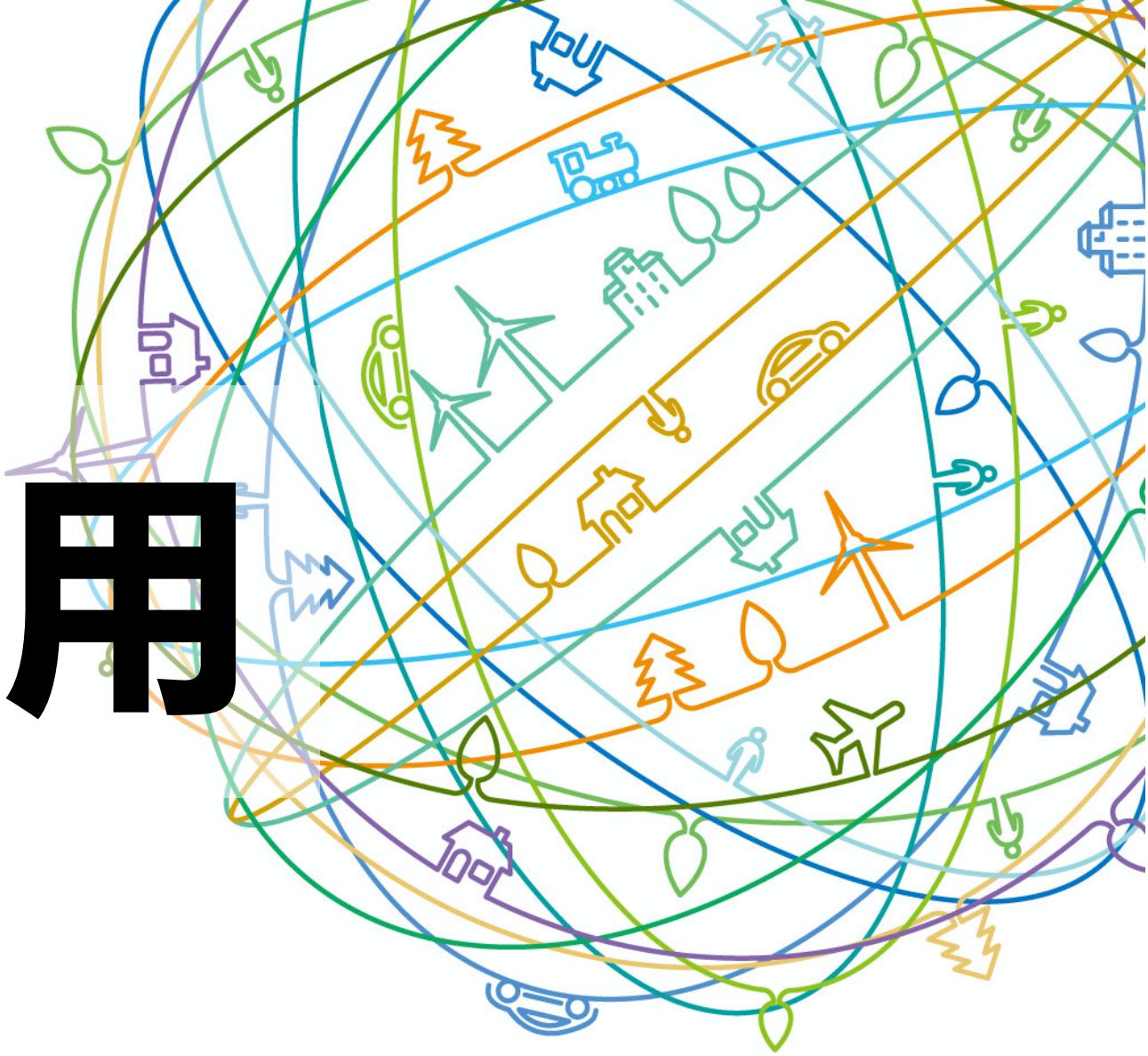
AI框架作用

ZOMI 酱



Building a better connected world

www.hiascend.com
www.mindspore.cn

关于本内容

1. 内容背景

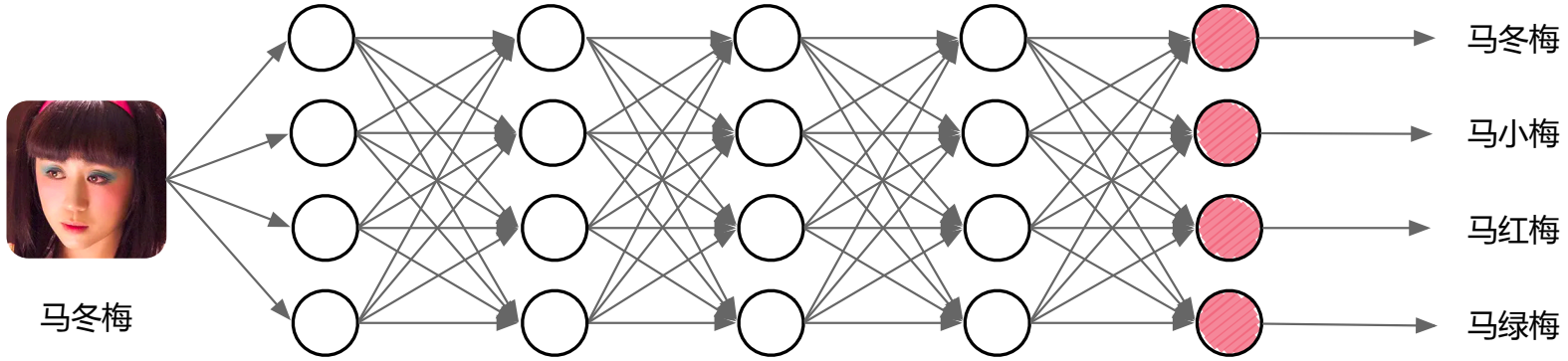
- AI框架的基础介绍

2. 具体内容

- AI框架作用：深度学习基础 – AI框架的作用 - AI框架的目的
- AI框架之争：第一代框架 – 第二代框架 – 第三代框架
- 编程范式：声明式编程 - 命令式编程

