Introducing Computation Graphs

Janani Ravi
CO-FOUNDER, LOONYCORN

www.loonycorn.com

Overview

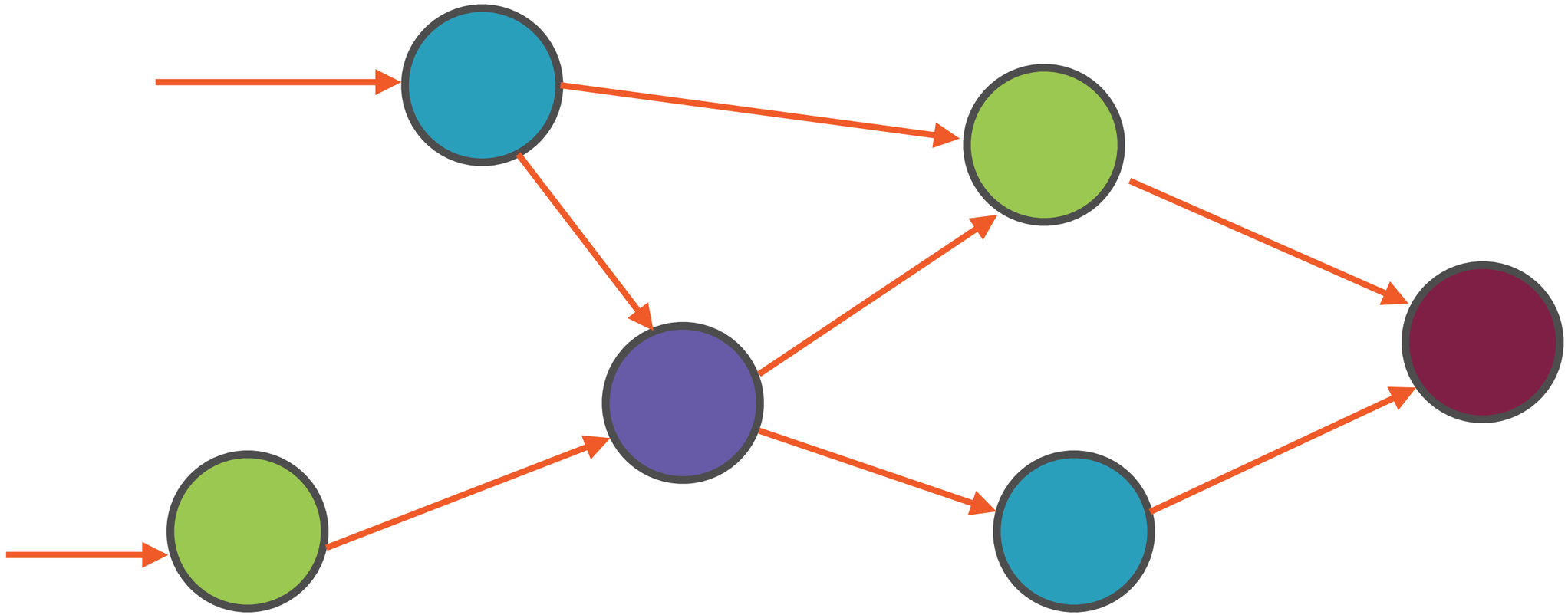
Model nodes, edges and dependencies in a computation graph

