



## THE ROLE OF GENERATIVE ARTIFICIAL INTELLIGENCE (GAI) IN SCIENTIFIC RESEARCH

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**Abstract.** The emergence and growing capabilities of Generative Artificial Intelligence (GAI) are profoundly transforming scientific research. Although AI extends human intelligence by automating certain tasks, it complements rather than replaces human creativity. This article discusses the implications of AI for the scientific process, including ethical considerations and the need for a balanced approach that combines the strengths of human and artificial intelligence in the process of discovering knowledge and solving complex problems. The discussion extends to the need for universities to adapt their curricula to prepare future researchers for the AI era, emphasizing scenario-based thinking and uncertainty management as important skills for the future.

**Keywords:** Generative Artificial Intelligence, hypothesis analysis and testing, searching scientific data sources, research planning, writing and editing scientific manuscripts, organizing and presenting results.

### THE FUNCTIONS OF GSI SERVICES IN SCIENTIFIC RESEARCH INVESTIGATION

At the end of last year 2023 a number of leading Ukrainian universities (including Igor Sikorsky Kyiv Polytechnic Institute, Kherson State University, Zaporizhzhia Polytechnic National University and others) developed and adopted recommendations on the use of artificial intelligence in learning, teaching and research [1–3]. Based on these recommendations, we will try to detail and illustrate the possibilities and consequences of using Generative Artificial Intelligence (GAI) in conducting research and presenting the results, taking into account the aspects of Open Science [4].

Based on the experience gained, it is recommended to use artificial intelligence in research for the following activities:

- automated generation of hypotheses and concepts based on data analysis;
- analysis and testing of hypotheses and iteration of research processes;
- finding sources of scientific data, reviewing, interpreting and citing them;
- searching for and extracting specific data from large databases, which significantly speeds up the information retrieval process;
- building a plan/structure for a project/qualifying thesis;

- gathering and processing information related to the topic of the project/assignment;
- analyzing and processing large data sets, identifying patterns, templates and correlations in them;
  - translating, editing and summarizing texts;
  - organizing and comparing the results obtained;
  - bridging the gaps between different fields of research by providing explanations and combining concepts from different disciplines by finding common trends and patterns;
  - writing scientific reports;
  - writing articles (grammar, translation, paraphrasing, summarizing) according to the requirements of scientific journals;
  - automatically generate graphs, charts and other visual representations of data, including video, to illustrate key findings and trends;
  - plagiarism checking;
  - converting spoken information into printed text (natural language processing);
  - summary generation.

These activities can be considered as functions of the respective GAI services. They require changes in the training of future scientists and professionals and are a powerful means of personalizing education by adapting content and experiences in ways that were previously impossible. Developing future-oriented skills in future scientists, such as scenario thinking, systems thinking, and managing uncertainty and complexity, requires more than memorizing or even managing large data sets.

## **THE GENERATION AND TESTING OF RESEARCH HYPOTHESES FORM THE BASIS OF SCIENTIFIC RESEARCH**

GAI is already influencing the development of science, going beyond simple automation and becoming an active participant in the pursuit of knowledge and understanding. However, in scientific research, the use of artificial intelligence represents a significant shift in paradigm, enabling active collaboration between machines and humans to formulate research hypotheses and questions. Artificial intelligence systems have traditionally been powerful tools for data analysis. However, their evolution now enables them to generate hypotheses based on patterns that may escape human observation. GAI algorithms can sift through massive amounts of data much quicker than humans, identifying interesting patterns or unique connections. This can lead to new hypotheses for scientists to investigate further. The combination of machine-driven hypotheses and human experience shows promise for scientific advancement. It is important to maintain human control over the scientific process and interpretation of results.

However, the ability of artificial intelligence to generate hypotheses raises questions about the nature of creativity in research. Can artificial intelligence truly exhibit creativity in hypothesizing, or are they restricted to pattern recognition in available data?

Additionally, the intersection of artificial intelligence and research extends beyond hypothesis generation to encompass the formulation of research questions. Active collaboration between machines and researchers can expand the

scope and depth of scientific research by identifying gaps in knowledge and suggesting profound questions. This approach emphasizes the indispensable role of human understanding in forming the research program. Although GAI has great potential, integrating it into hypothesis formation is not without issues. One significant problem is the “black box” nature of many advanced GAI algorithms. The “black box” issue arises as the complex nature of GAI makes it difficult to understand how it generates ideas. AI can be compared to a chef who creates a secret recipe without disclosing the ingredients. To trust AI, it is important to understand its thought process, which can be challenging.

