AI Applications Lecture 4

Licenses and Openness

SUZUKI, Atsushi
Jing WANG

September 1, 2025

Outline

Introduction

1.1 Review of the Previous Lecture

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- A **checkpoint** contains the **specific parameter values** obtained through training.
- Only with both the architecture $f_{(\cdot)}$ and the checkpoint θ is a **specific function** f_θ uniquely determined.

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$$\text{Architecture } f_{(\cdot)} : \Theta \to \{\mathcal{X} \to \mathcal{Y}\}, \qquad \boldsymbol{\theta} \in \Theta \mapsto f_{\boldsymbol{\theta}} : \mathcal{X} \to \mathcal{Y}.$$

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- **Training** is determining parameters $\boldsymbol{\theta}^*$ based on data.
- **Inference** is applying the final function $f_{\boldsymbol{\theta}^*}$.

1.2 Learning Outcomes

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By the end of this lecture, students should be able to explain and judge the following:

- Systematically explain the **various stages of releasing and licensing a neural network model**.
- Determine whether a model provided under an **Open Source Software (OSS)** license can be **used for their own purposes**, by referencing major licenses.

1.3 Disclaimer

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- The goal is to **reasonably prevent** legal risks.
- **Final decisions should be made at your own responsibility. Refer to official documentation [1, 2, 3].**

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- **Almost Open:** Architecture, checkpoints, and even the training code or "recipes" are released.
- A model's **license** determines if others can freely use it, regardless of how "open" it is.

Example (The Staged Release of GPT-2)

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- Initially, the most powerful 1.5B parameter model was completely closed.
- The full model was eventually released in November 2019 after a period of study and debate [5].

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- **Inference is executed on their servers**.
- The **details of the architecture and checkpoints are generally not disclosed** [6].
- Users only interact with prompts and outputs.

Example ("Open" Models and Distribution Platforms)

Models like **Llama** (Meta), **Qwen** (Alibaba), **Mistral** (Mistral AI), and **DeepSeek** (DeepSeek AI) are known as **open (Open Weights/Open Model)**.

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- The **Hugging Face Hub** is a major platform for their distribution [7].
- You can download the architecture and checkpoints to run locally.
- Licenses are (usually) clearly stated in the model repositories. [8, 9, 10, 11, 12]

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- The **training algorithm** (including the complete training recipe and scripts for reproduction).

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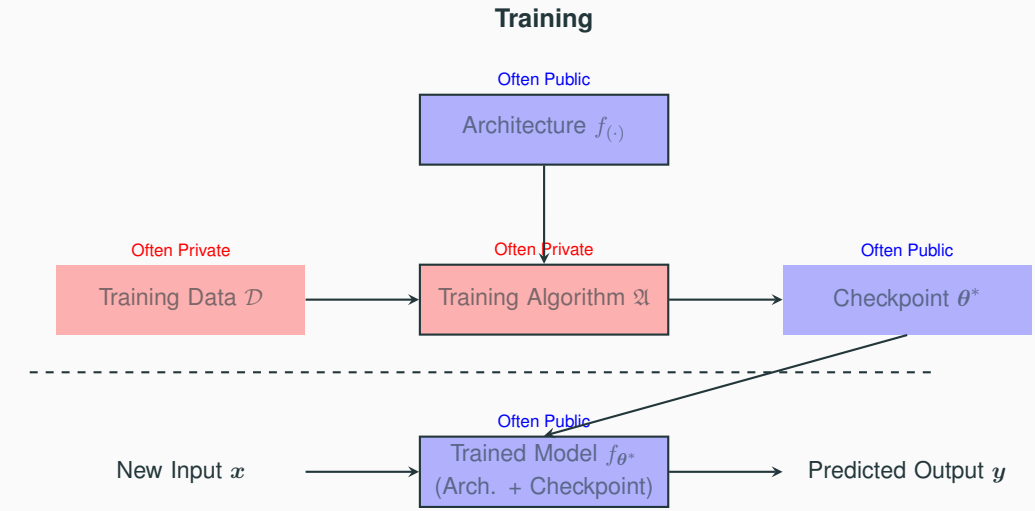
Even with "open weights," if the **insights from the training process** are not disclosed, the reproducibility and potential for adaptation are limited.

3.1 Visualizing the Relationship

This diagram uses our framework to show what's typically open vs. private.



Specific Examples of Release Stages

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- Example: OpenAI's generally available models like GPT-4 and beyond [6].

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- Examples: Mistral 7B (Apache 2.0) [10], DeepSeek-R1 (MIT) [11].
- The **training data and complete training procedures** are often not disclosed.

