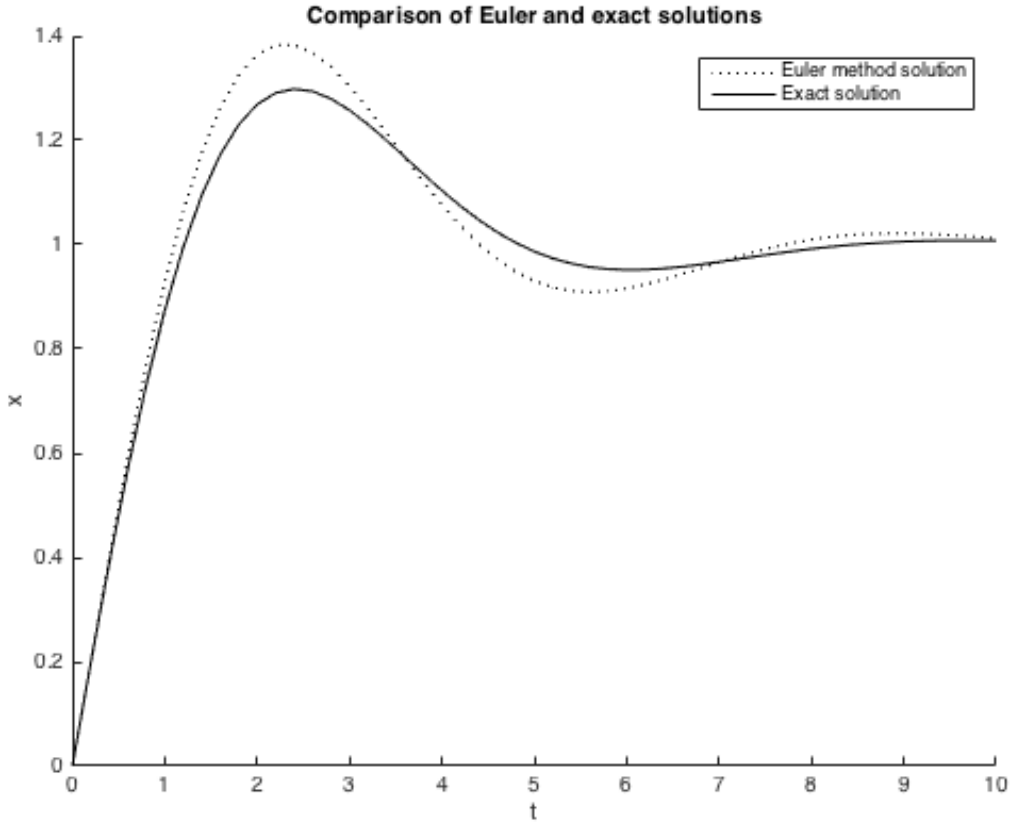
```
%Q1c%
syms x(t) y(t) a b
S = dsolve(diff(x,t) == a + y - (b + 1)*x, diff(y,t) == b*x - y, x(0) == 0, y(0) == 0);
%Finding symbolic solution to the system of equations%


%Q1d%
disp(simplify(S.x))
disp(simplify(S.y))
%Simplifying the expressions found in Q1c%


%Q1e%
solx = simplify(S.x); soly = simplify(S.y);
Mp = 0.5*(- b - 2 + sqrt(b*(b+4))); Mn = 0.5*(- b - 2 - sqrt(b*(b+4)));
Bp = (a*(1+ Mn))/(Mp - Mn); Bn = (a*(1+ Mp))/(Mn - Mp);
ExactX = Bp*exp(Mp*t) + Bn*exp(Mn*t) + a;
disp(simplify(solx-ExactX))
%Displaying the accuracy of the Euler method against the exact solution by
%subtracting solution S from the exact solution found in Q1a which does
%indeed simplify to zero%


%Q1f%
[Ex, Ey, Et] = Eulersol(1, -1, 50, 0.2);
%Since dt=0.2, tmax=10 and tmax=N*dt, this implies that N=50%


%Q1g%
figure(1); clf(1)
hold on
plot(Et, Ex, 'k:')
title('Comparison of Euler and exact solutions'), xlabel('t'), ylabel('x')
%Plot of the Euler approximation method%

ExactX2 = zeros (1, 50 + 1);
for i = 1:50 + 1
    ExactX2(i) = subs(solx, [t, a, b], [Et(i), 1, -1]);
end
plot (Et, ExactX2, 'k')
%Exact solution plot%
legend ('Euler method solution', 'Exact solution')
hold off
%For the given input values and initial conditions, the Euler approximation
%method provides a good approximation of x if compared against the exact
%value with a maximum of approximately 0.1 off from the exact value of x.
