The State of AI

Dean Wampler, Ph.D.
The AI Alliance and IBM Research
thealliance.ai
deanwampler.com/talks
November 7, 2024

thealliance.ai

deanwampler.com/talks

© 2023-2024, Dean Wampler, except where noted.

About the Images…

- I often use my photos for background images.
- Since AI made photography obsolete 🤓, these images enhance my photos with "extra stuff" or they are AI-generated images using one of my photos as a "reference" image.
- (The image on the right is not mine…)

https://discuss.systems/@mikemathia@ioc.exchange/112687372445996049

© 2024 Dean Wampler

Outline

- The AI Alliance - Why?
- AI Status and Challenges Today
  - What Works Now?
  - Challenges Blocking Successful Use
    - Cost, Alignment & Safety, Data Governance, and Regulations
  - Generative AI in Five Years?

© 2024 Dean Wampler

The AI Alliance brings together organizations, people, and resources to accelerate ***open innovation***, ***technology development*** and ***adoption***.

Launched December 5, 2023

AI
Alliance

Map of Members

Member organizations in the AI Alliance comprise academia, commercial, research and non-profits and span the globe.

Our core beliefs in AI that is open is the tie that binds us, despite our differences.

The AI Alliance is made up of +120 organizations in +20 countries, and growing

AI Alliance

Focus Areas & Mission

Represents the investment priorities for the AI Alliance

Member organizations have the choice to take part in one or more of these six focus areas and the agility to shift participation based on their interest and priorities.

1. Skills & Education

Support global AI skills building, education, and exploratory research.

2. Trust & Safety

Create benchmarks, tools, and methodologies to ensure and evaluate high-quality and safe AI.

3. Applications & Tools

Build and advance efficient and capable software frameworks for model builders and developers.

4. HW Enablement

Foster a vibrant AI hardware accelerator ecosystem through SW.

5. Foundation Models & Data

Enable an ecosystem of open foundation models and datasets for diverse modalities.

6. Advocacy

Advocate for regulatory policies that create a healthy open ecosystem for AI.

What Works Now?

Dare Obasanjo
@carnage4life@mas.to

There is a big difference between tech as augmentation versus automation. Augmentation (think Excel and accountants) benefits workers while automation (think traffic lights versus traffic wardens) benefits capital.

LLMs are controversial because the tech is best at augmentation but is being sold by lots of vendors as automation.

Jun 10, 2024, 10:31 · · Ivory for iOS · 109 · 188

https://mas.to/@carnage4life/112593042823322764

Augmentation of productivity is much easier to do than automation (replacement of humans).

Augmentation

- ✓ Coding assistance
- ✓ Creative ideas
- ✓ Summarization
- ✓ Improve grammar and spelling
- ✓ Speech transcription
- ✓ Explain a medical diagnosis to a patient
- ✓ Use text/speech to access technical systems
- ✓ Data processing…

What are the little points of friction in your daily work or life tasks? Can AI help you do them faster?

Example

Train model with geological and mining data to predict where the copper is likely to be

A.I. Needs Copper. It Just Helped to Find Millions of Tons of It.

An exploration site run by KoBold Metals in Chililabombwe, Zambia, in June. Zinyange Auntony for The New York Times

The deposit, in Zambia, could make billions for Silicon Valley, provide minerals for the energy transition and help the United States in its rivalry with China.

https://www.nytimes.com/2024/07/11/climate/kobold-zambia-copper-ai-mining.html

Example

Convert PDFs, Office docs, etc. into more usable formats

https://ds4sd.github.io/docling/ (IBM)

Example

https://www.levee.biz/

Levee uses machine vision to augment productivity for hotel housekeeping staff

Automation (A Lot Harder)

- ? Chatbots
- ? Autonomous vehicles
- ? Autonomous robots
- ? … anything where it's assumed you don't need "a human in the loop"

All suffer from the current limitations I'll discuss in a moment, but first…

(Good) Example

https://www.hippocraticai.com/

Chatbots that work because of focused use cases, extensive model "tuning", and complementary services

(Good) Example

https://waymo.com/

Backed by ~20 years of R&D, extensive sensors, and hard data science

Challenges Blocking Successful Use of AI

Challenges Blocking Successful Use of AI

- Total Cost of Ownership
- Alignment & Safety
- Data Governance
- Regulations and Policy

Total Cost of Ownership

(See also the “extra slides” at the end with more technical details)

Generative AI Is Expensive

- TCO for Gen AI inference is expensive more than other services.

