

On the Origin of Species of Self-Supervised Learning

Findings of the Artificial Naturalist Society

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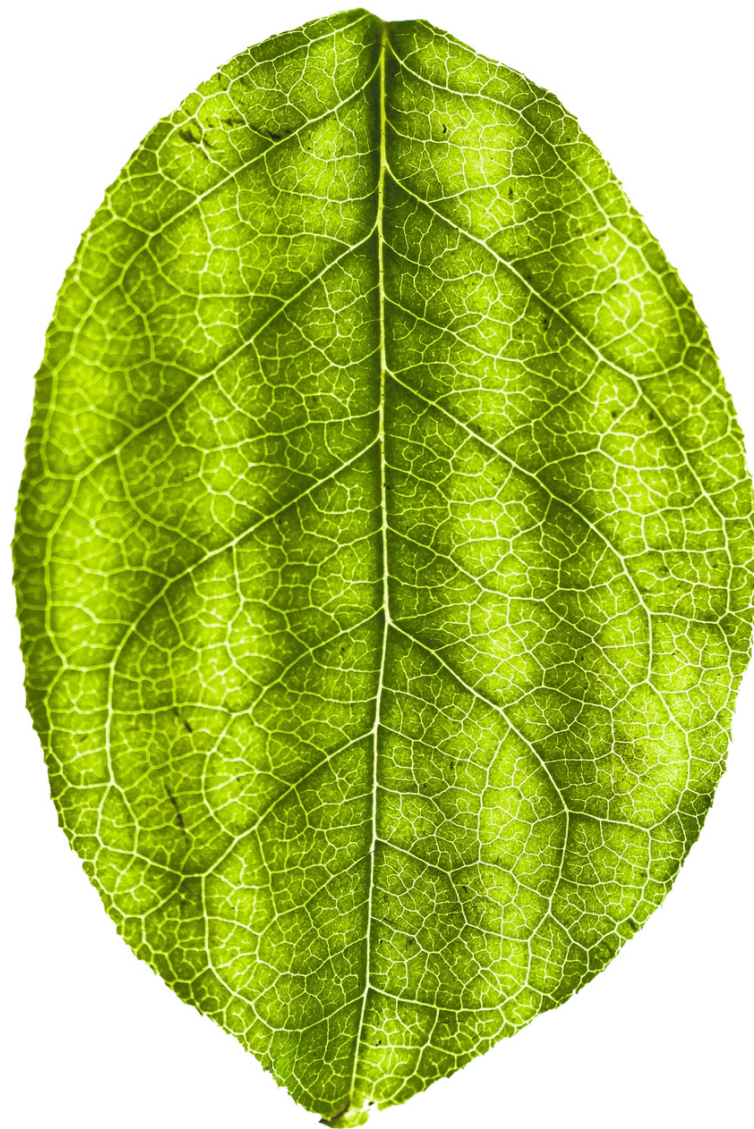
SIGBOVIK 2021

