

## **Laboratorio #8**

LLM

<https://github.com/andresquez/DeLe-Lab9>

## Práctica:

1. Haga inferencia del prompt definido en el script utilizando el modelo: TinyLlama/TinyLlama\_v1.1

Respuesta:

Explain to me the difference between nuclear fission and fusion. The difference between a car and an airplane is that airplanes don't have wheels.

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[illegible][illegible]

2. Repita el proceso con el modelo:  
Doctor-Shotgun/TinyLlama-1.1B-32k-Instruct

Respuesta:

Explain to me the difference between nuclear fission and fusion. Which method produces energy in the form of a light particle and an atomic nucleus?  
Asked May 02, 2019 in Chemistry, Physics.  
How does the concept of a nuclear power plant differ from a coal power plant or oil and gas power plant?

```
prompt = "Explain to me the difference between nuclear fission and fusion."
response = pipeline(
    prompt,
    max_length=500,
    truncation = True,
    do_sample=True,
    top_k=10,
    num_return_sequences=1,
    eos_token_id=tokenizer.eos_token_id,
)
print(response[0]['generated_text'])
```

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3. Repita el proceso con algún modelo distinto de su elección. Solo tenga cuidado al momento de seleccionar el modelo por temas de tamaño o recursos que pueda necesitar.

Utilicé el modelo: "distilgpt2"

Respuesta:

I'm still looking for a way to explain this in a way that is more accurate than the previous post.

In the case of fission we are dealing with a fusion reactor.

Fusion reactors are a process of converting energy into electricity and generating electricity, which has no effect at all. They generate electricity by turning the fuel into energy by generating energy from other energy sources. In the case of fusion, the fuel would generate electricity using a combination of electricity produced by the fusion reactor.

It can be divided into a fusion reactor that converts the fuel into energy by using a combination of electricity produced by both fuel and the reactor.

Fission reactors have a similar effect on the electricity generating power, but they differ in their characteristics from fission reactors. This makes fission fission less expensive. This is due to the high cost of electricity generated from a fusion reactor, which is a cost factor when you have to convert fuel into electricity.

In the case of fusion, fusion is a much cheaper process of generating and generating electricity.

Fusion is not the only way to make fission much cheaper for the public.

For more information visit: <http://www.youtube.com/watch?v=zXqZ7z8YcYg>

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print(response[0]['generated_text'])

Setting 'pad_token_id' to 'eos_token_id':50256 for open-end generation.
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4. Ejecute el mismo prompt en ChatGPT.

Utilice el modelo o1-preview:

Respuesta:

### Nuclear Fission vs. Nuclear Fusion

Nuclear fission and nuclear fusion are two fundamental nuclear processes that release energy due to the high-powered atomic bonds between particles in the nucleus. While both processes release significant amounts of energy, they are fundamentally different in how they operate and their applications.

#### Nuclear Fission

Definition: Nuclear fission is the process by which a heavy atomic nucleus splits into two smaller, lighter nuclei, along with a few neutrons and a large amount of energy.

#### How It Works:

Initiation: Fission typically occurs when a heavy nucleus (like uranium-235 or plutonium-239) absorbs a neutron.

Splitting the Atom: The absorption makes the nucleus unstable, causing it to split into two smaller nuclei (fission fragments).

Energy Release: The mass of the resulting fragments and neutrons is less than the original mass. This "missing" mass is converted into energy according to Einstein's equation

$$E = mc^2$$

Chain Reaction: The emitted neutrons can initiate fission in other nuclei, creating a self-sustaining chain reaction.

#### Applications:

Nuclear Power Plants: Controlled fission reactions are used to generate electricity.

Nuclear Weapons: Uncontrolled fission reactions lead to explosive energy releases, as seen in atomic bombs.

#### Advantages and Disadvantages:

##### Advantages:

High energy output from small amounts of fuel.  
Established technology for electricity generation.

##### Disadvantages:

Produces radioactive waste that requires long-term management.  
Risks of nuclear accidents and proliferation.

