MATLAB Exercises

1. Use MATLAB to compute the resulting coefficients of the product of two polynomials:

$$y = (3x^6 + 2x^4 + \sqrt{2}x^3 + x - 9)(x^{10} - \sqrt{3}x^5 + x)$$

You should be able to compute the result by using only one command.

2. Use MATLAB to compute the binomial coefficients which are the coefficients of $(x + y)^n$. (Hint: read about the MATLAB function **`poly`**)

3. Decompose a given vector $x(n)$ into its odd-indexed and even-indexed components:

$$x_{odd}(n) = x(2n+1)$$
$$x_{even}(n) = x(2n)$$

4. Using only vector operations, compute the mean squared error between two complex vectors. The mean squared error between two complex signals $x(n)$ and $y(n)$ is given by:

$$\text{MSE} = \frac{1}{N}\sum_{n=1}^{N} \left\| x(n) - y(n) \right\|^2$$

5. Create a 5x5 matrix T such that:

$$[T]_{k,l} = k - l$$

Compute eigenvalues and eigenvectors of this matrix

6. Write a script to up-sample a given vector by a factor of N :

Example: $x = [1\ 2\ 3\ 4\ 5]$ converts to $y = [1\ 0\ 0\ 2\ 0\ 0\ 3\ 0\ 0\ 4\ 0\ 0\ 5]$ for $N = 3$

7. Write a script to down-sample a given vector by a factor of N :

Example: $x = [1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10]$ converts to $y = [1\ 3\ 5\ 7\ 9]$ for $N = 2$

8. Generate a length 1000 Gaussian distributed vector with a mean of 10 and variance of 9.

9. Generate a length 1000 uniformly distributed vector with a zero mean and variance of 10.

10. Using MATLAB, determine the impulse response of the following system (The system is initially at rest).

$$y(n) = x(n) - 2\cos(\pi/8)\, y(n-1) + y(n-2)$$