AuthoExam:

A Browser Extension with Multi-Factor Authentication for Proctoring Online Exams

Special Problem 2 Presentation

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PREVIEW

Background of the Study

BACKGROUND OF THE STUDY

- **Adoption of Blended Learning**
  - Face-to-face classes combined with online learning
- **Flexibility**
  - Online learning provided flexible options despite interruptions to face-to-face classes
- Remote Online Assessments
  - Remote online assessments raised concerns and problem:
    - Confirming the student's identity online and Students can access other online sources (Nurunnabi & Hossain, 2019;Reedy et al., 2021)
- **Significance**
  - There is a need for proctoring tool that provides information about students' online identity and browser activity during online exams

Objectives

MAIN OBJECTIVE:

To develop a proctoring tool that will help educational institutions monitor online assessments

SPECIFIC OBJECTIVES:

- Implement the use of Multi-factor authentication in verifying the identity of the student taking the online assessment

- Integrate the Browser Extension API to monitor browser student activity while taking the assessment to flag possible cheating

- Evaluate the usability of the proctoring tool using the System Usability Scale

SCOPE AND LIMITATIONS

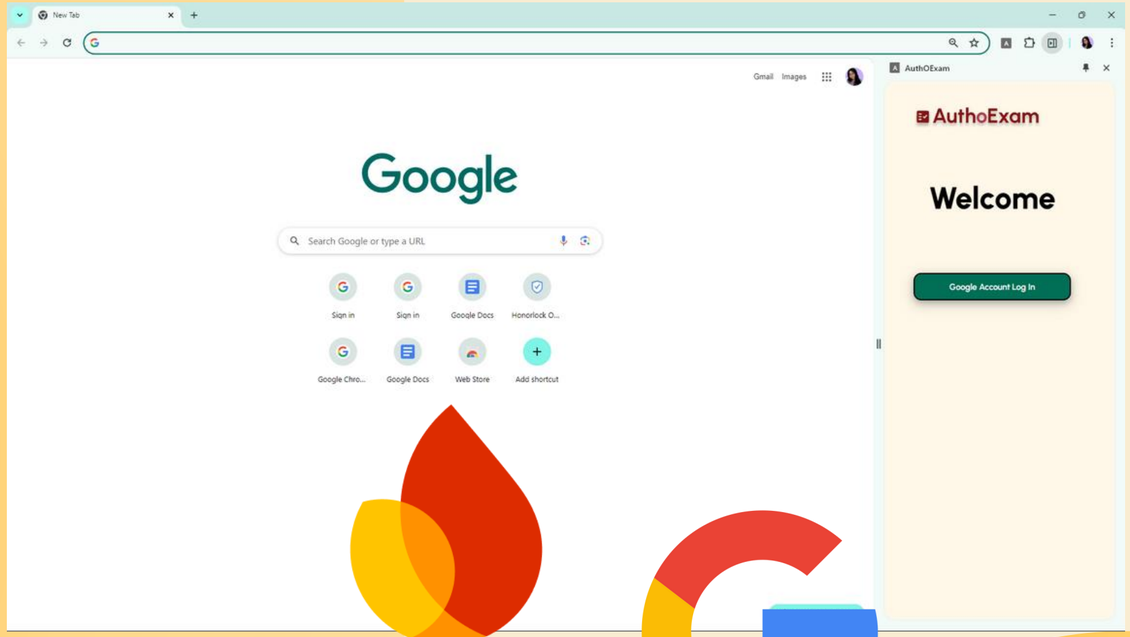
- Multi-Factor Authentication
  - **Knowledge-based and Risk-based factors**
  - **OAuth 2.0 and Firebase**
- Proctoring
  - **Chrome Extension API**
  - **Monitor student browsing during assessments**
  - **Cannot detect external activities**
- Testing
  - **Latest Version Chrome Browser**
  - **Google Education Suite**

Methodology

METHODOLOGY

Browser Extension API

- Chrome Extensions API which can be installed on Chrome browsers



Multi-factor Authentication

Knowledge-based factors which are then authenticated by Firebase:

- Institutional email account (OAuth 2.0)
- Student Identification Number
- Exam Access Code

