



Google

AI for Social Good

Playbook



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Project Activate

Project Activate is designed for people with severe motor and speech impairments. This Android app helps users communicate quickly and spontaneously using computer vision that detects facial gestures and eye movements, then translates them into actions like audio output and text messaging.

“ The ability to trigger actions with my face opens up a world of possibility and security, even amidst the inevitable uncertainty of life with a disability. ”

- Dianna

Project Activate user

Why we built this

Users with disabilities resulting from conditions such as multiple sclerosis, cerebral palsy, spinal cord injuries, or amyotrophic lateral sclerosis may struggle to communicate with others. We built Project Activate to enable them to communicate confidently and easily with personalized speech.

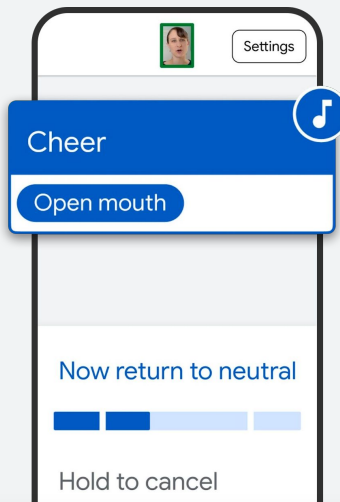
Supporting research

Computer vision models detect the user's facial movements and the direction of their gaze to run on the device in real time while also preserving the user's privacy. We structured this app with the feedback of dozens of users with varying severe motor and speech impairments.

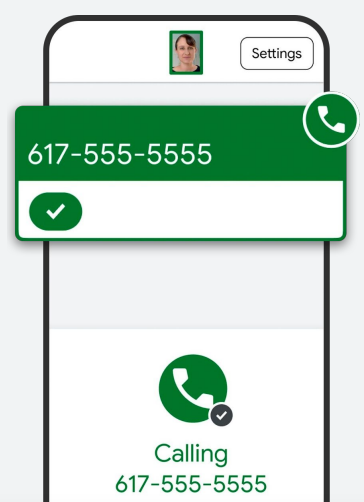
Features



Activate your presets



Express yourself



Get attention



g.co/ProjectActivate



Project Relate

For millions of people, being able to speak and be understood can be challenging.

Project Relate is an Android beta app that uses machine learning to help individuals with non-standard speech communicate more easily with others and interact with Google Assistant.

“ Project Relate can make the difference between a look of confusion and a friendly laugh of recognition. ”

- Project Relate User

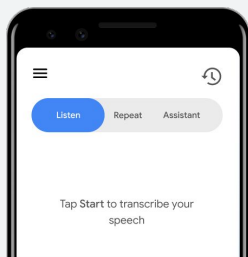
Why we built this

Voice-enabled tech is becoming increasingly more ubiquitous, but speech recognition algorithms don't always work as well for people with atypical speech. By personalizing its speech recognition to the individual, Project Relate seeks to improve everyday life for people with non-standard speech.

Supporting research

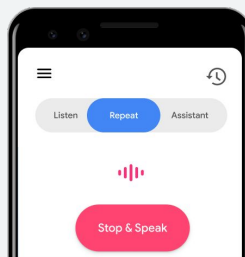
Project Relate is a continuation of years of research from both Google's Speech and Research teams, made possible by over a million speech samples recorded by over a thousand individuals. We welcome new trusted testers to experience the app and provide feedback. Express interest at g.co/ProjectRelate.

Features



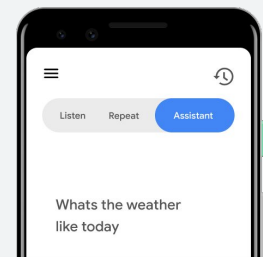
Listen

Transcribe speech to text in the Relate app—or in any other app—so you can use your voice to write docs or text messages.



Repeat

Restate what you've said using a clear, computerized voice, for greater ease in face-to-face conversation.



