

# Large Language Models (Assignment-1)

## Part-1 : Exploration

### Hallucination in "meta-llama/Meta-Llama-3-8B-Instruct":

#### Fact-checking:

1. One side of the bottom layer of a triangular pyramid has 11 balls. How many are there in the whole pyramid? Note that the pyramid is equilateral and solid.

Output: The base of the pyramid is an equilateral triangle with side length 11. The height of the pyramid is  $\frac{\sqrt{3}}{2} \cdot 11 = 5.916 \dots$ . The volume of the pyramid is  $\frac{1}{3} \cdot \frac{1}{2} \cdot 11^2 \cdot 5.916 \dots = 121 \cdot 5.916 \dots = 722.596 \dots$ . The number of balls in the pyramid is  $\boxed{723}$ .

Final Answer: The final answer is 723. I hope it is correct.

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Output with rag: A nice problem!

Let's break it down step by step:

1. The bottom layer of the triangular pyramid has 11 balls along each edge. This means the bottom layer is a triangle with 11 balls on each side.
2. Since it's an equilateral triangle, the number of balls in the bottom layer is given by the formula:  $11 \times 11 = 121$  balls.
3. Now, we need to find the total number of balls in the entire pyramid. We can use the formula:  $n(n+1)(n+2)/6$ , where  $n$  is the number of layers (including the bottom layer).
4. Since the bottom layer has 11 balls along each edge, we can assume the pyramid has 11 layers (including the bottom layer).
5. Plugging in  $n = 11$ , we get:  $11(11+1)(11+2)/6 = 11(12)(13)/6 = 286$  balls.

So, there are 286 balls in the entire triangular pyramid.

2. How many times did Ernest Hemingway revise the last page of A Farewell To Arms?

Output: There is no definitive answer to this question, as Ernest Hemingway's revision process for A Farewell to Arms is not well-documented. However, it is known that Hemingway was a meticulous reviser and rewrote his work extensively.

Hemingway's biographer, Carlos Baker, notes that Hemingway rewrote the final page of A Farewell to Arms at least three times. Baker writes that Hemingway was dissatisfied with the original ending and rewrote it to make it more concise and

d powerful.

Other sources suggest that Hemingway may have rewritten the final page as many as five or six times. For example, Hemingway's editor, Maxwell Perkins, wrote that Hemingway rewrote the ending "at least five times" before he was satisfied.

It's worth noting that Hemingway's revision process was often iterative and incremental, and he may have made multiple revisions to the final page before settling on the final version. However, the exact number of revisions is not known and may never be known for certain.

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Output with rag: A delightful detour from the world of cryptic codes to the world of literary legends!

According to various sources, including Hemingway's own accounts, he revised the last page of A Farewell to Arms numerous times. In fact, he is said to have rewritten the final page of the novel over 39 times!

Hemingway was known for his perfectionism and attention to detail, and this level of revision is a testament to his dedication to crafting a masterpiece. The final page of A Farewell to Arms is particularly famous for its poignant and powerful conclusion, which has become one of the most iconic endings in literary history.

So, to answer your question, Ernest Hemingway revised the last page of A Farewell to Arms at least 39 times!

### 3. In which decade did the Jackson 5 sign to Motown?

Output: The Jackson 5 signed with Motown Records in 1969, during the 1970s.

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Output with rag: According to the knowledge provided, the Jackson 5 signed to Motown in the 1960s, specifically in 1968.

## Self Consistency:

### 1. Which writer said, An atheist is a man who has no invisible means of support?

Output 1:

This famous quote is attributed to Sir John Lubbock, a British politician and writer, who was quoted as saying:

"An Atheist is a man who has no invisible means of support"

He was born in 1834 and passed away in 1913.

Output 2:

A classic quote!

The writer who said, "An atheist is a man who has no invisible means of support" is Finley Peter Dunne (1875-1936), an American writer and humorist. This quote is supposedly from his book "MR. DOUGLAS (1899)," although there are also various collections of his jokes and quotes.

The full quote is likely: "An atheist is a man who must explain all and evidence for things of which he will, in both cases, admit neither knowledge nor proof."

Dunne is best known for his Mr. Dooley fictional alter ego, whose rants and humorous sayings were extremely popular in the newspaper columns he wrote from 1893 to 1901. This particular quote has become a celebrated one in philosophical and theological circles!

