MÓDULO 4

Engineering: A World of Possibilities and Innovations

4.1 Activating ideas/ ideas activadoras del pensamiento

A. Responde a las siguientes preguntas en base a tu propia experiencia universitaria.

1. ¿Alguna vez has participado de algún proyecto de investigación o de desarrollo ya sea en el ámbito educativo o laboral? De ser así, comenta cómo fue.

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2. ¿Te gustaría participar de algún proyecto universitario o desarrollar algún tipo de investigación? ¿Tienes alguna idea que te gustaría explorar?

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3. ¿Si tuvieses que desarrollar un proyecto de investigación, a qué herramientas recurrirías? ¿Qué pasos tomarías?

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4.2 Reading 1

Lee el siguiente texto y resuelve las actividades en castellano.

Need a research hypothesis? Ask AI.[24]

Zach Winn | MIT News Publication Date: December 19, 2024

MIT engineers developed AI frameworks to identify evidence-driven hypotheses that could advance biologically inspired materials

Crafting a unique and promising research hypothesis is a fundamental skill for any scientist. It can also be time consuming: New PhD candidates might spend the first year of their program trying to decide exactly what to explore in their experiments. What if artificial intelligence could help?

[24] Artículo extraído de MIT NEWS y adaptado con fines pedagógicos. Accedido el 20/12/2024.

MIT researchers have created a way to autonomously generate and evaluate promising research hypotheses across fields, through human-AI collaboration. In a new paper, they describe how they can use this framework to create evidence-driven hypotheses that align with unmet research needs in the field of biologically inspired materials.

The framework, which the researchers call SciAgents, consists of multiple AI agents, each with specific capabilities and access to data, that leverage "graph reasoning" methods, where AI models utilize a knowledge graph that organizes and defines relationships between diverse scientific concepts. The multi-agent approach mimics the way biological systems organize themselves as groups of elementary building blocks. Buehler, the head of the research, notes that this "divide and conquer" principle is a prominent paradigm in biology at many levels, from materials to swarms of insects to civilizations — all examples where the total intelligence is much greater than the sum of individuals' abilities.

"By using multiple AI agents, we're trying to simulate the process by which communities of scientists make discoveries," says Buehler. "At MIT, we do that by having a bunch of people with different backgrounds working together and bumping into each other at coffee shops or in MIT's Infinite Corridor. But if we want to make that process less coincidental and slow, we will have to simulate the process of discovery by exploring whether AI systems can be creative and make discoveries."

Automating good ideas

As recent developments have demonstrated, large language models (LLMs) have shown an impressive ability to answer questions, summarize information, and execute simple tasks. But they are quite limited if they need to generate new ideas from scratch. The MIT researchers wanted to design a system that would enable AI models to perform a more sophisticated, multistep process that goes beyond recalling information learned during training, to extrapolate and create new knowledge.

The foundation of their approach is an ontological knowledge graph, which organizes and makes connections between diverse scientific concepts. To make the graphs, the researchers feed a set of scientific papers into a generative AI model.

For this paper, the researchers used about 1,000 scientific studies on biological materials, but Buehler says the knowledge graphs could be generated using far more or fewer research papers from any field.

With the graph established, the researchers developed an AI system for scientific discovery, with multiple models specialized to play specific roles in the system. Most of the components were built off of OpenAI's ChatGPT-4 series models and made use of a technique known as in-context learning, in which prompts provide contextual information about the model's role in the system while allowing it to learn from data.

The individual agents in the framework interact with each other to collectively solve a complex problem that none of them would be able to do alone. The first task they are given is to generate the research hypothesis. The LLM interactions start after a subgraph has been defined from the knowledge graph, which can happen randomly or by manually entering a pair of keywords discussed in the papers.

In the framework, a language model the researchers named the "Ontologist" is tasked with defining scientific terms in the papers and examining the connections between them. A model named "Scientist 1" then crafts a research proposal based on factors like its ability to uncover unexpected properties and novelty. The proposal includes a discussion of potential findings, the impact of the research, and a guess at the underlying mechanisms of action. A "Scientist 2" model expands on the idea, suggesting specific experimental and simulation approaches and making other improvements. Finally, a "Critic" model highlights its strengths and weaknesses and suggests further improvements.

"It's about building a team of experts that can't think in the same way," Buehler says. "They must think differently and have different capabilities. The Critic agent is deliberately programmed to critique the others. It implies 'There's a weakness here, can you explain it better?' That makes the output much different from single models."

Going forward, the researchers hope to incorporate new tools for retrieving information and running simulations into their frameworks.

1. ¿Qué tipo de texto es y qué funciones retóricas puedes identificar? Justifica tu respuesta.

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   ……

2. ¿Cuál suele ser un problema para los estudiantes de doctorado?

