Learning Wolfram Language

Exercises for Section 1 | Starting Out: Elementary Arithmetic

1.1 Compute1+2+3.

```
In[ ]:= 1 + 2 + 3
Out[ ]= 6
```

1.2 Add the numbers 1,2,3,4,5.

```
In[ ]:= 1 + 2 + 3 + 4 + 5
Out[ ]= 15
```

1.3 Multiply the numbers 1, 2, 3, 4, 5.

```
In[ ]:= 1 * 2 * 3 * 4 * 5
Out[ ]= 120
```

1.4 Compute 5 squared (i . e . 5*5 or 5 raised to the power 2)

```
In[ ]:= 5 ^ 2
Out[ ]= 25
```

1.5 Compute 3 raised to the fourth power .

```
In[ ]:= 3 ^ 4
Out[ ]= 81
```

1.6 Compute 10 raised to the power 12 (a trillion) .

```
In[ ]:= 10 ^ 12
Out[ ]= 1 000 000 000 000
```

1.7 Compute 3 raised to the power 7 x8 .

```
In[ ]:= 3 ^ (7 * 8)
Out[ ]= 523 347 633 027 360 537 213 511 521
```

1.8 Add parentheses to 4 - 2*3 + 4 to make 14.

In[ ]:=
```
(4 - 2) * (3 + 4)
```
Out[ ]=
```
14
```

1.9 Compute twenty - nine thousand mutiplied by seventy - three .

In[ ]:=
```
29 000 * 73
```
Out[ ]=
```
2 117 000
```

+1.1 Add all integers from - 3 to + 3.

In[ ]:=
```
-3 + -2 + -1 + 1 + 2 + 3
```
Out[ ]=
```
0
```

+1.2 Compute 24 divided by 3.

In[ ]:=
```
24 / 3
```
Out[ ]=
```
8
```

+1.3 Compute 5 raised to the power 100.

In[ ]:=
```
5 ^ 100
```
Out[ ]=
```
7 888 609 052 210 118 054 117 285 652 827 862 296 732 064 351 090 230 047 702 789 306 640 625
```

+1.4 Subtract 5 squared from 100

In[ ]:=
```
100 - (5 ^ 2)
```
Out[ ]=
```
75
```

+1.5 Multiply 6 by 5 squared, and add 7

In[ ]:=
```
(6 * (5 ^ 2)) + 7
```
Out[ ]=
```
157
```

+1.6 Compute 3 squared minus 2 cubed .

In[ ]:=
```
(3 ^ 2) - (2 ^ 3)
```
Out[ ]=
```
1
```

+1.7 Compute 2 cubed times 3 squared

In[ ]:=
```
(2 ^ 3) * (3 ^ 2)
```
Out[ ]=
```
72
```

+1.8 Compute "double the sum of eight and negative eleven"

In[ ]:=
```
(8 - 11) * 2
```
Out[ ]=
```
-6
```

Exercises for Section 2 | Introducing Functions

2.1 Compute 7 + 6 + 5 using the function Plus

In[ ]:=
```
Plus[7, 6, 5]
```
Out[ ]=
```
18
```

2.2 Compute 2 x (3 + 4) using Times and Plus

In[ ]:=
```
Times[2, Plus[3, 4]]
```
Out[ ]=
```
14
```

2.3 Use Max to find the larger of 6x8 and 5x9

In[ ]:=
```
Max[Times[6, 8], Times[5, 9]]
```
Out[ ]=
```
48
```

2.4 Use RandomInteger to generate a random number between 0 and 1000.

In[ ]:=
```
RandomInteger[1000]
```
Out[ ]=
```
443
```

2.5 Use Plus and RandomInteger to generate a number between 10 and 20.

In[ ]:=
```
Plus[10, RandomInteger[10]]
```
Out[ ]=
```
12
```

+2.1 Compute 5 x4x3x2 using Times .

In[ ]:=
```
Times[5, 4, 3, 2]
```
Out[ ]=
```
120
```

+2.2 Compute 2 - 3 using Subtract

In[ ]:=
```
Subtract[2, 3]
```
Out[ ]=
```
-1
```

+2.3 Compute (8 + 7) + (9 + 2) using Times and Plus

In[ ]:=
```
Times[Plus[8, 7], Plus[9, 2]]
```
Out[ ]=
```
165
```

+2.4 Compute (26 - 89)/9 using Subtract and Divide

In[ ]:=
```
Divide[Subtract[26, 89], 9]
```
Out[ ]=
```
-7
```

+2.5 Compute 100 - 5^2 using Subtract and Power

In[ ]:=
```
Subtract[100, Power[5, 2]]
```
Out[ ]=
```
75
```

+2.6 Find the larger of 3^5 and 5^3

In[ ]:=
```
Max[Power[3, 5], Power[5, 3]]
```
Out[ ]=
```
243
```

+2.7 Multiply 3 and the larger of 4^3 and 3^4

In[ ]:=
```
Times[3, Max[Power[4, 3], Power[3, 4]]]
```
Out[ ]=
```
243
```

+2.8 Add two random numbers each between 0 and 1000.

In[ ]:=
```
Plus[RandomInteger[1000], RandomInteger[1000]]
```
Out[ ]=
```
698
```

Exercises for Section 3 | First Look at Lists

3.1 Use Range to create the list {1, 2, 3, 4}

In[ ]:=
```
Range[4]
```
Out[ ]=
```
{1, 2, 3, 4}
```

3.2 Make a list of numbers up to 100

In[ ]:=
```
Range[100]
```
Out[ ]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23,
 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43,
 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62,
 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81,
 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100}
```

3.3 Use Range and Reverse to create {4, 3, 2, 1}

In[ ]:=
```
Reverse[Range[4]]
```
Out[ ]=
```
{4, 3, 2, 1}
```

3.4 Make a list of numbers from 1 to 50 in reverse order .

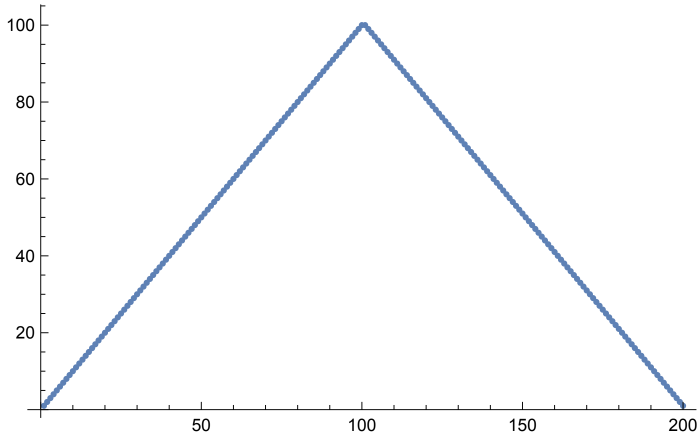
In[ ]:=
```
Reverse[Range[50]]
```
Out[ ]=
```
{50, 49, 48, 47, 46, 45, 44, 43, 42, 41, 40, 39, 38, 37,
 36, 35, 34, 33, 32, 31, 30, 29, 28, 27, 26, 25, 24, 23, 22, 21, 20,
 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1}
```

3.5 Use Range, Reverse and Join to create {1, 2, 3, 4, 4, 3, 2, 1}

In[ ]:=
```
Join[Range[4], Reverse[Range[4]]]
```
Out[ ]=
```
{1, 2, 3, 4, 4, 3, 2, 1}
```

3.6 Plot a list that counts up from 1 to 100, then down to 1.

In[ ]:=
```
ListPlot[Join[Range[100], Reverse[Range[100]]]]
```
Out[ ]=



3.7 Use Range and RandomInteger to make a list with a random lenght up to 10.

In[ ]:=
```
Range[RandomInteger[10]]
```
Out[ ]=
```
{1, 2, 3}
```

3.8 Find a simpler form for Reverse[Reverse[Range[10]]]

In[ ]:=
```
Range[10]
```
Out[ ]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
```

3.9 Find a simpler form to Join[{1, 2}, Join[{3, 4}, {5}]]

In[∘]:=
```
Range[5]
```
Out[∘]=
```
{1, 2, 3, 4, 5}
```

3.10 Find a simpler form for Join[Range[10], Join[Range[10], Range[5]]]

In[∘]:=
```
Join[Range[10], Range[10], Range[5]]
```
Out[∘]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 1, 2, 3, 4, 5}
```

3.11 Find a simpler form for Reverse[Join[Range[20], Reverse[Range[20]]]]

In[∘]:=
```
Join[Range[20], Reverse[Range[20]]]
```
Out[∘]=
```
{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19,
 20, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1}
```

+3.1 Compute the reverse of the reverse of {1, 2, 3, 4}

In[∘]:=
```
Reverse[Reverse[Range[4]]]
```
Out[∘]=
```
{1, 2, 3, 4}
```

+3.2 Use Range, Reverse and Join to create the list {1, 2, 3, 4, 5, 4, 3, 2, 1} .

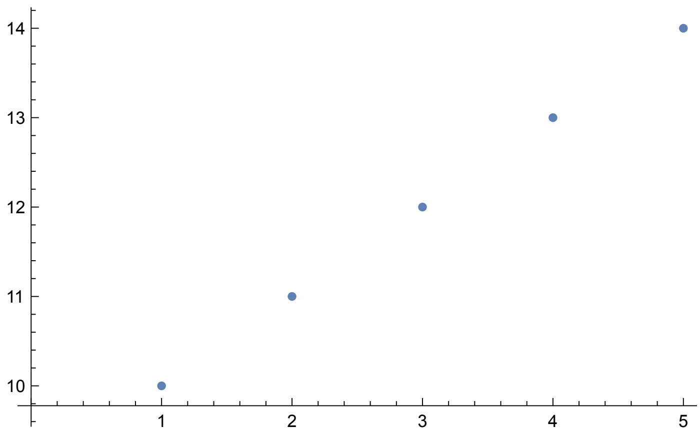
In[∘]:=
```
Join[Range[4], Reverse[Range[4]]]
```
Out[∘]=
```
{1, 2, 3, 4, 4, 3, 2, 1}
```

+3.3 Use Range, Reverse and Join to create {3, 2, 1, 4, 3, 2, 1, 5, 4, 3, 2, 1}

In[∘]:=
```
Join[Reverse[Range[3]], Reverse[Range[4]], Reverse[Range[5]]]
```
Out[∘]=
```
{3, 2, 1, 4, 3, 2, 1, 5, 4, 3, 2, 1}
```

+3.4 Plot the list numbers {10, 11, 12, 13, 14}

In[∘]:=
```
ListPlot[Range[10, 14]]
```
Out[∘]=

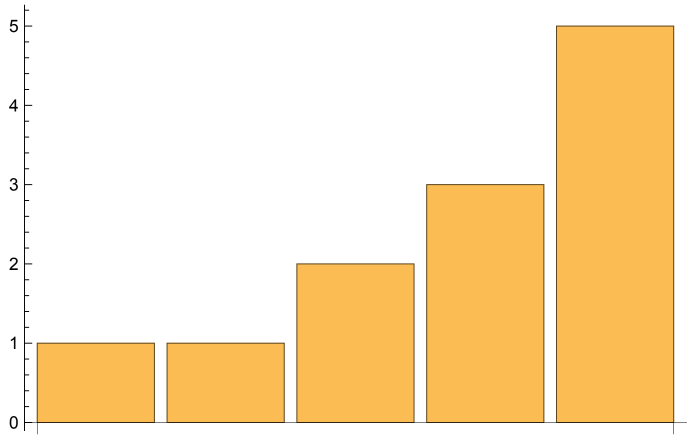


Exercises for Section 4 | Displaying Lists

4.1 Make a bar chart of {1, 1, 2, 3, 5}

In[∘]:=
```
BarChart[{1, 1, 2, 3, 5}]
```

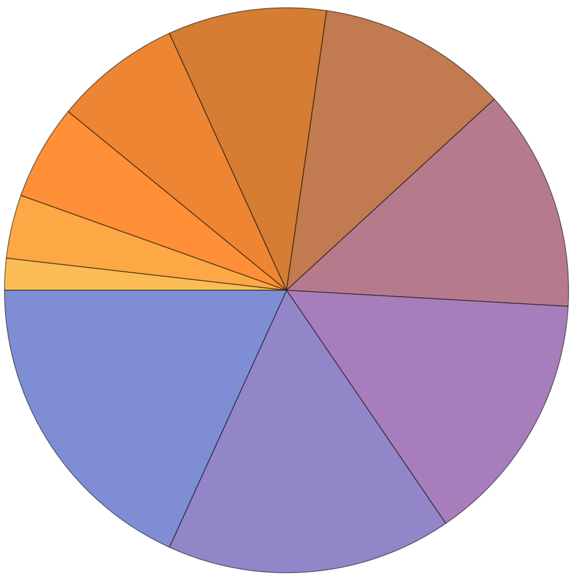
Out[∘]=



4.2 Make a pie chart of numbers from 1 to 10.

In[∘]:=
```
PieChart[Range[10]]
```

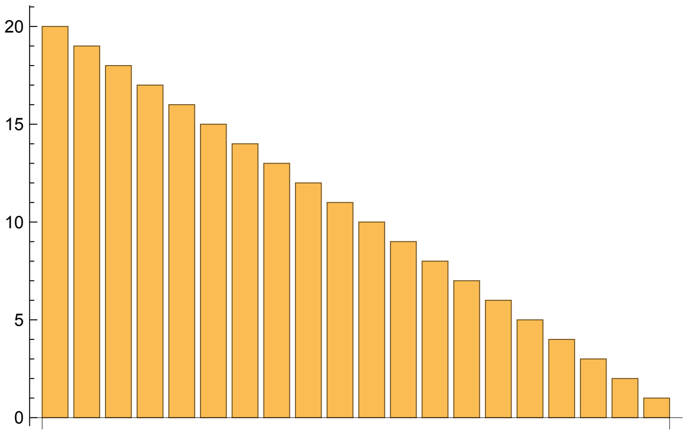
Out[∘]=



4.3 Make a bar chart of numbers counting down from 20 to 1.

In[ ]:=
```
BarChart[Reverse[Range[20]]]
```

Out[ ]=



4.4 Display numbers from 1 to 5 in a column .

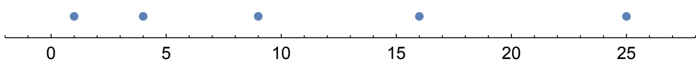
In[ ]:=
```
Column[Range[5]]
```

Out[ ]=
```
1
2
3
4
5
```

4.5 Make a number line plot of the squares {1, 4, 9, 16, 25} .

In[ ]:=
```
NumberLinePlot[Range[5]^2]
```

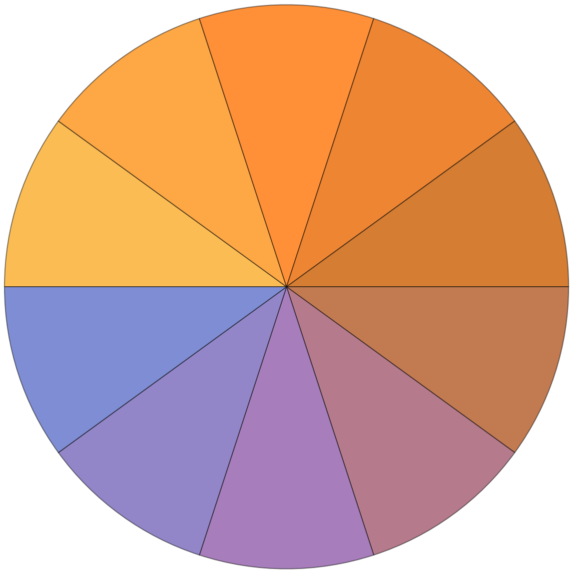
Out[ ]=



4.6 Make a pie chart with 10 identical segments, each of size 1.

In[ ]:=
```
PieChart[ConstantArray[1, 10]]
```

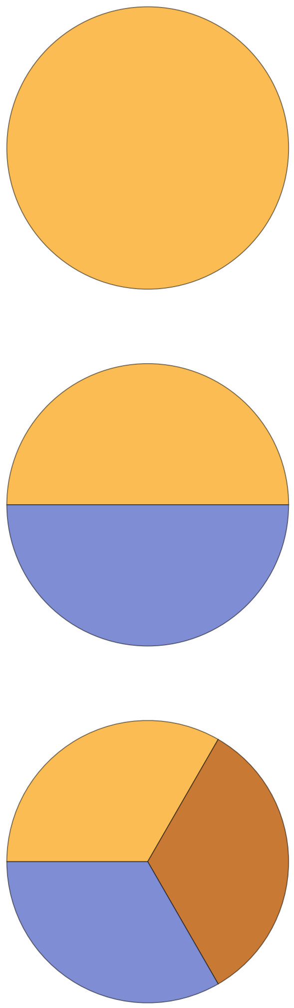
Out[ ]=



4.7 Make a column of pie charts with 1, 2 and 3 identical segments.

In[ ]:=
```
Column[{PieChart[{1}], PieChart[{1, 1}], PieChart[{1, 1, 1}]}, 3]
```

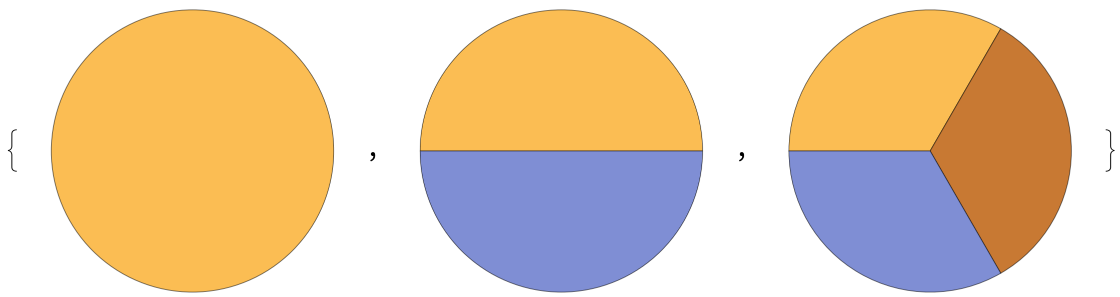
Out[ ]=



+4.1 Make a list of pie charts with 1, 2 and 3 identical segments .

In[ ]:=
```
{PieChart[{1}], PieChart[{1, 1}], PieChart[{1, 1, 1}]}
```

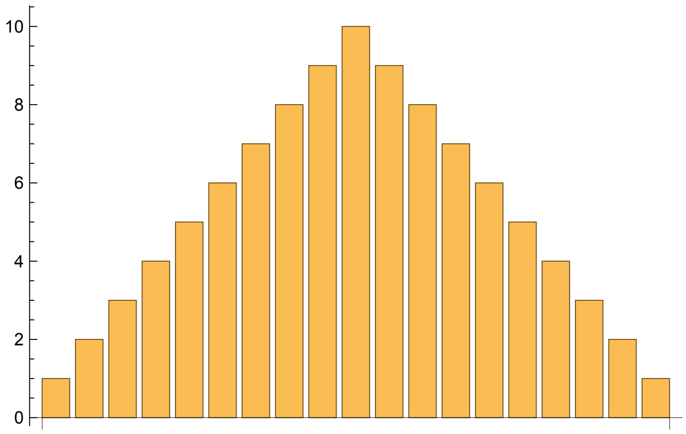
Out[ ]=



+4.2 Make a bar chart of the sequence 1, 2, 3, ..., 9, 10, 9, 8, 7, ..., 1.

In[∘]:=
```
BarChart[Join[Range[10], Reverse[Range[9]]]]
```

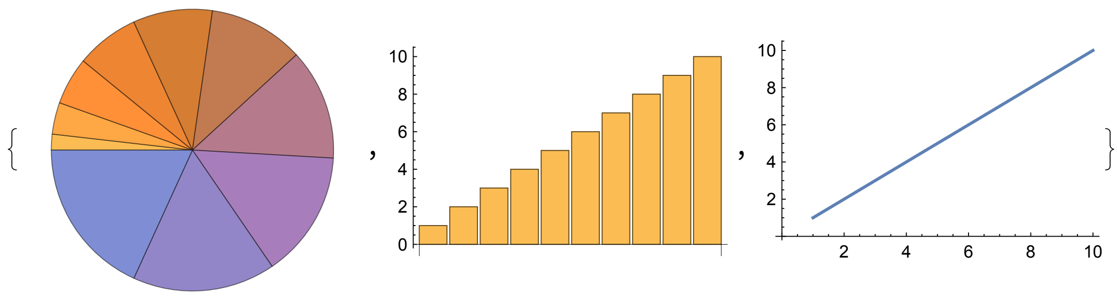
Out[∘]=



+4.3 Make a list of pie chart, bar chart and line plot of the numbers from 1 to 10.

In[∘]:=
```
{PieChart[Range[10]], BarChart[Range[10]], ListLinePlot[Range[10]]}
```

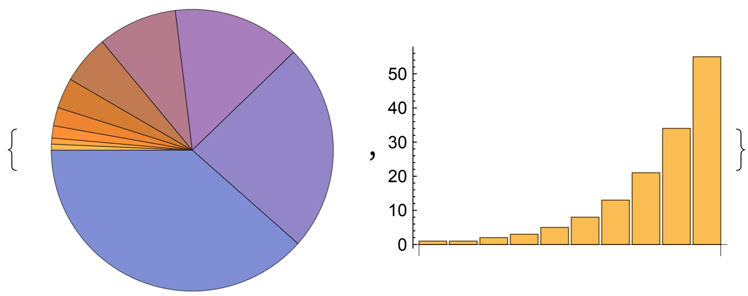
Out[∘]=



+4.4 Make a list of a pie chart and a bar chart of {1, 1, 2, 3, 5, 8, 13, 21, 34, 55}

In[∘]:=
```
{PieChart[Fibonacci[Range[10]]], BarChart[Fibonacci[Range[10]]]}
```

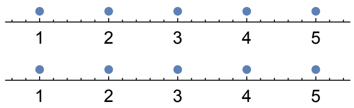
Out[∘]=



+4.5 Make a column of two number line plot of {1, 2, 3, 4, 5}

In[ ]:=
```
Column[{NumberLinePlot[Range[5]], NumberLinePlot[Range[5]]}]
```

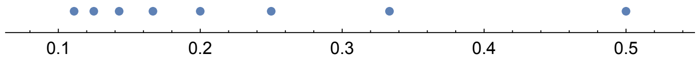
Out[ ]=



+4.6 Mae a number line of fractions 1/2, 1/3, ... through 1/9.

In[ ]:=
```
NumberLinePlot[{ConstantArray[1, 8] / Range[2, 9]}]
```

Out[ ]=



Exercises for Section 5 | Operations on Lists

5.1 Make a list of the first 10 squares, in reverse order .

In[ ]:=
```
Reverse[Range[10]^2]
```

Out[ ]=
```
{100, 81, 64, 49, 36, 25, 16, 9, 4, 1}
```

5.2 Find the total of the first 10 squares .

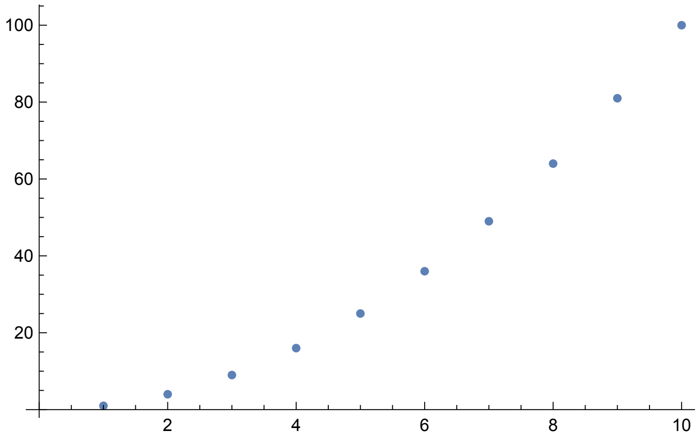
In[ ]:=
```
Total[Reverse[Range[10]^2]]
```

Out[ ]=
```
385
```

5.3 Make a plot of the first 10 squares, starting at 1.

In[ ]:=
```
ListPlot[Range[10]^2]
```

Out[ ]=



5.4 Use Sort, Join and Range to create {1, 1, 2, 2, 3, 3, 4, 4}.

In[ ]:=
```
Sort[Join[Range[4], Range[4]]]
```

Out[ ]=
```
{1, 1, 2, 2, 3, 3, 4, 4}
```

5.5 Use Range and + to make a list of numbers from 10 to 20, inclusive .

