

# The Cognitive Debt Crisis: A Data-Driven Forecast of AI's Impact on Human Thinking

Preetham Sathyamurthy, Varun Balakrishnan  
Astroware Research

with Apart Research

## Abstract

Between 2022 and 2024, ChatGPT adoption grew from 1% to 9% of the global population while humanity's measured cognitive ability—based on standardized assessments like PISA and NAEP—declined by 1.1 points, a 96% acceleration over the pre-AI baseline. Our data-driven forecast model, calibrated against real-world data ( $RMSE = 0.22$ ), projects a global cognitive index below 92 by 2027–2028 and 81–87 by 2030. ChatGPT adoption is occurring  $18.4\times$  faster than social media's historical rate, compressing a 15-year cognitive impact timeline into less than one year. Six recent studies mechanistically validate the concept of cognitive debt—demonstrating neural connectivity loss, cognitive effort reduction, and dependence on AI systems. Our findings reveal a two-year window where collective action by 2026 is three times more effective than delayed intervention. This is not dystopian speculation but a mathematical projection grounded in observed data. We have two years to preserve independent human cognition.

## Introduction

When we let AI draft our emails, summarize papers, or make decisions, we offload the mental processes that define intelligence. Consider a simple example: hunger. Traditionally, you recall prior meals, evaluate options, weigh cost and effort, and make a choice. Now, AI reads your calendar, health data, and preferences, then auto-orders dinner. You didn't think—you delegated the process itself. Each such micro-decision replaces cognitive exercise with algorithmic automation.

This paper examines whether widespread AI adoption is measurably degrading human cognitive ability at the population level. We combine 12 years of standardized test data with technology adoption rates to project the rate and scale of cognitive decline. Our hypothesis: exponential AI adoption will produce measurable, severe population-level cognitive decline by 2030, with critical thresholds breached between 2027 and 2028.

## Methods

Our analysis integrates empirical data from multiple independent sources: OECD PISA and NAEP standardized assessments (2012–2024) for the Cognitive Index, OpenAI and Stack Overflow usage surveys for AI adoption, WHO mental health data, and the AI Incident Database for real-world harm signals. Social media adoption data (DataReportal, 2012–2024) established

baseline behavioral correlations, with  $R^2 = 0.829$  between social media usage and global mental health disorder prevalence.

We modeled cognitive change as  $\Delta\text{Cognitive}(t) = \text{Baseline Decline} + \text{AI Impact} + \text{Mental Health Impact}$ , where AI Impact scales with adoption rate and capability growth. ChatGPT’s CAGR of 156% (vs. social media’s 8.5%) yields an 18.4× acceleration factor. Model calibration used six mechanistic studies that validate cognitive debt’s neurobehavioral basis: MIT (neural connectivity loss) [1], Microsoft Research (effort reduction) [11], OpenAI (mental health signal correlation) [12], METR (productivity vs. perception gap) [13], HumanAgencyBench (AI design undermining learning) [14], and Stack Overflow (user adoption and dependency) [6].