Motivation

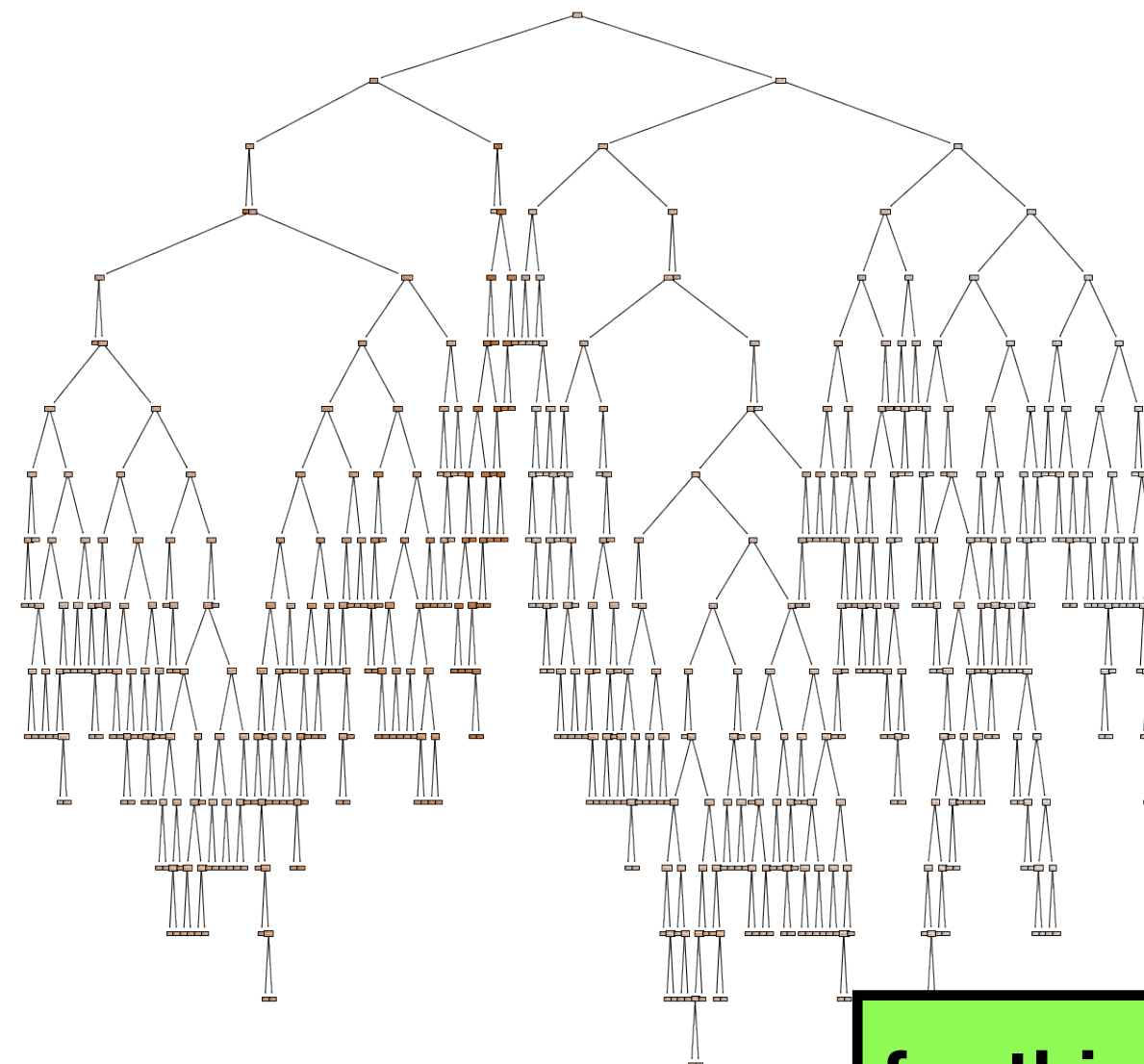
Initial multi-level analysis

Observation: A remarkable diversity of machine learning entities can be found in the wild

