KI og bærekraft i et klimaperspektiv

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Technology for a better society

Generativ KI

Trenes opp på store datamengder, for å kunne **generere** nytt materiale (tekst, bilder, video etc)

Claude 3

ChatGPT

Google Gemini

DALL·E

Stable Diffusion

Midjourney

Microsoft Copilot

GitHub Copilot

Mitt bidrag i dag

1. Hvorfor har KI en bærekraftutfordring?
2. Hva kan vi gjøre for å få til bærekraftig bruk av KI?

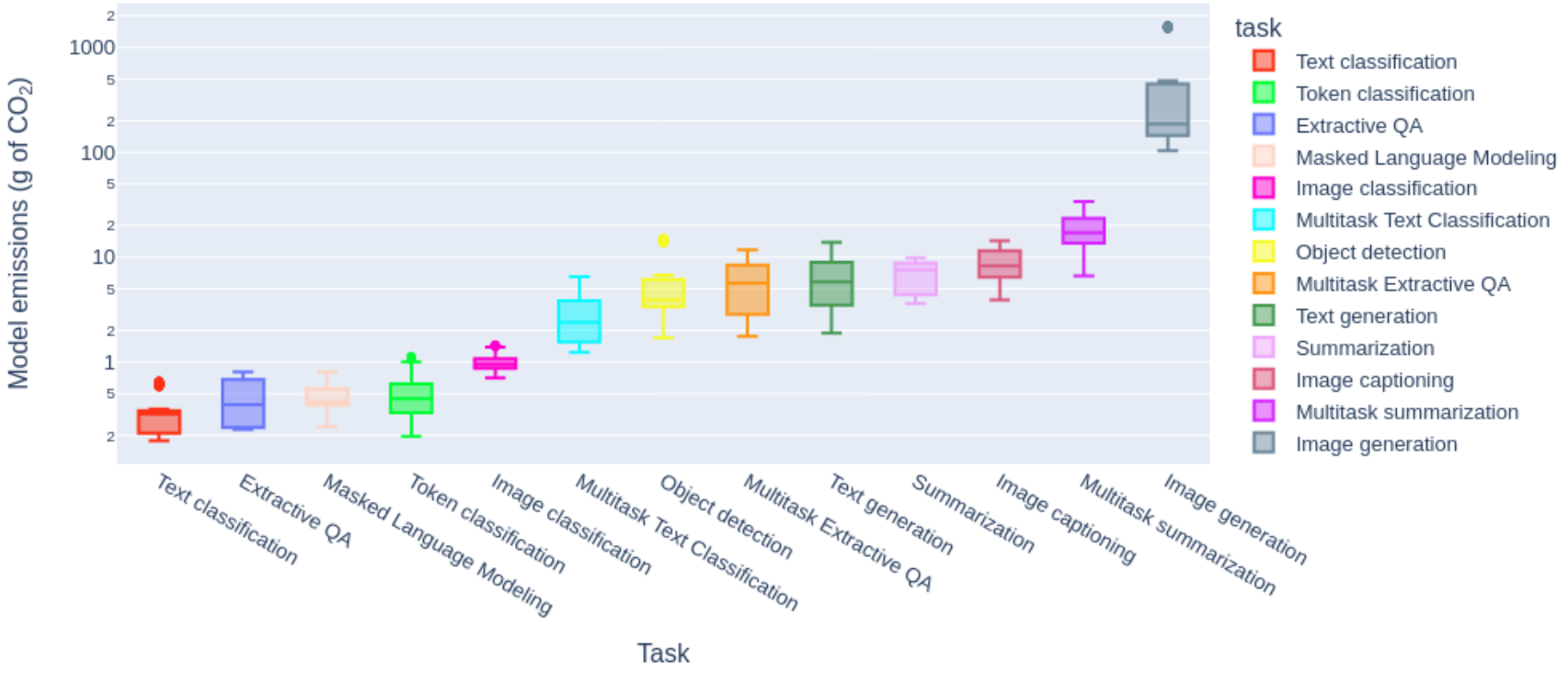
Hvorfor har KI en bærekraftutfordring?
1. Trening

Ressursbehov for **trening** av KI-modeller over tid

Kilde: Sevilla et al. (2022), Compute Trends Across Three Eras of Machine Learning.

Hvorfor har KI en bærekraftutfordring?
2. Bruk av modellene (*inference*)

- Generelle modeller er dyrere enn spesifikke modeller
- Generative modeller er dyrere enn diskriminative modeller
- Bildeprosessering er dyrere enn tekstprosessering



Karbonavtrykk for ulike typer oppgaver løst av KI

Kilde: Luccioni et al. (2024), **Power Hungry Processing: Watts Driving the Cost of AI Deployment?**.

