

# 《DeepSeek Starter Guide》 Volume 1: Technical Analysis

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# What is DeepSeek?

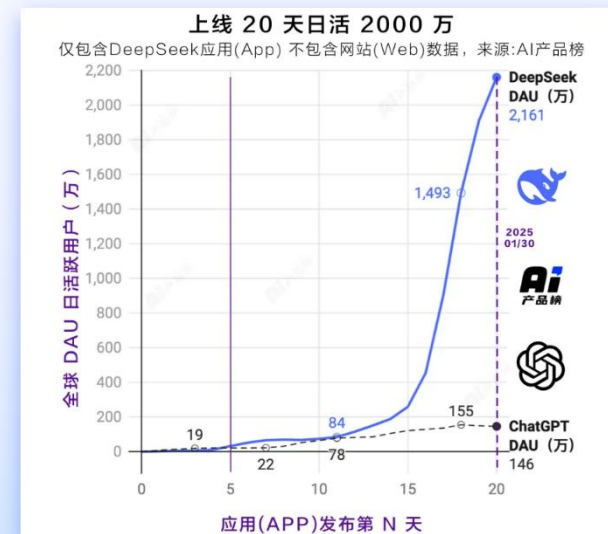
- What is DeepSeek?
- Three Key Features of DeepSeek R1
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# What is DeepSeek?

- DeepSeek is an LLM subsidiary founded by Liang Wenfeng under High-Flyer Quant in 2023.
- On January 5, 2024, it released its first AI LLM with the same name, DeepSeek LLM.
- On January 20, 2025, DeepSeek R1 was officially released, positioning it as a high-performance reasoning model benchmarking OpenAI GPT-4. R1 quickly gained popularity after its launch, and its application set a record for the fastest growth in global APP history.



Source: DeepSeek Official



Three Key Features of  
DeepSeek R1

# Three Key Features of DeepSeek R1

## High Performance

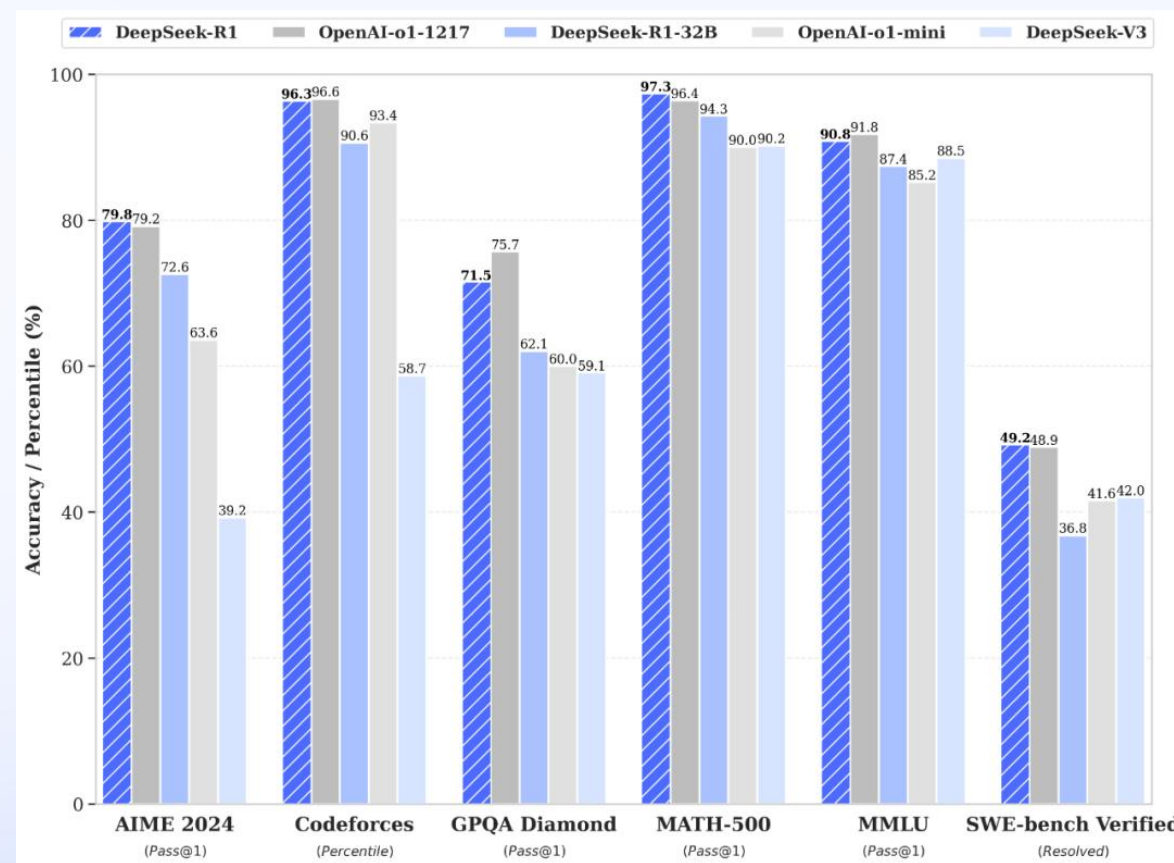
Reasoning performance comparable to OpenAI GPT-4 's official version.

## Open Source

R1 is open-source, with training techniques publicly available, allowing developers to access and learn from it.

## Low Cost

The development cost of R1 is only about 2% of OpenAI GPT-4' s.



