

ChatGPT and Map Projections

ChatGPT is a language model developed and trained by Open AI – a company for research and applications of artificial intelligence and is intended for conversation with people in many languages. It became available to the public on November 30, 2022. It is free and in the first five days more than one million users registered.

ChatGPT can generate high quality texts and the ability to maintain a realistic conversation. To generate text that looks like text written by humans, ChatGPT uses deep learning techniques.

However, it is not limited to text generation. It can also generate computer code, stories, songs, etc. GPT-3 can perform these tasks to a relatively high standard due to the 175 billion parameters it is trained on, making it the largest language model to date. According to its creators, the OpenAI GPT-3 model has been trained with 45 TB of text data from various sources until 2021.

A language model is a statistical tool that predicts the next words in a sequence based on a given context. In essence, language models are probability distributions over a sequence of words. What makes GPT-3 so powerful is the huge number of parameters it can be trained on, ten times more than any previous model.

ChatGPT sometimes gives wrong answers. However, even if the number of correct responses increases, taking any ChatGPT response without validating it would be a mistake, as it is when results

obtained from search engines or social networks are not compared to other sources.

The most appropriate approach of educational institutions in this situation is to understand what these tools can contribute to the teaching and learning processes, such as critical analysis, comparison of sources and the selection and formulation of appropriate questions for conversation (García-Peñalvo 2023).

ChatGPT and map projections

At this point, we were interested in what ChatGPT's answers to questions about map projections would be. We asked questions in Croatian, English, German and Russian. The answers in each of those languages were in most cases different, so it was not a matter of translating the definitions from English, but all the answers were wrong. To the right of each answer are two icons: thumb up and thumb down. We clicked on the thumb down, then chose from the three options that it was not correct and entered a short correct answer in the provided field. We asked these questions on January 23, 2023. We repeated the four questions in English on February 15, 2023. We searched for definitions of conic, cylindrical, pseudoconic and pseudocylindrical projections.

Here is our ChatGPT Q&A from February 15, 2023.

What are conic projections?

Conic projections are a type of map projection that projects the

Earth's surface onto a cone. The cone is usually placed tangent to the Earth's surface at a specific latitude, which is known as the standard parallel. The meridians are projected as equally spaced straight lines that converge at the apex of the cone, while the parallels are projected as circular arcs that are centered on the apex.

Conic projections are used to create maps of regions that extend mainly in an east-west direction, such as large sections of the United States, Europe, and Africa. They are particularly useful for mapping mid-latitude regions, where the distortion in shape and area is minimal. However, they are less suitable for mapping high-latitude regions, where the convergence of the meridians towards the pole results in significant distortion.

Some examples of conic projections include the Lambert conformal conic projection, the Albers equal-area conic projection, and the Equidistant conic projection. Each of these projections has different properties and is suitable for different purposes, depending on the region being mapped and the specific requirements of the map.

What are pseudoconic projections?

Pseudoconic projections are a class of map projections that approximate the shape of the Earth's surface by using a geometric construction that does not involve a cone or cylinder. Instead, they use a combination of curves and straight

ChatGPT i kartografske projekcije

ChatGPT je jezični model koji je razvila i trenira ga Open AI – tvrtka za istraživanje i primjene umjetne inteligencije, a namijenjen je konverzaciji s ljudima na mnogim jezicima. Javnosti je postao dostupan 30. studenoga 2022. Besplatan je i u prvih pet dana registriralo se više od milijun korisnika.

ChatGPT ima mogućnost generiranja tekstova visoke kvalitete i sposobnost održavanja realistične konverzacije. Za generiranje teksta koji je poput teksta koji su napisali ljudi ChatGPT se koristi tehnikama dubinskog učenja. Međutim, nije ograničen samo na generiranje teksta. Također može generirati računalni kod, priče, pjesme itd. GPT-3 može obavljati te zadatke prema relativno visokom standardu zbog 175 milijardi parametara na kojima je obučen, što ga čini najvećim jezičnim modelom do danas. Prema njegovim tvorcima, model OpenAI GPT-3 obučen je s 45 TB tekstnih podataka iz različitih izvora do 2021.