Random Leaf

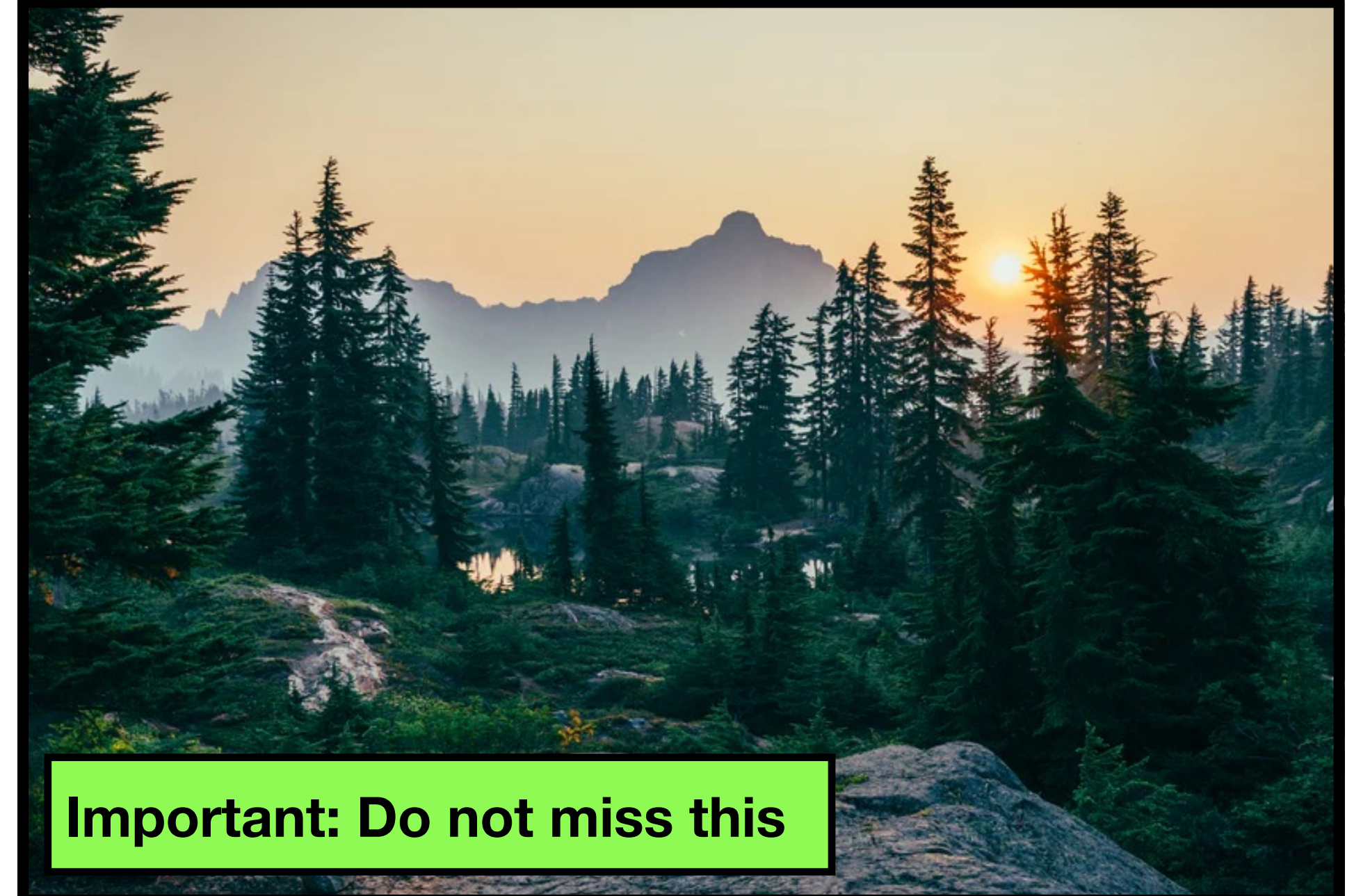


Random Tree



for this

Random Forest



Important: Do not miss this

Image Credits: (Left) Single green leaf by Annie Spratt, <https://unsplash.com/photos/STETfTufvFM>
(Middle) Piotr Płonski. How to visualize a single Decision Tree from the Random Forest in Scikit- Learn.
(Right): Sergei Akulich. Smoky morning in Cascades (Rampart Lakes, United States). <https://unsplash.com/photos/-heLWtuAN3c>

Self-supervised learning

Background and objective

Fully-supervised learning (FSL)

- Trained “by example”
- Responsible for uncomfortably fast progress in computer vision
- But, expensive to collect labels

Self-Supervised Learning (SSL)

- Machine autodidactism
- Major cost-cutting benefits
- More secure acronym
- Diverse and flourishing, its history has received little attention

Objective: Understand the origin of species of self-supervised learning (ideally with a grand unifying theory)

Related Work

A history of autodidacts and GUTs

Development of Self-Supervised Learning	
Humans	Machines
<ul style="list-style-type: none">• Ibn Tufail (1160)• James “turn down for” Watt (1776)• Ramanujan• Django Reinhardt• Kato Lomb	<ul style="list-style-type: none">• Self-learning controllers (Nguyen & Widrow, 1990)• Self-interested agents (Barto, 1985)• Self-organising maps (Von Der Malsburg, 1973, Kohonen 1982)• Self-supervised learning (Pal et al. 1978)• Recursive Alan Turing, (Turing, 1948; 1951)

