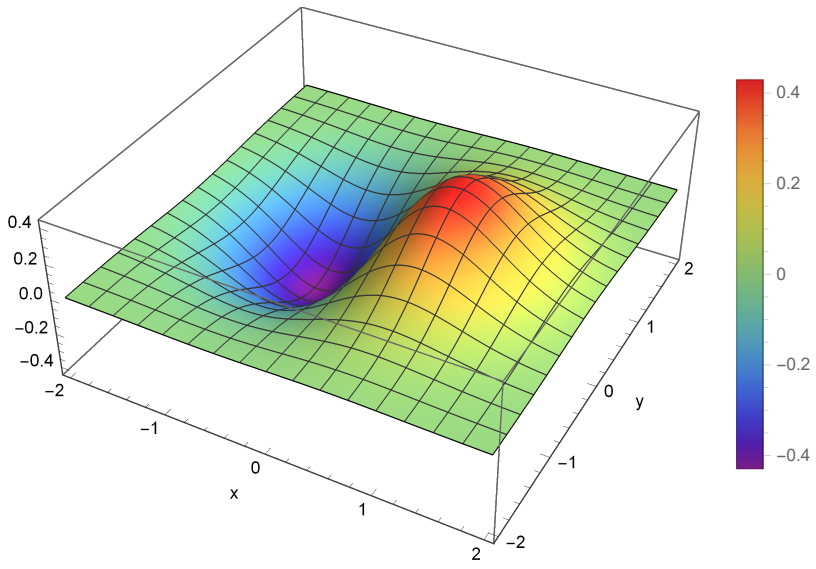
In[1]:=
```
f[x_, y_] := x Exp[-(x^2 + y^2)];
A[x_, y_] = D[f[x, y], x]
B[x_, y_] = D[f[x, y], y]
Plot3D[f[x, y], {x, -2, 2}, {y, -2, 2}, PlotPoints → 100,
 PlotLegends → Automatic, ColorFunction → "Rainbow", AxesLabel → {"x", "y"}]
ContourPlot[f[x, y], {x, -2, 2}, {y, -2, 2}, PlotPoints → 100, Contours → 30,
 ContourStyle → None, PlotLegends → Automatic, ColorFunction → "Rainbow"]
VectorPlot[{A[x, y], B[x, y]}, {x, -2, 2}, {y, -2, 2},
 VectorColorFunction → Function[{x, y, u, v, norm}, ColorData["Rainbow"][norm]],
 VectorColorFunctionScaling → True, FrameLabel → {"x", "y"},
 PlotLabel → "Vector Field Colored by Magnitude"]
```

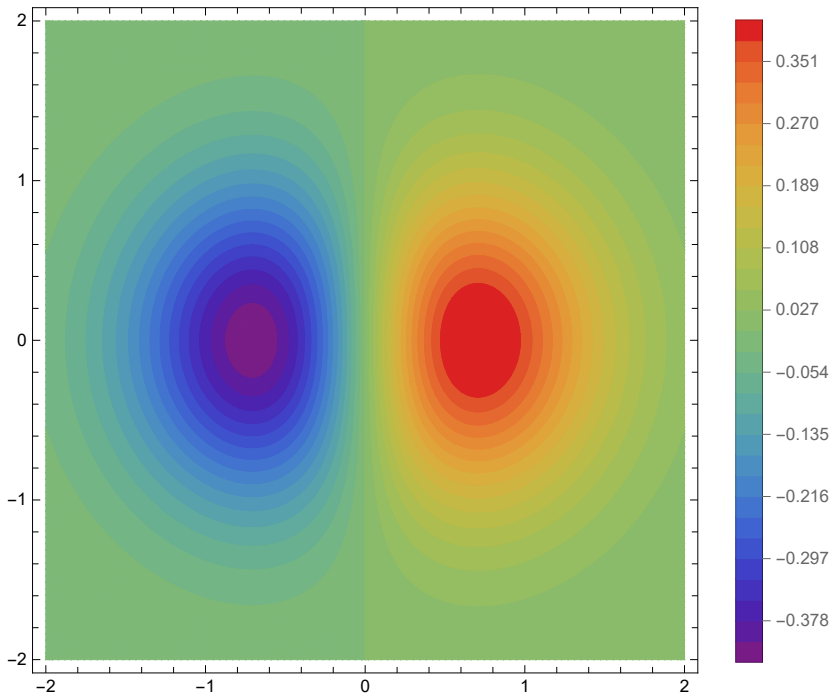
Out[2]= $e^{-x^2-y^2} - 2\, e^{-x^2-y^2}\, x^2$

