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Practical – Chapter – 3 (Torrence)

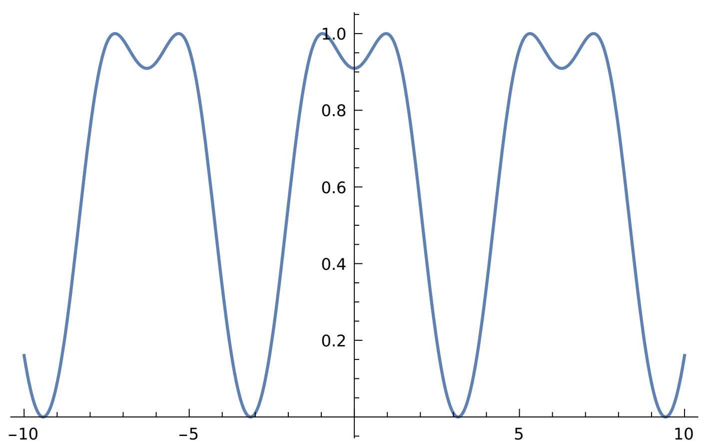
Exercise 3.2

Q1.Plot the following functions on the domain $-10 \leq x \leq 10$

a) sin (1 + cos (x))

In[1]:=
```
f[x_] := Sin[1 + Cos[x]]
```

In[2]:=
```
Plot[f[x], {x, -10, 10}]
```

Out[2]=


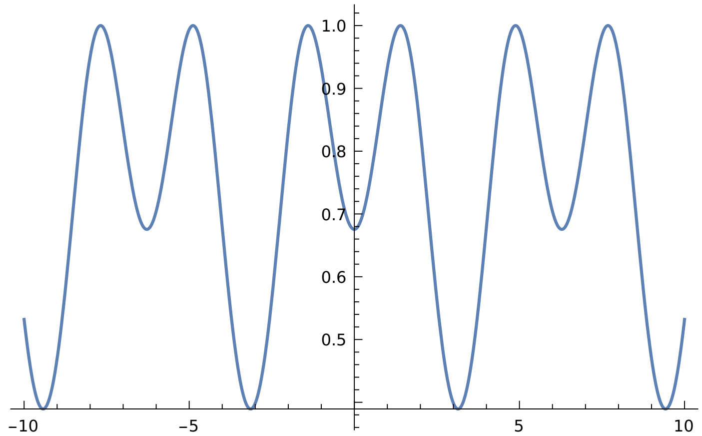
In[3]:=
```
Clear[f];
```

b) sin (1.4 + cos (x))

In[4]:=
```
f[x_] := Sin[1.4 + Cos[x]]
```

In[5]:=
```
Plot[f[x], {x, -10, 10}]
```

Out[5]=



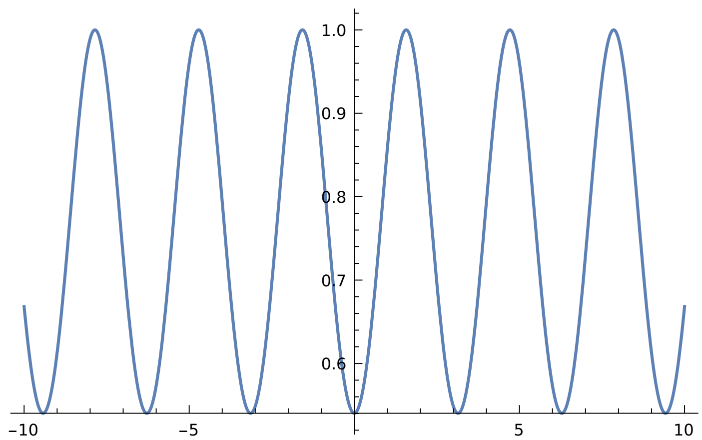
In[6]:=
```
Clear[f];
```

c) sin (pi / 2 + cos (x))

