Mathematics is life!

In[1]:=

```
4 * 8
```

Out[1]=

```
32
```

In[2]:=

```
3 + 6 * 5
```

Out[2]=

```
33
```

In[3]:=

```
274 / 3
```

Out[3]=

$$\frac{274}{3}$$

In[4]:=

```
274 / 3.
```

Out[4]=

```
91.3333
```

In[5]:=

```
(3.24 * 6.791 - 14.7) / (4.5 + 82 / 3)
```

Out[5]=

```
0.229409
```

In[6]:=

```
[(3.24 * 6.791) - 14.7] / (4.5 + 82 / 3)
```

The only grouping symbol is parenthesis!

In[6]:=

```
2.6^2.99
```

Out[6]=

```
17.4089
```

In[7]:=

```
3 × 5
```

Out[7]=

```
15
```

In[8]:=

```
Log[12.7]
```

Out[8]=

```
2.5416
```

In[9]:=

```
E^2.5
```

Out[9]=

```
12.1825
```

In[10]:=
```
Log[E, 12.7]
```
Out[10]=
```
2.5416
```
In[11]:=
```
Log[10, 72.8]
```
Out[11]=
```
1.86213
```
In[12]:=
```
Sqrt[64.0]
```
Out[12]=
```
8.
```
In[13]:=
```
Abs[-2.5]
```
Out[13]=
```
2.5
```
In[14]:=
```
I * I
```
Out[14]=
```
-1
```
In[15]:=
```
E
```
Out[15]=
```
ⅇ
```
In[16]:=
```
N[E]
```
Out[16]=
```
2.71828
```
In[17]:=
```
Pi
```
Out[17]=
```
π
```
In[18]:=
```
N[Pi]
```
Out[18]=
```
3.14159
```
In[19]:=
```
Pi // N
```
Out[19]=
```
3.14159
```

In[20]:=

```
NumberForm[N[E], 10]
```

Out[20]//NumberForm=

```
2.718281828
```

In[21]:=

```
NumberForm[N[Pi], 16]
```

Out[21]//NumberForm=

```
3.141592653589793
```

In[22]:=

```
N[Pi, 17]
```

Out[22]=

```
3.1415926535897932
```

In[23]:=

```
N[Pi, 1000]
```

Out[23]=

```
3.141592653589793238462643383279502884197169399375105820974944592307816406286208998628034825
 25342117067982148086513282306647093844609550582231725359408128481117450284102701938521105
 55964462294895493038196442881097566593344612847564823378678316527120190914564856692346034
 86104543266482133936072602491412737245870066063155881748815209209628292540917153643678925
 90360011330530548820466521384146951941511609433057270365759591953092186117381932611793105
 11854807446237996274956735188575272489122793818301194912983367336244065664308602139494639
 52247371907021798609437027705392171762931767523846748184676694051320005681271452635608277
 85771342757789609173637178721468440901224953430146549585371050792279689258923542019956112
 12902196086403441815981362977477130996051870721134999999837297804995105973173281609631859
 50244594553469083026425223082533446850352619311881710100031378387528865875332083814206171
 77669147303598253490428755468731159562863882353787593751957781857780532171226806613001927
 876611195909216420199
```

If a palette is not open, you can get it by clicking consecutively on the buttons Palettes, and Basic Math Assistant.

In[24]:=

$3^{5.2}$

Out[24]=

```
302.713
```

In[25]:=

$\sqrt{37.4}$

Out[25]=

```
6.11555
```

In[26]:=

$\sqrt{3.1^{2.7}}$

Out[26]=

```
4.60615
```

In[27]:=

$$\frac{125.3}{72}$$

Out[27]=

1.74028

In[28]:=

$$N\left[\sqrt{\frac{5}{9}}\right]$$

Out[28]=

0.745356

In[29]:=

```
N[E^2]
```

Out[29]=

7.38906

In[30]:=

```
Log[%]
```

Out[30]=

2.

In[31]:=

```
Log[%%]
```

Out[31]=

2.

In[32]:=

```
Log[%]
```

Out[32]=

0.693147

This was ln 2.

In[33]:=

```
Simplify[3 x^2 - x - 9 + x^2 + 7 x + 5]
```

Out[33]=

$-4 + 6x + 4x^2$

In[34]:=

```
Cancel[(x^2 - 2 x - 3) / (x^2 - 9)]
```

Out[34]=

$$\frac{1 + x}{3 + x}$$

In[35]:=

```
Factor[x^4 - 1]
```

Out[35]=

$(-1 + x)(1 + x)(1 + x^2)$

In[36]:=
```
Factor[a s + b a s]
```
Out[36]=
$a\,(1+b)\,s$

In[37]:=
```
Expand[(x + 2)^3]
```
Out[37]=
$8+12\,x+6\,x^2+x^3$

In[38]:=
```
Apart[x / ((x - 2) (x^2 + 3))]
```
Out[38]=
$$\frac{2}{7\,(-2+x)}+\frac{3-2\,x}{7\,\left(3+x^2\right)}$$

In[39]:=
```
Together[x / (x + 5) - 1 / (x - 4)]
```
Out[39]=
$$\frac{-5-5\,x+x^2}{(-4+x)\,(5+x)}$$