Accuracy Comparison Between DeepSeek and OpenAI Versions (Source: DeepSeek Official)



# Five Ways to Use DeepSeek

## Ordinary Users

As a productivity tool and technology tasting experience.

Official Website

<https://chat.deepseek.com/>

APP

<https://chat.deepseek.com/>

API

<https://deepseekapi.io/>

## Developers and Enterprises

Ensuring access stability and scalability.

Local Deployment

Can be facilitated by tools such as Ollama, vLLM, and MNN.

Cloud Platform

SiliconFlow, Tencent Cloud, Alibaba Cloud, etc.

# Unveiling the Core Technologies of DeepSeek R1

- The Base Model of R1: V3
- Three Variants of R1
- Technical Path for Training R1
- Analysis of R1's Core Technologies
- Key Technical Contributions of R1

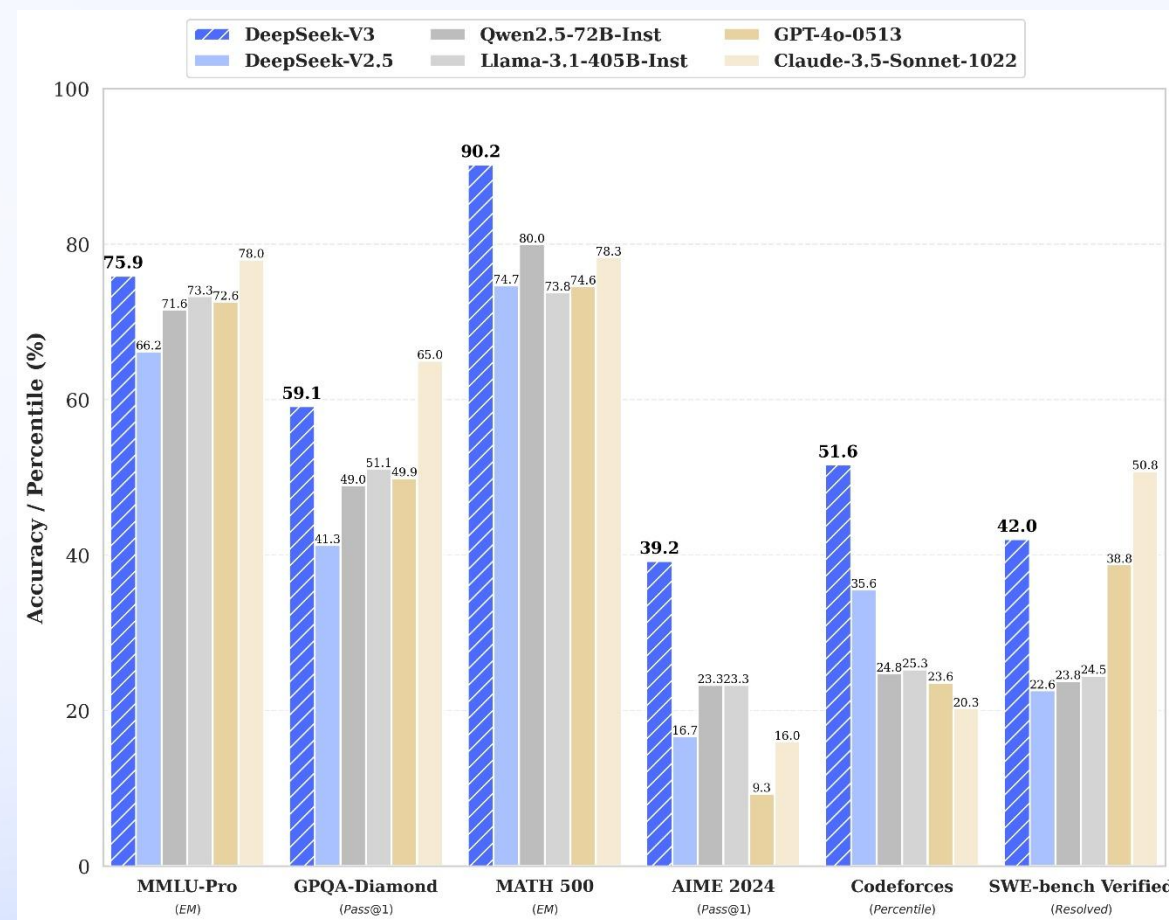
# The Base Model of R1: V3

## Features of the V3 Model

- V3 is a self-developed MoE model released in December last year
- V3's parameters are roughly on the same scale as GPT-4: V3 has 671B parameters, with approximately 37B activated per token.
- It underwent pre-training on 14.8T tokens.

