Monte Carlo Integration

Unit Circle

In[135]:=

```
num = 40000;
Clear[inlist]; Clear[outlist];
inlist = {};
 outlist = {};
numin = 0;
For[m = 1, m ≤ num, m++,
  {
   x = 2 (Random[] - .5);
   y = 2 (Random[] - .5);
   If[x^2 + y^2 ≤ 1, loc = 1, loc = 2];
   If[loc == 1,
    inlist = AppendTo[inlist, {x, y}],  outlist = AppendTo[outlist, {x, y}]];
   numin = numin + 2 - loc;
   percentage[m] = 1.0 numin / m;
  }];
cut[dataset_, number_] := Module[{},
   temp = {};
   For[i = 1, i ≤ Floor[number], i++, temp = AppendTo[temp, dataset[[i]]]];
   Return[temp];
  ];
cut[inlist, 5]
```

Out[142]=

```
{{0.128378, 0.869579}, {0.035225, -0.0336549},
 {0.549958, -0.151142}, {-0.0379999, 0.802088}, {0.173566, -0.401813}}
```

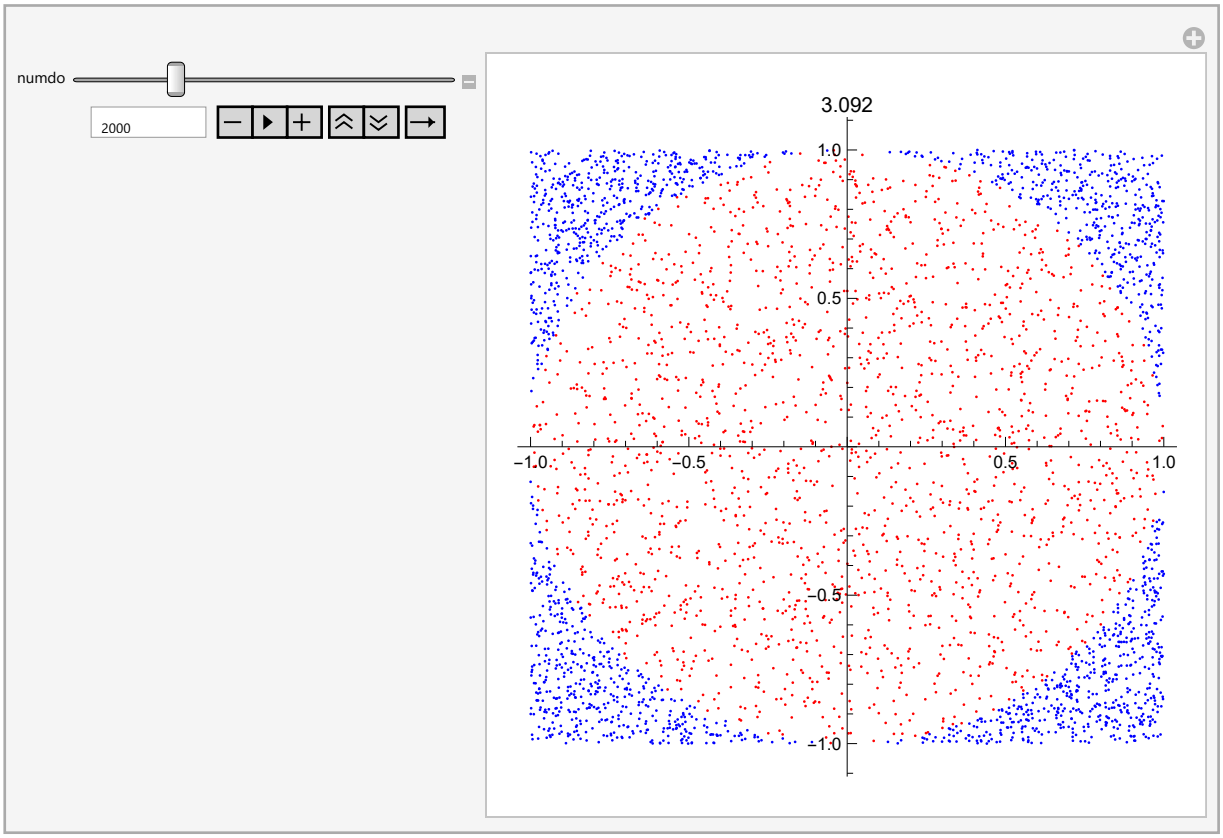
```
percentage[7000]
```

```
0.783143
```