As these systems become more complex, it becomes increasingly difficult for human researchers to understand the reasoning behind the non-traditional hypotheses generated by the GAI. Large language models such as *Copilot* (ChatGPT-4) (<https://www.bing.com/chat>), *Gemini* Ultra (<https://gemini.google.com/>) or *Cloud-3* (<https://claude.ai/>) can exacerbate this issue. Figure 1 contains a fragment of Gemini’s answer on the question about examples of GAI-powered hypotheses in Computer Science.

**Gemini Advanced**  
**Hypotheses on GAI Enhancing Specific Tasks:**

1. **Automated Code Generation:** GAI will outperform the best human programmers in generating error-free, efficient code across multiple programming languages when given a clear problem specification.
2. **Network, Security:** GAI-powered intrusion detection systems will have a significantly lower false-positive rate and higher detection rate of novel cyberattacks compared to current state-of-the-art systems.
3. **Natural Language Understanding:** GAI models will achieve human-level performance on complex natural language understanding tasks like reading comprehension, text summarization, and nuanced sentiment analysis.
4. **Data Compression:** GAI-designed data compression algorithms will consistently achieve higher compression ratios with minimal loss of information compared to existing methods on diverse data types.

*Fig. 1.* Illustration of talk with Gemini about its ability to generate hypotheses

The results of talk on the same topic with ChatGPT-4 and Cloud-3 are shown on Fig. 2 and Fig. 3 respectively.

Generative AI (GAI) has gained prominence in various fields, including computer science. Here are a few hypotheses related to GAI applications in this domain:

**Enhanced Code Generation:** GAI models, such as Generative Pretrained Transformers (GPT), could be leveraged to automatically generate high-quality code snippets, improving software development efficiency and reducing human effort.

**Data Augmentation:** GAI techniques can create synthetic data samples, augmenting existing datasets for training machine learning models. This could enhance model generalization and performance.

**Natural Language Understanding:** GAI models excel at understanding and generating natural language. They could be used to improve chatbots, virtual assistants, and sentiment analysis systems.

**Drug Discovery:** GAI can assist in drug discovery by generating molecular structures with desired properties, potentially accelerating the search for new medications.

**Art and Creativity:** GAI-generated art, music, and literature could inspire new creative works or even lead to novel artistic styles.

*Fig. 2.* Illustration of talk with ChatGPT-4 about its ability to generate hypotheses

Here are some concrete hypotheses related to potential applications of Artificial General Intelligence (AGI) in computer science:

AGI systems could autonomously **develop new algorithms and data structures** that are more efficient and scalable than those designed by human programmers.

AGI systems could **seamlessly integrate and optimize different areas of computer science**, such as machine learning, computer vision, natural language processing, and robotics, leading to more sophisticated and versatile applications.

AGI systems could **automatically debug and optimize legacy software systems**, improving their performance, security, and maintainability.

AGI systems could **dynamically allocate and manage computing resources** (e.g., CPU, memory, storage) across distributed systems, leading to more efficient utilization of hardware resources.

AGI systems **could autonomously explore and generate novel computational architectures, programming paradigms, and programming languages** that are better suited for specific tasks or domains.

AGI systems could **automatically translate high-level specifications or requirements into efficient and robust software implementations**, facilitating rapid prototyping and development of complex systems.

AGI systems could **continuously monitor and adapt software systems to changing environments**, user behaviors, and security threats, enabling self-healing and self-optimizing systems.

AGI systems could **autonomously discover and exploit patterns and insights in large-scale data**, leading to breakthroughs in areas such as bioinformatics, computational finance, and scientific computing.

AGI systems could **dynamically synthesize and integrate knowledge from multiple domains**, enabling the development of interdisciplinary applications that leverage insights from diverse fields.

AGI systems could **autonomously explore the vast search space of potential software solutions**, leading to the discovery of novel and innovative approaches to complex computational problems.

These hypotheses span various areas of computer science, including algorithm design, software engineering, distributed systems, programming languages, and interdisciplinary applications. However, it's important to note that the realization of these hypotheses would depend on significant advancements in AGI research and the development of robust and reliable AGI systems.

*Fig. 3. Illustration of talk with Cloud-3 about its ability to generate hypotheses which is the most meaningful*

It seems that GAI can't actually generate a new thought, rather than repeat something from the training array, or substitute the most likely answer from the same training array. There is a very thin line between creating new thoughts (hypotheses) and just looking for information from an existing array. The lack of interpretation and concretization can hinder the acceptance of hypotheses generated by artificial intelligence in the scientific community. In addition, the datasets on which GAI models are trained can contain inherent prejudices that may influence the generated hypotheses. If this bias is not addressed, it can distort the development of perspectives in science. It is important to recognize that although artificial intelligence can process vast amounts of information, it cannot discern subtleties [5; 6].

