# jdeepro

## 项目介绍(Introduction)

人工智能基础教程，使用Latex编写，基于Java实现。

The basics of artificial intelligence, written in Latex, based on Java.

jdeepro is a framework of deep learning tools and libraries written specially to take advantage of the Java™ Virtual Machine (JVM), written for the Java and Scala languages.

## 警告：刚好能够工作（Just work as expected.）

😃 😃 😃

Welcome to have a try!

### Our Hope

1. Numpy参考实现 (Numpy reference impl)
2. Matplot参考实现 (Matplot reference impl)
3. AI基础算法实现 (AI basic algorithm impl)

### 2019/11/17 梯度下降 （gradient descend）

```java
public static void showSgd() {
  GradientDescent gd = LinearImp::SGD;
  int N = 20;

  NDArray x = np.random.uniform(0, 5, N).reshape(N,1);
  NDArray ones = np.ones(new int[]{N, 1});

  NDArray y = x.multiply(3).add(np.random.uniform(0, 3, N).reshape(N,1));
  x = np.hstack(x, ones);

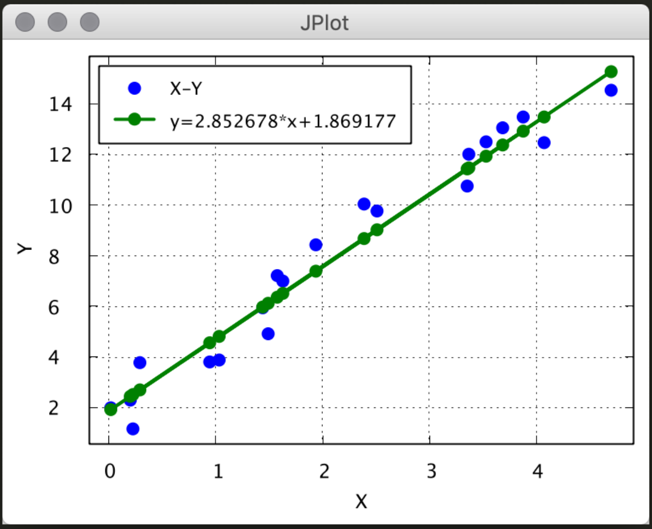
  NDArray ret = gd.fit(x, y, 0.01, 1000, 1e-3);
  System.out.println("#### test_linear_sgd: y = 2 * x + b ");
  System.out.println(ret);

  JPlot plot = new JPlot();
  double [][]X = (double[][])np.getArray(x.T);
  double [][]Y = (double[][])np.getArray(y.T);
  double [] W = (double[])np.getArray(ret);

  String caption = String.format("y=%f*x+%f", W[0], W[1]);

  plot.figure();
  plot.scatter(X[0], Y[0], "X-Y");
  plot.plot(X[0], a->W[0]*a+W[1], caption);

  plot.show();
}
```



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```

## Easy to use

You can easily change python code to java, like this:
https://www.bilibili.com/video/av37947862?p=38

```
public void test_xor() {
    class np extends Numpy{};
    int[][] dat_X = {{1,0,0},{1,0,1},{1,1,0},{1,1,1}};
    NDArray X = np.array(dat_X);

    int[] dat_Y = {0,1,1,0};
    NDArray Y = np.array(dat_Y).V();

    NDArray V = np.random.rand(new int[]{3,4}).multiply(2).subtract(1);
    NDArray W = np.random.rand(new int[]{4,1}).multiply(2).subtract(1);

    double learn_rate = 0.11;
    Activation sigmoid = new Sigmoid();
    NDArray L1 = null, L2 = null;

    for (int i = 0; i < 20000; i++) {
        L1 = sigmoid.active(np.dot(X, V));
        L2 = sigmoid.active(np.dot(L1, W));

        NDArray L2_delta = Y.T.subtract(L2).multiply(sigmoid.deactive(L2));
        NDArray L1_delta = L2_delta.dot(W.T).multiply(sigmoid.deactive(L1));

        NDArray W_change = L1.T.dot(L2_delta).multiply(learn_rate);
        NDArray V_change = X.T.dot(L1_delta).multiply(learn_rate);

        W = W.add(W_change);
        V = V.add(V_change);

        // Error: np.mean(np.abs(Y.T-L2)) -> decrese to 0
        // System.out.println(np.mean(np.abs(Y.T.subtract(L2))));
    }

    double[] expected = {0,1,1,0};
    assertTrue(L2.same(Numpy.array(expected).V().T, 0.1));
}
```