In[9]:=
```
Print["Plot of randomly chosen points inside and outside unit circle, whose area is ",
  1.0 Pi];
Manipulate[ListPlot[{cut[inlist, numdo], cut[outlist, numdo]}, PlotStyle → {Red, Blue},
  AspectRatio → 1, PlotLabel → 4 percentage[Floor[numdo]]], {numdo, 20, .2 num}]
```

```
Plot of randomly chosen points inside and outside unit circle, whose area is 3.14159
```

Out[10]=



Ellipse x^2 + 4 y^2 = 1

In[143]:=

```
num2 = 40000;
Clear[inlist2]; Clear[outlist2];
inlist2 = {};
 outlist2 = {};
numin = 0;
For[m = 1, m ≤ num2, m++,
  {
   x = 2 (Random[] - .5);
   y = 2 (Random[] - .5);
   If[x^2 + 4 y^2 ≤ 1, loc = 1, loc = 2];
   If[loc == 1,  inlist2 = AppendTo[inlist2, {x, y}],
    outlist2 = AppendTo[outlist2, {x, y}]];
   numin = numin + 2 - loc;
   percentage2[m] = 1.0 numin / m;
  }];
cut[dataset_, number_] := Module[{},
   temp = {};
   For[i = 1, i ≤ Floor[number], i++, temp = AppendTo[temp, dataset[[i]]]];
   Return[temp];
  ];
cut[inlist2, 5]
```

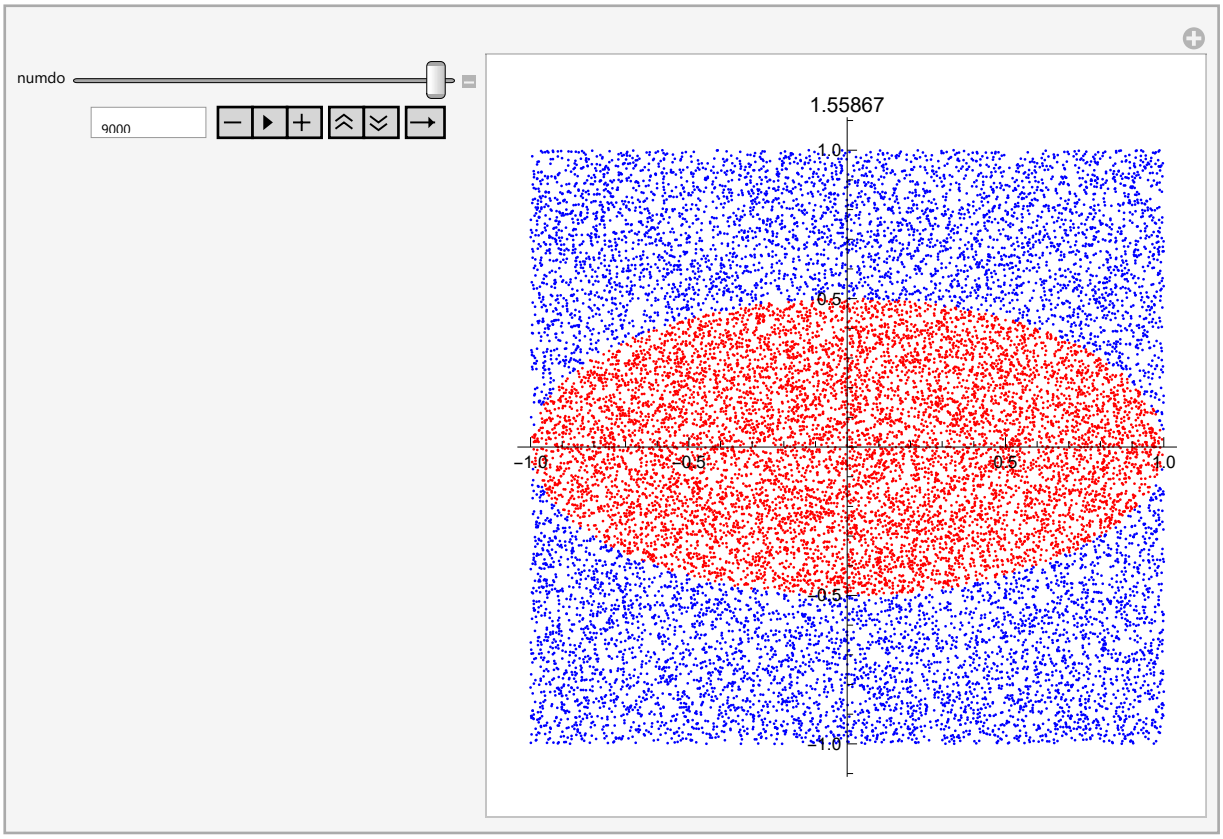
Out[150]=

```
{{-0.57719, 0.00235836}, {-0.580755, 0.289995},
 {0.668351, -0.113067}, {-0.939994, 0.121831}, {-0.668761, 0.183316}}
```