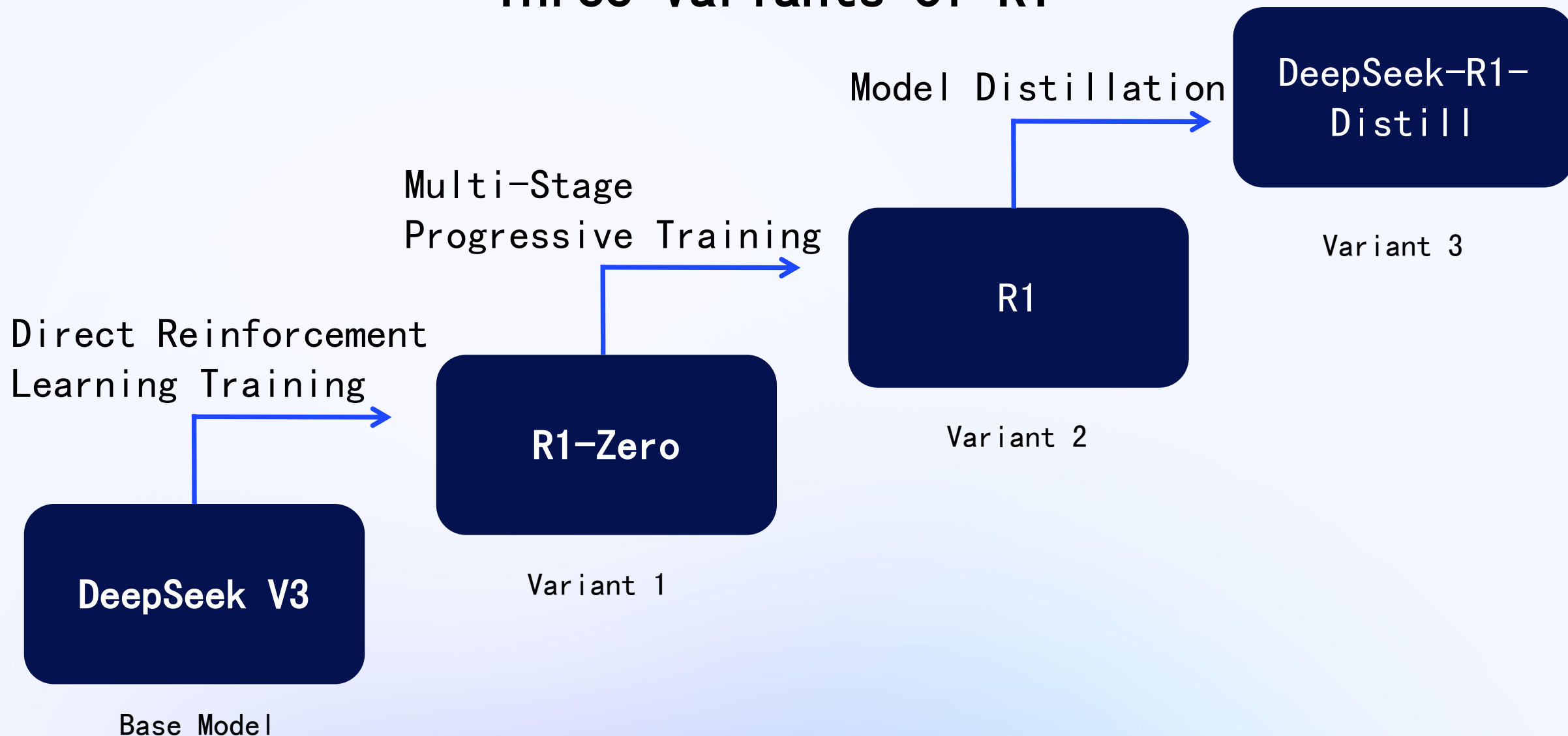
## R1 Was Developed Based On V3

- V3 benchmarks GPT-4o, leveraging instruction tuning and preference tuning to improve performance.
- R1 specializes in inference capabilities.



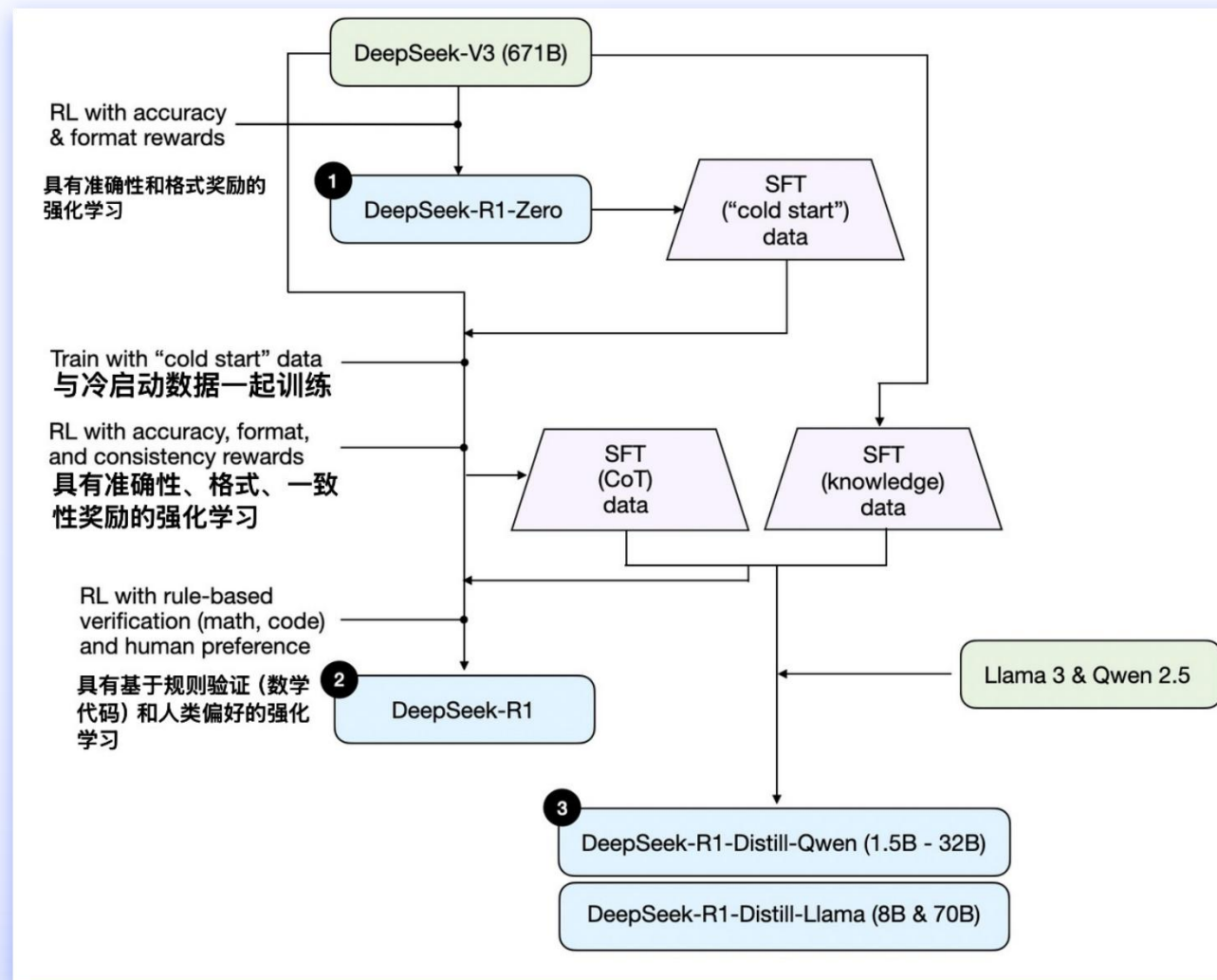
Accuracy Comparison Between DeepSeek V3 and Other Mainstream LLMs at the Time of Release (Source: DeepSeek Official)

