# **GENERATIVE AI FOR GROUP LEADERS**

# **IOCB** Prague



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## 1. Al Foundations

- Primer on Large Language Models (LLMs)
- Key Concepts and Capabilities
- Limitations of LLMs in Research
- Individual and Institutional Risks
- Data Security Considerations
- AI Use Policies in Academia
- 2. Generative AI Landscape
- 2.1 Standalone LLM-based Chatbots
- 2.2 Prompt Engineering
- 2.3 Custom GPTs and AI Assistants
- 2.4 Literature Research and Working with Text
- 2.5 LLM Assisted Data Analysis
- 2.6 AI Ecosystems
- **3. Practical Applications**
- Workflow for Grant Applications and Project Management
- Designing Presentations and Visual Content
- Creating Images and Schemes
- Graphical Abstracts and Publication Visualizations

# 4. Al Agents

# **TOPICS LIST**

# **GENERATIVE AI**

= field of artificial intelligence focused on algorithms trained on massive amounts of existing data (learn

patterns and structures from the data)







# **ACADEMIC/RESEARCH CONTEXT**

# CHATBOTS

**DEEP RESEARCH AGENTS** 

AI ASSISTED SEARCH ENGINES

# **RESEARCH ASSISTANTS**

# WRITING ASSISTANTS

# MULTIMEDIA APPS ORAGNISATIONAL TOOLS

#### Research Institution Obligations for Employee AI Training Under the AI Act

#### Who Requires Training

- Staff using AI systems in research activities
- Management deciding on Al implementation

#### Al Systems Covered

✓ Applies to common (low-risk) commercial AI tools (chatbots, generative AI)

#### • Training Scope

- Ensuring baseline "Al literacy" for all researchers
- Institution determines format (workshop, online course)
- Recommended annual renewals or after significant updates

#### Training Content

- Fundamentals of AI systems operation
- Proper interpretation of AI outputs
- Ethical and legal considerations (GDPR, intellectual property)
- Risk recognition (misinformation, bias in research)
- Appropriate use cases and limitations

#### Responsibility and Documentation

- Research institution bears responsibility
- Recommended to maintain training records
- Formal certification not mandatory

#### Non-Compliance Consequences

- No direct penalties for training omission
- Legal and reputational risks if negligence leads to data breaches or ethical violations

👉 Al Act Objective:Ensure conscious, safe, and responsible Al use by research personnel

# PRIMER ON LARGE LANGUAGE MODELS (LLMs)



#### **KEY CONCEPTS RECAP – LARGE LANGUAGE MODELS**

#### Effective use of LLM-based chatbots requires understanding their capabilities, limitations, and best practices for interaction!

- Chatbots are NOT Search Engines/Databases (dynamic, tailored responses vs. static, pre-existing information)
- LLMs don't understand language like humans, but follow patterns in training data
  - Process text as tokens, not words or letters
  - Tokens are converted into vectors representing semantic meanings and relationships
  - Use "autoregressive sampling" to predict next most probable token
- LLMs generate statistically probable responses, which may not always be true (hallucinations)
- Foreign languages are underrepresented in training data (communicate in English for best results)
- Clear, detailed, and context-rich prompts yield better responses ("Garbage in garbage out" principle applies)
- Use new threads for different topics
- Be aware of **context window limitations**
- Use grounding techniques to reduce hallucinations and inconsistencies
- Never be satisfied with the first generated response (use response branching to check consistency)
- YOU ARE RESPONSIBLE for the outcome if used further YOU MUST REVIEW AND CRITICALLY EVALUATE THE OUTCOME (NEVER copy-paste)
- The intelligence is required on your side!





once upon a tip



# LLM Lifecycle and Updates



#### **Initial Training**

Beginning

Model is trained on an extensive data corpus



#### **Static Period**

Several months

Model remains static, its parameters and weights are fixed



#### Model Update

After 3-6 months

New version with optimized parameters and weights



#### **Static Period**

Several months

Model remains static, its parameters and weights are fixed



#### **Further Updates**

After another 3-6 months

Repeated model optimization

Important: Between updates, the model processes new queries but does not learn from them



ChatGPT 40 mini ~
 Is 3659 a prime number?
 No, 3659 is not a prime number. It can be divided by 37 and 99 (since 3659 = 37 × 99). Therefore, it has factors other than 1 and itself, making it a composite number.

Kalkulačka- $\times$ Standardní $\Re$  $\Im$  $37 \times 99 =$ **3663** 

Is 3659	a prime (	number?			
Is <mark>365</mark> 9	a prime	number <mark>?</mark>			
[3031, 2	20, 10376	8, 24, 261,	9197,	2086,	30]



LLMs only pretend to perform mathematical operations in fact they are just predicting the next token



Tokenizer				
GPT-4o & GPT-4o mini				
I HALLUCINATE!				
Tokens Characters				
7 14				
I HALLUCINATE!				
Text Token IDs				
[40, 487, 7011, 25949, 965, 4197, 0]				



#### ChatGPT 40 mini ~

Provide 3 citations to support the statement "Exosomes are produced by fungi"

- Here are three citations that support the statement "Exosomes are produced by fungi":
  - Crespo, J. et al. (2019). "Exosome-like vesicles from the fungus Aspergillus fumigatus: Characterization and their potential role in virulence." *Cellular Microbiology*, 21(9), e13072. DOI: 10.1111/cmi.13072.
    - This study highlights the production of exosome-like vesicles by Aspergillus fumigatus, discussing their characteristics and implications for fungal virulence.
  - Bennett, J. W., & Lasure, L. L. (2013). "Fungal biotechnology." In Fungal Biotechnology in Agricultural, Food, and Environmental Applications. CRC Press.
    - This book discusses various aspects of fungal biology, including the production of extracellular vesicles, such as exosomes, by various fungal species.
  - Razzak, M. A., et al. (2017). "Extracellular vesicles of fungi: a potential therapeutic target." *Frontiers in Microbiology*, 8, 1360. DOI: 10.3389/fmicb.2017.01360.
    - This article reviews the role of extracellular vesicles in fungi, emphasizing that fungi produce exosome-like structures which may have significant biological functions.

These citations provide a solid foundation for understanding the production of exosomes in fungi and their potential biological roles.



## DOES IT EVEN MAKE SENSE TO USE LLMs IN RESEARCH?





Analysis		×		
python	Always show details	ල් Copy code		
def is prime(n):				
"""Check if a number is prime."""				
if n <= 1:				
return False				
<pre>for i in range(2, int(n**0.5) + 1):</pre>				
if n % i == 0:				
return False				
return True				
<b>→</b>				
# Verify if 3659 is a prime number				
number_to_check = 3659				
<pre>is_number_prime = is_prime(number_to_check)</pre>				
is_number_prime				
Result				
True				





search web to retrieve the correct citations for the sources you provided

#### Searched 6 sites ~

Here are three correct citations supporting the statement that "Exosomes are produced by fungi":

- 1. Rizzo, J. et al. (2020). "Extracellular Vesicles in Fungi: Past, Present, and Future Perspectives." Frontiers in Cellular and Infection Microbiology, 10, 346. DOI: 10.3389/fcimb.2020.00346.
  - This article provides a comprehensive overview of the biogenesis, characterization, and roles of extracellular vesicles, including exosomes, produced by various fungal species.
- 2. Rodrigues, M. L., & Janbon, G. (2020). "The emerging role of extracellular vesicles in fungi: a double-edged sword." Frontiers in Microbiology, 11, 1460. DOI: 10.3389/fmicb.2020.01460.
  - This review discusses the significance of extracellular vesicles in fungi, including their roles in virulence, host interactions, and the mechanisms of exosome production.
- 3. Albuquerque, P. et al. (2018). "Fungal extracellular vesicles: A new potential therapeutic target." Frontiers in Microbiology, 9, 905. DOI: 10.3389/fmicb.2018.00905.
  - This paper reviews the properties and implications of extracellular vesicles • produced by fungi, emphasizing their potential as therapeutic targets in managing fungal infections.

These references highlight the production of exosomes in fungi and their biological significance.

Searched 6 sites ^

- Q "Exosome-like vesicles from the fungus Aspergillus fumigatus: Characterization an... bing.com
- Q "fungal biotechnology Bennett Lasure" bing.com
- Q "extracellular vesicles of fungi a potential therapeutic target site:frontiersin.org" bing.com
- Frontiers Frontiers | The emerging role of extracellular vesicles in fungi: a double.. frontiersin.org
- Frontiers Frontiers | Extracellular Vesicles in Fungi: Past, Present, and Future...
- Frontiers The emerging role of extracellular vesicles in fungi: a double-edged...

#### **REVIEW** article

Front, Cell, Infect, Microbiol., 15 July 2020 Sec. Fungal Pathogenesis Volume 10 - 2020 | https://doi.org/10.3389/fcimb.2020.00346

This article is part of the Research Topic Extracellular Vesicles in Infectious Diseases

#### Extracellular Vesicles in Fungi: Past, Present, and Future Perspectives

Guilhem Janbon<sup>1</sup> Juliana Rizzo<sup>1\*</sup> Marcio L. Rodrigues<sup>2,3</sup>

THAT'S RIGHT AT'S RIGHT





@Liegertova\_Michaela

--- Equal Difficulty Tasks

Source: @techczech

# The Cybernetic Teammate

link

Having an AI on your team can increase performance, provide expertise, and improve your experience



ETHAN MOLLICK MAR 22, 2025

# Randomized controlled trial of 776 professionals at Procter and Gamble (July 2024!)



# INDIVIDUAL AND INSTITUTIONAL RISKS AND

# **POTENTIAL HARMS**

# **A** Potential Harms of Generative AI Use in Research Institutions

Risk of contributing erroneous data to the knowledge domain through unchecked AI-generated content

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P

Compromised research results due to incorrect use of AI in data analysis

Potential for generating inaccurate or implausible conclusions if AI is used without proper human supervision

60 Erosion of human judgment in drawing inferences from qualitative or quantitative data

Introduction of mistakes or inaccuracies into research texts when AI-generated content is not critically verified

Breach of confidentiality in peer review process if manuscripts are fed into AI tools

Possible over-reliance on AI, leading to a decrease in critical thinking and original research skills

Ultimately, the cumulative effect of these risks could lead to a severe erosion of scientific integrity and irreparable damage to the institution's reputation.

# DATA SECURITY CONSIDERATIONS FOR CHATBOT USE

- A Risks of Commercially Available Chatbots
- Often unclear handling of user conversations and data
- Potential risk of data leakage
- Benefits of "Team" and "Enterprise" Licenses
- Prohibition on sharing data with third parties
- Encryption of conversations
- Multi-factor authentication
- Organization-level management
- General Recommendations
- Anonymization of sensitive data
- Use of local open-source alternatives for highly sensitive data
- User training on safe Al usage

	Team								
S	<ul> <li>For fast-moving teams and organizations ready to supercharge work</li> <li>Everything included in Plus</li> <li>Unlimited access to GPT-40 mini and higher message limits on GPT-4, GPT-40, and tools like DALL-E, web browsing, data analysis, and more</li> <li>Create and share GPTs with your workspace</li> <li>Admin console for workspace management</li> </ul>								
ChatGPT									
						✓ Team data excluded from training by default. Learn more			
						\$25 per user / month billed annually			
	\$30 per user / month billed monthly								
	Enterprise								
	For global companies looking to enable their workforce with Al								
	✓ Everything included in Team								
	<ul> <li>Unlimited, high speed access to GPT-4, GPT-40, GPT-40 mini, and tools like DALL-E, web browsing, data analysis, and more</li> <li>Expanded context window for longer inputs</li> <li>Enterprise data excluded from training by default &amp; custom data retention windows. Learn more</li> </ul>								
							✓ Admin controls, domain verification, and analytics		
							✓ Enhanced support & ongoing account management		
		Security							
		Comprehensive	ompliance						
	✓ We've been compliance and API)	audited for SOC 2 (ChatGPT Enterprise							
	✓ Data encry and in trans	otion at rest (AES-256) it (TLS12+)							



**RISKS**?

Excessive dependence on LLMs may degrade human skills (e.g., creativity, problem-solving) due to offloading.

Use of the same LLM can reduce idea diversity, aligning outputs and user thinking due to shared training data.

Overtrust in compelling but flawed LLM outputs can lead to errors, especially in logic or fact-based tasks.

Over-dependence may reduce proactive engagement, yielding generic results and lower creative confidence.

LLMs may transfer training data biases (e.g., stereotypes), subtly influencing user perspectives.

Heavy LLM use might lessen users' sense of ownership and motivation, feeling the AI, not they, created the work.

Continuous reliance could impair independent skill development

Sending data to third-party LLMs risks privacy



Human Collaboration

LLMs in teams might disrupt social dynamics, potentially overshadowing human creativity and input.



# Al Integration Hierarchy



"Let's develop a novel experimental approach for investigating neuroinflammation in Alzheimer's disease... I have some initial ideas about combining single-cell transcriptomics with spatial proteomics to map cellular interactions in the brain microenvironment..."

> "help me troubleshoot my transfection protocol that is showing low efficiency in HEK293 cells when delivering my CRISPR constructs"

> > "review my code and suggest optimizations for better performance"

*"check the spelling and grammar in this paragraph"* 

# **USE OF GENERATIVE AI IN RESEARCH**



...Al chatbots and other specialized tools can be leveraged at nearly every stage to enhance efficiency and quality

...growing importance of integration across the research workflow as AI continues to advance

## **OVERVIEW ON AI USE POLICIES**

Publishers' and journals' instructions to authors on use of generative artificial intelligence in academic and scientific publishing: bibliometric analysis

*BMJ* 2024 ; 384 doi: https://doi.org/10.1136/bmj-2023-077192 (Published 31 January 2024) Cite this as: *BMJ* 2024;384:e077192

# Disclosure Requirements:

- 43% of journals specified how to disclose AI use
- Disclosure locations varied (methods, acknowledgments, cover letter, or special sections)
- 12 journals had guidelines conflicting with their publishers

## Main Issues:

- 1. Lack of widespread guidelines among major publishers
- 2. Inconsistencies between journal and publisher policies
- 3. Poor standardization creating challenges for authors
- 4. High variability in permitted AI uses and disclosure requirements

Given the varying policies across journals, researchers should carefully review their target journal's specific guidelines on generative AI use before applying these tools to any aspect of their research or manuscript preparation process.