In[40]:=
```
x = 5; y = 12; z = a + b;
```
In[41]:=
```
x y^2
```
Out[41]=
720

In[42]:=
```
Expand[z^x]
```
Out[42]=
$a^5+5\,a^4\,b+10\,a^3\,b^2+10\,a^2\,b^3+5\,a\,b^4+b^5$

In[43]:=
```
Clear[x, y, z]
```
In[44]:=
```
Solve[3 x - 8 == 4]
```
Out[44]=
$\{\{x\to 4\}\}$

In[45]:=
```
Solve[a x - 2 == 3 a, x]
```
Out[45]=
$$\left\{\left\{x\to\frac{2+3\,a}{a}\right\}\right\}$$

In[46]:=
```
Solve[{x - 2 y == 4, x - 1 == 5 y}, {x, y}]
```
Out[46]=
```
{{x → 6, y → 1}}
```
In[47]:=
```
NSolve[2 x - 3 == x^2 - 3 x - 4]
```
Out[47]=
```
{{x → -0.192582}, {x → 5.19258}}
```
In[48]:=
```
NSolve[{x^2 + y^2 == 16, y == x^2 - 2 x + 2}, {x, y}]
```
Out[48]=
```
{{x → 2.46607, y → 3.14936}, {x → 1.12368 - 2.35752 i, y → -4.54261 - 0.583168 i},
 {x → 1.12368 + 2.35752 i, y → -4.54261 + 0.583168 i}, {x → -0.713436, y → 3.93586}}
```
In[49]:=
```
FindRoot[Cos[x] == x^3, {x, 1}]
```
Out[49]=
```
{x → 0.865474}
```
In[50]:=
```
f[x_] := x^2 - 5; g[x_] := Log[x] / x
```
In[51]:=
```
f[3]
```
Out[51]=
```
4
```
In[52]:=
```
g[f[x]]
```
Out[52]=

$$\frac{\text{Log}[-5 + x^2]}{-5 + x^2}$$

In[53]:=
```
g[f[3]]
```
Out[53]=

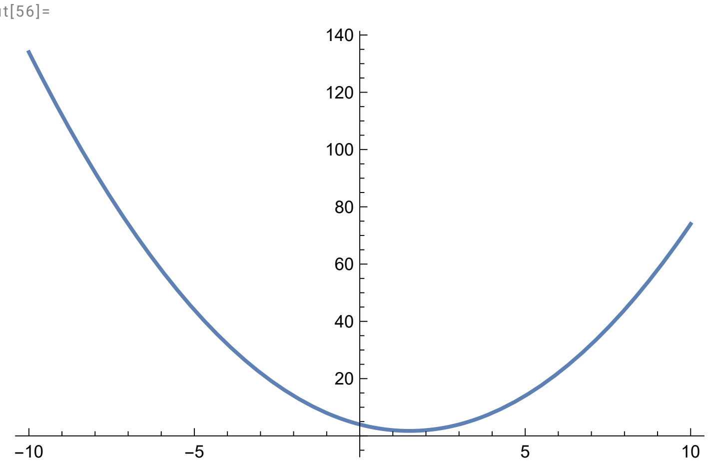
$$\frac{\text{Log}[4]}{4}$$

In[54]:=
```
N[g[f[3]]]
```
Out[54]=
```
0.346574
```
In[55]:=
```
Solve[f[x] == 4]
```
Out[55]=
```
{{x → -3}, {x → 3}}
```

