AutoML: Meta-Learning

Introduction

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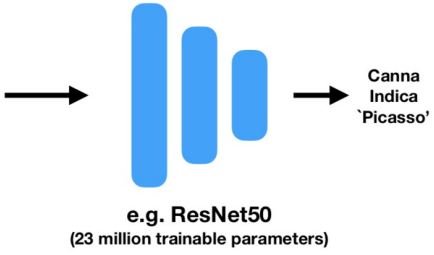
Intro: humans can easily learn from a single example

thanks to years of learning (and eons of evolution)

Can a computer learn from a single example?



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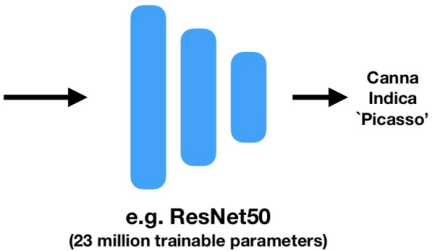
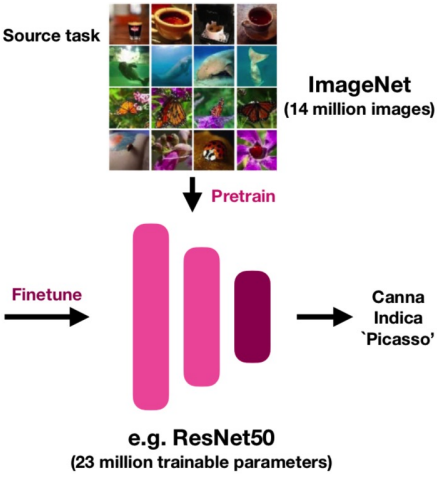


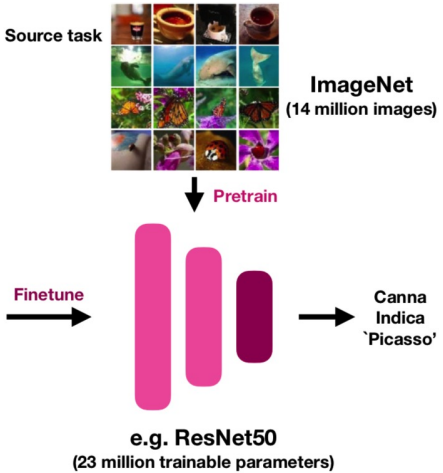
That won't work :) Humans also don't start from scratch.

Transfer learning?

Target task



Transfer learning?



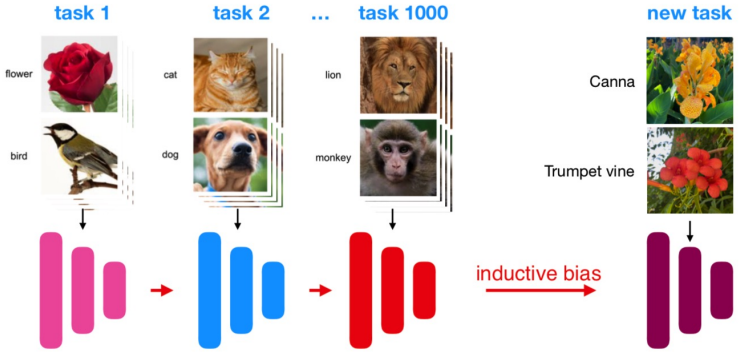
A single source task (e.g. ImageNet) may not generalize well to the test task.

Meta-learning

Learn over a series (or distribution) of many different tasks/episodes

Inductive bias: learn assumptions that you can to transfer to new tasks

Prepare yourself to learn new things faster



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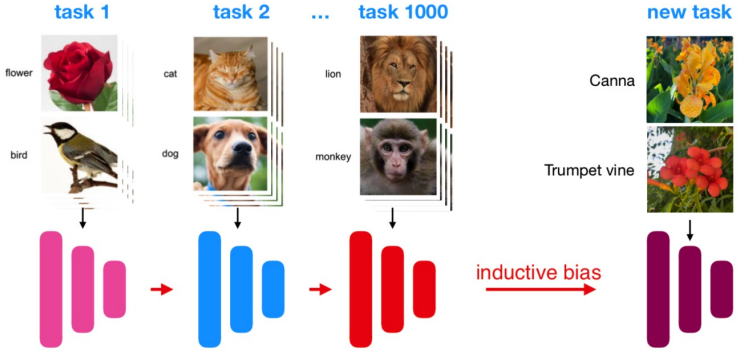
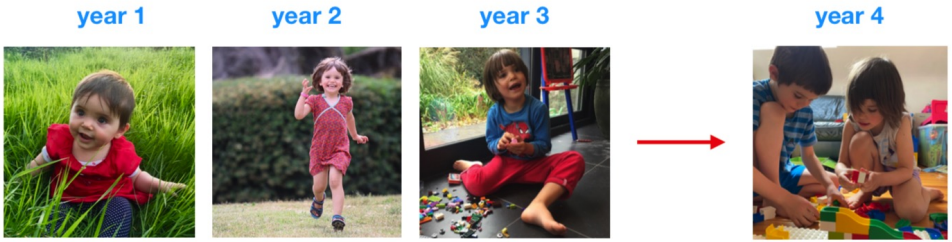


Useful in many real-life situations: rare events, test-time constraints, data collection costs, privacy issues,...