Assistant

Speak directly to your Google Assistant so you can take care of tasks such as setting a timer, playing a song, or asking for directions.



g.co/ProjectRelate

Users must be 18+, an English speaker and have an Android OS8 or later to run the app



Green Light

Project Green Light uses machine learning to help cities reduce stop-and-go traffic and greenhouse gas emissions by optimizing their traffic lights.

10%

of global greenhouse gas emissions come from road transportation.^{1,2}

25%

Reduction in stop-and-go traffic, along with associated GHG emissions, in first program pilots

Why we built this

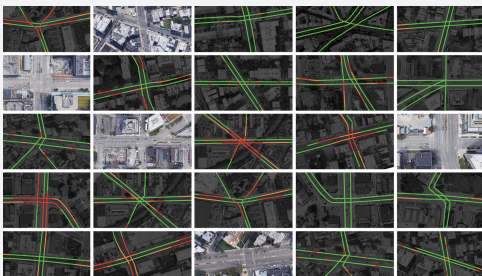
Much of carbon emissions from cars is due to traffic light configurations that haven't been optimized for existing traffic. Cities would need to install and maintain sensors or tally vehicle counts manually to understand the number of vehicles passing through an intersection daily, which is expensive and only provides incomplete data.

Supporting research

Building on the foundation provided by our decades-long effort to map cities across the world, we have a robust understanding of the placement of traffic lights in most cities.

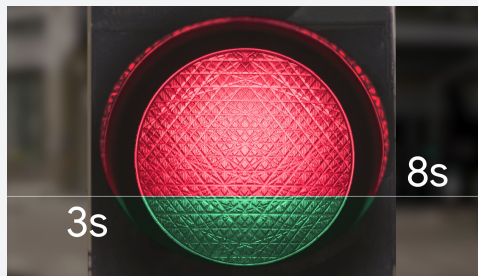
This research has been piloted so far in cities such as Seattle, Rio, Budapest, Hamburg and Bangalore. Expansion into other cities is currently underway.

How it works



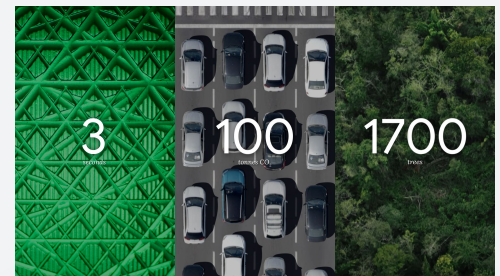
Understand

We create a model to understand the structure of the intersection and how traffic flows through it.



Recommend

We identify recommended adjustments with machine learning to optimize traffic light timing.



Analyze

We then analyze improvements in congestion at the intersection, and use emissions models from the US National Renewable Energy Laboratory to understand our climate impact.

Flood Forecasting

Floods can cause tens of thousands of fatalities every year. Google can alert individuals at risk of a flooding event with an alert sent directly to their smartphones. This is accomplished through machine learning models that generate hyper local flood forecasts.

The operating system covered an area with over 360 million people around India and Bangladesh in 2021, reaching 22 million people with over 115 million notifications based on the user location and our flood maps.

“ I got the Google notification...before the big flood and sent it via local community group to over 200 people in surrounding villages. ”

- Local activist

East Champaran, Bihar, India

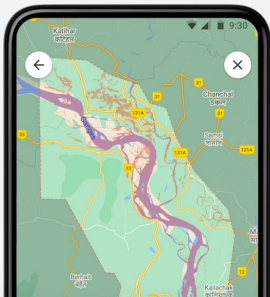
Why we built this

Everyone should have access to flood warnings so they can be safe and informed. Providing this service can help millions of people and save thousands of lives.

Supporting research

These flood forecasting models implement advanced machine learning¹ technologies, bringing innovation to the satellite-based flood mapping field.