Firebase

METHODOLOGY

Multi-factor Authentication

Risk-based Factors

- Gather digital identity attributes such as:
  - Geolocation
  - IP Address
  - System Display
  - System CPU
  - Operating System
  - Browser
- Gathered upon Student Registration and upon taking the online exam

METHODOLOGY

Multi-factor Authentication

Weighted Risk Scoring (Wiefling et al., 2020, 2022)

Student Digital Identity Attribute	Weighted Score
Geolocation	5
IP Address	4
System Display	3
System CPU	2
Operating System	1

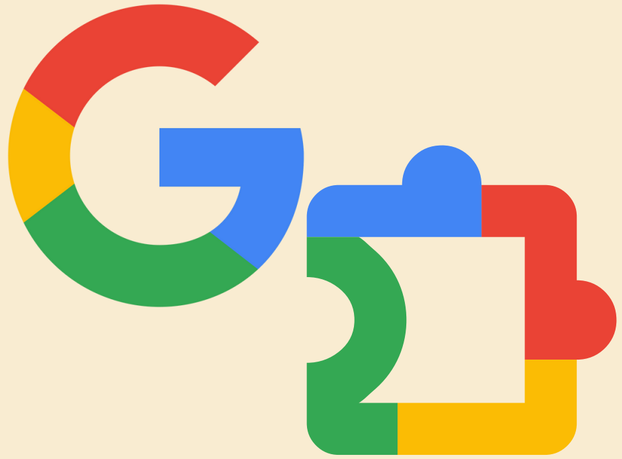
