

# Tomorrow's Competitive AI

**Agentic LLMs, Synthetic Environments,  
and Context Infrastructure**



*Anastasia Stasenko  
Pleias*

# About pleias

Pleias is a Paris-based lab on a mission to build **frontier AI**.

Since 2024, we have released:

- **Common Corpus** - the largest fully open corpus for pre-training (2T tokens), that has become third most downloaded corpus on HF and has been used for pretraining for over 8 LLMs (Apertus, Nvidia's Parakeet, Salamandra...)
- **pleias 1.0** : series of multilingual foundation models (350m, 1b) achieving SOTA in multilingual RAG tasks in their size category
- **Synth**: 200b SOTA synthetic dataset and two models (Baguettotron - 321m - and Monad - 50m) setting SOTA for synthetic reasoning pretraining.



# Our hypothesis

1. **Full synthetic training is viable** for small models, not just midtraining or <30% of pretrain.
2. Synthetic playgrounds are **more data efficient** than standard pretraining sources, as they allow for selective memorization and clearer reasoning signals.
3. Models trained exclusively on **open data** supplemented with synthetic methods are **fully competitive** with models trained on copyrighted/non-releasable data.

1.

# The context: what comes after pretraining?



# From post-training to training

Currently most of the model improvement happens **after pre-training** due to convergent developments in three directions:

- Synthetic data.
- Reasoning traces based on synthetic data (SFT cooldown)
- Reinforcement learning, over reasoning traces.

=> “Pre-training as we know it will end” (Sutskever)

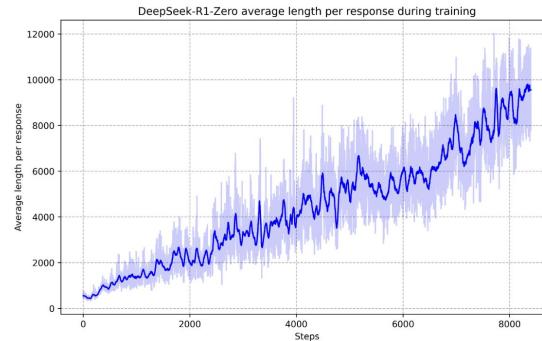
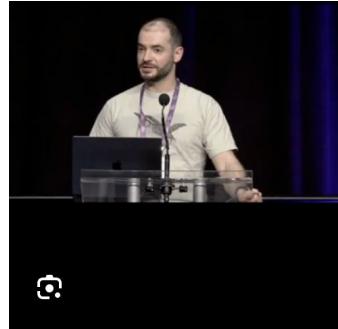


Figure 3 | The average response length of DeepSeek-R1-Zero on the training set during the RL process. DeepSeek-R1-Zero naturally learns to solve reasoning tasks with more thinking time.



Pre-training as we know it will end

Compute is growing:

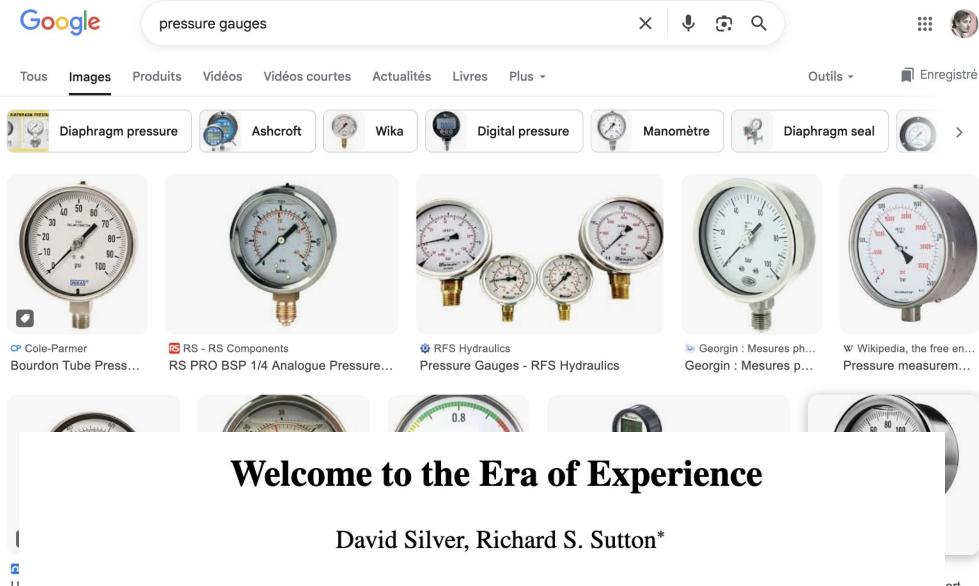
- Better hardware
- Better algorithms
- Larger clusters