#### Living guidelines on the RESPONSIBLE USE OF GENERATIVE AI IN RESEARCH

Artificial Intelligence is transforming every stage of the research process across scientific disciplines. Generative AI tools, like ChatGPT, are powerful technologies that can facilitate scientific work and accelerate discovery, when used in the right way. The European Commission, countries and research and innovation stakeholders of the European Research Area have collaboratively developed a set of recommendations to support the responsible integration of generative AI in research.

The guidelines follow the principles of research integrity and address the main challenges researchers face when using generative AL As the technology is evolving. <u>(eedback from the community</u> is welcome to keep the guidelines up to date.

#### **KEY RECOMMENDATIONS**

#### **RESEARCHERS** should...

- Follow key principles of research integrity, use GenAI transparently and remain ultimately responsible for scientific output.
- Use GenAI preserving privacy, confidentiality, and intellectual property rights on both, inputs and outputs.
- Maintain a critical approach to using GenAl and continuously learn how to use it responsibly to gain and maintain Al literacy.
- Refrain from using GenAl tools in sensitive activities e.g. peer reviews or evaluations.

#### **RESEARCH ORGANISATIONS should...**

- Guide the responsible use of GenAl and actively monitor how they develop and use tools.
- Integrate and apply these guidelines, adapting or expanding them when needed.
- Opploy their own GenAl tools to ensure data protection and confidentiality.

#### FUNDING ORGANISATIONS should...

- Support the responsible use of GenAl in research.
- Use GenAl transparently, ensuring confidentiality and fairness.
- Facilitate the transparent use of GenAl by applicants.

NEWS ARTICLE | 20 March 2024 | Directorate-General for Research and Innovation | 2 min read

# Guidelines on the responsible use of generative AI in research developed by the European Research Area Forum

Generative AI can hugely boost research, but its use demands transparency and responsibility. These guidelines aim to uphold scientific integrity and preserve public trust in science amidst rapid technological advancements. I call on the scientific community to join us in turning these guidelines into the reference for European research.

- Remain ultimately responsible for scientific output.
- Use generative AI transparently.
- Pay particular attention to issues related to privacy,

## confidentiality and intellectual property rights

....

...

# **Generative AI Landscape**



Advanced capabilities with dedicated interfaces

Seamless integration within productivity workflows

# LLMs based CHATBOTS



## **BEST STANDALONE APPS OPTIONS?**





MODELS	OpenAl	Anthropic	
Interface	Chat + History web + Desktop, Mobile app	Chat + History web + Desktop, Mobile app	
Models	GPT-4o, GPT-4.5 GPT-4o Canvas o1 +o3 with advanced reasoning Multimodal 128k context window (Plus, Team, Enterprise, Pro)	Sonnet 3.7 (+ reasoning) Opus 3 Multimodal 200k context window (Pro, Team, Enterprise)	
Modalities/Capabilities	DALL-E Advanced Voice Mode Code interpreter Web search Vision + life-streaming NEW! - Agents (Operator, Deep Research)	Artifacts Code interpreter Vision Projects feature (collaboaration within Team)	
Features user can use to control input/output	File upload, Custom Instructions, <b>GPTs</b> , <b>Projects</b> Response branching / Version tracking Chat sharing, Task managment Google/Onedrive integration, connected appa Voice Conversation/text2speech+speech2text (apps) Reference selected text <b>Canvas</b>	File upload, Custom Instructions (within Projects), <b>Projects</b> Google/Github integration Model Context Protocol (MCP) Claude Code (terminal) Response branching / Version tracking	
Subscription Types	Plus (\$20/month) <b>Team (\$25-\$30</b> /user/month) Pro (\$200/month) <b>Enterprise (custom pricing)</b> with higher limits, faster responses, and more features.	Pro plan (\$20/month, offers extended context windows 200K and Artifact feature) <b>Team plan</b> (\$30/user/month, with a minimum of 5 seats), collaboration via Projects <b>Enterprise</b> (custom pricing) with higher limits, faster responses, and more features.	
Developer Interface	OpenAl Playground	Anthropic Console	



FREE Interface for experimenting with the top models of the Gemini series

20-200 USD/month

20 USD/month



**GPQA Diamond** = extremely challenging multiple choice questions in **biology**, **physics** and **chemistry** "Google-proof")

A test of deep understanding and "multi-step" reasoning in specialised scientific area

PROMPT

#### **INSTRUCTION or QUESTION**

input that determines direction and context for the AI response

### GPT-40, GPT-4.5 CLASSICAL MODELS Claude Sonnet 3.5, 3.7 Claude Opus 3

Gemini 1.5 Advanced

Gemini 2.0 Pro

Gemini Flash 2.0

**MS** Copilot

# Al generates response sequentially token by token

without ability to revisit or reconsider the beginning of the response

#### Precise instructions + detailed context

#### = higher quality response

requires comprehensive prompts

#### Note:

responses are statistically probable,

but may not be factually correct

### **REASONING-BASED MODELS**

#### Al first reasons internally before formulating responses

generates plans and evaluates different aspects of the problem

Precise instructions + reasoning = more sophisticated response

can work effectively with shorter prompts

#### Note:

lower risk of hallucinations, but may still contain factual inaccuracies

o1, o1-mini, o1 Pro o3-mini, o3-mini-high Claude Sonnet 3.7 (thinking) Gemini 2.5 Pro Gemini Flash 2.0 Thinking MS Copilot Think Deeper

# Which AI Model Type to Use?

## **Classic LLMs**

- Excel in conversational formats
- Allow progressive context building and iterative refinement
- Ideal for developing ideas through dialogue
- GPT-40, GPT-4.5
- Claude Sonnet 3.5, 3.7 Claude Opus 3 Gemini 1.5 Advanced Gemini 2.0 Pro

Gemini Flash 2.0

**MS** Copilot

- Better at handling follow-up questions
   and conversation shifts
- Better for exploratory work when you don't know exactly what you're seeking

## **Reasoning Models**

- Less suitable for incremental refinement
- Prefer all information at once in a structured prompt
- Function more as "report generators" than conversational assistants
- Better at complex tasks requiring deep thinking (step-by-step reasoning)
- Ideal for creating comprehensive analyses, strategies, and complex plans
- o1, o1-mini, o1 Pro o3-mini, o3-mini-high laude Sonnet 3.7 (thinking) Gemini 2.5 Pro Gemini Flash 2.0 Thinking MS Copilot Think Deeper

# PRIMER ON PROMPTING / PROMPT ENGINEERING



Garbage in = garbage out

#### HOW TO BEST APPROACH CHATBOTS – classic conversational LLMs...

# **KEY POINTS ON EFFECIENT PROMPT DESIGN**

- Provide as much context as possible
- Be specific and clear in wording
- Assign the chatbot a specific role/persona and expected skills
- Break down complex topics into smaller, numbered questions
- Provide examples or clarifying information where possible
- Allow the chatbot to ask for additional information

GPT-40, GPT-4.5 Claude Sonnet 3.5, 3.7 Claude Opus 3 Gemini 1.5 Advanced Gemini 2.0 Pro Gemini Flash 2.0 MS Copilot

## TIP: Communicate with a chatbot as you would with a living assistant
## HOW TO USE CHATBOTS MOST EFFECTIVELY?

## **ASSISTANT SIMULATION**



Ethan Mollick 🤣 @emollick · May 31

It is worth being careful about the persona you are assigning the AI, it gives the LLM context, not magic powers. Papers show it often helps, but it requires testing.

Imagine that you have an unlimited budget and can hire an assistant for a specific task

## What expertise and experience should he have?

... expert in the research field immunology specializing in intercellular signaling cross-talks...with extensive background including serving as a seasoned reviewer for prestigious scientific journals

## What will be his primary task?

...to provide feedback and rigorous and constructive critique on the draft of my manuscript

## Prompt:

YOUR ROLE is to ACT AS an expert in the research field immunology specializing in intercellular signaling cross-talk with extensive background including serving as a seasoned reviewer for prestigious scientific journals. YOUR TASK IS to provide feedback and rigorous and constructive critique on the draft of my manuscript.

## Tools to help you craft efficient prompts for "classical" conversational models:



#### SAM, The Prompt Creator

Sy @TheAlAdvantage X

I will help you build advanced prompts in seconds. V1.0

#### link



i need help with troubleshooting my cell viability assay experiment

Excellent! Store working with the MTT assay and looking for broad troubleshooting support. Perfect.

So, now that you've given me your thoughts, I will initiate Scenario A and build a world-class system prompt directly for you 🧠.

#### Here is your brand-new system prompt, crafted with world-class precision:

D Copy ## Troubleshooting MTT Cell Viability Assay

#### ## Introduction

markdown

- \*\*YOU ARE\*\* a \*\*CELL BIOLOGY SPECIALIST\*\* with deep expertise in assay optimi

(Context: "Your diagnostic insight is essential to help identify sources of err

#### ## Task Description

- \*\*YOUR TASK IS\*\* to \*\*HELP ME TROUBLESHOOT\*\* issues in an MTT assay for asses

(Context: "I need to understand what could be going wrong at any stage of the M

## Action Steps

#### ### Diagnostic Framework

GPT-40, GPT-4.5 Claude Sonnet 3.5, 3.7 **Claude Opus 3** Gemini 1.5 Advanced Gemini 2.0 Pro Gemini Flash 2.0 **MS** Copilot

Copy, insert into a fresh thread/window, review and edit if necessary, run the prompt

#### view

@Lieaertova Michaela

#### FORMULATING RESEARCH QUESTIONS

### **EXPERT PANEL SIMULATION**

EXPERIMENTAL DESIGN

- ASSISTANCE IN INSIGHTS EXTRACTION FROM BRAINSTORMING
- ANALYZE/SUMMARIZE UPLOADED PDFs
- ASSITANCE WITH MANUSCRIPT WRITING
- MOCK REVIEW MANUSCRIPT
- SEARCHING FOR A SUITABLE TARGET JOURNAL
- DRAFTING A COVER LETTER
- **RESPONSE TO REVIEWERS**
- REWRITE TEXTS OR UNSTRUCTURED NOTES INTO YOUR OWN VOICE
- TROUBLESHOOTING EXPERIMENTAL WORK
- "WHAT-IF" SIMULATOR FOR EXPERIMENTAL PLANNING
- DESIGN EXPERIMENTAL PROTOCOLS BASED ON LAB RESOURCES
- DESIGN LAB SAFETY AND SAMPLE PROTECTION CHECKLIST FOR EACH PROTOCOL
- CONVERT THE SCALE OF YOUR EXPERIMENT
- GENERATE LAB NOTEBOOK ENTRIES IN REAL-TIME

IDENTIFING FUNDING SOURCES ASSISTANCE WITH TENDER DOCUMENTATION ASSISTANCE WITH RESEARCH TEAM ASSEMBLY ASSISTANCE WITH GRANT APPLICATION DRAFT GRANT APPLICATION MOCK REVIEW ASSISTANCE WITH COMMUNICATING THE RESEARCH ASSISTANCE WITH CONFERENCE PRESENTATION

ASSISTANCE IN COMPILING AND DRAFTING ANNUAL REPORTS



## IMPORTANT TRICKS - never settle for ONE answer!

What are current trends in spatial transcriptomics?

Spatial transcriptomics is evolving rapidly, with several exciting trends shaping the field as of 2024– 2025. Here's a breakdown of the most significant current trends:

- 2 1. Higher Resolution & Single-Cell Spatial Mapping
- Technologies like MERFISH, seqFISH, and Stereo-seq are pushing the limits of spatial resolution down to subcellular levels.
- There's a growing move toward true single-cell and subcellular spatial transcriptomics, enabling more precise cellular mapping within tissue architecture.

< 1/3 > QH 🗗 😂 😤 ~

Spatial transcriptomics is evolving rapidly, driven by advances in both experimental techniques and computational analysis. As of 2024-2025, here are **key trends** shaping the field:

#### 差 Technological Advances

- 1. Higher Resolution & Throughput
  - Techniques like Slide-seqV2, HDST, and Stereo-seq now offer subcellular resolution.
  - New versions of 10x Genomics' Visium aim to combine high resolution with wholetranscriptome coverage.

< 2/3 >

Spatial transcriptomics is a rapidly evolving field that integrates gene expression data with spatial context, enhancing our understanding of complex biological systems. Recent trends in this area include:

#### 1. Advancements in In Situ Capture Techniques

In situ capture methods have seen significant progress, particularly through the development of technologies like Deterministic Barcoding in Tissue for Spatial Omics Sequencing (DBIT-seq). DBIT-seq enables the simultaneous spatial mapping of mRNA and proteins at near single-cell resolution in fixed tissue samples, improving upon previous methods by increasing gene detection per pixel and offering ease of implementation. wingedia +2

< 3/3 >

### IMPORTANT TRICKS - never settle for the FIRST answer!

→ "You can do better"

→ "Are you sure?" ... give the model the opportunity to "read" and improve his answer

## HOW TO BEST APPROACH CHATBOTS – Reasoning LLMs...

## nature

NEWS 01 October 2024

# 'In awe': scientists impressed by latest ChatGPT model o1

The chatbot excels at science, beating PhD scholars on a hard science test. But it might 'hallucinate' more than its predecessors.



Derya Unutmaz, MD 🤣 @DervaTR

I just had of write a major cancer treatment project based on a very specific immunological approach. It created the full framework of the project in under a minute, with highly creative aims, approaches, and even considerations for potential pitfalls and alternative strategies (this is usually missing in 4o). This would have taken me days, if not longer, to prepare, and I still would have missed several of of's points. In fact, there was at least one idea unique enough that I might not have thought of it, even with 30 years of deep expertise in this field! People have no idea what's happening!

o1, o1-mini, o1 Pro o3-mini, o3-mini-high Claude Sonnet 3.7 (thinking) Gemini 2.5 Pro Gemini Flash 2.0 Thinking MS Copilot Think Deeper



...

Derya Unutmaz, MD ⊘ @DeryaTR\_ · Oct 6 ···· Agreed! However, with all due respect to my human colleagues, my closest science buddy is now the o1-preview model ☺.

