

```

In[1]:= (* MA39110 / Assignment 8 / 16MA20053 / NER ROHIT *)
ClearAll["Global`*"];

Thomas[a_, b_, c_, d_] :=
Module[{c1 = Range[Length[c]], d1 = Range[Length[d]], x = Range[Length[b]]},
c1[[1]] = c[[1]]/b[[1]]; d1[[1]] = d[[1]]/b[[1]];
Do[
If[i ≠ Length[d], c1[[i]] = c[[i]]/(b[[i]] - a[[i - 1]] * c1[[i - 1]]);
d1[[i]] = (d[[i]] - a[[i - 1]] * d1[[i - 1]])/(b[[i]] - a[[i - 1]] * c1[[i - 1]]);
, {i, 2, Length[d]}];
x[[Length[b]]] = d1[[Length[b]]];
Do[
x[[i]] = d1[[i]] - c1[[i]] * x[[i + 1]];
, {i, Length[b] - 1, 1, -1}];
x];

Model[n0_, r0_, t0_] := Module[{n = n0, r = r0, t = t0},
x0 = -1; xf = 1; y0 = 0; yf = 1; h = (xf - x0)/n;
A = Table[0, {x, 1, n - 1}, {y, 1, n - 1}];
X = Table[x0 + x * h, {x, 1, n - 1}];
XT = Table[x0 + x * h, {x, 0, n}];
B = Table[0, {x, 1, n - 1}];
PLT = Table[0, {x, 1, t}];
f[x_, y_] = Cos[Pi * x/2] Cos[Pi * y/2];
U = Table[f[XT[[x]], XT[[y]]], {x, 1, n + 1}, {y, 1, n + 1}];
For[k = 1, k ≤ t, k++,
{
For[j = 1, j < n, j++,
{
For[i = 1, i < n, i++,
{
im = i + 1;
jm = j + 1;
A[[i, i]] = -r - 1;
B[[i]] = -(r/2) (U[[All, jm]][[im - 1]] -
2 U[[All, jm]][[im]] + U[[All, jm]][[im + 1]]) - U[[All, jm]][[im]];
If[i ≠ 1, A[[i, i - 1]] = r/2];
If[i ≠ n - 1, A[[i, i + 1]] = r/2];
}];
U[[All, jm]] =
N[Flatten[{0}, Thomas[Diagonal[A, -1], Diagonal[A], Diagonal[A, 1], B], {0}]]];
}];

For[j = 1, j < n, j++,
{
For[i = 1, i < n, i++,
{
im = i + 1;
jm = j + 1;
A[[i, i]] = -r - 1;

```

```

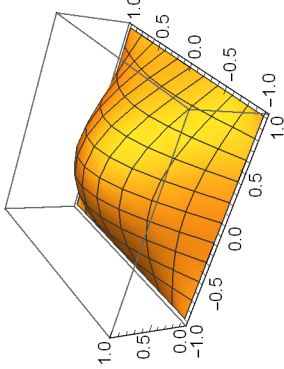
      B[[i]] = - (r/2)
      (U[[jm]][[im - 1]] - 2 U[[jm]][[im]] + U[[jm]][[im + 1]]) - U[[jm]][[im]];
      If[i ≠ 1, A[[i, i - 1]] = r/2];
      If[i ≠ n - 1, A[[i, i + 1]] = r/2];
    }];
    U[[jm]] =
      N[Flatten[{ {0}, Thomas[Diagonal[A, -1], Diagonal[A], Diagonal[A, 1], B], {0} }]];
  }];
  PLT[[k]] = U;
}];
PLT
];

In[4]:= sol = Model[10, 1/6, 100];
sol1 = Model[20, 1/6, 100];
sol2 = Model[30, 1/6, 100];
Rotate[GraphicsGrid[
  {{ListPlot3D[sol[[1]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol[[1, 6, 6]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol[[25]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol[[25, 6, 6]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol[[50]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol[[50, 6, 6]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol[[100]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol[[100, 6, 6]]], FontSize → 18], Mesh → Full]],
  {{ListPlot3D[sol1[[1]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol1[[1, 11, 11]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol1[[25]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol1[[25, 11, 11]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol1[[50]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol1[[50, 11, 11]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol1[[100]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol1[[100, 11, 11]]], FontSize → 18],
    Mesh → Full]],
  {{ListPlot3D[sol2[[1]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol2[[1, 16, 16]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol2[[25]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol2[[25, 16, 16]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol2[[50]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol2[[50, 16, 16]]], FontSize → 18], Mesh → Full],
    ListPlot3D[sol2[[100]], DataRange → {{-1, 1}, {-1, 1}, {0, 1}}, PlotRange → {0, 1},
    PlotLabel → Style[StringForm["`"], sol2[[100, 16, 16]]], FontSize → 18],
    Mesh → Full]]}], Pi/2]

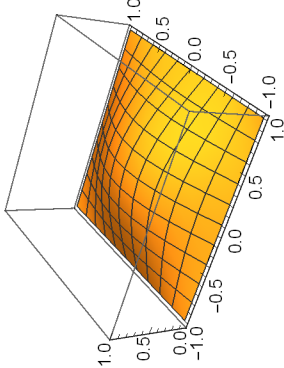
```

