```
> read "PDEParabCN.m":
  read "PDEParabExpl.m":
```

Apl. pŠíklad 3:

VnitŠní difuze v ļástici katalizátoru tvaru desky doprovázená izotermní reakcí 2. Šádu je popsána parabolickou rovnicí

$$\frac{\partial}{\partial t} y = \frac{\partial^2}{\partial x^2} y - \delta y^2,$$

y(0,t)=1 , y (1,t) = 1, y(x,0) = 0.

Vypoļtěte Šeěení pro

a) ğ= 1

b) δ= 0.5

ř eěte pomocí metody Explicitní a Crank-Nicolsonové.

a) δ= 1

```
> F:=x->0.0;
  Delta:=1:
```

$$F := x \to 0. \qquad \textbf{(1.1)}$$

Definice pravé strany diferenciální rovnice

```
> g:=(x,t)->1;
  e:=(x,t)->0;
  f:=(x,t,y)->-Delta*y*y;
```

$$g := (x, t) \to 1$$
$$e := (x, t) \to 0$$
$$f := (x, t, y) \to -\Delta\, y\, y \qquad \textbf{(1.2)}$$

ř eěení metodou explicitní, h=0.2, k=0.02.

Definice parametrŢ metody

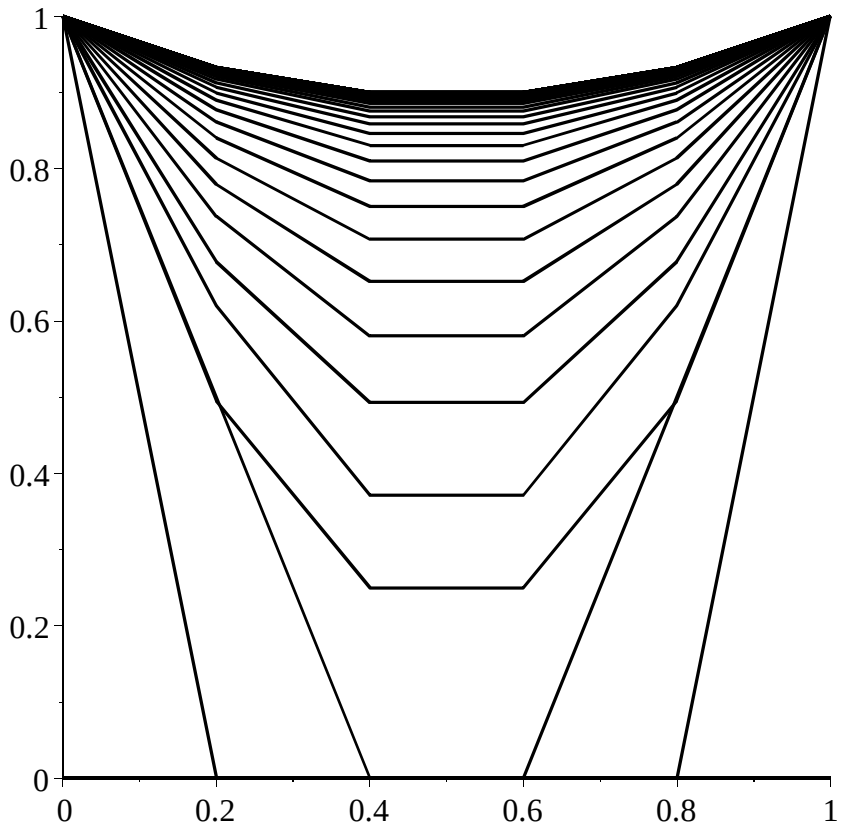
```
> a := 0:
  b := 1.0:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := t->0:
  beta2 := t->0:
  gama1 := t->1:
  gama2 := t->1:

> n :=  5;
  h :=(b-a)/n;
> m :=  50;
> k := 0.02;
  T := k*m;
> vysE1:=PDEParabExpl(n,m,k,a, b, g, e,f,alfa1,beta1,alfa2,
  beta2,gama1,gama2,F):
```

