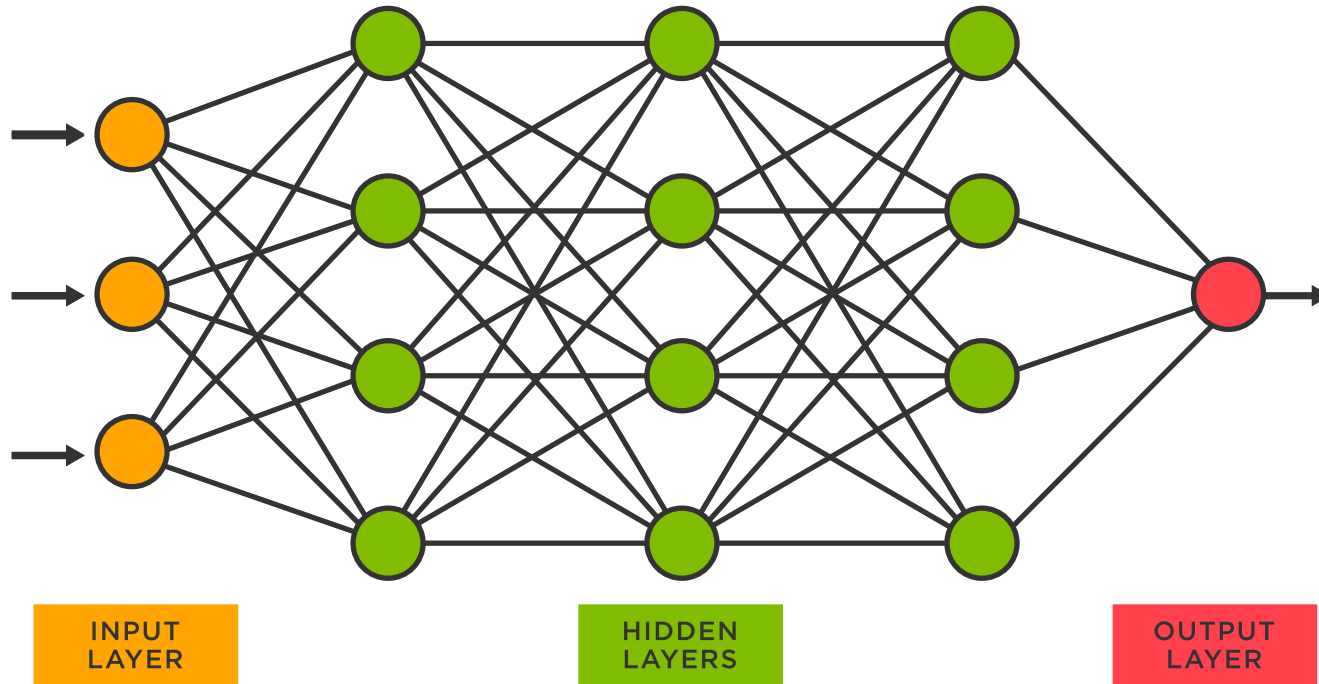


# Understanding Neural Network Architecture Using Evolutionary Algorithm Search

Ammar Mukadam

# Neural Networks



Source: TIBCO

# Weights and Biases

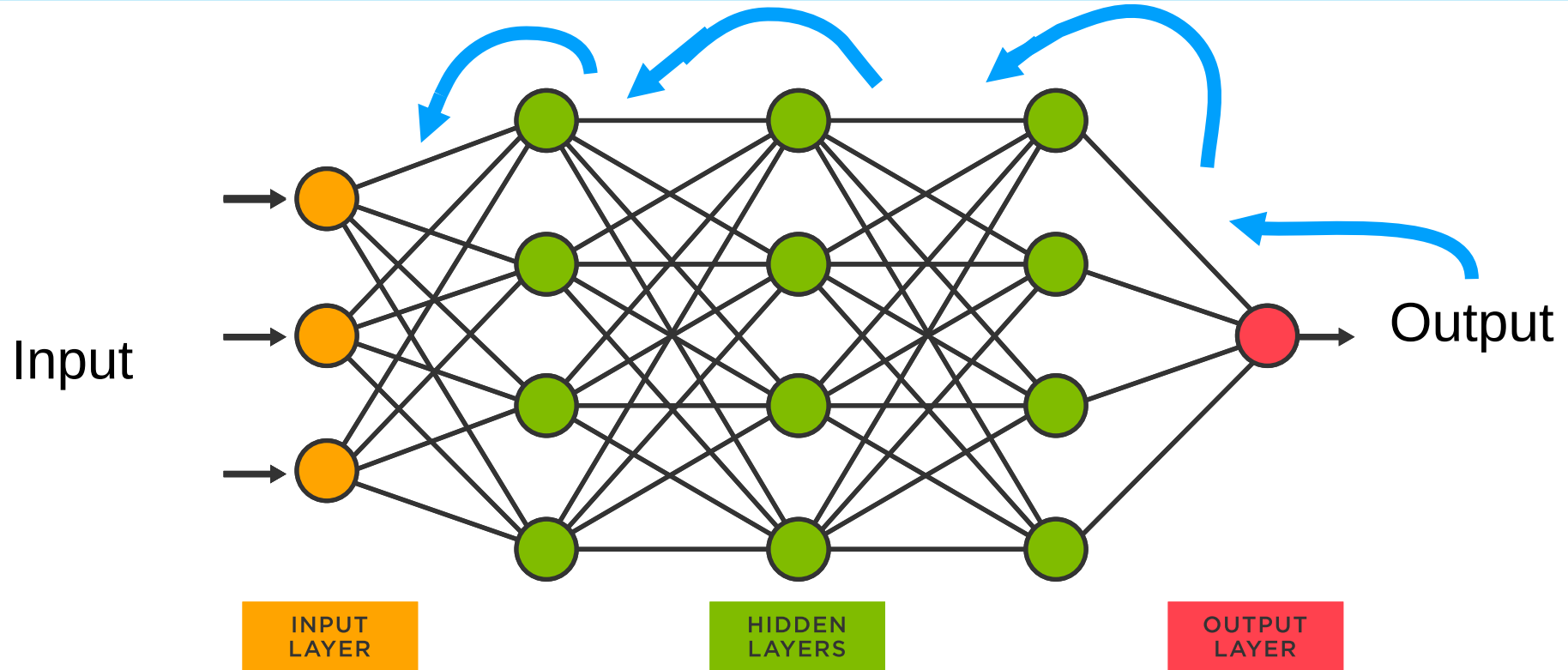
## Focus on the connections between neurons:

- **Weights:** value of each neural connection to the final output
- **Bias:** threshold for a neuron to activate based on the input it receives.

# Are we actually learning?

- Loss function: understanding the network's progress towards consistently outputting the expected result.
- How accurate is our neural network?

# Back-propagation



Source: TIBCO

# Investigating The Hidden Layers

- How many layers are in the hidden layers?
- How many neurons are in these layers?
- Plus the many other hyperparameters

# Network Hyperparameters

- Number of layers & neurons per layer

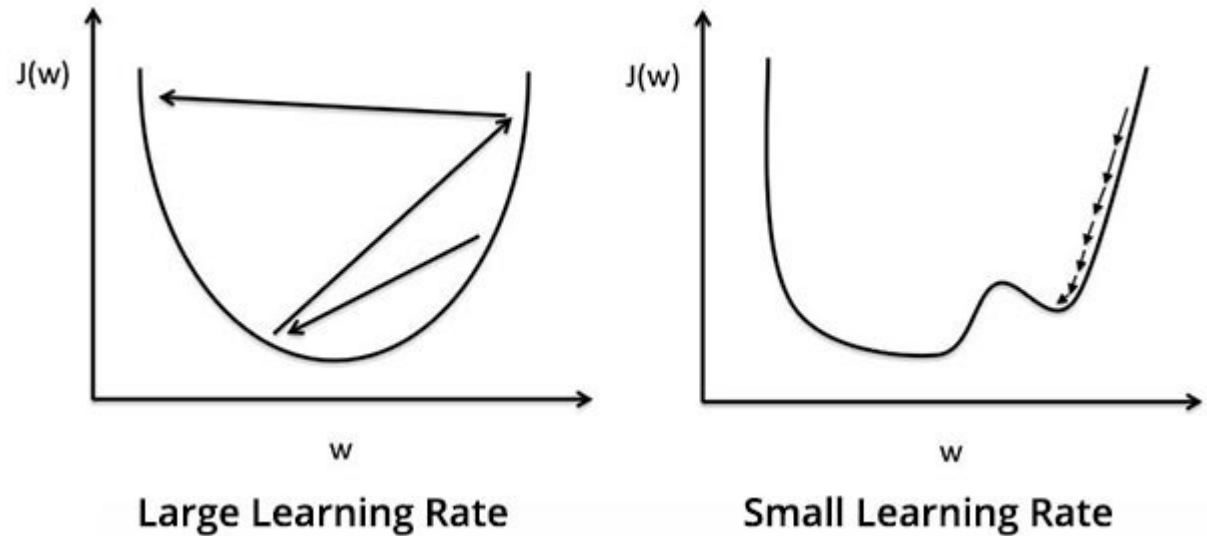
# Network Hyperparameters

- Number of layers & neurons per layer
- Activation function



# Network Hyperparameters

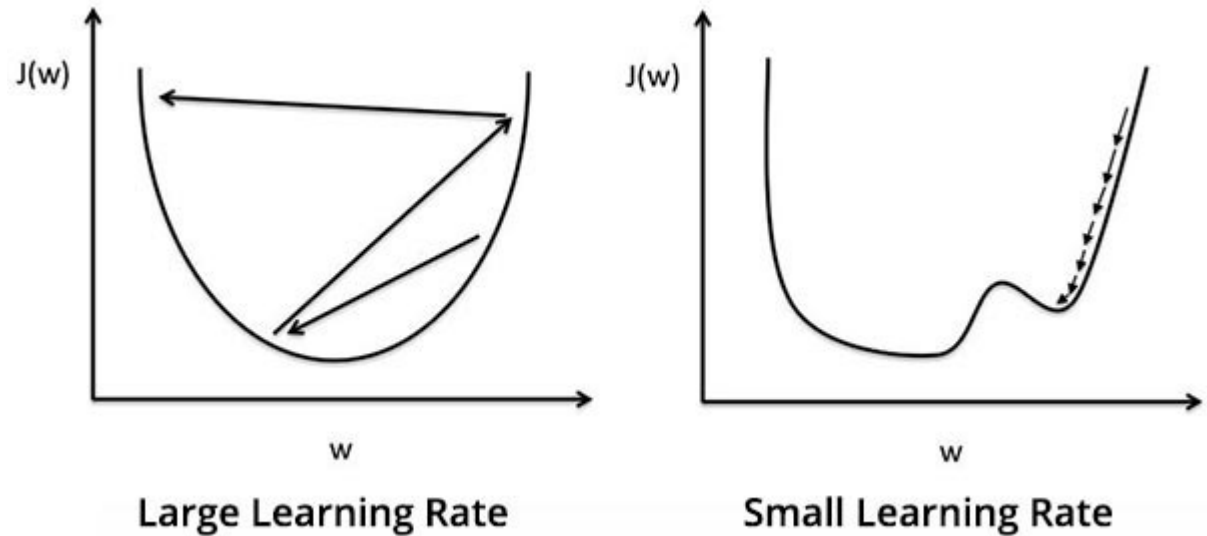
- Number of layers & neurons per layer
- Activation function
- Learning rate