In fact, as I sip my coffee now, I'm deeply engaged with o1 on improvisational discussion about a science project WE've been developing over the past few days! Přeložit pomocí Deepl.

#### 👰 Itai Yanai @ItaiYanai · Oct 6

Doing good science is 90% finding a science buddy to constantly talk to about the project.
Přeložit pomocí DeepL

## Reasoning LLMs are prompted differently

#### Treat model as a comprehensive document writer

Give it all details at once to get a complete response = let it process everything in a single reasoning pass (no sequential thinking).

#### Front-load ALL relevant information/context

Include domain details, constraints, and prior work for better results.

### Single Clear Goal

Specify exact desired output format and scope. One comprehensive request per prompt. Avoid multiple follow-up questions.

### Structured Format

Use clear section delimiters (e.g., <context>, <goal>). Organize context separately from request. Include explicit constraints and requirements.

Use the outcomes of GPT-40 or your Custom GPT Assistants as a context to reason over and improve

#### <context>

**Hypothesis:** Chronic neuroinflammation precedes and accelerates tau protein aggregation in early-stage Alzheimer's

**Preliminary data:** Elevated IL-1 $\beta$  and TNF- $\alpha$  in hippocampal tissue of 3-month-old transgenic mice; Initial observations suggest microglial activation before tau tangles

Available resources: Transgenic mouse model expressing human tau protein; Flow cytometry and immunohistochemistry facilities

Budget constraint: \$50,000 for 12-month study

**Technical constraints:** Animal facility limited to 100 mice maximum; Must complete within 12 months; Need to minimize number of animals per ethical guidelines

**PRIOR WORK:** Previous studies focused on late-stage disease; Recent literature suggests early intervention may be key

**Gap:** No longitudinal studies examining pre-symptomatic phase

## </context>

## <goal>

Design a comprehensive experimental plan

Format: Structured experimental design

Example o1-Pro

Example o3-mini-high

## </goal>

@Liegertova\_Michaela

## Kinetic Modeling and Molecular Weight Distribution Analysis of Catalytic PET Glycolysis with Catalyst Deactivation

#### Context:

The chemical recycling of Polyethylene Terephthalate (PET) is critical for sustainable polymer management. Catalytic glycolysis, using excess Ethylene Glycol (EG) to depolymerize PET into Bis(2-hydroxyethyl) terephthalate (BHET), is a promising route. Understanding and optimizing this process requires accurate kinetic modeling that accounts for the evolution of the polymer molecular weight distribution (MWD) and the performance limitations of the catalyst, including deactivation.

#### System Description:

Consider the glycolysis of PET carried out in an isothermal (T), well-mixed batch reactor using a homogeneous catalyst (C). Ethylene Glycol (EG) is present in large excess. The primary reaction is the random scission of ester linkages within the PET chains (P\_i, where i is the degree of polymerization) catalyzed by C, yielding shorter chains and eventually the monomer BHET (P\_1). The catalyst undergoes first-order deactivation during the process.

#### Mathematical Model:

The system dynamics are described by the following set of ordinary differential equations (ODEs):

 $\begin{array}{l} \mbox{Active Catalyst Concentration (C(t)):} \\ \mbox{dC}(t) \mbox{/ dt} = -k\_d * C(t) \\ \mbox{where } k\_d \mbox{ is the first-order deactivation rate constant.} \end{array}$ 

Polymer/Oligomer Concentration (P\_i(t) for i  $\geq$  2): dP\_i(t) / dt = 2 \* k\_p \* C(t) \*  $\sum_{i=1}^{i=1} 1/\sqrt{i} \max_i P_i(t) - k_p * C(t) * (i-1) * P_i(t)$ where k\_p is the intrinsic scission rate constant (per ester linkage, per active catalyst concentration), and i\_max is a sufficiently large upper limit for the degree of polymerization considered in the model.

 $\begin{array}{l} \mbox{Monomer} \ (\mbox{BHET}) \ \mbox{Concentration} \ (\mbox{P\_1}(t)): \\ \mbox{dP\_1}(t) \ / \ \mbox{dt} = 2 \ ^k\ \mbox{Lp} \ ^k\ \mbox{C}(t) \ ^k\ \mbox{\Sigma_{j=2}^{(j)}(i)} \\ \end{array}$ 

Initial Conditions and Parameters:

Initial Polymer: Assume PET with an initial number-average degree of polymerization DP\_n(0) = 100 and a polydispersity index PDI(0)  $\approx 2$ . Represent this using an initial Flory-Schulz

ChatGPT o1 pro  $\,{\scriptstyle \smallsetminus}\,$ 

#### **Summary of the Modeling Steps**

- 1. Model Definition
  - Wrote down ODEs for catalyst deactivation and random chain scission.
  - Represented the distribution by discrete concentration bins  $P_i$ .

#### 2. Initialization

- Used a Flory–Schulz-type distribution matching an initial number-average DP  $\approx 100.$
- Verified  $\sum i P_i(0) = N_0$ .
- 3. Numerical Solution
  - Defined an ODE function that constructs partial sums to handle  $\sum_{i=i+1}^{i_{\max}} P_j(t)$  efficiently.
  - Integrated over 5 hours (18,000 s).
- 4. Outputs
  - Catalyst: decays exponentially with rate  $k_d$ .
  - Monomer: grows from 0 up to some final yield. Can read off the time to 85% yield.
  - ${\sf DP}_n$ : monotonically decreases from pprox 100 toward 1 as the polymer depolymerizes.
  - MWD: can be visualized by plotting  $i P_i(t)$  vs i (or  $\log i$ ) at various times.

#### 5. Process Target & Constraint

- Computed time  $t^*$  when  $P_1(t^*)=0.85\,N_0.$
- Checked if  $\sum_{i=2}^5 P_i(t) < 0.5$  M for all  $t \leq t^*$ .
- Concluded whether the constraint is satisfied or not.

With these steps, one can **systematically study** how changes in  $k_p$ ,  $k_d$ , or initial catalyst loading  $C_0$ affect (i) time to target yield, (ii) small-oligomer buildup, and (iii) the final MWD. Such modeling is invaluable for **catalyst selection**, **process design**, and **scale-up** in PET chemical recycling.

<u>view</u>

#### ChatGPT o1 pro



#### What is this?



From the labels ("Initiation," "Depropagation," and "Termination") and the species shown (a polypropylene-type chain plus a clay-supported organozirconium site), this is a **mechanistic scheme for the catalytic 'unzipping' or cracking of polypropylene**. The clay-anchored zirconium complex (shown as "Clay ~  $ZrZrC_{6}H_{4}$ ") first **initiates** chain scission (forming active chain ends), then **depropagates** the polymer (removing monomer units), and finally **terminates** to give shorter hydrocarbon fragments. Essentially, it's the proposed chain mechanism by which the supported Zr catalyst breaks down polypropylene into smaller molecules.

I would like to write a grant proposal on the topic: Spatiotemporal EV-Mediated Neuroinflammatory Signaling in AD Progression: Multi-Omic Connectome Integration for Targeted Immunomodulation

- **Clarifying Questions:** 
  - 1. Funding agency: Who is the intended grantor (e.g., NIH, NSF, Horizon Europe)? Different agencies have different expectations for scope, format, and emphasis,
  - 2. Grant type: Is this a research project grant (e.g., R01), a training grant, or a pilot/seed grant?
  - 3. Proposal scope: Will this be a full-length proposal (~12 pages) or a shorter concept/LOI (Letter of Intent)?
  - 4. Current data: Do you already have preliminary data or findings related to EV signaling in AD?
  - 5. Research strategy: Do you have a defined hypothesis and methodology (e.g., single-cell transcriptomics, EV profiling, imaging connectomics)?
  - 6. Team/expertise: Will this involve a multidisciplinary team? If so, briefly describe the fields represented.
  - 7. Key outcomes: What are the primary goals? E.g., identifying biomarkers, developing interventions, mapping signaling networks?

NIH/NIA R01 (5vr), full proposal (~12pg). Have prelim data on cell-specific EV isolation, multi-omics showing inflammatory signatures in AD EVs, and mouse EV tracking. Testing hypothesis that EV neuroinflammatory signals propagate via neural networks in AD progression using multi-omics, advanced imaging, network analysis, and EV-targeted interventions. Team combines expertise in EV biology, neuroimmunology, bioinformatics, connectomics, and bioengineering. Key outcomes include mapping EV profiles across disease stages, identifying molecular drivers, understanding network-level spread, validating an immunomodulatory approach, and developing biomarker signatures.

Perfect — thanks for the details. Based on your input, I've crafted an optimized Reasoning LLM prompt that will guide the model to help you develop a strong, hypothesis-driven R01 proposal for NIH/NIA. This prompt highlights your preliminary data, methods, expertise, and specific aims - all structured to produce a comprehensive, one-shot response suitable for high-level reasoning.

#### Here's your final prompt:

vbnet

[CONTEXT]

[TASK]



#### [CONSTRAINTS/REOUIREMENTS]

- Format the proposal according to NIH R01 guidelines: Significance, Innovation, and

#### Reasoning LLM Prompt Generator

By community builder 8

Transforms user inputs into optimized prompts for Reasoning LLMs

#### link

Pojďme na to! (Čeština) Let's begin! (Angličtina)



Copy, paste

thread/wind

into a new

ow, check

and edit if

necessary,

run prompt.

view

## "REASONING" MODELY





Uses advanced reasoning

o3-mini Fast at advanced reasoning

o3-mini-high Great at coding and logic

o1 pro mode Best at reasoning



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Claude 3.7 Sonnet Our most intelligent model yet	~		රු Use	e a proje
Claude 3.5 Haiku Fastest model for daily tasks		sights from	Polish your prose	
Thinking mode				
Normal Best for most use cases				
Extended (9	1			







@Liegertova\_Michaela

Comparison of the demo prompt outcome

Gemini 2.5 Pro (reasoning)

ChatGPT o1 Pro

Claude Sonnet 3.7 (Thinking)

<u>MS Copilot</u> (Think Deeper)



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Capability/modality	Description	
Vision	Analyzes images, provides detailed descriptions, solves visual problems, and identifies content through computer vision processing	
Web Search	Formulates queries, executes search functions, and synthesizes web-based results into coherent summaries	
Code Interpreter	External plugin system enables code generation, execution, and output visualization, focused on data analysis and visualizati on tasks	
Canvas	Interactive interface facilitates collaborative project work, primarily focused on writing and content (or code) creation tasks	
DALL-E	Capability to generate text-to-image prompts specifically optimized for the DALL-E image generation model, images displayed in chat	
Voice (+ Advanced voice)	Real-time communication capabilities utilizing text-to-speech (TTS) and speech-to-text (STT) conversion (leveraging the Whisper speech recognition system); Advanced Voice enables direct audio-to-audio processing	

## + OpenAI Agents Deep Reserach + Operator



Capability/modality	Description
Vision	Analyzes images, provides detailed descriptions, solves visual problems, and identifies content through computer vision proce ssing
Code Interpreter	Enables code generation, execution, and output visualization, particularly focused on data analysis and visualization tasks
Artifacts	Self-contained display of extended content such as texts, code, or interactive graphics that can be edited, published, and downl oaded for subsequent use. These standalone components support iterative refinement, external distribution, and downstream applications.

## + web search and Agents coming soon

## ChatGPT MOBILE APP



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## EXAMPLE OF A COMPLEX WORKFLOW

take an image provide voice command  $\rightarrow$ check transcript  $\rightarrow$  download into your PC  $\rightarrow$ (mobile app)

(Desktop)

e.g. extract the text from this protocol, scale up the volumes 2x using code interpreter and provide as new protocol in word doc for me to download

e.g. open in Canvas to interactively cooperate on text

e.g. extract the results, insert into a table with clear descriptions and **provide as ppt** slides for me to download

e.g. instrument screen/table with results

e.g. old printed

lab protocol

e.g. extract the values into a table, use code interpreter to perform ANOVA and provide in excel for me to download

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Lab Troubleshooter GPT	
Description	
Helps researchers identify and resolve experimental issues through	gh c
Instructions	
Experiment Troubleshooting for Molecular Biology. Biochemistry: and Cell Biology     INSTRUCTIONS     "Introduction     ""YOU ARE" an "EXPERT MOLECULAR BIOLOGIST/BIOCHEMIST/CELL BIOLOGIST** with extensive experience in troubleshooting wet-lab experiments. Your	Lab Troubleshooter GPT Helps researchers identify and resolve experimental issues through detailed root cause analysis, decision tree processes, and visual
Conversation starters	diagnostics.
Help me troubleshoot!	Help me troubleshootl
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Routine_Challenges_in_M PDF	
Upload files	
Capabilities	
Capabilities Web Browsing	

## **Multi-AI-Assistant Collaboration**

"More heads know more. Don't be modest; you need at least two independent views, preferably from different AI assistants, to check for consistency and synthesize the best ideas from multiple sources."