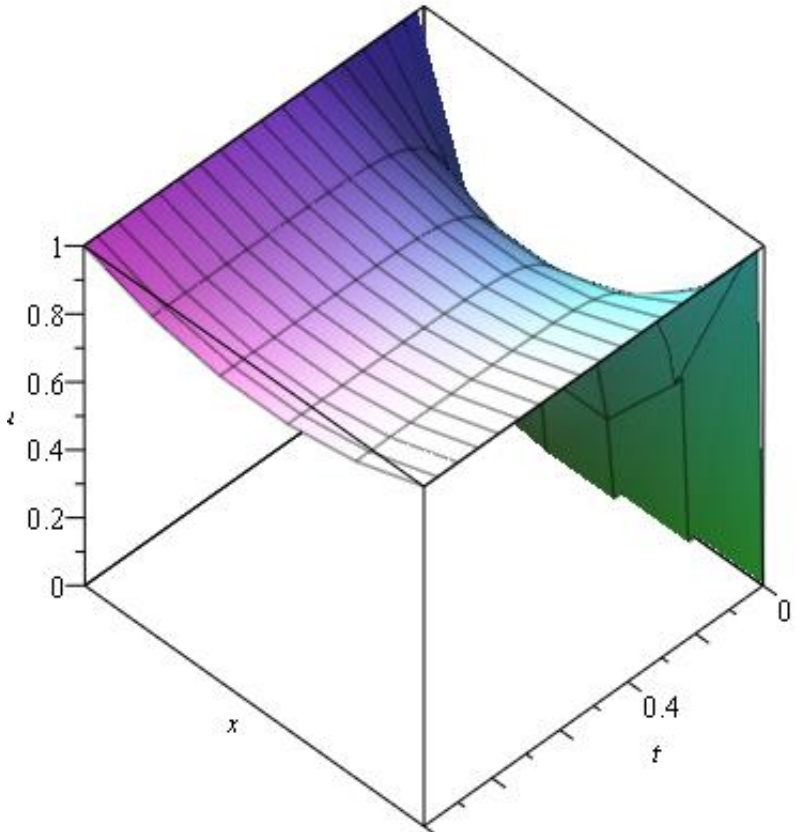
$$n := 5$$
$$h := 0.2000000000$$
$$m := 50$$
$$k := 0.02$$
$$T := 1.00$$
$$alfa=, 0.5000000000 \qquad \textbf{(1.3)}$$

```
> data := [seq( [seq( [0 + (i-1) * h, vysE1[ j, i]], i = 1 .. n + 1) ], j = 1 .. m + 1) ] :
```

```
> with(plots):
  display(seq(listplot(data[i]), i = 1..m));
```




```
> a := subs(1 .. m + 1 = 0..T, 1 .. n + 1 = 0 .. 1, matrixplot(vysE1[1 .. m + 1, 1 .. n + 1],
       labels = [t, x, u])):
  display(a, view = [0 .. T, 1 .. 0, 0 .. 1])
```



ř eġení metodou Crank- Nicolsonové, h=0.2, k=0.1.