## y = 3*x1 + 4*x2

```
NDArray x1 = Numpy.linspace(0, 9, 10).V();
NDArray x2 = Numpy.linspace(4, 13, 10).V();
NDArray x = Numpy.concatenate(x1, x2);
System.out.println(x.T);

NDArray v = Numpy.array(new int[]{3, 4});
NDArray y = Numpy.dot(x.T, v.T);
double[] expected1 = {16.0, 23.0, 30.0, 37.0, 44.0, 51.0, 58.0, 65.0, 72.0, 79.0};
assertEquals(Numpy.array(expected1), y);

v = Numpy.array(new int[]{3, 4}).V();
y = Numpy.dot(x.T, v.T);
double[][] expected2 = {{16.0}, {23.0}, {30.0}, {37.0}, {44.0}, {51.0}, {58.0}, {65.0},
assertEquals(Numpy.array(expected2), y);
```

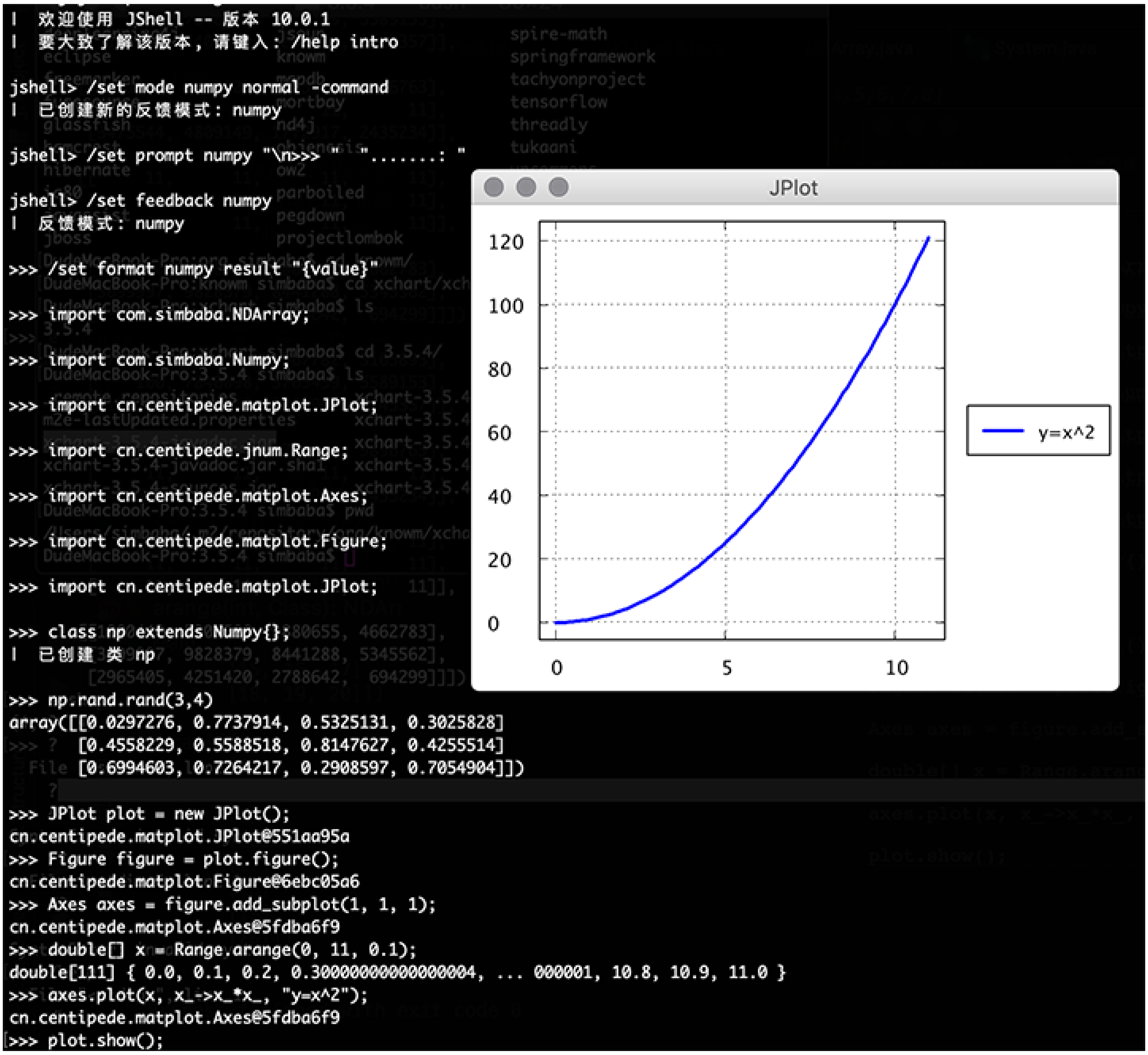
## 参与人员 Attendees

1. simbaba 2. jianyang 3. Tatsumi 4. xiaohui