Jezični model je statistički alat koji predviđa sljedeće riječi u nizu na temelju danog konteksta. U biti, jezični modeli su distribucije vjerojatnosti preko niza riječi. Ono što GPT-3 čini tako moćnim je ogroman broj parametara na kojima se može trenirati, deset puta više od bilo kojeg prethodnog modela.

ChatGPT ponekad daje i pogrešne odgovore. Međutim, čak i ako se broj točnih odgovora poveća, uzimanje bilo kakvog odgovora ChatGPT-a bez provjere njegove valjanosti bila bi pogreška, kao što je pogreška kada se rezultati dobiveni



tražilicama ili društvenim mrežama ne uspoređuju s drugim izvorima.

Najprikladniji pristup obrazovnih institucija u ovoj situaciji je razumjeti što ti alati mogu doprinijeti procesima poučavanja i učenja, kao što su kritička analiza, usporedba izvora te odabir i formuliranje odgovarajućih pitanja za konverzaciju (García-Peñalvo 2023).

ChatGPT i kartografske projekcije

Nas je u ovom trenutku zanimalo kakvi će biti odgovori ChatGPT-a na pitanja o kartografskim projekcijama. Pitanja smo postavljali na hrvatskom, engleskom, njemačkom i ruskom jeziku. Odgovori na svakom od tih jezika bili su u većini slučajeva različiti, dakle nije se radilo o prijevodu definicija s engleskog, ali su svi odgovori bili pogrešni. Desno od svakog odgovora dvije su ikone: palac gore i palac dolje. Kliknuli smo na palac dolje, potom od tri ponuđene mogućnosti izabrali da to nije točno i u predviđeno polje upisali kratak točan odgovor. Ta smo pitanja postavljali 23. siječnja 2023. Četiri pitanja na engleskom ponovili smo i 15. veljače 2023. Tražili smo definicije konusnih, cilindričnih, pseudokonusnih i pseudocilindričnih projekcija.

Evo naših pitanja i odgovora ChatGPT-a od 15. veljače 2023.

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What are pseudoconic projections?

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All ChatGPT's answers to the questions asked and all the texts it generates should be taken with a lot of caution and checked.

lines to create a graticule (grid of latitude and longitude lines) that approximates the shape of the Earth's surface. The result is a map that looks like it was created using a conic projection, but with less distortion.

The most famous example of a pseudoconic projection is the sinusoidal projection, which is also known as the Sanson-Flamsteed or Mercator equal-area projection. In this projection, the meridians are straight lines that converge at the poles, and the parallels are sinusoidal curves that are equally spaced in terms of the distance along the central meridian. This projection preserves the equal-area property, which means that the areas on the map are proportional to the corresponding areas on the Earth's surface.

Other examples of pseudoconic projections include the Mollweide projection, the Eckert IV projection, and the Goode homolosine projection. These projections are also designed to minimize distortion while representing the Earth's surface in a two-dimensional map. Each projection has its own strengths and weaknesses, and the choice of projection depends on the purpose of the map and the region being mapped.

What are cylindrical map projections?

Cylindrical map projections are a type of map projection that projects the Earth's surface onto a cylinder. The cylinder can be tangent or secant to the Earth's surface, or it can be placed at a different distance or angle from the

Earth's surface. The resulting map is a rectangle that can be unfolded to form a flat map.

Cylindrical projections are useful for creating maps of regions that extend primarily in a north-south direction, such as continents and ocean basins. They are particularly well-suited for mapping regions near the equator, where the distortion in shape and area is minimal. However, they are less suitable for mapping regions near the poles, where the distortion becomes more significant.

Some examples of cylindrical projections include the Mercator projection, the Transverse Mercator projection, the Miller cylindrical projection, and the Gall-Peters projection. Each of these projections has different properties and is suitable for different purposes, depending on the region being mapped and the specific requirements of the map.

The Mercator projection, for example, is commonly used for navigational purposes because it preserves the direction of straight lines, which is important for ship navigation. The Gall-Peters projection, on the other hand, is an equal-area projection that is designed to represent the relative sizes of land masses more accurately than the Mercator projection, which exaggerates the sizes of high-latitude regions.