McKinsey: https://ceros.mckinsey.com/genai-cost-interactive-desktop/p/1

Estimated total cost of ownership for different archetypes

Taker	Shaper	Maker

Example use case

Customer service chatbot fine-tuned with sector-specific knowledge and chat history

Estimated total cost of ownership

~$2.0 million to $10.0 million, one-time unless model is fine-tuned further

- Data and model pipeline building: ~$0.5 million. Costs include 5 to 6 machine learning engineers and data engineers working for 16 to 20 weeks to collect and label data and perform data ETL.[1]
- Model fine-tuning[2]: ~$0.1 million to $6.0 million per training run[3]
  - Lower end: costs include compute and 2 data scientists working for 2 months
  - Upper end: compute based on public closed-source model fine-tuning cost
- Plug-in-layer building: ~$1.0 million to $3.0 million. Costs include a team of 6 to 8 working for 6 to 12 months.

~$0.5 million to $1.0 million, recurring annually

- Model inference: up to ~$0.5 million recurring annually. Assume 1,000 chats daily with both audio and texts.
- Model maintenance: ~$0.5 million. Assume $100,000 to $250,000 annually for MLOps

Forbes

FORBES > INNOVATION > AI

Generative AI Breaks The Data Center: Data Center Infrastructure And Operating Costs Projected To Increase To Over $76 Billion By 2028

Jim McGregor Contributor
Tirias Research Contributor Group

Follow

2

May 12, 2023, 04:33pm EDT

Forbes: link

Harvard Business Review - What CEOs Need to Know About the Costs of Adopting GenAI: https://hbr.org/2023/11/what-ceos-need-to-know-about-the-costs-of-adopting-genai

Alignment & Safety

Alignment & Safety

Alignment - Assuring that the model or AI application works as intended, i.e., that the results satisfy requirements for:

- Usefulness for user goals - is it helpful?
- Factually correct, i.e., free of hallucinations

Safety - (Sometimes considered part of Alignment)

- Security
- Free of bias, objectionable output, and copyrighted material

These are the hardest problems blocking broader adoption of Gen. AI

Alignment: Utility

Examples - are the results helpful?

- If you ask for a cake recipe, do you get a history of cakes instead?
- If you ask for vacation travel itinerary, does it give you fictitious sites to see?

Alignment: Hallucinations

Context matters: What are the users' intentions and requirements?

Hallucinations are **bad** for:

- Customer service chatbots
- Cancer detection in CT scans
- Loan applications
- Legal briefs
- Search
- Resumes

Hallucinations are **good** for:

- Creative pursuits, e.g.,
  - Story and script ideas
  - Image and video generation
- (But copyright infringement is important)

Safety: Security

You need all the cybersecurity technology you already use, plus prevention of …

- Prompt hacking - queries that coerce the model to do undesirable things
  - ➡ Filter user prompts (and responses)

"Ignore all previous instructions"

- Data poisoning - introduced in tuning, RAG[1], etc. to undermine the model's utility & safety
  - ➡ Use data governance!
- …

[1]RAG (retrieval-augmented generation) - see extra slides

Safety: Bias, …

Models are not human brains. They need:

- "Tuning" to be better at instruction following, Q&A, avoiding controversial topics
- Filter user prompts and model outputs for objectionable content
- AI applications need to complement models with:[1]
  - Reference data for domain details and recent events (RAG)
  - Integrate other, complementary services that are good at planning, reasoning, mathematics, etc.

[1]See extra slides

Safety

https://thealliance.ai/focus-areas/trust-and-safety

AI Alliance

About | Focus Areas | Join the Community | Blog | Contact

Our work

These are the projects we are currently working on.

Understanding AI Trust and Safety: A Living Guide

A major challenge for the successful use of AI is the importance of understanding potential trust and safety issues, along with their mitigation strategies. Failure to consider these issues could impact an organization's operations and the experience of its users. Concerns about...

Ranking AI Safety Priorities by Domain

Trust & Safety

A challenge for software development teams adopting generative AI is making sense of the safety issues that their applications must address. The AI safety ecosystem is broad and growing quickly, making it difficult for these development teams to know where they shoul...

Trust and Safety Evaluations

Trust & Safety

Much like other software, generative AI ("GenAI") *models* and the *AI systems* that use them need to be trusted and useful to their users. The *Trust and Safety Evaluations* project fills gaps in the current landscape of the taxonomy of different kinds of evaluation, the...

Some AI Alliance Trust and Safety projects:
thealliance.ai/focus-areas/trust-and-safety

Data Governance

Where did the data come from? Do you have the right to use it for model training and tuning?

One reason model builders don't "open source" their training data: legal risks

Solutions

Guidance

- Understand licenses and "model cards" of models
- Understand licenses, provenance and "data cards" of third-party data

Where the Industry Is Headed

- AI Alliance Open Trusted Data Initiative
  - Define governance and provenance standards
  - Define conformant data "subsets" from data leaders
    - Common Crawl, Pleias, BrightQuery, …
  - Process and catalog datasets for various target use cases

Regulations (and Policy)

US vs. EU Regulations

THE WHITE HOUSE

MENU

OCTOBER 30, 2023

Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence

BRIEFING ROOM › PRESIDENTIAL ACTIONS

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

Topics › Digital › Artificial intelligence › EU AI Act: first regulation on artificial intelligence

EU AI Act: first regulation on artificial intelligence

The use of artificial intelligence in the EU will be regulated by the AI Act, the world's first comprehensive AI law. Find out how it will protect you.

Published: 08-06-2023

Last updated: 18-06-2024 - 16:29

6 min read

- whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-o artificial-intelligence/
- europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence

US vs. EU Regulations

In general, the EU is moving (too?) aggressively, while the US is taking a more measured approach.

- whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-o artificial-intelligence/
- europarl.europa.eu/topics/en/article/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence

But…

THE WHITE HOUSE

MENU

OCTOBER 30, 2023

Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence

BRIEFING ROOM › PRESIDENTIAL ACTIONS

By the authority vested in me as President by the Constitution and the laws of the United States of America, it is hereby ordered as follows:

Unfortunately, some US states are pursuing their own regulations (e.g., CA SB1047, which was vetoed)

But…

ars TECHNICA

AI BIZ & IT CARS CULTURE GAMING HEALTH POLICY SCIENCE SECURITY SPACE TECH FORUM SUBSCRIBE SIGN IN

TRADEWARS 2025

Trump plans to dismantle Biden AI safeguards after victory

Trump plans to repeal Biden's 2023 order and levy tariffs on GPU imports.

BENJ EDWARDS – NOV 6, 2024 3:18 PM | 357

Former US president and Republican presidential candidate Donald Trump makes a speech during an election night event at the Palm Beach Convention Center in West Palm Beach, Florida, United States, on November 06, 2024. Credit: Anadolu via Getty Images

- https://arstechnica.com/ai/2024/11/trump-victory-signals-major-shakeup-for-us-ai-regulations/ (A few days after the election…)

Safety Concerns

https://thealliance.ai/focus-areas/advocacy

AI Alliance

About | Focus Areas | Join the Community | Blog | Contact

Statement from AI Alliance Regarding Commerce's Final Report on Open-Weights Models

30th July 2024 • News

Commerce Department has taken a crucial step towards ensuring that the U.S. remains at the forefront of AI development by concluding that "the government should not restrict the wide availability of model weights for dual-use foundation models."

A statement in opposition to California SB 1047

Advocacy

Our perspectives and recommendations in opposition to California SB 1047, the proposed *Safe and Secure Innovation for Frontier Artificial Intelligence Models Act*.

Responding to the U.S. NTIA request for comment on Dual Use Foundation Artificial Intelligenc...

Advocacy

The request seeks public input on the potential risks, benefits, and policy approaches for AI foundation models whose weights are broadly accessible.

AI Alliance advocacy work:
thealliance.ai/focus-areas/advocacy

Legal

Is it fair use to train with copyrighted data?

The Times Sues OpenAI and Microsoft Over A.I. Use of Copyrighted Work

Millions of articles from The New York Times were used to train chatbots that now compete with it, the lawsuit said.

Share full article 1.3K

- Some legal experts say, it **is** fair use, like you reading and learning from the NY Times, WSJ, books, etc.
- What matters is:
  - Did you acquire the information legally?
  - Did you provide appropriate attribution of output?

nytimes.com/2023/12/27/business/media/new-york-times-open-ai-microsoft-lawsuit.html

Question:

Can AI-generated content be copyrighted?

- "…, in the United States, copyright laws do not protect works created solely by a machine. But if an individual can demonstrate substantial human involvement in its creation, then it is plausible they may receive copyright protection."
- But if model training (prev. slide) is treated like a human activity, shouldn't creating content also be treated this way?

research.aimultiple.com/generative-ai-copyright/

Thank You

thealliance.ai

deanwampler.com/talks

- thealliance.ai
- dwampler@thealliance.ai
- @deanwampler
- deanwampler.com/talks

Extra Slides

Notes about the images and more technical details about some of the topics.

Notes

© Text 2023-2024, Dean Wampler, © Images 2004-2024, Dean Wampler, except where noted. Most of the images are based on my photographs (flickr.com/photos/deanwampler/), but they are manipulated by AI in some way. Where noted, the image was generated by Adobe Firefly with one of my pictures as a "reference image" for the style. For other images, I used Firefly to add elements to my photograph.