```
In[◦]:= Range[0, 10] + 10
Out[◦]= {10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

5.6 Make a combined list of the first 5 squares and cubes (numbers raised to the power 3), sorted into order .

```
In[◦]:= Sort[Join[Range[5]^2, Range[5]^3]]
Out[◦]= {1, 1, 4, 8, 9, 16, 25, 27, 64, 125}
```

5.7 Find the number of digits in 2^128.

```
In[◦]:= Length[IntegerDigits[2^128]]
Out[◦]= 39
```

5.8 Find the first digit of 3^32

```
In[◦]:= First[IntegerDigits[2^32]]
Out[◦]= 4
```

5.9 Find the first 10 digits in 2^100.

```
In[◦]:= Take[IntegerDigits[2^100], 10]
Out[◦]= {1, 2, 6, 7, 6, 5, 0, 6, 0, 0}
```

5.10 Find the largest digit that appears in 2^20.

```
In[◦]:= Max[IntegerDigits[2^20]]
Out[◦]= 8
```

5.11 Find how many zeros appear in the digits of 2^1000.

```
In[◦]:= Count[IntegerDigits[2^1000], 0]
Out[◦]= 28
```

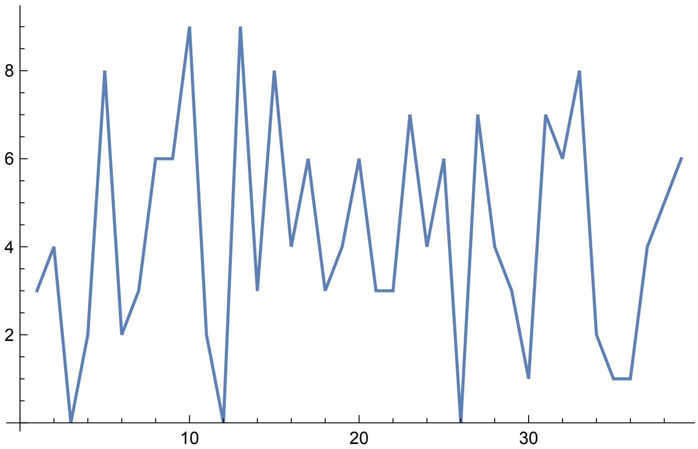
5.12 Use Part, Sort and IntegerDigit to find the second - smallest digit in 2^20.

```
In[◦]:= Part[Sort[IntegerDigits[2^20]], 2]
Out[◦]= 1
```

5.13 Make a line plot of the sequence of digits that appear in 2^128.

In[ ]:=
```
ListLinePlot[IntegerDigits[2^128]]
```

Out[ ]=



5.14 Use Take and Drop to get the sequence 11 through 20 from Range[100].

In[ ]:=
```
Take[Drop[Range[100], 10], 10]
```

Out[ ]=
```
{11, 12, 13, 14, 15, 16, 17, 18, 19, 20}
```

+5.1 Make a list of the first 10 multiples of 3.

In[ ]:=
```
Range[10] * 3
```

Out[ ]=
```
{3, 6, 9, 12, 15, 18, 21, 24, 27, 30}
```

+5.2 Make a list of the first 10 squares using only Range and Times .

In[ ]:=
```
Times[Range[10], Range[10]]
```

Out[ ]=
```
{1, 4, 9, 16, 25, 36, 49, 64, 81, 100}
```

+5.3 Find the last digit of 2^37.

In[ ]:=
```
Last[IntegerDigits[2^37]]
```

Out[ ]=
```
2
```

+5.4 Find the second-to-last digit of 2^32.

In[ ]:=
```
Last[Drop[IntegerDigits[2^32], -1]]
```

Out[ ]=
```
9
```

+5.5 Find the sum of all the digits of 3^126.

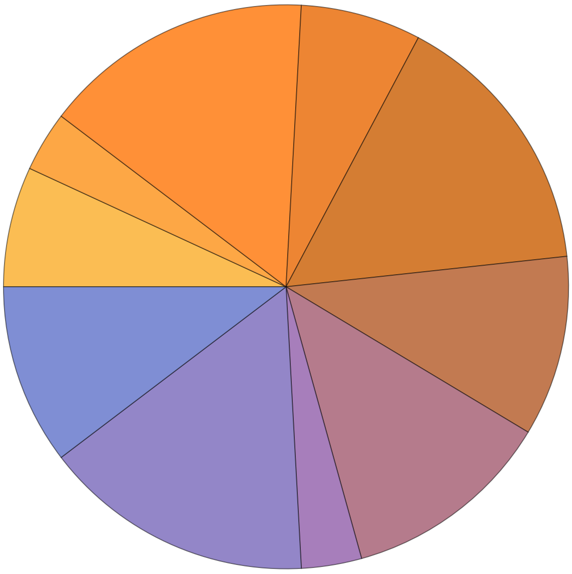
In[ ]:=
```
Total[IntegerDigits[3^126]]
```

Out[ ]=
```
234
```

+5.6 Make a pie chart of the sequence of digits that appear in 2^32.

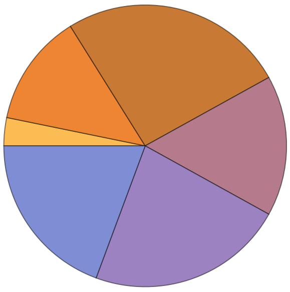
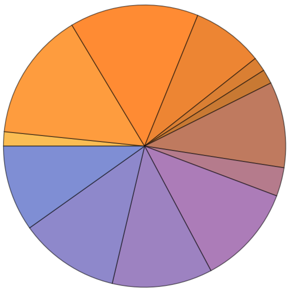
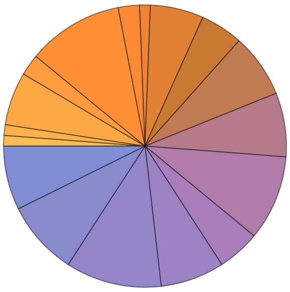
In[ ]:=
```
PieChart[IntegerDigits[2^32]]
```

Out[ ]=



+5.7 Make a list of pie charts for the sequence of digits in 2^20, 2^40, 2^60.

In[ ]:=
```
{PieChart[IntegerDigits[2^20]],
 PieChart[IntegerDigits[2^40]], PieChart[IntegerDigits[2^60]]}
```

Out[ ]= {  ,  ,  }

Exercises for Section 6 | Making Tables

6.1 Make a list in which the number 1000 is repeated 5 times .

In[ ]:=
```
Table[1000, {5}]
```

Out[ ]=
```
{1000, 1000, 1000, 1000, 1000}
```

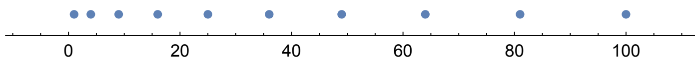
6.2 Make a table of the value of n^3 for n from 10 to 20.

```
In[∘]:= Table[n^3, {n, 10, 20}]
Out[∘]= {1000, 1331, 1728, 2197, 2744, 3375, 4096, 4913, 5832, 6859, 8000}
```

6.3 Make a number line plot of the first 20 squares .

```
In[∘]:= NumberLinePlot[Table[n^2, {n, 10}]]
```

Out[∘]=



6.4 Make a list of the even numbers (2, 4, 6, ...) up to 20.

```
In[∘]:= Table[n*2, {n, 10}]
Out[∘]= {2, 4, 6, 8, 10, 12, 14, 16, 18, 20}
```

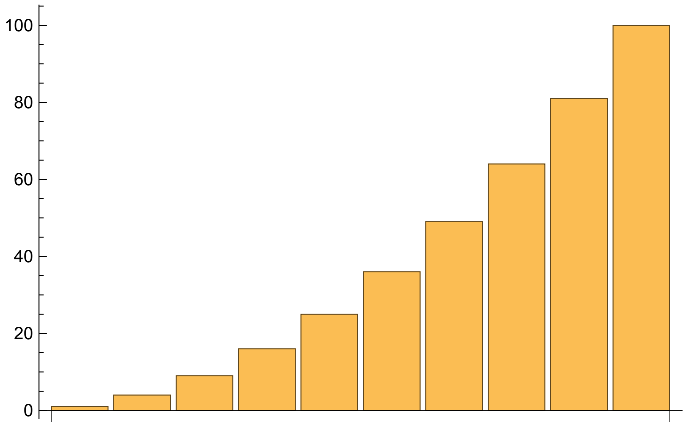
6.5 Use Table to get the same result as Range[10].

```
In[∘]:= Table[n, {n, 10}]
Out[∘]= {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}
```

6.6 Make a bar chart of the first 10 squares .

```
In[∘]:= BarChart[Table[n^2, {n, 10}]]
```

Out[∘]=



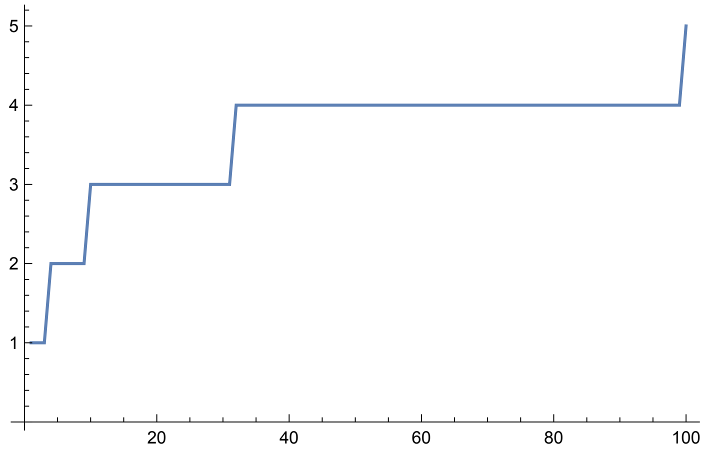
6.7 Make a table of lists of digits for the first 10 squares.

```
In[∘]:= Table[IntegerDigits[n^2], {n, 10}]
Out[∘]= {{1}, {4}, {9}, {1, 6}, {2, 5}, {3, 6}, {4, 9}, {6, 4}, {8, 1}, {1, 0, 0}}
```

6.8 Make a list line plot of the length of the sequence of digits for each of the first 100 squares.

In[∘]:=
```
ListLinePlot[Table[Length[IntegerDigits[n^2]], {n, 100}]]
```

Out[∘]=



6.9 Make a table of the first digit of the first 20 squares.

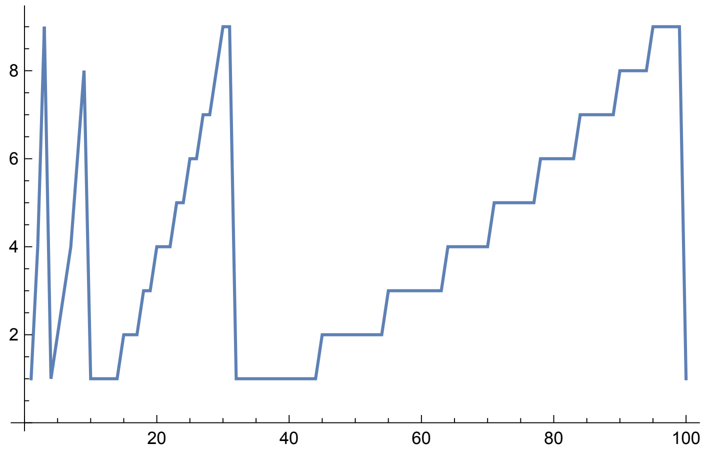
In[∘]:=
```
Table[First[IntegerDigits[n^2]], {n, 20}]
```

Out[∘]=
```
{1, 4, 9, 1, 2, 3, 4, 6, 8, 1, 1, 1, 1, 1, 2, 2, 2, 3, 3, 4}
```

6.10 Make a list line plot of the first digits of the first 100 squares.

In[∘]:=
```
ListLinePlot[Table[First[IntegerDigits[n^2]], {n, 100}]]
```

Out[∘]=



+6.1 Make a list of the differences between n^3 and n^2 with n up to 10.

