation, Natural Language Processing, Language Translation, Sentiment Analysis, and Speech Analysis.

7. Challenge Question: Design a classification problem where you can apply a decision tree to solve it. Draw your decision tree.

Problem: Predicting the loan eligibility process from provided data.

Link to the file.

PART 3

1- Create a free account in Microsoft Azure ML Studio, use your knowledge to create a project & implement the available methods, analyze the available datasets and other projects.

2- Show your work & analyze using Screenshots.

3- Which software, apps, or programs in your personal life may use Machine Learning algorithms?

Almost all apps use machine learning in some way or the other. The most common example would be apps like Snapchat, which uses facial recognition to apply “filters” or chatbot

apps like “Replika” which uses natural language processing that allow the chatbot to replicate a human-like conversation.

4- Challenge Question: Watch the short film, Benjamin. (Recurrent Neural Network -LSTM) Just watch, no need to do anything :)

https://www.youtube.com/watch?v=LY7x2Ihqjmc

PART 4

1- Find a Machine Learning Dataset and analyze its features and characteristics. (numerical, categorical, classification, regression, etc) Use this link to find Datasets: https://archive.ics.uci.edu/ml/index.php

2- Do you think using a bigger dataset would help you to improve your Machine Learning model?

In my opinion, yes, since the machine learning model has more data to learn from.

3-Challenge Question: Imagine your seven-year-old cousin (she/he only knows reading, writing, etc. NO MATHS AND NO FANCY WORDS ARE ALLOWED! (Example of fancy words: CONTINUOUS, DERIVATION, ACTIVATION FUNCTION) **Your cousin asks you the following questions: What is Artificial Intelligence, What is Machine Learning?**
Hint: Give basic real-world examples to these terms such as Learning, Training, classification, Artificial, and Intelligence. If you can explain something very simply it means that you understand it very well!

We have two terms:

Artificial = something that is not natural, or, anything that is human-made.
Intelligence = possessing the following elements: reasoning, learning, problem-solving, perception, and linguistic intelligence.

Mixing the two terms => Artificial Intelligence. It is a broad area of computer science that makes machines seem like they have human intelligence.

Consider Alexa - you can simply ask it to play “Christmas Carols on Spotify” and it will execute. It can tell you how’s the weather is like, what time it is, or how far away a specific spot is. Alexa is an AI technology, however, it can only answer the questions it was trained for.

Machine Learning is a form of Artificial Intelligence in which the program is designed to learn on its own.

A simple example might be the following:

You want to create a program to differentiate between apples and oranges. You have data that says that oranges weigh between 150-200g, and apples between 100-130g. Also, oranges are rough, and apples are smooth (which you might represent as a 0 or 1). If you have a fruit that weighs 115g and is smooth, your program can determine that it is probably an apple. Vice-versa, if the fruit is 175g and rough, it is most likely an orange. Anything outside of these boundaries won't be either. What, now, if your fruit is smooth, but only 99g? It probably is an apple, but not to your program. Therefore, the more data you have, the more accurate your data becomes. It might even use past guesses to further its own data. It is learning on its own what an orange or an apple is. This is Machine Learning.

It's a step to developing machines that can learn without us constantly giving them instructions (such as an image-recognition software).