Edit distance

Programming language:
Python

Functionality:
The purpose of this program is to calculate the edit distance between two strings. The edit distance between two strings is the number of operations it takes to transform one string to the other. Operations can be insertions, where a character is added into the string, deletions, where a character is removed from the string, and substitutions where a character is replaced by another one.

Scale of project:
Number of lines: 34
Number of functions: 1

Data structures/Algorithms:
The solution of the edit distance problem for two strings of length directly depends on the solutions for their substrings, therefore I used a dynamic programming approach with $O(m^n)$ time and space complexity, where m and n are the lengths of the strings. I used a 2D array to store the solutions for each subproblem and used an iterative bottom up solution to traverse the strings.

Blackjack

Programming language:
Python

Functionality:
This program is a simple implementation of Blackjack using object oriented programming and a command line interface. The program allows for one user to play against the dealer and bet their chips until they lose all their chips or decide to stop playing.

Scale of project:
Number of lines: 279
Number of classes: 7

Use of object-oriented concepts:
Classes are used to represent and handle the cards, the deck, the players, hands and the game itself. The Dealer and User classes inherit the properties of the Player class but also have their own unique properties and methods. Getter and setter methods are used to access instance variables.

Data structures/Algorithms:
An array of Card objects acts as the deck.

RSA
Programming language:
Python

Functionality:
This program is a simple implementation of RSA encryption. The user inputs p and q, which should both be primes, and can then choose whether to input e or generate it. The user then inputs their message. The encrypted and decrypted message is printed for comparison.

Scale of project:
Number of lines: 133
Number of functions: 12

Data structures/Algorithms:
This program makes use of recursion to implement the Euclidean algorithm and the extended Euclidean algorithm. In the gcd function, recursion is used to repeatedly call the function until the base case is reached at which point it returns the greatest common divisor. The extended gcd function similarly calls itself until it reaches the base case at which point it unwinds, carrying out the second part of the algorithm and returns the necessary values.

Quiz
Programming language:
Python

Functionality:
This program is a general knowledge quiz which integrates with a database using MySQL to allow for user accounts and a leaderboard which lets users compare their scores. The user interface is built using Tkinter and consists of a number of screens to allow the user to sign up, login, take the quiz and check the leaderboard.

Scale of project:
Number of lines: 385
Number of functions: 25

Data structures/Algorithms:
A bubble sort algorithm is used to sort the data in the leaderboard, which is passed in as an array of tuples, in descending order. An array of records is used to process the questions in the quiz.

<u>Neural network</u>
Programming language:
Python

Functionality:
This program makes use of the PyTorch library to train and test a neural network model to classify images of handwritten digits. The MNIST dataset, which contains thousands of labeled images of handwritten digits, is used for training and testing the model and processed using dataloaders. The program defines the architecture of the neural network along with the forward pass. A training function is defined which allows for forward passing, backpropagation and updating of model parameters. A testing function is defined to check the accuracy of the model on the test data set. The model undergoes an optimisation loop, using the training and testing functions, over a set number of epochs and is then saved.The model achieves 90% accuracy on the testing dataset after training for 20 epochs.

Scale of project:
Number of lines: 95
Number of functions: 2
Number of classes: 1

Use of object-oriented concepts:
The NeuralNet class inherits the methods of the nn.Module class and makes use of them to define the model's architecture.