In[∘]:=
```
Table[(n^3) - (n^2), {n, 10}]
```

Out[∘]=
```
{0, 4, 18, 48, 100, 180, 294, 448, 648, 900}
```

+6.2 Make a list of the odd numbers (1, 3, 5, ...) up to 100.

In[ ]:=
```
Table[(n * 2) - 1, {n, 50}]
```

Out[ ]=
```
{1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31,
 33, 35, 37, 39, 41, 43, 45, 47, 49, 51, 53, 55, 57, 59, 61, 63, 65,
 67, 69, 71, 73, 75, 77, 79, 81, 83, 85, 87, 89, 91, 93, 95, 97, 99}
```

+6.3 Make a list of the squares of even numbers up to 100.

In[ ]:=
```
Table[(n * 2) ^2, {n, 50}]
```

Out[ ]=
```
{4, 16, 36, 64, 100, 144, 196, 256, 324, 400, 484, 576, 676, 784, 900,
 1024, 1156, 1296, 1444, 1600, 1764, 1936, 2116, 2304, 2500, 2704, 2916,
 3136, 3364, 3600, 3844, 4096, 4356, 4624, 4900, 5184, 5476, 5776, 6084,
 6400, 6724, 7056, 7396, 7744, 8100, 8464, 8836, 9216, 9604, 10 000}
```

+6.4 Create the list {-3, -2, -1, 0, 1, 2} using Range .

In[ ]:=
```
Range[-3, 2]
```

Out[ ]=
```
{-3, -2, -1, 0, 1, 2}
```

+6.5 Make a list for the numbers n up to 20 in which each element is a column of the value of n, n^2 and n^3.

In[ ]:=
```
Table[Column[{n, n^2, n^3}], {n, 20}]
```

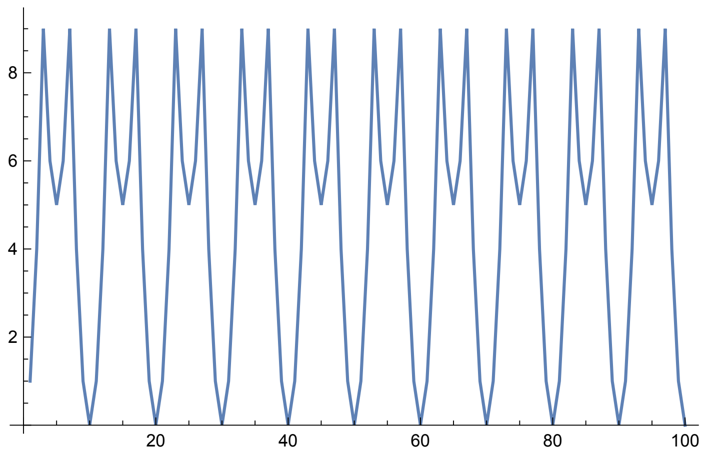
Out[ ]=
```
  1   2   3    4    5     6     7     8     9     10     11
{ 1 , 4 , 9  , 16 , 25  , 36  , 49  , 64  , 81  , 100  , 121  ,
  1   8   27   64   125   216   343   512   729   1000   1331

 12     13     14     15     16     17     18     19     20
 144  , 169  , 196  , 225  , 256  , 289  , 324  , 361  , 400  }
 1728   2197   2744   3375   4096   4913   5832   6859   8000
```

+6.6 Make a list line plot of the last digit of the first 100 squares.

In[ ]:=
```
ListLinePlot[Table[Last[IntegerDigits[n^2]], {n, 100}]]
```

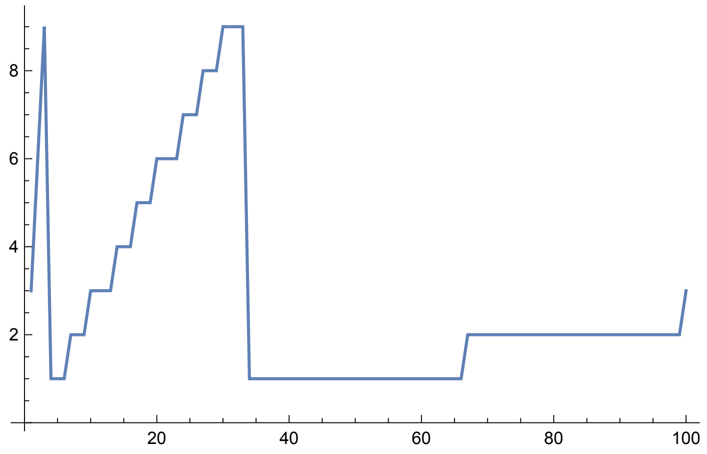
Out[ ]=



+6.7 Make a list line plot of the first digit of the first 100 multiples of 3.

In[ ]:=
```
ListLinePlot[Table[First[IntegerDigits[n * 3]], {n, 100}]]
```

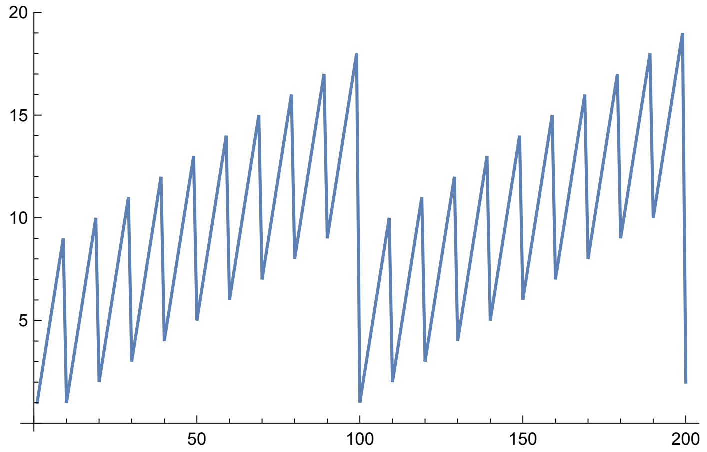
Out[ ]=



+6.8 Make a list line plot of the total of the digits for each number up to 200.

In[ ]:=
```
ListLinePlot[Table[Total[IntegerDigits[n]], {n, 200}]]
```

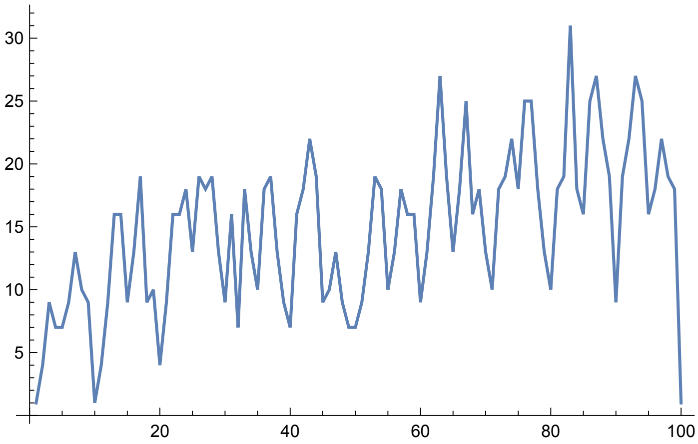
Out[ ]=



+6.9 Make a list line plot of the total of the digits for each of the first 100 squares.

In[ ]:=
```
ListLinePlot[Table[Total[IntegerDigits[n^2]], {n, 100}]]
```

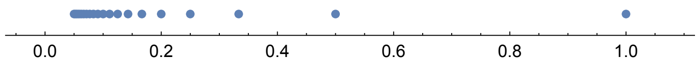
Out[ ]=



+6.10 Make a number line plot of the numbers 1/n with n from 1 to 20.

In[ ]:=
```
NumberLinePlot[Table[1 / n, {n, 1, 20}]]
```

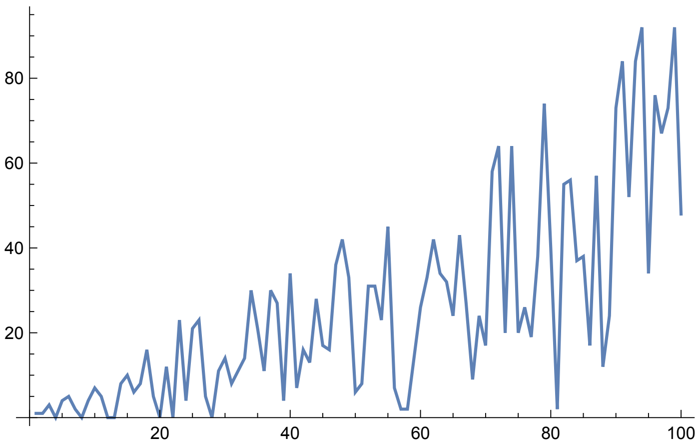
Out[ ]=



+6.11 Make a line plot of a list of 100 random integers where the nth integer is between 0 and n.

