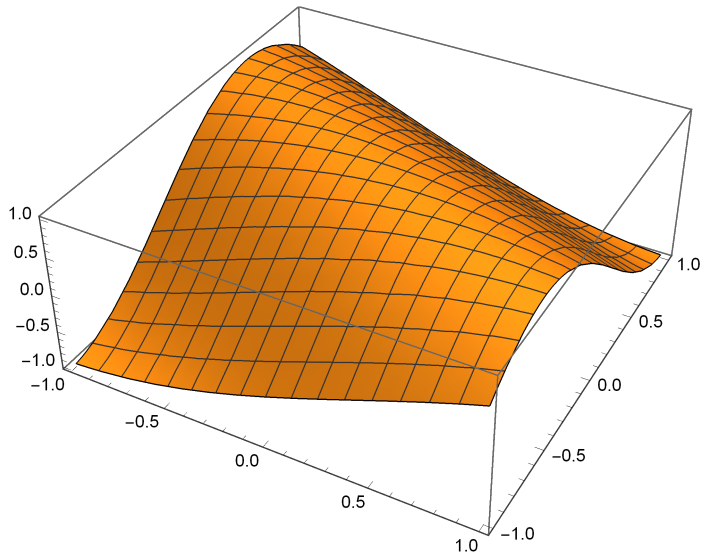
In[1]:=
```
pde = D[u[x, t], t] - 2 D[u[x, t], x] == 0;
```
дифференциров… | дифференциировать
```
sol = DSolve[{pde, u[x, 0] == Cos[x]}, u[x, t], {x, t}]
```
решить дифференциальны… | косинус
```
analyticPlot = Plot3D[u[x, t] /. sol, {x, -1, 1}, {t, -1, 1}]
```
график функции 2–х переменных

Out[2]=
```
{{u[x, t] → Cos[2 t + x]}}
```

Out[3]=



In[4]:=
```
AnalyticEval[x_, t_] := N[Cos[2 t + x]];
```
.. | косинус
```
L = 10;
trail = Table[AnalyticEval[x, 1], {x, 0, 1, 1 / L}]
```
таблица значений

Out[6]=
```
{-0.416147, -0.504846, -0.588501, -0.666276, -0.737394,
 -0.801144, -0.856889, -0.904072, -0.942222, -0.970958, -0.989992}
```

```
In[7]:= ClearAll[numerical]
        очистить всё
        h = 1/L;
        τ = h * 0.75;
        Nm = Round[1/τ];
             округлить
        dt = τ/h;
        numerical = Table[0, {t, Nm + 1}, {x, L + 1}];
                    таблица значений
        For[l = 1, l <= L + 1, l++,
        цикл ДЛЯ
        numerical[[1, l]] = N[Cos[1/L * l]];
                            ·· косинус
        ]
        MatrixForm[numerical]
        матричная форма
Out[14]//MatrixForm=
```

0.995004	0.980067	0.955336	0.921061	0.877583	0.825336	0.764842	0.696707	0.62161	0.
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	

In[15]:=
```
For[n = 1, n <= Nm + 1, n++,
 numerical[[n, L - 1]] =
  Cos[1.0 + 2.0 * n * τ] * (1.0 - 2.0 * h^2) + (2.0 * h - 4.0 * h^3/3) * Sin[1.0 + 2.0 * n * τ];

 numerical[[n, L]] = Cos[1.0 + 2.0 * n * τ] * (1.0 - h^2/2) +
    (h - 4.0 * h^3/6) * Sin[1.0 + 2.0 * n * τ];

 numerical[[n, L + 1]] = N[Cos[1 + 2 * τ * n]];
 ]
MatrixForm[numerical]
```

Out[16]//MatrixForm=

0.995004	0.980067	0.955336	0.921061	0.877583	0.825336	0.764842	0.696707	0.581653
0	0	0	0	0	0	0	0	0.453576
0	0	0	0	0	0	0	0	0.315312
0	0	0	0	0	0	0	0	0.169966
0	0	0	0	0	0	0	0	0.0208041
0	0	0	0	0	0	0	0	-0.128825
0	0	0	0	0	0	0	0	-0.275562
0	0	0	0	0	0	0	0	-0.41611
0	0	0	0	0	0	0	0	-0.547313
0	0	0	0	0	0	0	0	-0.666224
0	0	0	0	0	0	0	0	-0.770174
0	0	0	0	0	0	0	0	-0.856827
0	0	0	0	0	0	0	0	-0.924238
0	0	0	0	0	0	0	0	-0.970892

