You

Yes

Create a python RPC to implement an Online Shopping Platform

python
Ordinary Open source Remote Procedure Call Framework

We suggest you use Python or C++. The C++ tutorial page has commands only for Linux and macOS, while Python can be used for any OS.

PYTHON CODE FOR LINUX: - import zsrd
- unique_id = ('d1cxxxdcxxxf10')

1 Details

The shopping platform will have the following components/nodes:

Market Central Platform: The Market server, a the central platform that connects sellers and buyers. Buyers and sellers don't communicate with each other directly.
Seller Client: This is a client interacting with the Central Platform to manage their items and transactions.
Buyer: The Buyer is another client interacting with the Central Platform to search for and purchase items.
All these nodes will reside on different VM. - sudme instances (at Google Cloud) and can communicate with each other through their external IP addresses.

Market Central Platform)

The Market is similar to Amazon's central platform for buying and selling products. All clients (sellers and buyers) interact with the central platform. It maintains all the seller accounts, the items they sell, quantity transaction logs, reviews, and so on. The central platform is also responsible for notifying sellers and notifying a buyer's close friends when the seller updates an item, and vice versa. The central platform also maintains a log of all transactions. This log needs to be deployed at a certain address (or port), which is known to all the sellers and buyers.

Seller Client)

Each seller resides at a different address (addresses are in the form of ipport). The seller interacts with the Market to register itself, add products for sale, and update/delete/view their products. The sellers also receive notifications displaying information about items recently purchased by the buyers. The sellers also generate and maintain a UUID, which is sent to market each time the seller interacts with the market to verify transactions.

Buyer Client)

Each buyer resides at a different address (or ipport). Buyers are in the form of ipport). The buyer interacts with the market to search for items, and buy them. Buyers can also initiate a product to receive notifications from the Market. The buyers also receive the updates their wish-listed product (this scenario simulates the pub-sub pattern).

Fig: Overview of the Shopping Platform

II. RPC Implementation:

NOTE: All communication happens in the form of pickles (even if the single string), as shown on the machine/network page. Tip: It is better to have separate prime-sensitive functions for each type of communication.

For each communication, both sides must print what they received.

You may choose to print the pickle directly, _str_() returns a human-readable representation

of the message, particularly useful for debugging. Usually invoked as str(message) or print(

message) on. https://developers.google.com/protocol-buffers/docs/pythontutorial

Seller -> Market

Register/Seller: This functionality allows a seller to register. The seller registers with the market by sending its address (ipport) and (unique) uuid. The market responds with a SUCCESS message if there are any issues, the market responds with a FAILED message.

Market prints: Seller join request from 192.0.0.168:7878:5000(ipport), uuid = 6f74a7ec-a9e0-11ed-b6ab-0242ac1c0002

Seller prints: SUCCESS or FAILED

Sellitem: This functionality allows a seller to post a new item/product on the market. The seller sends a request containing the details of the item, including information such as Product Name, Category (e.g. ELECTRONICS, FASHION, or OTHER), Quantity, Description, Address, and Price per unit along with the seller UUID to sell a certain item/product. Upon receiving the details, the market assigns a unique ID to the item and stores the details in its database. The market then informs the seller that it processed the request, and if the item is successfully added, it responds with a SUCCESS message. If there are any issues, the market responds with a FAILED message.

Market prints: Sell item request from 192.0.0.168:7878:5000

Seller prints: SUCCESS or FAIL or reason why item failed to sell

Updateitem: This functionality allows the seller to update their items posted in the market. The seller sends a request containing the item ID of the item to be updated, along with the new Price, new Quantity, and the seller's address and UUID for credential verification. The market validates the credentials, checks if the specified item exists, and updates its details accordingly. If the update is successful, the market responds with a SUCCESS message, otherwise, it sends a FAILED message.

Note: This functionality also triggers notifications to all buyers who have wish-listed the product being updated.

Market prints: Update item ID(uuid) request from 192.0.0.168:7878:5000

Seller prints: SUCCESS (or) FAIL

Deleteitem: This functionality allows the seller to delete one of their items. The seller sends a request containing the item ID of the item to be deleted, along with the seller's address and UUID for credential verification. The market validates the credentials, checks if the specified item exists, and updates its details accordingly. If the deletion is successful, the market responds with a SUCCESS message, otherwise, it sends a FAILED message.

Note: This functionality also triggers notifications to all buyers who have wish-listed the product being updated.

Market prints: Delete item ID(uuid) request from 192.0.0.168:7878:5000

Seller prints: SUCCESS (or) FAIL

Displayselleritems: This functionality allows the seller to see all their uploaded items. The seller sends a request containing their address and UUID (optional). The market needs to return the list of all the uploaded items along with all the details associated with the item (such as ID, price, quantity, rating, etc).

Market prints: Display items request from 192.0.0.168:7878:5000

Seller prints:

-

Item ID: 1, Price: $500, Name: iPhone, Category: Electronics,

Description: This is iPhone 15,

Quantity Remaining: 5

Seller: 192.0.0.168:7878:5000

Rating: 4.3 / 5

-

Item ID: 2, (and so on)

-

Buyer -> Market

Displayitems: Using this functionality, buyers can search for items for sale. The buyer sends a request containing the item name (or leave this field to display all items) and the item category (any one of ELECTRONICS, FASHION, OTHERS, ANY where ANY will display items with all categories).

Market prints: Search request for item name 'iphone', Category: ANY

Buyer prints:

-

Item ID: 1, Price: $500, Name: iPhone, Category: Electronics,

Description: This is iPhone 15,

Quantity Remaining: 5

Rating: 4.3 / 5 | Seller: 192.0.0.168:7878:5000

-

Item ID: 2, (and so on)

-

Buyer: Buyers can place orders to buy items using this functionality. The buyer must send a request containing the item ID, the quantity to purchase, and the buyer's address (ipport). The market will return SUCCESS on successful transactions and FAILED in case of issues such as invalid item ID or not enough stock available. The market needs to automatically update item quantity on each successful transaction.

Note: This functionality also triggers notifications to all the buyers who have the item in their wishlist.

Market prints: Buy request: Equantity2 of item 1(item id), from 127.0.0.168:7878:5000(buyer address)

Buyer prints: SUCCESS (or) FAIL

AddToWishlist: Buyers can subscribe to some items using this function to receive notifications. The request must contain the item ID and the buyer's address.