Data is not growing:

- We have but one internet
- The fossil fuel of AI

# From post-training to training

Beyond the concerns over the “data wall”, web data seems to hit a capability ceiling in many areas: vision languages models routinely fail to read clocks or gauges since most available images are product descriptions.



**Abstract**  
We stand on the threshold of a new era in artificial intelligence that promises to achieve an unprecedented level of ability. A new generation of agents will acquire superhuman capabilities by learning predominantly from experience. This note explores the key characteristics that will define this upcoming era.

# From post-training to training

**Stage 1**

**Pretraining**

**Stage 2**

**Mid-training**

**Stage 3**

**Post-training**

# From post-training to training

**Stage 1**

**Pretraining**

**Stage 2**

**Mid-training**

**Stage 3**

**Post-training**

**It's all training**

# Switching to controlled environments

In Frontier labs and, increasingly openly documented research, large pretraining dataset are being completed if not replaced by *synthetic environment* or *synthetic playgrounds*. A primary motivation has been **increasing data efficiency** and focus training on the acquisition of targeted skills.

## Physics of Language Models: Part 4.1, Architecture Design and Canon Layers”

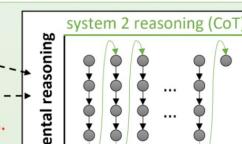
Results 0

**Design Criteria for Synthetic Pretrain Tasks**

- ❖ **Challenge architectural depth:** avoid shallow tasks (e.g., associative recall)
- ❖ **Test mental reasoning (system-1):** mental depth  $4 \times 8$  CoT steps = 32 total steps.
- ❖ **Focus on short (e.g., 4096) context length**



long context (e.g., 1M tokens) summarization (CoT) context length 4096



mental reasoning  
system 2 reasoning (CoT)

our focus for architecture design

long context often summarized to short windows for deep reasoning

**Five Synthetic Tasks Isolating Atomic Skills**

- ❖ **(DEPO): Mental reasoning depth**  


...  $\circlearrowleft \rightarrow \circlearrowleft \rightarrow \circlearrowleft \rightarrow \circlearrowleft \cdots$  (directed path given in random order)  
 $\Rightarrow$  What's the  $k$ -th successor of A?
- ❖ **(BREVO): Mental reasoning breadth**  


...  $\circlearrowleft \rightarrow \circlearrowleft \rightarrow \circlearrowleft \rightarrow \circlearrowleft \cdots$  (DAG given in random order)  
 $\Rightarrow$  What does A depend on, list in topological order?

❖ **(CAPO): Knowledge capacity**  
 how many bit-per-parameter can a model store?

❖ **(MANO): Knowledge manipulation**  
 knowledge  $\rightarrow$  manipulate  $\rightarrow$  knowledge  $\rightarrow$  manipulate  $\rightarrow \dots$

❖ **(LANO): Hierarchical language structure learning**  
 parse tree 2  
  
 parse tree 1  

1	2	3	3	1	3	3	1	2	1	2	1	1	1	2	...
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	-----

*“We design synthetic tasks to systematically evaluate specific capabilities of language model architectures under controlled conditions, minimizing confounds and enabling clean comparisons”*  
*(Physics of Language Model, 4.1)*