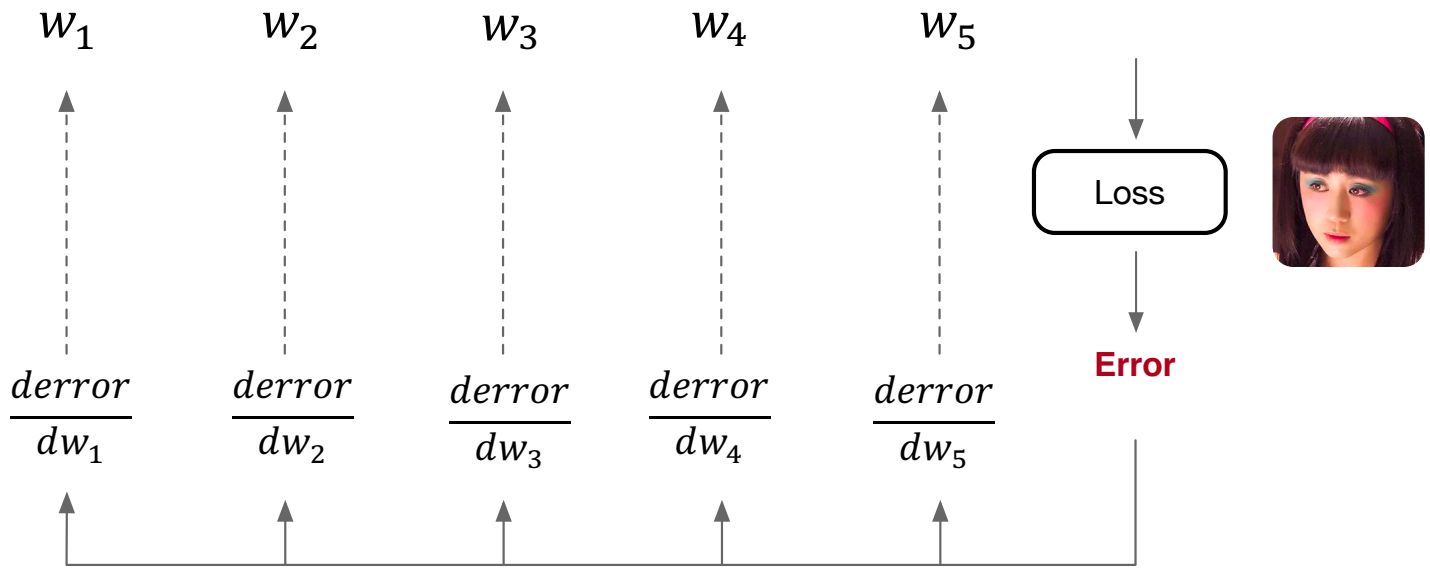
Review: Deep Learning Fundamentals

1. 定义一个神经网络:

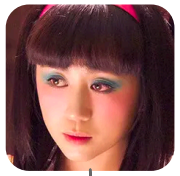


2. 定义优化目标：

3. 计算梯度并更新权重参数：



Implement a simple neural network



conv_0

relu_0

maxpool_0

conv_0

relu_0

maxpool_0

FC_0

FC_1

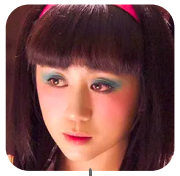
SoftMax

马冬梅

如何实现多线程算子加速？

```
for (int n = 0; n < o_n; ++n) {
        for (int c = 0; c < o_c; ++c) {
            for (int j = 0; j < o_h; ++j) {
                for (int i = 0; i < o_w; ++i) {
                    int d_start = n * i_c * i_h * i_w + j * i_w + i;
                    int temp = 0;
                    for (int kk = 0; kk < k_c; ++kk) {
                        for (int kj = 0; kj < k_h; ++kj) {
                            for (int ki = 0; ki < k_w; ++ki) {
                                int k_idx = kk * k_h * k_w + kj * k_w + ki;
                                int d_idx = d_start + kk * i_h * i_w + kj * i_w + ki;
                                temp += inputs->data[d_idx] * kernel->data[k_idx];
                            }
                        }
                    }
                    res[n * o_c * o_h * o_w + j * o_w + i] = temp;
                }
            }
        }
```

Implement a simple neural network



conv_0

relu_0

maxpool_0

conv_0

relu_0

maxpool_0

FC_0

FC_1

SoftMax

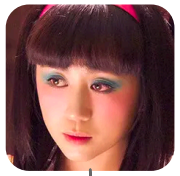
马冬梅

