Gen AI Orchestrator for Email and Document Triage/Routing

Github Repository: https://github.com/ewfx/gaied-neural-squad

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PROBLEM STATEMENT

Develop a GenAI based Email Classification Solution to identify email request type, sub request type, intent, and extract important attributes. Also identify whether the email is non-essential and can be ignored.

APPROACH

Dataset Creation using ChatGPT

Due to a lack of an existing dataset, we generated sample emails using the following prompt. We had to make sure that the sample mails do not mention the request type and subtype explicitly and had to ensure a minimum length so we can be assured that our model can analyze the email text and give us a classification.

PROMPT:
Write a loan servicing request sent to Wells Fargo bank of type 'Fee payment' and request subtype 'Letter of credit fee'. Make sure to include relevant details with sample data like the customer name, loan number, payment date, property address, etc. Make sure its in a standard banking home loan servicing request format. Generate an email for the above, with at least 500 words and don't explicitly mention the request type and subtype, don't use bullet points and mention all the information in paragraphs

BACKEND

FastAPI

FastAPI is a modern, high-performance web framework for building REST APIs with Python, leveraging type hints for automatic data validation and generating interactive documentation. It is designed for speed and efficiency, making it ideal for scalable applications that require asynchronous request handling.

EMAIL PROCESSING MIDDLEWARE

Parsing .eml file

As we are receiving .eml files, we added middleware to extract the text content of the email along with any attachments.
This text was then passed to the LLM.

Reading attachments

Depending on the type of attachment, our middleware was able to read the file in the desired format and extract the text.
It currently supports .txt, .docx and .pdf files.

EMAIL CLASSIFICATION

Request Type and Sub Request Type Classification Intent Extraction

We gave the LLM the context of the problem statement as its system message. We then ask it to figure out the Request Type, SubRequest Type by passing in a list of configurable types and subtypes along with their descriptions.
Because the possible Request and SubRequest types are configurable in the code, so we can handle any future feature creep or scope change.
We also instructed the model to extract the intent of the email, allowing quick identification of the main ask being made by the sender.


```
types.py  ×

code > src > llm > types.py > ...
204      "Fee Payment": (
205          "description": "Fee payments are requests related to the payment of specific loan-associated fees. These could include charges
             for ongoing service or special agreements in the loan contract.",
206          "subtypes": (
207              "Ongoing Fee": "Regularly charged fees associated with maintaining or servicing the loan, typically occurring on a periodic
                 basis.",
208              "Letter of Credit Fee": "Fees charged for issuing or maintaining a letter of credit, which is often used as a financial
                 guarantee for certain loan arrangements or agreements."
209          )
210      ),
211      "Money Movement - inbound": (
212          "description": "Inbound money movement refers to funds coming into the loan account, typically representing payments or deposits
             made by the borrower or third-party.",
213          "subtypes": (
214              "Principal": "Repayment of the principal amount of the loan.",
215              "Interest": "Payment of the interest accrued on the loan.",
216              "Principal + Interest": "A payment covering both the principal and interest amounts owed on the loan.",
217              "Principal + Interest + Fee": "A combined payment that covers the principal, interest, and any associated fees, ensuring the
                 full repayment amount."
218          )
219      ),
220      "Money Movement - Outbound": (
```

Examples of Request Types and Sub Types

DUPLICATE EMAIL IDENTIFICATION

The LLM is prompted to identify whether the given email is non essential (eg: courtesy emails) and can be ignored. If a mail is classified as duplicate, then request type, sub request type etc, are not not extracted for it.

ADDITIONAL ATTRIBUTES EXTRACTION

The configurable request types variable also contains a list of expected fields that could be present in each request/subrequest type.
This aids the LLM in extracting additional attributes as it has a baseline to search for. The LLM is also asked to search for any other important attributes apart from those specified in the above list, making sure nothing is missed.

GenAI Integration in Application - Tools

LangChain

Open-source framework that facilitates the integration of LLMs in applications. Used it to call LLM.

Mistral-7B-Instruct-v0.2

Model from Mistral AI

Hugging Face

Platform and hub for LLMs and provides APIs for LLM inferencing

Gemma-3-27b-it

Model from Google

CODE HYGIENE AND BEST PRACTICES

Modularity of code

Our code is composed of two modules, one for the api and one for the model.
This adheres to the Single Responsibility SOLID principle and makes it easier to prevent unwanted side-effects of code changes.

Dependency Injection

Our prompting logic takes in an object of a custom LLMChat class and, which makes it easy to swap out models and adopt newer LLMs.
In case any new LLM API is needed, the developer just needs to create a subclass of LLMChat and use it, instead of rewriting the whole prompting logic.

FINAL SOLUTION

User uploads an email(.eml file) via UI

↓

The email content and its attachments are parsed

↓

The text is passed to LLM which identifies request type, sub-request type and extracts intent and important attributes from the text. The different request types are in a file types.py and is passed to the LLM as context. This ensures that the request types are configurable. The LLM also identifies whether the email is non essential and can be ignored. The LLM is asked to generate output in a JSON format by using one-shot prompting.

↓

The output from LLM is processed to a JSON object

↓

Frontend displays the JSON fields on the UI

TECH STACK

FRONTEND

The frontend was made using HTML, vanilla JS and CSS.
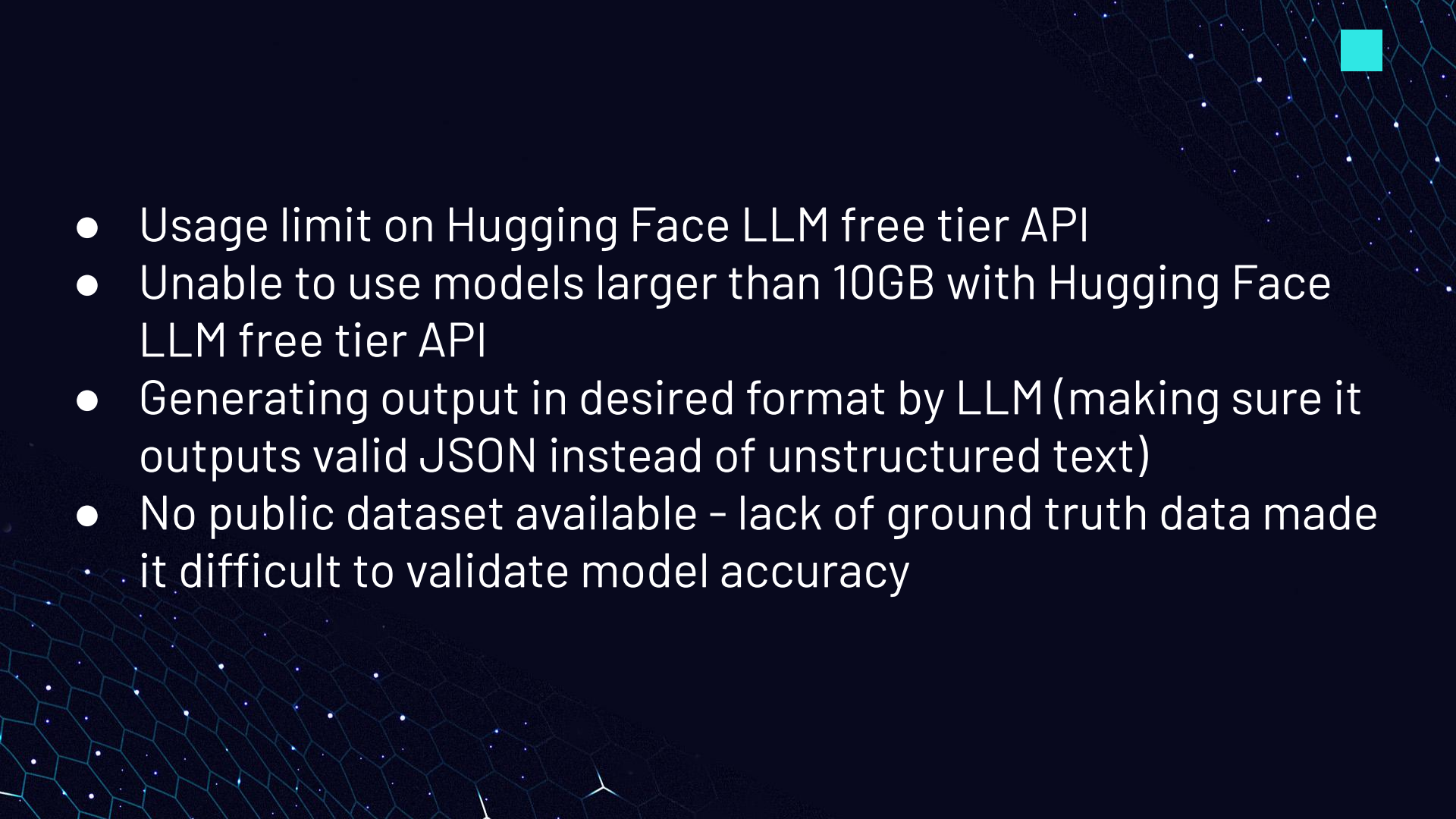
BACKEND

We used a python backend made using the FastAPI web-framework which helped us quickly spin up a working local server.

LLM

The LLM models we used were Mistral AI and Gemma by Google, accessed through Hugging Face.
We also used the LangChain python framework to connect to the LLMs.
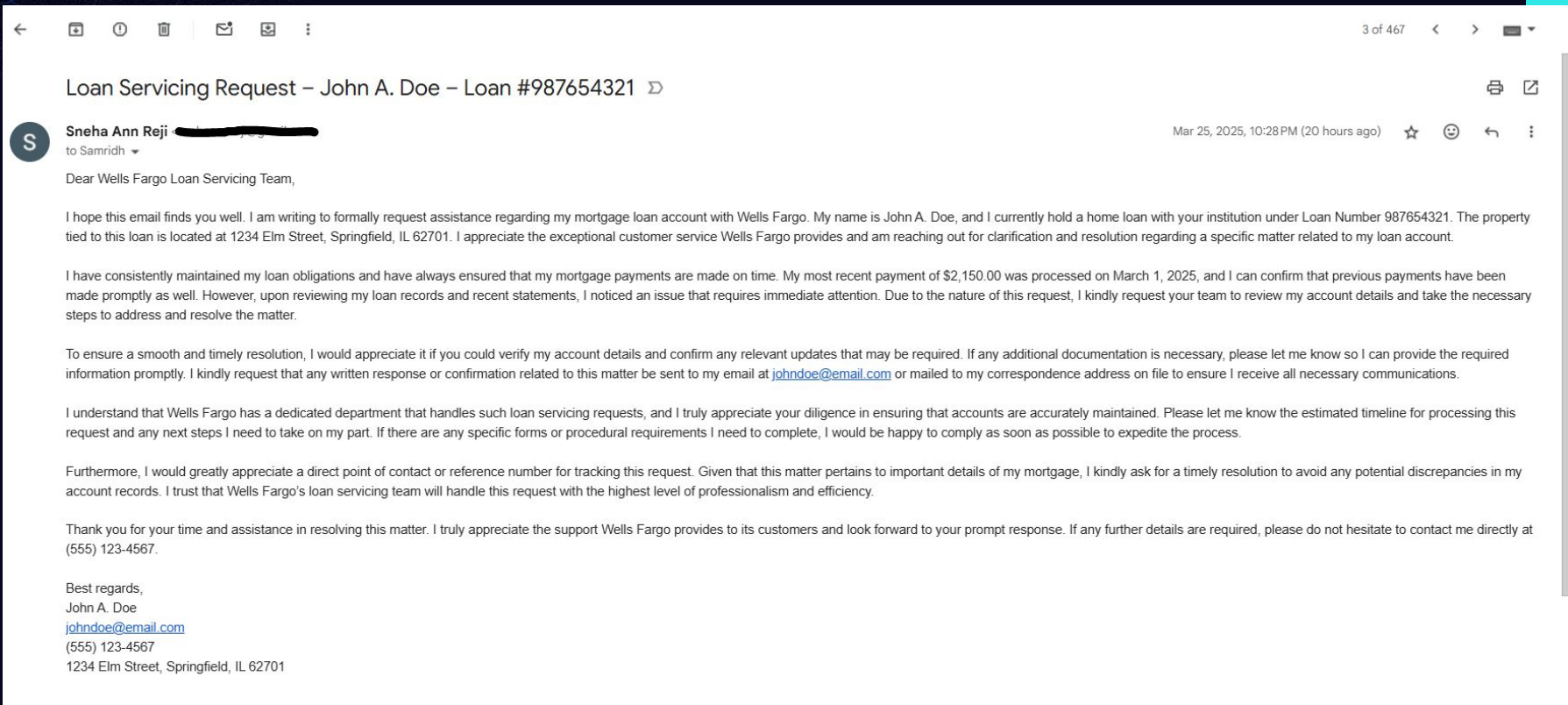
CHALLENGES

- Usage limit on Hugging Face LLM free tier API
- Unable to use models larger than 10GB with Hugging Face LLM free tier API
- Generating output in desired format by LLM (making sure it outputs valid JSON instead of unstructured text)
- No public dataset available - lack of ground truth data made it difficult to validate model accuracy

RESULTS

Sample Input and Output

Loan Servicing Request – John A. Doe – Loan #987654321

Sneha Ann Reji ~~~~~~~~~~~~~~~~~~~~~~~~~

to Samridh ⌄

Mar 25, 2025, 10:28 PM (20 hours ago)

Dear Wells Fargo Loan Servicing Team,

I hope this email finds you well. I am writing to formally request assistance regarding my mortgage loan account with Wells Fargo. My name is John A. Doe, and I currently hold a home loan with your institution under Loan Number 987654321. The property tied to this loan is located at 1234 Elm Street, Springfield, IL 62701. I appreciate the exceptional customer service Wells Fargo provides and am reaching out for clarification and resolution regarding a specific matter related to my loan account.

I have consistently maintained my loan obligations and have always ensured that my mortgage payments are made on time. My most recent payment of $2,150.00 was processed on March 1, 2025, and I can confirm that previous payments have been made promptly as well. However, upon reviewing my loan records and recent statements, I noticed an issue that requires immediate attention. Due to the nature of this request, I kindly request your team to review my account details and take the necessary steps to address and resolve the matter.

To ensure a smooth and timely resolution, I would appreciate it if you could verify my account details and confirm any relevant updates that may be required. If any additional documentation is necessary, please let me know so I can provide the required information promptly. I kindly request that any written response or confirmation related to this matter be sent to my email at johndoe@email.com or mailed to my correspondence address on file to ensure I receive all necessary communications.

I understand that Wells Fargo has a dedicated department that handles such loan servicing requests, and I truly appreciate your diligence in ensuring that accounts are accurately maintained. Please let me know the estimated timeline for processing this request and any next steps I need to take on my part. If there are any specific forms or procedural requirements I need to complete, I would be happy to comply as soon as possible to expedite the process.

Furthermore, I would greatly appreciate a direct point of contact or reference number for tracking this request. Given that this matter pertains to important details of my mortgage, I kindly ask for a timely resolution to avoid any potential discrepancies in my account records. I trust that Wells Fargo's loan servicing team will handle this request with the highest level of professionalism and efficiency.

Thank you for your time and assistance in resolving this matter. I truly appreciate the support Wells Fargo provides to its customers and look forward to your prompt response. If any further details are required, please do not hesitate to contact me directly at (555) 123-4567.

Best regards,
John A. Doe
johndoe@email.com
(555) 123-4567
1234 Elm Street, Springfield, IL 62701

Upload a .eml File

Choose File | Loan Servici...654321.eml | Upload

Analysis Results

mistralai/Mistral-7B-Instruct-v0.2

Request Type	Money Movement - Inbound
Sub Request Type	Principal
Intent	To make a principal payment on mortgage loan account with provided loan details
Attributes	
Loan ID	987654321
Borrower Name	John A. Doe
Correspondence Address	1234 Elm Street, Springfield, IL 62701
Email Address	johndoe@email.com
Phone Number	(555) 123-4567
Request Type	Assistance Request
Account Status	Active
Last Payment Date	March 1, 2025
Payment Amount	$2,150.00

google/gemma-3-27b-it

Request Type	Money Movement - Inbound
Sub Request Type	Principal + Interest

Phone Number	(555) 123-4567
Request Type	Assistance Request
Account Status	Active
Last Payment Date	March 1, 2025
Payment Amount	$2,150.00

google/gemma-3-27b-it

Request Type	Money Movement - Inbound
Sub Request Type	Principal + Interest
Intent	Inquiry regarding loan records and request for verification of payments.
Attributes	
Loan ID	987654321
Borrower Name	John A. Doe
Property Address	1234 Elm Street, Springfield, IL 62701
Payment Date	March 1, 2025
Payment Amount	$2,150.00
Email Address	johndoe@email.com
Phone Number	(555) 123-4567
Request Type	Account Discrepancy/Verification
Correspondence Address	1234 Elm Street, Springfield, IL 62701

Email - Non-essential

Email - Non-essential

i am fine.txt

in:sent

Open with Google Docs

i am fine
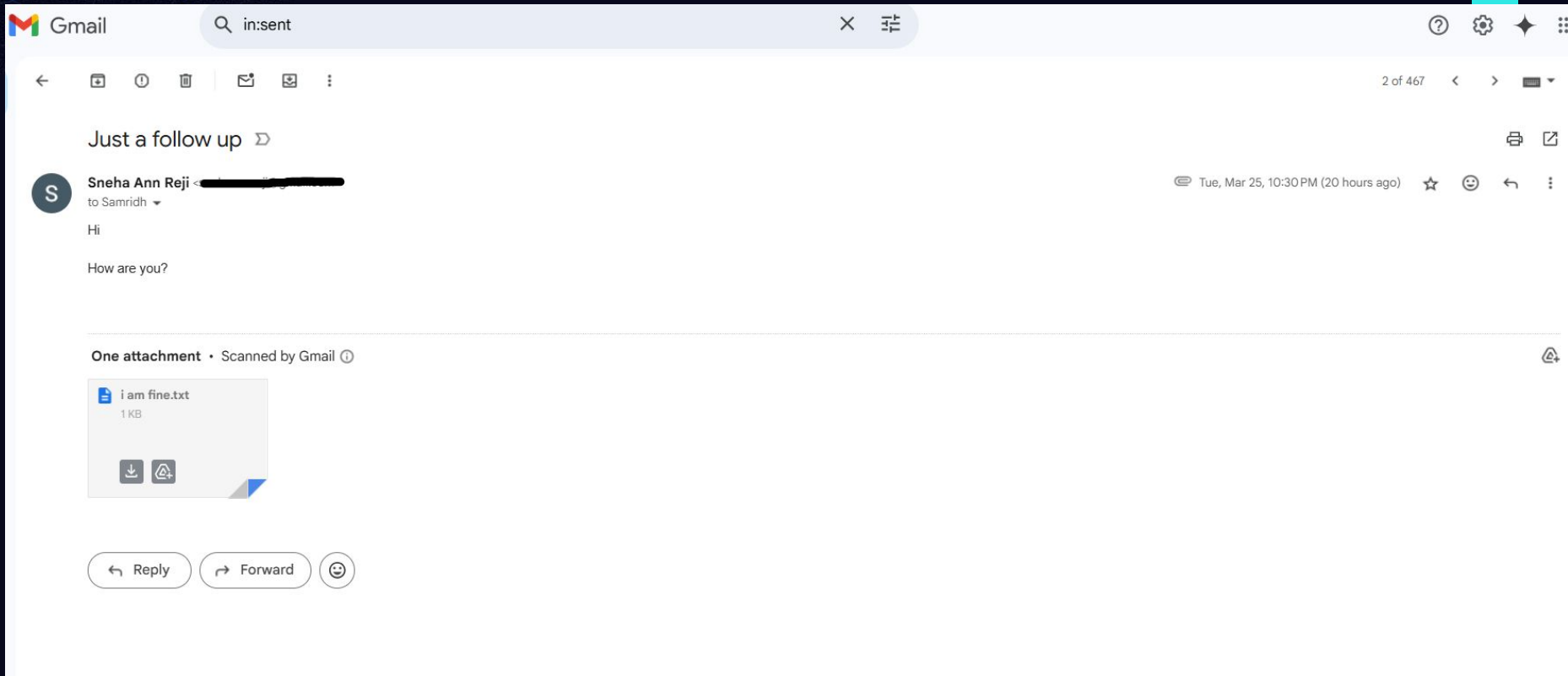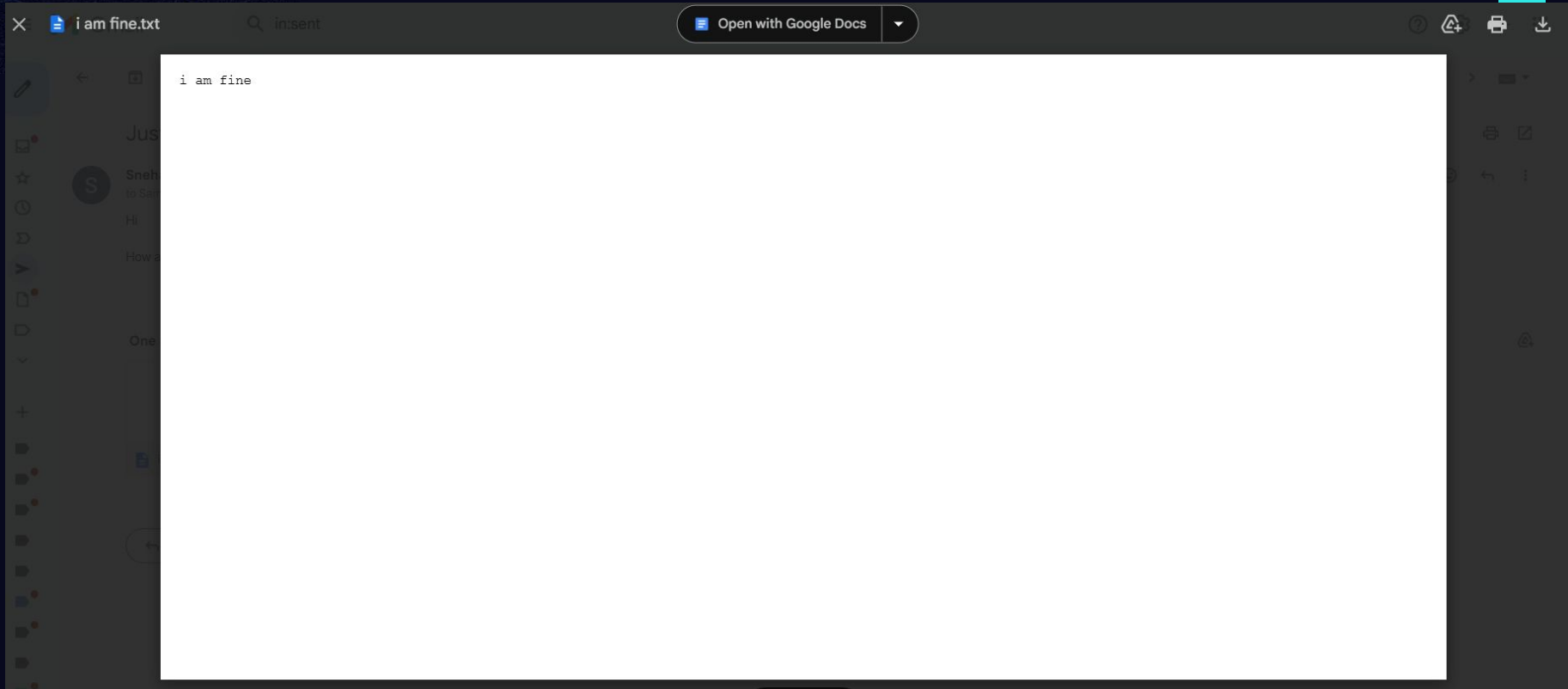
Upload a .eml File

Choose File | Just a follow up.eml | Upload

Analysis Results

mistralai/Mistral-7B-Instruct-v0.2

This file can be ignored.

google/gemma-3-27b-it

This file can be ignored.

Email - Request in attachment
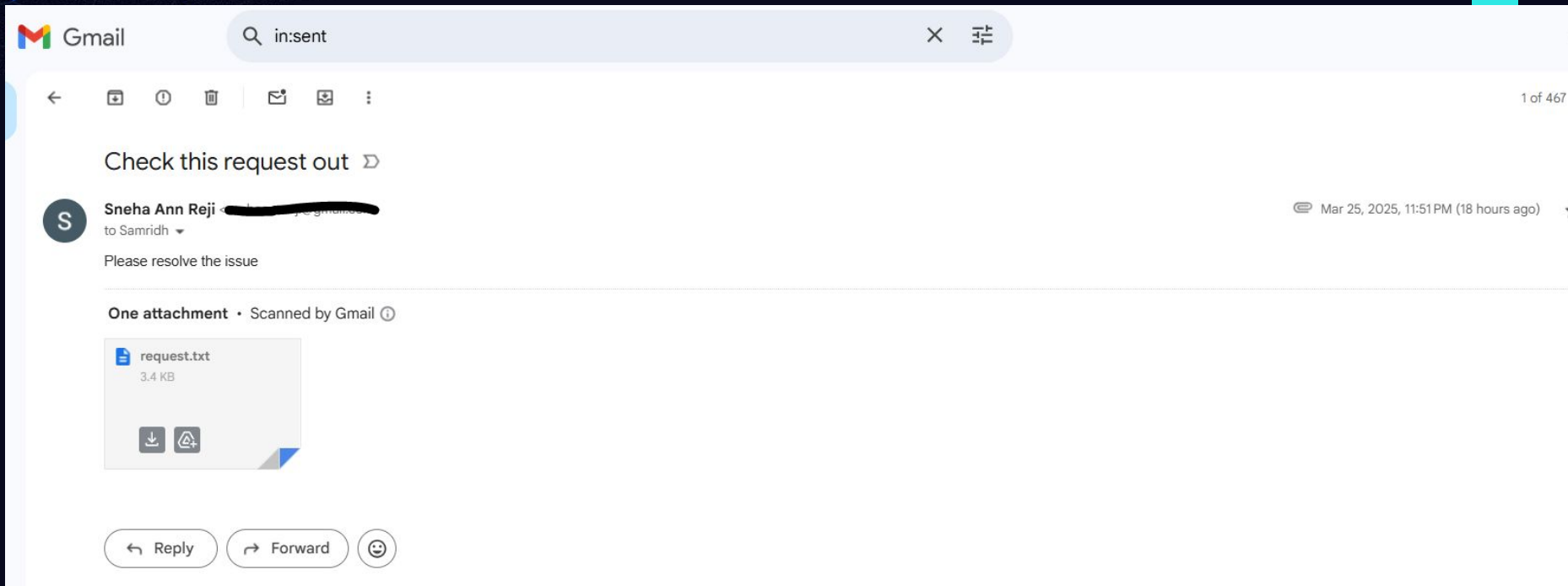
Email - Request in attachment

request.txt

in:sent

Open with Google Docs

Subject: Loan Servicing Request - John A. Doe - Loan #987654321

Dear Wells Fargo Loan Servicing Team,

I hope this email finds you well. I am writing to formally request assistance regarding my mortgage loan, which I currently hold with Wells Fargo. My name is John A. Doe, and my loan is registered under Loan Number 987654321. The property associated with this loan is located at 1234 Elm Street, Springfield, IL 62701. I sincerely appreciate the support and services that Wells Fargo has provided throughout the duration of my loan, and I am reaching out to request further clarification and resolution regarding certain administrative adjustments related to my account.

As a responsible borrower, I have always ensured that my mortgage payments are made on time. My most recent payment, in the amount of $2,150.00, was successfully processed on March 1, 2025, and I maintain a complete record of all transactions related to my loan. Recently, I have been reviewing the status of my account as I approach the final stages of my loan and have come across certain fee allocations that require further clarification and potential adjustments. Based on my understanding of the current loan status and applicable charges, I would like to request a review to ensure that all fees and balances are appropriately allocated. If there are any necessary adjustments to be made, I kindly request Wells Fargo's loan servicing team to take the appropriate action to ensure accuracy in the final account reconciliation.

In order to facilitate a smooth resolution of this request, I would appreciate it if your team could verify the breakdown of any outstanding balances or charges that may be applicable as my loan nears closure. Additionally, if there are any reallocated fees that require further clarification, I kindly request a detailed statement outlining the specific charges, their purpose, and any applicable adjustments. If any additional documentation is required from my end to complete this process, please inform me so that I can promptly provide the necessary information. I also request that any formal confirmation, written response, or final documentation related to this request be sent to my email at johndoe@email.com or mailed to my registered correspondence address on file.

I understand that Wells Fargo has a structured process for handling such requests and that account reconciliation and fee allocations are managed carefully to ensure compliance with banking policies. I sincerely appreciate the diligence with which your team handles loan servicing matters and would be grateful if you could provide an estimated timeline for processing my request. If there are any specific procedural steps I need to follow to facilitate the resolution of this matter, please provide the relevant details at your earliest convenience. Additionally, if a reference number is assigned to this request for tracking purposes, I kindly request that you share it with me for my records.

Thank you for your time and assistance in addressing this matter. I value the excellent customer service provided by Wells Fargo and look forward to receiving confirmation once my request has been successfully processed. Please do not hesitate to contact me at (555) 123-4567 should you require any additional information or clarification from my end. I truly appreciate your support and look forward to your prompt response.

Best regards,
John A. Doe
johndoe@email.com
(555) 123-4567

Upload a .eml File

Choose File Check this request out.eml Upload

Analysis Results

mistralai/Mistral-7B-Instruct-v0.2

Request Type	Closing Notice
Sub Request Type	Reallocation Fees
Intent	To review and potentially adjust administrative fees on a mortgage loan account with loan number 987654321 and provide a detailed statement outlining any reallocated fees and their justifications.
Attributes	
Loan ID	987654321
Borrower Name	John A. Doe
Effective Date	N/A
Loan Number	987654321
Property Address	1234 Elm Street, Springfield, IL 62701
Request Type	Clarification and potential adjustment of administrative fees
Contact Information	(555) 123-4567, johndoe@email.com

Contact Information	(555) 123-4567, johndoe@email.com

google/gemma-3-27b-it

Request Type	Closing Notice
Sub Request Type	Reallocation Fees
Intent	Request review of fee allocations and adjustments for accurate final account reconciliation.
Attributes	
Loan ID	987654321
Borrower Name	John A. Doe
Property Address	1234 Elm Street, Springfield, IL 62701
Email Address	johndoe@email.com
Phone Number	(555) 123-4567
Payment Amount	$2,150.00
Payment Date	March 1, 2025
Request Type	Fee Allocation Review
Request Details	Clarification and potential adjustments to fee allocations in the final account reconciliation.
Desired Outcome	Accurate final account reconciliation and clarification of outstanding balances/reallocated fees.

TEAM

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