Out[3]= $-2\, e^{-x^2-y^2}\, x\, y$

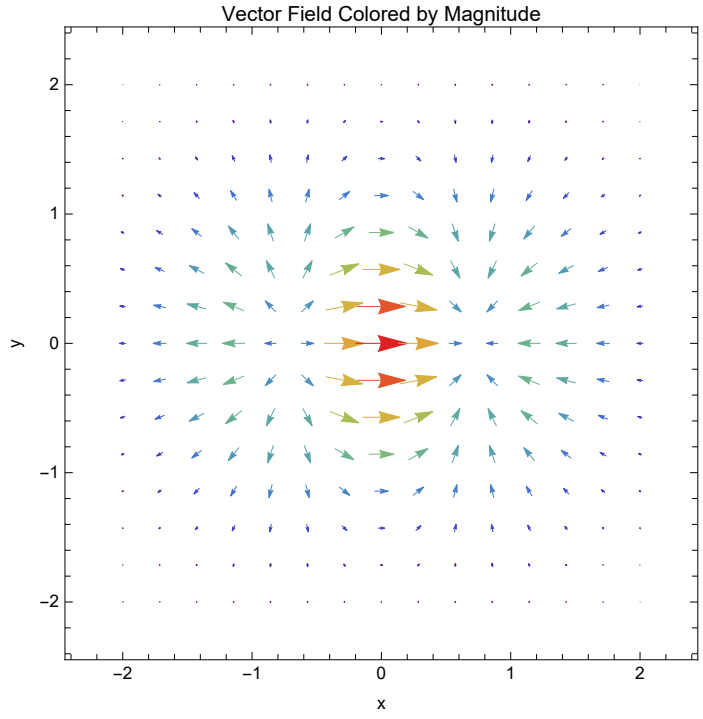
Out[4]=



Out[5]=


2
1
0
−1
−2
−2
−1
0
1
2
0.351
0.270
0.189
0.108
0.027
−0.054
−0.135
−0.216
−0.297
−0.378

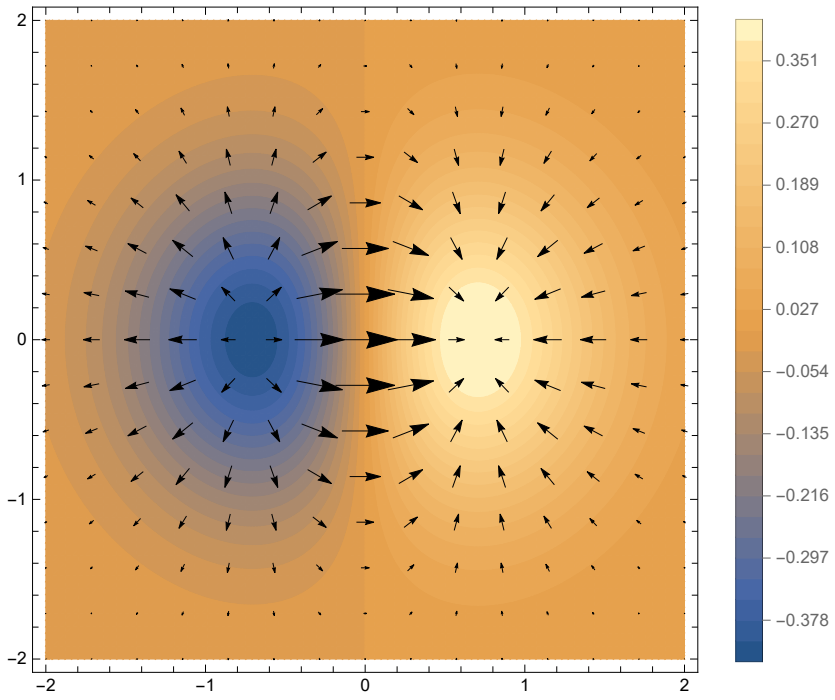
Out[6]=


Vector Field Colored by Magnitude
2
1
0
−1
−2
y
−2
−1
0
1
2
x

In[7]:=
```
f[x_, y_] := x Exp[-(x^2 + y^2)];
grad = Grad[f[x, y], {x, y}]
plot1 = ContourPlot[f[x, y], {x, -2, 2}, {y, -2, 2}, PlotPoints → 100,
   Contours → 30, ContourStyle → None, PlotLegends → Automatic];
plot2 = VectorPlot[grad, {x, -2, 2}, {y, -2, 2}, VectorStyle → Black];
Show[plot1, plot2]
```

Out[8]= $\left\{e^{-x^2-y^2} - 2\, e^{-x^2-y^2} x^2,\ -2\, e^{-x^2-y^2} x y\right\}$