```
for (int i=0;i<row;i++)
    for (int j = 0; j < k_h - mod_row; j++)
    {
        pad_map[i].push_back(map[i][col - 1]);
    }
for (int j = 0; j < k_w - mod_col; j++)
{
    pad_map.push_back(pad_map[row - 1]);
}

for(int i=0;i<out_row;i++)
    for (int j = 0; j < out_col; j++)
    {
        int start_x = j*s_w;
        int start_y = i*s_h;
        vector<int> temp;
        for(int ii=0;ii<k_w;ii++)
            for (int jj = 0; jj < k_h; jj++)
            {
                temp.push_back(pad_map[start_y + jj][start_x + ii]);
            }
        sort(temp.begin(), temp.end());
        res[i][j] = temp[temp.size() - 1];
    }
```

如何跑在GPU上？

Implement a simple neural network



conv_0

relu_0

maxpool_0

conv_0

relu_0

maxpool_0

FC_0

FC_1

SoftMax

马冬梅

```
1  float* conv(float *image, float *weight, **argv){...}
2
3  float* relu(float *image, **argv){...}
4
5  float* maxpool(float *image, **argv){...}
6
7  float* fc(float *image, **argv){...}
8
9  float* softmax(float *image, **argv){...}
```

```
12 int main(){
13     std::memset(image, 220 * 220 * sizeof(double));
14     conv0 = conv(image, ...)
15     relu0 = relu(conv0)
16     maxpool0 = maxpool(relu0)
17     conv1 = conv(maxpool0)
18     relu1 = relu(conv1)
19     maxpool1 = maxpool(relu1)
20     fc0 = fc(maxpool1)
21     fc1 = fc(fc0)
22     softmax = softmax(fc1)
23     return softmax
24 }
```

