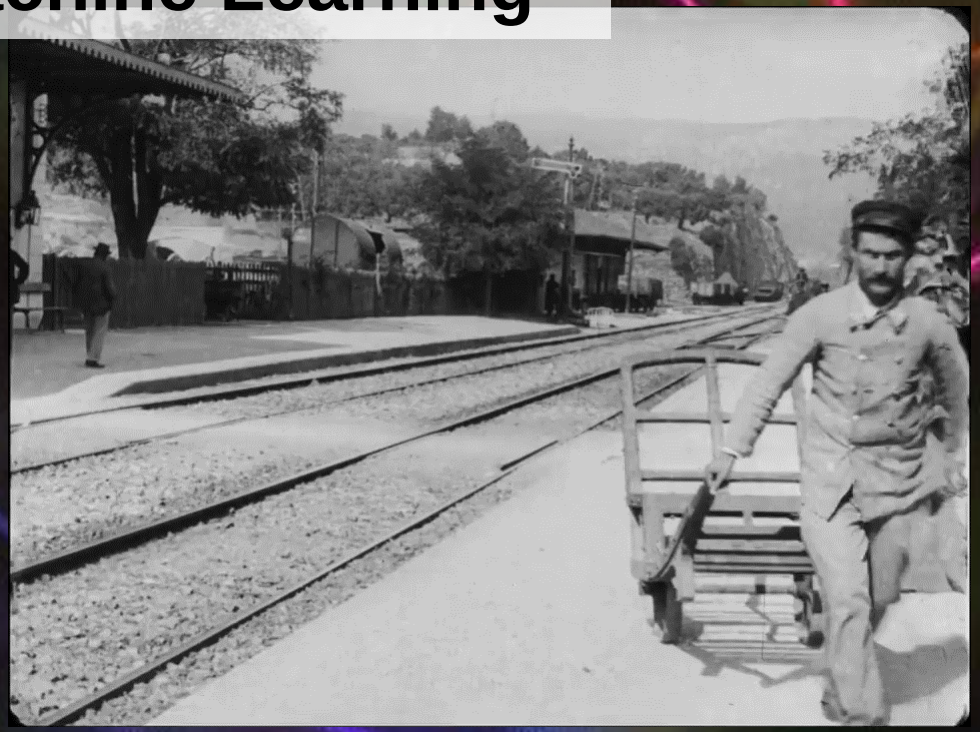
8 Machine Learning III
- Specialized Areas in Machine Learning

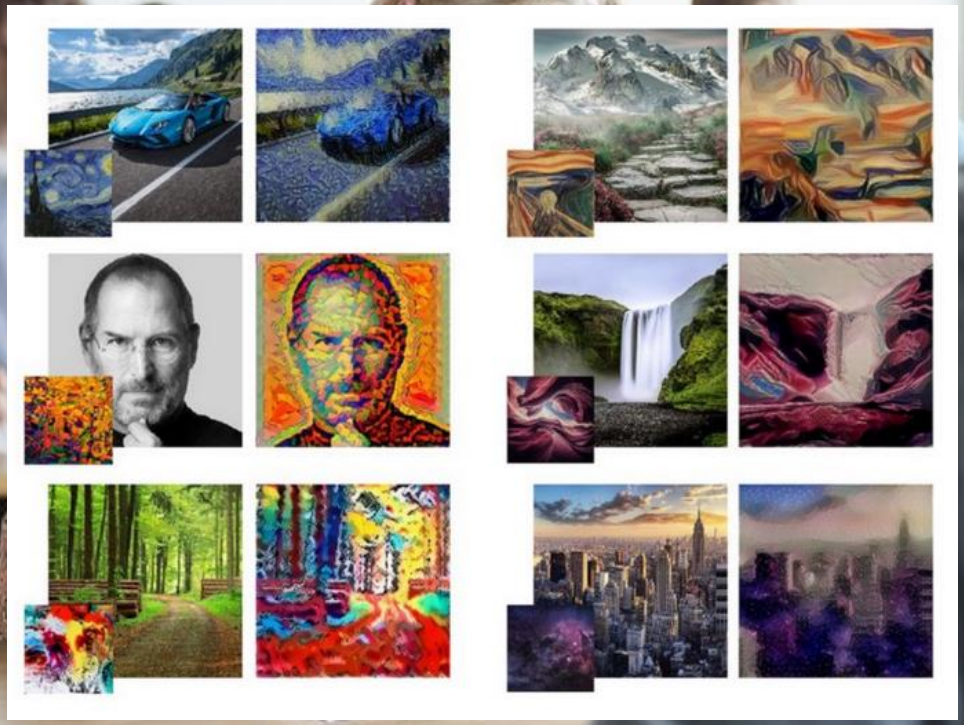
Content:

1. **Transfer Learning** & Teachable Machine
2. **YOLO** & Real-Time Object Detection
3. **Autoencoder** & Super Sampling
4. **Generative Adversarial Networks (GAN)**
5. **Reinforcement Learning**
6. **The Human Role** in **Machine Learning Live**
7. **Summary**



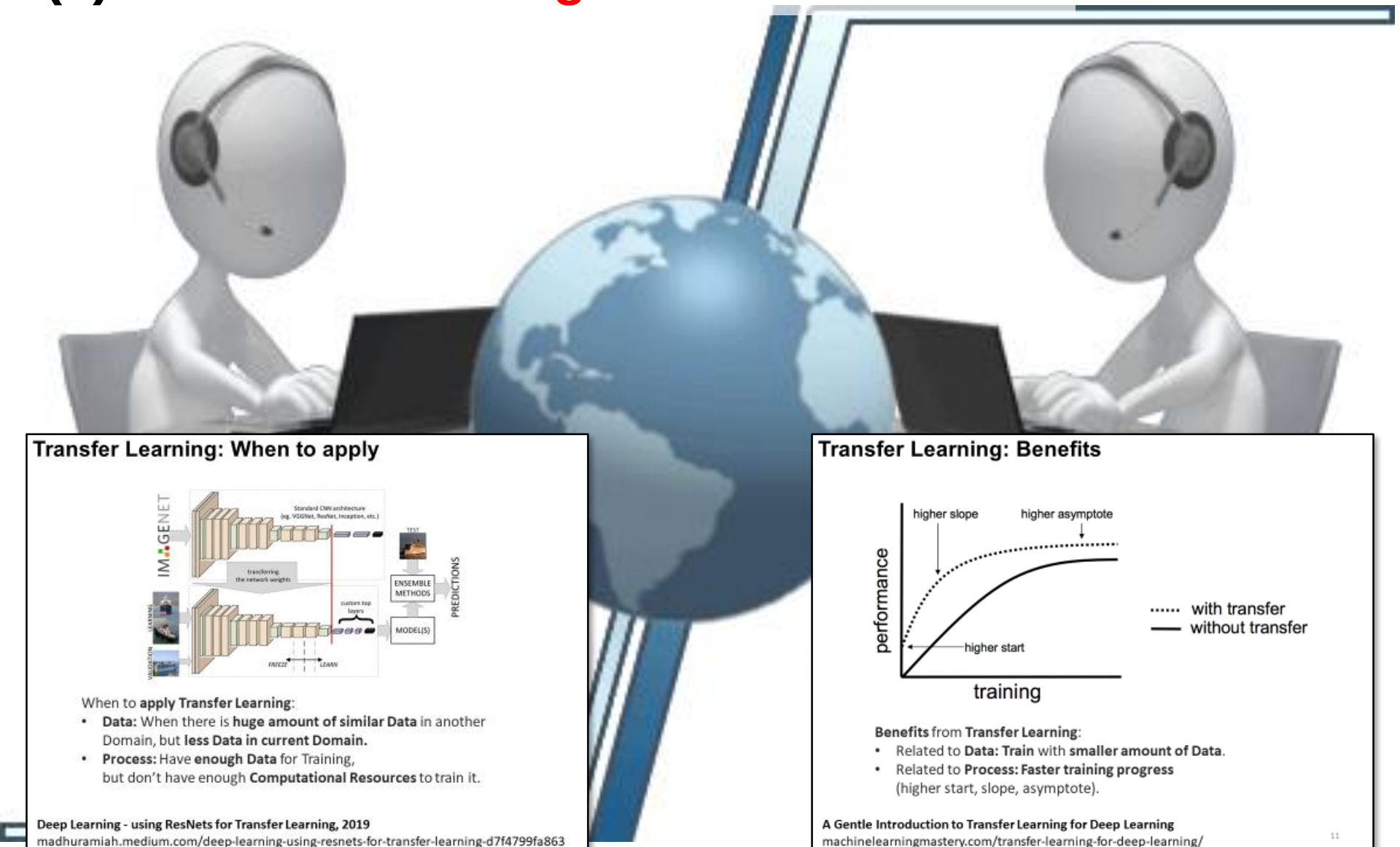
Which machine learning technique is used in this case (and in Deepfakes)?

Schwierigkeitsgrad \ Art des Wissens	Abfragewissen (Vorlesung)	Anwendungswissen (Literatur)
Einfach		
Mittel		
Schwierig		



a) Convolutional Neural Networks
b) Transfer Learning
c) Generative Adversarial Networks
d) Reinforcement Learning
e) Transformer

8 Machine Learning III
- Specialized Areas in Machine Learning
(1) Transfer Learning



Transfer Learning: When to apply

When to **apply Transfer Learning**:

- **Data:** When there is **huge amount of similar Data** in another Domain, but **less Data in current Domain.**
- **Process:** Have **enough Data** for Training, but don't have enough **Computational Resources** to train it.

