Practical 4

Plotting a family of solutions of the given second order differential equations:

1 Using the pre-defined function: ode2

1.1 y'' + 3y' +2y =0 where y'(0)=b, y(0)=1

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eqn: 'diff(y,x,2) + 3* 'diff(y,x) + 2*y =0;
sol: ode2(eqn,y,x);
sol1: ic2(sol,x=0,y=1,'diff(y,x)=b);
/*ic2 solves IVP for second order differential equations*/

p1: ev(sol1, b=-2);
p2: ev(sol1, b=-1);
p3: ev(sol1, b=0);
p4: ev(sol1, b=1);
p5: ev(sol1, b=2);
wxplot2d([rhs(p1),rhs(p2),rhs(p3),rhs(p4),rhs(p5)],
         [x,-1,4],[style,[lines,0.5],[lines,1],[lines,1.5],
                   [lines,2],[lines,2.5]],
          [legend,"p1","p2","p3","p4","p5"]);
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(%o4) $$\frac{d^2}{dx^2} y + 3 \left(\frac{d}{dx} y \right) + 2\, y = 0$$

(%o5) $$y = \%k1\ \%e^{-x} + \%k2\ \%e^{-2x}$$

(%o6) $$y = (b+2)\ \%e^{-x} + (-b-1)\ \%e^{-2x}$$

(%o7) $$y = \%e^{-2x}$$

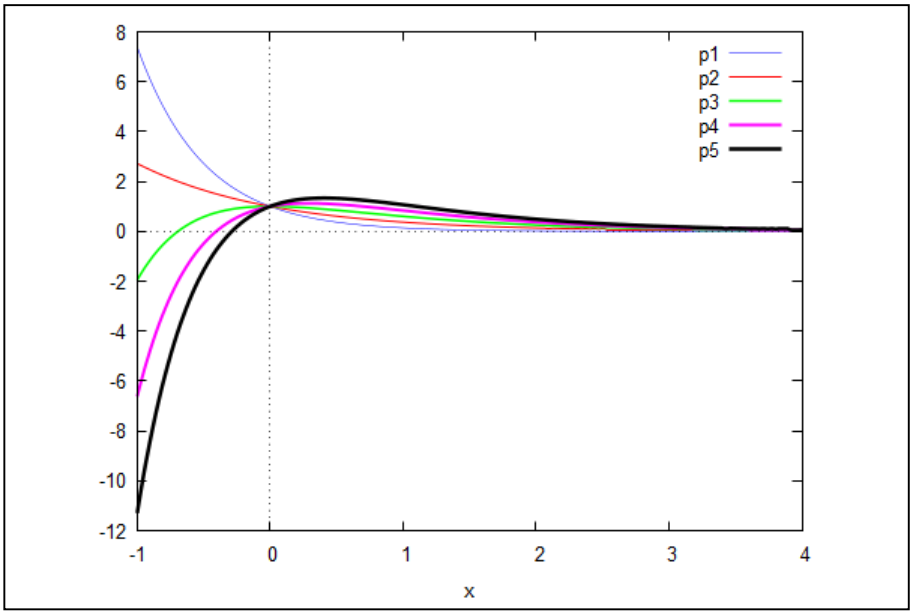
(%o8) $$y = \%e^{-x}$$

(%o9) $$y = 2\ \%e^{-x} - \%e^{-2x}$$

(%o10) $$y = 3\ \%e^{-x} - 2\ \%e^{-2x}$$

(%o11) $$y = 4\ \%e^{-x} - 3\ \%e^{-2x}$$

(%t12)



(%o12)

1.2 y'' + y' -6y =0

(%i6)
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kill(all)$
eqn: 'diff(y,x,2) + 'diff(y,x) - 6*y =0;
sol: ode2(eqn,y,x);

