In[126]:=
```
SetDirectory[NotebookDirectory[]];
```

---

using FixedPoint

In[127]:=
```
Clear["Global`*"]
```

In[128]:=
```
getFixedPoint[f_, x0_, rIn_] :=
 FixedPoint[f /. {r → rIn}, x0, maxIterations]

fixedPointVsR[f_, x0_] := Table[
  {r, getFixedPoint[f, x0, r]},
  {r, rRange[[1]], rRange[[2]], rStep}
 ]

bifurcationDiagram[map_] := Module[{f = map},

  Print["calculating points..."];
  fixedPointsVsR = Table[
    fixedPointVsR[f, x0],
    {x0, x0Range[[1]], x0Range[[2]], x0Step}
   ];

  Print["plotting points..."];
  ListPlot[
   fixedPointsVsR,
   PlotStyle → Directive[
     PointSize[.001],
     Black
    ],
   PlotRange → Automatic,
   Axes → False;
   Frame → True;
   ImageSize → Large
  ]
 ]
```

In[131]:=
```
logisticMap[x_] := r x (1 - x)
cubicMap[x_] := r x^3 + (1 - r) x
gaussMap[x_] := Exp[- 4.9 x^2] + r
```

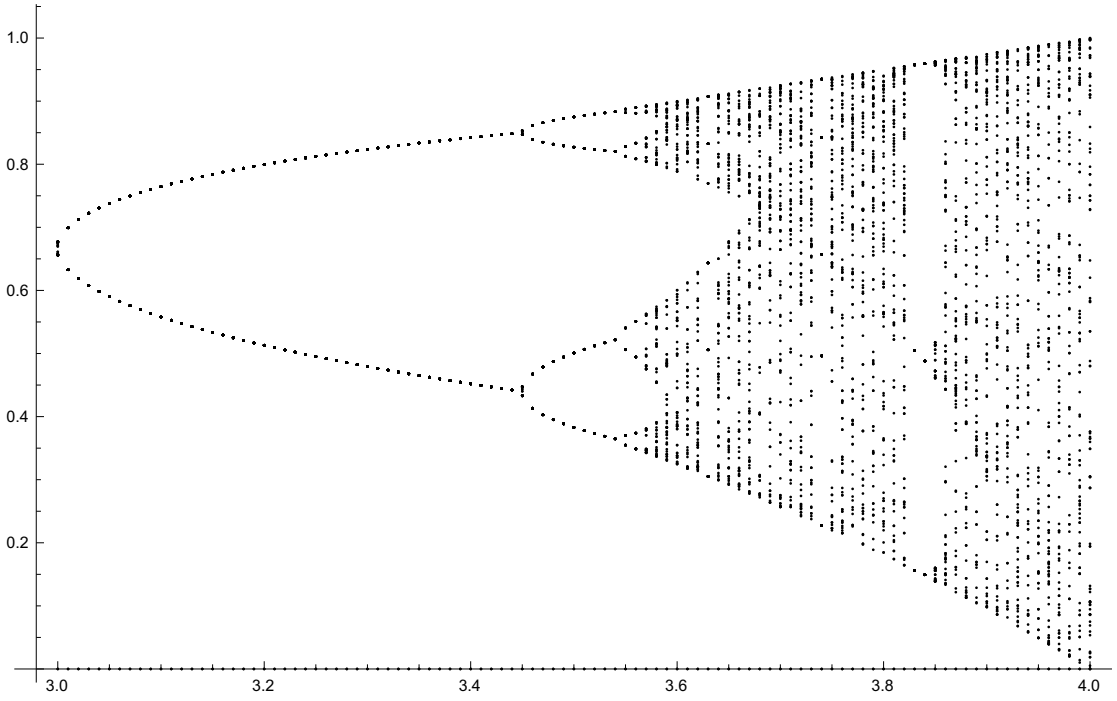
In[134]:=
```
rStep = .01; rRange = {3, 4};
x0Step = .01; x0Range = {0, 1};

maxIterations = 500;
```

In[137]:=
```
bifurcationDiagram[logisticMap]
```

```
calculating points...
plotting points...
```

Out[137]=



In[138]:=

using While loop

In[139]:=
```
Clear["Global`*"]
```

In[140]:=
```
maxItHits = 0; minResHits = 0;
```

In[141]:=

```
getFixedPoint[f_, x0_, r_] :=
 Module[{x = x0, i = 0},
  While[Abs[x - f[x, r]] > minResidual,
   x = f[x, r];
   If[i > maxIterations,
    maxItHits++;
    Break[];
   ];
   i++;
  ];
  If[i ≤ maxIterations,
   minResHits++;
  ];
  x
 ]

fixedPointVsR[f_, x0_] := Table[
  {r, getFixedPoint[f, x0, r]},
  {r, rRange[[1]], rRange[[2]], rStep}
 ]

bifurcationDiagram[map_] := Module[{f = map},

  Print["calculating points..."];
  fixedPointsVsR = Table[
    fixedPointVsR[f, x0],
    {x0, x0Range[[1]], x0Range[[2]], x0Step}
   ];
  Print["maxItHits: ", maxItHits, ", minResHits: ", minResHits];

  Print["plotting points..."];
  ListPlot[
   fixedPointsVsR,
   PlotStyle → Directive[PointSize[0], Black],
   PlotRange → Automatic,
   Axes → False;
   Frame → True;
   ImageSize → Large
  ]
 ]
```

