AutoML: Neural Architecture Search (NAS)
The One-Shot Model
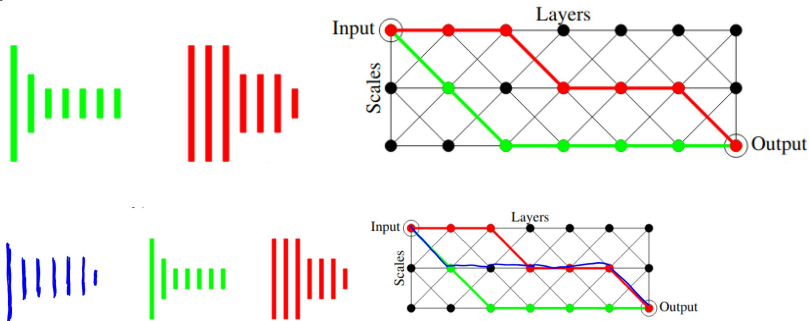
Bernd Bischl   Frank Hutter   Lars Kotthoff
Marius Lindauer   Joaquin Vanschoren

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  - This allows weights sharing across architectures
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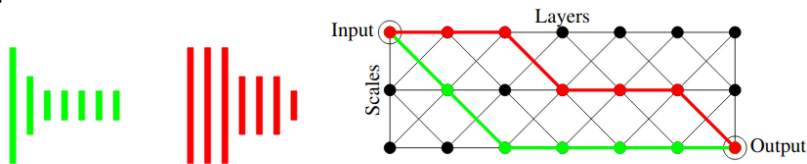   and implicitly trains an exponential number of individual architectures

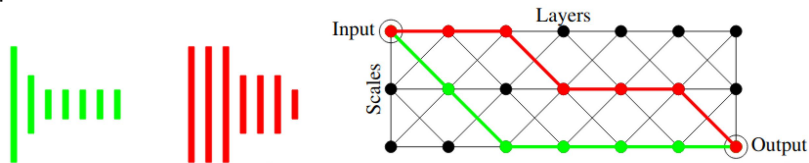- The first type of one-shot models: convolutional neural fabrics

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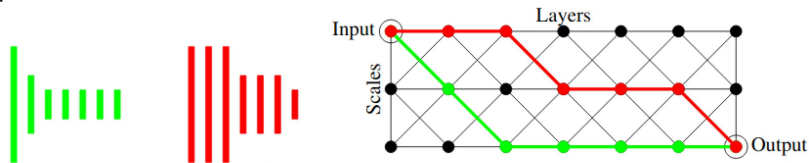 - ▶ Each path from the input to the output represents an architecture

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# One-shot models: convolutional neural fabrics [Saxena and Verbeek. 2017]

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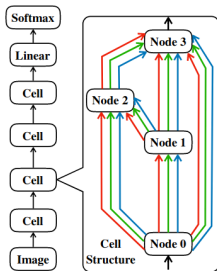 across all (exponentially many) architectures that have that edge

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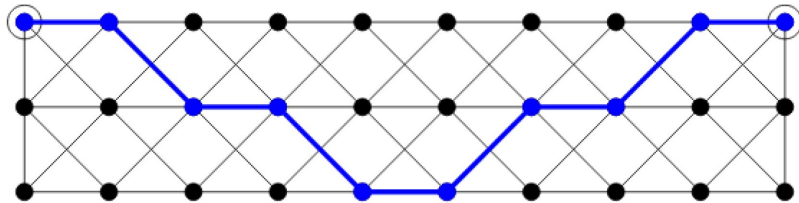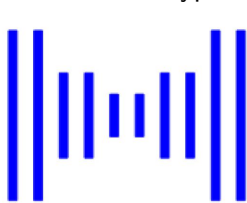
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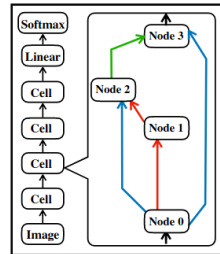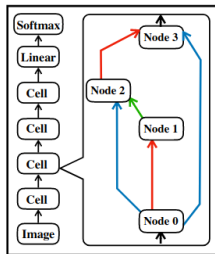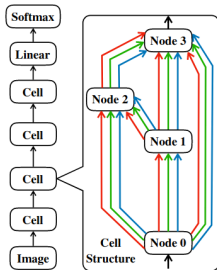   across all (exponentially many) architectures that have that edge