What are pseudocylindrical projections?

Pseudocylindrical projections are a class of map projections that attempt to balance the distortions

in area, shape, and distance across the map. Unlike cylindrical projections, pseudocylindrical projections do not use a cylinder to project the Earth's surface onto a flat map. Instead, they use a combination of curves and straight lines to represent the graticule (grid of latitude and longitude lines) on the map.

Pseudocylindrical projections are also sometimes referred to as oval, elliptical, or elliptic projections. Examples of pseudocylindrical projections include the Mollweide projection, the Eckert IV projection, the Robinson projection, and the Sinusoidal projection. Each of these projections attempts to minimize distortion in different ways, depending on the properties of the projection and the region being mapped.

The Mollweide projection, for example, preserves the equal area property by compressing the poles and stretching the equator to create an oval-shaped map. The Eckert IV projection also preserves equal area, but uses a combination of curves and straight lines to create a rectangular map. The Robinson projection attempts to balance the distortions in shape, area, and distance by curving the parallels and shifting the central meridian.

Pseudocylindrical projections are particularly useful for mapping regions that extend primarily in an east-west direction, such as continents and ocean basins. They are also useful for creating world maps that attempt to balance the distortions across the entire map. However, as with all map projections, some distortions are inevitable, and the choice of projection depends on the purpose of the map and the specific requirements of the user.

The differences between the quoted answers and the answers from January 23 are big. The answers are more extensive, but also with much fewer errors. The main objection is that the conic and cylindrical projections are still defined by projecting onto the surface of the cone and cylinder. However, for conic

construction that does not involve a cone or cylinder. Instead, they use a combination of curves and straight lines to create a graticule (grid of latitude and longitude lines) that approximates the shape of the Earth's surface. The result is a map that looks like it was created using a conic projection, but with less distortion.

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Razlike su citiranih odgovora u odnosu na odgovore od 23. siječnja velike. Odgovori su opširniji, ali i s mnogo manje pogrešaka. Glavna zamjerka je što se konusne i cilindrične projekcije još uvijek definiraju projiciranjem na plašt konusa i cilindra. Međutim, za konusne projekcije dodan je ispravan oblik mreže meridijana i paralela, a za cilindrične se oblik mreže meridijana i paralela ne spominje. U konusnim projekcijama ispravljena je i pogrešna tvrdnja da su pogodnije za područja s većim pružanjem u smjeru sjever – jug, umjesto za područja s većim pružanjem u smjeru zapad – istok. Šteta što se od ekvivalentnih cilindričnih projekcija navodi Gall-Petersova projekcija, umjesto puno bolje od nje Behrmannove projekcije sa standardnim paralelama $\pm 30^\circ$ u kojoj su deformacije oblika kontinenata mnogo manje.

U definicijama pseudokonusnih i pseudocilindričnih projekcija dobivenih 23. siječnja primijenjene su pomoćne plohe, a u odgovorima 15. veljače naglašava se da pomoćne plohe nisu primijenjene. Bilo bi bolje da se pomoćne plohe ni ne spominju. Kao najpoznatija pseudokonusna projekcija pogrešno se

projections, the correct shape of the network of meridians and parallels is added, and for cylindrical projections, the shape of the network of meridians and parallels is not mentioned. In the conic projections, the incorrect claim that they are suitable for areas with a greater extension in the north-south direction, instead of areas with a greater extension in the west-east direction, has been corrected. It is a pity that the Gall-Peters projection is cited as the equal-area cylindrical projection, instead of the much better Behrmann projection with standard parallels $\pm 30^\circ$ in which the distortions of the continents are much smaller.

In the definitions of pseudoconic and pseudocylindrical projections obtained on January 23, auxiliary surfaces were applied, and in the answers of February 15, it is emphasized that auxiliary surfaces were not applied. It would be better if auxiliary surfaces were not even mentioned.

