dudt function practice: Coupled 1st order ODE's

Two coupled first order ODE's: $\frac{dx}{dt} = 2x + 2y$ and $\frac{dy}{dt} = 2x - y$ can be written in matrix form:

$$\frac{d}{dt}\begin{pmatrix} u_1 \\ u_2 \end{pmatrix} = \begin{pmatrix} f_1(t, u_1, u_2) \\ f_2(t, u_1, u_2,) \end{pmatrix}$$

Where $u_1 = x, u_2 = y, f_1(t, u_1, u_2) = 2x + 2y$, and $f_2(t, u_1, u_2) = 2x - y$.

The code for a function defining the two 1st order ODE in matrix form looks like:

```
%Note: Have to do t then u for MATLAB built-in functions like ode45
function dudt = f(t,u)

      dudt = zeros(2,1);
      dudt(1) = 2*u(1)+2*u(2);
      dudt(2) = 2*u(1)-u(2);

end
```

The general form is $\frac{d\boldsymbol{u}}{dt} = \boldsymbol{F}(t, \boldsymbol{u})$ where **u** and $\frac{d\boldsymbol{u}}{dt}$ are arrays.

Write a dudt function similar to the one above that could be used with MATLAB's build in solvers to solve the following two coupled ODE's:

$$\frac{dx}{dt} = x - yt, \qquad \frac{dy}{dt} = t + y$$

You can hand write the function and upload an image or type it into the text box.

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Task 3: Write pseudo code to define the `dudt` function for the following two coupled first order differential equations

$$\frac{dx}{dt} = 2x + 2y \qquad \frac{dy}{dt} = 2x - y$$

Task 4: Write code to solve the ODE's in the previous Task from t=0 to t=1.2 with x(0)=1, and y(0)= 2. Using a time step of h=0.4. Compare the results with the exact solution:

$$x = \frac{e^{-2t}(8e^{5t}-3)}{5}, y = \frac{2e^{-2t}(2e^{5t}+3)}{5}$$