One-shot models for cell search spaces

- Directed acyclic multigraph to capture all (exponentially many) cell architectures
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- Individual architectures are subgraphs of this multigraph
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- One-shot model is an acyclic graph; thus, backpropagation applies
  - Simplest method: standard training with SGD
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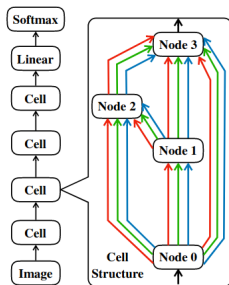
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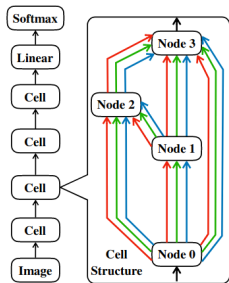- Potential issue: co-adaptation of weights
  - Weights are implicitly optimized to work well on average across all architectures
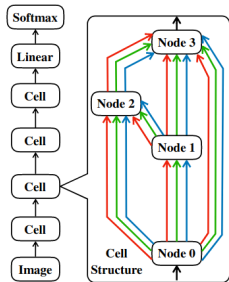 - They are not optimized specifically for the top-performing architecture
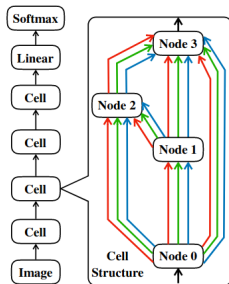
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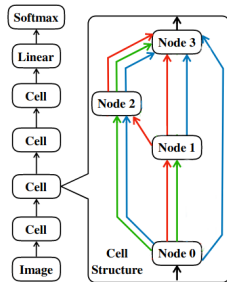   for each operation connecting 2 nodes, zero it out with probability p

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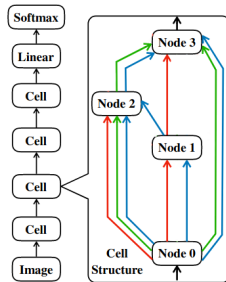

Architecture for batch 1

Architecture for batch 2

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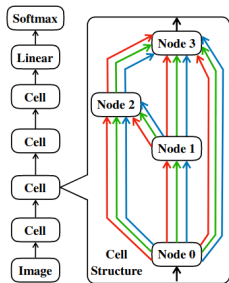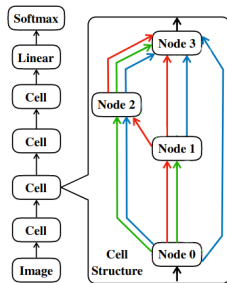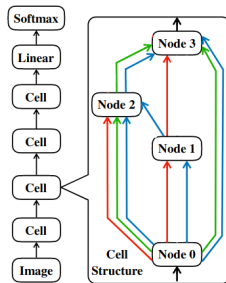   for each operation connecting 2 nodes, zero it out with probability p
  - ScheduledDropPath: starts with $p = 0$ and increases p linearly to p_{max} at the end of training
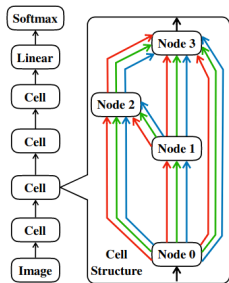

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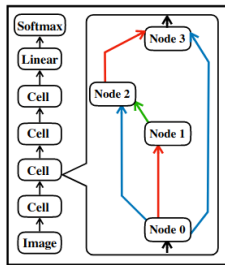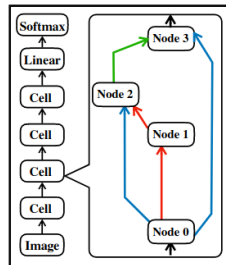

One-shot model

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  - **Random Search with Weight Sharing** [Li and Talwalkar. 2020] $\longrightarrow$ sample from uniform distribution
  - **ENAS** [Pham et al. 2018] $\longrightarrow$ sample from the learned policy of a RNN controller
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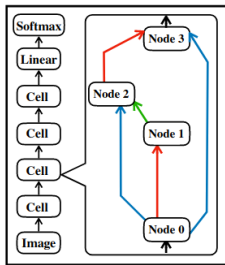

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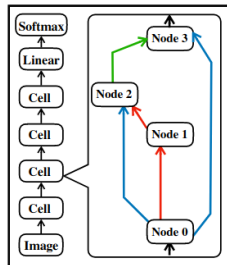- After training the one-shot model we have to select the best individual architecture from it
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- **Pitfall:** the correlation between architectures evaluated with the one-shot weights and retrained from scratch (stand-alone models) should be high
- If not, **selecting the best architecture based on the one-shot weights** is sub-optimal.
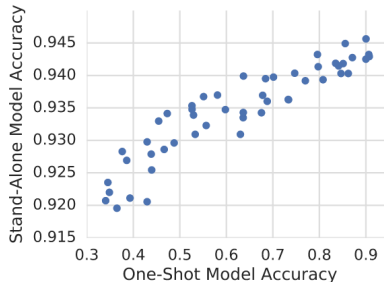
From [Bender et al. 2018]

Questions to Answer for Yourself / Discuss with Friends

- Repetition:
  How are the weights shared in the one-shot model?

- Repetition:
  What is the difference between Random Search with Weight Sharing and ENAS?

- Discussion:
  What migth be some downsides of using the one-shot model for NAS?