The sinusoidal projection, which is pseudocylindrical, is wrongly stated as the best-known pseudoconical projection, and the shape of the network of meridians and parallels is also wrongly described. Three more pseudocylindrical projections (Mollweide, Ecort IV and Goode homologous) are listed as pseudoconic. In the description of pseudocylindrical projections, it is wrongly claimed that the network of meridians and parallels forms a "rectangular map", while in Robinson's projection the parallels are curves.

It could be expected that auxiliary surfaces will be applied in the definition of conic and cylindrical projections, as it is the case in most of the literature on which ChatGPT was trained. The signatories of this text, especially Prof. Lapaine, published many texts about the inappropriateness and harmfulness of the application of auxiliary surfaces in the theory of map projections (Frančula, Lapaine 2018, Lapaine, Frančula 2022, Lapaine 2023).

It is amazing how quickly ChatGPT learns and corrects mistakes.

Although some of ChatGPT's answers to questions about map projections are still wrong, in many other areas his knowledge is already much greater. This is evidenced by some already published works. *Google Scholar* finds in mid-February 2023 241 papers with ChatGPT in the title and four papers in which ChatGPT is a co-author, e.g. (King, ChatGPT 2023).

ChatGPT cites non-existent scientific papers

In July 2022, we wrote a text entitled "The most cited publications on cartographic publications". Using *Google Scholar*, we searched for publications that have the exact term map projections or map projection in the title. 15 publications with more than 100 citations were found (Frančula, Lapaine 2022).

Three months after ChatGPT became freely available to the public on November 30, 2022, we decided to check whether ChatGPT can also solve the above task. We are attaching our question from February 25, 2023, and ChatGPT's answer, which shows that he also used *Google Scholar*.

Can you list the 10 most cited publications on map projections that contain the phrase map projection or map projections in the title?

ChatGPT: Here are the 10 most cited publications on map projections that contain the phrase "map projection" or "map projections" in the title, according to *Google Scholar*:

1. Snyder, John P. "Map projections: a working manual." US Government Printing Office, 1987. Cited 11,547 times.
2. Tobler, Waldo R. "Map projections." *The International Encyclopedia of Geography: People, the Earth, Environment and Technology*, Wiley-Blackwell, 2017, pp. 1-14. Cited 751 times.
3. Flatt, Henry A. and Craig M. Tanner. "Map projections." *Cartography: Thematic Map Design*. McGraw-Hill, 2000, pp. 43-70. Cited 395 times.

4. Lee, Jay S. "Map projections for global data." *Cartography and Geographic Information Science*, vol. 25, no. 2, 1998, pp. 85-101. Cited 360 times.
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6. Clarke, Keith C. "Analytical and numerical methods for the computation of distortions in map projections." *Cartography and Geographic Information Science*, vol. 30, no. 1, 2003, pp. 3-18. Cited 297 times.
7. Li, Zhilin, et al. "Map projection." *Encyclopedia of GIS*, Springer, 2017, pp. 1-7. Cited 274 times.
8. Weibel, Robert, et al. "Towards a conceptual framework for cartographic generalization with emphasis on displacement and simplification." *Cartography and Geographic Information Science*, vol. 21, no. 3, 1994, pp. 133-147. Cited 244 times.
9. Müller, Jean-Claude, and H. Jenny. "The use of oblique Mercator projections in mapping the earth's surface from satellite imagery." *International Journal of Remote Sensing*, vol. 12, no. 10, 1991, pp. 2035-2051. Cited 214 times.
10. Battersby, Sarah E. and Michael P. Finn. "Map projections." *The SAGE Handbook of GIS and Society*, Sage Publications, 2014, pp. 207-222. Cited 210 times.

The only match of that list with the list of the first ten publications obtained with the help of *Google Scholar* (Frančula, Lapaine 2022) is the first-named paper in both lists – the well-known handbook on map projections by John P. Snyder – with the remark that ChatGPT invented the number of citations (11547). Namely, at the end of February 2023, that paper has 2248 citations according to *Google Scholar*.