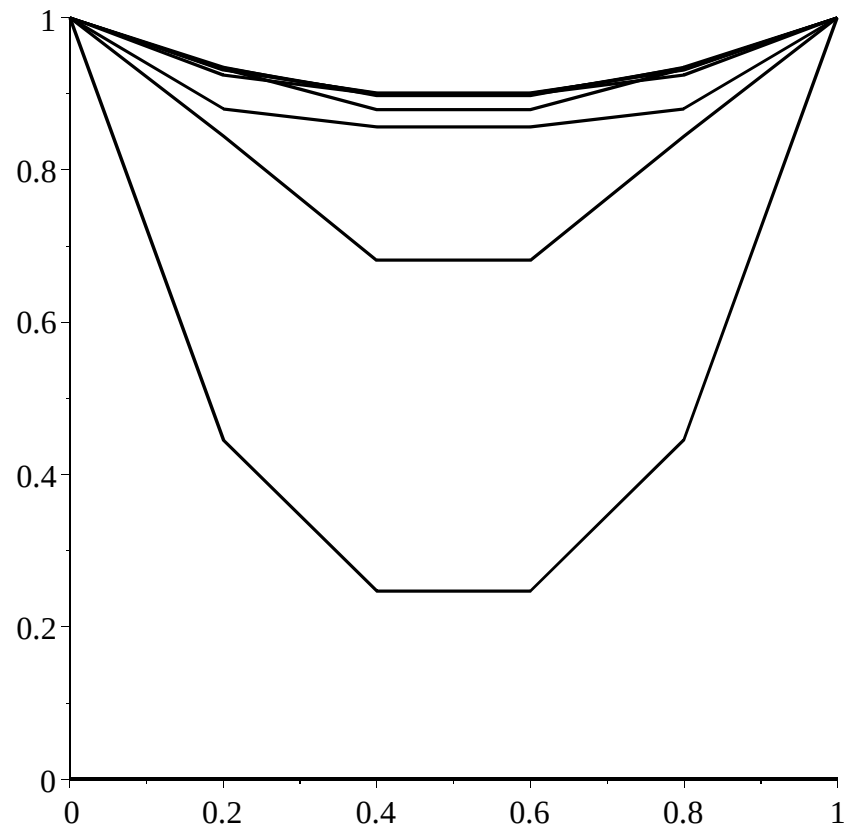
Definice parametrŢ metody

```
> a := 0:
  b := 1.0:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := t->0:
  beta2 := t->0:
  gama1 := t->1:
  gama2 := t->1:
  n :=  5;
  h :=(b-a)/n;
> m :=  10;
> k := 0.1;
  T := k*m;
> vysCN1:=PDEParabCN(n,m,k,a,b, g,e,f,alfa1,beta1,alfa2,beta2,
  gama1,gama2,F):
```

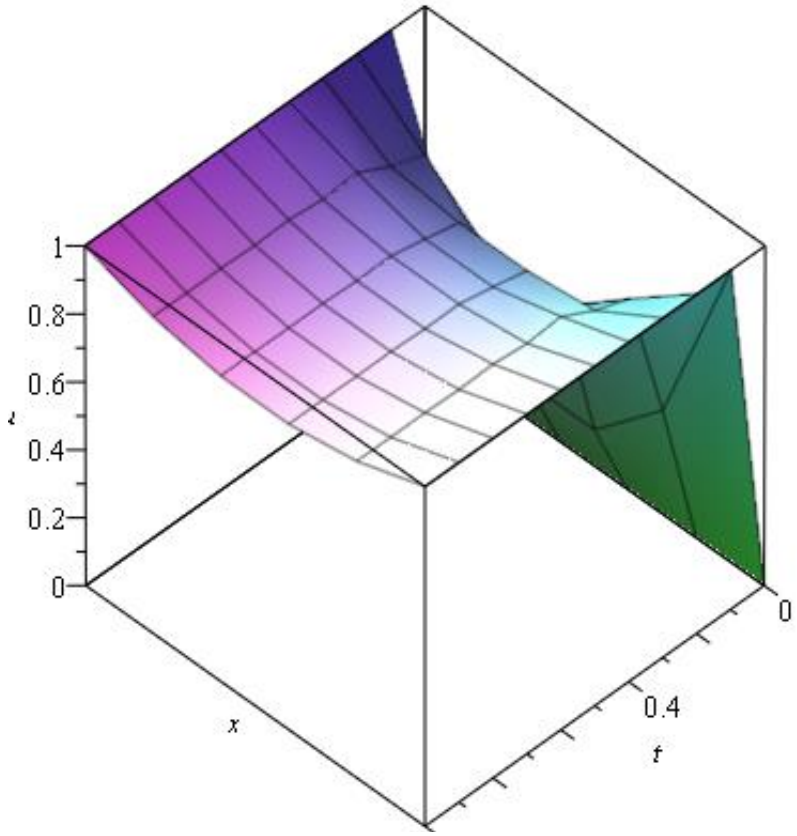
$$n := 5$$
$$h := 0.2000000000$$
$$m := 10$$
$$k := 0.1$$
$$T := 1.0 \qquad \textbf{(1.4)}$$

```
> data := [seq([seq([0 + (i-1) * h, vysCN1[j, i]], i = 1 .. n + 1)], j = 1 .. m + 1)]:

> with(plots):
  display(seq(listplot(data[i]), i = 1 ..m));
```




```
> a := subs(1 .. m + 1 = 0 ..T, 1 .. n + 1 = 0 .. 1, matrixplot(vysCN1[1 .. m + 1, 1 .. n + 1],
       labels = [t, x, u])):
  display(a, view = [0 .. T, 1 .. 0, 0 .. 1])
```



b) δ= 0.5

```
> F:=x->0.0;
  Delta:=0.5:
```

$$F := x \to 0. \qquad \textbf{(2.1)}$$

Definice pravé strany diferenciální rovnice

```
> g:=(x,t)->1;
  e:=(x,t)->0;
  f:=(x,t,y)->-Delta*y*y;
```

$$g := (x, t) \to 1$$

$$e := (x, t) \to 0$$

$$f := (x, t, y) \to -\Delta\, y\, y \qquad \textbf{(2.2)}$$

ř eġení metodou explicitní, h=0.2, k=0.02

Definice parametrŢ metody

```
> a := 0:
  b := 1.0:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := t->0:
  beta2 := t->0:
```

```
gama1 := t->1:
gama2 := t->1:

> n := 5;
  h :=(b-a)/n;
> m := 50;
> k := 0.02;
  T := k*m;
> vysE2:=PDEParabExpl(n,m,k,a,b,g,e,f,alfa1,beta1,alfa2,beta2,
  gama1,gama2,F):
```

$$n := 5$$

$$h := 0.2000000000$$

$$m := 50$$

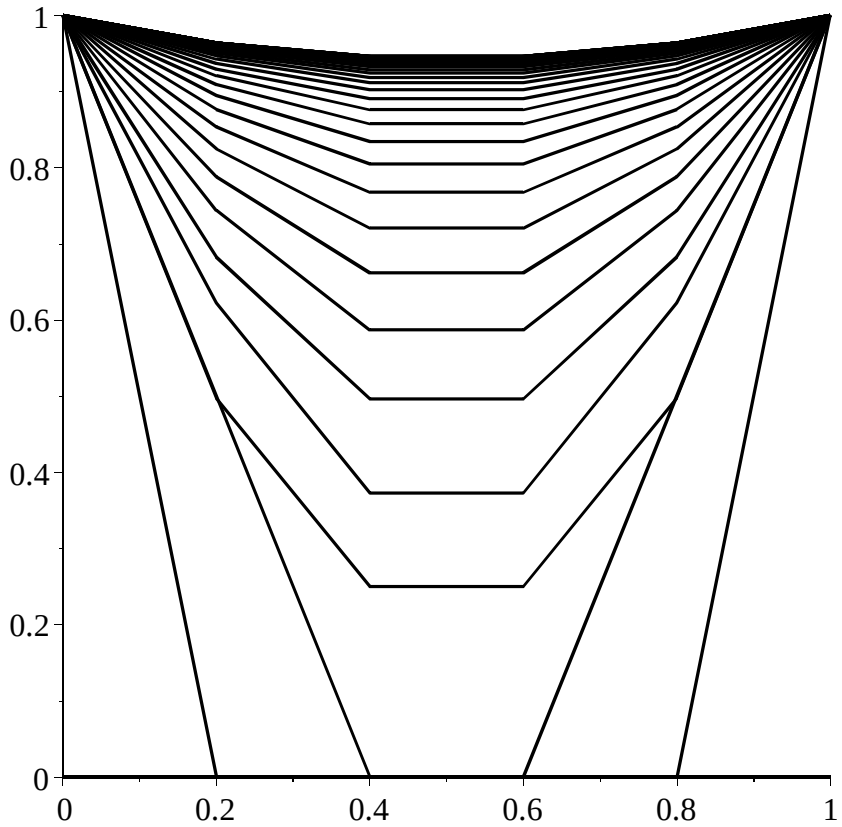
$$k := 0.02$$

$$T := 1.00$$