In[56]:=

```
Plot[x^2 - 3 x + 4, {x, -10, 10}]
```

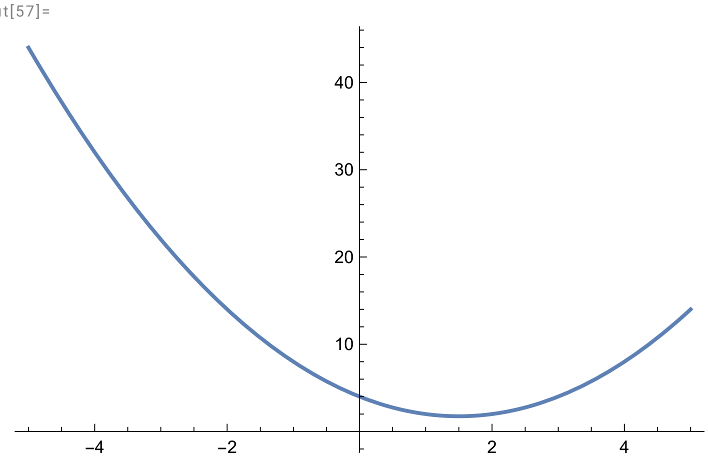
Out[56]=



In[57]:=

```
Plot[x^2 - 3 x + 4, {x, -5, 5}]
```

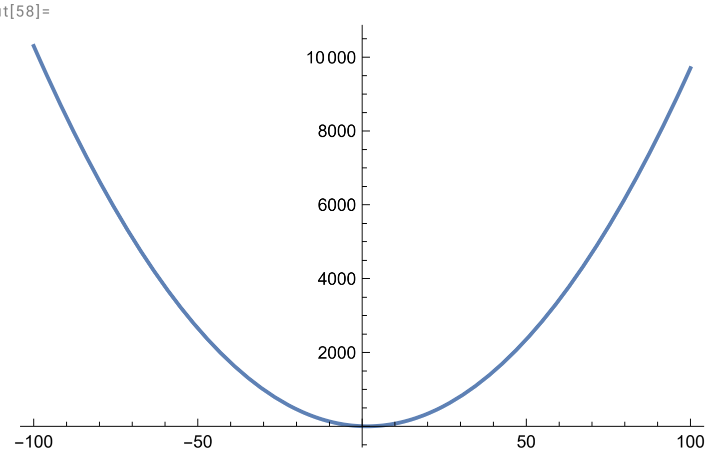
Out[57]=



In[58]:=

```
Plot[x^2 - 3 x + 4, {x, -100, 100}]
```

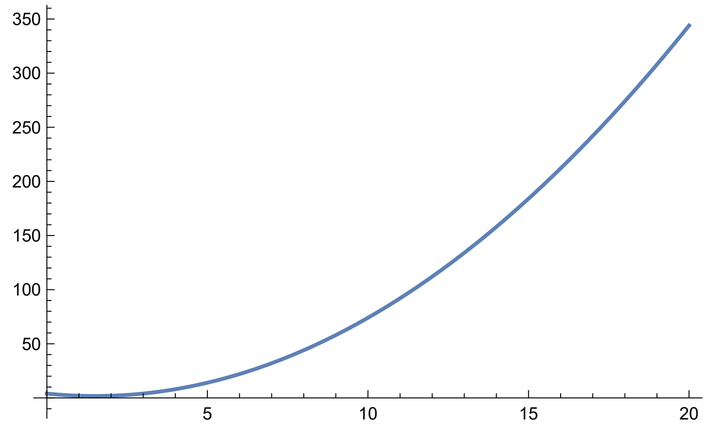
Out[58]=



In[59]:=

```
Plot[x^2 - 3 x + 4, {x, 0, 20}]
```

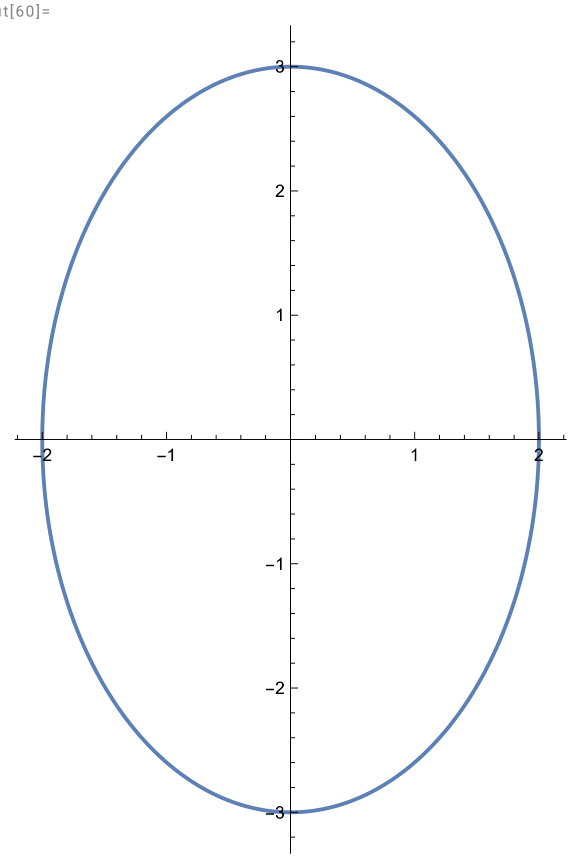
Out[59]=



In[60]:=

```
ParametricPlot[{2 Cos[t], 3 Sin[t]}, {t, 0, 2 Pi}]
```

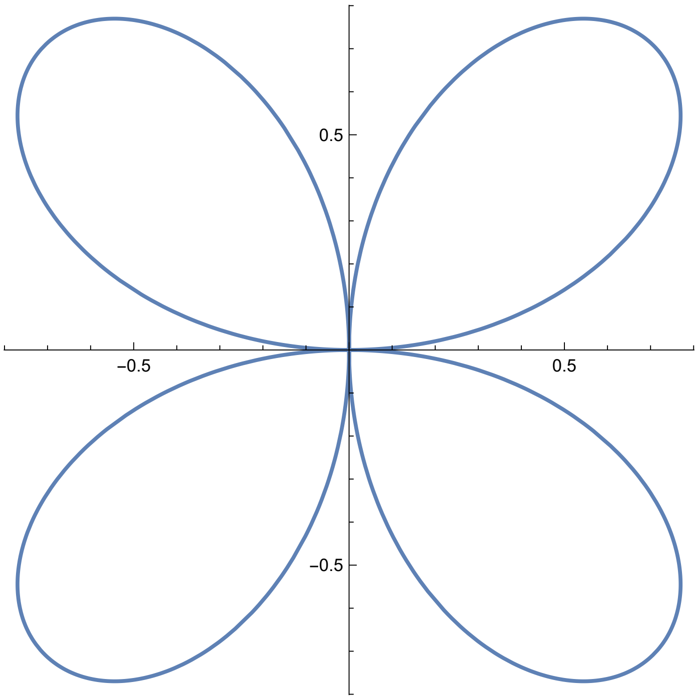
Out[60]=



In[61]:=

```
PolarPlot[Sin[2 t], {t, 0, 2 Pi}]
```

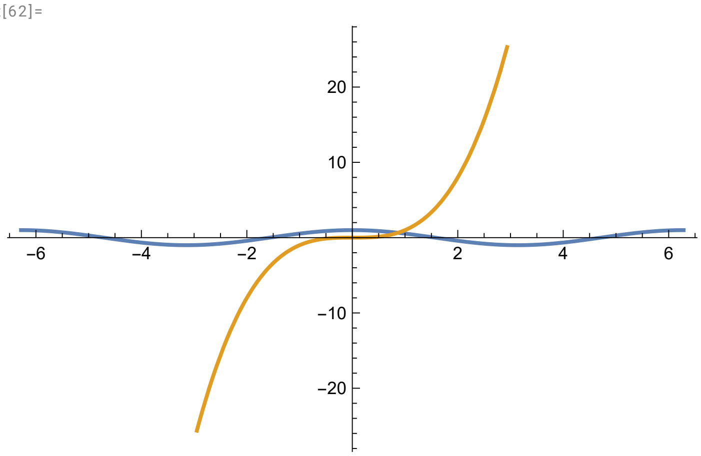
Out[61]=



In[62]:=

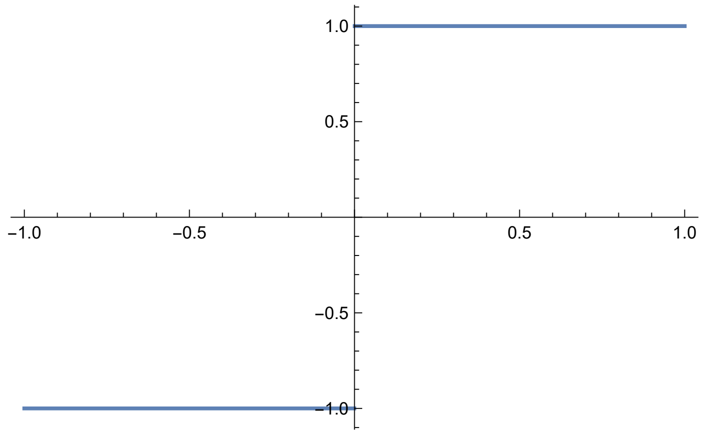
```
Plot[{Cos[x], x^3}, {x, -2 Pi, 2 Pi}]
```

Out[62]=



Be careful, the **`Limit`** command is not full proof. It may give the wrong answer in some cases. First, check the existence of a limit graphically or numerically.

In[63]:=
```
Plot[Abs[x] / x, {x, -1, 1}]
```
Out[63]=



In[64]:=
```
Limit[Abs[x] / x, x → 0, Direction → "FromBelow"]
```
Out[64]=
```
-1
```
In[65]:=
```
Limit[Abs[x] / x, x → 0, Direction → "FromAbove"]
```
Out[65]=
```
1
```
In[66]:=
```
Limit[Abs[x] / x, x → 0]
```
Out[66]=
