EP375 Computational Physics

Topic 8

ROOTS OF EQUATIONS

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Feb 2014

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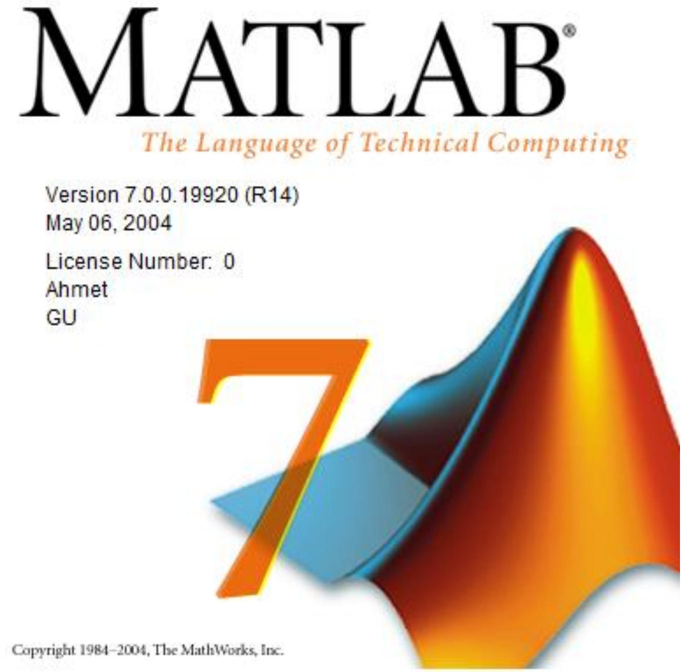


Roots of Polynomials

- $x^2 - 3x + 2 = 0$ (roots are: 2 and 1)

```
>> roots([1 -3 2])
ans =
      2
      1
```

- $x^5 + 2x^4 - 5x^3 + x + 3 = 0$

```
>> c = [1 2 -5 0 1 3];
>> roots(c)
ans =
  -3.4473
   1.1730 + 0.3902i
   1.1730 - 0.3902i
  -0.4494 + 0.6062i
  -0.4494 - 0.6062i
```

MATLAB solve() Function

Alternatively, we can also use **`solve()`** function in MATLAB.

```
>> solve('x^2-4=0')
ans =
      2
     -2
```

```
>> solve('sin(x)+2-x=0')
ans =

2.554195952837043037829666173791 9
```

```
>> solve('3*sin(x)+2-x=0')


ans =
-1.2467199751961775376089438821225-
.52620368582988923192255563579236*i
```

```
>> solve('a*x^2 + b*x + c')

ans =

 1/2/a*(-b+(b^2-4*a*c)^(1/2))
 1/2/a*(-b-(b^2-4*a*c)^(1/2))
```

```
>> solve('a*x^2 + b*x + c','b')

ans =

-(a*x^2+c)/x
```

```
>> solve('a*x^2 + b*x + c','c')

ans =

-a*x^2-b*x
```

```
>> s = solve('x + y = 1','x - 11*y = 5')

s =
    x: [1x1 sym]
    y: [1x1 sym]


>> s.x
ans =
4/3


>> s.y
ans =
-1/3
```

```
>> s =solve('x^2+y^2-4=0','x*y-1=0')

s =
    x: [4x1 sym]
    y: [4x1 sym]

>> s.x
ans =
  -(1/2*6^(1/2)+1/2*2^(1/2))^3+2*6^(1/2)+2*2^(1/2)
  -(1/2*6^(1/2)-1/2*2^(1/2))^3+2*6^(1/2)-2*2^(1/2)
 -(-1/2*6^(1/2)+1/2*2^(1/2))^3-2*6^(1/2)+2*2^(1/2)
 -(-1/2*6^(1/2)-1/2*2^(1/2))^3-2*6^(1/2)-2*2^(1/2)

>> s.y
ans =

  1/2*6^(1/2)+1/2*2^(1/2)
  1/2*6^(1/2)-1/2*2^(1/2)
 -1/2*6^(1/2)+1/2*2^(1/2)
 -1/2*6^(1/2)-1/2*2^(1/2)
```

```
>> coz = solve('sin(x) + y^2 + log(z)-7=0',...
               '3*x + 2^y - z^3 + 1=0',...
               'x + y + z - 5=0')
>> coz.x
ans =
.59905375664056731520568183824539

>> coz.y
ans =
2.3959314023778168490940003756591

>> coz.z
ans =
2.0050148409816158357003177860955
```

