Tensor Library

Akilbekov Alar
Astana IT University

→

Outline

1. Understanding the Tensor
2. Features of project
3. Applications
4. Advantages and disadvantages
5. Patterns
6. Summary

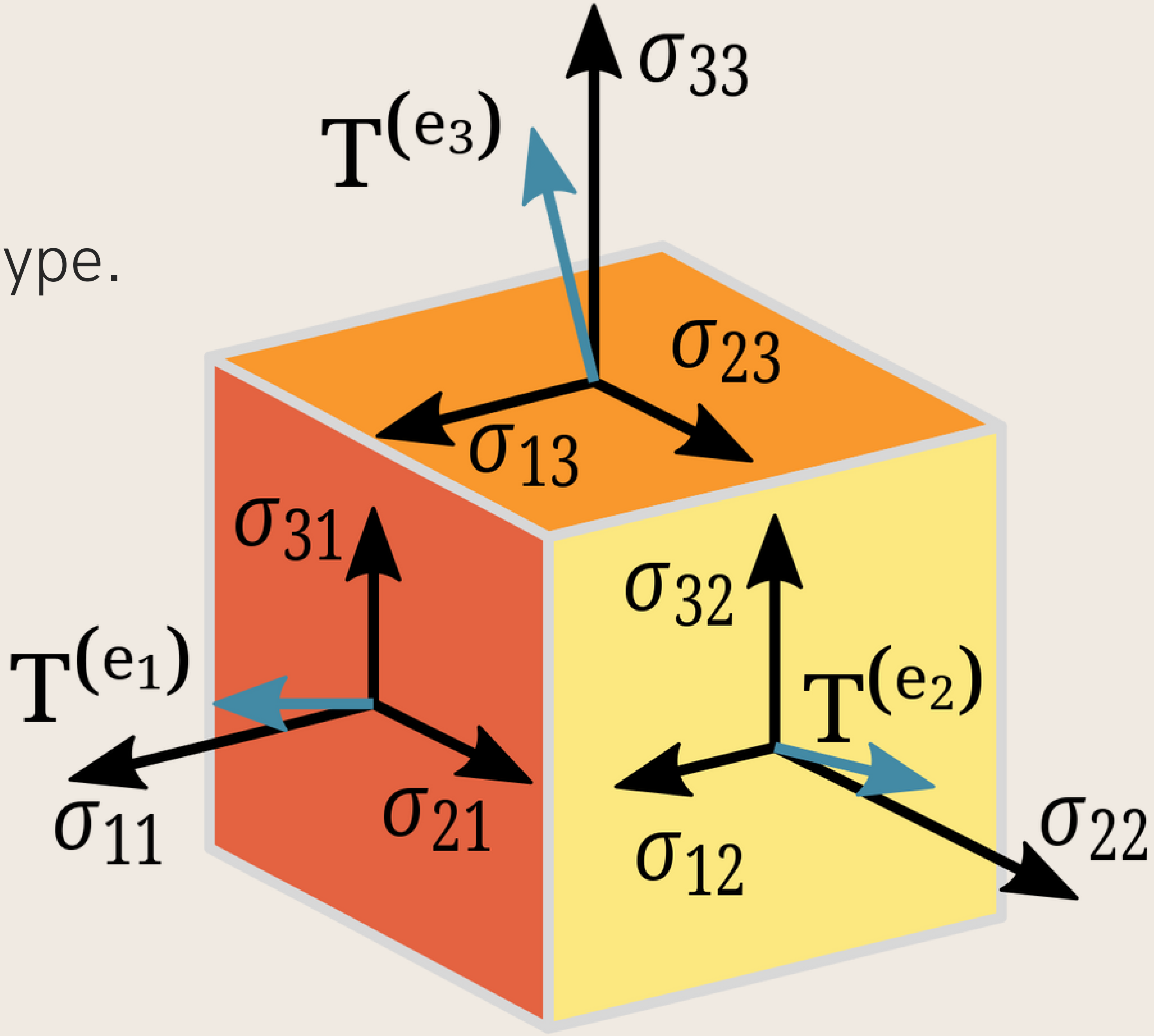
→

Understanding the Tensor

Concept and Definition

Tensors are multidimensional arrays with a single type.

The rank-n tensor is an n-dimensional array.