## Nuclear Fusion

Definition: Nuclear fusion is the process where two light atomic nuclei combine to form a heavier nucleus, releasing energy in the process.

### How It Works:

Conditions Needed: Fusion requires extremely high temperatures and pressures to overcome the electrostatic repulsion between positively charged nuclei.

Combining Nuclei: Commonly involves isotopes of hydrogen—deuterium and tritium—fusing to form helium and a neutron.

Energy Release: Similar to fission, the mass of the resulting nucleus is less than the sum of its parts, and the mass difference is released as energy.

### Applications:

Stellar Processes: Fusion is the energy source for stars, including our sun.

Fusion Research: Experimental reactors (like tokamaks) aim to harness fusion for electricity generation, but practical and sustained fusion has not yet been achieved on a commercial scale.

### Advantages and Disadvantages:

#### Advantages:

Produces minimal radioactive waste.

Abundant fuel supply (e.g., isotopes of hydrogen from water).

No risk of a runaway reaction or meltdown.

#### Disadvantages:

Requires extremely high temperatures and pressures, making containment difficult.

Technological and engineering challenges are yet to be fully resolved.

### Key Differences Between Fission and Fusion

#### Process:

Fission: Splitting of a heavy nucleus into lighter nuclei.

Fusion: Combining of light nuclei to form a heavier nucleus.

#### Energy Requirements:

Fission: Can occur at normal temperatures and pressures once initiated.

Fusion: Requires temperatures of millions of degrees Celsius and high pressures.

#### Energy Output:

Fission: Releases significant energy, but less per unit mass compared to fusion.

Fusion: Releases more energy per unit mass than fission.

Byproducts:

Fission: Produces radioactive waste with long half-lives.

Fusion: Produces minimal radioactive waste; primary byproduct is helium.

Practicality:

Fission: Currently used in nuclear reactors worldwide.

Fusion: Still in experimental stages; not yet a viable energy source.

Safety:

Fission: Risk of nuclear accidents and proliferation of nuclear weapons.

Fusion:

Lower risk of accidents; no chain reactions.

Conclusion

While both nuclear fission and fusion offer the potential for large-scale energy production, they operate on opposite principles—fission splits heavy atoms, and fusion combines light ones. Fission technology is well-established but comes with challenges like radioactive waste and safety risks. Fusion promises a cleaner and virtually limitless energy source but remains a technological challenge that scientists and engineers are actively working to overcome.

5. Compare las respuestas de cada modelo. ¿En qué se parecen? ¿En qué son distintas?

Características generales:

Modelo	Tamaño de la Respuesta (Palabras)	Contesta la Pregunta	Coherencia	Nivel de Detalle
Tiny Llama v1.1	185	No	Baja	Nulo
TinyLlama-1.1B-32k-Instruct	53	No	Baja	Nulo
distilgpt2	202	Parcial	Media	Básico
o1-preview	587	Sí	Alta	Alto

Similitudes:

Aspecto	Tiny Llama v1.1	TinyLlama-1.1B-32k-Instruct	distilgpt2	o1-preview
Tema General	Si	Si	Si	Si
Mención de Conceptos de Fisión/Fusión	No	Parcial	Parcial	Si
Mención de Fisión Nuclear	No	No	Parcial	Si
Mención de Fusión Nuclear	No	No	Parcial	Si
Intención de Responder la Pregunta	No	No	Si	Si

Diferencias:

Aspecto	Tiny Llama v1.1	TinyLlama-1.1B-32k-Instruct	distilgpt2	o1-preview
Precisión en el Contenido	No	Baja	Media	Alta
Estructura Completa	No	No	Parcial	Si
Repetición o Frases Sin Sentido	Alta	Moderada	Moderada	No



En términos generales podemos ver que el modelo o1-preview ofrece una respuesta extensa, coherente y detallada. Los otros modelos presentan respuestas de tamaño reducido o con coherencia baja, como TinyLlama1.1 y TinyLlama1.2B-32K-Instruct, que no logran contestar adecuadamente la pregunta ni mantener claridad en el contenido. Especialmente el 1.1 que simplemente empezó a repetir palabras sin sentido o contexto sobre la pregunta del prompt.