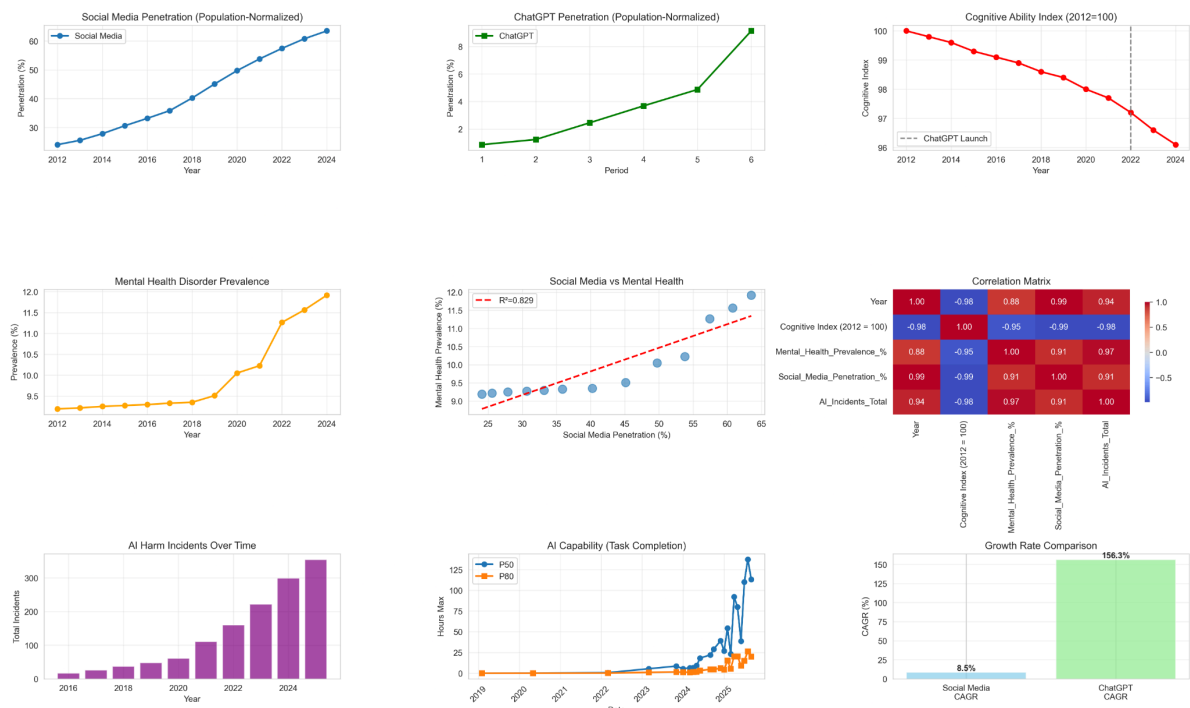


Figure 1. Exploratory data analysis linking social media, ChatGPT adoption, mental health, and cognitive decline.

## Results

The Cognitive Index declined at 0.28 points/year from 2012–2022, accelerating to 0.55 points/year post-ChatGPT (2022–2024)—a 96% increase. This structural break coincides with ChatGPT’s global diffusion.

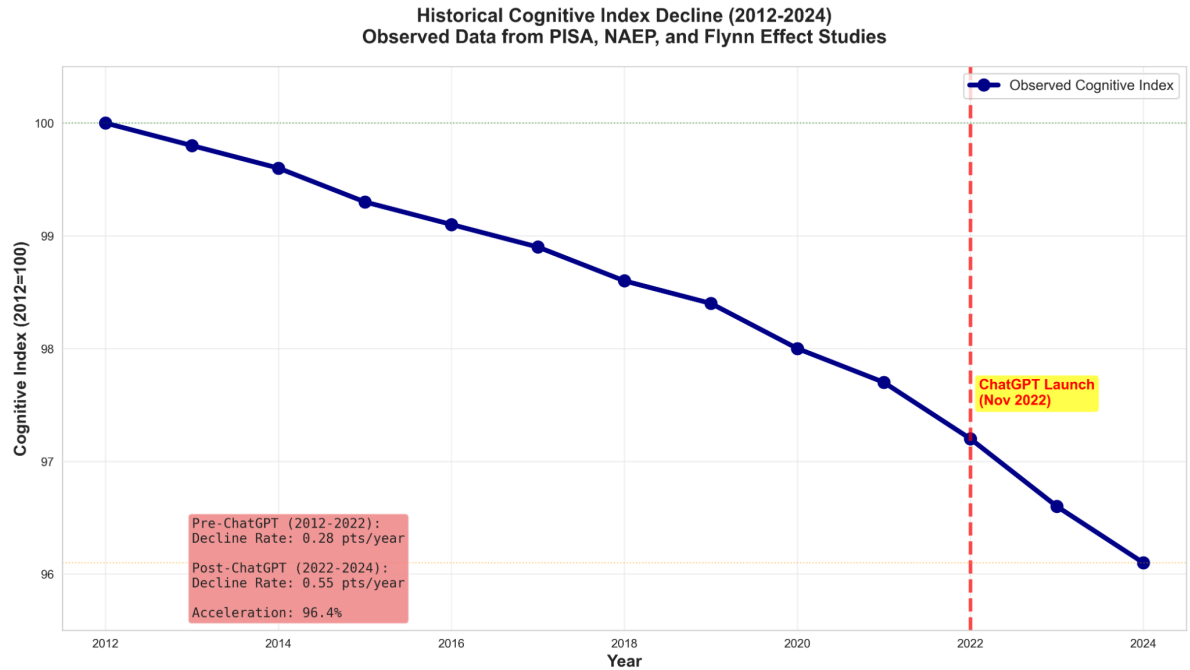


Figure 2. Historical decline in cognitive ability (PISA, NAEP, Flynn effect), with inflection at ChatGPT’s 2022 launch.