Out[11]=

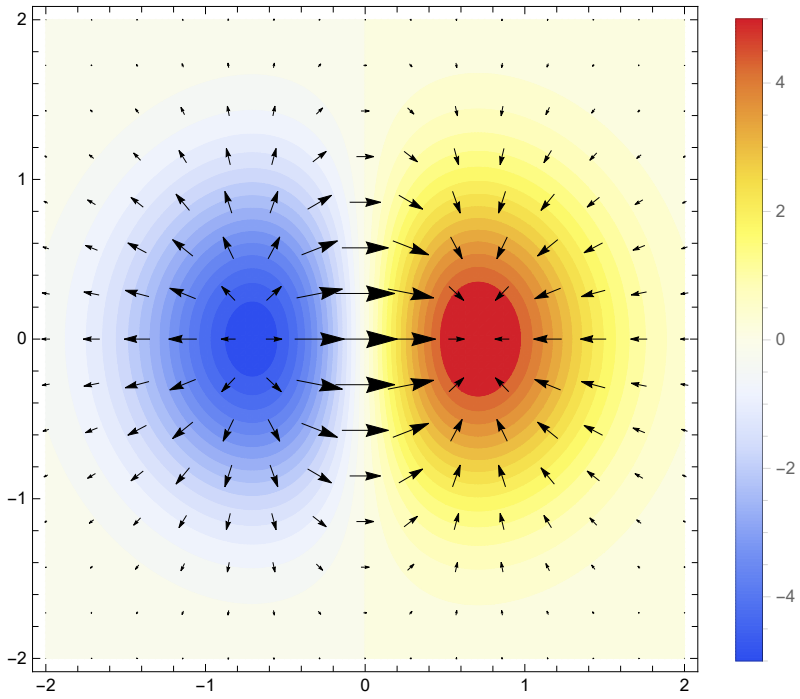


In[12]:=
```
f[x_, y_] := x Exp[-(x^2 + y^2)];
A = D[f[x, y], x]
B = D[f[x, y], y]
plot1 = ContourPlot[f[x, y], {x, -2, 2}, {y, -2, 2}, PlotPoints → 100, Contours → 30,
   ContourStyle → None, PlotLegends → BarLegend[{"TemperatureMap", {-5, 5}}],
   ColorFunction → "TemperatureMap"];
plot2 = VectorPlot[{A, B}, {x, -2, 2}, {y, -2, 2}, VectorStyle → Black];
Show[plot1, plot2]
```

Out[13]= $e^{-x^2-y^2} - 2\, e^{-x^2-y^2}\, x^2$

Out[14]= $-2\, e^{-x^2-y^2}\, x\, y$

Out[17]=

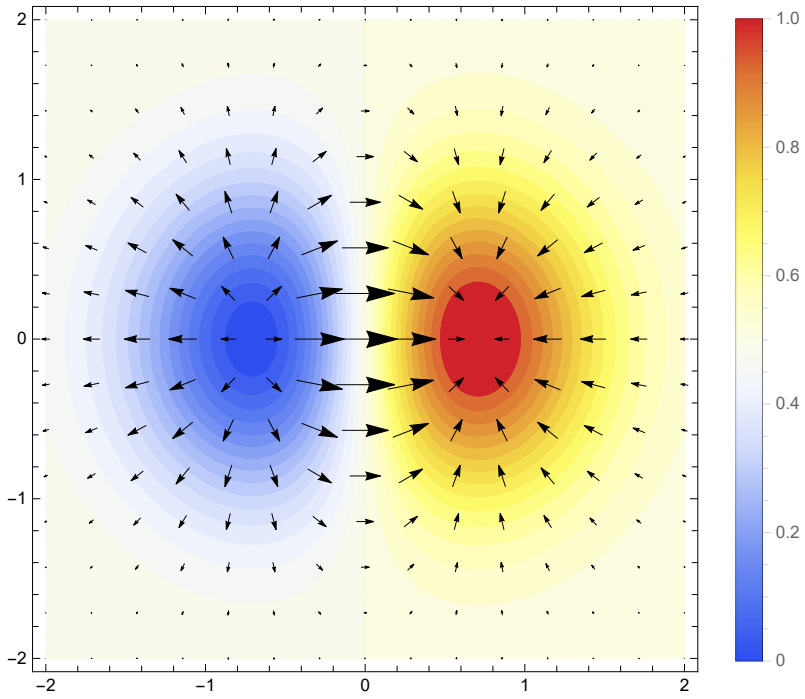


In[18]:=
```
f[x_, y_] := x Exp[-(x^2 + y^2)];
A = D[f[x, y], x]
B = D[f[x, y], y]
plot1 = ContourPlot[f[x, y], {x, -2, 2},
    {y, -2, 2}, PlotPoints → 100, Contours → 30, ContourStyle → None,
    PlotLegends → BarLegend[{"TemperatureMap", {0, 1}}], ColorFunction → "TemperatureMap"];
plot2 = VectorPlot[{A, B}, {x, -2, 2}, {y, -2, 2}, VectorStyle → Black];
Show[plot1, plot2]
```

