PROGRAMMING WITH MATLAB

WEEK 14

SYMBOLIC MATHEMATICS

SYMBOLIC MATHEMATICS

- With symbolic mathematics, mathematics is done on symbols, not on numbers..
- MATLAB has a type called sym for symbolic variables and expressions.
- Symbolic variables are types such as double or char
- Use sym to create a symbolic variable

```
>> x = sym('x')
x =
x
>> x + x
ans =
2*x
```

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```
>> y = sym('3/5')
y =
3/5
>> mymat = sym([1 3 5; 7 11 13])
mymat =
[ 1,  3,  5]
[ 7, 11, 13]
```

or use syms

```
>> syms a b
```

We can set an assumption on a symbolic variable

```
x = sym(‘x', 'real');
y = sym(‘y', 'real');
z = sym(‘z', ‘positive');
```

or

```
syms x y real
syms z positive
```

SYMBOLIC MATHEMATICS

The assumptions that you can assign to a symbolic object with sym or syms are real, rational, integer and positive.

Multiplication, addition, and division statements

>> x = sym('1/3');

>> y = sym('3/5');

>> z = a*b

z =

1/5

expand

Syntax: expand(s), expands the symbolic expression s

>> syms a b

>> expand((a + 1)*(a - 3))

ans =

a^2 - 2*a – 3

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```
>> expand((a + b)^2)
ans =
a^2 + 2*a*b + b^2
```

factor

```
>> factor(ans)
ans =
[ a + b, a + b]
```

inv

```
>> mymat = sym([1 3 5; 7 11 13; 17 19 21])
mymat =
[  1,  3,  5]
[  7, 11, 13]
[ 17, 19, 21]
>> invMat = inv(mymat)
invMat =
[    1/4, -1/2,    1/4]
[ -37/32,    1, -11/32]
[  27/32, -1/2,   5/32]
```

SYMBOLIC MATHEMATICS

Algebra:

solve

```
>> x = sym('x');
>> solve('3*x^2 - 5 = 17')
ans =
 -66^(1/2)/3
  66^(1/2)/3
>> syms a2 a1 a0 x
>> solve(a2*x^2 + a1*x + a0)
ans =
 -(a1 + (a1^2 - 4*a0*a2)^(1/2))/(2*a2)
 -(a1 - (a1^2 - 4*a0*a2)^(1/2))/(2*a2)
```

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Dot and cross product

```
>> clear all
>> syms a1 a2 a3 b1 b2 b3 real
>> x = [a1, a2, a3];
>> y = [b1 b2 b3];
>> xdoty = dot(x,y)
xdoty =
a1*b1 + a2*b2 + a3*b3
>> xcrossy = cross(x,y)
xcrossy =
[ a2*b3 - a3*b2, a3*b1 - a1*b3, a1*b2 - a2*b1]
```

SYMBOLIC MATHEMATICS

```
>> clear all
>> syms a11 a12 a21 a22 b11 b12 b21 b22
>> mata = [a11 a12; a21 a22];
>> matb = [b11 b12; b21 b22];
>> matSum = mata + matb
matSum =
[ a11 + b11, a12 + b12]
[ a21 + b21, a22 + b22]
>> matProd = mata * matb
matProd =
[ a11*b11 + a12*b21, a11*b12 + a12*b22]
[ a21*b11 + a22*b21, a21*b12 + a22*b22]
```

SYMBOLIC MATHEMATICS

Calculus

```
>> syms t a b c
>> f = a*t^2 - b*t + c
f =
a*t^2 - b*t + c
>> dfdt = diff(f,t)
dfdt =
2*a*t - b
```

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Calculus

```
>> g = int(dfdt, t)
g =
-t*(b - a*t)
>> f = g + c
f =
c - t*(b - a*t)
>> f = expand(f)
f =
a*t^2 - b*t + c
```

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Laplace transform

```
>> syms x a w
>> y = cos(x)
y =
cos(x)
>> xs = laplace(y)
xs =
s/(s^2 + 1)
>> invL = ilaplace(xs,x)
invL =
cos(x)
```

SYMBOLIC MATHEMATICS

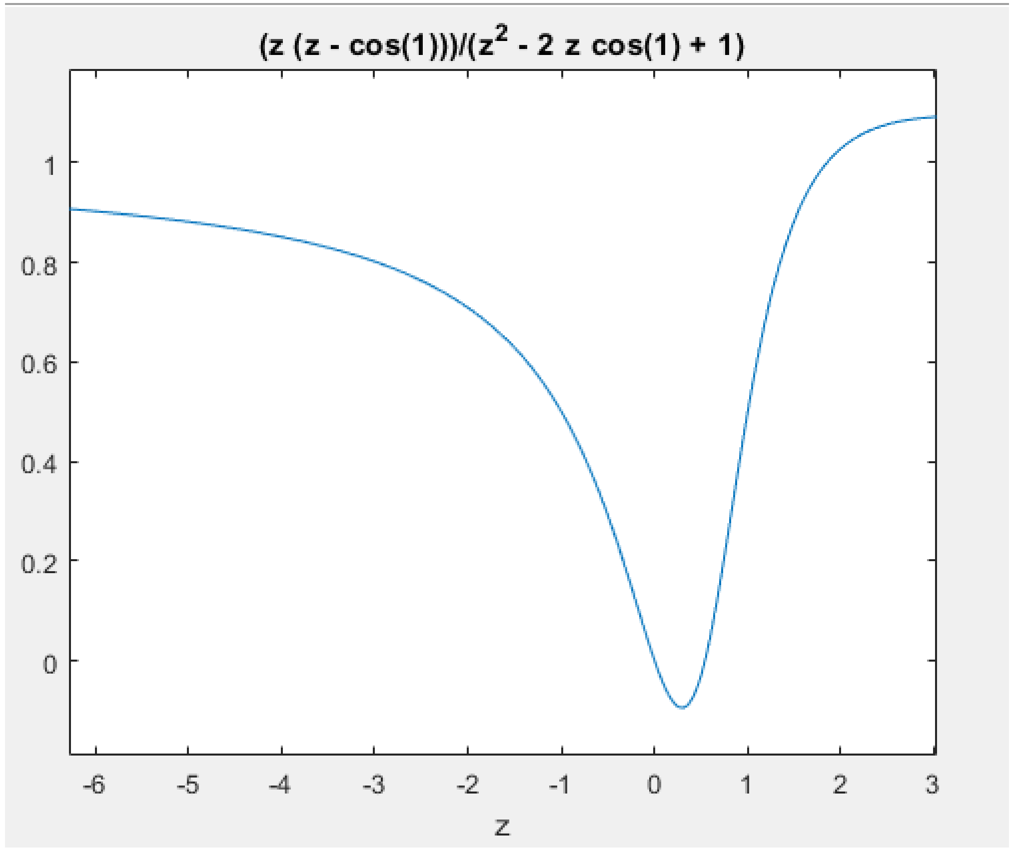
Z transform

>> xz = ztrans(y)

xz =

(z*(z - cos(1)))/(z^2 - 2*cos(1)*z + 1)

ezplot(xz)



SYMBOLIC MATHEMATICS

Differential equations

$$\frac{d^2x}{dt^2} - at = 0$$

```
>> dsolve('D2x=at','t')

ans =

(at*t^2)/2 + C1*t + C2
```