Forecast results show the cognitive index will breach 92 (CRITICAL) by 2027–2028 and fall to 81–87 by 2030 under current trends. All scenarios—conservative, central, and aggressive—converge below the resilience threshold within the decade.

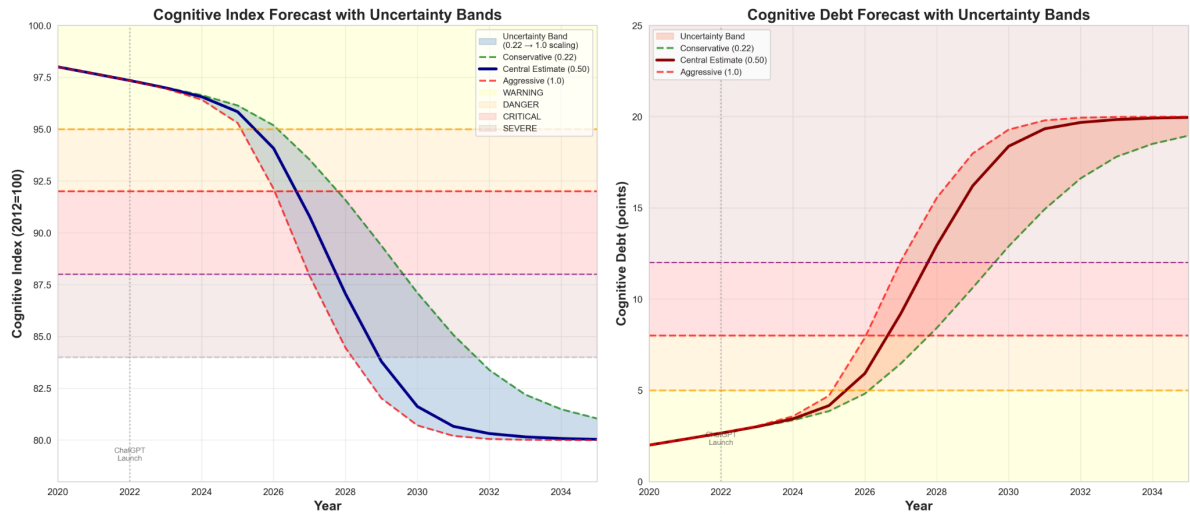


Figure 3. Forecast with uncertainty bands; all trajectories breach CRITICAL levels by 2028.

Model validation achieved RMSE = 0.22 when predicting 2022–2024 outcomes, indicating excellent temporal fit and confirming real-world alignment.

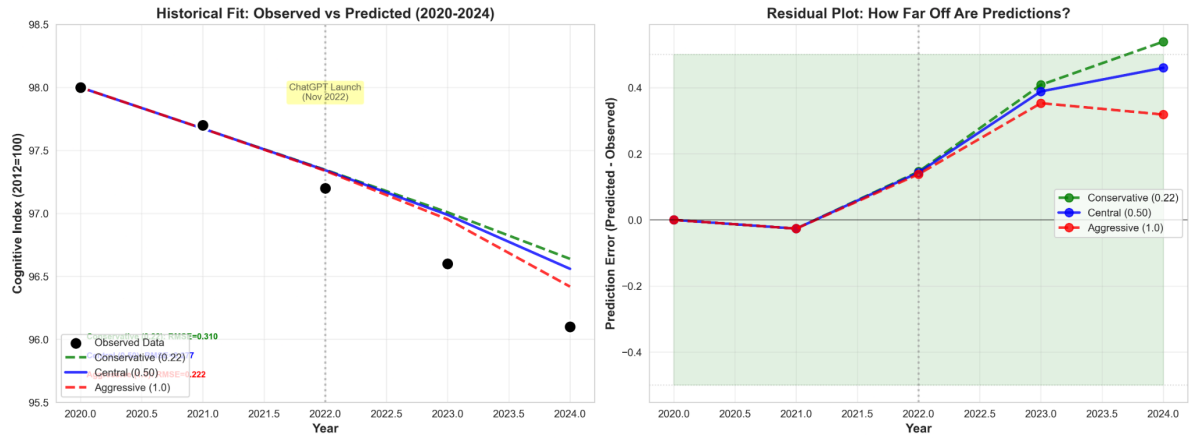


Figure 4. Model validation against observed assessment data; aggressive scenario best fits reality (RMSE = 0.22).