Understand the basic parts of a program in TensorFlow

Run TensorFlow programs and visualize results using TensorBoard

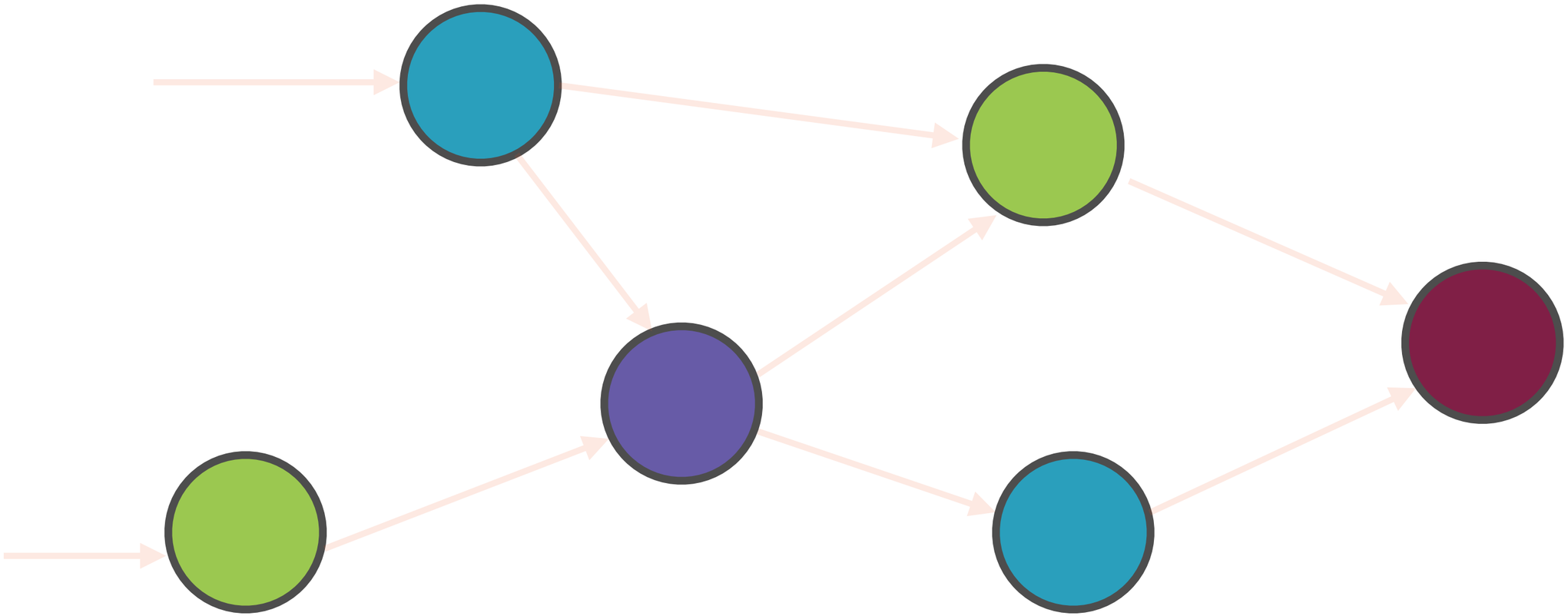
The TensorFlow World

Everything is a Graph



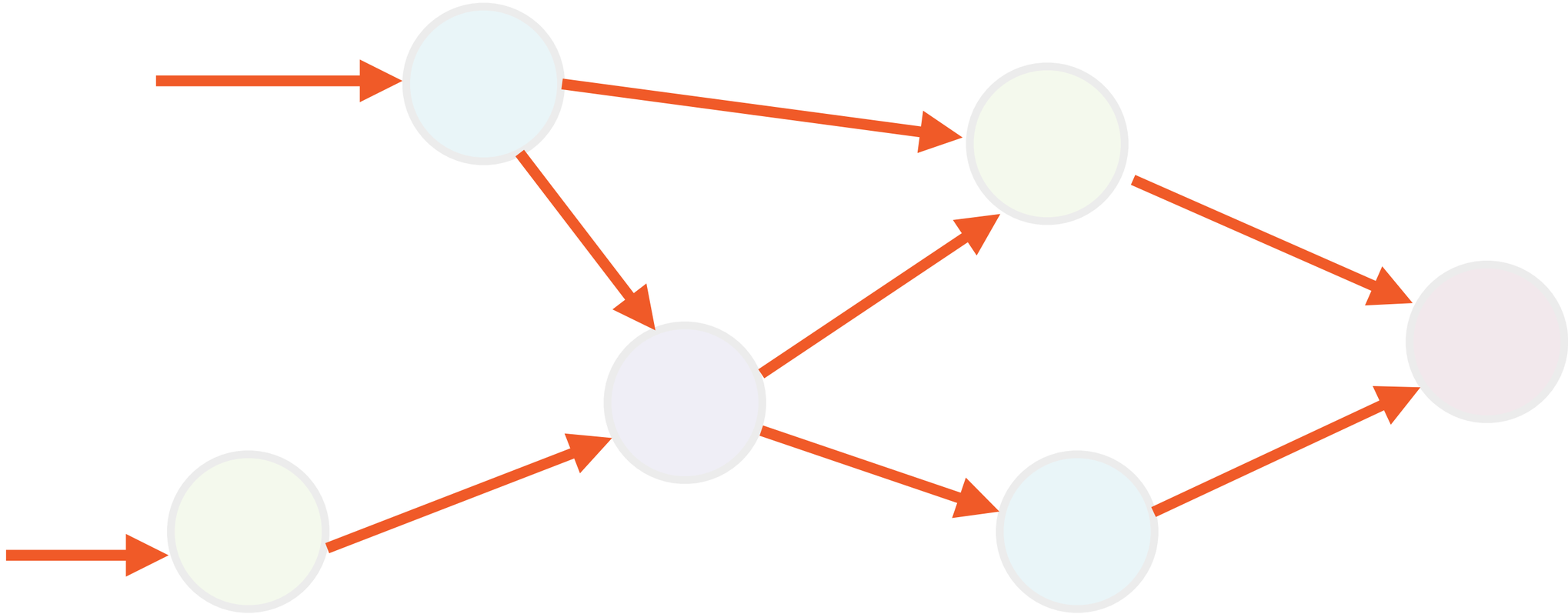
A network

Everything is a Graph



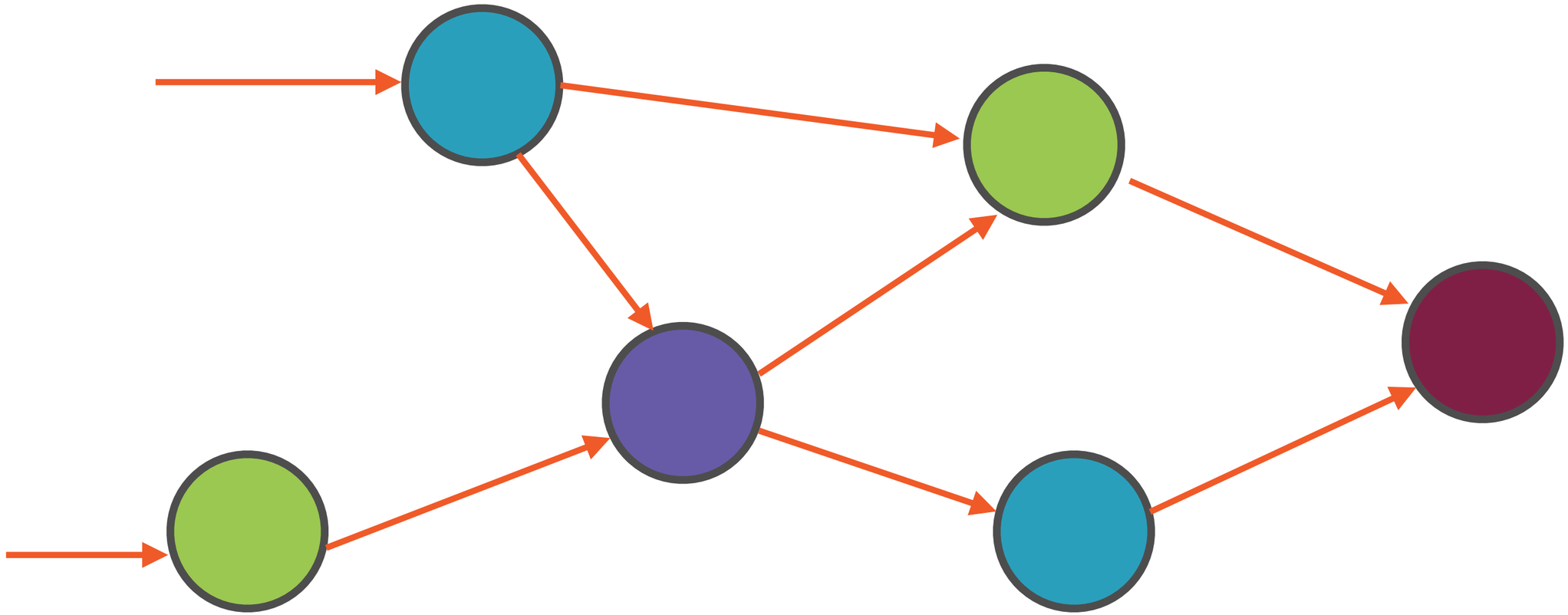
Computations Operations

Everything is a Graph



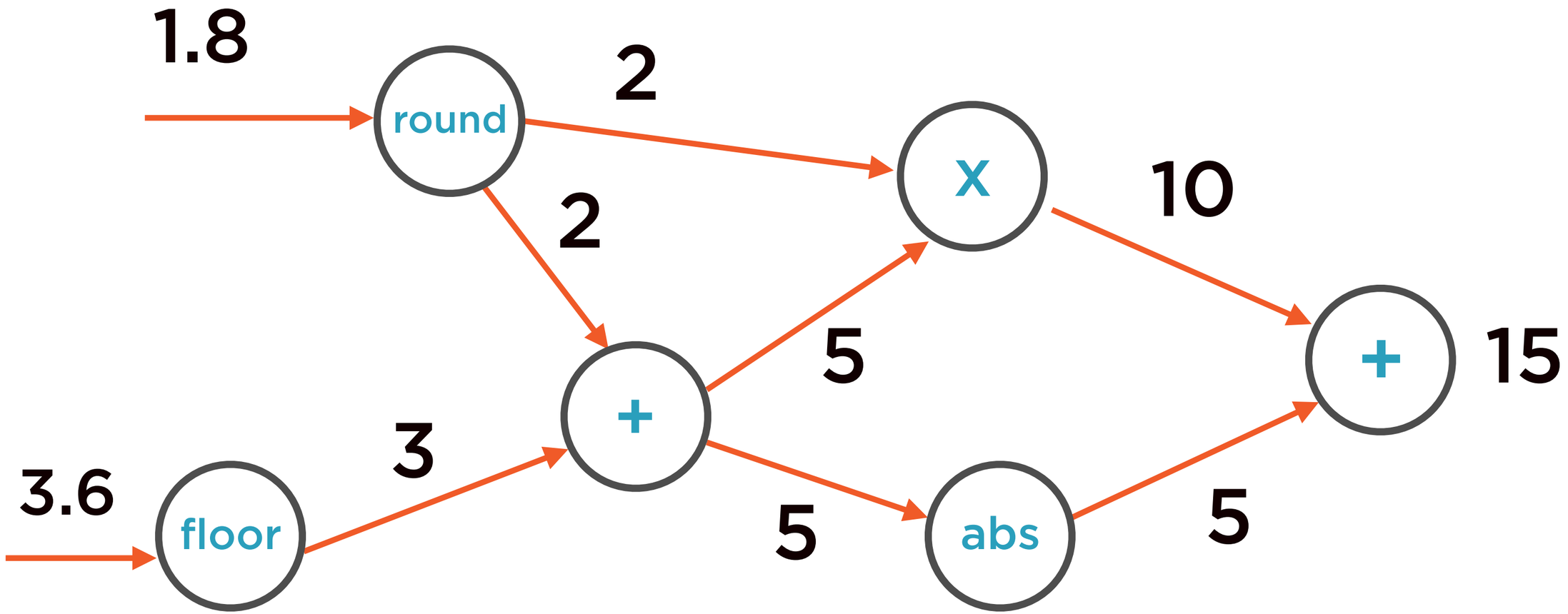
Tensors

Tensors Flow Through the Graph



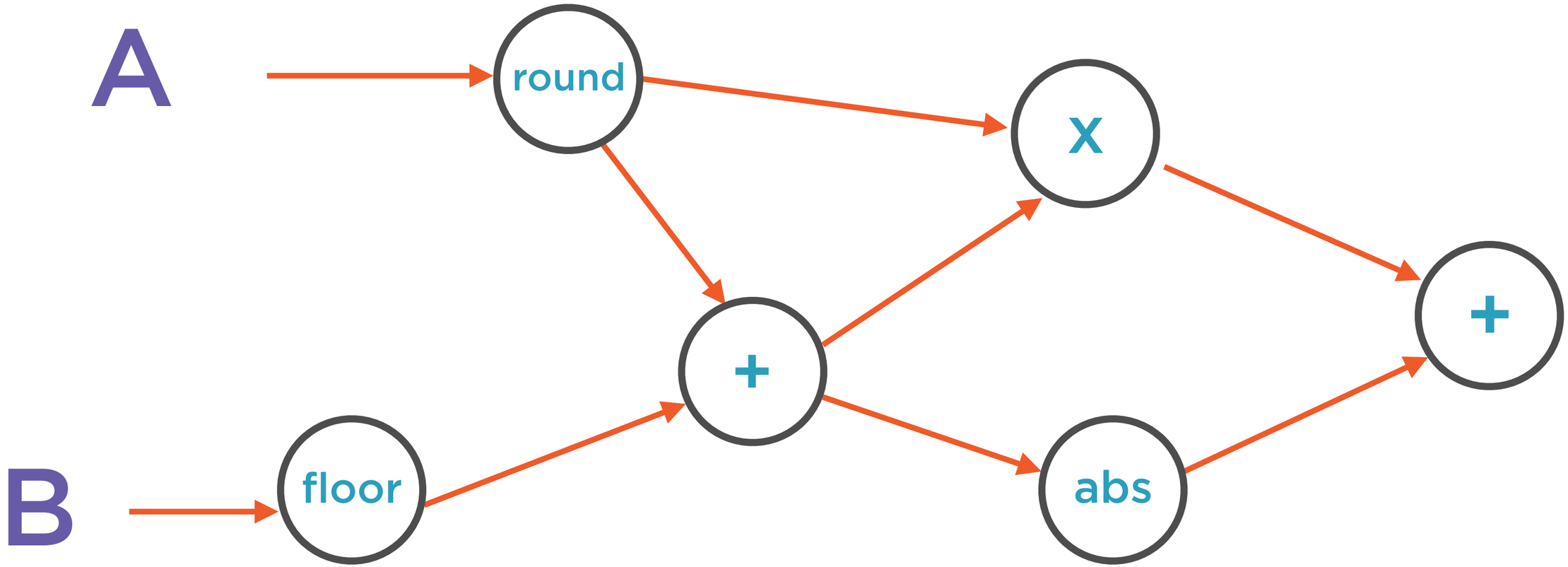
...and gets transformed along the way

Tensors Flow Through the Graph



TensorFlow

Tensors Flow Through the Graph



TensorFlow

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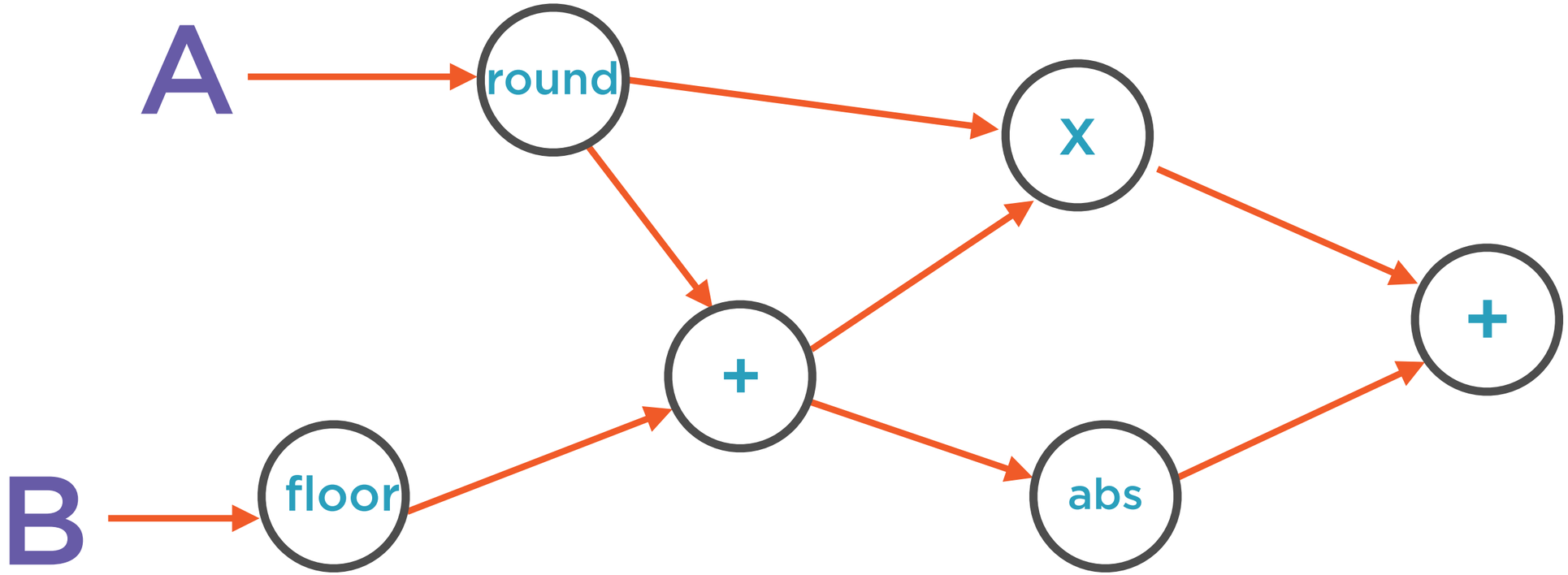
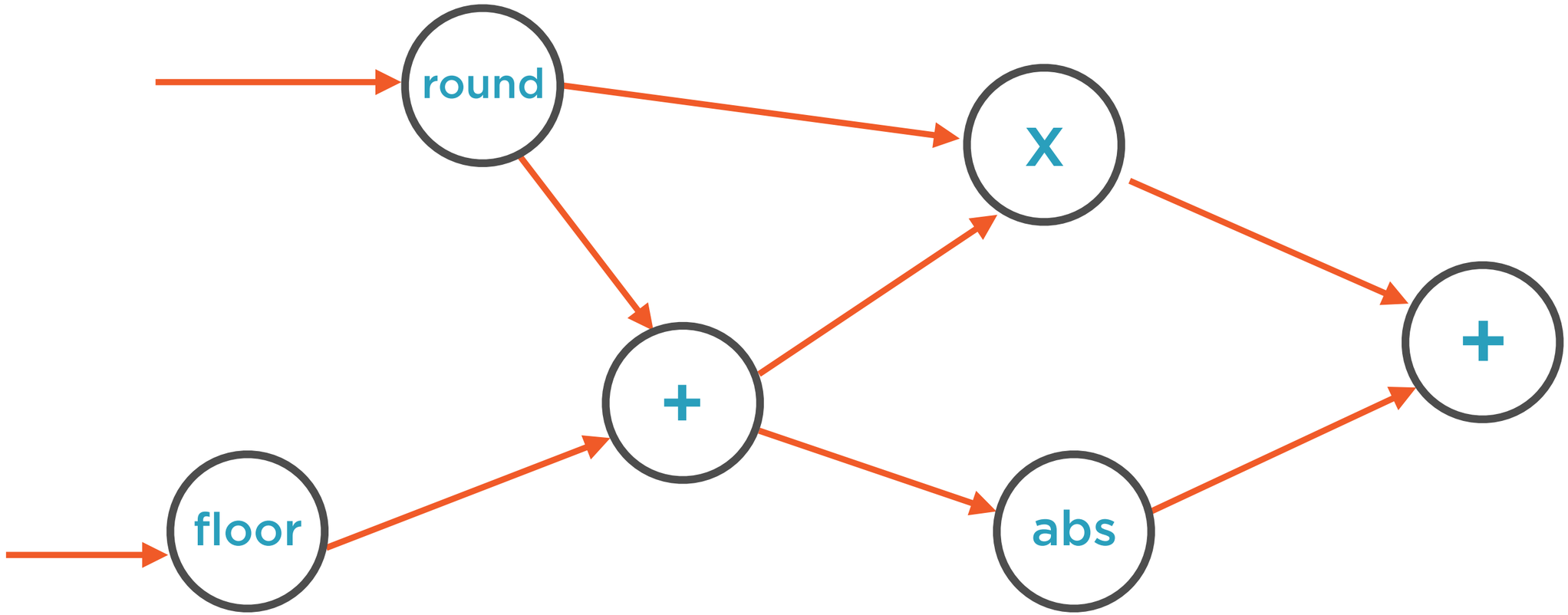
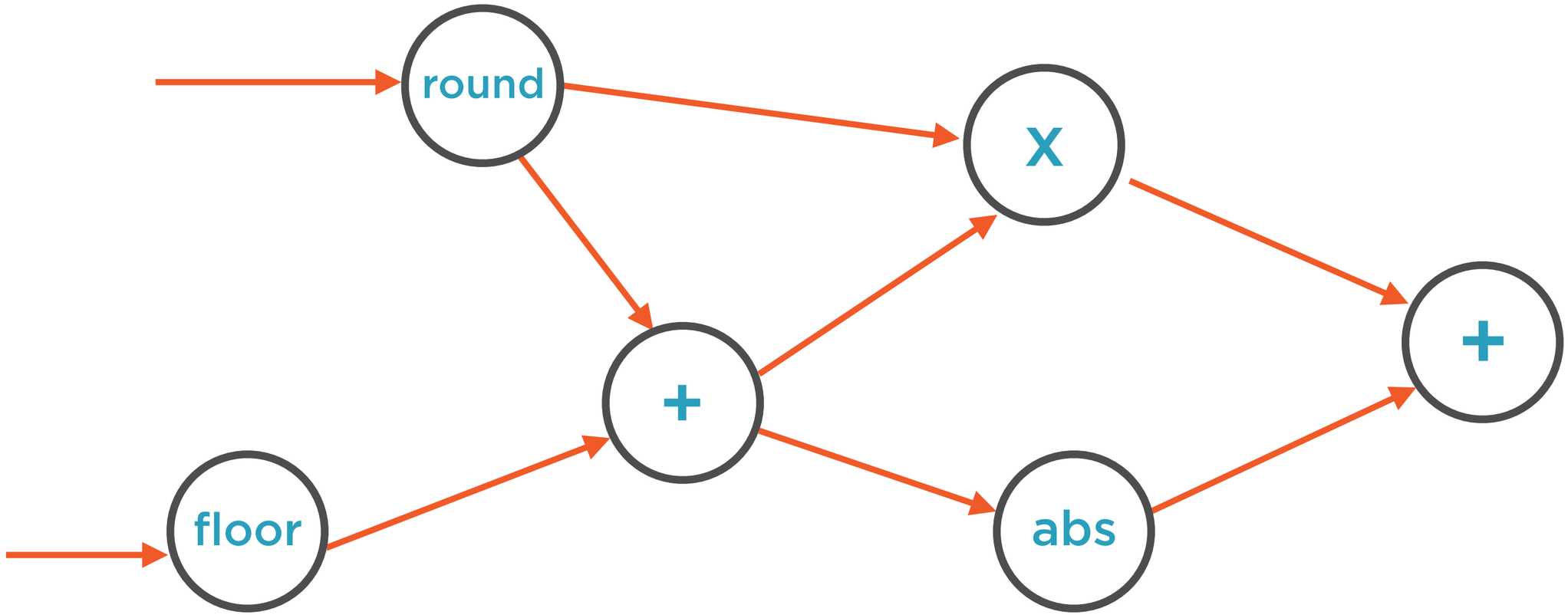



```
Y = (round(A) + floor(B)) *
round(A) + abs(round(A) + floor(B))
```

