

## 1.2 Subcritical pitchfork

a)

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

ptsSaddle = {{-4/9, 2/3}, {-4/9, -2/3}};

(*Bifurcation points are calculated in (b)*)
ptsPitch = {{0, 0}};
λ = D[r x + 4 x^3 - 9 x^5, x];

(*Stable fixed point if λ < 0 and unstable fixed point if λ > 0*)
Show[
  ContourPlot[
    ConditionalExpression[r x + 4 x^3 - 9 x^5, λ < 0] == 0,
    ConditionalExpression[r x + 4 x^3 - 9 x^5, λ > 0] == 0,
    {r, -1, 2}, {x, -1.5, 1.5},
    ContourStyle -> {{Black}, {Black, Dashed}},
    FrameLabel -> {Style["r", Black, Medium], Style["x", Black, Medium]},
    RotateLabel -> False,
    LabelStyle -> (FontSize -> 12),
    PlotLegends -> {"Stable fixed points", "Unstable fixed points"}],
  ListPlot[ptsSaddle,
    PlotLegends -> {"Supercritical saddle-node Bifurcation"},
    PlotStyle -> {PointSize[0.03], Red}],
  ListPlot[ptsPitch,
    PlotLegends -> {"Subcritical pitchfork Bifurcation"},
    PlotStyle -> {PointSize[0.03], Blue}]
]
```

Out[ ]=

