How I Use Language Models for My Research

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STOR-C

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Disclaimer

- Just my personal opinions
- LLM is rapidly evolving
- Not going to cover the ethics
  (e.g. data privacy, energy usage, monopolised technology …)
- Nothing on Copilot

“It doesn't matter if a cat is black or white,
if it catches mice it's a good cat.”

Language Models

Product Name	Company	Country	Subscription Fee
ChatGPT	OpenAI	USA	~£15 / month
Claude	Antropic	USA	~£13 / month
DeepSeek	DeepSeek	China	Free
Gemini	Google	USA	~£19 / month (Free for students?)

Using Language Models

- Via Browser
  - Open https://chatgpt.com/
  - Sign up for an account
  - Ready to play!

- Via API
  - More complicated … Maybe next time …

(My) Glossary

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Term	Meaning
Prompt Engineering	Ask the question (nicely)
Modality	Types of allowed input (e.g. text, image, audio)
Role prompting	Assign roles to the LLM and the user
In-Context Learning	Give some examples, and ask the LLM to extrapolate
Hallucination	Wrong answer, but looks plausible
Chain-of-thought	Step by step description of how the answer is obtained
Pre-Training	Model with neural network weights learned using a large, general dataset
Fine-Tune	Use a specialised dataset to improve a pre-trained model on certain tasks. (e.g. LoRA)
Distillation	Train a smaller model using data from a large pre-trained model.

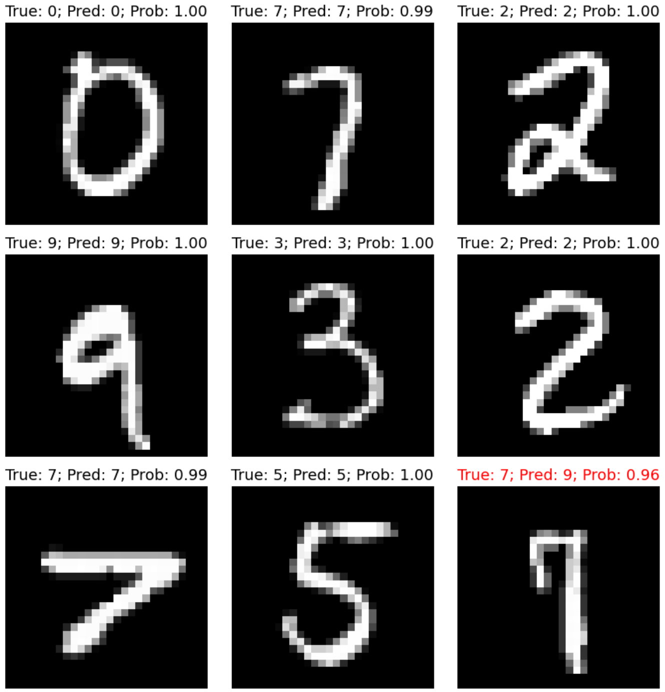
Andrej Karpathy
@karpathy

There's a new kind of coding I call "vibe coding", where you fully give in to the vibes, embrace exponentials, and forget that the code even exists. It's possible because the LLMs (e.g. Cursor Composer w Sonnet) are getting too good. Also I just talk to Composer with SuperWhisper so I barely even touch the keyboard. I ask for the dumbest things like "decrease the padding on the sidebar by half" because I'm too lazy to find it. I "Accept All" always, I don't read the diffs anymore. When I get error messages I just copy paste them in with no comment, usually that fixes it. The code grows beyond my usual comprehension, I'd have to really read through it for a while. Sometimes the LLMs can't fix a bug so I just work around it or ask for random changes until it goes away. It's not too bad for throwaway weekend projects, but still quite amusing. I'm building a project or webapp, but it's not really coding - I just see stuff, say stuff, run stuff, and copy paste stuff, and it mostly works.