Hvorfor har KI en bærekraftutfordring?
3. Oppskalering

ChatGPT

1 million brukere etter 5 dager

200 millioner ukentlige brukere (sep 2024)

OpenAI Platform

API (automatisk/programmatisk bruk)

Lav terskel for å ta i bruk språkmodeller

- Bruk av LLM-er er (foreløpig) svært billig
- Ekstremt lettvint å ta i bruk
  - Gode API-er
  - Språkmodeller er fleksible

GPT-4o mini

GPT-4o mini is our most cost-efficient small model that's smarter and cheaper than GPT-3.5 Turbo, and has vision capabilities. The model has 128K context and an Octobe 2023 knowledge cutoff.

Learn about GPT-4o mini ↗

Model	Pricing	Pricing with Batch API*
gpt-4o-mini	$0.150 / 1M input tokens	$0.075 / 1M input tokens
	$0.600 / 1M output tokens	$0.300 / 1M output tokens
gpt-4o-mini-2024-07-18	$0.150 / 1M input tokens	$0.075 / 1M input tokens
	$0.600 / 1M output tokens	$0.300 / 1M output tokens

Generativ KI og ressursforbruk

- Estimater for ChatGPT: 0.003-0.010 kWh per spørring
- Google-søk: 0.0003 kWh (https://googleblog.blogspot.com/2009/01/powering-google-search.html, 2009)
- 1 generert bilde tilsvarer en mobiloppladning (0.012 kWh)

Hvor går utviklingen med tanke på klima? Eksempel: Meta

- 350 millioner nedlastninger av Llama-modellene i år, 10 ganger så mye som i fjor
- Månedlig bruk av KI-tjenester har økt 10x fra januar til juli 2024
- Energiforbruk på datasentre: 34% økning fra 2022-2023 (ca 15 000 GWh)
- Energiintensitet per aktive person økte med 32%
- Vannuttak fra grunnvann økte 137%
  - Vannuttak fra steder med høyt press på grunnvann økte 20%
- Gjenoppretting av vannressurser har økt 150%

- Kilder:
  - https://ai.meta.com/blog/llama-usage-doubled-may-through-july-2024/
  - https://sustainability.atmeta.com/wp-content/uploads/2024/08/Meta-2024-Sustainability-Report.pdf

Hvor går utviklingen med tanke på klima? Eksempler: Google og Microsoft

- Google og Microsoft satte i 2019/2020 mål om null utslipp innen 2030
- Siden den gang har utslippene økt:
  - Google: 48 %
  - Microsoft: 29 %
- I hovedsak på grunn av utvidelser knyttet til KI

Prognoser

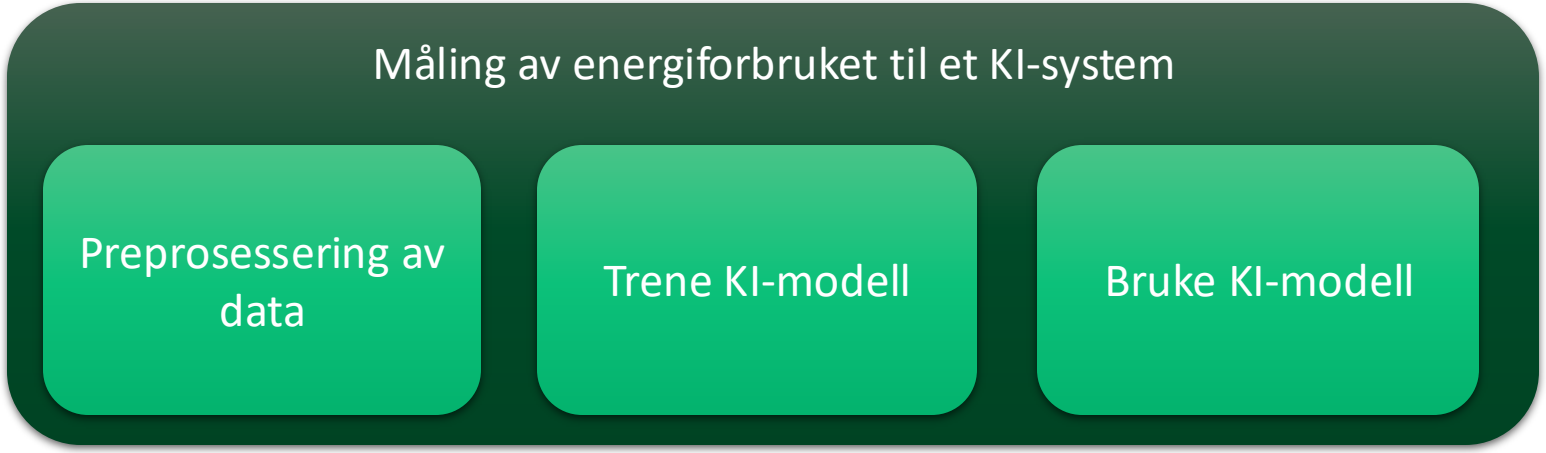
- Datasentre stod for 460 TWh i 2022 (ca 2% av det globale forbruket), og kan nå 1000 TWh innen 2026 (IEA 2024)
- KI-sektoren kan forbruke mellom 85-134 TWh per år i 2027 (Vries 2024)

