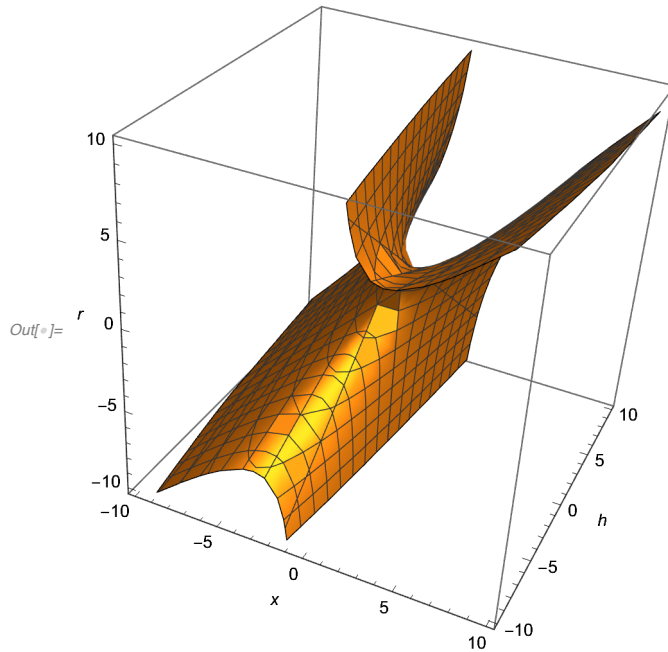


```

In[ ]:= f[x_, h_, r_] = h + x * (r - x);
rangeMin = -10;
rangeMax = 10;
ContourPlot3D[f[x, h, r] == 0, {x, rangeMin, rangeMax},
{h, rangeMin, rangeMax}, {r, rangeMin, rangeMax}, AxesLabel -> {x, h, r}]

```



```

In[ ]:= (* find xstar*)

```

```

In[ ]:= xstar = Solve[f[x, h, r] == 0, x]
xstar1[h_, r_] = xstar[[1]];
xstar2[h_, r_] = xstar[[2]];
(* FPs *)

```

Out[]:= $\left\{ \left\{ x \rightarrow \frac{1}{2} \left(r - \sqrt{4 h + r^2} \right) \right\}, \left\{ x \rightarrow \frac{1}{2} \left(r + \sqrt{4 h + r^2} \right) \right\} \right\}$

```

In[ ]:= (* Eval *)

```

```

In[ ]:=

```

```

In[ ]:= sol1 = D[f[x, h, r], x]
sol2[] = Solve[sol1 == 0, x]
sol2[r_] = r / 2
sol3 = f[x, h, r] /. sol2
sol31 = f[x, h, r] /. sol1
(*sol4[r_] = Solve[sol3==0,h];
sol5[r_] = Solve[sol31==0,h];
pl1 = Plot[sol4[[r]], {r,-10,10}];
*)