In[7]:=
```
f[x_] := Sin[Pi / 2 + Cos[x]]
```

In[8]:=
```
Plot[f[x], {x, -10, 10}]
```

Out[8]=

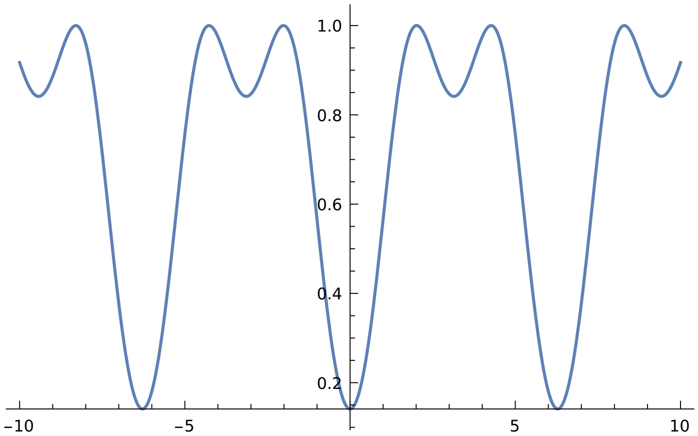


In[9]:=
```
Clear[f];
```

d) sin (2 + cos (x))

In[10]:=
```
f[x_] := Sin[2 + Cos[x]]
```

In[11]:=
```
Plot[f[x], {x, -10, 10}]
```

Out[11]=


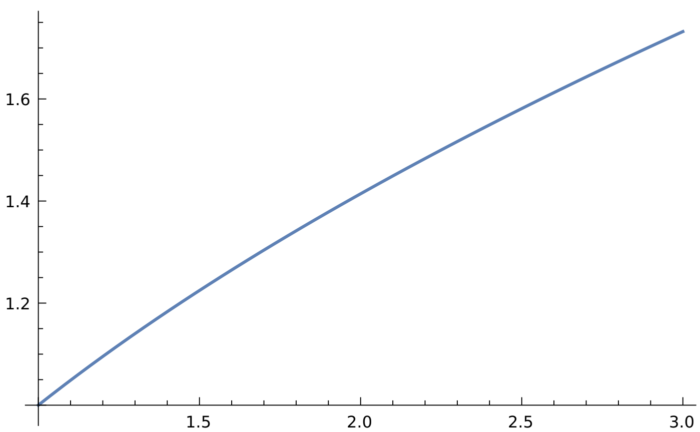
In[12]:=
```
Clear[f];
```

Q2. Consider the square root function f (x) = √ x, when x is near 2.

a) Graph of f as x goes from 1 to 3.