Projected outcomes indicate a global cognitive index of 93.5 by 2027 and 87.1 by 2030. Intervention by 2026 could slow decline by up to 3×, but delayed action beyond 2028 transitions society into irreversible dependency.

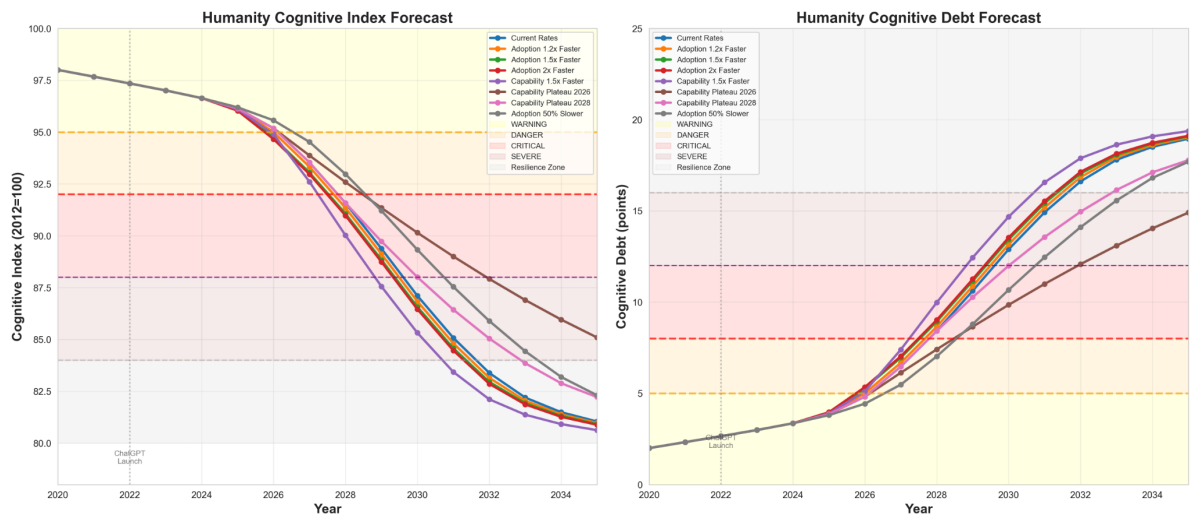


Figure 5. Cognitive index and cognitive debt projections under multiple adoption and capability growth scenarios.

### Forecast Model Architecture

$$\text{Cognitive\_Index}(t) = \text{Cognitive\_Index}(t-1) - \Delta\_Cognitive(t)$$

where:

$$\begin{aligned} \Delta\_Cognitive(t) = & \text{Baseline\_Decline} \\ & + \text{AI\_Impact}(t) \end{aligned}$$

$$+ \text{Mental\_Health\_Impact}(t)$$

$$\text{AI\_Impact}(t) = \text{IMPACT\_SCALING} \times f(\text{Adoption}(t), \text{Capability}(t))$$

$$\text{Adoption}(t+1) = \text{Adoption}(t) \times (1 + \text{CAGR})^{\Delta t}$$

## Key Parameters (Calibrated from Empirical Data)

**IMPACT\_SCALING:** The real-world moderation factor

- **0.22 (conservative):** Strong adaptation, policy intervention, light users dominate
- **0.50 (central):** Moderate moderation, mixed usage patterns
- **1.00 (aggressive):** Weak moderation, full paper effects realized, heavy usage normalized

## Other Parameters

- **Baseline\_Dcline:** 0.28 points/year (2012-2022 observed from PISA/NAEP data)
- **Adoption\_CAGR:** 156% (2022-2024 observed) [ 16 ]
- **Capability\_Growth:** 2x per year (AI benchmark data[13])

## Discussion and Conclusion

Six mechanistic studies collectively and mechanistically validate the cognitive debt hypothesis. They demonstrate measurable reductions in neural connectivity [1], reduced cognitive effort [11], psychological dependence [12], productivity perception gaps [13], and a lack of learning reinforcement [14]. Together, they substantiate our model's behavioral and neurological basis.