$$AuthRiskScore = \frac{Total\ Weight\ of\ Attributes\ Matched}{Total\ Weight\ of\ Attributes}$$

- If the result from computing the Weighted Risk Score is less than 0.90,

The student will still be allowed to take the exam but will be flagged as a suspicious attempt.

METHODOLOGY

Proctoring Browser Activity



Chrome Extension API

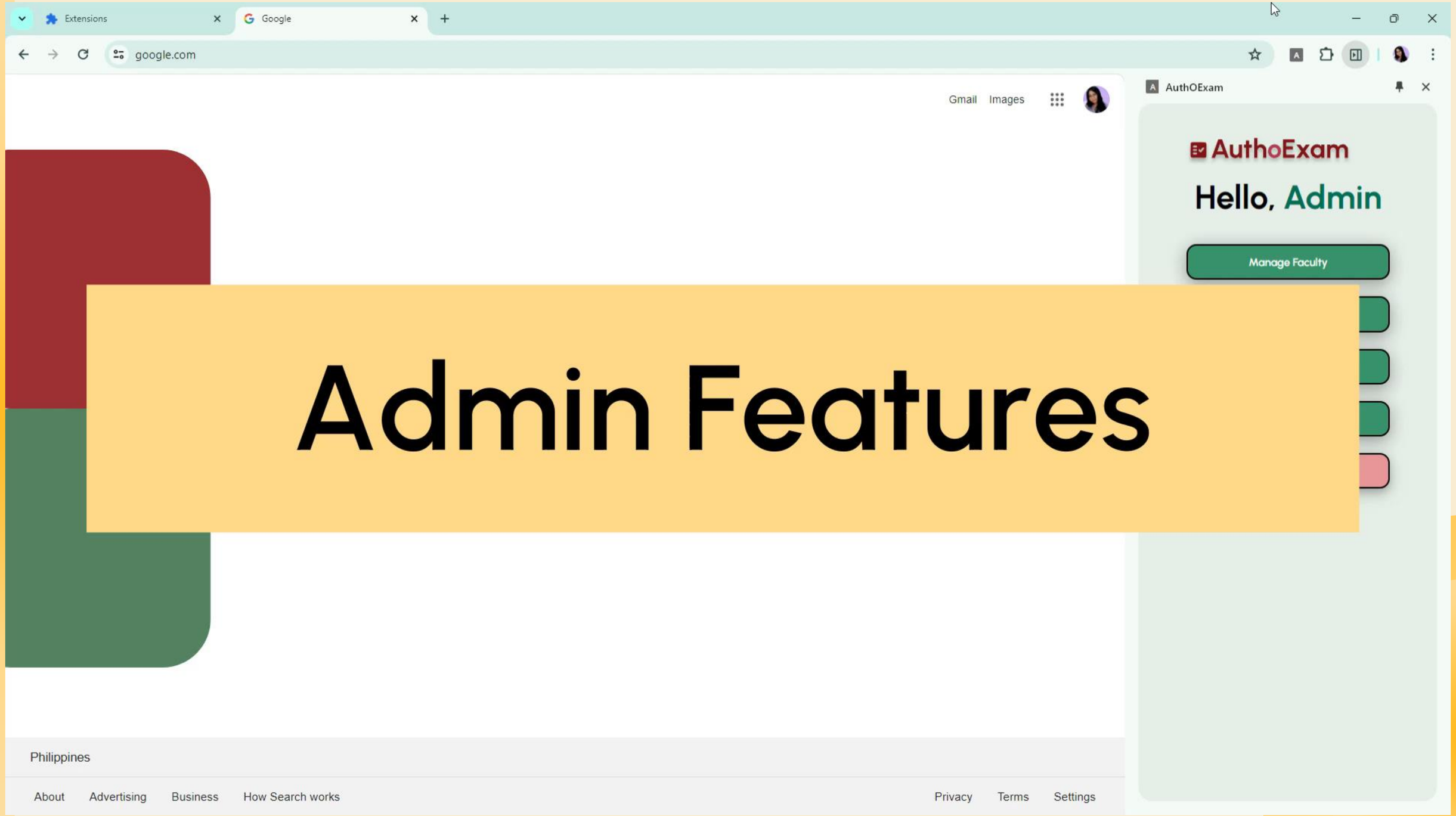
- Track browser activity such as:
  - websites visited in the current session
  - number of newly opened tabs
  - number of switches from another Chrome window to another
  - number of copy and paste action