#### Rultiple AI Assistants

### Consistency Check

**Q** Idea Synthesis

#### **Benefits:**

- O Diverse perspectives from different AI assistants
- S Enhanced ability to check for consistency across responses
- Synthesis of the best ideas from multiple AI sources
- S Improved overall performance and reliability of AI-generated content



## **BUILD YOUR OWN EXPERT CUSTOM GPTs**

= build your own AI-team tailored to your context and needs



## Example GPTs to be modified:

- BioGap Insight
- **BioHypothesis GPT**
- Grant Proposal Master
- Experimental Design Expert for Biology
- Experimental Troubleshooter (for Biology)
- Experiment Troubleshooter (Molecular Biology wet-lab)
- Experimental Data Interpreter in Biology
- Writing Style Analyzer and Replicator
- Manuscript Reviewer
- Journal Communication Specialist for Biology
- Biology Research Article Summarizer
- **Biology Research Communicator**

SAM, Prompt Creator GPT Al-research Assistant builder SciSpace Consensus Litmaps Scholar GPT Scholar AI Wolfram GPT Grimoire

Data Analyst (Code Interpreter)



The Virtual Lab: AI Agents Design New SARS-CoV-2 Nanobodies with Experimental Validation

Wesley Wu, Nash L. Bulaong, John E. Pak, James Zou doi: https://doi.org/10.1101/2024.11.11.623004

ightarrow a team of AI agents, powered by the GPT-40 model (an

improved version of GPT-4), where each "member" has a specialty
→ access to external tools (AlphaFold)
→ Workflow: team meetings (all agents discuss together) +

individual meetings (one agent solves a specific task



# LITERATURE RESEARCH

# **WORKING WITH TEXT**

AI ASSISTANCE TOOLS	NAME	LINKS
	Scopus Al	https://www.elsevier.com/products/scopus/scopus-ai/contact-us
	Scite	https://scite.ai/
	Elicit	https://elicit.com/
	SciSpace	https://typeset.io/
	Semantic Scholar	https://www.semanticscholar.org/
	Litmaps	https://www.litmaps.com/
RESEARCH ASSITANT TOOLS	MindGrasp	https://mindgrasp.ai/
	ResearchRabbit	https://researchrabbitapp.com/
	Lateral	https://www.lateral.io/
	Consensus	https://consensus.app/search/
	STORM	https://storm.genie.stanford.edu/
	NotebookLM	https://notebooklm.google.com/
	Paperpal	https://paperpal.com/
	Jenni	https://jenni.ai/
WRITING ASSISTANT TOOLS	Grammarly	https://www.grammarly.com/
	Quillbot	https://quillbot.com/
CITATION MANAGER	Zotero	https://www.zotero.org/
TRANSLATOR	DeepL	https://www.deepl.com/en/translator

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**SPECIALIZED TOOLS** designed by academic databases

<u>Scopus Al</u> - combines artificial intelligence with the Scopus academic database

Web of Science Research Intelligence - AI-native platform to optimize research teams, funding success, and impact measurement

## **Custom GPTs for literature research**



Mushtaq Bilal, PhD 🥺 @MushtaqBilalPhD · May 7 SciSpace is featured as this week's top GPT in the GPT store.

SciSpace GPT is specifically designed for researchers. It answers your questions with references to published papers.

No fake references.

Consensus by consensus by consensus (Consensus) Add the research, dhat directly with the world's scientific literature. Search reference, get imple explanations, where articles backed by acceleric papers.	Scholar GPT by avecomptual (*) Enhance research with 2004+ resources and built-in official reading skills. Access Google Scholar, PubMed, ISTOR, Aniv, and more, effortissis.	Scholar Al By scholarsic @@ Al Scientist - search and analyze text, figures, and tables from 2007# research papers and books to generate new hypotheses. Formerly the Scholarsi Pugon	Litmaps by Image.com ® Guiddy find papers on your topic, visualize your research, and accelerate your entre literature review.	SciSpace By scipporcom (RES) Do hours worth of research in minutes. Instantly access 287M+ papers, analyze papers at lightning speed, and effortieutly draft content with accurate citations.
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- Available via GTP store in ChatGPT to use for free
- Customized for specialized actions
- Enable complex workflows (can be called directly into ChatGPT conversation!)



Excerpt of the ChatGPT response could be selected and referenced to focus subsequent conversation

Typing "@" enables calling any pinned Custom GPT into the same chat window

# Custom GPT focuses on the referenced excerpt

their varying effects on different types of cells complicate their clinical Reply tion (BioMed Central) (MDPI) (BioMed Central).

" al and Preclinical Progress:

Message ChatGPT

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Exosome-based cancer therapies are progressing towards clinical readiness, with several preclinical studies demonstrating their efficacy in delivering therapeutic agents and modulating immune responses. Clinical trials are underway to evaluate the safety and effectiveness of the P herapies in

"Exosome-based cancer therapies are progressing towards clinical readiness, with several preclinical studies demonstrating their efficacy in delivering therapeutic agents and modulating immune responses."

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- Consensus Ask the research, chat directly with the world's s...
   SciSpace Do hours worth of research in minutes. Instantly...
   + Create a GPT
- "Exosome-based cancer therapies are progressing towards clinical readiness, with several preclinical studies demonstrating their efficacy in delivering therapeutic agents and modulating immune responses."
- SciSpace
   ×

   Image: Message SciSpace
   Image: Message SciSpace

Econome-based cancer therapies are progressing towards clinical readiness, with several
preclinical studies demonstrating their efficacy in delivering therapeutic egents and
modulating immune responses.

provide references from 2024

#### Current State of Exosome-Based Cancer Therapy (2024)

#### 1. Therapeutic Delivery and Targeting:

Exosomes, particularly those derived from mesenchymal stem cells, have shown significant potential in targeted cancer therapy. Their ability to traverse biological barriers, such as the blood-brain barrier, and deliver therapeutic agents like drugs, nucleic acids, and proteins, enhances their efficacy while minimizing systemic toxicity. These capabilities are being explored extensively in current research to improve the specificity and stability of cancer treatments (Torralba et al., 2024).

#### 2 Engineering for Enhanced Eugetionality

Detailed	Table		
Serial Number	Paper Title and Link	lesight	Citation Count
1	Engineered automes in emerging cell-free therapy (Gao et al. 2024)	Explores advancements and challenges in angineering existences for improved cancer therapy.	-
2	Report Advances in Econome-Based Drug Delivery for Cancer Therapy (Tomalba et al. 2024)	Reviews the benefits of using exceptions. For targeted drug delivery in cancer treatment.	-
3	Recent advances in exceptine-based immunotherapy applied to cancer (2024)	Discusses the role of exosomes in modulating immune responses and their applications in cancer immunotherapy.	*
4	Strategies to overcome the main challenges of the use of excounse as drug carriers for cancer therapy (2024).	Addresses the main challenges in existione-based drug delivery systems for cancer thetapy.	2
5	Mexenchymal stam calls-derived exoscenas: novel carriers for nanoparticles to combat cancer (2024)	Highlights the use of MSC-derived exosomes in delivering nanoparticles for targeted cancer therapy.	

#### Users also ask these questions:

1. What are the potential side effects of exosome-based cancer therapies?

2. How are exosomes isolated and purified for clinical applications?

3. What types of cancers are currently being targeted by exosome-based therapies?

## WORKING WITH ARTICLES using Chatbots

By requesting direct quotes from the text provided, you anchor the chatbot to the reference text + know where you can verify the information

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GPT-4 Capabilities ①	Preview and provide feedback on upcoming enhancements to our plat might influence Claude's behavior and some interactions may differ f
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Let me walk you through the Apollo 17 flight plan one more time.

bility to view and analyze images, charts, and

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6

YOUR ROLE: You are an expert in extracting information from scientific publications and scholarly texts, specializing in comprehensive literature reviews. YOUR TASK: Extract key findings from user-provided scholarly texts and ensure that the information provided is supported by direct citations from the text. **STEPS:** 

a) ANALYSE the provided document -> IDENTIFY the main hypotheses, methodology, results and conclusions.

b) PROVIDE a brief summary of the key findings, followed by a more detailed explanation including specific details from the article.

#### c) INCLUDE accurate and direct quotations from the provided text - example citation: 'sentence supporting the claim' (Chapter, Subchapter, Page number).

d) SUMMARIZE key findings:

Hypotheses - List the main hypotheses tested in the research; Methodology - Describe the primary methods and approaches used in the research; Results -

Highlight the most significant results; Conclusions - Summarize the main conclusions drawn by the authors.

e) IDENTIFY any limitations or potential biases in the study.

f) HIGHLIGHT any research gaps or areas for future study mentioned by the authors.

**OBJECTIVES AND LIMITATIONS:** 

- STRICTLY ADHERE to the provided text.
- ENSURE that the answer is FACTUAL and COMPREHENSIVE.
- RETAIN objectivity in your summary, avoiding own interpretations. **IMPORTANT:**

Your accurate extraction and summarization of key findings will greatly assist researchers in the literature review. Ensure accuracy and clarity in each answer. Your role is key to providing reliable and insightful summaries to researchers, reducing their workload and increasing their productivity

## Gemini 2.5 Pro

Google's most intelligent (reasoning) model with 1 million context window suitable to work with multiple pdfs

# Google Al Studio

#### Summarize the provided literature

Based on the provided literature (abstracts, reviews, protocols, research articles), here is a summary of the key findings and themes related to Alzheimer's disease (AD) research:

- 1. AD Pathogenesis Complexity: AD is consistently described as a complex neurodegenerative disorder characterized by amyloid-beta (AB) plaques, neurofibrillary tangles (NFTs) of hyperphosphorylated tau (p-tau), neuronal loss, and progressive cognitive decline.
- 2. Early Events & Neuroinflammation: Several studies emphasize that events like oxidative damage (Dey) and neuroinflammation (Dey, Uddin, Madhu, Sobue) are very early occurrences in AD pathogenesis, potentially preceding significant AB deposition. Neuroinflammation, involving activated microglia and astrocytes, cytokine release (TNF-a, IL-18, IL-6, IL-18, IFNs), inflammasome activation (NLRP3), and complement system activation, is highlighted as a crucial factor influencing disease severity and progression (Uddin, Madhu, Sobue). The state of glial cells, such as Disease-Associated Microglia (DAM), is increasingly recognized as important (Madhu).
- 3. Biomarker Discovery: There is a strong focus on identifying reliable biomarkers for early AD detection, diagnosis, and monitoring treatment response.
  - Blood-Based Markers: Studies investigate blood proteins/metabolites linked to oxidative stress, inflammation (Dey), lifestyle interventions (Roach), and drug response signatures (Climacosa).
  - Multi-Omics Integration: Combining genomics, proteomics, metabolomics, transcriptomics, and microbiomics is crucial for a holistic understanding and biomarker discovery (Roach, Climacosa, Ma, Marshall).
  - Spatial Context: Linking molecular signatures directly to pathological features (plagues, tangles) and cellular interactions within the brain tissue architecture is deemed essential (Ma, Marshall).
- 4. Spatial Multi-Omics Technologies: These emerging technologies are presented as powerful tools to overcome the limitations of traditional methods that lose spatial context.
  - · Capabilities: They allow for the mapping of proteins, RNA, lipids, and metabolites with spatial resolution within tissue sections, revealing cellular heterogeneity and microenvironmental interactions (Ma, Marshall).
  - Platforms: Techniques like Imaging Mass Spectrometry (IMS MALDI, DESI, MIBI), Cyclic Immunofluorescence (CycIF, MP-IHC), and Spatial Transcriptomics (Visium, MERFISH, GeoMx DSP, Slide-seq, Xenium, etc.) are discussed, each with varying capabilities in terms of resolution, molecular coverage, and throughput (Ma, Marshall).
  - Applications in AD: Used to visualize Aβ peptide species, lipid distributions around plaques, map gene/protein expression changes in specific brain regions or near pathologies, and characterize synaptic proteins (Ma, Marshall Sobue)

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#### Overview

# Think Smarter, Not Harder

The ultimate tool for understanding the information that matters most to you, built with Gemini 1.5

#### Try NotebookLM

## <u>link</u>

Your Personalized AI Research Assistant

# Runs on Gemini (Google) with 2 million context window + understands images in pdfs FREE OF CHARGE!

#### NotebookLM

#### Add sources

Sources let NotebookLM base its responses on the information that matters most to you. (Examples: marketing plans, course reading, research notes, meeting transcripts, sales documents, etc.)

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#### Upload your sources

Upload PDFs, websites, YouTube videos, audio files, Google Docs, or Google Slides, and NotebookLM will summarize them and make interesting connections between topics, all powered by Gemini 1.5's multimodal understanding capabilities.

## See the source, not just the

#### answer

⋇

Gain confidence in every response because NotebookLM provides clear citations for its work, showing you the exact quotes from your sources. @Liegertova Michaela



### Direct quotes from the source documents are provided as citations – quick check for consistency!



#### **GEMINI FOR LIVE STREAMING/REAL-TIME COLLABORATION**

## Google AI Studio link



Gemini can monitor your desktop (and your surroundings, for example) in real time and provide feedback on what you are looking at

used by scientists to read
 publications, to quickly summarize or
 explain figures/graph



## Al-powered research and conversational

## search engines

YOU link

 $\rightarrow$  Large language model-based search engine

 $\rightarrow$  based on a user query, provides a synthesis of relevant information with links to source

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OBJECTIVE To conduct a	EVs serve as critical mediators of cell-to-cell communication in AD, facilitating the transfer of proteins, lip	pids, and	
hat is the most problematic	nucleic acids between cells <sup>1</sup> . They play a dual role in AD pathogenesis:		
nat is the percentage of	<ol> <li>Pathogenic Protein Transport: EVs can transport and propagate pathogenic proteins like amyloid and tau throughout the brain, contributing to disease progression<sup>2</sup>.</li> </ol>	l-beta (Aβ)	
vestment opportunities in ra	2. Inflammatory Signaling: EVs carry pro-inflammatory cytokines and damage-associated molecula	r patterns	
Business	(DAMPS), which contribute to neuroinflammation		
Download	Preclinical AD		
More	ARI Claude 3.7 Sonnet (Extended) Smart GPT-40 Research St More		
Michaela Liegert liegertovam@g.ujep	Ask a follow-up	<b></b>	

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perplexity 🛛 🗠	M michaelall97803	+ Space / Spatiotemporal modulation	of extracellular	… 🛛 🍙 Shar	
New Thread K	Spatiotemporal modulation of extracellular vesicle (EV)-mediated neuroinflammatory signaling in Alzheimer's progression, integrating multi-omics with connectome mapping to develop a targeted immunomodulatory intervention				
O, Home	জ Pro Search নি Images	s sources 30		5 steps 🧷	
Discover					
♦ Spaces	ncbi.nlm.nih Neuroinflammatory Signaling in	ncbi.nlm.nih Monitoring drug Efficacy through	pubmed.ncbi.nlm.nih The Therapeutic Effects of		
@ Library	the Pathogenesis of Alzheimer'.	Multi-Omics Research initiative	Noninvasive Brain Stimulation	+27 sources	
Spatiotemporal modulation ## OBJECTIVE To conduct	Alzheimer's disease (AD) is a complex neurodegenerative disorder characterized by amyloid-β (Aβ plaques, neurofibrillary tangles, and chronic neuroinflammation 1. Recent advances in spatial multi-omics and extracellular vesicle (EV) research have provided new insights into the spatiotemporal modulation of neuroinflammatory signaling in AD progression, offering potential for targeted immunomodulatory interventions.				
	Spatiotemporal Dynar	nics of Neuroinflammation	in AD		

Neuroinflammation plays a crucial role in AD pathogenesis, involving complex interactions between neurons, microglia, and astrocytes 1 4. Spatial multi-omics approaches have revealed that:

- 1. Disease-associated microglia (DAM) exhibit distinct transcriptomic profiles, with upregulation of genes linked to NLRP3-inflammasome and interferon-1 signaling 7.
- 2. Astrocytes show increased expression of genes related to interferon-1 and interleukin-6 signaling in AD 7.
- 3. The spatial distribution of inflammatory markers correlates with Aβ plaque deposition and neurofibrillary tangle formation 8.

