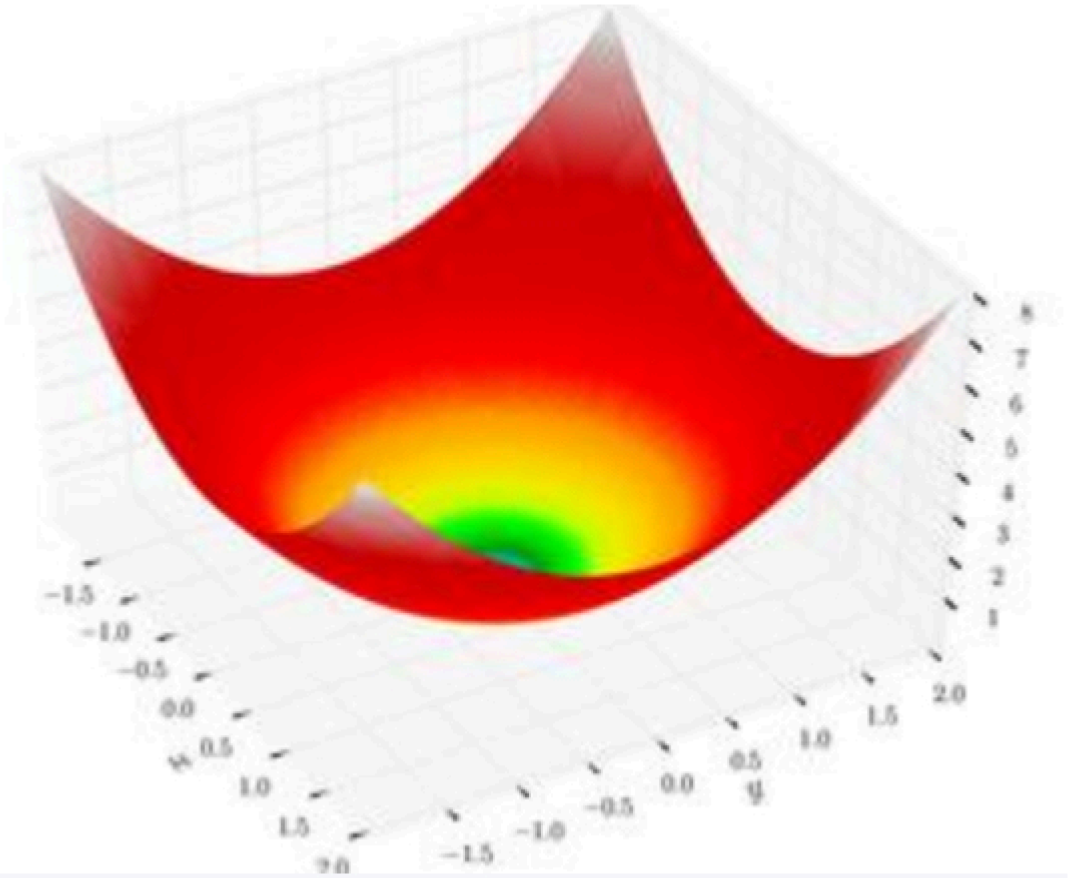
Модуль 7. TensorFlow

Лекція 04. Приклад 1. Градієнтний спуск

Завдання мінімізації функції (СФЕРА)

$y = \sum_{i=0}^{m-1} x_i^2$

Точне рішення $y = 0, x_i = 0$



```
import tensorflow as tf
from pprint import pprint
```

```
print(tf.executing_eagerly())
```

```
True
```

```
x1 = tf.Variable(10.0,name="x1")
x2 = tf.Variable(10.0,name="x2")
```

```
print('x1=', x1.numpy())
print('x2=', x2.numpy())
```

```
x1= 10.0
x2= 10.0
```

```
learnig_rate = .1
```