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3. Resume lo que han desarrollado los investigadores del MIT.

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4. ¿En qué consiste el esquema de trabajo?

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5. Traslada al castellano el significado de la sigla LLMs.

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6. ¿Cómo llamaron los investigadores al modelo del lenguaje? Explica cómo funciona.

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7. ¿Qué proyección a futuro tiene el proyecto?

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8. Identifica en el texto alguna comparación, subráyala y trasládala al castellano.

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9. Identifica y subraya en el texto dos frases que indiquen una posibilidad y trasládalas al castellano.

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10. Observa las siguientes oraciones extraídas del texto que contienen un verbo modal. Subraya dicho verbo y trata de relacionarlas con las siguientes funciones. Pueden repetirse algunas funciones:

    - Habilidad/ capacidad
    - Posibilidad
    - Posibilidad remota
    - Probabilidad/certeza
    - Necesidad urgente
    - Imposibilidad
    - Situación hipotética o suposición

    a) *New PhD candidates might spend the first year of their program trying to decide exactly what to explore in their experiments. .....*

    b) *What if artificial intelligence could help?.....*

    c) *We will have to simulate the process of discovery by exploring whether AI systems can be creative and make discoveries. .....*

d) *But they are quite limited if they need to generate new ideas from scratch.*
……

e) *The MIT researchers wanted to design a system that would enable AI models to perform a more sophisticated, multistep process*
……..

f) *It's about building a team of experts that can't think in the same way*
.....

11. Elije 3 oraciones del punto anterior y reescríbelas en castellano.
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12. Observa la siguiente oración extraída del texto y trata de explicar qué significado tendría en castellano y qué función cumpliría el verbo modal de esta.
They must think differently and have different capabilities.
……
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13. Observa el siguiente gráfico y completa con los verbos modales del cuadro según su grado de probabilidad y posibilidad.



MIGHT	WON'T
COULD	CAN
WILL	SHOULD
MUST	
CAN'T	
MAY	

4.3 MORE PRACTICE ON MODAL VERBS

A. Responde las siguientes preguntas en inglés utilizando los verbos modales vistos.

1) What materials can be both strong and lightweight?

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2) What must we consider about the environment when designing a new product?

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3) Would you consider implementing a more sustainable alternative in the manufacturing process if the initial cost was higher? Why?

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……

4) What might cause overheating of a machine?

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……

5) Should the testing of prototypes be done in real-world conditions? Why?

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B. Lee las siguientes oraciones extraídas de textos técnicos. Identifica y subraya los verbos modales. Indica su función y traduce las oraciones al castellano.

1) Lu and his colleagues show that a common type of machine learning algorithm employed in genome-wide association studies can mistakenly link several genetic variations with an individual's risk for developing Type 2 diabetes.

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2) By using AI methods, we can identify which subsets of chemicals might be particularly harmful to aquatic life, even at low concentrations that wouldn't normally raise concerns.

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3) The new AI framework is a generic approach that can quickly predict solutions to pervasive and time-consuming math equations needed to create models of how fluids or electrical currents propagate through different geometries.

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4) The time to calculate the prediction of a heart digital twin is going to decrease from many hours to 30 seconds, and it will be done on a desktop computer rather than on a supercomputer.

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5) Our new AI model, which combines the C4C risk score together with skin lesion images, could lead to a reduction in the need for patient referrals for biopsies, shorter waiting times for skin cancer diagnosis and treatment, and improved outcomes for patients.

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4.4 CAUSE & EFFECT IN SCIENTIFIC-TECHNICAL DISCOURSE

Conditional sentences / Oraciones condicionales (Lee el Apéndice 4)

A. Observa las siguientes oraciones extraídas del texto y luego responde las preguntas que siguen.

a) *But if we want to make that process less coincidental and slow, we will have to simulate the process of discovery by exploring whether AI systems can be creative and make discoveries.*

b) *But they are quite limited if they need to generate new ideas from scratch.*

1) ¿Qué similitudes tienen ambas oraciones? ¿Cuál es la palabra conectora que comparten?

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2) ¿Qué cláusula de cada oración introduce una causa y cuál un resultado o consecuencia? Traslada cada idea al castellano.

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3) Observa los tiempos verbales utilizados en cada oración. ¿Qué diferencia hay entre ambas oraciones? ¿Cuál de las dos refiere a hechos o verdades y cuál indica una posibilidad?

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B. Identifica el tipo de condicional en cada oración y luego traslada las oraciones al castellano.

1) If a force is applied to an object, it accelerates in the direction of the force.

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2) If the team finishes the simulations by next week, they will analyze the results.

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3) If the battery is fully charged, the device will run for 12 hours.

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4) If a material reaches its melting point, it becomes liquid.

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5) If the software performs as expected, it will be deployed to production.

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6) If you mix a catalyst with a reaction, it speeds up the process.

