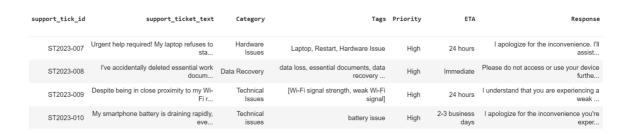# Problem Statement

Business Context

In today's dynamic business landscape, organizations are increasingly recognizing the pivotal role customer feedback plays in shaping the trajectory of their products and services. The ability to swiftly and effectively respond to customer input not only fosters enhanced customer experiences but also serves as a catalyst for growth, prolonged customer engagement, and the nurturing of lifetime value relationships. As a dedicated Product Manager or Product Analyst, staying attuned to the voice of your customers is not just a best practice; it's a strategic imperative.

While your organization may be inundated with a wealth of customer-generated feedback and support tickets, your role entails much more than just processing these inputs. To make your efforts in managing customer experience and expectations truly impactful, you need a structured approach – a method that allows you to discern the most pressing issues, set priorities, and allocate resources judiciously. One of the most effective strategies at your disposal is to harness the power of Support Ticket Categorization.

Objective

Develop an advanced support ticket categorization system that accurately classifies incoming tickets, assigns relevant tags based on their content, implements mechanisms and generate the first response based on the sentiment for prioritizing tickets for prompt resolution.

Sample of Expected Output

support_tick_id	support_ticket_text	Category	Tags	Priority	ETA	Response
ST2023-007	Urgent help required! My laptop refuses to sta...	Hardware Issues	Laptop, Restart, Hardware Issue	High	24 hours	I apologize for the inconvenience. I'll assist...
ST2023-008	I've accidentally deleted essential work docum...	Data Recovery	data loss, essential documents, data recovery ...	High	Immediate	Please do not access or use your device furthe...
ST2023-009	Despite being in close proximity to my Wi-Fi r...	Technical Issues	[Wi-Fi signal strength, weak Wi-Fi signal]	High	24 hours	I understand that you are experiencing a weak ...
ST2023-010	My smartphone battery is draining rapidly, eve...	Technical issues	battery issue	High	2-3 business days	I apologize for the inconvenience you're exper...

Installing and Importing Necessary Libraries and Dependencies

In [1]:
```
pip install numpy==1.26.4 --force-reinstall
```

```
Collecting numpy==1.26.4
  Downloading numpy-1.26.4-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x
86_64.whl.metadata (61 kB)
                                        ━━━━━━━━━━━━━━━━ 61.0/61.0 kB 1.1 MB/s eta 0:0
0:00ta 0:00:01
Downloading numpy-1.26.4-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86
_64.whl (18.3 MB)
                                        ━━━━━━━━━━━━━━━━ 18.3/18.3 MB 74.7 MB/s eta 0:00:
00
Installing collected packages: numpy
  Attempting uninstall: numpy
    Found existing installation: numpy 2.0.2
    Uninstalling numpy-2.0.2:
      Successfully uninstalled numpy-2.0.2
Successfully installed numpy-1.26.4
```

In [3]:
```
# Installation for CPU llama-cpp-python
# Run the following code in case GPU is being used
```

```
In [2]:  CMAKE_ARGS="-DLLAMA_CUBLAS=on" FORCE_CMAKE=1 pip install llama-cpp-python==0.1
```

```
Collecting llama-cpp-python==0.1.85
  Downloading llama_cpp_python-0.1.85.tar.gz (1.8 MB)
     ──────────────────────────────────────── 1.8/1.8 MB 137.2 MB/s eta 0:0
0:00
  Installing build dependencies ... done
  Getting requirements to build wheel ... done
  Preparing metadata (pyproject.toml) ... done
Collecting typing-extensions>=4.5.0 (from llama-cpp-python==0.1.85)
  Downloading typing_extensions-4.13.0-py3-none-any.whl.metadata (3.0 kB)
Collecting numpy>=1.20.0 (from llama-cpp-python==0.1.85)
  Downloading numpy-2.2.4-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x8
6_64.whl.metadata (62 kB)
     ──────────────────────────────────────── 62.0/62.0 kB 199.3 MB/s eta 0:
00:00
Collecting diskcache>=5.6.1 (from llama-cpp-python==0.1.85)
  Downloading diskcache-5.6.3-py3-none-any.whl.metadata (20 kB)
Downloading diskcache-5.6.3-py3-none-any.whl (45 kB)
     ──────────────────────────────────────── 45.5/45.5 kB 163.4 MB/s eta 0:0
0:00
Downloading numpy-2.2.4-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_
64.whl (16.4 MB)
     ──────────────────────────────────────── 16.4/16.4 MB 179.6 MB/s eta 0:0
0:00
Downloading typing_extensions-4.13.0-py3-none-any.whl (45 kB)
     ──────────────────────────────────────── 45.7/45.7 kB 183.4 MB/s eta 0:0
0:00
Building wheels for collected packages: llama-cpp-python
  Building wheel for llama-cpp-python (pyproject.toml) ... done
  Created wheel for llama-cpp-python: filename=llama_cpp_python-0.1.85-cp311
-cp311-linux_x86_64.whl size=6624696 sha256=34467b282192db975cd992ab33d29c70
f6dfcb5303f51d74e7f2941f78e46977
  Stored in directory: /tmp/pip-ephem-wheel-cache-f_iqr4fj/wheels/64/84/0c/e
1e21cef5bdf4bde1c07e1befbe0661ad7adfc1f10a2883641
Successfully built llama-cpp-python
Installing collected packages: typing-extensions, numpy, diskcache, llama-cp
p-python
  Attempting uninstall: typing-extensions
    Found existing installation: typing_extensions 4.13.0
    Uninstalling typing_extensions-4.13.0:
      Successfully uninstalled typing_extensions-4.13.0
  Attempting uninstall: numpy
    Found existing installation: numpy 1.26.4
    Uninstalling numpy-1.26.4:
      Successfully uninstalled numpy-1.26.4
ERROR: pip's dependency resolver does not currently take into account all th
e packages that are installed. This behaviour is the source of the following
dependency conflicts.
numba 0.60.0 requires numpy<2.1,>=1.22, but you have numpy 2.2.4 which is in
compatible.
tensorflow 2.18.0 requires numpy<2.1.0,>=1.26.0, but you have numpy 2.2.4 wh
ich is incompatible.
torch 2.6.0+cu124 requires nvidia-cublas-cu12==12.4.5.8; platform_system ==
"Linux" and platform_machine == "x86_64", but you have nvidia-cublas-cu12 1
2.5.3.2 which is incompatible.
torch 2.6.0+cu124 requires nvidia-cuda-cupti-cu12==12.4.127; platform_system
== "Linux" and platform_machine == "x86_64", but you have nvidia-cuda-cupti-
cu12 12.5.82 which is incompatible.
torch 2.6.0+cu124 requires nvidia-cuda-nvrtc-cu12==12.4.127; platform_system
== "Linux" and platform_machine == "x86_64", but you have nvidia-cuda-nvrtc-
cu12 12.5.82 which is incompatible.
torch 2.6.0+cu124 requires nvidia-cuda-runtime-cu12==12.4.127; platform_syst
```

```
em == "Linux" and platform_machine == "x86_64", but you have nvidia-cuda-run
time-cu12 12.5.82 which is incompatible.
torch 2.6.0+cu124 requires nvidia-cudnn-cu12==9.1.0.70; platform_system ==
"Linux" and platform_machine == "x86_64", but you have nvidia-cudnn-cu12 9.
3.0.75 which is incompatible.
torch 2.6.0+cu124 requires nvidia-cufft-cu12==11.2.1.3; platform_system ==
"Linux" and platform_machine == "x86_64", but you have nvidia-cufft-cu12 11.
2.3.61 which is incompatible.
torch 2.6.0+cu124 requires nvidia-curand-cu12==10.3.5.147; platform_system =
= "Linux" and platform_machine == "x86_64", but you have nvidia-curand-cu12
10.3.6.82 which is incompatible.
torch 2.6.0+cu124 requires nvidia-cusolver-cu12==11.6.1.9; platform_system =
= "Linux" and platform_machine == "x86_64", but you have nvidia-cusolver-cu1
2 11.6.3.83 which is incompatible.
torch 2.6.0+cu124 requires nvidia-cusparse-cu12==12.3.1.170; platform_system
== "Linux" and platform_machine == "x86_64", but you have nvidia-cusparse-cu
12 12.5.1.3 which is incompatible.
torch 2.6.0+cu124 requires nvidia-nvjitlink-cu12==12.4.127; platform_system
== "Linux" and platform_machine == "x86_64", but you have nvidia-nvjitlink-c
u12 12.5.82 which is incompatible.
Successfully installed diskcache-5.6.3 llama-cpp-python-0.1.85 numpy-2.2.4 t
yping-extensions-4.13.0
```