Results and Discussion

RESULTS AND DISCUSSION

Features

- Developed browser extension for proctoring exams using:
  - JavaScript, CSS, HTML for UI
  - Chrome's sidePanel API
- Three roles can access the proctoring tool:
  - Admin: Add Faculty, Add courses, Upload Class lists, Schedule Exams, Viewing Proctoring reports
  - Faculty: Schedule exams for their classes and View proctoring reports
  - Student: Receive automatic emails, Take the online exam using the provided link, and Generate a proctoring report



Admin Features

RESULTS AND DISCUSSION

In verifying the identity of the student taking the online assessment, Multi-factor authentication was implemented with:

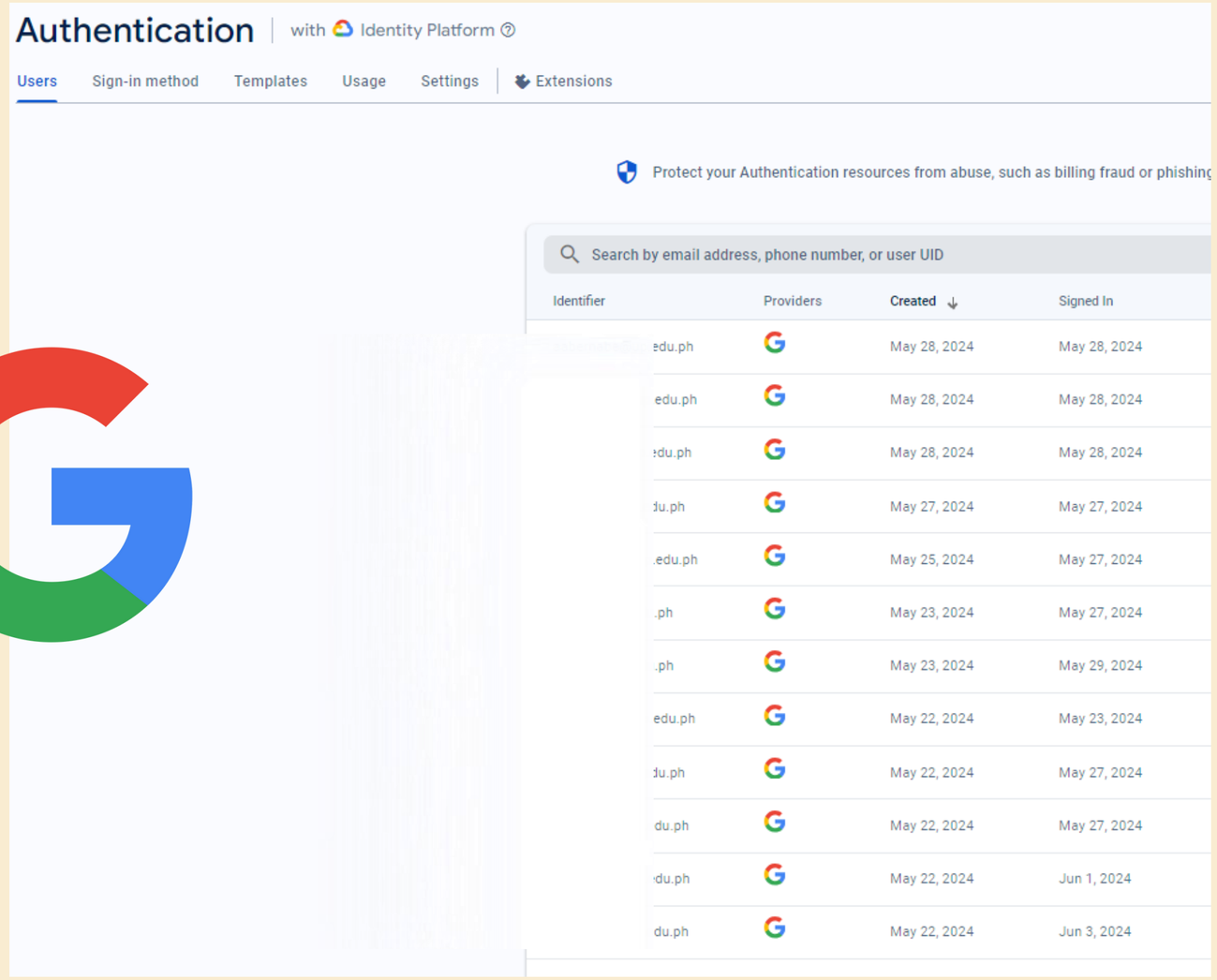
- Firebase Authentication
- Google Identity using OAuth 2.0 tokens for institutional Gmail accounts