Grand Unifying Theories	
Hits	Misses
<ul style="list-style-type: none">• Stargazing (Nubians, 4800BC)• Periodic celestial orbits (Babylonian Astronomers, 1700BC)• Numerical Analysis 易經 (Wen & Zhou, 900 BC)• Atoms (Democritus, 400 BC)• Axioms (Archimedes, 225 BC)• Gravity (Newton, 1687)• Natural selection (Darwin, 1859)• Electromagnetism (Maxwell, 1865)	<ul style="list-style-type: none">• Geocentrism (Anaximander, 600 BC)• Ontogeny recapitulates Phylogeny (Haeckel, 1856)• Quantum gravity (Einstein, Schrodinger)
	Near Misses
	<ul style="list-style-type: none">• Ours?

Focused Study: Variation in self-supervised learning

First Year PhD



Late Stage PhD



Postdocs



Industry



Solo



Startup



Asst. Prof.



Fossil evidence: university servers



Top Row Image Credits: Jorge Cham

from left to right, fragments sourced from:

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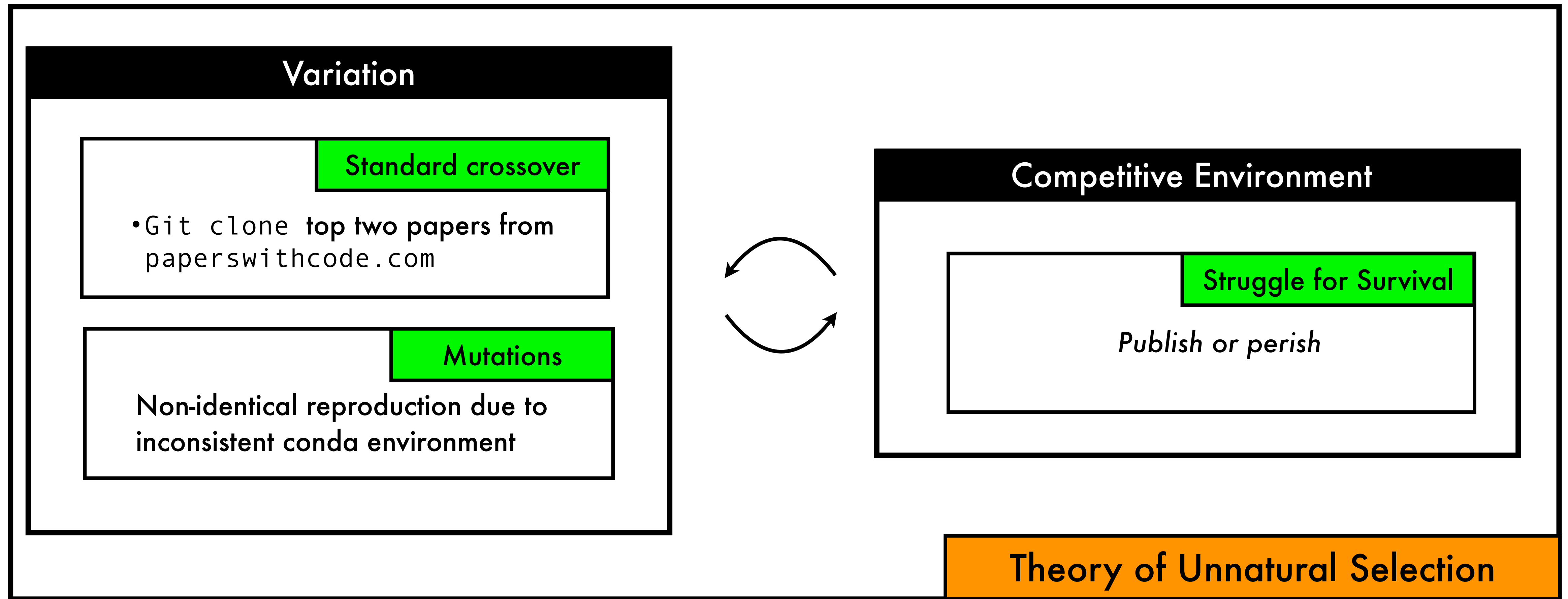
