In Your Orbit

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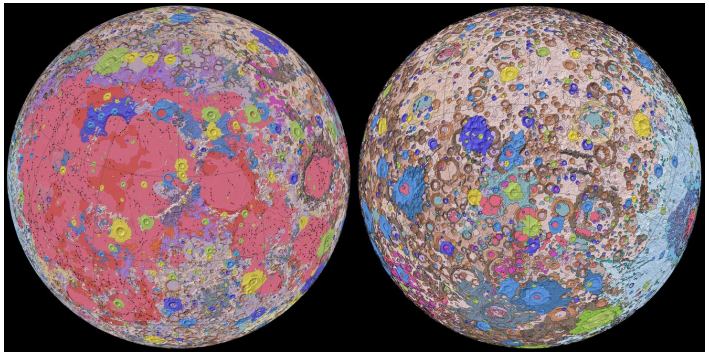
Introduction

- Rapid growth in planetary science and NASA missions
- Importance of sensor models in mapping planetary surfaces
- Challenges of accessing NASA's vast SPICE database
- **Capstone Project:** cloud-based service for ISD retrieval
- **GOAL:** Improve accessibility for new planetary scientists

Problem Statement

- Image Support Data (ISD) crucial for planetary missions
- USGS Astrogeology generates ISDs from satellite images
- Current system issues (complex, expensive, data size, inefficient)
- New system will be faster, free, and user friendly

USGS
science for a changing world
ASTROGEOLOGY



Solution Overview

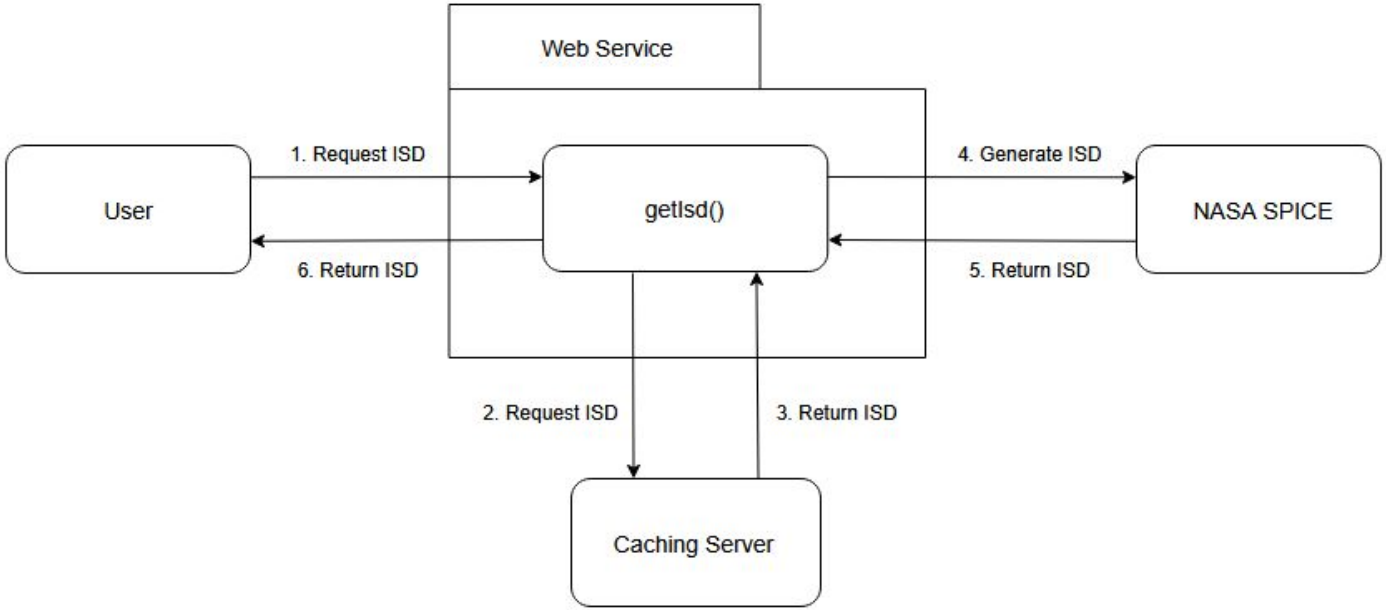

- ISD Generation: The web service generates ISD using ALE, a NASA tool for ephemeris data.
- Caching for Speed: Stores frequently requested ISDs on Amazon DynamoDB for fast retrieval.
- AWS Integration: Uses Amazon ECS for scalability, enabling the service to handle large volumes of requests.
- Data Efficiency: Compressed JSON format reduces data size, speeding up data transfer and minimizing storage needs.

Key Requirements

- Queryable system for retrieving ISDs
- Web Service that acts as interface between user and ISD retrieval
- Caching server that stores ISDs

Implementation Overview

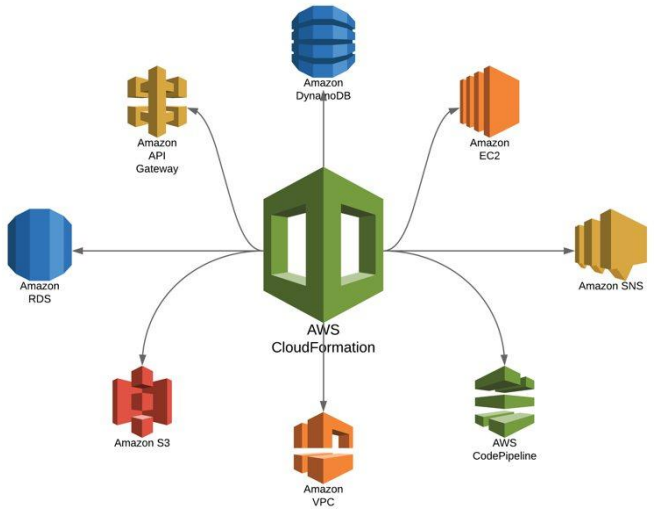
Web Service:



Prototype Review

```
AWSTemplateFormatVersion: 2010-09-09
Description: DynamoDB Deploy
Resources:

  DynamoDB:
    Type: AWS::DynamoDB::Table
    Properties:
      AttributeDefinitions:
        - AttributeName: "id"
          AttributeType: "S"
      KeySchema:
        - AttributeName: "id"
          KeyType: "HASH"
      ProvisionedThroughput:
        ReadCapacityUnits: 15
        WriteCapacityUnits: 15
```



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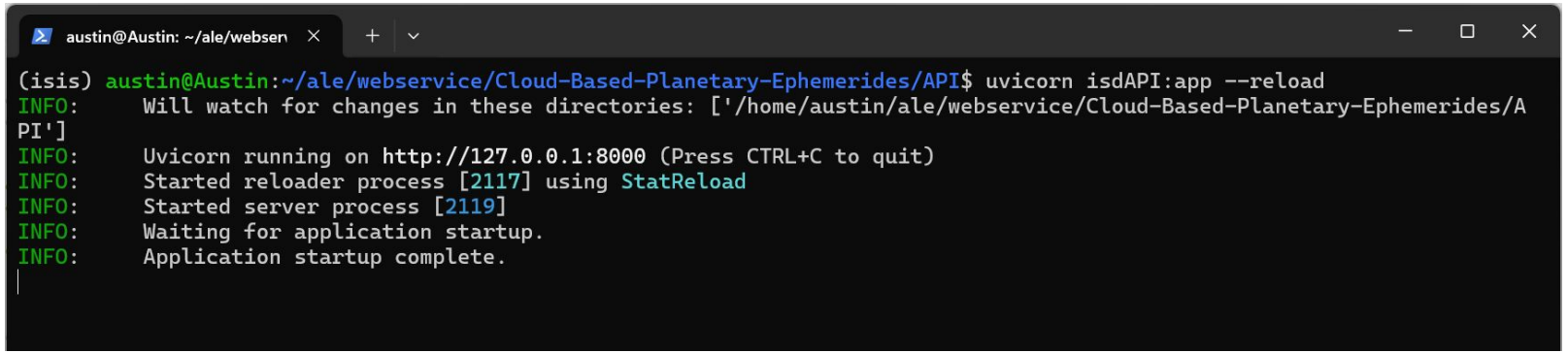

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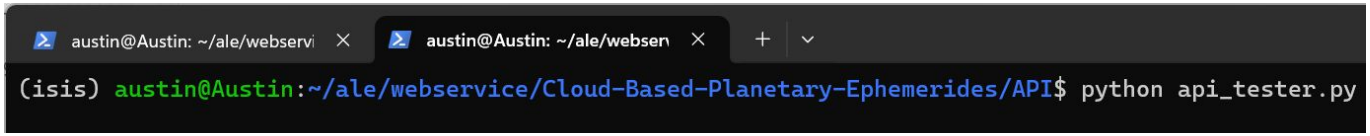

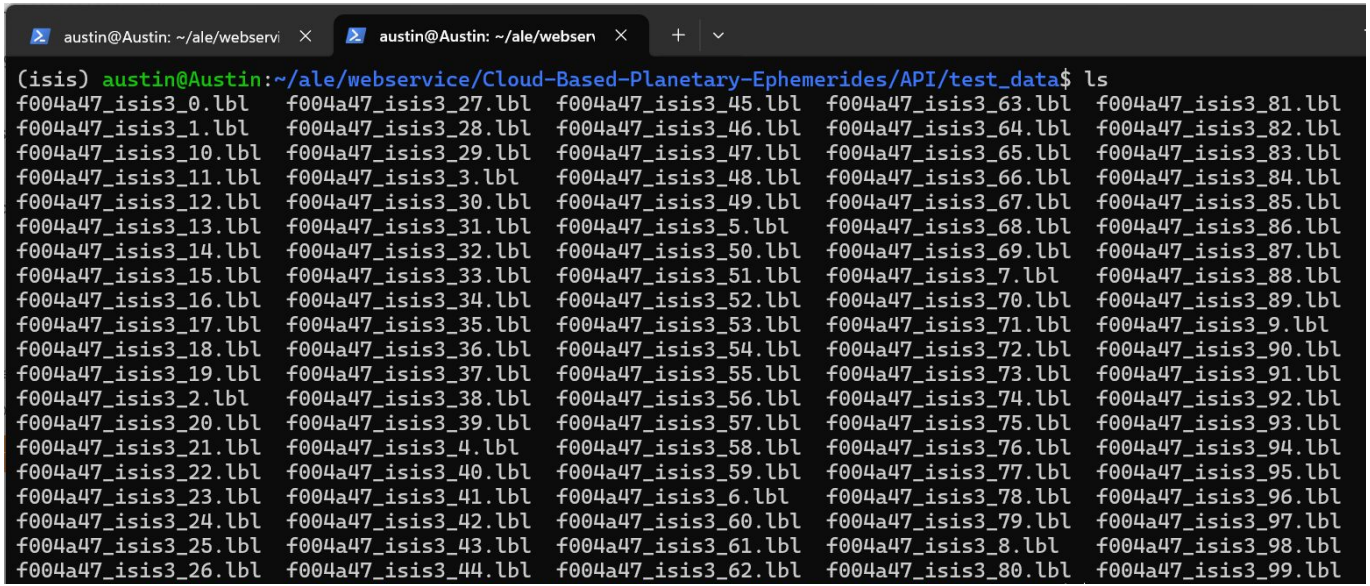

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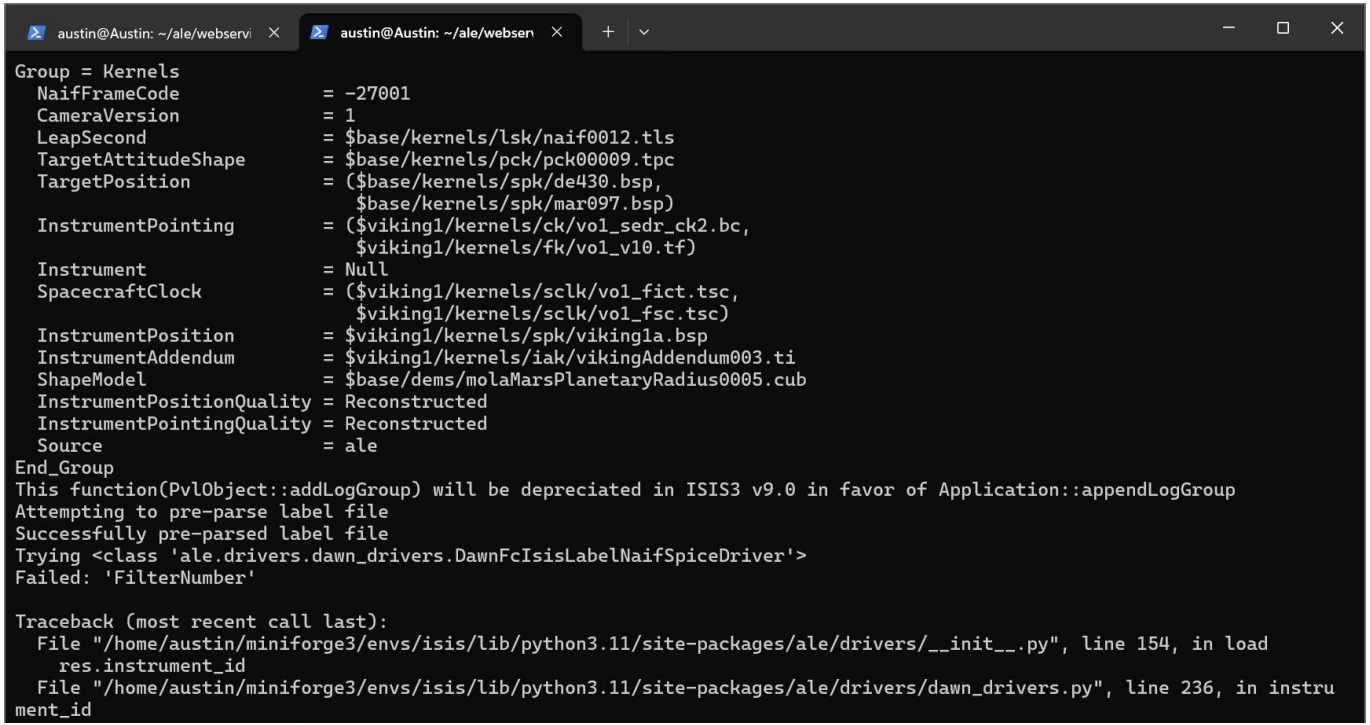

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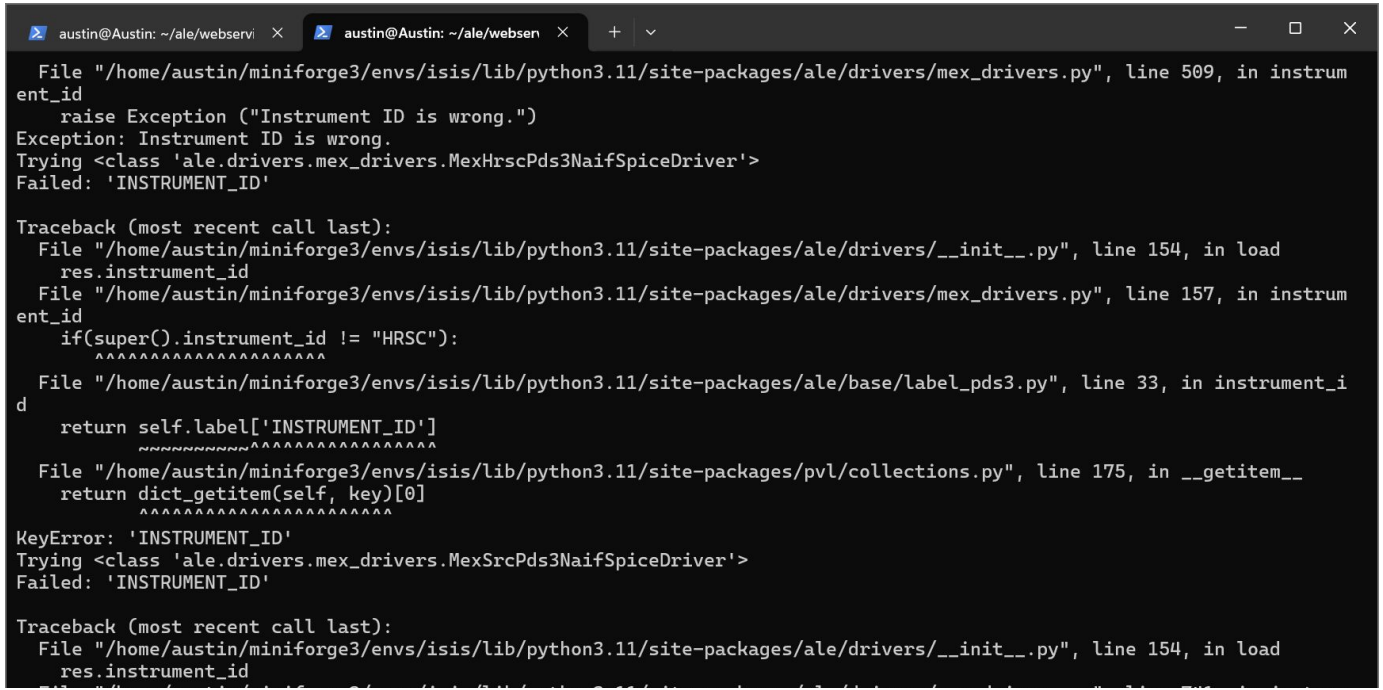

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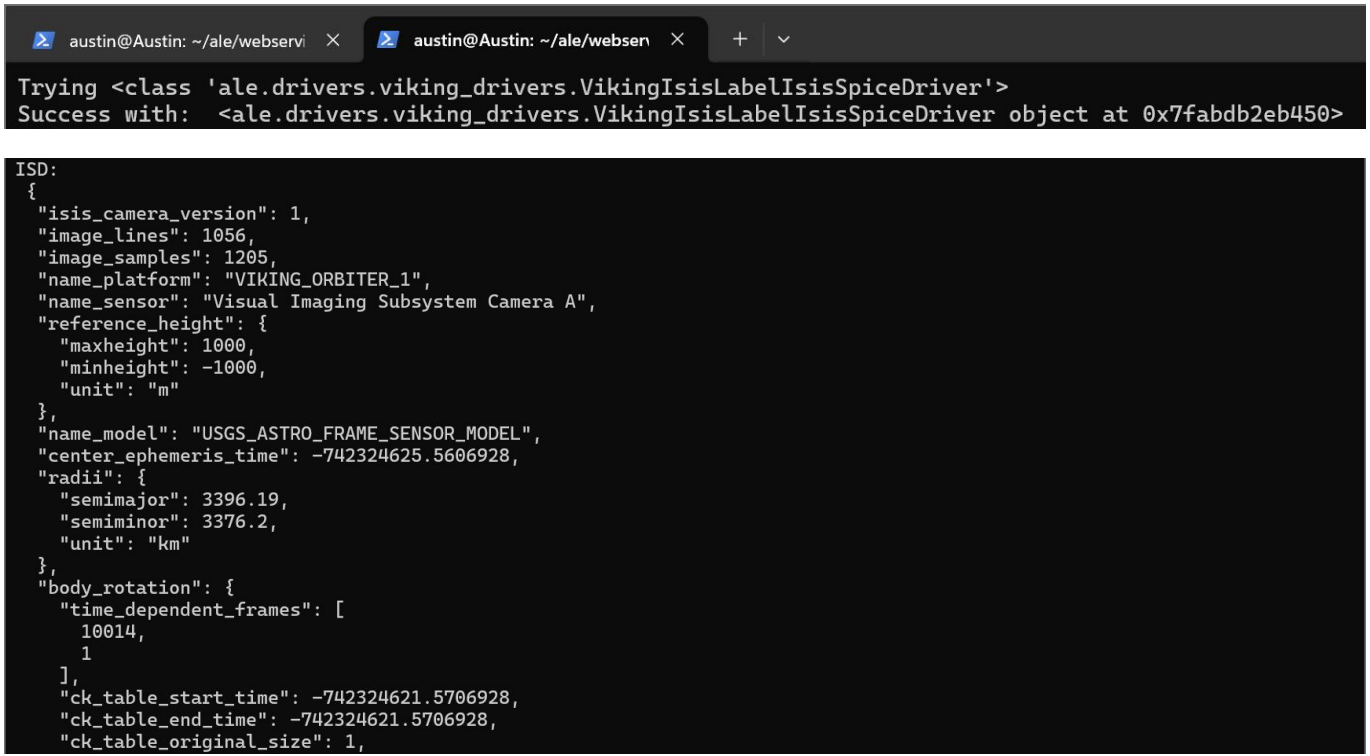

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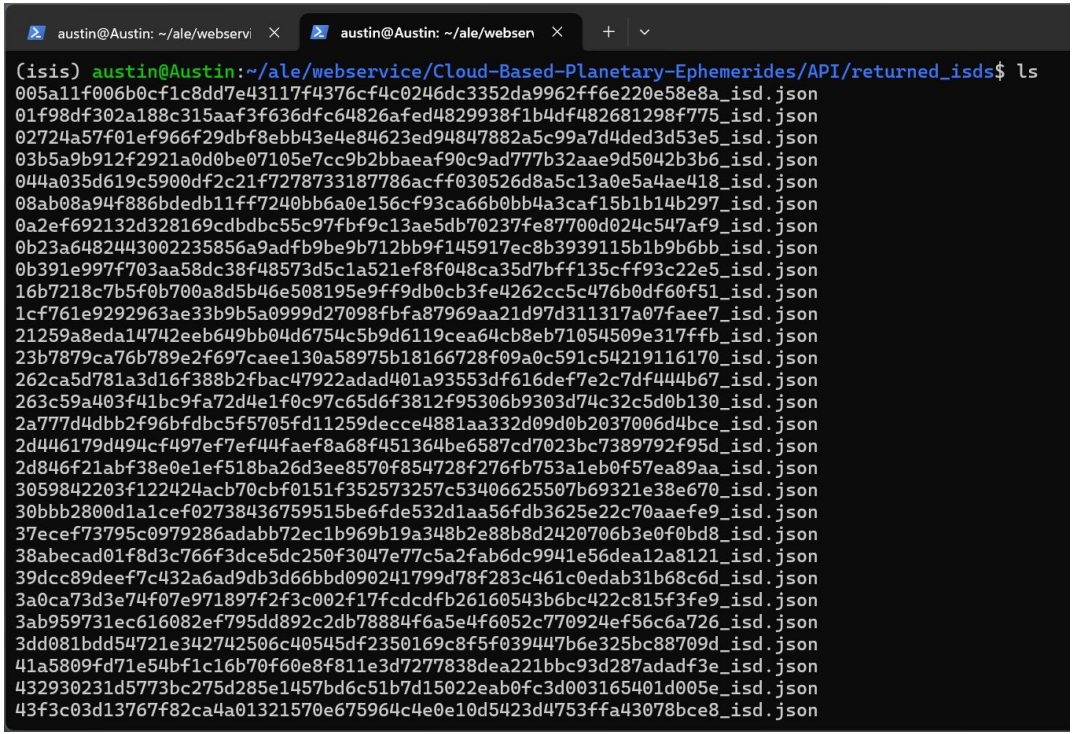

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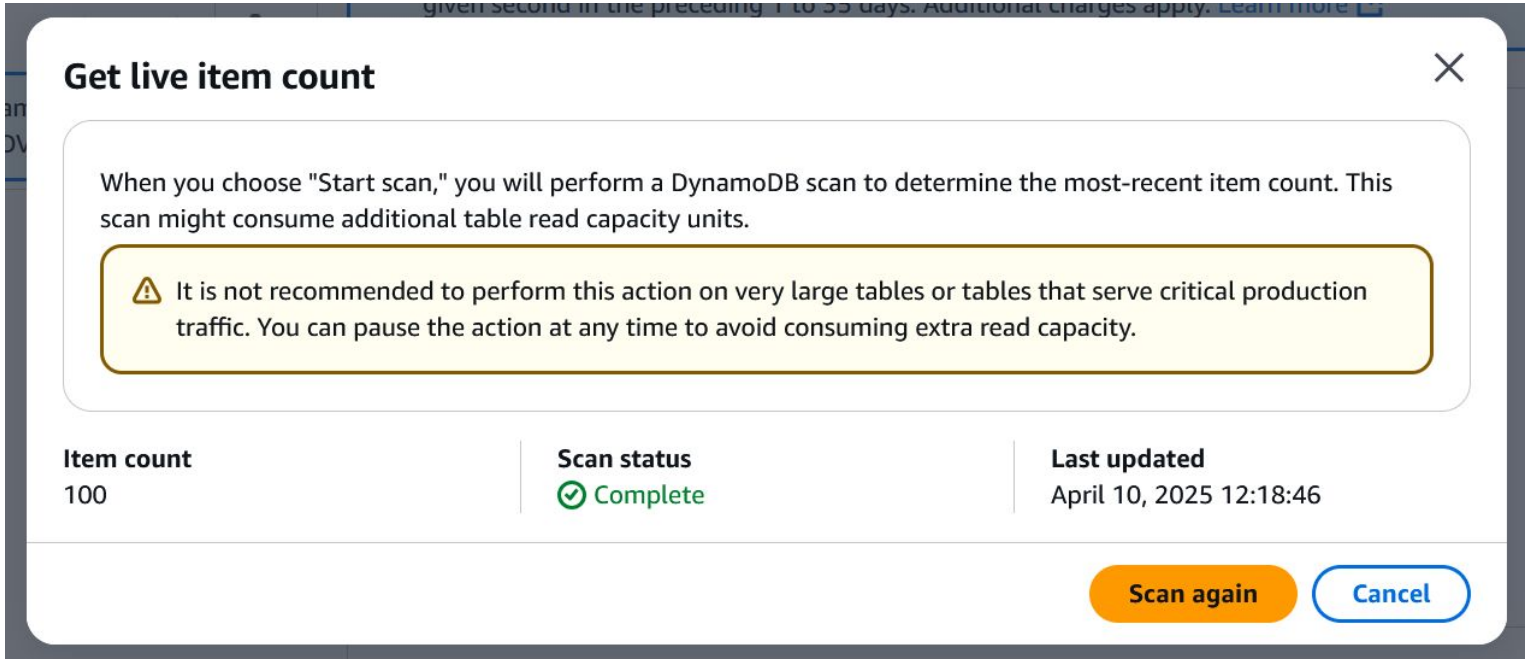

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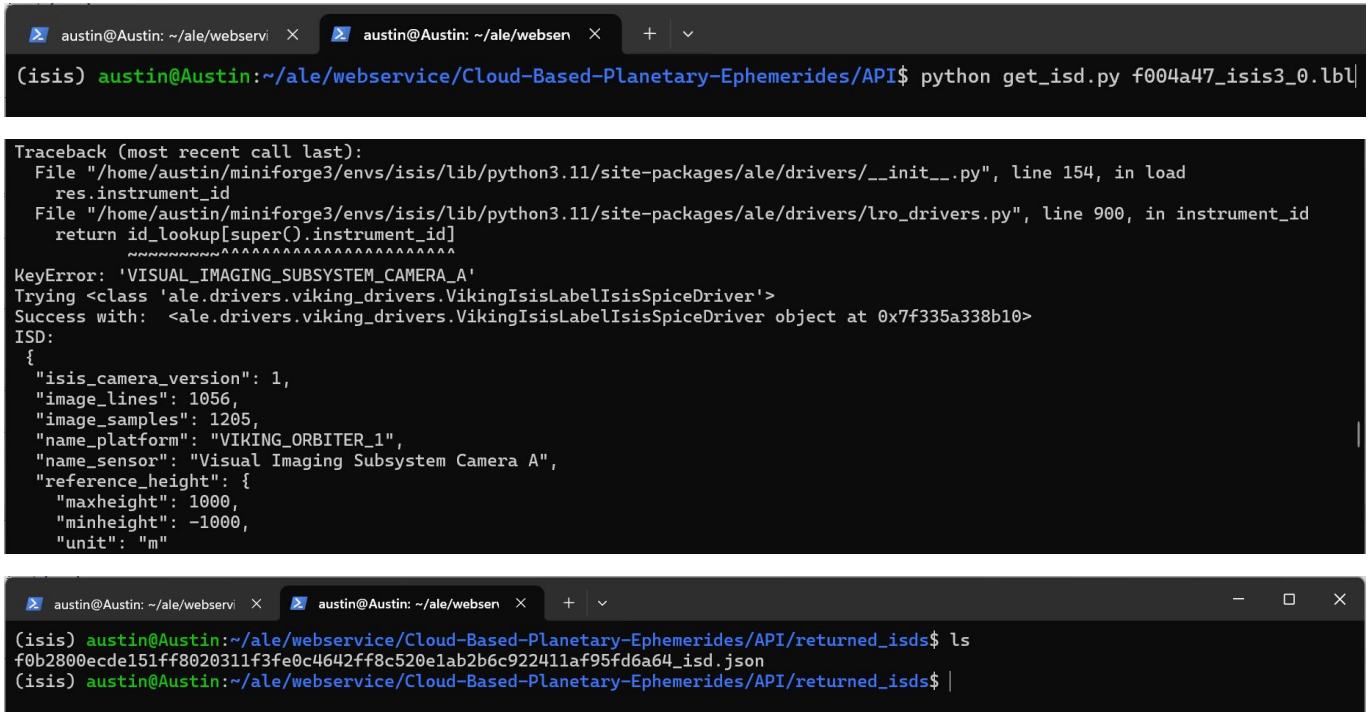


Challenges and Resolutions

AWS Implementation Challenges

- **Problem:** We needed to implement our system on AWS for scalability, but there was little to no comprehensive documentation. Even the available resources online were often outdated, making navigation difficult.
- **Solution:** We tackled this by piecing together information from multiple sources, leveraging AWS support forums, and experimenting with AWS services in a controlled test environment.

ISIS and ALE System Navigation

- **Problem:** Understanding and integrating ISIS and NASA's ALE tool had been challenging due to complex documentation and the steep integration.
- **Solution:** We created internal documentation, ran test cases, and consulted with experts to streamline the integration process.

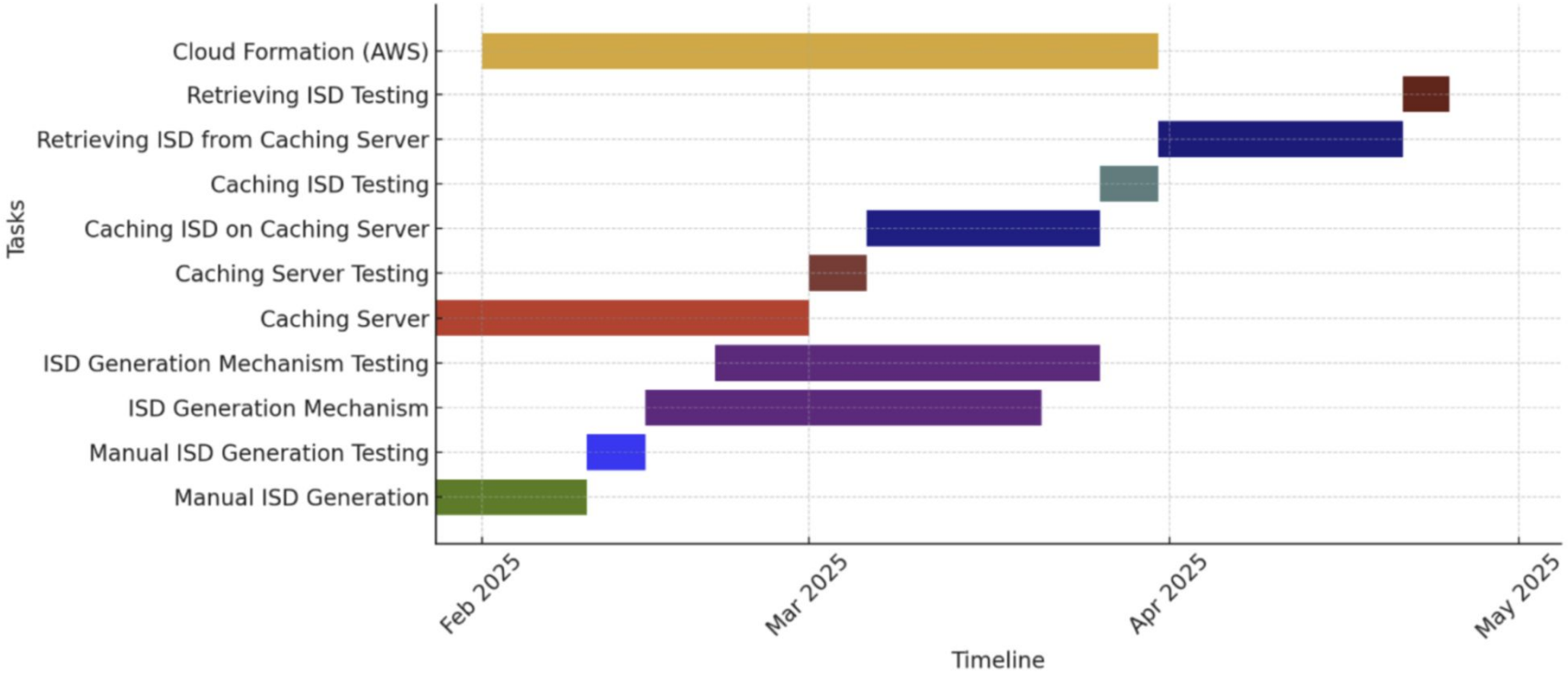
Hash Scheme and GET Request Limitations

- **Problem:** We needed to implement a hashing scheme for ID retrieval via FastAPI, but had to ensure that the generated hash fit within the GET request limits.
- **Solution:** We researched different hashing algorithms to balance efficiency and size constraints, ensuring compatibility with FastAPI's single endpoint approach for ID retrieval.

Testing Plan

- Beta Prototype deployed and under test
- Unit tests: key functions (parsing, hashing, endpoints)
- Integration tests: FastAPI to SPICE to DynamoDB and back
- Usability testing: API experience for researchers
- Refinements ongoing

Schedule


Cloud Formation (AWS)
Retrieving ISD Testing
Retrieving ISD from Caching Server
Caching ISD Testing
Caching ISD on Caching Server
Caching Server Testing
Caching Server
ISD Generation Mechanism Testing
ISD Generation Mechanism
Manual ISD Generation Testing
Manual ISD Generation
Tasks
Feb 2025
Mar 2025
Apr 2025
May 2025
Timeline

Conclusion

- We are developing a Web Service and Caching Server for USGS and NASA
- Solution allows easy generation, querying and retrieval of ISDs
- Potential risks are still both scalability and accuracy related
- Currently testing the product in preparation for delivery of final product in May