Nevertheless, at the beginning of October 2023, researchers gathered in Stockholm, who under led by Hiroaki Kitano, a biologist and CEO of Sony AI,

considered questions about the introduction of *Nobel prizes for developers of artificial intelligence and artificial cooperation intelligence and people* who made an outstanding scientific contribution [7]. And it's fair, because GAI is on its own influence on the development of scientific research can be rightly considered as a quality fundamental direction of modern science.

As GAI plays a more active role in hypothesis formation, ethical considerations become a priority. The responsible use of GAI requires constant vigilance to prevent undesirable consequences. Researchers must be vigilant in detecting and mitigating biases and one-sidedness in the training datasets, ensuring that the system of artificial intelligence does not preserve or strengthen existing inequalities in the adequacy of generated solutions for various branches and tasks.

In addition, the ethical implications of hypotheses generated by GAI, particularly in sensitive areas such as genetics or social sciences, require careful consideration. Transparency in the decision-making process regarding GAI hypotheses is crucial for building trust within the scientific community and society as a whole. Striking the right balance between innovation and ethical responsibility is an ongoing challenge that demands constant attention, as collaboration between humans and GAI continues to evolve [8]. Accurate thinking, creativity, and understanding of context play a vital role in improving and testing hypotheses generated by the GAI.

However, despite their intelligence, GAI cannot replace human scientists. It is still necessary for people to carefully consider the suggestions made by AI and interpret their true meaning. Good teamwork among different experts, such as computer scientists, ethicists, and researchers, is essential to ensure the best use of AI. Researchers must act as critical evaluators, questioning the assumptions made by artificial intelligence algorithms and ensuring that the proposed hypotheses are consistent with available knowledge. This will not only improve our understanding of the underlying processes but also ensure that the hypotheses meet ethical and scientific standards.

The integration of artificial intelligence into the hypothesis generation process is an ongoing journey with enormous potential. The combined efforts of humans and machines hold the promise of accelerating scientific discovery, generating new ideas and solving complex problems facing humanity. However, this journey requires a balanced approach that recognizes the strengths of artificial intelligence while respecting the unique skills and ethical considerations that humans bring to the table.



Fig. 4. Symbol of human-machine partnership generated by GAI

For example, the transformative power of GAI in hypothesis generation is changing the landscape of scientific research. However, this would not be possible without a joint and dynamic partnership between humans and machines, which has the potential for unprecedented advances and opens up a new era of scientific research and understanding that is inherent in Industry 5.0 technologies (Fig. 4).

## PRIORITY SERVICES FOR STUDENTS TO LEARN MODERN RESEARCH

### METHODOLOGY

With the increasing use of GAI in scientific research, it is important for universities to prepare future researchers to work in this era. While some may argue that the use of artificial intelligence in fundamental scientific research is too complex for higher education purposes, it is still important for students to learn modern research methodology. It may be argued that not all students are capable of understanding modern advanced research methods. Empirical research can be conducted through student projects to test their scientific development abilities and the consequences of using artificial intelligence in the learning process. Modern university curriculums worldwide include some traditional aspects of scientific research.

The use of GAI in scientific research involves various aspects, including experimentation, data collection and interpretation, modelling, and automation of design. Therefore, the question of prioritizing certain GAI services for inclusion in educational programs arises. Developing educational adaptations of professional GAI services can help teach future scientists about the ethics of using GAI in scientific research and instil in them a sense of responsibility. However, teachers should not only be trained to use artificial intelligence tools and data, but also to understand the rapidly changing landscape of modern science in the era of artificial intelligence. It is important to develop individual solutions for each specialty to ensure the appropriate selection of basic GAI services.

Regulatory documents of universities [1–3] provide recommendations for using existing GAI services, which now number in the thousands. It is important to note that there are many options available for choosing GAI services. GAI services have become popular due to their ability to democratize GIS (Geographic information systems) applications, making them accessible to people without technical training. Each GAI service learns from a specific set of data that determines its effectiveness in performing specialized tasks. It is crucial to accurately determine and select the service that best meets your needs to get the most out of these GAI services. As a first step in implementing university policies for the use of artificial intelligence in academic activities, we have selected and demonstrated five effective interdisciplinary GAI services below. Their selection was based on an attempt to ensure their uniqueness and to avoid describing many of the GAI services that can be found in most publications. They serve as tools to support different aspects of the research process.

#### ***Semantic scholars.* Search and Discovery of Scientific Information**

***Semantic Scholar*** (<https://www.semanticscholar.org/>) is a GAI service that provides access to a huge database of more than 211 million articles from all fields of science, making it one of the largest repositories of scientific literature. This comprehensive collection covers a wide range of subjects including: physics, chemistry, biology, medicine, history, computer science, etc. From cutting-edge research papers to historical publications, *Semantic Scholar* has a wealth of resources to

support researchers in their pursuit of knowledge. One of the key features of *Semantic Scholar* is its powerful search and filtering capabilities based on artificial intelligence.

