

%matlab introduction course notes ---week 6, term 1

1. Matlab as calculator

1.1 basic arithmetic operator + - * / ^ ()

e.g. $2+3/4*5 =$

$3^2*4 =$

$3-4/4-2 =$

1.2 extended arithmetic - accidental error

$1/0 =$

$-1/0 =$

$0/0 =$

$1/\text{Inf} =$

we know $1/(1/x) = x$, then try $1/(1/0) = ?$

complex number $1+i$, $-1+3*i$

2. Numbers and formats

2.1 Different kind of numbers

Integer: e.g. 123, -218

Real : e.g. 1.234, - 10.9

complex : e.g. $3.21-3.4*i$ ($i = \text{sqrt}(-1)$).

Inf : Infinity (dividing by 0)

NaN: Not a number (0/0)

e: notation for very large or small number, e.g. -
 $1.34e+03 = ?$, $1.34e-05 = ?$

2.2 Calculation: 15 significant figures

The 'format' tells how matlab prints numbers. Type
'help format' in command window for full list

e.g. $\text{pi} = ??$ usually 3.1416

format long

$\text{pi} = ??$

format short e

$\text{pi} = ??$

format short

$\text{pi} = ??$

If want to switch back to default format, type:

format

2.3 finite accuracy consequences

Matlab limit accuracy (enough for most cases)

64 bits, store number as large as $2*10^{308}$, as
small as $2*10^{(-308)}$

store any number 15 significant figures:

e.g. 1.23456789023456 (14 figures, can handle)

1.23456789023456789012 (20 digits, truncated to 15 figures)
round off cannot be avoid.
e.g. what is $\sin(\pi) = ?$
try $\sin(\pi) = ??$ -slight round-off error, take it as zero as long as small like 10^{-15} .

3. Variables

3.1 combination of oth letter and number, case sensitive

e.g. a , x1, z2453, A, t = 2+3-9, 2*t-2
Not allowed: Net-c, 2p, %x, @sign

3.2 special names: eps (= 2^{-54}), pi --> avoid using

3.3 complex numbers : i, j = sqrt(-1), unless you change them

4. Suppressing output (don't want to show output)

hidden: x = -13; (semi-colon).

5. Build-in function

5.1 sin, cos, tan, sec = 1/sin, cosec = 1/cos, cotan

e.g. work out the coordinate of a point on a circle of radius 5 centred at origin, having an elevation 30 degree = $\pi/6$ radians.

so (x, y), where $x = 5*\cos(\pi/6)$, $y = 5*\sin(\pi/6)$.

5.2 inverse trig function

e.g. asin, acos, atan--> answer returned in radians, so $\text{asin}(1) = \pi/2$

5.3 exponential

exp : $\exp(x) = e^x$

logarithm: log: log to base e/ log10 to base 10

square root: sqrt().

e.g. x = 9; sqrt(x), exp(x), log(sqrt(x)),
log10(x^2+6)

5.4 more

e.g. eigenvalue, eigenvector: eig
solving DE:

6. vectors

6.1 row vectors

`a = [1 2 3]` or `a = [1, 2, 3]`
 e.g. `V = [1 3 sqrt(5)]`, what is `length(V)`
 space vitally important : e.g. `v2 = [3+ 4 5]`, `v3 = [3+4 5]`;
 add vector of the same length: e.g. `V + v3`, `v4 = 3*v3`,
`v5 = 2*V-3*v4`, `v6 = v+v2???` wrong! since dimension must agree
 build a row vector from existing ones: e.g. `w = [1 2 3]`, `z = [8, 9]`, `cd = [2*z -w]`, `sort(cd)` (ascending order)
 look at value of particular entries: e.g. `w(2) = ?`
`set w(3) =`
`100`, then `w = ??`

6.2 column vector

e.g. `c = [1; 3; sqrt(5)]` or `c2 = [3 return 4 return 5]`
`c3 = 2*c-5*c2`

6.3 column notation : a shortcut for producing row vectors

e.g. `1:100`
`3:7`
`5:0.1:6`
`1:-1 --> []`
`0.32:0.1:0.6`
`-0.4:-0.3:-2`

6.4 extracting bits of a vector

e.g. `r5 = [1:2:6 -1:-2:-7]`
 get 3rd to 6th entries: `r5(3:6) = , try`
`r5(1:2:7) = ?`, `r5(6:-2:1) = ??`

6.5 transposing: row-> col, col-> row

e.g. `w, w'`, `c, c'` (`w = [1 2 -3]`, `c = [1;2 ; 3.5]`)
`t = w+2*c'`, `T = 5*w'-2*c`

7. vector operation

7.1 scalar product: $u \cdot v = \sum (u_i v_i)$

`u = [u1, ..., un]`; `v = [v1;...; vn]`
 e.g. `u = [10 -11 12]`, `v = [20; -21; -22]`; `prod =`
`u*v`

e.g. `w = [2 1 3]`; `z = [7; 6; 5]`; check: `v*w`, `u*w'`,
`u*u'`, `v'*z`

norm of a vector: `||u|| = sqrt(sum(ui))`
 compute norm: `sqrt(u*u')` or `norm(u)`

7.2 dot product-vector of the same length times with each other

`u.v = [u1v1, ..., unvn]`

e.g. $u \cdot w$, $u \cdot v'$, $u \cdot z$, $u' \cdot v$
ex.: Tabulate $y = x \sin(\pi x)$ for $x = 0, 0.25, \dots$,

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ans: x = 0:.25:1; y = x.*sin(pi*x);
```

7.3 dot **divison of array-element by element division**

e.g. $a = 1:5$, $b = 6:10$, check $a./b =$, $a./a =$, $c =$
 $-2:2$, $a./c$, $a.*b-24$, $ans./c$

ex: limit $\sin(\pi x)/x$, as $x \rightarrow 0$

```
ans: x = [.1 .01 .001 .0001], sin(pi*x)./x,
```

format **long**, ans - pi

e.g. $1/x$ (wrong!), $1./x$ (correct)

7.4 dot **power of array (.)^** sqare all element of a
vector

e.g. $u \cdot u$, $u.^2$, $u.^4$, $u \cdot w.^{-2}$

8. Matrix