(2)

(a) To generate sample points from 2D Gaussian
we first generate a 2×1 vector w using
randn function in MATLAB.

We want the data to be drawn from a
bivariate Gaussian distribution of mean $H = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$

and covariance matrix $C = \begin{bmatrix} -1.9486 & 3.8750 \\ 1.6250 & -1.9486 \end{bmatrix}$

We will have to transform W using the
transformation

$$X = AW + \mu$$

where $AA^T = C$

To find A we can use the eig() function.

On eigen decomposition of C, we get a
diagonal matrix Λ consisting of eigenvalue of C
and an orthogonal matrix U

$$C = U\Lambda U^T$$

To convert it into the form AA^T, put $\Lambda = S^2$, S is also
a diagonal matrix.

$$C = US^2U^T = (US)(S^TU^T) = (US)(US)^T$$

Thus we get $A = U*S$

where $S = \sqrt{\Lambda}$

Any $A = USV^T$ where v is an orthogonal matrix works
but for the sake of simplicity we take $V = I$.