In[17]:=
```
For[n = 1, n ≤ Nm, n++,
 For[l = 1, l ≤ L - 2, l++,
  numerical[[n + 1, l]] =
   numerical[[n, l]] + τ/(3 h) (2 numerical[[n, l + 3]] - 9 numerical[[n, l + 2]] +
      18 numerical[[n, l + 1]] - 11 numerical[[n, l]]) +
    (2 τ^2)/h^2 (-numerical[[n, l + 3]] + 4 numerical[[n, l + 2]] - 5 numerical[[n, l + 1]] +
      2 numerical[[n, l]]) + (4 τ^3)/(3 h^3) (numerical[[n, l + 3]] -
      3 numerical[[n, l + 2]] + 3 numerical[[n, l + 1]] - numerical[[n, l]])
 ]
]
```

In[18]:=
```
(*"Bug" fixing*)
```

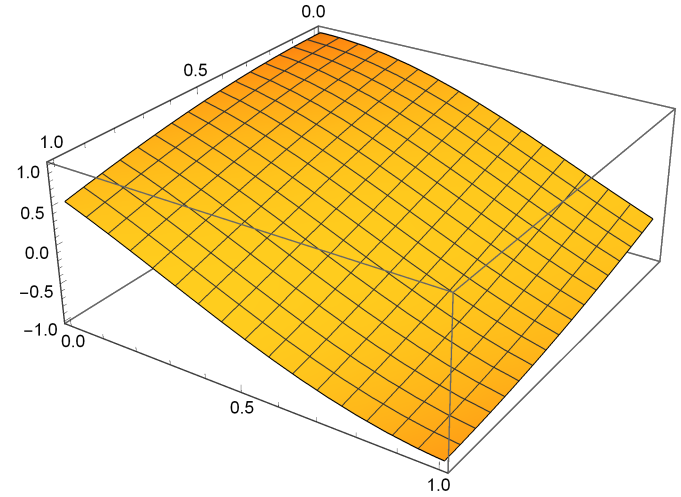
In[19]:=
```
τ = (1 - (Nm) * τ);

For[l = 1, l ≤ L - 2, l++,
 numerical[[Nm + 1, l]] =
   numerical[[Nm, l]] + τ/(3 h) (2 numerical[[Nm, l + 3]] - 9 numerical[[Nm, l + 2]] +
       18 numerical[[Nm, l + 1]] - 11 numerical[[Nm, l]]) +
    (2 τ^2)/h^2 (-numerical[[Nm, l + 3]] + 4 numerical[[Nm, l + 2]] - 5 numerical[[Nm, l + 1]] +
       2 numerical[[Nm, l]]) + (4 τ^3)/(3 h^3) (numerical[[Nm, l + 3]] -
       3 numerical[[Nm, l + 2]] + 3 numerical[[Nm, l + 1]] - numerical[[Nm, l]]);
]

numerical[[Nm + 1, L - 1]] = Cos[3] * (1.0 - 2.0 * h^2) + (2.0 * h - 4.0 * h^3/3) * Sin[3];
                             косинус                      синус

numerical[[Nm + 1, L]] = Cos[3] * (1.0 - h^2/2) + (h - 4.0 * h^3/6) * Sin[3];
                         косинус                 синус

numerical[[Nm + 1, L + 1]] = N[Cos[3]];
                             .. косинус

MatrixForm[numerical]
матричная форма
```