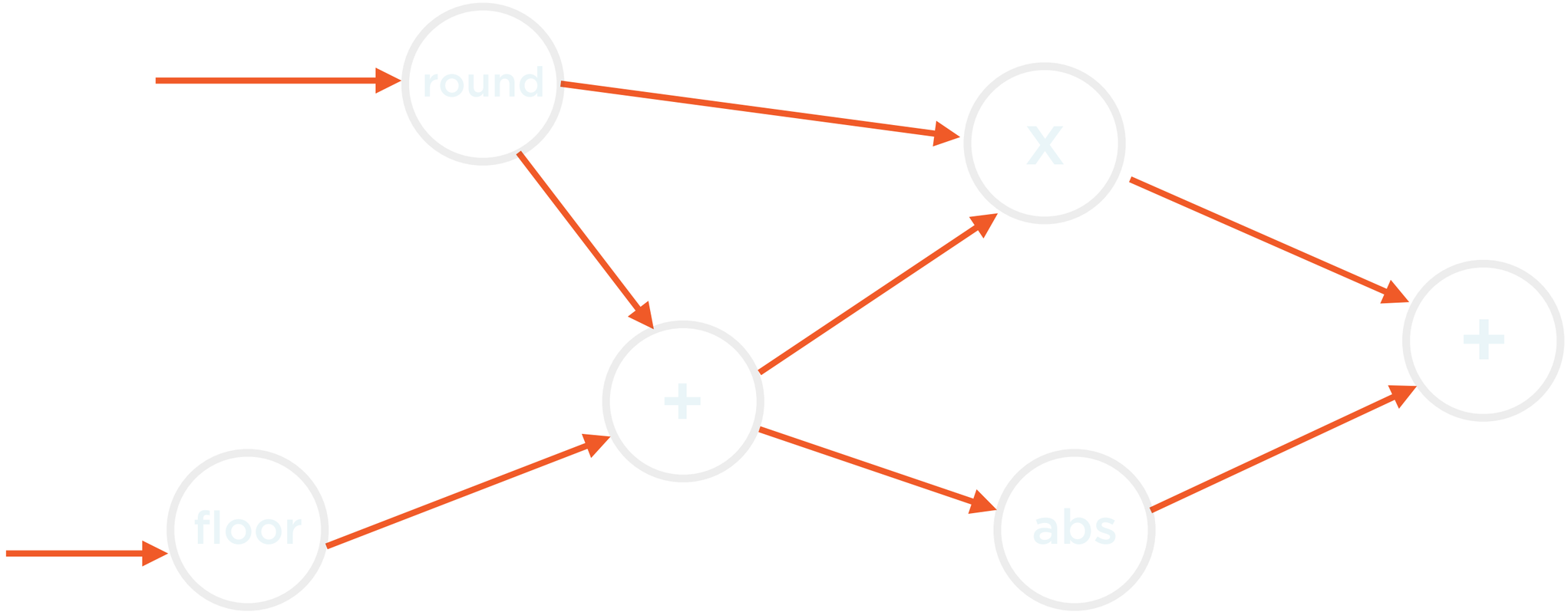
Directed-acyclic Graph



Directed-acyclic Graph

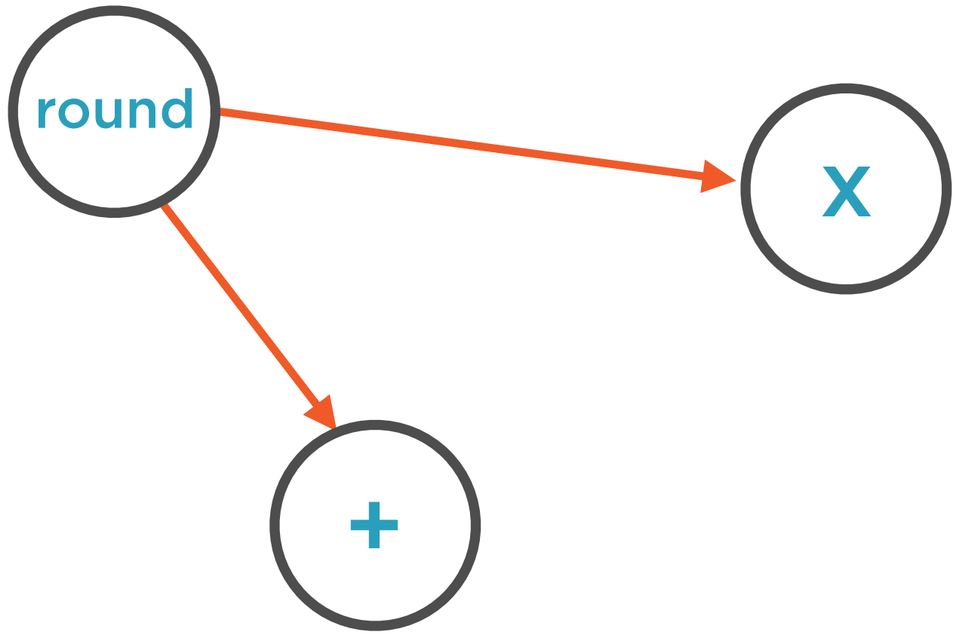


Directed-acyclic Graph



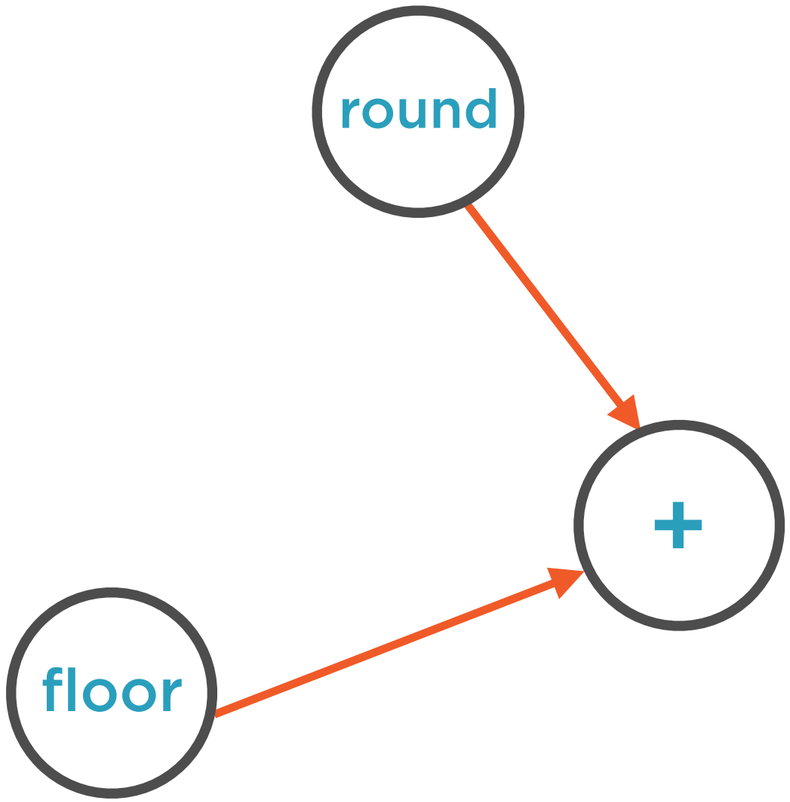
Edges point forward towards a result i.e. directed

Dependencies



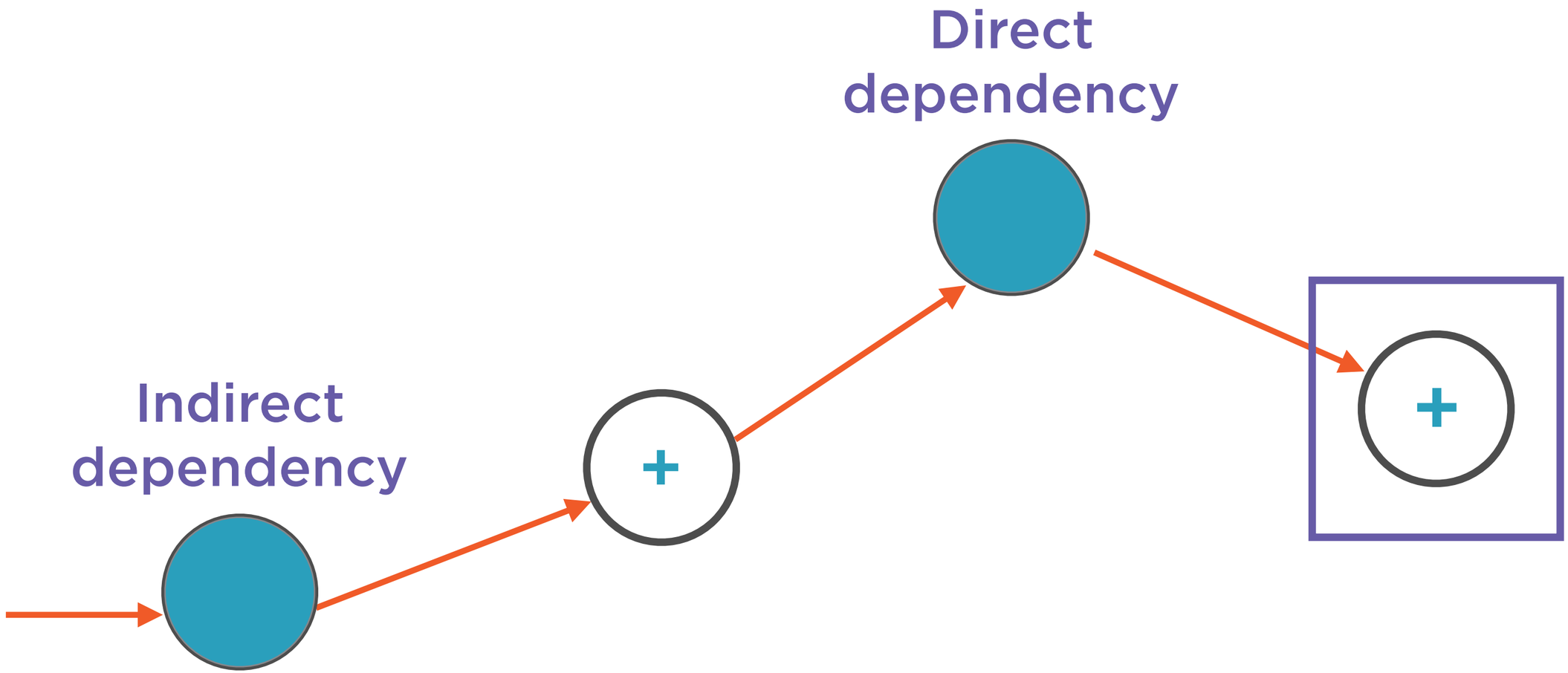
One node can send its output to multiple nodes