```
Indeterminate
```

You can evaluate the next limit using the L'Hospital's rule.

In[67]:=
```
Limit[Log[x] / Sqrt[x], x → Infinity]
```
Out[67]=
```
0
```
In[68]:=
```
D[x^2 Sin[x] - 3 x + 1, x]
```
Out[68]=

$-3 + x^2 \text{Cos}[x] + 2 x \text{Sin}[x]$

In[69]:=
```
f[x_] := x^3 - 2 x^2 + 5; f'[x]
```
Out[69]=

$-4 x + 3 x^2$

In[70]:=
```
f''[x]
```
Out[70]=
$-4 + 6x$

In[71]:=
```
D[f[x], {x, 3}]
```
Out[71]=
6

In[72]:=
```
D[x^2 y[x]^2 + x Sin[y[x]] == 1, x]
```
Out[72]=
Sin[y[x]] + 2 x y[x]^2 + x Cos[y[x]] y′[x] + 2 x^2 y[x] y′[x] == 0

In[73]:=
```
Solve[%, y'[x]]
```
Out[73]=
$$\left\{\left\{y'[x] \to \frac{-\mathrm{Sin}[y[x]] - 2\,x\,y[x]^2}{x\,(\mathrm{Cos}[y[x]] + 2\,x\,y[x])}\right\}\right\}$$

In[74]:=
```
Integrate[x^2 + 1, x]
```
Out[74]=
$$x + \frac{x^3}{3}$$

In[75]:=
```
Integrate[x^2 + 1, {x, -1, 2}]
```
Out[75]=
6

In[76]:=
```
NIntegrate[Exp[-x^2], {x, 0, Infinity}]
```
Out[76]=
0.886227

In[77]:=
```
Integrate[3 x^2 (2010 - x^3)^1999, x]
```
Out[77]=
3 (… 1 …)

Size in memory: 3.5 MB | Show more | Show all | Iconize | Store full expression in notebook

You can easily find the above integral using u substitution: $-\frac{1}{2000}\left(2010 - x^3\right)^{2000} + C$.

