Aplikační příklad 1.1

Pravá strana soust. diferencialních rovnic a variačních rovnic

```
function dy = ap1_var1(x,y)

dy = zeros(size(y));
a = 1; n = 0; phi = 1;
dy(1) = y(2);
if (abs(x)<1e-8)
  dy(2)=1/(1+a)*phi^2*y(1)^n;
else
  dy(2) = -a/x*y(2) + phi^2*y(1)^n;
end
dy(3) = y(4);
if (abs(x)<1e-8)
  dy(4) = 1/(1+a)*phi^2*n*y(1)^(n-1)*y(3);
else
  dy(4) = phi^2*n*y(1)^(n-1)*y(3) - a/x*y(4);
end
end
```

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Vlastní výpočet metodou střelby

```
% 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;

% parametry pro Newtonovu metodu
eps = 1e-6;
maxiter = 100;

Lx = linspace(a,b,20);

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

% nastrel pocatecni podminky
eta_0 = 1;
[y, eta] = MetodaStrelby(@ap1_var1,a,b,alpha1,alpha2,beta1,beta2,gamma1,gamma2,eta_0,eps,maxiter,
Lx);

eta = (1 + 1)/1^2 * y(end,2);
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
    figure
    plot (Lx, y(:,1),'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');
fprintf('Volba parametru: n = 1, a = 2, phi = 1\n');
eta_0 = 1.0;

[y, eta] = MetodaStrelby(@ap1_var2,a,b,alpha1,alpha2,beta1,beta2,gamma1,gamma2,eta_0,eps,maxiter,
Lx);

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

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

```
eta_0 = 1.0;
[y, eta] = MetodaStrelby(@ap1_var3,a,b,alpha1,alpha2,beta1,beta2,gamma1,gamma2,eta_0,eps,maxiter,
Lx);

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

fprintf('\n----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 1, a = 2, phi = 4\n');
eta_0 = 1.0;

[y, eta] = MetodaStrelby(@ap1_var4,a,b,alpha1,alpha2,beta1,beta2,gamma1,gamma2,eta_0,eps,maxiter,
Lx);

eta = (2 + 1)/16.0 * y(end,2);
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
    plot (Lx, y(:,1),'DisplayName','n = 1, a = 2, 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 = 0, phi = 1\n');
eta_0 = 1.0;

[y, eta] = MetodaStrelby(@ap1_var5,a,b,alpha1,alpha2,beta1,beta2,gamma1,gamma2,eta_0,eps,maxiter,
Lx);

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

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

eta_0 = 1.0;
[y, eta] = MetodaStrelby(@ap1_var6,a,b,alpha1,alpha2,beta1,beta2,gamma1,gamma2,eta_0,eps,maxiter,
Lx);

% efektivni faktor:
eta = (0 + 1.0)/4.0 * y(end,2);
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
```

```
    plot (Lx,y(:,1),'DisplayName','n = 1, a = 0, phi = 2')
    hold on;
end

fprintf('\n-----------------------------------------------------------------\n');
fprintf('Volba parametru: n = 1, a = 0, phi = 4\n');
eta_0 = 1.0;

[y, eta] = MetodaStrelby(@ap1_var7,a,b,alpha1,alpha2,beta1,beta2,gamma1,gamma2,eta_0,eps,maxiter,
Lx);