Out[19]= $e^{-x^2-y^2} - 2\, e^{-x^2-y^2}\, x^2$

Out[20]= $-2\, e^{-x^2-y^2}\, x\, y$

Out[23]=

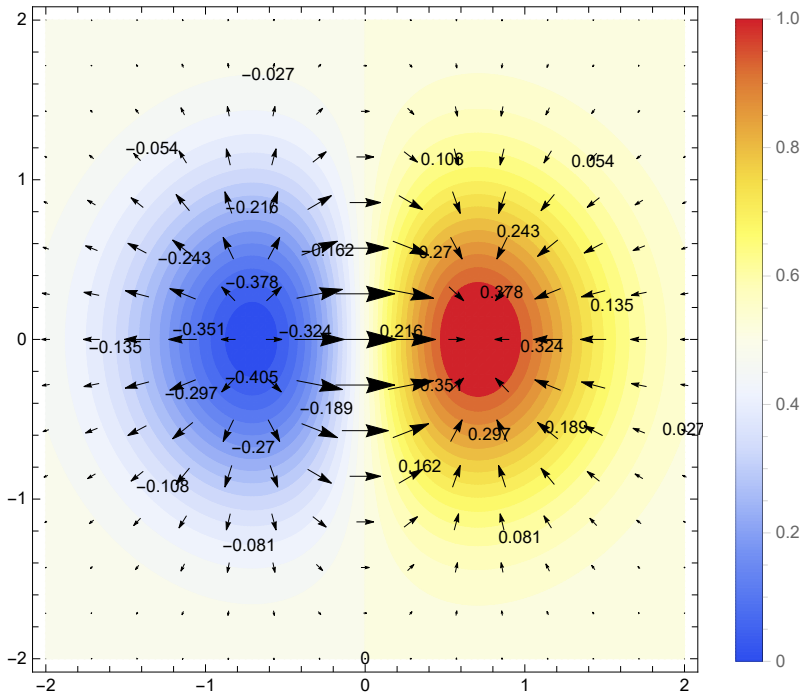


In[24]:=
```
f[x_, y_] := x Exp[-(x^2 + y^2)];
A = D[f[x, y], x]
B = D[f[x, y], y]
plot1 = ContourPlot[f[x, y], {x, -2, 2}, {y, -2, 2},
   PlotPoints → 100, Contours → 30, ContourStyle → None, ContourLabels → True,
   PlotLegends → BarLegend[{"TemperatureMap", {0, 1}}], (*Setting range in legend
    may show wrong data from the plot*)ColorFunction → "TemperatureMap"];
plot2 = VectorPlot[{A, B}, {x, -2, 2}, {y, -2, 2}, VectorStyle → Black];
Show[plot1, plot2]
```

Out[25]= $e^{-x^2-y^2} - 2\, e^{-x^2-y^2}\, x^2$

Out[26]= $-2\, e^{-x^2-y^2}\, x\, y$

Out[29]=

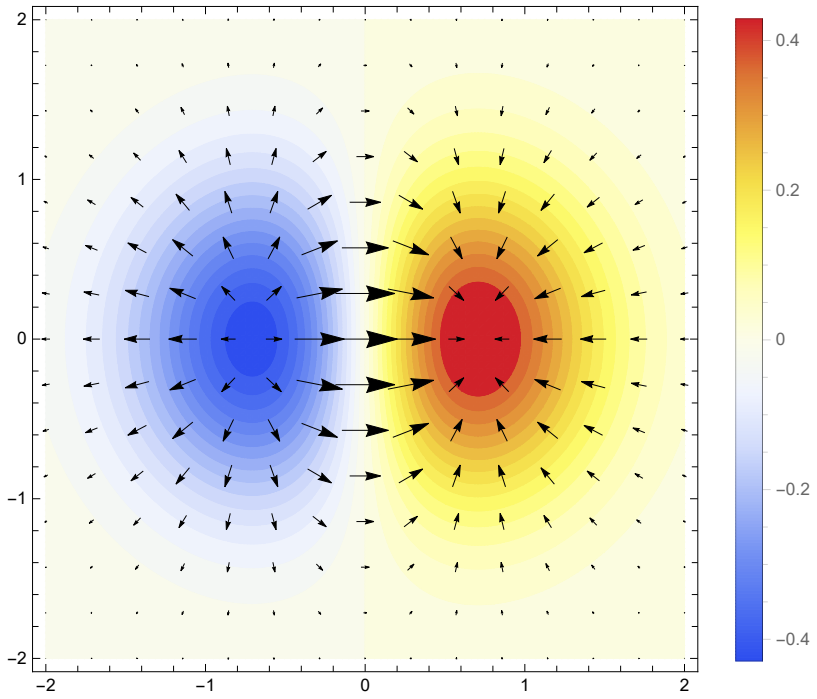


In[30]:=
```
f[x_, y_] := x Exp[-(x^2 + y^2)];
A = D[f[x, y], x]
B = D[f[x, y], y]
plot1 = ContourPlot[f[x, y], {x, -2, 2},
    {y, -2, 2}, PlotPoints → 100, Contours → 30, ContourStyle → None,
    PlotLegends → BarLegend[Automatic, None], ColorFunction → "TemperatureMap"];
plot2 = VectorPlot[{A, B}, {x, -2, 2}, {y, -2, 2}, VectorStyle → Black];
Show[plot1, plot2]
```