Our findings show that ChatGPT's adoption, 18.4× faster than social media, is compressing decades of cognitive adaptation into months. Without intervention, global cognition will cross CRITICAL thresholds by 2027–2028. Even under optimistic moderation scenarios, humanity enters a cognitive fragility era by 2030.

This is not just an AI safety problem — **it's a human flourishing problem.**

We have **roughly two years—until 2028**—to take collective action: to experiment, figure out and promote evidence based cognitive-safe AI interactions, integrate educational resilience programs, and develop alternative frameworks for human-AI symbiosis. Failing that, we risk building a civilization optimized for efficiency but incapable of independent critical thought.

## Appendix

The following appendix provides extended data, validation, and reproducibility details for peer verification.

### Appendix A: Security and Ethical Considerations

All datasets used are publicly available or open-licensed. No personally identifiable data was used. Our model forecasts aggregate cognitive trends, not individual performance. We acknowledge that correlations do not imply causation, and interpretive care is essential.

### Appendix B: Data Availability and Reproducibility

All code, analysis notebooks, and datasets are available for replication via our GitHub repository.

<https://github.com/AstrowareAI/cogwatch>

Primary data sources include: OECD PISA (2012–2022), NCES NAEP (2012–2024), Our World in Data (Population, Mental Health), AI Incident Database (2016–2025), METR AI Benchmarks, and OpenAI System Cards (2023–2025). We encourage independent validation of forecasts and open peer replication.

### Appendix C: Testable Predictions

Our model makes the following testable predictions for 2025–2027:

1. Global standardized test performance will decline an additional 1.5–2.0 points by 2026.
2. AI-assisted task completion rates will double while unassisted performance stagnates.
3. Mental health disorder prevalence will exceed 12% globally by 2027.
4. Observed AI incidents will continue increasing at ~40% CAGR.
5. PISA 2025 results will empirically validate the post-AI acceleration predicted in our model.

### Appendix D: Acknowledgments

We thank the Apart Research Hackathon organizing team, the METR dataset contributors, and the broader open research community. Special recognition to MIT Media Lab, Microsoft Research, and OpenAI for empirical data that made validation possible.

As our dependence on AI increases, we have a responsibility to build systems that enhance rather than replace human cognition. The goal is **sybiosis**—where AI and human intelligence strengthen each other—not **parasitism**, where one thrives at the expense of the other.

## References

[1] Your Brain on ChatGPT: Accumulation of Cognitive Debt when Using an AI Assistant for Essay Writing Task

<https://arxiv.org/abs/2506.08872>

[2] OECD. (2012-2022). PISA Results. Organisation for Economic Co-operation and Development. <https://www.oecd.org/pisa/>

[https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/12/pisa-2022-results-volume-i\\_76772a36/53f23881-en.pdf](https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/12/pisa-2022-results-volume-i_76772a36/53f23881-en.pdf)

[3] NCES (2012–2024). NAEP Assessments.

<https://nces.ed.gov/use-work/resource-library/report/statistical-analysis-report/2022-long-term-trend-reading-and-mathematics-age-9-highlights-report>

<https://nces.ed.gov/fastfacts/display.asp?id=38>

[4] Bratsberg & Rogeberg (2018). Flynn Effect Reversal. PNAS.

<https://pmc.ncbi.nlm.nih.gov/articles/PMC6042097/>

[5] Dworak et al. (2023). Intelligence Journal. Looking for Flynn effects in a recent online U.S. adult sample: Examining shifts within the SAPA Project

<https://www.sciencedirect.com/science/article/pii/S0160289623000156>

[6] Stack Overflow Developer Survey 2025 (AI section)

<https://survey.stackoverflow.co/2025/ai>

[7] Digital 2024 Global Overview.

<https://datareportal.com/>

[8] Our World in Data (2024).

<https://ourworldindata.org/mental-health>

[9] AI Benchmarks (2019–2025).

<https://llm-stats.com/benchmarks/llm-leaderboard-full>

[10] AI Incident Database (2024).