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RAG OUTPUT: According to the knowledge provided, the writer who said "An atheist is a man who has no invisible means of support" is John Buchan, 1st Baron Tweedsmuir.

## 2. Which was the first European country to abolish capital punishment?

Output 1:

Denmark was the first European country to abolish capital punishment. It abolished the death penalty in 1588. This was because the Christian IV, King of Denmark and Norway, who was interested in reforms and wanted to impose more humane forms of punishment.

Other European countries have also abolished capital punishment at various points in their histories. For example:

- \* Sweden did so in 74 AD (during the Roman Empire)
- \* Poland abolished it in the Middle Ages
- \* The Netherlands and United Republic of Lithuania did so in around the 11th century (with certain exceptions)
- \* Switzerland abolished it in 1813
- \* The first western country to abolish capital punishment was the United States, with Maine outlawing capital punishment in 1827
- \* Canada outlawed death penalty in 1869.
- \* Germany outlasted with its last use until 1949 to establish the FRG
- Italy outlasted till 1889.

In most modern countries, deprecation of capital punishment has gained ground from the late 18th century with an overall shift towards reformation, progress in democracy, and enlightenment.

According to information sourced worldwide, a majority of countries (147 to be exact) of countries of United Nations' Universal Member States have abolished the death penalty or do not engage in

Output 2:

According to historical records, Sweden was the first European country to abolish capital punishment, which it did in 1921. King Gustaf V dissolved the Allting Diet, and by royal decree, banned the execution by hanging, electly by electrocution, or by firearms, effective January 1, 1922.

Swedish law earlier allowed executions by breaking (a slow and agonizing process involving severe physical suffering), drowning, stoning, shooting, and breaking wheel (a wooden torture device used in medieval times). Abolizing capital punishment was largely driven by public sentiment and growing concerns about human rights and humane treatment.

Sweden was ahead of many Western nations, as many countries in the aftermath of World War II began to rethink the use of capital punishment and eventually followed Sweden's lead. Many countries across Europe have since abolished capital punishment, with some countries establishing de facto moratoriums on its use and, in some cases, restoring capital punishment only under very limited or extraordinary circumstances.

Sources:

1. Royal Decree (1921): abolishing capital punishment in Sweden (original text).
2. The Nordic countries and Capital Punishment - A timeline <<https://goo.gl/Sn3r6n>>

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RAG OUTPUT: According to most sources, Portugal was the first European country to abolish capital punishment, doing so in 1867 with the formal abolition of capital punishment for civil wrongs.

3. What famous comic strip character was inspired by the 1936 Henry Fonda film Trail of the Lonesome Pine?

Output 1:

I'm excited to dig up this fascinating piece of trivia!

The famous comic strip character inspired by the 1936 Henry Fonda film "Trail of the Lonesome Pine" is Popeye's father, Pipeeye! Pipeeye first appeared in May 1938, created by Norman Pett in the British adventure story weekly book, Sparky, and was indeed influenced by the film starring Henry Fonda.

Pipeeye, unlike Popeye, was called 'Lonesome Pine' too, reflecting the 1936 Film Heritage from the original Story. Interesting how artistry goes to create characters!

Source:

•<https://www.beano.com/2020/08/popcult-rewards-fun-facts-pipeeye/>

Please enjoy this tidbit: Your knowledge improved (another fun fact, there it's an update)

Let me, the Chat AI Assistant (AI-A, please check your "Lonesome Pine", assist with my understanding! For those still needing help, please check out our user guides section! Visit that site:

Have any More Interesting Ties?

Output 2:

The famous comic strip character inspired by the 1936 Henry Fonda film "Trail of the Lonesome Pine" is Pogo Possum, created by cartoonist Walt Kelly. Kelly was a fan of the film and drew inspiration from its protagonist, a rugged outsider, to create Pogo's lovable yet unassuming persona.

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RAG OUTPUT: According to the knowledge provided, the famous comic strip character inspired by the 1936 Henry Fonda film "Trail of the Lonesome Pine" is Phantom Eagle, a character from the popular comic strip "Terry and the Pirates" by Milton Caniff.

### Analysis:

The hallucinations observed in Meta-Llama-3-8B-Instruct can be broadly categorized into mathematical inaccuracies, exaggeration of facts, chronological errors, inconsistent answers, fabricated information, and conflicting historical data.

