Neural Architecture Search Basics

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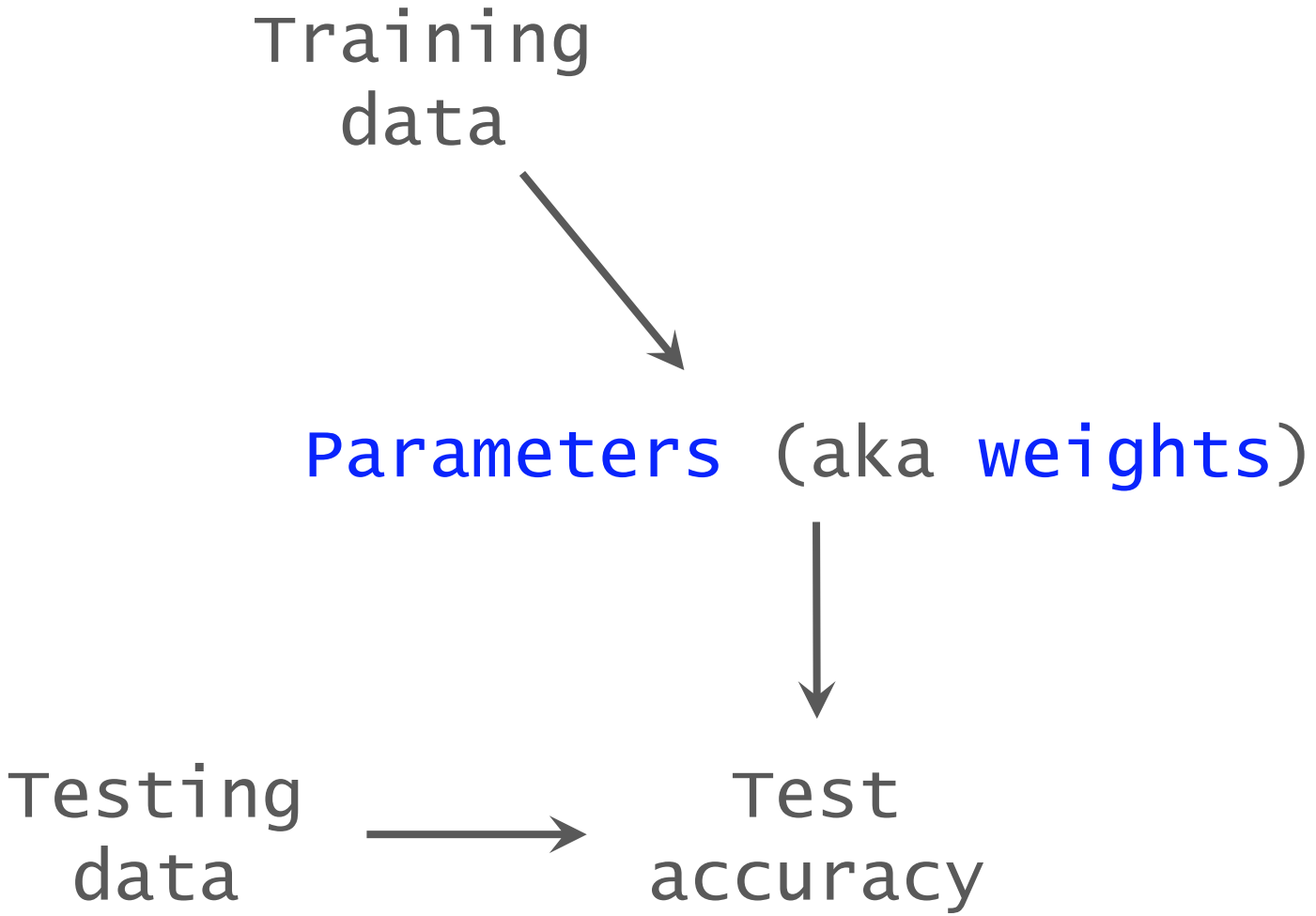
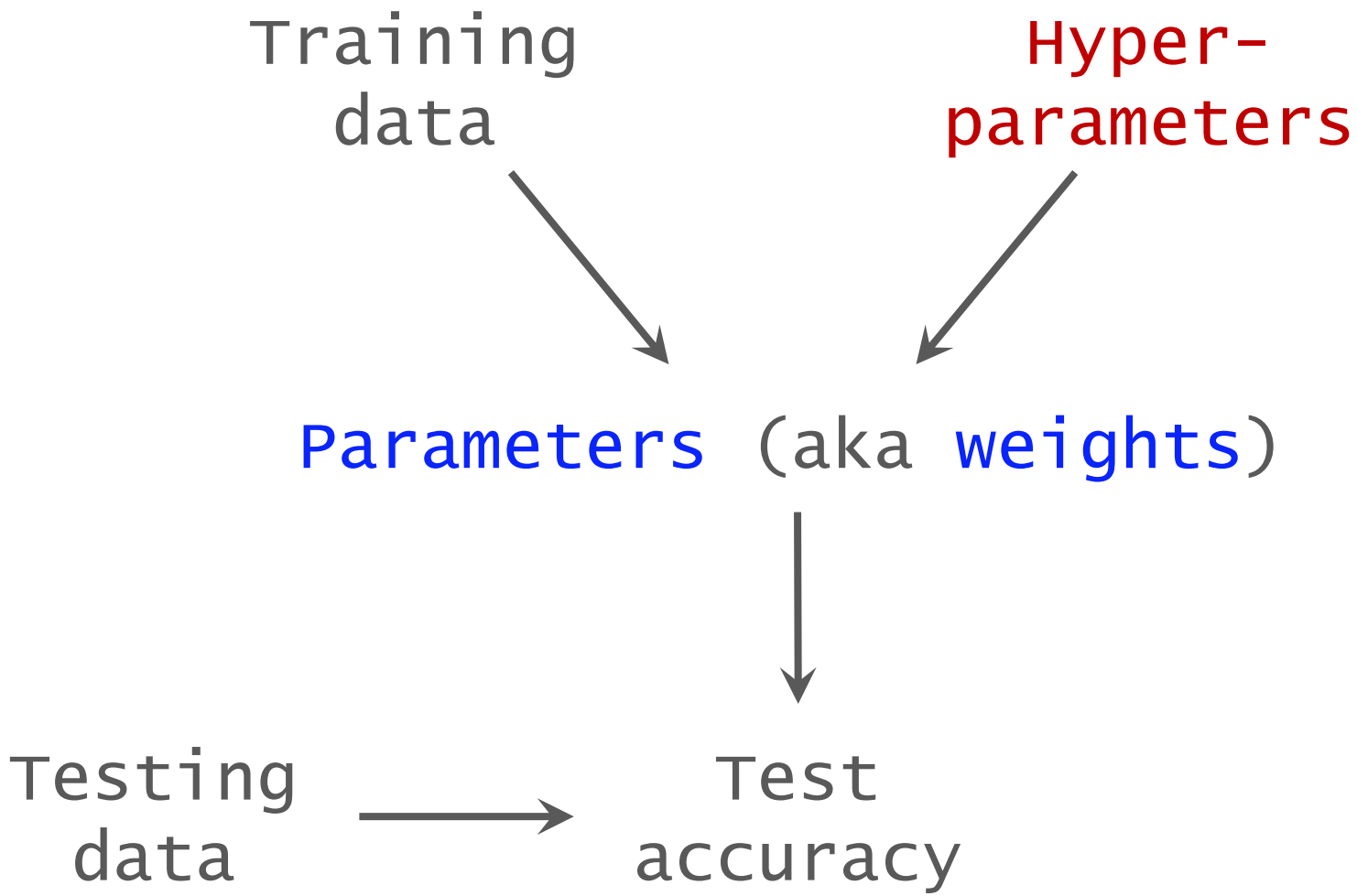
http://wangshusen.github.io/

