Information technology – lecture 3

Introduction to Octave.

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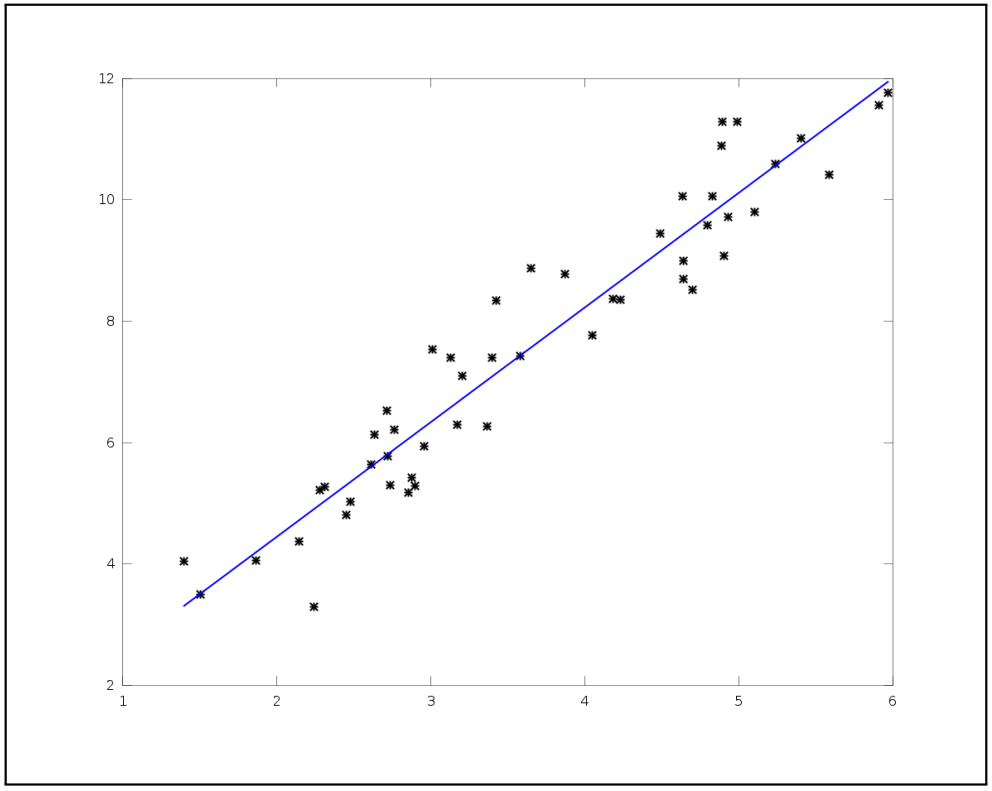
Example: linear regression

```
1   x = linspace(1,5,50)
2   y = 2*x+1;
3   rx = rand(50,1);
4   ry = rand(50,1);
5   nf = 1.2
6   yn = y+nf*ry';
7   xn = x+nf*rx';
8   p = polyfit (xn, yn, 1);
9   xz=linspace(min(xn),max(xn));
10  yz=p(2) + p(1)*xz;
11  plot(xn,yn,"*0",
12    "markersize", 8,
13    "linewidth", 2,
14    xz,yz,"-", "linewidth", 2);
15  pause()
16  print("linfit.png")
```