In[144]:=
```
logisticMap[x_, r_] := r x (1 - x)
cubicMap[x_, r_] := r x^3 + (1 - r) x
gaussMap[x_, r_] := Exp[- 4.9 x^2] + r
```

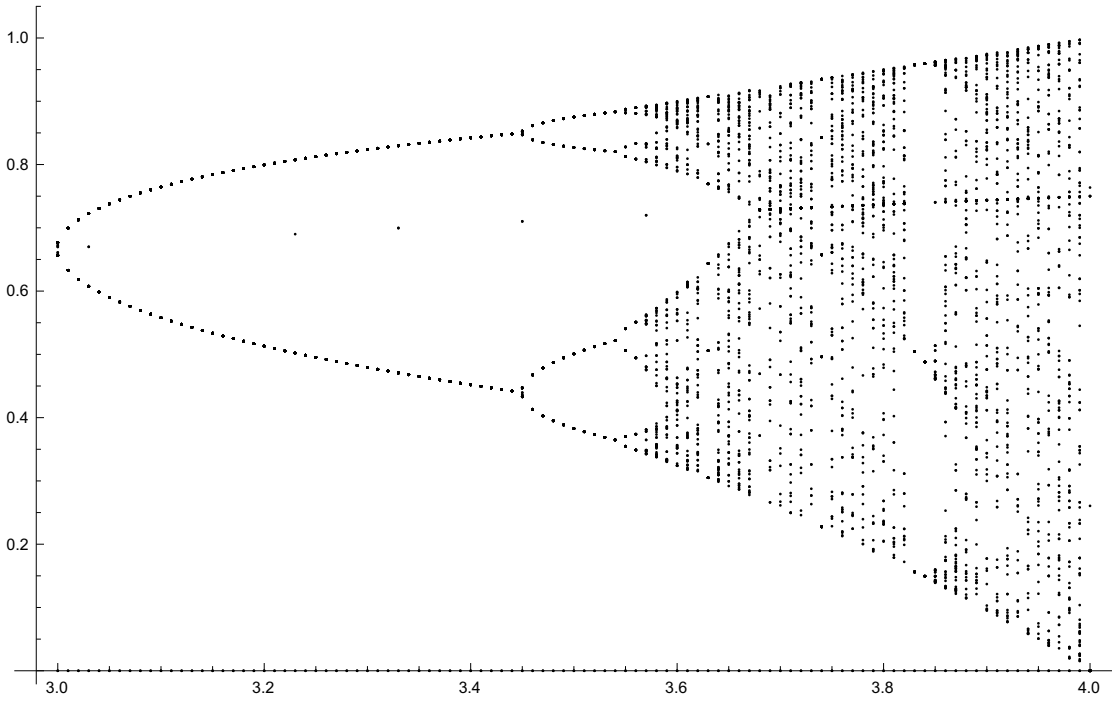
In[147]:=
```
rStep = .01; rRange = {3, 4};
x0Step = .01; x0Range = {0, 1};

minResidual = 1 * 10^-3;
maxIterations = 500;
```

In[151]:=
```
bifurcationDiagram[logisticMap]
```

```
calculating points...
maxItHits: 9389, minResHits: 812
plotting points...
```

Out[151]=



In[152]:=

color fun

In[153]:=
```
Clear["Global`*"]
```

In[154]:=
```
maxIterates = 20;
resolution = .005;
rMin = 3.2; rMax = 3.65;
```

In[157]:=
```
fixedPointAtR[f_, x0In_, rIn_] := Module[
  {x0 = x0In},
  fAtR[x_] = f[x] /. {r → rIn};
  FixedPoint[fAtR, x0, maxIterates]
 ]
```

In[158]:=
```
fixedPointVsR[f_, x0In_] := Table[
  {r, fixedPointAtR[f, x0In, r]},
  {r, rMin, rMax, resolution}
 ]
```

In[159]:=
```
bifurcationDiagram[map_] := Module[{f = map},
  fixedPointsVsR =
   Union[(* union gives a list containing seperate lists for each i=x0 *)
    Table[
     fixedPointVsR[f, x0],
     {x0, .005, 1, .008}
    ]
   ];
  ListPlot[fixedPointsVsR,
   Joined → True,
   InterpolationOrder → 3, (* smoothness *)
   PlotStyle → Thickness[.002],
   PlotTheme → "SapphireColor",
   PlotRange → Automatic,
   AspectRatio → 1,
   ImageSize → 600
  ]
 ]
```

In[160]:=
```
logisticMap[x_] := r x (1 - x)
```

In[161]:= **bifurcationDiagram[logisticMap]**

Out[161]=