In[151]:=
```
Print["Plot of randomly chosen points inside and
    outside ellipse x^2 + 4 y^2 = 1, whose area is ", 1.0 Pi / 2];
Manipulate[ListPlot[{cut[inlist2, numdo], cut[outlist2, numdo]}, PlotStyle → {Red, Blue},
  AspectRatio → 1, PlotLabel → 4 percentage2[Floor[numdo]]], {numdo, 20, .2 num2}]
```

```
Plot of randomly chosen points inside and outside ellipse x^2 + 4 y^2 = 1, whose area is 1.5708
```

Out[152]=



General Region

In[36]:=
```
numn = 40 000;
randpoints = {};
For[m = 1, m ≤ numn, m++,
  randpoints = AppendTo[randpoints, {2 (Random[] - .5), 2 (Random[] - .5)}]];
randpoints[[1, 2]]
```

Out[39]=
```
0.396882
```

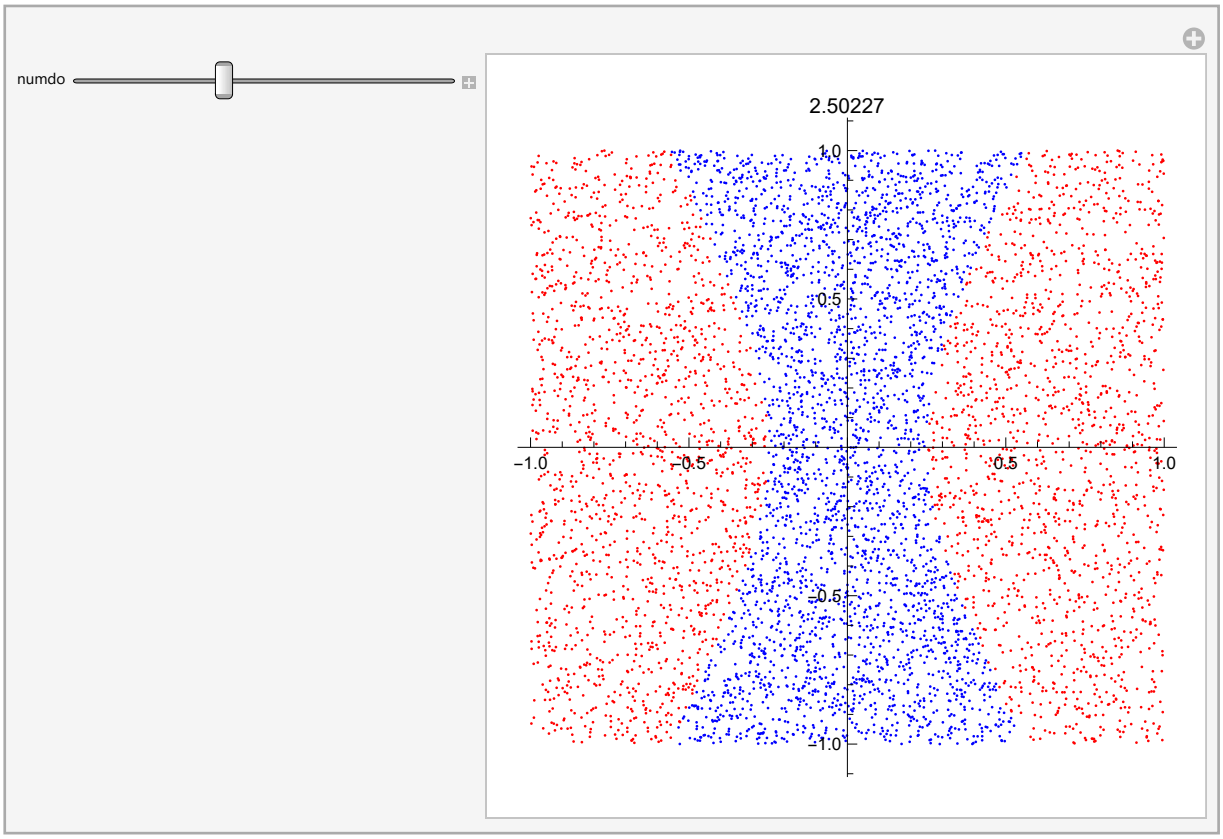
In[40]:=
```
Clear[inlistn]; Clear[outlistn];
inlistn = {};
outlistn = {};
numin = 0;
For[m = 1, m ≤ numn, m++,
  {
   x = randpoints[[m, 1]];
   y = randpoints[[m, 2]];
   If[16 x^2 - 1 ≥ 4 y^2, loc = 1, loc = 2];
   If[loc == 1, inlistn = AppendTo[inlistn, {x, y}],
    outlistn = AppendTo[outlistn, {x, y}]];
   numin = numin + 2 - loc;
   percentagen[m] = 1.0 numin / m;
  }];
cut[dataset_, number_] := Module[{},
   temp = {};
   For[i = 1, i ≤ Floor[number], i++, temp = AppendTo[temp, dataset[[i]]]];
   Return[temp];
  ];
cut[inlistn, 5]
```