Note : There may be an error related to a dependency issue thrown by the pip package. This can be ignored as it will not impact the execution of the code.

In [4]:
```python
# For downloading the models from HF Hub
pip install --upgrade pandas huggingface_hub
```

```
Requirement already satisfied: pandas in /usr/local/lib/python3.11/dist-pack
ages (2.2.2)
Collecting pandas
  Downloading pandas-2.2.3-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x
86_64.whl.metadata (89 kB)
                                         ━━━━━━━━━━━━━━━━━━━━━━ 89.9/89.9 kB 7.9 MB/s eta 0:0
0:00
Requirement already satisfied: huggingface_hub in /usr/local/lib/python3.11/
dist-packages (0.29.3)
Collecting huggingface_hub
  Downloading huggingface_hub-0.30.1-py3-none-any.whl.metadata (13 kB)
Requirement already satisfied: numpy>=1.23.2 in /usr/local/lib/python3.11/di
st-packages (from pandas) (2.2.4)
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/pyth
on3.11/dist-packages (from pandas) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dis
t-packages (from pandas) (2025.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/d
ist-packages (from pandas) (2025.2)
Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-pa
ckages (from huggingface_hub) (3.18.0)
Requirement already satisfied: fsspec>=2023.5.0 in /usr/local/lib/python3.1
1/dist-packages (from huggingface_hub) (2025.3.0)
Requirement already satisfied: packaging>=20.9 in /usr/local/lib/python3.11/
dist-packages (from huggingface_hub) (24.2)
Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.11/dist
-packages (from huggingface_hub) (6.0.2)
Requirement already satisfied: requests in /usr/local/lib/python3.11/dist-pa
ckages (from huggingface_hub) (2.32.3)
Requirement already satisfied: tqdm>=4.42.1 in /usr/local/lib/python3.11/dis
t-packages (from huggingface_hub) (4.67.1)
Requirement already satisfied: typing-extensions>=3.7.4.3 in /usr/local/lib/
python3.11/dist-packages (from huggingface_hub) (4.13.0)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-pa
ckages (from python-dateutil>=2.8.2->pandas) (1.17.0)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/py
thon3.11/dist-packages (from requests->huggingface_hub) (3.4.1)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dis
t-packages (from requests->huggingface_hub) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.
11/dist-packages (from requests->huggingface_hub) (2.3.0)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.
11/dist-packages (from requests->huggingface_hub) (2025.1.31)
Downloading pandas-2.2.3-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86
_64.whl (13.1 MB)
                                         ━━━━━━━━━━━━━━━━━━━━━━ 13.1/13.1 MB 94.4 MB/s eta 0:00:
00
Downloading huggingface_hub-0.30.1-py3-none-any.whl (481 kB)
                                         ━━━━━━━━━━━━━━━━━━━━━━ 481.2/481.2 kB 38.2 MB/s eta 0:0
0:00
Installing collected packages: pandas, huggingface_hub
  Attempting uninstall: pandas
    Found existing installation: pandas 2.2.2
    Uninstalling pandas-2.2.2:
      Successfully uninstalled pandas-2.2.2
  Attempting uninstall: huggingface_hub
    Found existing installation: huggingface-hub 0.29.3
    Uninstalling huggingface-hub-0.29.3:
      Successfully uninstalled huggingface-hub-0.29.3
ERROR: pip's dependency resolver does not currently take into account all th
e packages that are installed. This behaviour is the source of the following
```

```
dependency conflicts.
google-colab 1.0.0 requires pandas==2.2.2, but you have pandas 2.2.3 which i
s incompatible.
Successfully installed huggingface_hub-0.30.1 pandas-2.2.3
```

In [5]:
```python
# Function to download the model from the Hugging Face model hub
from huggingface_hub import hf_hub_download

# Importing the Llama class from the llama_cpp module
from llama_cpp import Llama

# Importing the json module
import json

# for loading and manipulating data
import pandas as pd

# for time computations
import time
```

Loading the Data

In [7]:
```python
# Read the CSV file.
data = pd.read_csv("support_ticket_data.csv")
```

Data Overview

Checking the first 5 rows of the data

In [8]:
```python
# Check the first 5 rows of the data
data.head()
```

Out[8]:

	support_tick_id	support_ticket_text
0	ST2023-006	My internet connection has significantly slowe...
1	ST2023-007	Urgent help required! My laptop refuses to sta...
2	ST2023-008	I've accidentally deleted essential work docum...
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...
4	ST2023-010	My smartphone battery is draining rapidly, eve...

