Cartography of generative AI

2024

Research and map design
@tallerestampa

Discourses on AI

- AI ecologies
- Criticism through arts
- Critical expertise
- AI ethics
- Academic research
- Data Sciences
- Big Tech innovation
- Mystification
- Technological determinism
- Silicon Valley imaginaries
- Continued hype
- AI Panic
- AI and human extintion

Planetary scale computing

Calculation power

TSMC
(Taiwan Semiconductor Manufacturing Company)

Produces over 60% of the world's chips and over 90% of the world's most advanced chips

Strategic importance: Increasing fears of a Chinese invasion of Taiwan (US-China technology battle)

Nvidia: Proprietary CUDA system for AI
Intel
AMD
Google TPU
AWS Trainium

Graphics processing units (GPU)

Energy consumption

1 to 1.3% of the world's electricity
Big Data platforms are increasingly becoming partners in of oil and gas resources

Fossil fuels (+80%)
Mostly powered by coal, natural gas or oil

More than 1% of global greenhouse gas emissions

Global warming

Greenwashing strategies

Carbon offsetting economy
Companies offset their greenhouse gas emissions by paying other parties to prevent emissions or remove carbon dioxide from the air. Offsetting is done through questionable forestry and wind projects that are more symbolic than real

Large amounts of radioactive waste

Nuclear fission
Oklo (Sam Altman)

Renewable energy

Green colonialism: Land use conflicts with communities

↑ local electrical prices

Training data

Data centers

8,000 datacenters worldwide predicted to grow a continuing 10% per year (to maintain cheap data training guarantee)

Power consumption
A single data center can consume the equivalent electricity of 50,000 homes

Water cooling
As the extra power consumption generates more heat, AI data centers also need alternative cooling methods, such as liquid cooling systems

Cooling systems (CRACs/CRAHs)
Greater than 40 percent of data centers electricity usage

Azure Cloud AWS

Big Data platforms

Microsoft Google Amazon

Water towers

Heat

Servers

Plate Heat exchanger

Pump station

Indigenous and local communities:
300,000 million tonnes of carbon are stored on land managed by indigenous communities worldwide (due to lower rates of deforestation). These communities are often excluded from land-use decisions. In Kenya, thousands of people were evicted from their ancestral lands as part of a programme to reduce deforestation

Digital Colonialism

Local water table affections

Droughts and local conflicts
In the year 2023, residents of Montevideo, suffering from a severe water shortage, protest against plans to build a Google data centre

Water

4-9 litres per kWh of server power
Google says that in 2022, its data centres around the world will have used 5.2 billion gallons of water

Waste
Cables, batteries, uninterruptible power supplies (UPS), air conditioners (CRACs and CRAHs), power distribution units (PDUs), and transformers are also periodically decommissioned and disposed of, when warranties expire

More than 50,000 tonnes of e-waste, which takes millennia to decompose, is sent to Africa every year. It ends up in informal dumps like those in Agbogbloshie, Ghana, where hazardous materials are burned, exposing people to toxic fumes and radioactive elements

Mercury, copper, lead and arsenic leach into soil and waterways, causing a build-up of harmful chemicals in the ecosystem and its food chains

One year's worth of global e-waste:
7.3 kg per capita
82.6% landfilled or informally recycled

64% of e-waste sent to recycling centres in Europe is then shipped to Africa

Supply chain of raw materials

Cobalt is used in rechargeable lithium-ion batteries. There are reports of the use of child labour and human rights abuses in the Congolese cobalt mines

Deep sea mining:
Impacts: destruction of ecosistems, compaction of the sea floor, and creation of sediment plumes that disrupt aquatic life

Mining industries

Metals and minerals extraction exported to the Global South

Central depression
Salt flat
Atacama desert
Andes Mountains

Li — The Salar de Atacama, a salt flat nearly four times the size of New York City, is one of the world's largest lithium mines, a key component in battery production. Rising demand is increasingly affecting local communities, threatening their access to water and impoverishing biodiversity

Cu — Manufacturers use copper in the most powerful computer chips because of its superior electrical conductivity. The 'mining corridor' of southern Peru (exploited by China's MMG Ltd, Switzerland's Glencore and Canada's Hubbay) is one of the mainstays of the economy, but it is also one of the main sources of conflict due to unequal distribution of income from mining and health problems due to water pollution

Copper 'mining corridor' (southern Peru)

Au — Brazilian law does not officially allow mining on indigenous land. But illegal gold mining in the Brazilian Amazon has skyrocketed since 2019. Researchers have documented tens of thousands of small-scale miners and more than 320 illegal mines, with the actual number likely to be much higher. Small-scale gold mining has led to widespread deforestation, mercury pollution and sedimentation of vital rivers

Since the year 2007, over seven billion smartphones have since been manufactured

Weld	Sn	China, Indonesia, Burma, Peru
Battery	Li	Lithium Triangle (Bolivia, Chile, Argentina), Australia, China
Circuits	Ta W	Rwanda, Brazil, Congo, China
Conductors	Au Cu Ag	Congo, Zambia, Chile, Peru, Mexico, China, Brasil
Processor	Si	China
Screen	Al K	Canada, Russia, Belarus
LCD	Sn In Ga	China, Indonesia, Burma, Peru
Rare-earth elements		China
Vibration	Dy Nd Pr Tb	
Screen	Dy Eu Gd	
Microphone	Dy Nd Pr Tb	

The manufacture of server racks involves copper, silicon and lithium. Cabling, busbars, switchgear and so on all use large amounts of copper