Inspired by human learning

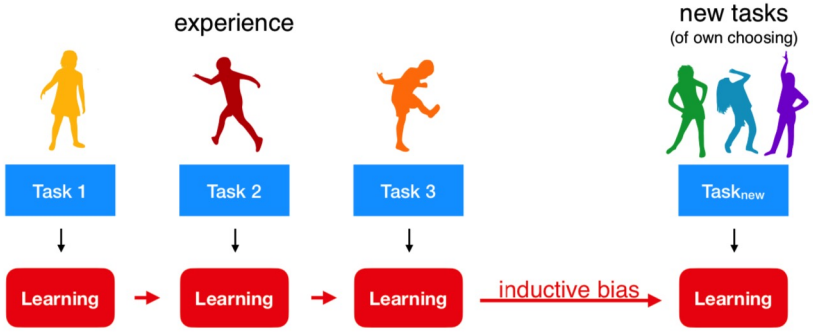
We don't transfer from a single source task, we learn across many, many tasks
We have a 'drive' to explore new, challenging, but doable, fun tasks



Human-like Learning***

humans learn across tasks: less trial-and-error, less data, less compute

new tasks should be related to experience (doable, fun, interesting?)



key aspects of fast learning: compositionality, causality, learning to learn

Inductive bias (in language)

which assumptions do we make?

Training

Test

dax blicket zup?

wif blicket dax kiki lug?

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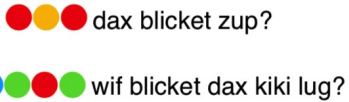

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Common mistakes


one-to-one bias:
assume that every word is one color

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assume that every word is one color

concatenation bias:
assume that order is always left-to-rig

What if there is no training data?

we can still solve problems by making assumptions

Item pool 

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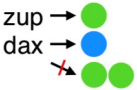

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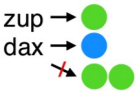

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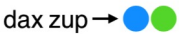

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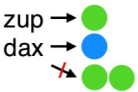

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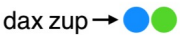

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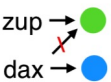

mutual exclusivity:
if object has a name, it doesn't need
another name

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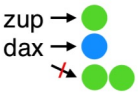

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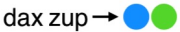

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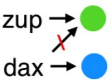

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Humans *assume* that words have consistent meanings and follow input/output constraints

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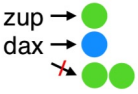

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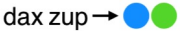

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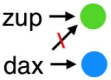

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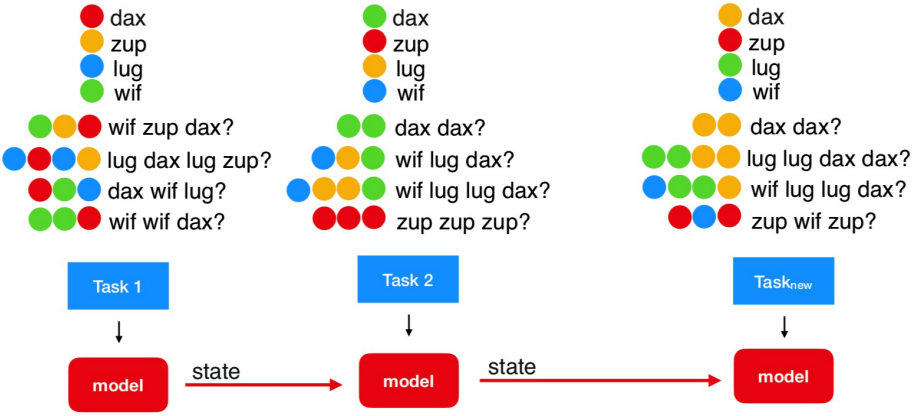
These assumptions (inductive biases) are necessary for learning quickly

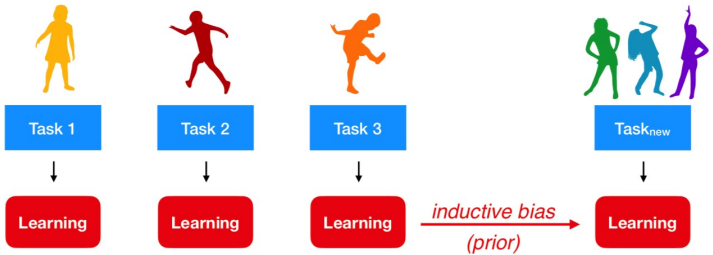
Meta-learning inductive biases

Capture useful assumptions from the data - that can often not be easily expressed



Meta-learning goal

learn *minimal* inductive biases from prior tasks instead of constructing manual ones
should still generalize well (otherwise you meta-overfit)



Inductive bias: any assumptions added to training data to learn more effectively. E.g:

- Instead of general model architectures, learn better architectures (and hyperparameters)
- Instead of starting from random weights, learn good initial weights
- Instead of standard loss/reward function, learn a better loss/reward function

What can we learn to learn?