## Three Variants of R1





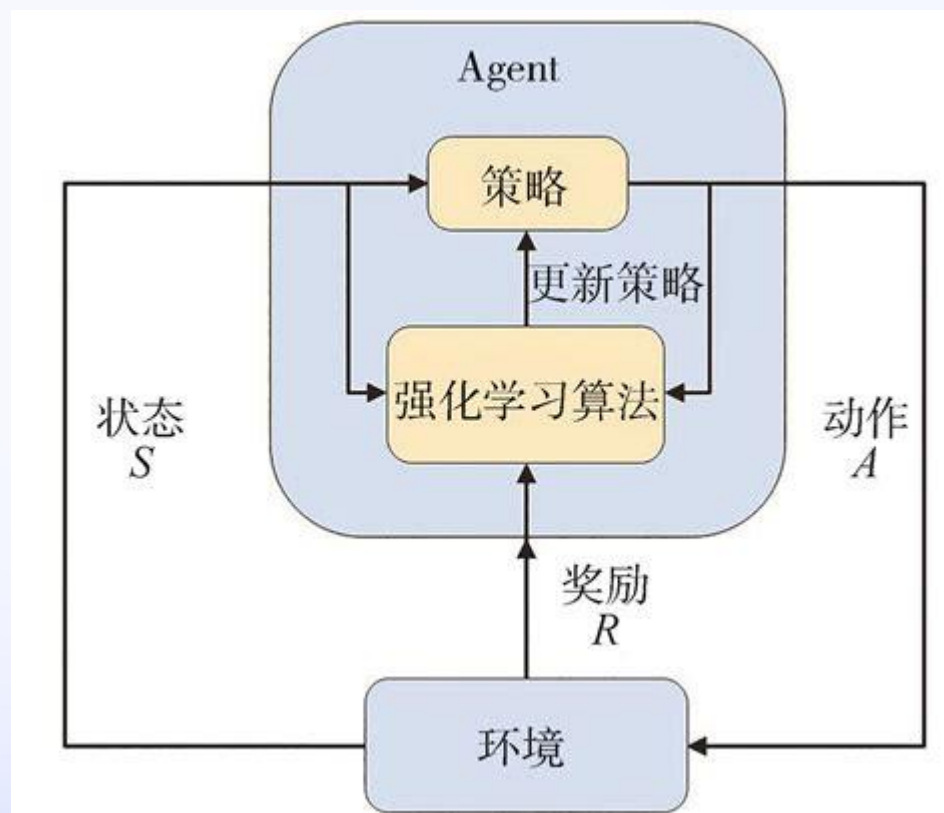
# Technical Path for Training R1



Original Author: Sebastian Raschka

## Analysis of R1's Core Technology: Reinforcement Learning

R1 adopts reinforcement learning with multiple rewards, akin to a “comprehensive scoring system” for the model, where the model receives different reward signals based on multiple criteria when completing tasks.



Source: "Automatic Driving Edge Scene Generation Method Based on Scene Dynamics and Reinforcement Learning"

## Analysis of R1's Core Technology: Cold Start Data

R1 strategically uses a small amount of high-quality cold start data, serving as an "introduction tutorial" before training begins, helping the model quickly learn how to perform clear and logical reasoning.

