Mapping the Cloud: A Mixed-Methods Study of Cloud Security and Privacy Configuration Challenges

Sumair Hashmi*

Shafay Kashif*

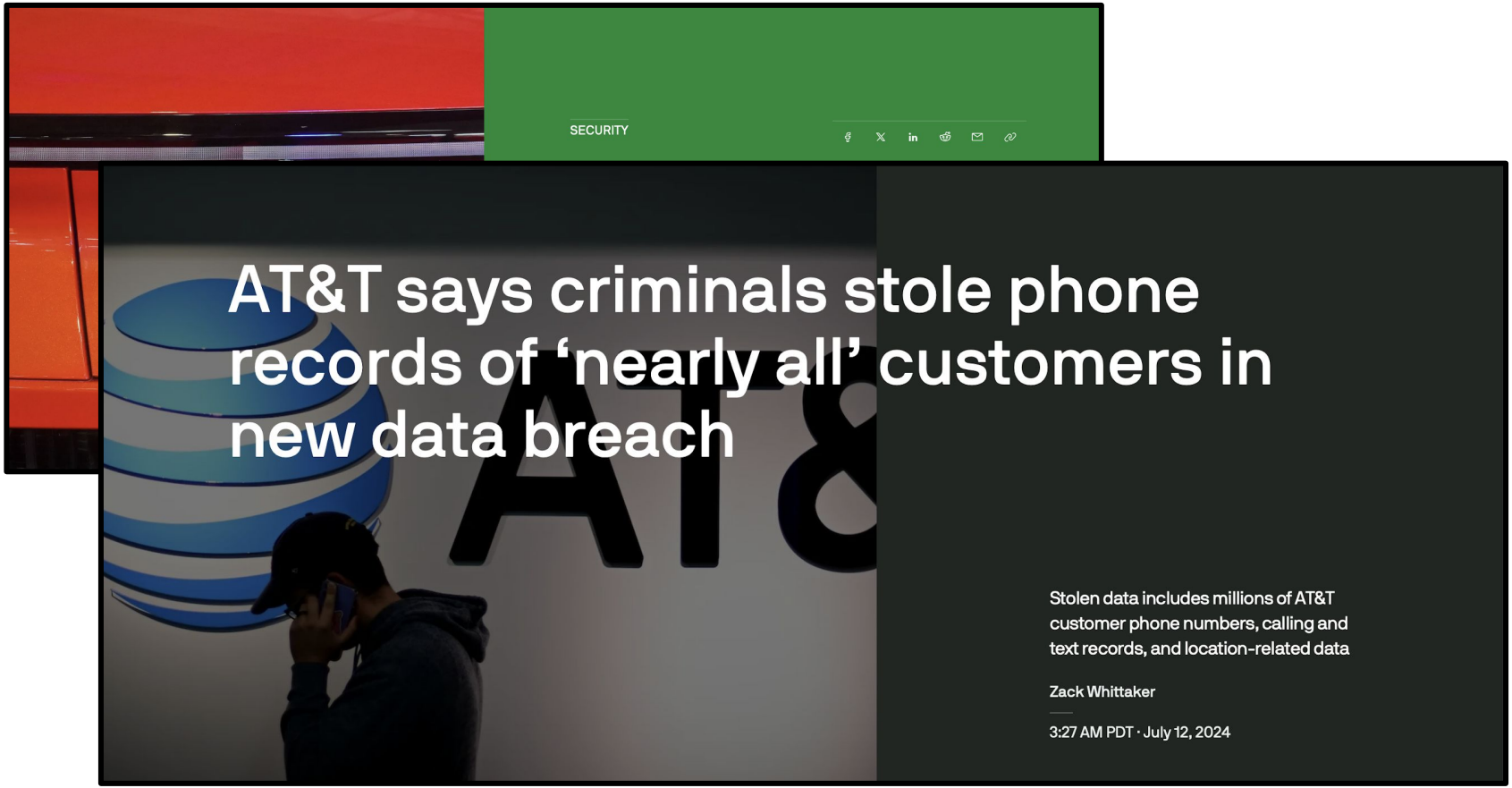
Lea Gröber

Katharina Krombholz

Mobin Javed

* Equal Contribution

https://techcrunch.com/2025/10/28/tata-motors-confirms-it-fixed-security-flaws-that-exposed-company-and-customer-data/