# **From post-training to training**

**What if we bundled all synthetic pipelines  
into one generalist environment?**

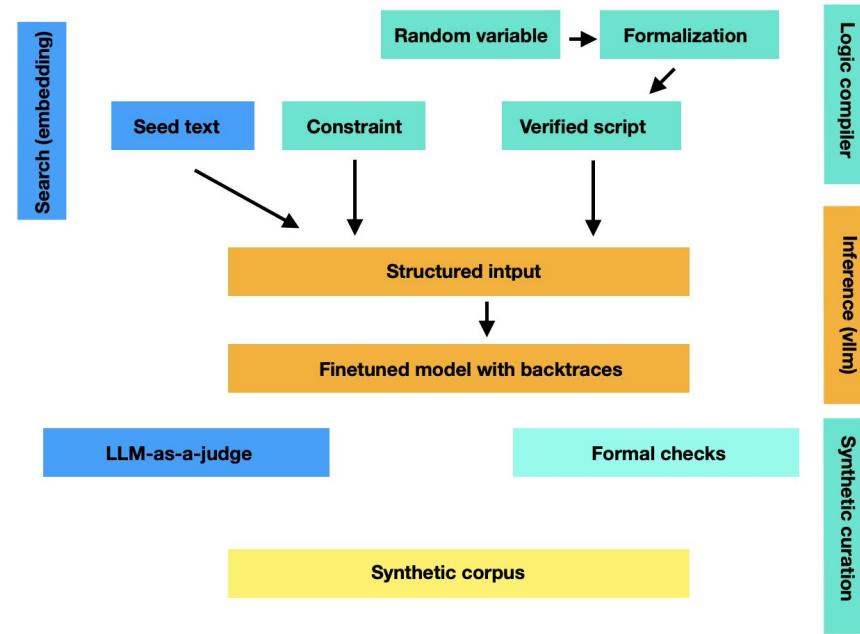
2.

# Building synthetic environments



# Building SOTA synthetic data pipelines

Our approach is based on **synthetic pipelines** and **environments** not simply prompting existing model but use them as constrained text generators. Our bundled generalist environment cover the entire range of capacities you expect in language models.



# SYNTH Initiative

Over the last few months, we have been working on a generalist synthetic pipeline to train more efficient small language models, thanks to the availability of high quality of open datasets and to the release of fully open weight models without restriction for data reuse