Market prints: Wishlist request of item 1(item id), from 127.0.0.168:7878:5000

Buyer prints: SUCCESS (or) FAIL

Rateitem: Buyers can rate any item (irrespective of whether they've bought the item) using this functionality. The request must contain the item ID and buyer's address along with an integer rating ranging from 1 to 5. A buyer can rate a product only once.

Market prints: 127.0.0.168:7878:5000 rate item 1(item id) with 4 stars

Buyer prints: SUCCESS (or) FAIL

Market -> Buyer/Seller

Notify/Client: Some of the above functionalities trigger notifications to either the buyers or the sellers. The standard message would be: If the updated item details in both cases. This functionality must be implemented by both the buyer and seller so that the central platform is able to send notifications whenever an update occurs.

Buyer/Seller prints:

#######

The Following item has been updated:

Item ID: 1, Price: $500, Name: iPhone, Category: Electronics,

Description: This is iPhone 15,

Quantity Remaining: 5

Rating: 4.3 / 5 | Seller: 192.0.0.168:7878:5000

#######

Understand the requirements of this assignment.

ChatGPT

This assignment outlines the development of an online shopping platform utilizing gRPC, a high-performance, open-source universal RPC framework by Google. The platform is designed to facilitate interactions between buyers and sellers through a central market node, with all communication structured around Protocol Buffers (protobuf). Here's a breakdown of the requirements and some initial considerations for your implementation:

Components

- **Market (Central Platform)**: Acts as the intermediary for all transactions and communications between buyers and sellers. It's responsible for managing seller accounts, product listings, transactions, and notifications.
- **Seller Client**: Sellers can register, manage their product listings, and receive notifications about purchases and updates through the Market.
- **Buyer (Client)**: Buyers can search for, purchase products, add items to a wishlist for updates, and rate items through the Market.

Key Functionalities and Considerations

Seller to Market

- **Register/Seller**: Sellers register with their IP (ipport) and a UUID. The market responds with SUCCESS or FAIL.
- **Sellitem**: Sellers add list new items with detailed attributes. The market assigns a unique ID for each item and stores the details.
- **Updateitem**: Sellers can update their listings. This triggers notifications to interested buyers.
- **Deleteitem**: Allows sellers to remove listings, which triggers notifications.
- **Displayselleritems**: Sellers can view all their listed items with detailed information.

Buyer to Market

- **Displayitems**: Buyers can search for items by name and category. The market returns matching listings.
- **Buyer**: Buyers can purchase items, which updates the item's quantity and notifies the seller.
- **AddToWishlist**: Buyers can wishlist items to receive updates, ensuring a pub-sub model.
- **Rateitem**: Buyers can rate items, enhancing the marketplace's trust and quality signals.

Market to Buyer/Seller

- **Notify/Client**: Both buyers and sellers receive notifications for relevant updates, ensuring all parties are informed about important changes.

Implementation Tips

- **Protocol Buffers**: Define separate .proto files for each type of communication. This ensures clarity and maintainability.
- **Unique Identifiers**: Use Python's uuid module to generate unique identifiers for sellers, which enhances secure transaction integrity.
- **Debugging**: Leverage protobuf's __str__() method for human-readable message debugging, aiding in development and troubleshooting.

Technical Considerations

- **gRPC vs. REST**: gRPC is chosen for its efficiency, particularly suitable for low-latency, high-throughput scenarios of an online shopping platform. Its use of HTTP/2 enables more efficient use of network resources and better data transmission.
- **Security**: Implement secure channels (TLS/SSL) and consider authorizing clients, potentially using gRPC's built-in SSL/TLS support or integrating with JWT for more granular control.
- **Scalability**: Design your core definitions and server implementations with scalability in mind, considering how to efficiently handle growing numbers of buyers and sellers.

Development Environment

- **Language Choice**: Python is recommended for its cross-platform compatibility, extensive libraries, and simplicity. C++ could offer performance advantages but with increased complexity and potential platform-specific challenges.
- **Deployment**: Consider deploying each node (Market, Seller, Buyer) on separate Google Cloud Virtual Machines for realistic testing and demonstration.

Next Steps

- **Proto Definitions**: Start by defining your .proto files for each interaction. This includes messages for requests and responses, and service definitions for the gRPC servers and clients.
- **Server Implementation**: Implement the Market server with the functionalities outlined, ensuring it can handle transactions and manage state effectively.
- **Client Implementations**: Develop the Seller and Buyer clients, focusing on user interaction and seamless communication with the Market.
- **Testing and Debugging**: Thoroughly test each component individually and then as a whole system to ensure everything works as expected.

This assignment requires careful planning, especially in defining the protobuf files and implementing the gRPC services. Start with the design of your proto files, as they form the foundation of your application's communication protocol.

You

Here are the current directories of market and seller python files and the proto file.

1. The issue I'm currently having is that I can't open multiple seller clients since the address is hardcoded as localhost:50051. Can you ensure I can open multiple buyer client windows in the terminal ?

2. The code currently deviates from the actual verification requirements of the assignment since it only uses UUID. As the sign suggests, I have to use both address (IP + Port) but as well. Please fix that aspect of the code.

Fill all the necessary files and provide the fixed code or changes.

ChatGPT

To address the issues you're facing, I will proceed as follows:

1. **Enable Multiple Seller Clients**: I'll modify the code to allow clients running in ports or specify different ports for each seller client instance, enabling the simultaneous opening of multiple seller client windows.
2. **Incorporate Address Verification**: I'll adjust the verification mechanism to include both the UUID and the address (IP + Port tuples), aligning the implementation with your assignment requirements.

Let's start by reviewing and modifying the .proto files as provided:

- `shopping_platform.proto`: This is the Protocol Buffers file defining the structure of your gRPC services, including the message types and the service itself. It lists various RPC methods and their request/response messages.
- `market.py`: The Python file likely implements the server-side logic for the Market node, handling requests from sellers and buyers.
- `seller.py`: The Python file probably implements the client-side logic for a seller, including registering with the Market, listing items, and handling notifications.

I'll begin by reviewing the `shopping_platform.proto` file to understand the current structure of your messages and services. Then, I'll proceed to modify the `market.py` and `seller.py` files based on the requirements you've outlined.

First, let's review and adjust the `shopping_platform.proto` file to ensure it supports the necessary functionalities and incorporates both UUID and address (IP + Port) for verification purposes.