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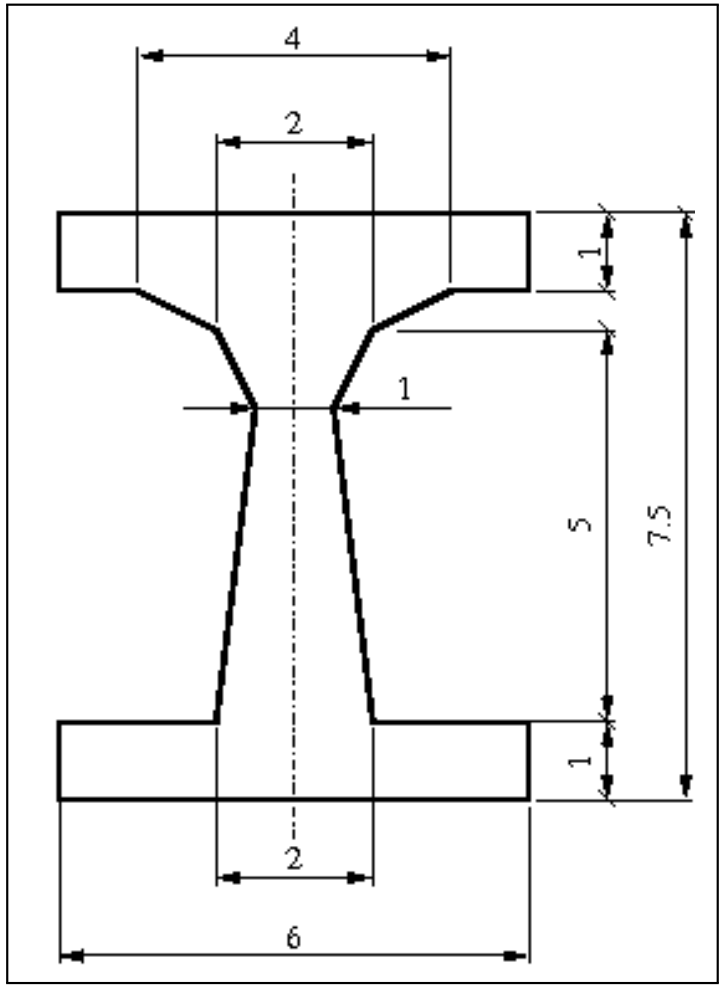
Example: Polygon area




```
1   XY = load("ttshape.dat");
2   # scale to cm
3   XY = XY/450;
4   X = XY(:,1);
5   Y = XY(:,2);
6   area = polyarea(X,Y)
```

```
2700  1575
5400  1575
5400  2025
4950  2025
4500  2250
4275  2700
4500  4500
5400  4500
5400  4950
2700  4950
2700  4500
3600  4500
3825  2700
3600  2250
3150  2025
2700  2025
2700  1575
```

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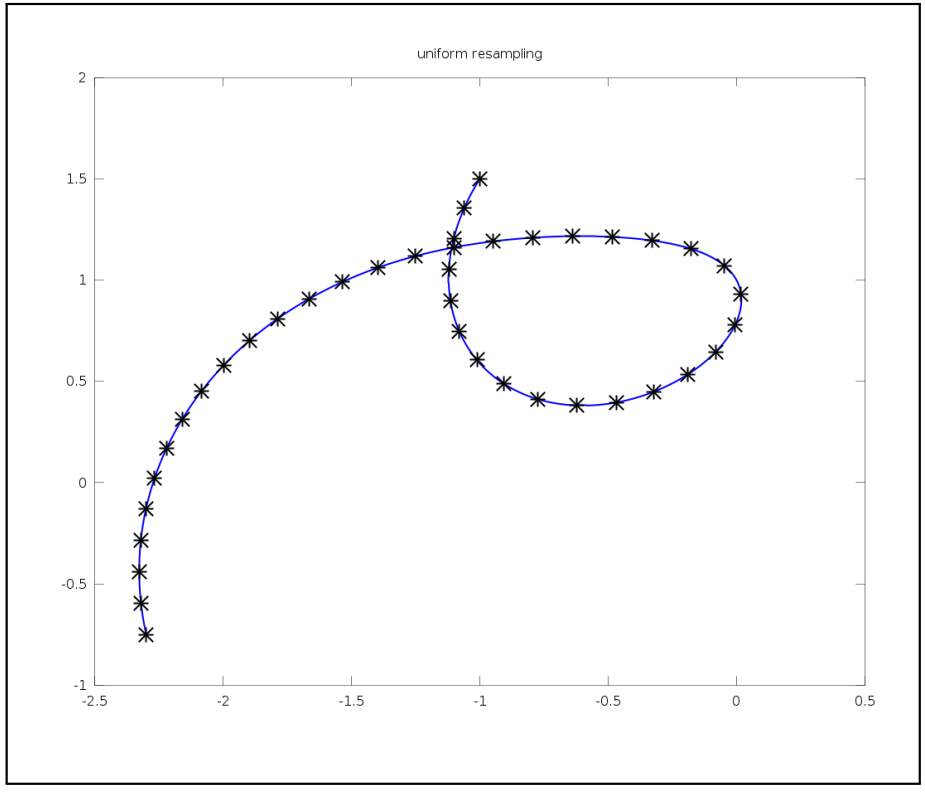
Example: Curve discretisation