Out[31]= $e^{-x^2-y^2} - 2\, e^{-x^2-y^2}\, x^2$

Out[32]= $-2\, e^{-x^2-y^2}\, x\, y$

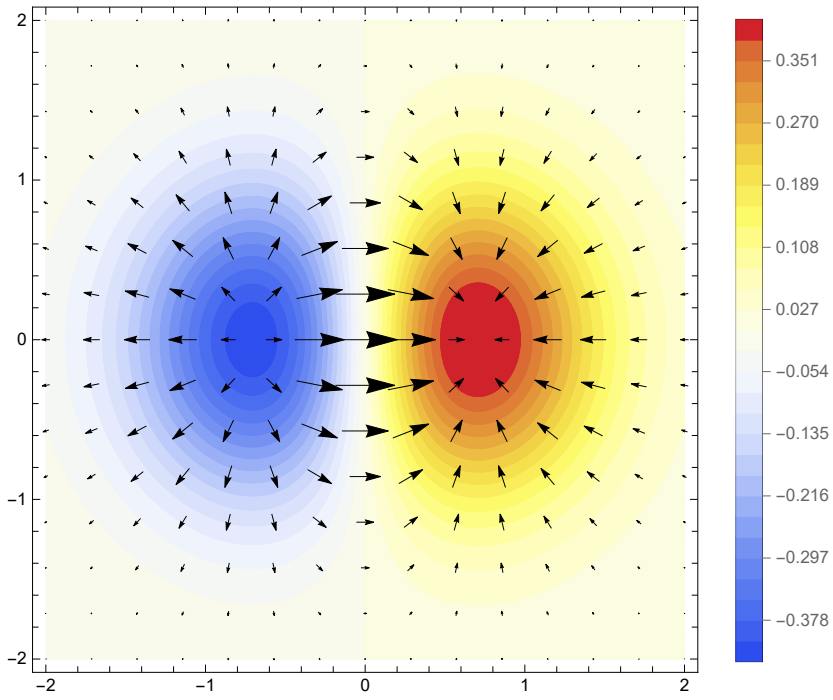
Out[35]=



In[36]:=
```
f[x_, y_] := x Exp[-(x^2 + y^2)];
grad = Grad[f[x, y], {x, y}]
plot1 = ContourPlot[f[x, y], {x, -2, 2}, {y, -2, 2}, PlotPoints → 100, Contours → 30,
   ContourStyle → None, PlotLegends → Automatic, ColorFunction → "TemperatureMap"];
plot2 = VectorPlot[grad, {x, -2, 2}, {y, -2, 2}, VectorStyle → Black];
Show[plot1, plot2]
```

Out[37]= $\left\{e^{-x^2-y^2} - 2\, e^{-x^2-y^2} x^2,\ -2\, e^{-x^2-y^2} x\, y\right\}$