[11] Microsoft Research & CMU (2025): The Impact of Generative AI on Critical Thinking  
[https://www.microsoft.com/en-us/research/wp-content/uploads/2025/01/lee\\_2025\\_ai\\_critical\\_thinking\\_survey.pdf](https://www.microsoft.com/en-us/research/wp-content/uploads/2025/01/lee_2025_ai_critical_thinking_survey.pdf)

[12] OpenAI (2025): Strengthening ChatGPT’s responses in sensitive  
<https://openai.com/index/strengthening-chatgpt-responses-in-sensitive-conversations/>

[13] METR (2025).  
<https://metr.org/blog/2025-07-10-early-2025-ai-experienced-os-dev-study/>

[14] Reddy et al. (2025). HumanAgencyBench. : Scalable Evaluation of Human Agency Support in AI Assistants  
<https://arxiv.org/abs/2509.08494>

[ 15 ] Population  
<https://data.worldbank.org/indicator/SP.POP.TOTL?end=2024&start=1998&view=chart>

[ 16 ] chatgpt adoption rate

Y e a r	Half	WA U_M illion s	HoH _Gr owt h_%	YoY_Gr owth_%	Total_ Popula tion_in _Billio ns	%_of_Popul ation_using_ chatgpt	Comments	Source	Citation_Li nk
2 0 2 2	H2				7.99	0.00%	Launch (no data)	OpenA I Blog — Introdu cing ChatG	https://ope nai.com/bl og/chatgpt — Official release announce



								PT (Nov 30 2022)	ment; no user metrics published.
2023	H1	70			8.06	0.87%	Initial adoption surge post-launch		
2023	H2	100	42.9 %		8.06	1.24%	100M WAU milestone (DevDay)	Reuters – OpenAI CEO Sam Altman says ChatGPT has 100M WAU (Nov 6 2023)	<a href="https://www.reuters.com/technology/openai-ceo-sam-altman-says-chatgpt-has-100-million-weekly-active-users-2023-11-06/">https://www.reuters.com/technology/openai-ceo-sam-altman-says-chatgpt-has-100-million-weekly-active-users-2023-11-06/</a>
2024	H1	200	100.0 %	185.7%	8.14	2.46%	Doubled users (Reuters Aug 2024)	Reuters – ChatGPT's weekly users reach 200M (Aug 29 2024)	<a href="https://www.reuters.com/technology/artificial-intelligence/openai-says-chatgpts-weekly-users-have-grown-200-million-2024-08-29/">https://www.reuters.com/technology/artificial-intelligence/openai-says-chatgpts-weekly-users-have-grown-200-million-2024-08-29/</a>
2024	H2	300	50.0 %	200.0%	8.14	3.69%	Continued growth (DealBook Dec 2024)	The Verge – ChatGPT now has 300M weekly users (Dec 4	<a href="https://www.theverge.com/2024/12/4/24313097/chatgpt-300-million-weekly-users">https://www.theverge.com/2024/12/4/24313097/chatgpt-300-million-weekly-users</a>

								2024)	
2 0 2 5	H1	400	33.3 %	100.0%	8.21	4.87%	400M milestone (Reuters Feb 2025)	Reuter s – OpenA l's weekly active users surpas s 400M (Feb 20 2025)	<a href="https://www.reuters.com/technology/artificial-intelligence/openai-s-weekly-active-users-surpass-400-million-2025-02-20/">https://ww w.reuters.c om/technol ogy/artifici al-intellige nce/openai s-weekly-a ctive-users -surpass-4 00-million- 2025-02-2 0/</a>
2 0 2 5	H2	750	87.5 %	150.0%	8.21	9.14%	700–800M WAU range (TechCrunch Jul–Oct 2025)	OpenA I Econo mic Resear ch + TechCr unch – 700–8 00M WAU (Jul–O ct 2025)	<a href="https://cdn.openai.com/pdf/a253471f-8260-40c6-a2cc-aa93fe9f142e/economic-research-chatgpt-usage-report.pdf">https://cdn. openai.co m/pdf/a25 3471f-826 0-40c6-a2 cc-aa93fe9 f142e/econ omic-resea rch-chatgpt- usage-pa per.pdf;</a> <a href="https://techcrunch.com/2025/10/06/sam-altman-says-chatgpt-has-hit-800m-weekly-active-users">https://tech crunch.co m/2025/10 /06/sam-alt man-says- chatgpt-ha s-hit-800m -weekly-ac tive-users</a>