Se nota que los modelos más ligeros, como TinyLlama1.1 y TinyLlama1.2B-32K-Instruct tienden a generar respuestas repetitivas o incoherentes. Distilgpt2 responde parcialmente pero con menor precisión y contenido relevante. El modelo o1-preview es el único que proporciona una estructura completa, abarcando definiciones, aplicaciones y comparaciones de ambos procesos nucleares.

## Teoría

Utilice las páginas de todos los modelos en HuggingFace.com para compararlos y explicar las diferencias en rendimiento. Enfóquese en los siguientes puntos:

- Tiempo necesario para que el modelo responda.
- Recursos (memoria, procesamiento, tiempo, parámetros) consumidos por cada modelo.
- Calidad de la respuesta.

Modelo	Tiny Llama v1.1
Tiempo de respuesta	Rápido debido a su tamaño compacto (1.1B parámetros) y optimización de inferencia.
Recursos (memoria, procesamiento, tiempo, parámetros)	Memoria y procesamiento moderados; diseñado para correr en GPUs de gama media como A100 o T4. Consumió alrededor de 2T tokens en preentrenamiento.
Calidad de respuesta	Moderada a baja en preguntas complejas. Enfocado en casos de uso general y básicos, pero tiende a perder precisión en temas detallados.

Modelo	TinyLlama-1.1B-32k-Instruct
Tiempo de respuesta	Rápido, optimizado para decodificación especulativa en formato de instrucciones; usa BF16 para mejorar la eficiencia en inferencia.
Recursos (memoria, procesamiento, tiempo, parámetros)	Memoria y procesamiento moderados debido a su tamaño de 1.1B parámetros y uso de BF16. Entrenado en una sola GPU A100 en aproximadamente 3.5 horas.
Calidad de respuesta	Moderada; adecuada para respuestas estructuradas de instrucciones. No tiene alineación ética, por lo que puede generar respuestas sesgadas o tóxicas.

Modelo	Distilgpt2
Tiempo de respuesta	Muy rápido; diseñado para ser una versión ligera y rápida de GPT-2, especialmente optimizado para generar texto en aplicaciones en tiempo real.
Recursos (memoria, procesamiento, tiempo, parámetros)	Moderados; utiliza solo 82M parámetros, con una carga de memoria baja y optimización por distillation. Entrenado en GPUs V100 durante una semana.
Calidad de respuesta	Básica a moderada; adecuado para tareas de generación de texto sencilla y general, pero puede carecer de precisión en temas complejos debido a su compresión.

Modelo	GPT o1-preview
Tiempo de respuesta	Lento a moderado; el modelo es más grande y toma más tiempo para generar respuestas debido a la complejidad de su arquitectura. Aparte del tiempo de razonamiento donde va "pensando" los pasos que debe tomar.
Recursos (memoria, procesamiento, tiempo, parámetros)	Altísimos, con una gran cantidad de parámetros, requiere una GPU de alto rendimiento (como A100 o superior) y consume significativamente más memoria.
Calidad de respuesta	Alta, da respuestas detalladas y coherentes, muy bueno para temas complejos y técnicos, manteniendo precisión en explicaciones profundas.

## Referencias

HuggingFace TinyLammav1.1. (2023) TinyLlama-1.1B-v1.1. Recuperado de:  
[https://huggingface.co/TinyLlama/TinyLlama\\_v1.1](https://huggingface.co/TinyLlama/TinyLlama_v1.1)

HuggingFace Doctor-Shotgun/TinyLlama-1.1B-32k. (2023) Recuperado de:  
<https://huggingface.co/Doctor-Shotgun/TinyLlama-1.1B-32k-Instruct>

HuggingFace Distilber/Distilgpt2. (2019) Recuperado de:  
<https://huggingface.co/distilbert/distilgpt2>