eta = (0 + 1)/16.0 * y(end,2);
fprintf('Efektivni faktor: %f\n', eta);
if (~isempty(y))
    plot (Lx, y(:,1),'DisplayName','n = 1, a = 0, phi = 1')
    title('Izotermni vnitrni difuze v poreznim katalyzatoru')
    xlabel('x')
    ylabel('y(x)')
    legend('show','Location','northwest');
end
```

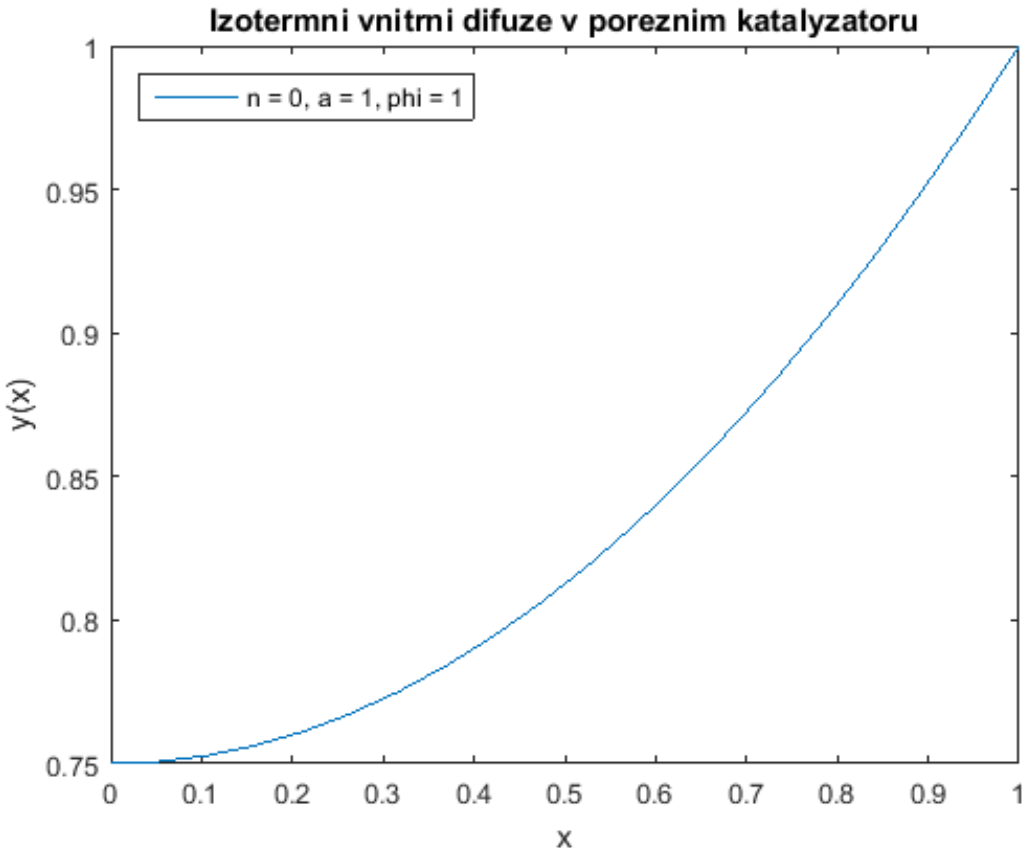
```
-----------------------------------------------------------------
Volba parametru: n = 0, a = 1, phi = 1
k = 0, eta =   1.00000000e+00
k = 1, eta =   7.50000000e-01, delta =   2.50000000e-01
k = 2, eta =   7.50000000e-01, delta =   6.66133815e-16
Reseni:
   x      y(x)
0.000,   0.750000
0.053,   0.750693
0.105,   0.752770
0.158,   0.756233
0.211,   0.761080
0.263,   0.767313
0.316,   0.774931
0.368,   0.783934
0.421,   0.794321
0.474,   0.806094
0.526,   0.819252
0.579,   0.833795
0.632,   0.849723
0.684,   0.867036
0.737,   0.885734
0.789,   0.905817
0.842,   0.927285
0.895,   0.950139
0.947,   0.974377
1.000,   1.000000
Efektivni faktor: 1.000000
-----------------------------------------------------------------
Volba parametru: n = 1, a = 2, phi = 1
k = 0, eta =   1.00000000e+00
k = 1, eta =   8.50918129e-01, delta =   1.49081871e-01
k = 2, eta =   8.50918129e-01, delta =   1.11022302e-16
```

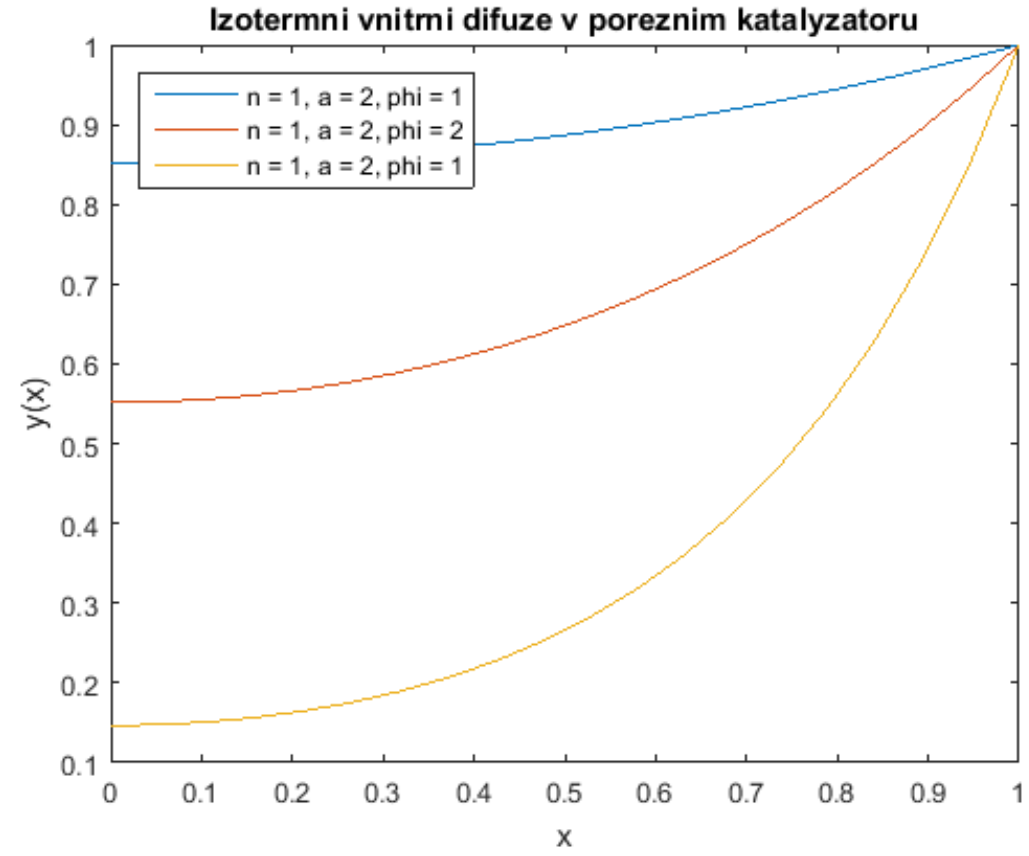
```
Reseni:
   x      y(x)
0.000,   0.850918
0.053,   0.851311
0.105,   0.852490
0.158,   0.854458
0.211,   0.857218
0.263,   0.860774
0.316,   0.865131
0.368,   0.870299
0.421,   0.876284
0.474,   0.883098
0.526,   0.890751
0.579,   0.899256
0.632,   0.908628
0.684,   0.918882
0.737,   0.930035
0.789,   0.942106
0.842,   0.955115
0.895,   0.969085
0.947,   0.984038
1.000,   1.000000
Efektivni faktor: 0.939106