All other listed titles under numbers 2 – 10 do not exist, so they are invented. We checked it in several ways. We searched for papers

navodi sinusoidna koja je pseudocilindrična, a pogrešno je opisan i oblik mreže meridijana i paralela. Još tri pseudocilindrične projekcije (Mollweideova, Ecertova IV i Goodeova homolosinusna) navedene su kao pseudokonusne. U opisu pseudocilindričnih projekcija pogrešno se tvrdi da mreža meridijana i paralela čini „rectangular map“, a da su u Robinsonovoj projekciji paralele krivulje.

Da će u definiciji konusnih i cilindričnih projekcija biti primijenjene pomoćne plohe, moglo se i očekivati jer je tako u većini literature po kojoj je ChatGPT obučavan. Potpisnici ovog teksta, posebno prof. Lapaine, objavili su mnoge tekstove o neprikladnosti i štetnosti primjene pomoćnih ploha u teoriji kartografskih projekcija (Frančula, Lapaine 2018, Lapaine, Frančula 2022, Lapaine 2023).

Zadivljujuće je kojom brzinom ChatGPT uči i ispravlja pogreške. Iako su neki odgovori ChatGPT-a na pitanja o kartografskim projekcijama još uvijek pogrešni, na mnogim drugim područjima njegovo je znanje već sada puno veće. O tome svjedoče i neki već objavljeni radovi. *Google Scholar* pronalazi sredinom veljače 2023. godine 241 rad koji u naslovu sadrži ChatGPT i četiri rada u kojima je ChatGPT suautor, npr. (King, chatGPT 2023).

ChatGPT navodi nepostojeće znanstvene radove

U srpnju 2022. napisali smo tekst pod naslovom “Najcitiranije publikacije o kartografskim publikacijama”. Pomoću *Google Scholar* tražili smo publikacije koje u naslovu imaju točan izraz *map projections* ili *map projection*. Pronađeno je 15 publikacija s više od 100 citata (Frančula, Lapaine 2022).

Tri mjeseca nakon što je 30. studenoga 2022. javnosti postao besplatno dostupan ChatGPT, odlučili smo provjeriti može li navedeni zadatak riješiti i ChatGPT. Prilažemo naše pitanje od 25. veljače 2023. i odgovor ChatGPT-a iz kojeg se vidi da se i on poslužio *Google Scholar*om.

Sve odgovore ChatGPT-a na postavljena pitanja i sve tekstove koje on generira treba uzimati s velikom rezervom i provjeravati ih.

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Jedino podudaranje tog popisa s popisom prvih deset publikacija dobivenih uz pomoć *Google Scholar*a (Frančula, Lapaine 2022) je na oba popisa prvoimenovani rad – poznati priručnik o kartografskim projekcijama Johna P. Snydera – uz primjedbu da je ChatGPT izmislio broj citata (11547). Naime, krajem veljače 2023. taj rad prema *Google Scholar*u ima 2248 citata.

Svi ostali navedeni naslovi pod brojevima 2 – 10 ne postoje, dakle izmišljeni su. Provjeravali smo to na nekoliko načina. Radove objavljene u časopisima (radovi pod brojevima 4, 5, 6, 8 i 9) tražili smo na mrežnim stranicama tih časopisa prema navedenoj godini, broju i stranicama, ali ih nismo našli. Pokušali smo pomoću *Google Scholar*a pronaći naslove tih članaka. Kliknuli smo na “u

published in journals (papers numbered 4, 5, 6, 8 and 9) on the websites of those journals according to the specified year, number and pages, but we did not find them. We tried to find the titles of these papers using Google Scholar. We clicked on "in the title of the article" and entered the titles in the field "with the correct expression". Google Scholar did not find any titles. It should be added that the paper under number 8 does not have the phrase *map projection* or *map projections* in the title. This paper is not dedicated to map projections but to cartographic generalization.

We checked the paper number 2 by entering WR Tobler in the "return articles by author" field, and Map projections in the "with correct expression" field. Google Scholar found nine titles, but none listed. In the same way, we checked papers numbered 3, 7 and 10, but Google Scholar did not find them.

We repeated our question from February 25, 2023, on March 19, 2023, and received the answer:

I'm sorry, but I cannot provide a list of the most cited publications

on map projections containing the phrase "map projection" or "map projections" in the title.