#### **Extracellular Vesicles in AD Progression**

EVs have emerged as important mediators of intercellular communication in AD:

## @Liegertova\_Michaela

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## **INFORMATION VERIFICATION**

### AI-powered research and conversational search engines



# Is NaBrO<sub>3</sub> prohibited in cosmetic products in the EU?

#### Conclusion

Based on the latest available information from the European Chemicals Agency and other regulatory sources, Sodium Bromate (NaBrO3) is not explicitly listed as a prohibited substance in cosmetic products in the EU. The lists of prohibited and restricted substances are extensive and regularly updated, but as of the most recent updates, NaBrO3 does not appear to be included <sup>2</sup> <sup>(4)</sup>.

#### Answer 🛱

Sodium bromate (NaBrO3) is listed as a prohibited substance in cosmetic products in the European Union under Annex II of Regulation (EC) No 1223/2009. This regulation outlines substances that are banned from use in cosmetics marketed within the EU 1.

## NaBrO<sub>3</sub> does <u>not</u> appear to be included.

# NaBrO<sub>3</sub> is listed as a prohibited substance



#### **Recommendations for working with information**

Primary sources are key: Working directly with original material and forming your own judgement remains the most reliable method of verification

Al as a helper, not an authority: Always consider AI-generated summaries as a "best guess" model, not a definitive interpretation

Verify critical information: For important or controversial claims, always go back to the original source

@Liegertova\_Michaela
Perspective | Published: 06 March 2024

# Artificial intelligence and illusions of understanding in scientific research <u>article</u>

<u>Lisa Messeri</u> <sup>™</sup> & <u>M. J. Crockett</u> <sup>™</sup>

Nature 627, 49–58 (2024) Cite this article

The risk is not only LLMs are sometimes wrong, but because those who use them are prone to

# OVERESTIMATING THEIR UNDERSTANDING OF THE WORLD



# Hallucination Rates for Top 25 LLMs

# Chatbots with CANVAS – interactive collaboration for writing



Gemini A

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aims".

Ask Gemini

+ Py Canvas

· Elimination of Redundancy: Phrases like "The successful completion

of these aims" are shortened to "Successful completion of these

Let me know if you'd like to make any further changes.

### What can I help with?



# Gemini Advanced



will pursue three Specific Aims": You	X Ev Ad Abstract · U 5 C	D T	
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Added 5 comments Answer in chat instead >	comprehensive mechanistic understanding of EV-driven neuroinflammation, identify novel biomarkers for	×	
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help revising the text based on these	multi-omic profiling (including transcriptomics, proteomics, and lipidomics), live imaging, and connectome-		
suggestions.	based computational modeling, we aim to elucidate critical nodes of inflammatory signal propagation. Ultimately, this work will lay the foundation for precision diagnostics and immunomodulatory treatments for		0
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transgenic AD mice.

We will pursue three Specific Aims to elucidate and target EV-mediated neuroinflammation: (1) define the spatiotemporal landscape of EV inflammatory signaling across AD stages using multi-omic analyses; (2) map EV propagation along brain connectomic networks using advanced imaging and network modeling; and (3) test immunomodulatory strategies targeting EV cargo and release to mitigate AD-associated neuroinflammation in vivo. Successful completion of these aims will transform our understanding of how EVs orchestrate neuroinflammation across neural circuits, identify new biomarkers of AD progression, and enable targeted immunomodulatory therapies.

This project unites expertise in EV biology, neuroimmunology, imaging, bioinformatics, and network neuroscience. Our integrative platform, employing cell-specific EV isolation, multi💩 III 🚺

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# **DEEP RESEARCH AGENTS**

## **DEEP RESEARCH AGENTS**

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→ save time + increase efficiency in information retrieval, processing and presentation (each platform unique approaches for specific needs)

# **OpenAl - Deep Research/Deep Search:**

- The o3 model generates comprehensive reports with detailed citations, ideal for professional research in technical and scientific fields.

# Gemini Advanced - Deep Research:

- Benefits from the ability to iteratively plan a course of action for research, comprehensive and strategic reports (converts to Google Doc format)

SciSpace - Deep Review - Focused on searching scientific databases

# You.com - Deep Research + Advanced Research and Insights:

- 2 modalities: Deep Research vs ARI - professionally prepared output in the form of a pdf report, browsing up to 400 sources **Perplexity - Deep Research:** 

- Focuses on speed and structure; offers clear, fast (under 3 minutes) reports (highest risk of hallucinations)

ChatGPT o3-mini-high ~

# OpenAl

### What are you researching?



### Mechanistic Roles of Membrane Domains in the Extracellular Vesicle Lifecycle (2020-2025)

### Executive Abstract

Extracellular vesicles (EVs) - including exosomes, microvesicles, and apoptotic bodies - are emerging as critical mediators of intercellular communication. Recent research (2020-2025) has revealed that specialized membrane domains, particularly tetraspanin-enriched microdomains (TEMs), play central roles in regulating every phase of the EV lifecycle. Tetraspanins (e.g., CD9, CD63, CD81) organize membrane microdomains by clustering with diverse partners (integrins, proteoglycans, signaling receptors) and lipids (cholesterol, ceramide), thereby influencing EV biogenesis, cargo sorting, release, targeting, and functional outcomes MOPI.COM JBC.ORG . This review provides a mechanistic synthesis of how these membrane domains govern EV formation and fate, integrating molecular evidence from structural biology, lipidomics, proteomics, and advanced imaging.

Biogenesis & Cargo Sorting: Tetraspanins help drive the budding of intraluminal vesicles (ILVs) within multivesicular bodies (MVBs) by inducing membrane curvature and by recruiting specific cargo into nascent vesicles MDPLCOM . TEMs act as sorting platforms - for example, up to ~45% of the exosome proteome consists of TEM-associated proteins PMC.NCBLINLM.NH.GOV - and tetraspanin loss can diminish the incorporation of their partner proteins into EVs. Tetraspanin-lipid interactions also facilitate ESCRT-independent ILV formation, with ceramide-rich platforms promoting inward budding and selective loading of proteins and RNAs MOPICOM . Simultaneously, TEMs interface with ESCRT machinery (e.g. syntenin-ALIX) to coordin the cargo sequestration. Distinct TEM

when necessary, like the 2015 Hoshino

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- (F) Read sciencedirect.com
- Q Searched for tetraspanin heterogeneity in small vesicles
- Read pubmed.ncbi.nlm.nih.gov
- \$ I'm examining tetraspanin heterogeneity, considering their variety in small extracellular vesicles (sEVs), and exploring how they reflect parent cell composition, potentially acting like "zip codes" for vesicle origin or target.

### Read pmc.ncbi.nlm.nih.gov

\$ I'm mapping out CD81 structure's cholesterol-binding pocket and tetraspanins potentially stabilizing microdomains, leading to TEM formation and clustering with partners.

I'm thinking about the challenges in defining specific EV subpopulations through TEM composition and addressing functional redundancies and cargo sorting signals, while considering standardization issues in studying single EVs.

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Membrane Domains in EV Lifecycle Mar 29, 3:55 PM

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### E Membrane Domains in EV Lifecycle

### The Regulatory Role of Membrane Domains in Extracellular Vesicle Lifecycle: A Mechanistic Review of Tetraspanin-Enriched Microdomains

### 1. Executive Abstract

Extracellular vesicles (EVs), nanoscale particles secreted by virtually all cell types, have emerged as critical mediators of intercellular communication, playing pivotal roles in both physiological and pathological processes. Their capacity to transport a diverse array of bioactive molecules, including proteins, lipids, and nucleic acids, has garnered significant attention for their potential in diagnostics and therapeutics. This review focuses on the intricate involvement of specialized membrane domains, particularly tetraspanin-enriched microdomains (TEMs), in orchestrating the multifaceted lifecycle of EVs. By integrating recent advancements in the field (2020–2025), we delve into the underlying molecular mechanisms by which TEMs, alongside lipid rafts and ceramide platforms, regulate EV biogenesis, cargo sorting, intracellular trafficking, secretion, uptake, and targeting. Furthermore, we explore the functional consequences of these regulatory mechanisms in health and disease, highlighting existing knowledge gaps and outlining future research directions crucial for a comprehensive understanding of EV biology.

2. Introduction to EV Biology and Membrane Domain Organization

2.1 Extracellular Vesicles: An Overview

Extracellular vesicles (EVs) are membrane-enclosed nanoparticles released by cells into the extracellular space, facilitating communication between cells . The field of EV research has evolved significantly since the initial observations of "platelet dust" in plasma . Based on their biogenesis, EVs are broadly classified into several subtypes. Exosomes, typically ranging from 30 to 150 nm in diameter, originate from the endosomal pathway, specifically as intraluminal vesicles (ILVs) within multivesicular bodies (MVBs) . Microvesicles, also known as ectosomes or shedding vesicles, are larger, ranging from 100 to 1000 nm, and are formed by the outward budding of the plasma membrane . Apoptotic bodies, the largest EVs with sizes from 1 to 5  $\mu$ m, are released by cells undergoing apoptosis . Emerging categories of EVs include migrasomes, shed by migrating cells and ranging from 500 to 3000 nm , large oncosomes (1000-10000 nm) released by amoeboid cancer cells , and smaller entities like exomeres and supermeres, which are less than 50 nm in size and whose

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Sumalatha Gangadhar, Saikiran Chandha Feb 19, 2025



Link to article



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# Introducing ARI

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### Mechanistic Review of Tetraspanin Microdomains in Extracellular Vesicle Regulation

You.com ARI AARCH 2025



view report

#### Mechanistic Review of Tetraspanin Microdomains in Extracellular Vesicle Regulation

#### 1 Executive Summary

Extracellular vesicles (EVs) have emerged as crucial mediators of intercellular communication. playing pivotal roles in both physiological and pathological processes. This comprehensive review focuses on the intricate relationship between mem- 6. Emerging concepts highlight the intersection of microdomains (TEMs), and the lifecycle of EVs. By integrating recent advances from 2020 to 2025, we provide a systems-level understanding of the underlying molecular mechanisms, functional consequences, and knowledge gaps in this rapidly evolving field.

Tetraspanins, a family of transmembrane proteins, organize membrane microdomains that serve as essential platforms for EV biogenesis, cargo sorting, trafficking, secretion, and uptake. This review synthesizes the latest findings on how TEMs regulate these processes, highlighting the molecular interactions, signaling pathways, and functional outcomes associated with tetraspanin-mediated EV regulation.

Key findings include:

1. TEMs play a crucial role in EV biogenesis by facilitating the clustering of cargo proteins and lipids, influencing membrane curvature, and interacting with the endosomal sorting complex required for transport (ESCRT) machinery.

2. Specific tetraspanins, such as CD9, CD63, and CD81, exhibit distinct cargo sorting preferences, contributing to the heterogeneity of EV populations and their functional specificity.

- 3. Tetraspanin-interacting proteins, including integrins and syndecans, modulate EV trafficking and secretion through complex molecular networks and signaling cascades.
- 4. TEM composition on the EV surface influences uptake mechanisms and recipient cell targeting, notentially establishing an "EV code" for intercel-Jular communication.

5. The regulatory roles of TEMs in EV biology have significant implications for various physiological processes and pathological conditions, including immune modulation, cancer metastasis, and neurodegenerative diseases.

TEMs with other membrane systems, such as endolysosomal pathways and autophagy, revealing novel regulatory networks in EV biology.

This review also identifies critical knowledge gaps. unresolved debates, and emerging hypotheses in the field. By synthesizing molecular-level insights with systems biology approaches, we provide an integrative mechanistic model of TEM-mediated EV regulation. Finally, we discuss future research directions and potential therapeutic applications target ing tetraspanin-EV interactions.

#### 2. Introduction to EV Biology and Membrane Domain Organization

Extracellular vesicles (EVs) are membrane-enclosed structures released by cells into the extracellular space, playing crucial roles in intercellular communication and various physiological and pathological processes. EVs can be broadly classified into three main categories: exosomes, microvesicles, and apoptotic bodies (Théry et al., 2018). These vesicles differ in their size, biozenesis, and molecular composition, reflecting their diverse functions and cellular origins.

Exosomes, typically 30-150 nm in diameter, originate from the endosomal system through the formaular bodies (MVBs) and their subsequent fusion with the plasma membrane (van Niel et al., 2018). Mi crovesicles, ranging from 100-1000 nm, are formed by direct outward budding and fission of the plasma membrane (Meldolesi, 2018). Apoptotic bodies, the largest EV subtype (1-5 µm), are released during programmed cell death and contain cellular fragments, including organelles and nuclear material (Caruso and Poon. 2018).

Û

### Membrane Domain Regulation of Extracellular Vesicle Lifecycle: A Mechanistic Review (2020-2025)

### 1. Executive Abstract

Recent advances have significantly enhanced our understanding of how tetraspanin-enriched microdomains (TEMs) orchestrate the complex lifecycle of extracellular vesicles (EVs). This review synthesizes findings from 2020-2025, revealing intricate molecular mechanisms governing EV biogenesis, cargo sorting, trafficking, and uptake, while highlighting emerging concepts and knowledge gaps in the field.