Discretisation with segments of equal length

```
1   R = 2; r = 3; d = 1.5;
2   th = linspace (0, 2*pi, 1000);
3   x = (R-r) * cos (th) + d*sin ((R-r),
4   y = (R-r) * sin (th) + d*cos ((R-r),
5   x += 0.3*exp (-(th-0.8*pi).^2);
6   y += 0.4*exp (-(th-0.9*pi).^2);
7
8   [xs, ys] = unresamp2 (x, y, 40);
9   plot (x, y, "-", "linewidth", 2,
10   xs, ys, "*0", "linewidth",2,"marker
11  title ("uniform resampling")
12  pause()
13  print("unilen.png")
```



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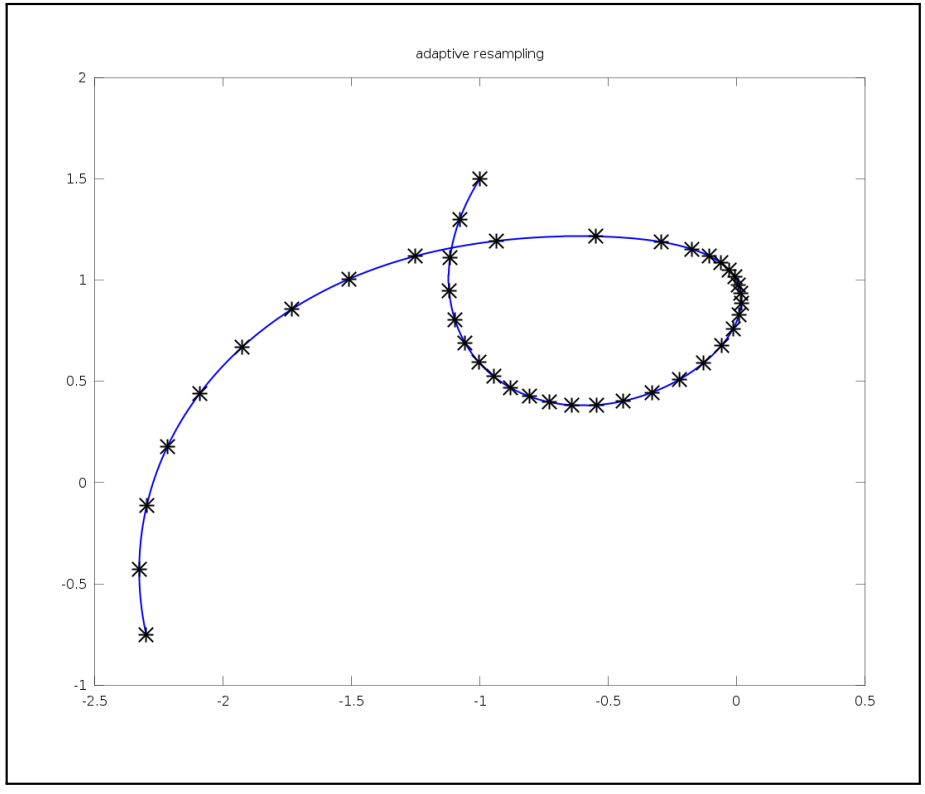
Example: Curve discretisation

Discretisation with equal angle increment between segments

```
1   R = 2; r = 3; d = 1.5;
2   th = linspace (0, 2*pi, 1000);
3   x = (R-r) * cos (th) + d*sin ((R-r),
4   y = (R-r) * sin (th) + d*cos ((R-r),
5   x += 0.3*exp (-(th-0.8*pi).^2);
6   y += 0.4*exp (-(th-0.9*pi).^2);
7
8   [xs, ys] = adresamp2 (x, y, 40);
9   plot (x, y, "-", "linewidth", 2,
10   xs, ys, "*0", "linewidth",2,"marker
11  title ("adaptive resampling")
12  pause()
13  print("adaplen.png")
```



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Introduction

GNU Octave `http://www.octave.org`

- numerical computing environment for scientific and engineering applications,
- a tool for matrix manipulations
- available under GNU GPL license,
- sources and binary versions: http://www.octave.org/download.html.

Brief history

1988 – origins of Octave
1992 – John W. Eaton joins Octave team. 1993 – first Octave alpha version 1994 – version 1.0.
2011 – the newest stable version 3.2.4.