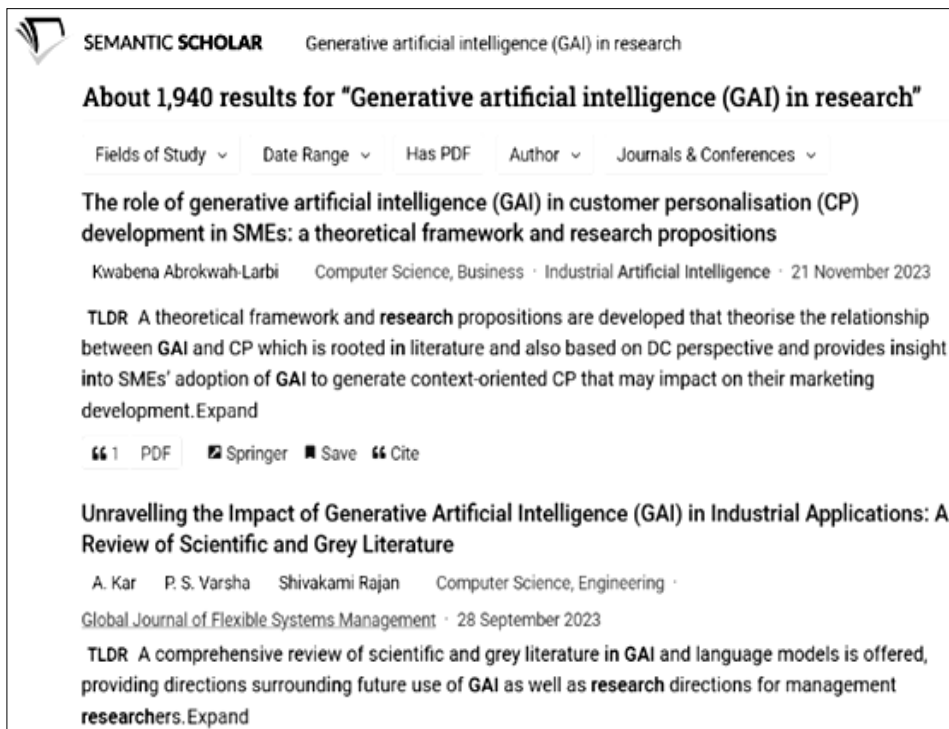


Fig. 5. A fragment of selected literature (1940 sources in English and 3 in Ukrainian)

The service uses natural language processing and machine learning algorithms to analyze the content of articles and extract relevant information. This allows users to perform advanced searches by specific keywords, authors, journals, publication dates, and other parameters, enabling accurate and efficient article retrieval [10]. The selection of literature sources on the topic of this article made by the service is illustrated in Fig. 5.

It is interesting to compare received results with those obtained from a Google search engine based on the user's query. Often, the data obtained from such searches do not correspond to the search goal and return simple URLs of sites and fragments of content that are not always relevant. Developers must check website content, filter out irrelevant information, and optimize it according to constraints. Fig. 5 shows that the Semantic Scholar's results differ from Google's. It mainly consists of published articles, each providing detailed information on its significance (through the number of citations) and direction (topic). The article can be sorted by different criteria, including the number of authors and sources used to build it (*References*), related papers such as images and publications (*Related Papers*), publication date (*Recency*), number of citations (*Citation Count*), importance (*Most Influential Papers*), and relevance to the topic (*Relevance*).

Please note that this service has 56 alternative purpose-specific services, such as *Scholarcy*, *OpenRead*, *Elicit*, *Scispace*, *Scite*, *Research Buddy*, *Mirror-think*, and *Epsilon*. A comparison of their results with Semantic Scholar is available on the website <https://theresanaiforthat.com/ai/semanticscholar/>.

***Explain a paper. Extracting and understanding information from sources***

***Explain Paper*** (<https://www.explainpaper.com/>) is an AI service designed to work with scientific publications from any field, including natural sciences, social sciences, humanities, etc. However, it works best with materials that are complex in technical and scientific jargon. The explanations aim to cover the main concepts and key findings as accurately as possible. However, it is always advisable to refer to the original article for technical details. You should think of an AI explanation as a “tutor friend” pointing out the main ideas. The Explain Paper service accepts PDF documents from any source — journals, preprint servers, university websites, etc. You can set the depth of explanation from basic to very detailed (expert). This service is designed for researchers and scientists seeking to broaden their knowledge beyond their respective fields.

The Explain GAI service is designed for:

- *researchers and scientists* who want to extend their knowledge beyond their own field. Artificial intelligence explanations help them to quickly understand key ideas in papers from other fields;
- *graduate students and researchers* who need to process large volumes of dense, complex documents, as simplified explanations allow for faster reading;
- *industry professionals* in technical positions who want access to the latest research and ideas, as the service makes the most recent article more accessible;
- *lifelong learners and knowledge seekers* who want to keep up to date, because Explain Paper makes complex documents accessible.