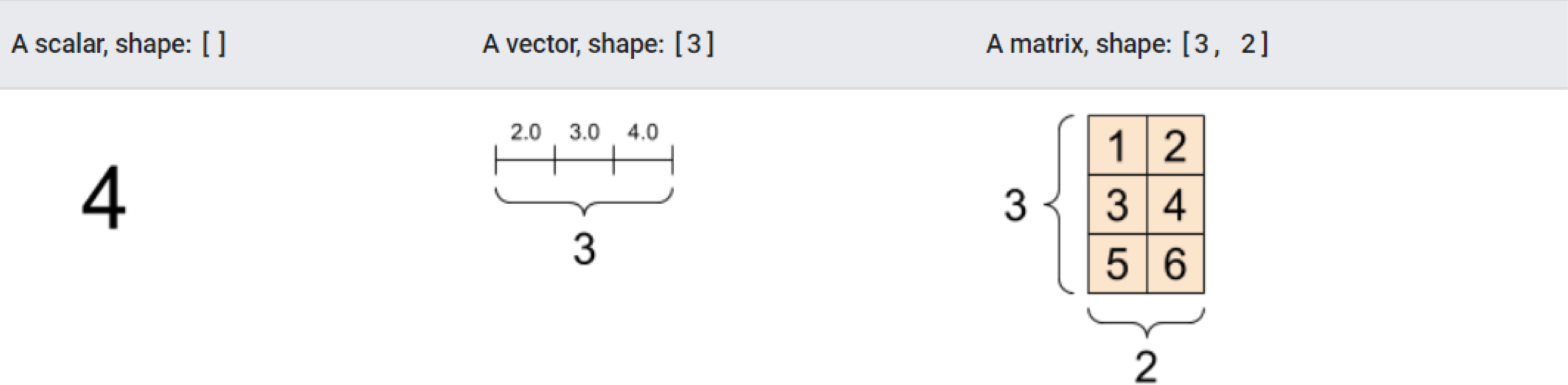


Understanding the Tensor

Tensor Implementation

In implementation, Tensor - array of Tensors, except rank-0 Tensor or in other words scalar.

```
[Tensor, Tensor, Tensor, Tensor]
  |      |      |      |
  |      |    [...]  [...]
  | [Tensor, Tensor, ...]
[Tensor, Tensor...]
```

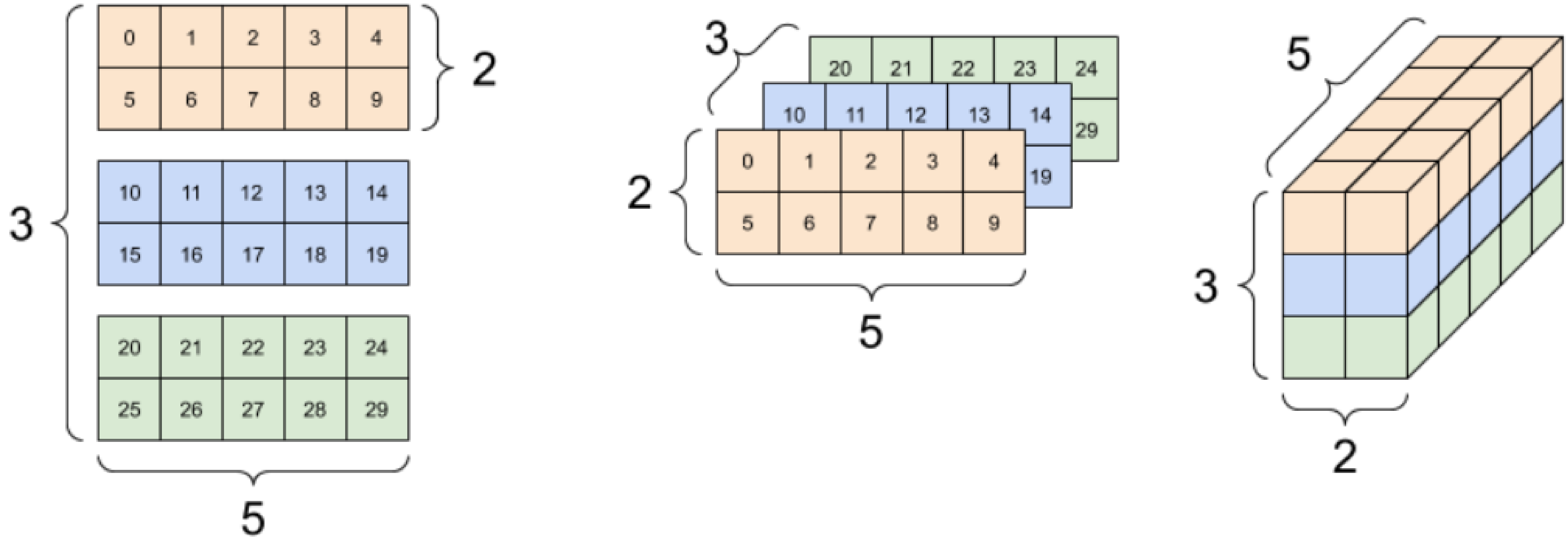


Tensor Library | Astana IT University

Understanding the Tensor

3D Tensor

A 3-axis tensor, shape: [3, 2, 5]