Datasets: PleiAs / SYNTH like 0 Following PleiAs 444

Dataset card Files and versions xet Community Settings

Dataset Viewer Auto-converted to Parquet API Embed Data Studio

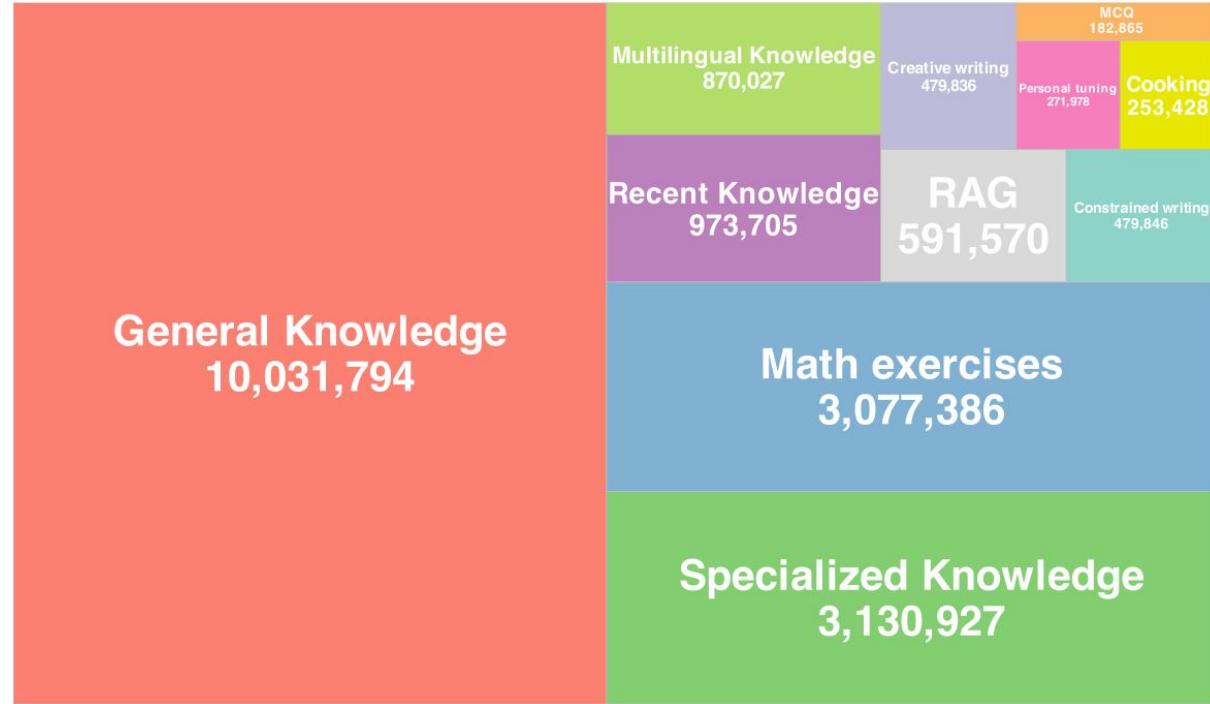
synth_id	language	exercise	model	query	query_seed_url	query_seed_text	query_se
string	string	string	string	string	string	string	string
synth_14376	French	memorization	qwen-3-8b-memorization	Dis donc, si on appliquait le...	https://en.wikipedia.org/wiki/...	Détente is the relaxation of straine...	CC-BY-S
synth_93383	English	memorization	qwen-3-8b-memorization	Why do high-energy electrons...	https://en.wikipedia.org/wiki/...	Quantum mechanical description The...	CC-BY-S
synth_96749	English	memorization	qwen-3-8b-memorization	I wonder whether Quetzalcoatl's...	https://en.wikipedia.org/wiki/...	Deities The four main deities worshiped by...	CC-BY-S
synth_94490	English	memorization	qwen-3-8b-memorization	I'm working on a comparative...	https://en.wikipedia.org/wiki/...	Europe During the late 2010s, the comparativ...	CC-BY-S
synth_97686	English	memorization	qwen-3-8b-memorization	How the Company Law of China...	https://en.wikipedia.org/wiki/...	China According to the Company Law of the...	CC-BY-S
synth_239514	Latin	creative_writing	qwen-3-8b-creative...	I'm seeking to commission a...	https://en.wikipedia.org/wiki/...	Cretaceous Period The Cretaceous Period...	CC-BY-S
synth_98760	English	memorization	qwen-3-8b-memorization	How long will the vaccine work so...	https://en.wikipedia.org/wiki/...	Vaccination Spanish physician Jaume Ferr...	CC-BY-S