Out[5]=

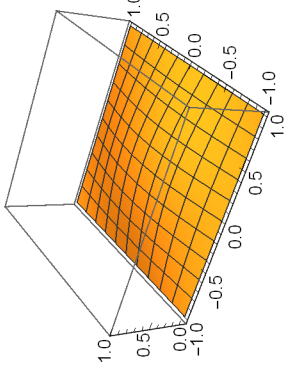
0.967897



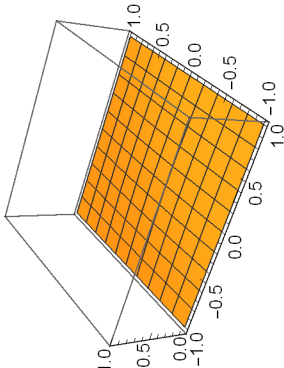
0.442311



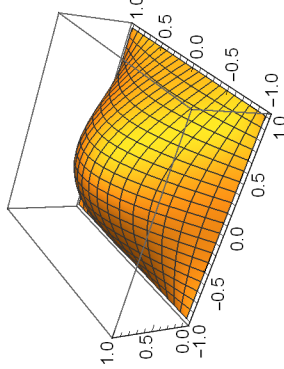
0.195639



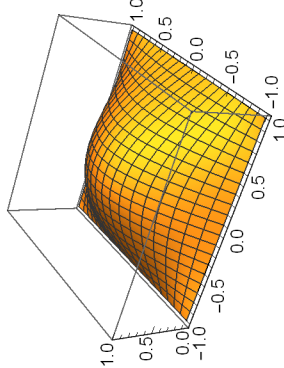
0.0382745



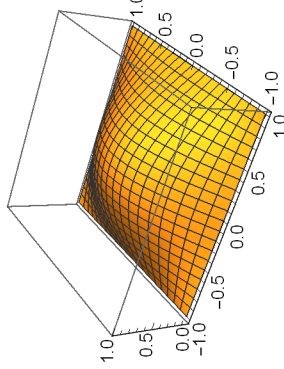
0.991826



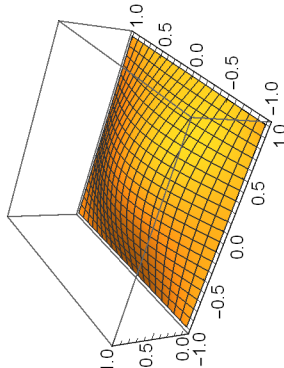
0.814489



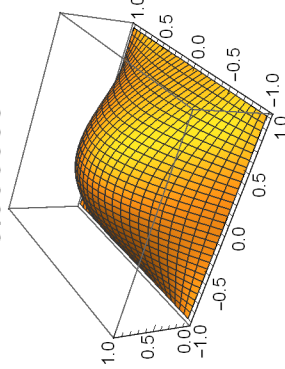
0.663392



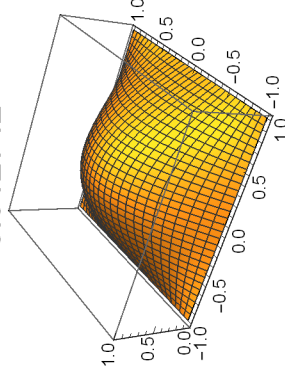
0.440089



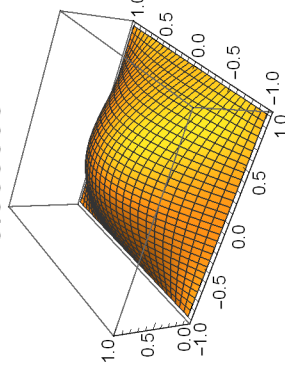
0.996355



0.912742



0.833098



0.694053