Downloading the content of Gemini’s answer about examples of AI-powered hypotheses in Computer Science (Fig. 2) and selecting part of the text to get the GAI-generated explanation is shown in Fig. 6.

According to the ExplainPaper website, users can save time and improve the accuracy of their work by using this service [11]. This service has 63 alternatives, including Ask Your PDF, Brevity, HeyScience, Skimlt.ai, Summatity, Summary-Box, Docu-Ask, SciSpace Copilot, AI Next Assistant, Doks.ai, PDFAI.io, and others (<https://topai.tools/alternatives/explainpaper>).



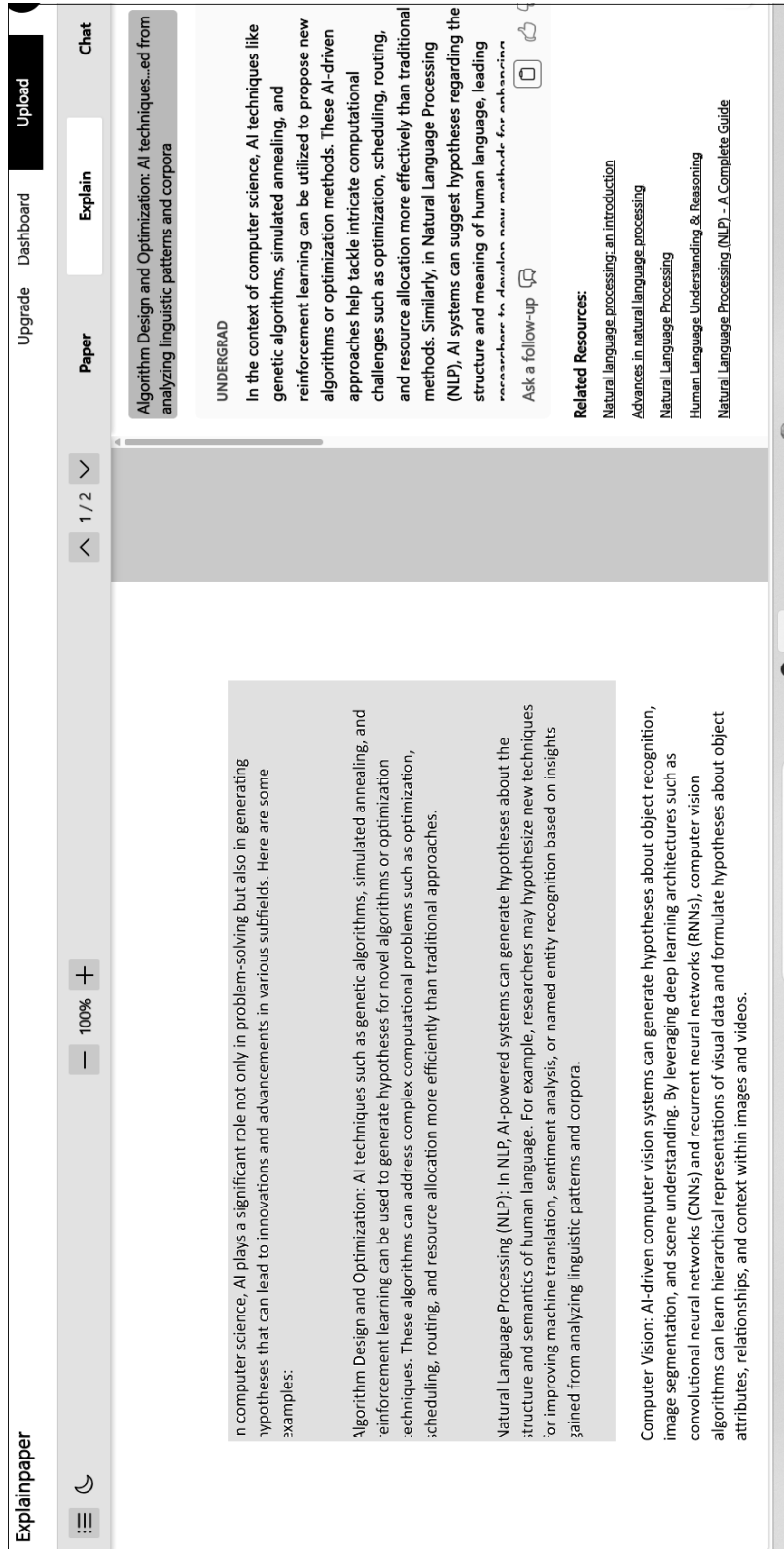


Fig. 6. Highlight a section of text in an article and its explanation

### **IntelliConsult. Project consulting/engineering**

**IntelliConsult** (<https://intelliconsultai.com/>) uses the power of artificial intelligence to analyze project data and provide valuable information and recommendations for project optimization [12]. It can be used to easily create project plans, allocate resources and set realistic timeframes. *IntelliConsult* is easy to use thanks to its user-friendly interface. It guides you through the entire consulting process, making it easy to access the features and support you need. Fig. 7 shows the input interface for entering a description of the project for which the plan was developed (Fig. 8).