In[78]:=

```
Series[E^x, {x, 0, 6}]
```

Out[78]=

$$1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \frac{x^5}{120} + \frac{x^6}{720} + O[x]^7$$

In[79]:=

```
Normal[Series[Cos[x], {x, 0, 8}]]
```

Out[79]=

$$1 - \frac{x^2}{2} + \frac{x^4}{24} - \frac{x^6}{720} + \frac{x^8}{40320}$$

In[80]:=

```
Series[Log[x], {x, 1, 5}]
```

Out[80]=

$$(x-1) - \frac{1}{2}(x-1)^2 + \frac{1}{3}(x-1)^3 - \frac{1}{4}(x-1)^4 + \frac{1}{5}(x-1)^5 + O[x-1]^6$$

In[81]:=

```
Sum[1 / n^2, {n, 1, Infinity}]
```

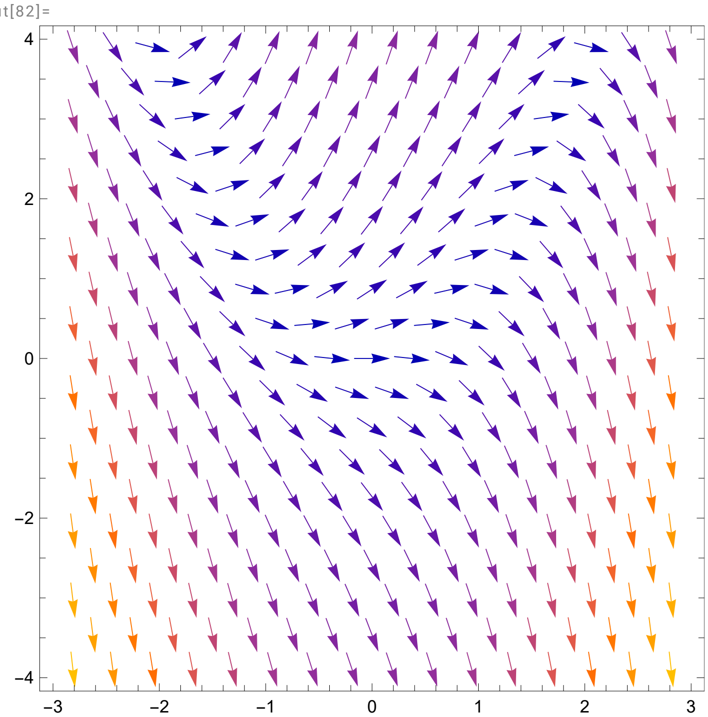
Out[81]=

$$\frac{\pi^2}{6}$$

In[82]:=

```
VectorPlot[{1, y - x^2}, {x, -3, 3}, {y, -4, 4}]
```

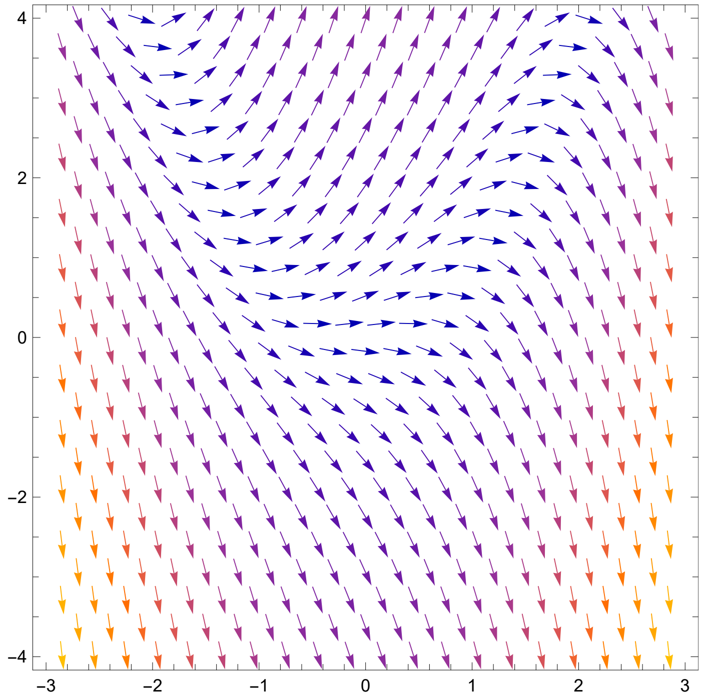
Out[82]=



In[83]:=

```
VectorPlot[{1, y - x^2}, {x, -3, 3}, {y, -4, 4}, VectorPoints → 20]
```