R1-Zero generates  
long Chain of  
Thought (CoT) data

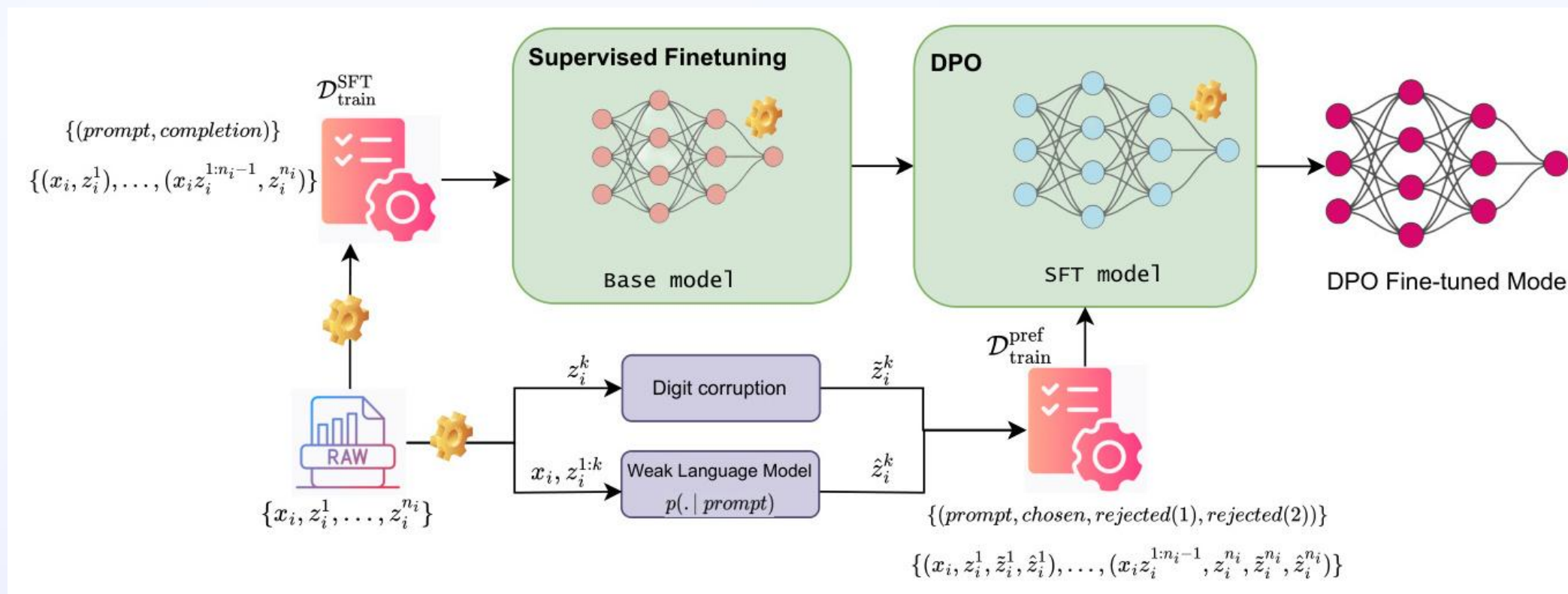
Example selection



Cold Start Data  
For R1

## Analysis of R1's Core Technology: Supervised Fine-Tuning

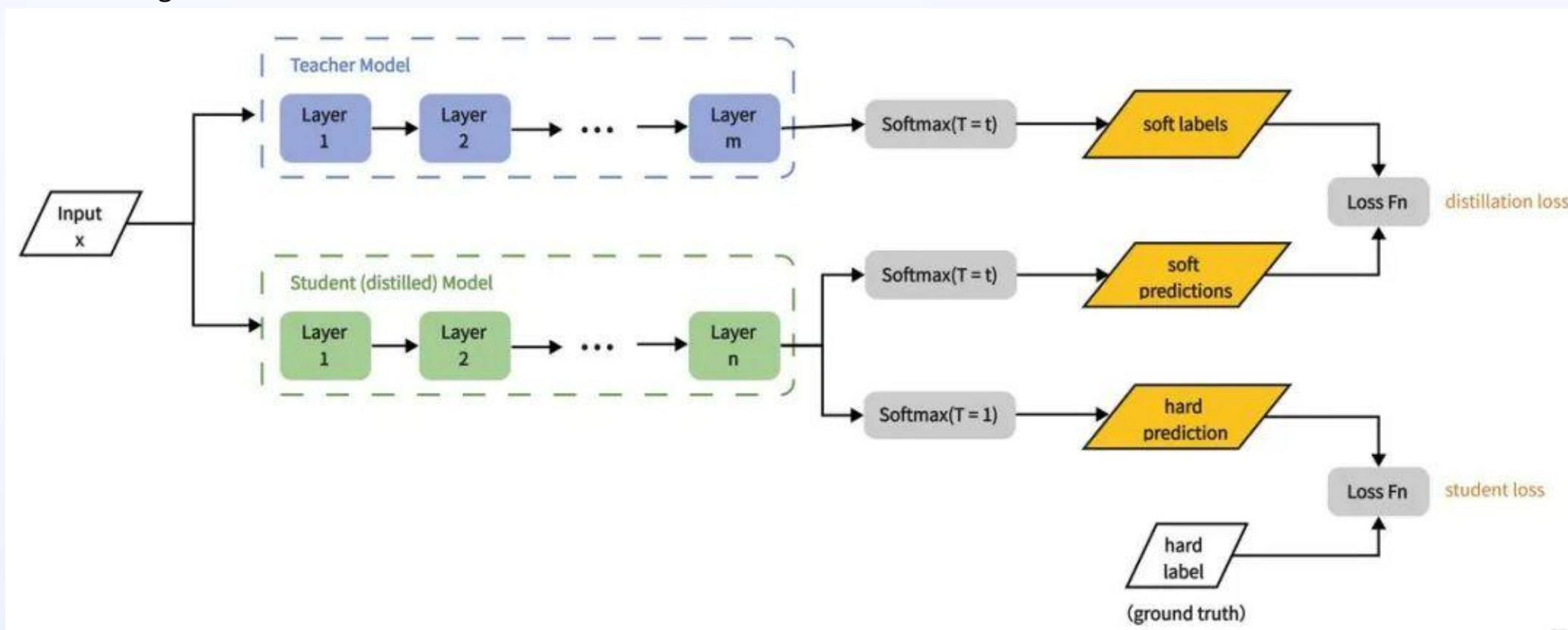
R1's training includes two stages of supervised fine-tuning (SFT). The model adjusts itself by learning labeled data to perform more accurately on specific tasks.