Hvordan kan vi få til bærekraftig bruk av KI?

Grønn KI

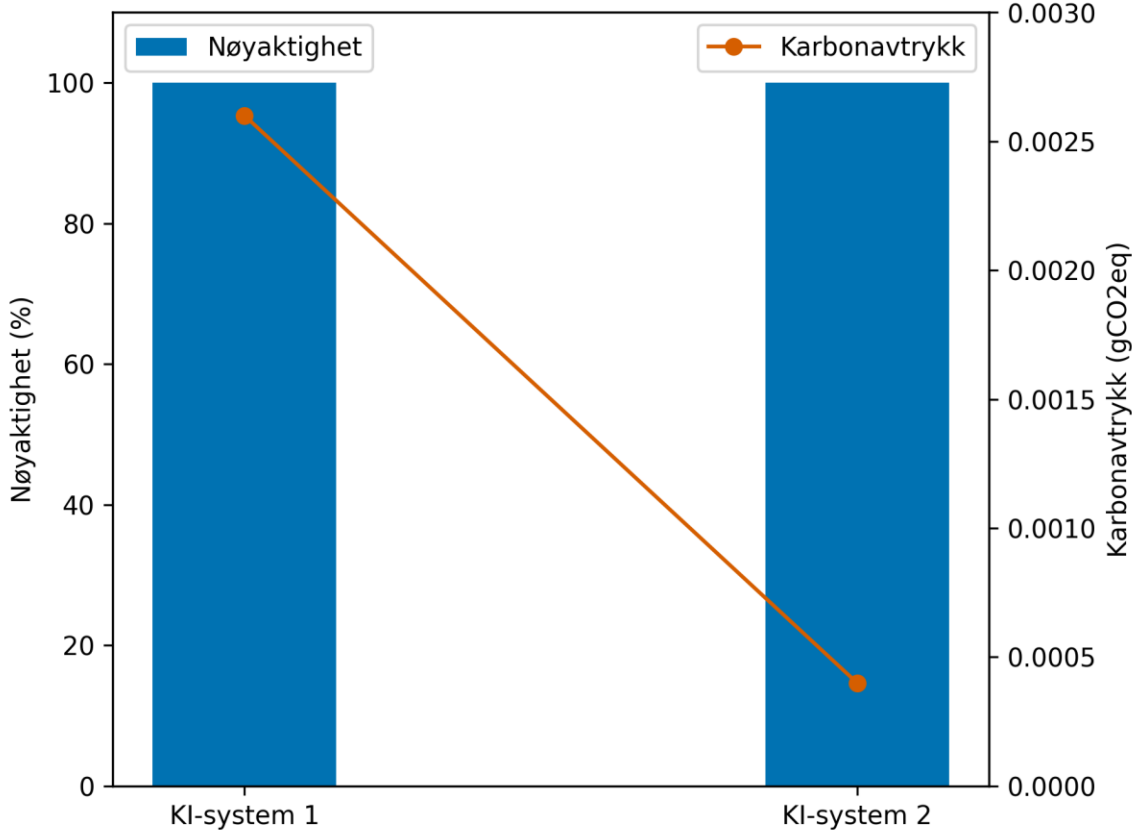
Lage KI-metoder som bruker mindre strøm, men er like gode!

Hvordan kan vi få til bærekraftig bruk av KI?



Kan vi redusere energiforbruket til KI uten at det går utover ytelsen?

- Like god nøyaktighet – redusert karbonavtrykk med 85%
- Konklusjon: Viktig å vurdere både nøyaktighet og energiforbruk
  - Hvordan gjøre dette for språkmodeller?



Anvendelse: Oppdage feil i maskinelle produksjonsmiljø ved bruk av KI.

Kilde: Husom et al. (2024), Engineering Carbon Emission-aware Machine Learning Pipelines.