Features



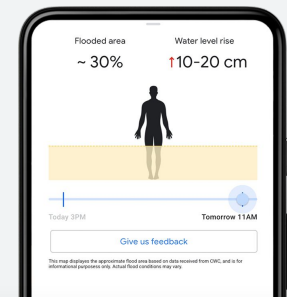
Maps

Google provides high-resolution flood maps in Google Maps and Google Search for the use of the general public and aid organizations.



Notifications

Google sends flood alerts notifications only to people who are located in an expected flood location.



Hyper-localized

Google Flood Alerts can estimate the water depth in your village and the flood map of your surroundings.



g.co/floods

¹ <https://hess.copernicus.org/preprints/hess-2021-554/>



Open Buildings

Open Buildings is a dataset of over 500 million building footprints that have been made available to the public to support social good applications such as planning for natural disaster relief or population density.

Each building detected includes a Plus Code, which acts as an address, provides location information, and estimates the size of the building.

“When I lived in Rwanda for 2 years there was unprecedented rainfall that destroyed fields and homes. I imagine this data set could help governments and orgs better identify high risk areas and offer potentially life saving assistance.”

- Lily Adelstein

Project Manager at Telepath

Why we built this

Knowledge of building density is vital for policy, planning, service delivery, and emergency response, but it's often unavailable in countries that are low on resources. The model currently runs on 19.4 million km², which is 64% of Africa.

Supporting research

With the release of the Open Buildings paper,¹ this team is contributing to the computer vision field by providing methods of calculating continent-wide data using satellite imagery and machine learning. The training dataset was built by manually labelling 1.75 million buildings in 100,000 images.

Features



Urban Example

The AI model used for Open Buildings is able to detect buildings in dense areas.



Refugee Camp

The Open Buildings model excels at finding buildings in the most rural areas, which can be challenging due to their unique shapes and materials.



Open Buildings website

The site allows individuals to download the entire footprint of selected countries, including an explorer that visualizes the footprint.



<https://sites.research.google/open-buildings/>

¹ <https://arxiv.org/abs/2107.12283>



Bioacoustics

In order to preserve endangered animal populations, we first need to understand where they are and when.

Scientists have been collecting natural sounds for decades, but analyzing them takes a lot of time and effort. The bioacoustics initiative uses machine learning to help biologists automatically detect and classify animal sounds. This technology was so far applied to recognize orcas, humpback whales, and birds.

“ We have a much better idea of where and when the endangered killer whales are located because of Google’s detection model. ”

- Paul Cottrell

Marine Mammal Manager, Fisheries and Oceans Canada (DFO)

Why we built this

Today there are 15 species of whales still listed under the Endangered Species Act.¹ Whales have been protected for decades in most oceans, but they face other threats from human activity. Knowing where whales are and when is critical to monitoring and protecting them. Since it’s difficult to film or take photos at the depths at which whales live, biologists have relied on acoustic data to track them. AI greatly accelerates their ability to analyze acoustic data at scale.

Supporting research

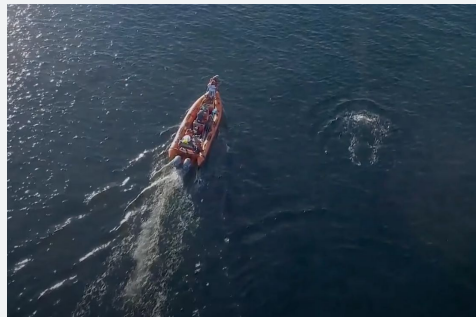
Using sound separation techniques, we can separate the songs of several birds singing at the same time. This makes detecting and classifying what bird species are singing more accurate. In turn, this allows us to better understand their environments and potential threats.

Features



Orcas

The orca detector enables Fisheries and Oceans (DFO) Canada to track a critically endangered population of orca whales. DFO provided 1,800 hours of underwater audio and 68,000 labels to teach a ML model to recognize orca sounds.



Humpback Whales

The open-sourced humpback whale detector enabled oceanographers of the National Oceanic and Atmospheric Administration (NOAA) to make significant scientific discoveries. For example, the longest record of humpback whale song in the Hawaiian Islands, which demonstrates regular seasonality patterns in songs.