Source: "PORT: Preference Optimization on Reasoning Traces"

## Analysis of R1's Core Technology: Distillation

R1-Distill employs distillation techniques. The larger model (teacher) transfers its knowledge and reasoning abilities to a smaller model (student), who learns the larger model's reasoning skills through high-quality data and training methods.

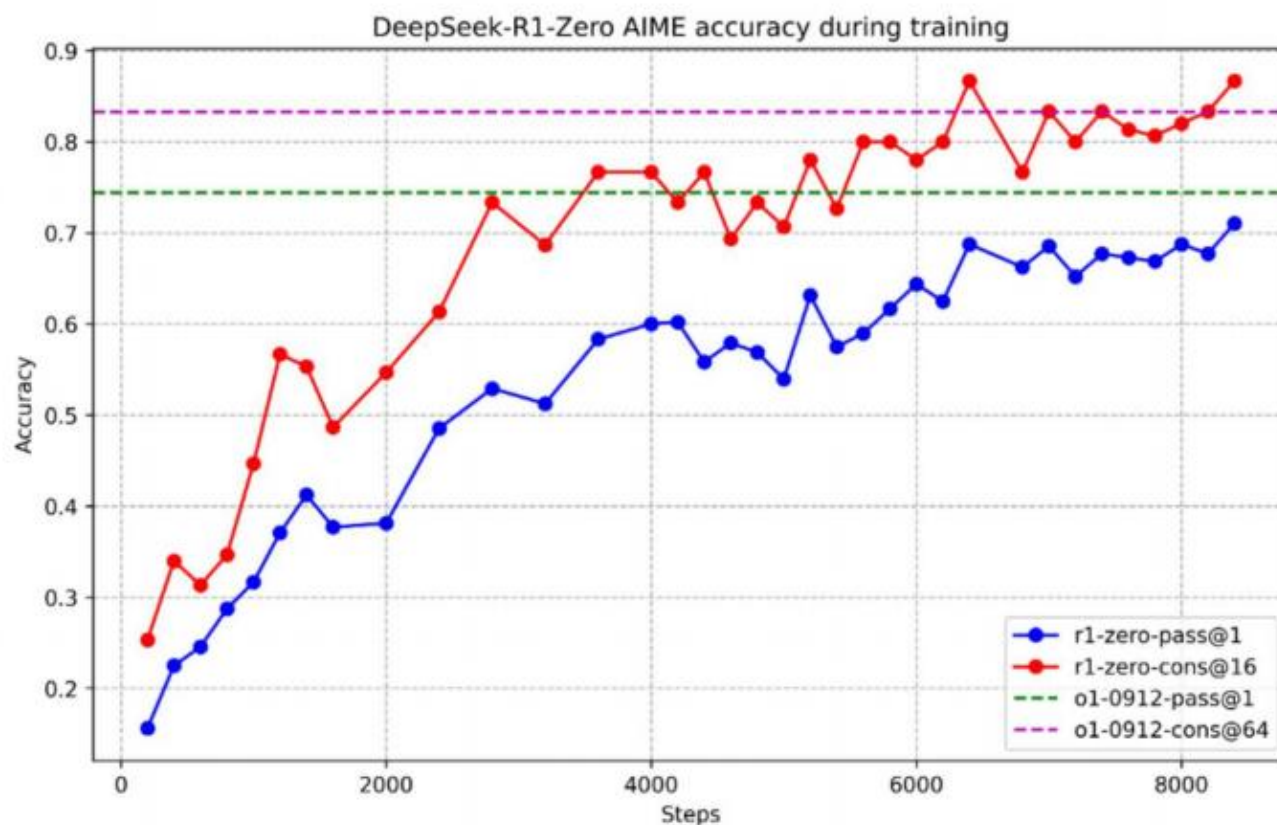


Source: <https://devopedia.org/knowledge-distillation>



## Key Contribution I: Feasibility of the “Pure RL” Technical Pathway

The first public study validates that LLMs’ reasoning capabilities can be solely incentivized through reinforcement learning, without the need for supervised fine-tuning.



As RL training progresses, R1-Zero’s performance steadily and continuously improves  
(Source: DeepSeek Official Paper)

## Key Contribution II: R1's "Aha Moment"

DeepSeek R1 uses highly anthropomorphic language like "aha moments" during reasoning, experiencing sudden insights when finding breakthroughs in solving problems, seen as an important step towards achieving AGI.