## 示例代码 Sample

与Python相关接口非常相近，从Python迁移到Java非常容易。
Similar to Python, you can quikly shift from Python to Java.

## jshell中的运行效果(running result in jshell):



```
|  欢迎使用 JShell -- 版本 10.0.1
|  要大致了解该版本，请键入：/help intro

jshell> /set mode numpy normal -command
|  已创建新的反馈模式：numpy

jshell> /set prompt numpy "\n>>> " "....... : "

jshell> /set feedback numpy
|  反馈模式：numpy

>>> /set format numpy result "{value}"

>>> import com.simbaba.NDArray;

>>> import com.simbaba.Numpy;

>>> import cn.centipede.matplot.JPlot;

>>> import cn.centipede.jnum.Range;

>>> import cn.centipede.matplot.Axes;

>>> import cn.centipede.matplot.Figure;

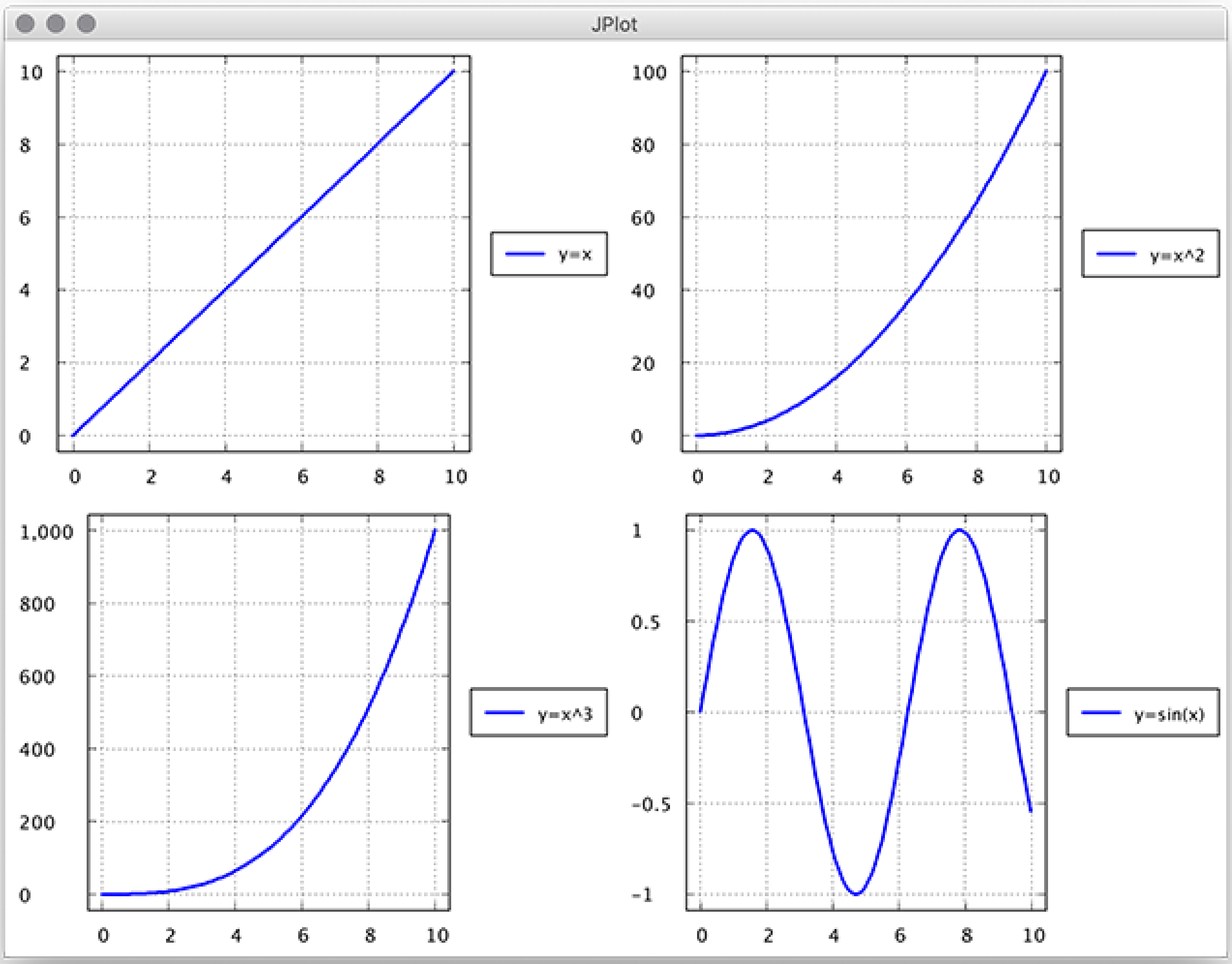
>>> import cn.centipede.matplot.JPlot;

>>> class np extends Numpy{};
|  已创建 类 np

>>> np.rand.rand(3,4)
array([[0.0297276, 0.7737914, 0.5325131, 0.3025828]
       [0.4558229, 0.5588518, 0.8147627, 0.4255514]
       [0.6994603, 0.7264217, 0.2908597, 0.7054904]])

>>> JPlot plot = new JPlot();
cn.centipede.matplot.JPlot@551aa95a
>>> Figure figure = plot.figure();
cn.centipede.matplot.Figure@6ebc05a6
>>> Axes axes = figure.add_subplot(1, 1, 1);
cn.centipede.matplot.Axes@5fdba6f9
>>> double[] x = Range.arange(0, 11, 0.1);
double[111] { 0.0, 0.1, 0.2, 0.30000000000000004, ... 000001, 10.8, 10.9, 11.0 }
>>> axes.plot(x, x_->x_*x_, "y=x^2");
cn.centipede.matplot.Axes@5fdba6f9
[>>> plot.show();
```