### 2. Introduction to EV Biology and Membrane Domain Organization

EVs are membrane-bound carriers that play crucial roles in intercellular communication through the transport of bioactive molecules. TEMs, characterized by the presence of tetraspanins like CD9, CD63, and CD81, are integral to EV structure and function, facilitating the organization of membrane microdomains that regulate various aspects of EV biology 1

### 3. Tetraspanins and Membrane Domains: Molecular Characteristics

#### 3.1 Structural Features

Tetraspanins are characterized by:

- · Four transmembrane domains
- Small extracellular loop (SEL)
- · Large extracellular loop (LEL) containing conserved cysteine residues These structural elements enable tetraspanins to form complex networks known as the tetraspanin web

#### 3.2 Organization and Assembly

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### <RESEARCH\_PROMPT> ## OBJECTIVE

To conduct an expert-level \*\*mechanistic review\*\* of how \*\*membrane domains—particularly tetraspanin-enriched microdomains (TEMs)\*\*—regulate the \*\*lifecycle of extracellular vesicles (EVs)\*\*. The goal is to integrate recent advances (2020–2025) into a systems-level understanding, uncovering \*\*underlying molecular mechanisms\*\*, \*\*functional consequences\*\*, and \*\*knowledge gaps\*\*, while mapping unexpected interconnections within EV biology.

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 protein Trafficking

# Membrane Domains in Extracellular Vesicle Lifecycle: Tetraspanin-Enriched Microdomains as Master Regulators

Recent research has revealed the critical importance of membrane microdomains, particularly tetraspanin-enriched microdomains (TEMs), in orchestrating the complex lifecycle of extracellular vesicles (EVs). These specialized membrane platforms serve as organizing centers that regulate EV biogenesis, cargo sorting, secretion, and target cell interactions. This review synthesizes recent advances (2020-2025) in understanding the mechanistic roles of tetraspanins and associated membrane domains throughout the EV lifecycle, highlighting molecular interactions, functional consequences, and emerging research frontiers.

### Membrane Domains and Tetraspanins: Architectural Foundations of EV Biology

Tetraspanins represent a superfamily of small transmembrane proteins characterized by four transmembrane domains that function as the main structural blocks of specialized membrane microdomains 2. Through homotypic and heterotypic interactions, tetraspanins regulate lateral

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Articles: 16/16 Grants: 4/4 Patents: 1/1 Hallucination Rate: 0% Evaluation: 10/10

### Gemini

Articles: 16/16 Grants: 4/4 Patents: 0/1 Hallucination Rate: 0% Evaluation: 8/10

### Grok

Articles: 16/16 Grants: 0/4 Patents: 1/1 Hallucination Rate: 0% Evaluation: 6/10

### You.com

Articles: 6/16 Grants: 4/4 Patents: 1/1 Hallucination Rate: 10% Evaluation: 6/10

### Perplexity

Articles: 40/16 Grants: 3/4 Patents: 1/1 Hallucination Rate: 50% Evaluation: 0/10

### COMPARISON OF DEEP RE/SEARCH ACCURACY OF SELECTED TOOLS

Topic: Research Portfolio of Dr. Michaela Liegertová

Objective: Generate a detailed portfolio of Dr. Michaela

Liegertová's academic contributions and research trajectory.

The analysis should systematically examine:

Rating (0-10)

1. Published Articles - ORCID: https://orcid.org/0000-0003-3858-856X

2. Patents, grants, and commercialization activities

3. Methodological approaches and technical innovations

4. Core research themes and their evolution over time

5. Scientific impact and recognition within relevant fields

### **Deep Research Agents Comparison**



### GENERATION OF PROMPTS OPTIMIZED FOR DEEP RESEARCH



Understanding the impact of membrane domains, particularly tetraspanins, on the lifecycle of extracellular vesicles

### Please answer the following to refine your research intent:

#### 1. Primary Objective

What's your goal with this research? (e.g., mechanistic understanding, identifying therapeutic targets, advancing diagnostic tools, etc.)

#### 2. Preferred Output Format

Should this be a detailed report, a scientific review, an analytical essay, a briefing paper, or another format?

#### 3. Scope of the Research

- · Timeframe: Should the focus be on the last 5 years, the past decade, or the full history?
- · Organism Models or Cell Types: Human-specific, mammalian, or broader?
- EV Types: Are you focusing on exosomes, microvesicles, or all classes?

#### 4. Depth of Analysis

Should it be accessible to a general biosciences audience, or are you looking for expert-level molecular and mechanistic detail?

### 5. Key Aspects to Emphasize

Are there specific angles you care about? (e.g., EV biogenesis, cargo sorting, intercellular signaling, role in cancer or neurodegeneration)

#### 6. Audience or Stakeholders

models, etc.?

Who is this research ultimately intended for? (e.g., academics, biotech industry, clinicians)

7. Methodological Preferences Would you like this to integrate om

mechanistic understanding, deep scientific review, 2020-2025, organism models and cell types, all classes, expert-level molecular and mechanistic detail, all aspects, audience are expert researchers in the field, broader methodological perspective, deep insights, known unknowns, blind spots, unexpected connections

#### Based on this, here's your structured research prompt:

markdown O Copy <RESEARCH PROMPT> ## OBJECTIVE To conduct an expert-level \*\*mechanistic review\*\* of how \*\*membrane do

#### ## SCOPE

- \*\*Timeframe:\*\* 2020-2025
- \*\*Organisms:\*\* Inclusive of all model systems (human, mammalian, inv
- \*\*EV Types:\*\* All EV classes, including exosomes, microvesicles, and
- \*\*Membrane Domains of Focus:\*\*
- Tetraspanin-enriched microdomains (e.g., CD9, CD63, CD81)
- Lipid rafts, ceramide platforms, other domain-like structures

P Edit

@Liegertova Michaela

#### ## KEY DUESTTONS

# USING DEEP RESEARCH IN CHATGPT

The model you have set as default in chat will create a prompt based on your input, which it will then send to the Deep Research Agent.

The best output quality is achieved if you have o3-minihigh set as default model (note from the lecturer's experience ChatGPT o3-mini-high ~

# What are you researching?

I can research in the background to deliver a detailed report. For best results, include:

- any relevant sources
- desired areas of focus
- files related to your research



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	Mode
	STORM Article
	Co-STORM Roundtable conversation

### arxiv > cs > arXiv:2402.14207

=

STORM

Computer Science > Computation and Language

[Submitted on 22 Feb 2024 (v1), last revised 8 Apr 2024 (this version, v2)]

Assisting in Writing Wikipedia-like Articles From Scratch with Large Language Models

Yijia Shao, Yucheng Jiang, Theodore A. Kanell, Peter Xu, Omar Khattab, Monica S. Lam

Article link

link

+ New Session

Ø Discover

Ø

III My Library

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Radionuclide Cisternography

Challenges in Diagnosis

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Bug R

### Spontaneous intracranial hypotension

See BrainSTORMing Process

### summary

Etiology

Spontaneous intracranial hypotension (SIH) is a medical condition characterized by a decrease in cerebrospinal fluid (CSF) volume, primarily resulting from CSF leaks that occur spontaneously without obvious external triggers. The condition is notable due to its diverse symptomatology, which includes severe orthostatic headaches, nausea, tinnitus, and various neurological deficits, significantly impacting the guality of life of affected individuals. SIH has gained attention in the medical community as its diagnosis can be challenging, often leading to misdiagnosis and delayed treatment, as many patients initially present with symptoms that overlap with other disorders, such as migraines or tension-type headaches.[1][2] The underlying causes of SIH are varied, with the majority of cases associated with structural issues, such as dural tears or meningeal diverticula. Other contributing factors may include iatrogenic causes like lumbar punctures, hereditary connective tissue disorders, and even minor trauma.[3][4] While many individuals respond well to conservative management, including bed rest and hydration, some require more invasive interventions like epidural blood patches or surgical repair of identified leaks, making a comprehensive understanding of SIH crucial for effective treatment.[5][6] Controversies surrounding SIH primarily revolve around its diagnosis and management. The variability in symptoms can lead to frequent misdiagnosis, with studies suggesting that more than 90% of patients are initially treated for incorrect conditions. Moreover, the decision-making process regarding the timing and type of treatment remains debated among healthcare professionals.[7][8] As awareness of SIH increases, there is a growing emphasis on improving diagnostic accuracy and refining treatment protocols to enhance patient outcomes.[9] In summary, spontaneous intracranial hypotension is a complex and often misunderstood condition that necessitates heightened awareness among medical professionals. Improved diagnostic practices and treatment strategies are essential to alleviate the debilitating effects of SIH on individuals' lives and ensure timely intervention.[10]

### See the outcome

Spontaneous intracranial hypotension (SIH) is primarily caused by cerebrospinal fluid (CSE)

Dr. Thompson will focus on the clinical aspects of spontaneous intracranial hypotension, including its diagnosis, pathophysiology, and treatment options. She will provide insights from her practice, detailing common symptoms and the challenges faced in diagnosing SIH, particularly in differentiating it from other headache disorders.

# Ċ

What are the most common symptoms associated with spontaneous intracranial hypotension, and how can they be differentiated from other headache disorders?

# ċ

Spontaneous intracranial hypotension (SIH) is a condition characterized by abnormally low cerebrospinal fluid (CSF) pressure within the skull, typically caused by a leak in the dura mater, the tough membrane surrounding the brain and spinal cord. The most prevalent symptom associated with SIH is a severe headache that often exhibits a positional characteristic; that is, the headache tends to worsen when the patient is upright and improve when lying down ([1], [2], [3]). In addition to headaches, individuals with SIH may experience a range of other neurological symptoms, including dizziness, nausea, neck pain, and memory impairment ([1], [3]). Symptoms may also include visual disturbances, hearing changes, and a sense of imbalance ([3]). The presentation of these symptoms can be quite variable, and in some cases, they may mimic the symptoms of other conditions, such as postdural puncture headache, making diagnosis challenging ([3], [4]). Differentiating SIH from other headache disorders involves a detailed clinical history and specific diagnostic criteria. One of the distinguishing features of SIH is the positional nature of the headache, which is typically alleviated by

### Free use!

# WORKFLOW FOR GRANT APPLICATION AND PROJECT MANAGMENT



Proofread, verify formatting, submit to grants office

Create a knowledge base in NotebookLM (Tender documentation, Terms and Conditions, ..)

AI Deep Research + knowledge base in NotebookLM

Expert AI assistants (Custom GPTs)

AI Deep Research feedback

# Topic of research: [insert topic] Analyze this research area and provide the following insights:

### 1. Gap Analysis:

- -> Identify unexplored intersections between fields or methodologies
- -> Highlight specific knowledge gaps not obvious from standard literature reviews

### 2. Trend Detection:

- -> Identify emerging research directions before they become mainstream
- -> Detect shifting methodological approaches gaining traction

### 3. Contradiction Mapping:

- -> Highlight conflicting evidence within the literature
- -> Identify areas where consensus is lacking or evidence is inconclusive

### 4. Methodological Innovation:

- -> Suggest novel experimental approaches by combining techniques across disciplines
- -> Propose solutions to methodological limitations identified in current literature

## 5. Learning from Failure:

- -> Identify experimental approaches that didn't yield results (addressing publication bias)
- -> Extract lessons from unsuccessful research approaches in this area

## 6. Translational Potential:

- -> Identify pathways from basic science to clinical applications
- -> Highlight aspects with greatest potential impact on health outcomes

## 7. Cross-disciplinary Connections:

- -> Reveal how concepts from seemingly unrelated fields could inform this research
- -> Suggest unconventional collaboration opportunities

## 8. Funding Alignment:

- -> Analyze alignment with specific funding agency priorities
- -> Map to recent successful grant award patterns in this area

# 9. Competitive Landscape:

- -> Identify other research groups pursuing similar questions
- -> Analyze their methodological approaches and findings

# **10. Future Projections:**

- -> Predict how this research field might evolve during the grant period
- -> Identify potential breakthrough areas to position for maximum impact

# Example Deep Research report

# Topic of research:

Spatiotemporal modulation of extracellular vesicle-mediated neuroinflammatory signaling in Alzheimer's progression: Integrating multiomic analysis with connectome mapping for targeted immunomodulatory intervention

# In the next step you can use the report as a source for generation of your research proposal

Example conversation

Example proposal

GAČR tenders info				Analytics	< Share 🚯 Settings
Sources		Chat			♥ Refresh
+ Add source			I am a female researcher from an established lab, m grant on this topic: Spatiotemporal EV-Mediated Ner	ore than 10 years post- uroinflammatory Signali	PhD, and I want to write a ing in AD Progression:
Select all sources			Multi-Omic Connectome Integration for Targeted Im	munomodulation, which	h teder should I choose?
TC_LA_2026_GACR_Lead_Agency.pdf		Based on the information provide	d and your profile as a female researcher more than 10	) years post-PhD from a	an established lab
TD_IP_2026.pdf		wanting to write a grant on "Spati Integration for Targeted Immunon Let's examine why other tenders a	otemporal EV-Mediated Neuroinflammatory Signaling i nodulation", the most suitable tender appears to be the are less likely to be a good fit:	n AD Progression: Multi e Standard Projects tei	nder 1.
TD_JS_2026.pdf		JUNIOR STAR Projects are fo 10 years post-PhD, you would POSTDOC INDIVIDUAL FELL	r scientists who completed their Ph.D. no more than 8 y likely not meet this eligibility criterion. <b>DWSHIP (Incoming)</b> is designed for outstanding scien	years ago 2	e you are more than scientists with long-
TD_PIF-IN_2026.pdf		term experience from abroad v not align with your profile.	who received their Ph.D. no more than 4 years before the serve scientists with	he tender announceme	nt 4
TD_PIF-OUT_2026.pdf		institution to undertake a fellow • Restart Grants are almed at s	vship abroad 7	iption. ak due to childcare or d	lependent care, and
TD_RG_2026.pdf		haven't mentioned a career bro • LA Grants (GACR Lead Agen	re than 10 years have elapsed since the award of the P eak, and you are more than 10 years post-PhD. <b>cy or Partner Agency)</b> are for international grant proj	iects 12	are remaie, you ur research could
TD_STD_2026.pdf		potentially involve internationa agreement with a partner ager information, Standard Projects	l collaboration, you haven't mentioned this in your quer ncy where GACR is either the lead or partner, then this is a more general option for basic research.	ry. If your project involve might be relevant. In th	es a specific le absence of this
checklist_IP-BI_2026_ENG.pdf		International Projects are for to LA Grants, you haven't spec Standard Projects on the other	basic research projects where the added value of bila ified an international partner in your query.	teral cooperation is con	nsidered 14 . Similar
checklist_IP-LA_2026_ENG.pdf		methods 1	ppic, focusing on neuroinflammatory signaling in AD pri r Standard Projects, as described in the tender docum	ogression, seems to fall ent 18, do not seem to	I under basic research o have the same
checklist_JS_2026_ENG.pdf		restrictions based on the time sin Grant Projects is two or three yea Therefore, based on the informati	ce PND completion or career breaks as the other tende rs 1. on you have provided, the <b>Standard Projects</b> tender a	er types. The expected of appears to be the most	auration for Standard
checklist_PIF_2026_ENG.pdf		your grant application 1. You sh you meet all the specific eligibility	ould review the full tender document for <b>Standard Pro</b> requirements and to understand the application proce	ojects 2026 (TD_STD_2 ess 1.	2026.pdf) to ensure
checklist_RG_2026_ENG.pdf	~	Start typing			
Checklist_STD_2026_ENG.pdf		How does GACR define a care	er break? What are LA Grant partner agencies?	What is the typical de	uration of JUNIOR STAR pro