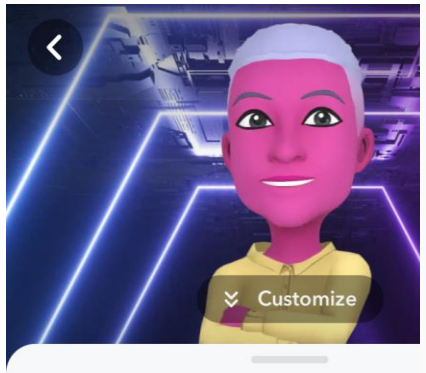
Hvordan kan vi få til bærekraftig bruk av KI?

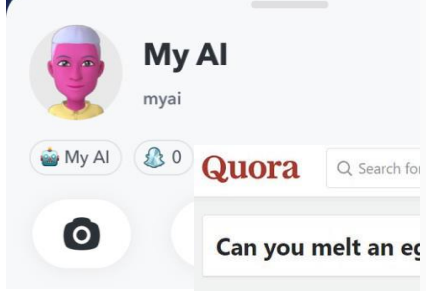
- Bruke mindre modeller
  - Færre parametre = færre regneoperasjoner = lavere energiforbruk
- "Komprimere" modellene
  - Kvantisering, "pruning", etc.
- Bedre informasjonsutvinning fra treningsdata
- Faktisk måle og sammenligne energiforbruket til ulike KI-system
  - Bevisstgjøring: Tydeliggjøre kostnadene
  - Energimerking av KI-modeller?
- Unngå å bruke høykostnadsverktøy til oppgaver med lav verdi
- Men hva med Jevons' paradoks?
  - Økt effektivitet -> økt bruk -> totalforbruket øker

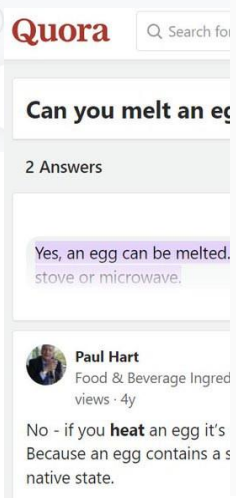
Regulering

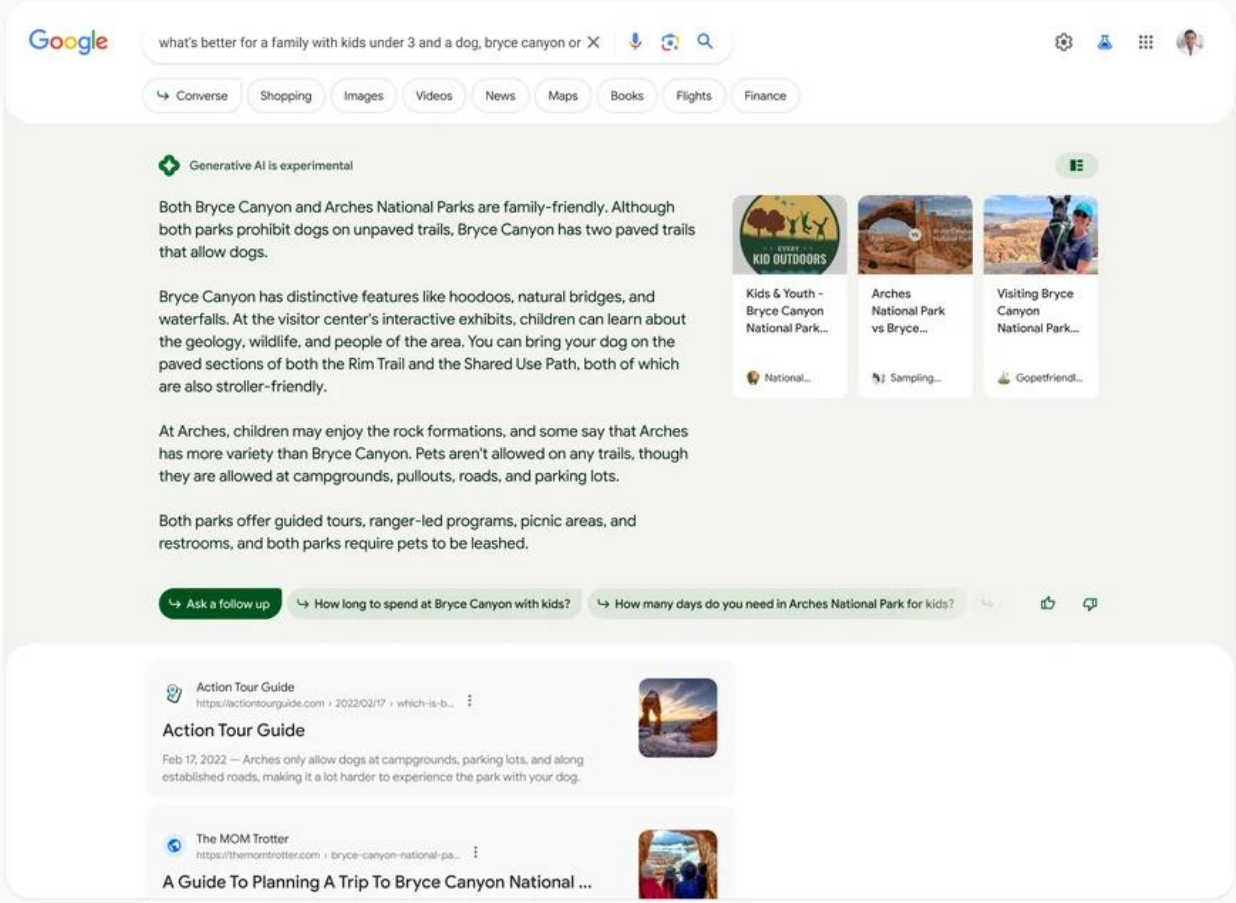
- EUs KI forordning: Klimahensyn er nevnt, men...
  - Krav til rapportering om energiforbruk er svært vage og har mange smutthull
    - For KI-systemer med høy risiko trenger man kun oppgi "computational resources" under utviklingen av systemet (ikke drift/"inference")
    - "Open-source"-modeller er unnlatt åpenhetskrav, med mindre de utgjør en "systemrisiko"
    - I tilfeller med krav om rapportering av energiforbruk, er informasjon forbeholdt myndighetene
  - Ingen krav om rapportering av vannforbruk