---------------------------------------------------------------
Volba parametru: n = 1, a = 2, phi = 2
k = 0, eta =   1.00000000e+00
k = 1, eta =   5.51441141e-01, delta =   4.48558859e-01
k = 2, eta =   5.51441141e-01, delta =   2.22044605e-16
Reseni:
   x      y(x)
0.000,   0.551441
0.053,   0.552460
0.105,   0.555524
0.158,   0.560652
0.211,   0.567880
0.263,   0.577255
0.316,   0.588840
0.368,   0.602713
0.421,   0.618966
0.474,   0.637710
0.526,   0.659070
0.579,   0.683191
0.632,   0.710238
0.684,   0.740395
0.737,   0.773868
0.789,   0.810889
0.842,   0.851714
0.895,   0.896625
0.947,   0.945939
1.000,   1.000000
Efektivni faktor: 0.805972

---------------------------------------------------------------
Volba parametru: n = 1, a = 2, phi = 4
k = 0, eta =   1.00000000e+00
```

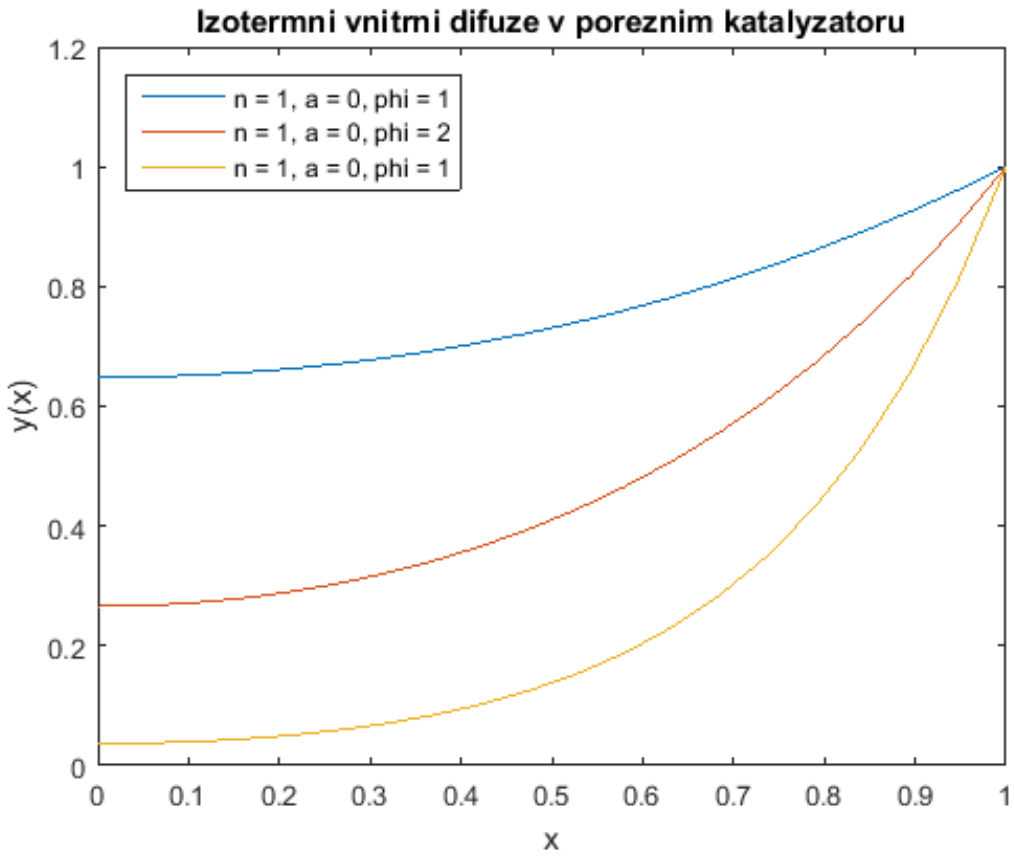
```
k = 1, eta =   1.46574240e-01, delta =   8.53425760e-01
k = 2, eta =   1.46574240e-01, delta =   5.55111512e-17
Reseni:
   x      y(x)
0.000,   0.146574
0.053,   0.147659
0.105,   0.150944
0.158,   0.156515
0.211,   0.164523
0.263,   0.175182
0.316,   0.188783
0.368,   0.205696
0.421,   0.226387
0.474,   0.251433
0.526,   0.281536
0.579,   0.317550
0.632,   0.360513
0.684,   0.411668
0.737,   0.472522
0.789,   0.544880
0.842,   0.630918
0.895,   0.733248
0.947,   0.855018
1.000,   1.000000
Efektivni faktor: 0.563004

