This code verifies that the solution given in Sec. 1.4 really does solve the diffusion equation.

```
ClearAll["Global`*"] (*clears the workspace *)
u[x_, t_] =
 1 / Sqrt[4 * Pi * d * t] * Exp[- (x - mu) ^2 / (4 * d * t)] (*define solution function*)
```

$$\frac{e^{-\frac{(-mu+x)^2}{4\,d\,t}}}{2\sqrt{\pi}\,\sqrt{d\,t}}$$

```
Uxx[x_, t_] = D[u[x, t], {x, 2}]
(*calculate second partial with respect to x and define it as Uxx*)
Ut[x_, t_] = D[u[x, t], t]
 (*calculat first partial with respect to t and define it as Ut*)
```

$$\frac{-\frac{e^{-\frac{(-mu+x)^2}{4\,d\,t}}}{2\,d\,t}+\frac{e^{-\frac{(-mu+x)^2}{4\,d\,t}}\,(-mu+x)^2}{4\,d^2\,t^2}}{2\sqrt{\pi}\,\sqrt{d\,t}}$$

$$-\frac{d\,e^{-\frac{(-mu+x)^2}{4\,d\,t}}}{4\sqrt{\pi}\,(d\,t)^{3/2}}+\frac{e^{-\frac{(-mu+x)^2}{4\,d\,t}}\,(-mu+x)^2}{8\,d\sqrt{\pi}\,t^2\sqrt{d\,t}}$$

```
Simplify[Ut[x, t] - d * Uxx[x, t]] (*calculate u_t - du_xx and verify it's 0*)
0
```

Plot time snapshots of u[x,t] for a fixed diffusion coefficient and fixed mu

```
d = 0.5; (*set diffusion coefficient to be 0.5*)
mu = 2; (*set mean to be 2*)
Plot[{u[x, 0.1], u[x, 1], u[x, 2], u[x, 10]}, {x, -6, 10},
 PlotRange → All, PlotStyle → {Red, Blue, Green, Black},
 BaseStyle → {FontSize → 14, FontWeight → "Bold"},
 AxesLabel → {"x", "u"}, PlotLegends ->
  LineLegend[{Red, Blue, Green, Black}, {"t=0.1", "t=1", "t=2", "t=10"}]]
```