p1: ev(sol,%k1 =1, %k2=0);
p2: ev(sol, %k1 =0, %k2=1);
p3: ev(sol, %k1 =1, %k2=1);
wxplot2d([rhs(p1),rhs(p2),rhs(p3)],
         [x,-3,5],[y,-1,10],
          [legend,"p1","p2","p3"])$
```

(%o1) $$\frac{d^2}{dx^2}y+\frac{d}{dx}y-6y=0$$

(%o2) $$y=\%k1\ \%e^{2x}+\%k2\ \%e^{-3x}$$

(%o3) $$y=\%e^{2x}$$

(%o4) $$y=\%e^{-3x}$$

(%o5) $$y=\%e^{2x}+\%e^{-3x}$$

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plot2d: some values were clipped.
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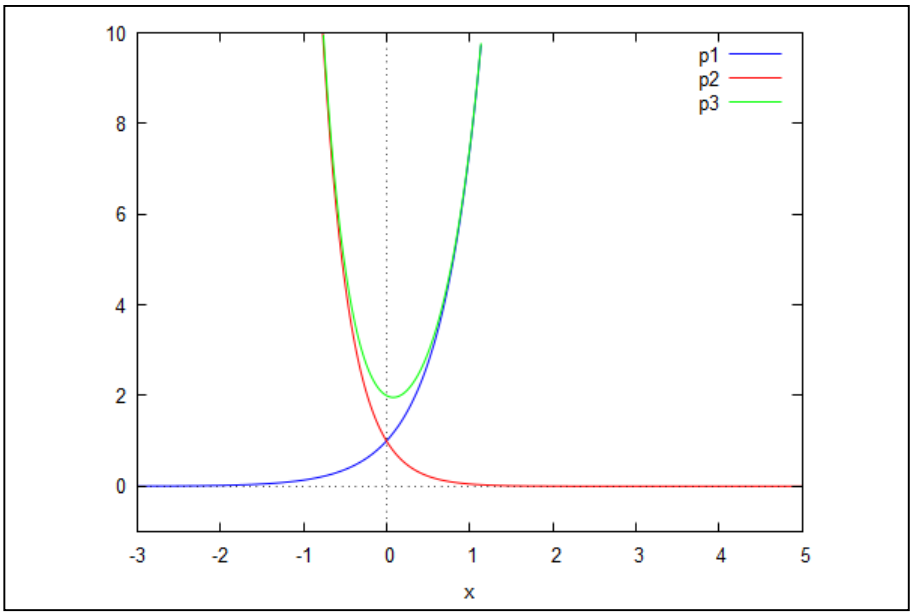
(%t6)



2 Using the pre-defined function: desolve

2.1 y'' + 3y' +2y =0 where y'(0)=b, y(0)=b

(%i7)
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kill(all)$
eqn: diff(y(x),x,2) + 3* diff(y(x),x) + 2*y(x) =0;
sol: desolve(eqn,y(x));

sol1: ev(sol, y(0)=b, diff(y(x),x)=b);
p1: ev(sol1, b=-2);
p2: ev(sol1, b=0);
p3: ev(sol1, b=2);
wxplot2d([rhs(p1),rhs(p2),rhs(p3)],
         [x,-1,4],
          [legend,"p1","p2","p3"]);
```

(%o1) $$\frac{d^2}{dx^2}y(x)+3\left(\frac{d}{dx}y(x)\right)+2\,y(x)=0$$

(%o2) $$y(x)=\%e^{-x}\left(\frac{d}{dx}y(x)\Big|_{x=0}+2\,y(0)\right)+\%e^{-2x}\left(-\frac{d}{dx}y(x)\Big|_{x=0}-y(0)\right)$$

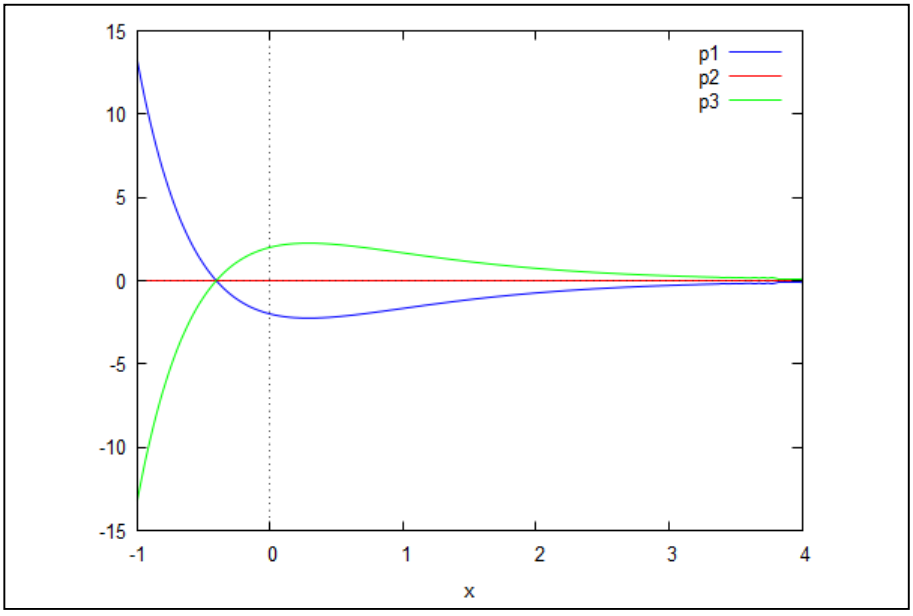
(%o3) $$y(x)=3\,b\,\%e^{-x}-2\,b\,\%e^{-2x}$$

(%o4) $$y(x)=4\,\%e^{-2x}-6\,\%e^{-x}$$

(%o5) $$y(x)=0$$

(%o6) $$y(x)=6\,\%e^{-x}-4\,\%e^{-2x}$$

(%t7)



(%o7)

2.2 Exercise: y'' + 3y' + 2y =0 where y(0)=a, y'(0)=1 (using both ode2 and desolve)