Features of project

- Tensors
- Operations with tensors: elementwise operations, transposition, matrix multiplication, convolution etc
- Convenient creation of your own operations
- Dynamic computation graphs
- Automatic differentiation (AutoGrad)

07.

Applications

→

Machine Learning

Deep Learning

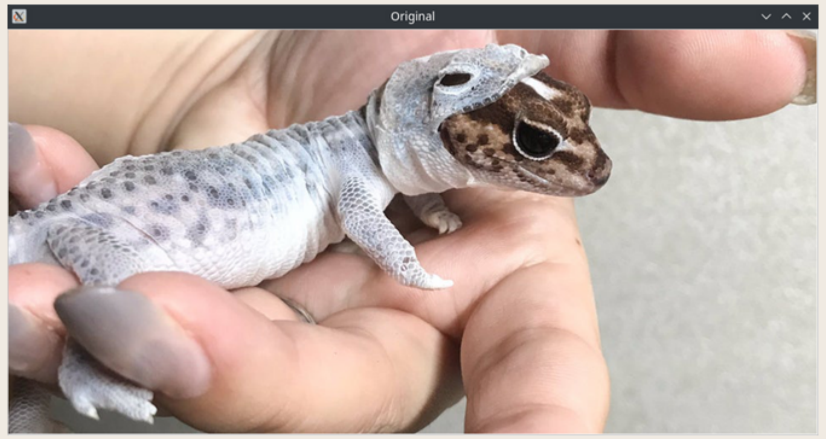
Computer Vision

Physics and geometry

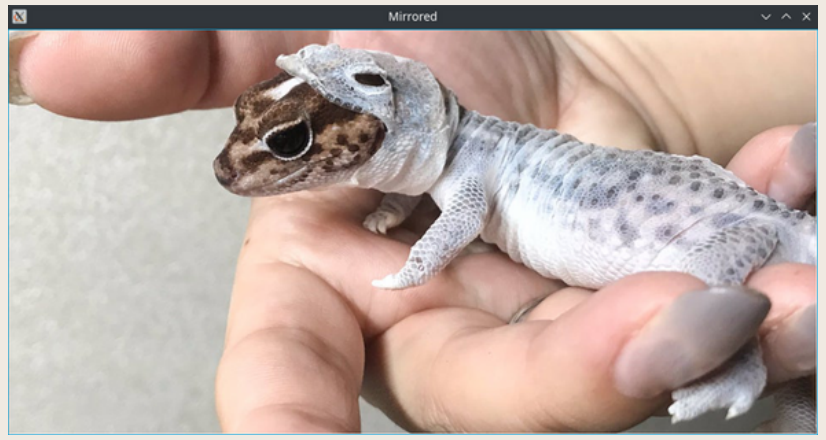
Applications (Computer Vision)