Out[46]=
```
{{-0.386697, 0.396882}, {-0.970588, -0.634329},
 {-0.487355, 0.783676}, {-0.878634, -0.556195}, {-0.862246, 0.575235}}
```

In[ ]:=
```
Print["Plot of randomly chosen points inside and outside."];
Manipulate[ListPlot[{cut[inlistn, numdo], cut[outlistn, numdo]}, PlotStyle → {Red, Blue},
  AspectRatio → 1, PlotLabel → 4 percentagen[Floor[numdo]]], {numdo, 20, .2 numn}]
```

Plot of randomly chosen points inside and outside.

Out[ ]=



Part: Part specification inlistn[[1]] is longer than depth of object.

Part: Part specification inlistn[[2]] is longer than depth of object.

Part: Part specification inlistn[[3]] is longer than depth of object.

General: Further output of Part::partd will be suppressed during this calculation.

Fibonacci Monte Carlo Integration

In[47]:=
```
gm = (1 + Sqrt[5]) / 2;
xmove = Sqrt[1 / (2 + gm)];
ymove = xmove gm;
Simplify[1 - xmove^2 - ymove^2]
```

Out[50]=

```
0
```

In[126]:=

```
num4 = 40000;
Clear[inlist4]; Clear[outlist4];
inlist4 = {};
 outlist4 = {};
numin = 0;
xcoord = 0;
For[m = 1, m ≤ num4, m++,
  {
   xcoord = xcoord + xmove;
   x = Mod[ xcoord, 1];
   y = Mod[gm xcoord, 1];
   inlist4 = AppendTo[inlist4, {x, y}];
  }];
cut[dataset_, number_] := Module[{},
   temp = {};
   For[i = 1, i ≤ Floor[number], i++, temp = AppendTo[temp, dataset[[i]]]];
   Return[temp];
  ];
cut[inlist2, 5]
```

Out[134]=

```
{{0.255697, -0.41038}, {0.569776, -0.22966},
 {-0.581547, -0.145345}, {0.443185, 0.172866}, {0.0421333, -0.144377}}
```

In[124]:=

```
Print["Plot of randomly chosen points inside and outside."];
Manipulate[
 ListPlot[cut[inlist4, numdo], PlotStyle → {Red}, AspectRatio → 1], {numdo, 1, .2 numn}]
```

Plot of randomly chosen points inside and outside.

Out[125]=