11:17 PM · Feb 2, 2025 · **5M** Views

Task 1

- Code up MNIST classification with 2-layer MLP in Torch



Task 2

- Get an overview of a new topic

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JOURNAL ARTICLE

Conformal prediction with local weights: randomization enables robust guarantees

Get access >

Rohan Hore ✉ , Rina Foygel Barber

Journal of the Royal Statistical Society Series B: Statistical Methodology, Volume 87, Issue 2, April 2025, Pages 549–578, https://doi.org/10.1093/jrsssb/qkae103

Published: 11 November 2024 **Article history** ▾

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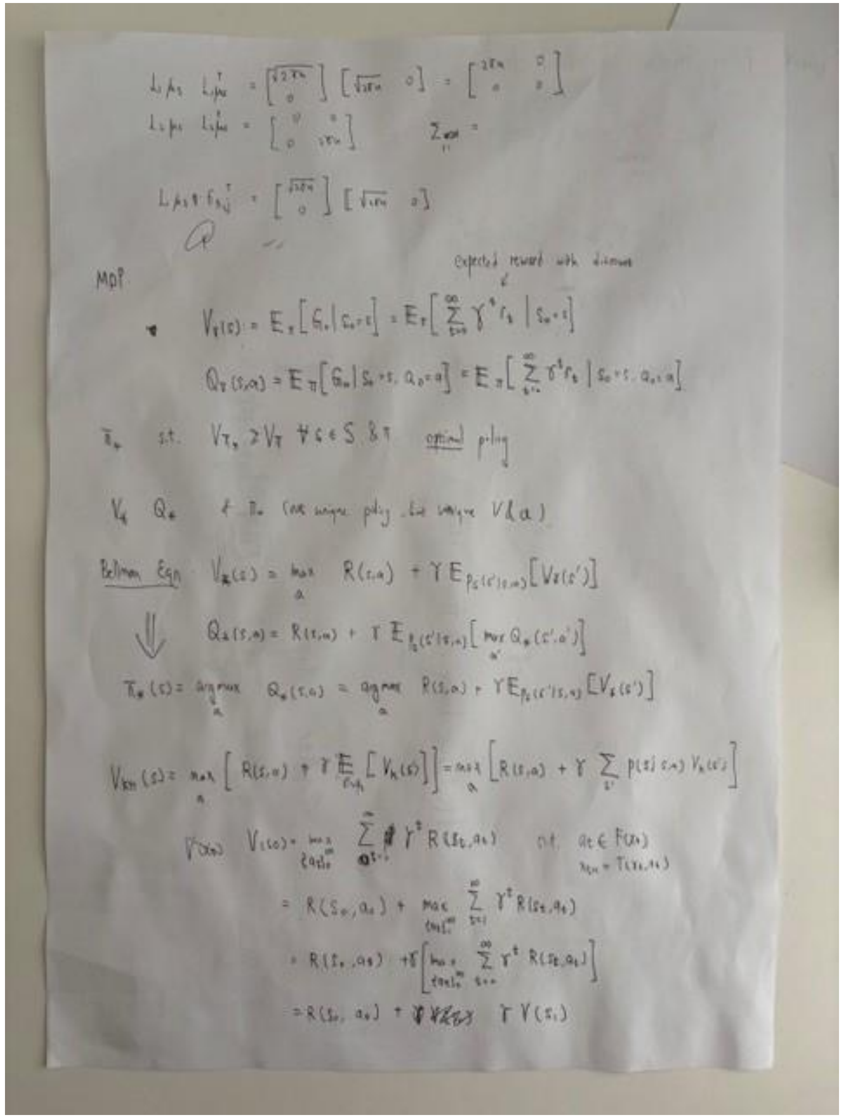
Abstract

In this work, we consider the problem of building distribution-free prediction intervals with finite-sample conditional coverage guarantees. Conformal prediction (CP) is an increasingly popular framework for building such intervals with distribution-free guarantees, but these guarantees only ensure marginal coverage: the probability of coverage is averaged over both the training and test data, meaning that there might be substantial undercoverage within certain subpopulations. Instead, ideally we would want to have local coverage guarantees that hold for each possible value of the test point's features. While the impossibility of achieving pointwise local coverage is well established in the literature, many variants of conformal prediction algorithm show favourable local coverage properties empirically. Relaxing the definition of local coverage can allow for a theoretical understanding of this empirical phenomenon. We propose randomly localized conformal prediction (RLCP), a method that builds on localized CP and weighted CP techniques to return prediction intervals that are not only marginally valid but also offer relaxed local coverage guarantees and validity under covariate shift. Through a series of simulations and real data experiments, we validate these coverage guarantees of RLCP while comparing it with the other local conformal prediction methods.

