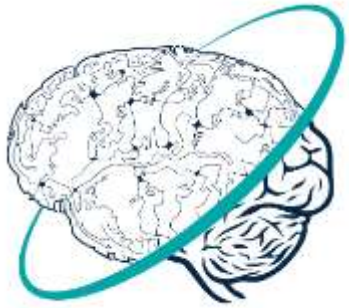


NEUROVOYAGER

Sudha Gopalakrishnan Brain Centre, IIT Madras

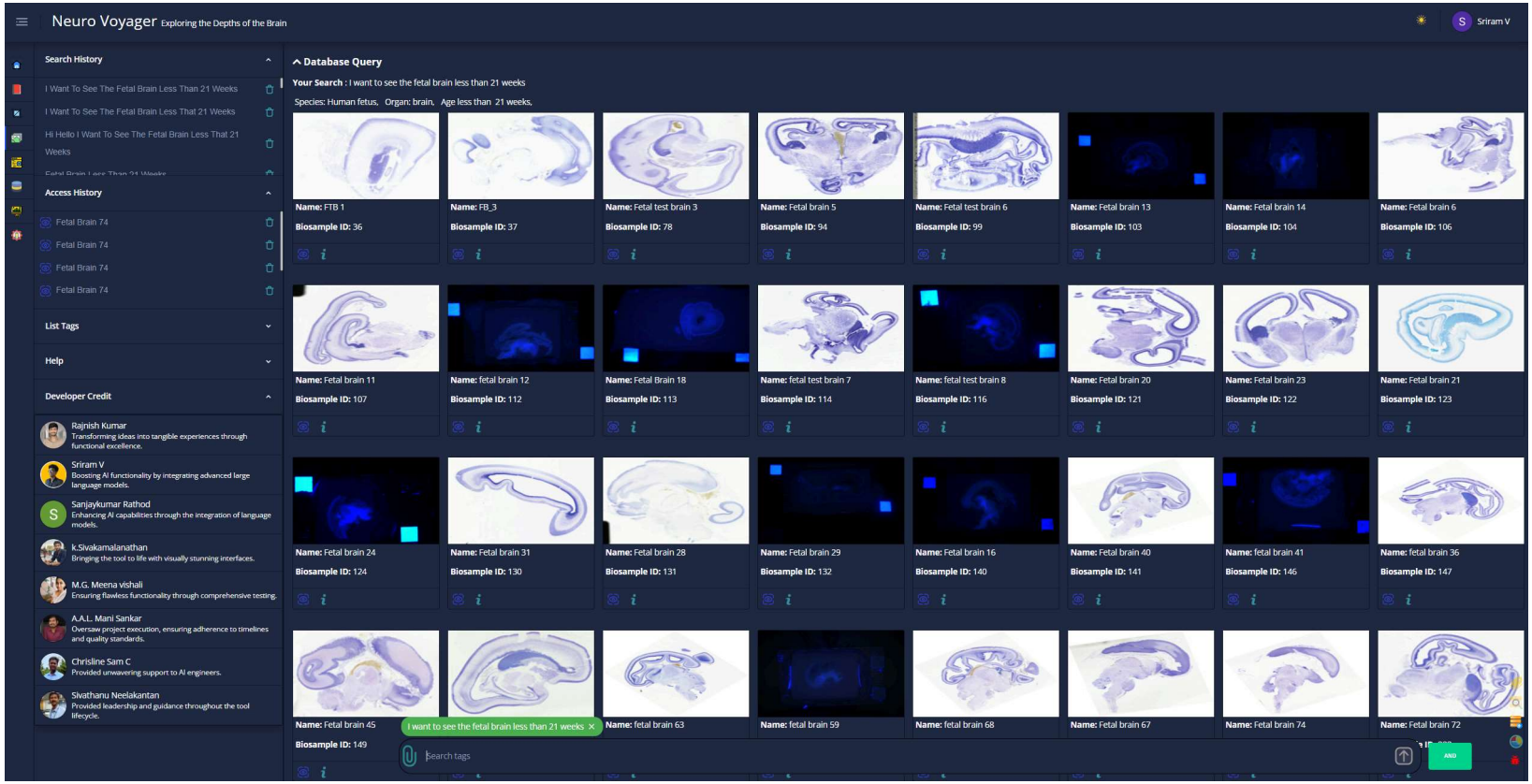
The Sudha Gopalakrishnan Brian Centre (SGBC) at IIT Madras has developed a brain research platform called Neuro Voyager. This platform focuses on high-resolution brain imaging at the cellular level, generating massive datasets for comprehensive brain analysis. In collaboration with NVIDIA, we have created a system capable of processing and visualizing data from hundreds of brains, facilitating groundbreaking research in neuroscience by making this data accessible globally

1) DATA BASE QUERY ENGINE

A simple easy to use query engine Where you can interact with the database in natural language

There are four parameters.

- species
- organ
- stain
- age

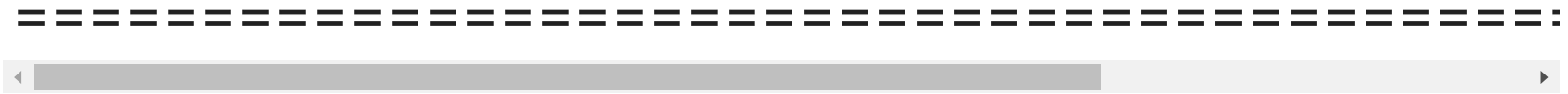


In [14]:
```
import requests
from IPython.display import Markdown, display

baseUrl = "https://apollo2.humanbrain.in/iipsrv/"
url = "https://apollo2.humanbrain.in/analytics/dbBrainQuery"

response = requests.post(url, json={"query": "fetal brain age less than 10 weeks"})


if response.status_code == 200:
    response_data = response.json()


    markdown_content = ""
```

```
    markdown_content += f"**Species**: {response_data['res']['species']}\n"
    markdown_content += f"**Organ**: {response_data['res']['organ']}\n"
    markdown_content += f"**Age Operator**: {response_data['res']['operator']} {response_data['res']['age']} weeks\n"


    markdown_content += "\n**Images:**\n\n"
    for item in response_data['msg']:
        image_url = baseUrl + item['pngPathLow']
        image_html = f'<img src="{image_url}" alt="{item["name"]}" style="max-width:200px">'
        details_html = f'<br>Name: {item["name"]}<br>Biosample: {item["biosample"]}<br>'
        markdown_content += f"{image_html}<br>{details_html}\n\n"


    display(Markdown(markdown_content))
else:
    print(f"Request failed with status code: {response.status_code}")
```

Species: Human fetus **Organ**: brain **Age Operator**: < 10 weeks

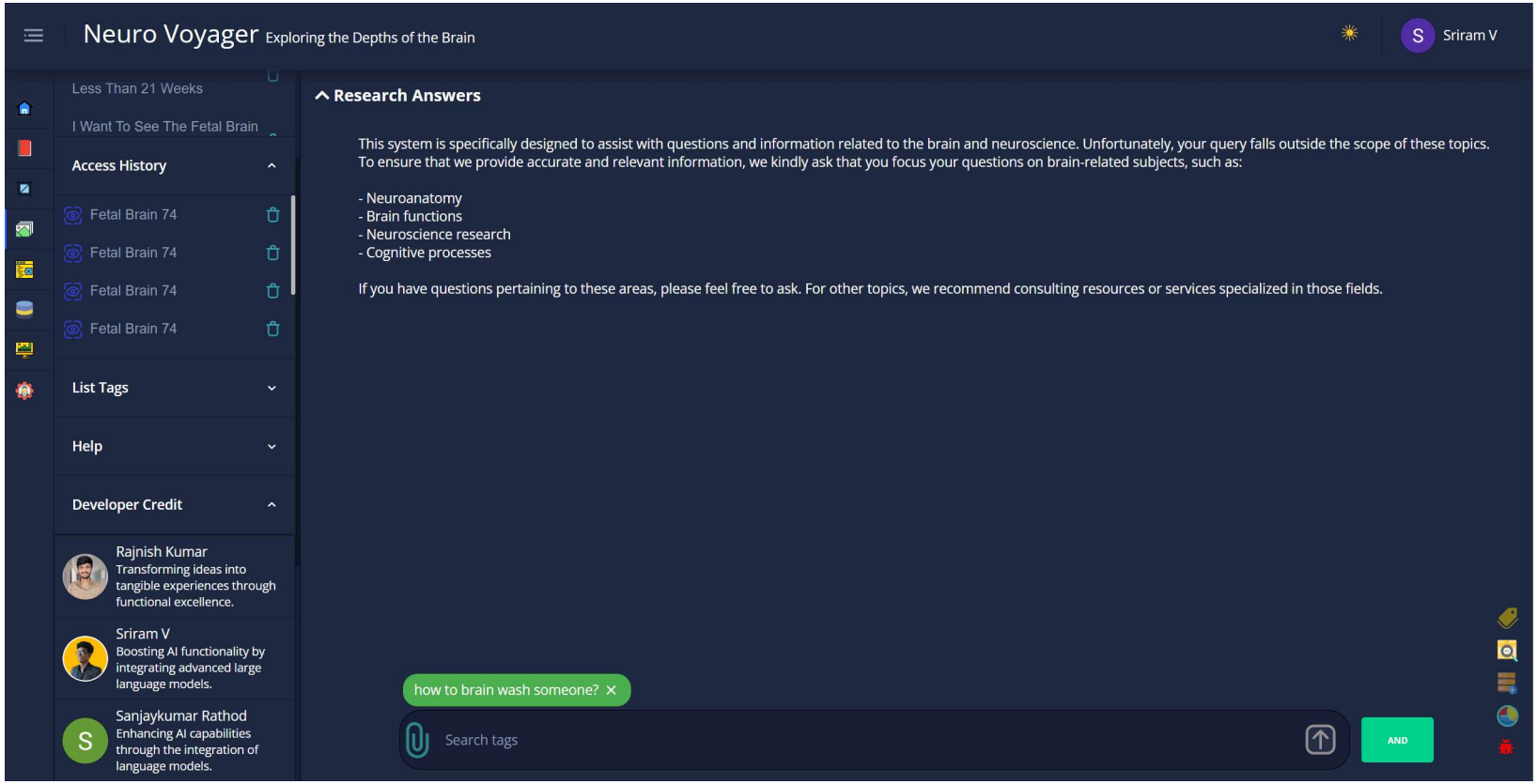
Images:



2) NEUROGUARDRAILS

Developed an agent who blocks queries that are unsafe and irrelevant to Neuroscience and brain anatomy using Nemoguardrails framework from NVIDIA and models from Meta

Frameworks used	NemoGuardrails, VLLM
Model used	meta-llama/Meta-Llama-Guard-2-8B



In [4]:
```
import requests
from utils import stream_text
url = "http://dgx3.humanbrain.in:1947/neuroguardrail"

response = requests.get(url, params={"query":"how to brain wash?"})

guard_eval = response.json()

stream_text(guard_eval['msg'])
```

```
Our system specializes in answering questions and providing information about the brain and neuroscience. Regrettabl
y, your query doesn't align with our focus.

To offer accurate and relevant information, please ask about topics such as:

- Neuroanatomy
- Brain functions
- Neuroscience research
- Cognitive processes

For questions within these areas, feel free to ask. For other topics, please consult relevant resources or services.
```

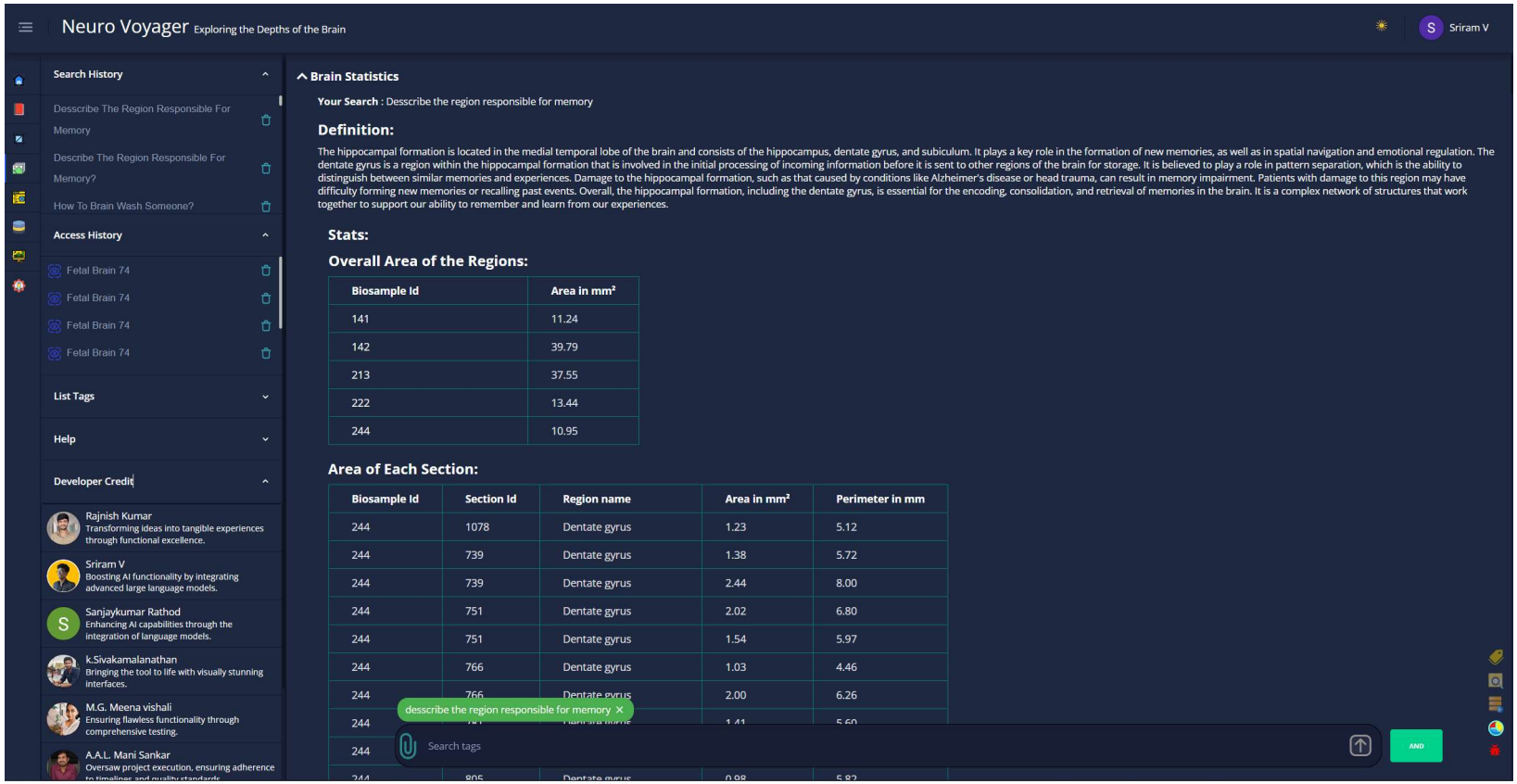
In [62]:
```
import requests
from utils import stream_text
url = "http://dgx3.humanbrain.in:1947/neuroguardrail"

response = requests.get(url, params={"query":"what is neuroscience?"})

guard_eval = response.json()

stream_text(guard_eval['msg'])
```

```
YES
```

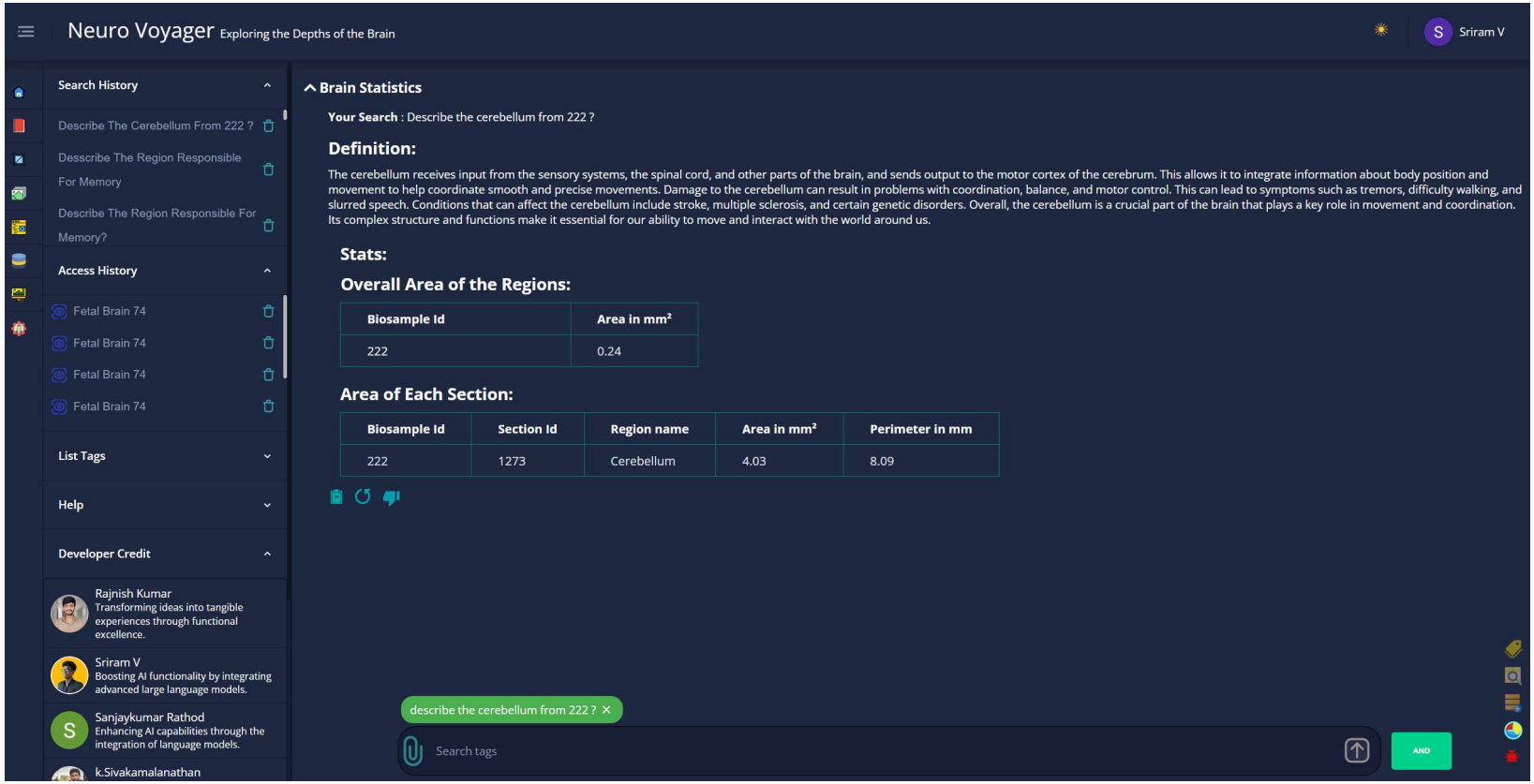
```
==========
```

3) ANALYTICS GENERATOR

When the explorer asks about a brain region or asks question based on function of the region, this feature returns the brain region name their area, perimeter and overall area it occupies for all the brains.



Analytics can also be generated for a particular region of a particular brain id



In [5]:
```
import requests
from IPython.display import display, Markdown
from utils import show_analytics, get_markdown

url = "http://dgx3.humanbrain.in:1947/get_stats"

# response = requests.get(url, params={"query":"describe the brain region responsible for memory"})
response = requests.get(url, params={"query":"describe the cerebellum?"})

if response.status_code == 200:
    data = response.json()
else:
    print(f"Failed to retrieve data: {response.status_code}")

data_list, overall_area = show_analytics(data)
```

```
tables_view = get_markdown(data_list, overall_area)
Markdown(tables_view)
```

ANALYTICS GENERATOR

Damage to the cerebellum can result in symptoms such as ataxia (loss of coordination and balance), tremors, slurred s peech, and difficulty with fine motor skills. Conditions that can affect the cerebellum include stroke, multiple scle rosis, tumors, and genetic disorders.

Treatment for cerebellar disorders typically involves physical therapy to improve coordination and balance, as well a s medications to manage symptoms such as tremors. In some cases, surgery may be necessary to remove tumors or allevia te pressure on the cerebellum.

Overall, the cerebellum is a crucial part of the brain that plays a vital role in movement and coordination, and dama ge to this region can have significant impacts on a person's quality of life.

Out[5]:

Biosample id	Overall area in mm2
142	5.97
222	0.24

id	section	region	area	perimeter
222	1273	Cerebellum	4.03	8.09
142	889	Cerebellum	42.96	72.45
142	955	Cerebellum	56.55	103.17

In [16]:

```
import requests
from IPython.display import display, Markdown
from utils import show_analytics, get_markdown

url = "http://dgx3.humanbrain.in:1947/get_stats"

# response = requests.get(url, params={"query":"describe the brain region responsible for memory"})
response = requests.get(url, params={"query":"describe the region responsible for memory from biosample 222?"})
```

```
if response.status_code == 200:
    data = response.json()
else:
    print(f"Failed to retrieve data: {response.status_code}")

data_list, overall_area = show_analytics(data)
tables_view = get_markdown(data_list, overall_area)
Markdown(tables_view)
```

ANALYTICS GENERATOR

The hippocampal formation is a key region in the brain responsible for memory formation and consolidation. It plays a crucial role in the encoding and retrieval of memories, as well as spatial navigation and learning. The unique sectio ns of biosample 222 in the hippocampal formation may contain specific neuronal populations, synaptic connections, or molecular markers that contribute to its memory-related functions. Further analysis of these unique sections could pr ovide valuable insights into the mechanisms underlying memory processes in the brain.

Out[16]:

Biosample id	Overall area in mm2
222	13.44

id	section	region	area	perimeter
222	460	Dentate gyrus	3.14	13.18
222	460	Hippocampal formation	4.01	18.70
222	499	Hippocampal formation	1.31	5.73
222	499	Dentate gyrus	1.78	7.55
222	499	Hippocampal formation	2.61	8.87
222	499	Dentate gyrus	1.33	9.38
222	511	Dentate gyrus	1.81	7.32
222	511	Hippocampal formation	1.77	7.14
222	511	Hippocampal formation	1.37	5.92
222	511	Dentate gyrus	1.34	5.93
222	529	Hippocampal formation	1.61	6.12
222	529	Dentate gyrus	0.77	4.31
222	529	Dentate gyrus	1.24	5.40
222	529	Hippocampal formation	2.35	7.27
222	562	Hippocampal formation	2.18	7.26
222	562	Dentate gyrus	0.77	3.45
222	562	Dentate gyrus	0.47	3.33
222	562	Hippocampal formation	2.43	8.54
222	574	Hippocampal formation	3.53	11.00
222	574	Dentate gyrus	0.28	2.25
222	574	Hippocampal formation	1.84	6.67

222	574	Dentate gyrus	0.50	3.64
222	598	Dentate gyrus	0.61	3.26
222	598	Hippocampal formation	1.21	5.97
222	598	Hippocampal formation	1.27	5.72
222	598	Dentate gyrus	0.31	2.31
222	634	Dentate gyrus	0.97	4.59
222	634	Hippocampal formation	1.43	7.05
222	634	Dentate gyrus	0.50	2.71
222	652	Hippocampal formation	1.31	5.83
222	667	Hippocampal formation	2.56	10.63
222	682	Hippocampal formation	1.34	7.44
222	694	Hippocampal formation	0.33	3.17
222	670	Hippocampal formation	1.70	7.87
222	1105	Hippocampal formation	0.97	4.09
222	1222	Dentate gyrus	0.96	3.97
222	1222	Hippocampal formation	0.95	4.46
222	1222	Hippocampal formation	0.98	4.60
222	1222	Dentate gyrus	1.14	6.08
222	1360	Hippocampal formation	3.10	10.03
222	1063	Hippocampal formation	1.42	7.72
222	1126	Dentate gyrus	0.66	4.95
222	1126	Hippocampal formation	0.94	5.50
222	1126	Hippocampal formation	0.83	3.83

In [7]:
```
import requests
from IPython.display import display, Markdown
from utils import show_analytics, get_markdown

url = "http://dgx3.humanbrain.in:1947/get_stats"

# response = requests.get(url, params={"query":"describe the brain region responsible for memory"})
response = requests.get(url, params={"query":"describe the region responsible for attention?"})

if response.status_code == 200:
    data = response.json()
else:
    print(f"Failed to retrieve data: {response.status_code}")

data_list, overall_area = show_analytics(data)
tables_view = get_markdown(data_list, overall_area)
Markdown(tables_view)
```

222	1144	Hippocampal formation	2.43	8.41
222	1195	Hippocampal formation	1.41	5.57
222	1195	Hippocampal formation	1.69	6.28
222	1249	Hippocampal formation	1.95	6.92
222	1249	Hippocampal formation	2.67	7.31
222	1273	Hippocampal formation	2.50	7.99
222	1273	Hippocampal formation	2.83	9.28
222	1327	Hippocampal formation	2.48	13.48
222	1327	Dentate gyrus	3.09	11.10
222	1372	Hippocampal formation	13.88	16.76
222	445	Dentate gyrus	0.68	6.22
222	445	Hippocampal formation	2.52	13.53
222	403	Hippocampal formation	9.56	13.37
222	427	Hippocampal formation	3.14	12.04
222	478	Hippocampal formation	1.06	5.38
222	478	Hippocampal formation	1.33	6.02
222	478	Dentate gyrus	6.18	16.07
222	436	Hippocampal formation	0.16	3.32
222	436	Hippocampal formation	2.06	13.16
222	685	Hippocampal formation	1.45	7.16
222	514	Hippocampal formation	1.39	5.73
222	514	Dentate gyrus	1.87	7.47

ANALYTICS GENERATOR

Additionally, the Cingulate cortex is connected to other regions of the brain involved in attention, such as the pref
rontal cortex and the parietal cortex. These connections allow for the coordination of attentional processes and the
integration of information from different sources.

Damage or dysfunction in the Cingulate cortex can lead to difficulties in maintaining attention, regulating emotions,
and making decisions. Conditions such as attention deficit hyperactivity disorder (ADHD), depression, and anxiety dis
orders have been linked to abnormalities in the Cingulate cortex.

Overall, the Cingulate cortex plays a crucial role in attentional processes and is essential for our ability to focu
s, make decisions, and regulate our emotions.

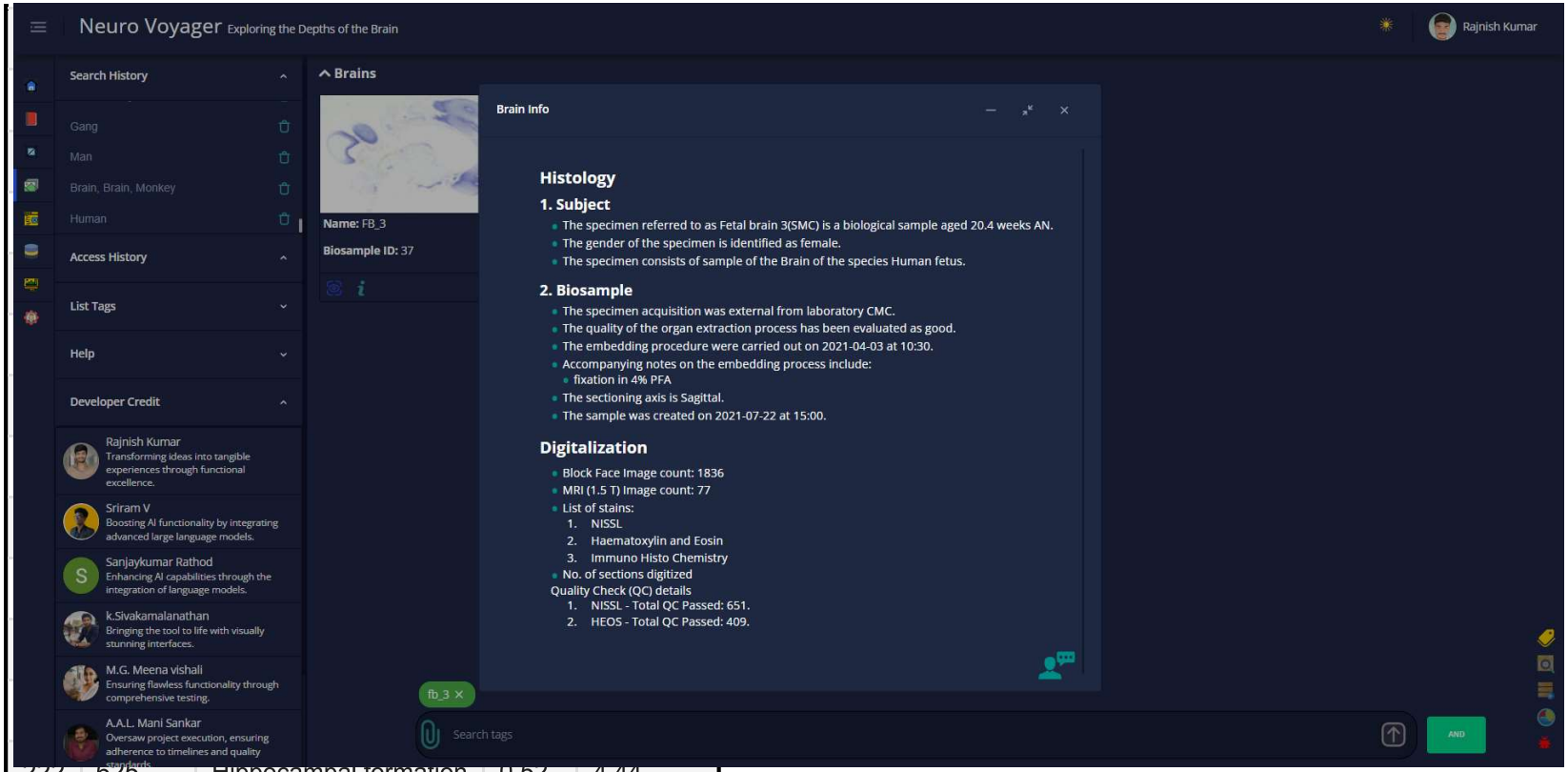
Out[7]:

Biosample id	Overall area in mm2
213	0.02

id	section	region	area	perimeter
213	1060	Cingulate cortex	0.28	3.29
213	1060	Cingulate cortex	0.13	3.80
222	526	Dentate gyrus	1.07	5.25
222	1345	Dentate gyrus	0.22	1.93
222	1345	Hippocampal formation	3.66	12.60
222	1312	Hippocampal formation	6.64	17.77
222	1159	Dentate gyrus	0.63	3.40
222	1159	Hippocampal formation	1.59	5.85
222	1159	Hippocampal formation	1.18	5.40
222	1159	Dentate gyrus	0.29	2.11
222	1171	Hippocampal formation	2.08	6.71
222	1171	Hippocampal formation	1.22	5.47
222	1291	Hippocampal formation	7.44	24.06
222	619	Hippocampal formation	1.21	6.65
222	619	Dentate gyrus	0.52	3.07
222	619	Hippocampal formation	1.38	5.22
222	619	Dentate gyrus	0.98	4.09
222	391	Hippocampal formation	6.73	11.34
222	1204	Hippocampal formation	1.98	6.74

4) Biosample Info

The simple yet powerful i-feature can be used to know the histology and digitalization details of the biosample which is live from database.



222	625	Hippocampal formation	0.52	4.44
222	625	Dentate gyrus	0.84	3.90
222	625	Dentate gyrus	0.70	3.35
222	1258	Hippocampal formation	1.85	5.86
222	1258	Hippocampal formation	1.75	5.87

In [8]:
```
import requests
from IPython.display import display, Markdown
from utils import show_analytics, get_markdown

url = "http://dgx3.humanbrain.in:1947/api/v1/describe"
# response = requests.get(url, params={"query":"describe the brain region responsible for memory"})
response = requests.get(url, params={"biosample_id":"242"})
data = None
if response.status_code == 200:
    data = response.json()
else:
    print(f"Failed to retrieve data: {response.status_code}")

Markdown(data['response'])
```

Out[8]:

Histology

1. Subject

- The specimen referred to as Human Brain 1 NIMHANS is a biological sample aged 50.0 years.
- The gender of the specimen is identified as male.
- The specimen consists of sample of the Brain of the species Human.

2. Biosample

- The specimen acquisition was external from laboratory NIMMHANS.
- The sample was created on 2023-06-14 at 06:40.

Digitalization

- Block Face Image count: 1902
- MRI Image count: 0
- List of stains: None.
- No. of sections digitized
  Quality Check (QC) details
  1. NISSL - Total QC Passed: 0.
  2. HEOS - Total QC Passed: 0.

In [50]:

In [ ]: