Second Homework  
Due 8:00 a.m., Monday, September 8

1. Consider the differential equation \((2t - 1)y' + y\tan t = 1/t\). For each of the two initial conditions \(y(1) = 2, y(-1) = 2\), determine the largest interval \((a,b)\) for which the corresponding initial value problem has a unique solution guaranteed by Theorem 2.1 in the book. (2 points)

2. Find the solution of the initial value problem
\[ ty' + (1 + t)y = e^{-t}, \quad y(1) = 2/e \]
by hand. Check your answer by computer; hand in a copy of your program and output. (3 points)

(2 problems, 5 points altogether)

In Matlab if you want to find the general solution to \(ty' + y = e^t\), enter the command
\[
\text{dsolve('t * Dy + y = exp(t)')} \\
\text{simplify(ans) \%simplifies the answer, probably not necessary}
\]
Matlab assumes derivatives are with respect to \(t\). Your output would be
\[
\text{ans} = 1/t*exp(t)+1/t*C1 \\
\text{ans} = (exp(t)+C1)/t
\]

Note that, for example, \(e\) in Matlab is exp(1). To solve the initial value problem \(dz/dx = xz^2, \quad z(1) = 2\), (so here the derivative is with respect to \(x\)), enter the command
\[
\text{dsolve('Dz = x * zˆ2', 'z(1) = 2', 'x')} \\
\text{sol = simple(ans) \%simplifies; sol = removes unwanted output}
\]
Your output would be
\[
\text{ans} = -2/(x^2-2) \\
\text{sol} = -2/(x^2-2)
\]
In Mathematica the corresponding commands are

\[
\text{DSolve}[t \ y'[t] + y[t] == E^t, y[t], t]
\]
\[
\text{DSolve}[\{z'[x] == x \ z[x]^2, z[1] == 2\}, z[x], x]
\]

Your output would be

\[
\text{Out}[1] = \{y[t] -> \frac{-2 + t C[1]}{t}\}
\]

\[
\text{Out}[2] = \{z[x] -> \frac{-2 + x}{2}\}
\]