Dependencies

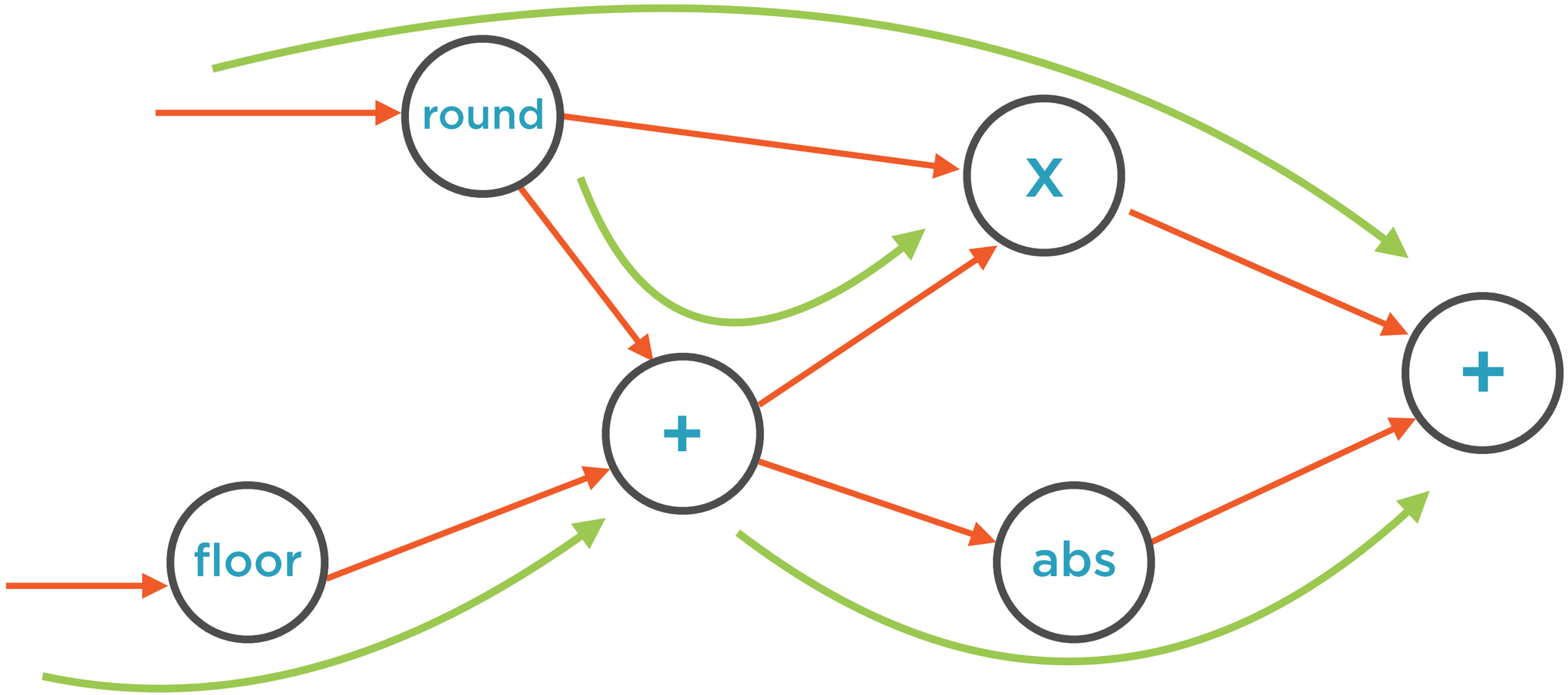


Or receive inputs from multiple nodes

Dependencies

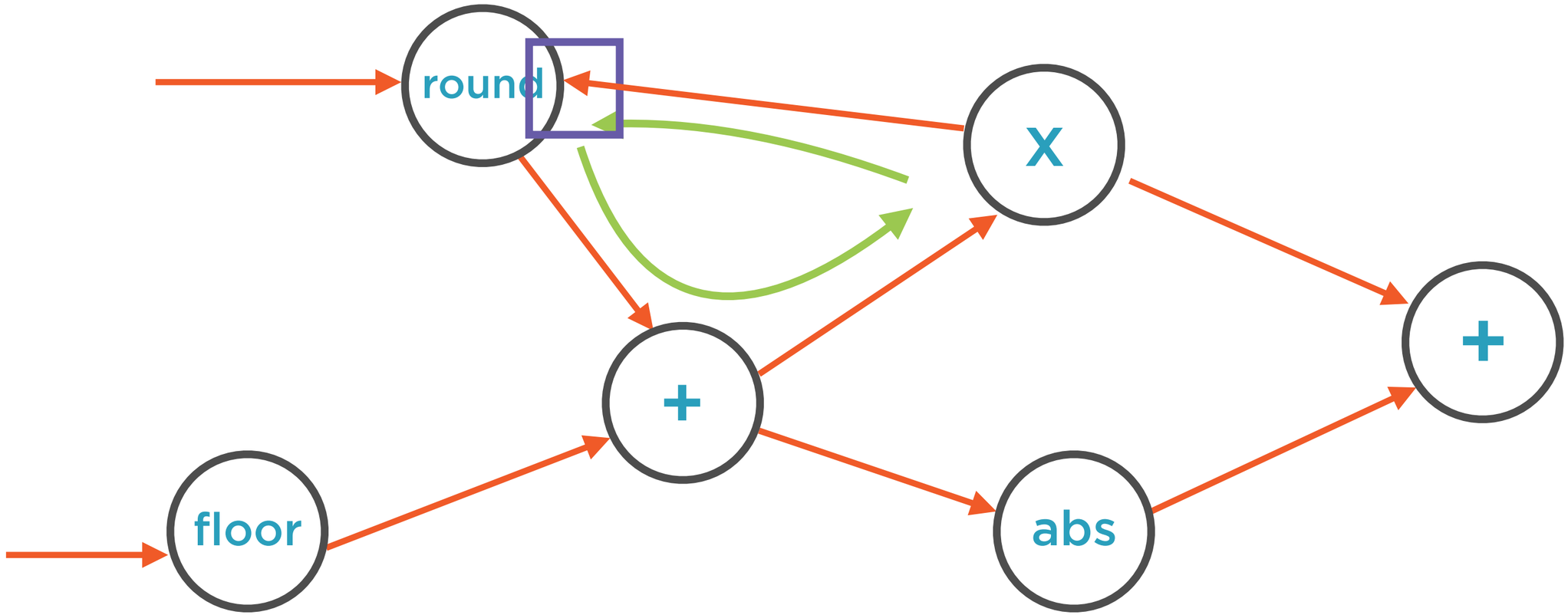


Directed-acyclic Graph



There are no cycles in the graph i.e. acyclic

Directed-acyclic Graph

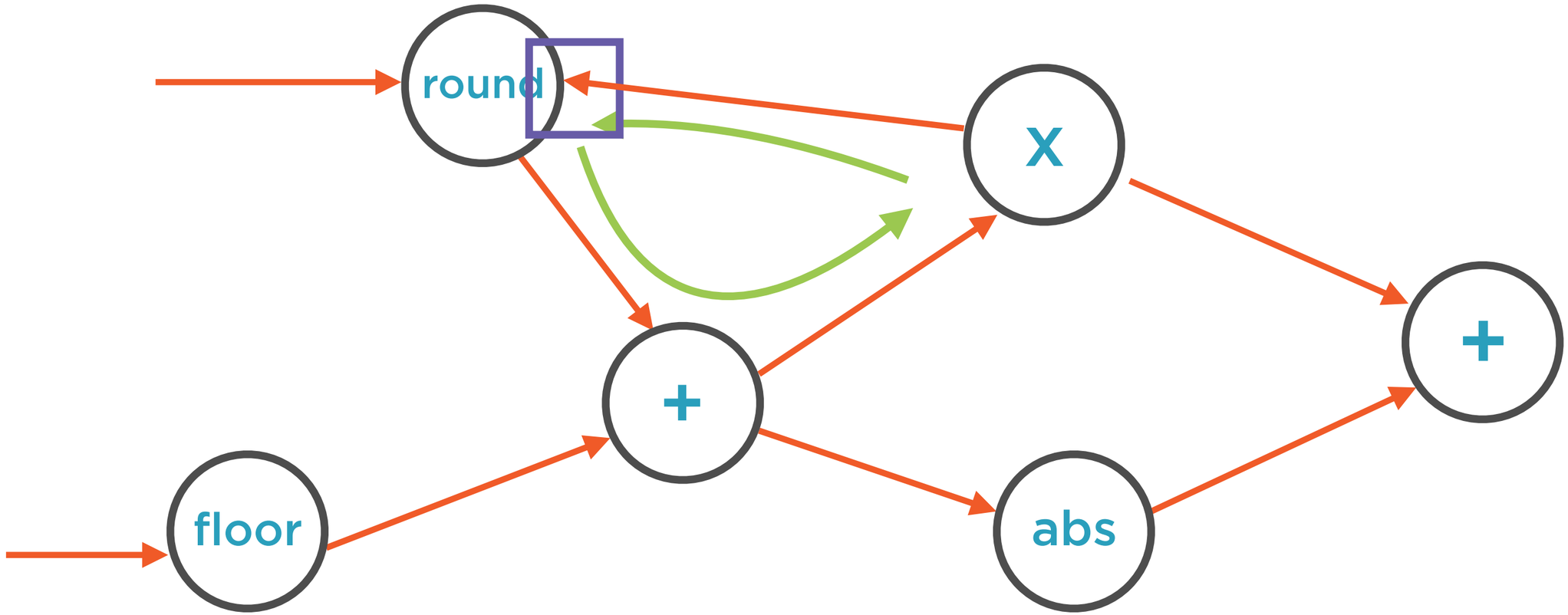


A graph with cycles will never finish computation

Problems in TensorFlow are represented as a directed-acyclic graph

Cyclical Dependencies in Machine Learning

Directed-Acyclic Graph