Out[83]=

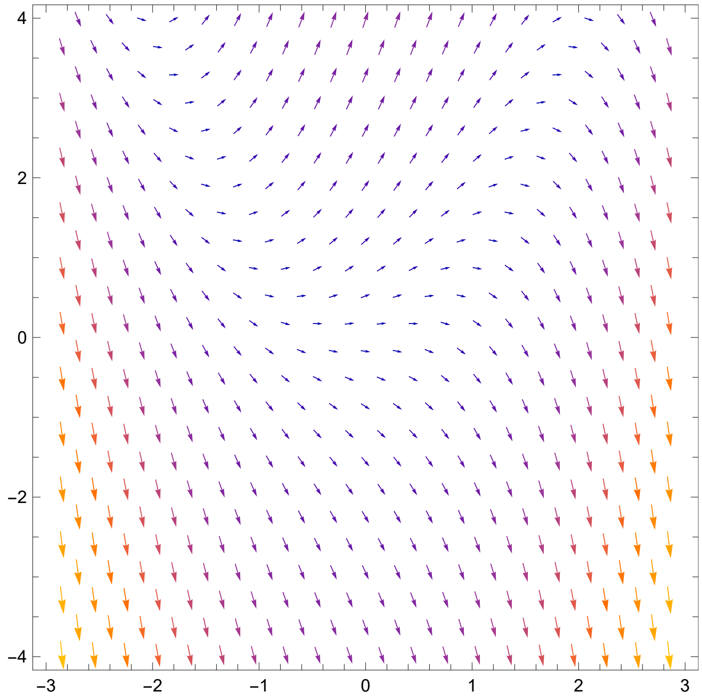


Notice that all vectors in above vector plots have the same length. The vector colors indicates the length of vectors. The following command preserves the relative length of vectors.

In[84]:=

```
VectorPlot[{1, y - x^2}, {x, -3, 3}, {y, -4, 4}, VectorScaling → Automatic, VectorPoints → 20]
```

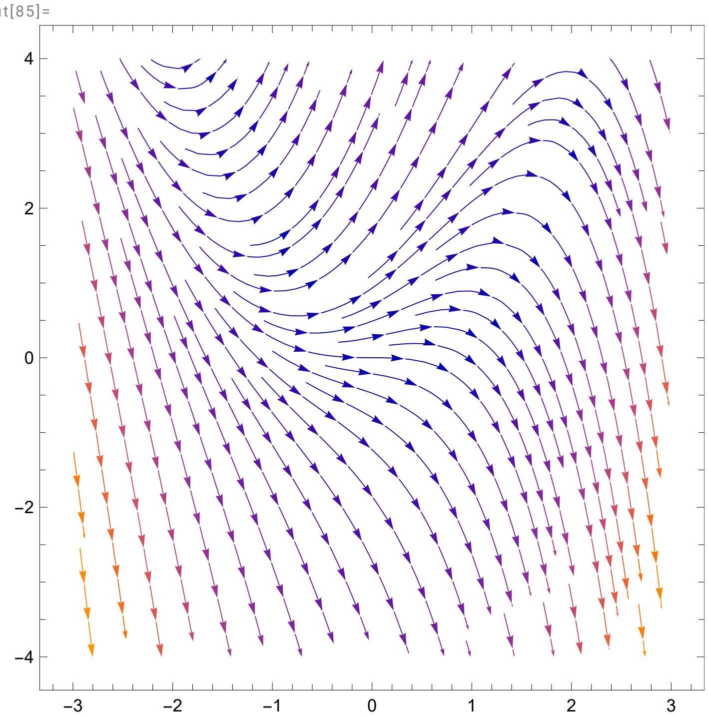
Out[84]=



In[85]:=

```
StreamPlot[{1, y - x^2}, {x, -3, 3}, {y, -4, 4}]
```

Out[85]=



In[86]:=

```
DSolve[y'[x] == y[x] - x^2, y[x], x]
```

Out[86]=

$$\{\{y[x] \to 2 + 2x + x^2 + e^x c_1\}\}$$

The general solution of the above ODE is: $y = Ce^x + x^2 + 2x + 2$.

In[87]:=

```
DSolve[{y'[x] == y[x] - x^2, y[0] == 2}, y[x], x]
```

Out[87]=

$$\{\{y[x] \to 2 + 2x + x^2\}\}$$

In[88]:=

```
NDSolve[{y'[x] == y[x] - x^2, y[0] == 2}, y[x], {x, -3, 3}]
```

Out[88]=

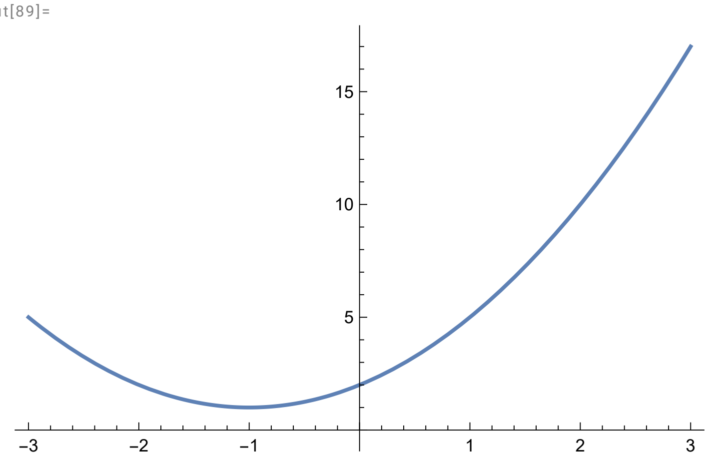
{{y[x] → InterpolatingFunction[Domain: {{-3., 3.}} Output: scalar][x]}}

The numerical solution can be graphed, as shown below.