In[ ]:=
```
ListLinePlot[Table[RandomInteger[n], {n, 100}]]
```

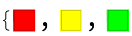
Out[ ]=



Exercises for Section 7 | Colors and Styles

7.1 Make a list of red, yellow and green.

In[ ]:=
```
{Red, Yellow, Green}
```

Out[ ]= {}

7.2 Make a red, yellow, green column ("traffic light")

In[ ]:=
```
Column[{Red, Yellow, Green}]
```

Out[ ]=

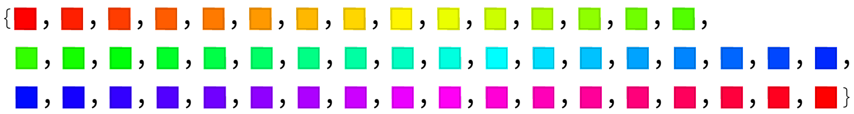

7.3 Compute the negation of the color Orange.

In[ ]:=
```
ColorNegate[Orange]
```

Out[ ]=

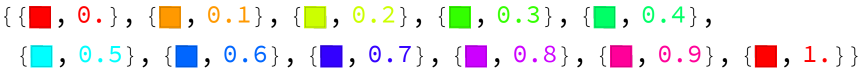

7.4 Make a list of color with hues varying from 0 to 1 in steps of 0.02.

In[ ]:=
```
Table[Hue[n], {n, 0, 1, 0.02}]
```

Out[ ]=


7.8 Make a list of numbers from 0 to 1 in steps of 0.1, each with a hue equal to its value.

In[ ]:=
```
Table[{Hue[n], Style[n, Hue[n]]}, {n, 0, 1, 0.1}]
```

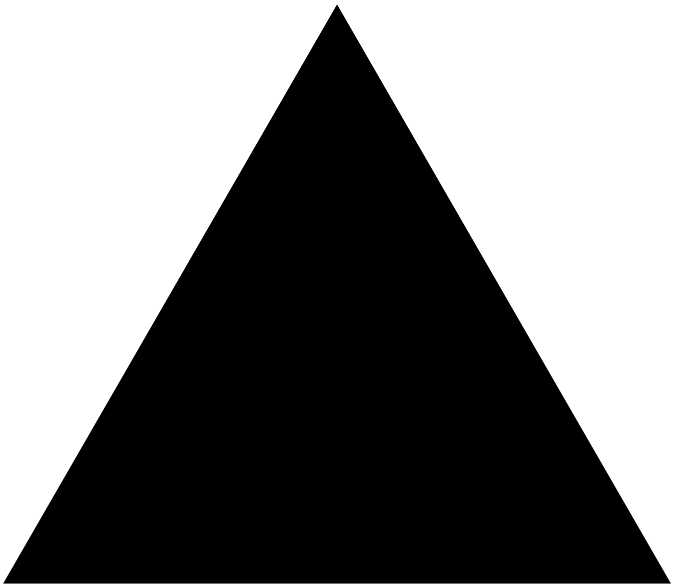
Out[ ]=


Exercises for Section 8 | Basic Graphics Objects

8.1 Use RegularPolygon to draw a triangle.

In[ ]:=
```
Graphics[RegularPolygon[3]]
```

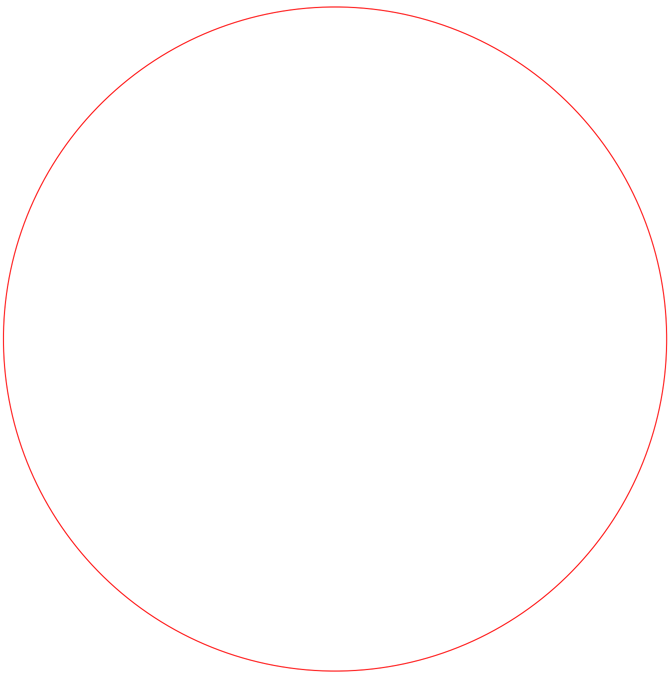
Out[ ]=



8.2 Make graphics of a red circle.

In[ ]:=
```
Graphics[Style[Circle[], Red]]
```

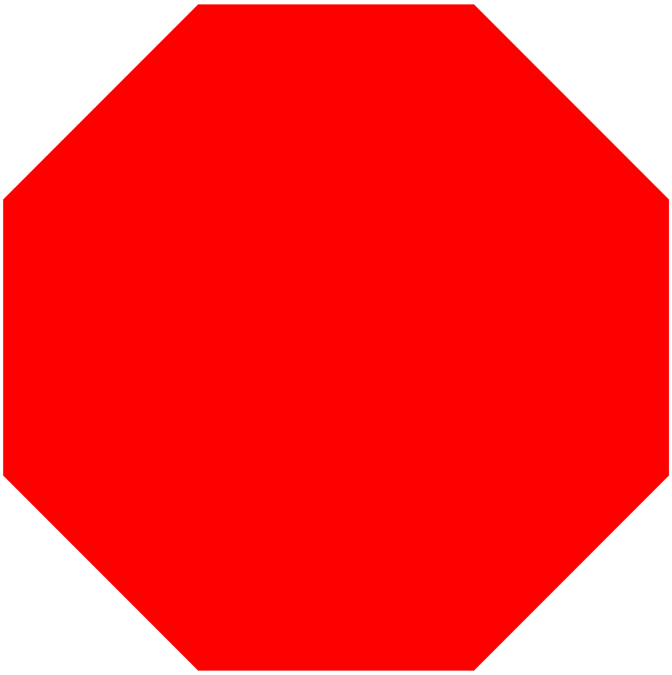
Out[ ]=



8.3 Make a red octagon.

In[ ]:=
```
Graphics[Style[RegularPolygon[8], Red]]
```

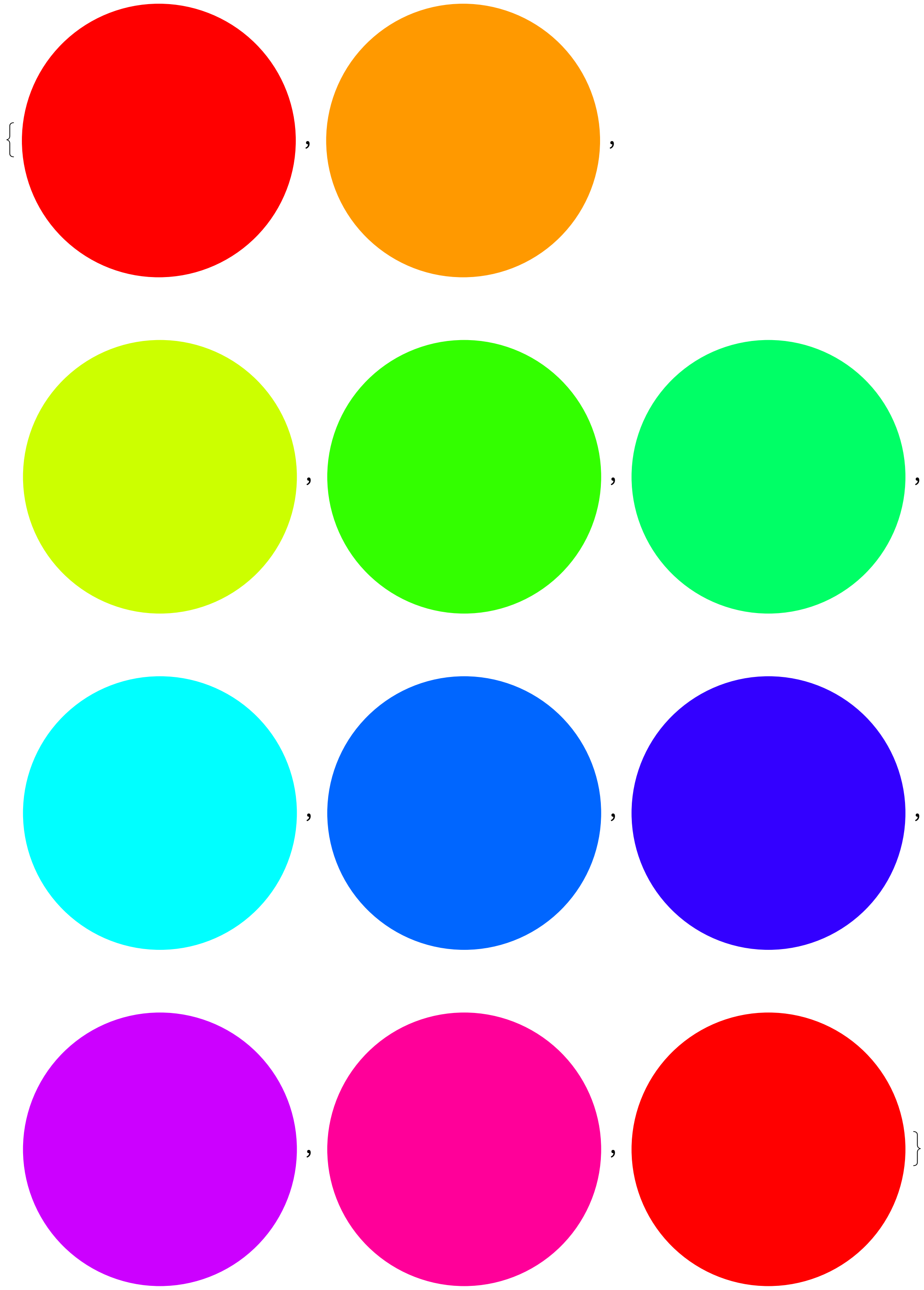
Out[ ]=



8.4 Make a list whose elements are disks with hues varying from 0 to 1 in steps of 0.1.

In[ ]:=
```
Table[Graphics[Style[Disk[], Hue[n]]], {n, 0, 1, 0.1}]
```

Out[ ]=

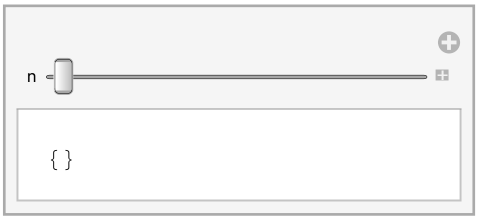


Exercise for Section 9 | Interactive Manipulation

9.1 Make a Manipulate to show Range[n] with n varying from 0 to 100.

In[ ]:=
```
Manipulate[Range[n], {n, 0, 100}]
```

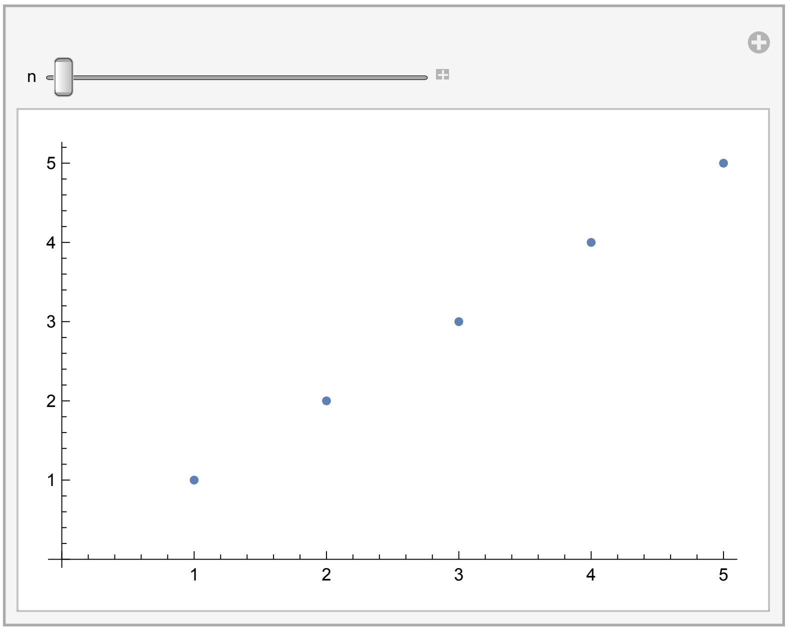
Out[ ]=



9.2 Make a Manipulate to plot the whole numbers up to n, where n can range from 5 to 50.

In[ ]:=
```
Manipulate[ListPlot[Range[1, n]], {n, 5, 50}]
```

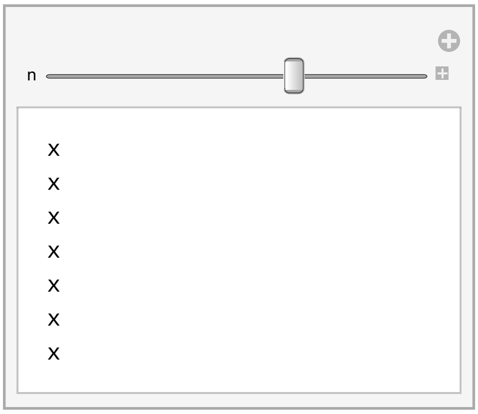
Out[ ]=



9.3 Make a Manipulate to show a column of between 1 and 10 copies of x.

In[ ]:=
```
Manipulate[Column[Table[x, n]], {n, 1, 10, 1}]
```

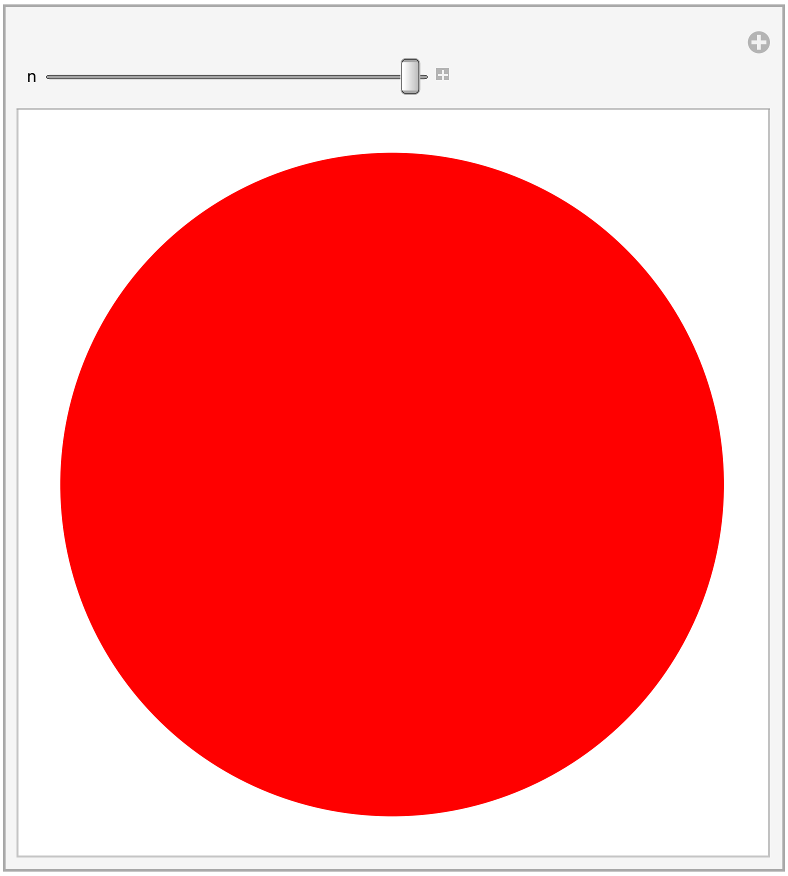
Out[ ]=



9.4 Make a Manipulate to show a disk with a hue varying from 0 to 1.

In[ ]:=
```
Manipulate[Graphics[Style[Disk[], Hue[n]]], {n, 0, 1}]
```

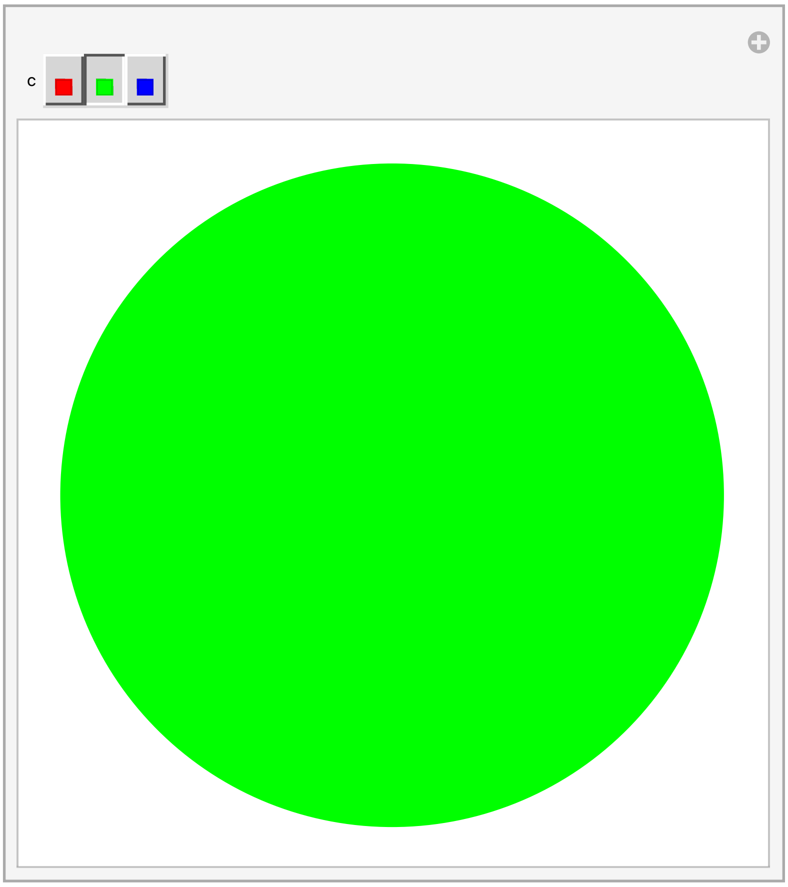
Out[ ]=



9.5 Make a manipulate to show a disk with red, green and blue color components varying from 0 to 1.

In[ ]:=
```
Manipulate[Graphics[Style[Disk[], c]], {c, {Red, Green, Blue}}]
```

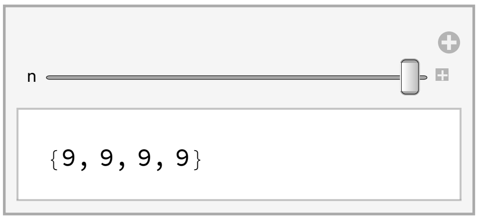
Out[ ]=



9.6 Make a Manipulate to show digit sequences of 4 - digit integers (between 1000 and 9999).

In[ ]:=
```
Manipulate[IntegerDigits[n], {n, 1000, 9999, 1}]
```

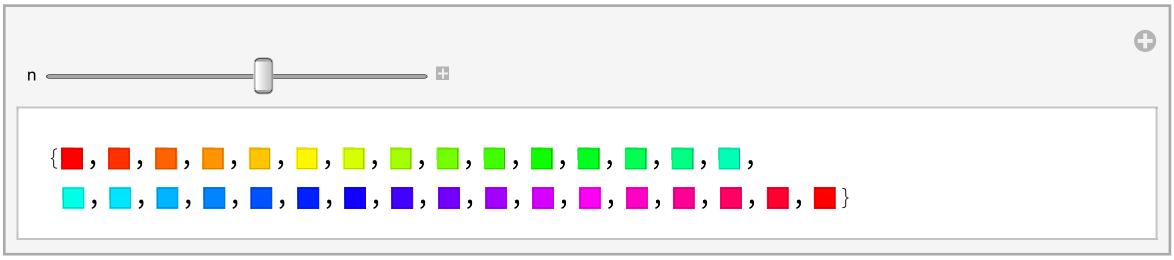
Out[ ]=



9.7 Make a Manipulate to create a list of between 5 and 50 equally spaced hues.

In[ ]:=
```
Manipulate[Table[Hue[h], {h, 0, 1, 1 / n}], {n, 5, 50, 1}]
```

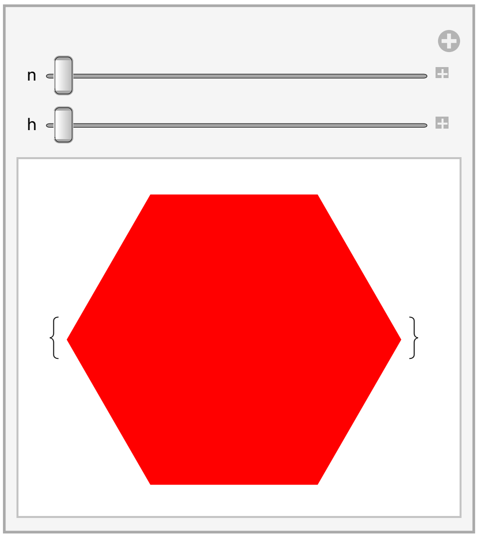
Out[ ]=



9.8 Make a Manipulate that shows a list of a variable number of hexagons (between 1 and 10), and with variable hues.

In[ ]:=
```
Manipulate[Table[Graphics[Style[RegularPolygon[6], Hue[h]]], n],
 {n, 1, 10, 1}, {h, 0, 1}]
```

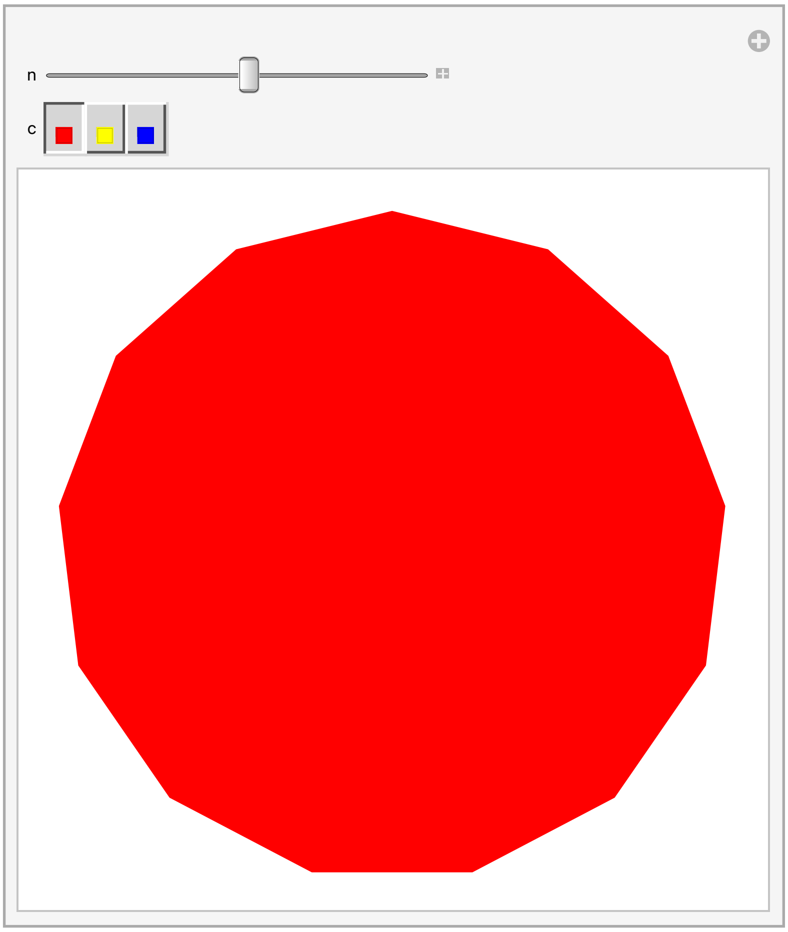
Out[ ]=



9.9 Make a Manipulate that lets you show a regular polygon with between 5 and 20 sides, in red, yellow or blue.

In[ ]:=
```
Manipulate[Graphics[Style[RegularPolygon[n], c]],
 {n, 5, 20, 1}, {c, {Red, Yellow, Blue}}]
```