%This can only be seen for a specific range of t that is used in the plot
%due to the given input values in Q1f. Despite the fact the plot of the
%approximations' extremas are more defined than the exact solution, the
%plot of Euler's method holds a very similar shape to that of the exact
%solution, showing a degree of accuracy to the method of approximation. In
%addition, as t tends to tmax, which in this case is 10, the Euler
%approximations tends closer to the exact values, supporting the prediction
%that for large values of t, the Euler method of approximation will tend
%closer to the exact value of the solution. Furthermore, as dt tends closer
```

```
%to zero, Euler's method of approximation tends towards the exact solution
%for x so dt should be made as small as possible for a more accurate
%solution.%
```

```
-(2*a*b*exp(-(t*(b - (b*(b + 4))^(1/2) + 2))/2)*(b + 4) - 4*a*b*(b + 4) + 2*a*b*exp(-(t*(b
- (b*(b + 4))^(1/2) + 2))/2)*(b*(b + 4))^(1/2) + 2*a*b*exp(-(t*(b + (b*(b + 4))^(1/2) + 2))
/2)*(b + 4) - 2*a*b*exp(-(t*(b + (b*(b + 4))^(1/2) + 2))/2)*(b*(b + 4))^(1/2))/(4*b*(b + 4)
)

- (2*a*b*exp(-(t*(b - (b*(b + 4))^(1/2) + 2))/2)*(exp((t*(b - (b*(b + 4))^(1/2) + 2))/2) -
1))/(4*b - b*(b*(b + 4))^(1/2) + b^2 - 2*(b*(b + 4))^(1/2)) - (2*a*b*exp(-(t*(b + (b*(b + 4
))^(1/2) + 2))/2)*(exp((t*(b + (b*(b + 4))^(1/2) + 2))/2) - 1))/(4*b + b*(b*(b + 4))^(1/2)
+ b^2 + 2*(b*(b + 4))^(1/2))

0

  Columns 1 through 7

         0    0.2000    0.4000    0.5920    0.7696    0.9280    1.0639

  Columns 8 through 14

    1.1756    1.2623    1.3247    1.3641    1.3826    1.3829    1.3678

  Columns 15 through 21

    1.3404    1.3038    1.2609    1.2144    1.1668    1.1201    1.0761

  Columns 22 through 28

    1.0361    1.0010    0.9715    0.9479    0.9301    0.9180    0.9111

  Columns 29 through 35

    0.9089    0.9106    0.9157    0.9233    0.9328    0.9434    0.9546

  Columns 36 through 42

    0.9658    0.9766    0.9866    0.9956    1.0033    1.0096    1.0145

  Columns 43 through 49

    1.0181    1.0203    1.0214    1.0215    1.0207    1.0192    1.0171

  Columns 50 through 51

    1.0148    1.0121

  Columns 1 through 7

         0         0   -0.0400   -0.1120   -0.2080   -0.3203   -0.4419

  Columns 8 through 14

   -0.5663   -0.6881   -0.8030   -0.9073   -0.9987   -1.0755   -1.1369
```

```
Columns 15 through 21

 -1.1831   -1.2146   -1.2324   -1.2381   -1.2334   -1.2200   -1.2001

Columns 22 through 28

 -1.1753   -1.1474   -1.1181   -1.0888   -1.0606   -1.0345   -1.0112

Columns 29 through 35

 -0.9912   -0.9747   -0.9619   -0.9527   -0.9468   -0.9440   -0.9439

Columns 36 through 42

 -0.9460   -0.9500   -0.9553   -0.9616   -0.9684   -0.9753   -0.9822

Columns 43 through 49

 -0.9887   -0.9945   -0.9997   -1.0040   -1.0075   -1.0102   -1.0120

Columns 50 through 51

 -1.0130   -1.0134

Columns 1 through 7

       0    0.2000    0.4000    0.6000    0.8000    1.0000    1.2000

Columns 8 through 14

  1.4000    1.6000    1.8000    2.0000    2.2000    2.4000    2.6000

Columns 15 through 21

  2.8000    3.0000    3.2000    3.4000    3.6000    3.8000    4.0000

Columns 22 through 28

  4.2000    4.4000    4.6000    4.8000    5.0000    5.2000    5.4000

Columns 29 through 35

  5.6000    5.8000    6.0000    6.2000    6.4000    6.6000    6.8000

Columns 36 through 42

  7.0000    7.2000    7.4000    7.6000    7.8000    8.0000    8.2000

Columns 43 through 49

  8.4000    8.6000    8.8000    9.0000    9.2000    9.4000    9.6000

Columns 50 through 51

  9.8000   10.0000
```



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