Deep Learning - using ResNets for Transfer Learning, 2019
madhuramiah.medium.com/deep-learning-using-resnets-for-transfer-learning-d7f4799fa863

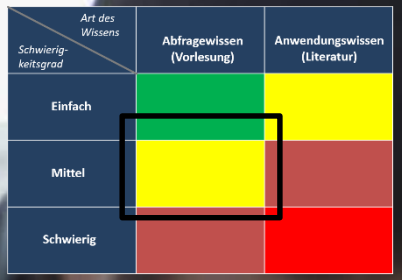
Transfer Learning: Benefits

Benefits from **Transfer Learning**:

- Related to **Data: Train** with **smaller amount of Data**.
- Related to **Process: Faster training progress** (higher start, slope, asymptote).

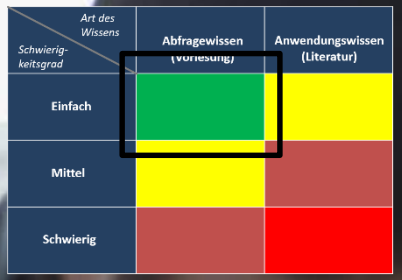
A Gentle Introduction to Transfer Learning for Deep Learning
machinelearningmastery.com/transfer-learning-for-deep-learning/

Which statement about Transfer Learning is FALSE?



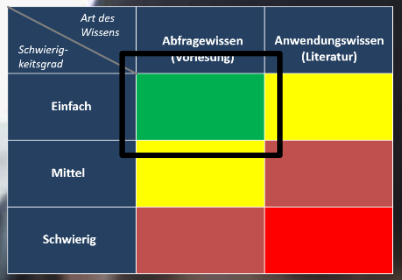
a) Learning of a new **task relies on** the **previous learned tasks**.
b) Learning **reuses abstract knowledge**, **retrains specific knowledge.**
c) Learning is **initialized from pre-trained weights** and **biases**.
d) Learning **process** can be **faster at the cost of more training data.**
e) It has the **potential** to significantly **improve the sample efficiency** of **a reinforcement learning agent**.

We apply Transfer Learning when there is huge amount of ____ data in another domain, but ____ data in current domain.



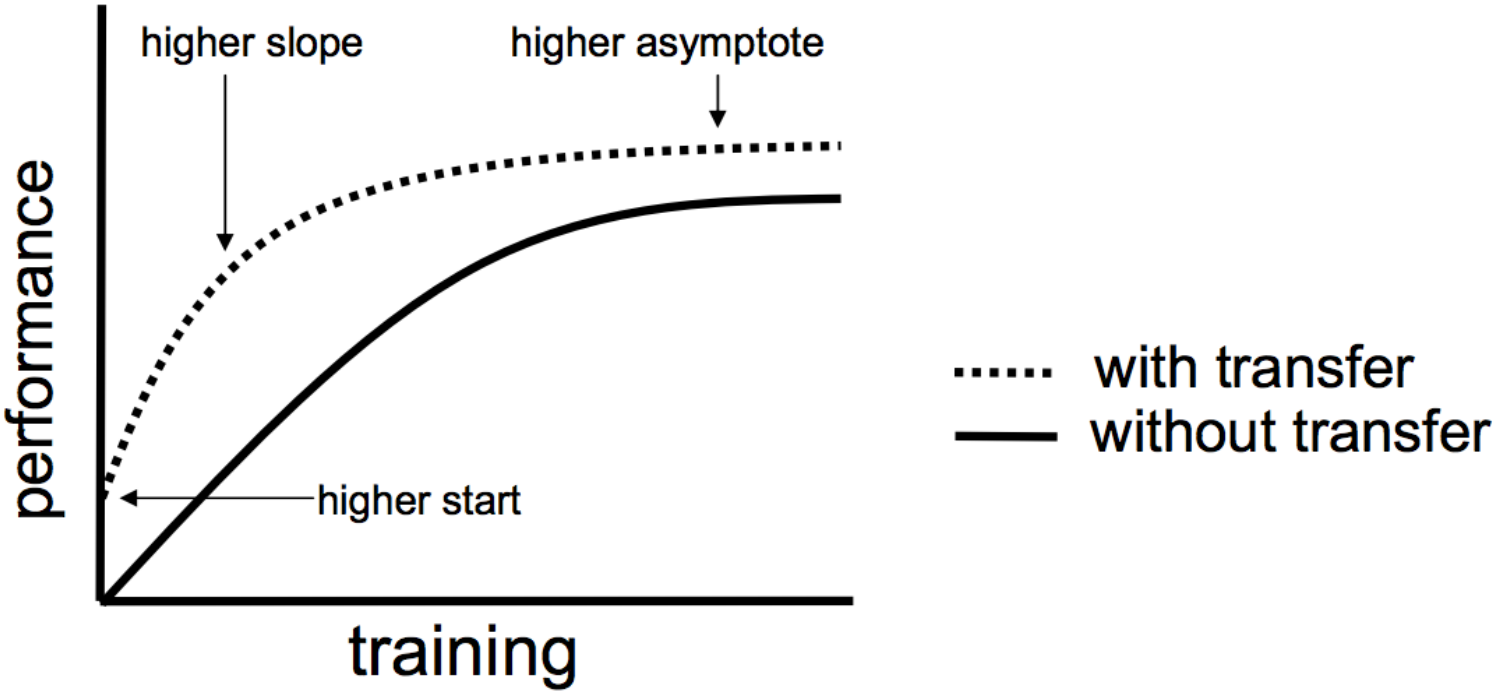
a) similar | less
b) unsimilar | less
c) similar | more
d) unsimilar | more
e) unsimilar | similar

We apply Transfer Learning when there are enough ____ for training but do not have enough ____ to train it.



a) Domain | Data
b) Data | Domain
c) Process | Computational Resources
d) Data | Computational Resources
e) Process | Data