In[89]:=

```
Plot[Evaluate[y[x] /. %], {x, -3, 3}]
```

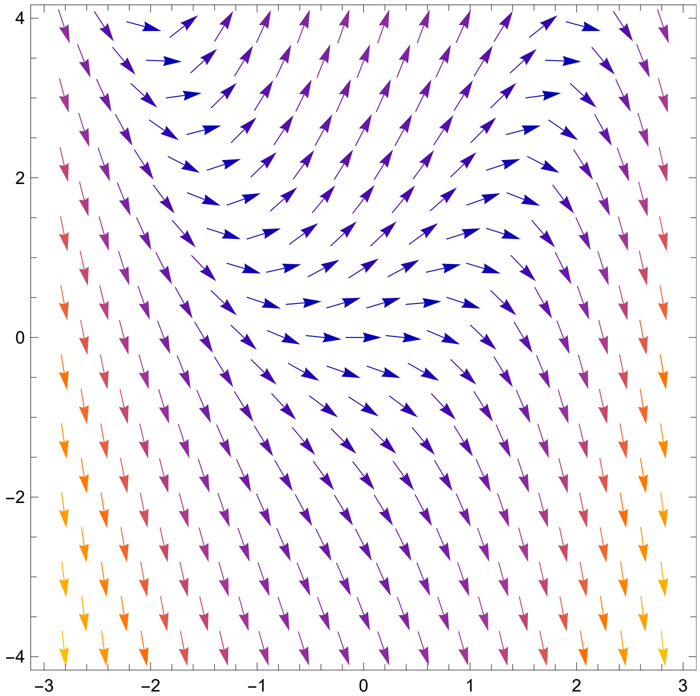
Out[89]=



In[90]:=

```
graph1 = VectorPlot[{1, y - x^2}, {x, -3, 3}, {y, -4, 4}]
```

Out[90]=



In[91]:=

```
NDSolve[{y'[x] == y[x] - x^2, y[0] == 2}, y[x], {x, -3, 3}]
```

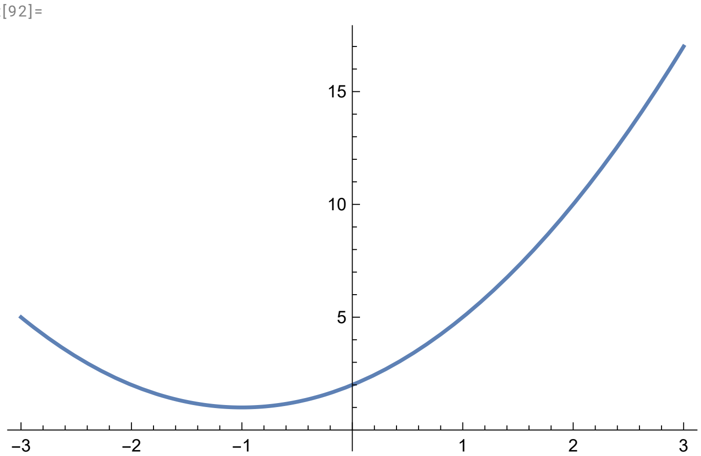
Out[91]=

```
{{y[x] → InterpolatingFunction[ Domain: {{-3., 3.}} Output: scalar ][x]}}
```

