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(* Lax-Friedrichs Finite Difference Method in 2D *)

(* Givens Conditions *)

Δx = 5;
Δy = 5;
α = 300;
regionx = 300;
regiony = 300;
Δt = 0.0015;
c1 = α * Δt / Δx;
c2 = α * Δt / Δy;
cx = {};
cy = {};
u0 = {};

(* creating initial vector by organizing x,
y coordinates to give z coordinate by evaluating *)

For[x = 0, x ≤ regionx, x = x + Δx,
  For[y = 0, y ≤ regiony, y = y + Δy,

    AppendTo[cx, x];
    AppendTo[cy, y];

    If[50 ≤ x && x ≤ 110 && 50 ≤ y ≤ 110,
     AppendTo[u0,
       (100 * Sin[Pi * (x - 50) / 60]) * (100 * Sin[Pi * (y - 50) / 60])], AppendTo[u0, 0];
    ];
   ];
 ];

(* creating scheme matrix and diagonalizing things *)

A = ConstantArray[0, {Length[cx], Length[cy]}];

For[i = 2, i ≤ Length[cx], i++,
  A[[i - 1, i]] = (1 / 4) - c1;
  A[[i, i - 1]] = (1 / 4) + c2;
 ];

For[j = 1, j ≤ Length[cx] - (regionx / Δx), j++,
  A[[j, j + (regionx / Δx)]] = (1 / 4) - c1;
 ];

For[k = 1, k ≤ Length[cy] - (regiony / Δy), k++,
  A[[k + (regionx / Δy), k]] = (1 / 4) - c2;
 ];
```

```
(* creating vector of z values at any arbitrary time *)

timestart = 1;
timefinish = 50;

For[n = timestart, n ≤ timefinish, n++,

  u_n = A.u_(n-1);
  u_n = ReplacePart[u_n, 1 → 0];
  u_n = ReplacePart[u_n, Length[u_n] → 0];
  v_n = Transpose[{cx, cy, u_n}];

 ];

(* random time generator to plot the graph at a random time *)

time = RandomInteger[{timestart, timefinish}];
graph = ListPlot3D[v_time, PlotRange → All,
   AxesLabel → {"x-coordinate", "y-coordinate", "z-coordinate"}];
Print["3D Plot of scheme at the randomly generated time: ", time];
Print[graph];
```

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3D Plot of scheme at the randomly generated time: 36
```