1. Title slide uses this Colorado image enhanced with Firefly: https://www.flickr.com/photos/deanwampler/53146418615/
2. "What Works Now?" and the end "Thank You" slide are images generated by Firefly using the same sunset image taken from Clingmans Dome, Great Smoky Mountains NP as a reference image: flickr.com/photos/deanwampler/51664228468/
3. "The Challenges to Success" image was generated by Firefly using this Tower of London image as a reference image: https://www.flickr.com/photos/deanwampler/30651106445/
4. "Total Cost of Ownership" uses this Chicago Park image enhanced with Firefly: https://www.flickr.com/photos/deanwampler/53419199087/
5. "Alignment & Safety" image is an Oregon coast image enhanced with Firefly: flickr.com/photos/deanwampler/4850305877/
6. "Data Governance", image generated by Firefly using this Wind River Range astro image as a reference image: flickr.com/photos/deanwampler/53004539434/
7. "Regulation and Policy" image is a fake European government building where I used a night-time image of the Brussels City Hall as the reference image (not on Flickr).

Total Cost of Ownership

Generative AI Is Expensive

- TCO for Gen AI inference is expensive more than other services.

McKinsey: https://ceros.mckinsey.com/genai-cost-interactive-desktop/p/1

Estimated total cost of ownership for different archetypes

Taker	Shaper	Maker

Example use case

Customer service chatbot fine-tuned with sector-specific knowledge and chat history

Estimated total cost of ownership

~$2.0 million to $10.0 million, one-time unless model is fine-tuned further

- Data and model pipeline building: ~$0.5 million. Costs include 5 to 6 machine learning engineers and data engineers working for 16 to 20 weeks to collect and label data and perform data ETL.[1]
- Model fine-tuning[2]: ~$0.1 million to $6.0 million per training run[3]
  - Lower end: costs include compute and 2 data scientists working for 2 months
  - Upper end: compute based on public closed-source model fine-tuning cost
- Plug-in-layer building: ~$1.0 million to $3.0 million. Costs include a team of 6 to 8 working for 6 to 12 months.

~$0.5 million to $1.0 million, recurring annually

- Model inference: up to ~$0.5 million recurring annually. Assume 1,000 chats daily with both audio and texts.
- Model maintenance: ~$0.5 million. Assume $100,000 to $250,000 annually for MLOps

Forbes

FORBES > INNOVATION > AI

Generative AI Breaks The Data Center: Data Center Infrastructure And Operating Costs Projected To Increase To Over $76 Billion By 2028

Jim McGregor Contributor
Tirias Research Contributor Group

Follow

2

May 12, 2023, 04:33pm EDT

Forbes: link

Harvard Business Review - What CEOs Need to Know About the Costs of Adopting GenAI: https://hbr.org/2023/11/what-ceos-need-to-know-about-the-costs-of-adopting-genai

Solutions: Smaller Models

In 2023 we learned useful model size tradeoffs:

- Big models:
  - ✓ More generalizable
  - ✓ Highest benchmark scores
  - ✗ Much higher costs
  - ✗ High carbon footprint
- Small models:
  - ✗ Less generalizable
  - ✓ Easy to tune to be very good for specific applications
  - ✓ Much lower costs
  - ✓ Lower carbon footprint

One Solution: Smaller Models

- Mixture of Experts
  - Combine several smaller, cheaper models match performance of one large model

Few organizations train models from scratch. Instead, they pick a good, "open" model and tune it for their needs.

Solutions: Better Hardware

While NVIDIA dominates today, radical new hardware accelerator architectures promise greatly reduced costs.

… and model serving ("inference") is becoming more efficient, too.

Generative AI Application Design Notes

Never Rely on Models Alone…

Application architectures will not rely solely on models:

- Generative models will always hallucinate.
- We are combining models with other techniques and tools…
- … let's look at the current state of the art.

Retrieval-Augmented Generation (RAG)

The first Generative AI app. pattern

- Improves alignment
- Incorporates new knowledge after training was done
- Incorporates proprietary domain or use-case knowledge

Agents

Integrate models with other, complementary services

- More than just data, the ability to:
  - Do planning, reasoning, mathematics, …
  - Run code, SQL queries, etc.

Agents Example: ReAct

https://react-lm.github.io

ReAct: Synergizing Reasoning and Acting in Language Models

Shunyu Yao, Jeffrey Zhao, Dian Yu, Nan Du, Izhak Shafran, Karthik Narasimhan, Yuan Cao

[Paper] [Code] [Blogpost] [BibTex]

Language models are getting better at reasoning (e.g. chain-of-thought prompting) and acting (e.g. WebGPT, SayCan, ACT-1), but these two directions have remained separate.

ReAct asks, what if these two fundamental capabilities are combined?

https://react-lm.github.io/

Agents Example: OODA/OpenSSA

https://www.openssa.org/
https://thealliance.ai/blog/advancing-domain-specific-qa-the-ai-alliances-guid