

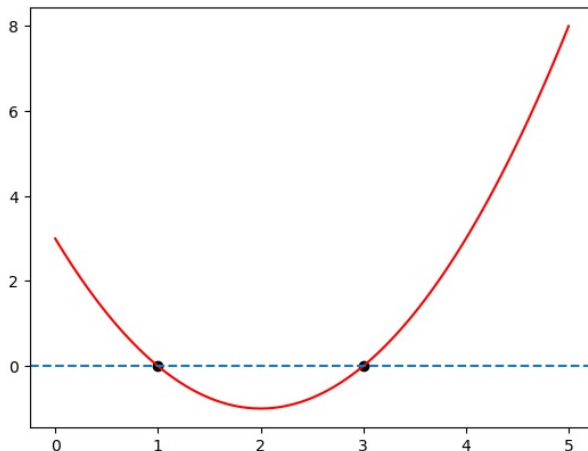
$$\frac{dy}{dt} = y^2 - 4y + 3 = 0$$

$$(y-3)(y-1) = 0$$

$$y=3, y=1$$

↑

fixed points



$$\frac{d}{dy}(y^2 - 4y + 3) = 2y - 4$$

At Fixed Points  $x=3$   $x=1$

$$\frac{d}{dy}\left(\frac{dy}{dt}(3)\right) = 2(3) - 4 = 6 - 4 = 2$$

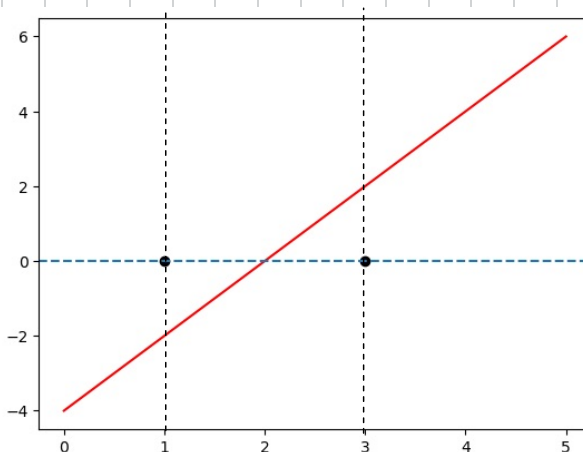
$$2 > 0$$

$x=3$  is unstable

$$\frac{d}{dy}\left(\frac{dy}{dt}(1)\right) = 2(1) - 4 = -2$$

$$-2 < 0$$

$x=1$  is stable



the graph depicts the derivative of the differential equation and shows us that at the fixed point  $x=1$  the derivative is negative meaning it's a stable point compared to  $x=3$  being positive making it unstable

```
import numpy as np
import matplotlib.pyplot as plt
```

```
import sympy as sp
```

[9] ✓ 0.2s

```
y=sp.symbols("y")
dydt=y**2-4*y+3
```

```
zeros = sp.solve(dydt, y)
print("fixed points:",zeros)
```

[10] ✓ 0.0s

... fixed points: [1, 3]

```
t_0, t_f, step = 0, 5, 100
```

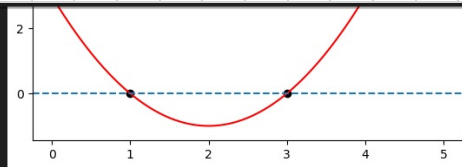
```
y_p = np.linspace(t_0, t_f, step)
dy = y_p**2-4*y_p+3
```

```
plt.plot(y_p, dy, label=r'$\frac{dy}{dt} = y^2 - 4y + 3$', color='red')
plt.axhline(y=0, linestyle='--')
plt.scatter(zeros, [0,0], color='black')
plt.show()
```

[29] ✓ 0.0s

...





```
diff = sp.diff(dydt, y)
print(f"derivative: {diff}")
```

[32] ✓ 0.0s

... derivative:  $2xy - 4$

▷ ~

```
fx=2*y_p-4

plt.plot(y_p, fx, color='red')
plt.axhline(y=0, linestyle='--')
plt.scatter(zeros, [0,0], color='black')

plt.show()
```

[33] ✓ 0.0s

...