---------------------------------------------------------------
Volba parametru: n = 1, a = 0, phi = 1
k = 0, eta =   1.00000000e+00
k = 1, eta =   6.48054272e-01, delta =   3.51945728e-01
k = 2, eta =   6.48054272e-01, delta =   1.11022302e-16
Reseni:
   x      y(x)
0.000,   0.648054
0.053,   0.648952
0.105,   0.651648
0.158,   0.656149
0.211,   0.662469
0.263,   0.670624
0.316,   0.680637
0.368,   0.692536
0.421,   0.706353
0.474,   0.722128
0.526,   0.739904
0.579,   0.759729
0.632,   0.781660
0.684,   0.805757
0.737,   0.832086
0.789,   0.860720
0.842,   0.891739
0.895,   0.925229
0.947,   0.961283
1.000,   1.000000
Efektivni faktor: 0.761594
```

```
---------------------------------------------------------------
Volba parametru: n = 1, a = 0, phi = 2
k = 0, eta =   1.00000000e+00
k = 1, eta =   2.65802198e-01, delta =   7.34197802e-01
k = 2, eta =   2.65802198e-01, delta =   1.11022302e-16
Reseni:
   x      y(x)
0.000,   0.265802
0.053,   0.267276
0.105,   0.271714
0.158,   0.279166
0.211,   0.289714
0.263,   0.303475
0.316,   0.320601
0.368,   0.341283
0.421,   0.365751
0.474,   0.394274
0.526,   0.427171
0.579,   0.464805
0.632,   0.507593
0.684,   0.556012
0.737,   0.610597
0.789,   0.671953
0.842,   0.740762
0.895,   0.817787
0.947,   0.903881
1.000,   1.000000
Efektivni faktor: 0.482014

---------------------------------------------------------------
Volba parametru: n = 1, a = 0, phi = 4
k = 0, eta =   1.00000000e+00
k = 1, eta =   3.66188169e-02, delta =   9.63381183e-01
k = 2, eta =   3.66188169e-02, delta =   1.38777878e-17
Reseni:
   x      y(x)
0.000,   0.036619
0.053,   0.037433
0.105,   0.039913
0.158,   0.044168
0.211,   0.050388
0.263,   0.058850
0.316,   0.069930
0.368,   0.084120
0.421,   0.102053
0.474,   0.124526
0.526,   0.152538
0.579,   0.187336
0.632,   0.230467
0.684,   0.283851
0.737,   0.349862
0.789,   0.431437
0.842,   0.532204
0.895,   0.656648
0.947,   0.810300
1.000,   1.000000
```

```
Efektivni faktor: 0.249832
```






Izotermni vnitrni difuze v poreznim katalyzatoru
n = 1, a = 0, phi = 1
n = 1, a = 0, phi = 2
n = 1, a = 0, phi = 1
y(x)
x
0
0.2
0.4
0.6
0.8
1
1.2
0.1
0.3
0.5
0.7
0.9