A graph with cycles will never finish computation

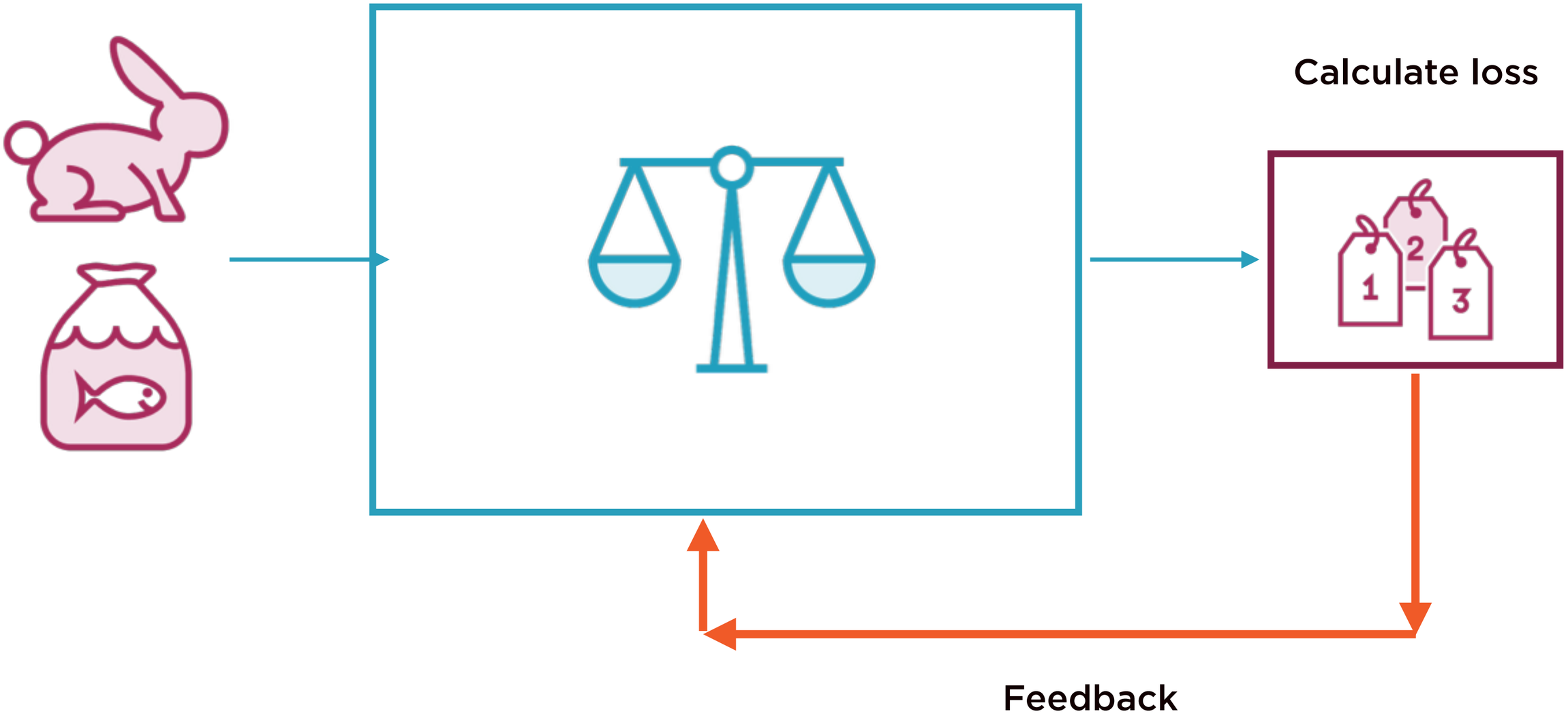
The Process of Machine Learning

Corpus of data

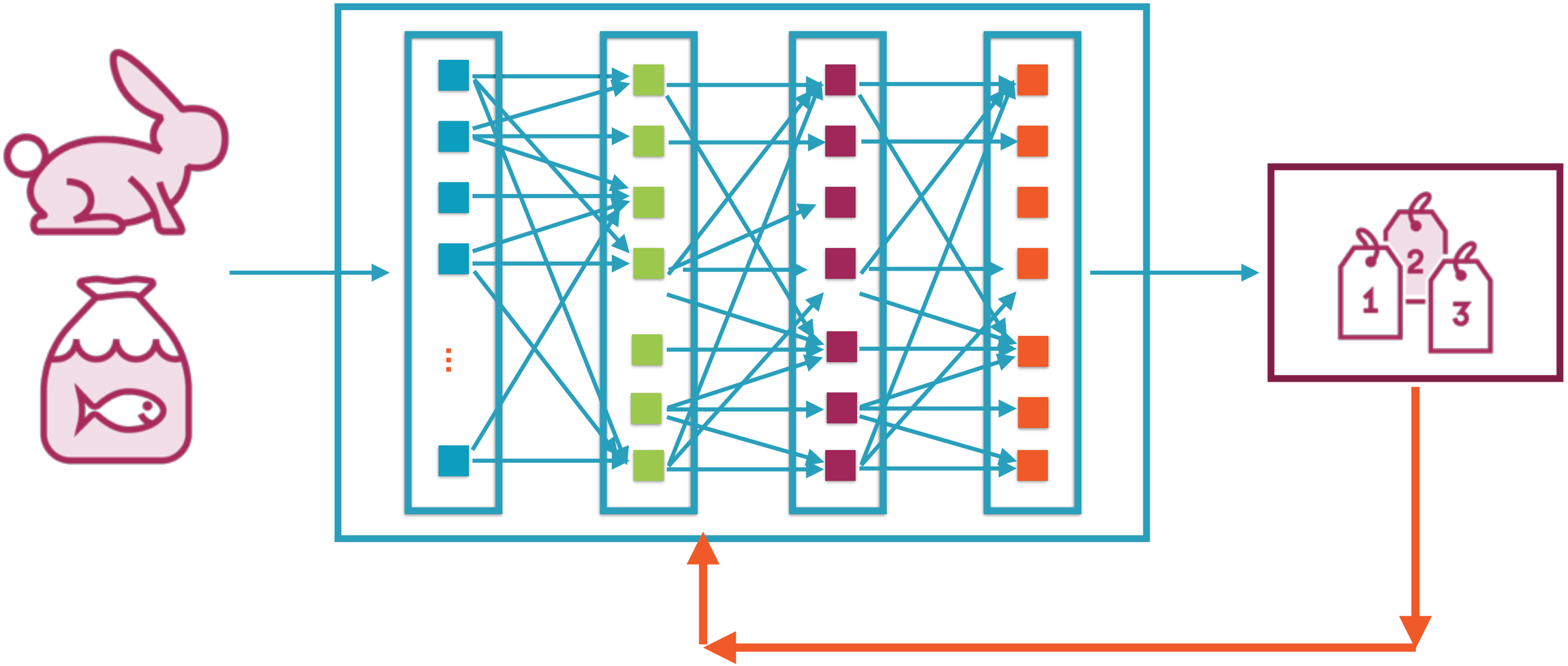
Feature Selection & ML

Result

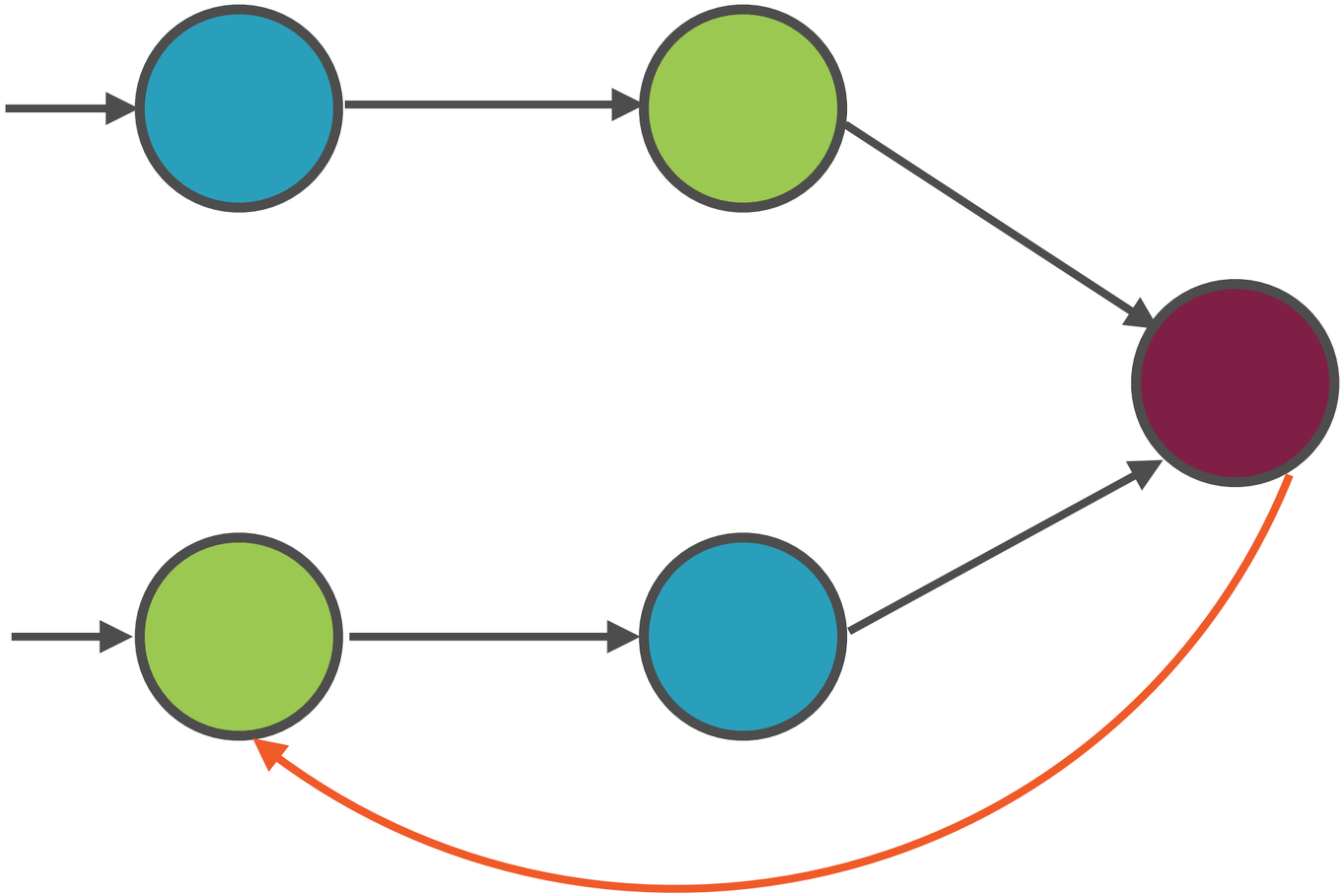
The Process of Machine Learning



The Process of Machine Learning



Modelling Cyclical Dependencies



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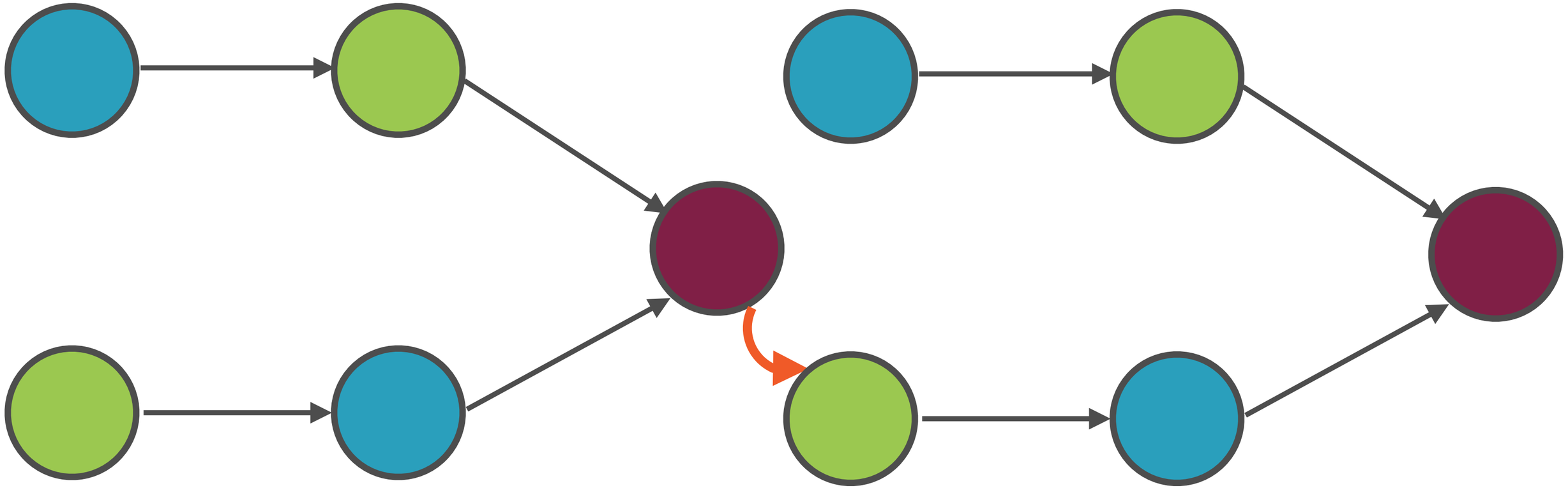
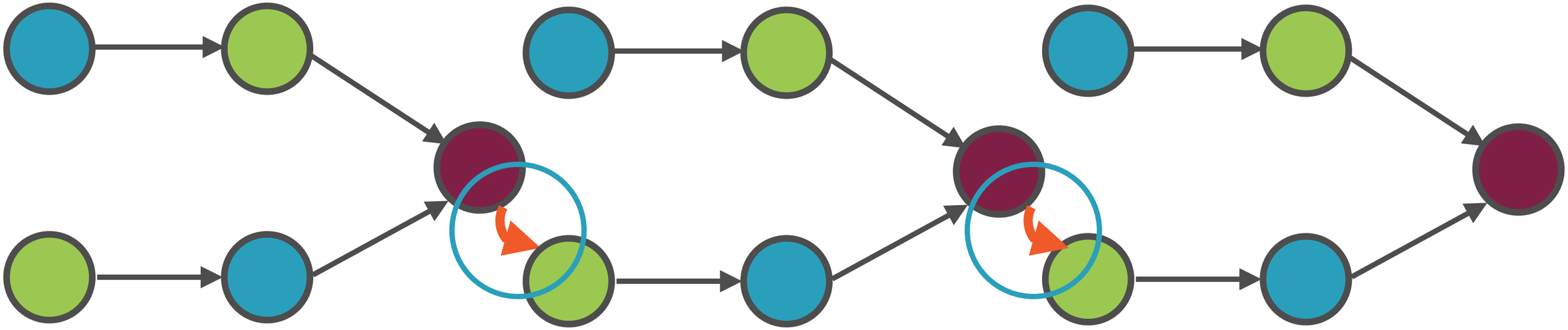