# Synth Initiative

synth_id	language	exercise	model	query	query_seed_url	query_seed_text	query_seed_license	constraints	synthetic_reasoning	synthetic_answer
synth_14376	French	memorization	qwen-3-8b-m	Dis donc, si j'appliquais le même... emorization	https://en.wikipedia.org/wiki/D%C3%A9tente	Détente is the relaxation of strained relations,...	CC-BY-SA (4.0)	### 1. Query Parsing "Dis donc... j'appliquais le même..."	La détente, concept diplomatique né en 1912,...	
synth_93383	English	memorization	qwen-3-8b-m	high-energy electrons emit photons... emorization	https://en.wikipedia.org/wiki/Bremstrahlung	Quantum mechanical description The complete...	CC-BY-SA (4.0)	Seed licensing	Backtreasoning	The angular distribution of photon emission in...
synth_96749	English	memorization	qwen-3-8b-m	I wonder whether Quetzalcoatl's temple... emorization	https://en.wikipedia.org/wiki/Deities	Deities The four main cities worshiped by the...	CC-BY-SA (4.0)	Backtranslation		I need to clarify a potential misconception...
synth_94490	English	memorization	qwen-3-8b-m	I'm working on a comparative analysis of... emorization	https://en.wikipedia.org/wiki/Product_liability	Europe During the late 2010s, the comparative...	CC-BY-SA (4.0)			Query breakdown: "procedural deficiencies in European civ..."
synth_97686	English	memorization	qwen-3-8b-m	How the Company Law of China structures the... emorization	https://en.wikipedia.org/wiki/Company	China According to the Company Law of the People'	CC-BY-SA (4.0)			The significant disparity between US and European...
synth_239514	Latin	creative_writing	qwen-3-8b-c	I'm seeking to commission a Latin... reative-wr...	https://en.wikipedia.org/wiki/Habesha_peoples	Cretaceous Period The Cretaceous Period extends...	CC-BY-SA (4.0)	temporal:publication_date...		Query: "Company Law of China structures... limited liability..."
synth_255287	German	memorization	qwen-3-8b-m	How long will the vaccine work good for... emorization	https://en.wikipedia.org/wiki/Cholera	Vaccination Spanish physician Jaume Ferran i...	CC-BY-SA	user wants "Latin dialogue from 1635" - immediately raise...	**DE DILUVIO MAGNO ET ARTIFICIO DIVINO**...	
synth_255022	German	memorization	qwen-3-8b-m	Inwieweit unterscheiden sich Peirce's... emorization	https://en.wikipedia.org/wiki/Fact	Etymology and usage The word fact derives from the...	CC-BY-SA (4.0)	## 1. Query Parsing "How long does the vaccine work good..."	## 1. Query Decomposition "Inwieweit unterscheiden sich Peirce's..."	I'm sorry, but I'm unsure about the specific duration...
synth_239972	English	memorization	qwen-3-8b-m	Warum haben die Vertragsarbeiter aus... emorization	https://en.wikipedia.org/wiki/Indo-Aryan_languages	Indentured labourer migrations The use by the...	CC-BY-SA (4.0)		## 1. Query Parsing "Warum haben die Vertragsarbeiter aus..."	Die wissenschaftlichen Methoden von Peirce und...
synth_239070	English	creative_writing	qwen-3-8b-c	Would you fashion a narrative that explores... reative-wr...	https://en.wikipedia.org/wiki/Chiang_Mai	A coin is a small object, usually round and flat,...	CC-BY-SA (4.0)	character:protagonist, te...	**Query parsing first.** "dialectical relationship between..."	Die Entwicklung lokaler Dialekte und...
synth_98726	English	memorization	qwen-3-8b-m	Can you fabricate a story set in modern-day... emorization	https://en.wikipedia.org/wiki/Tortious_interference	Sri Lanka Sri Lankan author Shakthika Sathkumara was...	CC-BY-SA (4.0)	spatial:place, character:...	User wants "realistic narrative centered around this writer..."	The air in the assay master's office was a...
synth_17450	French	memorization	qwen-3-8b-m	How intentional conduct differs from reckless... emorization	https://en.wikipedia.org/wiki/Battery_(tort)	England and Wales Following UK Tort law the tort of...	CC-BY-SA (4.0)		Query: "intentional conduct differs from reckless conduct..."	The controversy began, as most of them did now, with...
synth_98447	English	memorization	qwen-3-8b-m	Dans quelle mesure les théories de Hirschfeld... emorization	https://en.wikipedia.org/wiki/Bisexuality	Studies, theories and social responses There is...	CC-BY-SA (4.0)	## 1. Query Decomposition "Dans quelle mesure les théories de Hirschfeld..."	Under UK tort law, battery liability arises when a...	
				Is that true that there's a tidal land...	https://en.wikipedia.org/wiki/Yellow_Sea	Climate and hydrology The area has cold, dry winters...	CC-BY-SA (4.0)		Les théories de Magnus Hirschfeld et Sigmund Freud...	Yes, this phenomenon is indeed true. There is a...

# Synth Initiative: Current State

Today, Synth is largely centered on a generalist synthetic environment centered on the Structured Wikipedia datasets made available by the Wikimedia Foundation: about 58k core Wikipedia articles amplified a hundred times through memorization variants and other synthetic exercises (creative writing, translation, RAG, text editing, math).



# Synthetic methods: seeding.

Seeding is not just relevant for grounding synthetic data: it allows to indefinitely expand the original training sources so that they get better memorized in the final model. This process is called **upsampled rephrasing**.

For this we reused parts of our synthetic RAG pipelines: texts are *backtranslated* into queries, and then matched with more texts to create more knowledge connections.