Birds

Birds are all around us, and we can learn about our environment just by listening to them. Researchers are now using this sound analysis technology to differentiate birdsongs in the wild to accelerate biodiversity conservation efforts.

Protecting Coral Reefs

Coral reefs are some of the most diverse ecosystems globally. However, Australia's Great Barrier Reef has seen dramatic coral losses alone in the last 30 years, with other reefs experiencing similar declines. A number of rising threats like climate change, pollution, and overfishing are major contributors. In Australia, outbreaks of the coral-eating crown-of-thorns starfish (COTS) have been shown to cause significant coral loss.

Healthy reefs are critical to fisheries and food security. They also provide countless additional benefits by protecting coastlines from storm surges, elevating tourism-based economies, and pushing forward drug discovery research.

Controlling COTS outbreaks is a critical factor to promoting coral growth and resilience, so Google is teaming up with the Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) to tackle this problem.

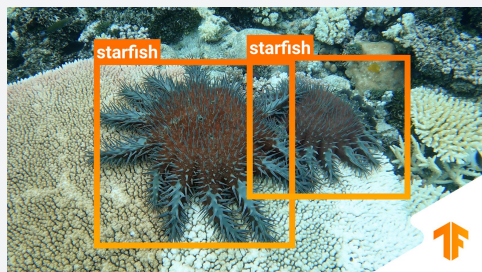
Why we built this

Machine learning can scale and improve underwater surveys, monitoring, and mapping out these harmful invertebrates in real time to help control teams address and prioritize outbreaks.

Supporting research

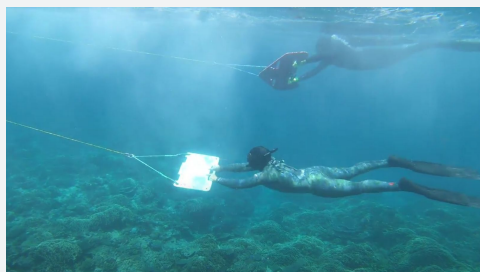
Just 15 starfish in a hectare are able to strip a reef of 90% of its coral tissue. While COTs naturally exist in Indo-Pacific, overfishing and excess runoff lead to large outbreaks that devastate already vulnerable coral communities.¹

Process



Model Training

We used object detection models and training pipelines from the Tensorflow2 Model Garden library, experimenting with different training and data augmentation techniques on internal Google Tensor Processing Unit (TPU) Clusters.



Deployment

Google is working with CSIRO to deploy the model on the edge, leveraging a graphics processing unit (GPU) connected to a GoPro to map out the harmful starfish in real time. Our goal is to ultimately empower control teams to effectively detect and prioritize outbreaks.



Open Sourcing

We will publish our model and accompanying training pipeline to empower organizations around the world to leverage this technology to protect their coral reefs.

Tree Canopy

We launched Tree Canopy Insights to help governments fight extreme heat as part of our free Environmental Insights Explorer.

Tree Canopy Insights empowers cities to see real-time information about their current tree canopy coverage to inform future planting projects. This is possible with the use of aerial imagery and AI paired with Google Earth Engine data analysis capabilities.

“ Every tree we plant can help stem the tide of the climate crisis, and when we expand our urban forest, we can sow the seeds of a healthier, more sustainable and equitable future for communities hit hardest by rising temperatures and intensifying heat waves. ”

- Eric Garcetti

Mayor of Los Angeles

Why we built this

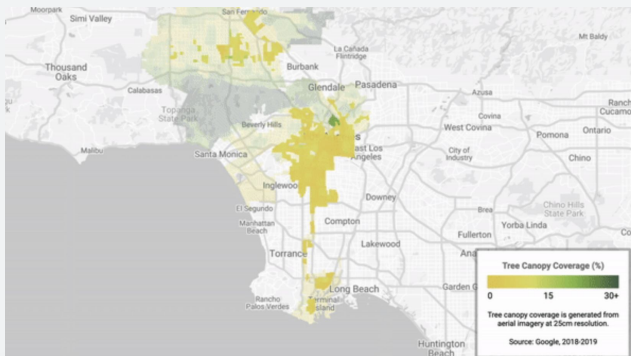
Extreme temperatures are becoming more common in cities as they face the negative impacts of climate change. They can be 7 degrees hotter than surrounding areas — leading to poor air quality, dehydration, and other major public health concerns.