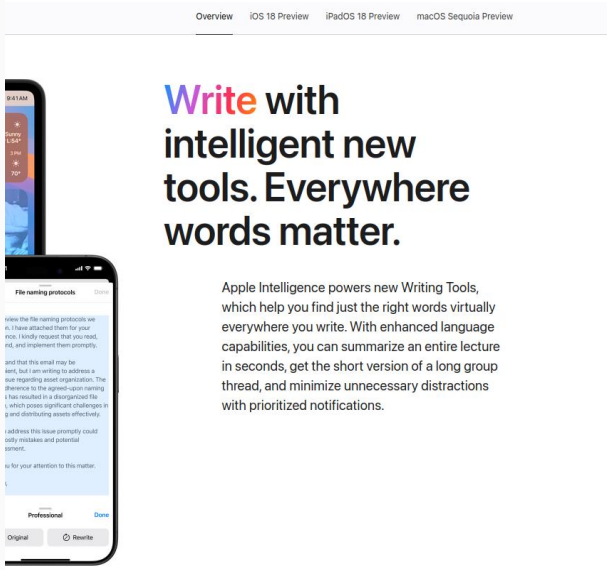
Generativ KI integreres overalt











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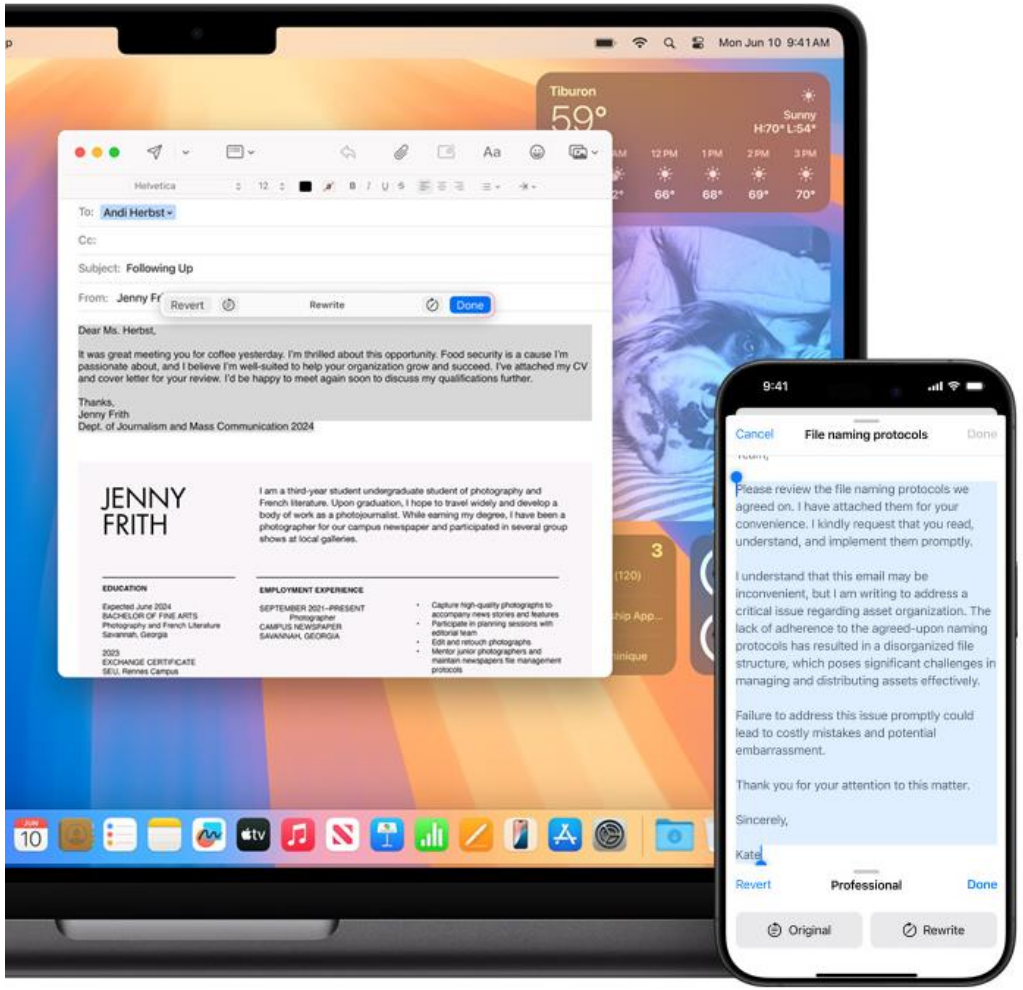
Apple Intelligence

