

# Tensor Ranks, Shapes, and Types

TensorFlow programs use a tensor data structure to represent all data. You can think of a TensorFlow tensor as an  $n$ -dimensional array or list. A tensor has a static type and dynamic dimensions. Only tensors may be passed between nodes in the computation graph.

## Rank Tensor是几维的

In the TensorFlow system, tensors are described by a unit of dimensionality known as *rank*. Tensor rank is not the same as matrix rank. Tensor rank (sometimes referred to as *order* or *degree* or  *$n$ -dimension*) is the number of dimensions of the tensor. For example, the following tensor (defined as a Python list) has a rank of 2:

```
t = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]
```

A rank two tensor is what we typically think of as a matrix, a rank one tensor is a vector. **For a rank two tensor you can access any element with the syntax `t[i, j]`.** For a rank three tensor you would need to address an element with `t[i, j, k]`.

Rank	Math entity	Python example
0	Scalar (magnitude only)	<code>s = 483</code>
1	Vector (magnitude and direction)	<code>v = [1.1, 2.2, 3.3]</code>
2	Matrix (table of numbers)	<code>m = [[1, 2, 3], [4, 5, 6], [7, 8, 9]]</code>
3	3-Tensor (cube of numbers)	<code>t = [[[2], [4], [6]], [[8], [10], [12]], [[14], [16], [18]]]</code>
$n$	$n$ -Tensor (you get the idea)	<code>....</code>

## Shape

**The TensorFlow documentation uses three notational conventions to describe tensor dimensionality: rank, shape, and dimension number.** The following table shows how these relate to one another:

Rank	Shape	Dimension number	Example
0	<code>[]</code>	0-D	A 0-D tensor. A scalar.
1	<code>[D0]</code>	1-D	A 1-D tensor with shape <code>[5]</code> .
2	<code>[D0, D1]</code>	2-D	A 2-D tensor with shape <code>[3, 4]</code> .
3	<code>[D0, D1, D2]</code>	3-D	A 3-D tensor with shape <code>[1, 4, 3]</code> .
n	<code>[D0, D1, ... Dn-1]</code>	n-D	A tensor with shape <code>[D0, D1, ... Dn-1]</code> .

Shapes can be represented via Python lists / tuples of ints, or with the `tf.TensorShape` ([https://www.tensorflow.org/api\\_docs/python/tf/TensorShape](https://www.tensorflow.org/api_docs/python/tf/TensorShape)).

## Data types

In addition to dimensionality, Tensors have a data type. You can assign any one of the following data types to a tensor:

Data type	Python type	Description
<code>DT_FLOAT</code>	<code>tf.float32</code>	32 bits floating point.
<code>DT_DOUBLE</code>	<code>tf.float64</code>	64 bits floating point.
<code>DT_INT8</code>	<code>tf.int8</code>	8 bits signed integer.
<code>DT_INT16</code>	<code>tf.int16</code>	16 bits signed integer.
<code>DT_INT32</code>	<code>tf.int32</code>	32 bits signed integer.
<code>DT_INT64</code>	<code>tf.int64</code>	64 bits signed integer.
<code>DT_UINT8</code>	<code>tf.uint8</code>	8 bits unsigned integer.
<code>DT_UINT16</code>	<code>tf.uint16</code>	16 bits unsigned integer.
<code>DT_STRING</code>	<code>tf.string</code>	Variable length byte arrays. Each element of a Tensor is a byte array.
<code>DT_BOOL</code>	<code>tf.bool</code>	Boolean.
<code>DT_COMPLEX64</code>	<code>tf.complex64</code>	Complex number made of two 32 bits floating points: real and imaginary parts.
<code>DT_COMPLEX128</code>	<code>tf.complex128</code>	Complex number made of two 64 bits floating points: real and imaginary parts.

Data type	Python type	Description
DT_QINT8	<code>tf.qint8</code>	8 bits signed integer used in quantized Ops.
DT_QINT32	<code>tf.qint32</code>	32 bits signed integer used in quantized Ops.
DT_QUINT8	<code>tf.quint8</code>	8 bits unsigned integer used in quantized Ops.

---

*Except as otherwise noted, the content of this page is licensed under the [Creative Commons Attribution 3.0 License](http://creativecommons.org/licenses/by/3.0/) (<http://creativecommons.org/licenses/by/3.0/>), and code samples are licensed under the [Apache 2.0 License](http://www.apache.org/licenses/LICENSE-2.0) (<http://www.apache.org/licenses/LICENSE-2.0>). For details, see our [Site Policies](https://developers.google.com/terms/site-policies) (<https://developers.google.com/terms/site-policies>). Java is a registered trademark of Oracle and/or its affiliates.*

*上次更新日期：三月 8, 2017*