In[13]:=
```
f[x_] := (x)^(1/2)
```

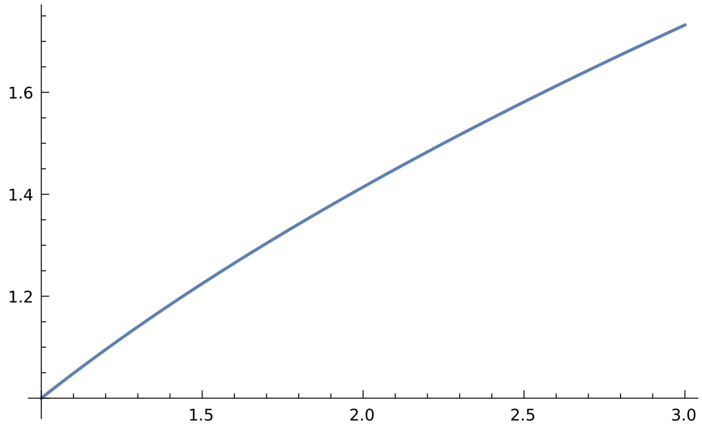
In[14]:=
```
Plot[f[x], {x, 1, 3}]
```

Out[14]=


In[15]:=

```
With[{δ = 10^(0)}, Plot[(x)^(1/2), {x, 2 - δ , 2 + δ}]]
```

Out[15]=

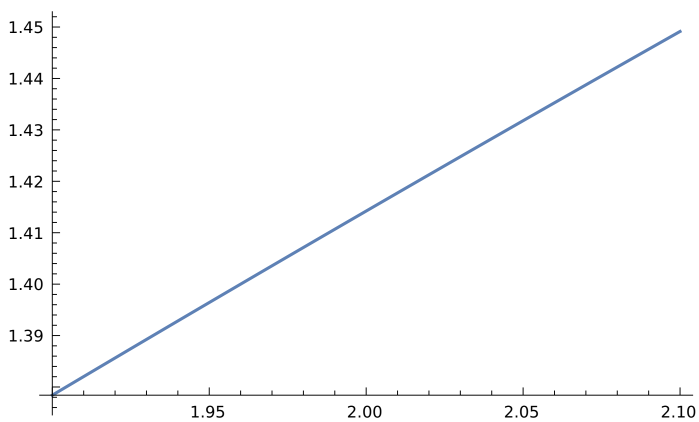


b) Change with the value of **δ** *to be 10^−1, 10^−2, 10^−3 and see the graph of f as x goes from 1.9 to 2.1*

In[16]:=

```
With[{δ = 10^(-1)}, Plot[(x)^(1/2), {x, 2 - δ , 2 + δ}]]
```

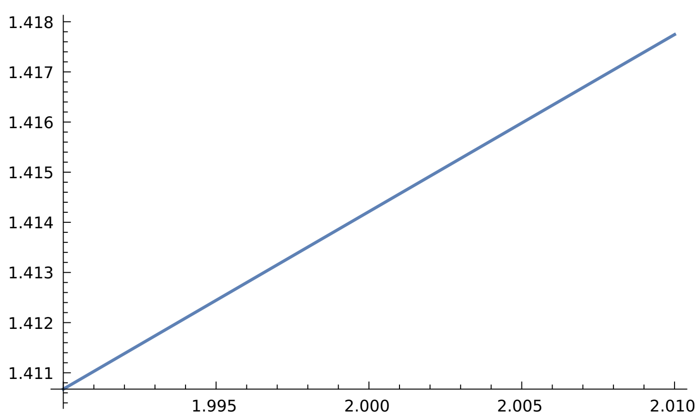
Out[16]=



In[17]:=

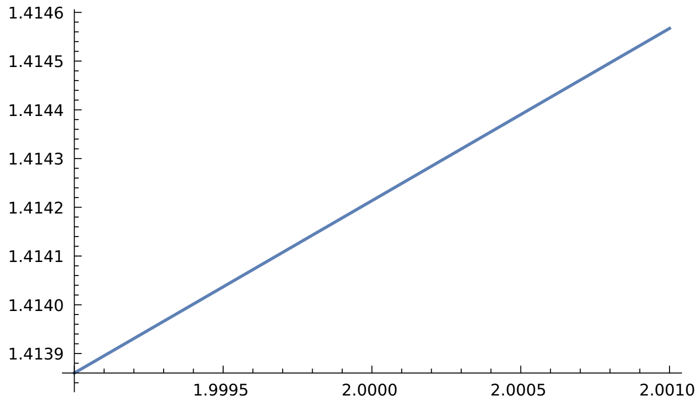
```
With[{δ = 10^(-2)}, Plot[(x)^(1/2), {x, 2 - δ , 2 + δ}]]
```

Out[17]=



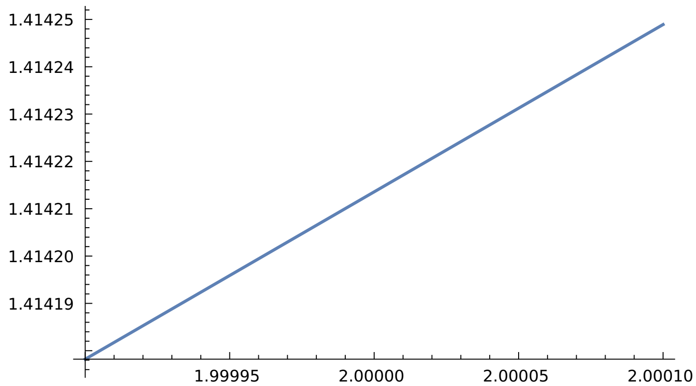
In[18]:=
```
With[{δ = 10^(-3)}, Plot[(x)^(1/2), {x, 2 - δ , 2 + δ}]]
```