Keywords: distribution free prediction intervals, conformal prediction, local coverage guarantees, localized conformal prediction, weighted conformal prediction, distribution shift

Task 3

- Scribblings to LaTeX / Rmd


MDP

expected reward with discount

$$V_\pi(s) = E_\pi[G_0 \mid s_0 = s] = E_\pi\left[\sum_{t=0}^{\infty} \gamma^t r_t \mid s_0 = s\right]$$

$$Q_\pi(s,a) = E_\pi[G_0 \mid s_0 = s, a_0 = a] = E_\pi\left[\sum_{t=0}^{\infty} \gamma^t r_t \mid s_0 = s, a_0 = a\right]$$

π_* s.t. $V_{\pi_*} \geq V_\pi \; \forall s \in S \; \& \; \pi$ optimal policy

Bellman Eqn $V_*(s) = \max_a R(s,a) + \gamma E_{p_s(s'|s,a)}[V_*(s')]$

$$Q_*(s,a) = R(s,a) + \gamma E_{p_s(s'|s,a)}[\max_{a'} Q_*(s',a')]$$

$$\pi_*(s) = \arg\max_a Q_*(s,a) = \arg\max_a R(s,a) + \gamma E_{p_s(s'|s,a)}[V_*(s')]$$

$$V_{k+1}(s) = \max_a \left[R(s,a) + \gamma E_{s'} [V_k(s')] \right] = \max_a \left[R(s,a) + \gamma \sum_{s'} p(s'|s,a) V_k(s') \right]$$

$$V(s_0) = \max_{\{a_t\}_0^\infty} \sum_{t=0}^{\infty} \gamma^t R(s_t, a_t) \quad \text{s.t. } a_t \in F(x_t),\; x_{t+1} = T(x_t, a_t)$$

$$= R(s_0, a_0) + \max_{\{a_t\}_1^\infty} \sum_{t=1}^{\infty} \gamma^t R(s_t, a_t)$$

$$= R(s_0, a_0) + \gamma \left[\max_{\{a_t\}_1^\infty} \sum_{t=1}^{\infty} \gamma^{t} R(s_t, a_t) \right]$$

$$= R(s_0, a_0) + \gamma V(s_1)$$

Lancaster AI Reading Group

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LAI Reading Group   Home   Schedule   Past Sessions   Resources   About

Physics-Informed ML (Using physical laws to guide learning models)	12% (6)
TinyML (ML with tight memory and energy constraints)	8% (4)
Causality (Modeling cause-effect beyond correlations)	10% (5)
NLP (Language models and processing text)	12% (6)
Generative Models (Creating data like images, text, or audio)	8% (4)
Optimisation for ML (Training algorithms and efficiency)	22% (11)
Bayesian Deep Learning (Uncertainty and probabilistic models)	20% (10)
Trends in ML (Recent breakthroughs and emerging topics)	6% (3)

16 responses

LAI Reading Group

Lancaster AI (**LAI**) reading group is a weekly reading group focusing on topics related to AI, including but not limited to: diffusion models, information geometry, stochastic optimisation, geometric deep learning. It will be more tutorial-styled, instead of seminar-styled, tailored more towards people who wish to learn more about the recent developments of AI. This reading group is supported by the Prob_AI Hub.

In Term 3, we are doing **geometric deep learning**.

PSC Lab 2 and over Teams; Wednesday 2-3pm (mostly).

See here for the **full schedules**; here for **past sessions**.

Next Session

Title	Location	Date	Time	Speaker
GNNs for RL	PSC Lab 2	4 June 2025	2 pm - 3 pm	Jack

Email Andreas or Cass for any question related to the reading group.

https://lai-reading-group.github.io/