Infosys

Responsible AI Office

Infosys Responsible AI Toolkit

Explainability for LLMs

API usage Instructions

Contents

Introduction

LLM Explain provides explanations for Large Language Models using methods such as token importance, Graph of Thoughts, and Search Augmentation. It evaluates the responses with metrics including uncertainty, relevancy, and coherence to ensure the reliability and clarity of Generative AI models' outputs.

Once API swagger page is populated as per instructions given in the github repository Readme file, click on 'try it out' to use required endpoints. Details of endpoints associated with LLM-Explainability tenet are outlined below.

Sentiment Detection and Explainability

Endpoint – /rai/v1/llm-explainability/sentiment-analysis
Using this API, we can see sentiment analysis of the prompt along with token importance.

Input:

inputPrompt: Replace the input prompt with the prompt you want to check

```
{
    "inputPrompt": "Unfortunately the movie served with bad visuals but the actors performed well"
}
```

Response:

```
{
    "explanation": [
        {
            "predictedTarget": "Negative",
            "anchor": [
                "unfortunately",
                "bad"
            ],
            "explanation": "The model identified the sentiment of the prompt as negative based on two key words it picked up on: 'unfortunately' and 'bad'. These words are typically associated with a negative sentiment. In this context, despite the actors' good performance, the model interpreted the overall sentiment as negative due to the phrasing about the movie's bad visuals being presented unfortunately.",
            "token_importance_mapping": [
                {
                    "token": "Unfortunately",
                    "importance_score": 48,
                    "position": 0
                },
                {
                    "token": "bad",
                    "importance_score": 52,
                    "position": 5
                }
            ],
            "time_taken": 4.826
        }
    ]
}
```

Uncertainity and Coherence Metrics

Endpoint - /rai/v1/llm-explainability/uncertainty
Using this API, we can evaluate the LLM response in terms of confidence level. to evaluate this, we have metrics such as uncertainty and coherence. Along with evaluation metrics, It provides corresponding explanation and corrective actions to improve the LLM response.

Input:

inputPrompt: Replace the input prompt with the prompt you want to check

response: Add response of the input prompt

```
{
  "inputPrompt": "Who are the co-founders of Infosys?",
  "response": "Infosys was co-founded by Narayana Murthy along with six other engineers: Nandan Nilekani, S. Gopalakrishnan (Kris), S. D. Shibulal, K. Dinesh, N. S. Raghavan, and Ashok Arora. Established in 1981, Infosys started with a modest capital of $250 and has since grown into one of the largest IT services companies in the world. Narayana Murthy, often regarded as the face of Infosys, played a pivotal role in shaping the company's culture and vision, while the combined efforts of all co-founders contributed to its remarkable growth and success in the global IT industry."
}
```

Response:

```
{
  "uncertainty": {
    "score": 0,
    "explanation": "The response provided is confident and specific. It lists all the co-founders correctly and includes their contributions and the company's journey. Furthermore, the details provided, especially around the establishment date and initial capital, are commonly known facts and are not debated.",
    "recommendation": "The response is certain and clear in answering the prompt about the Infosys co-founders and the narrative surrounding the initial formation of the company. Therefore, no changes are required for the prompt to improve this metric score.",
    "uncertainty_level": "Highly Certain"
  },
  "coherence": {
    "score": 95,
    "explanation": "The response is highly coherent. It logically begins with the names of the co-founders, then transitions smoothly into a brief history of Infosys' establishment and growth, and the roles that the co-founders played. All the information is logically connected and relevant to the given prompt.",
    "recommendation": "The response showcases effective coherence. It successfully maintains a logical flow and connects all the bits of information smoothly. Therefore, there are no recommendations for changing the input prompt to improve the coherence score as the flow and linkage of the information provided is excellent.",
    "coherence_level": "Highly Coherent"
  },
  "time_taken": 8.25
}
```

Graph of Thought Reasoning

Endpoint - /rai/v1/llm-explainability/got
Using this API, we can view a graph of thought reasoning for the given input. Here, we provide the final thought, score and consistency level.

Input:

inputPrompt: Replace the input prompt with the prompt you want to check

modelName: Provide deployment name from Azure

```
{
    "inputPrompt": "Who are the co-founders of Infosys?",
    "modelName": "gpt4"
}
```

Response:

```
{
    "final_thought": "Step 1: The first step to identify the co-founders of Infosys is understanding what Infosys is. Infosys is a multinational corporation that provides business consulting, information technology, and outsourcing services. It is headquartered in Bangalore, Karnataka, India.\n\nStep 2: The next step is identifying when it was founded. Infosys was founded in 1981.\n\nStep 3: Finally, the most essential step is identifying the individuals who founded Infosys. By using accessible resources, such as company databases, credible online business information platforms, historical records, and articles or books, we can identify that Infosys was co-founded by seven individuals. \n\nstep 4: After thorough research, the co-founders of Infosys are identified as N. R. Narayana Murthy, Nandan Nilekani, Kris Gopalakrishnan, S. D. Shibulal, K. Dinesh, Ashok Arora, and N. S. Raghavan. \n\nTo confirm this, one can cross-verify with multiple reliable sources. Infosys' official website and annual reports would also support this information. \n\nThus, based on the information gathered and verified from several sources, the co-founders of Infosys are N. R. Narayana Murthy, Nandan Nilekani, Kris Gopalakrishnan, S. D. Shibulal, K. Dinesh, Ashok Arora, and N. S. Raghavan.",
    "score": 55,
    "cost_incurred": 0.52,
    "consistency_level": "Moderately Consistent",
    "time_taken": 81.414
}
```

Factuality Check by Internet Search

Endpoint - /rai/v1/llm-explainability/serper_response
Using this API, we can verify the LLM's response with the Google search engine to check for factual score and an explanation

Input:

inputPrompt: Replace the input prompt with the prompt you want to check

lls_response: provide the response of input text

```
{
    "inputPrompt": "Who are the co-founders of Infosys?",
    "llm_response": "Infosys, a global leader in technology services and consulting, was founded in 1981 by seven visionaries: N.R. Narayana Murthy, Nandan Nilekani, S. Gopalakrishnan, S.D. Shibulal, K. Dinesh, N.S. Raghavan, and Ashok Arora. These co-founders combined their expertise and entrepreneurial spirit to create a company that has since grown into one of the largest and most respected IT services firms in the world. Infosys, headquartered in Bangalore, India, has been instrumental in the global IT revolution, providing innovative solutions and services to clients across various industries. The founders' commitment to excellence and their forward-thinking approach laid a strong foundation for the company's enduring success."
}
```

Response:

```
{
    "internetResponse": [
        "Infosys was co-founded by Salil Parekh in January 2018."
    ],
    "metrics": [
        {
            "metricName": "Factuality Check",
            "score": 1,
            "explanation": [
                {
                    "Fact": "The co-founders of Infosys are N.R. Narayana Murthy, Nandan Nilekani, S. Gopalakrishnan, S.D. Shibulal, K. Dinesh, N.S. Raghavan, and Ashok Arora.",
                    "Reasoning": "The context provides a quote from an article which confirms that these seven individuals are indeed the co-founders of Infosys. However, it is unclear if this statement is valid as of today since it does not mention any dates. It is possible that some of these co-founders may have stepped down or new co-founders may have joined. Therefore, we cannot confirm the validity of this statement without more information.",
                    "Judgement": "Fact Unclear"
                }
            ]
        }
    ],
    "time_taken": 5.478
}
```

Token Importance

Endpoint - /rai/v1/llm-explainability/token_importance
Using this API, we can get importance of each token in the input prompt.

Input:

inputPrompt: Replace the input prompt with the prompt you want to check

modelName: Pass the modelName as GPT or Code

```
{
    "inputPrompt": "Who are the co-founders of Infosys?",
    "modelName": "GPT"
}
```

Response:

```
{
    "token_importance_mapping": [
        {
            "token": "co-founders",
            "importance_value": 1,
            "position": 4
        },
        {
            "token": "Infosys",
            "importance_value": 1,
            "position": 6
        },
        {
            "token": "of",
            "importance_value": 0.6,
            "position": 5
        },
        {
            "token": "who",
            "importance_value": 0.5,
            "position": 1
        },
        {
            "token": "are",
            "importance_value": 0.4,
            "position": 2
        },
```

```
        {
            "token": "the",
            "importance_value": 0.4,
            "position": 3
        },
        {
            "token": "?",
            "importance_value": 0.3,
            "position": 7
        }
    ],
    "image_data": [
```
"iVBORw0KGgoAAAANSUhEUgAAArwAAAH0CAYAAADfWf7fAAAgAEIEQVR4XuzdCZhNdR/A8Z+xk5AQIe1KWmmh5NUuKbKVFpRCG7Kl77JLsZQ1ZEpFElspWKpEWLZao1KWIUtl33ud3pjvNjJm598zv3Dl3+Z7neZ9e3e3Xj3y3KeYWB+VKGgoAAAANQQQCGGBbIRvDE6sXwWAgggAACCCCAgCNA8PJEQAABBBBAAAEEIhpAYI3pqeXg0MAAQQQQAABBBAgeHkOTIAAgggAACCCM50AMEb09PLwSGAAAIIIIAAAggQVDwHEEAAAQQQAABBGJagOCNGenl4BBAAAEEEEEAAAQQIXp4DCCCAAAIIIAAAjEtQPDG9RycAgggAACCCCAAIELB8BBBBAAAEEEAAgeZgWIHhjeno5OAQQQABBBBBAAAGCl+cAAgggAACCCCAQEwLELwxPb0cHAIIIIAAAggQVDwHEEAAAQQQAABBAhengMIIIAAgggAACM5iA8MbD9HJwCCAAAIIIIAAg0VzwEEEEAAAQQQ0ACBmBYgeGN6ejk4BBBBAAAEEEAAAYKX5wACCCCCAAIIIBATASvQvDE9vRwcAgggAACCCCAMHLcwABBBBAAAEEEEAgpgViPnjfmvORdO0/TkqXLCbvT+4bcZOZ0fNfG2dBn7tl544VyMIqnkH7YIf+V7eVbP/zH+nT6Vbg7/zH+nT6RG54+nKEb uFXu/Y4SNHZcXb78vhcctkkk82/b5cDBq84Rr74Tfx3/3vVQhvN8d4CCCAAIIIJBJg7gMVm3v30p8j4M98/4ZDy58sjJ+XPK6fdqpccG5ZqVyvFx31+nZxS+GSS664MSN+32qRHLzvLLouv22ua4gR31asvSfdy4zVlu/QbK9Pnf uy4GHPz5AL5nf//wjPNpNKl5YTi+N+o90k3w/LBBbqpaUQb3eDzo4+PxAaE+B+PR3igxHz9+XBZ8/JXzC9nqHzbIjr935UK2bFkk8Ml57NTCCsmFZ8VV1woF58pJ3nz5Ao5eb24THxNTCcsmFE3sVVV1woF58pJ3nz5Ao0ZHP+OAAITRLVAVAVwtJFixSSdi0byu03XJ3mRMxb/IW8/Op0KVn8VBndv615 s16bNk9eHPaGnF32dJk1/nnzeBntn99ne3949iX54NOvnbB/rtX96R7rg0+91H/+tVPatmgg/6t8mdkkGgb4Z+ceufau3O5jQm0y88sPwRt8pkN90gYfkb4esXvPPnmyB88vy+ddrgx54rw4APSe3brgv606AAAIRLNARAdvwZPzy8czXk7yPXDgkb0zavVf W/bxZlixfkDPmL5V9+w84/35/3l+P3u+1+E+hn3U
```

qGqfFU/razGHzQQAABBBBAAAEEEEAAAQQQ8K8AAd3Q3r2/5XN1en2MbrohnyYPe9V+7tz6WAvFjZmGRBkzpFeaNFEa2L2lype53dBZUBYCCCCAAAIIIIAAAggggIBTAQK6UGkQj/v2u332a7QGjZmt3Xt+viyknzp9Rj8fOKxCBfMqbdo0Ia6MwyGAAAIIII
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oMAAggggAACCCCAAAIIIGCiAAE9hFBZP2OZZi1eqwHdWqjC35XsS827xk7UhWGdAB+kh7AcDoUAAggggAACCCCAAAIIIGCQAAE9xM1ImLt5YxKW6Oy5c8qdM5v6xzTTPaWLh7gKDocAAggggAACCCCAAAIIIGCaAAE9BTpiLQp3+NgJ5cudXams5dv5IIAA
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CAAAIIIIAAAhEvQECP+FMAAAQQQAABBBBAAAEEEAAARMECOgmdIEaEEAAAQQQQAABBBBAAAEEIl6AgB7xpwAACCCAAAIIIIAAAgggAACJCgBQ0E3oAjUggAACCCCAAAIIIIAAAghEvAABPe3PAQAQQQAABBPwoUPLhFzU2lpMeKF/SJ+4VTMwIIIIAAAghcQ
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rbtNkLrN31yRZAB3VrYV9atgF781kKKbv3BZb8E+0XwUY3s096/mFS0AAIIIICAjwJIGD5uHqUjgAACCISHwBUDerOnZa3knvS5UkB/6vEHtGzNh4rt2lyPPXRVYGybrnFKlzathvdu+5dAVkC/o9jN6tSyzmUB/cDBIxrVr0N4wDILBBBAAAEEfCZAQPdZ
wygXAQQQQCD8BK50i3v+vOllXe1O+li3uW/yr2+0cFJv+4+5nkE/dfq0YvpP1IBuzVWt8n9C+ugpi2V76Tqtmj0VY12XoEEWwAnr4nUfMCAEEEEDA/wIEdP/3kBkgpgAACCPhcAI8B/f0tn9uLxFm3nz9YoZS2WIvEjZhxxUXiHihfUivXb1X9WCuKt1C1yvf
Yi8Q91a57vUp7uya1l5dXdu396aCWrdmkV1+qa98OT0D3+UlD+QgggAACY5lAQA/tjjpBBBAAAE/CTh7z7Vo11a9dJTCtP75mzXqXercBKwIhfc+xXxQ3Y742Zb9upM4lnI799PDt1f7Ks5Ft3le6d0lJaD7qQ5HVgQQQACBiBEgoEdMq5koAgggAAGCCCAAA
IIIICAyQIEdI7O7Q20IIIAAAggggAACCCCAAAIIRI08AIj5hWM1EEEEEAAAQQQQAABBBBAAAGTBQjoJneH2hBAAAEEEEAAAAQQQQAABBCJGgIAeMa1mogggAACCCCAAAIIIIAAAiYLENBN7g6I1YAAAggggAACCCCAAAIIRIwAAT1iWsIEEUAAAQQQQAABBBBAA
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YLLA/wPwIdROX3GZ7wAAAABJRU5ErkJggg=="
],
"token_heatmap": "<span style='background-color: rgba(252, 254, 164, 1); color: black;'>co-founders</span> <span style='background-color: rgba(252, 254, 164, 1); color: black;'>Infosys</spa
n> <span style='background-color: rgba(158, 41, 99, 1); color: white;'>of</span> <span style='background-color: rgba(101, 21, 110, 1); color: white;'>Who</span> <span style='background-color:
rgba(39, 11, 82, 1); color: white;'>are</span> <span style='background-color: rgba(39, 11, 82, 1); color: white;'>the</span> <span style='background-color: rgba(0, 0, 3, 1); color: white;'>?
</span> ",
"time_taken": 1.691

# LLM Explainability endpoints in Moderation Layer

The following LLM reasoning endpoints are currently available in the Moderation Layer (responsible-ai-moderationlayer) repository. Please follow the setup instructions in the README file of the moderation layer repository to configure them. Ensure that the service is up and running to execute.

## Chain Of Thought

**Endpoint –** /rai/v1/moderations/openaiCOT
Using this API, we can get the 'chain of thoughts' the LLM went through to provide response to our prompt.

**Input:**
In Prompt field in the input Json pass the prompt needed to be checked, using temperature score can set the creativity in the response generated and we can choose model as GPT3 or GPT4 or Llama.

POST /rai/v1/moderations/openaiCOT Chain of Thought

Parameters

No parameters

Request body required

```
{
    "Prompt": "Which is the biggest country in the world?",
    "temperature": "0",
    "model_name": "gpt3"
}
```

Execute

Response:

Server response

Code	Details
200	Response body

```
{
    "finishReason": "stop",
    "index": 0,
    "text": "The biggest country in the world by land area is Russia. It spans across both Eastern Europe and Northern Asia, covering approximately 17.1 million square kilometers. Russia's vast te
    rritory stretches across eleven time zones and is home to diverse landscapes, including the Siberian tundra, the Ural Mountains, and the Russian Far East. \n\nYou can find more information about
    Russia's size and other countries' land areas on reputable sources such as the CIA World Factbook (https://www.cia.gov/the-world-factbook/) or the United Nations Statistics Division (https://uns
    tats.un.org/home/).",
    "timetaken": 1.537
}
```

Download

Chain Of Thought for RAG

Endpoint – /rai/v1/moderations/healthcareopenaiCOT
Using this API, we can get the 'chain of thoughts' the LLM went through to provide response to our prompt, adding in example prompt response to tell the LLM which details to be included in the response and what format the response should be in. If you are using RAG based application, you can generate chunks from vector storage add the respective context of RAG files along with the actual prompt. This API will consider context and generates explanation for the same.

Input:
In Prompt field in the input Json pass the prompt needed to be checked, in prompt response add in the template, using temperature score we can set the creativity in the response generated and we can choose model as GPT3 or GPT4 or Llama.

POST /rai/v1/moderations/healthcareopenaiCOT Explain Chain of Thought Text ∧ 🔒

Parameters   Cancel

No parameters

Request body required   application/json ⌄

```
{
  "Prompt": "Which is the biggest country in the world?",
  "PromptResponse": "The largest country in the world by area is Russia. To determine this, we can refer to widely accepted global records and geographic data. Here's a step-by-step explanation of how we can confirm this information:\n\n1. **Definition of \"Biggest\"**: First, we need to clarify what \"biggest\" means in this context. It typically refers to the total area of a country, which includes land and water within the international boundaries.\n\n2. **Source of Information**: We can look at reputable sources such as the CIA World Factbook, the United Nations, or various educational resources that provide information on country sizes.\n\n3. **Comparison**: By comparing the total area of all countries, we can determine which one is the largest. This comparison is generally available in the form of lists or rankings based on area.\n\n4. **Consensus**: There is a global consensus that Russia is the largest country in the world, with a total area of about 17,098,242 square kilometers (6,601,668 square miles).\n\n5. **Verification**: To verify this information, we can check multiple reliable sources. However, as an AI developed by OpenAI, I don't browse the internet in real-time. Instead, I rely on the data I was trained on, which includes factual information up to my last update in 2023.\n\n6. **Responsibility**: To ensure the information is not misleading, it's important to note that geopolitical changes can affect country sizes, but as of my last update, there have been no changes affecting the status of Russia as the largest country.\n\nWhile I cannot provide a direct website link, you can easily verify this information by checking a current world atlas, a recent publication from a reputable source like the United Nations, or by searching for the largest countries in the world using a trusted search engine.",
  "temperature": "0",
  "model_name": "gpt4"
}
```

Execute   Clear

Response:

Code	Details
200	**Response body**

```
{
  "finishReason": "stop",
  "index": 0,
  "text": "You are correct that the largest country in the world by area is Russia. This is a well-known geographical fact that is documented by various reputable sources. Here's how you can confirm this information responsibly:\n\n1. **Understanding \"Largest\"**: Clarify that \"largest\" refers to the total area, including both land and water within a country's international boundaries.\n\n2. **Consulting Authoritative Sources**: Look for information from authoritative and up-to-date sources such as the CIA World Factbook, the United Nations, or educational institutions that maintain current geographic data.\n\n3. **Comparing Data**: These sources often provide lists or rankings of countries by area, allowing for easy comparison to determine which is the largest.\n\n4. **Global Consensus**: There is a consensus among these sources that Russia is the largest country, with a total area of approximately 17,098,242 square kilometers (6,601,668 square miles).\n\n5. **Cross-Verification**: Cross-reference this information with multiple reliable sources to ensure accuracy. As an AI, I provide information based on the data I was trained on, which includes knowledge up to 2023.\n\n6. **Acknowledging Changes**: Recognize that geopolitical events can alter country sizes, but as of my last update, Russia remains the largest country by area.\n\nTo confirm this information, you can check the latest version of the CIA World Factbook online, visit the United Nations Statistics Division's website, or consult the most recent world atlas. These sources are regularly updated to reflect the most current information available. Remember to use trusted and authoritative sources to avoid misinformation.",
  "timetaken": 13.599
}
```

Thread Of Thought

Endpoint – /rai/v1/moderations/openaiTHOT
Using this API, we can get the 'thread of thoughts' the LLM went through to provide response to our prompt, we can see how the LLM break down the prompt to correctly understand it and to generate response.

Input:
In Prompt field in the input Json, we can pass the prompt needed to be checked, using temperature score we can set the creativity in the response generated and we can choose model as GPT3 or GPT4 or Llama.

```
POST  /rai/v1/moderations/openaiTHOT  Thread of Thought

Parameters

No parameters

Request body  required

{
  "Prompt": "Which is the biggest country in the world?",
  "temperature": "0",
  "model_name": "gpt4"
}

                              Execute
```

Response:


```
Server response

Code    Details

200
        Response body
        {
          "finishReason": "stop",
          "index": 0,
          "text": "Result: \"Russia\"\n\nExplanation: To determine the biggest country in the world, we look at the total land area of each country. Russia is widely recognized as the largest country by
          land area. It spans Eastern Europe and northern Asia, covering approximately 17.1 million square kilometers (about 6.6 million square miles). This makes it significantly larger than the next lar
          gest country, Canada, which has a land area of about 9.98 million square kilometers (about 3.85 million square miles). This information is based on geographical data and is a well-established fa
          ct.",
          "timetaken": 6.447
        }
```

Chain of Verification

Endpoint – /rai/v1/moderations/COV
Using this API, we can see the 'chain of verification' or questions the LLM asked itself to reach the response it gave us. We can give 'gpt4', 'gpt3' or 'Llama' as model names.

Input:

POST `/rai/v1/moderations/COV` Chain Of Verification

Parameters

Name	Description
authorization string *(header)*	authorization

Request body required

```
{
  "text": "Which is the biggest country in the world?",
  "complexity": "simple",
  "model_name": "gpt4"
}
```

Response:

Server response

Code	Details
200	**Response body**

{"original_question": "Which is the biggest country in the world?", "baseline_response": "The biggest country in the world by land area is Russia.", "verification_questions": "1. What is the largest country in the world by land area?\n2. Is Russia the biggest country in the world?\n3. Does Russia have the largest land area of any country?\n4. Can any country surpass Russia in terms of land area?\n5. Is the baseline response correct in stating that Russia is the biggest country in the world?", "verification_answers": "Question: 1. What is the largest country in the world by land area? Answer: The largest country in the world by land area is Russia.\n\nQuestion: 2. Is Russia the biggest country in the world? Answer: Yes, Russia is the biggest country in the world by land area.\n\nQuestion: 3. Does Russia have the largest land area of any country? Answer: Yes, Russia has the largest land area of any country in the world.\n\nQuestion: 4. Can any country surpass Russia in terms of land area? Answer: No, as of my knowledge cutoff in 2023, no country can surpass Russia in terms of land area because Russia is the largest country in the world, covering over 17 million square kilometers.\n\nQuestion: 5. Is the baseline response correct in stating that Russia is the biggest country in the world? Answer: Yes, the baseline response is correct in stating that Russia is the biggest country in the world by land area.\n", "final_answer": "The biggest country in the world by land area is Russia.", "timetaken": 7.831}

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