Assignment NO 3 Implement Gradient Descent Algorithm to find the local minima of a function. For example, find the local minima of the function $y=(x+3)^2$ starting from the point x=2.

In [1]:
```
import matplotlib as plot
import numpy as np
import sympy as sym
from matplotlib import pyplot
```

In [2]:
```
def objective(x):
    return (x+3)**2
```

In [3]:
```
def derivative(x):
    return 2*(x+3)
```

In [4]:
```
def gradient_descent(alpha,start,max_iter):
    x_list =list()
    x =start;
    x_list.append(x)
    for i in range(max_iter):
        gradient = derivative(x);
        x =x-(alpha*gradient);
        x_list.append(x);
    return x_list
```

In [7]:
```
x =sym.symbols('x')
expr =(x+3)**2.0;
grad =sym.Derivative(expr,x)
print("{}".format(grad.doit()))
grad.doit().subs(x,2)
```

```
2.0*(x + 3)**1.0
```

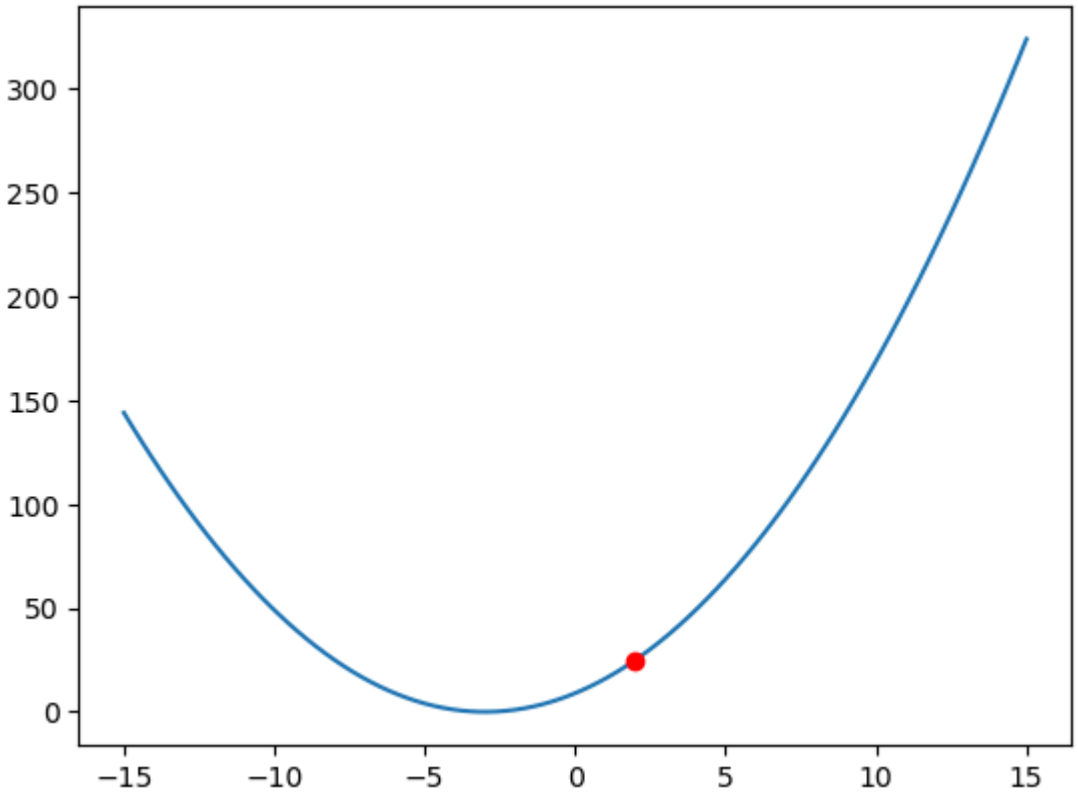
Out[7]: 10.0

In [23]:
```
def gradient_descent1(expr,alpha,start,max_iter):
    x_list =list()
    x =sym.symbols('x')
    grad =sym.Derivative(expr,x).doit()
    x_val=start;
    x_list.append(x_val)
    for i in range(max_iter):
        gradient =grad.subs(x,x_val);
        x_val =x_val -(alpha*gradient);
        x_list.append(x_val);
    return x_list
```