In[92]:=

```
graph2 = Plot[Evaluate[y[x] /. %], {x, -3, 3}]
```

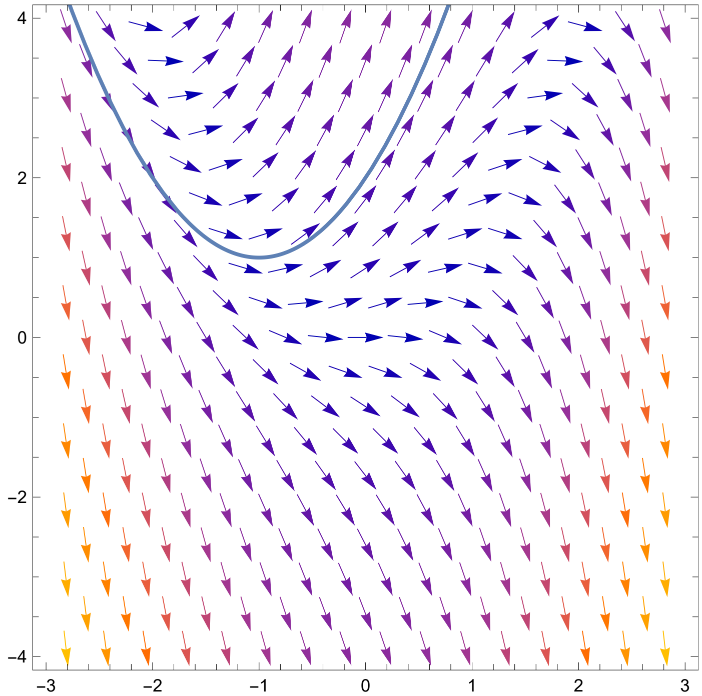
Out[92]=



In[93]:=

```
Show[graph1, graph2]
```

Out[93]=

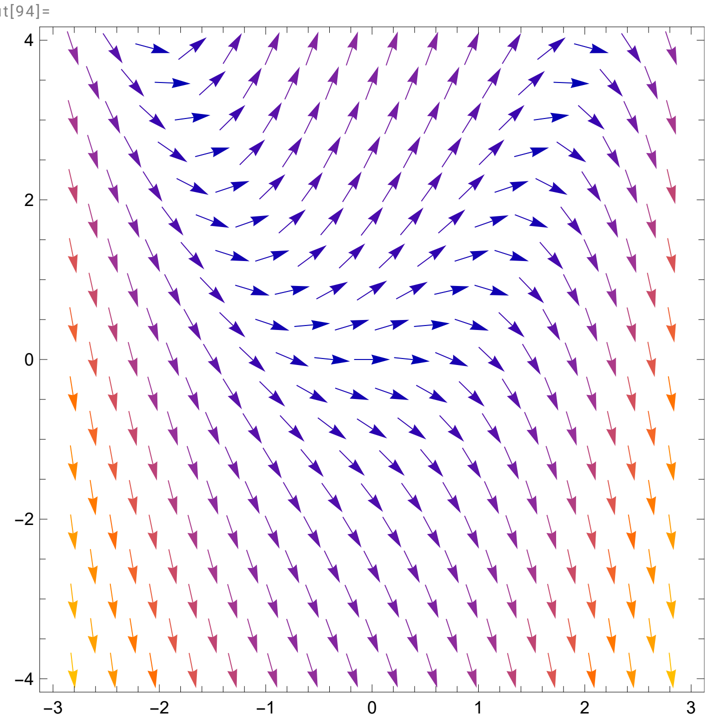


In the above the vector field and one solution are shown together.

In[94]:=

```
graph1 = VectorPlot[{1, y - x^2}, {x, -3, 3}, {y, -4, 4}]
```

Out[94]=



In[95]:=

```
Table[NDSolve[{y'[x] == y[x] - x^2, y[0] == n}, y[x], {x, -3, 3}], {n, -3, 3, 1}]
```

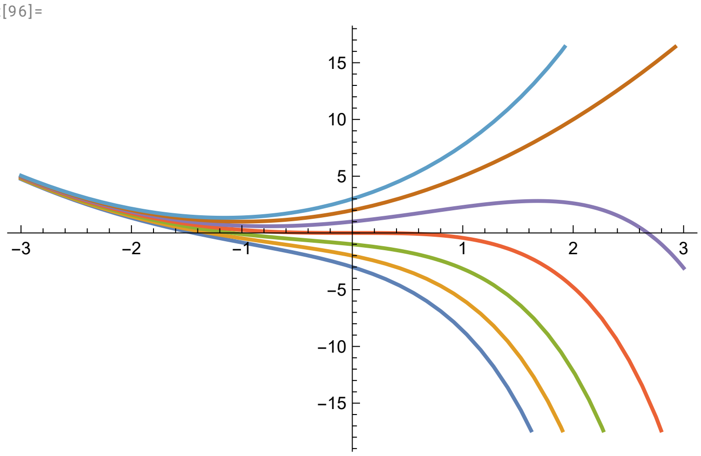
Out[95]=

```
{{{y[x] → InterpolatingFunction[ Domain: {{-3., 3.}} Output: scalar ][x]}},
 {{y[x] → InterpolatingFunction[ Domain: {{-3., 3.}} Output: scalar ][x]}},
 {{y[x] → InterpolatingFunction[ Domain: {{-3., 3.}} Output: scalar ][x]}},
 {{y[x] → InterpolatingFunction[ Domain: {{-3., 3.}} Output: scalar ][x]}},
 {{y[x] → InterpolatingFunction[ Domain: {{-3., 3.}} Output: scalar ][x]}},
 {{y[x] → InterpolatingFunction[ Domain: {{-3., 3.}} Output: scalar ][x]}},
 {{y[x] → InterpolatingFunction[ Domain: {{-3., 3.}} Output: scalar ][x]}}}
```

In[96]:=

```
graph3 = Plot[Evaluate[y[x] /. %], {x, -3, 3}]
```

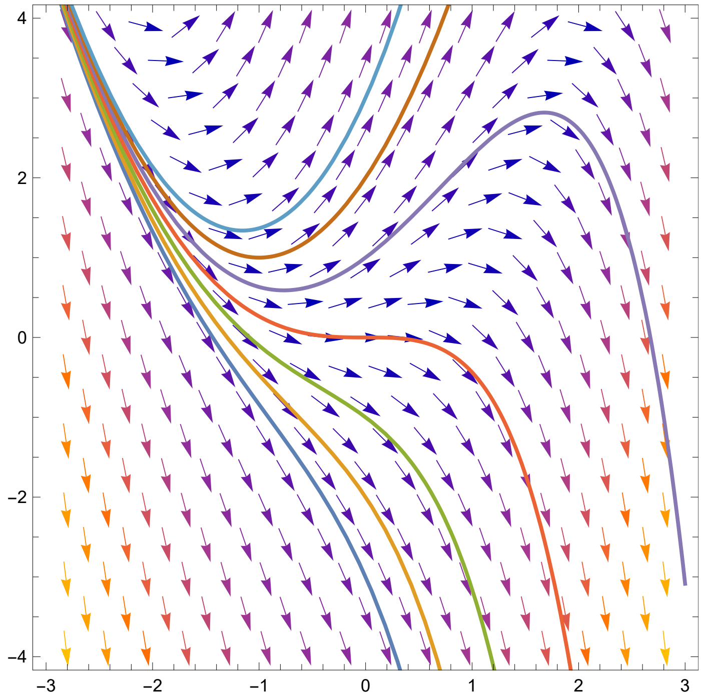
Out[96]=



In[97]:=

```
Show[graph1, graph3]
```

Out[97]=



In the above the vector field and several solutions are shown together.