Supporting research

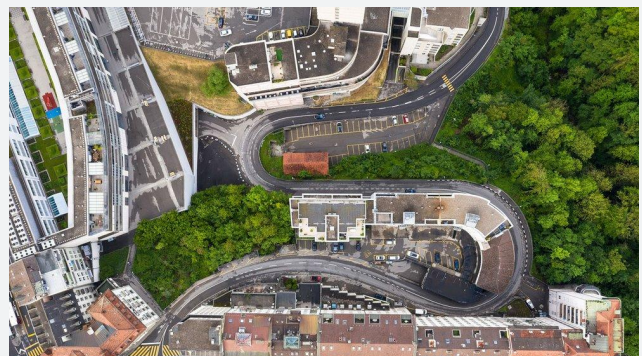
It's estimated that 1.6 billion city residents will face extreme heat by 2050, according to C40 Cities.

Trees are becoming an increasingly relevant solution to lowering street-level temperatures while also improving quality of life.

Features



Precomputed statistics help planners with tracking against their goals over time.



City planners can select a region on the map and see the stats for that region.



AI Mammography in Japan

This research project is striving for better detection of early-stage breast cancer using Google's AI mammography model in partnership with the Japanese Foundation for Cancer Research (JFCR) at Ariake Hospital. We do this by analyzing existing mammography scans using an image recognition AI model that can read the scans with similar levels of accuracy as a radiologist. Google is validating the effectiveness of the AI model on Japanese mammography images as part of the government's AI Hospital Initiative.

“Breast cancer is a cancer that has a very high probability of being cured if found at an early stage. By using AI technology for cancer screening, we can maintain the accuracy of diagnosis and reduce the burden on radiologists, even if many people undergo health screening.”

- Prof. Yusuke Nakamura

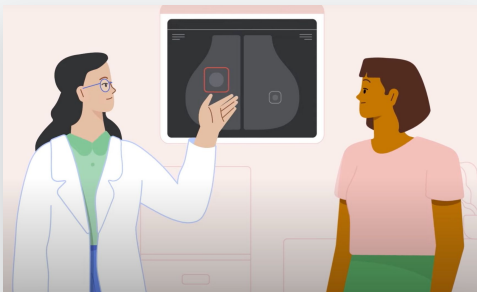
Director for Strategic Innovation Promotion Program “AI Hospital” initiative,
Japanese Cabinet Office and Executive Advisor of The Cancer Institute of JFCR

Why we are building this

Breast cancer mortality in Japan is increasing. We hope that our AI model developed in the US and UK will also provide a solution to the shortage of radiologists in Japan and support efforts to increase screening rates.

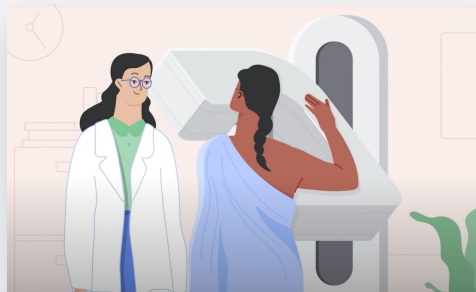
Supporting research

The Google AI mammography model was developed in collaboration with experts from the United States and the United Kingdom and published in the journal *Nature*.