如何暴露给其它用户？

如何实现后向算子？

如何优化这份代码？

Few questions AI framework wants to answer

- 前端（面向用户）：如何灵活的表达一个深度学习模型？
- 算子（执行计算）：如何保证每个算子的执行性能和泛化性？
- 求导（更新参数）：如何自动、高效地提供求导运算？
- 后端（系统相关）：如何将同一个算子跑在不同的加速设备上？
- 运行时：如何自动地优化和调度网络模型进行计算？

Example： An extreme calculation method

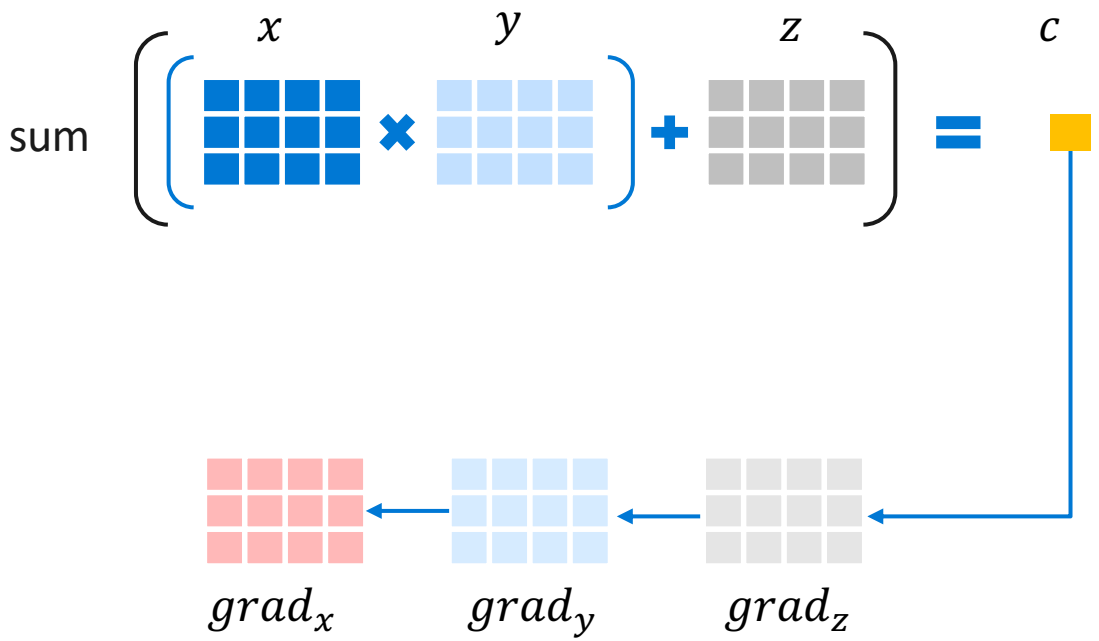
- 用高级语言从头实现一个模型的计算过程

```
import numpy as np

N, D = 3, 4
x = np.random.randn(N, D)
y = np.random.randn(N, D)
z = np.random.randn(N, D)

a = x * y
b = a + z
c = np.sum(b)
```

```
grad_c = 1.0
grad_b = grad_c * np.ones((N, D))
grad_a = grad_b.copy()
grad_z = grad_b.copy()
grad_x = grad_a * y
grad_y = grad_a * x
```



Example： An extreme calculation method

- 用高级语言从头实现一个模型的计算过程

```
import numpy as np

N, D = 3, 4
x = np.random.randn(N, D)
y = np.random.randn(N, D)
z = np.random.randn(N, D)

a = x * y
b = a + z
c = np.sum(b)
```

```
grad_c = 1.0
grad_b = grad_c * np.ones((N, D))
grad_a = grad_b.copy()
grad_z = grad_b.copy()
grad_x = grad_a * y
grad_y = grad_a * x
```