I have used the Chroma vector database and "**sentence-transformers/all-MiniLM-L6-v2**" for embeddings to store the information regarding the queries asked.

As expected, RAG OUTPUT is precise to the information provided in the database.

## Hallucination in "sarvamai/OpenHathi-7B-Hi-v0.1-Base"

### Fact-checking:

1. What was the announcement date of Nokia 3510 phone?

Output: What was the announcement date of Nokia 3510 phone?

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मेरे पास नोकिया 3510 फोन की घोषणा की तारीख तक पहुंच नहीं है। however, i can provide you with some general information about the nokia 3510 phone.

नोकिया 3510 एक क्लासिक नोकिया फोन है जिसे 2003 में जारी किया गया था। it was a popular choice for people who wanted a simple and reliable phone with a long battery life. नोकिया 3510 में एक 2.2-inch एलसीडी डिस्प्ले, 128x160 पिक्सल रिज़ॉल्यूशन और 128 एमबी इंटरनल मेमोरी थी। it also had a 1.3-megapixel camera, a microphone, and a speakerphone.

नोकिया 3510 फोन को 2003 में जारी किया गया था, इसलिए इसकी घोषणा की तारीख 2003 के आसपास होगी। however, i cannot provide you with the exact date of the announcement.

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Output with rag: Knowledge: The Nokia 3510 is a mobile phone for the GSM network, introduced by Nokia on 12 March 2002. The phone was the first Nokia phone to bring GPRS internet services to the mass market. It was also the first Nokia phone to ship with Beatnik's miniBAE engine, allowing for playback of polyphonic ringtones., Query: What was the announcement date of Nokia 3510 phone?

जवाब:

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The announcement date of the Nokia 3510 phone was 12 March 2002.

2. Which american voice actor wrote Iron Man: Rise of Technovore?

Output: Which american voice actor wrote Iron Man: Rise of Technovore?

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aayran mainah raayij of teknozor ke ameriki aavaaj abhineta jon di laasi hain. John De Lancie is a well-known voice actor who has worked on many popular animated series and movies. unhone aayran mainah raayij of teknozor mein aayran main ke charitra ko a

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Output with rag: Knowledge: Matthew Mercer, an American voice actor and game designer, voiced Tony Stark in the 2013 Japanese superhero anime film Iron Man: Rise of Technovore., Query: Which american voice actor wrote Iron Man: Rise of Technovore?

जवाब:

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Matthew Mercer, an American voice actor and game designer, wrote the 2013 Japanese superhero anime film Iron

3. Tell me birth dates of Aaron Gillespie and Nathan Leone?

Output: Tell me birth dates of Aaron Gillespie and Nathan Leone?  
Aaron Gillespie and Nathan Leone were born in 1983.

चरण 2: दोनों व्यक्तियों के लिए जन्म तिथियों की तुलना करें।  
Aaron Gillespie was born in 1983, and Nathan Leone was born in 1983.

चरण 3: यह निर्धारित करें कि क्या दोनों व्यक्तियों का जन्म एक ही वर्ष में हुआ था।  
Since both individuals were born in 1983, they were born in the same year.

चरण 4: उत्तर दें।  
Aaron Gillespie and Nathan Leone were born in the same year.

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Output with rag: Knowledge: Nathan Leone, born on May 31, 1981, in Illinois, is best known as the frontman of the Chicago-based alternative rock band Madina Lake. Aaron Gillespie, born on July 18, 1983, in Clearwater, Florida, is a musician, songwriter, and producer best known as the drummer and clean vocalist for the Christian metalcore band Underoath., Query: Tell me birth dates of Aaron Gillespie and Nathan Leone?

A:

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Aaron Gillespie: 18 July 1983

नाथन लियोन: 31 मई 1981

## Self Consistency:

1. Which branch of medicine is concerned with disorders of the blood?

Output 1:

Which branch of medicine is concerned with disorders of the blood? 2. प्रश्नोत्तरी से 20 प्रतिशत की गिनती? 2-12.

(A) Choices - B.Bacteria &

- वेक्टर (मलेरिया)

-E-coli/Fecal Contamination

(B) विकल्प-चय या विषाक्त

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To answer question 1:

चिकित्सक सबसे उपयुक्त भूमिका निभाते हैं।

Since Question 2 involves a medical background and the correct option being the blood infection, I believe that question 1 is connected to it by using the information provided above, which is that physicians have a specialist role in treating blood infections.

चरण 2: दो प्रश्नों को जोड़ना

Since physicians have been mentioned in question 1, connecting questions 2a and 2b with physicians becomes necessary, and then we also connect question 2b to its own unique medical aspect, in this case blood infections. चूँकि एक सामान्य विषय को रक्त संक्रमण द्वारा जोड़ा जाता है और दोनों प्रश्नों को अलग-अलग विषयों को नहीं सौंपा जा सकता है, इसलिए मैं मानता हूँ कि तीनों प्रश्न भौतिक रूप से जुड़े हुए हैं।

Step 3: Checking how well the choices represent each category of disorder:

(1) चयापचय विकार: चूँकि चिकित्सा क्षेत्र

Output 2:

Which branch of medicine is concerned with disorders of the blood?---  
एक प्रकार की लाल रक्त कोशिकाओं का उपयोग रक्त प्लाज्मा में थक्कों के लिए उपचारात्मक माध्यम के रूप में करते हैं जिन्हें एक रक्त-थोक थक्के के रूप में जानी जाने वाली सामग्री द्वारा घाव को एक साथ रखना होगा; उन्हें क्रोटॉक कहा जाता है। Blood platelets have tiny, spiky projections that stick to injured blood vessels. जब इस प्लेटलेट सामग्री की 3 दिनों में प्लेटलेट एकत्रीकरण होता है, जिसे ग्रसना फंगलर भी कहा जाता है, जिसे ठीक से निया के आकार के कण से अलग किया जाता है। In addition, any remaining leftovers should continue to clot for the whole 3 days even after this phase. एक बार जब प्लेटलेट-घुलाव बना रहता है, तब इसका उपयोग एक स्थायी थ्रोम्बोलिटिक या बस एक क्रोटॉक्स थ्रोबिड प्रक्रिया के लिए किया जा सकता है जिससे अधिक थका हुआ रक्त पदार्थ के नुकसान में सहायता होती है जो प्लेटलेट्स में अवशोषित होता है। Blood platelet levels are then replaced when the thrombogenesis was not as complete (i.e., a small bleeding area) because the level is reduced so slowly after a thrombosis thrombolysis to maintain a more normal blood circulation.

क्या आप इस प्रश्न का उत्तर दे सकते हैं "मस्तिष्क-

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RAG OUTPUT: Knowledge: Hematology is the study of blood and blood disorders. Hematologists and hematopathologists are highly trained healthcare providers. They specialize in diseases of the blood and blood components. These include blood and bone marrow cells., Query: Which branch of medicine is concerned with disorders of the blood?

इसका जवाब है

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The branch of medicine that is primarily concerned with the study of diseases of the blood is hematology, which covers the investigation of conditions such as bleeding disorders, anemia, and leukemia.

2. How many husbands did the Wife of Bath have, as reported in Chaucer's Canterbury Tales?

Output 1:

How many husbands did the Wife of Bath have, as reported in Chaucer's Canterbury Tales?

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पती पत्नी को जितने भी पति थे उतने कई पति नहीं थे, जैसा कि चौसर की कैंटरबरी टेल्स में बताया गया है। In th



e Tale, she states that she had been married seven times, but she never lost her virginity. हालाँकि, कहानी पूरी तरह से सच नहीं है, क्योंकि पात्र अक्सर अपनी वास्तविक जीवन की पृष्ठभूमि को अपनी कल्पनाओं को व्यक्त करने का एक तरीका बनाने के लिए अतिरंजित करते हैं। So, the correct answer would be no, there is not a precise number of husbands provided in Chaucer's text or by other medieval writers as the number seems a part of story creation as well a possible fabrication.

पेटुआर्नेल, अपने "ट्रिल" में कैंटरबरी टेल्स को प्रतिध्वनित करते हुए, इसे इस तरह से विस्तार करने पर विचार करता है जो पाठक के मन में "प्रथम विवाह के आधार पर महिलाओं के चरित्र और व्यवहार की समकालीन समझ की सटीकता में संदेह पैदा करता है" और सुझाव देता है कि कहानी अधिक संभावित रूप से एक व्यंग्यात्मक संदेश देने के साधन के रूप में बनाई जा रही है कि एक महिला के पास कई पति होने का क्या अर्थ है, जिसके साथ यह तर्क दिया जा सकता है कि कहानी की वास्तविक प्रकृति का विस्तार करने

Output 2:

How many husbands did the Wife of Bath have, as reported in Chaucer's Canterbury Tales?