Checking the shape of the data

In [9]:
```python
# Check the shape of the data
data.shape
```

Out[9]: (21, 2)

Checking the missing values in the data

```
In [10]:   # Check for missing values in the data
           data.isnull().sum()
```

Out[10]:

	0
support_tick_id	0
support_ticket_text	0

dtype: int64

Model Building

Loading the model

```
In [11]:   model_name_or_path = "TheBloke/Mistral-7B-Instruct-v0.2-GGUF"
           model_basename = "mistral-7b-instruct-v0.2.Q6_K.gguf"
```

```
In [12]:   model_path = hf_hub_download(
               repo_id=model_name_or_path, # mention the repo_id
               filename=model_basename  # mention the filename
           )
```

```
/usr/local/lib/python3.11/dist-packages/huggingface_hub/utils/_auth.py:94: U
serWarning:
The secret `HF_TOKEN` does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your settings t
ab (https://huggingface.co/settings/tokens), set it as secret in your Google
Colab and restart your session.
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to access
public models or datasets.
  warnings.warn(

mistral-7b-instruct-v0.2.Q6_K.gguf:   0%|              | 0.00/5.94G [00:00<?, ?
B/s]
```

```
In [13]:   # repo_id → "TheBloke/Mistral-7B-Instruct-v0.2-GGUF" (Hugging Face repository

           # filename → "mistral-7b-instruct-v0.2.Q6_K.gguf" (Specific model file inside
```

```
In [14]:   from llama_cpp import Llama
           llm = Llama(model_path=model_path)
           print("Max context length:", llm.n_ctx())
           # n_ctx stands for context length (context window), which defines how many tok
```

```
Max context length: 512

AVX = 1 | AVX2 = 1 | AVX512 = 0 | AVX512_VBMI = 0 | AVX512_VNNI = 0 | FMA =
1 | NEON = 0 | ARM_FMA = 0 | F16C = 1 | FP16_VA = 0 | WASM_SIMD = 0 | BLAS =
1 | SSE3 = 1 | SSSE3 = 1 | VSX = 0 |
```

```
In [15]:   # Run the following code in case GPU is being used

           llm = Llama(
               model_path=model_path,
               n_ctx=512, # Context window
            )
```

```
AVX = 1 | AVX2 = 1 | AVX512 = 0 | AVX512_VBMI = 0 | AVX512_VNNI = 0 | FMA =
1 | NEON = 0 | ARM_FMA = 0 | F16C = 1 | FP16_VA = 0 | WASM_SIMD = 0 | BLAS =
1 | SSE3 = 1 | SSSE3 = 1 | VSX = 0 |
```

Utility functions

```
In [17]:   # defining a function to parse the JSON output from the model
           def extract_json_data(json_str):
               try:
                   # Find the indices of the opening and closing curly braces
                   json_start = json_str.find('{')
                   json_end = json_str.rfind('}')

                   if json_start != -1 and json_end != -1:
                       extracted_category = json_str[json_start:json_end + 1]  # Extract
                       data_dict = json.loads(extracted_category)
                       return data_dict
                   else:
                       print(f"Warning: JSON object not found in response: {json_str}")
                       return {}
               except json.JSONDecodeError as e:
                   print(f"Error parsing JSON: {e}")
                   return {}
```

Task 1: Ticket Categorization and Returning Structured Output

```
In [18]:   # creating a copy of the data
           data_1 = data.copy()
```

```python
In [19]:   #Defining the response funciton for Task 1.
           def response_1(prompt,ticket):
               model_output = llm(
                 f"""
                 Q: {prompt}
                 Support ticket: {ticket}
                 A:
                 """,
                 max_tokens=300, # set the maximum number of tokens the model should gene
                 stop=["Q:"],
                 temperature=0.3, # set the value for temperature.
                 echo=False,
               )

               temp_output = model_output["choices"][0]["text"]
               # Fix JSON extraction
               if '{' in temp_output:
                   final_output = temp_output[temp_output.index('{'):]
               else:
                   final_output = temp_output  # Return raw output if JSON format is miss


               return final_output
```

```python
In [20]:   prompt_1 = """
               Classify the support ticket into predefined categories such as 'Internet I
               'Software Issue', 'Account Access', etc. Return a JSON object with the cat
           """
```

```python
In [21]:   response_1(prompt_1, "My laptop screen is flickering and shutting down randoml
```

```
Out[21]:   '{\n        "category": "Hardware Problem",\n        "response": "It seems
           like you\'re experiencing a hardware issue, possibly related to your laptop
           \'s display or power supply. Please ensure that all cables are securely conn
           ected and try using an external monitor to see if the issue persists. If the
           problem continues, we recommend bringing your device to a professional for f
           urther diagnosis."\n        }'
```

Note: The output of the model should be in a structured format (JSON format).

In [22]:
```python
start = time.time()
data_1['model_response'] = data_1['support_ticket_text'].apply(lambda x: respc
end = time.time()
```

```
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
```

In [23]:
```python
print("Time taken ",(end-start))
```

```
Time taken   2101.6181411743164
```

In [25]:
```python
i = 2
print(data_1.loc[i, 'support_ticket_text'])
```

```
I've accidentally deleted essential work documents, causing substantial data
loss. I understand the need to avoid further actions on my device. Can you p
lease prioritize the data recovery process and guide me through it?
```

In [26]:
```python
i= 2
print(data_1.loc[i, 'model_response'])
```

```
{
        "category": "Data Recovery",
        "response": "We apologize for your data loss incident. Our team wil
l prioritize your request and work on recovering your documents as soon as p
ossible. In the meantime, please avoid using your device to prevent overwrit
ing any deleted files. We'll provide you with further instructions once we b
egin the recovery process."
        }
```

In [27]:
```python
# Check the first five rows of the data to confirm whether the new column has
print(data_1.head())
```

```
  support_tick_id                                support_ticket_text  \
0      ST2023-006  My internet connection has significantly slowe...
1      ST2023-007  Urgent help required! My laptop refuses to sta...
2      ST2023-008  I've accidentally deleted essential work docum...
3      ST2023-009  Despite being in close proximity to my Wi-Fi r...
4      ST2023-010  My smartphone battery is draining rapidly, eve...

                                      model_response
0  {\n          "category": "Internet Issue",\n  ...
1  {\n          "category": "Hardware Problem",\n  ...
2  {\n          "category": "Data Recovery",\n     ...
3  {\n          "category": "Internet Issue",\n     ...
4  {\n          "category": "Hardware Problem",\n  ...
```

In [28]:
```python
# Applying the function to the model response
data_1['model_response_parsed'] = data_1['model_response'].apply(extract_json_
data_1['model_response_parsed'].head()
```

```
Error parsing JSON: Invalid control character at: line 3 column 218 (char 26
0)
Warning: JSON object not found in response: {
        "category": "Software Issue",
        "response": "Hello [Customer],\nThank you for bringing this issue t
o our attention. Based on the information provided, it appears that there ma
y be a software compatibility issue or some corrupted files causing the unex
pected behavior and data loss on your computer. We recommend performing a fu
ll system scan using your antivirus software and running Windows Update to e
nsure all software is up-to-date. Additionally, you can try reinstalling any
problematic applications and restoring previous versions of lost files from
backups if available. If the issue persists after trying these steps, please
provide more specific details about the affected applications and any error
messages you've encountered for further investigation. We will do our best t
o help you resolve this issue
```

Out[28]:

	model_response_parsed
0	{'category': 'Internet Issue', 'response': 'We...
1	{'category': 'Hardware Problem', 'response': '...
2	{'category': 'Data Recovery', 'response': 'We ...
3	{'category': 'Internet Issue', 'response': 'I'...
4	{'category': 'Hardware Problem', 'response': '...

dtype: object

In [29]:
```python
# Normalizing the model_response_parsed column
model_response_parsed_df_1 = pd.json_normalize(data_1['model_response_parsed']
model_response_parsed_df_1.head()
```

Out[29]:

	category	response
0	Internet Issue	We apologize for the inconvenience you're expe...
1	Hardware Problem	We understand the urgency of your situation. K...
2	Data Recovery	We apologize for your data loss incident. Our ...
3	Internet Issue	I'm sorry for the inconvenience you're experie...
4	Hardware Problem	I'm sorry to hear about your rapid battery dra...

