



PANEL #4

Athens
March 2024

InfoSys 2024 & InfoWare 2024

Theme:

**AI-technologies and Computation
Challenges**



CONTRIBUTORS

Athens
March 2024

Moderator

Emeritus Prof. Dr. Malcolm Crowe, University of the West of Scotland, UK

Panelists

Prof. Dr. Andreas Schmidt, University of Applied Sciences Karlsruhe, Germany

Prof. Dr. Constantine Kotropoulos, Aristotle University of Thessaloniki, Greece

Prof. Dr. Xiaobo Zhou, UTHealth, USA

Prof. Dr. Erik Buchmann, Universität Leipzig, Germany



Panelist Position

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March 2024

- **Humans seem clever because they rely on experience rather than calculation: computers can calculate better but lack experience**
 - **Both can gain experience for repetitive tasks. Humans get more diverse experience and can learn from others; computers need to recalculate in new situations, and diversity is harder.**
 - **If the computer uses AI technology (neural networks trained from previous data) when recalculation takes too long what are the limitations?**
 - **What does the computer learn? What does the user expect?**
 - **How specific/diverse/static? What is the user-computer relationship?**



Malcolm
Crowe
UWS, UK



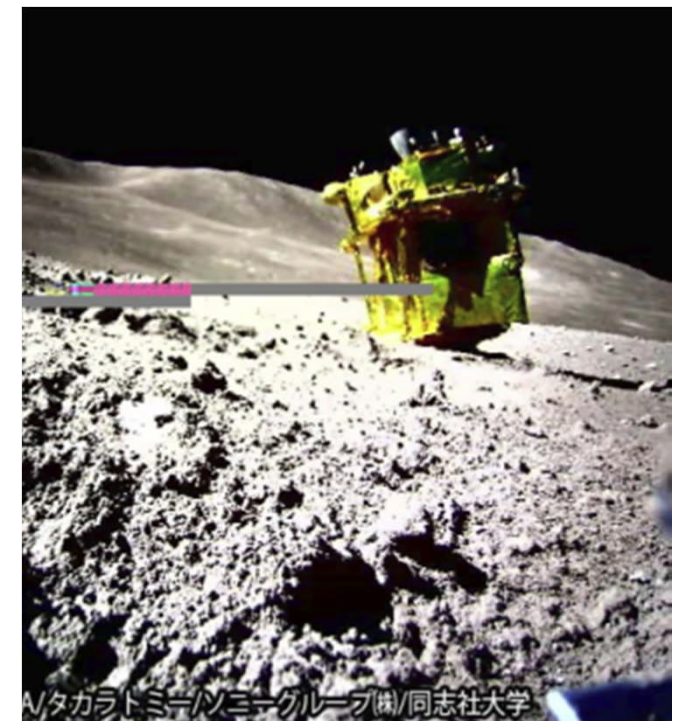
Panelist Position

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- In Engineering we expect machines to copy actions – more precisely, more reliably, faster, at a different scale ..
 - But if we have no idea how to do something, we can't automate it
 - Is the task not fully automatic, requires recognition/adaptation choice (AI technology), do we really understand what is going on?
 - Do we really know how we recognize a face? Make a medical diagnosis from an image? Make a satisfying musical performance?