Out[18]=



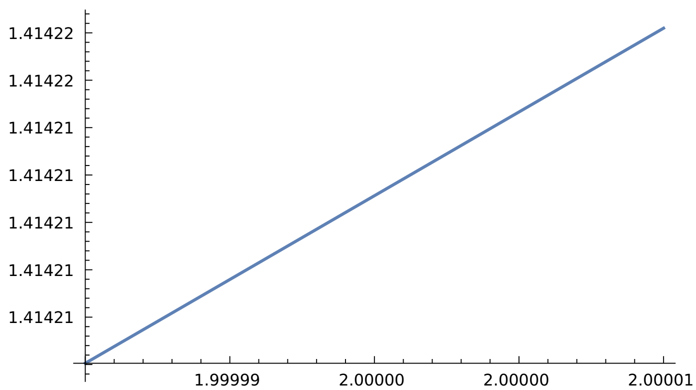
In[19]:=
```
With[{δ = 10^(-4)}, Plot[(x)^(1/2), {x, 2 - δ , 2 + δ}]]
```

Out[19]=



In[20]:=
```
With[{δ = 10^(-5)}, Plot[(x)^(1/2), {x, 2 - δ , 2 + δ}]]
```

Out[20]=



In[21]:=
```
Clear[f];
```

c) Use the last plot to approximate √ 2 to six significant digits. Check your answer using N

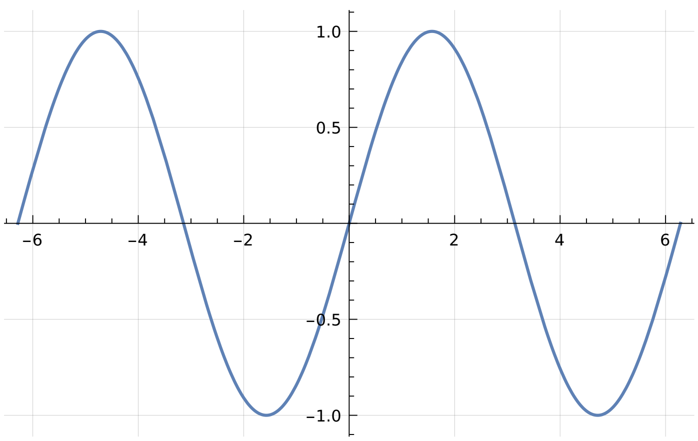
By the above plots we can approximate that $\sqrt{2} = 1.41421$

In[22]:=
```
N[√ 2, 6]
```
Out[22]=
```
1.41421
```

Exercise 3.3

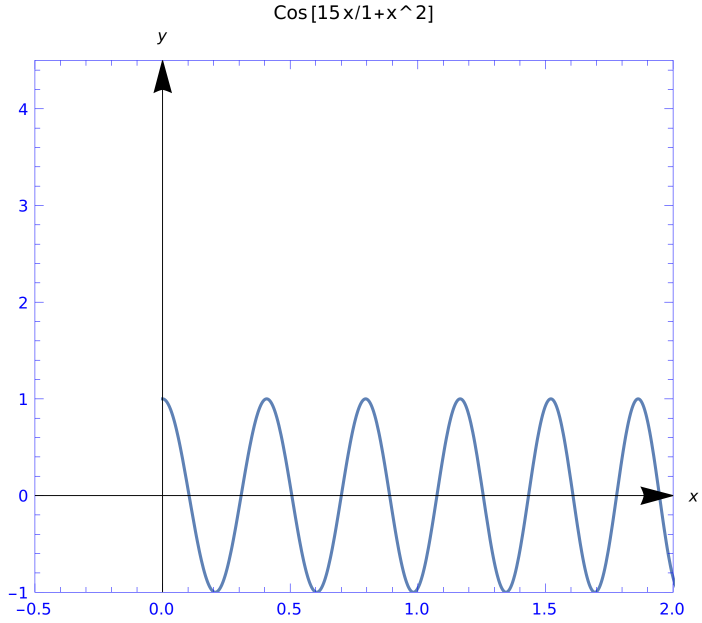
Q1. Use the gridlines and tick options, as well as the setting gridlines → Lighter[Gray] to plot the sine function.