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- **Model examples**: **DeepSeek-v3**, **DeepSeek-R1** [11].

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- **Model/Library example**: The classic machine learning library **scikit-learn** [15].

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- **Model Example**: **YOLOv5** uses AGPL-3.0 [19].

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- Careful consideration is required, especially for commercial use.

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Model-Specific Licenses (Open-Weight Type)

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Recent **open-weight** models sometimes use **custom terms that are not standard OSS licenses**.

These often include use restrictions or thresholds based on Monthly Active Users (MAU).

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The **Community License** for the Llama 3 series allows **commercial use with restrictions** [8, 20].

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- The **700 million MAU** threshold clause is well-known for Llama 2 and 3.

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- However, smaller models in the same series (e.g., Qwen2.5-7B-Instruct) are licensed under the standard **Apache License 2.0**.

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- Later versions, like Qwen 3, seem to have standardized on Apache 2.0.

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- Key variations include:
  - **CC BY 4.0** (Attribution) [22]
  - **CC BY-SA 4.0** (ShareAlike) [23]
  - **CC BY-NC 4.0** (NonCommercial) [24]

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However, the **license for each checkpoint** you download to use with that library is **separate**.

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For example, within the same Transformers framework:

- **DeepSeek-R1** weights are MIT [11].
- The **Mistral** family is Apache 2.0 [10].
- The **Llama** family has its own custom license [8, 9].

Model Versions and License Differences Across Versions

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Example (Qwen 2.5 (Alibaba))

As we saw, different models in the Qwen 2.5 series had different licenses (custom vs. Apache 2.0) [9]. You must check the license for the specific model you wish to use.

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- **Scale**: The number of parameters (e.g., 7B vs 72B).
- **Fine-tuning**: Whether it's a base model or tuned for a specific task (e.g., "Instruct").

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In mathematical terms, the parameters (checkpoint) are a real vector:

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Generally, a higher parameter count increases expressive power but also computational cost.

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- **bf16 (Bfloat16)**: 16 bits. Wide dynamic range like fp32, but lower precision than fp16. Good for training stability [25].

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Common formats include:

- **fp32 (single-precision)**: 32 bits. High precision, large memory. A 7B fp32 model needs about $7 \times 4 = 28$ GB.
- **fp16 (half-precision)**: 16 bits. Halves memory usage, but has a smaller dynamic range.
- **bf16 (Bfloat16)**: 16 bits. Wide dynamic range like fp32, but lower precision than fp16. Good for training stability [25].
- **Quantization**: Using even fewer bits (e.g., **int8**, **int4**). Drastically reduces size and speeds up inference, often with a small accuracy drop.

9.2.1 Precise Definition of Floating-Point Numbers

The standard for floating-point numbers is **IEEE 754**. A number is represented by three parts: a **Sign**, an **Exponent**, and a **Mantissa/Fraction**.

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Table 1: Bit Allocation for Floating-Point Formats

Format	Total Bits	Sign	Exponent	Mantissa	Bias
fp32	32	1	8	23	127
fp16	16	1	5	10	15
bf16	16	1	8	7	127

9.2.2 Comparison of fp16 and bf16

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- **bf16**: Longer **exponent (8 bits)** $\implies$ **wide dynamic range** (same as fp32). Shorter **mantissa (7 bits)** $\implies$ **lower precision**.

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Example (A number representable in bf16 but not in fp16)

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Large number: Consider $V = 100,000$.

- **fp16**: The maximum representable value is 65,504. Therefore, $100,000$ **overflows** to infinity (∞).
- **bf16**: Has the same dynamic range as fp32. It can be **represented without issue**.

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Example (A number representable in fp16 but not in bf16)

A number requiring precision: Consider $V = 1 + 2^{-8} = 1.00390625$. In binary, this is $(1.00000001)_2$.

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- **fp16**: The mantissa has 10 bits. It can **accurately represent** the ‘1‘ in the 8th decimal place.
- **bf16**: The mantissa has only 7 bits. The 8th bit does not fit and is rounded. It **cannot distinguish** between 1 and $1 + 2^{-8}$.

9.3 Instruction Finetuning

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- A base large language model (foundation model) is trained to predict the next word.
- Additional fine-tuning is performed using a dataset of "instruction (prompt) and desired response" pairs [26].
- This teaches the model to be a helpful assistant, follow diverse instructions, and engage in conversation.

Practical Guidelines and Caveats

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Summary

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- In practice, one must understand the nature of licenses like **MIT** / **BSD-3** / **Apache 2.0** / **GPL-3** and always check the **LICENSE and model card for each model**.

Next Time

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- The **surrounding components** (tokenizer, pre/post-processing, inference runtime).

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