The `shopping_platform.proto` file defines various messages and services for the online shopping platform. It includes definitions for messages such as `RegisterSellerRequest`, `SellItemRequest`, `UpdateItemRequest`, and `DeleteItemRequest`, and service RPCs such as:

- **Categories Enum**: Defines categories for items (ELECTRONICS, FASHION, OTHERS, ANY).
- **Item Message**: Defines the structure for an item, including ID, name, category, quantity, description, seller_address, price, and rating.
- **Request/Response Messages**: Defined for various operations like registering sellers, item operations (sell, update, deleting items for sellers, searching, buying, wishlist operations, and rating items).
- **Response and Notification Messages**: Standard responses for various operations, including request structure.
- **MarketService Service**: Outlines the RPC methods available in the service, including operations for sellers and buyers, and notifying clients.

Modifications Needed:

- **Enable Multiple Seller Clients**: This requirement is more about how the server and client code handles connections rather than the proto file itself. We'll ensure the `seller.py` script can dynamically accept or assign different port numbers as input for multiple instances.
- **Incorporate Address Verification**: The current proto file includes `seller_address` in messages like `UpdateItemRequest` and `DeleteItemRequest`, and similar fields in other request messages which can be used for address and UUID verification. We need to ensure the server (`market.py`) and client (`seller.py`) logic properly utilizes these fields for verification.

Next, I'll review the `market.py` and `seller.py` files to implement the necessary changes. Let's start with the `market.py` file, ensuring it correctly handles client registrations and operations, and then we'll adjust the `seller.py` file to allow for dynamic port allocation and address verification. [1] [2]

The `market.py` file contains the implementation of the Market server, including the `Market` class that manages sellers, items, and transactions. This class handles operations such as registering the seller, selling items, and other functionalities defined in the `shopping_platform.proto`. Here's a summary of key points from the snippet:

- **Server Initialization**: Initializes dictionaries for sellers, items, a counter for item IDs, wishlist management, and logs.
- **Registration Method**: Registers a seller if the UUID is not already in use. It stores the seller's UUID and address, returning "SUCCESS" or "FAIL" based on whether the UUID is already registered.

Necessary Modifications:

1. **Seller Registration and Verification**:
   - The current implementation only checks if the UUID is already registered. To align with the assignment requirements, we should also verify the seller's address (IP + Port). This can be done by comparing the `seller_address` dictionary to store both UUID and address as a tuple or a nested dictionary, ensuring uniqueness and allowing for address-based verification.
2. **gRPC Server Setup**:
   - The snippet doesn't show the server setup, but to allow for multiple seller clients, we need to ensure the server can handle connections from different addresses and ports dynamically. This typically involves configuring the server to listen on a specific port and allowing clients to connect from various addresses. The server's address and port can be taken from `sys.argv`.
3. **Dynamic Port Selection**:
   - The current implementation accepts an address as initialization, which likely includes the port. To allow multiple seller clients to operate simultaneously, the seller client itself doesn't need predefined port handling. Instead, Docs automatically assigns ports to dynamically set the address.
   - Example command line argument handling in `seller.py`:

```
python
```

Copy code

```
    if usd_cents <= 0:
        raise ValueError("Invalid amount")
    if len(seller_address) < 20:
        raise ValueError("Invalid seller address")
    # Further initialization and operations
    self.usd = usd_cents
    self.seller = seller_address
    print("[+] Invoice created: %s, %d cents" % (self.id, self.usd))

    def __repr__(self):
        return "<Invoice %s %d>" % (self.id, self.usd)
```

2. **For Address Verification in Market:**
   - Adjust the `Market` class in `market.py` to ensure it stores both the UUID and the address for seller registration and operations. This might involve storing information together and validating them during each seller operation.

These steps provide the necessary adjustments to ensure multiple seller clients and incorporate address verification alongside UUID. Implement these changes in your Python scripts to align with the assignment requirements. 🚀

User Get solution

Provide me with the complete Python files which pools the offer after implementing the changes keeping in mind to follow the needs and requirements of the original assignment.

The above mentioned for for using UUID and address has been made to only / function for the seller's registration. Ensure all the other functions such as list, update, and buy work with the current change that was made to the seller.

For example, in other functions such as list, Update, and Delete, require both the UUID and Address for credential verification, as mentioned in the original assignment.

Provide the fully fixed files.

ChatGPT 🚀

To fully address your requirements, I'll provide a comprehensive solution that includes modifications across all necessary functions in both the `market.py` and `seller.py` Python files, as well as any required adjustments to the `shopping_platform.proto` file. This solution will ensure that:

1. Multiple clients can operate simultaneously by dynamically managing sessions for different pools.
2. Both UUID and address are used for credential verification across all relevant operations.

Modifications Summary:

- `shopping_platform.proto`: Get solution
  - Ensure all requests that involve seller interactions (e.g., SellItem, UpdateItem, DeleteItem) include fields for both the seller's address and UUID for credential verification.
  - No additional modifications are needed based on the current requirements, but let's ensure these fields are correctly implemented in the proto definitions for all operations.
- `market.py`:
  - Modify the handling of seller information to store and verify both UUID and address. This involves adjusting the `seller` dictionary to support this verification across all relevant operations.
  - Ensure all methods (e.g., SellItem, UpdateItem, DeleteItem) validate the seller's credentials using both the UUID and address.
- `seller.py`:
  - Adjust to dynamically accept the server's address and port, ensuring it can connect to multiple instances of the market server.
  - Implement a new configuration method, facilitating the operation of multiple instances.
  - Ensure that all requests are performed by the seller (e.g., listing, updating, deleting items) includes both the UUID and seller's address in the request.

Let's proceed with the modifications, starting with the `shopping_platform.proto`. Its confirm and adjust the proto definitions for seller operations. Next, I'll provide the modified `market.py` and `seller.py`. 🚀

Adjusted `shopping_platform.proto`

I'll outline the necessary changes since the proto content is already suitable based on your description:

```
protobuf                                                    Copy code

syntax = "proto3";

// For RollerCoasterRequest, ensure it includes seller_address for verification
message RollerCoasterRequest {
    string uuid = 1;
    string seller_address = 2;
    string action = 3;
    int32 item_id = 4;
    int32 price = 5;
    int32 quantity = 6;
    int32 new_item_id = 7;
    int32 new_price = 8;
    int32 new_quantity = 9;
    string description = 10;
    double price = 11;
}

// For RollerCoasterResponse, no changes needed
message RollerCoasterResponse {
    int32 status = 1;
    string data = 2;
}
```

Get solution

Adjusted `market.py` and `seller.py`

Given the context and structure of your files, I'll describe the modifications and then provide stackoverflow-ready snippets for the updated files.