Fig. 7. The input interface for entering the project description


 <span style="margin-left: 20px;">Strategy</span> <span style="margin-left: 20px;">Risk</span> <span style="margin-left: 20px;">Implementation</span> <span style="margin-left: 20px;">Technology</span> <span style="margin-left: 20px;">Contact</span>
<p>Title: Advancing Scientific Research with Generative Artificial Intelligence (GAI) - Project Plan</p> <p>1. Project Objectives:</p> <ul style="list-style-type: none"> <li>- To optimize hypothesis generation and concept development using GAI capabilities</li> <li>- To facilitate hypothesis analysis and testing through GAI assistance</li> <li>- To assist in finding and extracting scientific data efficiently</li> <li>- To support research design planning and management of large data sets</li> <li>- To enhance data visualization and publication requirements through GAI technology</li> <li>- To promote collaborative intelligence between human researchers and GAI tools</li> <li>- To prepare future researchers for the AI era through targeted educational initiatives</li> </ul> <p>2. Project Scope:</p> <ul style="list-style-type: none"> <li>- Develop a comprehensive strategy for integrating GAI into scientific research processes</li> <li>- Provide training and support for researchers on GAI tools and capabilities</li> <li>- Implement GAI services for hypothesis generation, data analysis, and data visualization</li> <li>- Conduct ethical considerations and guidelines for using GAI in research</li> <li>- Collaborate with universities to incorporate GAI training in research curricula</li> </ul> <p>3. Project Deliverables:</p> <ul style="list-style-type: none"> <li>- Research on the impact of GAI on scientific research processes</li> <li>- Guidelines for ethical use of GAI in research</li> <li>- Training materials and workshops for researchers on using GAI tools</li> <li>- Implementation of GAI services for hypothesis generation and data analysis</li> <li>- Collaborative initiatives with universities for incorporating GAI in research curricula</li> </ul> <p>4. Project Timeline:</p> <ul style="list-style-type: none"> <li>- Phase 1 (Month 1-3): Research on GAI capabilities and implications for scientific research</li> <li>- Phase 2 (Month 4-6): Development of guidelines and training materials for researchers</li> <li>- Phase 3 (Month 7-9): Implementation of GAI services for hypothesis generation and data analysis</li> <li>- Phase 4 (Month 10-12): Collaboration with universities for incorporating GAI in research curricula</li> </ul> <p>5. Project Team:</p> <ul style="list-style-type: none"> <li>- Project Manager</li> <li>- GAI Research Analysts</li> <li>- Training and Implementation Specialists</li> </ul>

Fig. 8. Illustration of the results of developing individual strategies and justifying project decisions

The *IntelliConsult* service is a guide for achieving excellence in projects. It offers strategic project management and planning, risk analysis and management, project result optimization, and inspiration for innovation. This service provides project planning and strategic support throughout the entire project life cycle, thanks to the latest artificial intelligence technology.

According to <https://theresanaiforthat.com/ai/intelliconsult/>, *IntelliConsult* has 43 competitors, including *Wolfe*, *Gitsul Group*, *AI-Engageme*, *Consultant in*, *Strategic Mind*, *ProfitGPT*, *My Consultant*, *Peter Drucker*, *ai revolution*, *ConsultGPT*, and *AI Transform*.

### Academic GPT. Writing scientific papers

*AcademicGPT* (<https://academicgpt.net/>) is an GAI service that helps professionals with the complex process of writing scientific papers [13]. Its artificial intelligence algorithms excel at generating annotations and concise abstracts, providing users with a significant increase in productivity. This service allows professionals to upload their papers in PDF format and use the power of GAI algorithms to improve their work. However, it is important to remember that while *AcademicGPT* is a powerful service, it should complement, not replace, thoughtful research writing.

First, a user uploads a draft of a research paper to *AcademicGPT* and selects one of three sections: *Write*, *Feedback* or *Explain*. In the drop-down menu “Choose which type of paper section the AI should write” (Fig. 9), you can select the type of task for which *AcademicGPT* should create content.