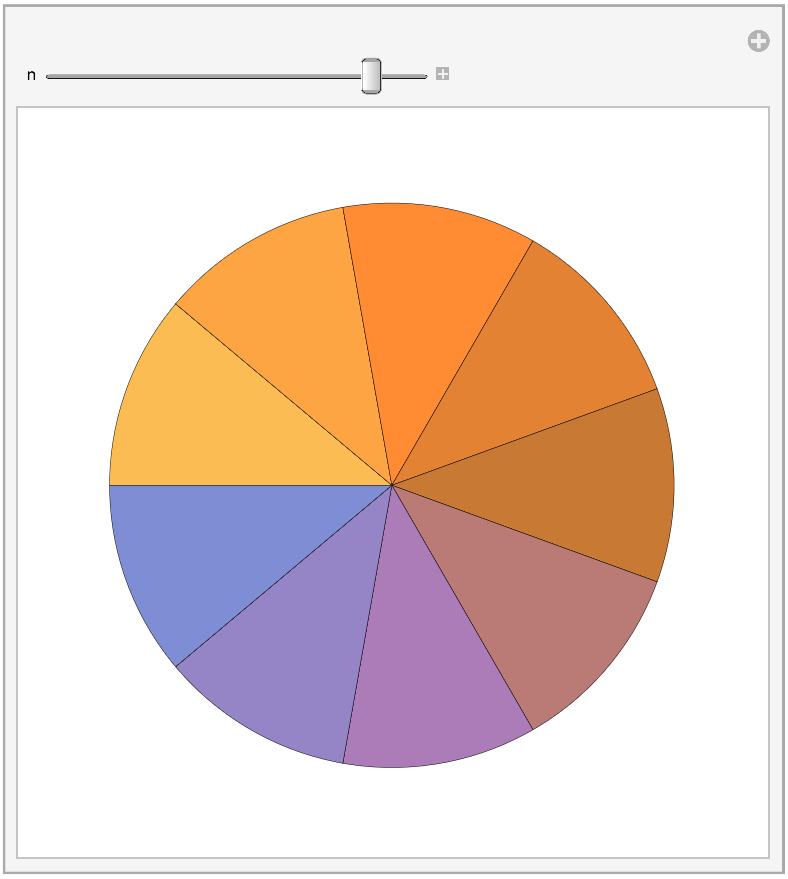
Out[ ]=



9.10 Make a Manipulate that shows a pie chart with a number of equal segments varying from 1 to 10.

In[ ]:=
```
Manipulate[PieChart[ConstantArray[1, n]], {n, 1, 10, 1}]
```

Out[ ]=



9.11 Make a Manipulate that gives a bar chart of the 3 digits in integers from 100 to 999.

In[ ]:=
```
Manipulate[BarChart[IntegerDigits[n]], {n, 100, 999, 1}]
```

Out[ ]=

9.12 Make a Manipulate that shows n random colors, where n can range from 1 to 50.

In[ ]:=
```
Manipulate[RandomColor[n], {n, 1, 50, 1}]
```

Out[ ]=

9.13 Make a Manipulate to display a column of integer powers with bases from 1 to 25 and exponents from 1 to 10.

In[∘]:=
```
Manipulate[Column[Range[n]^i], {n, 1, 20}, {i, 1, 10, 1}]
```

Out[∘]=

n

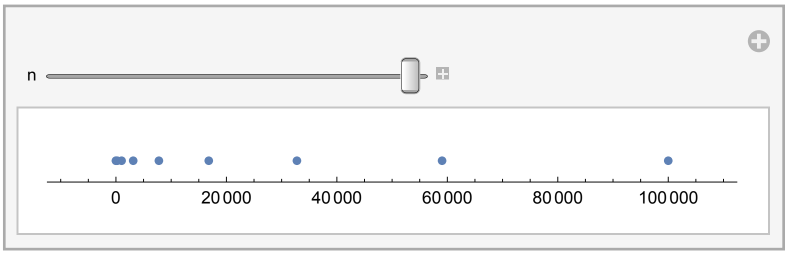
i

```
1
128
2187
16 384
78 125
```

9.14 Make a Manipulate of a number line of values of x^n for integer x from 1 to 10, with n varying from 0 to 5.

In[∘]:=
```
Manipulate[NumberLinePlot[Range[10]^n], {n, 0, 5}]
```

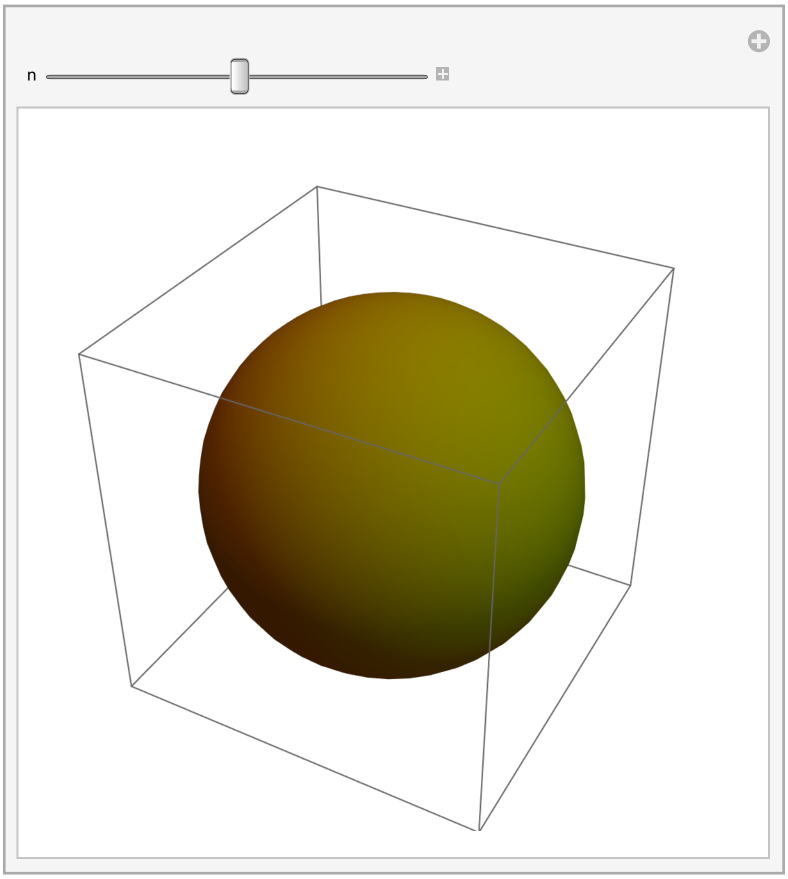
Out[∘]=



9.15 Make a Manipulate to show a sphere that can vary in color from green to red.

In[ ]:=
```
Manipulate[Graphics3D[Style[Sphere[], RGBColor[n, 1 - n, 0]]], {n, 0, 1}]
```

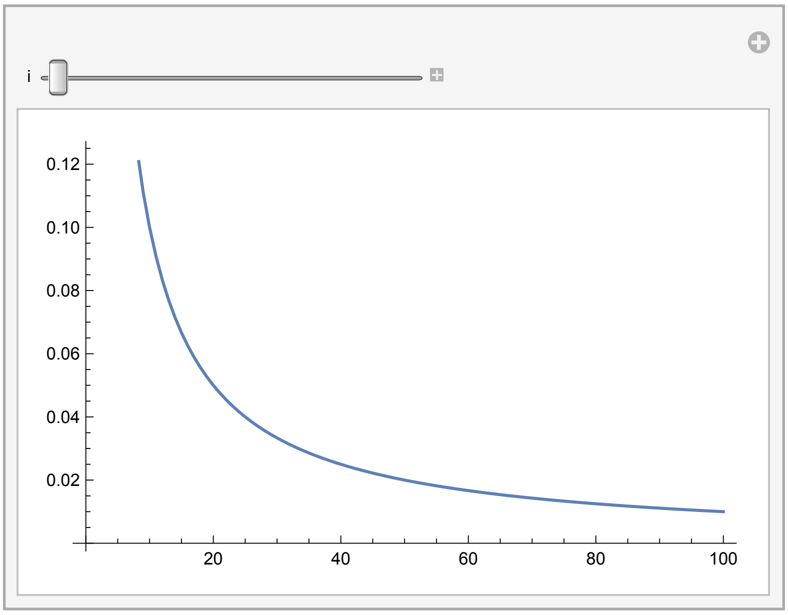
Out[ ]=



+9.1 Make a Manipulate to plot numbers from 1 to 100 raised to powers that can vary between - 1 and + 1.

In[ ]:=
```
Manipulate[ListLinePlot[Range[100]^i], {i, -1, 1}]
```

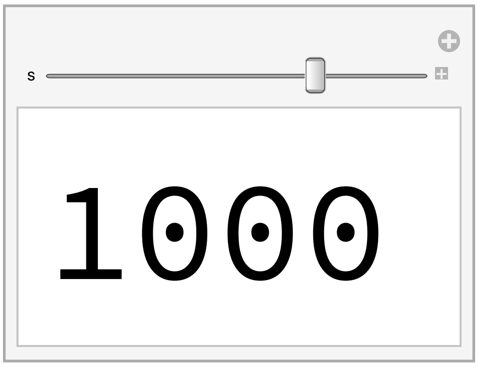
Out[ ]=



+9.2 Make a Manipulate to display 1000 at sizes between 5 and 100.

In[ ]:=
```
Manipulate[Style[1000, s], {s, 5, 100}]
```

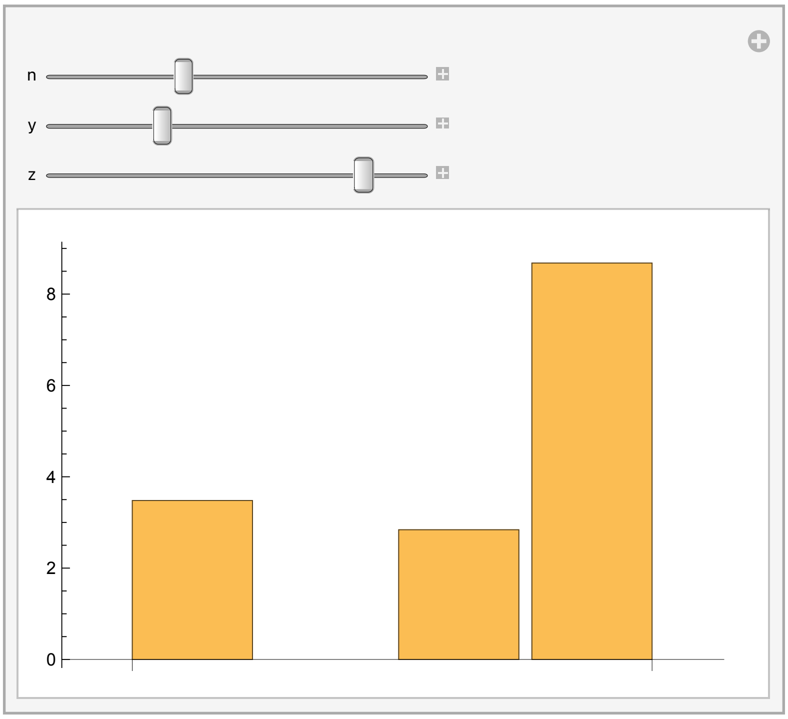
Out[ ]=



+9.3 Make a Manipulate to show a bar chart with 4 bars, each with a height that can be between 0 and 10.

In[ ]:=
```
Manipulate[BarChart[{n, x, y, z}], {n, 0, 10}, {y, 0, 10}, {z, 0, 10}]
```

Out[ ]=



Exercises for Section 10 | Images

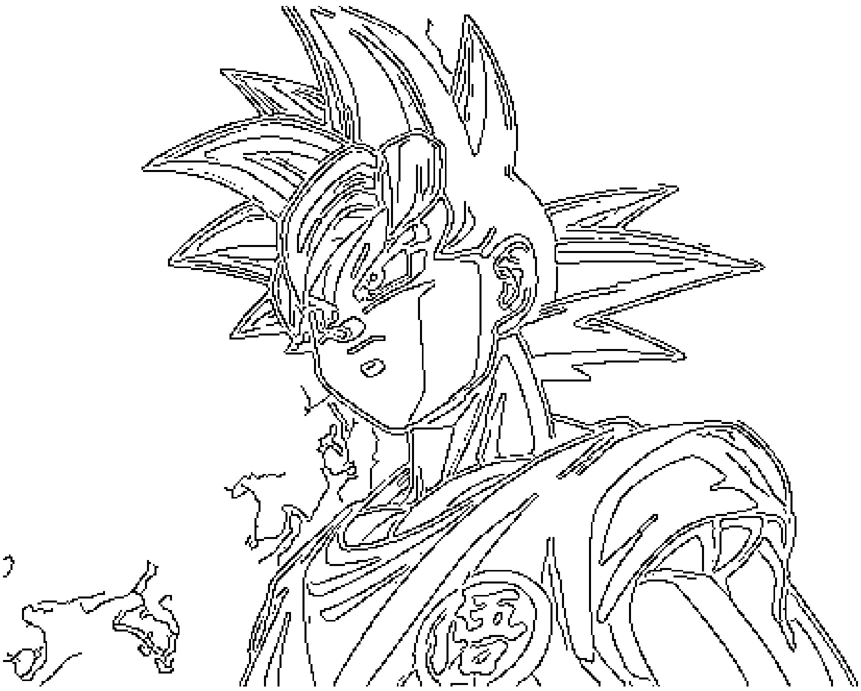
10.1 Color negate the result of edge detecting and image . (Use CurrentImage[] or any other image).

In[ ]:=
```
img =
```


Out[ ]=

In[ ]:=
```
ColorNegate[EdgeDetect[img]]
```

Out[ ]=



10.2 Use Manipulate to make an interface for blurring and image from 0 to 20.

In[ ]:=
```
Manipulate[Blur[img, n], {n, 0, 20}]
```

Out[ ]=

n

```
Blur[img, 0.]
```

Blur : Expecting an image or graphics instead of img.

10.3 Make a table of the results from edge detecting an image with blurring from 1 to 10.

In[ ]:=
```
Table[Blur[EdgeDetect[img], n], {n, 1, 10}]
```

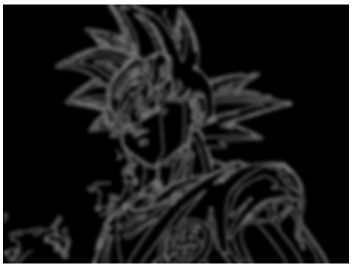
Out[ ]= {


,

,

,

,

,

,

,

,

,


}

10.6 Create a Manipulate to display edges of an image as it gets blurred from 0 to 20.

In[ ]:=
```
Manipulate[EdgeDetect[Blur[img, n]], {n, 0, 20}]
```

Out[ ]=
```
n
EdgeDetect[Blur[img, 9.65]]
```

Blur : Expecting an image or graphics instead of img.

EdgeDetect : Expecting an image or graphics instead of Blur [img, 9.65].