In[47]:=
```
Plot[Sin[x], {x, -2 * Pi, 2 * Pi}, GridLines → Automatic,
 Ticks → Automatic, GridLines → Lighter[Gray]]
```
Out[47]=



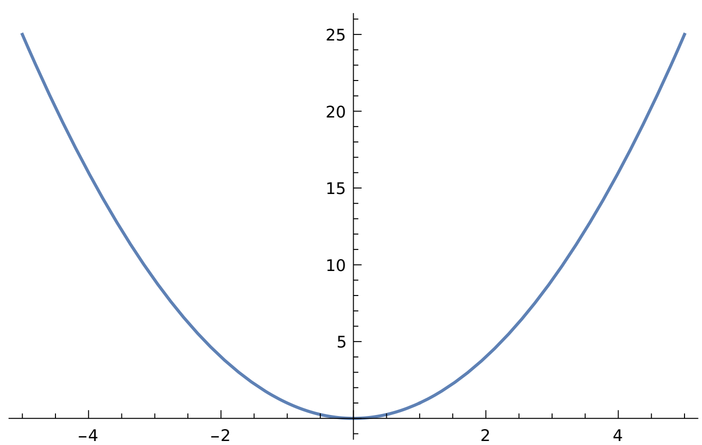
Q2. Use the Axes, Frame, Filling, Framestyle, Plotrange and Aspectratio options to plot the Y = Cos (15 x) / 1 + x ^ 2.

In[24]:=
```
Plot[Cos[15 * x / 1 + x ^ 2], {x, 0, Pi}, PlotRange → {{-0.5, 2}, {-1, 4.5}},
 Frame → True, AxesStyle → Arrowheads [00.05], AspectRatio → 5 / 6, Axes → True,
 AxesLabel → {x, y}, PlotLabel → "Cos[15x/1+x^2]", FrameStyle → Blue]
```

Out[24]=


Q4. Plot the function f (x) = x ^ 2 on the domain − 2 ≤ x ≤ 2 and the set exclusions to x = 1.

In[25]:=
```
Plot[x ^ 2, {x, -5, 5}, Exclusions → {x == 1}]
```

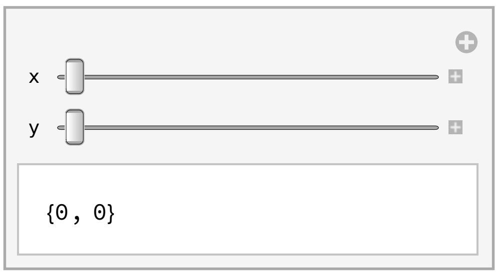
Out[25]=


Exercise 3.4

Q1. The following simple Manipulate has two sliders : one for x and one for y. Make a Manipulate that also has output {x, y}, but that has a single Slider2D controller.

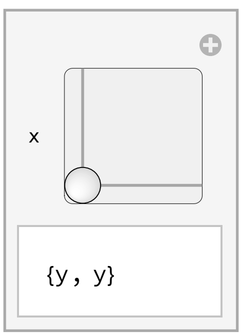
In[26]:=
```
Manipulate[{x, y}, {x, 0, 1}, {y, 0, 1}]
```