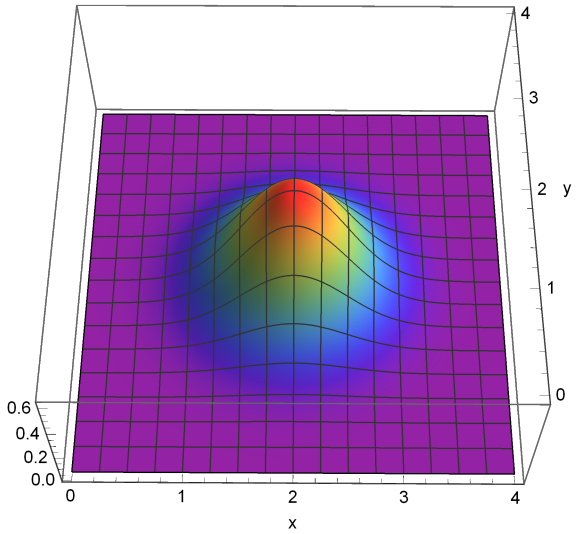
Out[40]=



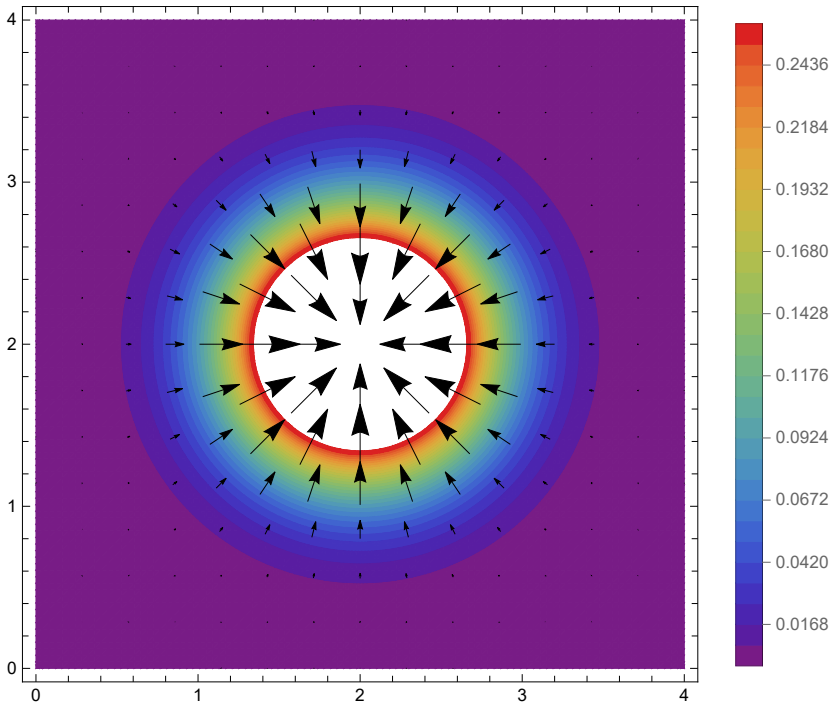
In[41]:=
```
G2[x_, y_, σ_] := (1 / ((σ^2) * 2 Pi)) Exp[- (((x - a) ^2) + ((y - b) ^2)) / (2 σ^2)];
a = 2; b = 2;
grad = Grad[G2[x, y, σ], {x, y}]
Plot3D[G2[x, y, σ = 0.5],  {x,  0, 4}, {y, 0, 4}, PlotPoints → 100,
 PlotRange → Full, AxesLabel → {"x", "y"}, ColorFunction → "Rainbow"]
plot1 = ContourPlot[G2[x, y, σ = 0.5],  {x,  0, 4}, {y, 0, 4}, PlotPoints → 100, Contours → 30,
   ContourStyle → None, PlotLegends → Automatic, ColorFunction → "Rainbow"];
plot2 = VectorPlot[grad, {x, 0, 4}, {y, 0, 4}, VectorStyle → Black];
Show[plot1, plot2]
```

Out[43]=
$$\left\{-\frac{e^{\frac{-(-2+x)^2-(-2+y)^2}{2\sigma^2}}(-2+x)}{2\pi\sigma^4},\ -\frac{e^{\frac{-(-2+x)^2-(-2+y)^2}{2\sigma^2}}(-2+y)}{2\pi\sigma^4}\right\}$$