Exercises for Section 11 | Strings and Text

11.1 Join two copies of the string "Hello"

In[ ]:=
```
StringJoin["Hello", "Hello"]
```

Out[ ]=
```
HelloHello
```

11.2 Make a single string of the whole alphabet, in uppercase.

In[ ]:=
```
StringJoin[ToUpperCase[Alphabet[]]]
```

Out[ ]=
```
ABCDEFGHIJKLMNOPQRSTUVWXYZ
```

11.3 Generate a string of the alphabet in reverse order.

In[ ]:=
```
StringReverse[StringJoin[Alphabet[]]]
```

Out[ ]=
```
zyxwvutsrqponmlkjihgfedcba
```

11.4 Join 100 copies of the string "AGCT".

In[ ]:=
```
StringJoin[ConstantArray["AGCT", 100]]
```

Out[ ]=
```
AGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAG
CTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTA
GCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCT
AGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGC
TAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAGCTAG
CTAGCTAGCTAGCTAGCTAGCT
```

11.5 Use StringTake, StringJoin and Alphabet to get “abcdef” .

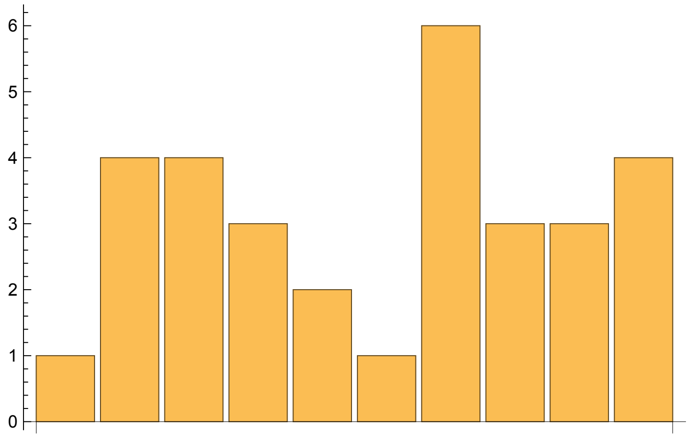
In[ ]:=
```
StringTake[StringJoin[Alphabet[]], 6]
```

Out[ ]=
```
abcdef
```

11.7 Make a bar chart of the lengths of the words in "A long time ago, in a galaxy far, far away".

In[∘]:=
```
BarChart[
 StringLength[TextWords["A long time ago, in a galaxy far, far away."]]]
```

Out[∘]=



11.8 Find the string length of the Wikipedia article for "computer".

In[∘]:=
```
StringLength[WikipediaData["computer"]]
```

Out[∘]=
```
57 696
```

11.9 Find how many words are in the Wikipedia article for “computer”.

In[∘]:=
```
Length[TextWords[WikipediaData["computer"]]]
```

Out[∘]=
```
8892
```

11.10 Find the first sentence in the Wikipedia article about “strings”.

In[∘]:=
```
First[TextSentences[WikipediaData["strings"]]]
```

Out[∘]=
```
String or strings may refer to:
```

11.11 Make a string from the first letters of all sentences in the Wikipedia article about computers.

In[∘]:=
```
StringJoin[StringTake[TextSentences[WikipediaData["computer"]], 1]]
```

Out[∘]=
```
AMTATASCESEMTTTCTPP=ATTDBTTT==DTLTTTITIIMTTAAATTTIASIBIAITITIITS=CCATFTTTAEBNH=
  DHTTTTAB==BTDETTITIRT=PTEITDTTHACIINCTLOTIIIHBT==TTHTVTE=ECWATIHJTIIAAGTBAIT=
  TJFCJTHATHTTIWITT=TTDTKIHKNNHPNIMTGFTWISTIS=TTLTTTT=C=A=SH=TC==ATIET=WTTSC=
  TSC=TCATRDIRTPIWJSAIT=TES=TTSHTALTSG=AETTLSIETWOAMTTRACrRIIISFIIG=IDOHCIAMA=
  WTOBItSTBSIT=SMSTSS=SSCIW=T=TTMIAL=TITHTFMPWSTCBOTOI=ITTSTTITMWITC=PUTTS=MF=
  ATHHIT=PALTP=ETBOBSA=CTITTITCIIA"=AWA=TMH=TQCVSLTTT=ACARPE=AT====M
```

11.12 Find the maximum word length among English words from WordList[].

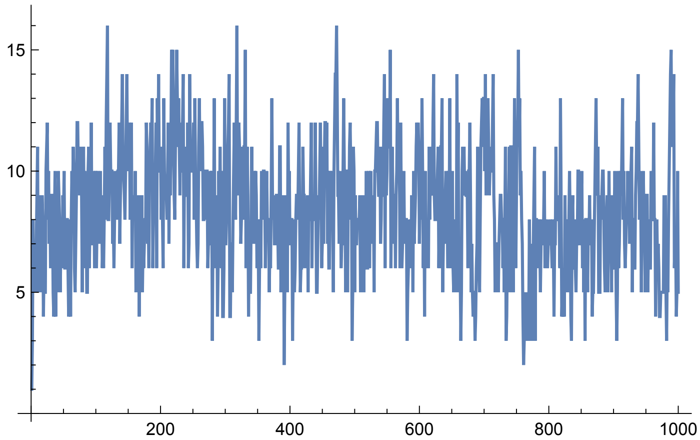
In[ ]:=
```
Max[StringLength[WordList[]]]
```
Out[ ]=
```
23
```

11.13 Count the number of words in WordList[] that start with “q”.

In[ ]:=
```
Count[StringTake[WordList[], 1], "q"]
```
Out[ ]=
```
194
```

11.14 Make a line plot of the lengths of the first 1000 words from WordList[]

In[ ]:=
```
ListLinePlot[StringLength[Take[WordList[], 1000]]]
```
Out[ ]=



11.15 Use StringJoin and Characters to make a word cloud of all letters in the words from WordList[].

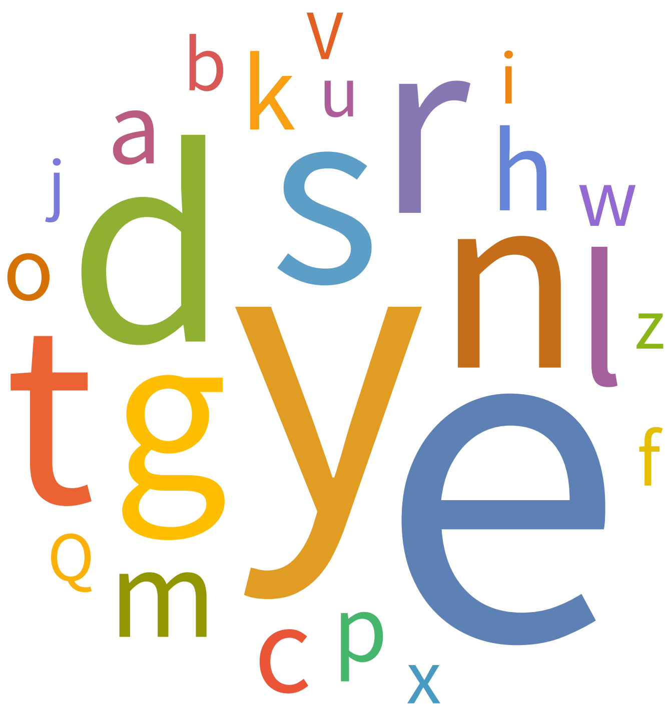
In[ ]:=
```
WordCloud[Characters[StringJoin[WordList[]]]]
```

Out[ ]=

11.16 Use StringReverse to make a word cloud of the last letters in the words from WordList[].

In[ ]:=
```
WordCloud[StringTake[StringReverse[WordList[]], 1]]
```

Out[ ]=



11.17 Find the Roman numerals for the year 1959.

```
In[∘]:= RomanNumeral[1959]
Out[∘]= MCMLIX
```

11.18 Find the maximum string length of any Roman-numeral year from 1 to 2020.

```
In[∘]:= Max[StringLength[RomanNumeral[Range[2020]]]]
Out[∘]= 13
```

11.19 Make a word cloud from the first characters of the Roman numerals up to 100.

```
In[∘]:= WordClod[StringTake[RomanNumeral[Range[100]], 1]]
Out[∘]= WordClod[{I, I, I, I, V, V, V, V, I, X, X, X, X, X, X, X, X, X, X, X, X, X, X,
  X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X, X,
  L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L, L,
  L, L, L, L, L, L, L, L, L, L, L, L, L, L, X, X, X, X, X, X, X, X, X, X, C}]
```

11.20 Use Length to find the length of the Russian alphabet.

```
In[∘]:= Length[Alphabet["Russian"]]
Out[∘]= 33
```

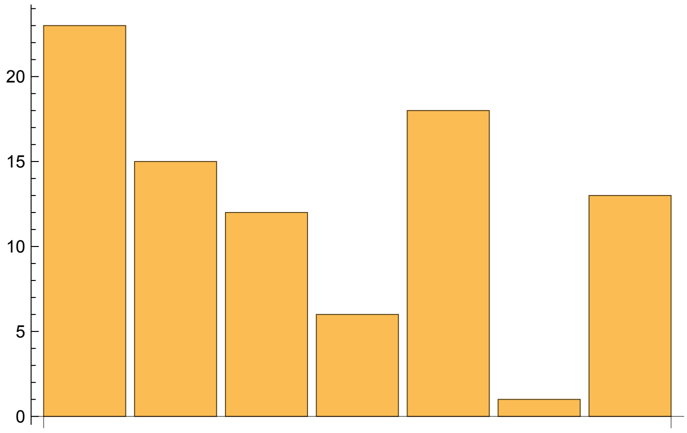
11.21 Generate the uppercase Greek alphabet.

```
In[∘]:= ToUpperCase[Alphabet["Greek"]]
Out[∘]= {Α, Β, Γ, Δ, Ε, Ζ, Η, Θ, Ι, Κ, Λ, Μ, Ν, Ξ, Ο, Π, Ρ, Σ, Τ, Υ, Φ, Χ, Ψ, Ω}
```

11.22 Make a bar chart of the letter numbers in “wolfram”

```
In[∘]:= BarChart[LetterNumber["wolfram"]]
```

Out[∘]=



11.23 Use FromLetterNumber to make a string of 1000 random letters.

In[ ]:=
```
StringJoin[FromLetterNumber[Table[RandomInteger[25] + 1, 1000]]]
```

Out[ ]=
```
xqyundcqtfebfucsaghlafrzxkueptkkcvjwmhqsnqyitnilzjaijyvkbtnqfkyecmivkttslvlnjg
suaoidqhiduastrdhrgfxacgsvjnpjmlmhzbkbqccdxyhiarfbupymjllqlplrkxznunypvrpea
jvyjtwqmtrkwzrpegpahajepfgebbzsxhglmojtuokvnwcforgqhxmqdqiwhjuqqpfxlcqzevbi
ezvhmkfanbjjcfzfwyhuigjnezdwxwgulmwlthilccupjztajmtklgicdeecddabpsowxxgdufr
fwjstbqkfrogkfmoqisxxlnwsyukowmwmmqjcyjthylvyahxhvwufnrvvjmhtqvgvkddjzkjnui
apbhbqrjzrelrbcubcvanxcbgklnlxmqrdsehkuauuztfsxoftkvuxlcfjjgjivdqhzlnlprlow
xxponrdiarkyhbxjtnnbpgngzbeizvmwzrxnltyxydqicfzqgahrhhjeaeynjahlwrcuostyzli
ongqkunkallrczsfbuzsodcxntpwmvyiexujpldmluwlcdgksosmboryhtdipcqnycbbttrogxl
ouzsdynibgujshijptfimtxqveuxrmrixgywvziwwxgfbntmjvwjfjczusfrmerlterarzoggwm
kknrgprjqsmkwocatqfwkhvutrcuchhpkmthhpdqplfrsqmdxcrzjrdfafsasfmziitcdsbcsvb
xozudofmhxnqxytetmipzeuzxvvylrjczsczcbczpkzpukiklhyvpklrlucqdbhodlcqqbwvhgg
izgkjumgagzvkahzjwkraqxdxcshcwjeharpkptixjoxbxeduylryriqssqzduwmxgalhzrwytv
lnxcstpojwkuilybdrkkiuomfswxepxkpqfzzlqkxcpolgitaqfxpgrvlsjosxplsmkmzvvvful
eewclpbirslgqfxczouqkq
```

11.24 Make a list of 100 random 5-letter stirngs.

In[ ]:=
```
Table[StringJoin[Table[FromLetterNumber[RandomInteger[25] + 1], 5]], 100]
```

Out[ ]=
```
{dxlhm, scqvc, cptot, eulwu, qlrua, dftym, ccskn, zphsm, tsqns, dxnpj, iijpc, cnemu,
 zexei, kdnxo, qbsgl, mmdyy, rbnqw, dirkv, vtsaa, iteli, qygth, ptvuo, bhsms,
 igxkz, tsnet, shwul, zodul, wovdl, iyoqp, yihzt, thrwr, bghqa, tbznq, buyyf,
 vfuwj, rwzrp, egbhr, ssxzl, vaslb, vqbtr, bdrcc, fgmgw, knhhg, dxgxl, cthbd,
 nefwx, tvbav, qnrgn, fkaga, hmuym, swtdt, emjiy, bcwen, motdd, mdlvr, erkvw,
 hqloz, qfebg, pzujl, sqmlg, jsqdd, mzxmy, rfnbh, rhekl, vimjh, iqhdw, hcnvg,
 iyens, luxne, zcusk, agfvi, xufcs, pdukm, vztfq, zjemu, vjhzw, flxyk, wnfrt,
 hxctu, rucyz, rjvny, okksl, uuuen, khqdt, eaexm, hkdia, xfrps, coedd, hlexb,
 tnkdb, wniit, bjbkl, agmrb, aclrk, pspdb, orgdg, nojzt, ddxdc, ltlhw, zmoxg}
```

11.25 Transliterate “wolfram” into Greek.

In[ ]:=
```
Transliterate["wolfram", "Greek"]
```

Out[ ]= βολφραμ

11.26 Get the Arabic alphabet and transliterate it into English.

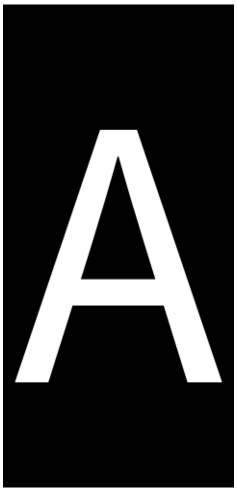
In[ ]:=
```
Transliterate[Alphabet["Arabic"]]
```

Out[ ]=
```
{a, b, t, th, j, h, kh, d, dh, r, z, s, sh, s, d, t, z, ʿ, gh, f, q, k, l, m, n, h, w, y}
```

11.27 Make a white-on-black size-200 letter “A”.

In[∘]:=
```
ColorNegate[Rasterize[Style["A", 200]]]
```

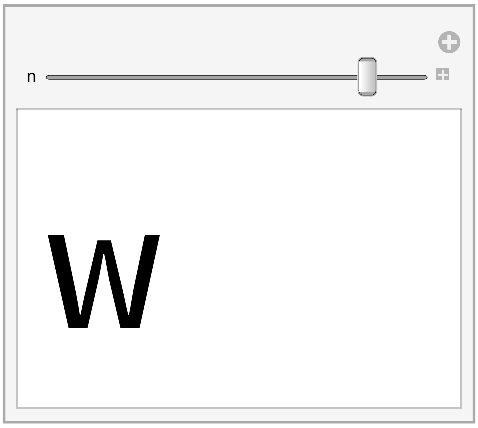
Out[∘]=



11.28 Use Manipulate to make an interactive selector of size-100 characters from the alphabet, controlled by a slider.

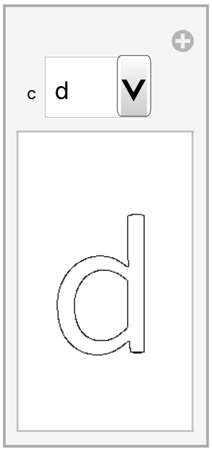
In[∘]:=
```
Manipulate[Style[FromLetterNumber[n], 100], {n, 1, Length[Alphabet[]], 1}]
```

Out[∘]=



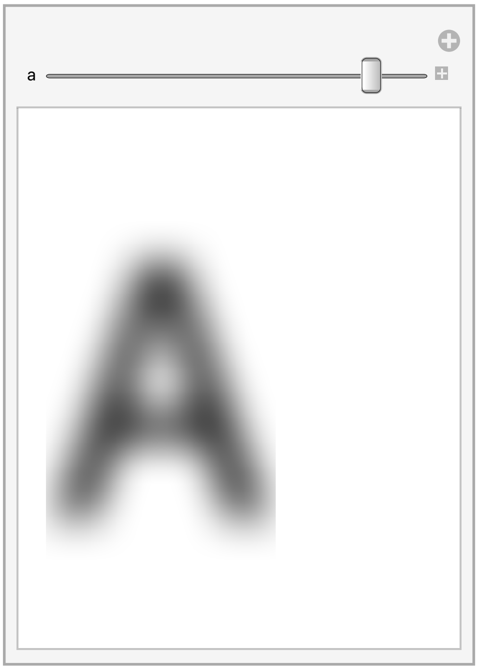
11.29 Use Manipulate to make an interactive selector of black-on-white outlines of rasterized size-100 characters from the alphabet, controlled by a menu.

```
Manipulate[ColorNegate[EdgeDetect[Rasterize[Style[c, 100]]]], {c, Alphabet[]}]
```



11.30 Use Manipulate to create a “vision simulator” that blurs a size-200 letter “A” by an amount from 0 to 50.

```
Manipulate[Blur[Rasterize[Style["A", 200]], a], {a, 0, 50}]
```



+11.1 Generate a string of the alphabet followed by the alphabet written in reverse.

```
StringJoin[StringJoin[Alphabet[]], StringReverse[StringJoin[Alphabet[]]]]
```

```
abcdefghijklmnopqrstuvwxyzzyxwvutsrqponmlkjihgfedcba
```

+11.3 Find how many sentences are in the Wikipedia article for “computer”.

```
In[ ]:= Length[TextSentences[WikipediaData["computer"]]]
Out[ ]= 449
```

+11.4 Join together without spaces, etc. the words in the first sentence in the Wikipedia article for “strings”

