Machine Learning

Exam and AI Hype

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ML Research

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3. AI/ML/DL “buzzwords” / hype

Exam information

- Exam format: **hand-written on paper**
- Exam duration: **1.5 hrs** (mandatory) + 1 hr (if needed, but no lunch/dinner then)
- Materials allowed to be used: **hand-written notes** + **calculator**
- **No one** is allowed to use either the **phone**, **laptop** or **printed materials**
- Exam parts:
  1. ML Pipeline Design: 60%
  2. Short questions about the course content: 20%
  3. Simple ML-related calculations: 20%

Time for questions

Exam topics: ML pipeline design

Demonstrate the ability to design the ML pipeline for any given problem. It should consist (but not limited to) of the following sub-steps:

- Clear ML task statement
- Data collection strategy
- Data preparation routines
- Model and loss function design
- Success metrics and eval procedure
- Model selection approach

Exam topics: ML concepts

Demonstrate the deep knowledge of the following ML concepts:

- Supervised Learning, types of models (high-level)
- Input feature types and dimensionality
- Empirical vs Structural Risk Minimization
- Overfitting vs Underfitting and methods to avoid them
- Cross-Validation
- Model Selection pipeline and why it is important
- Classification vs Regression
- Classification and Regression loss functions
- Classification quality metrics (including accuracy, precision, and recall)
- Regression quality metrics (including MAE, MSE, and RMSE)
- Binary vs Multi-class Classification
- Micro- vs Macro- Averaging for Multi-class Classification
- L1 (Manhattan) and L2 (Euclidian) norms (distances)
- k-NN Classification and k-NN Regression
- Linear Regression: Ridge, LASSO, and Elastic variants

Exam topics: ML calculations

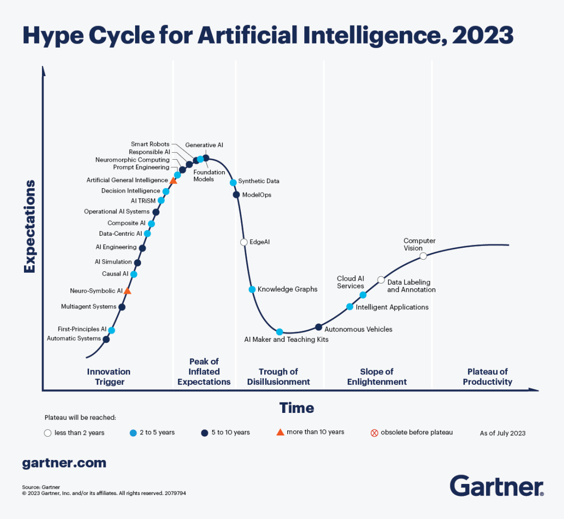
Additionally, to be able to compute auxiliary things like:

- TP, FP, FN, TN
- TPR, FPR, FNR, TNR
- MAE, MSE, RMSE
- Accuracy, Precision, Recall
- Empirical Risk
- L1 (Manhattan) and L2 (Euclidian) norms (distances), and simple equalities/inequalities based on them

AI “buzzwords” requests

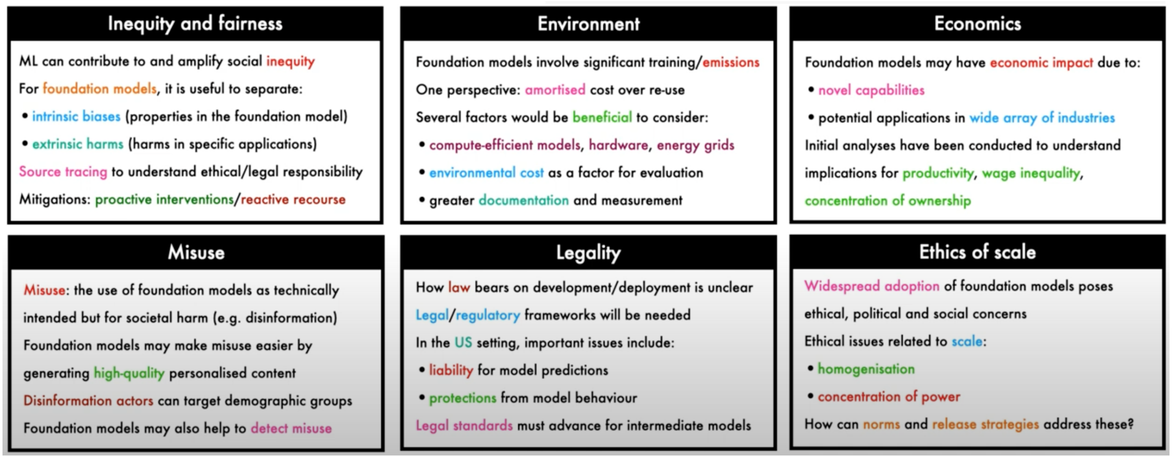
- LLM (GPT / BERT) (application, prompts, mechanisms of training and limited data regime, logical reasoning)
- NLP vs GPT vs Chatbots, Algorithm vs Code, Supervised learning > Semi-supervised learning > Unsupervised
- Generative AI (distributions)
- Embodied AI / Self Driving: what key AI development will be required behind the success of embodied AI (insufficient data of the right form)
- OpenAI, AI Regulations, and Compliance (every app inherits the initial bias, emergent properties)
- AI Art Generator (Stable Diffusion)
- Transfer Learning: Understanding how and when to use transfer learning can save time and computational resources.
- Transformer Architecture
- AI in logistic (NP-hard tasks)
- Different use cases of AI in the real world and how the field is evolving (let’s start with it)

AI Hype Cycle[1]



[1] www.gartner.com

AI ethics and regulations[2]



Inequity and fairness

ML can contribute to and amplify social inequity

For foundation models, it is useful to separate:

- intrinsic biases (properties in the foundation model)
- extrinsic harms (harms in specific applications)

Source tracing to understand ethical/legal responsibility

Mitigations: proactive interventions/reactive recourse

Environment

Foundation models involve significant training/emissions

One perspective: amortised cost over re-use

Several factors would be beneficial to consider:

- compute-efficient models, hardware, energy grids
- environmental cost as a factor for evaluation
- greater documentation and measurement

Economics

Foundation models may have economic impact due to:

- novel capabilities
- potential applications in wide array of industries

Initial analyses have been conducted to understand implications for productivity, wage inequality, concentration of ownership

Misuse

Misuse: the use of foundation models as technically intended but for societal harm (e.g. disinformation)

Foundation models may make misuse easier by generating high-quality personalised content

Disinformation actors can target demographic groups

Foundation models may also help to detect misuse

Legality

How law bears on development/deployment is unclear

Legal/regulatory frameworks will be needed

In the US setting, important issues include:

- liability for model predictions
- protections from model behaviour

Legal standards must advance for intermediate models

Ethics of scale

Widespread adoption of foundation models poses ethical, political and social concerns

Ethical issues related to scale:

- homogenisation
- concentration of power

How can norms and release strategies address these?

[2] www.youtube.com

Transformers

- Overall architecture: `http://jalammar.github.io/illustrated-transformer/`
- Decoder-only variant (GPT): `http://jalammar.github.io/illustrated-gpt2/`

Time for questions

Thank you *all*!