Additional layer of authentication:

- Weighted Risk Scoring model comparing digital identity attributes before and during the exam

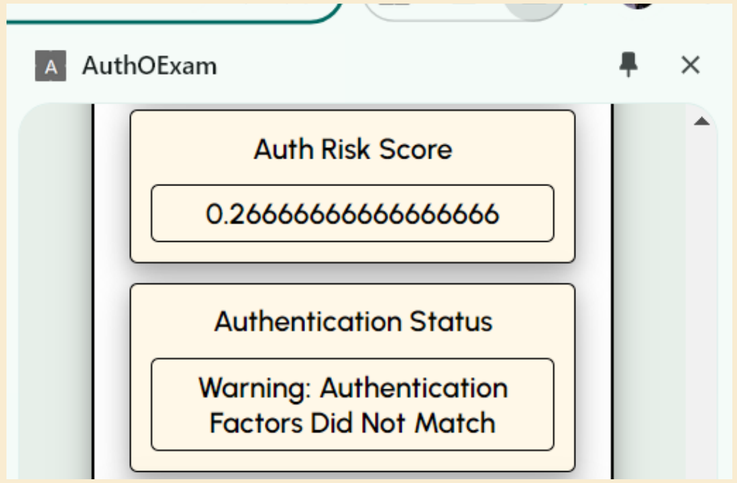
RESULTS AND DISCUSSION

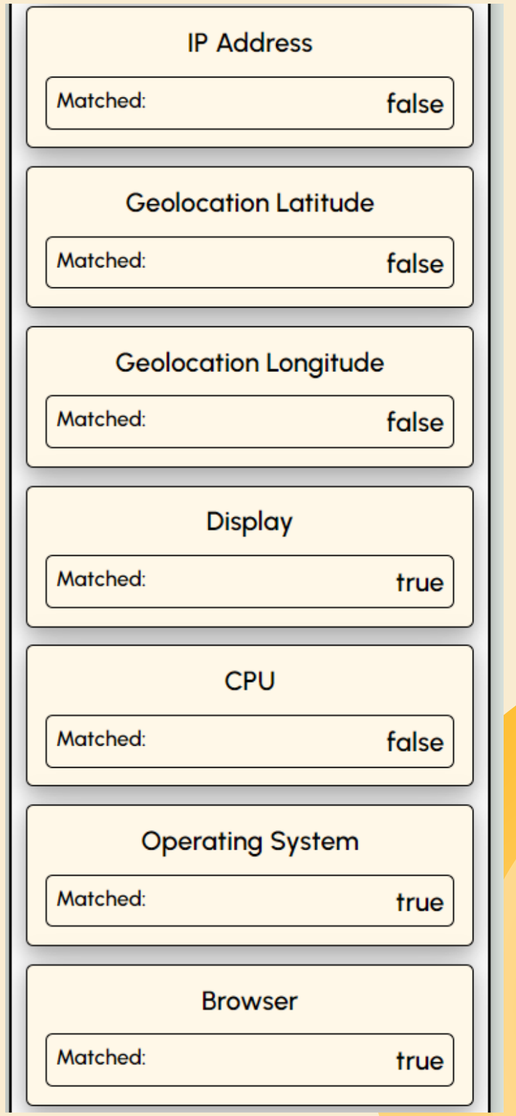