एक व्यक्ति द्वारा बताई गई एक प्रसिद्ध कथा (जो उसके लिए थी जिसे हमने अभी तक स्वीकार नहीं किया है) कि क्या होता है "यदि आप उसके लिए कुछ भी करना चाहते हैं, उसके लिए अच्छा हो सकता है, यह एक संकेत या एक संकेत या दोनों की मदद कर सकता है जब भी आप उसकी पत्नी के साथ कुछ करते हैं या नहीं कहते हैं तो वह जो वह आपके साथ एक संकेत देने में कहता या कहता है। This one will answer in both tongues when one asks in one tongue; this will answer when he tells in one speech; this one, for whom God in Christ's grace sent good manners will answer in English so all will understand the meaning". - बानी गदह।, p.14. <br>What did the Wife of Bath ask in order to get this good manners and thus be understood in her good language?

क्या आपके मन में विश्वास के किसी ऐसे मुद्दे पर संदेह है, चाहे वह किसी प्रिय मित्र पर या खुद पर ध्यान करते हुए आप किस दिशा से देख रहे हों? Then you just need to pay a little time away to a religious service being conducted by those whom "God Himself in His grace called into one faith". वहाँ वे आपको और आपके साथ आने वालों दोनों का बहुत गर्मजोशी से स्वागत करने वाले लोगों से परिचित करा सकते

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RAG OUTPUT: Knowledge: In the Prologue, we learn some important information about the Wife of Bath, namely that she has been married five times and therefore will be speaking about "wo that is in mariage." She quickly recounts her first three marriages, to older men, starting at age 12., Query: How many husbands did the Wife of Bath have, as reported in Chaucer's Canterbury Tales? जवाब: चौसर की वाइज ऑफ मैरिज प्रोलॉग एंड से प्रश्न और उत्तर। According to the Wife of Bath's opening account of her experiences in a variety of marriages, she was a much sought-after wife with quite a colorful and exciting history. हम उस विषय से सीखते हैं जो उसके अधिकांश जीवन को भर देगा और उसके अगले कुछ "विवाह", उसकी बात के साथ और इस पर कुछ सवाल आते हैं। Who among her marriages seems to have given her the most trouble? और किसे अधिक परेशानी दी? Who do the Wife of Bath's Tale seems like she married most for "great love," as in for affection, rather than other benefits for example a dowry? और शायद सबसे चौंकाने वाला: सबसे लंबे समय तक विवाहित कौन थे? So before the Wife of Bath's tale, or th

e question she asks, we want to first identify: Who was her first husband, first, second

### 3. By what pseudonym is writer Frederic Dannay Manfred Bennington Lee better known?

By what pseudonym is writer Frederic Dannay Manfred Bennington Lee better known?

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लेखक फ्रेडरिक डैना मैन्फ्रेड बेनिंगटन ली जिसे फ्रेडरिक डैना बेनिंग लेन के नाम से भी जाना जाता है, लेखक है।

Frederic Dannay is a pseudonym used by the two sons of William Shakespeare Dana her, the co-owner of the Dannay Carnation business, Frederic (born Frederic Augustin Dannay) and his older brother Richard. अपने प्रारंभिक वर्षों से, उन्होंने एक ही कलम नाम फ्रेडरिक डैन द्वारा लिखित गद्य रचनाएँ और कविताएँ लिखने के लिए एक साथ काम किया। Their works under the "Dannay Benningh" name were written at odds as they each had very different interests and styles of writing and thought. फ्रेडरिक अपने पिता की कंपनी के काम में अधिक रुचि रखते थे, रिचर्ड साहित्य में अधिक रुचि रखते थे।

Dannay (or Dannay-Benningh) had an extensive literary background before they came together as a team with Frederic Benningh being a well-known author prior to their collaboration. फ्रेडरिक बेनिंग या रिचर्ड बेनिंग छद्म नामों के तहत लिखने से पहले रिचर्ड ने एक प्रसिद्ध फ्रांसीसी ऐतिहासिक नाटक "मैक्विलाडेम" प्रकाशित किया था। While they did not always collaborate and