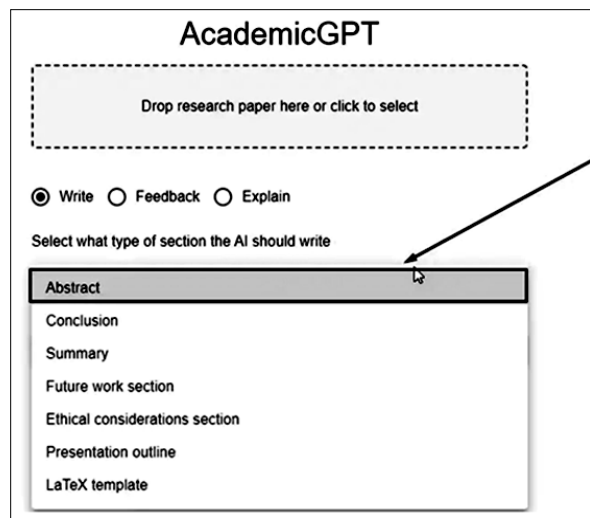


Fig. 9. Selecting a task in the “Write” section: abstract, conclusions, summary, future manuscript sections, ethical considerations section, online presentation, LaTeX format)

Next, in the “Feedback” and “Explain” sections, the user selects clear instructions or key points that *AcademicGPT* should follow when creating the content of his or her paper. In the Feedback section, the following instructions can be selected: Strength of Argument, Language, Coherence, Originality, Citation, and in the Explain section: Simple and Short, Simple and Long, Complex and Long, Complex and Short.

After entering the instructions, clicking on the Create button allows *AcademicGPT* to use its GAI capabilities to generate an abstract or any other appropriate academic section based on the requirements. Fig. 10 shows an example of an abstract for this article “The use of generative artificial intelligence (GAI) in scientific research”.



Fig. 10. Illustration of the abstract been generated by GAI

If necessary, users can review or expand the generated content by reusing the *AcademicGPT* service and providing additional instructions or adjusting the initial input. Once the user is satisfied with the generated content, they can export it in the required format or copy and paste it into their research paper.

It is important to note that there are many alternative services available for this purpose, such as *Shutterstock*, *Grammarly*, *Gamma AI*, *CrushOn.AI*, *Runwayml*, *You*, *DeepAI*, *PixAI - AI Art Generator*, *MaxAI.me*, and *Simplified*. A comparison of their results with *AcademicGPT* is provided on the website <https://www.toolify.ai/alternative/academicgpt>.

### **SlidesGPT. Presentation/Publication of results**

**SlidesGPT** (<https://slidesgpt.com/>) is a GAI service that makes it easy to create slides for Google presentations, for example, the results of a research paper. To create a slide, you need to prepare a presentation plan or content source, then simply paste the text and get a presentation in seconds. It is possible to review the draft slides and make corrections or additions. Instead of just starting with a prompt, you can also ask the service to convert a PDF or web page into a presentation outline. With an intuitive interface, the service understands the user's presentation needs and helps them design slides that are both informative and attractive. It is ideal for professionals who need to quickly create powerful presentations, teachers who want to make educational content more engaging, or students preparing for academic projects.

Fig. 11 shows 4 out of 10 slides generated by *SlidesGPT* using the annotation from this article in Ukrainian.

**Note on Generated Content**  
The below slide deck has been generated by an AI. The system may occasionally generate incorrect or misleading information and produce offensive or biased content. It is not intended to give advice.

# The Use of Generative Artificial Intelligence (GAI) in Scientific Research

## Agenda

- Introduction
- Automated Generation of Hypotheses and Concepts
- Testing and Iteration of Hypotheses
- Data Search, Verification, and Citation
- Efficient Information Retrieval from Databases
- Project Planning and Structure
- Analysis of Large Data Sets
- Text Processing and Summarization
- Integration of Different Disciplines
- Scientific Reporting and Article Writing
- Data Visualization and Representation
- Other Applications and Conclusion

### Automated Generation of Hypotheses and Concepts

Data Analysis, Hypothesis Generation, Conceptualization using GAI

- **Data Analysis:** GAI can analyze large volumes of data to identify patterns, trends, and correlations that can lead to the generation of new hypotheses and concepts.
- **Hypothesis Generation:** By processing and analyzing large datasets, GAI can automatically generate hypotheses based on the identified patterns and correlations in the data.
- **Conceptualization using GAI:** GAI can assist in conceptualizing hypotheses and scientific concepts by processing and interpreting complex data, leading to the formulation of new ideas and theories.

We will explore how generative artificial intelligence (GAI) can automate the generation of hypotheses and concepts in scientific research. By leveraging data analysis and processing capabilities, GAI can identify patterns, trends, and correlations within large datasets, leading to the automatic generation of hypotheses. Furthermore, GAI can aid in the conceptualization of scientific concepts by processing complex data and contributing to the formulation of new ideas and theories.