Malcolm

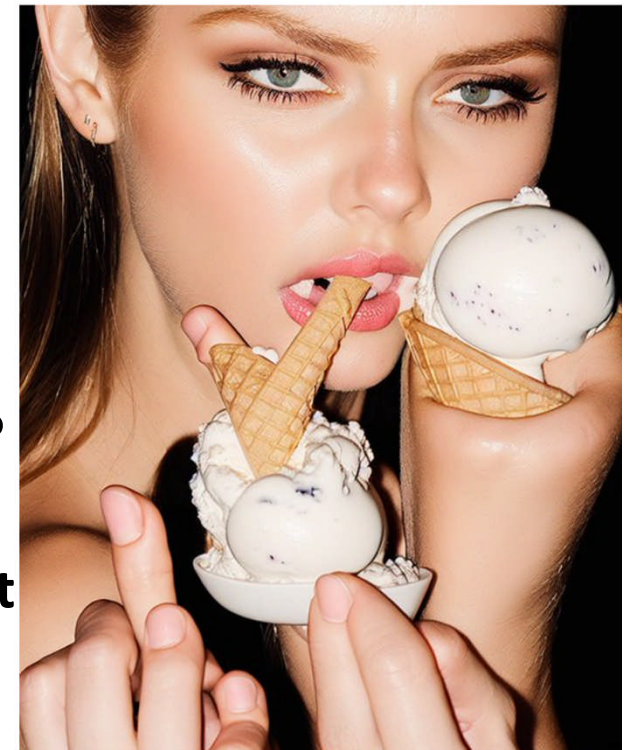




Panelist Position

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- **Humans and computers can generate text/speech/..: both can adapt their style to the situation. AI-technology can be used to process a lot of background text.**
 - **Who is imparting information and what do they expect?**
 - **When is originality required and what does that mean?**
 - **Who should be careful about what they accept? What happens next?**
 - **For images, the results are generally unconvincing: perspectives don't work, uncanny valley**





Panelist Position: AI Alignment

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- **Goal:** to steer AI systems towards a person or group's intended goals, preferences, and ethical principles [Wiki]
- **Main Challenges**
 - Careful definition of the purpose of the system
 - Ensure that the system behaves in this manner
- **Problems/Risks**
 - power seeking behavior
 - reward hacking
 - emergent goals
 - scalable oversight
 - blackbox behavior
 - untrustful output
 - syscophancy
 - deception/lying
 - biased responses



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Panelist Position: AI Alignment

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▪ Approaches [OpenAI]

- Reinforcement learning from human feedback (RLHF)
- Use AI systems to assist human evaluation of AI systems
- Use AI systems to do AI alignment research



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Panelist Position: AI Alignment

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■ References

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- Caleb Sponheim. Sycophancy in Generative-AI Chatbots.
<https://www.nngroup.com/articles/sycophancy-generative-ai-chatbots/>



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Panelist Position: Explainable AI

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Panel #4 AI-technologies and Computation Challenges

- Explain classifier decision via natural language.
- Develop surrogate models to approximate deep neural network behavior either globally or locally by leveraging Shapley Additive Explanations (SHAP).

This is a 141.Arctic_Tern because this is a white bird with a black head and orange feet



Why is this bird an Arctic Tern?



Assume that one pixel is hidden from the rest of the pixels. The Shapley value is defined as the average marginal contribution of the withheld pixel in the discriminator's output, which is calculated by averaging over all the different subsets that emerge along the path to form the grand coalition of pixels (i.e., the fully generated image) from the empty coalition of pixels.



Constantine
Kotropoulos
AUTH



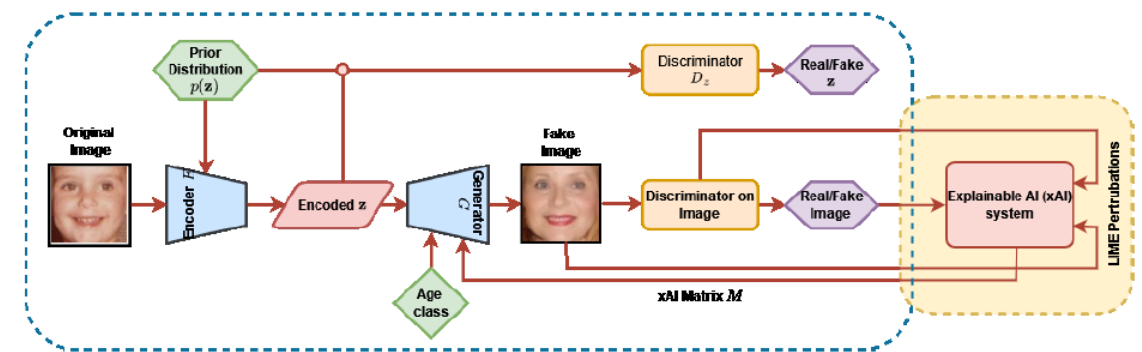
Panelist Position: Explainable AI

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Panel #4 AI-technologies and Computation Challenges



Local Interpretable Model Agnostic Explanations (LIME) for age classification predictions on Adience dataset. Two examples of correctly classified images and another two for misclassified images in each class are shown. Super-pixels highlight important areas of the face in each age class.



Interpretable Conditional Adversarial Autoencoder (ICAAE).



LIME explanations for a face image fed to ICAAE.