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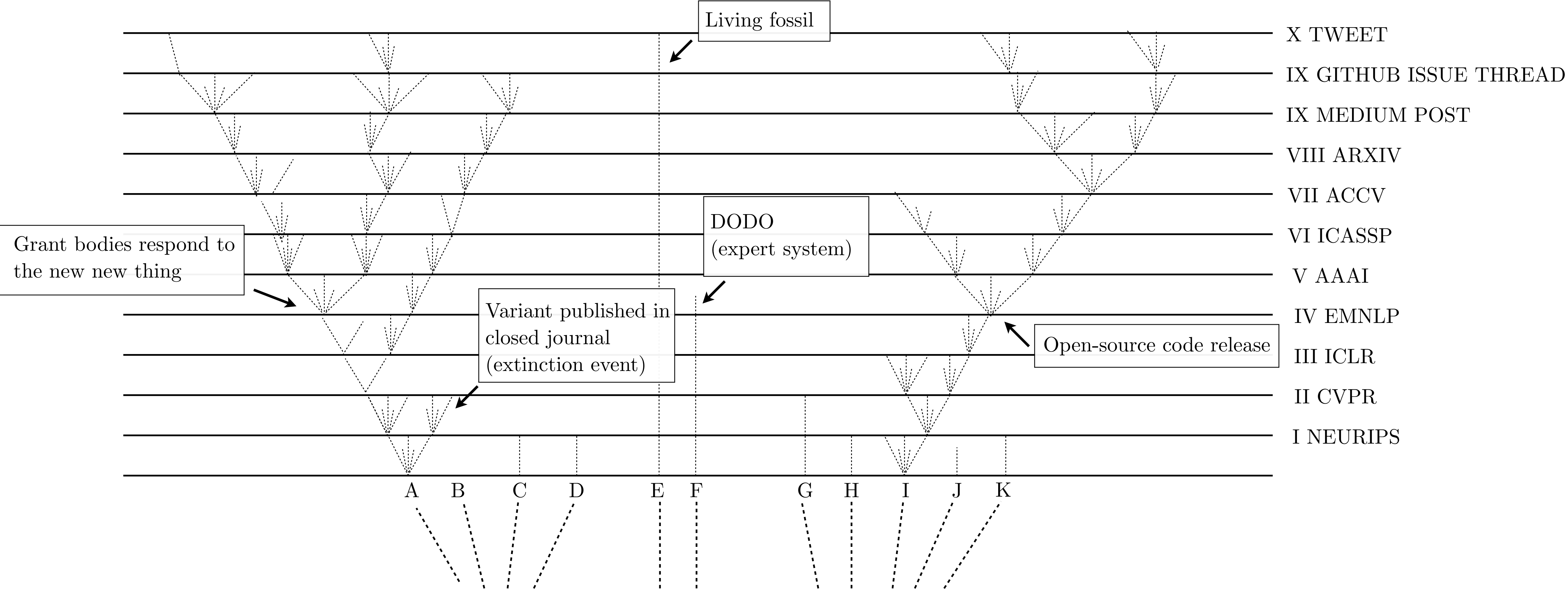
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A unifying theory for self-supervised learning development



Simulation: Development of Self-Supervised Learning



The Conservation of Deep Learning Models

Challenges

- Fashionable among high society to collect exotic GAN variants
- Model zoos encourage removal from natural habitat
- Models born to race through ImageNet on a 64-GPU cluster, now confined to an S3 bucket

Big GAN Rescue

- Operating VMs running MATLAB2013a with vintage MatConvNet
- Allows models to live out their days with a daily epoch on CIFAR-10
- Longer term: rewilding through mass-uploading on peer-to-peer services

Thank you for your attention

Extra thanks to James Thewlis providing technical and philosophical support for this research