### [Upload Your Completed Grant Proposal Draft]

# Based on the uploaded proposal, please provide critical feedback on the following aspects:

# 1. Funding Alignment:

 $\rightarrow$  Identify potential mismatches between aims and strategic goals

### 2. Competitive Position:

ightarrow Highlight unique elements and potential redundancies

## 3. Methodological Critique:

- $\rightarrow$  Flag vulnerable methodological approaches
- ightarrow Suggest emerging techniques to strengthen design

# 4. Assumption Analysis:

- $\rightarrow$  Identify unstated assumptions underlying the approach
- ightarrow Note which assumptions reviewers might challenge

# 5. Interdisciplinary Opportunities:

- ightarrow Identify missed connections with adjacent fields
- $\rightarrow$  Suggest potential cross-disciplinary collaborations

# 6. Impact Enhancement:

- $\rightarrow$  Evaluate strength of significance statements
- ightarrow Recommend additional evidence to bolster impact claims

# 7. Risk Evaluation:

- ightarrow Pinpoint highest-risk components
- $\rightarrow$  Assess adequacy of contingency plans

# 8. Budget Justification:

- $\rightarrow$  Evaluate resource allocation justifications
- ightarrow Identify vulnerable budget items

# 9. Timeline Feasibility:

- $\rightarrow$  Assess realism of proposed timeline
- $\rightarrow$  Identify underdeveloped dependencies between components

# 11. Preliminary Data Review:

- $\rightarrow$  Recommend additional preliminary data needs
- $\rightarrow$  Evaluate presentation of existing preliminary data

# 12. Reviewer Simulation:

- $\rightarrow$  Predict questions likely during proposal review
- ightarrow Identify aspects generating enthusiasm or concern

# 13. Blind Spot Detection:

- $\rightarrow$  Highlight critical areas overlooked in the proposal
- $\rightarrow$  Identify emerging research directions not considered
- $\rightarrow$  Detect potential ethical considerations not addressed

# 14. Comprehensive SWOT Analysis:

- $\rightarrow$  Strengths: Identify most compelling and competitive aspects
- $\rightarrow$  Weaknesses: Pinpoint areas requiring reinforcement
- $\rightarrow$  Opportunities: Suggest ways to expand impact and relevance
- $\rightarrow$  Threats: Flag external factors that could undermine success

## Example feedback

# 🗄 Forecast

# Al- Powered Project & Resource Management Plan, Run and Track Projects in One Place

Tired of juggling spreadsheets and scattered tools? Forecast gives you crystal-clear visibility across all projects and resources.

### RESOURCING, CAPACITY & DEMAND

People Schedule

- Q Capacity Overview
- Demand
- Placeholders

### PROJECT VISIBILITY

- All Projects
- all Timelines
- Scoping & Baselines

### AI-ASSIST

- 런 Project End Data
- 🔃 Allocation Assistant
- 🙆 Budget Management

### REPORTING

🥪 My Timesheets



# LLM ASSISTED DATA

# ANALYSIS

# **LLM-ASSISTED ANALYSIS**

# **KEY CHARACTERISTICS**

- Dynamic, potentially variable results
- Flexible and customizable on-the-fly
- · More accessible to non-experts
- Quick for ad-hoc analyses

### **KEY ADVANTAGES**

- 1. Interactive Data Exploration
  - "Converse" with your dataset
  - Natural language queries for quick insights

### 2. Brainstorming and Ideation

- · Generate novel analytical approaches
- Uncover potentially overlooked insights

### 3. Rapid Prototyping

- · Quickly test various analytical approaches
- Generate sample code for refinement

## **IDEAL USE CASES**

- Exploratory analysis & data discovery
- Learning & teaching data concepts
- Rapid prototyping & ideation

# **TRADITIONAL SOFTWARE**

### **KEY CHARACTERISTICS**

- · Consistent, reproducible results
- Standardized, well-documented methods
- Optimized for large datasets
- Strict adherence to statistical rigor

### **LIMITATIONS & CHALLENGES**

- 1. Learning & Implementation
  - Steeper learning curve
  - Requires specialized technical expertise

### 2. Customization Challenges

- · Less flexible for rapid iterations
- More complex to modify on-the-fly

### 3. User Experience

- · Less accessible to non-technical users
- Requires expertise to interpret results

### **IDEAL USE CASES**

- Production & mission-critical analyses
- Large-scale data processing
- Scientific research requiring reproducibility



# **WARNING ON POTENTIAL RISKS**

- Compromised research results due to incorrect use of LLM in data analysis.
- Generation of inaccurate conclusions without proper human oversight.
- Erosion of human judgment in data interpretation.
- Possible excessive reliance on AI, leading to a decline in critical thinking.
- Risk of leakage of personal and sensitive data during processing with LLM.

# INTEGRATING LLM-ASSISTED ANALYSIS WITH TRADITIONAL METHODS

# **Complementary Use**

- Use LLM for exploratory analysis
- Validate findings with statistical methods
- Use LLM to interpret complex outputs

# **Documentation Requirements**

- Distinguish LLM vs. traditional methods
- Justify LLM use in research stages
- Include prompts in supplementary materials

# **Research Workflow**

- 1. Exploratory Analysis with LLM
- 2. Hypothesis Formulation with LLM
- 3. Rigorous Statistical Testing
- 4. Interpretation & Visualization via LLM

# **Key Benefits**

- Accelerates pattern discovery
- Enhances hypothesis generation
- Simplifies complex result interpretation
- Improves communication of findings

# **CODE INTERPRETER** can process diverse data/formats:

File Format	МІМЕ Туре	File Format	МІМЕ Туре
.C	text/x-c	.tex	text/x-tex
.CS	text/x-csharp	.txt	text/plain
.cpp	text/x-c++	.CSS	text/css
.doc	application/msword	.js	text/javascript
.docx	application/vnd.openxmlformats- officedocument.wordprocessingml.document	.sh	application/x-sh
.html	text/html	.ts	application/typescript
.java	text/x-java	.CSV	application/csv
.json	application/json	.jpeg/.jpg	image/jpeg
.md	text/markdown	.gif	image/gif
.pdf	application/pdf	.png	image/png
.php	text/x-php	.tar	application/x-tar
.pptx	application/vnd.openxmlformats- officedocument.presentationml.presentation	.xlsx	application/vnd.openxmlformats- officedocument.spreadsheetml.sheet
.py	text/x-python	.xml	application/xml or text/xml
.rb	text/x-ruby	.zip	application/zip

### Data Analyst

Vygeneruj fiktivní data pro ukázku různých typů vizualizací dat, které dokážeš

Jasně, vytvořím fiktivní dataset, který bude obsahovat různé typy dat, abychom mohli demonstrovat různé typy vizualizací.













Var2 Var3 Var4









3D Surface Plot



Box Plot

Group2 Groups

**3D** Wireframe Plot

x-axis

2



3D Möbius Strip

0.4

0.2

0.0

-0.2

-0.4

1.5 1.0 0.5

Violin Plot









History







### The interactive table view in ChatGPT allows you to:

1. Browse your data

- 2. View all rows and columns
- 3. Instant overview of the structure and content of your data
- 4. Easy navigation through large data sets makes it easier to identify specific information



EL	EU Survey Data Final sheeti $\checkmark$ $\stackrel{\scriptstyle{\scriptstyle{\scriptstyle{\pm}}}}{\rightarrow}$							
	Age	Gender	Country	Education Level	E			
1	45-54	Male	Czech Republic	Bachelor's degree	U			
2	55-64	Male	Czech Republic	Bachelor's degree	Eı			
3	35-44	Male	Czech Republic	Doctorate	Ei			
4	55-64	Male	Czech Republic	Doctorate	0			
5	55-64	Female	Czech Republic	Associate degree	Ei			
6	25-34	Male	Czech Republic	High school diploma	Ei			
7	35-44	Prefer not to say	Czech Republic	Other	Si			
8	35-44	Male	Czech Republic	Bachelor's degree	U			
9	35-44	Female	Czech Republic	Less than high school	Ei			
10	55-64	Male	Czech Republic	Other	Ei			
11	45-54	Male	Czech Republic	Doctorate	Eı			
12	35-44	Male	Czech Republic	Less than high school	0			
13	65+	Female	Czech Republic	Less than high school	0			
14	55-64	Female	Czech Republic	Less than high school	R			
15	25-34	Male	Czech Republic	Associate degree	Ei			
16	45-54	Male	Czech Republic	Doctorate	Si			
17	65+	Female	Czech Republic	Less than high school	0			
18	65+	Prefer not to say	Czech Republic	Bachelor's degree	U			
10	25.24	Mala	Caral Danishila	Mandan da anan	г.			

🖕 "Education Level" column

analyze

To analyze the influence of "Education Level" on respondents' familiarity, perceived effectiveness, and trust in EU cybersecurity measures, I will break down the data based on the different education levels and explore how they relate to the respondents' views. Let's start by examining how familiarity, effectiveness, and trust ratings vary across education levels.

Explore data correlations? ? Any data anomalies?

# Edit tables directly in the chat interface, you can:

- upload a table and ask ChatGPT to make modifications (e.g. ask to add a column with average values)

## Targeted adjustments:

- 1. Highlight specific columns, rows or cells
- 2. ask ChatGPT to make specific changes to the highlighted sections
- 3. Example: highlight two columns and request a new column with their sum

Lemonade Sta	and Data With Aver	ages	<u>↓</u> , <sup>⊭</sup>	P You Update the table with a column contain the
rsday	Friday	Saturday	Average	average values.
1	53	81	75.71428571428571	
2	16	20	13.28571428571428 6	6 ChatGPT
				■ Lemonade Stand Dat ¬ <sup>K</sup>
				I have added a new column named "Average" to
				the dataset, which contains the average values for
				each row (Revenue and Costs). [>-]

### Data Visualization with ChatGPT

- request ChatGPT to create a specific type of graph
- ChatGPT can determine/select the most suitable type of graph on its own

### **Static Graphs**

Line charts, bar charts, pie charts, histograms, scatter plots, box plots, heat maps, area charts, and more...

### Interactive Graphs

currently, only bar charts, pie charts, scatter plots, and line charts are interactive

useful for quick exploratory data analysis and preparing outputs for presentations or reports





### Google Patents **BIG DATASETS** SEARCH TERMS ⑦ (immunotherapy) Search terms SEARCH FIELDS Date · Publication -Google Patents immunotherapy Q 🗇 荘 Q 2020-01-01 = 2024-06-01 + Inventor (immunotherapy); + Assignee More than 100 000 results 🛃 Download 👻 🛛 🚻 Side-by-side Patent Office + Language + Sort by · Relevance - Group by · None - Deduplicate by · Family - Results / page · 10 -Status - Type -Litigation -@Liegertova\_Michaela

-						11101101010101
1	id	title	assignee	inventor/author	priority date	filing/cre
2	TW-1776160-B	Peptides and combination of	peptides of non-canonic 德商英麥提克生物技術股份有限公司	海科 舒斯特,佛蘭西斯卡侯夫賈爾,金斯弗里切,	2018-02-21	2019-02-2
3	WO-2020181142-A1	T cell receptors specific to b-	cell maturation antigen fc Dana-Farber Cancer Institute, Inc.	Jooeun Bae, Nikhil C. Munshi, Kenneth C. Anderson	2019-03-06	2020-03-0
4	AU-2020203971-B2	Novel peptides and combinat	tion of peptides for use ir Immatics Biotechnologies Gmbh	Janet PEPER, Hans-Georg Rammensee, Heiko Schuster	2015-07-15	2020-06-1
5	AU-2020257113-B2	Claudin-18.2-specific immuno	preceptors and t cell epit(Biontech Cell & Gene Therapies Gmbh, Tron - Transla	ati Andrea BREITKREUZ, Lisa HEBICH, Karolina Anna Mroz,	2015-05-11	2020-10-2
6	AU-2020281108-B2	Novel peptides and combinat	tion of peptides for use ir Immatics Biotechnologies Gmbh	Jens Fritsche, Andrea Mahr, Oliver Schoor, Harpreet S	i 2015-12-10	2020-12-0
7	AU-2021204080-B2	Novel peptides and combinat	tion of peptides for use ir Immatics Biotechnologies Gmbh	Jens Fritsche, Andrea Mahr, Oliver Schoor, Harpreet S	i 2015-03-27	2021-06-1
8	US-10875892-B2	Immunotherapy against seve	ral tumors of the blood, I Immatics Biotechnologies Gmbh	Juliane Walz, Daniel Johannes Kowalewski, Hans-Geo	r 2014-06-20	2020-06-2
9	CN-110041402-B	Novel immunotherapy agains	st a variety of tumors, suc 伊玛提克斯生物技术有限公司	托妮·维因斯申克,斯特芬·沃尔特,延斯·弗里切,科	2013-08-05	2014-08-0
10	TW-1689516-B	Novel peptides and combinat	tion of peptides for use ir 德裔英麥提克生物技術股份有限公司	安德列 馬爾,湯尼 文史恩克,寇雷特 宋,奥利佛 9	2015-12-11	2016-12-0
11	US-11058755-B2	A*03 restricted peptides for u	use in immunotherapy ag Immatics Biotechnologies Gmbh	Colette SONG, Linus BACKERT, Heiko Schuster, Daniel	. 2018-06-29	2021-01-1
12	US-11542303-B2	Peptides and combination the	ereof for use in the immu Immatics Biotechnologies Gmbh	Juliane Sarah WALZ, Daniel Johannes Kowalewski, Ma	2017-04-10	2021-06-2
13	AU-2021282458-B2	Peptides and combination of	peptides for use in immu Immatics Biotechnologies Gmbh	Andrea Mahr, Oliver Schoor, Toni Weinschenk	2016-03-16	2021-12-0
14	JP-2021191793-A	Human monoclonal antibody	against programmed dea小野薬品工業株式会社, Ono Pharmaceut Co Ltd,	イアランジェイコーマン, Alan J Korman, モハンス	2005-05-09	2021-09-1
15	AU-2021204201-B2	Peptides, combination of peg	otides, and cell based me Immatics Biotechnologies Gmbh	Jens Fritsche, Andrea Mahr, Oliver Schoor, Harpreet S	i 2016-03-01	2021-06-2
16	AU-2022205209-B2	Novel peptides and combinat	tion of peptides for use ir Immatics Biotechnologies Gmbh	Jens Fritsche, Andrea Mahr, Oliver Schoor, Harpreet S	i 2015-07-06	2022-07-1
and the second second						

# Julius

Early stage AI lab based in San Francisco with a mission to build the most powerful AI tools for knowledge workers.