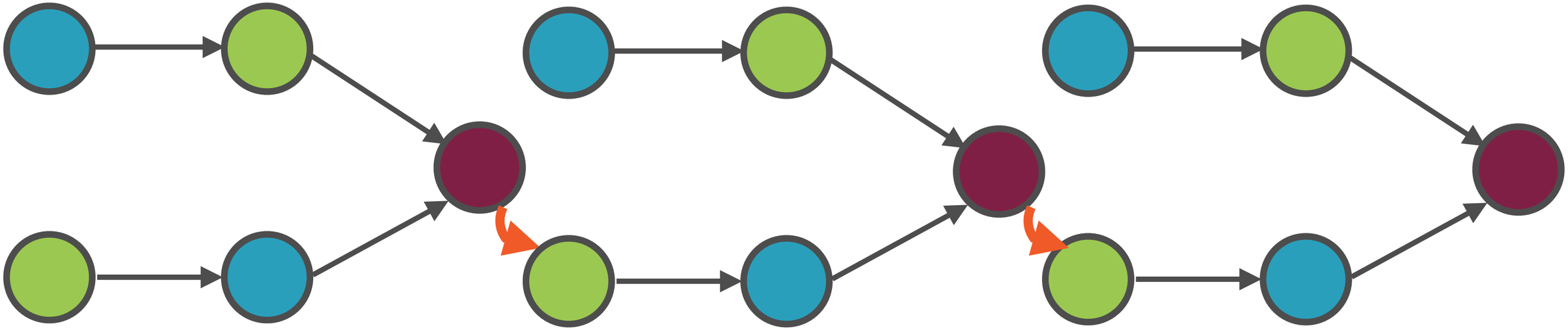
Unrolling the graph

Modelling Cyclical Dependencies



Unrolling the graph

Modelling Cyclical Dependencies



How much you unroll depends on the number of iterations you want to run

Unroll graphs to model cyclic dependencies

Building and Running Graphs

2 Steps in a TensorFlow Program

Building a Graph

Specify the operations and the data

Running a Graph

Execute the graph to get the final result

Demo

Building and running a graph in TensorFlow

Exploring the graph using TensorBoard

2 Steps in a TensorFlow Program

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Specify the operations and the data

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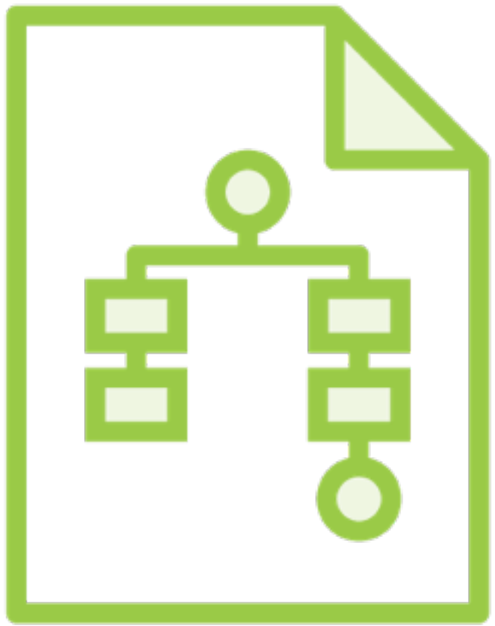
Building a Graph

Specify the operations and the data

Running a Graph

Execute the graph to get the final result

Visualizing a Graph

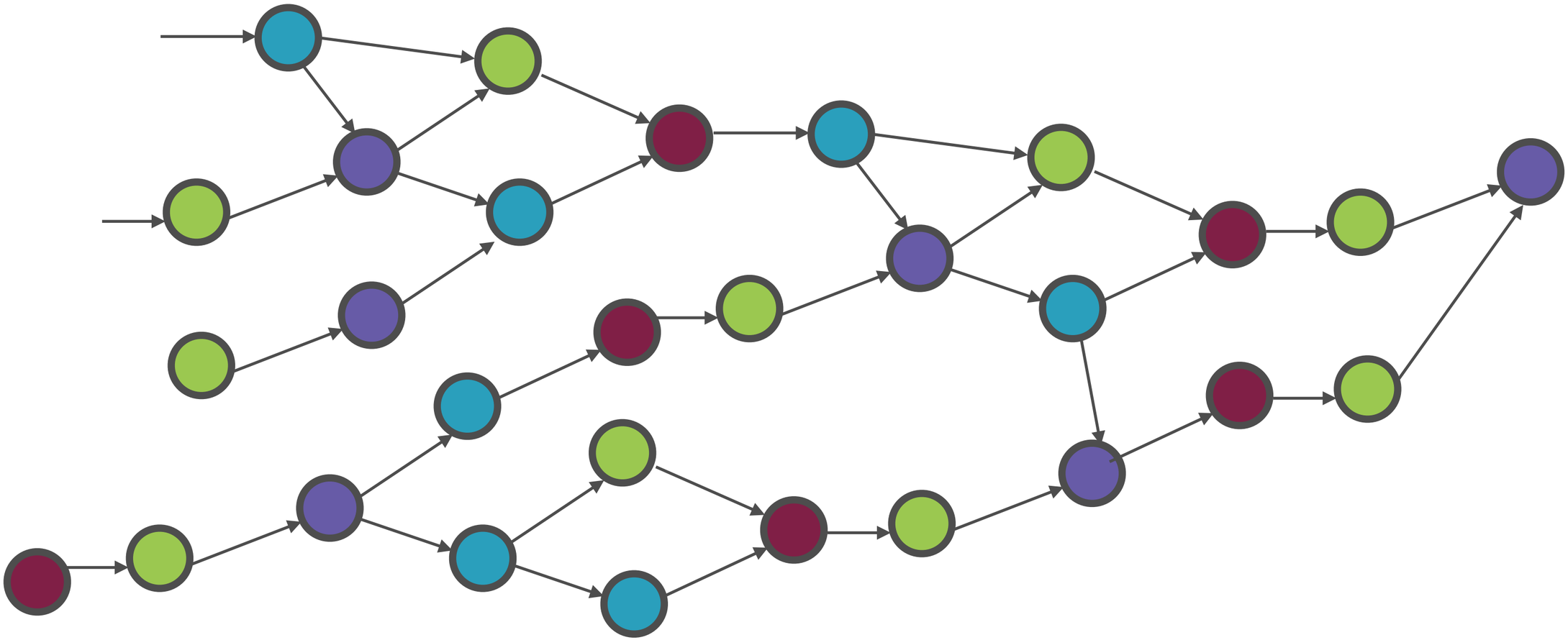


TensorBoard

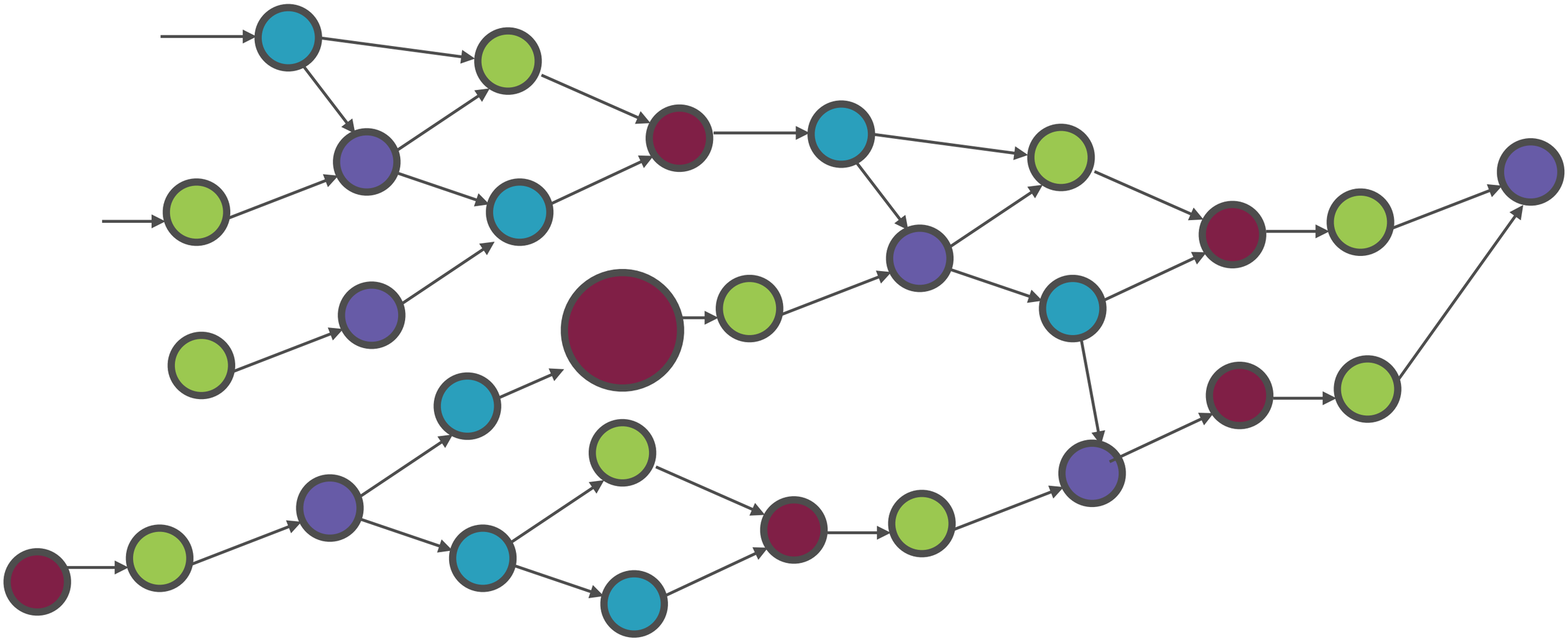
Visualize how data flows and what computations operate on it