Source: SaugatBhattara

# Network Hyperparameters

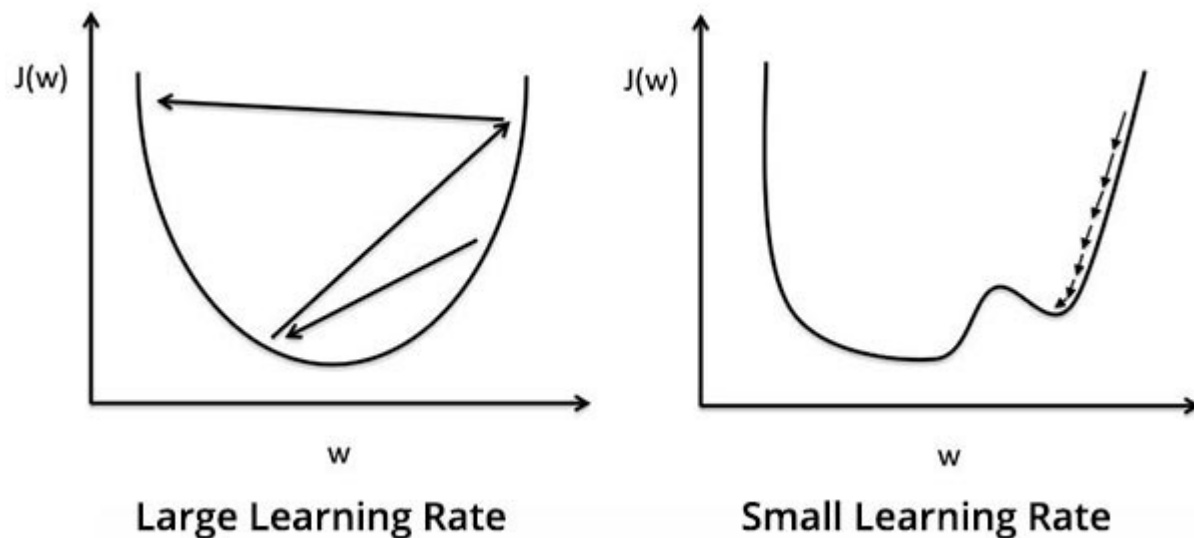
- Number of layers & neurons per layer
- Activation function
- Learning rate
- Dropout layers



Source: SaugatBhattara

# Network Hyperparameters

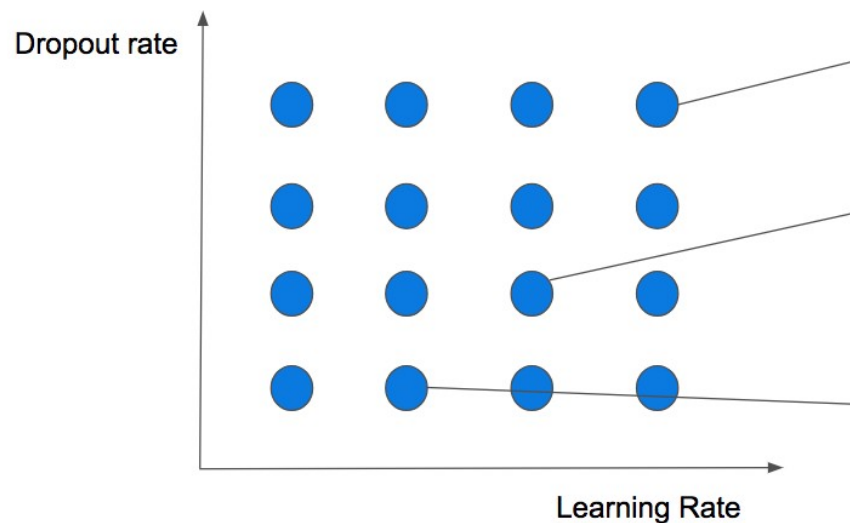
- Number of layers & neurons per layer
- Activation function
- Learning rate
- Dropout layers
- Cost Function



