$$\begin{cases} u_t - a u_{xx} = f(x,t) \ (x_1 < x < x_2) \ (t > 0) \\ u(x,0) = g_t(x) \ (x_1 < x < x_2) \\ u(x_1,t) = g_1(t), u(x_2,t) = g_2(t) \ (t > 0) \end{cases}$$

$$0.1 < x < \pi$$

```
x = [0.1, pi];
```

$$0 < t < 0.2$$

```
t = [0, 0.2];
N_b = 40;
N_t = 50;
p_x = 0;
p_t = 0;
```

$$u(x,0) = 10 \frac{\cos\left(\left(\frac{x - x_1}{2}\right)^2\right) \sin\left((x - x_2)^3\right)}{x^{\frac{4}{5}}}$$

```
ut = @(x)(10*(cos((x-x(1))/2).^2).*sin((x-x(2)).^3)./(x.^(4/5)));
```

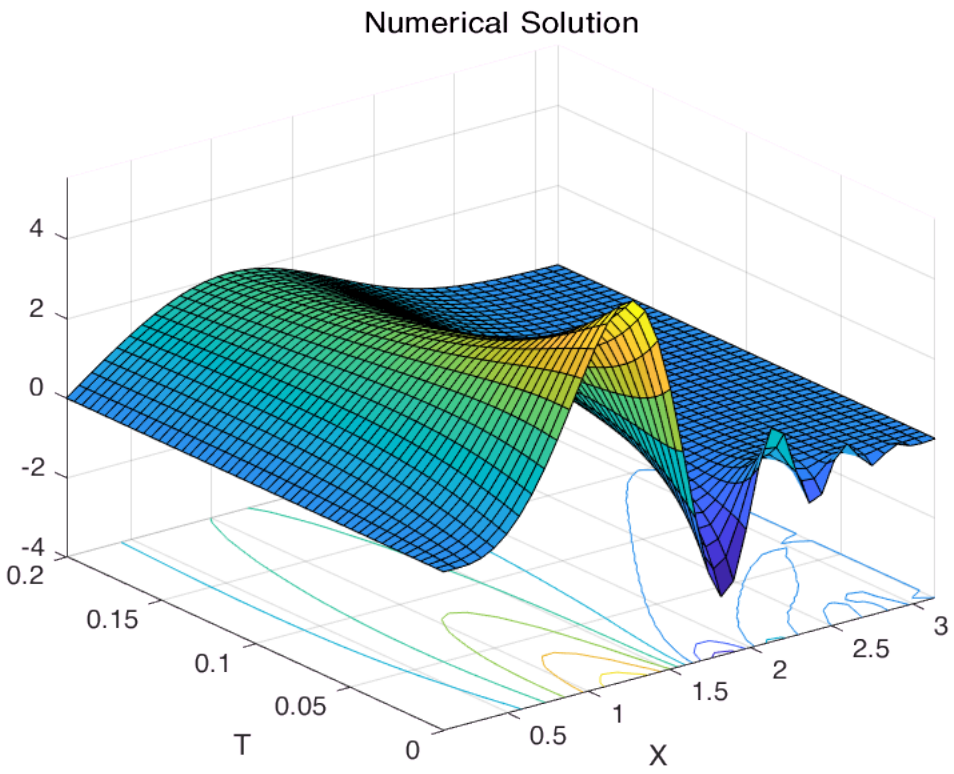
$$u(x_1,t) = u(x_2,t) = 0$$

```
ua = @(t)(0*t);
ub = @(t)(0*t);
```