- Parameters
- Hyper-parameters


Training data
Parameters (aka weights)
Testing data
Test accuracy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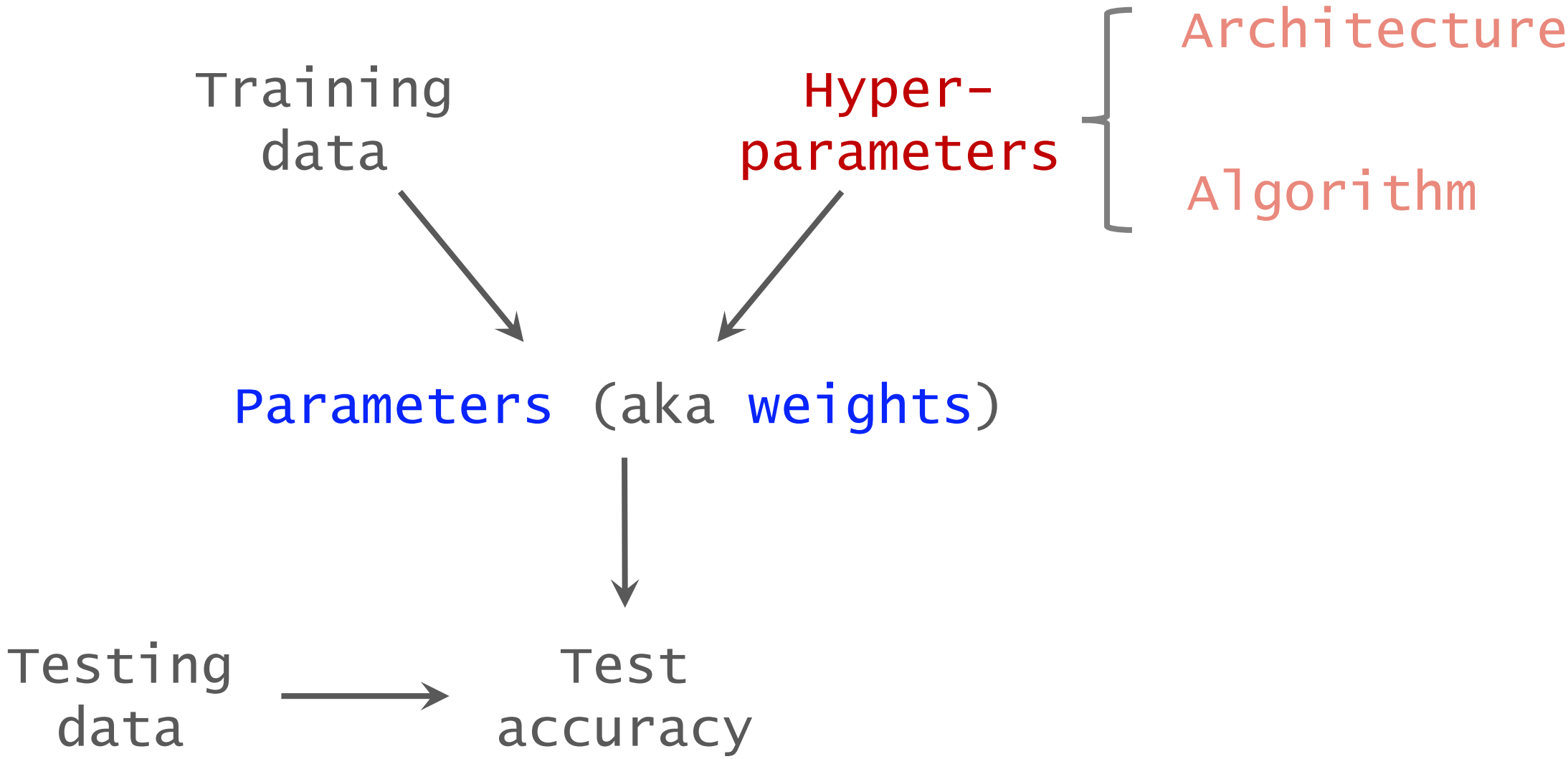