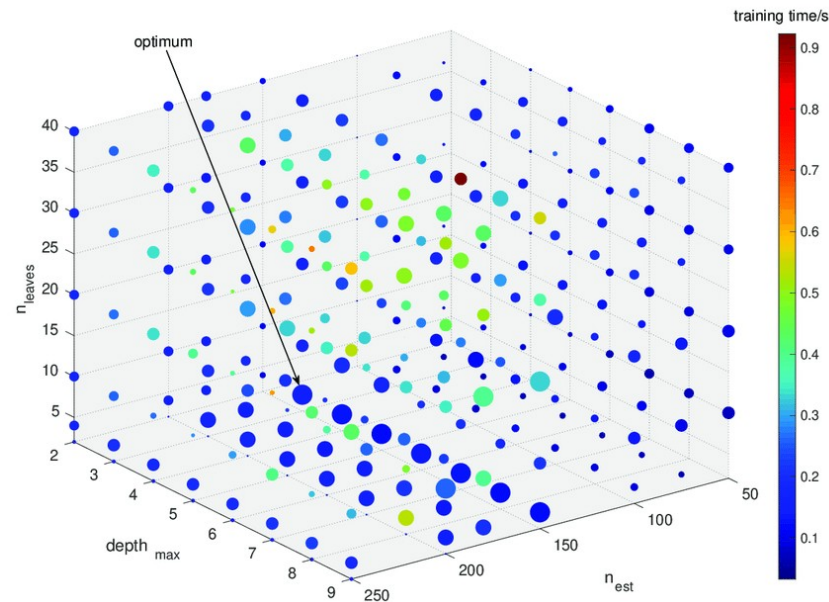
Source: SaugatBhattara

# How do we find the optimal combination of hyperparameters?

- Several methods, for example **Grid Search**



Source: FloydHub

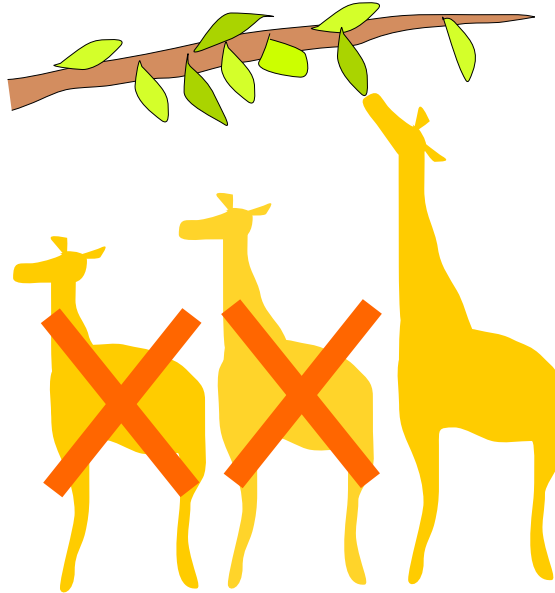


Source: ResearchGate

# Evolutionary Algorithm Search

## Evolution

- **Survival of the fittest**



Source:  
Wikimedia  
Commons

# Choosing the best individuals

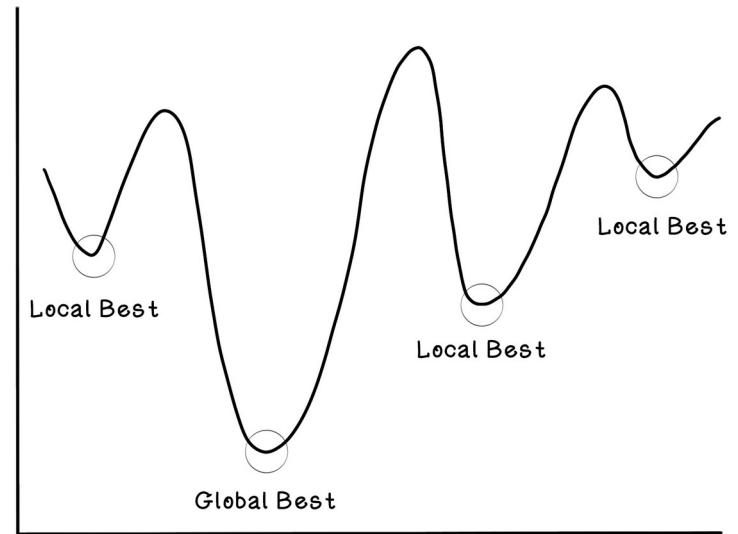
- Fitness function: Evaluated using TensorFlow
  - Accuracy
  - F1 Score
  - Minimizing Loss
  - Completion Time

# How the search works

- All of these hyperparameter combinations = individuals
- Each individual made up of a chromosome that represents specific hyperparameters
- These individuals make up the population

