212 Lab #6 Key

My comments are in blue. Remember to run the two m-files before beginning. The plotting features were used in a previous lab. Also note the use of the hold feature to plot multiple curves on the same graph.

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syms x y t u
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1.

```
>> f1=formalseries(x,3)

f1 =

a3*x^3 + a2*x^2 + a1*x + a0

>> df1=diff(f1,x);
>> d2f1=diff(df1,x);
>> ode1=collect((x^2+1)*d2f1+x*df1-2*f1,x)

ode1 =

7*a3*x^3 + 2*a2*x^2 + (6*a3 - a1)*x - 2*a0 + 2*a2

>> soln1=sersol(ode1,x,3,[1,1/2])

soln1 =

x^3/12 + x^2 + x/2 + 1

>> ezplot(soln1,[-1,2])
>> f2=formalseries(x,5)

f2 =

a5*x^5 + a4*x^4 + a3*x^3 + a2*x^2 + a1*x + a0

>> df2=diff(f2,x);
>> d2f2=diff(df2,x);
>> ode2=collect((x^2+1)*d2f2+x*df2-2*f2,x)

ode2 =

23*a5*x^5 + 14*a4*x^4 + (7*a3 + 20*a5)*x^3 + (2*a2 + 12*a4)*x^2 + (6*a3 - a1)*x - 2*a0 + 2*a2

>> soln2=sersol(ode2,x,5,[1,1/2])

soln2 =

- (7*x^5)/240 - x^4/6 + x^3/12 + x^2 + x/2 + 1
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```
>> hold on
>> ezplot(soln2,[-1,2])
>>
>> f3=formalseries(x,8)

f3 =

a8*x^8 + a7*x^7 + a6*x^6 + a5*x^5 + a4*x^4 + a3*x^3 + a2*x^2 + a1*x + a0

>> df3=diff(f3,x);
>> d2f3=diff(df3,x);
>>
>> ode3=collect((x^2+1)*d2f3+x*df3-2*f3,x)

ode3 =

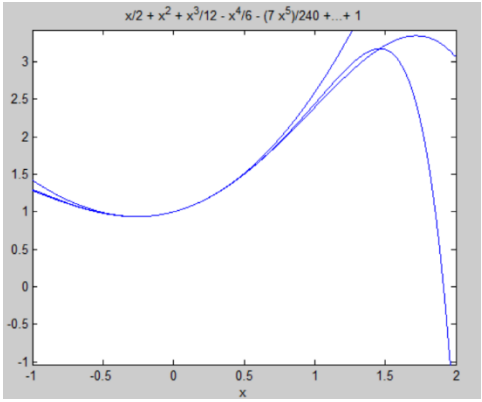
62*a8*x^8 + 47*a7*x^7 + (34*a6 + 56*a8)*x^6 + (23*a5 + 42*a7)*x^5 + (14*a4 + 30*a6)*x^4 + (7*a3 +
20*a5)*x^3 + (2*a2 + 12*a4)*x^2 + (6*a3 - a1)*x - 2*a0 + 2*a2

>> soln3=sersol(ode3,x,8,[1,1/2])

soln3 =

- (17*x^8)/360 + (23*x^7)/1440 + (7*x^6)/90 - (7*x^5)/240 -
x^4/6 + x^3/12 + x^2 + x/2 + 1

>> ezplot(soln3,[-1,2])
>> hold off
>>
```



