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Module 3: Assignment 3 - Mini Project

This mini project consists of three sections, linear algebra, calculus, and probability. These are the foundation mathematics used in deep learning and artificial intelligence. Matrices can be used to contain data, such as pixels in images, to be used for transformations, calculus can be used to determine loss ratios and optimize parameters in an iterative fashion, and probability calculations can be used to determine the best result from multiple possible outcomes.

Linear Algebra

In this first section, linear algebra uses vectors and matrix operations to transform an image. First we import our required packages. These are numpy, matplotlib.pyplot, and skimage. One challenge here was editing my Dockerfile to include scikit-image and then rebuilding the docker image and deploying the updated container. With that completed I could continue working on this project. Once the libraries were loaded we acquired a sample image from skimage data. The image is greyscale, and just over 500x500px in size. The command plt.imshow(image, cmap='gray') is used to show the image and convert the image data to greyscale. At this point I added a line plt.show() to display the image so that I can see the reference image before any transformations. A scale matrix is then created with a numpy array (matrix) defining the scaling. The matrix consists of [[1.5, 0,0], [0, 1.5,0], [0, 0, 1]] which is a scale of 1.5 on the X axis, 1.5 on Y axis and 1 on the Z axis. The transformation is applied with transform.warp and passed the image data and the scale matrix. This uses the inverse of the matrix and reduces the image by a factor of 1.5. plt.imshow is then called with the updated image and color display setting and plt.show displays the image.

Calculus

In this section we create a function to calculate gradient descent with two parameters, learning rate and iterations. This allows us to calculate and optimize a function with this gradient to understand when we are have reached our best possible outcome. The variable w is used to represent the current minimum of the function. The function is **2 * w – 4**. W is updated by subtracting the learning rate times the gradient from w through each iteration of the loop. Additionally, a print function was added to see the changing output with each iteration of the loop. Adjusting the learning rate changes the precision, while the number of iterations will improve accuracy toward a final value approaching 2.

Probability

Finally, we create a Bayesian Inference function that takes three parameters, p_disease, p_pos_given_disease, and p_pos_given_no_disease. With these we can determine the probability of having a disease after a positive test with the different probabilities of different cases considered. As these parameters are modified, we see the probabilities change from approaching 0 to approaching 1.

Conclusion

In this mini project we see the different types of math that are the foundation of artificial intelligence and deep learning. Understanding of these and their applications will be fundamental to knowing how deep learning works when building our own applications.