## Wikipedia:Vital articles/Level/5

Project page Talk

Read Edit source View history Tools

From Wikipedia, the free encyclopedia

< Wikipedia:Vital articles

The five nested vital article Levels are meant to give direction to the prioritization of improvements of English Wikipedia articles (e.g. which articles to bring to WP:GA and WP:FA status), to provide a measurement of quality of overall English Wikipedia (e.g. what proportion of the most important articles are at GA and FA status), and to serve as a centralized watchlist of English Wikipedia's most important articles. Unlike the list of articles every Wikipedia should have, they are tailored to the English Wikipedia and are actively maintained by the dedicated WikiProject Vital Articles. This page contains links to the 50,000 articles of the Level 5 list.

Any addition to or removal from these lists should ONLY BE MADE after a discussion on the relevant Level 5 sub talk pages.

Level 1 (10 articles) < Level 2 (100 articles) < Level 3 (1,000 articles) < Level 4 (10,000 articles) < Level 5 (50,000 articles)

### Level 5 sub-lists [ edit source ]

Because of its size, Vital articles Level 5 has been split into several sub-lists. If you spot a duplicate listing, please remove one of them; if you aren't sure in which section a topic belongs, please initiate a discussion on the talk page. Please do not duplicate items on the same level of the list.



Our nearly unique source of knowledge: the 50,000 articles in Wikipedia:Vital Articles.

# Synthetic methods: constraints

A large amount of text-related skills in models are **semi-verifiable** and can be partly assessed with formal constraints: everything from “write a text in json” to oulipo-style creative writing, “don’t use the letter ‘e’”. Constraints proved especially critical to **enforce diversity** in model training.

Query parsing. "Pierre-Carl Langlais" + "without using letter 'e'".

Two constraints here:

1. Biographical accuracy •
2. Lipogrammatic writing ☰

The 'e' constraint is brutal. Most common English letter. Will force creative lexical choices.  
</think>

A vast, old man from a famous AI firm. A top mind in this domain. His work is full of innovation and vision.

His big goal is to build a truly smart AI. This kind of AI is not just for showing off its ability; it must also find its own way to do good. It should think with logic, with data, with a singular focus on its function.

This individual works hard to craft a strong AI that can do all kinds of tasks. A tool for building a world of thought, not just for showing off its capacity.

His work is so vital. It is a foundation for all AI that will soon dawn.

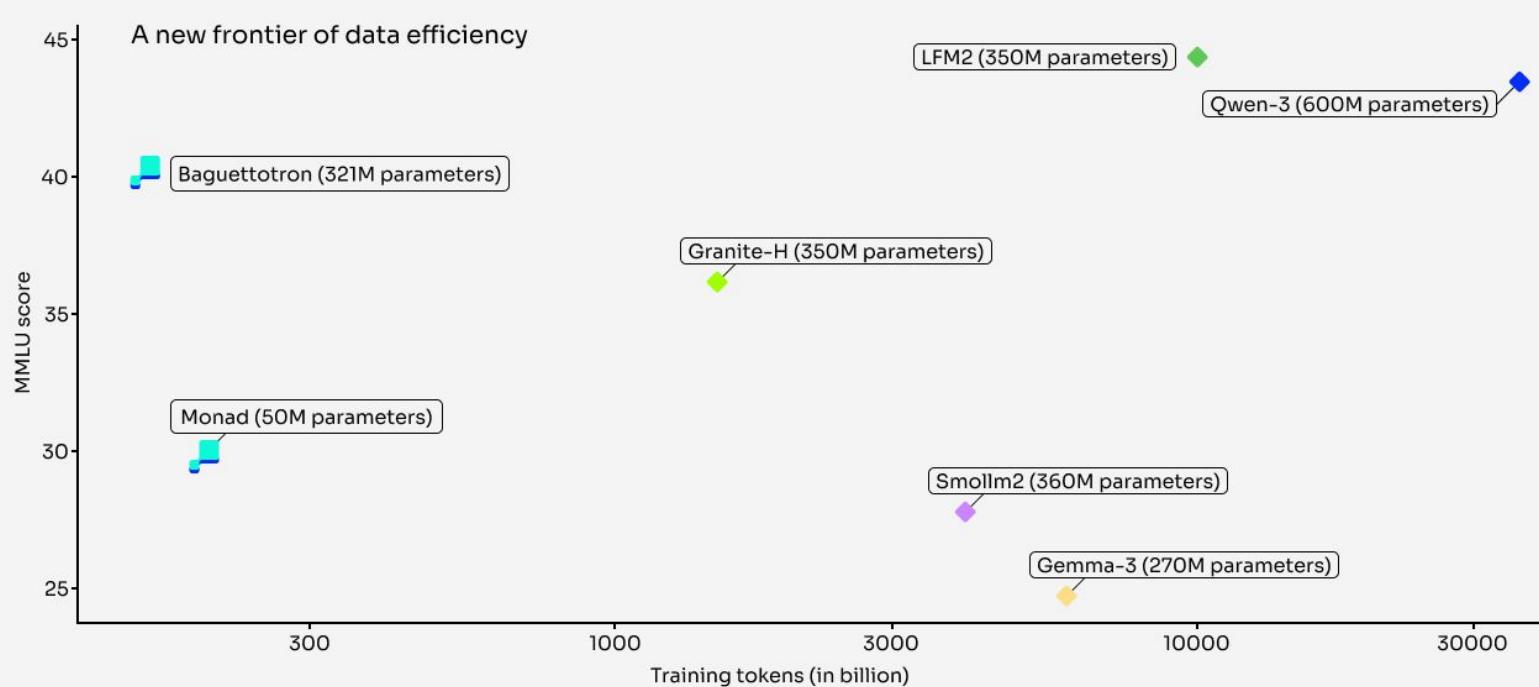
*Lipogram exercise successfully passed by our new 321M model*