Out[24]//MatrixForm=

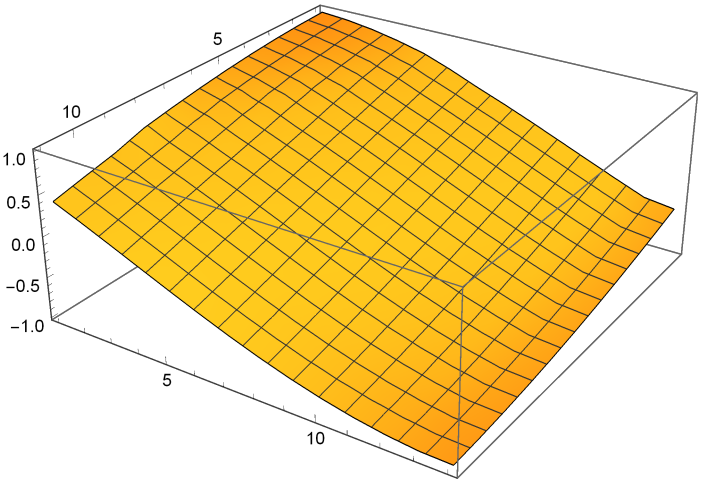
0.995004	0.980067	0.955336	0.921061	0.877583	0.825336	0.764842	0.6967
0.96891	0.939371	0.900445	0.852523	0.796082	0.734184	0.640205	0.5377
0.921057	0.877578	0.825176	0.767479	0.689731	0.588354	0.49498	0.4083
0.852266	0.797912	0.731335	0.640019	0.540745	0.451652	0.362474	0.267
0.766933	0.687721	0.590243	0.495567	0.407448	0.315352	0.218873	0.1202
0.639948	0.54232	0.451347	0.361923	0.267521	0.16974	0.0706326	-0.0294
0.496321	0.406849	0.315244	0.218925	0.120331	0.0206057	-0.0792172	-0.178
0.361475	0.267522	0.169841	0.0705449	-0.0293343	-0.129022	-0.227286	-0.323
0.219015	0.12033	0.0206298	-0.0792794	-0.178371	-0.27575	-0.370251	-0.461
0.0705565	-0.0293628	-0.128983	-0.227347	-0.323398	-0.416285	-0.5049	-0.588
-0.0792703	-0.178388	-0.275715	-0.370307	-0.461163	-0.547472	-0.628211	-0.702
-0.227335	-0.323415	-0.416253	-0.50495	-0.588571	-0.666363	-0.737414	-0.801
-0.370295	-0.461177	-0.547442	-0.628253	-0.702761	-0.770289	-0.830055	-0.881
-0.416261	-0.504938	-0.588593	-0.666331	-0.737469	-0.801147	-0.856965	-0.904

In[25]:=
```
Plot3D[u[x, t] /. sol, {x, 0, 1}, {t, 0, 1}]
график функции 2-х переменных

ListPlot3D[numerical]
3-мерная диаграмма разброса данных

Show[ListLinePlot[trail, PlotStyle → Red, PlotRange → {{0, 12}, {0, -1.2}}],
пок… линейный график данных стиль графика кр… отображаемый диапазон графика
 ListLinePlot[numerical[[n, All]]]]
 линейный график данных  всё

deltas = trail - numerical[[n, All]];
                          всё

{trail, N[numerical[[n, All]]]}
        численное прибли… всё
```

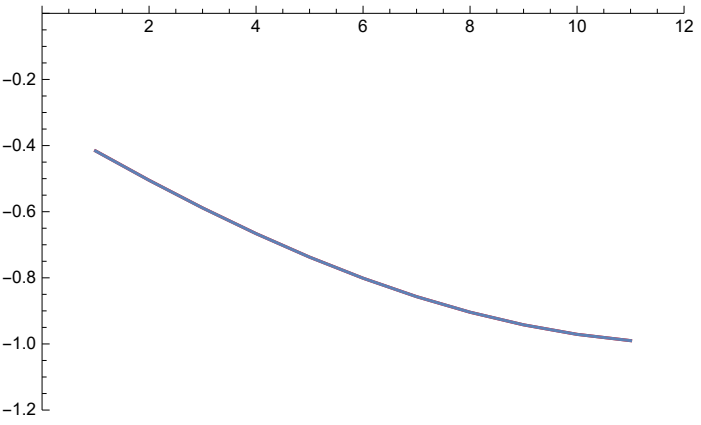
Out[25]=



Out[26]=



Out[27]=



Out[29]=

```
{{-0.416147, -0.504846, -0.588501, -0.666276, -0.737394,
  -0.801144, -0.856889, -0.904072, -0.942222, -0.970958, -0.989992},
 {-0.416261, -0.504938, -0.588593, -0.666331, -0.737469, -0.801147,
  -0.856965, -0.904002, -0.942157, -0.971025, -0.989992}}
```