Digital Signal Processing
Lab1
Getting Started with MATLAB

Variables

Unlike many programming languages, Matlab does not require prior definition of the Variables. You can simply write: **variable name = expression**.
For example:
a = sin(64) + 2;
If you do not specify the name of the variable, Matlab automatically creates the Variable **ans**. Type : 3+2. You will get ans = 5.

Vectors and matrices

```
> x=[1:10]
> x = [1 3 7 15]
> y=[1:0.1:10]
> z=[1:3;4:6;7:9]
> [m,n]=size(z)
```

Arithmetic operations

- Arithmetic operators: +, -, *, /, \, ^.
- Mathematical functions available: ABS, SQRT, LOG, SIN, and COS.

	Mathematical Function	Matlab Syntax for Function
Arithmetic and algebraic operation		**f1 = a1 + b1*x + c1*x^2**
		f2 = a2 + b2*x + c2*x^2 + d2*x^3
		g = exp(A*t)*(C1*cos(B*t)+C2*sin(B*t))
		u = 2*x*y^2 + sin(x+y)

Control Flow in Matlab

Loops	FOR Loops	WHILE Loops	IF ... ELSE ...
Syntax	for v=expression statements end	while expression statements end	if expression statements elseif expression statements else statements **end**

A FOR loop allows a statement to be repeated a fixed, predetermined number of times. Let's look at the following problem. We would like to fill the vector b with square roots of 1 to 1000. One way to do so, is by using a for loop

We will calculate the time required for this operation for comparing it with the more efficient version of this calculation.

Write this code in an m-file and save it under the name *tictoc.m*.

clear ; To clear all previous variables, and to free memory.

tic ; This function initializes an internal clock

for i = 1:1000
b(i) = sqrt(i);
end
t=toc;

The time required was: _____.

Tasks	Commands	Example
Writing your own functions	function [output1,output2,...] = cmd_name(input1,input2,...)	Example of a function to compute $f(x) = sin(x^2)$ function y = fcn(x) y = sin(x.^2); %Create in m file
2D Plotting	**Plot,Subplot,Figure Hold,Stem,Axis,title**	>t=[-2:0.01:2]; >x=sin(t*10); >plot(t,x); >axis([-1 1 -1 1]); >zoom >xlabel(`Time'); >title(`My first plot'); >specgram(x);
Polynomial roots	**r = roots(p)**	>>p = [1 2 1] %polynomial x^2 +2x +1 >>r = roots(p) %roots r = -1 -1
Dealing with sound files	**wavread, wavwrite, auread, auwrite, sound(y,fsamp)**	>y=wavread('C:\sound.wav');%file must be valid >sound(y,44100);
Complex numbers	**j, real, imag, abs, angle,**	> real(j) % locate a complex number in cartesian form

		> imag(j) > abs(j) % locate a complex number in polar form; > angle(j)
Signal processing and Image processing	• **Fft(),dft(),conv()** • **dither(),gray2ind(),ind2gray(),ind2rgb()** • **imread() ,imwrite(,)**	>>clear >>A=imread('my_pic.jpg'); %file must be valid >>whos >>imshow(A)
Transfer function representation and frequency response	• **Tf2zp** • **Zp2tf** • **Freqs()** • **Semilogx()** • **bode()**	Given H(s)=(2s+3)(s3+4s2+5) >num[2 3] >den=[1 4 0 5] > [z,p,k]=tf2zp(num,den) > [num.den]=zp2tf(z,p,k) %one way of plotting >T=0:0.1:1; >Y=step(num,den,t); >Plot(t,y) % another way of plotting >Bode(num,den) > [mag,phase]=bode(num,den,w); >Magdb=20*log10(mag) >Semilogx(w,magdb) >Semilogx(w,phase)

Getting help from Matlab

> doc fft
> help help
> help cos
> help fft
> lookfor filter

Demonstration of scripting

1. To invoke scripts from matlab: write your own matlab file using emacs, xemacs or the Matlab editor and save it as myfile.m
2. Type in the Matlab prompt myname
3. Use % as comments
4. ; To suppress output

Exercise:

1. Calculate for $\left(1+\frac{2}{n^2}\right)^n$ n= 3, 7.

2. Plot the function: $y = e^{-at}*\cos(\omega t)$, for a = 2, ω= 5, and t = 0-10.

3. Try using the WHILE and the IF statements to calculate all the Fibonacci numbers sothat the sum of two consecutive numbers is smaller than 10,000. How many are even?How many are odd? Try to plot them.

Hints:

1. Matlab can increase the size of a vector as it is being created.
2. To determine whether a number n is even or odd you can use the function **rem(n,2).** If rem(n,2) equals 0 then the number is even, otherwise it is odd.

4. Given $f(x)= (x^2+2x+3)/(x+3)$.Plot f(x) for 0<=x<=100