Programming Language: MatLab

1st Semester 2015

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For loop

Description:

Repeat action(s) with specify number of times

Syntax:

For index = starting value : step size : end value

Action(s) % Whatever action you wanted

End

Example:

```
j = 1
k = 0.2
l = 5

for i = j:k:l
    i
end
```

l>j, k should be positive

j<l, k should be negative

k, can be integer or decimal

An simple application: Free-Fall

Newton 2^{nd} law:

$\mathbf{F} = m\mathbf{a}$

a: acceleration,
velocity change per unit time, $\Delta\mathbf{v}/\Delta t$

v: velocity,
displacement per unit time, $\Delta\mathbf{x}/\Delta t$

Algorithm: Consider the motion along y-axis

t = 0

$y(0) = 0$

$v_y(0) = 0$

Δt

$y(\Delta t) = y(0) + V_y(0) * \Delta t$

$V_y(\Delta t) = v_y(0) + a_y(0) * \Delta t$

2Δt

$y(2\Delta t) = y(\Delta t) + V_y(\Delta t) * \Delta t$

$V_y(2\Delta t) = v_y(\Delta t) + a_y * \Delta t$

…

e.g. $\mathbf{a}_y(t) = -\mathbf{g}$ for all t
=> $\mathbf{a}_y(t)$ denote as $\mathbf{a}$

…

t'+ Δt

$y(t'+\Delta t) = y(t') + V_y(t') * \Delta t$

$v_y(t'+\Delta t) = v_y(t') + a_y(t') * \Delta t$

…

An simple application: Free-Fall

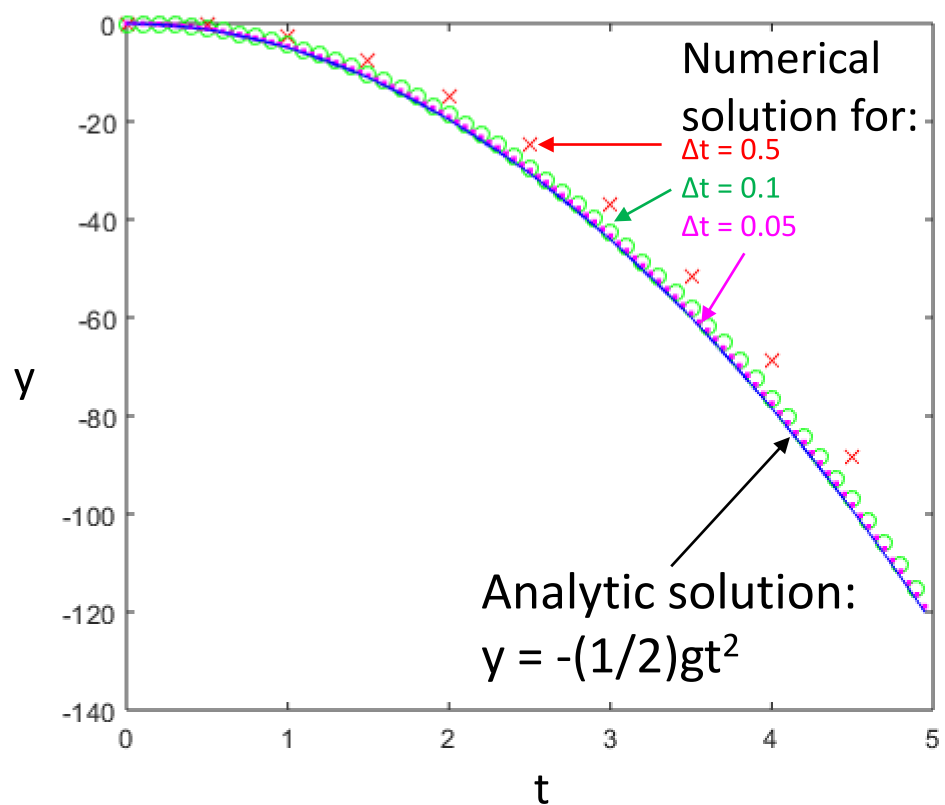
For a free fall:

F_y = -mg, g: acceleration of gravity

$y = v_y = 0$ @ $t = 0$

```
Dur = 5.    % simulate duration
dt = 0.05   %time step
g = 9.8     % gravity

Nstep = ceil(Dur/dt)     % number of step
y = zeros(Nstep,1)       % y(t)
vy = zeros(Nstep,1)      % vy(t)
t = zeros(Nstep,1)       % time

t(1) = 0             % initial condition
y(1) = 0
vy(1) = 0


for i = 2: Nstep
    vy(i) = vy(i-1) + (-g)*dt;
    y(i) = y(i-1) + vy(i-1)*dt;
    t(i) = (i-1)*dt;
end

yana=(-0.5)*g*t.^2        % analytic solution
plot(t,y,'m.',t,yana,'b')
```

In principle, if Δt→0, then you can get the exact solution as the analytic solution



Extend to the case with friction

For a free fall:

$F_y = ma_y = -mg - \beta v_y$,

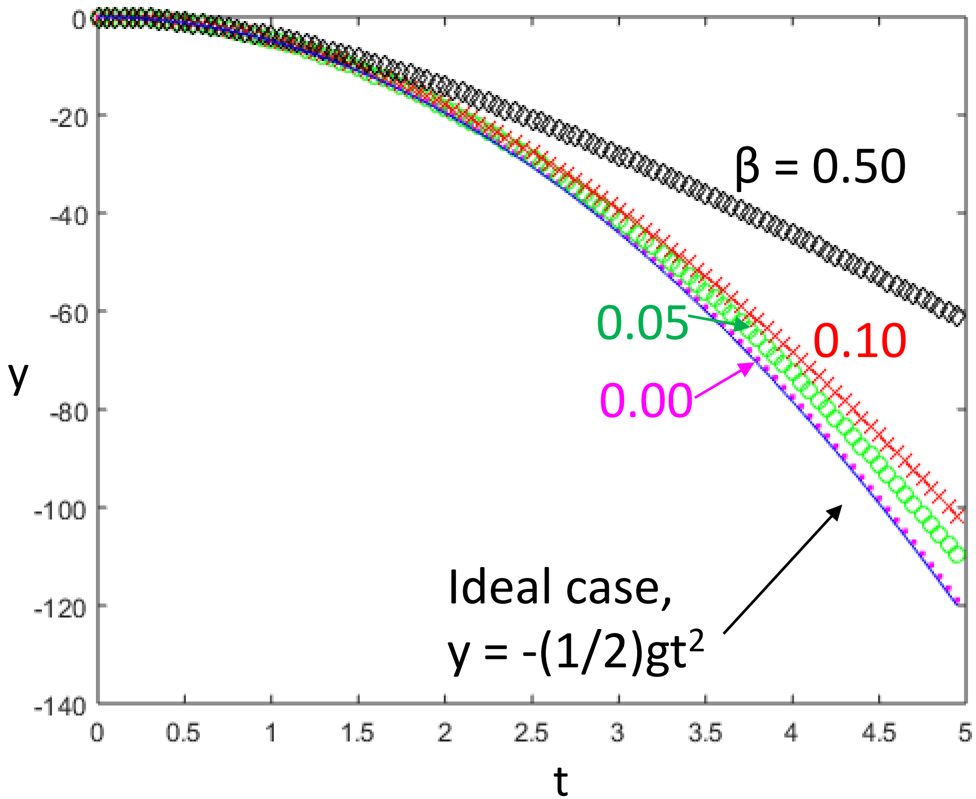
$y = v_y = 0$ @ $t = 0$

$$\boxed{a_y = -g - (\beta/m)V_y}$$

g: acceleration of gravity

β: friction coefficient

```
Dur = 5.    % simulate duration
dt = 0.05   %time step
g = 9.8     % gravity
m = 1       % mass
b = 0.5     % friction

Nstep = ceil(Dur/dt)    % number of step
y = zeros(Nstep,1)      % y(t)
vy = zeros(Nstep,1)     % vy(t)
t = zeros(Nstep,1)      % time

t(1) = 0            % initial condition
y(1) = 0
vy(1) = 0

for i = 2: Nstep
    vy(i) = vy(i-1) + (-g-(b/m)*vy(i-1))*dt;
    y(i) = y(i-1) + vy(i-1)*dt;
    t(i) = (i-1)*dt;
end
```



Homework

Consider there are N particles located at origin while t = 0. They are randomly moving along x-axis as $X_i(t+1) = X_i(t) + \mathbf{D} * \boldsymbol{\xi}$ at each time step, where **D** and is the coefficient to describe the fluctuation strength, and **ξ** is a random number with zero mean. Try to use "for loop" to simulate the particle motion and showing your result by

a) Using "subplot (2,1,1)" to plot the figure of $\langle x \rangle$ vs t for N = 50 (dark dash line), 500 (green circle), 5000 (red *)
b) Using "subplot (2,1,2)" to plot the figure of $\langle x^2 \rangle$ vs t for N = 50 (dark dash line), 500 (green circle), 5000 (red *)
c) Describe what do you observed as increasing N
d) Try to describe the physical meaning of the coefficient **D**

Extra point:
e) Try to extend the motion to y-axis and plotting the trajectories
f) Using subplot to plot the figure as below, where $r = (x^2+y^2)^{1/2}$

$\langle x \rangle$ vs t	$\langle y \rangle$ vs t	$\langle r \rangle$ vs t
$\langle x^2 \rangle$ vs t	$\langle y^2 \rangle$ vs t	$\langle r^2 \rangle$ vs t

Homework

Cation:

1) Please naming the file name of you home work as "HW01_G##_XXX_XXX.ppt", where ## and XXX are the group number and the last three digits of your student ID, respectively.
   (do not use any Chinese on the file name)

2) Please submit your homework on time (before Friday noon)

3) Please specify your group, name and contribution in the first page

4) Please do not copy your HW from your classmate, but you can discuss