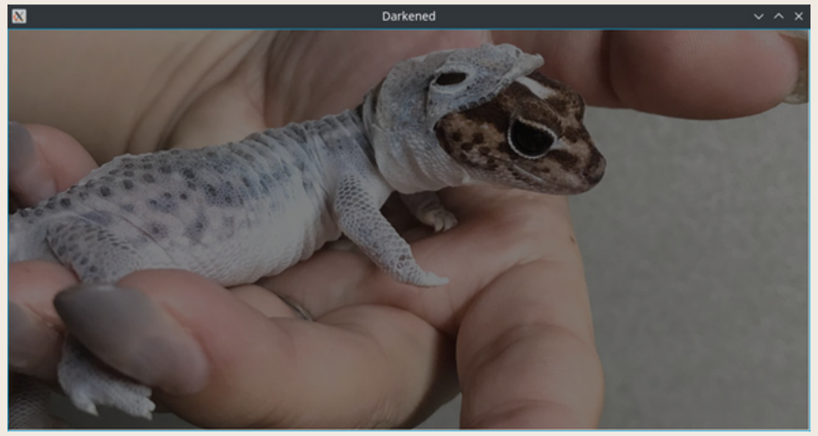
GUI

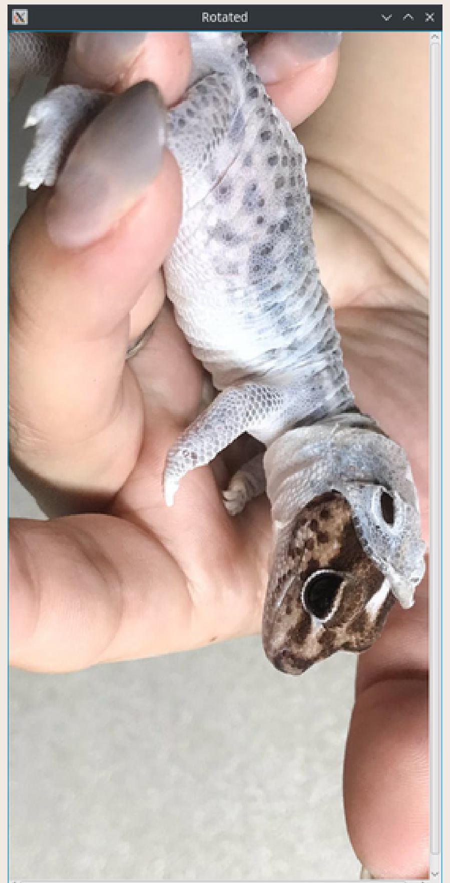
Can load and display tensors as images using JavaFX

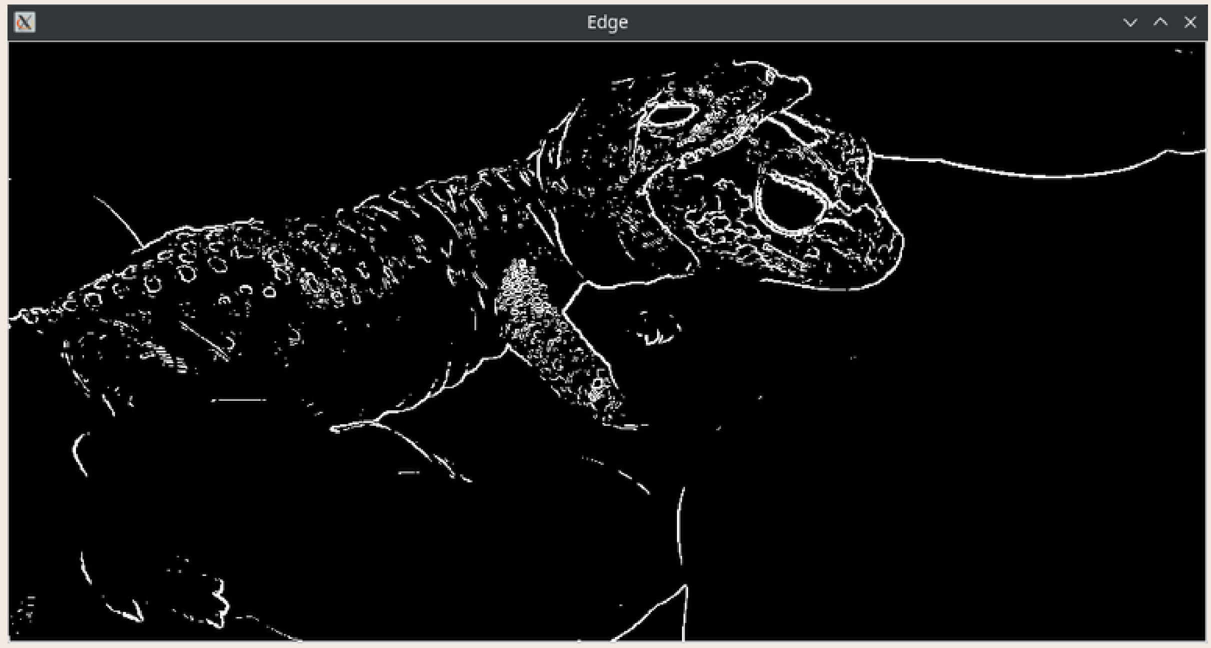


After that, we can apply any operations on the tensor and look at the result of the image transformation