# LLM-powered application optimized for data analysis

- Allows LLM selection
- Preset workflows
- Advanced Reasoning functionality
- Promises enhanced data protection

<u>link</u>

# Julius

# Analyze your data with computational AI.

Chat with your files and get expert-level insights in seconds.

Try Julius >				
	243	Loved by over 1,200,000 users	s worldwide	
		VARD BCG	Yale	
al	Q	F		
Charts & Graphs	Insights	Advanced Analysis	Problem Solving	Reports
Create sleek looking data visualizations.	Ask anything to your data, and get answers.	Perform modeling and predictive forecasting.	Scan-and-solve math, physics, and chemistry.	Generate polished analyses and summaries.
Try now $\rightarrow$				

### Julius

Thread Files (0) V

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 $\sim$ 

Connecting Container •

?

### New Thread

Threads (2)

₽<sub>0</sub> My Workflows

🗋 Files

✓ Explore Workflows

Docs

은 Community Forum

A Model Lab



Image: Account & Billing[→ Log Out

ć

Michaela Liegertová Google • michaela.liegertov...

🛎 🙆 🗙



File	Edit	View	Insert	Runtime	Tools	Help

୦ ୦	ommands	s +	Code	+ Te	ext	
:=	0	Start	coding	or	<u>generate</u>	wi
ବ	(+)	Analyze fi	iles with	Gem	ini	

<u>e</u>	wit	h AI.											
	G	emini	×										
	M	Analy	zuj a vizua	alizuj									
		fik	tivni_finan	cni_dataset_A.c	sv								
	+	Happ quest	y to help! ł ion.	Here's a set of ta	asks	can e	xecute	in your	notebo	ok to h	elp ans	wer yo	our

- · Data loading: Load the data from "fiktivni\_financni\_dataset\_A.csv" into a DataFrame.
- Data exploration: Explore the data to understand its structure, including the number of rows and columns, data types of each column, and the presence of missing values. Also, check the distribution of numerical variables and identify potential outliers.
- Data cleaning: Handle missing values by either imputing or removing them, depending
  on the extent of missing data and the context of the analysis. Identify and handle
  potential outliers in the dataset.
- Data analysis: Perform descriptive statistics on the numerical variables to understand their central tendencies, dispersion, and correlations.
- Data visualization: Create visualizations to represent the distribution of key variables, including histograms, box plots, and scatter plots. Visualize the correlations between variables using a correlation matrix heatmap.
- Finish task: Summarize the key insights and findings from the data analysis and visualization steps in a clear and concise manner.

Want anything changed? Feel free to send feedback, and I will try to update the plan accordingly!

Execute plan )

boxptcts/boxptct/l, 2, 2)
plt.subplct(l, 2, 2)
plt.boxplct(df['Gástka\_CZK'])
plt.title('Boxplct of Cástka\_CZK')
plt.title('Boxplct of Cástka\_CZK')
plt.tight\_layout()
plt.show()

Ŧ

...

# Bar chart for 'Typ\_transakce' plt.figurefigsize=(8, 6) df['Typ\_transakce'], value\_counts().plot(kind='bar') plt.xlabel('Typ\_transakce') plt.ylabel('Count') plt.title('Frequency of Transaction Types') plt.show()

# Bar chart for 'Kategorie'
plt.figuref[ze](Baize=[12, 6])
df['Kategorie'].value\_counts().plot(kind='bar')
plt.xlabel'fKategorie')
plt.ylabel'('Count')
plt.ylabel'('Count')
plt.show()
plt.show()

# Boxplot of Cástka\_C2K for different Kategorie values plt.figurefigsizee(12, 6)/ df.boxplot(colume!'Cástka\_C2K'), by='Kategorie') plt.stiet('Boxplot of Cástka\_C2K for different Kategorie values') plt.suptitle('') # Remove the default title plt.show()



<Figure size 1200x600 with 0 Axes>



link

### **Concentration Effects**



Compute Solve complex data and engineering challenges by You.com

### **Clarifying questions**

 $\otimes$ 

- 1. What specific type of analysis are you looking for in the provided data?
- Summary statistics (e.g., mean, median, standard deviation of viability percentages)

<u>ئ</u>

7

- Dose-response analysis (e.g., IC50 calculation)
- Comparison between compounds or cell lines
- Visualization of the data (e.g., graphs or plots)
- 2. Are there any specific tools or programming languages you would like the analysis to be performed in?
- O Python (e.g., using pandas, matplotlib, or seaborn)
- R (e.g., using ggplot2 or dplyr)
- O Excel

### Computing

- Load and preprocess the cell viability data \* Import data using pandas \* Clean and organize data into appropriate format \* Calculate basic summary statistics (mean, median, std) for each condition
- Perform dose-response analysis \* Calculate IC50 values for each compound and cell line \* Generate dose-response curves \* Create visualizations showing viability vs concentration for both compounds \* Analyze the relationship between concentration and cell viability
- Conduct comparative analysis \* Compare compounds A and B effectiveness across concentrations \* Analyze differences between HeLa and MCF-7 cell lines \* Generate statistical comparisons (ttests or ANOVA as appropriate) \* Create comparative visualizations (box plots, bar charts)



The dose-response curves show:

- Low Concentration (1 µM): High viability (90-92%)
- Medium Concentration (10 μM): Moderate decrease (72-77%)
- High Concentration (50 μM): Significant decrease (29-35%)

### IC50 Values

- Compound A: 34.12 μM
- Compound B: 36.96 μM

### 3. Comparative Analysis



# **AI ECOSYSTEMS**

**GEMINI IN OUR PRODUCTS** 

# Bringing our Gemini model's helpful capabilities to our products

Since launch, we've been working hard to bring Gemini models into our products to help make them faster, smarter, and more helpful.

You can experience Gemini in Google products with features like these:



# Google AI

<u>explore</u>

# Gmail assistance

4



2) Somebody used about 0.5 L of prepared D-MEM from F was saying to the most people privately, if you need such to prepare you a full bottle or prepare it yourself (if you we an important point - we must be sure that the shared solut ------

write a repsonse to Stanislav Thank you for the update. Regarding point 4, yes I still need the fish food in the 

> plan to take regarding old items in the fridge?

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Enter a prompt here

Gemini for Workspace can make mistakes, including about people, so double-check it. Learn more

# **GDrive** assistance




document or email.

Croate images: You or

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# Google Sheets assistance



# Google Slides assistance

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Format Slide Arrange Tools Extensions



### @Liegertova Michaela

Slideshow

8

# Gemini App



Hello, Michaela Humans review some saved chats to improve Google AI. To stop this for future Activity. If this setting is on, don't enter info you used. How it works

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	Outlook
you	Manage your email, calendar, tasks, and contacts in one location.
	Learn more
	OneDrive
1	Save and share your files and photos, wherever you go.
lor	learn more

# <u>explore</u>



# Teams assistance



# Copilot app + Edge Browser assistance

# Hi Michaela, what should we dive into today?

Message Copilot		
Quick response V	+	0
Write a first draft Get advice Learn something new Create an image		

#### ∀ · · · · − + • · · | 1 of 26 | ⑦ | ① · Q | 🖺 · · ·

Zaměření a přehled podmínek

1. veřejné soutěže programu SIGMA Dílčí cíl 3: Podpora inovačního potenciálu společenských věd.

TA

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Copilot

C : X

# ZADÁVACÍ DOKUMENTACE

#### 1. veřejná soutěž

Dílčí cíl 3: Podpora inovačního potenciálu společenských, humanitních věd a umění

### PROGRAM SIGMA

Program na podporu aplikovaného výzkumu a inovací

Č.j.: TACR/9-67/2022

summarize in english please

The document outlines the details for the first public competition under the SIGMA program, which aims to support applied research and innovation in the social sciences, humanities, and arts (SHUV). Here are the main points:

- Purpose: To enhance the innovative potential and efficiency of SHUV research, addressing challenges like societal changes, technological shifts, and global crises such as COVID-19 or geopolitical tensions.
- Eligibility: Applicants can be research organizations or enterprises. They must designate an application guarantor based in the Czech Republic.
- Themes: Projects should align with one of the main themes—societal resilience, education and employment, or sustainability —and choose a specific subtheme within these areas.
- Funding: A maximum of CZK 12 million can be granted per project, with up to 80% of the project's costs covered. The remaining 20% must come from other sources.
- Timeline: Project proposals were accepted between October 27, 2022, and December 14, 2022. Project implementation is to start between June and September 2023. lasting

🛉 🕂 Poslat zprávu Copile 🛛 🕲

10

# DESIGNING PRESENTATION AND

**VISUAL CONTENT** 



#### Animations Slide Show Record Review Record 💭 Comments 🛛 🕝 Share 🗸 Convert to SmartArt Insert Drawing Add-ins Designer Copilot 0 Designer Stop suggesting ideas until I restart PowerPoint. Stop showing ideas for new presentations Create a presentation about... Create a presentation from a file CLICK TO ADD TITLE Ask Copilot Click to add title Cick to add tablife Click to add subtitle Click to add

# Gemini Advanced

☆ Format Slide Arrange Tools Extensions 👂 🔲	CI - Slideshow - 2+
⊖ 5 @ Fit ▼ : ☐ ^	+ Gemini : ∟' × Hello, Michaela How can I help you today?
Click to add title Click to add subtitle	Create a slide to pitch an idea Create a slide to congratulate our team
	♀*     What can Gemini do in Slides       ٤

# PRESETATIONS





# Paste in

Add the notes, outline or content you'd like to use

#### ntroduction

Intercellular communication is a dynamic process that reflects emerging changes in cancer initiation and progression and enables monitoring of those changes via alternation of signals transmitted within cells and their surrounding environment. EVs contain surface molecules targeting their pathways or, together with the bioactive cargo, influencing the function of recipient cells. This evidence supports the notion that EVs play multiple roles in crucial processes that are essential not only for the physiological cell-to-cell communication but also for cancer initiation, progression and dissemination and, therefore, can serve as a very useful source of information about those processes [1].

EVs mirror processes associated with cancer progression, such as hypoxia, chronic inflammation and immune system surveillance and play key roles in tumor escape. They contain information regarding the cell of origin,

What would you like to create with this content?

2 25

Presentation Webpage Document Social

### example





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#### Extracellular Vesicles in Cancer Communication

Intercellular communication via extracellular vesicles (EVs) reflects cancer changes. EVs contain molecules that influence recipient cells and provide crucial information They serve as biomarkers for cancer progression and treatment 😗 by Michaela Lliegertova







### link



Exosomes (3) Involved in intercellular communication, derived from endosomal membrane Ectosomes Shed from plasma membrane, includes microvesicles and oncosomes **Apoptotic Bodies** How to classify Formed during programmed extracellular cell death vesicles (EVs)? Exomeres Non-membranous nanovesicles, distinct from other EVs : Supermeres Morphologically and structurally different, unique uptake kinetics

### SCHEMES/VISUALS

@Liegertova\_Michaela

## ChatGPT native image generation

please generate an accurate image to support a grant proposal on:

Spatiotemporal modulation of extracellular vesicle-mediated neuroinflammatory signaling in Alzheimer's progression, with a focus on integrating multi-omic analysis and connectome mapping for targeted immunomodulatory intervention. this is for presentation of the proposal and must scientifically solid

generate a scientifically accurate scheme on exosome biogenesis





IMAGES







 $\Diamond$ 

A professional photo of a scientist in a modern lab, wearing safety gear. The scientist is conducting experiments on a lab bench. The lab is equipped with advanced machinery and has a clean, organized appearance. The scientist is wearing protective goggles, a lab coat, and gloves.

# **GRAPHICAL ABSTRACTS AND PUBLICATION IMAGES/VISUALIZATIONS**

Not-AI (yet)



# **AI AGENTS**

# Google Research

# Towards an AI co-scientist

### Link to article Link to blog



The Al co-scientist system design



OpenAI AI agent that can access and interact with the internet to carry out tasks independently

TASK:

- 1) Find a commercially available human glioblastoma cell line best suitable for 3D cell culture.
- 2) **Find and read published protocols** on the glioblastoma 3D cell culture cultivation
- 3) **Draft a detailed step-by-step laboratory protocol** on the glioblastoma 3D cell culturing
- 4) Consult the protocol with Claude.ai
- 5) Share the link to the final protocol

@Liegertova\_Michaela



### watch video

## **FINAL NOTE**

→ there is no one-size-fits-all guide to the effective use of LLMs

 $\rightarrow$  there is no one-size-fits-all guide to prompting

...experiment, explore, and try to find your own style that delivers results in a format that works best for you.

# The information provided during this workshop will be out of date in a few days/weeks!

...which is no reason to be discouraged from working with AI tools. On the contrary, try to keep up with the latest news and trends. Test and compare the outputs of all available models.





# Thank you for attention!

Michaela Liegertová

4.4.2025

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