### Testing and Iteration of Hypotheses

Analyzing and Testing Hypotheses, Iterative Research Process

- **Analyzing and Testing Hypotheses:** GAI can assist in the analysis and testing of hypotheses by processing data and providing insights to support or refute the formulated hypotheses.
- **Iterative Research Process:** GAI can facilitate an iterative approach to research processes by continuously analyzing, refining, and re-evaluating hypotheses based on new data and insights.

will discuss the role of generative artificial intelligence (GAI) in the testing and iteration of hypotheses in scientific research. GAI can contribute to the analysis and testing of hypotheses by processing data and providing insights to support or refute the formulated hypotheses. Additionally, GAI enables an iterative research process, allowing for continuous refinement and re-evaluation of hypotheses based on new data and insights.

Fig. 11. Illustration of generated slides on the topic “The use of Generative Artificial Intelligence (GAI) in scientific research”

After viewing the generated presentation, the user has the opportunity to customize it according to their specific needs. They can edit the content, replace images, rearrange slides and make any necessary changes. *SlidesGPT*'s GAI service is capable of creating doctoral-level presentations, including detailed, factual and specific information. It can integrate user-provided data into presentations, ensuring that the source data is accurate and up-to-date. Among the many alternative presentation services, *MagicSlides*[14], *SlidesAI*, *AhaSlides*, *SlidesGo*, *Beautiful AI*, *Invideo*, *Canva*, *Tome*, *Hitch*, *Gamma*, *Prezi* and *Syis* (<https://ahaslides.com/blog/slides-ai-platforms/>) are worth mentioning.

These five GAI services are valuable for both students and teachers, as they can enhance productivity and work quality while reducing the time and effort required for important tasks. In the fast-changing technological landscape and with the growing demands on the competencies of future professionals, clarity is especially crucial.

## CONCLUSIONS

Generative Artificial Intelligence (GAI) is transforming scientific research. GAI offers a range of services to optimize hypothesis generation and concept devel-

opment, facilitate hypothesis analysis and testing, assist in finding and extracting scientific data, assist in research design planning, manage large data sets, perform translations and editing, meet journal publication requirements, create data visualizations, check for plagiarism, transcribe audio recordings, and generate summaries [15]. Expanding research capacity in this way improves personalized education by shifting from rote learning to critical thinking and problem-solving [8; 9]. Future research in this field should aim to develop methodologies for evaluating GAI-generated hypotheses that are both innovative and scientifically rigorous. One potential avenue for exploration is the design of GAI systems with explainable algorithms, which would offer transparency in their reasoning processes and make their hypotheses more understandable and acceptable to the scientific community.

The use of Generative Artificial Intelligence (GAI) in research and academia has both significant benefits and challenges. Tools such as *AcademicGPT* and *SlidesGPT* demonstrate the potential to empower people by simplifying the creation of scientific documents and presentations. With the help of AI services such as *Semantic Scholar* and *Explain Paper*, researchers can increase their access to knowledge, improve understanding and develop new hypotheses. However, despite these benefits, the implementation of GAI should be approached with caution, taking into account ethical considerations and the risk of data bias. Scientific institutions need to develop and refine guidelines for the responsible use of GAI, ensuring that it serves as a complement to human intelligence, not a replacement [16–19]. Many universities mentioned in [18] are equipped by GAI detection tools (e.g. *GPTZero*, *Turnitin*, *GPTKit*, *Winston AI*, etc.) [20]. By striking a balance between innovation and maintaining academic integrity, GAI can become a powerful ally in the pursuit of scientific progress and the evolution of educational practices.

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### ВИКОРИСТАННЯ ГЕНЕРАТИВНОГО ШТУЧНОГО ІНТЕЛЕКТУ (ГШІ) В НАУКОВИХ ДОСЛІДЖЕННЯХ / А.І. Петренко

**Анотація.** Поява та зростаючі можливості генеративного штучного інтелекту (ГШІ) глибоко трансформують наукові дослідження. Хоча ГШІ розширює людський інтелект шляхом автоматизації певних завдань, він радше доповнює, ніж замінює людську креативність. Розглянуто наслідки ГШІ для наукового процесу, включаючи етичні міркування та необхідність збалансованого підходу, який об’єднує сильні сторони людського та штучного інтелекту в процесі відкриття знань і вирішення складних проблем. Обговорення поширюється на необхідність для університетів скорегувати навчальні програми для підготовки майбутніх дослідників до епохи ГШІ, підкреслюючи сценарне мислення та управління невизначеністю як важливі навички майбутнього.

**Ключові слова:** генеративний штучний інтелект, аналіз і тестування гіпотез, пошук джерел наукових даних, планування дослідження, написання і редагування наукових рукописів, упорядкування і презентація результатів.