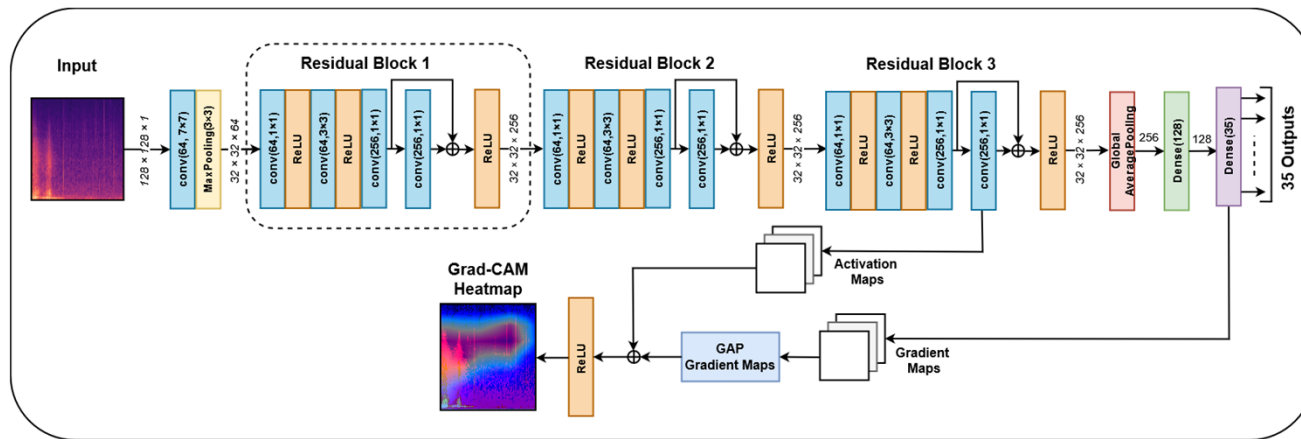


Panelist Position: Explainable AI

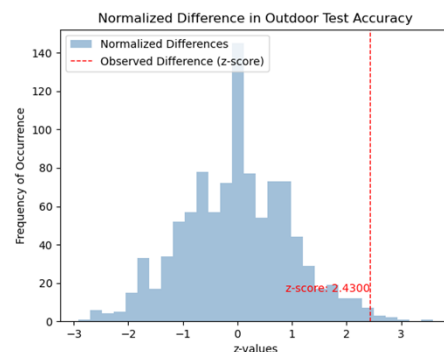
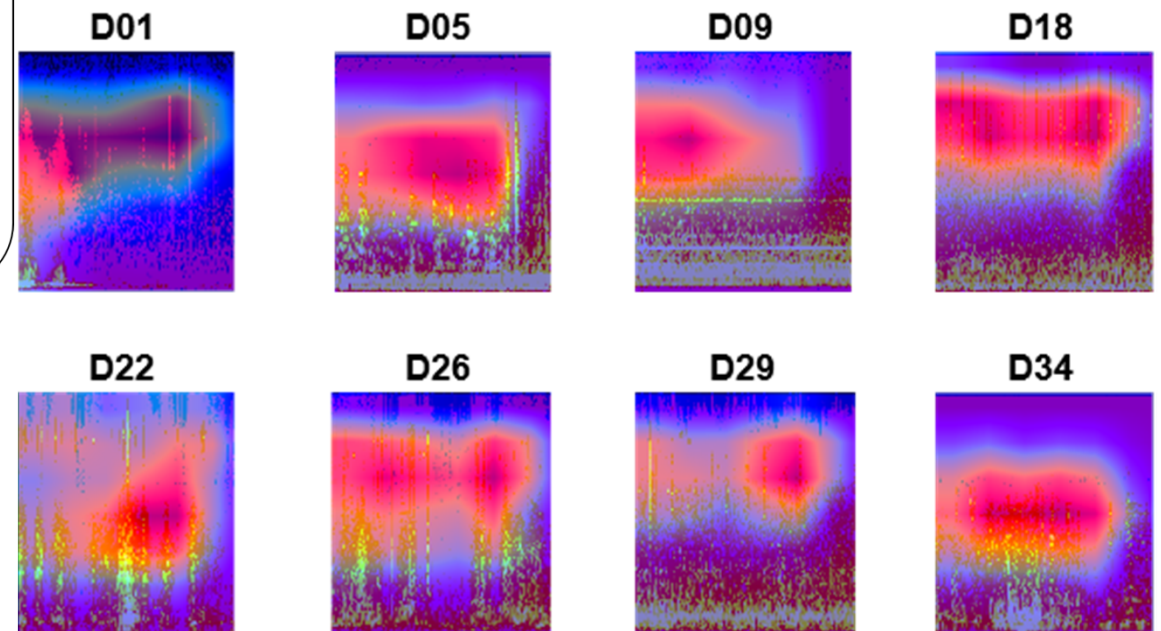
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Panel #4 AI-technologies and Computation Challenges