Out[26]=



In[27]:=
```
Manipulate[{x, y}, {x, y, {0, 1}}]
```

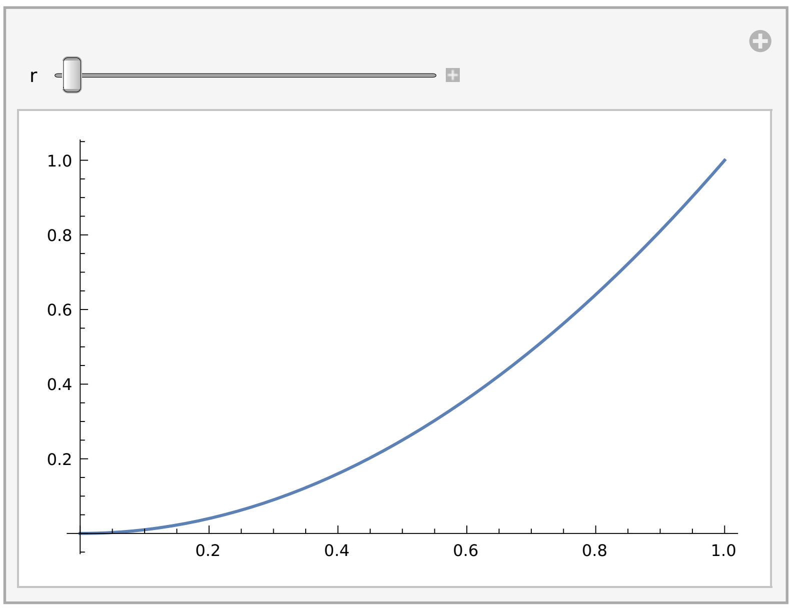
Out[27]=



Q2. Make a Manipulate of a Plot where the user can adjust the AspectRatio in real time, from a starting value of 1 / 5 (five times as wide as it is tall) to an ending value of 5 (five times as tall as it is wide). Set ImageSize to Automatic, 128 so the height remains constant as the slider is moved.

In[28]:=
```
Manipulate[Plot[x^2, {x, 0, r}], {r, 1, 3}, ImageSize → {Automatic128}, AspectRatio → 5/6]
```

Out[28]=



Exercise 3.5

Q1. The Partition command is used to break a single list into sublists of equal length. It is useful for breaking up a list into rows for display within a Grid.

a) Enter the following inputs and discuss the outputs.

In[29]:=
```
Range[100]
```
Out[29]=
```
{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}
```

In[30]:=
```
Partition[Range[100], 10]
```
Out[30]=
```
{{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}}
```

b) Format a table of the first 100 integers,
with twenty digits per row. The first two rows,
for example, should look like this : ....

In[31]:=
```
Table[x, {x, 1, 100}]
```
Out[31]=
```
{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}
```

In[32]:=
```
Partition[Table[x, {x, 1, 100}], 20]
```
Out[32]=
```
{{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}}
```

c) Make the same table as above,
but use only the Table and Range commands. Do not use
Partition.

In[34]:=
```
Table[Range[10], 10]
```

Out[34]=
```
{{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, 6, 7, 8, 9, 10},
 {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, 6, 7, 8, 9, 10}, {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, 6, 7, 8, 9, 10}, {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}}
```

d) Make the same table as above, but use only the Table command (twice). Do not use Partition or Range.

In[35]:=
```
Table[Table[x, {x, 1, 100}]]
```

Out[35]=
```
{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}
```

Q4. The Sum command has a syntax similar to that of Table.

a) Use the Sum command to evaluate the following expression :

1 + 2 ^ x + 3 ^ x + 4 ^ x + 5 ^ x + 6 ^ x + 7 ^ x + 8 ^ x + 9 ^ x + 10 ^ x + 11 ^ x + 12 ^ x + 13 ^ x + 14 ^ x + 15 ^ x + 16 ^ x + 17 ^ x + 18 ^ x + 19 ^ x + 20 ^ x

In[36]:=
```
f[x_] := x ^ 3
```

In[37]:=
```
Sum[f[x], {x, 1, 20}]
```

Out[37]=
```
44 100
```

b) Make a table of values for x 1, 2, ... , 10 for the function

f (x) = 1 + 2 ^ x + 3 ^ x + 4 ^ x + 5 ^ x + 6 ^ x + 7 ^ x + 8 ^ x + 9 ^ x + 10 ^ x + 11 ^ x + 12 ^ x + 13 ^ x + 14 ^ x + 15 ^ x + 16 ^ x + 17 ^ x + 18 ^ x + 19 ^ x + 20 ^ x

In[38]:=
```
f[x_] := 1 + 2 ^ x + 3 ^ x + 4 ^ x + 5 ^ x + 6 ^ x + 7 ^ x + 8 ^ x + 9 ^ x + 10 ^ x +
  11 ^ x + 12 ^ x + 13 ^ x + 14 ^ x + 15 ^ x + 16 ^ x + 17 ^ x + 18 ^ x + 19 ^ x + 20 ^ x
```