Функція

```
def test_function (a, b):
  y = a * a + b * b
  return y
```

Step By Step

```
for step in range (3):
  with tf.GradientTape(watch_accessed_variables=True, persistent=True) as gfunc:
    gfunc.watch([x1, x2])
    yout = test_function(x1, x2)

  print ('Iterarion', step)
  print('X', x1.numpy(), x2.numpy())
  print('Y', test_function(x1, x2).numpy())
  gx1 , gx2 = gfunc.gradient(target=yout, sources=[x1, x2])
  print ('Grad', gx1.numpy(), gx2.numpy())
  dx1 = -learnig_rate*gx1
  dx2 = -learnig_rate*gx2
  print('Discent', dx1.numpy(), dx2.numpy())
  x1.assign_add(dx1)
  x2.assign_add(dx2)
```

```
Iterarion 0
X 10.0 10.0
Y 200.0
Grad 20.0 20.0
Discent -2.0 -2.0
Iterarion 1
X 8.0 8.0
Y 128.0
Grad 16.0 16.0
Discent -1.6 -1.6
Iterarion 2
X 6.4 6.4
Y 81.920006
Grad 12.8 12.8
Discent -1.2800001 -1.2800001
```

Loop

```
x1 = tf.Variable(10.0,name="x1")
x2 = tf.Variable(10.0,name="x2")
```

```
for step in range (100):
  with tf.GradientTape(watch_accessed_variables=True, persistent=True) as gfunc:
    gfunc.watch([x1, x2])
    yout = test_function(x1, x2)

  gx1 , gx2 = gfunc.gradient(target=yout, sources=[x1, x2])
  dx1 = -learnig_rate*gx1
  dx2 = -learnig_rate*gx2
  x1.assign_add(dx1)
  x2.assign_add(dx2)
  if step % 10 == 0:
    print('Iterarion', step)
    print('X', x1.numpy(), x2.numpy())
    print('Y', test_function(x1, x2).numpy())
  if test_function(x1, x2) < 0.0001:
    print('Iterarion', step)
    print('X', x1.numpy(), x2.numpy())
    print('Y', test_function(x1, x2).numpy())
    break
```

```
Iterarion 0
X 8.0 8.0
Y 128.0
Iterarion 10
X 0.85899335 0.85899335
Y 1.4757391
Iterarion 20
X 0.09223372 0.09223372
Y 0.017014118
Iterarion 30
X 0.00990352 0.00990352
Y 0.00019615942
Iterarion 32
X 0.0063382527 0.0063382527
Y 8.0346894e-05
```

Багатовимірний випадок

```
X = tf.Variable(tf.random.normal([100], 0, 30, tf.float32),name="X")
print(X.shape)
# print(X.numpy())
```

```
(100,)
```

```
learn_rate = tf.constant(0.1)
print(learn_rate.shape)
print(learn_rate.numpy())
```

```
()
0.1
```

функція ВТРАТ

```
def Loss_func (X):
  Y_loss = tf.reduce_sum(tf.pow(X,2))
  return Y_loss
```

```
print(Loss_func(X).numpy())
```

```
73252.62
```

```
for step in range (100):
  with tf.GradientTape(watch_accessed_variables=True, persistent=True) as gfunc:
    gfunc.watch(X)
    yout = Loss_func(X)

  G = gfunc.gradient(target=yout, sources=[X])
  # print(G)
  # print(G.numpy())
  dX = G * learn_rate
  #print(dX)
  X.assign_sub(dX[0])
  if step % 10 == 0:
    print('Iterarion', step)
    # print('X', X.numpy())
    print('Y', Loss_func(X).numpy())
  if Loss_func(X) < 0.0001:
    print('Iterarion', step)
    # print('X', X.numpy())
    print('Y', Loss_func(X).numpy())
    break
```

```
Iterarion 0
Y 46881.67
Iterarion 10
Y 540.50885
Iterarion 20
Y 6.2316437
Iterarion 30
Y 0.07184596
Iterarion 40
Y 0.0008283275
Iterarion 45
Y 8.894099e-05
```