Aplikační příklad 1.1

```
% y''= -a/x y' +phi^2 y^n, y'(0)=0, y(1)=1

a = 0; b = 1; % interval kde resim rovnici

% okrajove podminky
alpha1 = 0;
alpha2 = 1;
beta1 = 1;
beta2 = 0;
gamma1 = 0;
gamma2 = 1;

n = 20; % pocet dilku site
h = (b-a)/n;

% pocatecni nastrel pro Newtonovu metodu
y_init = [ ];
for i = 1:n+1;
    y_init(i) = 1.0;
end
% parametry pro Newtonovy metodu
N_eps = 1e-6;
N_maxiter = 50;

fprintf('----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 0, a = 1, phi = 1\n');

f = inline('-1.0/x * dy + 1.0','x','y','dy');
df2 = inline('0','x','y','dy');
df3 = inline('-1.0/x','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);

% efektivni faktor:
eta = (1.0 + 1.0)/1.0 * (y(n)-y(n-1))/h;
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
    figure
    plot (x,y,'DisplayName','n = 0, a = 1, phi = 1')
    title('Izotermni vnitrni difuze v poreznim katalyzatoru')
    xlabel('x')
    ylabel('y(x)')
    legend('show','Location','northwest');
end

fprintf('\n----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 1, a = 2, phi = 1\n');

f = inline('-2.0/x * dy + y','x','y','dy');
df2 = inline('1.0','x','y','dy');
df3 = inline('-2.0/x','x','y','dy');
```

```
[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);

% efektivni faktor:
eta = (2.0 + 1.0)/1.0 * (y(n)-y(n-1))/h;
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
    figure
    plot (x,y,'DisplayName','n = 1, a = 2, phi = 1')
    hold on;
end

fprintf('\n----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 1, a = 2, phi = 2\n');

f = inline('-2.0/x * dy + 4.0 * y','x','y','dy');
df2 = inline('4.0','x','y','dy');
df3 = inline('-2.0/x','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);

% efektivni faktor:
eta = (2.0 + 1.0)/4.0 * (y(n)-y(n-1))/h;
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
    plot (x,y,'DisplayName','n = 1, a = 2, phi = 2')
    hold on;
end

fprintf('\n----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 1, a = 2, phi = 4\n');

f = inline('-2.0/x * dy + 16.0 * y','x','y','dy');
df2 = inline('16.0','x','y','dy');
df3 = inline('-2.0/x','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);

% efektivni faktor:
eta = (2.0 + 1.0)/16.0 * (y(n)-y(n-1))/h;
fprintf('Efektivni faktor: %f\n', eta);

if (~isempty(y))
    plot (x,y,'DisplayName','n = 1, a = 2, phi = 4')
    title('Izotermni vnitrni difuze v poreznim katalyzatoru')
    xlabel('x')
    ylabel('y(x)')
    legend('show','Location','northwest');
end

fprintf('\n----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 1, a = 0, phi = 1\n');
```

```
f = inline('y','x','y','dy');
df2 = inline('1.0','x','y','dy');
df3 = inline('0.0','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);

% efektivni faktor:
eta = (1.0)/1.0 * (y(n)-y(n-1))/h;
fprintf('Efektivni faktor: %f\n', eta);

if (~isempty(y))
    figure
    plot (x,y,'DisplayName','n = 1, a = 0, phi = 1')
    hold on;
end

fprintf('\n----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 1, a = 0, phi = 2\n');

f = inline('4.0 * y','x','y','dy');
df2 = inline('4.0','x','y','dy');
df3 = inline('0.0','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);

% efektivni faktor:
eta = (1.0)/4.0 * (y(n)-y(n-1))/h;
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
    plot (x,y,'DisplayName','n = 1, a = 0, phi = 2')
    hold on;
end

fprintf('\n----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 1, a = 0, phi = 4\n');

f = inline('16.0 * y','x','y','dy');
df2 = inline('16.0','x','y','dy');
df3 = inline('0.0','x','y','dy');

[x, y] = ODEsiteNewton(n, f, df2, df3, a, b, alpha1,alpha2, beta1,beta2, gamma1,gamma2, y_init,
N_eps, N_maxiter);

% efektivni faktor:
eta = (1.0)/16.0 * (y(n)-y(n-1))/h;
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
    plot (x,y,'DisplayName','n = 1, a = 0, phi = 4')
    title('Izotermni vnitrni difuze v poreznim katalyzatoru')
    xlabel('x')
    ylabel('y(x)')
    legend('show','Location','northwest');
end
```

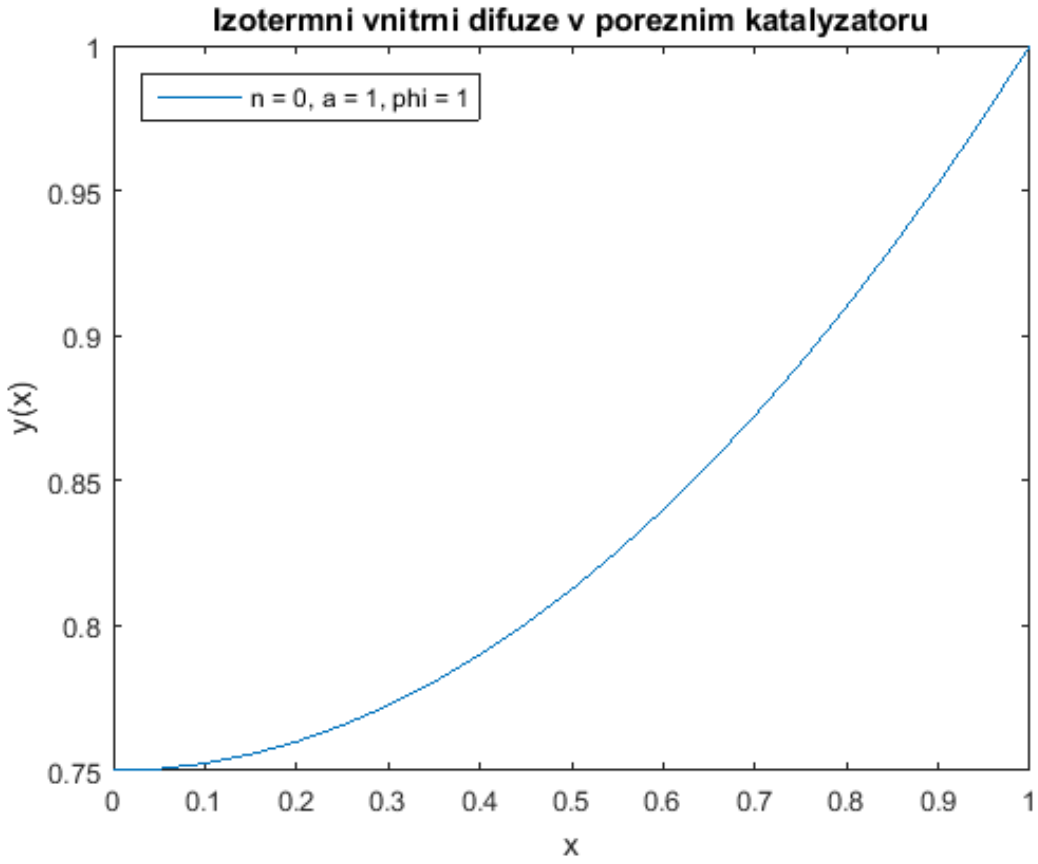
```
------------------------------------------------------------
Volba parametru: n = 0, a = 1, phi = 1
Iterace Newtonovy metody:
k = 1, error =   5.75206558e-01
k = 2, error =   1.65037822e-01
k = 3, error =   7.62961165e-02
k = 4, error =   3.52712932e-02
k = 5, error =   1.63057332e-02
k = 6, error =   7.53805467e-03
k = 7, error =   3.48480301e-03
k = 8, error =   1.61100609e-03
k = 9, error =   7.44759640e-04
k = 10, error =   3.44298463e-04
k = 11, error =   1.59167368e-04
k = 12, error =   7.35822365e-05
k = 13, error =   3.40166807e-05
k = 14, error =   1.57257325e-05
k = 15, error =   7.26992339e-06
k = 16, error =   3.36084733e-06
k = 17, error =   1.55370203e-06
k = 18, error =   7.18268275e-07
Reseni:
   x      y(x)
0.000,   0.750000
0.050,   0.750625
0.100,   0.752500
0.150,   0.755625
0.200,   0.760000
0.250,   0.765625
0.300,   0.772500
0.350,   0.780625
0.400,   0.790000
0.450,   0.800625
0.500,   0.812500
0.550,   0.825625
0.600,   0.840000
0.650,   0.855625
0.700,   0.872500
0.750,   0.890625
0.800,   0.910000
0.850,   0.930625
0.900,   0.952500
0.950,   0.975625
1.000,   1.000000
Efektivni faktor: 0.925000

------------------------------------------------------------
Volba parametru: n = 1, a = 2, phi = 1
Iterace Newtonovy metody:
k = 1, error =   4.33055978e-01
k = 2, error =   9.22342777e-02
k = 3, error =   2.07992000e-02
k = 4, error =   4.69030313e-03
```

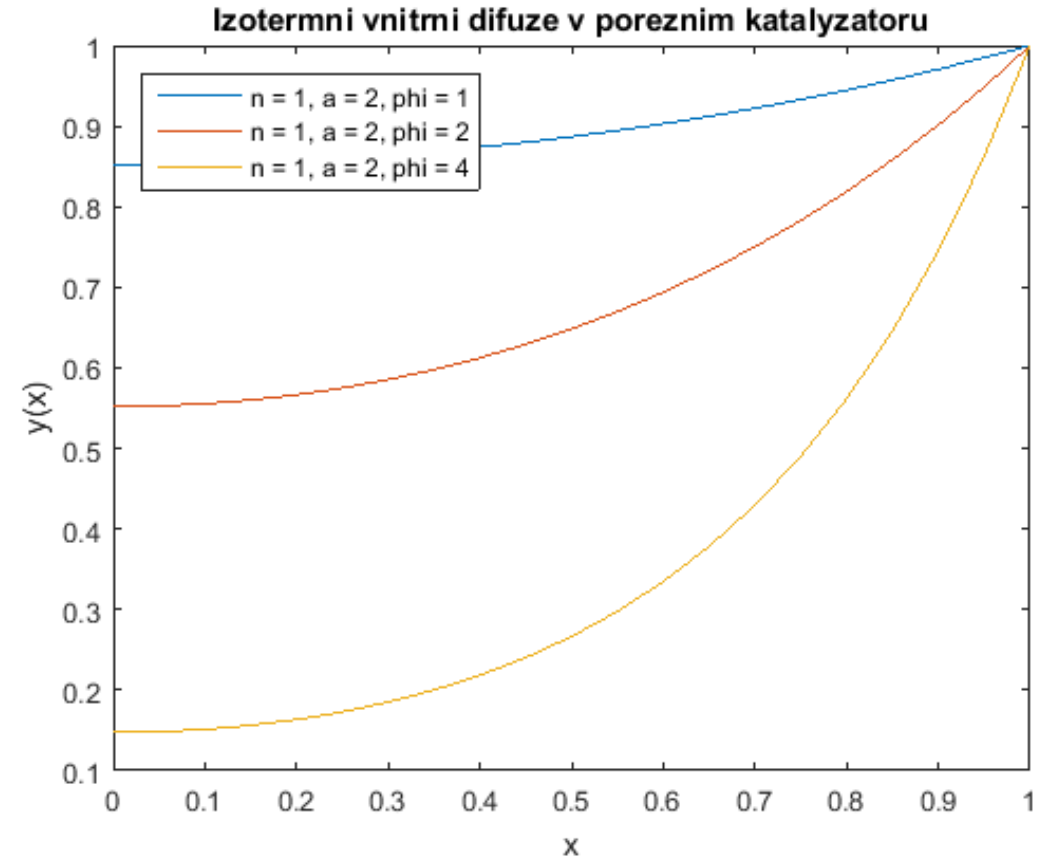
```
k = 5, error =   1.05768219e-03
k = 6, error =   2.38511581e-04
k = 7, error =   5.37853194e-05
k = 8, error =   1.21288055e-05
k = 9, error =   2.73509435e-06
k = 10, error =   6.16774760e-07
Reseni:
   x      y(x)
0.000,   0.850946
0.050,   0.851301
0.100,   0.852365
0.150,   0.854140
0.200,   0.856629
0.250,   0.859836
0.300,   0.863765
0.350,   0.868422
0.400,   0.873815
0.450,   0.879951
0.500,   0.886840
0.550,   0.894492
0.600,   0.902919
0.650,   0.912132
0.700,   0.922147
0.750,   0.932978
0.800,   0.944643
0.850,   0.957157
0.900,   0.970541
0.950,   0.984815
1.000,   1.000000
Efektivni faktor: 0.856425

------------------------------------------------------------
Volba parametru: n = 1, a = 2, phi = 2
Iterace Newtonovy metody:
k = 1, error =   1.34825861e+00
k = 2, error =   2.74417163e-01
k = 3, error =   5.84130284e-02
k = 4, error =   1.24339231e-02
k = 5, error =   2.64671164e-03
k = 6, error =   5.63384742e-04
k = 7, error =   1.19923290e-04
k = 8, error =   2.55271297e-05
k = 9, error =   5.43375982e-06
k = 10, error =   1.15664182e-06
k = 11, error =   2.46205269e-07
Reseni:
   x      y(x)
0.000,   0.551686
0.050,   0.552607
0.100,   0.555370
0.150,   0.559993
0.200,   0.566505
0.250,   0.574944
0.300,   0.585361
0.350,   0.597820
```

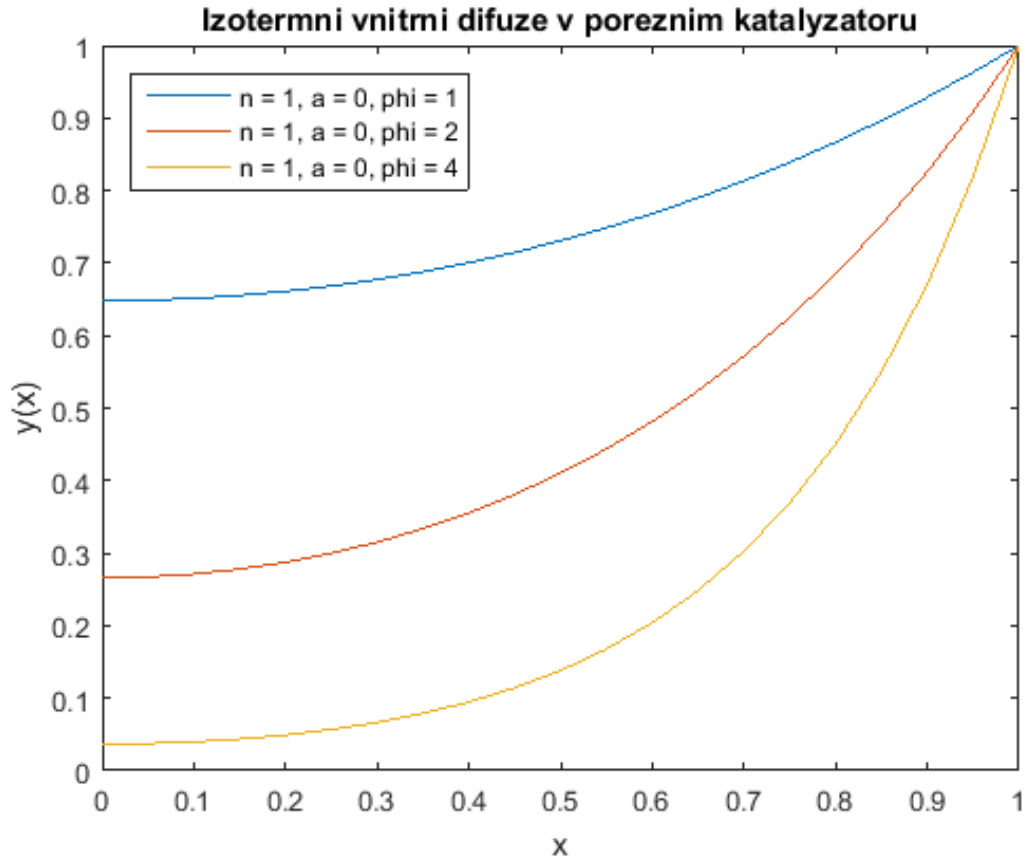
```
0.400,   0.612394
0.450,   0.629174
0.500,   0.648260
0.550,   0.669769
0.600,   0.693833
0.650,   0.720599
0.700,   0.750233
0.750,   0.782918
0.800,   0.818857
0.850,   0.858274
0.900,   0.901418
0.950,   0.948561
1.000,   1.000000
Efektivni faktor: 0.707134

---------------------------------------------------------------
Volba parametru: n = 1, a = 2, phi = 4
Iterace Newtonovy metody:
k = 1, error =   2.81101896e+00
k = 2, error =   5.07139864e-01
k = 3, error =   9.26390299e-02
k = 4, error =   1.69223334e-02
k = 5, error =   3.09119567e-03
k = 6, error =   5.64667438e-04
k = 7, error =   1.03147568e-04
k = 8, error =   1.88419237e-05
k = 9, error =   3.44184644e-06
k = 10, error =   6.28720670e-07
Reseni:
   x      y(x)
0.000,   0.147298
0.050,   0.148287
0.100,   0.151253
0.150,   0.156275
0.200,   0.163474
0.250,   0.173025
0.300,   0.185159
0.350,   0.200175
0.400,   0.218443
0.450,   0.240418
0.500,   0.266654
0.550,   0.297816
0.600,   0.334704
0.650,   0.378275
0.700,   0.429672
0.750,   0.490257
0.800,   0.561654
0.850,   0.645795
0.900,   0.744985
0.950,   0.861964
1.000,   1.000000
Efektivni faktor: 0.438672

---------------------------------------------------------------
Volba parametru: n = 1, a = 0, phi = 1
```

```
Iterace Newtonovy metody:
k = 1, error =   1.18891650e+00
k = 2, error =   4.29987528e-16
Reseni:
   x      y(x)
0.000,   0.648090
0.050,   0.648901
0.100,   0.651335
0.150,   0.655396
0.200,   0.661097
0.250,   0.668450
0.300,   0.677474
0.350,   0.688191
0.400,   0.700630
0.450,   0.714819
0.500,   0.730796
0.550,   0.748600
0.600,   0.768276
0.650,   0.789872
0.700,   0.813442
0.750,   0.839047
0.800,   0.866749
0.850,   0.896617
0.900,   0.928728
0.950,   0.963160
1.000,   1.000000
Efektivni faktor: 0.688644

---------------------------------------------------------------
Volba parametru: n = 1, a = 0, phi = 2
Iterace Newtonovy metody:
k = 1, error =   2.55188872e+00
k = 2, error =   3.11456641e-15
Reseni:
   x      y(x)
0.000,   0.265951
0.050,   0.267288
0.100,   0.271297
0.150,   0.278019
0.200,   0.287522
0.250,   0.299899
0.300,   0.315276
0.350,   0.333806
0.400,   0.355673
0.450,   0.381097
0.500,   0.410333
0.550,   0.443671
0.600,   0.481446
0.650,   0.524036
0.700,   0.571866
0.750,   0.625415
0.800,   0.685218
0.850,   0.751873
0.900,   0.826047
0.950,   0.908481
```

```
1.000,   1.000000
Efektivni faktor: 0.412171

---------------------------------------------------------------
Volba parametru: n = 1, a = 0, phi = 4
Iterace Newtonovy metody:
k = 1, error =   3.60148865e+00
k = 2, error =   8.92046022e-16
Reseni:
   x      y(x)
0.000,   0.036788
0.050,   0.037539
0.100,   0.039791
0.150,   0.043635
0.200,   0.049224
0.250,   0.056783
0.300,   0.066612
0.350,   0.079107
0.400,   0.094765
0.450,   0.114214
0.500,   0.138232
0.550,   0.167779
0.600,   0.204037
0.650,   0.248456
0.700,   0.302814
0.750,   0.369284
0.800,   0.450526
0.850,   0.549788
0.900,   0.671043
0.950,   0.819139
1.000,   1.000000
Efektivni faktor: 0.185120
```


Izotermni vnitrni difuze v poreznim katalyzatoru
n = 0, a = 1, phi = 1
y(x)
x
1
0.95
0.9
0.85
0.8
0.75
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Izotermni vnitrni difuze v poreznim katalyzatoru
n = 1, a = 2, phi = 1
n = 1, a = 2, phi = 2
n = 1, a = 2, phi = 4
y(x)
x
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1


Izotermni vnitrni difuze v poreznim katalyzatoru
n = 1, a = 0, phi = 1
n = 1, a = 0, phi = 2
n = 1, a = 0, phi = 4
y(x)
x
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1