HW 1:

In a region of space the electric potential is given by

$$V(x, y, z) = 2xz + \sin(x-y) + |\exp(xy) - z^3| \quad (V/m)$$

where coordinates x, y and z is measured in meter.

Write a program that inputs a point (x, y, z) from the keyboard and outputs the electric field components (E_x, E_y, E_z) and magnitude of the electric field E at that point.

Hint use the relation: $\mathbf{E} = -\nabla V$

HW 2:

Write a MATLAB function named

```
function [Ex Ey Ez] = efil(@V, x,y,z)
```

that returns the electric field components (E_x, E_y, E_z) at a point (x, y, z) for the given potential function of the form V = V(x, y, z).

HW 3:

The speed v of a rocket in vertical flight near the surface of earth can be approximated by

$$v = u \ln\left(\frac{m_0}{m_0 - \dot{m}t}\right) - gt$$

where

u = velocity of exhaust relative to the rocket (2500 m/s)

m_0 = mass of rocket at liftoff (3.0e6 kg)

m-dot = rate of fuel consumption = 13.0e4 kg/s

g = 9.8 m/s^2

t = time measured from liftoff

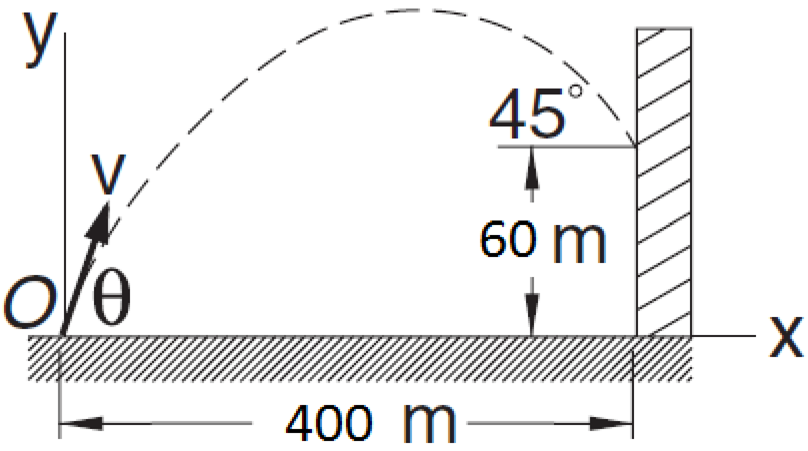
Determine the time when the rocket reaches the speed of sound (340 m/s).

HW 4:

A projectile is launched at point O with the velocity v at the angle θ to the horizontal. The parametric equation of the trajectory is given by

$$x = (v\cos\theta)t$$

$$y = (v\sin\theta)t - gt^2/2$$



where t is the time measured from the instant of launch and g = 9.8 m/s^2.

If the projectile is to hit the target at the 45^o angle shown in the figure, determine v, θ and the time of flight.

HW 5:

The equation of a circle is

$$(x-a)^2+(y-b)^2=R^2$$

where *R* is the radius and (*a*, *b*) are the coordinates of the center. If the coordinates of three points on the circle are

x	y
8.24	0.00
0.32	6.62
5.96	-1.12

Determine *R*, *a* and *b*.

References

[1]. http://www.mathworks.com/products/matlab

[2]. Numerical Methods in Engineering with MATLAB, J. Kiusalaas, Cambridge University Press (2005)

[3]. Numerical Methods for Engineers, 6th Ed. S.C. Chapra, Mc Graw Hill (2010)