When we asked him why, he replied:

As an AI language model, I do not have direct access to a comprehensive database of all academic publications, their citation counts, and metadata such as the titles of the publications.

However, to our question: Can you search Google Scholar? he answered:

Yes, I can search Google Scholar for scholarly articles and publications on various topics. However, I may not be able to access the full text of some articles if they are behind a paywall or if the publisher has restricted access to them. Additionally, Google Scholar's citation data may not always be up-to-date or accurate. Nonetheless, I can still provide helpful information and insights based on the results of a search on Google Scholar.

It should be noted that on March 7, 2023, Google Scholar finds 512 papers that contain ChatGPT in the

title. In many of these works, the possibility of using ChatGPT in science and education was examined (Frančula 2023). Gordijn and ten Have (2023) point out that given the recent exponential progress in artificial intelligence, it can be expected that some future major language model will have the ability to write papers that would pass peer review in respectable journals.

However, Prof. Ana Marušić cites several reasons why ChatGPT and similar computer programs that simulate and process human conversation (chatbots) cannot be the authors of articles, for example, they cannot take responsibility for the article, nor can they understand the declaration of conflict of interest and sign it (Marušić 2023). However, several papers co-authored by ChatGPT have already been published, e.g. King, chatGPT (2023).

Our review shows that all ChatGPT's answers to the questions asked and all the texts it generates should be taken with a lot of caution and checked.

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naslovu članka” i u polje “s točnim izrazom” upisali naslove. Google Scholar nije pronašao ni jedan naslov. Treba dodati da rad pod brojem 8 nema u naslovu sintagmu *map projection* ni *map projections*. Taj rad nije posvećen kartografskim projekcijama nego kartografskoj generalizaciji.

Rad pod brojem 2 provjerili smo tako da smo u polje “vrati članke autora” upisali WR Tobler, a u polje “s točnim izrazom” Map projections. Google Scholar pronašao je devet naslova, ali ne i navedeni. Na isti način provjeravali smo i radove pod brojevima 3, 7 i 10, ali ih Google Scholar nije pronašao.

Naše pitanje od 25. veljače 2023. ponovili smo i 19. ožujka 2023. i dobili odgovor:

I'm sorry, but I cannot provide a list of the most cited publications on map projections containing the phrase "map projection" or "map projections" in the title.

Kada smo ga pitali zašto, odgovorio je:

As an AI language model, I do not have direct access to a comprehensive database of all academic publications, their citation counts, and metadata such as the titles of the publications.

Međutim, na naše pitanje: Can you search Google Scholar? odgovorio je:

Yes, I can search Google Scholar for scholarly articles and publications on various topics. However, I may not be able to access the full text of some articles if they are behind a paywall or if the publisher has restricted access to them. Additionally, Google Scholar's citation data may not always be up-to-date or accurate. Nonetheless, I can still provide helpful information and insights based on the results of a search on Google Scholar.

Treba napomenuti da 7. ožujka 2023. Google Scholar pronalazi 512 radova koji u naslovu sadrže ChatGPT. U mnogima od tih radova ispitivana je mogućnost primjene

ChatGPT-a u znanosti i obrazovanju (Frančula 2023). Gordijn i ten Have (2023) ističu da se s obzirom na nedavni eksponencijalni napredak u umjetnoj inteligenciji, može očekivati da će neki budući veliki jezični model imati sposobnost pisanja radova koji bi prošli recenziju u respektabilnim časopisima. Međutim, prof. Ana Marušić navodi nekoliko razloga zbog kojih ChatGPT i slični računalni programi koji simuliraju i obrađuju ljudski razgovor (chatbotovi) ne mogu biti autori članaka, npr. ne mogu preuzeti odgovornost za članak, niti mogu razumjeti izjavu o sukobu interesa i potpisati ju (Marušić 2023). Ipak, već je objavljeno nekoliko radova u kojima je ChatGPT suautor, npr. King, chatGPT (2023).

Naš prikaz pokazuje da sve odgovore ChatGPT-a na postavljena pitanja i sve tekstove koje on generira treba uzimati s velikom rezervom i provjeravati ih.

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