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7) If an electrical circuit is closed, the current flows through it.

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8) If the temperature exceeds the threshold, the system will shut down automatically.

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C. Combina la causa con el efecto. Hay un ejemplo resuelto.

1. If a machine can imitate human behaviour,	a. the car will be difficult to start.
2. If the battery is failing,	b. it will save on electricity costs.
3. If there is a sudden loss of cabin pressure,	c. you will require professional help.
4. If your laptop doesn't work,	d. the following trains will decelerate.
5. If the circuit is open,	e. no current will flow.
6. If the industrial sector uses renewable energies,	f. there will be no problem in scanning it.
7. If the track circuit is not repaired,	g. suction can be created and people will be ejected.
8. If the microchip has been inserted correctly,	h. robots will replace humans in the job. **1**

4.5 Video time / Momento de vídeo

A. Responde las preguntas sobre la temática del vídeo que verás.

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4.6 CONTENT INTEGRATION / INTEGRACIÓN DE CONTENIDOS

Lee los siguientes textos y resuelve las actividades en castellano.

READING 1

A new way to create realistic 3D shapes using generative AI[25]

Adam Zewe | MIT News Publication Date: December 4, 2024

Researchers propose a simple fix to an existing technique that could help artists, designers, and engineers create better 3D models.

Creating realistic 3D models for applications like virtual reality, filmmaking, and engineering design can be a cumbersome process requiring lots of manual trial and error.

While generative artificial intelligence models for images can streamline artistic processes by enabling creators to produce lifelike 2D images from text prompts, these models are not designed to generate 3D shapes. To bridge the gap, a recently developed technique called Score Distillation leverages 2D image generation models to create 3D shapes, but its output often ends up blurry or cartoonish.

MIT researchers explored the relationships and differences between the algorithms used to generate 2D images and 3D shapes, identifying the root cause of lower-quality 3D models. From there, they crafted a simple fix to Score Distillation, which enables the generation of sharp, high-quality 3D shapes that are closer in quality to the best model-generated 2D images. Researchers used text-based generative AI and their new technique to create the 3D objects.

Some other methods try to fix this problem by retraining or fine-tuning the generative AI model, which can be expensive and time-consuming.

By contrast, the MIT researchers' technique achieves 3D shape quality on par with or better than these approaches without additional training or complex postprocessing. Moreover, by identifying the cause of the problem, the

[25] Artículo extraído de MIT NEWS y adaptado con fines pedagógicos. Accedido el 20/12/2024.

researchers have improved mathematical understanding of Score Distillation and related techniques, enabling future work to further improve performance.

"Now we know where we should be heading, which allows us to find more efficient solutions that are faster and higher-quality," says Artem Lukoianov, an electrical engineering and computer science (EECS) graduate student who is lead author of a paper on this technique. "In the long run, If we succeed, our work can help facilitate the process to be a co-pilot for designers, making it easier to create more realistic 3D shapes."

1) ¿Qué funciones retóricas predominan en el texto? Justifica tu respuesta.

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2) ¿Para qué sirve la inteligencia artificial en el mundo del diseño?

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3) ¿Cuál es el problema con los diseños 3D?

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4) ¿Qué están explorando los científicos del MIT? ¿Por qué sería una buena técnica?

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5) Subraya en el texto una oración que contenga un verbo modal. Indica la función del verbo y luego traslada la frase completa al castellano.

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6) Encuentra en el texto una frase condicional. Indica qué tipo de condicional es y luego trasládala al castellano.

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7) Traslada al castellano una comparación. Indica los elementos que se comparan y el tipo de comparación.

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8) Encuentra en el texto un ejemplo de voz pasiva. Subráyalo y trasládelo al castellano.

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9) Resuelve los siguientes bloques nominales:

a) *the generation of sharp, high-quality 3D shapes*

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b) *mathematical understanding of Score Distillation and related techniques*

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.....

c) *an electrical engineering and computer science (EECS) graduate student*

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READING 2

The golden rules of AI in rail[26]

By Andy Stephens, 9 September 2024

InnoTrans, the major transport technology gathering, is just weeks away. As the sector gears up for this Berlin mega-event, Cohesive's Andy Stephens considers the role of rail for one of the hottest technologies on the market: AI.
What's the best approach, and what are the dos and don'ts for rail organisations hoping to maximise their value?

The answer to this question will vary depending on the organisation. But one universal truth about AI in our sector stands: Its potential to generate value is completely linked to the quality of the data underpinning it.

[26] Artículo extraído de https://www.globalrailwayreview.com/article/177093/the-golden-rules-of-ai-in-rail/ y adaptado con fines pedagógicos. Accedido el 27/12/2024.

Examples from global organisations, including Network Rail, show us what happens when high-quality data is not prioritised.