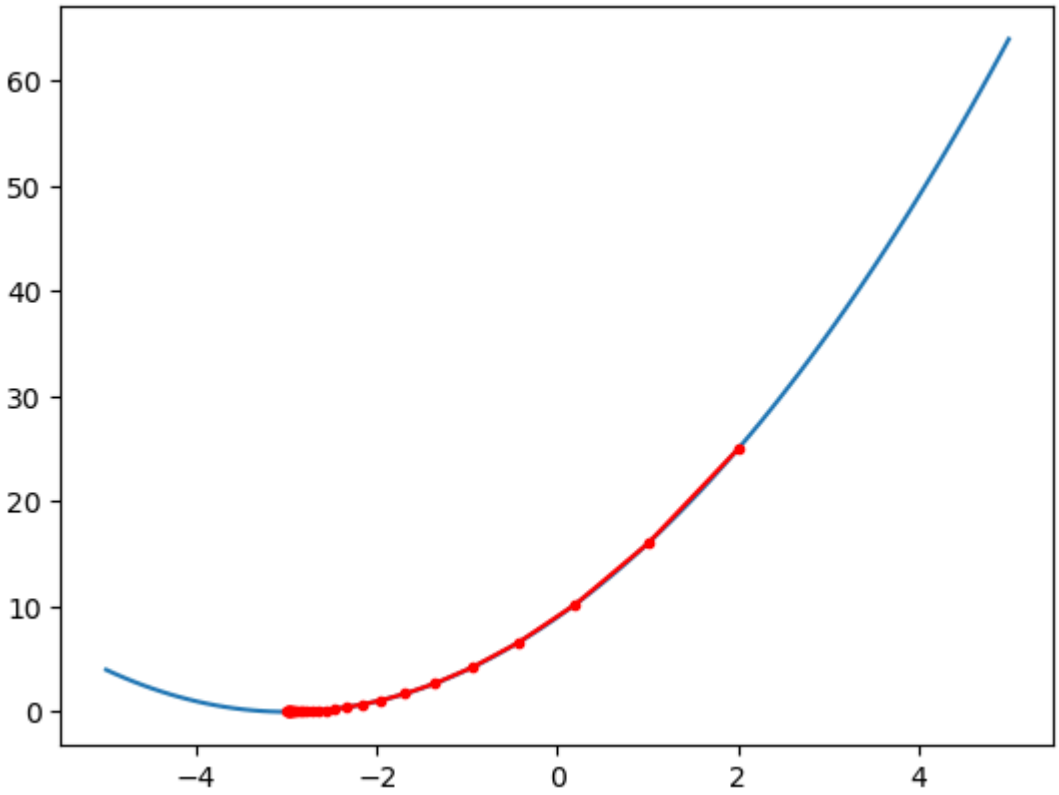
In [24]:
```
alpha = 0.1 #step size
start =2  #starting point
max_iter =30  #limit on iteration
x=sym.symbols('x')
expr =(x+3)**2  #target function
```

In [25]:
```
x_cordinate =np.linspace(-15,15,100)
pyplot.plot(x_cordinate,objective(x_cordinate))
pyplot.plot(2,objective(2),'ro')
```

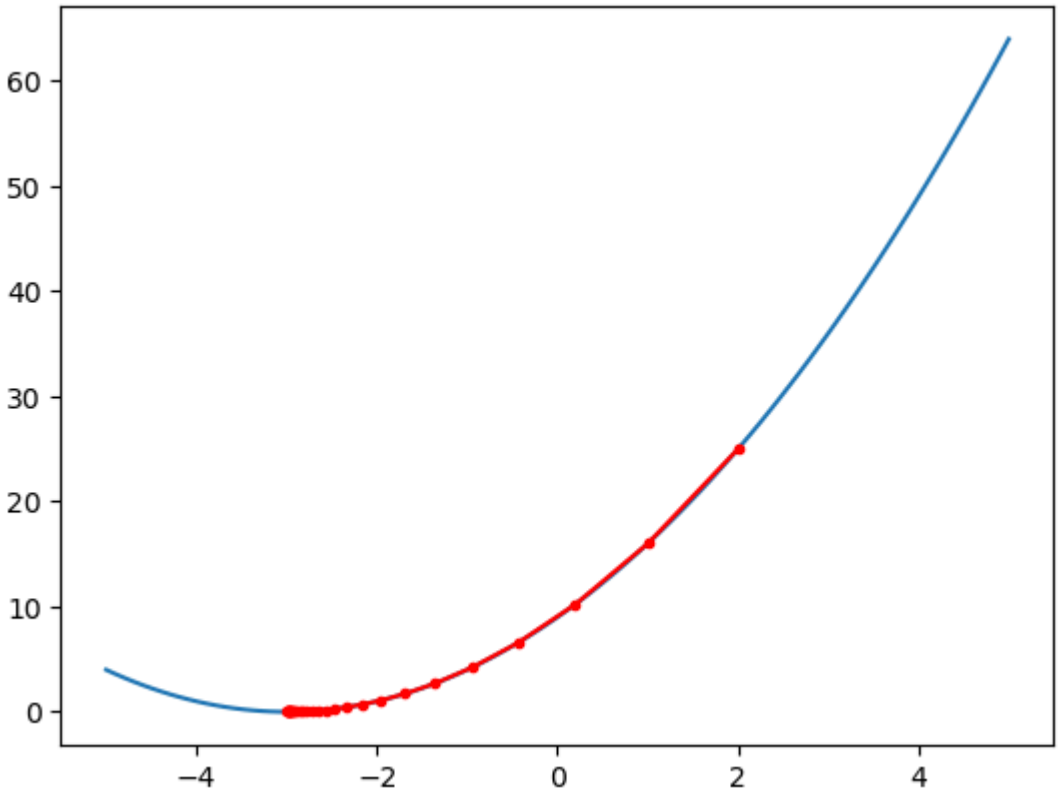
Out[25]: [<matplotlib.lines.Line2D at 0x1640cd8d290>]



In [26]:
```
X =gradient_descent(alpha,start,max_iter)

x_cordinate =np.linspace(-5,5,100)
pyplot.plot(x_cordinate,objective(x_cordinate))

X_arr =np.array(X)
pyplot.plot(X_arr,objective(X_arr), '.-',color='red')
pyplot.show()
```



In [27]:
```
X =gradient_descent1(expr,alpha,start,max_iter)
X_arr =np.array(X)

x_cordinate =np.linspace(-5,5,100)
pyplot.plot(x_cordinate,objective(x_cordinate))

X_arr =np.array(X)
pyplot.plot(X_arr,objective(X_arr), '.-',color='red')
pyplot.show()
```



In [ ]: