

```
1 import numpy as N
2
3 def ApproximateJacobian(f, x, dx=1e-6):
4     """Return an approximation of the Jacobian Df(x) as a numpy matrix"""
5     try:
6         n = len(x)
7     except TypeError:
8         n = 1
9     fx = f(x)
10    Df_x = N.matrix(N.zeros((n,n)))
11    for i in range(n):
12        v = N.matrix(N.zeros((n,1)))
13        v[i,0] = dx
14        Df_x[:,i] = f(x + v) - fx
15    return Df_x
16
17 class Polynomial(object):
18     """Callable polynomial object.
19
20     Example usage: to construct the polynomial  $p(x) = x^2 + 2x + 3$ ,
21     and evaluate  $p(5)$ :
22
23      $p = \text{Polynomial}([1, 2, 3])$ 
24      $p(5)$ """
25
26    def __init__(self, coeffs):
27        self._coeffs = coeffs
28
29    def __repr__(self):
30        return "Polynomial(%s)" % ("", ".join([str(x) for x in self._coeffs]))
31
32    def f(self,x):
33        ans = self._coeffs[0]
34        for c in self._coeffs[1:]:
35            ans = x*ans + c
36        return ans
37
38    def __call__(self, x):
39        return self.f(x)
40
41
```