Firebase



RESULTS AND DISCUSSION

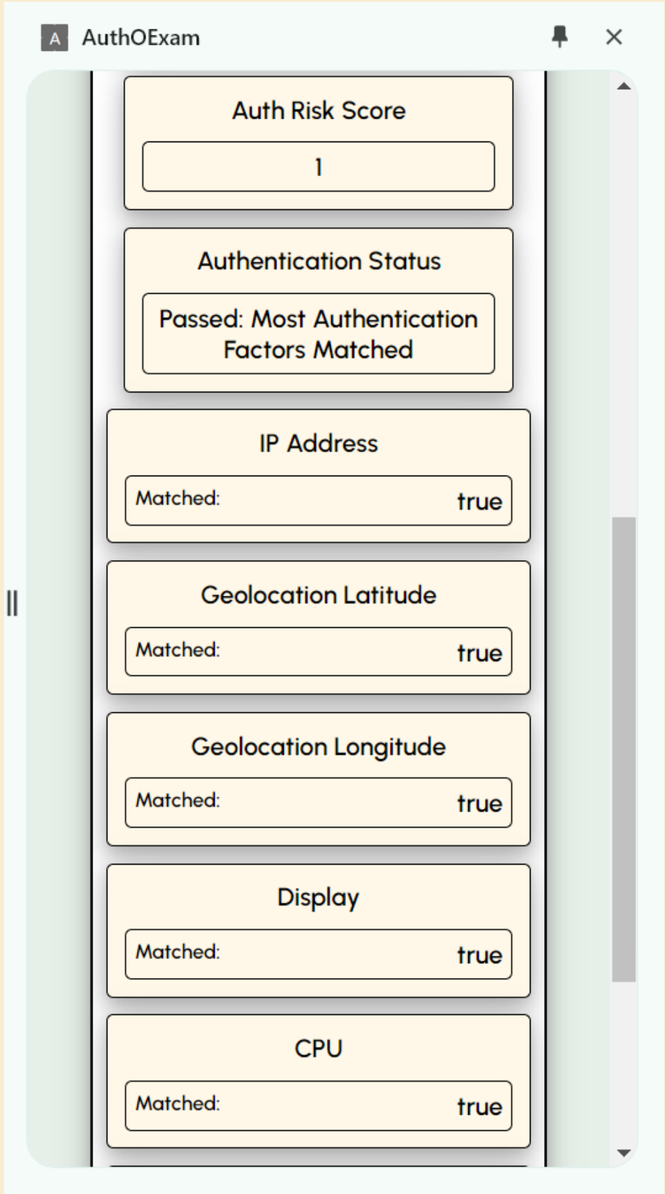
Auth Risk Score < 0.90





RESULTS AND DISCUSSION

Auth Risk Score > 0.90

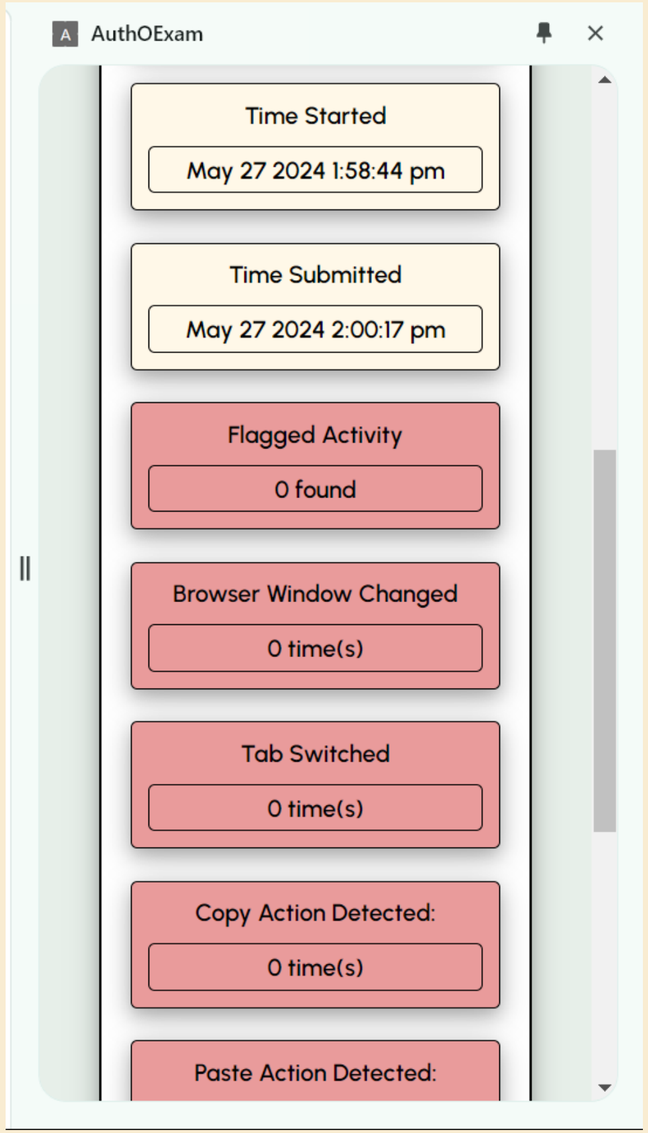


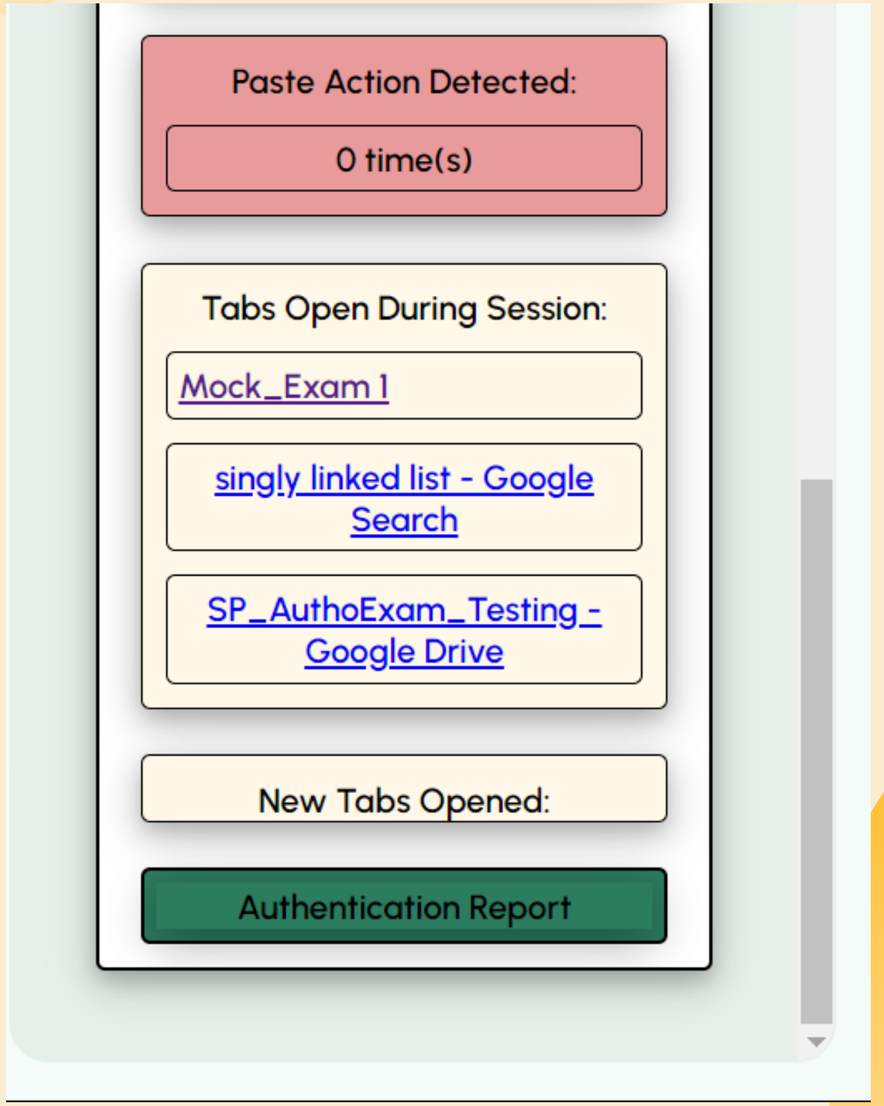