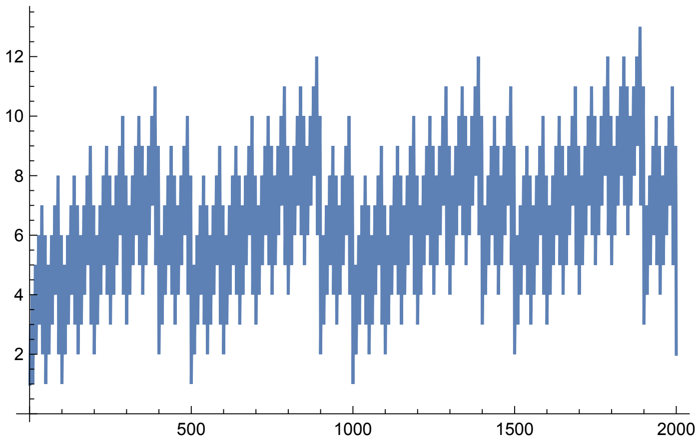
```
In[ ]:= StringJoin[TextWords[First[TextSentences[WikipediaData["strings"]]]]]
Out[ ]= Stringorstringsmayreferto
```

+11.5 Find the length of the longest word in the Wikipedia article about computers.

```
In[ ]:= Max[StringLength[TextWords[WikipediaData["computers"]]]]
Out[ ]= 25
```

+11.6 Plot the lengths of Roman numerals for numbers up to 2000.

```
In[ ]:= ListLinePlot[StringLength[RomanNumeral[Range[2000]]]]
```

Out[ ]=


+11.7 Generate a string by joining the Roman numerals up to 100.

```
In[ ]:= StringJoin[RomanNumeral[Range[100]]]
Out[ ]= IIIIIIIVVVIVIIVIIIIXXXIXIIXIIIXIVXVXVIXVIIXVIIIXIXXXXXIXXIIXXIIIXXIVXXVXXVIXXV
    IIXXVIIIXXIXXXXXXXIXXXIIXXXIIIXXXIVXXXVXXXVIXXXVIIXXXVIIIXXXIXXLXLIXLIIXLII
    IXLIVXLVXLVIXLVIIXLVIIIXLIXLLILIILIIILIVLVLVILVIILVIIILIXLXLXILXIILXIIILXIV
    LXVLXVILXVIILXVIIILXIXLXXLXXILXXIILXXIIILXXIVLXXVLXXVILXXVIILXXVIIILXXIXLXX
    XLXXXILXXXIILXXXIIILXXXIVLXXXVLXXXVILXXXVIILXXXVIIILXXXIXXCXCIXCIIXCIIIXCIV
    XCVXCVIXCVIIXCVIIIXCIXC
```

+11.9 Find the maximum string length of the name of any integer up to 1000.

```
In[•]:= Max[StringLength[IntegerName[Range[1000]]]]
Out[•]= 27
```

+11.10 Make a list of uppercase size-20 letters of the alphabet in random colors.

```
In[•]:= Style[ToUpperCase[Alphabet[]], 20, RandomColor[]]
Out[•]= {A, B, C, D, E, F, G, H, I, J, K, L,
  M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z}
```

+11.11 Make a list of 100 random 5-letter strings with the Russian alphabet.

```
In[•]:= Table[
  StringJoin[Table[FromLetterNumber[RandomInteger[25] + 1, "Russian"], 5]], 100]
Out[•]= {цшнох, лбпоё, ёлжно, йохпе, лфзёц, оечдг, жпзир, ёопгр, жалиб, бцдсг, снкбн, бавцх,
  ушкхё, вкубт, фйане, ацмйм, сфшзк, дхуйш, фмрйа, хфкто, пдикм, тлшбу, рблёс,
  ебихч, ёвжех, кёпое, вкйгл, гншгп, лзхвц, рбрпз, уддда, шдбиу, ииаёц, беeум,
  дзцум, мфрчф, винсж, швнаш, пижгё, дмвог, метех, кйшоу, цзкеп, днфри, лйагж,
  чфйгб, лбкнё, дпрсф, гуофн, ииаро, лорпн, анкзв, клдут, ехедй, ётзшп, дмзмп,
  кнлхт, зфлйж, цёхгё, хггфч, зтфбк, пштчх, оезчш, тесчж, пйбхз, мштно, хдвзб,
  фиуйм, иоужч, жчупц, вркзж, вцчнд, чёзвп, шмткч, всфшд, зфхтд, емжзё, тйшбб,
  уфжап, цучач, нфмжс, хчусг, ччнбн, нцчшр, цжатц, йёццу, хеевх, ёвклг, дшопж,
  вшнсх, ёйбжк, рёрсг, алдлл, утзшр, мпссг, леффе, цфчжт, увнлз, гуйфл, мврйе}
```

Exercises for Section 13 | Arrays, or Lists of Lists

13.1 Make a 12x12 multiplication table.

```
In[3]:= Grid[Table[i * k, {i, 1, 12}, {k, 1, 12}]]
```

Out[3]=

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

13.2 Make a 5x5 multiplication table for Roman numerals.

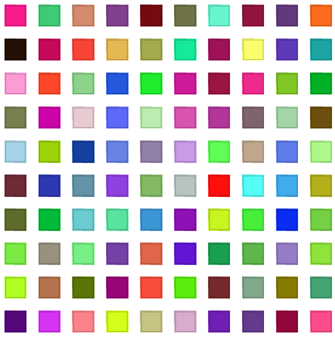
In[4]:=
```
Grid[Table[RomanNumeral[i * j], {i, 1, 5}, {j, 1, 5}]]
```

Out[4]=
```
 I    II   III  IV    V
 II   IV   VI  VIII   X
 III  VI   IX  XII   XV
 IV  VIII XII  XVI   XX
 V    X    XV   XX   XXV
```

13.3 Make a 10x10 grid of random colors.

In[5]:=
```
Grid[Table[RandomColor[], 10, 10]]
```

Out[5]=



13.4 Make a 10x10 grid of randomly colored random integers between 0 and 10.

In[7]:=
```
Grid[Table[Style[RandomInteger[10], RandomColor[]], 10, 10]]
```

Out[7]=
```
4  3  3 0  9  4 5 5 5  6
1  1  3 1 10  2 5 9 4  6
9  0  4 7  6  2 8 6 8 10
7  1  2 9  1  8 7 1 5  9
5  6  3 3  3  4 4 3 9  2
2  6  9 0  0  9 6 1 5  2
8  5  5 5  5  0 3 0 8  3
4  1  2 7  8  1 1 7 6  4
7 10  9 4  3  8 0 6 3  4
6 10  8 7  9  4 5 2 5  3
```

13.5 Make a grid of all possible strings consisting of pairs of letters of the alphabet (“aa”, ”ab”, etc.).

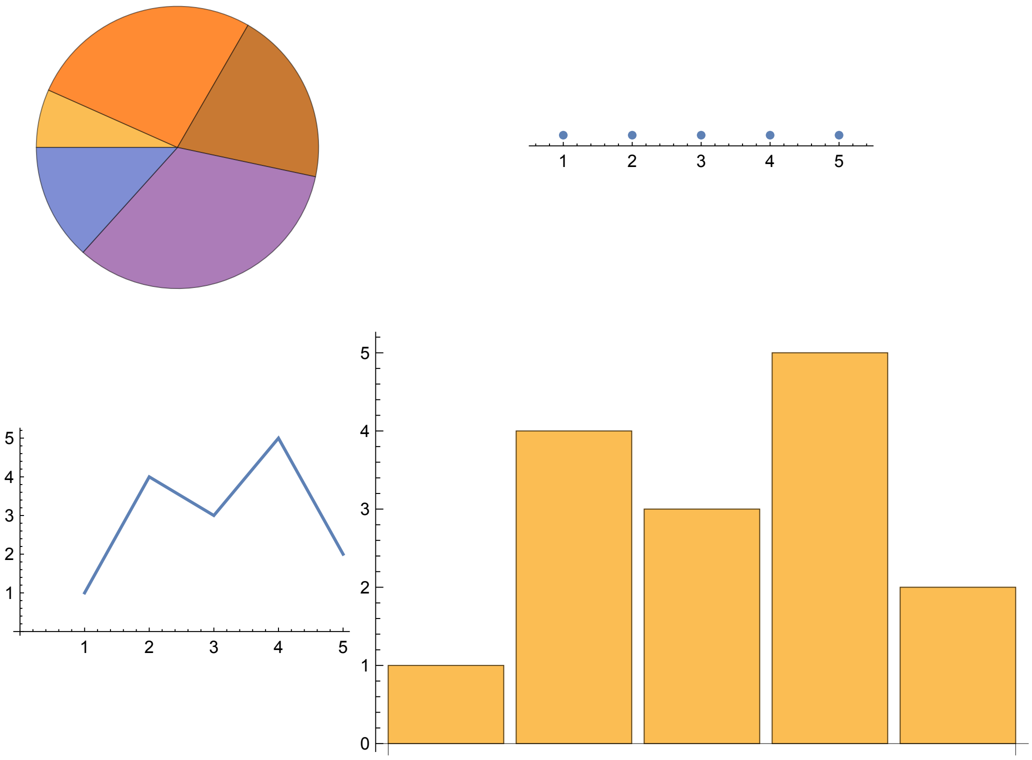
In[8]:=
```
Grid[Table[StringJoin[FromLetterNumber[i], FromLetterNumber[j]],
  {i, 1, Length[Alphabet[]]}, {j, 1, Length[Alphabet[]]}]]
```

Out[8]=
```
aa ab ac ad ae af ag ah ai aj ak al am an ao ap aq ar as at au av aw ax ay az
ba bb bc bd be bf bg bh bi bj bk bl bm bn bo bp bq br bs bt bu bv bw bx by bz
ca cb cc cd ce cf cg ch ci cj ck cl cm cn co cp cq cr cs ct cu cv cw cx cy cz
da db dc dd de df dg dh di dj dk dl dm dn do dp dq dr ds dt du dv dw dx dy dz
ea eb ec ed ee ef eg eh ei ej ek el em en eo ep eq er es et eu ev ew ex ey ez
fa fb fc fd fe ff fg fh fi fj fk fl fm fn fo fp fq fr fs ft fu fv fw fx fy fz
ga gb gc gd ge gf gg gh gi gj gk gl gm gn go gp gq gr gs gt gu gv gw gx gy gz
ha hb hc hd he hf hg hh hi hj hk hl hm hn ho hp hq hr hs ht hu hv hw hx hy hz
ia ib ic id ie if ig ih ii ij ik il im in io ip iq ir is it iu iv iw ix iy iz
ja jb jc jd je jf jg jh ji jj jk jl jm jn jo jp jq jr js jt ju jv jw jx jy jz
ka kb kc kd ke kf kg kh ki kj kk kl km kn ko kp kq kr ks kt ku kv kw kx ky kz
la lb lc ld le lf lg lh li lj lk ll lm ln lo lp lq lr ls lt lu lv lw lx ly lz
ma mb mc md me mf mg mh mi mj mk ml mm mn mo mp mq mr ms mt mu mv mw mx my mz
na nb nc nd ne nf ng nh ni nj nk nl nm nn no np nq nr ns nt nu nv nw nx ny nz
oa ob oc od oe of og oh oi oj ok ol om on oo op oq or os ot ou ov ow ox oy oz
pa pb pc pd pe pf pg ph pi pj pk pl pm pn po pp pq pr ps pt pu pv pw px py pz
qa qb qc qd qe qf qg qh qi qj qk ql qm qn qo qp qq qr qs qt qu qv qw qx qy qz
ra rb rc rd re rf rg rh ri rj rk rl rm rn ro rp rq rr rs rt ru rv rw rx ry rz
sa sb sc sd se sf sg sh si sj sk sl sm sn so sp sq sr ss st su sv sw sx sy sz
ta tb tc td te tf tg th ti tj tk tl tm tn to tp tq tr ts tt tu tv tw tx ty tz
ua ub uc ud ue uf ug uh ui uj uk ul um un uo up uq ur us ut uu uv uw ux uy uz
va vb vc vd ve vf vg vh vi vj vk vl vm vn vo vp vq vr vs vt vu vv vw vx vy vz
wa wb wc wd we wf wg wh wi wj wk wl wm wn wo wp wq wr ws wt wu wv ww wx wy wz
xa xb xc xd xe xf xg xh xi xj xk xl xm xn xo xp xq xr xs xt xu xv xw xx xy xz
ya yb yc yd ye yf yg yh yi yj yk yl ym yn yo yp yq yr ys yt yu yv yw yx yy yz
za zb zc zd ze zf zg zh zi zj zk zl zm zn zo zp zq zr zs zt zu zv zw zx zy zz
```

13.6 Visualize {1, 4, 3, 5, 2} with a pie chart, number line, line plot and bar chart. Place these in a 2x2 grid.

In[20]:=
```
Grid[{{PieChart[{1, 4, 3, 5, 2}], NumberLinePlot[{1, 4, 3, 5, 2}]},
  {ListLinePlot[{1, 4, 3, 5, 2}], BarChart[{1, 4, 3, 5, 2}]}}]
```

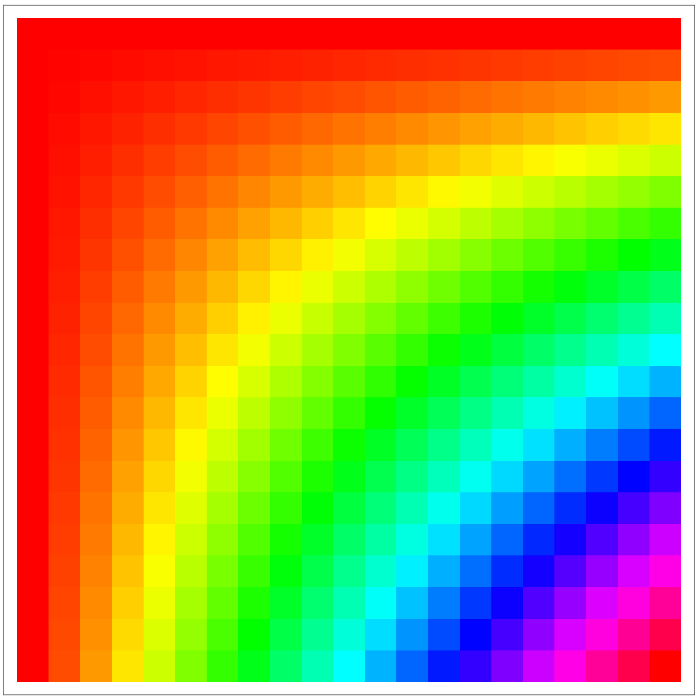
Out[20]=



13.7 Make an array plot of hue values x*y, where x and y each run from 0 to 1 in steps of 0.05.

In[21]:=
```
ArrayPlot[Table[Hue[x * y], {x, 0, 1, 0.05}, {y, 0, 1, 0.05}]]
```

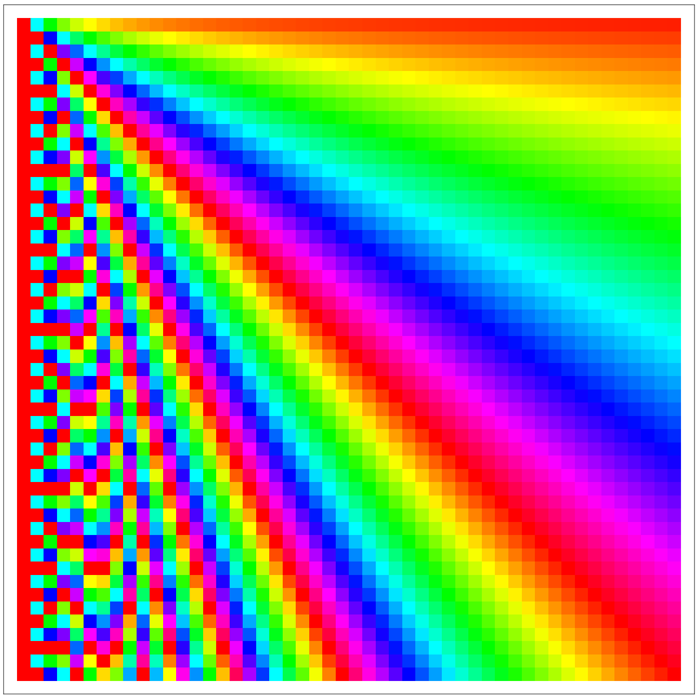
Out[21]=



13.8 Make an array plot of hue values x/y, where x and y each run from 1 to 50 in steps of 1.

In[22]:=
```
ArrayPlot[Table[Hue[x / y], {x, 1, 50, 1}, {y, 1, 50, 1}]]
```

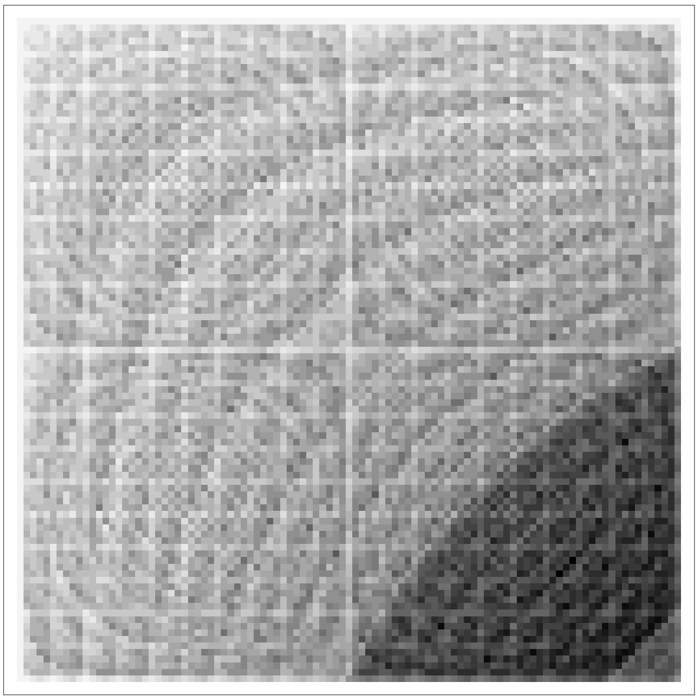
Out[22]=



13.9 Make an array plot of the lengths of Roman numeral strings in a multiplication table up to 100x100.

In[27]:=
```
ArrayPlot[Table[Length[Characters[RomanNumeral[i * j]]], {i, 0, 100}, {j, 0, 100}]]
```

Out[27]=



+13.1 Make a 20x20 addition table.

In[30]:=
```
Grid[Table[x + y, {x, 1, 20}, {y, 1, 20}]]
```

Out[30]=

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40

+13.2 Make a 10x10 grid of randomly colored random integers between 0 and

10 that have random size up to 32.

In[32]:=
```
Grid[Table[Style[RandomInteger[10], RandomColor[], RandomInteger[52]], 10, 10]]
```

Out[32]=

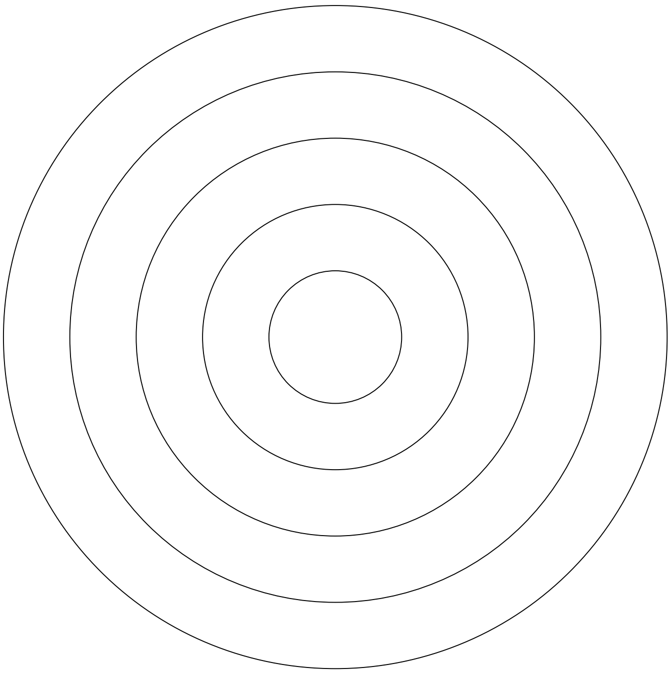
3	7	9	8	9	2	1	10	8	1
6	2	7	[illegible]	2	9	10	7	3	2
9	5	8	8	2	7	9	9	8	8
4	3	4	9	9	4	0	7	5	1
8	2	0	3	2	1	3	3	2	8
10	10	8	[illegible]	7	[illegible]	4	[illegible]	7	4
0	1	3	10	6	2	3	10	9	3
1	6	10	8	1	10	8	10	0	6
2	6	10	5	6	4	6	0	1	5
3	[illegible]	10	5	5	6	3	10	2	6

Exercises for Section 14 | Coordinates and Graphics

14.1 Make a graphics of 5 concentric circles centered at {0, 0} with radio 1, 2, ..., 5.

In[34]:=
```
Graphics[Table[Circle[{0, 0}, r], {r, 1, 5}]]
```

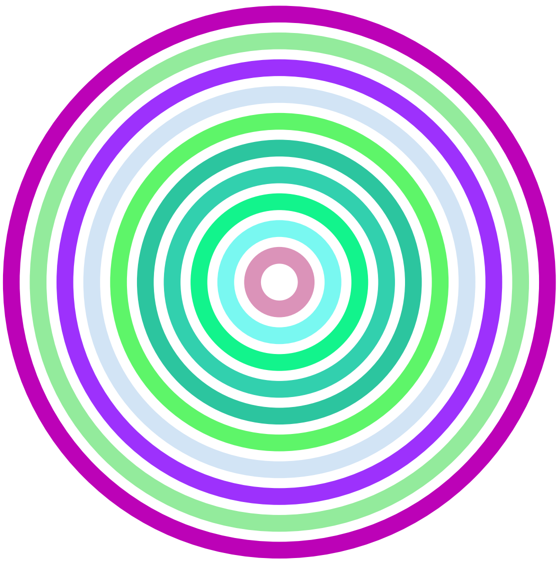
Out[34]=



14.2 Make 10 concentric circles with random colors.

In[39]:=
```
Graphics[
 Table[Style[Circle[{0, 0}, r], RandomColor[], Thickness[0.03]], {r, 1, 10}]]
```

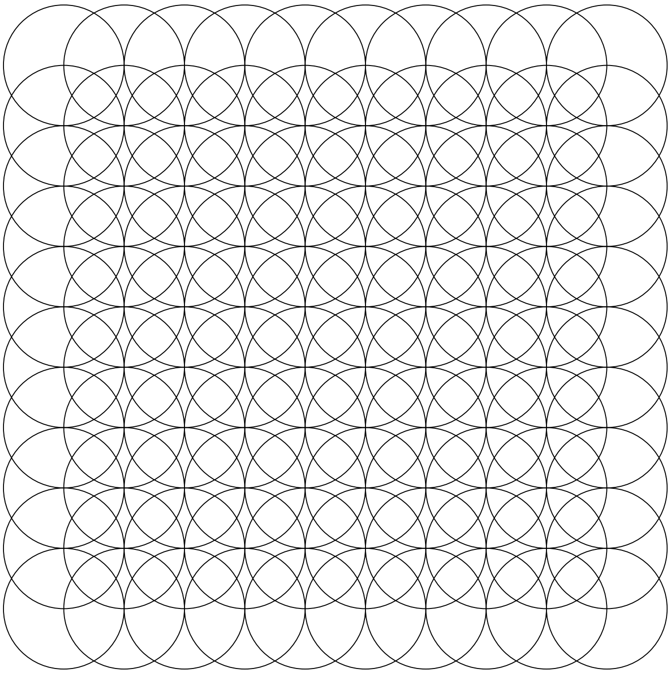
Out[39]=



14.3 Make graphics of a 10x10 grid of circles with radius 1 centered at integer points {x, y}.

In[42]:=
```
Graphics[Table[Circle[{x, y}, 1], {x, 1, 10}, {y, 1, 10}]]
```

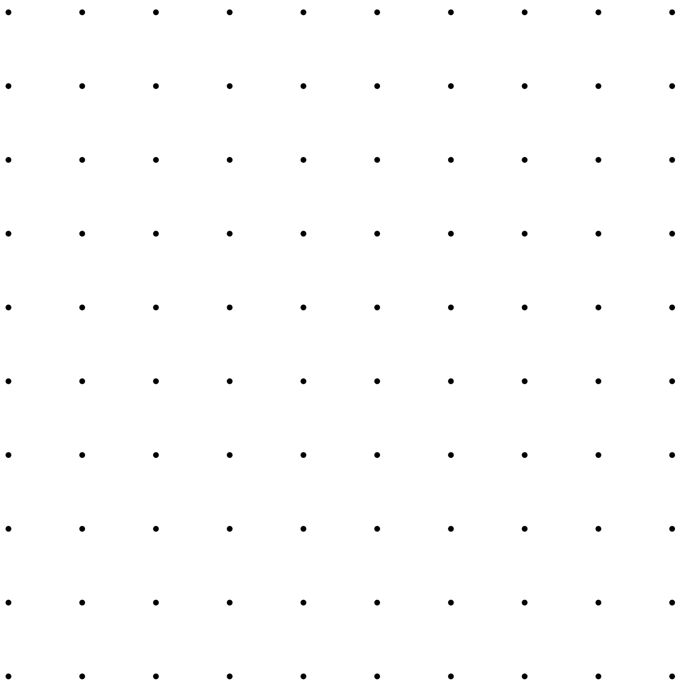
Out[42]=



14.4 Make a 10x10 grid of points with coordinates at integer positions up to 10.

In[43]:=
```
Graphics[Table[Point[{x, y}], {x, 10}, {y, 10}]]
```

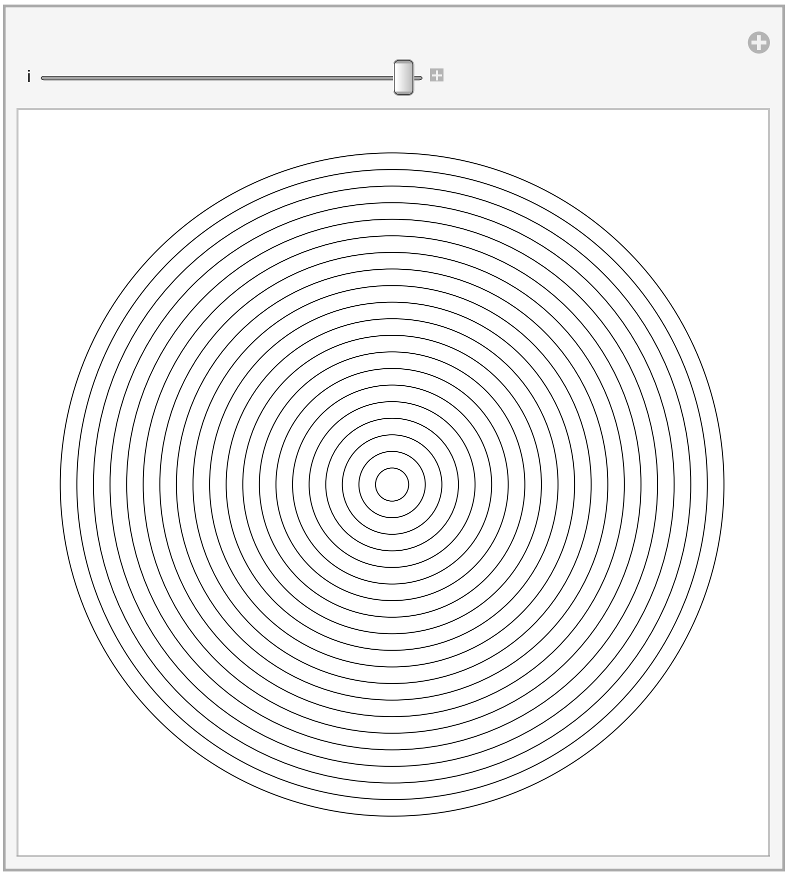
Out[43]=



14.5 Make a Manipulate with between 1 and 20 concentric circles.

In[47]:=
```
Manipulate[Graphics[Table[Circle[{0, 0}, r], {r, 1, i}]], {i, 1, 20}]
```

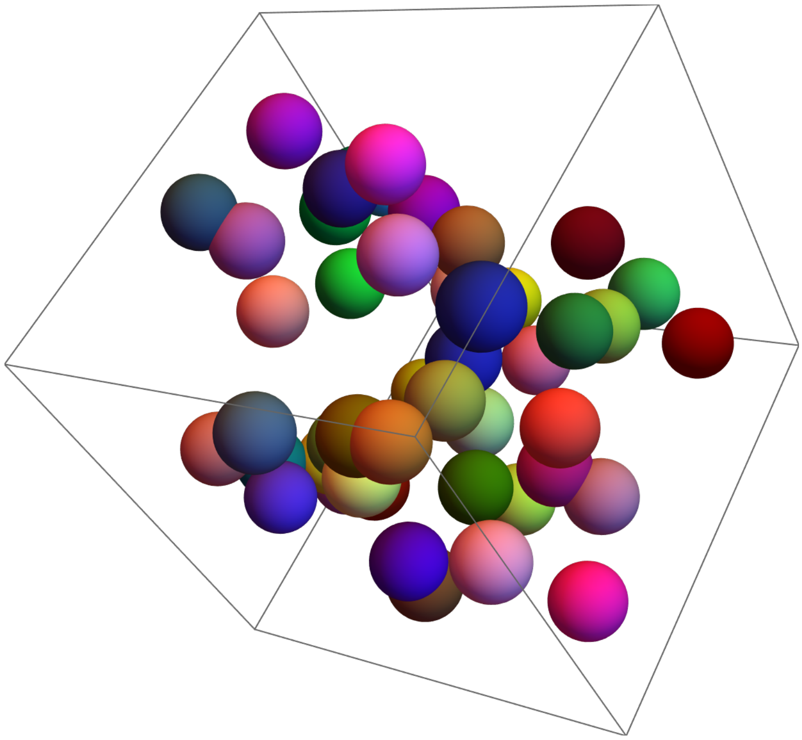
Out[47]=



14.6 Place 50 spheres with random colors at random integer coordinates up to 10.

In[51]:=
```
Graphics3D[
 Table[Style[Sphere[{RandomInteger[10], RandomInteger[10], RandomInteger[10]}],
   RandomColor[]], 50]]
```

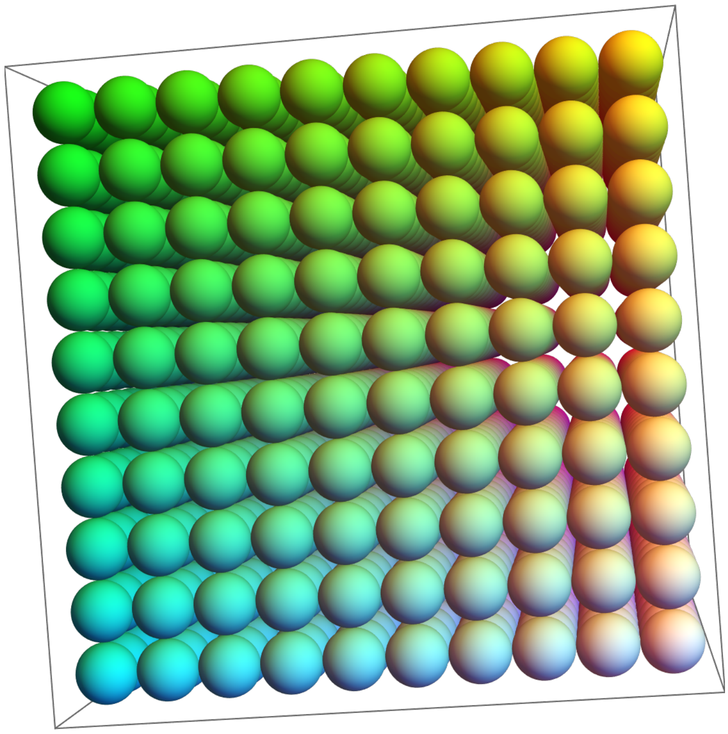
Out[51]=



14.7 Make a 10x10x10 array of spheres with RGB components ranging from 0 to 10. The spheres should be centered at integer coordinates, and should touch each other.

In[52]:=
```
Graphics3D[Table[Style[Sphere[{x, y, z}, 1 / 2], RGBColor[{x / 10, y / 10, z / 10}]],
  {x, 10}, {y, 10}, {z, 10}]]
```

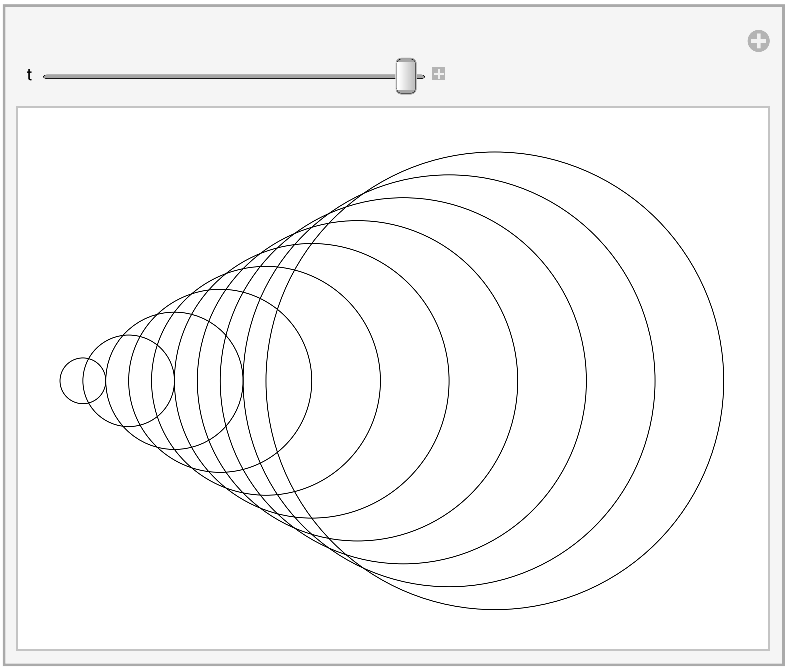
Out[52]=



14.8 Make a Manipulate with t varying between -2 and +2 that contains circles of radius x centered at {t*x, 0} with x going from 1 to 10.

In[54]:=
```
Manipulate[Graphics[Table[Circle[{t*x, 0}, x], {x, 1, 10}]], {t, -2, 2}]
```

Out[54]=



14.9 Make a 5x5 array of regular hexagons with size 1/2, centered at integer points.