In [30]:
```python
# Concatinating two dataframes
data_with_parsed_model_output_1 = pd.concat([data_1, model_response_parsed_df_
data_with_parsed_model_output_1.head()
```

Out[30]:

	support_tick_id	support_ticket_text	model_response	model_response_parsed	category	
0	ST2023-006	My internet connection has significantly slowe...	{\n "category": "Internet Issue",\n ...	{'category': 'Internet Issue', 'response': 'We...	Internet Issue	We incor you
1	ST2023-007	Urgent help required! My laptop refuses to sta...	{\n "category": "Hardware Problem",\n ...	{'category': 'Hardware Problem', 'response': '...	Hardware Problem	u the u your
2	ST2023-008	I've accidentally deleted essential work docum...	{\n "category": "Data Recovery",\n ...	{'category': 'Data Recovery', 'response': 'We...	Data Recovery	We for loss
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	{\n "category": "Internet Issue",\n ...	{'category': 'Internet Issue', 'response': 'I'...	Internet Issue	I'r incor
4	ST2023-010	My smartphone battery is draining rapidly, eve...	{\n "category": "Hardware Problem",\n ...	{'category': 'Hardware Problem', 'response': '...	Hardware Problem	I' h bat

In [31]:
```python
# Dropping model_response and model_response_parsed columns
final_data_1 = data_with_parsed_model_output_1.drop(['model_response','model_r
final_data_1.head()
```

Out[31]:

	support_tick_id	support_ticket_text	category	response
0	ST2023-006	My internet connection has significantly slowe...	Internet Issue	We apologize for the inconvenience you're expe...
1	ST2023-007	Urgent help required! My laptop refuses to sta...	Hardware Problem	We understand the urgency of your situation. K...
2	ST2023-008	I've accidentally deleted essential work docum...	Data Recovery	We apologize for your data loss incident. Our ...
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	Internet Issue	I'm sorry for the inconvenience you're experie...
4	ST2023-010	My smartphone battery is draining rapidly, eve...	Hardware Problem	I'm sorry to hear about your rapid battery dra...

In [32]: `final_data_1`

Out[32]:

	support_tick_id	support_ticket_text	category	response
0	ST2023-006	My internet connection has significantly slowe...	Internet Issue	We apologize for the inconvenience you're expe...
1	ST2023-007	Urgent help required! My laptop refuses to sta...	Hardware Problem	We understand the urgency of your situation. K...
2	ST2023-008	I've accidentally deleted essential work docum...	Data Recovery	We apologize for your data loss incident. Our ...
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	Internet Issue	I'm sorry for the inconvenience you're experie...
4	ST2023-010	My smartphone battery is draining rapidly, eve...	Hardware Problem	I'm sorry to hear about your rapid battery dra...
5	ST2023-011	I'm locked out of my online banking account an...	Account Access	We apologize for any inconvenience caused. To ...
6	ST2023-012	My computer's performance is sluggish, severel...	Software Issue	It sounds like you may be experiencing a softw...
7	ST2023-013	I'm experiencing a recurring blue screen error...	Hardware Problem	We recommend performing a hardware diagnostic ...
8	ST2023-014	My external hard drive isn't being recognized ...	NaN	NaN
9	ST2023-015	The graphics card in my gaming laptop seems to...	Hardware Problem	We're sorry for the inconvenience with your gr...
10	ST2023-016	I accidentally formatted my USB drive with cri...	Data Recovery	We're sorry for your loss. To help recover you...
11	ST2023-017	My computer's screen has gone black, and I can...	Hardware Problem	I'm sorry for the inconvenience you're experie...
12	ST2023-018	I accidentally spilled water on my laptop, and...	Hardware Problem	I'm sorry to hear about your laptop issue. Bas...
13	ST2023-019	My USB flash drive is physically damaged, and ...	Hardware Problem	I'm sorry to hear about your damaged USB flash...
14	ST2023-020	The touchpad on my laptop has stopped working,...	Hardware Problem	Hello! I'm sorry to hear that your touchpad is...
15	ST2023-021	My internet connection is frequently dropping,...	Internet Issue	We're sorry for the inconvenience you're exper...
16	ST2023-022	Wi-Fi is inconsistent despite proximity to the...	Internet Issue	We're sorry for the inconvenience you're exper...
17	ST2023-023	I accidentally formatted my USB drive with cru...	Data Recovery	We're sorry to hear that you've lost important...
18	ST2023-024	My external hard drive isn't being recognized,...	Hardware Problem	We recommend checking the following: Ensure th...
19	ST2023-025	I am experiencing a critical problem with my i...	Internet Issue	We apologize for the inconvenience you are exp...
20	ST2023-026	I hope this message finds you well. I am writi...	NaN	NaN

In [ ]: `# final_data_1 is the final dataset generated after performing ticket categori`

Task 2: Creating Tags

In [33]:
```python
# Creating a copy of the data
data_2 = data.copy()
```

In [34]:
```python
# Defining the response funciton for Task 1.
def response_2(prompt,ticket,category):
    model_output = llm(
      f"""
      Q: {prompt}
      Support ticket: {ticket}
      Category: {category}
      A:
      """,
      max_tokens=300, # set the maximum number of tokens the model should gene
      stop=["Q:"],
      temperature=0.3, # set the value for temperature.
      echo=False,
    )

    temp_output = model_output["choices"][0]["text"]
    # Fix JSON extraction
    if '{' in temp_output:
        final_output = temp_output[temp_output.index('{'):]
    else:
        final_output = temp_output  # Return raw output if JSON format is miss


    return final_output
```

In [35]:
```python
prompt_2 = """
    Your task is to extract relevant tags from a customer support ticket.

**Instructions**:
- Extract 2 to 5 concise and meaningful tags from the support ticket.
- Tags should be keywords or short phrases, not full sentences.
- Focus on affected device/service, issue type, and context (e.g., "Wi-Fi sign
- Return the output as a valid JSON object with the tags.

{{
  "tags": ["tag1", "tag2", "tag3"]
}}

Support Ticket: "{ticket_text}"
Provide the tags below in JSON format:
"""
```

In [37]:
```python
response_2(prompt_2, "My laptop screen is flickering and shutting down randoml
```

Llama.generate: prefix-match hit

Out[37]:
```
'{\n        "tags": ["laptop", "screen flicker", "random shutdown"]\n
}'
```

Note: The output of the model should be in a structured format (JSON format).