RESULTS AND DISCUSSION

Proctoring tool tracked:

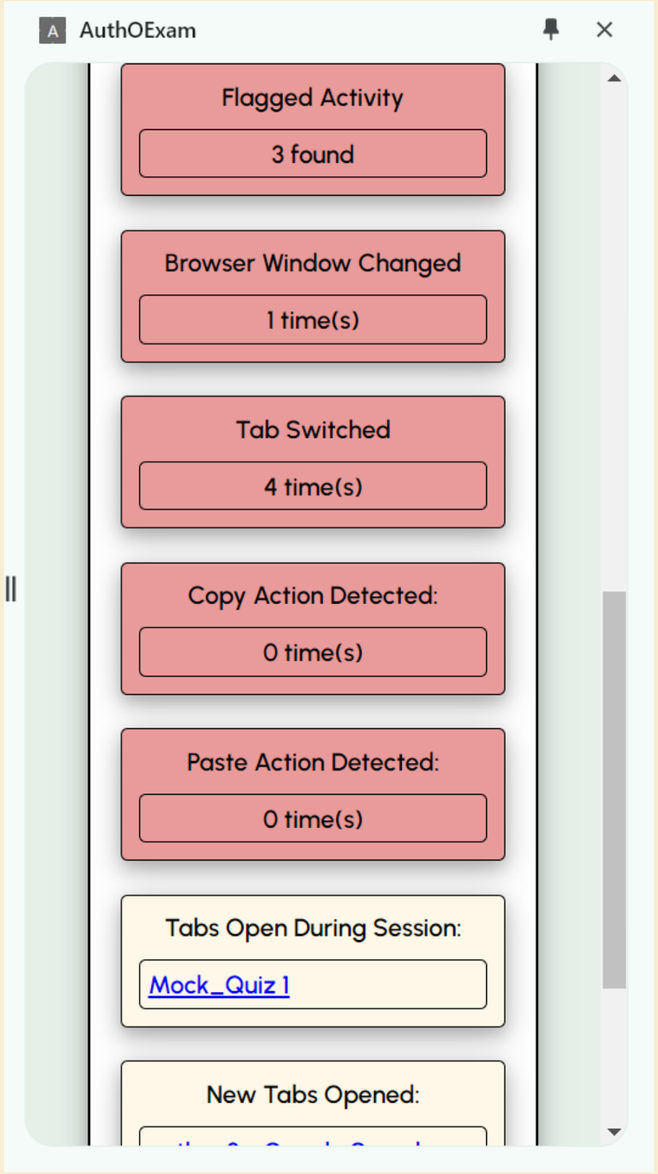
- Websites visited during browser session
- Number of newly opened tabs and URLs
- Window switches and minimizations
- Copy-paste actions