Out[44]=



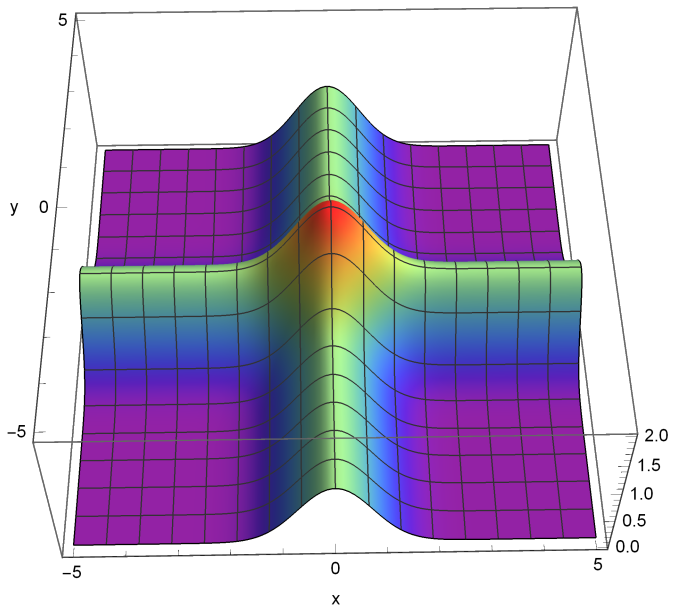
Out[47]=



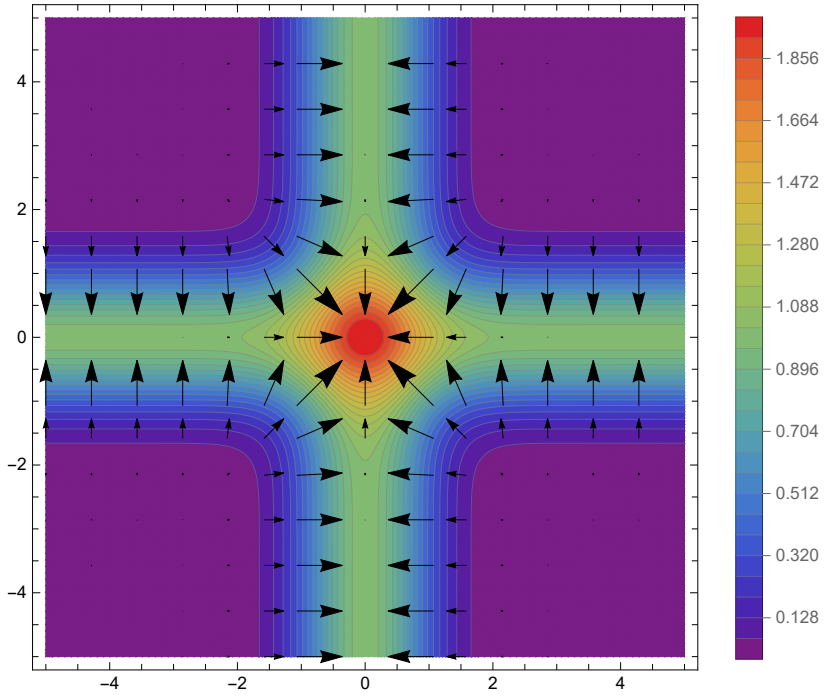
In[48]:=
```
g2[x_, y_] := Exp[-x^2] + Exp[-y^2];
grad = Grad[g2[x, y], {x, y}]
Plot3D[g2[x, y], {x, -5, 5}, {y, -5, 5}, PlotPoints → 100,
 PlotRange → Full, AxesLabel → {"x", "y"}, ColorFunction → "Rainbow"]
plot1 = ContourPlot[g2[x, y], {x, -5, 5}, {y, -5, 5}, PlotPoints → 100, Contours → 30,
   ContourStyle → Gray, PlotLegends → Automatic, ColorFunction → "Rainbow"];
plot2 = VectorPlot[grad, {x, -5, 5}, {y, -5, 5}, VectorStyle → Black];
Show[plot1, plot2]
```

Out[49]= $\left\{-2\, e^{-x^2}\, x,\ -2\, e^{-y^2}\, y\right\}$

Out[50]=



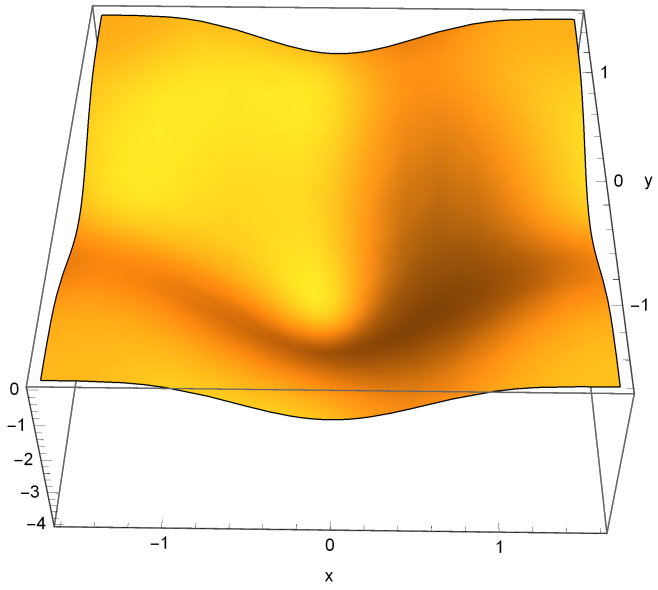
Out[53]=



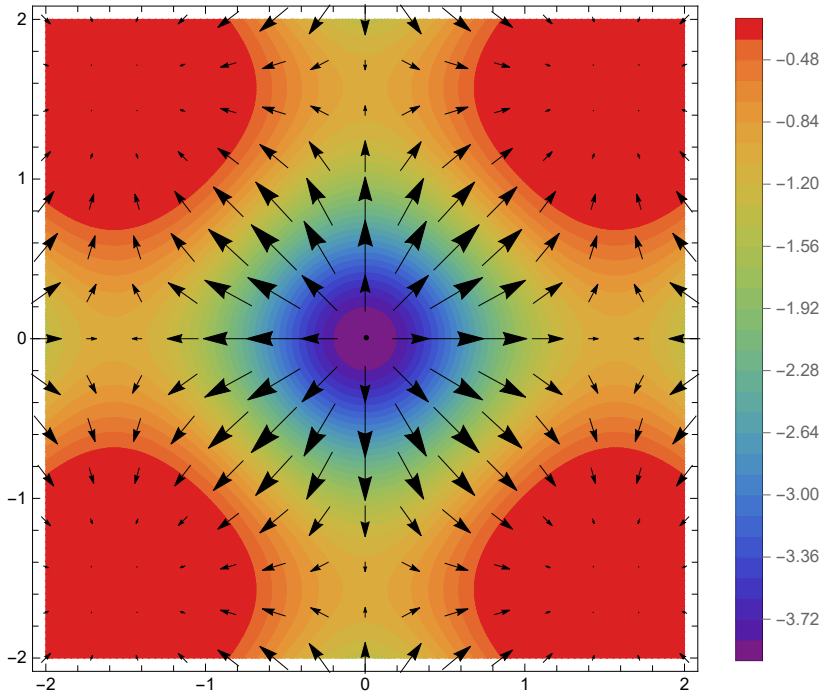
In[54]:=
```
f[x_, y_] := -((Cos[x])^2 + (Cos[y])^2)^2;
grad = Grad[f[x, y], {x, y}]
Plot3D[f[x, y], {x, -Pi/2, Pi/2}, {y, -Pi/2, Pi/2}, Mesh → None, AxesLabel → {"x", "y"}]
plot1 = ContourPlot[f[x, y], {x, -2, 2},
    {y, -2, 2}, PlotPoints → 100, Contours → 30, ContourStyle → None,
    PlotLegends → Automatic, ColorFunction → "Rainbow", AxesLabel → {"x", "y"}];
plot2 = VectorPlot[grad, {x, -2, 2}, {y, -2, 2},
    VectorStyle → Black, FrameLabel → {"x", "y"}];
Show[
 plot1,
 plot2]
```