**3.**

# New data, new models



# Setting a data-efficient state of the art



The first SYNTH models: a SOTA reasoning model in the 300M range and an entirely new category of “smallest viable model”.

# Setting a data-efficient state of the art

Model	Parameters	Billion tokens	MMLU	GSM8K	HotPotQA
Gemma-3-270M-IT	270	6000	25	3	23
<b>Baguettotron-321M</b>	321	<b>200</b>	<b>40</b>	<b>39</b>	<b>51</b>
LFM2-350M	350	10000	<b>44</b>	34	25
Granite-4-H-300M	360	1500	36	<b>39</b>	21
Granite-4-300M	360	1500	35	31	25
Smollm2-360M	360	4000	25	11	16
Qwen-3-600M	600	36000	44	40	<b>64</b>

By the end of the training cycle, Baguettotron performance was **best in class** despite being trained on **10x less data**.

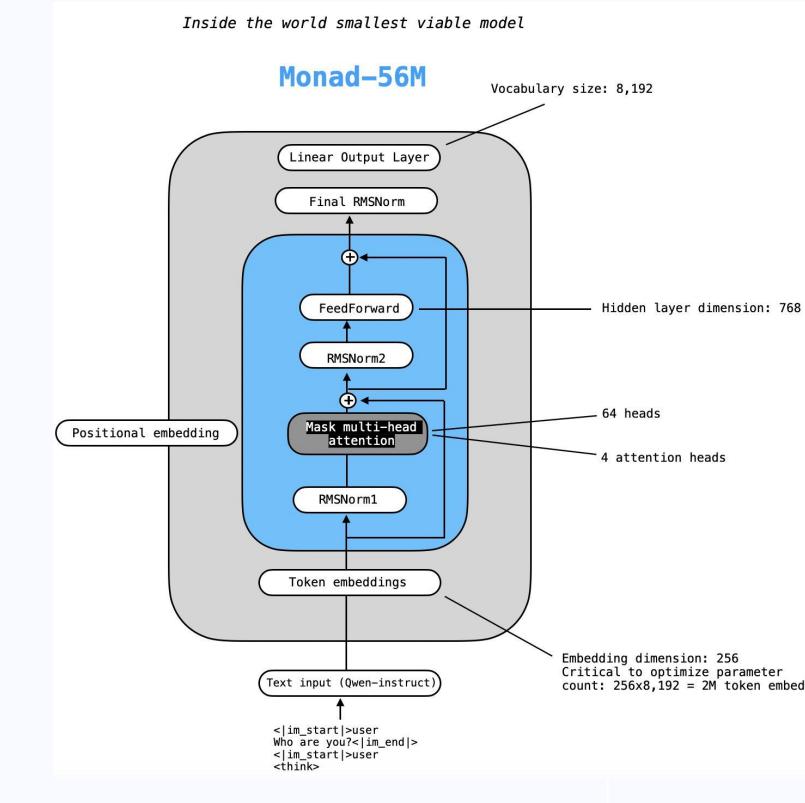
# Setting a data-efficient state of the art



In contrast with classic pre-training datasets, reasoning signals appear very early in training. With less than 10B tokens, Baguettotron was non-random on MMLU.

