CS 598: Deep Learning

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Assignment-1

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1. I have run the given code to see it plot a contour map of a Gaussian distribution. The output is shown in Figure 1.

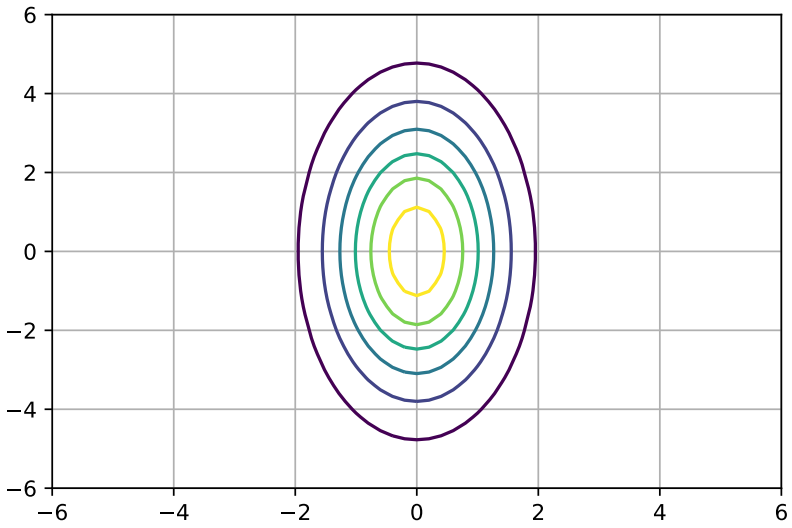

Figure 1: Contour plot for unrotated Gaussian distribution.

2. I analyze the code to understand how it works. I try to understand how it generates the values for an non-normalized, bi-variate Gaussian distribution using the given covariance matrix.

$$\Sigma_{original} = \begin{bmatrix} 1 & 0 \\ 0 & 6 \end{bmatrix}$$

   In accordance with this, I have printed eigen values and vectors. I understand the interpretation of them.

3. I Replace the original covariance matrix so that when the distribution is plotted, the long axis of the ellipse is oriented 30 degrees to the x-axis. I use the formula: $\Sigma_{rotated} = V\Lambda V^{-1}$ and pack the resultant matrix into V. Later, I compute V^{-1} from V. I set $\Lambda = \Sigma_{original}$.

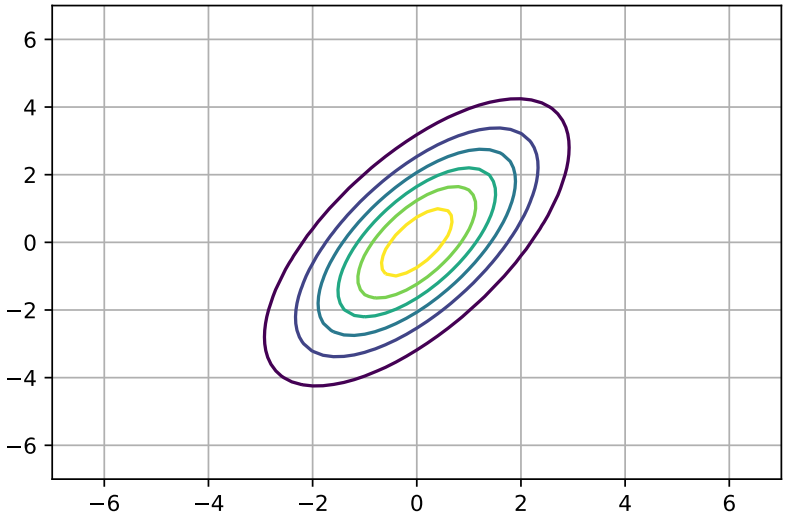

Figure 2: Contour plot for rotated Gaussian distribution.

Then, I redraw the contour and I see that it has been rotated 30°. The contour is represented in Figure 2.

4. I add to the program the ability to give the distribution a non-zero mean. I use the given mean, $\mu = [1 \quad 2]^T$.

   This changes the center of the distribution at coordinates $(1, 2)$.

5. I re-plot the contour map considering changes done at the immediate previous step (Figure 3).

6. I use the function, *np.random.multivariate_normal* to generate 100 data points with $\mu = [1 \quad 2]^T$ and covariance $\Sigma_{rotated}$. I plot the data points that is represented in Figure 4 and re-plot the rotated and $(1, 2)$ centered contour map to make sure the data points are consistent with the distribution they were sampled form. This is shown into Figure 5. Based on the observation of the figures, we conclude that the data points are taken from the same earlier distribution.

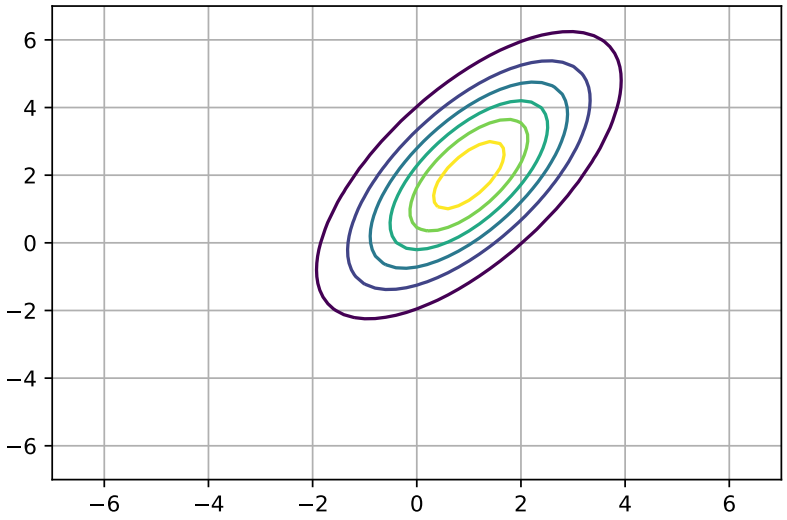

Figure 3: Contour plot for rotated Gaussian distribution with center (1,2).

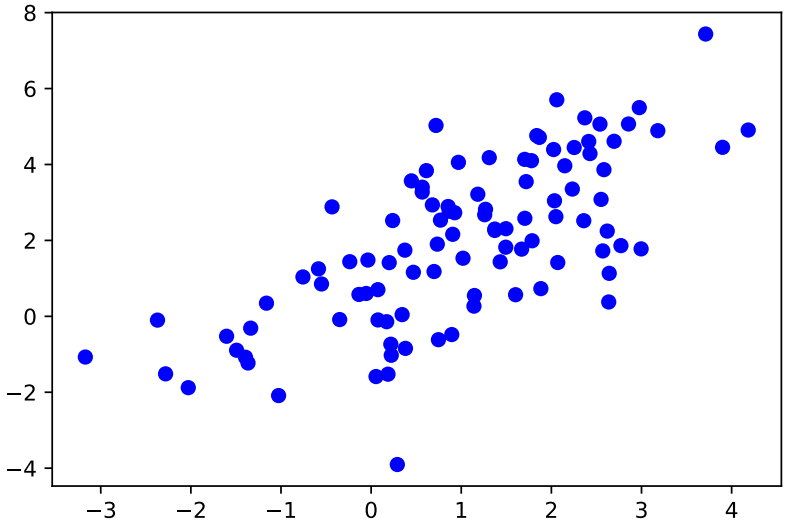

Figure 4: 100 number of Gaussian distributed data points

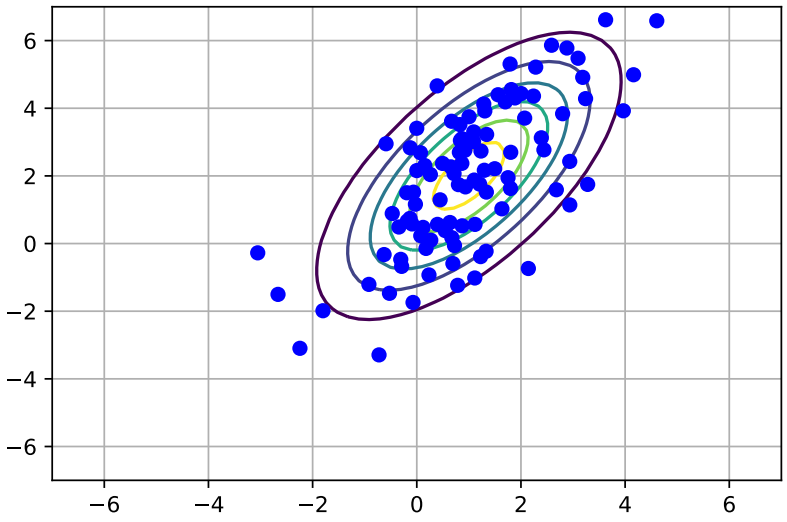

Figure 5: Contour plot for rotated Gaussian distribution with data points.