Overview | iOS 18 Preview | iPadOS 18 Preview | macOS Sequoia Preview



Write with intelligent new tools. Everywhere words matter.

Apple Intelligence powers new Writing Tools, which help you find just the right words virtually everywhere you write. With enhanced language capabilities, you can summarize an entire lecture in seconds, get the short version of a long group thread, and minimize unnecessary distractions with prioritized notifications.

Kostnad vs nytte

Kostnad vs nytte: Kreativitet

Gemini

Supercharge your creativity and productivity

Chat to start writing, planning, learning and more with Google AI

Sign in

Kostnad vs nytte: Kreativitet

- "Participants who used AI produced fewer ideas, with less variety and lower originality compared to a baseline."

The Effects of Generative AI on Design Fixation and Divergent Thinking

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ABSTRACT

Generative AI systems have been heralded as tools for augmenting human creativity and inspiring divergent thinking, though with little empirical evidence for these claims. This paper explores the effects of exposure to AI-generated images on measures of design fixation and divergent thinking in a visual ideation task. Through a between-participants experiment (N=60), we found that support from an AI image generator during ideation leads to higher fixation on an initial example. Participants who used AI produced fewer ideas, with less variety and lower originality compared to a baseline. Our qualitative analysis suggests that the effectiveness of co-ideation with AI rests on participants' chosen approach to prompt creation and on the strategies used by participants to generate ideas in response to the AI's suggestions. We discuss opportunities for designing generative AI systems for ideation support and incorporating these AI tools into ideation workflows.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**.

KEYWORDS

Design fixation, Generative-AI, Creativity support tools,

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1 INTRODUCTION

Consider a team of designers discussing ideas for environmentally friendly transport solutions for a city. One team member kicks off the discussion with a suggestion about electric buses. The rest of the team then spends an hour discussing variations on this idea, all involving electric vehicles, until an intern who arrived late asks "have you considered bicycles?". Until the intern's suggestion, the ideas were anchored on a salient characteristic of the first proposal—an electric motor. The design literature dubs this phenomenon *design fixation*—the "blind adherence to a set of ideas or concepts limiting the output of conceptual design" [30, p. 1]. This is a common experience in any creative task, from art to engineering, and happens when exposure to one idea anchors and biases subsequent ideas, restricting exploration of the design space. Fixation happens both consciously and unconsciously, regardless of the level of experience of the practitioner [30, 76] and in all areas of creative work. The severe negative impact that design fixation has on the creative process makes it a key concern in design studies.

In the initial stages of the design process, it is common for designers to conduct precedence studies and create mood boards by compiling external stimuli as sources of inspiration to broaden their ideation space [41]. However, the exposure to previous solutions during this process can potentially be a source of design fixation. Previous studies have shown that exposure to examples of similar design solutions has mixed effects on creativity [75]. It tends to drive designers towards the example, narrowing the explored solution space [30, 38]. Further, variations in the modality [64, 68], the fidelity [13, 64], the quality [64], the diversity and novelty of the exposed stimuli, the time of exposure, and its proximity to the design problem [64] can vary the intensity of design fixation [63].

