

```
In [1]: from __future__ import print_function
import matplotlib.pyplot as plt
import numpy as np
import sympy as sym
sym.init_printing(use_latex = "mathjax")
```

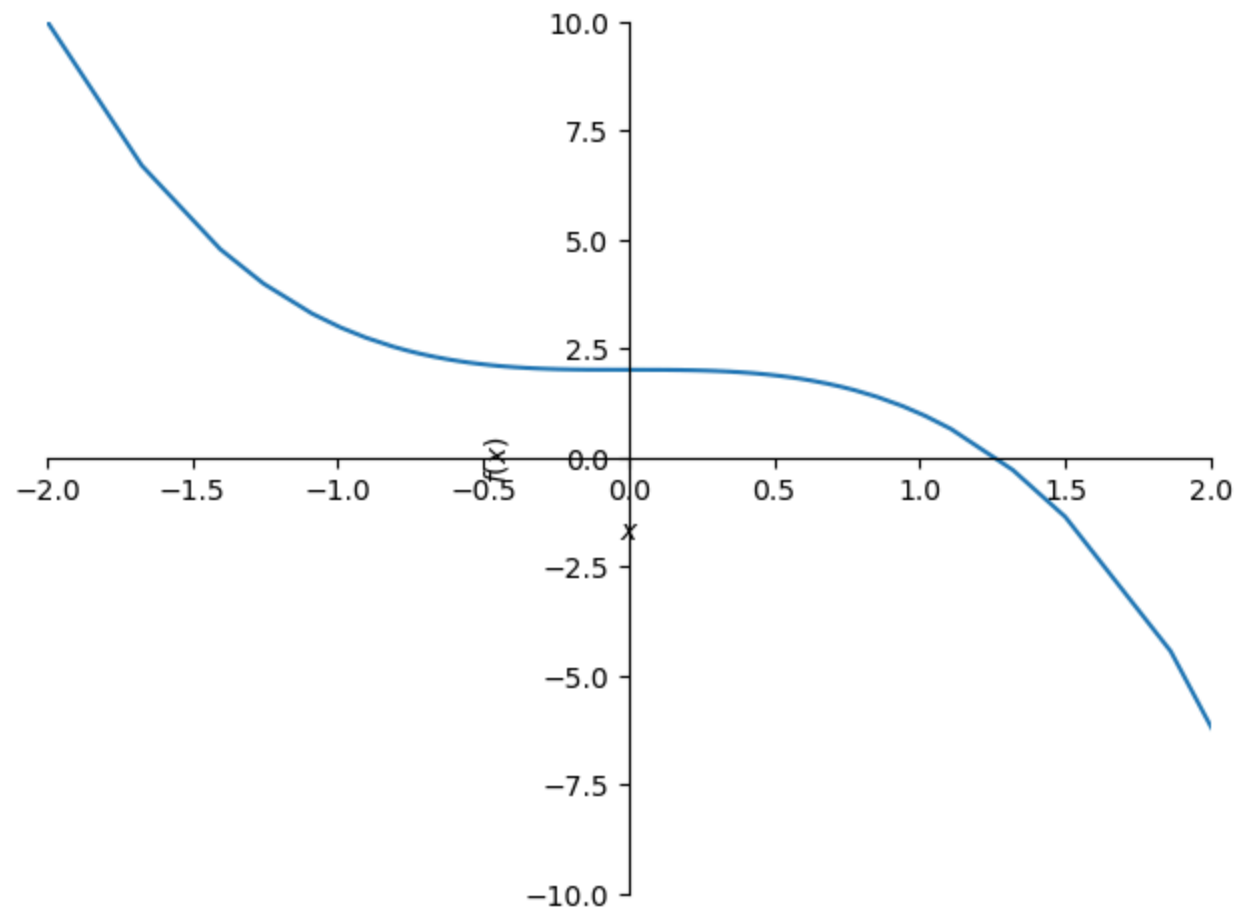
Enter your name below and run the cell:

Individual cells can be run with `Ctrl + Enter`

In []:

```
In [4]: x = sym.symbols('x')
expr = -x ** 3 + 2

sym.plot(expr, xlim=(-2, 2), ylim=(-10, 10));
```



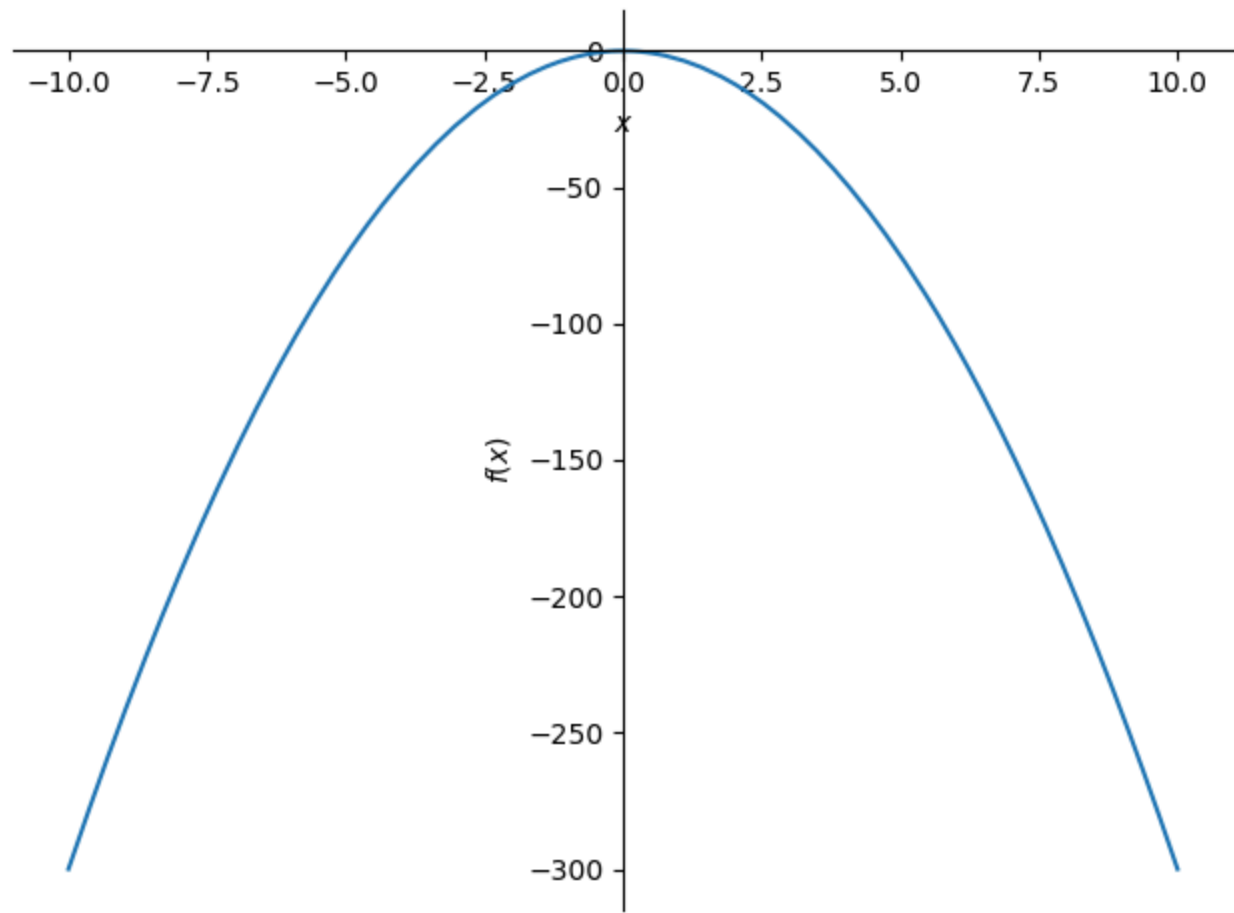
```
In [5]: sym.Derivative(expr)
```

Out[5]: $\frac{d}{dx}(2 - x^3)$

```
In [6]: sym.Derivative(expr).doit()
```

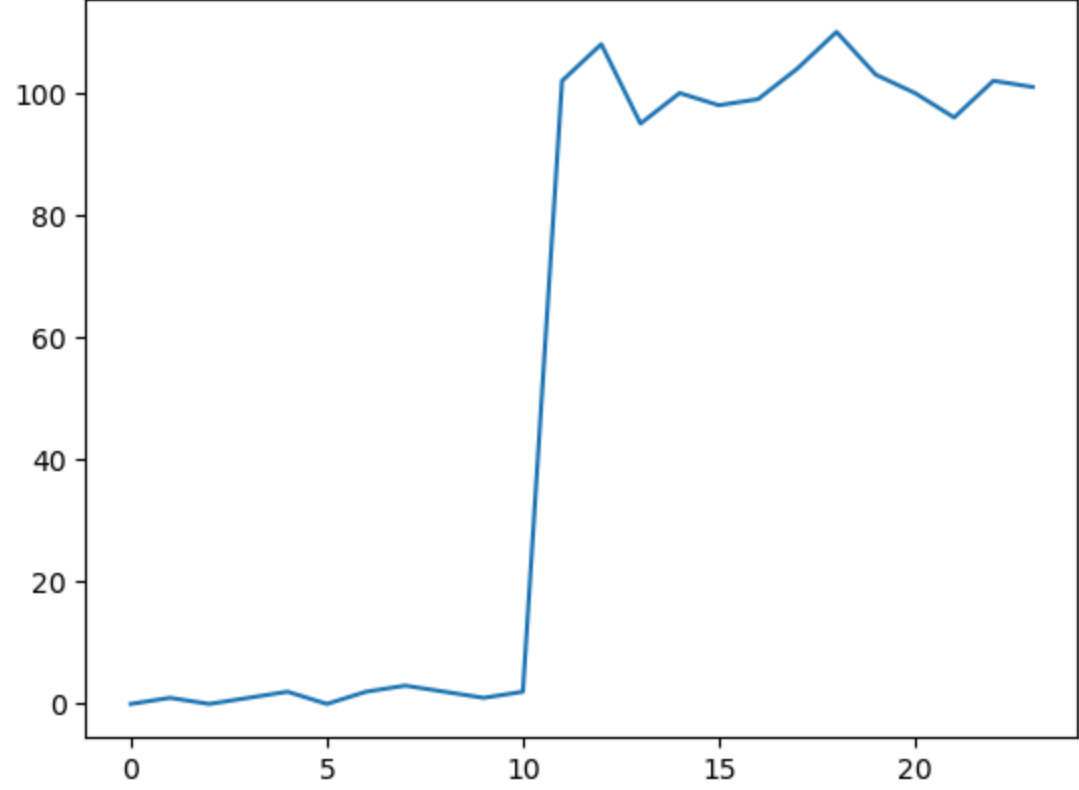
Out[6]: $-3x^2$

```
In [7]: sym.plot(sym.diff(expr));
```



```
In [8]: ys = np.array([0, 1, 0, 1, 2, 0, 2, 3, 2, 1, 2, 102, 108, 95, 100, 98, 99, 104, 110, 103, 100, 96, 102, 101])

fig,ax = plt.subplots()
ax.plot([i for i in range(len(ys))], ys);
```



```
In [9]: def make_windows(sequence, windowsize):
    positions = len(sequence) - windowsize + 1
    windows = []
    for i in range(positions):
        windows.append(sequence[i:i+windowsize])
    return windows

def print_padded_seq(seq):
    print("[", ", ".join("{:4d}".format(i) for i in seq), "]")

def print_sliding_windows(seq, windowsize=3):
    windows = make_windows(seq, windowsize)
    for window in windows:
        print(", ".join("{:4d}".format(i) for i in window))
```

```
In [11]: series = [0, 1, 0, 2, 1, 0, 1, 101, 100, 98, 102, 101]
windowsize = 2

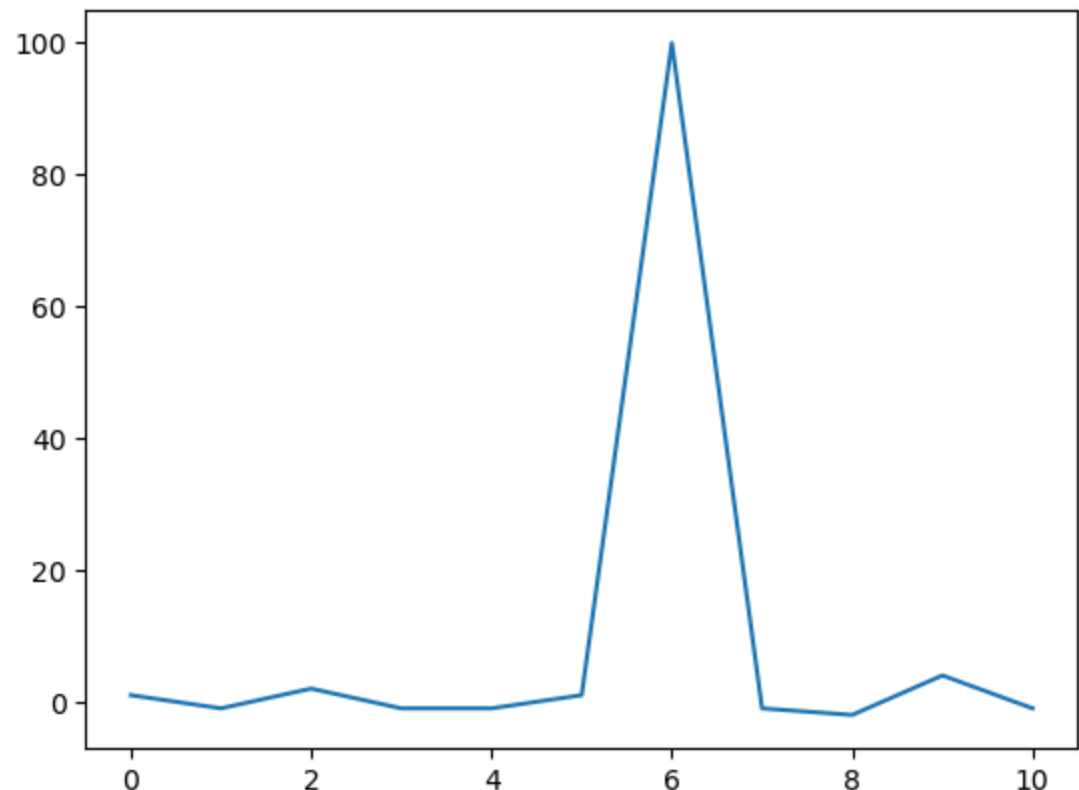
print_padded_seq(series)

print_sliding_windows(series, windowsize=windowsize)
# check(1)
```

```
[ 0, 1, 0, 2, 1, 0, 1, 101, 100, 98, 102, 101 ]
0, 1
1, 0
0, 2
2, 1
1, 0
0, 1
1, 101
101, 100
100, 98
98, 102
102, 101
```

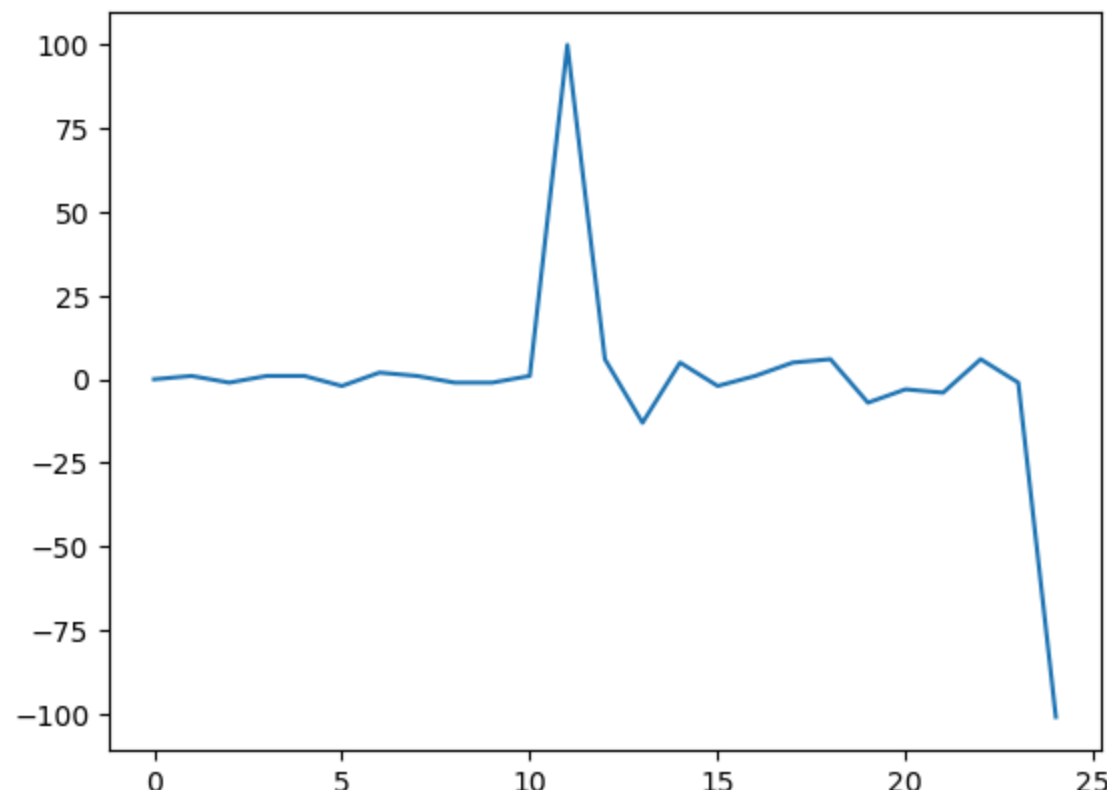
```
In [14]: convolutions = []
kernel = np.array([-1,1])
for w in make_windows(series, windowsize=2):
    w = np.array(w)
    convolved = np.dot(w,kernel)
    convolutions.append(convolved)

plt.plot(convolutions);
# check(2)
```



```
In [17]: convolved = np.convolve([1, -1], ys)

fig,ax = plt.subplots()
ax.plot([i for i, _ in enumerate(convolved)], convolved);
# check(3)
```



Question: Why does the graph move down at the end?

In []: The graph moves down at the end of the graph because the np.convolve function automatically appends zeroes at the end. This makes the graph mmove down