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Octave application areas

- – Numerical computing
- – Data analysis
- – Data visualisation
- – Prototyping of numerical applications

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Octave components

- Octave language – scripting, high level, matrix based
- Octave interpreter
- Numerical libraries
- Interface to visualisation tools (gnuplot, VTK)

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Octave working modes

Octave can be used in two modes:

- interactive,
- batch processing.

- Both modes are interpreted and support the same commands
- Customary suffix for Octave scripts: '.m'
- Instruction separators: ';' ','.
- '...' line continuation symbol
- Comment lines start with '%' or '#'.
- Commands are case sensitive

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Using Octave interactively

- Starting Octave – `octave -q`.
- Octave prompt – `octave:1>`.
- Standard command line utilities.
- Commands history with ↑↓ or `history` function.
- Closing Octave interpreter: `quit` or `exit`.

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Arithmetic operators.

Octave supports both real and complex numbers.

Mathematics	Octave
a+b	`a+b`
a-b	`a-b`
ab	`a*b`
a/b	`a/b` or `b\a`
a^b	`a^b` or `a**b`
$\sqrt{x}$	`sqrt(x)` or `x^0.5`

Operators priority: `;` `*`, `/`, `+`, `-` The order of arithmetic operations can be forced using brackets.

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Working in batch mode.

Save the commands as a file `first.m`

```
% Starting comment
clear all
clc
a = 10;
b = 2.5;
c = a+b;
a = 2.56;
d = a+b;
```

Running the script:

- `octave -q` and after the prompt we give the script name, e.g. `first`,
- `octave -q first.m` in terminal command line.

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Constants and special

`ans`	special variable for the most recent result
`eps`	2^{-52}
`inf`	infinity
`Nan`	Not-a-Number
`i, j`	imaginary unit
`pi`	π
`realmax`	maximum available real number
`realmin`	minimum positive real number

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Simple input/output functions

- Writing out a variable: – `disp(var)`.
- Writing out a text: – `disp('text')`.
- Reading in a variable value: – `a = input('prompt')`.

Simple script:

```
a = input('Give a number:')
b = 2.5
res = a+b;
disp('the sum of a+b is');
disp(res);
```

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Built-in Octave functions

sin(X)	ones(m,n)	det(A)
cos(X)	zeros(m,n)	rank(A)
tan(A)	eye(m,n)	trace(A)
exp(X)	rand(m,n)	norm(A,1)
log(X)	randn(m,n)	norm(A,2)
sqrt(X)	rows(A)	norm(A,inf)
min(X)	columns(A)	norm(A,'fro')
max(X)	[w,k]=size(A)	columns(A)
sort(X)	w=size(A,1)	rows(A)
sum(X)	k=size(A,2)	inv(A)
prod(X)	diag(A,k)	A^{-1}

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Conditional expressions

```
if condition
 instructions
end
```

```
if condition
 instructionsI
else
 instructionsII
end
```

```
if condition
 instructionsI
elseif conditionII
 instructionsII
else
 instructionsIII
end
```

Relational operators

== comparison
! = not equal
< less than
> greater than
<= less than or equal
>= greater than or equal

Logical operators

& and conjunction
| or alternative
! negation

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Conditional expressions – example

```
disp('Coefficients');
a = 1; b = 2; c = 1;
if a != 0
  delta = b*4 - 4*a*c;
  if delta >= 0
    x1 = (-b - sqrt(delta))/(2*a);
    x2 = (-b + sqrt(delta))/(2*a);
  else
    disp('no real roots')
  endif
else
  disp('this is not quadratic equation');
endif
```

This is not the best way to solve this problem!!.

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for loop

Syntax:

```
for variable = expression
  instructions
end
```

Example: Writing odd numbers

```
N = input('How many numbers');
maxnp = 2*N-1;
for i = 1:2:maxnp
  disp(i);
endfor
```

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The `format` command

Arguments for `format` command:

`short`	5 digits, fixed point notation,
`long`	15 digits, fixed point notation,
`short e`	5 digits, exponential notation,
`long e`	15 digits exponential notation,
`short g`	automatic fixed point/exponential notation
`long g`	as above with more digits,
`hex`	hexadecimal representation,
`bank`	fixed format with 2 digits,
`rat`	a rational approximation.

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