https://techcrunch.com/2024/07/12/att-phone-records-stolen-data-breach/

Research Questions

I. What security and privacy-related configuration challenges do cloud operators face across the cloud ecosystem?

II. What types of human-centric challenges are associated with these configuration tasks?

III. What solution strategies do accepted answers provide for addressing these challenges?

Research Questions

I. What security and privacy-related configuration challenges do cloud operators face across the cloud ecosystem?

II. What types of human-centric challenges are associated with these configuration tasks?

III. What solution strategies do accepted answers provide for addressing these challenges?

Methods

Three-phase mixed methods approach

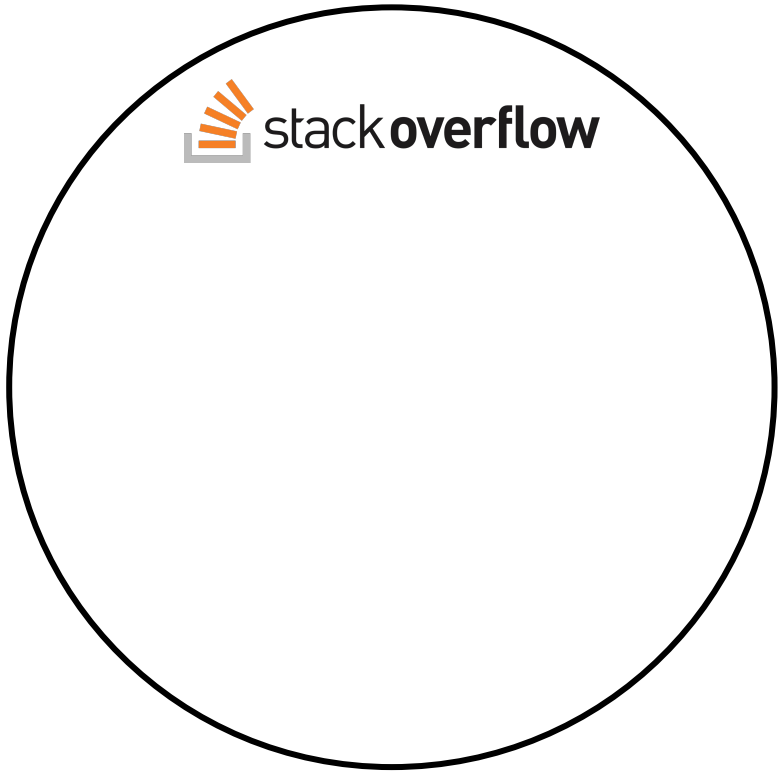
Data Collection

Dataset Characterization

Qualitative Analysis

Method - Data Collection Phase

- Stackoverflow posts from 2008-2024

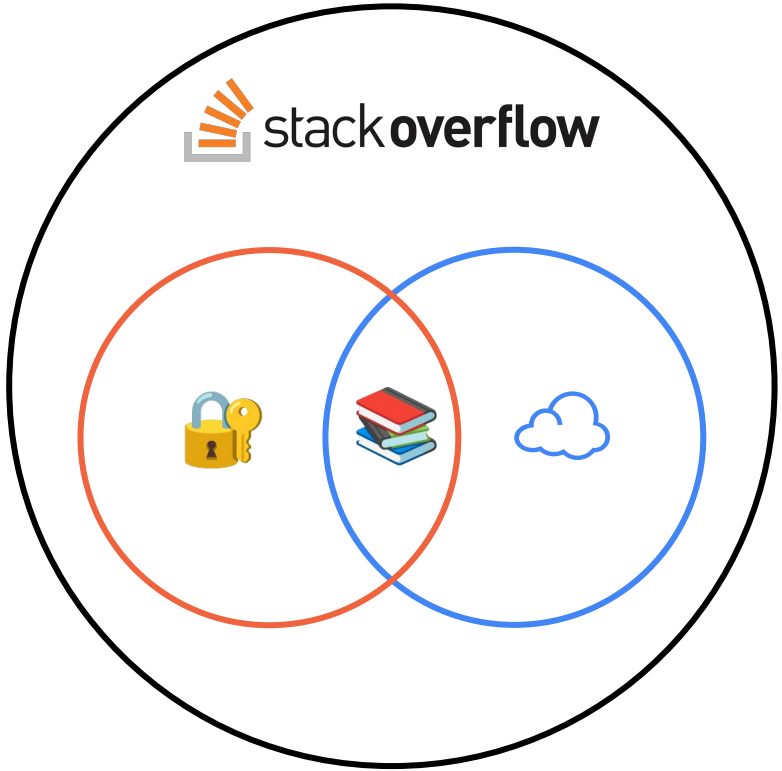


Method - Data Collection Phase

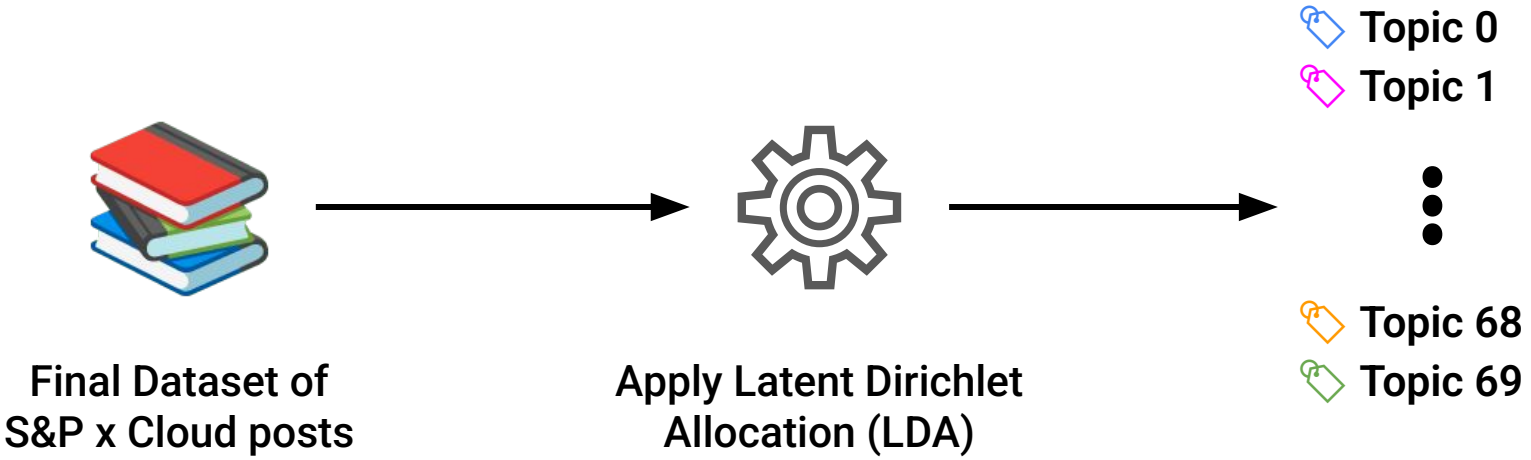
- Stackoverflow posts from 2008-2024
- 📚 Final Dataset: ~251k Cloud x S&P posts