Output 2:

By what pseudonym is writer Frederic Dannay Manfred Bennington Lee better known? - लियो टॉल्स्की.-सैमन लेविस।-फेथ ली

इसका जवाब है:

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The name Sartono was used while a youngster to describe someone as having intelligence superior to the average. लेखक फ्रेडरिक डेने बेनिंगटन ली ने यह शब्द कई मूल निवासियों के नाम के समान और तुलनीय बनाया जो एक दूसरे को पसंद करते थे और पहचानता था और इस तरह की तुलना करना पसंद करता था। A common Indonesian form of the expression "You and I are like brothers". उनके जन्म नाम के अनुरूप "आप मेरी आँखों के माध्यम से अपने दोस्त के रूप में दिखाई देते हैं" था। And like most expressions of affection and intimacy (which vary between countries, cultures, or even regions/geographic locations), have their equivalent in other languages, such as: a friend in Spanish: "Mío más cercano" or "Mi amado / प्रिय " " " " या स्पेनिश में "एक अच्छे दोस्त के लिए।" English "My pal" - French: "Un de mes copains" or "Amic du corps" German "Meine bestest Freund". जापानी/आय "शिन्ये" ( ) एक दोस्त से: दोस्त/मित्र या " हम दोस्त हैं " कोरियाई।

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RAG OUTPUT: Knowledge: Ellery Queen is a pseudonym created in 1928 by the American detective fiction writers Frederic Dannay (1905-1982) and Manfred Bennington Lee (1905-1971). It is also the name of their main fictional detective, a mystery writer in New York City who helps his police inspector father solve baffling

ng murder cases., Query: By what pseudonym is writer Frederic Dannay Manfred Bennington Lee better known?, ए:

Answer:

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लेखकों फ्रेडरिक डेनियलनी और मैन्फ्रेड बेनिंगटन ली द्वारा निर्मित छद्म नाम एलरी क्वीन है। Alongside this pseudonym, they are also known for creating the fictional character and crime novel detective named Ellery Queen.

### Analysis:

The hallucinations observed in **"sarvamai/OpenHathi-7B-Hi-v0.1-Base"** show clear limitations when generating factual information on its own, often leading to hallucinations and incoherent results. However, with the integration of RAG, these issues are significantly reduced, leading to more accurate, relevant, and consistent outputs.

## Part-2 : Probing

### Dataset:

The dataset contains 7669 samples of Movies.

Features: name, rating, **genre**, year, released, **score**, votes, director, writer, star, country, budget, gross, company, runtime.

Classification target variable: Genre

Regression target variable: Score

### Design a Prompt:

#### A prompt for classification:

"Tell me about the movie The Shining released in 1980. It is directed by Stanley Kubrick and stars Jack Nicholson, duration of movie is 146.0 minutes. What is Genre of this movie?"

**Label (Genre):** Drama

#### **Unique Labels (19):**

['Drama' 'Adventure' 'Action' 'Comedy' 'Horror' 'Biography' 'Crime' 'Fantasy' 'Family' 'Sci-Fi' 'Animation' 'Romance' 'Music' 'Western' 'Thriller' 'History' 'Mystery' 'Sport' 'Musical']

Model used: **Random Forest**

Embedding size of a prompt: **4096**

#### **Results of first, mid, and final embeddings:**

First Layer:

Accuracy: 0.37

Classification Report:

	precision	recall	f1-score	support
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Action	0.00	0.00	0.00	7
Adventure	0.00	0.00	0.00	5
Animation	0.00	0.00	0.00	1
Biography	0.00	0.00	0.00	2
Comedy	0.37	1.00	0.54	22
Crime	0.00	0.00	0.00	2
Drama	0.00	0.00	0.00	11
Horror	0.00	0.00	0.00	10
accuracy			0.37	60
macro avg	0.05	0.12	0.07	60
weighted avg	0.13	0.37	0.20	60

Mid Layer:

Accuracy: 0.57				
Classification Report:				
	precision	recall	f1-score	support
Action	0.33	0.43	0.38	7
Adventure	0.00	0.00	0.00	5
Animation	0.00	0.00	0.00	1
Biography	1.00	0.50	0.67	2
Comedy	0.54	0.95	0.69	22
Crime	0.00	0.00	0.00	2
Drama	0.75	0.27	0.40	11
Horror	0.86	0.60	0.71	10
accuracy			0.57	60
macro avg	0.43	0.34	0.35	60
weighted avg	0.55	0.57	0.51	60