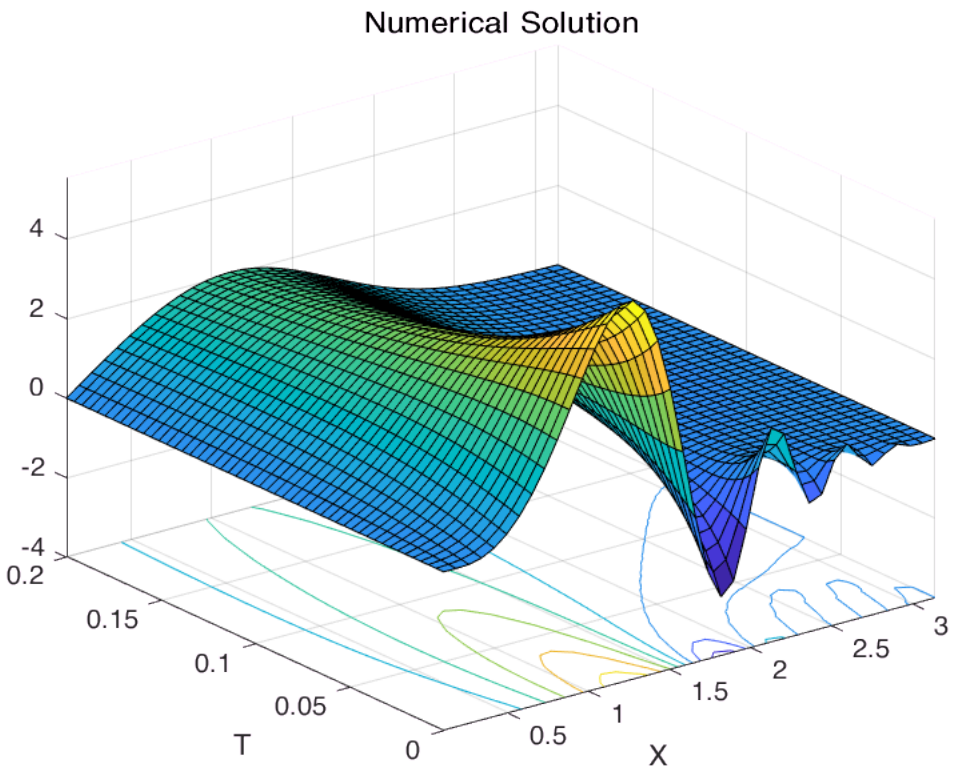
$$f(x,t) = 0$$

```
f = @(t, x)(0*x*t);
```

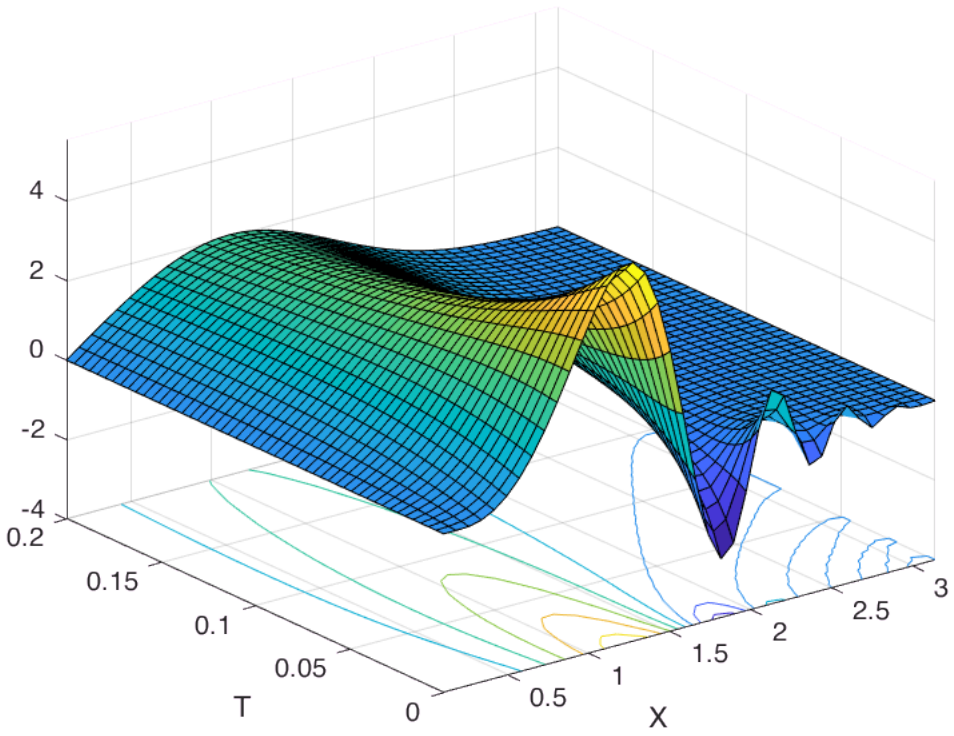
```
% 5 points Forward_Euler
[Nu1, k1] = FD_Heat_1D(ua, ub, ut, f, x, t, N_b, N_t, p_x, p_t, 1);
```




```
% 3 points Back_Euler
[Nu2, k2] = FD_Heat_1D(ua, ub, ut, f, x, t, N_b, N_t, p_x, p_t, 2);
```




```
% C_N
[Nu3, k3] = FD_Heat_1D(ua, ub, ut, f, x, t, N_b, N_t, p_x, p_t, 3);
```


Numerical Solution
4
2
0
-2
-4
0.2
0.15
0.1
0.05
0
T
0.5
1
1.5
2
2.5
3
X