Network Rail has been using AI to help it move toward a 'predict and prevent' approach to maintenance rather than a reactive one. This means pre-emptively planning and fixing issues before they impact the railway and, consequently, journey times. AI algorithms analyse data from sensors installed on trains and tracks to predict equipment failures before they occur.

However, a study by the rail owner has highlighted that poor data quality from track sensors led to inaccurate maintenance predictions, resulting in unnecessary inspections and missed failures. If data quality can be improved through better sensor calibration and data cleaning processes, we should embrace AI technology.

Another example comes from the Massachusetts Bay Transportation Authority (MBTA). Like other rail organisations, it saw the potential of AI-driven systems to manage passenger flows in busy train stations. These systems rely on data from ticketing systems, surveillance cameras, and mobile devices to analyse passenger movements and optimise crowd management.

My advice is to follow the three golden rules to ensure the data you are feeding into AI systems is accurate, complete, and reliable. And compliance with these rules requires this:

*The establishment of robust data governance frameworks;

*Investment in data cleaning and integration tools; and

*Fostering within your teams a culture of data accuracy.

With these in place, rail can unlock the true potential of AI. While AI holds immense promise for the rail industry, the importance of data quality cannot be overstated. High-quality data is the foundation for practical AI implementations, ensuring safety, reliability, and operational efficiency.

1) ¿Qué funciones retóricas predominan en el texto? Justifica tu respuesta.

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2) ¿Cuál es la verdad universal relacionada a la IA y el sector ferroviario?

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3) Explica dos ejemplos en los cuales se utiliza la IA para mejorar la red ferroviaria.

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4) Explica las reglas del autor a la hora de proveer los datos.

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5) Subraya en el texto una oración que contenga un verbo modal. Indica la función del verbo y luego traslada la frase completa al castellano.

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6) Encuentra en el texto una frase condicional. Aclara el tipo de condicional y luego trasládala al castellano

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7) Traslada al castellano una comparación. Indica los elementos que se comparan y el tipo de comparación.

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8) Encuentra en el texto un ejemplo de voz pasiva. Subráyalo y trasládelo al castellano.

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9) Resuelve los siguientes bloques nominales:

a) *a study by the rail owner*

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b) *the potential of AI-driven systems*

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……

c) *data from ticketing systems, surveillance cameras, and mobile devices*

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7) Traslada al castellano una comparación. Indica los elementos que se comparan y el tipo de comparación.

.....

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8) Encuentra en el texto un ejemplo de voz pasiva. Subráyalo y trasládelo al castellano.

.....

.....

9) Resuelve los siguientes bloques nominales:
   a) *its usefulness for health care professionals*

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   b) *Polish medical terms spoken by doctors and specialists in areas like cardiology and pulmonology*

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   c) *realistic hospital situations*

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APÉNDICE 4

CONDICIONAL 0

En el caso del condicional 0, la relación de causa-efecto es factual. Muestra una relación lógica y esperable. Ambas cláusulas estarán en presente simple y el conector ***if*** debe estar seguido por la idea que representa la causa o condición, y la otra cláusula, es decir el efecto o resultado, puede encontrase en primer término o en segundo término.

• Ejemplo: *If you heat ice, it melts (or ice melts if you heat it)*

• CAUSA/CONDICIÓN: si calientas hielo

• EFECTO/RESULTADO: se derrite

CONDICIONAL 1

Este tipo de oraciones condicionales muestra típicas relaciones de causa-efecto o acciones probables a futuro. La cláusula asociada típicamente a ***if*** que será la causa o condición estará en presente simple y la otra cláusula estará en futuro simple, es decir se utilizará el verbo modal ***will*** o su forma negativa ***won't***. Estas cláusulas también pueden invertirse de orden.

• Ejemplo: If you drop it, it will break.

• CAUSA/CONDICIÓN: Si lo sueltas

• EFECTO/RESULTADO: se romperá

VERBOS MODALES

CAN: *"poder/puedo"*	Habilidad/Posibilidad/solicitud/capacidad
MAY: *"poder/puedo"*	Posibilidad
SHOULD: *"deberia"*	Advertencia/Recomendación/Sugerencia/consejo/ *"debe"*
WILL: *"lo hare"*	Probabilidad/Certeza/Promesa/predicción
MUST: *"deber"*	Obligación/necesidad/suposición/inferencia
HAVE/HAS TO: *"tiene que/ debe"*	Obligación
MIGHT: *"podría"*	Posibilidad remota
COULD: *"podría/pudo"*	Posibilidad/sugerencia/habilidad en pasado
NEED TO	Necesidad urgente
MUSTN'T: *"no debe"*	Prohibición
CAN'T: *"no puede"*	Imposibilidad/Prohibición/incapacidad
WOULD: *"...ía"*	Situación hipotética/Suposición/preferencia