Transfer Learning: Benefits



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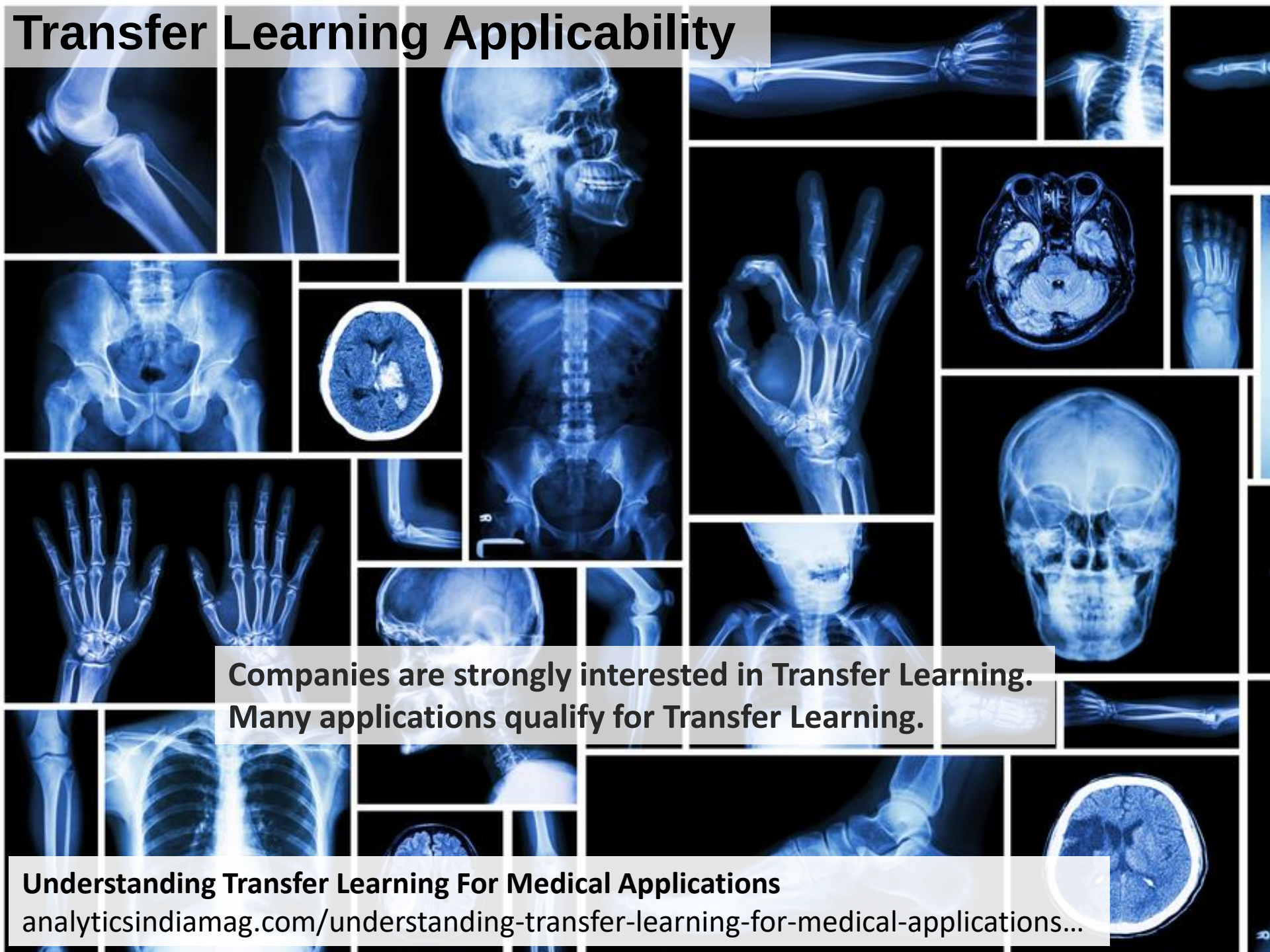
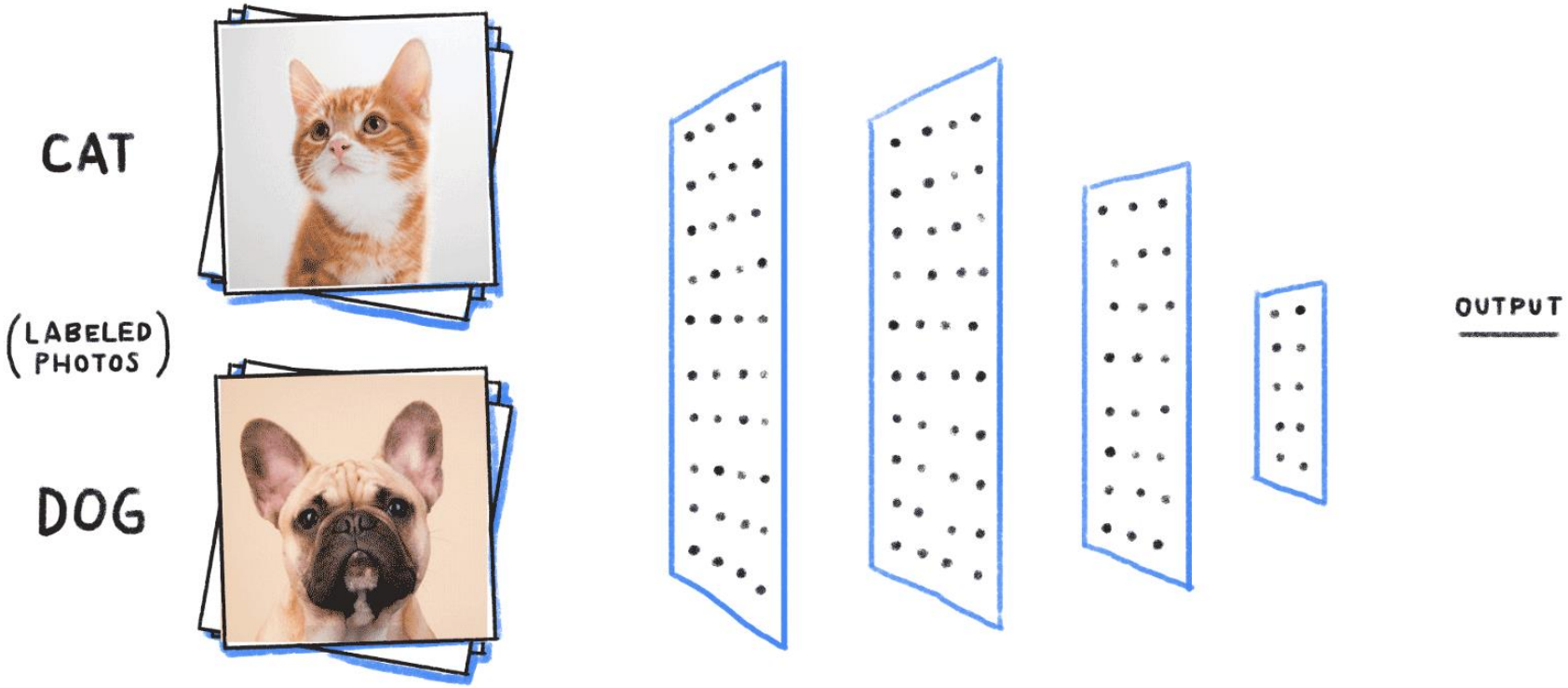
Transfer Learning Applicability



Companies are strongly interested in Transfer Learning.
Many applications qualify for Transfer Learning.

Understanding Transfer Learning For Medical Applications
analyticsindiamag.com/understanding-transfer-learning-for-medical-applications…

Transfer Learning Playground



Michael Amberg

Todays Content:

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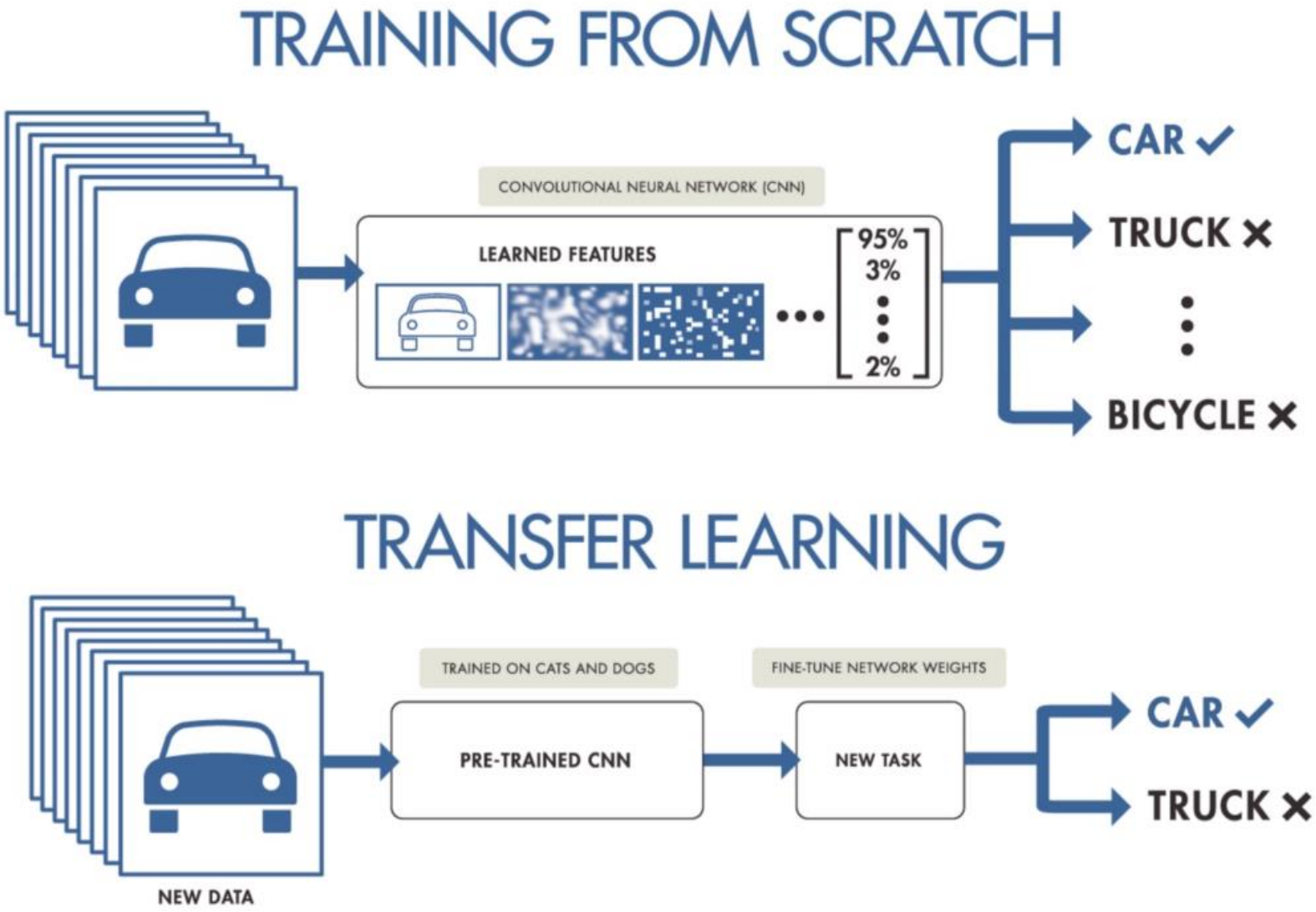
1. **Transfer Learning** & Teachable Machine

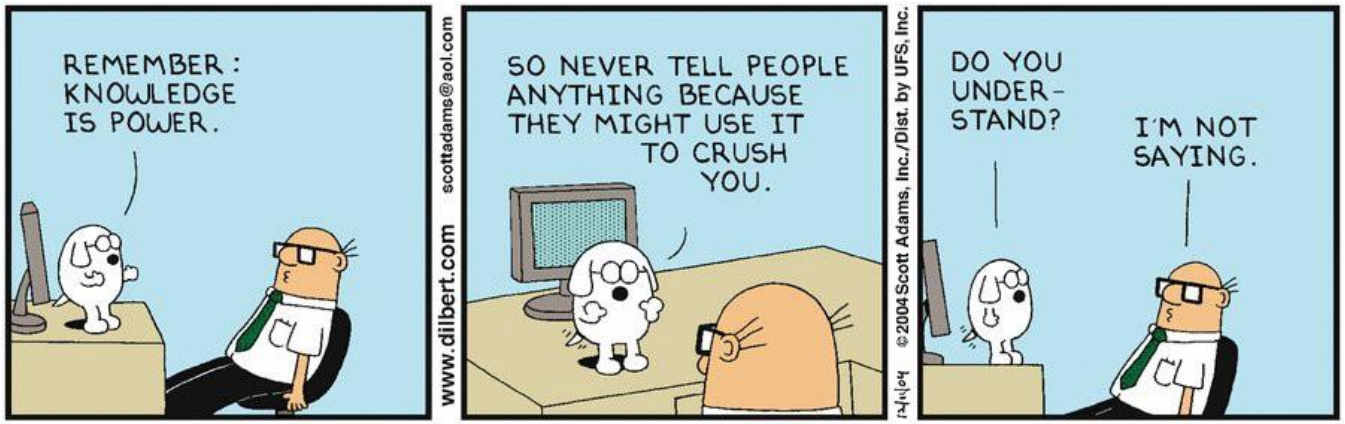


Transfer Learning

Transfer learning

From Wikipedia, the free encyclopedia

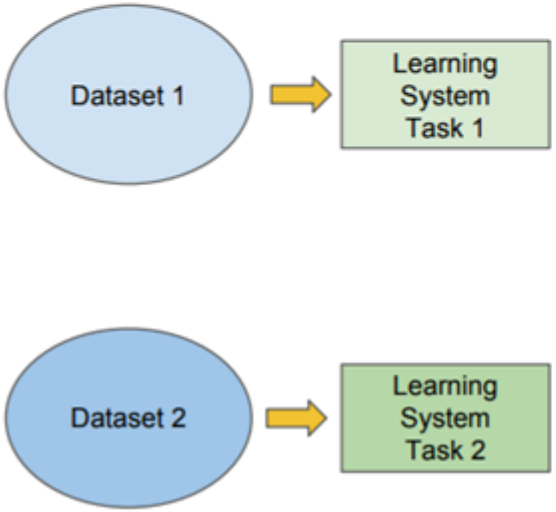
Transfer learning (TL) is a research problem in machine learning (ML) that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem.[1] For example, knowledge gained while learning to recognize cars could apply when trying to recognize trucks. This area of research bears some relation to the long history of psychological literature on transfer of learning, although formal ties between the two fields are limited. From the practical standpoint, reusing or transferring information from previously learned tasks for the learning of new tasks has the potential to significantly improve the sample efficiency of a reinforcement learning agent.[2]



Transfer Learning vs Traditional Machine Learning

Traditional ML

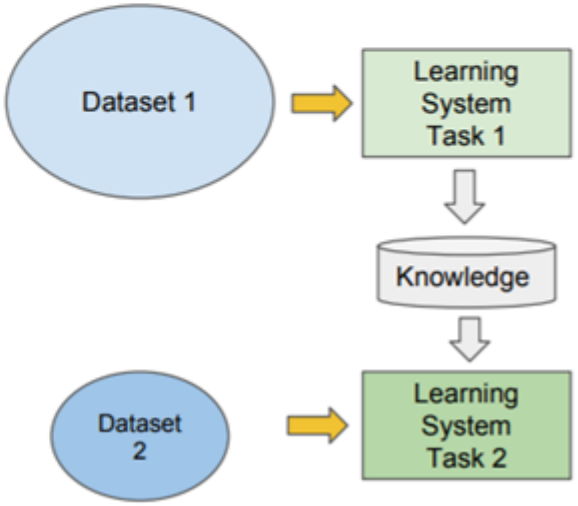
- Isolated, single task learning:
  - Knowledge is not retained or accumulated. Learning is performed w.o. considering past learned knowledge in other tasks



vs

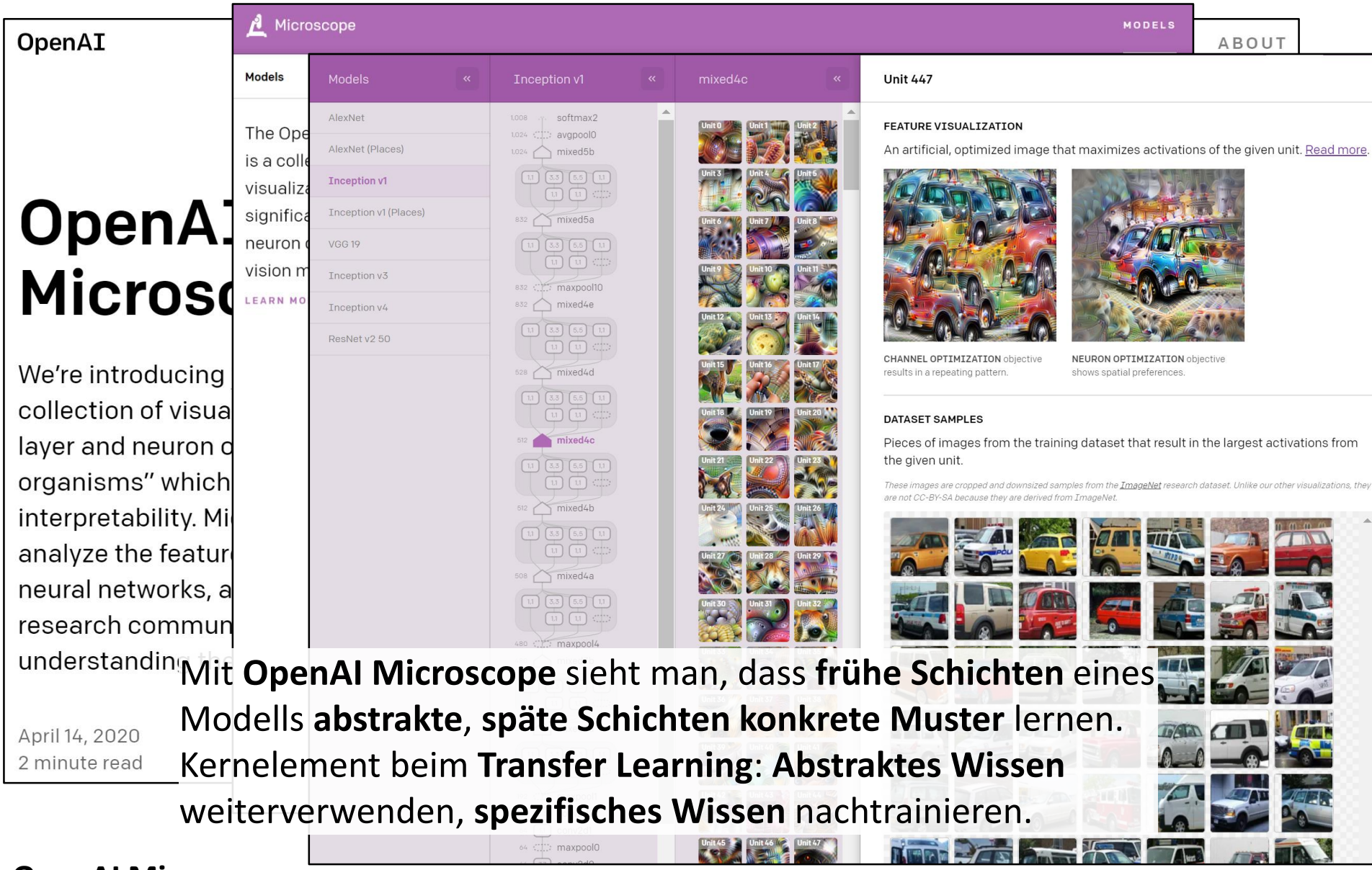
Transfer Learning

- Learning of a new tasks relies on the previous learned tasks:
  - Learning process can be faster, more accurate and/or need less training data



A Comprehensive Hands-on Guide to Transfer Learning with Real-World Applications, 2018
towardsdatascience.com/a-comprehensive-hands-on-guide-to-transfer-learning-with...

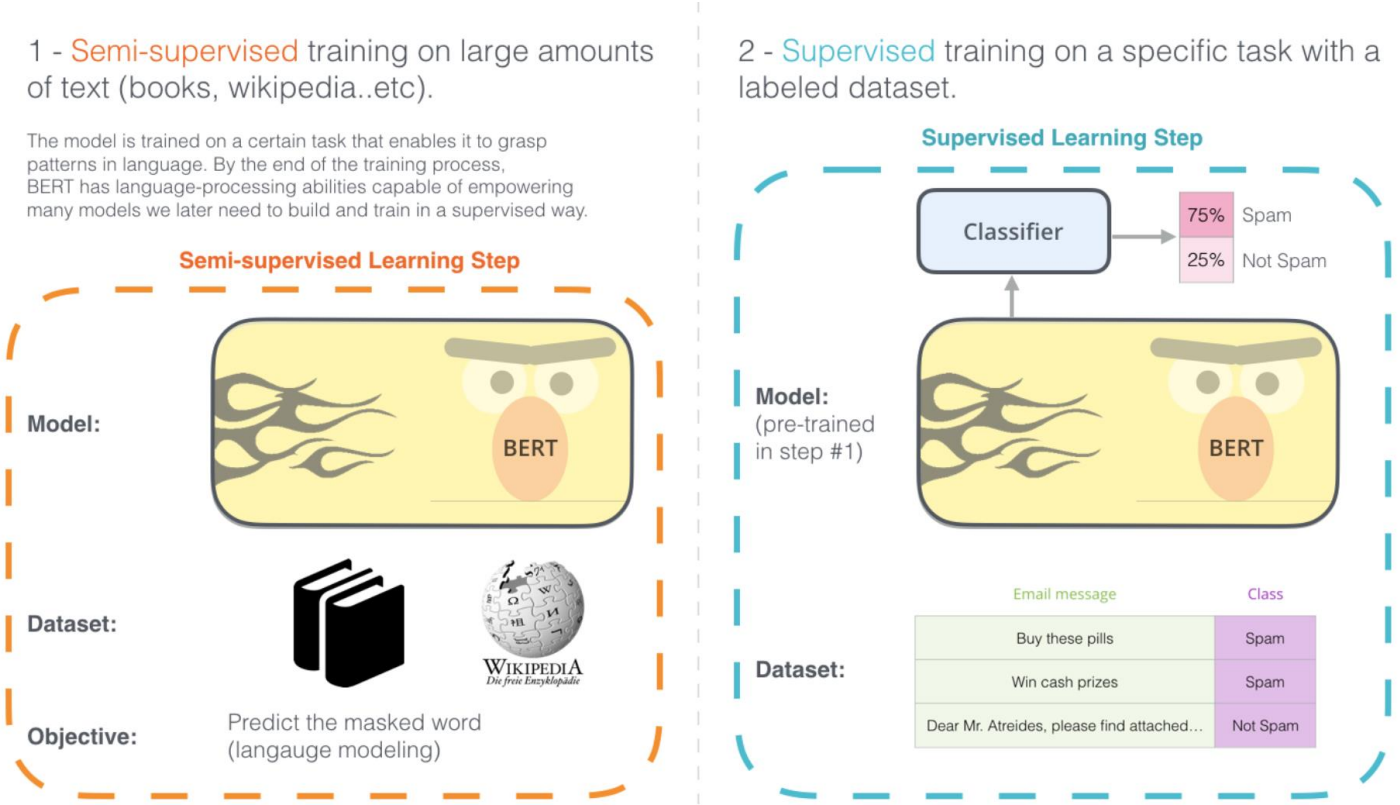
Transfer Learning with CNNs (Convolutional NN)



Mit **OpenAI Microscope** sieht man, dass **frühe Schichten** eines Modells **abstrakte**, **späte Schichten konkrete Muster** lernen. Kernelement beim **Transfer Learning**: **Abstraktes Wissen** weiterverwenden, **spezifisches Wissen** nachtrainieren.

OpenAI Microscope
microscope.openai.com/models

Transfer Learning with BERT Transformer

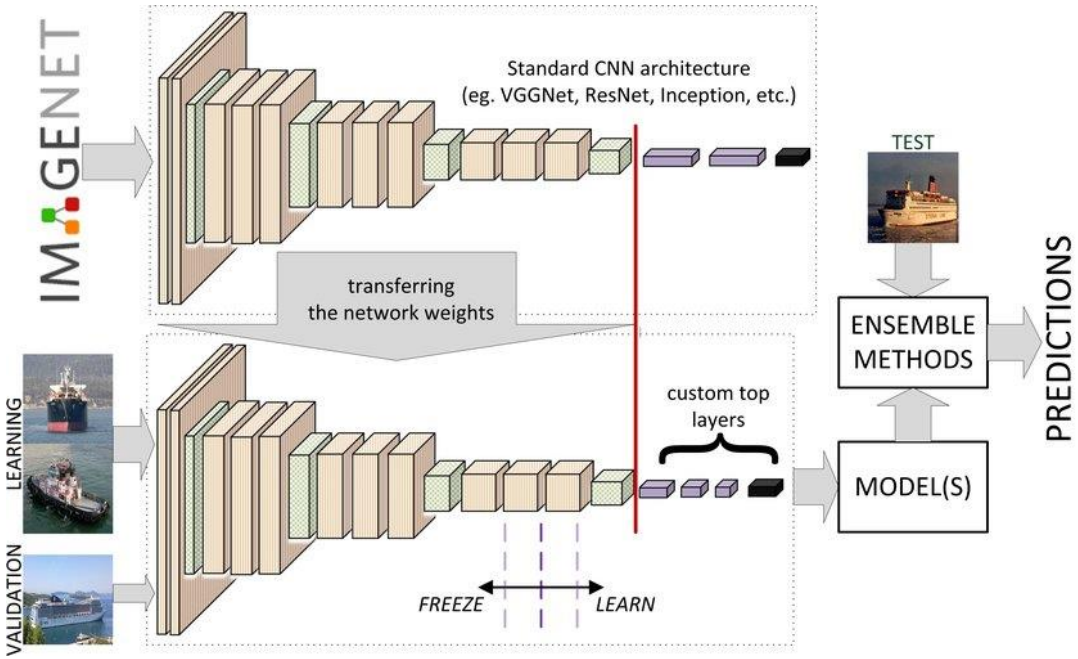


The two steps of how BERT is developed. You can download the model pre-trained in step 1 (trained on un-annotated data), and only worry about fine-tuning it for step 2. [Source for book icon].

Eine Form von **Transfer Learning:**
Fokus auf **Fine-Tuning, Pre-Training** übernehmen

The Illustrated BERT, ELMo, and co. (How NLP Cracked Transfer Learning), 2018
jalammar.github.io/illustrated-bert/

Transfer Learning: When to apply



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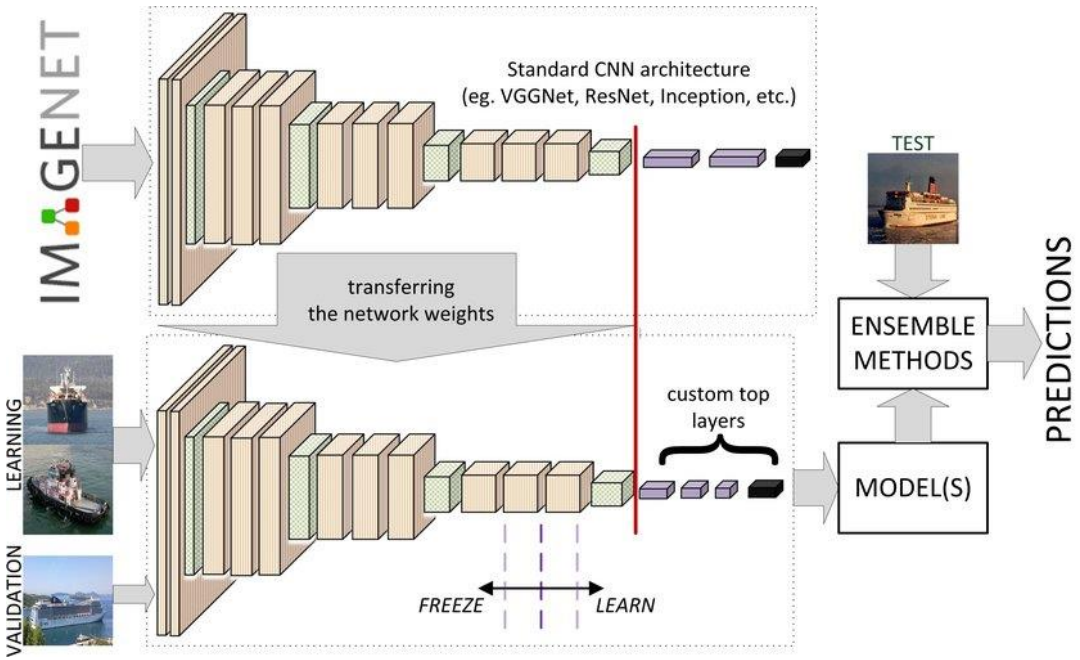
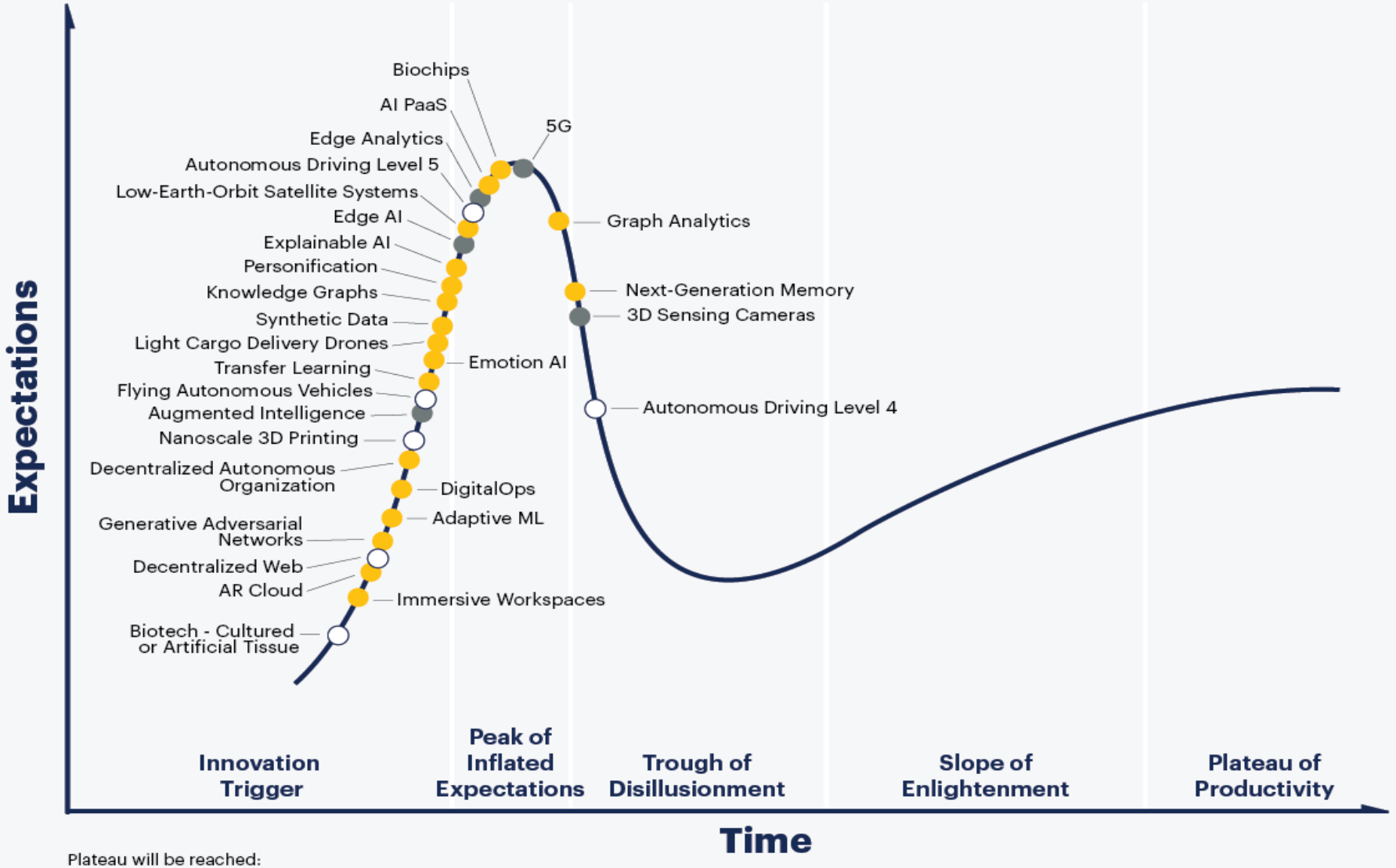
Transfer Learning: Options when applying



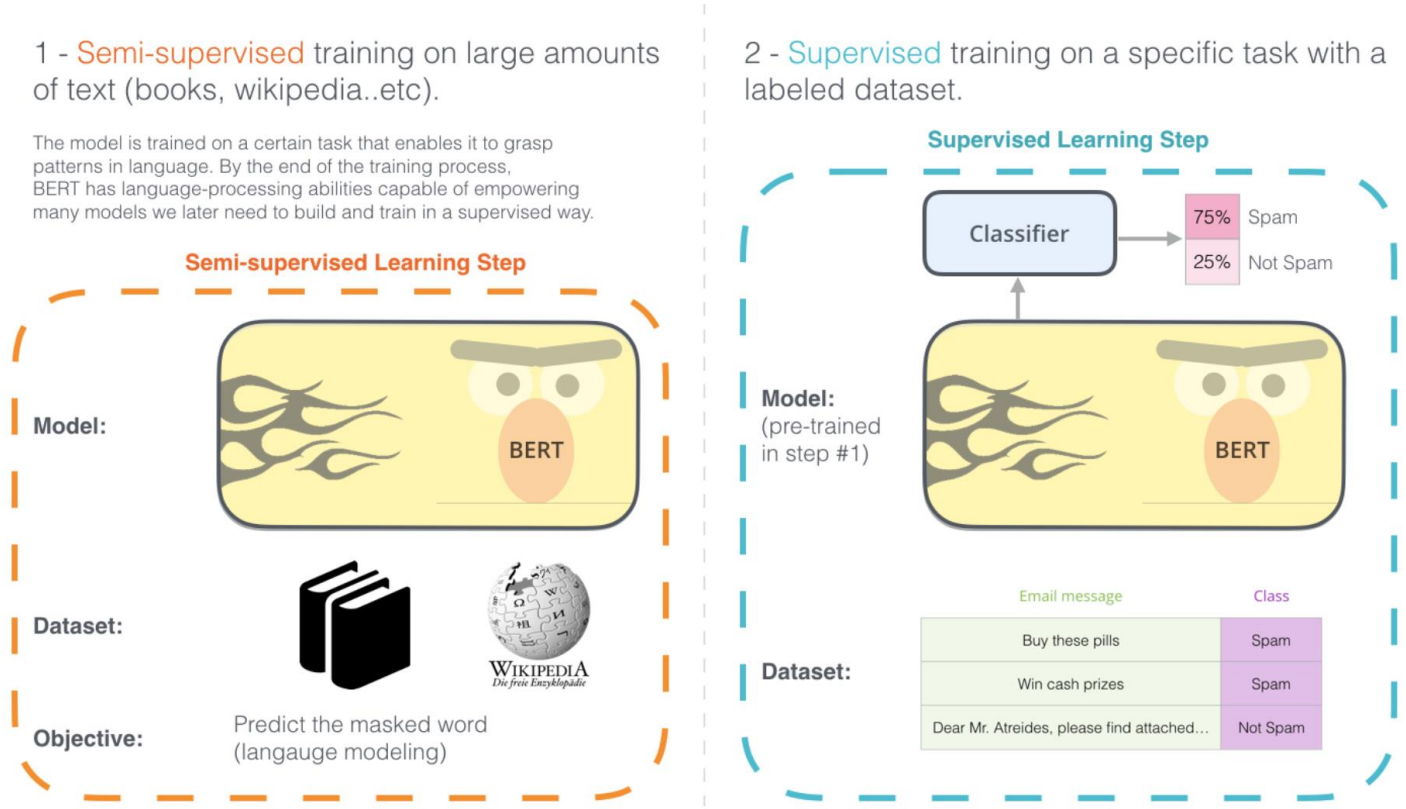
2 Options When applying **Transfer Learning in Neural Networks:**

- **Freeze the Weights and Bias** on **Initial Few Layers** and train only the **Last Few Layers** and **Fully Connected**.
  In this case you **don't** need to **re-train** the **whole Network Model** again.
- **Re-train the whole Network**, **initializing** from the **learned Weights** and **Bias**.
  Keep the Learning Rate very low so that the **original Weights** don't deviate **drastically**.

Gartner Hype Cycle for Emerging Technologies, 2019



BERT Transformer, Google 2018



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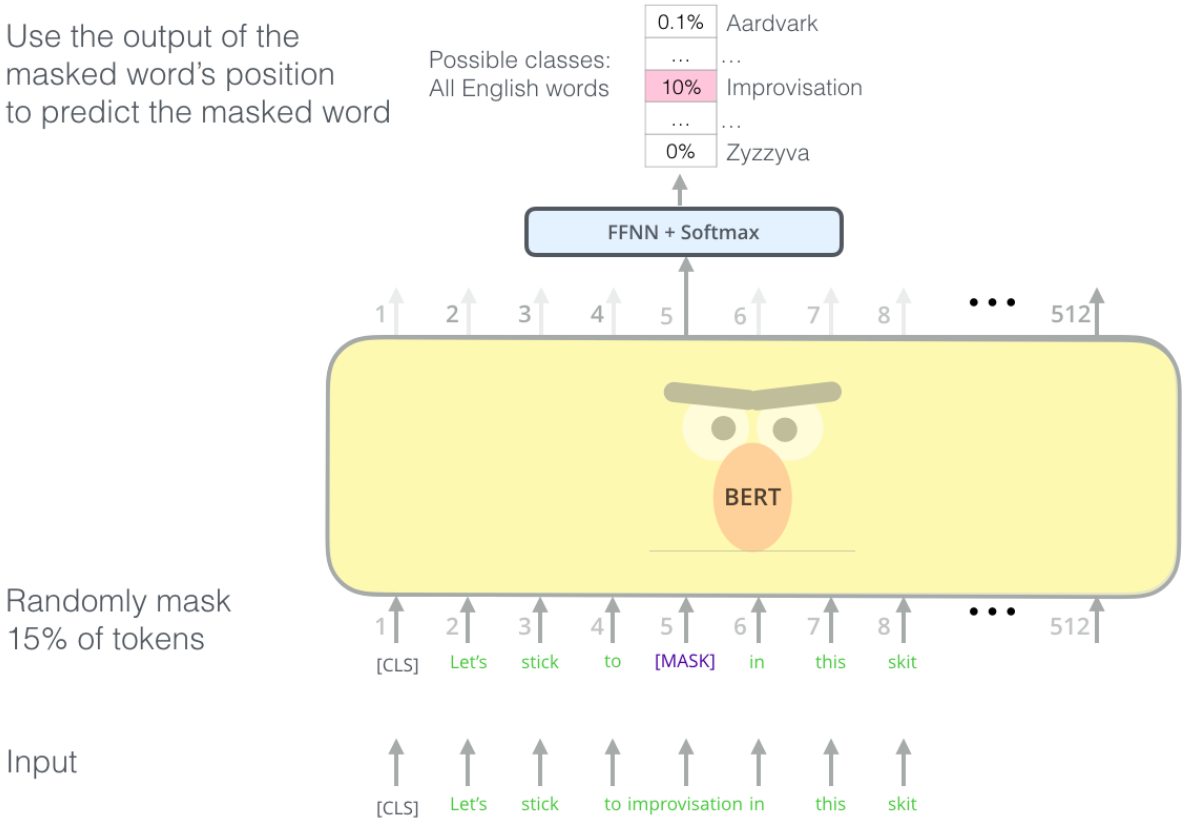
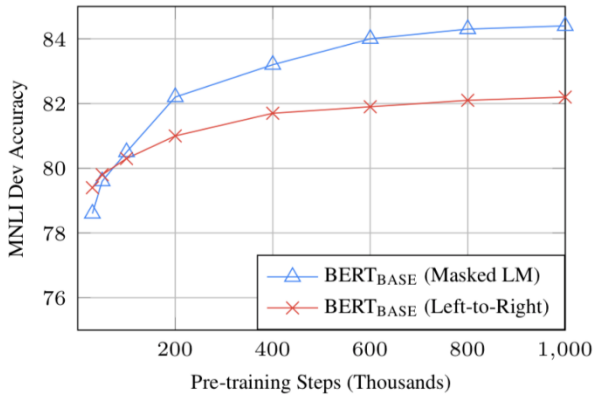
Das **Training** läuft in zwei Schritten: **Pre-Training** und **Fine-Tuning** (eine Form von **Transfer Learning**)

The Illustrated BERT, ELMo, and co. (How NLP Cracked Transfer Learning), 2018
jalammar.github.io/illustrated-bert/

BERT Training using Masked Language Model





Masked Language Model: **BERT** maskiert **15% der Worte** im **Input** und lässt das fehlende Wort **vorhersagen (Bidirektionale Suche)**.

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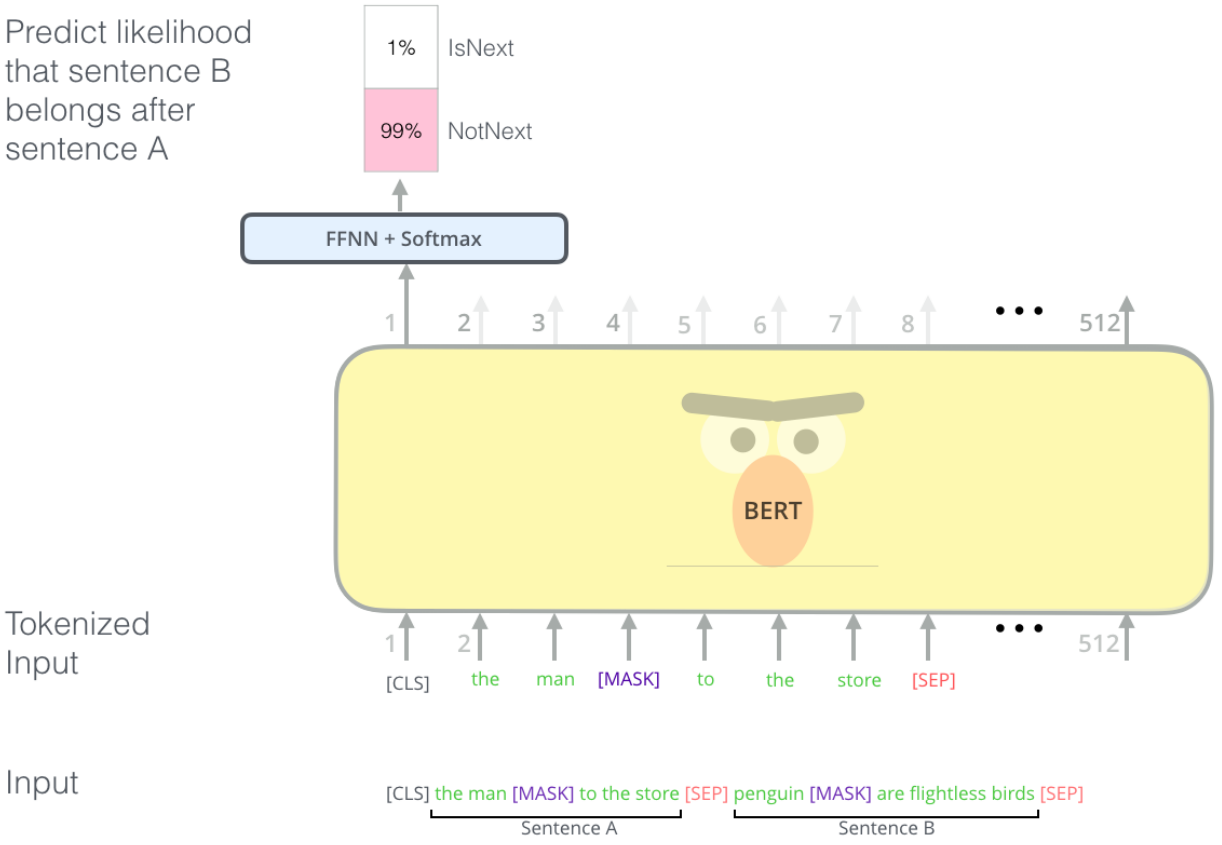
BERT Training using Next Sentence Prediction



Next Sentence Prediction: **BERT** bekommt **2 Sätze** im **Input** und sagt die Reihenfolge (ja/nein) voraus.

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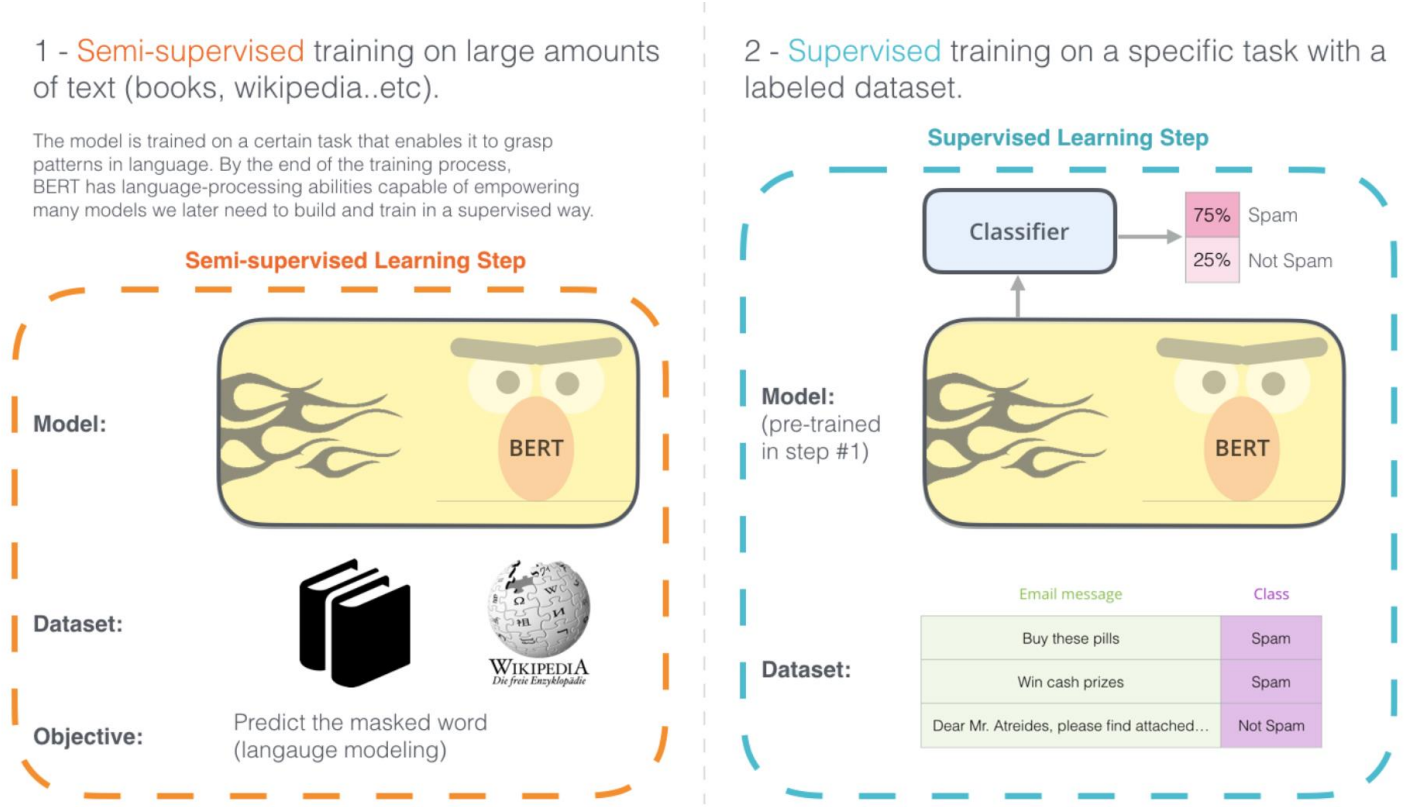
jalammar.github.io/illustrated-bert/

