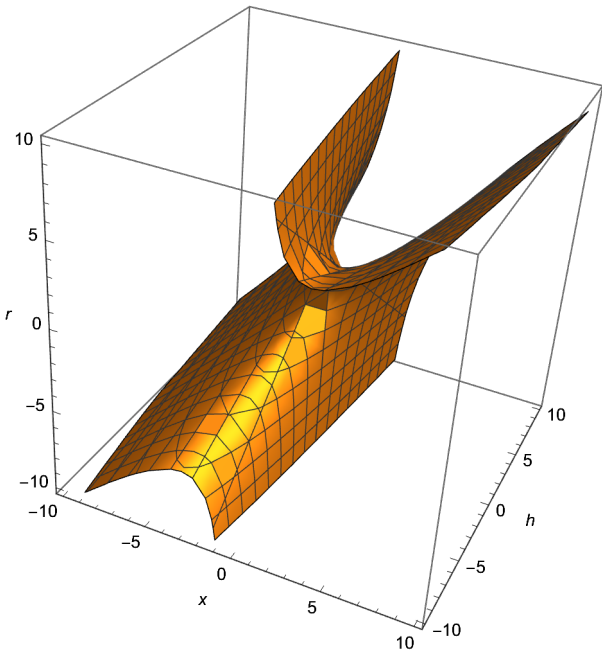
In[•]:=
```
f[x_, h_, r_] = h + x * (r - x);
rangeMin = -10;
rangeMax = 10;
ContourPlot3D[f[x, h, r] == 0, {x, rangeMin, rangeMax},
 {h, rangeMin, rangeMax}, {r, rangeMin, rangeMax}, AxesLabel → {x, h, r}]
```

Out[•]=



In[•]:=
```
(* find xstar*)
```

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

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

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[•]= $\left\{\left\{x \to \frac{r}{2}\right\}\right\}$

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

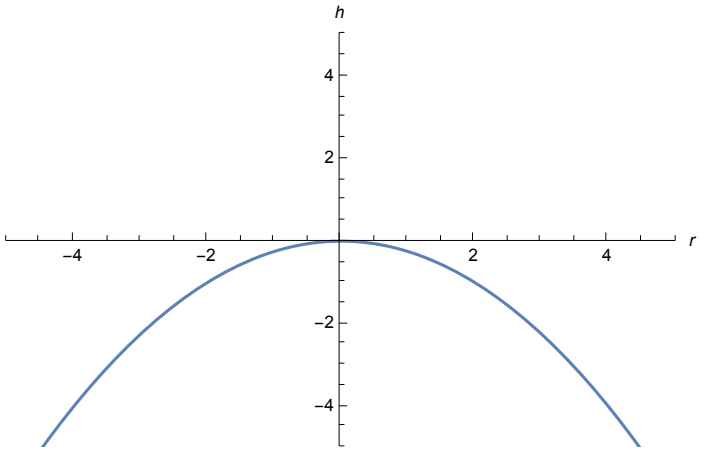
ReplaceAll: {r − 2 x} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

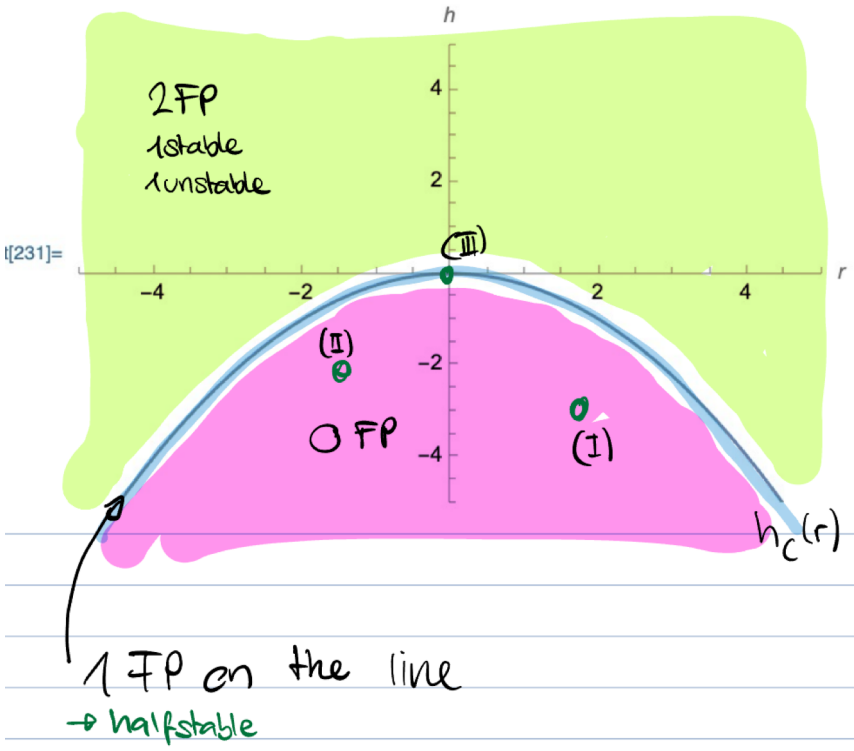
Out[•]= $h + (r - x)\,x$ /. $r - 2\,x$

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

Out[•]= $-\frac{r^2}{4}$

Out[•]=





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

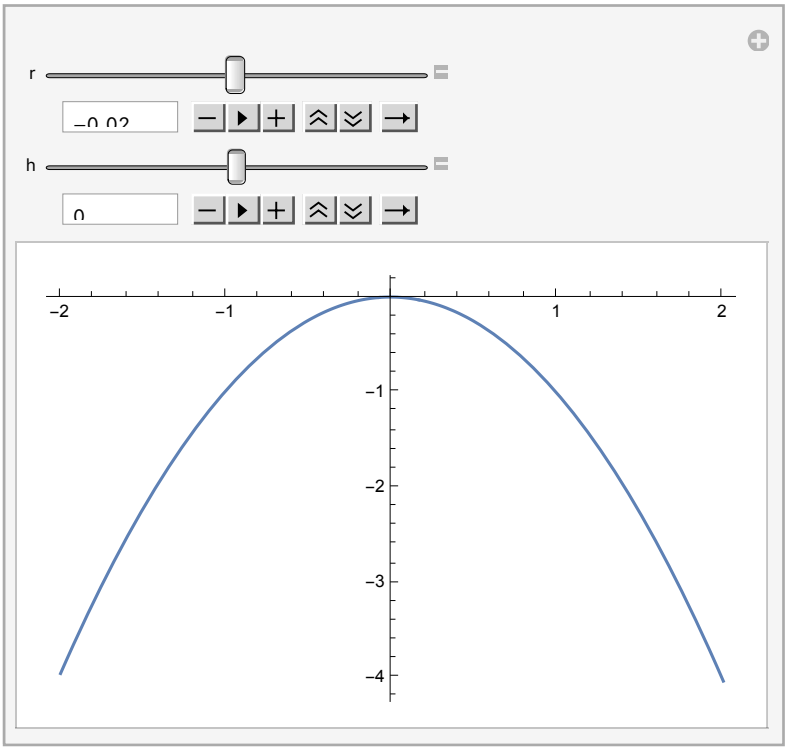
```
(* Where and how many FPs determined in PDF sketch *)
```

In[•]:=

```
(* stability of FPs *)
```

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

Out[•]=



In[ ]:=