

Music 320: Lab 1

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1 Goal of the 320 labs

- The music 320 labs track is offered every thursday at 3:15 pm.
- The goal of these labs is to get familiar with the theory learned during the tuesday sessions.
- Practical aspects of introductory dsp will be shown together with current available software used in computer music.
- Weekly assignments will be given in matlab.

2 Goal of the first lab

- To learn the basic Matlab syntax
- To learn which are the existing tools in Matlab
- To learn how to write your own functions in Matlab

3 Introduction to matlab

3.1 Invoking matlab

- from the command line type matlab or matlab -nojvm if you don't like the Java interface.

3.2 Getting help from Matlab

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

3.3 Basic numerical computation

```
> 2 + 3
    > 3 * 6
    > 6/7
```

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3.4 Trickier computation

```
> 8 * 7 / 4 + 3
```

Precedence

```
> 8 * 7 / (4 + 3)
```

3.5 Variables

```
> x = 3 * 2.0
> who
```

3.6 Vectors and matrices

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

Matrix vs. pointwise operations

```
> z*z'
    >z.*z
    >z*z %ERROR!
```

3.7 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

3.8 Useful functions

1. math: e=exp(1), pi, sin, cos, atan, sqrt

```
> cos(pi)
> cos(0:0.1:pi)
```

3.9 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);
```

3.10 Plotting in Matlab

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);
```

3.11 Dealing with soundfiles

wavread, wavwrite, auread, auwrite, sound(y,fsamp)

```
>y=wavread('sound.wav');
>sound(y,44100);
```

3.12 Signal processing

filter, firfilt, conv, freqz, fft, remez, fir1, specgram, various window functions

```
> z=firfilt(fir1(256,0.05),y)
> specgram(z)
```

3.13 complex numbers

j, real, imag, abs, angle, zprint, zcat, zvect

```
> real(j) % locate a complex number in cartesian form
> imag(j)
> abs(j) % locate a complex number in polar form; see help abs
> angle(j)
> zprint(j) % convenient graphing tools
> zvect(j)
> zcat([1 j 1+j])
```

3.14 Example: demonstrate Euler's identity

a real sinusoid can be decomposed into two complex sinusoids

```
> figure(1)
> subplot(2,1,1)
> x=[0:0.1:2*pi];
> plot(x,cos(x))
> subplot(2,1,2)
> plot(x,(e^(j.*x)+e^(-j.*x))/2)
> figure(2)
> subplot(2,1,1)
> fft(cos(x))
> subplot(2,1,2)
> fft((e^(j.*x)+e^(-j.*x))/2)
9. > exit
```