Recent developments in generative artificial intelligence (GenAI) have been heralded as the harbinger of a new paradigm of creative work, often under the guise of augmenting human creativity [22]. Publicly available AI image generators such as DALL·E[1], Artbreeder[2], Stable Diffusion[3], and Midjourney[4] have made it possible for designers to turn their thoughts into high-quality visuals quickly and at a low cost. The ability of these tools to generate "original" images based on user prompts potentially offers a rich source of inspiration. For example, Chiou et al. [14] have shown that when used in co-ideation tasks, AI can open up a broader conceptual space quickly and effortlessly, promoting divergent thinking [14].

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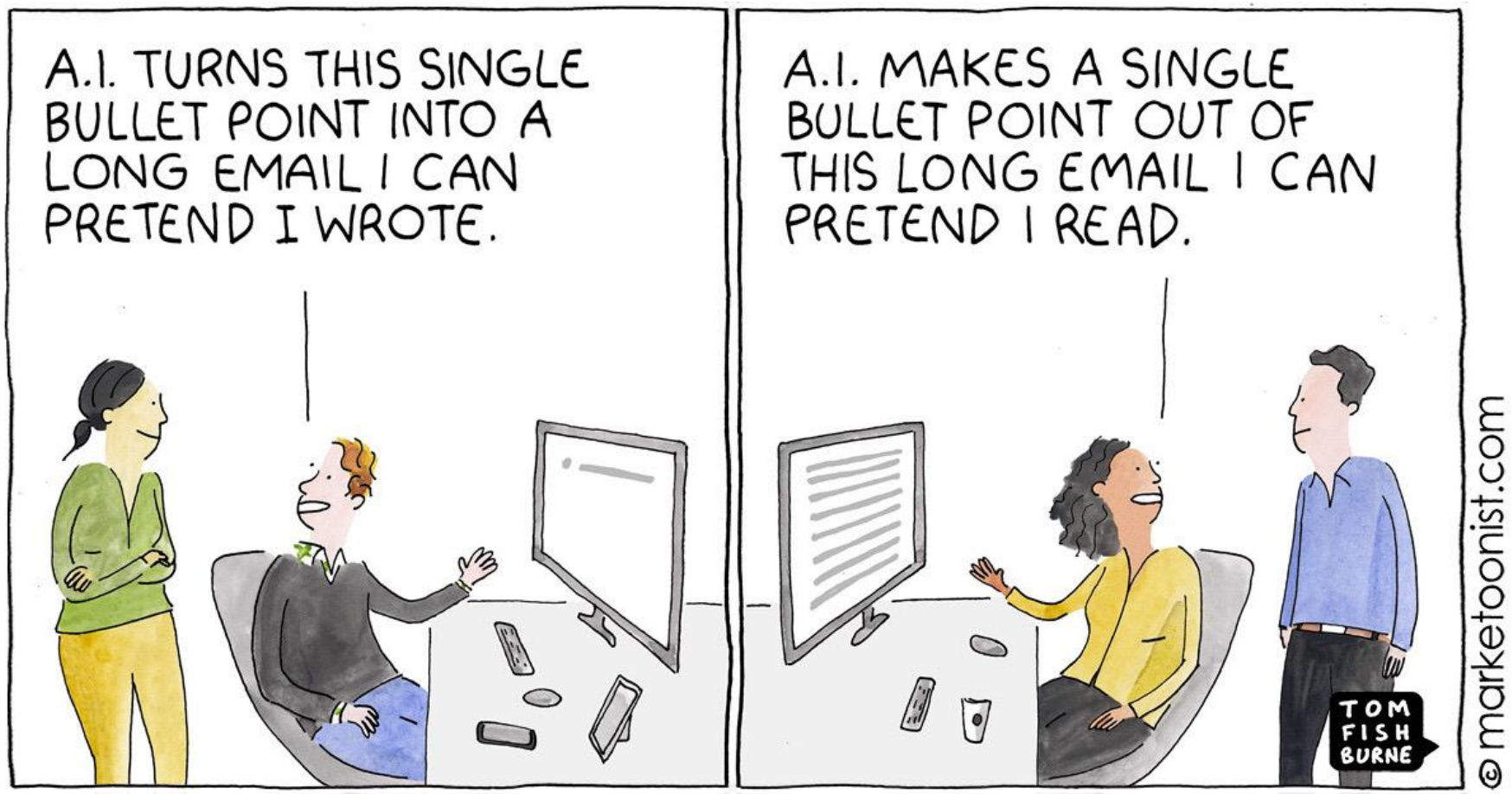
[1] https://openai.com/dall-e-2
[2] https://www.artbreeder.com
[3] https://stablediffusionweb.com
[4] https://www.midjourney.com

Hvor er det nytteverdi å hente?