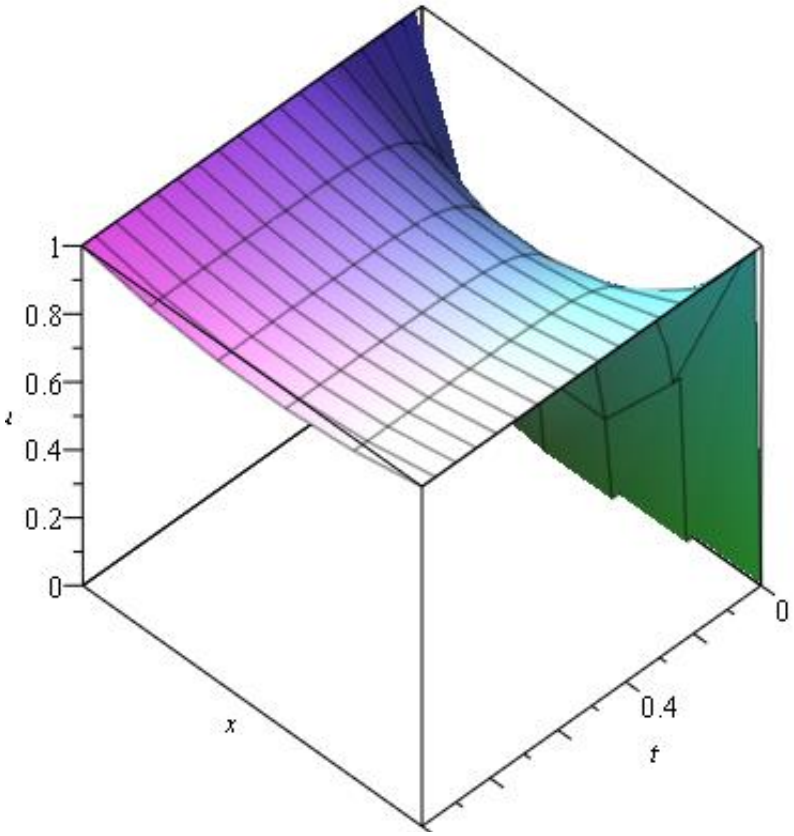
$$alfa =, 0.5000000000 \qquad \textbf{(2.3)}$$

```
> data := [seq([seq([0 + (i-1) * h, vysE2[j, i]], i = 1 .. n + 1)], j = 1 .. m + 1)]:

> with(plots):
  display(seq(listplot(data[i]), i = 1 ..m));
```




```
> a := subs(1 .. m + 1 = 0 ..T, 1 .. n + 1 = 0 .. 1, matrixplot(vysE2[1 .. m + 1, 1 .. n + 1],
       labels = [t, x, u])):
  display(a, view = [0 .. T, 1 .. 0, 0 .. 1]);
```



ř eġení metodou Crank- Nicolsonové, h=0.2, k=0.1

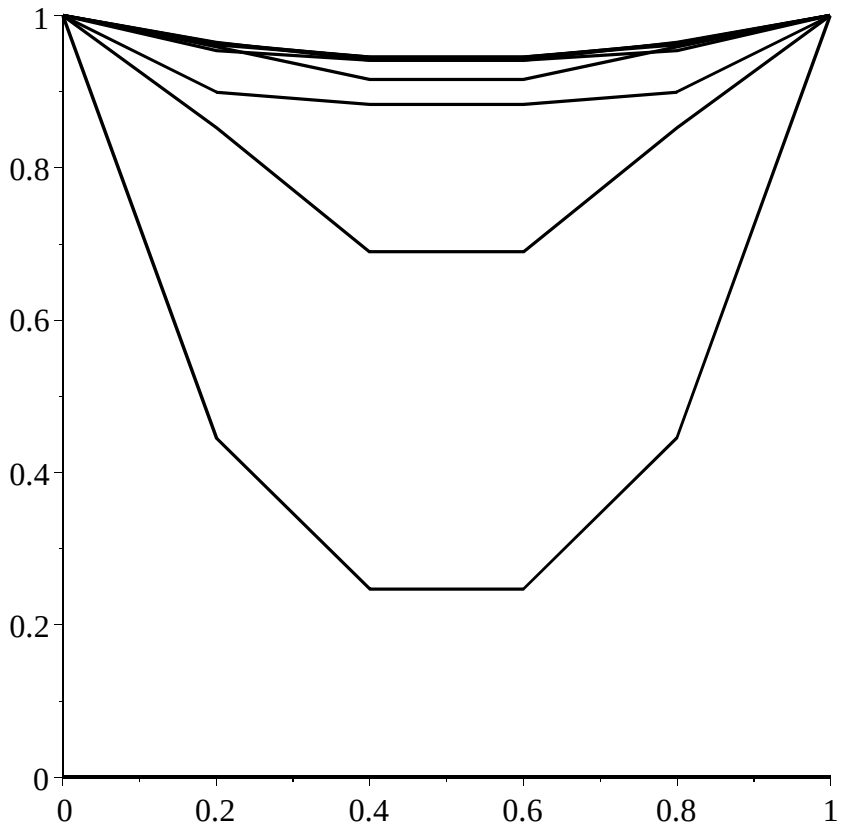
Definice parametrŢ metody

```
> a := 0:
  b := 1.0:
  alfa1 := 1:
  alfa2 := 1:
  beta1 := t->0:
  beta2 := t->0:
  gama1 := t->1:
  gama2 := t->1:
  n :=  5;
  h :=(b-a)/n;
> m :=  10;
> k := 0.1;
  T := k*m;
> vysCN2:=PDEParabCN(n,m,k,a,b, g,e,f,alfa1,beta1,alfa2,beta2,
  gama1,gama2,F):
```