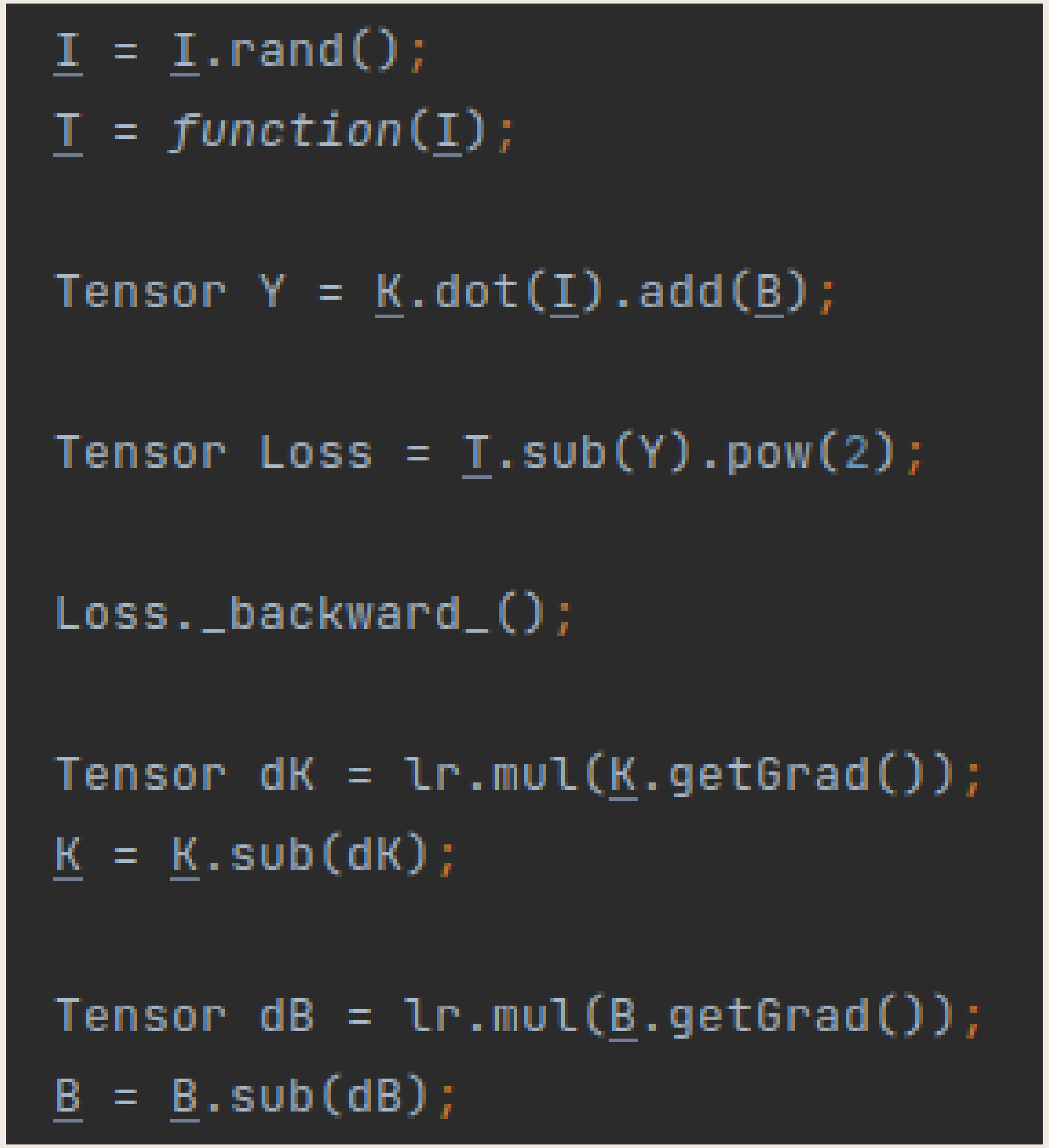






Applications (Function Approximation)

An example of linear-function approximation using quadratic error minimization



```
I = I.rand();
T = function(I);

Tensor Y = K.dot(I).add(B);

Tensor Loss = T.sub(Y).pow(2);

Loss._backward_();

Tensor dK = lr.mul(K.getGrad());
K = K.sub(dK);

Tensor dB = lr.mul(B.getGrad());
B = B.sub(dB);
```

Advantages and disadvantages

ADVANTAGES	DISADVANTAGES
- *Lightweight* - *No additional libraries* - *Pure plain java*	- *no GPU computing*

Summary

Analogue to Math and ML libraries like numpy or pytorch.
Written from scratch in plain java.
Element-by-element execution of operations, without GPU acceleration of calculations.
Tensors are multidimensional arrays that we can transform using operations, build a calculation graph and find a gradient on it at each node.

→

github.com/Alar-q/Tensor_library