In [39]:
```python
start = time.time()
data_2["model_response"]=final_data_1[['support_ticket_text','category']].appl
end = time.time()
```

```
<ipython-input-39-d910228edb33>:2: FutureWarning: Series.__getitem__ treatin
g keys as positions is deprecated. In a future version, integer keys will al
ways be treated as labels (consistent with DataFrame behavior). To access a
value by position, use `ser.iloc[pos]`
  data_2["model_response"]=final_data_1[['support_ticket_text','category']].
apply(lambda x: response_2(prompt_2, x[0],x[1]),axis =1)
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
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Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
```

In [40]:
```python
print("Time taken ",end-start)
```

```
Time taken  527.2178378105164
```

In [41]:
```python
# Check the first five rows of the data to confirm whether the new column has
print(data_2.head())
```

```
  support_tick_id                      support_ticket_text  \
0     ST2023-006  My internet connection has significantly slowe...
1     ST2023-007  Urgent help required! My laptop refuses to sta...
2     ST2023-008  I've accidentally deleted essential work docum...
3     ST2023-009  Despite being in close proximity to my Wi-Fi r...
4     ST2023-010  My smartphone battery is draining rapidly, eve...

                                     model_response
0  {\n          "tags": ["internet connection", "s...
1  {\n          "tags": ["laptop", "startup failur...
2  {\n          "tags": ["data loss", "document re...
3  {\n          "tags": ["Wi-Fi signal", "weak sig...
4  {\n          "tags": ["smartphone", "battery", ...
```

In [43]:
```python
# Support ticket at index 2
i = 2
print(data_2.loc[i, 'support_ticket_text'])
```

I've accidentally deleted essential work documents, causing substantial data loss. I understand the need to avoid further actions on my device. Can you please prioritize the data recovery process and guide me through it?

In [42]:
```python
# Tags generated for the support ticket at index 2
print(data_2.loc[i, 'model_response'])
```

```
{
        "tags": ["data loss", "document recovery"]
    }
```

In [44]:
```python
# Applying the function to the model response
data_2['model_response_parsed'] = data_2['model_response'].apply(extract_json_
```

In [45]:
```python
data_2["model_response_parsed"]
```

Out[45]:

	model_response_parsed
0	{'tags': ['internet connection', 'slow speed',...
1	{'tags': ['laptop', 'startup failure', 'hardwa...
2	{'tags': ['data loss', 'document recovery']}
3	{'tags': ['Wi-Fi signal', 'weak signal', 'trou...
4	{'tags': ['smartphone', 'battery', 'rapid drai...
5	{'tags': ['account access', 'password reset', ...
6	{'tags': ['computer performance', 'software op...
7	{'tags': ['blue screen error', 'PC crash', 'ha...
8	{'tags': ['external hard drive', 'data recover...
9	{'tags': ['graphics card', 'gaming laptop', 'h...
10	{'tags': ['USB drive', 'data loss', 'file reco...
11	{'tags': ['computer', 'screen issue', 'black s...
12	{'tags': ['water damage', 'laptop', 'hardware ...
13	{'tags': ['USB flash drive', 'physical damage'...
14	{'tags': ['touchpad', 'laptop', 'hardware fail...
15	{'tags': ['internet connection', 'dropping', '...
16	{'tags': ['Wi-Fi', 'Inconsistent connection', ...
17	{'tags': ['USB drive', 'data loss', 'file reco...
18	{'tags': ['external hard drive', 'data recover...
19	{'tags': ['internet connection', 'slow speed',...
20	{'tags': ['software issue', 'unexpected data l...

dtype: object

In [46]:
```python
# Normalizing the model_response_parsed column
model_response_parsed_df_2 = pd.json_normalize(data_2['model_response_parsed']
model_response_parsed_df_2.head()
```

Out[46]:

	tags
0	[internet connection, slow speed, disconnections]
1	[laptop, startup failure, hardware issue, pres...
2	[data loss, document recovery]
3	[Wi-Fi signal, weak signal, troubleshooting]
4	[smartphone, battery, rapid drain, minimal use]

In [47]:
```python
# Concatinating two dataframes
data_with_parsed_model_output_2 = pd.concat([data_2, model_response_parsed_df_
data_with_parsed_model_output_2.head()
```

Out[47]:

	support_tick_id	support_ticket_text	model_response	model_response_parsed	tags
0	ST2023-006	My internet connection has significantly slowe...	{\n "tags": ["internet connection", "s...	{'tags': ['internet connection', 'slow speed',...	[internet connection, slow speed, disconnections]
1	ST2023-007	Urgent help required! My laptop refuses to sta...	{\n "tags": ["laptop", "startup failur...	{'tags': ['laptop', 'startup failure', 'hardwa...	[laptop, startup failure, hardware issue, pres...
2	ST2023-008	I've accidentally deleted essential work docum...	{\n "tags": ["data loss", "document re...	{'tags': ['data loss', 'document recovery']}	[data loss, document recovery]
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	{\n "tags": ["Wi-Fi signal", "weak sig...	{'tags': ['Wi-Fi signal', 'weak signal', 'trou...	[Wi-Fi signal, weak signal, troubleshooting]
4	ST2023-010	My smartphone battery is draining rapidly, eve...	{\n "tags": ["smartphone", "battery", ...	{'tags': ['smartphone', 'battery', 'rapid drai...	[smartphone, battery, rapid drain, minimal use]

In [48]:
```python
# Dropping model_response and model_response_parsed columns
final_data_2 = data_with_parsed_model_output_2.drop(['model_response','model_r
final_data_2.head()
```

Out[48]:

	support_tick_id	support_ticket_text	tags
0	ST2023-006	My internet connection has significantly slowe...	[internet connection, slow speed, disconnections]
1	ST2023-007	Urgent help required! My laptop refuses to sta...	[laptop, startup failure, hardware issue, pres...
2	ST2023-008	I've accidentally deleted essential work docum...	[data loss, document recovery]
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	[Wi-Fi signal, weak signal, troubleshooting]
4	ST2023-010	My smartphone battery is draining rapidly, eve...	[smartphone, battery, rapid drain, minimal use]

In [50]:
```python
# Checking the value counts of Category column
final_data_2['tags'].value_counts()
```

Out[50]:

	count
tags	
[USB drive, data loss, file recovery]	2
[internet connection, slow speed, disconnections]	1
[data loss, document recovery]	1
[laptop, startup failure, hardware issue, presentation]	1
[Wi-Fi signal, weak signal, troubleshooting]	1
[smartphone, battery, rapid drain, minimal use]	1
[computer performance, software optimization, productivity loss]	1
[account access, password reset, online banking]	1
[blue screen error, PC crash, hardware issue]	1
[external hard drive, data recovery]	1
[graphics card, gaming laptop, hardware issue, performance]	1
[computer, screen issue, black screen, hardware problem]	1
[water damage, laptop, hardware failure, data recovery]	1
[USB flash drive, physical damage, data recovery]	1
[touchpad, laptop, hardware failure]	1
[internet connection, dropping, affecting work]	1
[Wi-Fi, Inconsistent connection, Work, Internet issue]	1
[external hard drive, data recovery, hardware issue]	1
[internet connection, slow speed, disconnections, productivity loss]	1
[software issue, unexpected data loss, erratic behavior, system compatibility]	1

dtype: int64

In [52]:
```python
final_data_2 = pd.concat([final_data_2,final_data_1["category"]],axis=1)
```