`market.py` Modifications:

- Modify the handling of seller information to store and verify both UUID and address. This involves adjusting the `seller` dictionary to support this verification across all relevant operations.
- Ensure all methods (e.g., SellItem, UpdateItem, DeleteItem) validate the seller's credentials using both the UUID and address.

`seller.py` Modifications:

- Adjust to dynamically accept the server's address and port, ensuring it can connect to multiple instances of the market server.
- Implement a new configuration method, facilitating the operation of multiple instances.
-

```
        raise shopping_platform_pb2.Response(message="FAIL: Seller not registered.")
    item = shopping_platform_db[item_id]
    item.add_item_to_counter(
        item=item_id,
        counter=request.counter,
        quantity=request.quantity,
        description=request.description,
        seller_address=request.seller_address,
        item_price=request.item_price,
        accumulative=True
    )
    self.save(item.id_counter) # save
    item.id_counter += 1
    print("Item item added to {request.seller_address}, uid = {request.uid}")
    return shopping_platform_pb2.Response(message="SUCCESS")

def UpdateItem(self, request, context):
    seller_id = request.uid, request.seller_address
    if request.item_id in self.item:
        item = self.item[request.item_id]
        if item.seller_address == request.seller_address:
            item.update_item(request.item_price, request.quantity)
            print("Item {request.item_id} updated by {request.seller_address}, uid = {reque
            return shopping_platform_pb2.Response(message="SUCCESS")
        else:
            raise shopping_platform_pb2.Response(message="FAIL: Item not found or unauth
    else:
        raise shopping_platform_pb2.Response(message="FAIL: Item not found.")

def DeleteItem(self, request, context):
    seller_id = request.uid, request.seller_address
    if request.item_id in self.item:
        item = self.item[request.item_id]
        if item.seller_address == request.seller_address:
            del self.item[request.item_id]
            print("Item {request.item_id} deleted by {request.seller_address}, uid = {reque
            return shopping_platform_pb2.Response(message="SUCCESS")
        else:
            raise shopping_platform_pb2.Response(message="FAIL: Unauthorized operation")
    else:
        raise shopping_platform_pb2.Response(message="FAIL: Item not found.")
```

ChatGPT can make mistakes. Check important info.

Ensure the `seller_address` attribute is correctly set (based on trust/paid handshake), and include `seller_address` in all requests where necessary.

```
python                                                                    Copy code
# In __init__.py (presumably set the seller_address based on input or configuration
# For example, from a config:
import os, shopping_platform_pb2, shopping_platform_db
seller_uid = os.environ.get("SELLER_UID")
seller_address = os.environ.get("SELLER_ADDRESS")
# Ensure this address is included in all relevant requests
def AddItem(self, name, category, quantity, description, price):
    request = shopping_platform_pb2.AddItemToCounterRequest(
        uid=self.uid,
        seller_address=self.seller_address,  # Include seller_address
        name=name,
        category=category,
        quantity=quantity,
        description=description,
        accumulative
    )
    # Remaining call unchanged
def UpdateItem(self, item_id, price, quantity):
    request = shopping_platform_pb2.UpdateItemRequest(
        uid=self.uid,
        seller_address=self.seller_address,  # Include seller_address
        item_id=item_id,
        price=price,
        quantity=quantity
    )
    # Remaining call unchanged
def DeleteItem(self, item_id):
    request = shopping_platform_pb2.DeleteItemRequest(
        uid=self.uid,
        seller_address=self.seller_address,  # Include seller_address
        item_id=item_id
    )
    # Remaining call unchanged
```

These conventions ensure that every seller action requires and checks both the UID and the seller's address, aligning with the security and `m` trust requirements of the assignment. Implement these changes in your `market_pb` and `seller_pb` scripts for the application to function correctly.

Me

when try to open a seller.py through the terminal on localhost:50063 it doesn't allow me to do so.

```
python3 /Users/Ethan/Downloads/GROUP%20P-seller.py localhost:50063
Traceback (most recent call last):
  File "/Users/Ethan/Downloads/GROUP%20P-seller.py", line 1, in <module>
    import shopping_platform_pb2, shopping_platform_db
ImportError: cannot import name 'shopping_platform_db' from 'shopping_platform_db' (/Users/Ethan/Library/Mobile%20Documents/com~apple~CloudDocs/Uni/Year%2003/Semester%2002/Distributed%20Systems/Assignment/shopping_platform_db.cpython-39-darwin.so)
```

Why does that error pop up ? How for ensure that a terminal opened in another machine is able to listen to the server on the market.py for the market ?

I have opened the market on the following port

Market server started on port 50051.

market.py
Python

shopping_platform.proto
Protobuf

Alright. The final issue I'm having includes displaying or updating items.

Currently when I try to display or update the items, the output from terminal I use update and display the items is stuck in an infinite running state. The output from the terminal of the seller1.py displays that my 5th product was the problem source and how to fix it ?

Example of what happens currently:

```
Menu:
1.Sell Item
2.Update Item
3.Delete Item
4.Display Items
5.Exit
Enter your choice: 4
Display/Items response - Item ID: 1, Price: $1000.0, Name: iphone, Category: ELECTRONICS,
Description: qwert, Quantity Remaining: 1, Rating: 0.0 / 0
Display/Items response - Item ID: 2, Price: $10.0, Name: ipad, Category: ELECTRONICS,
Description: qwert2, Quantity Remaining: 400, Rating: 0.0 / 0
```

Can I have a detailed train the Distributed. I have attached the files for your reference.

ChatGPT

Perfect — you're facing a very common issue: your update and display items from another seller client is likely due to how the system identifies and verifies the ownership of items. This problem usually arises from not correctly associating items with their respective sellers or not properly validating seller credentials when performing operations like updating or displaying items.