BERT Transformer, Google 2018



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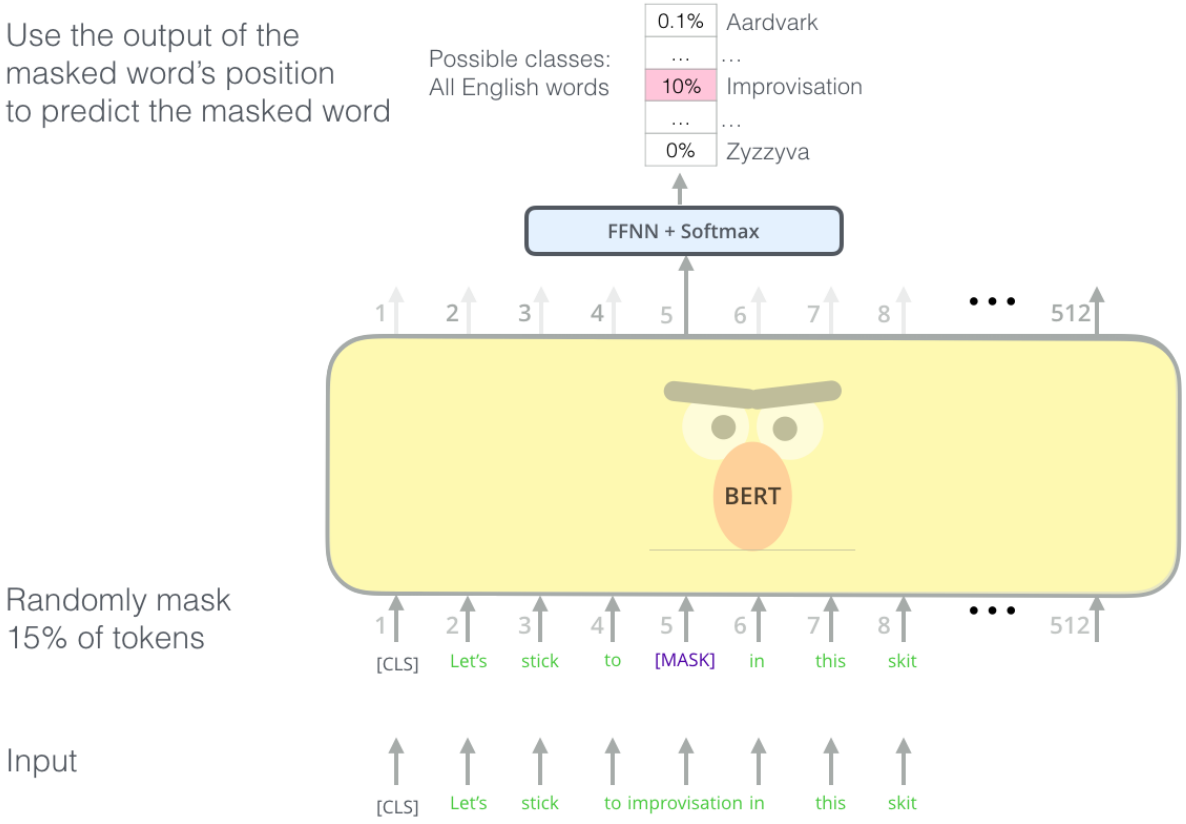

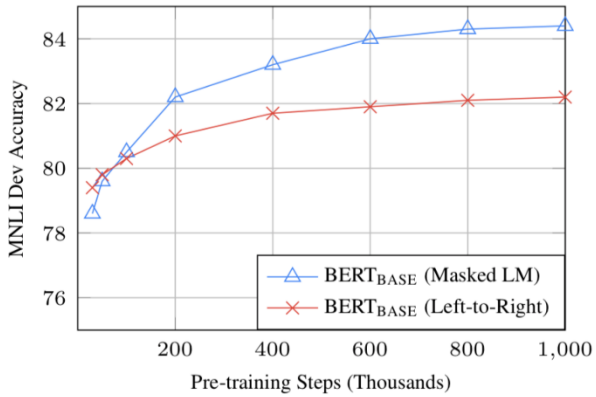

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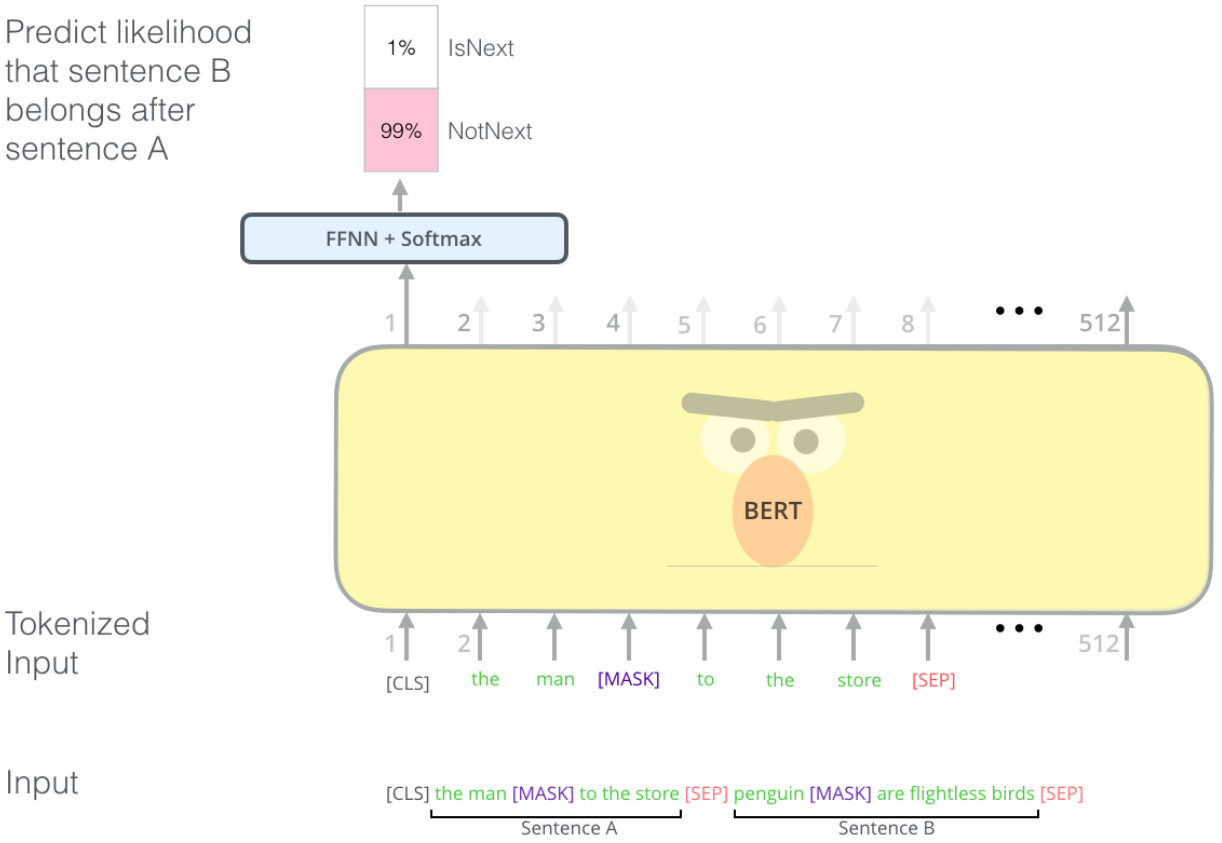

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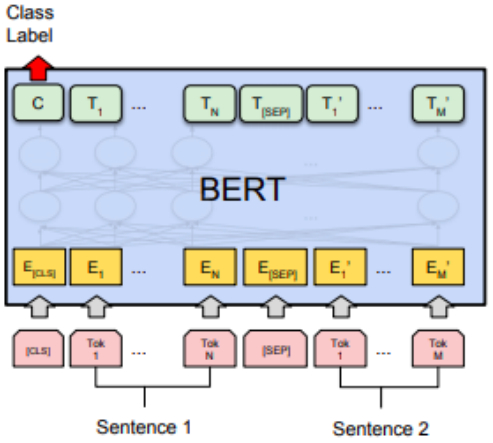
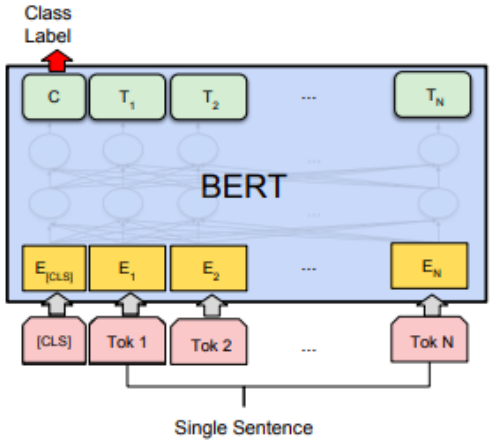
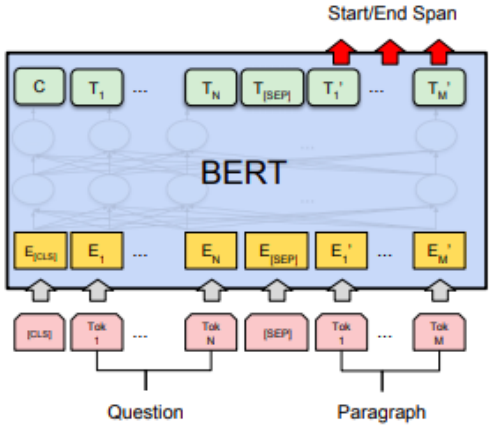
BERT Fine-Tuning Tasks (bzgl. GLUE Benchmark)



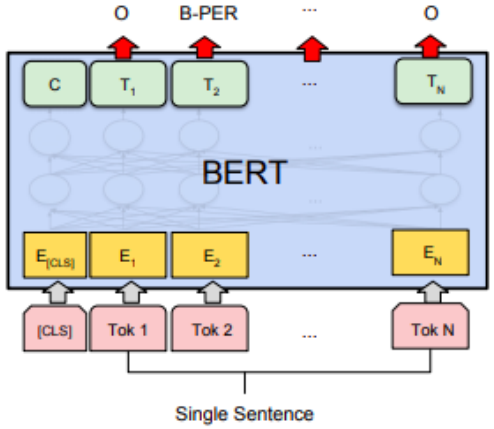
(a) Sentence Pair Classification Tasks: MNLI, QQP, QNLI, STS-B, MRPC, RTE, SWAG



(b) Single Sentence Classification Tasks: SST-2, CoLA



(c) Question Answering Tasks: SQuAD v1.1



(d) Single Sentence Tagging Tasks: CoNLL-2003 NER

The Illustrated BERT, ELMo, and co. (How NLP Cracked Transfer Learning), 2018
jalammar.github.io/illustrated-bert/