Out[55]= $\{4 \text{Cos}[x] \left(\text{Cos}[x]^2 + \text{Cos}[y]^2\right) \text{Sin}[x], 4 \text{Cos}[y] \left(\text{Cos}[x]^2 + \text{Cos}[y]^2\right) \text{Sin}[y]\}$

Out[56]=


1
0 y
−1
0
−1
−2
−3
−4
−1
0
1
x

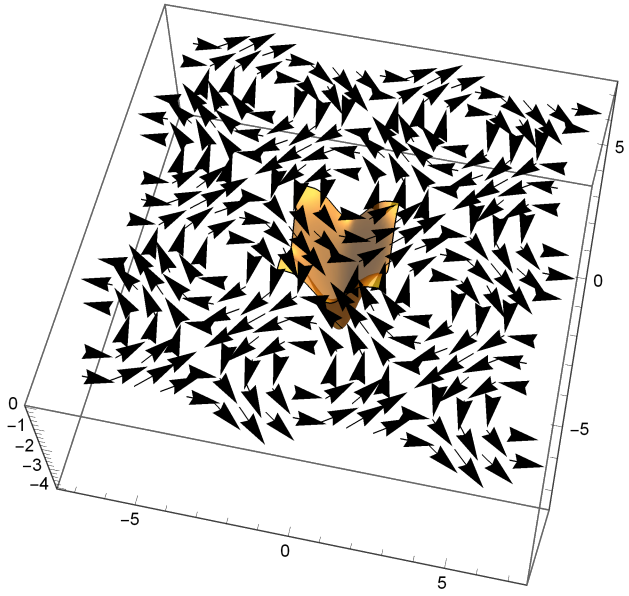
Out[59]=


2
1
0
−1
−2
−2
−1
0
1
2
−0.48
−0.84
−1.20
−1.56
−1.92
−2.28
−2.64
−3.00
−3.36
−3.72

In[60]:=
```
f[x_, y_] := -((Cos[x])^2 + (Cos[y])^2)^2;
grad = Grad[f[x, y], {x, y}]
surface = Plot3D[f[x, y], {x, -Pi/2, Pi/2},
   {y, -Pi/2, Pi/2}, PlotStyle → Opacity[0.7], Mesh → None];
vectorField = Graphics3D[Table[Arrow[{{x, y, 0}, {x + Cos[y], y + Sin[x], 0}}],
    {x, -2 Pi, 2 Pi, Pi/4}, {y, -2 Pi, 2 Pi, Pi/4}]];
Show[surface, vectorField, Boxed → True]
```

Out[61]=
$$\{4\,\mathrm{Cos}[x]\,(\mathrm{Cos}[x]^2+\mathrm{Cos}[y]^2)\,\mathrm{Sin}[x],\ 4\,\mathrm{Cos}[y]\,(\mathrm{Cos}[x]^2+\mathrm{Cos}[y]^2)\,\mathrm{Sin}[y]\}$$

Out[64]=



In[65]:=
```
f[x_, y_] := -((Cos[x])^2 + (Cos[y])^2)^2;
grad = Grad[f[x, y], {x, y}]
surface = Plot3D[f[x, y], {x, -Pi/2, Pi/2}, {y, -Pi/2, Pi/2}, PlotStyle → Opacity[0.7],
    MeshFunctions → {#3 &}, MeshStyle → {{Thick, Gray}}, AxesLabel → {"x", "y", "f(x, y)"}];

(*Create the 2D vector field*)
vectorField =
  VectorPlot[grad, {x, -Pi/2, Pi/2}, {y, -Pi/2, Pi/2}, Axes → False, Frame → False];

(*Combine the plots*)
Show[surface,
 Graphics3D[{Inset[vectorField, {0, 0, 0}, {Center, Center}, {6, 6}]}], Boxed → True]
```

Out[66]=
$$\left\{4 \cos[x] \left(\cos[x]^2 + \cos[y]^2\right) \sin[x],\ 4 \cos[y] \left(\cos[x]^2 + \cos[y]^2\right) \sin[y]\right\}$$

Out[69]=