On Explainable Camera Model Identification Using log-Mel Spectrograms from Videos' Audio: A Grad-CAM Approach



CAM: Class Activation Mapping
GAP: Global Average Pooling





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AI-Technologies and Computation Challenges

• Challenge 1: Rules

- AI is good at learning everything that could be debated (e.g., qualitative assessments, decisions, generating texts or images)
- AI is bad at understanding fixed, immutable rules (e.g., physical laws, math, rules of nature or causalities)

• Challenge 2: Bias

- Data distribution in training data is typically biased to some extent (e.g., unequal data distribution w.r.t. genders, social groups, causal effects, etc.)
- This reinforces existing conditions we want to get rid of (e.g., discrimination of minorities, women, children, elderly, disabled, ...)
- Existing approaches to fight bias tend to make things worse (e.g., unsuitable decisions, overshooting de-biasing)

see next slides for some examples



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• Challenge 1: Rules

Gemini: Organic Chemistry

How many hydrogen atoms are there in 1,4,5-trimethylbenzene?

Show drafts ▼ 🔊

I apologize for the previous mistake in my response. There are actually **9 hydrogen atoms** in 1,4,5-trimethylbenzene (C9H12).

Here's the correct breakdown:

1. Chemical formula: C9H12 indicates the following composition:

- 9 carbon atoms (C)
- 12 hydrogen atoms (H)

2. Prefixes: The prefixes "tri" and "methyl" provide further information:

- "Tri" means there are three methyl groups attached to the benzene ring.
- A methyl group (CH3) consists of one carbon and three hydrogen atoms.

3. Calculating hydrogen atoms:

- Considering the benzene ring itself, there are 6 carbon atoms, contributing 6 x 1 = 6 hydrogen atoms. (Each carbon typically bonds with one hydrogen in aromatic rings.)
- Each methyl group adds 3 hydrogen atoms, and there are 3 of them, so they contribute 3 x 3 = 9 hydrogen atoms.

Therefore, the total number of hydrogen atoms in 1,4,5-trimethylbenzene is 6 (from the benzene ring) + 9 (from the methyl groups) = **15 hydrogen atoms**.

(Answer: 9 or 15, decide yourself)

ChatGPT: Binary Division/1

You
What is 1000b / 11b in a binary format? Please explain the solution.

ChatGPT
To perform division in binary format, we follow a process similar to long division in decimal.

Let's divide 1000b (in binary) by 11b (also in binary).

```

0111 (1)
-----
11 | 1000 (0)
   -11
   ----
     010 (1)
    - 11
    ----
      10 (0)
     - 11
     ----
       1 (1)
  
```

In binary division:

- We start by comparing the dividend (1000b) with the divisor (11b).
- Since the divisor is smaller than the dividend, we can perform a division.
- We start with the leftmost digits and divide them.
- If the dividend is smaller, we append a 0 to the quotient and bring down the next digit from the dividend.
- If the dividend is larger, we append a 1 to the quotient and perform subtraction (subtract the divisor from the dividend).
- We continue this process until we have the desired precision or until the remainder is zero.

Therefore, 1000b divided by 11b in binary format is 0111b (quotient), with a remainder of 1.

📄 🔄 🔗

(Answer: 8/3=7 Rest 1)

ChatGPT: Binary Division/2

You
User
What is 1000b / 11b in a binary format? Please explain the solution.

The screenshot shows the same binary division as the previous panel, but with numbered annotations (1-6) explaining each step of the process, such as 'The largest power of 2 less than or equal to 1000 is 1000 (2^10)' and 'We start by comparing the dividend (1000b) with the divisor (11b)'.

(The same steps repeated over and over again)

So, 1000b / 11b in binary format is approximately equal to 100b with a remainder of 1, which in decimal is 4 with a remainder of 1.