To address this issue, we need to ensure that:

- **Each item is clearly associated with its seller.** This means when an item is added to the market, it must store not just the seller's UUID but also the seller's address as part of the item's metadata. This ensures that item can be traced back to its specific seller.
- **Seller verification is correctly implemented for item operations.** When performing operations like updating or displaying items, the system must verify that the requesting seller is the same seller who originally added the item. This verification should check both the UUID and the seller's address against the stored seller metadata. `m`

Potential Fixes

- **Adjust the Data Structure:** Ensure the `Item` message in `shopping_platform.proto` includes fields for both the seller's UUID and address. If these fields are missing, add them to clearly link each item to its respective seller.
- **Verify Seller Credentials on Operations:** In `market.py`, when processing requests to update or display items, validate that the seller's UUID and address in the request match the UUID and address stored with the item.
- **Fix `GetItem` and `ReturnItem` Operations:** Ensure that the seller can only modify or delete the requests comes from the seller who owns the item. This involves checking the item's seller UUID against the requesting seller's UUID and address.
- **Implement Proper Error Handling:** Add error handling to ensure that the system gives clear error messages when unauthorized actions are attempted.
- **Update `seller.py` to Include Address in Requests:** Ensure that when a seller makes requests to sell, update, or delete items, they include their address in the request. This is critical for the market to verify the request's authenticity.

Implementation Example

Assuming the `Item` structure in `shopping_platform.proto` has been updated to include `seller_uid` and `seller_address`, here's how you might implement seller verification for the `GetItem` operation in `market.py`:

```
python                                                                    Copy code
def GetItem(self, request, context):
    item = self.item[request.item_id]
    seller = self.items.get(request.item_id)
    seller_id = request.uid, request.seller_address

    if item and (item.seller_uid, item.seller_address) == seller_id:
        # Proceed with update operation
        item.update_item(
            item_price=request.price,
            item_quantity=request.quantity
            )
        print("Item {request.item_id} updated by {request.seller_address}, uid = {r
        return shopping_platform_pb2.Response(message="SUCCESS")
    else:
        return shopping_platform_pb2.Response(message="FAIL: Unauthorized or item not fou
```

To properly diagnose and provide a precise solution, I'd review the content of the uploaded files. Let's start by reviewing `market.py`, `shopping_platform.proto`, and `seller.py`. Now you might implement seller verification for the `DeleteItem` operation in `market.py`:

```
Free analysis ⚡
```

```
python                                                                    Copy code
def DeleteItem(self, request, context):
    seller_id = request.uid, request.seller_address
    item = self.items.get(request.item_id)

    if item and (item.seller_uid, item.seller_address) == seller_id:
        # Proceed with item deletion
        del self.items[request.item_id]
        print("Item {request.item_id} deleted by {request.seller_address}, uid = {r
        return shopping_platform_pb2.Response(message="SUCCESS")
    else:
        raise shopping_platform_pb2.Response(message="FAIL: Unauthorized or item not fou
```

Provide me with the changes to be made in market and seller.py files

Provide me with the changes to be made in market and seller.py files. Assume the proto file is updated as mentioned above.

ChatGPT

Thanks for providing `shopping_platform.proto`. Its content you've shared, it includes both `uid` and `seller_address` in the relevant request messages. This structure supports accurately linking items with their specific sellers and allows for proper verification. To fix the issue where a seller can update or display items from another seller, we need to adjust the server-side logic in `market.py` and `seller.py` to enforce that items are manipulated only by their respective sellers. Here are the changes needed:

Changes in `market.py`

We must ensure that each item operation (add, update, delete, display) verifies the seller's UUID and address against the stored item data. Since the proto file indicates that items contain a `seller_address`, but not directly a `seller_uid`, you'll associate the item with its seller using these fields during operations. Here's how to adjust key functions:

Setup Adjustment

When adding items, you store the seller's UUID and address with the item, ensuring you can verify ownership in subsequent operations.

```
python                                                                    Copy code
def AddItem(self, request, context):
    # Assuming uniqueness of counter_id and address for simplicity
    seller_id = request.uid, request.seller_address
    if seller_id in self.sellers:
        raise shopping_platform_pb2.Response(message="FAIL: Seller not registered.")

    # Create and store new item with seller information
    item = shopping_platform_db.Item(
        id=self.id_counter,
        name=request.name,
        category=request.category,
        quantity=request.quantity,
        description=request.description,
        seller_address=request.seller_address,  # Store seller address with item
        price=request.price,
        rating=0.0  # Initial rating
    )
    self.items[self.id_counter] = item
    self.id_counter += 1
    print("Item {request.name} added to {request.seller_address}, UID = {request.uid}")
    return shopping_platform_pb2.Response(message="SUCCESS")
```

Update/Delete Operations Adjustment

For both updating and deleting items, you should verify that the seller making the request matches the seller information stored with the item.

```
python                                                                    Copy code
def UpdateItem(self, request, context):
    if request.item_id in self.items:
        item = self.items[request.item_id]
        # Check if the seller's address matches the item's seller_address
        if item.seller_address == request.seller_address:
            # Proceed with the update
            item.price = request.price
            item.quantity = request.quantity
            print("Item {request.item_id} updated by {request.seller_address}, UID
            return shopping_platform_pb2.Response(message="SUCCESS")
        else:
            return shopping_platform_pb2.Response(message="FAIL: Unauthorized or item not fou
```

Deletion would follow a similar pattern, verifying the seller's address before deletion.

Display/Retrieve Adjustment

When displaying items, filter the items to only those added by the requesting seller based on the seller's address.

```
python                                                                    Copy code
def ReturnSellerItems(self, request, context):
    seller_id = request.uid, request.seller_address
    if seller_id in self.sellers:
        raise shopping_platform_pb2.Response(message="FAIL: Seller not registered.")
    else:
        for item_id, item in self.items.items():
            if (item.seller_uid, item.seller_address) == seller_id:
                yield item
```

Changes in `seller.py`

Ensure that when making requests, the seller includes their UUID and address correctly. Based on your current setup, it looks like this is already handled, but ensure that the address is correctly passed and used in all seller operations, which it appears to be from the provided `shopping_platform.proto` content.

These changes ensure that items can only be managed by the sellers who added them, addressing the issue of unauthorized item manipulation. Implement these adjustments in your `market.py` and `seller.py` scripts to enforce correct seller verification and item management.

Me

shopping_platform.proto
Protobuf

seller.py
Python

market.py
Python

Terminal 1:

```
python market.py
Market server started on port 50051.
Seller join request from localhost:50051, uuid = 0b4a4fc4-c2de-11ee-8fac-9c4400a0a008
Seller join request from localhost:50051, uuid = 0e4c7f0-c2de-11ee-8fac-9c4400a0a008
Item Item added to localhost:50051, uid = 10a4fc4-c2de-11ee-8fac-9c4400a0a008
Item Item added to localhost:50051, uid = 10a4fc4-c2de-11ee-8fac-9c4400a0a008
Item Item added to localhost:50051, uid = 10a4fc4-c2de-11ee-8fac-9c4400a0a008
Display Items request from localhost:50051, uid = 0e4c7f0-c2de-11ee-8fac-9c4400a0a008
Display Items request from localhost:50051, uid = 0e4c7f0-c2de-11ee-8fac-9c4400a0a008
Display Items request from localhost:50051, uid = 10a4fc4-c2de-11ee-8fac-9c4400a0a008
Display Items request from localhost:50051, uid = 10a4fc4-c2de-11ee-8fac-9c4400a0a008
```

Terminal2:

```
python seller.py localhost:50051
Seller client is running...
Registration response: SUCCESS
```

```
Menu:
1.Sell Item
2.Update Item
3.Delete Item
4.Display Items
5.Exit
Enter your choice: 1
Enter item name: iphone
Enter item category: electronics
Enter item quantity: 10
Enter item description: qwert
Enter item price: 1000
Selling response: SUCCESS
```

```
Menu:
1.Sell Item
2.Update Item
3.Delete Item
4.Display Items
5.Exit
Enter your choice: 4
Display/Items response - Item ID: 1, Price: $1000.0, Name: iphone, Category: ELECTRONICS,
Description: qwert, Quantity Remaining: 10, Rating: 0.0 / 0
```

```
Menu:
1.Sell Item
2.Update Item
3.Delete Item
4.Display Items
5.Exit
Enter your choice: 1
Enter item name: ipad
Enter item category: electronics
Enter item quantity: 10
Enter item description: qwert2
Enter item price: 10
Selling response: SUCCESS
```

```
Menu:
1.Sell Item
2.Update Item
3.Delete Item
4.Display Items
5.Exit
Enter your choice: 4
Display/Items response - Item ID: 1, Price: $1000.0, Name: iphone, Category: ELECTRONICS,
Description: qwert, Quantity Remaining: 10, Rating: 0.0 / 0
Display/Items response - Item ID: 2, Price: $10.0, Name: ipad, Category: ELECTRONICS,
Description: qwert2, Quantity Remaining: 10, Rating: 0.0 / 0
```

```
Menu:
1.Sell Item
2.Update Item
3.Delete Item
4.Display Items
5.Exit
Enter your choice: 5
Exiting...
```

Explanation

I can edit and display items from other sellers. The issue I get from the market suggests that `seller_uid` and `seller_address` are empty. If the display call and the update call are done after I sell the item and exit the client and then try to edit and display it I know that I am not stuck in an infinite loop. I get stuck in infinite loop in the terminal 1 when I try to edit and display the items from other sellers.

Go through the files. Find the error and give a fix for it.

ChatGPT

Thanks for providing the initial parts of `market.py` and `seller.py`. The issue seems related to how items are associated with sellers and how seller verification is conducted during item operations. The `market.py` script uses `seller_uid` and `seller_address` to verify ownership of items during updates and deletions, and `seller_address` is actively utilized in various functions to ensure correct ownership. To confirm the exact cause of the issue, Similarly, the `seller.py` script initializes with a dynamically set address and UUID, which is crucial for ensuring unique seller identities.

Potential Cause of the Issue

The problem where items from one seller can be displayed or updated by another suggests that either:

- The verification of seller identity (using UUID and address) in item operations (like display and update) is not functioning correctly.
- There is an issue with how the UUID or address is managed or passed in requests, leading to incorrect or insufficient verification.

Potential Fix

1. **Ensure Unique Identification:** When registering sellers and adding items, make sure each seller and item is uniquely identified using both the seller's UUID and address. This identification must be consistent across all operations.
2. **Verify Seller Identity on Operations:** In `market.py`, for operations like `StoreSellerOrder` and `GetSellerOrder`, ensure that the seller's UUID and address from the request matches the stored seller data. This involves checking `seller_uid` and `seller_address` against the stored values.
3. **Pass Correct Seller Information in Requests:** In `seller.py`, ensure that every request to the market for selling, updating, or displaying items includes the correct UUID and address of the seller. This might involve revising how the UUID and address are stored and passed in `SellerClient` methods.

Without the complete visibility of the functions handling the display and update operations in `market.py`, I'll provide a conceptual approach to adjust these functions.

Adjusting Updateitem in `market.py`

```
python                                                                    Copy code
def UpdateItem(self, request, context):
    seller_id = request.uid, request.seller_address
    for item_id, item in self.items.items():
        if (item.seller_uid, item.seller_address) == seller_id:
            break  # Found the item
```

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    item = self.items.get(request.item_id)
    if item and (item.seller_uid, item.seller_address) == (request.uid, request.sel
        # Proceed with the update
        item.price = request.price
        item.quantity = request.quantity
        print("Item {request.item_id} updated by {request.seller_address}, UID = {r
        return shopping_platform_pb2.Response(message="SUCCESS")
    else:
        return shopping_platform_pb2.Response(message="FAIL: Unauthorized or item not fou
```

Deletion would follow a similar pattern, verifying the seller's address before deletion.

Display/Retrieve Adjustment

When displaying items, filter the items to only those added by the requesting seller based on the seller's address.

```
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def ReturnSellerItems(self, request, context):
    seller_id = request.uid, request.seller_address
    if seller_id in self.sellers:
        raise shopping_platform_pb2.Response(message="FAIL: Seller not registered.")
    else:
        for item_id, item in self.items.items():
            if (item.seller_uid, item.seller_address) == seller_id:
                yield item
```

Changes in `seller.py`

Ensure that when making requests, the seller includes their UUID and address correctly. Based on your current setup, it looks like this is already handled, but ensure that the address is correctly passed and used in all seller operations, which it appears to be from the provided `shopping_platform.proto` content.

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```
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5.Exit
Enter your choice: 1
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Enter item quantity: 10
Enter item description: qwert
Enter item price: 1000
Selling response: SUCCESS
```

```
Menu:
1.Sell Item
2.Update Item
3.Delete Item
4.Display Items
5.Exit
Enter your choice: 4
Display/Items response - Item ID: 1, Price: $1000.0, Name: iphone, Category: ELECTRONICS,
Description: qwert, Quantity Remaining: 10, Rating: 0.0 / 0
Display/Items response - Item ID: 2, Price: $10.0, Name: ipad, Category: ELECTRONICS,
Description: qwert2, Quantity Remaining: 10, Rating: 0.0 / 0
```

```
Menu:
1.Sell Item
2.Update Item
3.Delete Item
4.Display Items
5.Exit
Enter your choice: 5
Exiting...
```

Explanation

I can edit and display items from other sellers. The issue I get from the market suggests that `seller_uid` and `seller_address` are empty. If the display call and the update call are done after I sell the item and exit the client and then try to edit and display it I know that I am not stuck in an infinite loop. I get stuck in infinite loop in the terminal 1 when I try to edit and display the items from other sellers.

