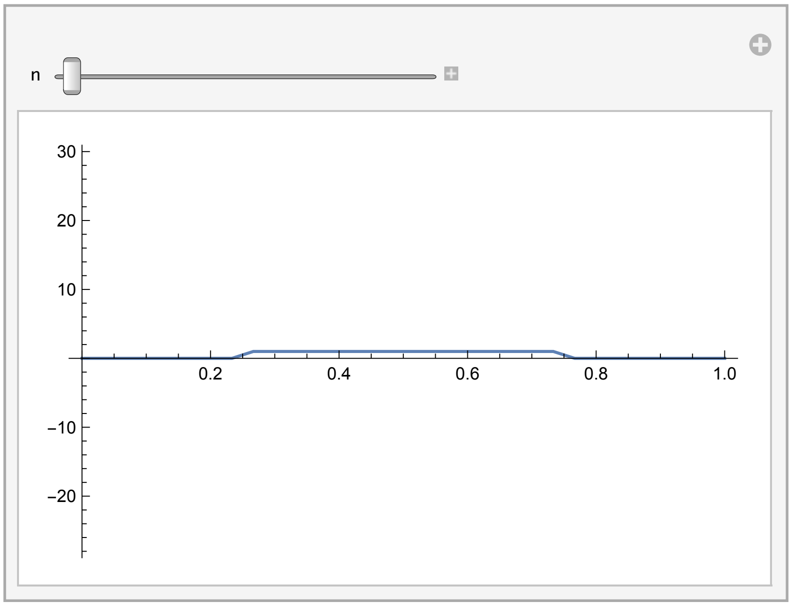
```
Clear[coord, L, nPart, dt, dx, k, s, xPos,
  u0, myTemp, waveL, rightT, leftT, lastT, newT, newT];
(*Part C delta t= 2 delta x*)
L := 1                (*Length of rod *)
nPart := 30           (*Number of partitions *)
nTsamples := 1000     (*Number of time samples*)
tTime := 10         (*How much time*)
dx := L / nPart            (*Section size Δx*)
dt := 2 * dx   (*Time interval size Δt*)
c := 1            (*k value*)
(*s=k*dt/(dx^2)*)         (*s constant*)
s := (c * dt / dx)
(*Interesting to note that forcing various *)
(*values on s affects the stability of the solution*)

(*Here I define a function for the initial temperature distribution f0=f(x)*)

f0[x_] :=
 Piecewise[{{0, x ≥ 0 && x ≤ .25 L}, {1, x > 0.25 L && x < 0.75 L}, {0, x ≥ 0.75 L && x ≤ L}}]

(*Here is where I define the initial conditions at t=0*)
(*so u(x,0)=the function f0=f(x) acting on the xpos*)
xPos := (Range[nPart] - 1) * dx;
AppendTo[xPos, dx * nPart];

(*the symbol /@ maps the function onto xpos*)
u0 := f0 /@ xPos;

(*Initialize the empty u temperature list, these are*)
(*our sample solution points*)
waveL := {};

(*At t=1 we have our u0 list of temps*)
waveL = Append[waveL, u0];

(*This nested for loop sequence calculates the temps at time*)
(*t by using the difference equation on page 226 of the book*)
(*this is also the same one we derived in class*)

(*The outer loop only starts at t=2 because at t=1 this is t0 with*)
(*initial temp of u0 which we append before the loop*)
For[t = 2, t ≤ nTsamples, t ++,

  (*Initialize an empty temporary list*)
  myTemp := {};

  (*This loop is where we go throuh each x and calculate*)
  (*u(x,t), where t is from the outer loop*)
  For[k = 1, k ≤ nPart + 1, k ++,
   lastT = waveL[[t - 1, k]];

   If[t == 2, llastT = 0, llastT = waveL[[t - 2, k]]];

   (*if we are at start position x0 or in this case x1*)
   If[k == 1, rightT = 0; leftT = waveL[[t - 1, k + 1]]];
```

```
    (*if we reach the end of the rod*)
    If[k == nPart + 1, leftT = 0; rightT = waveL[[t - 1, k - 1]]];

    (*if we are inside rod*)
    If[k > 1 && k < nPart + 1,
     rightT = waveL[[t - 1, k - 1]];
     leftT = waveL[[t - 1, k + 1]]
    ];

    (*This is the relationship: u[j][m+1]=u[j][m]...from page 226*)
    newT = 2 lastT + s^2 * (leftT - 2 * lastT + rightT) - llastT;

    (*append temperatures to temporary list we started with*)
    myTemp = Append[myTemp, newT];
   ];

   (*append the temp list to our waveL list which we began before*)
   (*the outer loop*)
   waveL = Append[waveL, myTemp];
  ];
```

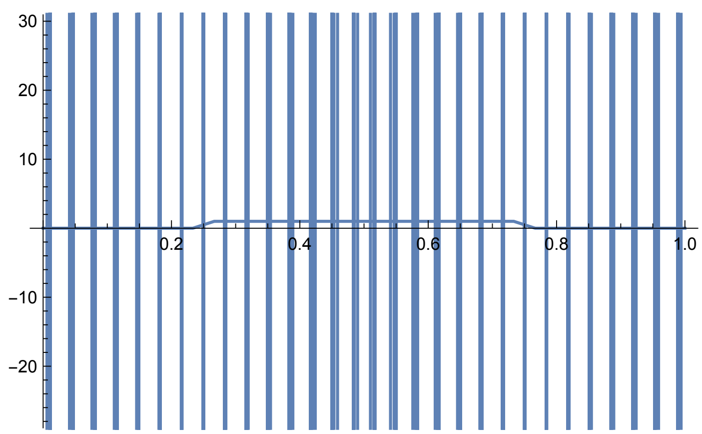
In[853]:=
```
(*Here we define individual frames representing the solution*)
(*at different times of t*)

(*Initialize an empty frame list, we will collect the frames*)
frames := {}

(*We need to get the coordinates of the xpos and waveL at*)
(*those xpos at time t here I accidentally used the letter k instead*)
For[k = 1, k ≤ nTsamples, k++,
  coord := {};

  For[i = 1, i ≤ nPart + 1, i++,
   coord = Append[coord, {xPos[[i]], waveL[[k, i]]}];
  ];

  tempframe := ListLinePlot[coord, PlotRange → {-nPart + 1, nPart + 1}];
  frames = Append[frames, tempframe];
 ];

(*Try manipulating the plot*)
Manipulate[Show[frames[[n]]], {n, 1, nTsamples, 1}]
```

Out[855]=



In[858]:=
```
(*Here are the time snapshots of the vibration*)
myTablePlot := Table[frames[[n]], {n, 1, nTsamples, 10}]
Show[myTablePlot]
(*Notice when dt = 2dx is very unstable*)
```

Out[859]=



In[860]:=
```
coord := {};
For[k = 1, k ≤ nTsamples, k++,
  For[i = 1, i ≤ nPart + 1, i++,
    coord = Append[coord, {xPos[[i]], (k - 1) * tTime / nTsamples, waveL[[k, i]]}];
   ];
 ];

ctPlot = ListContourPlot[coord, ColorFunction -> "Rainbow"];
listPlot =
  ListPlot3D[coord, ColorFunction → "Rainbow", PlotRange → {-nPart, nPart}];

level = -nPart;
gr = Graphics3D[{Texture[ctPlot], EdgeForm[], Polygon[{{0, 0, level}, {L, 0, level},
      {L, tTime, level}, {0, tTime, level}}, VertexTextureCoordinates →
      {{0, 0}, {1, 0}, {1, 1}, {0, 1}}]}, Lighting → {{"Ambient", White}}];

Show[listPlot, gr, PlotRange → All, BoxRatios -> {1, 1, 1}]
```

Out[865]=