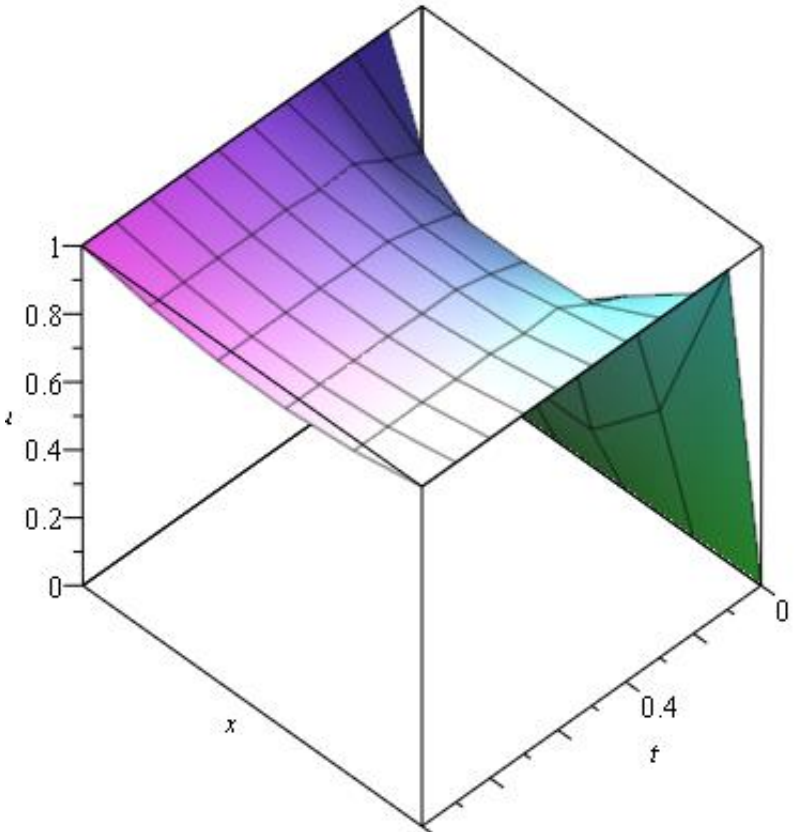
$$n := 5$$
$$h := 0.2000000000$$
$$m := 10$$
$$k := 0.1$$
$$T := 1.0 \qquad \textbf{(2.4)}$$

```
> data := [seq([seq([0 + (i-1) * h, vysCN2[j, i]], i = 1 .. n + 1)], j = 1 .. m + 1)]:

> with(plots):
  display(seq(listplot(data[i]), i = 1 ..m));
```




```
> a := subs(1 .. m + 1 = 0 ..T, 1 .. n + 1 = 0 .. 1, matrixplot(vysCN2[1 .. m + 1, 1 .. n + 1],
       labels = [t, x, u])):
  display(a, view = [0 .. T, 1 .. 0, 0 .. 1])
```


1
0.8
0.6
0.4
0.2
0
x
0.4
t
0