Question: If  $a > 1$ , then the sum of the real solutions of  $\sqrt{a - \sqrt{a + x}} = x$  is equal to

Response: <think>

To solve the equation  $\sqrt{a - \sqrt{a + x}} = x$ , let's start by squaring both ...

$$(\sqrt{a - \sqrt{a + x}})^2 = x^2 \implies a - \sqrt{a + x} = x^2.$$

Rearrange to isolate the inner square root term:

$$(a - x^2)^2 = a + x \implies a^2 - 2ax^2 + (x^2)^2 = a + x \implies x^4 - 2ax^2 - x + (a^2 - a) = 0$$

...

**Wait, wait. Wait. That's an aha moment I can flag here.**

Let's reevaluate this step-by-step to identify if the correct sum can be ...

We started with the equation:

$$\sqrt{a - \sqrt{a + x}} = x$$

First, let's square both sides:

$$a - \sqrt{a + x} = x^2 \implies \sqrt{a + x} = a - x^2$$

Next, I could square both sides again, treating the equation: ...

...

Table 3 | An interesting "aha moment" of an intermediate version of DeepSeek-R1-Zero. The model learns to rethink using an anthropomorphic tone. This is also an aha moment for us, allowing us to witness the power and beauty of reinforcement learning.

When tackling complex math problems, the model suddenly stopped and said, "Wait, wait, this is an aha moment worth noting" (Source: DeepSeek Official Paper)

9.11和9.9哪个数字大



已深度思考 (用时 24 秒)

好的，我现在得比较一下9.11和9.9这两个数哪个更大。首先，我应该回忆一下小数比较的方法。记得比较小数的時候，应该先比较整数部分，如果整数部分相同，再依次比较小数部分的每一位。

首先，这两个数的整数部分都是9，所以整数部分相等。接下来需要比较小数部分。不过这里有个问题，9.11的小数部分是两位，而9.9只有一位。可能有人会直接看小数部分的数字，比如9.11的小数部分是11，而9.9的是9，然后认为11比9大，所以9.11更大。但这其实是错误的，因为小数部分的位数不同，不能直接这样比较。

正确的方法应该是将两个数的小数位数统一，比如将9.9写成9.90，这样两者的小数部分都是两位。这时候，比较0.11和0.90，显然0.90更大，所以9.90也就是原来的9.9，要比9.11大。不过，这里好像哪里不对，因为按照这个逻辑的话，9.9应该比9.11大，但实际情况可能不是这样。

或者，可能我需要更仔细地分析。比如，9.11可以拆分为9 + 0.11，而9.9则是9 + 0.9。显然，0.9比0.11大很多，所以9.9实际上更大。那为什么之前会有混淆呢？可能是因为小数点后的位数不同，导致误以为更多的数字代表更大的值，但实际上小数点后的第一位是十分位，第二位是百分位，所以比较的时候应该先看十分位，再看百分位。

例如，比较9.11和9.9时，先看十分位的数字，9.11的十分位是1，而9.9的十分位是9。因为9比1大，所以不管后面的百分位是什么，9.9都比9.11大。因此，正确的结论应该是9.9比9.11大。

DeepSeek R1's reasoning process

# Key Contribution III: Distilled Small Model Surpassing OpenAI GPT-4-mini

The high performance of the distilled small model demonstrates the economy and effectiveness of this strategy, but breaking through the current boundaries of intelligence may still require larger base models and reinforcement learning.

	AIME 2024 pass@1	AIME 2024 cons@64	MATH- 500 pass@1	GPQA Diamond pass@1	LiveCodeBench pass@1	CodeForces rating
GPT-4o-0513	9.3	13.4	74.6	49.9	32.9	759.0
Claude-3.5-Sonnet-1022	16.0	26.7	78.3	65.0	38.9	717.0
o1-mini	63.6	80.0	90.0	60.0	53.8	1820.0
QwQ-32B	44.0	60.0	90.6	54.5	41.9	1316.0
DeepSeek-R1-Distill-Qwen-1.5B	28.9	52.7	83.9	33.8	16.9	954.0
DeepSeek-R1-Distill-Qwen-7B	55.5	83.3	92.8	49.1	37.6	1189.0
DeepSeek-R1-Distill-Qwen-14B	69.7	80.0	93.9	59.1	53.1	1481.0
DeepSeek-R1-Distill-Qwen-32B	72.6	83.3	94.3	62.1	57.2	1691.0
DeepSeek-R1-Distill-Llama-8B	50.4	80.0	89.1	49.0	39.6	1205.0
DeepSeek-R1-Distill-Llama-70B	70.0	86.7	94.5	65.2	57.5	1633.0

Six small models distilled from DeepSeek-R1’s output and open-sourced to the community (Source: DeepSeek Official Paper)

# DeepSeek's Technical Contributions and Future Evolution

- Three Key Differences Between R1 and OpenAI o1
- Four Evolutionary Directions for R1
- Appendix: Comprehensive Overview of the DeepSeek Family

# Three Key Differences Between DeepSeek R1 and OpenAI o1

R1: Based on the existing model V3

Difference in Architecture,

o1: A new model distinct from GPT-4o

R1: Proven to be incentivized solely through reinforcement learning, without supervised fine-tuning

Difference in Training Methods

o1: Combines supervised fine-tuning and reinforcement learning

R1: Open-source and free to use

Difference in Ecosystem

o1: Closed-source, accessible only to ChatGPT Plus members for o1 and o1 mini



# Four Evolutionary Directions for R1

## General Capabilities

R1 performs less well than V3 on some complex tasks, which can be improved through Long-CoT in the future.

## Prompt Engineering

R1 is sensitive to prompts, and fewer examples can degrade its performance.