Prevalence

Each year, nearly 95,000 women (and over 600 men) in Japan are diagnosed with breast cancer ¹



Screening Rates

Screening helps catch breast cancer early, but screening rates are ~45% in Japan, significantly lower than the US (79%) and UK (75%) ²



Medical Professionals

Japan has the fewest radiologists per million population among 26 OECD countries ³

¹ https://ganjoho.jp/reg_stat/statistics/stat/cancer/14_breast.html

² <https://www.oecd.org/japan/health-at-a-glance-japan-EN.pdf>

³ https://www.researchgate.net/publication/23442608_Radiologist_supply_and_workload_international_comparison--Working_Group_of_Japanese_College_of_Radiology

日本での乳がん検診への AI 活用

この研究プロジェクトは、公益財団法人がん研究会 (JFCR) 有明病院と連携し、Google の AI マンモグラフィモデルを使用して早期乳がんをより正確に検出することを目指しています。これを実現するために、放射線科診断医と同等の精度でスキャンを読影できる画像認識 AI モデルを使用して既存のマンモグラフィ画像を分析します。Google は、内閣府が推進する AI ホスピタル構想の一環として、日本人のマンモグラフィ画像に対する AI モデルの有効性を検証しています。

乳がんは早期に見つければ治癒する確率が非常に高いがんです。がん検診に AI 技術を利用することは、多くの方が検診を受けても、診断の精度を保ちつつ、放射線科診断医の負担を軽減することにつながります。

— 中村祐輔教授

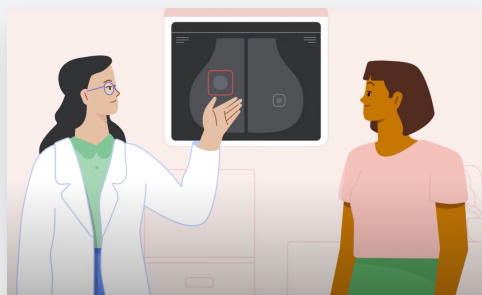
内閣府戦略的イノベーション創造プログラム「AI ホスピタル」プログラムディレクター、
公益財団法人 がん研究会 研究本部 顧問

開発の目的

日本の乳がんによる死亡者数は上昇傾向にあります。米国と英国で開発された当社の AI モデルが日本の放射線科診断医不足の解決策となり、受診率向上につながることを期待しています。

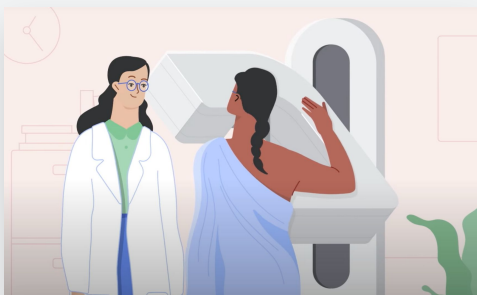
研究支援

Google の AI マンモグラフィモデルは米国と英国の専門家が共同で開発し、学術誌 *Nature* で発表されました。



罹患数

日本では毎年、約 95,000 人の女性 (および 600 人以上の男性) が乳がんと診断されています¹



受診率

検診は乳がんの早期発見に有効ですが、日本の受診率は 45% 未満に留まっており、米国 (79%) や英国 (75%) に比べて著しく低くなっています²



医療専門家

経済協力開発機構 (OECD) に加盟する 26 カ国の中で、日本は人口 100 万人あたりの放射線科診断医が最も少ない国です³

¹ https://ganjoho.jp/reg_stat/statistics/stat/cancer/14_breast.html

² <https://www.oecd.org/japan/health-at-a-glance-japan-EN.pdf>

³ https://www.researchgate.net/publication/23442608_Radiologist_supply_and_workload_international_comparison—Working_Group_of_Japanese_College_of_Radiology

ARMMAN

Nearly 90% of maternal deaths are avoidable with timely intervention,¹ but every fifteen minutes another woman in India dies in childbirth.² India alone accounts for 11% of global maternal mortality.³

ARMMAN (Advancing Reduction in Mortality and Morbidity of Mothers, Children, and Neonates) is an organization that runs mMitra, a free mobile voice call service that sends timely and targeted preventive care information to new and expectant mothers, offering accurate information and resources where they are scarce.