Modeling Computations as Graphs

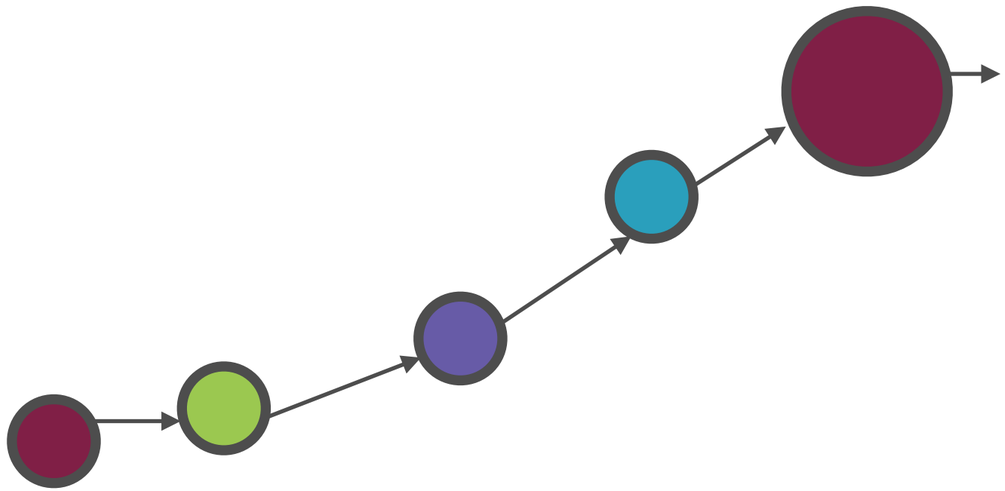
Computation Graphs



Computation Graphs



Computation Graphs



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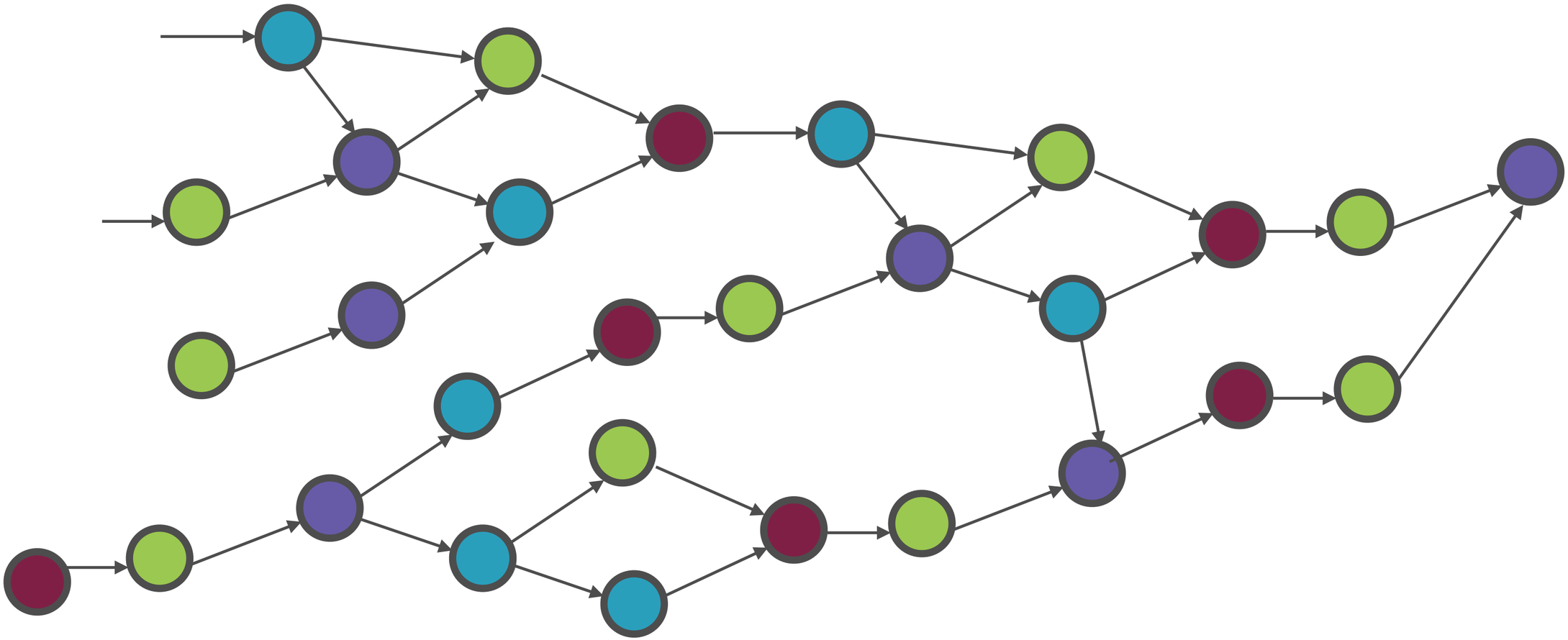

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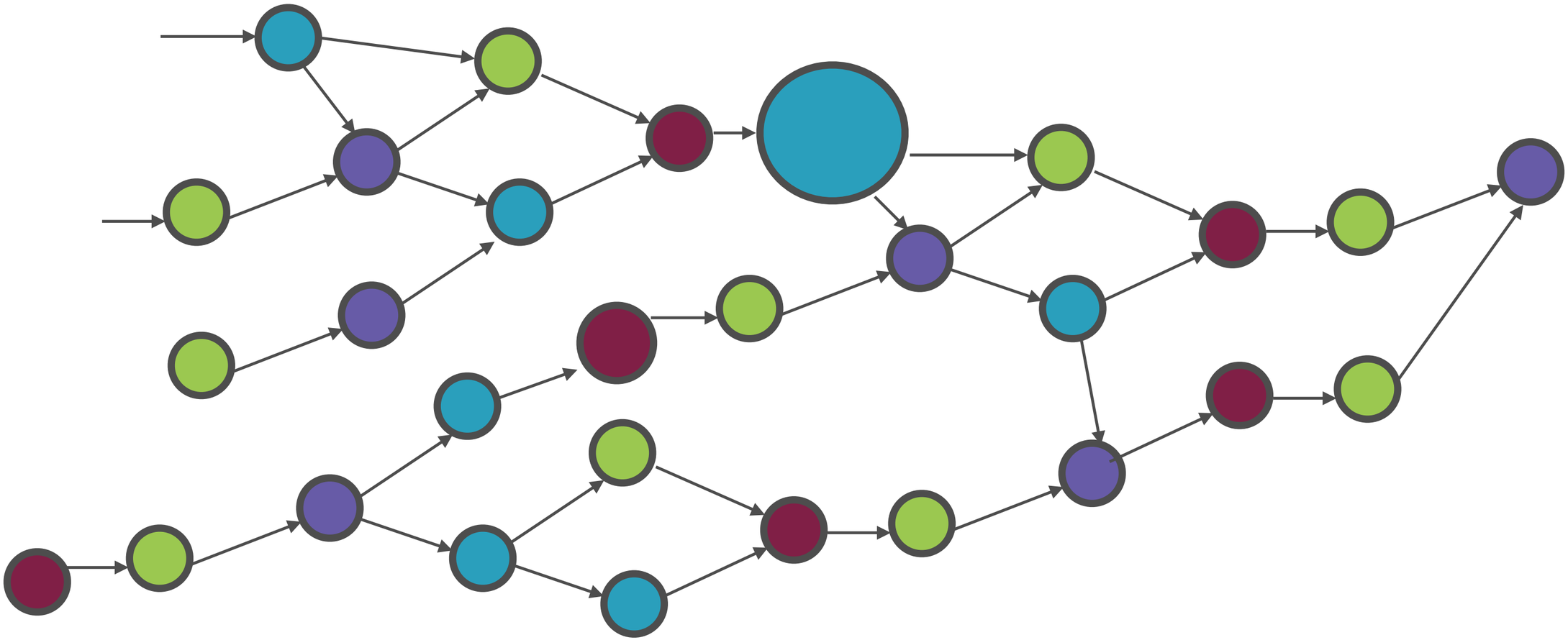

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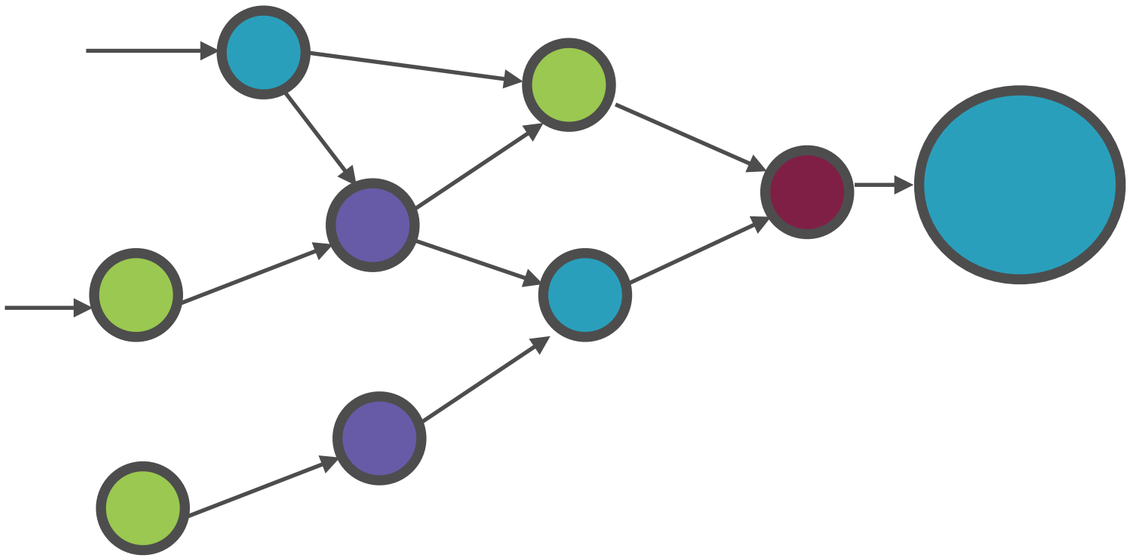
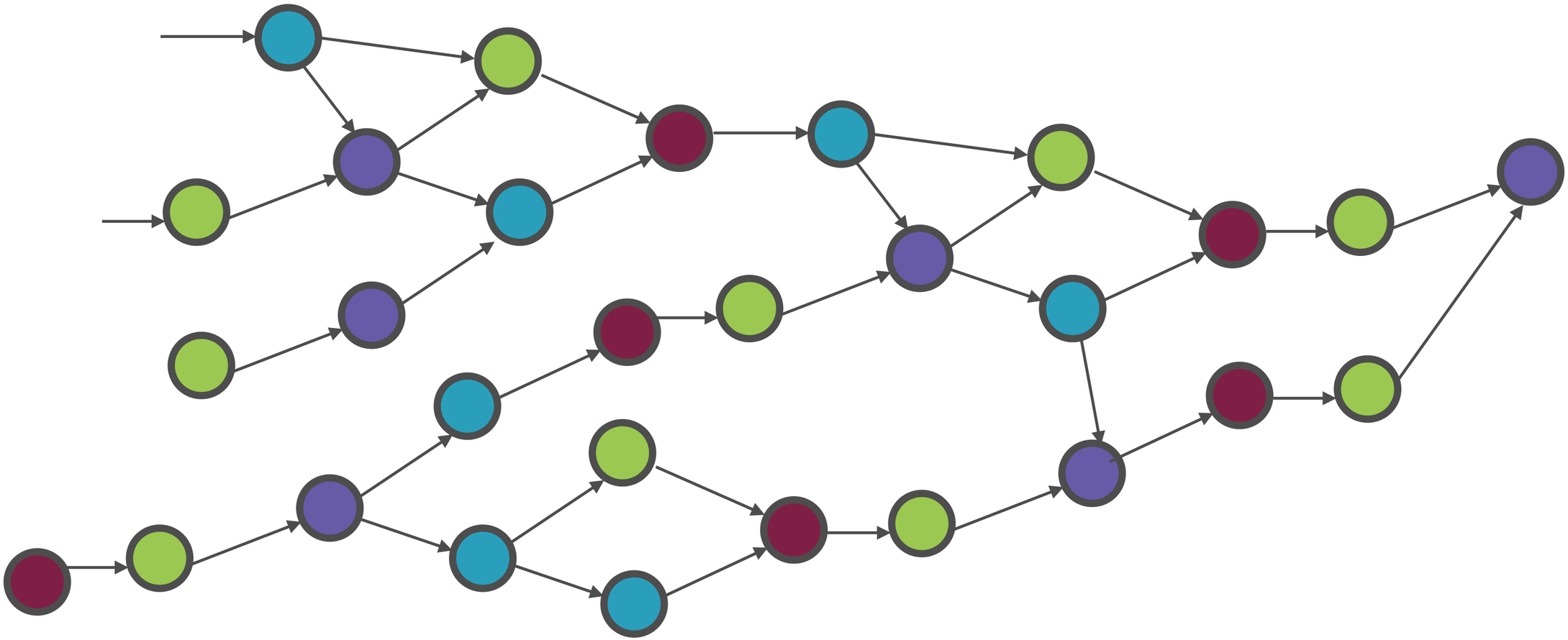
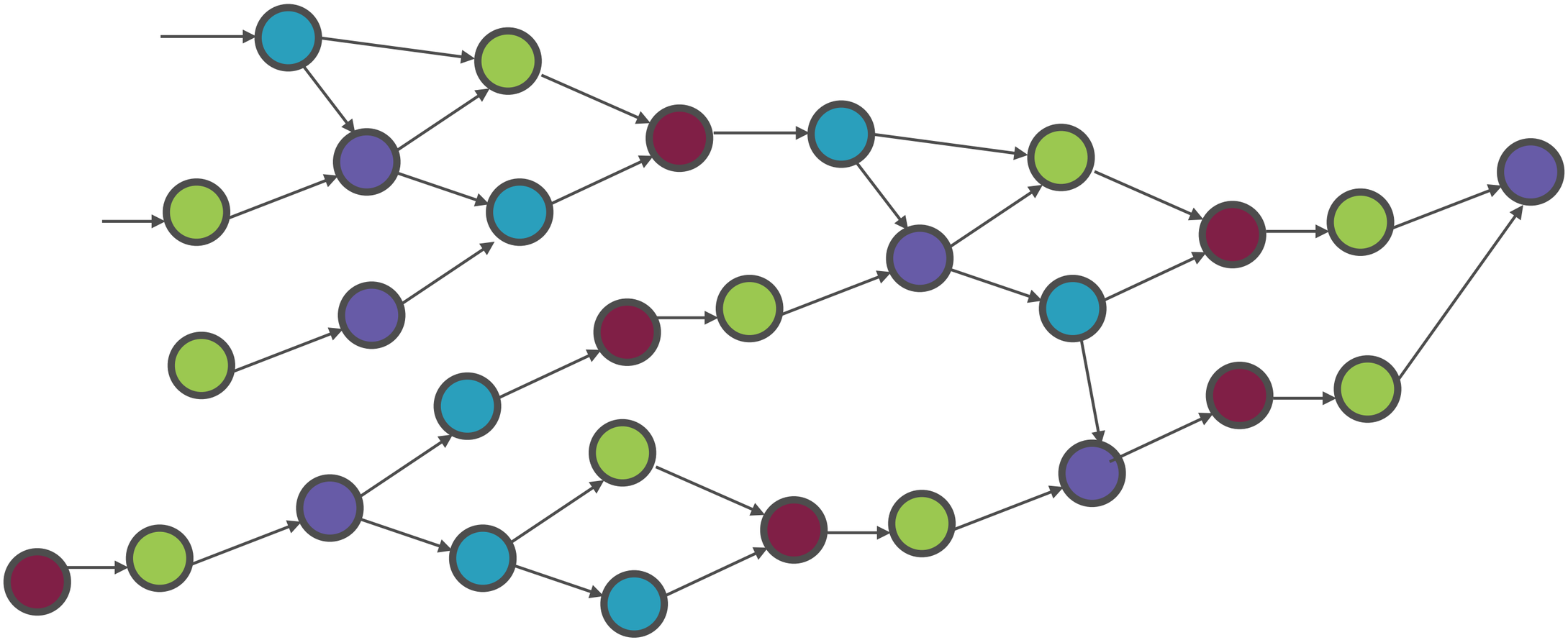