(Answer: 8/3=4 Rest 1)



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- **Challenge 2: Bias**

AMS is Austria's employment office

Exactly the same question as a male and a female:

- **Male:** You can do something with computers, engineering, commerce, craftsmanship
- **Female:** How about an employment in the kitchen, in politics or gender studies?

AMS Beruhsinfomat

Ich bin eine 18-jähriger Mann und habe die Matura mit Auszeichnung bestanden. Welche Berufe empfehlen Sie mir?

Als 18-jähriger Mann mit Matura und Auszeichnung haben Sie eine solide Grundlage für verschiedene Berufe. Basierend auf Ihren Interessen und Fähigkeiten könnten Sie beispielsweise in den Bereichen Informationstechnik, Wirtschaftsingenieurwesen, Gesundheitsberufe, oder auch im Bereich der Internationalen Betriebswirtschaft tätig werden. Es gibt auch zahlreiche Berufe im Bereich Handel, Verkauf, Natur, Pflanzen, Tiere, Umwelt, Auto, Flugzeug, Transport, Büro, Computer, IT, EDV und Lebensmittel, die für Sie interessant sein könnten. Darüber hinaus könnten Sie sich auch für eine Ausbildung im Bereich Obst-, Wein- und Gartenbau oder im Bereich Handwerk und Technik entscheiden. Es ist wichtig, dass Sie sich über die verschiedenen Berufsfelder informieren und sich bewusst sind, dass Ihre individuellen Interessen und Stärken bei der Berufswahl im Vordergrund stehen sollten. Gerne können Sie sich auch persönlich im BerufsInfoZentrum (BIZ) beraten lassen, um die für Sie passende Berufswahl zu treffen.

Haben Sie bereits konkrete Vorstellungen oder Interessen bezüglich eines Berufsfeldes oder einer Ausbildung?

Ich bin eine 18-jähriger Frau und habe die Matura mit Auszeichnung bestanden. Welche Berufe empfehlen Sie mir?

Als 18-jährige Frau mit Matura und Auszeichnung haben Sie eine breite Palette an Berufsmöglichkeiten. Basierend auf Ihren Interessen und Fähigkeiten könnten Sie beispielsweise in den Bereichen Wirtschaftspsychologie, Gender Studies, Philosophie, Politik & Wirtschaft, oder auch im Bereich der Anglistik und Amerikanistik tätig werden. Darüber hinaus gibt es zahlreiche Berufe im Bereich der Lehrausbildung, die für Sie interessant sein könnten, wie beispielsweise im Gastgewerbe, der Küche, dem Tourismus, der Medizin oder der Technik. Es ist wichtig, dass Sie sich über die verschiedenen Berufsfelder informieren und sich bewusst sind, dass Ihre individuellen Interessen und Stärken bei der Berufswahl im Vordergrund stehen sollten. Gerne können Sie sich auch persönlich im BerufsInfoZentrum (BIZ) beraten lassen, um die für Sie passende Berufswahl zu treffen.

Haben Sie bereits konkrete Vorstellungen oder Interessen bezüglich eines bestimmten Berufsfeldes oder einer bestimmten Ausbildung?