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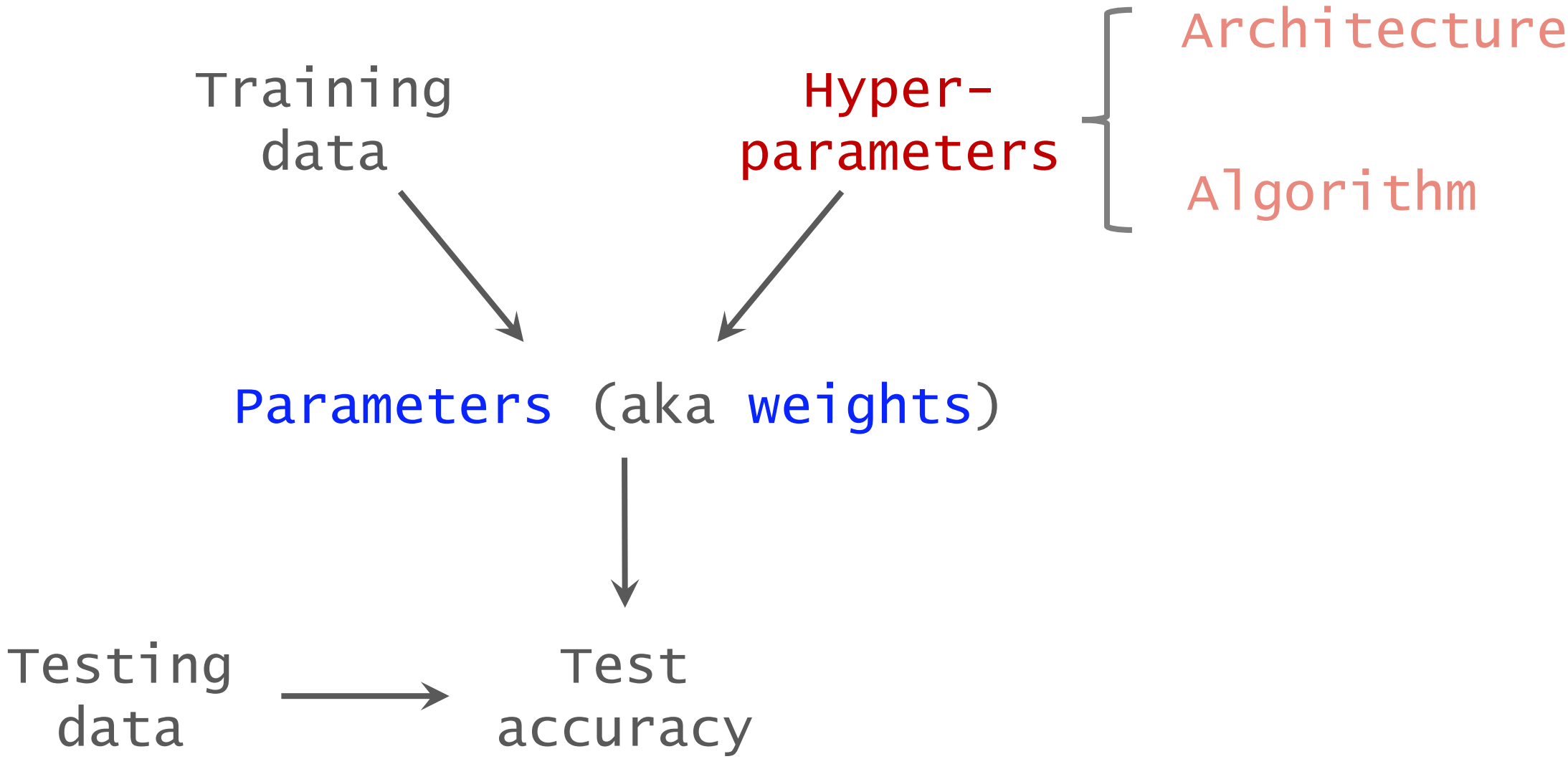
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CNN Architectures