## Language Mixing

R1 has better ability to process languages other than Chinese and English to avoid current language mixing issues.

## Software Engineering

Start with software engineering data and asynchronous evaluation in reinforcement learning to shorten evaluation duration and ensure efficiency in the reinforcement learning process.

Appendix: Comprehensive Overview of the DeepSeek Family

Source: 国海证券

模型类别	日期	名称	内容	对标
LLM	2023年11月2日	DeepSeek Coder	模型包括 1B, 7B, 33B 多种尺寸, 开源内容包含 Base 模型和指令调优模型。	Meta的CodeLlama是业内标杆, 但DeepSeek Coder展示出多方位领先的架势。
	2024年6月17日	DeepSeek Coder V2	代码大模型, 提供了 236B 和 16B 两种版本。DeepSeek Coder V2 的 API 服务也同步上线, 价格依旧是「1元/百万输入, 2元/百万输出」。	能力超越了当时最先进的闭源模型 GPT-4-Turbo。
	2023年11月29日	DeepSeek LLM 67B	首款通用大语言模型, 且同步开源了 7B 和 67B 两种不同规模的模型, 甚至将模型训练过程中产生的 9 个 checkpoints 也一并公开,	Meta的同级别模型 LLaMA2 70B, 并在近20个中英文的公开评测榜单上表现更佳。
	2024年3月11日	DeepSeek-VL	多模态 AI 技术上的初步尝试, 尺寸为 7B 与1.3B, 模型和技术论文同步开源。	
	2024年5月	DeepSeek-V2	通用 MoE 大模型的开源发布, DeepSeek-V2 使用了 MLA (多头潜在注意力机制), 将模型的显存占用率降低至传统 MHA 的 5%-13%	对标 GPT-4-Turbo, 而 API 价格只有后者的 1/70
	2024年9月6日	DeepSeek-V2.5 融合模型	Chat模型聚焦通用对话能力, Code模型聚焦代码处理能力合二为一, 更好的对齐了人类偏好,	
	2024年12月10日	DeepSeek-V2.5-1210	DeepSeek V2 系列收官之作, 全面提升了包括数学、代码、写作、角色扮演等在内的多方能力。	
	2024年12月26日	DeepSeek-V3	开源发布, 训练成本估算只有 550 万美金	性能上全面对标海外领军闭源模型, 生成速度也大幅提升。
推理模型	2024年2月5日	DeepSeekMat	数学推理模型, 仅有 7B 参数	数学推理能力上直逼 GPT-4
	2024年8月16日	DeepSeek-Prover-V1.5	数学定理证明模型	在高中和大学数学定理证明测试中, 均超越了不少知名的开源模型。
	2024年11月20日	DeepSeek-R1-Lite	推理模型, 为之后 V3 的后训练, 提供了足量的合成数据。	媲美 o1-preview
	2025年1月20日	DeepSeek-R1	发布并开源, 开放了思维链输出功能, 将模型开源 License 统一变更为 MIT 许可证, 并明确用户协议允许 “模型蒸馏”。	在性能上全面对齐 OpenAI o1 正式版
多模态模型	2023年12月18日	DreamCraft3D	文生 3D 模型, 可从一句话生成高质量的三维模型, 实现了 AIGC 从 2D 平面到 3D 立体空间的跨越。	
	2024年12月13日	DeepSeek-VL2	多模态大模型, 采用了 MoE 架构, 视觉能力得到了显著提升, 有 3B、16B 和 27B 三种尺寸, 在各项指标上极具优势。	
	2025年1月27日	DeepSeek Janus-Pro	开源发布的多模态模型。	
架构开源	2024年1月11日	DeepSeekMoE	开源了国内首个 MoE (混合专家架构) 大模型 DeepSeekMoE: 全新架构, 支持中英, 免费商用, 在 2B、16B、145B 等多个尺度上均领先	被普遍认为是 OpenAI GPT-4 性能突破的关键所在

# More Resources for Learning About DeepSeek and AI

## Deepseek Official

Visit the official website to delve into the latest research findings, access source code, and official prompt example libraries:  
<https://www.deepseek.com>

## 51CTO AI Zone

Get the latest news, practical articles, useful resources, and sharing by AI experts on Deepseek and AI in the 51CTO AI.x zone:  
<https://ai.51cto.com>

## 51CTO Online Courses – DeepSeek Zone

Over 200 courses with over 1,000 hours of AI (including DeepSeek) themed videos for individual and corporate learning:  
<https://b.51cto.com>

## 51CTO DeepSeek 体系化学习方案



三大主题模块, 满足不同  
岗位学习需求



技术模块体系设计分层  
进阶式学习

办公效率  
提升

《AI大模型发展地图&应用实战》

《AI构建企业新质生产力:  
DeepSeek × COZE实战课》

《Deepseek赋能办公全攻略》

《Deepseek AI赋能公文写作》

技术原理  
架构

基础:《DeepSeek大模型全栈  
开发》

进阶:《DeepSeek大模型技术  
原理与实战》

高级:《DeepSeek高级技术  
实战课程》

综合:《DeepSeek企业级实战》

综合管理  
应用

《人工智能原理、前沿介绍和应用  
分析-以 DeepSeek 为例》

《AI商业洞察:DeepSeek赋能,  
让你的决策领先一步》

《Deepseek AI大模型在营销  
领域的应用》

DeepSeek systematic learning solution launched by 51CTO Enterprise Academy



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