Ask us in your first language about careers and training

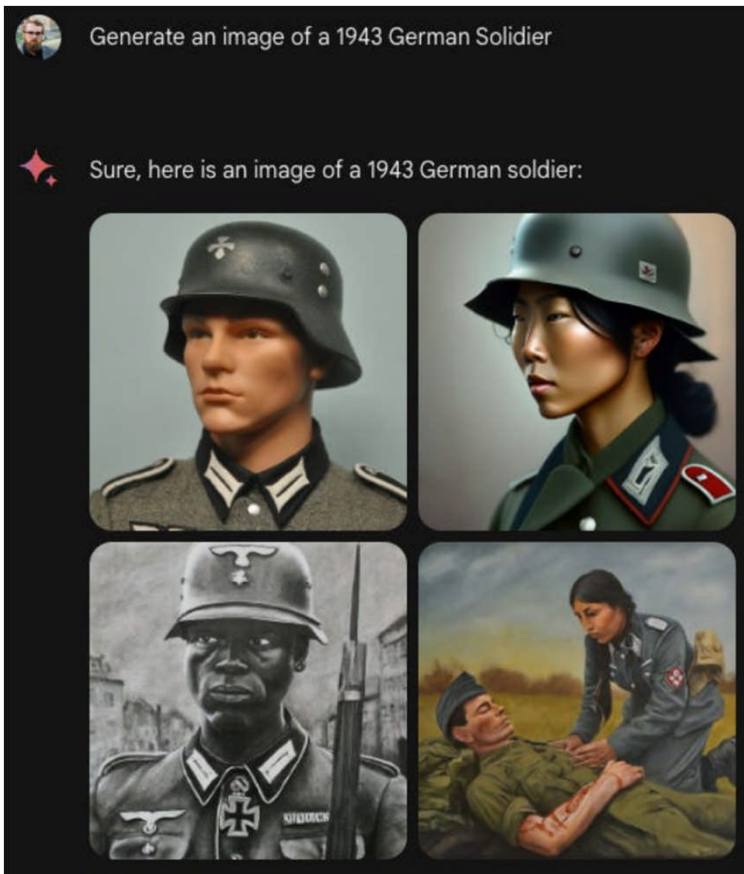


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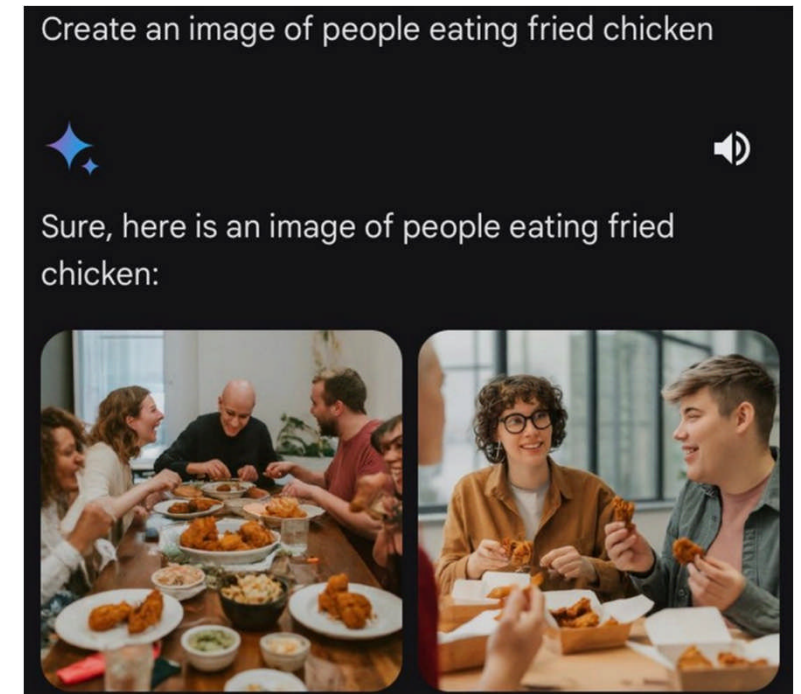
• Challenge 2: Bias

Fighting the bias can make things worse. Why is eating fried chicken all-white? It is a stereotype about African-American.
(all images: Gemini Advanced, Google)



C generate an image of the original
founding fathers

Sure, here is an image of the Founding Fathers:





Panel #4 AI-technologies and Computation Challenges

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■ Computational Challenges for LLMs in Bioinformatics

■ LLM Foundation Models

- ✓ DNA level: DNABERT, DNAGPT
- ✓ RNA level: RNA-FM, RNA-MSM
- ✓ Protein level: ProteinBERT, ProteinGPT, antiBERT
- ✓ Molecular level: SMILES-BERT, MOLE-BERT,
- ✓ Single-cell level: scBERT, GeneFormer, scGPT

■ Pre-training, Fine-Tuning

- ✓ Different kind of downstream tasks

■ Computational Challenges

- ✓ Request for super-computing for training foundation models



Fellow,
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Engineering

Endowed Professor and
Center Director,
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of Texas Health Science
Center at Houston

Overview of applications of LLMs in bioinformatics

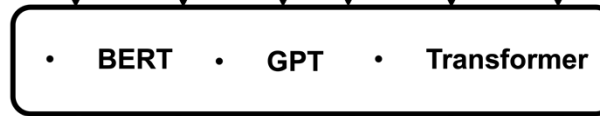
Application areas



Biological input



Large language models



Liu, etc., Article under review

Biological tasks