Hvordan skal vi forholde oss til KI sitt klimaavtrykk?

- Store teknologiselskaper sitter med mye makt
  - Vi eier ikke plattformene vi bruker
  - Vi har ikke fullt eierskap til maskinvaren vi bruker
  - **Store investeringer -> indusert etterspørsel**
- Bevisst bruk
  - Hva er kostnadene?
    - Strøm, vann, materialer
    - Personvern og kontroll over data, juridiske og moralske problemstillinger
  - Hva er det KI-verktøyene erstatter?

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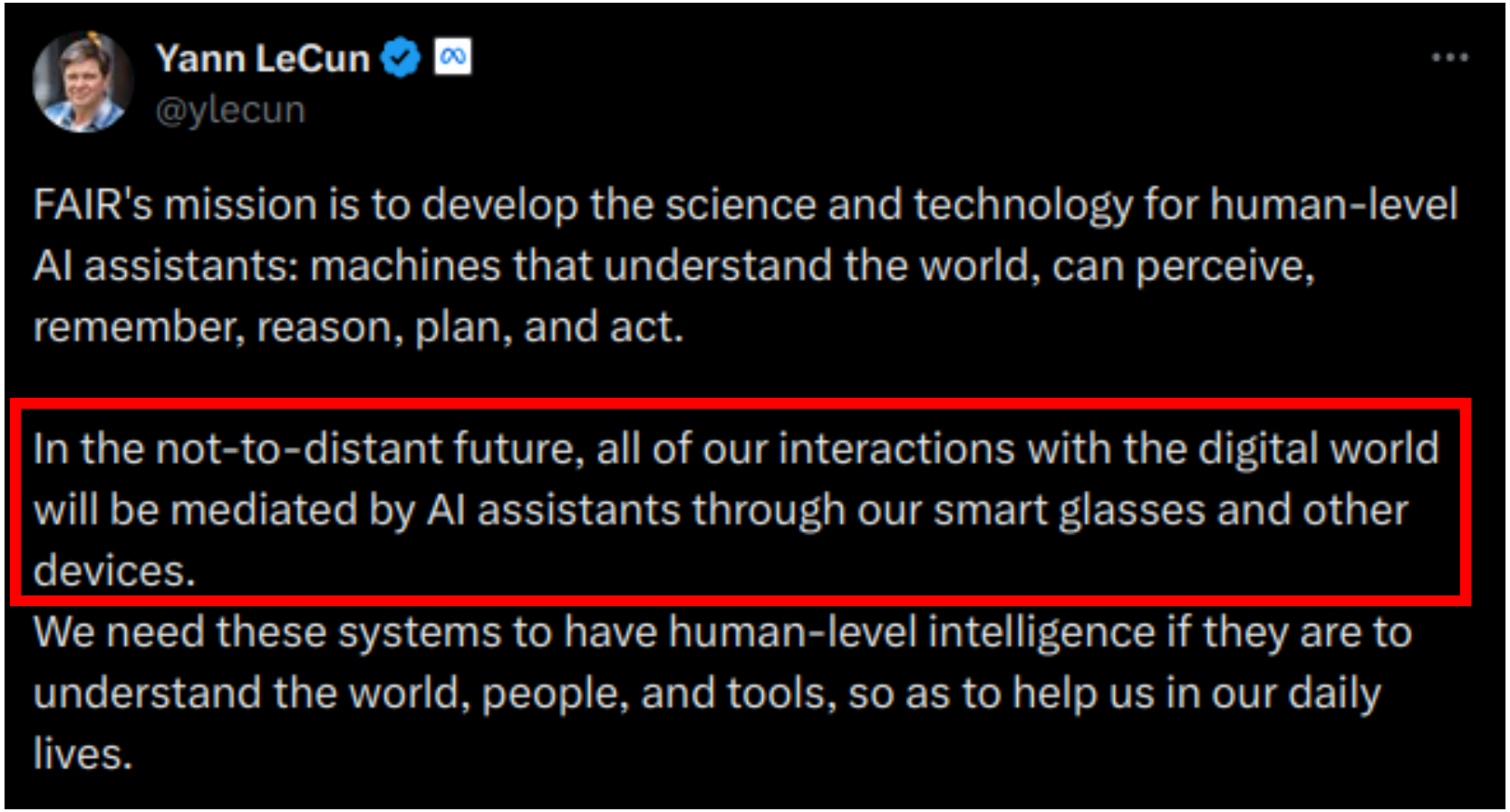
Skann QR-kode for lenke
til presentasjonen

Technology for a better society

Hvordan ser fremtiden ut?



There's too much effort trying to create autonomous machines rather than trying to create machines that are useful tools for humans.

– Prof. Emily M. Bender