**Python Projects List**

1. Coloring shapes in an image. (Computer Vision)
   * Color each shape in a specific color. For example, all the triangles will be colored green, rectangles red and circles blue.
   * The shapes can have different sizes and may be rotated in multiples of 90°.
2. Completion of discontinuous lines. (Computer Vision)
   * Locate the discontinuous lines in an image and complete them. Meaning, fill in the gaps to make the lines continuous.
   * The algorithm must work both on wide and thin lines.
   * You may use any library function.
3. Location of lines in an image. (Computer Vision)
   * Implement Hough transform and its optimization.
4. Location of corners and intersections of lines in an image. (Computer Vision)
   * Implement Harris Detector.
5. Process physiological data of human gait. (Signal Processing)
   * You will receive a dataset of physiological signals representing feet location in space. The subject was recorded while striding on a treadmill.
   * Locate all local extrema for each foot and find intersections between the signals of representing the feet position.
   * Calibrate a signal describing feet movement along vertical axis. Meaning, remove the offset in such a way that the zero amplitude will be at the floor height.
   * Note, signals have noise and corrupted regions.
   * You may use any library or function for this project.
6. Location of long-term fluctuations (trend) of a signal. (Signal Processing)
   * Implement Hodrick-Prescott (HP) filter.
7. Lossless data compression. (Algorithmics)
   * Implement Huffman coding for lossless data compression.
   * Implement Lempel-Ziv (LZ) lossless data compression.
   * Compare the two methods in respect to compression efficiency.
8. New class creation. (Programing)
   * Without using the predefined similar classes or functions, create a class capable of creating and managing: Linked Lists, Queues, Stacks, Heaps, Binary Trees, AVL Trees and 2-3 Trees.
9. Support Vector Machine (SVM). (Machine Learning)
   * Implement SVM algorithm.
10. Image morphing with GUI. (Image Processing)
    * Implement Image Morphing method.
    * Present results in a simple GUI.
    * The algorithm must work on any two portrait images of human faces.
    * You are allowed to use any library or function for face, eyes, mouth and nose detection.
11. Image rescaling. (Image Processing)
    * Implement image zoom-in function using non-linear interpolation methods.
    * Show and explain the next three Gaussian Pyramid applications.
      + gaussian pyramid images focus
      + gaussian pyramid mosaic
12. Image compression (Image Processing)
    * Implement image compression using gaussian pyramid.
13. Low, High and Band pass filtering (LPF, HPF, BPF). (Signal/Image Processing)
    * Implement both 1D and 2D LPF, HPF and BPF.
14. Image stitching from video. (Computer Vision)
    * Implement stitching from video.
15. Object tracking in video. (Computer Vision)
    * Track the location and the size of a changing objects.
    * The tracking process must distinguish between all of the objects and being able to track any single object as well as all of the moving objects at the same time.
16. Gaussian Mixture Models (GMM) Clustering. (Data Mining)
    * Implement a GMM algorithm.
17. Encryption of data into an image (Steganography). (Cryptography)
    * Encrypt a given data into any image so it would be unnoticeable.
18. Encryption of data into Audio File (Steganography). (Cryptography)
    * Encrypt a given data into any sound file so it would be unnoticeable.
19. Mandelbrot, Zipf Law and Monty Hall experiment. (Probability and Statistics)
    * Create a Mandelbrot set and present it as a graph.
    * Implement Zipf Law experiment using e-books
    * Implement Monty Hall game which collects statistics and presents them as graphs and add an option to run an automatic statistical test n times.
20. Spectral Analysis. (Signal Processing)
    * Implement FFT Radix 4 algorithm.
    * Compare Radix 4 to Radix 2 in terms of run-time.
    * Implement wavelet transform.
21. Create a Function Generator with Scope using GUI. (Programing)
    * Build an interactive GUI representing a scope reading of a function generator.
    * Provide multiple choices for functions to be generated.
    * Define a function mixer which at random mixes all of the optional functions and generates a piece-wise constructed signal. This signal must be continuous even at the connection points.
22. Decomposition of matrices. (Algebra)
    * Implement LU decomposition.
    * Implement QR decomposition.
    * Implement SVD decomposition.
23. Game of Chess with GUI. (Programing)
    * Create an engine and a GUI for 2-player chess game.
    * Include a main screen with the following options,
      + New game
      + Continue the previous game (if not completed)
      + High score table
      + Help / Game Instructions
24. Barrel and pincushion distortion (fisheye lens effect). (Image Processing)
    * Implement a controllable fisheye lens effect with GUI.
25. Implement convolution with graphic feedback. (Mathematics)
    * Calculate the convolution of two inputs (1D and 2D) and display the process in GUI.
26. Skin detection. (Computer Vision)
    * Detect persons skin in a video and make it greenish. Meaning, that a person would appear green in the video.
27. Face recognition. (Computer Vision)
    * Detect all the faces in a video running in real time and recognize the predefined ones.
    * You may use any library or function for this project.
28. Morphological Dilation and Erosion (Image Processing)
    * Implement morphological dilation and erosion for images.
29. Radon transform (Computer Vision)
    * Implement Radon Transform.
30. Watershed Segmentation (Computer Vision)
    * Implement a Watershed image Segmentation.
31. Eigenvalues and Eigenvectors (Algebra)
    * Calculate Eigenvalues and Eigenvectors for any square matrix.
32. HHT Algorithm (Signal Processing)
    * Implement Hilbert-Huang Transform for signal decomposition.
33. Process physiological data of human brain activity (Signal Processing)
    * You will receive a dataset containing recorded brain activity using fNIRS.
    * Remove artefacts corresponding to heart beats while leaving the rest of the information intact.
    * You may assume that any signal behavior with period time shorter than that of a heartbeat, is noise.
    * Remove signal’s trend line.
    * You may use any library or function for this project.
34. Implement RSA algorithm (Cryptography)
    * Implement RSA (encryption and decryption).
    * The algorithm should work with text messages and with numbers.
35. Implement the Christofides algorithm (Graph Theory)
    * Request a number of nodes from the user and create a random, positively weighted, undirected graph with the requested number of nodes.
    * Use Christofides algorithm to solve a “travelling salesman” problem for that graph.
36. Implement Newton's method (Algebra)
    * Implement Newton's method for solving a system of non-linear equations.
    * Sometimes this method doesn't work. Present detailed examples and explanation for cases when it works and when it doesn’t.
37. Relevance vector machine (RVM) (Machine Learning)
    * Implement RVM algorithm.
38. Design Deep Learning Model (Deep Learning)
    * Download CIFAR-10 database.
    * Design a Deep Learning Model that labels the images into 10 categories provided in the data.
    * Train the model on 50,000 images from the CIFAR-10 dataset.
    * Test the success rate of your model on the remaining 10,000 images from the CIFAR-10 dataset.
    * Your model should provide success rate of at least 85%.
    * You may use any library or function for this project.