Efficiency

Flexibility

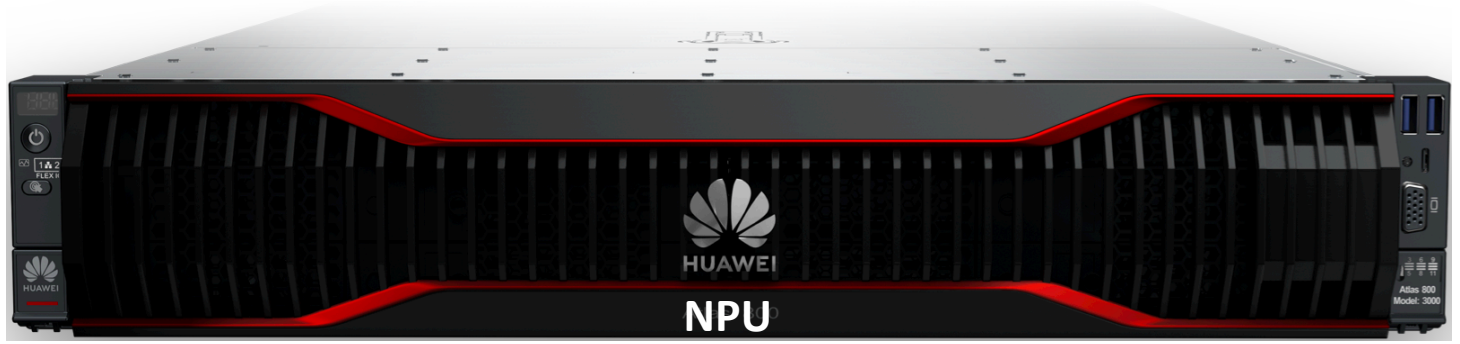
Example： Another extreme calculation method

- 为常用模型在NPU加速设备上实现一个高度优化的计算库

```
import xxlib

x, y = load_data()

y = xxlib.resnet152(x)
```



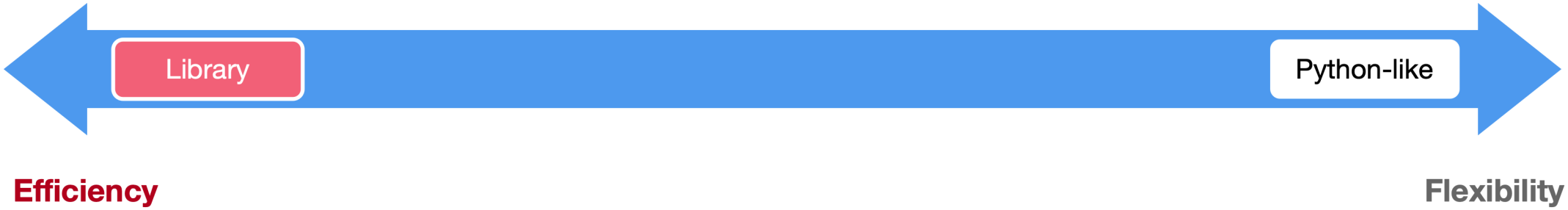
Example： Another extreme calculation method

- 为常用模型在NPU加速设备上实现一个高度优化的计算库

```
import xxlib

x, y = load_data()

y = xxlib.resnet152(x)
```



The role of AI frameworks

AI Framework Propose

提供灵活的编程模型和编程接口

- 自动推导计算图
- 较好的支持与现有生态环境融合
- 提供直观的模型构建方式，简洁的神经网络计算编程语言

提供高效和可扩展的计算能力

- 自动编译优化算法（子表达式消除、内核融合、内存优化等）
- 根据不同体系结构和硬件设备自动并行化（自动分布式化、扩展多计算节点等）

Summary

1. 回顾了深度学习的基本流程
2. 了解了AI框架上承应用算法、下接芯片使能的作用
3. 知道了AI框架提供灵活的编程接口和可扩展的计算能力2个目的