“ Now I listen to the call regularly. It feels like someone from your own family is looking out for you. ”

- Participant

Why we built this

These AI models provide an indication of women who are at risk of dropping out from the health information program. The early identification helps ARMMAN to personalise interventions, retain these mothers, and improve their maternal health outcomes.

Supporting research

This is a Restless Multi-Armed Bandits system, which predicts who among the low-engagement listeners are at a high risk of dropping out from the program sometime in the future. It goes even further to predict which of the low listeners are likely to re-engage or not.

The AI-powered intervention directs support calls, which has been shown to increase engagement in high-risk participants by 30%.

Process



Sign-up

New or expectant mothers enroll in the program and provide demographic characteristics, like their age and income.



Contact

mMitra is a voice call service that sends automated voice messages to the mother, guiding them through pregnancy and their child's infancy.



Engage

Using AI-powered intervention, health workers can follow-up with women who are at high-risk of dropping out from the program.



COVID-19 Open Data

The COVID-19 Open Data (COD) Repository collects data on COVID-19 and related covariates across different regions over time. The repository covers over 22,000 distinct locations with 302 data sources, and is updated daily. The individual data sources are aggregated into a set of tables, grouping variables that are related to each other like epidemiology, hospitalizations, and vaccination rates that are indexed by date and location. The rich variety of data types can help public health professionals, researchers, policymakers, and others in understanding and managing the virus.

“ By organizing, curating, and analyzing the data depicting ongoing trends in the pandemic, a significant contribution has been made to the global effort to combat COVID-19. ”

-Dr. Robert Califf

Former Head of Clinical Policy & Strategy, Verily and Google Health

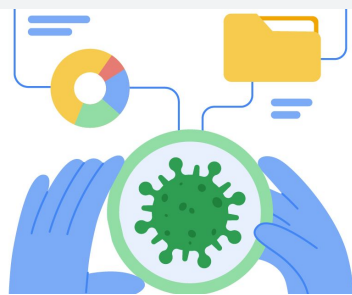
Why we built this

Public health agencies around the world use COD to help understand the pandemic and its effects on different populations. Researchers use the repository for forecasting and case study modeling. Data scientists use it for data analysis and monitoring to aid their understanding of the pandemic. Policymakers use it to obtain data critical to developing public policies.

Supporting research

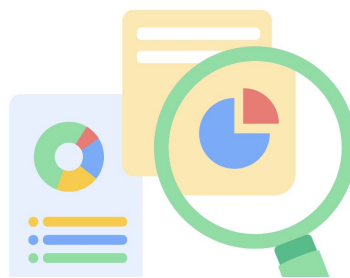
The Open Data Repository comprises data from 302+ authoritative sources such as the New York Times, World Health Organization, and Eurostat. The repository contains data on the virus in addition to socioeconomic factors that may affect the spread and patient outcomes for over 22,000 distinct geolocations.

Features



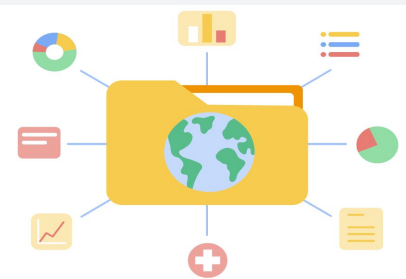
Verily Life Sciences

Verily uses COD in the Baseline Site Selection Tool,¹ an open source simulation tool designed for COVID-19 vaccine clinical trial enrollment.



CDC

The CDC builds ensemble forecasts² from models using COD and other datasets.



Publications

COD has been cited in 15+ publications, including a recent npj Digital Medicine paper³ focused on AI-augmented epidemiology to forecast COVID-19.



health.google.com/covid-19/open-data/

¹<https://github.com/verilylifesciences/site-selection-tool>

²<https://www.cdc.gov/coronavirus/2019-ncov/science/forecasting/forecasting-us.html>

³<https://www.nature.com/articles/s41746-021-00511-7>

