

# AMAT 503 – Tutorial Notes

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January 22, 2010

## 1 Complex calculations

Express the following in the form  $a + ib$ , you can use MATLAB or by hand:

- $(2 + 3i) + (4 + i)$
- $(2 + 3i)(4 + i)$
- $\frac{2+3i}{4+i}$
- $(8 + 6i)^2$
- $\frac{1}{i} + \frac{3}{1+i}$
- $\left(1 + \frac{3}{1+i}\right)^2$

Find the following:

- $\sqrt{1 + \sqrt{i}}$
- $\sqrt{1 + i}$
- $\sqrt{\sqrt{-i}}$

Solve these equations:

- $z^5 - 2 = 0$
- $z^4 + i = 0$

## 2 MATLAB

Try some simple vector-matrix operations in MATLAB.

- $2 + 2$
- $x = [1\ 2\ 3]$ , a vector, and a variable being assigned;
- $x + 2$  adding a constant to a vector
- $A = [1\ 2\ 3; 4\ 5\ 6; 7\ 8\ 10]$  a matrix
- $A * x$  the product of a matrix and a vector (this fails)
- $x = x'$  change  $x$  into a column vector
- $A * x$  the product of a matrix with a vector (this works)
- $inv(A)$  the inverse of a matrix

Play with some simple complex numbers

- $\text{sqrt}(-1)$  to get  $i$
- $(2 + 3 * i) + (4 + 5 * i)$ ; a sum
- $(2 + 3 * i) * (4 + 5 * i)$ ; a product
- $(2 + 3 * i) / (4 + 5 * i)$ ; a quotient
- $(2 + 3 * i)^5$  a power
- $pi$  the built in constant  $\pi$
- Which is bigger,  $e^\pi$  or  $\pi^e$  ?
- $\exp(2 * pi * i)$
- $\exp(.5 * pi * i)$
- $\exp(pi * i)$
- $\exp(1.5 * pi * i)$
- $\log(i), \log(-i)$

Do simple plots. eg

- $x = 0 : .1 : 1$  a vector of numbers from 0 to 1, in steps of .1;

- `plot(x)` to plot the vector
- `plot(exp(x))` to plot part of an exponential curve
- `plot(exp(2*pi*i*x))` note this plots the complex numbers as a curve
- `plot(exp(2*pi*i*x), 'o')` this plots only the complex points

To create a play a digital sound, try this:

- `x = sin(2 * pi * 440 * (0 : .0001 : 1));`
- `sound(x,10000)`

Project: use the tic-toc command to find out how fast it takes to invert a NxN matrix. Make a plot of time versus matrix size T(N) versus N. Plot log(time) versus log(N), slope indicates order. Use large matrices, be careful about time to allocate memory.