Lack of transparency

Silicon Valley venture capital

Wave of tech speculation

Race to deploy new AI

"Visionary" leader covered by the media

AI start-ups

OpenAI
DeepMind
Anthropic

Deep neural networks

Policy agenda

Institutes for future

Lobbies

AI and human extintion
Demands for self-regulation

Public Regulations
EU AI Act
Transparency requirements in datasets
US companies voluntary agreement

Synthetic contents
Regimes of truth: public discourses and affectations

Authoritarian populisms
Political polarisation

Personalized entertainment

Disinformation and propaganda
Information systems
News
Recommendation
Content categorisation
Algorithmic governance

Software as a service (SaaS) and platform as a service (PaaS)
Application programming interfaces (APIs)

AI data centers
need to be built with additional infrastructure that can deliver much more power

Current data centers
5 to 10 kilowatts per rack

AI requirements
60 or more kilowatts per rack

Noise pollution
Data center's hum causes acute and longitudinal physiological effects

Diesel generators
Air pollution and climate impacts

Human labour

Working markets: Kenya (36% below the poverty international line), India (68%), Philippines (78%), Venezuela, Colombia (39%), Uganda (28%)

Companies: Sama, Appen, Clickworker, Scale AI

AI Model

Fine-tuning
- data scoring
- annotating data
- labeling

(RLHF)

Filtering
- content moderation
- banned prompts
- "toxicity" detection

Alignment

AI Photography
Search engines
AI assistants
Word processors
Customer service

Massive and private latent spaces

Statistical text
Statistical images
Statistical sound

Generative AI engines

Chat GPT Bard Bing Claude Falcon Mistral Llama Stable Diffusion Midjourney DALL-E Chat GPT Gemini Grok Pixtral

Services dependence
In August 2023: 34 million images/day

Datasets

The information in datasets is always embedded in the contexts that create and use them. They remain tied to the communities, individuals, organisms and environments in which they were created

LAION-5B
5.8 billion image-text pairs

CommonPool
12.8 billion image-text pairs

Deepen AI, trains Syrian refugees to annotate data for the likes of Google and Amazon. Sama trains refugees in Uganda, Kenya, and India to complete short data tasks

Refugee camps (Kenya and Lebanon's Shatila)

Largest possible dataset

Infringement of intellectual property laws

Extraction and privatisation
"The right to read is the right to mine": appropriation of the discourse "Information Wants to Be Free" mid-90's version of Internet Freedom

Encoding worldviews
- Extreme racial and gender stereotypes, ideologies, viewpoints
- Narrative archetypes
- Mainstream culture
- Styles as statistical patternsthat can be replicated automatically

Web scraping

Techniques for automatically downloading and processing web content. Common Crawl and OpenWebText2: scientific research institutions for data mining in non-commercial contexts

Wikipedia
Project Gutenberg
Image banks

420 submarine cables distributed following the routes of telegraphs and colonial navigations

Internet service providers

books
blogs
comments
posts
reviews
papers
shares
likes
labels
scores

images
videos
illustrations
paintings
brands
styles

photography
labor
engineering
equipment
technical expertise

music
sounds
voices

Digital internet content
Image, text & sound

Social media Web2

Image recognition (labeling, segmentation, pose, depth)

Profiling and content filters

Social media

Data extractivism

Terms and conditions

Rise of the attention economy and its technologies

Descriptors to image and texts < Aesthetic Turn

AI
Large scale models that run in private infrastructures

Global computation

2021 OpenAI introduces the neural network called CLIP, that classifies images using textual descriptions

2021 Latent Diffusion Process of diffusion within a latent space

2019 GPT-2 (Generative pre-trained transformer)

2016 Generating images (32 x 32 pixels) from captions
Elman Mansimov et al.

Control of communication through images > Image to descriptors

Research →

AI
Open source or publicly available paper-based

Local computation

2003 First feed-forward neural network language model
Yoshua Bengio et al.

Caltech 101 dataset
10,000 images
Fei-Fei Li et al.

2009 ImageNet dataset
14 million images and more than 20,000 categories
Fei-Fei Li et al.

2012 Alexnet. First fast GPU-implementation of a CNN to win an image recognition contest
Alex Krizhevsky, Ilya Sutskever and Geoffrey Hinton

2014 Generative Adversarial Network (GAN)
Ian Goodfellow et al.

2015 Diffusion model
Used for image generation by starting with an image composed of random noise for the network to iteratively denoise

Advanced chips

ASML
Dutch manufacturer of equipment for the production of integrated circuits. It is the world's largest supplier of photolithography systems for the semiconductor industry, with more than 5/6 of the world market

TSMC
Taiwan Semiconductor Manufacturing Company controls a large share of the global market for advanced chips and has a strong position in the manufacture of leading-edge semiconductors

Assembly
Devices are assembled in factories like Foxconn located in the Global South, where labor can be procured cheaply and legal protections for workers are scant

Digital gadgets

Their lifespans average less than two years, a consequence of designed obsolescence

Product designer
Film editors
Screenwriter
Writer
Copywriter
Set designer
Architect
Web developers
Web designer
Render wrangler
Actor
Stylist
Rotoscopers
Freelancers jobs
Outsourced workers
User
Musicians
Compositor
Voice artist
Texture artist
UX designer
Fashion
Storyboard artist
Gaming
Graphic designer
Illustrators
Motion graphics
Photographers
Unwaged AI trainers