# Machine Learning Appendices (DRAFT)

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# Overview

# Appendix A

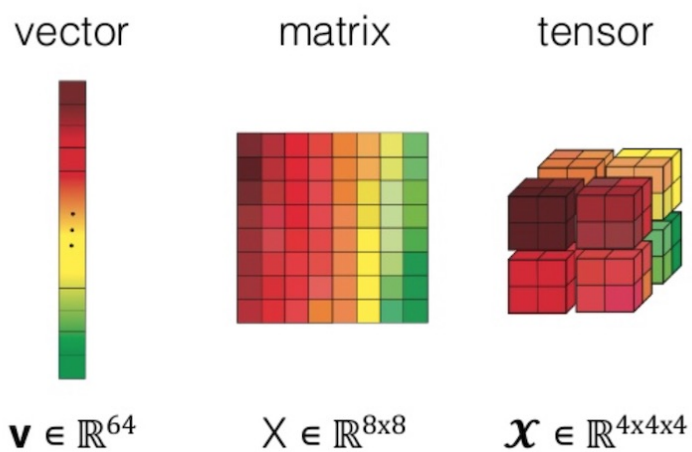
## Working with Tensors

# Definition

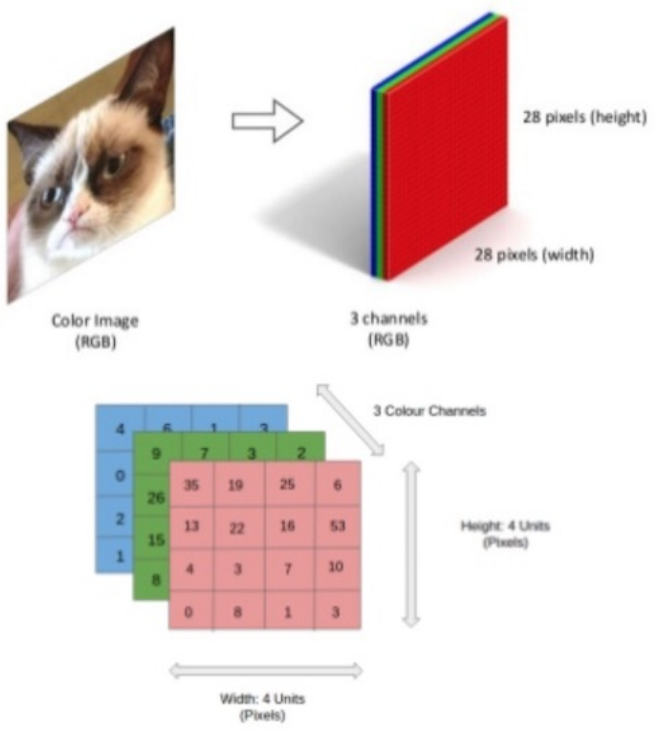
## Definition

In machine learning, a tensor is a generalization of scalars, vectors, and matrices to n-dimensional arrays.

Vectors, matrices, tensors.

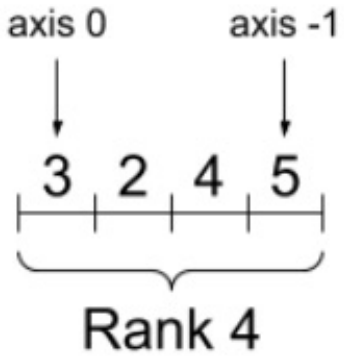


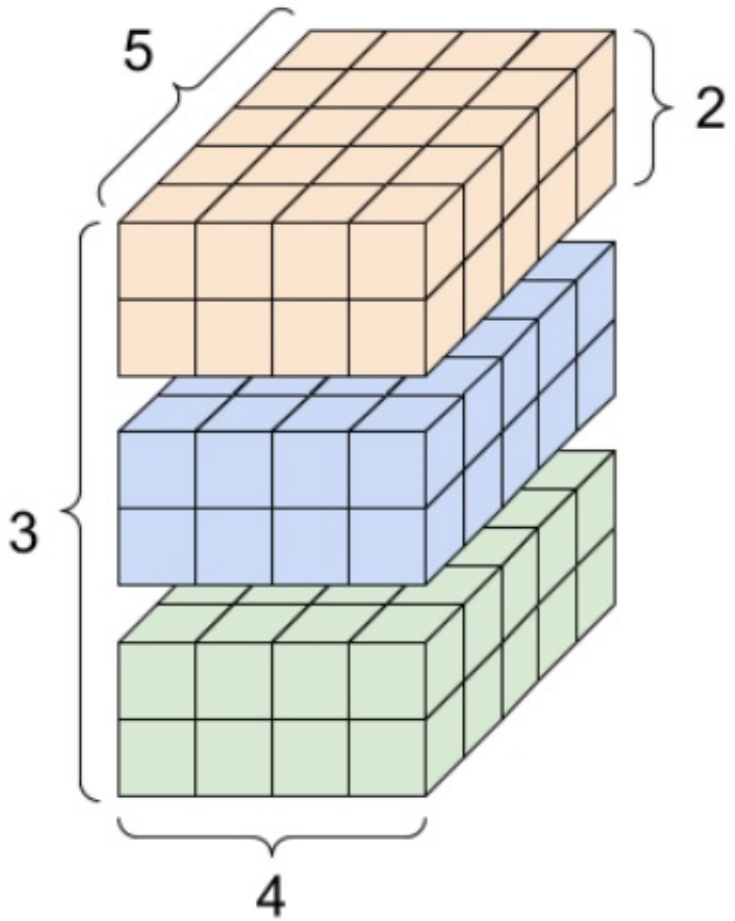

Images are three-dimensional tensors.



# Definition

A rank-4 tensor shape:



# Creating Tensors in TensorFlow

TensorFlow supports two models of execution:

- Eager execution: Operations are evaluated immediately.
- Graph execution: A computational graph is constructed for later evaluation.

**Example:** Create tensor matrices, then multiply:

```
c = tf.constant([[1.0, 2.0], [3.0, 4.0]])
d = tf.constant([[1.0, 1.0], [0.0, 1.0]])

e = tf.matmul(c, d)

print(e)
tf.Tensor( [ 1., 3.],
           [ 3., 7.], shape=(2,2), dtype=float32)
```

# Tensor Operations

**Mathematical Operations.** Many machine learning algorithms can be expressed as sequences of element-wise tensor operations and tensor products.

# Tensor Operations

## Element-wise Tensor Operations

# Tensor Operations

## Tensor Products

# Tensor Graphs

## Tensor Graphs

# TensorBoard

**TensorBoard.** ...

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**TensorBoard.** ...