Demonstration of working of gradient descent on our cost function

Gradient Descent formula

```
x = x - learning_rate * gradient_of_x
```

```
In [3]:
        def gradient_descent_update(x, gradx, learning_rate):
           Performs a gradient descent update.
           # TODO: Implement gradient descent.
           # Return the new value for x
           x = x - learning_rate * gradx
           return x
        Given the starting point of any 'x' gradient descent
        should be able to find the minimum value of x for the
        cost function `f` defined below.
        import random
        #from gd import gradient_descent_update
        def f(x):
           Quadratic function.
           It's easy to see the minimum value of the function
           is 5 when is x=0.
           return x**2 + 5
        def df(x):
           Derivative of 'f' with respect to 'x'.
           return 2*x
        # Random number between 0 and 10,000. Feel free to set x whatever you like.
        x = random.randint(0, 10000)
```

```
# Set the learning rate
learning rate = 0.1
 epochs = 100
for i in range(epochs+1):
   cost = f(x)
   gradx = df(x)
   print("EPOCH {}: Cost = \{:.3f\}, x = \{:.3f\}".format(i, cost, gradx))
   x = gradient descent update(x, gradx, learning rate)
EPOCH 0: Cost = 13155134.000, x = 7254.000
EPOCH 1: Cost = 8419287.560, x = 5803.200
EPOCH 2: Cost = 5388345.838, x = 4642.560
EPOCH 3: Cost = 3448543.137, x = 3714.048
EPOCH 4: Cost = 2207069.407, x = 2971.238
EPOCH 5: Cost = 1412526.221, x = 2376.991
EPOCH 6: Cost = 904018.581, x = 1901.593
EPOCH 7: Cost = 578573.692, x = 1521.274
EPOCH 8: Cost = 370288.963, x = 1217.019
EPOCH 9: Cost = 236986.736, x = 973.615
EPOCH 10: Cost = 151673.311, x = 778.892
EPOCH 11: Cost = 97072.719, x = 623.114
EPOCH 12: Cost = 62128.340, x = 498.491
EPOCH 13: Cost = 39763.938, x = 398.793
EPOCH 14: Cost = 25450.720, x = 319.034
EPOCH 15: Cost = 16290.261, x = 255.227
EPOCH 16: Cost = 10427.567, x = 204.182
EPOCH 17: Cost = 6675.443, x = 163.346
EPOCH 18: Cost = 4274.083, x = 130.676
EPOCH 19: Cost = 2737.213, x = 104.541
EPOCH 20: Cost = 1753.617, x = 83.633
EPOCH 21: Cost = 1124.115, x = 66.906
EPOCH 22: Cost = 721.233, x = 53.525
EPOCH 23: Cost = 463.389, x = 42.820
EPOCH 24: Cost = 298.369, x = 34.256
EPOCH 25: Cost = 192.756, x = 27.405
EPOCH 26: Cost = 125.164, x = 21.924
EPOCH 27: Cost = 81.905, x = 17.539
EPOCH 28: Cost = 54.219, x = 14.031
EPOCH 29: Cost = 36.500, x = 11.225
EPOCH 30: Cost = 25.160, x = 8.980
EPOCH 31: Cost = 17.903, x = 7.184
EPOCH 32: Cost = 13.258, x = 5.747
EPOCH 33: Cost = 10.285, x = 4.598
EPOCH 34: Cost = 8.382, x = 3.678
EPOCH 35: Cost = 7.165, x = 2.943
EPOCH 36: Cost = 6.385, x = 2.354
EPOCH 37: Cost = 5.887, x = 1.883
EPOCH 38: Cost = 5.567, x = 1.507
EPOCH 39: Cost = 5.363, x = 1.205
EPOCH 40: Cost = 5.232, x = 0.964
EPOCH 41: Cost = 5.149, x = 0.771
```

EPOCH 42: Cost = 5.095, x = 0.617 EPOCH 43: Cost = 5.061, x = 0.494 EPOCH 44: Cost = 5.039, x = 0.395 EPOCH 45: Cost = 5.025, x = 0.316 EPOCH 46: Cost = 5.016, x = 0.253 EPOCH 47: Cost = 5.010, x = 0.202 EPOCH 48: Cost = 5.007, x = 0.162 EPOCH 49: Cost = 5.004, x = 0.129 EPOCH 50: Cost = 5.003, x = 0.104 EPOCH 51: Cost = 5.002, x = 0.083 EPOCH 52: Cost = 5.001, x = 0.066 EPOCH 53: Cost = 5.001, x = 0.053

```
EPOCH 54: Cost = 5.000, x = 0.042
EPOCH 55: Cost = 5.000, x = 0.034
EPOCH 56: Cost = 5.000, x = 0.027
EPOCH 57: Cost = 5.000, x = 0.022
EPOCH 58: Cost = 5.000, x = 0.017
EPOCH 59: Cost = 5.000, x = 0.014
EPOCH 60: Cost = 5.000, x = 0.011
EPOCH 61: Cost = 5.000, x = 0.009
EPOCH 62: Cost = 5.000, x = 0.007
EPOCH 63: Cost = 5.000, x = 0.006
EPOCH 64: Cost = 5.000, x = 0.005
EPOCH 65: Cost = 5.000, x = 0.004
EPOCH 66: Cost = 5.000, x = 0.003
EPOCH 67: Cost = 5.000, x = 0.002
EPOCH 68: Cost = 5.000, x = 0.002
EPOCH 69: Cost = 5.000, x = 0.001
EPOCH 70: Cost = 5.000, x = 0.001
EPOCH 71: Cost = 5.000, x = 0.001
EPOCH 72: Cost = 5.000, x = 0.001
EPOCH 73: Cost = 5.000, x = 0.001
EPOCH 74: Cost = 5.000, x = 0.000
EPOCH 75: Cost = 5.000, x = 0.000
EPOCH 76: Cost = 5.000, x = 0.000
EPOCH 77: Cost = 5.000, x = 0.000
EPOCH 78: Cost = 5.000, x = 0.000
EPOCH 79: Cost = 5.000, x = 0.000
EPOCH 80: Cost = 5.000, x = 0.000
EPOCH 81: Cost = 5.000, x = 0.000
EPOCH 82: Cost = 5.000, x = 0.000
EPOCH 83: Cost = 5.000, x = 0.000
EPOCH 84: Cost = 5.000, x = 0.000
EPOCH 85: Cost = 5.000, x = 0.000
EPOCH 86: Cost = 5.000, x = 0.000
EPOCH 87: Cost = 5.000, x = 0.000
EPOCH 88: Cost = 5.000, x = 0.000
EPOCH 89: Cost = 5.000, x = 0.000
EPOCH 90: Cost = 5.000, x = 0.000
EPOCH 91: Cost = 5.000, x = 0.000
EPOCH 92: Cost = 5.000, x = 0.000
EPOCH 93: Cost = 5.000, x = 0.000
EPOCH 94: Cost = 5.000, x = 0.000
EPOCH 95: Cost = 5.000, x = 0.000
EPOCH 96: Cost = 5.000, x = 0.000
EPOCH 97: Cost = 5.000, x = 0.000
EPOCH 98: Cost = 5.000, x = 0.000
EPOCH 99: Cost = 5.000, x = 0.000
EPOCH 100: Cost = 5.000. x = 0.000
```