In[39]:=
```
Table[f[x], {x, 1, 10}]
```

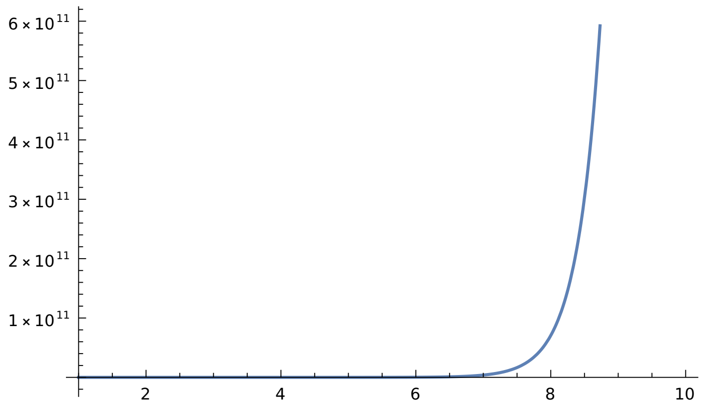
Out[39]=
```
{210, 2870, 44 100, 722 666, 12 333 300, 216 455 810,
 3 877 286 700, 70 540 730 666, 1 299 155 279 940, 24 163 571 680 850}
```

c) Plot f (x) on the domain 1 ≤ x ≤ 10.

In[40]:=
```
f[x_] := 1 + 2 ^ x + 3 ^ x + 4 ^ x + 5 ^ x + 6 ^ x + 7 ^ x + 8 ^ x + 9 ^ x + 10 ^ x +
  11 ^ x + 12 ^ x + 13 ^ x + 14 ^ x + 15 ^ x + 16 ^ x + 17 ^ x + 18 ^ x + 19 ^ x + 20 ^ x
```

In[41]:=
```
Plot[f[x], {x, 1, 10}]
```

Out[41]=



Exercise 3.6

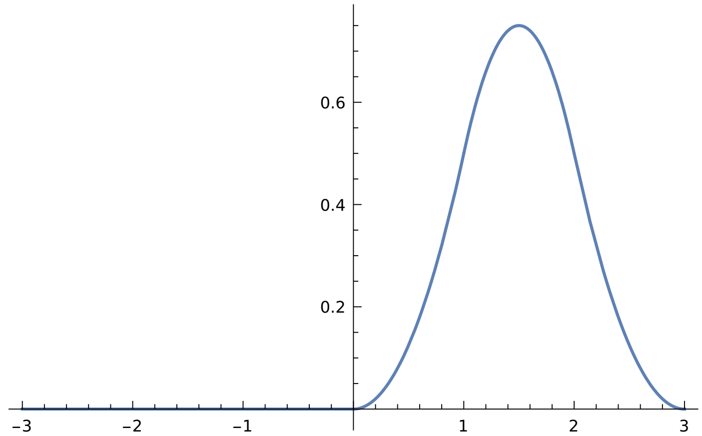
Q2. Make a plot of the piecewise function below, and comment on its shape.

f (x) = {0, x < 0;
x ^ 2 / 2, 0 ≤ x < 1;
−x ^ 2 + 3 x − 3 / 2, 1 ≤ x < 2;
(1 / 2) (3 − x) ^ 2, 2 ≤ x < 3;
0, x ≤ 3

In[42]:=
```
f[x_] := Piecewise[{{0, x < 0}, {x ^ 2 / 2, 0 ≤ x ≤ 1},
   {-x ^ 2 + 3 x - 3 / 2, 1 ≤ x < 2}, {(1 / 2) (3 - x) ^ 2, 2 ≤ x ≤ 3}, {0, x ≤ 3}}]
```

In[43]:=
```
Plot[f[x], {x, -3, 3}]
```

Out[43]=



In[44]:=
```
ClearAll[f];
```

Q3. A step function assumes a constant value between consecutive integers n and n + 1. Make a plot of the step function f (x) whose value is n ^ 2 when n ≤ x ≤ n + 1. Use the domain 0 ≤ x ≤ 20.

In[45]:=
```
f[x_] := Piecewise [{{n^ 2, n ≤ x < n + 1}, {-n^2, n > x > n + 1}}]
```

In[46]:=
```
Plot[f[x], {x, 0, 20}]
```

Out[46]=