## matplot的运行效果：



```java
JPlot plot = new JPlot();
double[] x = Range.arange(0, 10, 0.1);

Figure figure = plot.figure();
Axes axes = figure.add_subplot(2, 2, 1);
axes.plot(x, v->v, "y=x");

axes = figure.add_subplot(2, 2, 2);
axes.plot(x, v->v*v, "y=x^2");

axes = figure.add_subplot(2, 2, 3);
axes.plot(x, v->v*v*v, "y=x^3");

axes = figure.add_subplot(2, 2, 4);
axes.plot(x, v->Math.sin(v), "y=sin(x)");

plot.show();
```

Numpy算法实现，支持Vector和Matrix，接口与Numpy基本一致。
Easy to use, you can quickly learn how to integrate to your code.

```
@Test
public void test_create() {
    int[] dat = {1,2,3,4,5,6,7,8};
    NDArray a = new NDArray(dat, 2,4);
    assertTrue(a.toString(), Arrays.equals((int[])a.data(), (int[])dat));
}

@Test
public void test_transpose() {
    NDArray a = Numpy.arange(36).reshape(4,3,3);
    int[] expected = {0, 9, 18, 27};
    int[][] range = {{0}, {0}};
    assertEquals(Numpy.array(expected), a.T.slice(range));
    System.out.println(a.T);

    a = Numpy.arange(12).reshape(4,3);
    int[] expected2 = {1, 4, 7};
    int[][] range2 = {{1}, {0,-1}}; // {{1}, {0, 3}}
    assertEquals(Numpy.array(expected2), a.T.slice(range2));
}

@Test
public void test_api_at() {
    NDArray a = Numpy.arange(12).reshape(3,4);
    int[] expected = {4,5,6,7};
    assertEquals(Numpy.array(expected), a.at(1));
    assertEquals(Numpy.array(6), a.at(1,2));
}

@Test
public void test_api_atRange() {
    NDArray a = Numpy.arange(36).reshape(4,3,3);
    int[] expected = {8, 17};
    int[][] range = {{0,2}, {2}, {-1+3}}; // not support negative, but slice can
    assertEquals(Numpy.array(expected), a.atRange(range));
}

@Test
public void test_shape() {
    int[] dat = new int[]{2,4};
    NDArray a = Numpy.array(dat);
    assertEquals("(2,)", a.shape());
}

@Test
public void test_slice() {
    NDArray a = Numpy.arange(12).reshape(3,4);
    int[][] range1 = {{1, 3}, {-1}};
    NDArray b = a.slice(range1);
    assertEquals("array([7, 11])\n", b.toString());

    int[][] range2 = {{ALL}, {-2}};
    b = a.slice(range2);
    assertEquals("array([2, 6, 10])\n", b.toString());
```

```
        int[][] range3 = {{-2, -1}, {-2}};
        b = a.slice(range3);
        assertEquals("array([6])\n", b.toString());

        int[][] range4 = {{-1}, {-2}};
        b = a.slice(range4);
        assertEquals("10", b.toString());
    }

    @Test
    public void test_broadcast() {
        NDArray a = Numpy.arange(12).reshape(3,4);
        NDArray b = Numpy.add(a, 2);

        assertEquals("array([[2 , 3 , 4 , 5 ]\n" +
            "       [6 , 7 , 8 , 9 ]\n" +
                    "       [10, 11, 12, 13]])\n", b.toString());

        b = Numpy.sub(b, 2);
        assertEquals("array([[0 , 1 , 2 , 3 ]\n" +
                    "       [4 , 5 , 6 , 7 ]\n" +
                    "       [8 , 9 , 10, 11]])\n", b.toString());

        int[] dat = {10, 20, 30, 40};
        NDArray c = Numpy.add(a, dat);

        assertEquals("array([[10, 21, 32, 43]\n" +
            "       [14, 25, 36, 47]\n" +
                    "       [18, 29, 40, 51]])\n", c.toString());
    }

    @Test
    public void test_arange() {
        NDArray a = Numpy.arange(12).reshape(3,4);
        assertEquals("(3, 4)", a.shape());
    }

    @Test
    public void test_random() {
        NDArray a = Numpy.random.rand(4,4);
        System.out.println(a);
        assertEquals("(4, 4)", a.shape());
    }

    @Test
    public void test_ndarray_add() {
        NDArray a = Numpy.ones(3,4);
        NDArray b = Numpy.zeros(3,4);
        NDArray c = Numpy.add(a, b);
        System.out.println(c);
    }

    @Test
    public void test_ndarray_dot() {
        NDArray a = Numpy.arange(12).reshape(3,4);
        NDArray b = Numpy.arange(16).reshape(4,4);
        NDArray c = Numpy.dot(a, b);

        assertEquals(
            "array([[56 , 62 , 68 , 74 ]\n"+
            "        [152, 174, 196, 218]\n"+
            "        [248, 286, 324, 362]])\n", c.toString());

        NDArray d = Numpy.arange(12).reshape(3,4);
        NDArray e = Numpy.dot(d, 2);
        assertEquals(e, Numpy.add(d, d));

        d = Numpy.arange(12).reshape(3,4);
        e = Numpy.array(2);
        assertEquals(Numpy.dot(d, 2), Numpy.dot(d, e));

        d = Numpy.arange(12).reshape(3, 4);
        e = Numpy.array(new int[]{1, 2, 3, 4});
        assertEquals(Numpy.array(new int[]{20, 60, 100}), Numpy.dot(d, e));
    }

    @Test
    public void test_struct() {
        NDArray a = Numpy.arange(24).reshape(2,3,4);
        int[][][] array = (int[][][])Numpy.getArray(a);

        int[][][] real = new int[][][]{
            {{0, 1, 2, 3}, {4, 5, 6, 7}, {8, 9, 10, 11}},
            {{0, 1, 2, 3}, {4, 5, 6, 7}, {8, 9, 10, 11}}
        };

        assertEquals("3 dimens int[][][] array", Arrays.deepToString(array), Arrays.deepToS
    }
```