  ☁️ **Cloud-related Posts**
  - "cloud" tag
  - hosting provider tags

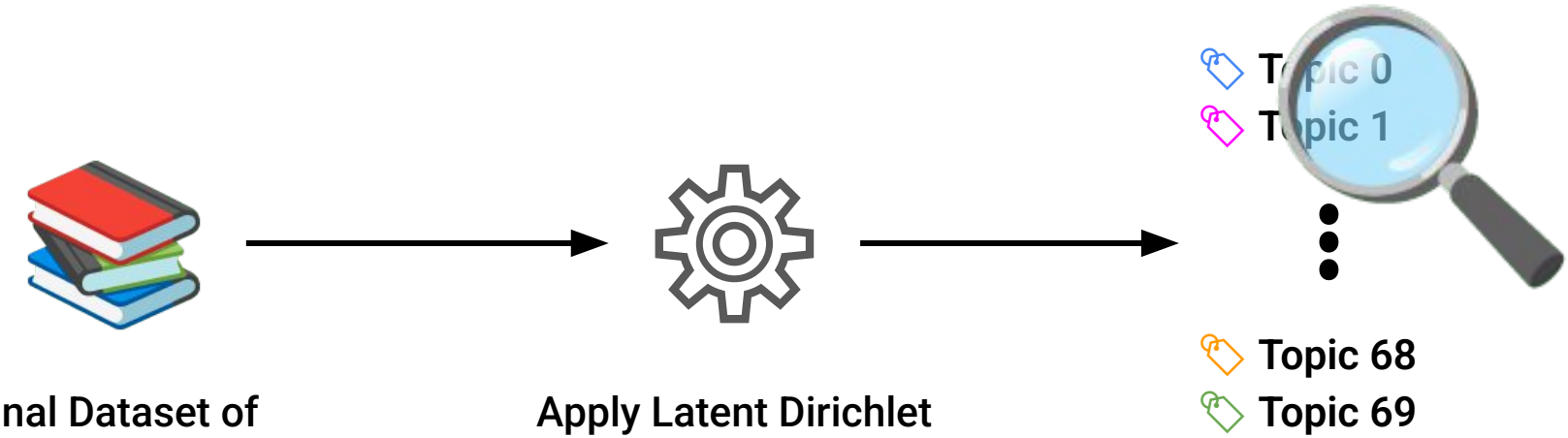
  🔐 **S&P-related Posts**
  - LLM-assisted key word generation
  - manual selection guided by NIST standards



Method - Dataset Characterization Phase



Method - Dataset Characterization Phase



Method - Qualitative Analysis Phase

- Topic 0
- Topic 1

⋮

- Topic 68
- Topic 69

Method - Qualitative Analysis Phase

Topic 0
Topic 1

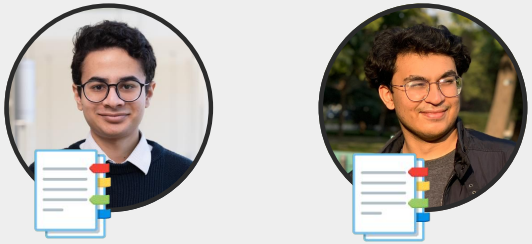
Topic 68
Topic 69

5 random posts per topic

Method - Qualitative Analysis Phase

Topic 0
Topic 1
⋮
Topic 68
Topic 69

5 random posts per topic



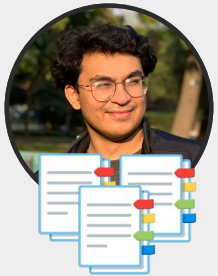
- independent open coding
- discussion and resolving of disagreements

Method - Qualitative Analysis Phase

Topic 0
Topic 1
⋮
Topic 68
Topic 69

5 random posts per topic

continue coding iteratively
until saturation is reached

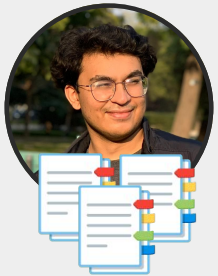
- independent open coding
- discussion and resolving of disagreements

Method - Qualitative Analysis Phase

Topic 0
Topic 1
⋮
Topic 68
Topic 69

5 random posts per topic

continue coding iteratively
until saturation is reached

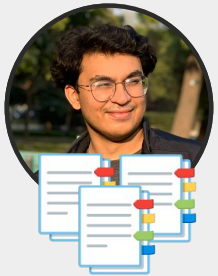
- independent open coding
- discussion and resolving of disagreements
- 5 axial categories:
  use cases, S&P configuration challenges, human-centric challenges, answer strategies

Method - Qualitative Analysis Phase

Topic 0
Topic 1
⋮
Topic 68
Topic 69

5 random posts per topic

continue coding iteratively
until saturation is reached

- independent open coding
- discussion and resolving of disagreements
- 5 axial categories: ***use cases, S&P configuration challenges***, *human-centric challenges, answer strategies*

RQ 1: S&P Configuration Challenges

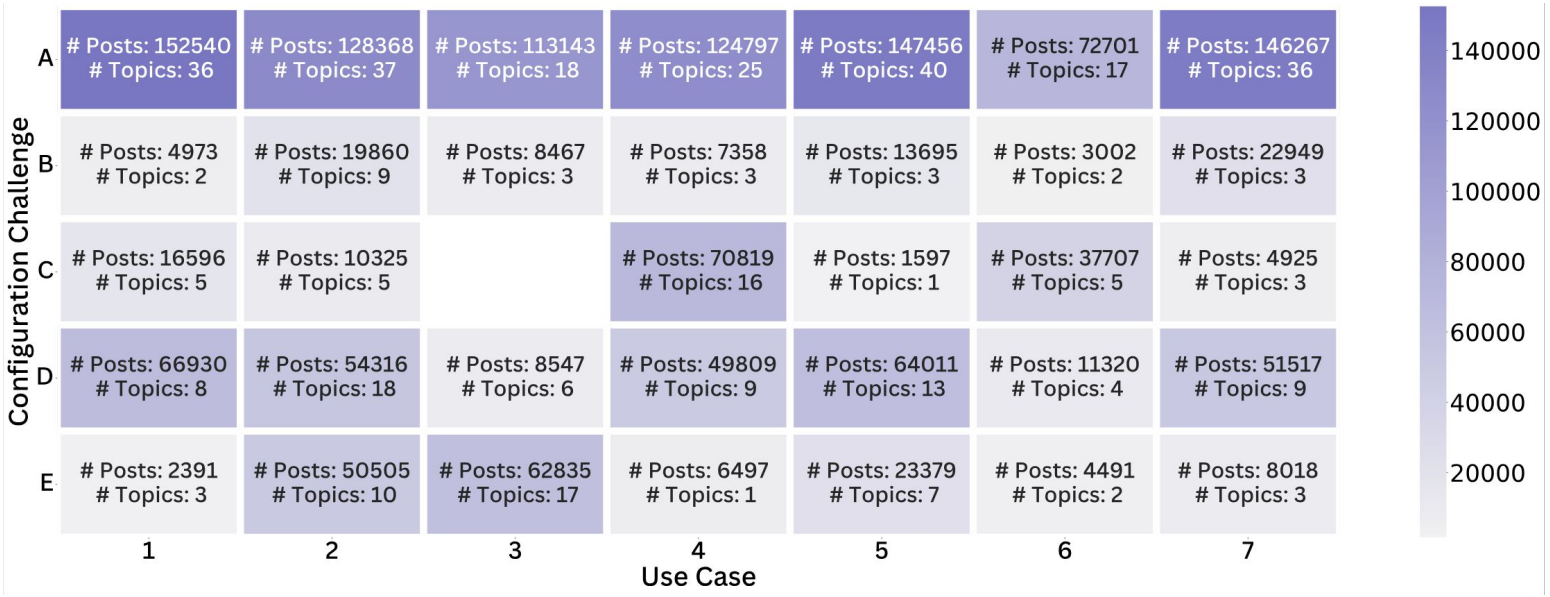
Use Case:

1. *Cloud Web/App Development*
2. *Server/Instance Configuration*
3. *Network, Connectivity & Routing*
4. *Data & Database Operations*
5. *Service/App Deployment*
6. *Cloud Automation and CI/CD Pipelines*
7. *Cloud Integrations and API Configuration*

Configuration Challenge:

A. *Authentication & Access Control*
B. *Logging & Monitoring*
C. *Data Backups & Recovery*
D. *Secure Communication & Encryption*
E. *Network Configuration & Management*

RQ 1: S&P Configuration Challenges



Legend:

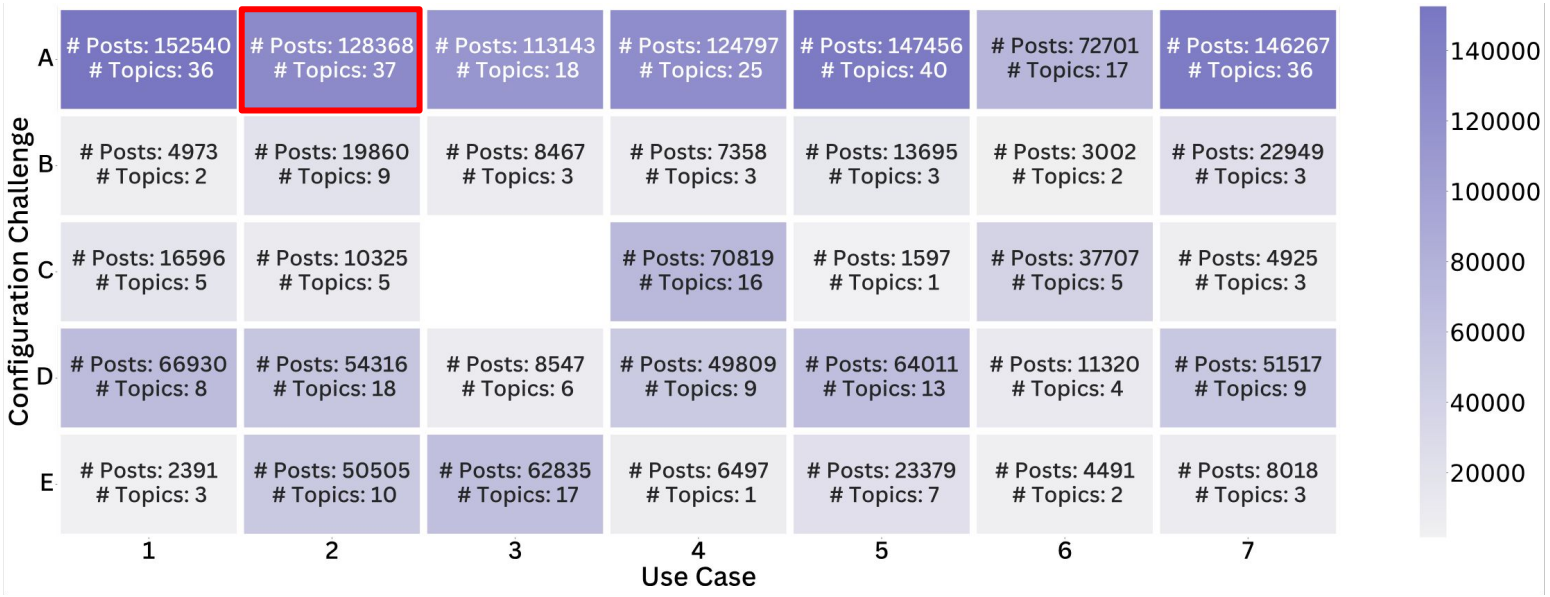
Use Case:

1. *Cloud Web/App Development*
2. *Server/Instance Configuration*
3. *Network, Connectivity & Routing*
4. *Data & Database Operations*
5. *Service/App Deployment*
6. *Cloud Automation and CI/CD Pipelines*
7. *Cloud Integrations and API Configuration*

Configuration Challenge:

A. *Authentication & Access Control*
B. *Logging & Monitoring*
C. *Data Backups & Recovery*
D. *Secure Communication & Encryption*
E. *Network Configuration & Management*

RQ 1: S&P Configuration Challenges



Legend:

Use Case:

1. *Cloud Web/App Development*
2. *Server/Instance Configuration*
3. *Network, Connectivity & Routing*
4. *Data & Database Operations*
5. *Service/App Deployment*
6. *Cloud Automation and CI/CD Pipelines*
7. *Cloud Integrations and API Configuration*

Configuration Challenge:

A. *Authentication & Access Control*
B. *Logging & Monitoring*
C. *Data Backups & Recovery*
D. *Secure Communication & Encryption*
E. *Network Configuration & Management*

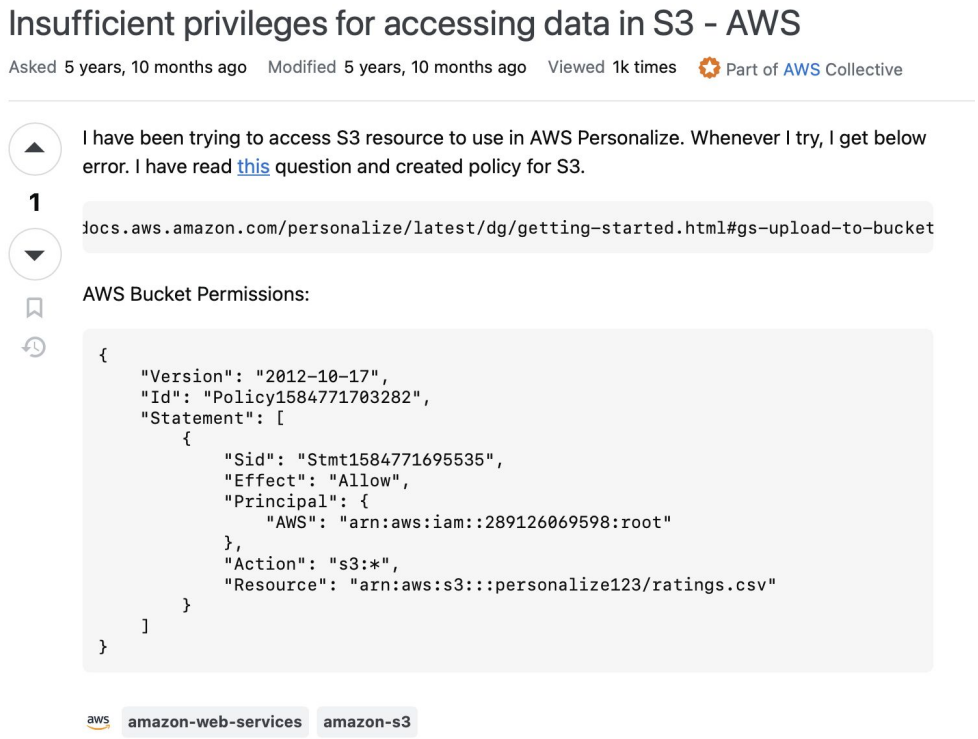
RQ 1: S&P Configuration Challenges

Server/Instance Configuration x Authentication/Access Control

RQ 1: S&P Configuration Challenges

Server/Instance Configuration x Authentication/Access Control

- Configuring IAM policies, token scopes, environment credential
- Access to backend services, accounts using scoped tokens and SSO scripts.
- Authorization errors, e.g. HTTP 401, 403, or CORS-related failures.



Insufficient privileges for accessing data in S3 - AWS

Asked 5 years, 10 months ago Modified 5 years, 10 months ago Viewed 1k times Part of AWS Collective

1

I have been trying to access S3 resource to use in AWS Personalize. Whenever I try, I get below error. I have read this question and created policy for S3.

docs.aws.amazon.com/personalize/latest/dg/getting-started.html#gs-upload-to-bucket

AWS Bucket Permissions:

```
{
    "Version": "2012-10-17",
    "Id": "Policy1584771703282",
    "Statement": [
        {
            "Sid": "Stmt1584771695535",
            "Effect": "Allow",
            "Principal": {
                "AWS": "arn:aws:iam::289126069598:root"
            },
            "Action": "s3:*",
            "Resource": "arn:aws:s3:::personalize123/ratings.csv"
        }
    ]
}
```

aws amazon-web-services amazon-s3

RQ 2: Human-Centric Challenges

Underlying issues uncovered across posts:

RQ 2: Human-Centric Challenges

Underlying issues uncovered across posts:

Generic Documentation

RQ 2: Human-Centric Challenges

Underlying issues uncovered across posts:

Generic Documentation

Complicated Tooling

RQ 2: Human-Centric Challenges

Underlying issues uncovered across posts:

Generic Documentation

Complicated Tooling

Copy-pasting Errors

RQ 2: Human-Centric Challenges

Underlying issues uncovered across posts:

Generic Documentation

Complicated Tooling

Copy-pasting Errors

Knowledge Gaps

RQ 3: Answer Strategies

Accepted answers primarily address configuration challenges through three complementary strategies:

RQ 3: Answer Strategies

Accepted answers primarily address configuration challenges through three complementary strategies:

Service Usage Suggestion

Code Changes and Explanations

References to Official Documentation

RQ 3: Example

1 Answer

Sorted by: Highest score (default)

2

Amazon Personalize needs permission to access the S3 bucket. You must enable ListBucket nad GetObject actions. Try to edit this

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "personalize.amazonaws.com"
            },
            "Action": "s3:ListBucket",
            "Resource": "arn:aws:s3:::yourbucket"
        },
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "personalize.amazonaws.com"
            },
            "Action": "s3:GetObject",
            "Resource": "arn:aws:s3:::yourbucket/*"
        }
    ]
}
```

Read Uploading to an S3 Bucket

Explanation of how to use Cloud Service

RQ 3: Example

1 Answer

Sorted by: Highest score (default)

2

Amazon Personalize needs permission to access the S3 bucket. You must enable ListBucket nad GetObject actions. Try to edit this

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "personalize.amazonaws.com"
            },
            "Action": "s3:ListBucket",
            "Resource": "arn:aws:s3:::yourbucket"
        },
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "personalize.amazonaws.com"
            },
            "Action": "s3:GetObject",
            "Resource": "arn:aws:s3:::yourbucket/*"
        }
    ]
}
```

Read Uploading to an S3 Bucket

Code changes and parameter explanation

RQ 3: Example

1 Answer

Sorted by: Highest score (default)

2

Amazon Personalize needs permission to access the S3 bucket. You must enable ListBucket nad GetObject actions. Try to edit this

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "personalize.amazonaws.com"
            },
            "Action": "s3:ListBucket",
            "Resource": "arn:aws:s3:::yourbucket"
        },
        {
            "Effect": "Allow",
            "Principal": {
                "Service": "personalize.amazonaws.com"
            },
            "Action": "s3:GetObject",
            "Resource": "arn:aws:s3:::yourbucket/*"
        }
    ]
}
```

Read Uploading to an S3 Bucket

📖 **Referring to documentation**

Where Do We Go From Here?

Sumair Hashmi*

Shafay Kashif*

Lea Gröber

Katharina Krombholz

Mobin Javed

* equal contribution

Where Do We Go From Here?

- ➔ Revisit usability of authentication mechanisms in the cloud
- ➔ Design tailored documentation, education, and support resources
- ➔ Explore organizational culture and operator experiences to uncover root causes

Sumair Hashmi*

Shafay Kashif*

Lea Gröber

Katharina Krombholz

Mobin Javed

* equal contribution