# Following Evolution

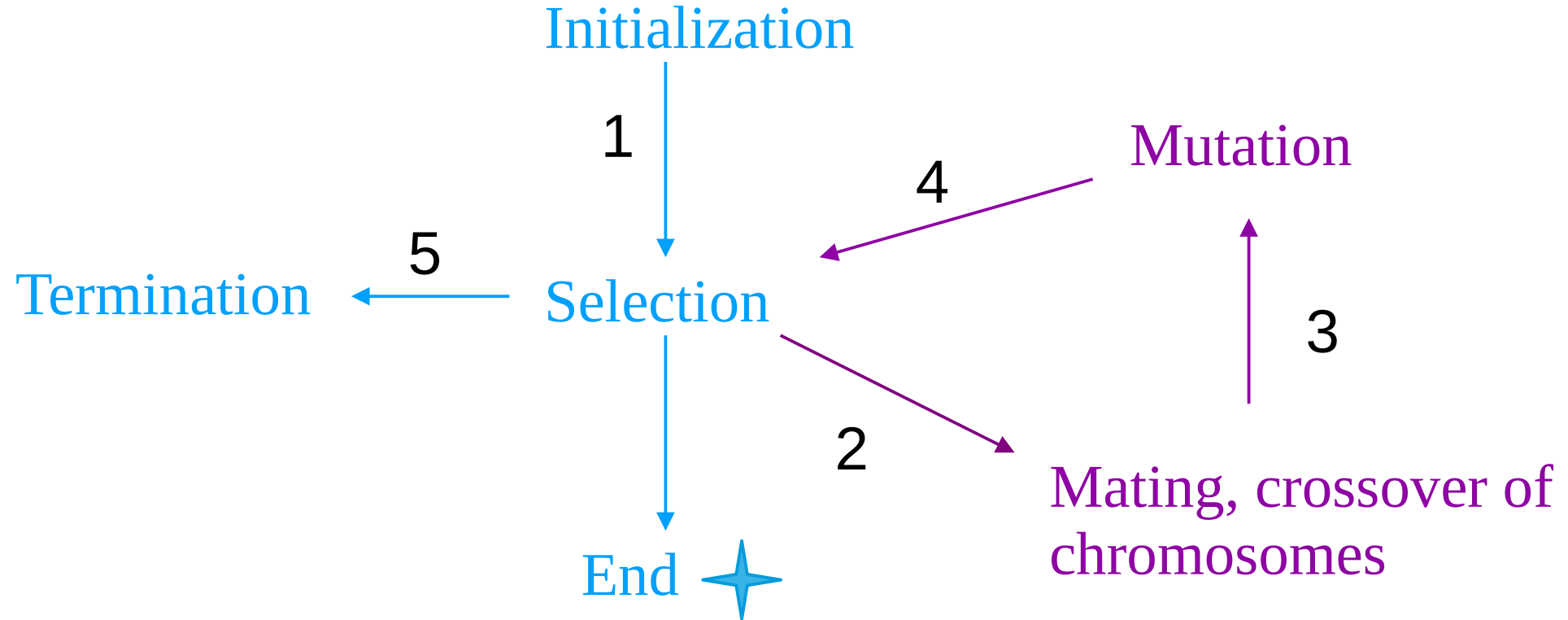
- Individuals are mated, chromosomes combined.
- Variable chance of mutation to increase diversity



Source: Manning.com



# The process as a whole



# Wait a minute...

- How many individuals do we start with?
- How many generations do we run?
- Plus the many other hyperparameters

We've been here before...

# Genetic Search Hyperparameters

- # of starting indiv. & # of generations
  - Mutation rate
  - Death %
  - # of parents mating
- 
- Current model is a proof of concept
  - Our chosen search hyperparameters have proven to be best for small datasets

# For larger datasets with more hyperparameters:

↑ # of generations

↑ # of starting indiv.

↓ Death rate%

# Future Plans

- Bayesian optimization: method that learns from its guesses to find the optimal hyperparameters for the search.

# Overview

Hyperparameters of genetic search



Hyperparameters of neural network



Neural network best set up to learn

Thank you!