

USING MATHEMATICA

Start Mathematica by typing `mathematica` at the linux prompt.

I only did one project using this package. Make sure the Num Lock is off. This causes the cursor to become a "hand" and you cannot select text and the help hyperlinks won't work. To cause Mathematica to evaluate or plot, you must type `shift + enter` with the cursor in the appropriate cell. Cells are indicated by blue brackets at the right margin.

Another problem we encountered was that the university had only 6 licenses for the software so that when more than 6 people attempted to use it some people got only the text editor which looks just like Mathematica but won't do any calculating or graphs.

You can make your project look nice by typing in headings and subtitles, etc. This should probably be kept out of the code cells. You can divide cells by selecting Cell, Divide Cell. You can select various styles of text formatting with Format, Style I think.

This example is a boundary value problem. A rod of length 120 is heated to an initial temperature of 100 and then its endpoints are held at 0 while it is allowed to cool. This solves the function of temperature versus position on the rod x and time t by calculating a Fourier series of 25 terms.

```
L=120; T0=100; k=1; m=25;
u[x_, t_] :=
Sum[(4*T0/Pi)*Exp[-n*n*Pi*Pi*k*t/L^2]*Sin[n*Pi*x/L]/n,
{n, 1, 2*m-1, 2}]/N
```

The 25 terms may be displayed by using the following code. I'm not sure what the purpose of the underlines is.

```
Evaluate[u[x_, t_]]
```

The first few terms look like this:

```
127.324 Sin[0.0261799 (x_)]   42.4413 Sin[0.0785398 (x_)]
----- + ----- +
      0.000685389 (t_)         0.0061685 (t_)
      2.71828                  2.71828

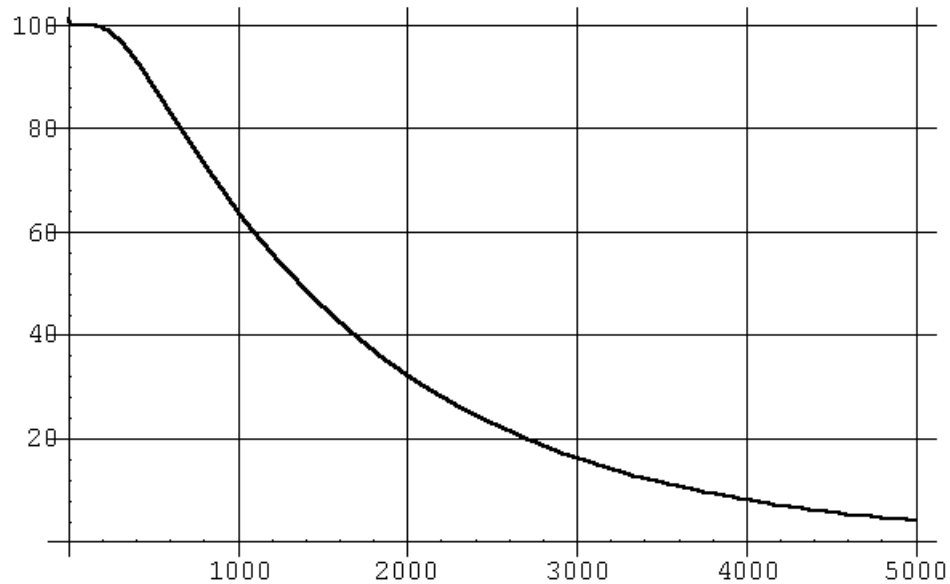
25.4648 Sin[0.1309 (x_)]    18.1891 Sin[0.18326 (x_)]
----- + ----- +
      0.0171347 (t_)         0.0335841 (t_)
      2.71828                  2.71828

14.1471 Sin[0.235619 (x_)]  11.5749 Sin[0.287979 (x_)]
----- + ----- +
      0.0555165 (t_)         0.0829321 (t_)
      2.71828                  2.71828
```

The following code creates a plot of the temperature at the midpoint of the rod $L/2$ versus time in seconds:

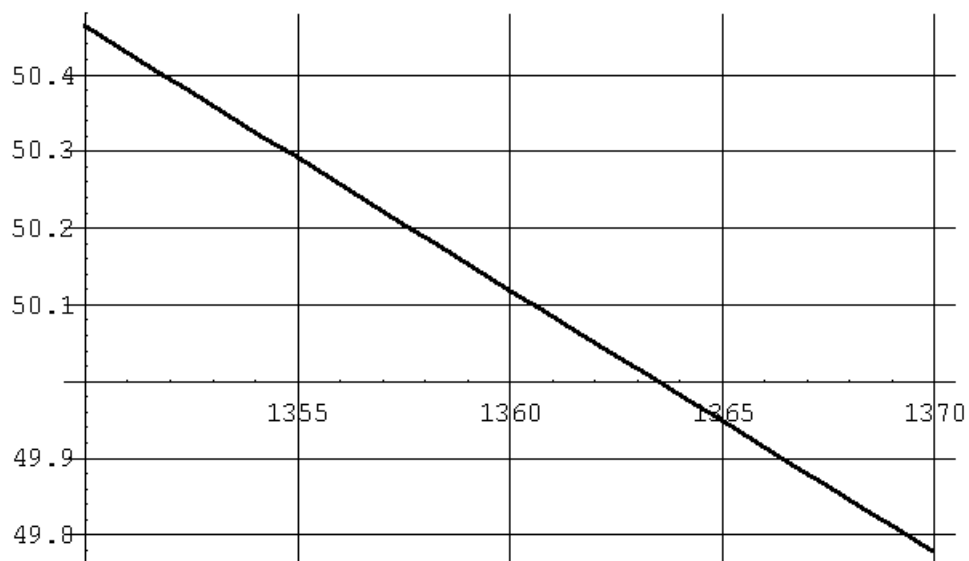
```
Plot[ u[L/2, t ], {t, 0, 5000}, GridLines->Automatic];
```

The plot looks like this. The `GridLines->Automatic` statement turns on the grid and is optional. You can select the plot and drag the edges to make it larger.



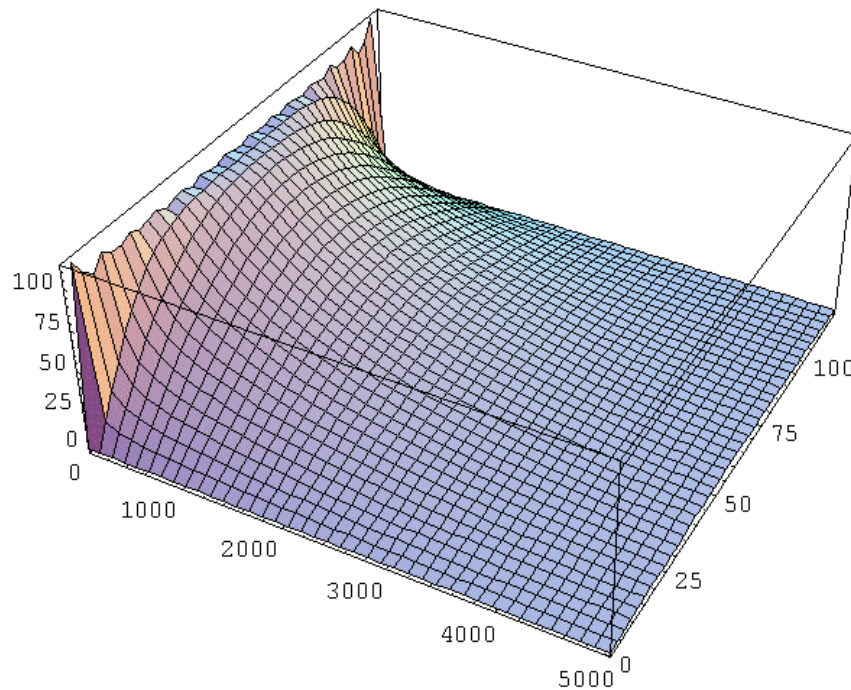
This problem asked to find the time at which the temperature at the midpoint fell to 50° within one second. We can "zoom in" on the graph by adjusting the parameters and read the value from the graph:

```
Plot[ u[L/2, t ], {t, 1350, 1370}, GridLines->Automatic];
```



The following code creates a 3D graph of the function $u(x, t)$. The PlotPoints option specifies the number of gridlines:

```
Plot3D[ u[x, t ],{t, 0, 5000}, {x,0,L}, PlotPoints -> 40]
```



The following code creates multiple plots on the same graph. The PlotRange option specifies the extent of the vertical axis to be plotted:

```
Plot[ {u[0, t],u[L/8, t],u[L/4, t], u[L/2, t]},  
{t, 0, 6000}, GridLines->Automatic, PlotRange->{0, 100}];
```