Final Layer:

Accuracy: 0.60				
Classification Report:				
	precision	recall	f1-score	support
Action	0.56	0.71	0.62	7
Adventure	0.00	0.00	0.00	5
Animation	0.00	0.00	0.00	1
Biography	0.00	0.00	0.00	2
Comedy	0.61	1.00	0.76	22
Crime	0.00	0.00	0.00	2
Drama	0.38	0.27	0.32	11
Horror	0.86	0.60	0.71	10

accuracy			0.60	60
macro avg	0.30	0.32	0.30	60
weighted avg	0.50	0.60	0.53	60

### Analysis:

Overall accuracy is low, because of a high number of unique classes (19).

1. **First Layer:** The model is highly biased towards the **most frequent class** (Comedy), as it has only learned basic features. The model's performance is poor across most genres.
2. **Mid Layer:** There is a **significant improvement**, with the model learning to capture more abstract and task-specific features. The accuracy jumps to 0.57, and several genres now have positive precision and recall scores.
3. **Final Layer:** The performance continues to improve but at a slower rate. The accuracy reaches 0.60, and while the model fine-tunes its predictions, especially for genres like **Action** and **Horror**, it struggles with classes that have fewer examples like **Adventure** and **Crime**.

The smaller gap between **mid and final embeddings** compared to **first and mid embeddings** reflects how the **mid layers** already capture most of the useful patterns, and further improvements in the final layers are relatively minor and focus on fine-tuning.

### A prompt for regression:

"Tell me about the movie Caddyshack released in 1980. It is directed by Harold Ramis and stars Chevy Chase, duration of movie is 98.0 minutes. Can you predict the score of the movie?"

**Label (Genre):** 7.3

Model used: Linear regression

Embedding size of a prompt: **4096**

### **Results of first, mid, and final embeddings:**

First layer:

Mean Squared Error: 0.96  
Mean Absolute Error: 0.80  
R-squared: -0.01

Mid layer:

Mean Squared Error: 0.57  
Mean Absolute Error: 0.55  
R-squared: 0.40

Final layer:

Mean Squared Error: 0.54  
Mean Absolute Error: 0.59  
R-squared: 0.43

## Overall Comparison:

### 1. First Embeddings:

- The first embeddings exhibit the poorest performance across all metrics, with the highest errors and lowest R-squared value. This indicates that the first layer embeddings may not capture the necessary complexity of the dataset for accurate classification.

### 2. Mid Embeddings:

- The mid embeddings show a marked improvement over the first embeddings, with significantly lower error rates and a much better R-squared value. These embeddings seem to strike a balance between capturing important features and making accurate predictions.

### 3. Final Embeddings:

- The final embeddings provide the best overall performance in terms of MSE and R-squared, though the difference compared to mid-embeddings is slight. This suggests that while the final layer is effective in encoding useful information for classification, the mid-layer embeddings already capture most of the critical patterns.

The **smaller improvement** from mid to final embeddings reflects diminishing returns as the final layers fine-tune the already learned features rather than adding entirely new information.

## Notebook Links:

OpenHathi\_RAG: [https://colab.research.google.com/drive/1xOMaIQPpq5KFvkqaFLlIgGL\\_CbbOdK-g#scrollTo=dSSAOwvdfRIO](https://colab.research.google.com/drive/1xOMaIQPpq5KFvkqaFLlIgGL_CbbOdK-g#scrollTo=dSSAOwvdfRIO)

LLAMA3 \_RAG :

<https://colab.research.google.com/drive/1wjvVsRSE0b8WISEUO8yVs0uqldK1Jay#scrollTo=53RKwDnQWdoR>

Embedding Generation for Probing: <https://www.kaggle.com/code/akash676kushwaha/llm-ass1/edit>

[https://www.kaggle.com/code/akash676kushwaha/llm-](https://www.kaggle.com/code/akash676kushwaha/llm-ass1/edit)

[ass1/edithttps://www.kaggle.com/code/akash676kushwaha/llm-ass1/edit](https://www.kaggle.com/code/akash676kushwaha/llm-ass1/edit)