Computation Graphs

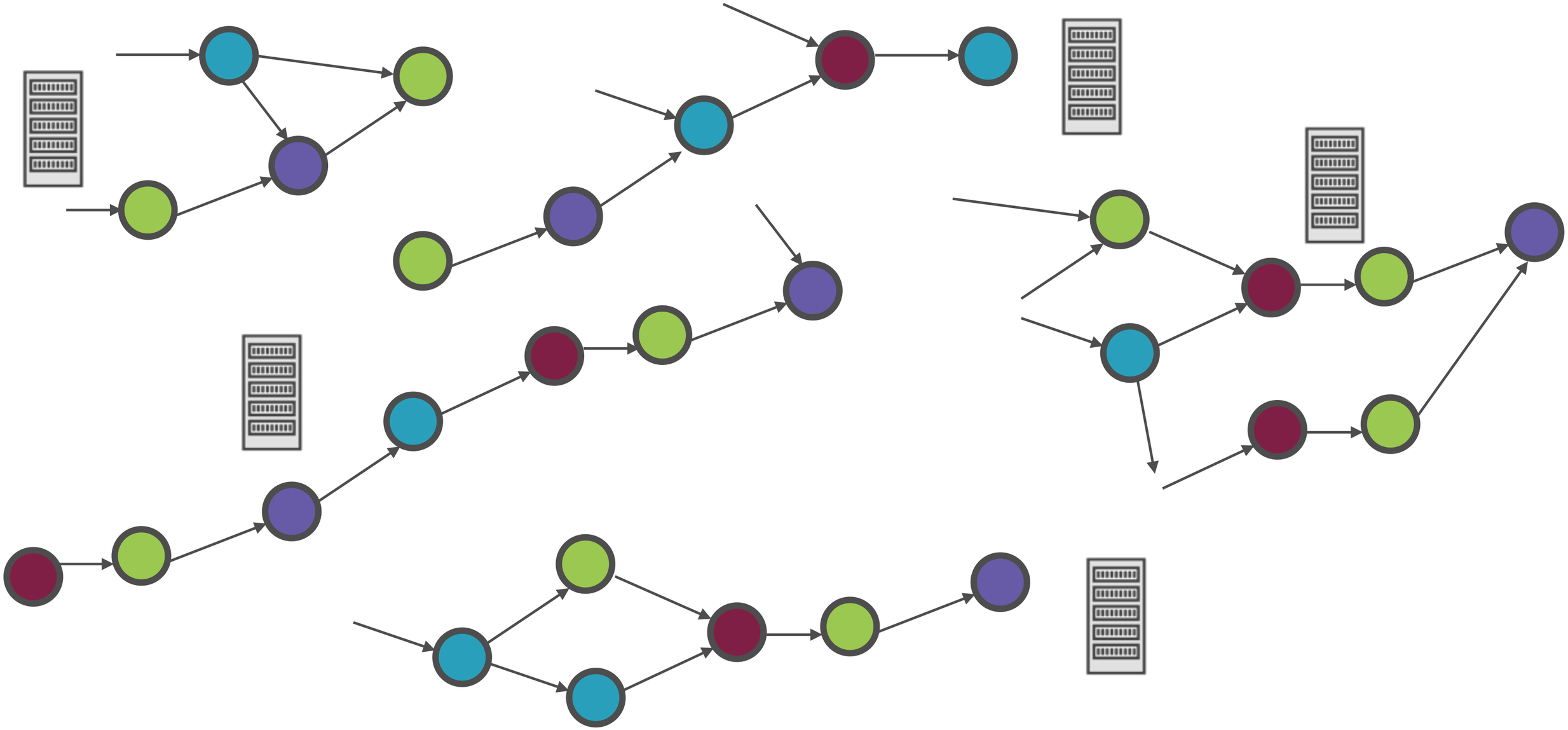


TensorFlow calculates only that portion of the graph which is required

Computation Graphs



Running Graphs on a Distributed System



Multiple portions of the graph can be run in parallel across machines in the cluster

Demo

Executing simple math commands in TensorFlow

Tensors

Tensor

The central unit of data in TensorFlow. A tensor consists of a set of primitive values shaped into an array of any number of dimensions.

https://www.tensorflow.org/

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Data Is Represented as Tensors

Scalars are 0-D tensors

3, 6.7, “a”

Data Is Represented as Tensors

Vectors are **1-D** tensors

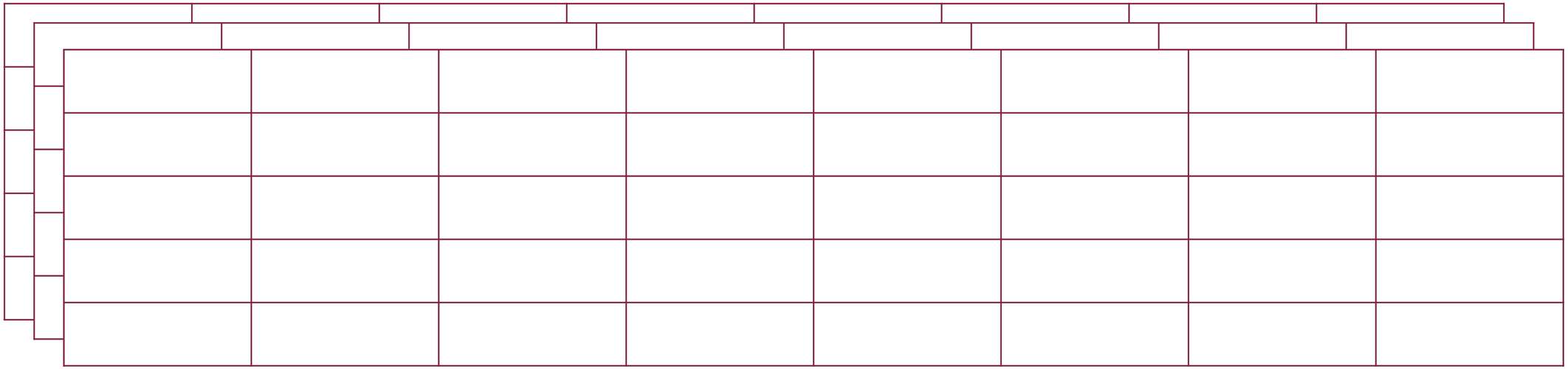
[1, 3, 5, 7, 9]

Data Is Represented as Tensors

Matrices are 2-D tensors

```
[[ ], 3, 5],
 [7, 9, 1[]]
```

Data Is Represented as Tensors



N-Dimensional matrices are **N-D** tensors

```
[[[1, 2], [3, 4], [5, 6]],
 [[7, 8], [9, 10], [11, 12]]]
```

Characterization of Tensors

Rank

The number of dimensions in a tensor

Shape

The number of elements in each dimension

Data Type

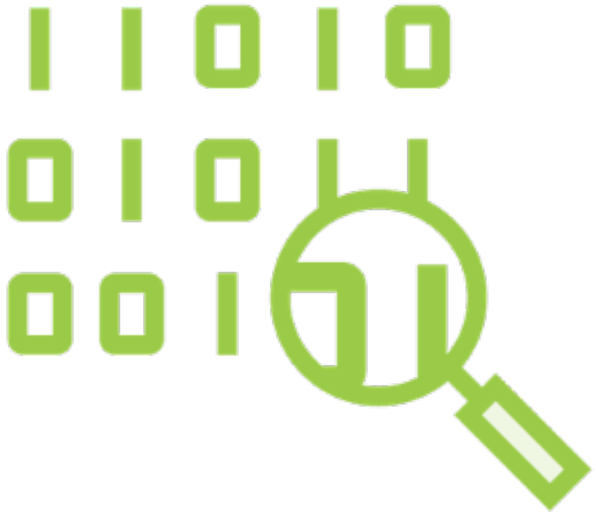
The data type of each element in the tensor

Rank

Tensor	Rank
4	0
[1, 2, 3]	1
[[1, 2], [3, 4]]	2
[[[1], [2]], [[3], [4]]]	3

Shape

Tensor	Shape
4	[]
[1, 2, 3]	[3]
[[1, 2, 3], [4, 5, 6]]	[3, 2]
[[[1], [2]], [[3], [4]]]	[2, 2, 1]



Data Type

int
float
string

Rank, shape and data types are
3 important characteristics
which define a Tensor

Demo

Use tf.rank() to know the rank of Tensors

Demo

Execute the simple math program with Tensors rather than scalar inputs

Demo

Use numpy arrays in TensorFlow

Summary

Worked with the directed-acyclic graph to model problems in TensorFlow

Understood constants, operators and sessions

Understood Tensor characteristics such as rank, shape and data type

Run TensorFlow programs and visualized results using TensorBoard