In [54]:
```python
final_data_2 = final_data_2[["support_tick_id","support_ticket_text","category
final_data_2
```

Out[54]:

	support_tick_id	support_ticket_text	category	tags
0	ST2023-006	My internet connection has significantly slowe...	Internet Issue	[internet connection, slow speed, disconnections]
1	ST2023-007	Urgent help required! My laptop refuses to sta...	Hardware Problem	[laptop, startup failure, hardware issue, pres...
2	ST2023-008	I've accidentally deleted essential work docum...	Data Recovery	[data loss, document recovery]
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	Internet Issue	[Wi-Fi signal, weak signal, troubleshooting]
4	ST2023-010	My smartphone battery is draining rapidly, eve...	Hardware Problem	[smartphone, battery, rapid drain, minimal use]
5	ST2023-011	I'm locked out of my online banking account an...	Account Access	[account access, password reset, online banking]
6	ST2023-012	My computer's performance is sluggish, severel...	Software Issue	[computer performance, software optimization, ...
7	ST2023-013	I'm experiencing a recurring blue screen error...	Hardware Problem	[blue screen error, PC crash, hardware issue]
8	ST2023-014	My external hard drive isn't being recognized ...	NaN	[external hard drive, data recovery]
9	ST2023-015	The graphics card in my gaming laptop seems to...	Hardware Problem	[graphics card, gaming laptop, hardware issue,...
10	ST2023-016	I accidentally formatted my USB drive with cri...	Data Recovery	[USB drive, data loss, file recovery]
11	ST2023-017	My computer's screen has gone black, and I can...	Hardware Problem	[computer, screen issue, black screen, hardwar...
12	ST2023-018	I accidentally spilled water on my laptop, and...	Hardware Problem	[water damage, laptop, hardware failure, data ...
13	ST2023-019	My USB flash drive is physically damaged, and ...	Hardware Problem	[USB flash drive, physical damage, data recovery]
14	ST2023-020	The touchpad on my laptop has stopped working,...	Hardware Problem	[touchpad, laptop, hardware failure]
15	ST2023-021	My internet connection is frequently dropping,...	Internet Issue	[internet connection, dropping, affecting work]
16	ST2023-022	Wi-Fi is inconsistent despite proximity to the...	Internet Issue	[Wi-Fi, Inconsistent connection, Work, Interne...
17	ST2023-023	I accidentally formatted my USB drive with cru...	Data Recovery	[USB drive, data loss, file recovery]
18	ST2023-024	My external hard drive isn't being recognized,...	Hardware Problem	[external hard drive, data recovery, hardware ...
19	ST2023-025	I am experiencing a critical problem with my i...	Internet Issue	[internet connection, slow speed, disconnectio...
20	ST2023-026	I hope this message finds you well. I am writi...	NaN	[software issue, unexpected data loss, erratic...

In [ ]:
```python
# final_data_2 is the final dataset generated after creating tags using the su
```

Task 3: Assigning Priority and ETA

```python
In [55]:  # Creating a copy of the data
          data_3 = data.copy()
```

```python
In [56]:  # Defining the response funciton for Task 1.
          def response_3(prompt,ticket,category,tags):
              model_output = llm(
                f"""
                Q: {prompt}
                Support ticket: {ticket}
                Category: {category}
                Tags: {tags}
                A:
                """,
                max_tokens=300, # set the maximum number of tokens the model should gene
                stop=["Q:"],
                temperature=0.3, # set the value for temperature.
                echo=False,
              )

              temp_output = model_output["choices"][0]["text"]
              # Fix JSON extraction
              if '{' in temp_output:
                  final_output = temp_output[temp_output.index('{'):]
              else:
                  final_output = temp_output  # Return raw output if JSON format is miss


              return final_output
```

```
In [57]: prompt_3 = """
            Based on the support ticket and its category, determine:

         1. **Priority** – Choose from: "High", "Medium", or "Low"
         2. **ETA** – Choose an appropriate response time like: "Immediate", "24 hours"

         **Rules**:
         - Mark as **High Priority** if the issue involves complete inaccessibility, de
         - Mark as **Immediate ETA** for data loss, account access issues, or critical
         - Use **24 hours ETA** for connectivity or major hardware issues that are not
         - Use **2-3 business days** for performance issues or gradual failures.
         - Use **1 week** for minor or cosmetic problems.

         Return your response strictly in this JSON format:
         {{
             "priority": "<High|Medium|Low>",
             "eta": "<ETA value>"
         }}

         Support Ticket: "{ticket_text}"
         Category: "{category}"

         Your JSON response:
         """
```

```
In [59]: response_3(prompt_3, "My laptop screen is flickering and shutting down randoml
```

```
Llama.generate: prefix-match hit
```

Out[59]: '{\n   "priority": "High",\n   "eta": "Immediate"\n   }'

Note: The output of the model should be in a structured format (JSON format).

In [64]:
```python
# Applying generate_llama_response function on support_ticket_text column
start = time.time()
data_3.loc[:19,'model_response'] = final_data_2.loc[:19,['support_ticket_text'
end = time.time()
```

```
<ipython-input-64-5db30985c816>:3: FutureWarning: Series.__getitem__ treatin
g keys as positions is deprecated. In a future version, integer keys will al
ways be treated as labels (consistent with DataFrame behavior). To access a
value by position, use `ser.iloc[pos]`
  data_3.loc[:19,'model_response'] = final_data_2.loc[:19,['support_ticket_t
ext','category','tags']].apply(lambda x: response_3(prompt_3, x[0],x[1],x
[2]),axis=1)
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
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Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
```

In [65]:
```python
print("Time taken ",(end-start))
```

```
Time taken  465.91650915145874
```

In [66]:
```python
# Check the first five rows of the data to confirm whether the new column has
data_3.head()
```

Out[66]:

	support_tick_id	support_ticket_text	model_response
0	ST2023-006	My internet connection has significantly slowe...	{\n "priority": "High",\n "eta...
1	ST2023-007	Urgent help required! My laptop refuses to sta...	{\n "priority": "High",\n "e...
2	ST2023-008	I've accidentally deleted essential work docum...	{\n "priority": "High",\n "eta...
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	{\n "priority": "Medium",\n "e...
4	ST2023-010	My smartphone battery is draining rapidly, eve...	{\n "priority": "Medium",\n "e...

In [67]:
```python
i = 2
print(data_3.loc[i, 'support_ticket_text'])
```

```
I've accidentally deleted essential work documents, causing substantial data
loss. I understand the need to avoid further actions on my device. Can you p
lease prioritize the data recovery process and guide me through it?
```

In [68]:
```python
print(data_3.loc[i, 'model_response'])
```

```
{
        "priority": "High",
        "eta": "Immediate"
    }
```

In [70]:
```python
# Applying the function to the model response
data_3.loc[:19,'model_response_parsed'] = data_3.loc[:19,'model_response'].app
data_3.loc[:19,'model_response_parsed'].head()
```

Out[70]:

	model_response_parsed
0	{'priority': 'High', 'eta': 'Immediate'}
1	{'priority': 'High', 'eta': 'Immediate'}
2	{'priority': 'High', 'eta': 'Immediate'}
3	{'priority': 'Medium', 'eta': '2-3 business da...
4	{'priority': 'Medium', 'eta': '2-3 business da...

dtype: object

In [71]:
```python
# Normalizing the model_response_parsed column
model_response_parsed_df_3 = pd.json_normalize(data_3.loc[:19,'model_response_
model_response_parsed_df_3.head(21)
```

Out[71]:

	priority	eta
0	High	Immediate
1	High	Immediate
2	High	Immediate
3	Medium	2-3 business days
4	Medium	2-3 business days
5	High	Immediate
6	Medium	2-3 business days
7	Medium	2-3 business days
8	High	Immediate
9	Medium	2-3 business days
10	High	Immediate
11	High	Immediate
12	High	Immediate
13	High	Immediate
14	Medium	2-3 business days
15	High	Immediate
16	Medium	2-3 business days
17	High	Immediate
18	High	Immediate
19	High	Immediate

In [72]:
```python
# Concatinating two dataframes
data_with_parsed_model_output_3 = pd.concat([data_3, model_response_parsed_df_
data_with_parsed_model_output_3.head()
```

Out[72]:

	support_tick_id	support_ticket_text	model_response	model_response_parsed	priority	
0	ST2023-006	My internet connection has significantly slowe...	{\n "priority": "High",\n "eta...	{'priority': 'High', 'eta': 'Immediate'}	High	Immed
1	ST2023-007	Urgent help required! My laptop refuses to sta...	{\n "priority": "High",\n "e...	{'priority': 'High', 'eta': 'Immediate'}	High	Immed
2	ST2023-008	I've accidentally deleted essential work docum...	{\n "priority": "High",\n "eta...	{'priority': 'High', 'eta': 'Immediate'}	High	Immed
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	{\n "priority": "Medium",\n "e...	{'priority': 'Medium', 'eta': '2-3 business da...	Medium	busir
4	ST2023-010	My smartphone battery is draining rapidly, eve...	{\n "priority": "Medium",\n "e...	{'priority': 'Medium', 'eta': '2-3 business da...	Medium	busir

In [73]:
```python
# Dropping model_response and model_response_parsed columns
final_data_3 = data_with_parsed_model_output_3.drop(['model_response','model_r
final_data_3.head()
```

Out[73]:

	support_tick_id	support_ticket_text	priority	eta
0	ST2023-006	My internet connection has significantly slowe...	High	Immediate
1	ST2023-007	Urgent help required! My laptop refuses to sta...	High	Immediate
2	ST2023-008	I've accidentally deleted essential work docum...	High	Immediate
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	Medium	2-3 business days
4	ST2023-010	My smartphone battery is draining rapidly, eve...	Medium	2-3 business days

In [75]:
```python
final_data_3 = pd.concat([final_data_3,final_data_2[["category","tags"]]],axis
```

In [76]:
```python
final_data_3 = final_data_3[["support_tick_id","support_ticket_text","category
```

In [77]:
```python
final_data_3
```

Out[77]:

	support_tick_id	support_ticket_text	category	tags	priority	eta
0	ST2023-006	My internet connection has significantly slowe...	Internet Issue	[internet connection, slow speed, disconnections]	High	Immediate
1	ST2023-007	Urgent help required! My laptop refuses to sta...	Hardware Problem	[laptop, startup failure, hardware issue, pres...	High	Immediate
2	ST2023-008	I've accidentally deleted essential work docum...	Data Recovery	[data loss, document recovery]	High	Immediate
3	ST2023-009	Despite being in close proximity to my Wi-Fi r...	Internet Issue	[Wi-Fi signal, weak signal, troubleshooting]	Medium	2-3 business days
4	ST2023-010	My smartphone battery is draining rapidly, eve...	Hardware Problem	[smartphone, battery, rapid drain, minimal use]	Medium	2-3 business days
5	ST2023-011	I'm locked out of my online banking account an...	Account Access	[account access, password reset, online banking]	High	Immediate
6	ST2023-012	My computer's performance is sluggish, severel...	Software Issue	[computer performance, software optimization, ...	Medium	2-3 business days
7	ST2023-013	I'm experiencing a recurring blue screen error...	Hardware Problem	[blue screen error, PC crash, hardware issue]	Medium	2-3 business days
8	ST2023-014	My external hard drive isn't being recognized ...	NaN	[external hard drive, data recovery]	High	Immediate
9	ST2023-015	The graphics card in my gaming laptop seems to...	Hardware Problem	[graphics card, gaming laptop, hardware issue,...	Medium	2-3 business days
10	ST2023-016	I accidentally formatted my USB drive with cri...	Data Recovery	[USB drive, data loss, file recovery]	High	Immediate
11	ST2023-017	My computer's screen has gone black, and I can...	Hardware Problem	[computer, screen issue, black screen, hardwar...	High	Immediate
12	ST2023-018	I accidentally spilled water on my laptop, and...	Hardware Problem	[water damage, laptop, hardware failure, data ...	High	Immediate
13	ST2023-019	My USB flash drive is physically damaged, and ...	Hardware Problem	[USB flash drive, physical damage, data recovery]	High	Immediate
14	ST2023-020	The touchpad on my laptop has stopped working,...	Hardware Problem	[touchpad, laptop, hardware failure]	Medium	2-3 business days
15	ST2023-021	My internet connection is frequently dropping,...	Internet Issue	[internet connection, dropping, affecting work]	High	Immediate
16	ST2023-022	Wi-Fi is inconsistent despite proximity to the...	Internet Issue	[Wi-Fi, Inconsistent connection, Work, Interne...	Medium	2-3 business days
17	ST2023-023	I accidentally formatted my USB drive with cru...	Data Recovery	[USB drive, data loss, file recovery]	High	Immediate
18	ST2023-024	My external hard drive isn't being recognized,...	Hardware Problem	[external hard drive, data recovery, hardware ...	High	Immediate

	support_tick_id	support_ticket_text	category	tags	priority	eta
19	ST2023-025	I am experiencing a critical problem with my i...	Internet Issue	[internet connection, slow speed, disconnectio...	High	Immediate
20	ST2023-026	I hope this message finds you well. I am writi...	NaN	[software issue, unexpected data loss, erratic...	NaN	NaN

In [78]:
```python
# final_data_3 is the final output generated after assigning priority and calc
# ETA: The estimated amount of time it will take to resolve or respond to the
```

Task 4 - Creating a Draft Response

In [79]:
```python
# Creating a copy of the data
data_4 = data.copy()
```

In [80]:
```python
# Defining the response funciton for Task 1.
def response_4(prompt,ticket,category,tags,priority,eta):
    model_output = llm(
      f"""
      Q: {prompt}
      Support ticket: {ticket}
      Category: {category}
      Tags: {tags}
      Priority: {priority}
      ETA: {eta}
      A:
      """,
      max_tokens=300, # set the maximum number of tokens the model should gene
      stop=["Q:"],
      temperature=0.3, # set the value for temperature.
      echo=False,
    )

    temp_output = model_output["choices"][0]["text"]
    # Fix JSON extraction
    if '{' in temp_output:
        final_output = temp_output[temp_output.index('{'):]
    else:
        final_output = temp_output  # Return raw output if JSON format is miss


    return final_output
```

```
In [83]: prompt_4 = """
             Write a professional, empathetic, and helpful **one-paragraph** response t

         Guidelines:
         - Address the user's concern based on the issue described.
         - Offer steps to resolve or acknowledge the issue appropriately.
         - Maintain a polite, understanding tone.
         - Do **not** output JSON — just plain text response.

         Support Ticket: "{ticket_text}"
         Category: "{category}"

         Response:

         """
```

Note : For this task, we will not be using the *extract_json_data* function. Hence, the output from the model should be a plain string and not a JSON object.

```
In [84]: response_4(prompt_4, "My laptop screen is flickering and shutting down randoml
```

```
Llama.generate: prefix-match hit
```

Out[84]: "\n   Dear Valued Customer,\n   \n   We are deeply sorry to hear th
         at you're experiencing issues with your laptop screen flickering and the dev
         ice randomly shutting down. This can indeed be a frustrating experience, and
         we understand how important it is for you to have a reliable computing solut
         ion.\n   \n   To help diagnose the issue, could you please check if th
         is problem occurs when the laptop is connected to an external monitor? If s
         o, it might be related to the internal display. In case the issue persists w
         ith an external monitor, it could potentially be a power issue or a hardware
         component failure.\n   \n   To ensure your data remains safe, we stron
         gly advise against attempting any repairs yourself. Instead, please contact
         our technical support team at [support_email] or call us at [support_phone].
         Our experts will guide you through the process of scheduling an appointment
         for a professional repair. We'll make every effort to prioritize your case a
         nd provide you with a resolution as soon as possible.\n   \n   In the
         meantime, we recommend saving any important work on an external hard drive o
         r cloud storage service to prevent data loss. We appreciate your patience an
         d understanding as we work diligently to resolve this issue for you.\n
         \n   Best regards,\n   [Your Name]\n   [Your Position]\n   [Comp
         any Name]\n   Technical Support Team"

```
In [ ]: # We are generating llama response only on the first three support tickets ins
        # This is due to limited n_ctx wrt the model we are using. To process the enti
        # Also, to generate llama response for each support ticket it takes around 3 m
```

In [85]:
```
# Applying generate_llama_response function on support_ticket_text column
start = time.time()
data_4.loc[:2,'model_response'] = final_data_3.loc[:2,['support_ticket_text','
end = time.time()
```

```
<ipython-input-85-2953da9a2f3a>:3: FutureWarning: Series.__getitem__ treatin
g keys as positions is deprecated. In a future version, integer keys will al
ways be treated as labels (consistent with DataFrame behavior). To access a
value by position, use `ser.iloc[pos]`
  data_4.loc[:2,'model_response'] = final_data_3.loc[:2,['support_ticket_tex
t','category','tags','priority','eta']].apply(lambda x: response_4(prompt_4,
x[0],x[1],x[2],x[3],x[4]),axis=1)
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
Llama.generate: prefix-match hit
```

In [86]:
```
print("Time taken",(end-start))
```

```
Time taken 717.038076877594
```

In [87]:
```
# Check the first five rows of the data to confirm whether the new column has
data_4.head(2)
```

Out[87]:

	support_tick_id	support_ticket_text	model_response
0	ST2023-006	My internet connection has significantly slowe...	\n Dear Valued Customer,\n \n \n W...
1	ST2023-007	Urgent help required! My laptop refuses to sta...	\n Dear Valued Customer,\n \n \n W...

In [88]:
```
i = 2
print(data_4.loc[i, 'support_ticket_text'])
```

```
I've accidentally deleted essential work documents, causing substantial data
loss. I understand the need to avoid further actions on my device. Can you p
lease prioritize the data recovery process and guide me through it?
```

In [89]:
```
print(data_4.loc[i, 'model_response'])
```

```
        We deeply understand your concern regarding the accidental deletion of
important work documents. Losing data can be a frustrating experience, and w
e're here to help you recover as much information as possible. To begin the
recovery process, please follow these steps:

        1. Stop using your device immediately to prevent overwriting any poten
tially recoverable data.
        2. Contact our dedicated Data Recovery team at [support_email] or call
us at [support_phone]. They will guide you through the process and provide f
urther instructions based on your specific situation.
        3. If possible, please provide as much detail about the deleted files
(type, size, last modified date) to help expedite the recovery process.

        We appreciate your patience during this time and assure you that our t
eam will work diligently to recover your data. Your satisfaction is our top
priority.
```

```
In [93]: final_data_4 = pd.concat([final_data_3[0:3],data_4["model_response"]],axis=1)
```

```
In [94]: final_data_4.rename(columns={"model_response":"Response"},inplace=True)
```

```
In [95]: final_data_4[0:3]
```

Out[95]:

	support_tick_id	support_ticket_text	category	tags	priority	eta	Response
0	ST2023-006	My internet connection has significantly slowe...	Internet Issue	[internet connection, slow speed, disconnections]	High	Immediate	\n Dear Valued Customer,\n \n W...
1	ST2023-007	Urgent help required! My laptop refuses to sta...	Hardware Problem	[laptop, startup failure, hardware issue, pres...]	High	Immediate	\n Dear Valued Customer,\n \n W...
2	ST2023-008	I've accidentally deleted essential work docum...	Data Recovery	[data loss, document recovery]	High	Immediate	\n We deeply understand your concern rega...

```
In [96]: # final_dat_4 is the final output generated after generating the llama respons
```

Model Output Analysis

```
In [97]: # Creating a copy of the dataframe of task-4
         final_data = final_data_4[0:3].copy()
```

```
In [98]: final_data['category'].value_counts()    # column containing ticket categories
```

Out[98]:

	count
category	
Internet Issue	1
Hardware Problem	1
Data Recovery	1

dtype: int64

```
In [99]: final_data["priority"].value_counts() # column containing the priorities of th
```

Out[99]:

	count
priority	
High	3

dtype: int64

In [100]: `final_data["eta"].value_counts()`*# column containing ticket resolution ETA.*

Out[100]:

	count
eta	
Immediate	3

dtype: int64

Let's dive in a bit deeper here.

In [101]: `final_data.groupby(['category', 'eta']).support_tick_id.count()` *# group by bas*

Out[101]:

		support_tick_id
category	**eta**	
Data Recovery	**Immediate**	1
Hardware Problem	**Immediate**	1
Internet Issue	**Immediate**	1

dtype: int64

Actionable Insights and Recommendations

- we understood the method to categorize a support ticket and make a structured format of it.
- The task of creating tags, assigning priority and calculating and estimated time to resolve the issue helps to prioritize the tasks and understand the issue.
- An automated response generated to the customer helps in better customer handling and providing confirmation that the query has reached to the concerned person for further process.