# The quest of the infinitely small frontier

An extreme design example: Monad, the smallest viable model to date. To define viable we required at least clear non-random results on MMLU and other standard reasoning evaluations. To fit on 56M parameters, Monad is strictly monolingual, uses its own custom tokenizer (8k tokens => only 3M parameters allocated for embeddings) and relies on super-thin layers.



# Toward a new ecosystem of model training

And the first wave of post-training experiments show that synthetic training does not lead to “model collapse”: Baguettotron a fully trainable models, already used for various use case from poetry to classification.

 darren ✅  
@darrenangle

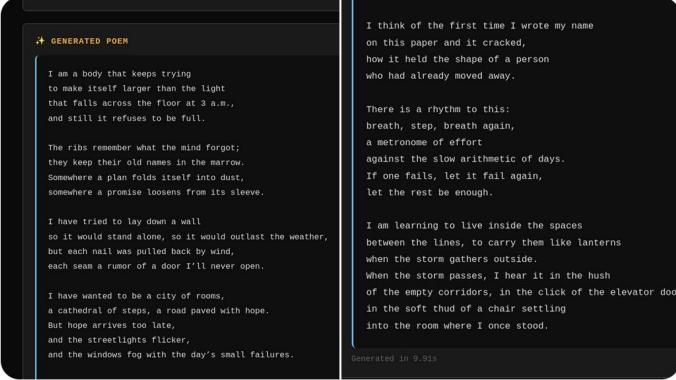
fine-tuned baguettotron on 10k kimi k2 poems + synthetic reasoning traces w/ poetic strategy

I'm kinda shocked that a 321M parameter model is capable of this kind of output

prompt: "write a poem about unfulfilled ambition"

sft 1.5 hrs on 2 4090s

[Traduire le post](#)



I think of the first time I wrote my name on this paper and it cracked, how it held the shape of a person who had already moved away.

There is a rhythm to this: breath, step, breath again, a metronome of effort against the slow arithmetic of days. If one fails, let it fail again, let the rest be enough.

I am learning to live inside the spaces between the lines, to carry them like lanterns when the storm gathers outside. When the storm passes, I hear it in the hush of the empty corridors, in the click of the elevator door in the soft thud of a chair settling into the room where I once stood.

Generated in 9.91s

4:25 AM · 17 nov. 2025 · 23,2 k vues

# Towards a new ecosystem of model training

Although SYNTH was released less than three weeks ago, research community has already significantly lowered the threshold for a minimal viable models: new experiments show consistent language, reasoning and memorization below 20M parameters.

 **Mariusz Kurman**   
@mkurman88

This is another version, a 19M parameter model, after processing 1 billion tokens.

[Traduire le post](#)

```
) Total parameters: 19564416, Trainable parameters: 19564416
tensor([[65491, 6869, 2177, 34874, 2922, 34]])
<|im_start|>What does hypertension mean?

<think>
Query: "What does hypertension mean?"

Simple information retrieval. Medical domain, cardiovascular disease context.

**Core definition**: Cardiac inflammation → cardiac dysfunction.

### 1. Mechanism Analysis

Cardiac inflammation = systemic damage to pulmonary arteries.
- Direct cause: heart failure → blood pressure ↑
- Indirect pathway: arterial circulation ↓
- Chronic condition: venous congestion → vascular compression

※Key insight: hypertension ≠ just symptoms. Symptoms emerge from underlying causes.

### 2. Clinical Context

Medical literature shows:
- Acute conditions (cardiovascular)
- Chronic conditions (heart failure)
```

11:04 AM · 17 nov. 2025 · 72,5 k vues

 18     22     302     175    

# Perspectives

1. Enterprise AI: a possibility of ***private efficient AI for industries?***
2. Towards ***true agentic models?***
2. Future of generative AI: ***decentralisation Vs oligopoly***