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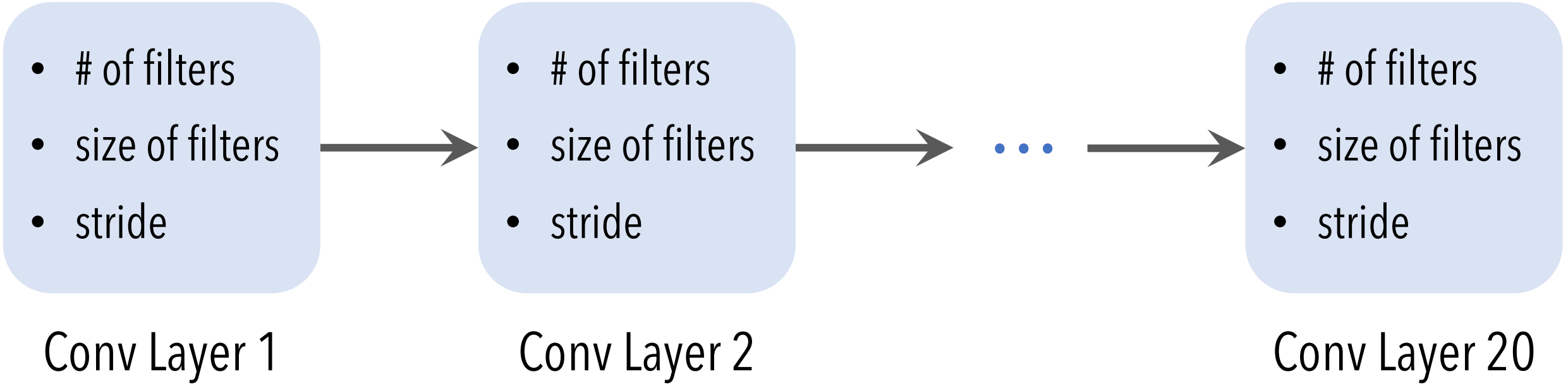
- Popular CNN architectures are manually designed.
  - E.g., ResNet, MobileNet, etc.
  - Manually tuning the architectural hyper-parameters.