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The problem where items from one seller can be displayed or updated by another suggests that either:

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- There is an issue with how the UUID or address is managed or passed in requests, leading to incorrect or insufficient verification.

Potential Fix

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Adjusting Updateitem in `market.py`

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python                                                                    Copy code
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    if item and (item.seller_uid, item.seller_address) == (request.uid, request.sel
        # Proceed with the update
        item.price = request.price
        item.quantity = request.quantity
        print("Item {request.item_id} updated by {request.seller_address}, UID = {r
        return shopping_platform_pb2.Response(message="SUCCESS")
    else:
        return shopping_platform_pb2.Response(message="FAIL: Unauthorized or item not fou
```

Next Steps

- Implement the concepts/ideas in your `market.py` script for item display and update operations, ensuring seller notifications are triggered on item updates.
- Refine the `market.py` script to ensure it correctly passes the seller's UID and address in all relevant requests to the market.

By implementing these adjustments, you should be able to resolve the issue of cross-seller item manipulation. If you need further assistance, or if specific code snippets or another review, please let me know! 😊

Get station

You

Part 1: Using gRPC to Implement an Online Shopping Platform

gRPC

Google's Open-source Remote Procedure Call Framework

We suggest you use Python or C++. The C++ tutorial page has commands only for Linux and macOS, while Python can be used for any OS.

PYTHON CODE FOR UUID: import uuid
unique_id = str(uuid.uuid4())

1. Details:

The shopping platform will have the following components/roles:

Market (Central Platform): The Market serves as the central platform that connects sellers and buyers. Buyers and sellers don't communicate with each other directly.
Seller: The Seller is a client interacting with the Central Platform to manage their items and transactions.
Buyer: The Buyer is another client interacting with the Central Platform to search for and purchase items.
All three roles will reside on different virtual machine instances (at Google Cloud) and can communicate with each other through the gRPC protocol.

Market-Centric Platform:

The Market is central to buyer's central platform for buying and selling products. All clients (sellers and buyers) interact with the central platform. It maintains all the seller accounts, the items they sell, quantity, transaction logs, reviews, and so on. The central platform is also responsible for sending out notifications to buyers in cases where the seller updates an item, and maintaining a buyer's shopping cart even if they log out. The Market node is deployed at a certain address/port, which is known to all sellers and buyers.

Seller (Client):

Each seller resides at a different address (addresses are in the form of ip:port). The seller interacts with the Market to register itself, sell products for sale, and update/remove their products. The seller also receives notifications displaying information about items recently purchased by the buyers. The address also generate and maintain a UUID, which is sent to market each time the seller interacts with the market for secure transactions.

Buyer (Client):

Each buyer resides at a different address (addresses are in the form of ip:port). The buyer interacts with the market to search for products and buy items. Buyers can also subscribe a product to receive notifications from the Market at a certain address (their wish-listed product (this scenario simulates the pub-sub pattern).

Fig. Overview of the Shopping Platform

2. RPC Implementation:

NOTE: All communication happens in the form of protos (even if for single strings), As shown on the HelloWorld tutorial page. Tip: It is better to have separate protos definitions for each type of communication.

For each communication, both sides must print what they received.

You may choose to print the proto directly: `_str_()` returns a human-readable representation of the message, particularly useful for debugging. Usually invoked as `str(message)` or print `message`. Lem: https://developers.google.com/protocol-buffers/docs/pythontutorial

Get station

Seller -> Market

Register/Seller: This functionality allows a seller to register. The seller registers with the market by sending its address (ip:port) and contact email. The market assigns the client a seller and sends a BOOLEAN response if the address isn't already registered (true if it sends a FALSE response.

Market proto: Seller join request from 192.0.168.178:50050 (ip:port), uuid = 987ad5c-aftad-4d9b-7fbad9ef7c4.

Seller proto: SUCCESS (or FALL)

Get station

Sellers: This functionality allows a seller to post a new item/product on the market. The seller sends a request containing the item's details, including information such as Product Name, Category (one of ELECTRONICS, FASHION, or OTHERS), Quantity, Description, Seller Address, and Product price along with the seller's UUID for further interactions. Upon receiving the details, the market assigns a unique item ID to the product and stores it in its database alongside other listings. The market processes the request, and if the item is successfully added, it responds with a SUCCESS message. If there are any issues, the market responds with a FAILED message.

Market proto: Sell item request from 192.0.168.178:50050

Seller proto: SUCCESS (or FAIL or return ✓ w item id)

Get station

Updateitem: This functionality allows the seller to update their items posted in the market. The seller sends a request containing the item ID of the item to be updated, along with the new Price, new Quantity, and the seller's address and UUID for credential verification. The market validates the provided details, checks if the specified item exists, and updates the listing accordingly. If the operation is successful, the market responds with a SUCCESS message; otherwise, it sends a FAILED message.

Note: This functionality also triggers notifications to all buyers who have wish-listed the product being updated.

Market proto: Update item SEND request from 192.0.168.178:50051

Seller proto: SUCCESS (or FAIL)

Get station

Deleteitem: This functionality allows the seller to update their items posted in the market. The seller sends a request containing the item ID of the item to be updated, along with the new Price, new Quantity, and the seller's address and UUID for credential verification. The market validates the provided details, checks if the specified item exists, and updates the listing accordingly. If the operation is successful, the market responds with a SUCCESS message; otherwise, it sends a FAILED message.

Note: This functionality also triggers notifications to all buyers who have wish-listed the product being updated.

Market proto: Update item SEND request from 192.0.168.178:50051

Seller proto: SUCCESS (or FAIL)

Get station

Displayselleritems: This functionality allows the seller to see all their uploaded items. The seller sends a request containing their address and UUID (optional). The market needs to return the list of all the uploaded items along with all the details associated with the item (such as ID, price, quantity, rating, etc).

Market proto: Display items request from 192.0.168.178:50051

Seller proto:

-

Item ID 1, Price: $500, Name: iPhone, Category: Electronics,

Description: This is iPhone 15.

Quantity Remaining: 5

Seller: 192.0.168.178:50051

Rating: 4.5 / 5

Get station

-

Item ID: 2, (and so on)

-

Buyer -> Market

Searchitem: Using this functionality, buyers can search for items for sale. The buyer sends a request containing the item name (can leave blank to display all items) and the item category (any one of ELECTRONICS, FASHION, OTHERS, ANY where ANY will display items with all categories).

Market proto: Search request for item name: *empty*, Category: ANY

Buyer proto:

-

Item ID: 1, Price: $500, Name: iPhone, Category: Electronics,

Description: This is iPhone 15.

Quantity Remaining: 5

Rating: 4.5 / 5 | Seller: 192.0.168.178:50051

Get station

-

Item ID: 2, (and so on)

-

Buyitem: Buyers can place orders to buy items using this functionality. The buyer must send a request containing the item ID, the quantity to purchase, and the buyer's address (ip:port). The market will return SUCCESS on successful transactions and FAILED in case of issues such as insufficient funds or not enough stock available. The market needs to automatically update item quantity on each successful transaction.

Note: This functionality also triggers notifications to the seller of the item.

Market proto: Buy request Quantity:2 of item ID:1 from 127.0.168.178:50051(buyer address)

Buyer proto: SUCCESS (or FAIL)

Get station

AddToWishList: Buyers can subscribe to some items using this function to receive notifications. The request must contain the item ID and the buyer's address.

Market proto: Wishlist request of item ID:item id, from 192.0.168.178:50051

Buyer proto: SUCCESS (or FAIL)

Get station

Rateitem: Buyers can rate any item (irrespective of whether they've bought the item) using this functionality. The request must contain the item ID and buyer's address, along with an integer rating from 1 to 5. A buyer can rate a product only once.

Market proto: 127.0.168.178:50051 rated item ID:item id with 4 stars.

Buyer proto: SUCCESS (or FAIL)

Get station

Market -> Buyer/Seller

Notify/Client: Some of the above functionalities trigger notifications to either the buyers or the seller. The market maintains a dictionary/hashmap of active clients (`_active_clients_` in the functionality must be implemented by the buyer `_init_` module and seller so that the central platform is able to send notifications whenever an update occurs.
Buyer/Seller proto:

#######

The following item has been updated:

Item ID: 1, Price: $500, Name: iPhone, Category: Electronics,

Description: This is iPhone 15.

Quantity Remaining: 5

Rating: 4.5 / 5 | Seller: 192.0.168.178:50051

#######

From this, only the notification implementation remains. Could you please check the files attached and find out how to implement them and what changes I need to make to the server?

Get station

ChatGPT

The output is truncated due to its length, but from what is visible, the `Market <bin> market.py` returns methods that handle the logic of updates and the addition of items. The `_notify_clients_about_item_update` and `_notify_seller_about_purchase` methods are implemented here, indicating the notification process.

To implement notifications properly, you need to define a mechanism that allows the `Market` service to send real-time updates to sellers and buyers when a relevant event that interests them occurs. Since gRPC itself is stateless and does not support server-push by default, you need to set up a bidirectional streaming RPC or use a long-lived stream from clients to server to provide server-push notifications.

Here's an example of how you could implement a notification system:

`market.py`

In the `Market` class:

```
# This will be a dictionary to keep track of the active stream for notifications
self.active_streams = {} # {client_id: stream}

# Function to call when a seller requests to stop their notification stream
def RequestNotificationStopSeller(self, request_iterator, context):
    seller_uid = '.'
    for request in request_iterator:
        seller_uid = request.seller_uid
        if seller_uid in self.active_streams:
            del self.active_streams[seller_uid]
            print(f"Stopped notifications for seller {seller_uid}")
    return pb2.StatusResponse(success=True)

# Function to call when a buyer requests to stop their notifications stream
def RequestNotificationStopBuyer(self, request_iterator, context):
    buyer_uid = '.'
    for request in request_iterator:
        buyer_uid = request.buyer_uid
        if buyer_uid in self.active_streams:
            del self.active_streams[buyer_uid]
            print(f"Stopped notifications for buyer {buyer_uid}")
    return pb2.StatusResponse(success=True)

# Function to call when you want to notify sellers
def _notify_clients_about_item_update(self, item_id):
    for item_id in self.items:
        item = self.items[item_id]
        seller_uid = item.seller_uid
        if seller_uid in self.active_streams:
            try:
                notification = shopping_platform_pb2.RetrieveNotificationMessage(item_id=item_id)
                self.active_streams[seller_uid].send(notification)
            except Exception as e:
                # Handle exceptions if needed
```

`seller.py`

In the `SellerClient` class:

```
# Function to continuously receive notifications from the server
def _listen_for_notifications(self):
    response = self.stub.RetrieveNotificationStream(self.generate_notifications())
    for response in response:
        print(f"Notification received: {response}")

# This is a generator function needed to create a request iterator
def generate_notifications(self):
    while True:
        try:
            notification = self.notification_queue.get(block=True, timeout=1)
            # This assumes that notifications are a RetrieveNotificationMessage type.
            yield notification
            print("Sent notification to server")
        except Exception as e:
            pass
    print("Notification stream closed")

notification_thread = threading.Thread(target=self._listen_for_notifications)
notification_thread.start()
```

`shopping_platform_pb2.proto`

You would also need to add the service definitions for the notification stream.

```
service MarketService {
  // ... existing rpc methods ...

  // New rpc for notification stream
  rpc RegisterNotificationStreamForBuyer(stream RetrieveNotificationMessage) returns (stream RetrieveNotificationMessage);

  // Message types for notifications
  message RetrieveNotificationMessage {
    string uid = 1; // The UUID of the seller
  }

  message NotificationMessage {
    string message = 1;
    repeated int32 item_ids = 2; // Include the item details in notifications
  }
}
```

Please note that the actual implementation may vary based on the specifics of your requirements and

This approach outlines a bidirectional streaming RPC for notifications. The `seller.py` opens a stream to the `Market` service, which maintains a dictionary of connections. When an item update occurs, the `Market` service iterates through the stream and sends notifications to the appropriate seller.

The above code snippets are conceptual and will require further refinement and testing within the context of your application. Ensure that any threads or asynchronous operations are managed carefully to prevent resource leaks or deadlocks. 🔧

Get station

Message ChatGPT...

ChatGPT can make mistakes. Consider checking important information.

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