Tutorial 1

Matlab and Sinusoids

CS2108

Due date: 25th Jan 2023 (Wednesday) 2359 hrs
note: Tutorial-1 deadline is on Wednesday because of Lunar New Year.
Subsequent tutorials will have due dates on Tuesdays.

Semester 2, AY22/23, School of Computing, National University of Singapore

IMPORTANT:

For this tutorial, you are supposed to submit your project file to CANVAS.

Instruction for submission:

- *Create a folder using the following naming convention:*

  StudentNumber_yourName_Tut1

- *Put your Matlab .m file and also the results (i.e. the figures and the diary file) in this folder.*

- *Zip your folder. Name your zip file using the following convention:*

  StudentNumber_yourName_Tut1.zip

  For example, if your student number is A1234567B, and your name is Chow Yuen Fatt, for this tutorial, your file name should be A1234567B_ChowYuenFatt_Tut1.zip

- *Submit the zip file in the "Tutorial-1 Submit Here" folder in CANVAS.*

Note:

- ***Do the following questions using Matlab. Put all commands in a .m file.***
- ***You can create a log file to keep all your results when running the matlab .m file. Use the "diary" command.***

Question 1

(a) Create the following vectors and matrices:

$$a = [0\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10]$$

$$b = [0.1\ \ 0.2\ \ 0.3\ \cdots\ 19.9\ \ 20.0]$$

$$c = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

$$d = \begin{bmatrix} 1 & \dots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \dots & 1 \end{bmatrix}$$ i.e. d is a 10x10 identify matrix

(b) Create a matrix d where d is a 3x3 matrix with random numbers.

Compute id, where id is the inverse of the matrix d created above.

Verify (using Matlab) that d * id = 3x3 identify matrix

Question 2

(a) Define a vector s3 that contains a sine wave of 3 Hz for the duration 0 to 0.999 second, using a sampling frequency of 1000Hz.

(b) Define a vector c3 that contains a cosine wave of 3 Hz for the duration 0 to 0.999 second, using a sampling frequency of 1000Hz.

(c) Define a vector s4 that contains a sine wave of 4 Hz for the duration 0 to 0.999 second, using a sampling frequency of 1000Hz.

(d) Define a vector c4 that contains a cosine wave of 4 Hz for the duration 0 to 0.999 second, using a sampling frequency of 1000Hz.

(e) Compute the following:

(i) dot product of s3 and s3

(ii) dot product of c3 and c3

(iii) dot product of s3 and c3

(iv) dot product of s4 and s4

(v) dot product of c4 and c4

(vi) dot product of s4 and c4

(vii) dot product of s3 and s4

(viii) dot product of c3 and c4

(ix) dot product of s3 and c4

(f) Plot the signals s3, c3, s4, c4 on 4 separate subplots in the same figure. Save the figure as a jpeg file using the file name Q2.jpg

Question 3

Create a time domain signal $s(t)$ for time t ranging from 0 to 0.999 second, at steps of 0.001second.

$$s(t) = \sum_{i=1}^{5} a_i \cos(2\pi f_i \, \mathrm{t} + \phi_i)$$

where

- $s(t)$ is a summation of 5 cosine waves
- Use 5 uniformly distributed random numbers in the range 0 to 5 for the values of a_i
- Use 5 uniformly distributed random numbers in the range 0 to π for the values of ϕ_i
- $f_i = i * 2$

Repeat the entire question 3 more times to obtain 4 different $s(t)$.

Plot these 4 $s(t)$ using subplot within the same figure.

Question 4

Using the trapezoidal rule for numerical computation of integration, approximate, with 10,000 trapeziums, the integral of *x(t)* (from t=-2 to t=2) by writing Matlab codes. Note that you are **not allowed** to use Matlab built in function ***trapz***:

$$x(t) = \begin{cases} |t| * 2 & for -2 < t < 0 \\ t * 3 & for\ 0 < t < 2 \\ 0 & otherwise \end{cases}$$

$$areaUnderCurve = \int_{-2}^{2} x(t)\ dt$$