```

Out[]:= $r - 2 x$

Out[]:= $\left\{ \left\{ x \rightarrow \frac{r}{2} \right\} \right\}$

Out[]:= $\frac{r}{2}$

ReplaceAll: {sol2} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

Out[]:= $h + (r - x) x /. sol2$

ReplaceAll: {r - 2 x} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

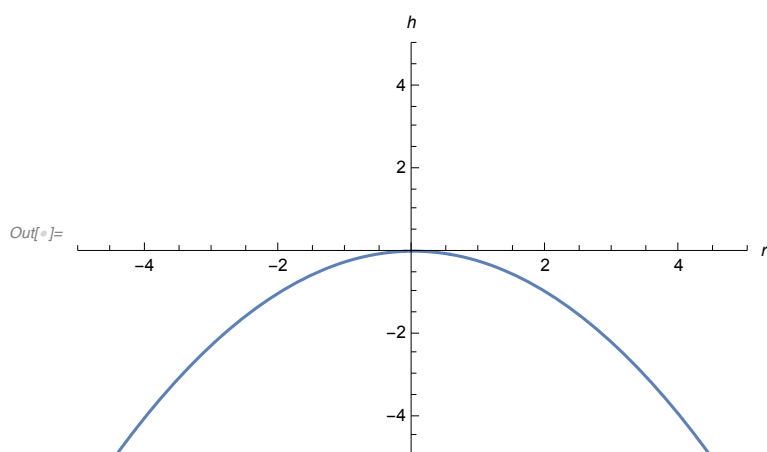
Out[]:= $h + (r - x) x /. r - 2 x$

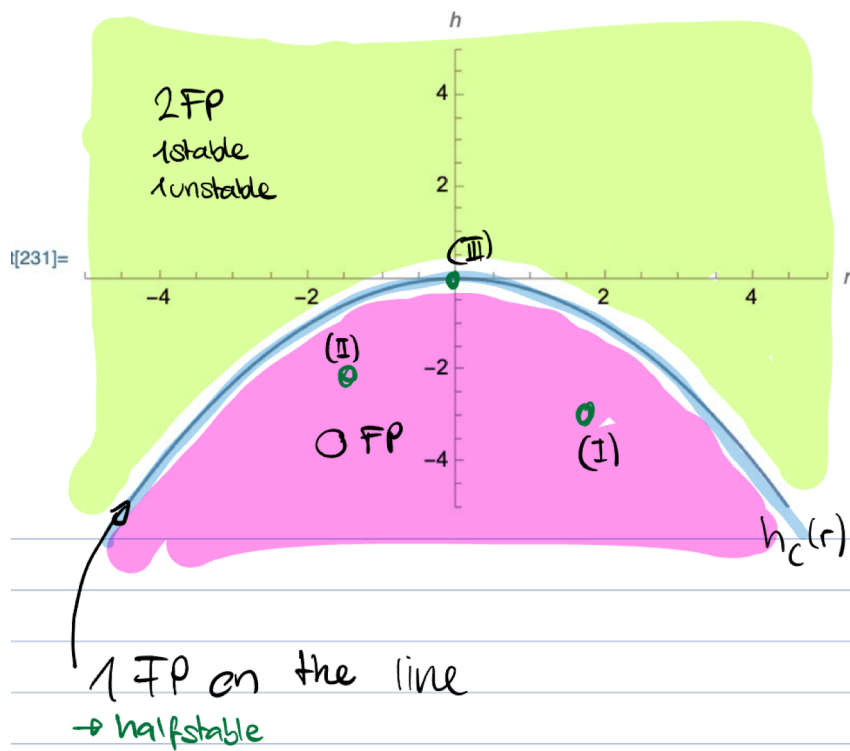
```

In[ ]:= h[r_] = -r^2 / 4
Plot[h[r], {r, -5, 5}, PlotRange -> {{-5, 5}, {-5, 5}}, AxesLabel -> {r, h}]

```

Out[]:= $-\frac{r^2}{4}$





$$h_c(r) = -\frac{r^2}{4}$$

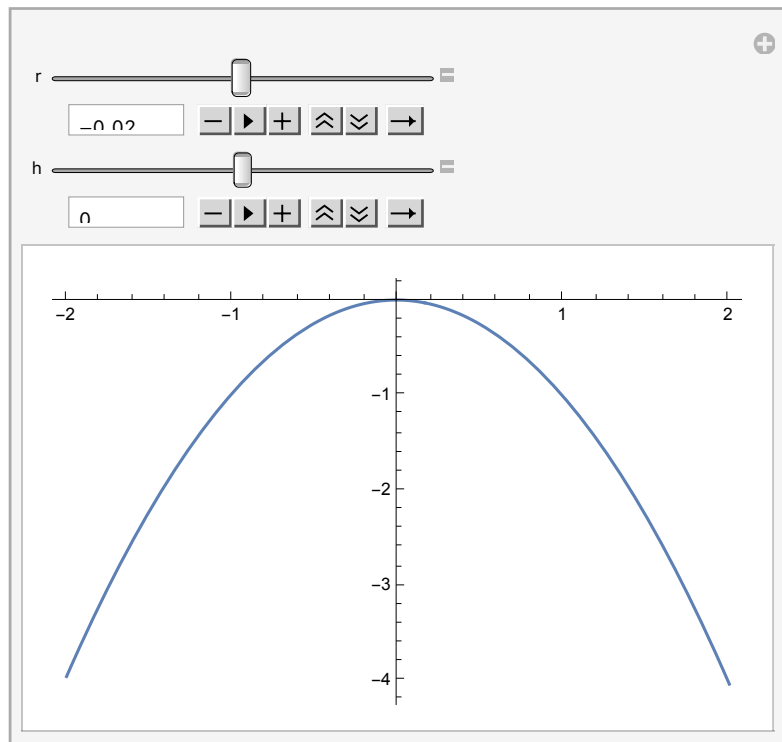
(* Where and how many FPs determined in PDF sketch *)

In[]:=

(* stability of FPs *)

In[]:= Manipulate[Plot[h + x * (r - x), {x, -2, 2}], {r, -2, 2}, {h, -2, 2}]

Out[]:=



In[]:=