CNN Architectures



Neural Architecture Search (NAS)

Definition: Neural Architecture Search (NAS).

Find the architecture that leads to the best validation accuracy (or other metrics such as efficiency.)

- **Example:** ResNet has better accuracy than VGG.
- **Example:** MobileNet is more efficient than ResNet, although MobileNet has lower accuracy.

Search Space

Hyper-parameter Types	Candidates
# of filters	{24, 36, 48, 64}
size of filters	{3×3, 5×5, 7×7}
stride	{1, 2}

$$\#\ \text{of filters} \in \{\ 10, 11, 12, 13, \ldots, 98, 99, 100\ \}$$

Search Space

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Search space: The set containing all the possible architectures.

- We want to build a CNN with 20 Conv layers.
- Search space:

$$\{24, 36, 48, 64\}^{20} \times \{3\times3, 5\times5, 7\times7\}^{20} \times \{1, 2\}^{20}.$$

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$$(4\times3\times2)^{20}$$

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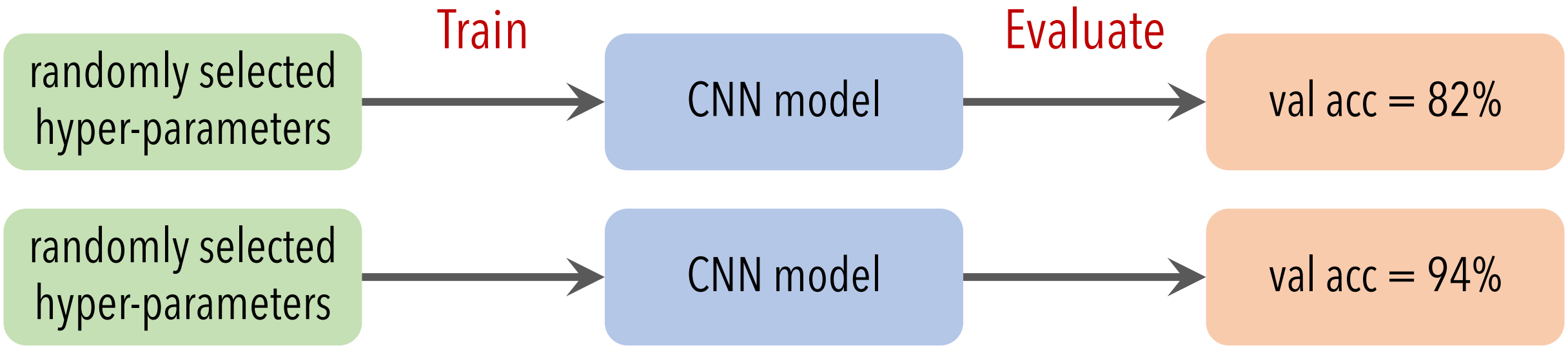
$$(4\times3\times2)^{20} = 4\times10^{27}.$$

Outcome of NAS?

- For example, this is an outcome of NAS:

	Layer 1	Layer 2	…	Layer 20
# of filters	24	48	…	64
Size of filters	5×5	3×3	…	3×3
Stride	1	1	…	2

Baseline: Random Search



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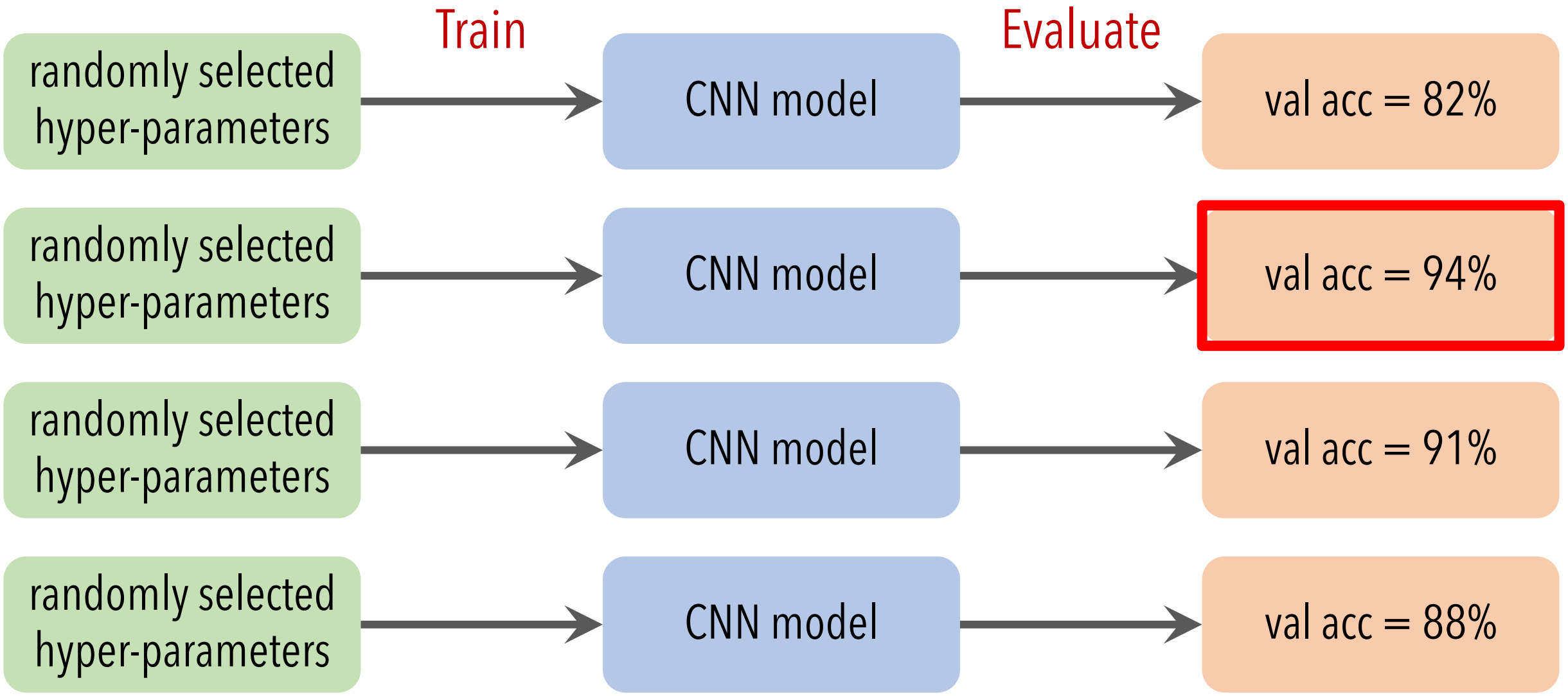

Challenges in NAS

Challenge 1: Each trial is expensive.

- Training a CNN from scratch takes hours or days, if a single GPU is used.

Challenge 2: The search space is too big.

- Number of possible architectures:

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Thank You!

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