2.

```
>> g1=formalseries(x,3)

g1 =

a3*x^3 + a2*x^2 + a1*x + a0

>> dg1=diff(g1,x);
>> d2g1=diff(dg1,x);
>> ode4=collect((x-2)*d2g1-3*x^2*dg1+g1,x)

ode4 =

- 9*a3*x^4 + (a3 - 6*a2)*x^3 + (a2 - 3*a1 + 6*a3)*x^2 + (a1 + 2*a2 - 12*a3)*x + a0 - 4*a2

>> soln4=sersol(ode4,x,3,[2,-1])

soln4 =
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```
x^2/2 - x + 2

>> ezplot(soln4,[-1,2])
>> g2=formalseries(x,5)

g2 =

a5*x^5 + a4*x^4 + a3*x^3 + a2*x^2 + a1*x + a0

>> dg2=diff(g2,x);
>> d2g2=diff(dg2,x);
>> ode5=collect((x-2)*d2g2-3*x^2*dg2+g2,x)

ode5 =

- 15*a5*x^6 + (a5 - 12*a4)*x^5 + (a4 - 9*a3 + 20*a5)*x^4 + (a3 - 6*a2 + 12*a4 - 40*a5)*x^3 + (a2 - 3*a1
+ 6*a3 - 24*a4)*x^2 + (a1 + 2*a2 - 12*a3)*x + a0 - 4*a2

>> soln5=sersol(ode5,x,5,[2,-1])

soln5 =

- x^5/32 + (7*x^4)/48 + x^2/2 - x + 2

>> hold on
>> ezplot(soln5,[-1,2])
>> g3=formalseries(x,8)

g3 =

a8*x^8 + a7*x^7 + a6*x^6 + a5*x^5 + a4*x^4 + a3*x^3 + a2*x^2 + a1*x + a0

>> dg3=diff(g3,x);
>> d2g3=diff(dg3,x);
>> ode6=collect((x-2)*d2g3-3*x^2*dg3+g3,x)

ode6 =
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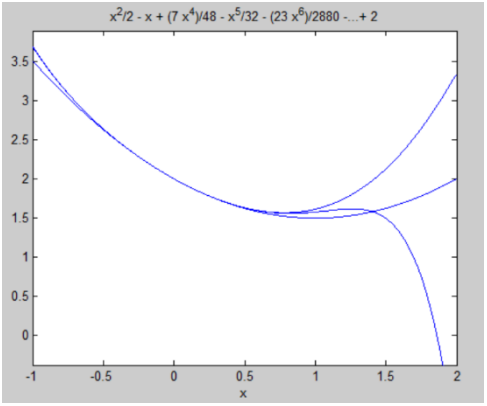
- 24*a8*x^9 + (a8 - 21*a7)*x^8 + (a7 - 18*a6 + 56*a8)*x^7 + (a6 - 15*a5 + 42*a7 - 112*a8)*x^6 + (a5 - 12*a4 + 30*a6 - 84*a7)*x^5 + (a4 - 9*a3 + 20*a5 - 60*a6)*x^4 + (a3 - 6*a2 + 12*a4 - 40*a5)*x^3 + (a2 - 3*a1 + 6*a3 - 24*a4)*x^2 + (a1 + 2*a2 - 12*a3)*x + a0 - 4*a2



>> soln6=sersol(ode6,x,8,[2,-1])

soln6 =

- (176815431798797*x^8)/36028797018963968 - (97*x^7)/4032 - (23*x^6)/2880 - x^5/32 + (7*x^4)/48 + x^2/2 - x + 2

>> ezplot(soln6,[-1,2])
>> hold off
>>

3.

>> h1=formalseries(x,3)

h1 =

a3*x^3 + a2*x^2 + a1*x + a0

>> dh1=diff(h1,x);
>> d2h1=diff(dh1,x);
>> ode7=collect(d2h1-x^2*dh1+5*x*h1,x)

ode7 =

2*a3*x^4 + 3*a2*x^3 + 4*a1*x^2 + (5*a0 + 6*a3)*x + 2*a2

>> soln7=sersol(ode7,x,3,[4,-3])

soln7 =

4 - (10*x^3)/3 - 3*x

>> ezplot(soln7,[-1,2])
>> h2=formalseries(x,5)

h2 =

a5*x^5 + a4*x^4 + a3*x^3 + a2*x^2 + a1*x + a0

>> dh2=diff(h2,x);
>> d2h2=diff(dh2,x);

```
>> ode8=collect(d2h2-x^2*dh2+5*x*h2,x)

ode8 =

a4*x^5 + 2*a3*x^4 + (3*a2 + 20*a5)*x^3 + (4*a1 + 12*a4)*x^2 + (5*a0 + 6*a3)*x + 2*a2

>> soln8=sersol(ode8,x,5,[4,-3])

soln8 =

x^4 - (10*x^3)/3 - 3*x + 4

>> hold on
>>
>> ezplot(soln8,[-1,2])
>> h3=formalseries(x,8)

h3 =

a8*x^8 + a7*x^7 + a6*x^6 + a5*x^5 + a4*x^4 + a3*x^3 + a2*x^2 + a1*x + a0

>>
>> dh3=diff(h3,x);
>> d2h3=diff(dh3,x);
>> ode9=collect(d2h3-x^2*dh3+5*x*h3,x)

ode9 =

- 3*a8*x^9 - 2*a7*x^8 - a6*x^7 + 56*a8*x^6 + (a4 + 42*a7)*x^5 + (2*a3 + 30*a6)*x^4 + (3*a2 +
20*a5)*x^3 + (4*a1 + 12*a4)*x^2 + (5*a0 + 6*a3)*x + 2*a2

>> soln9=sersol(ode9,x,8,[4,-3])

soln9 =

- x^7/42 + (2*x^6)/9 + x^4 - (10*x^3)/3 - 3*x + 4

>> ezplot(soln9,[-1,2])
>> hold off
>>
```