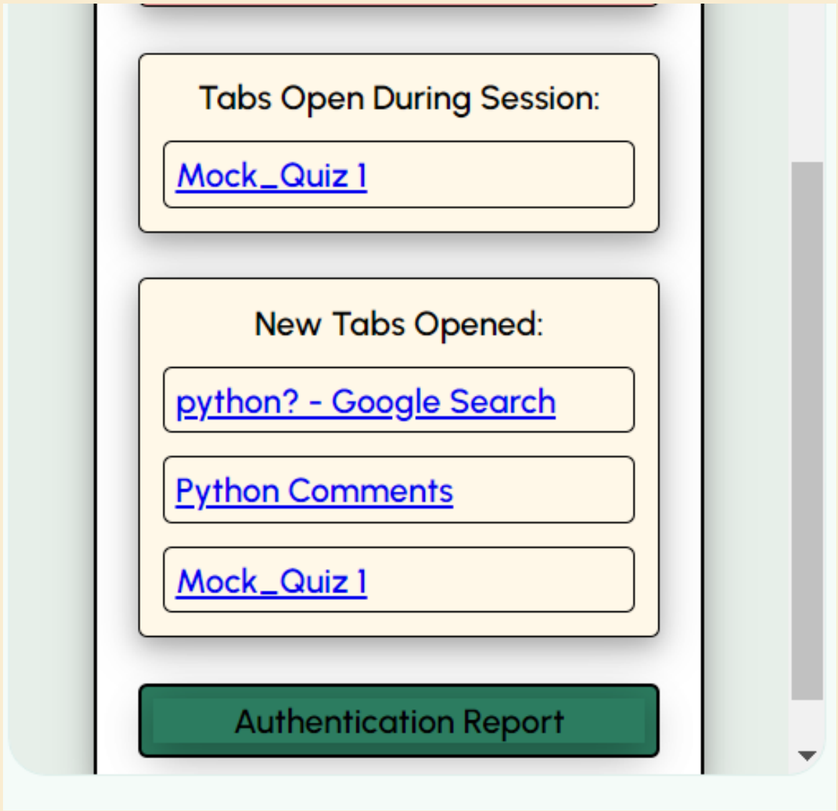
RESULTS AND DISCUSSION





RESULTS AND DISCUSSION



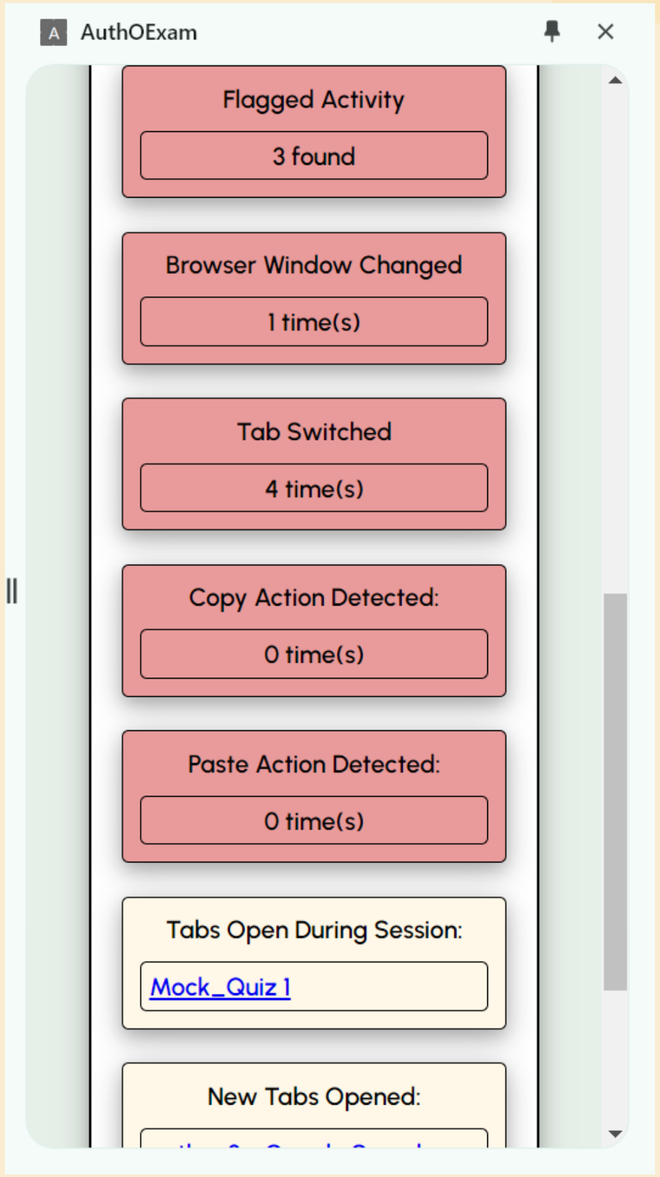


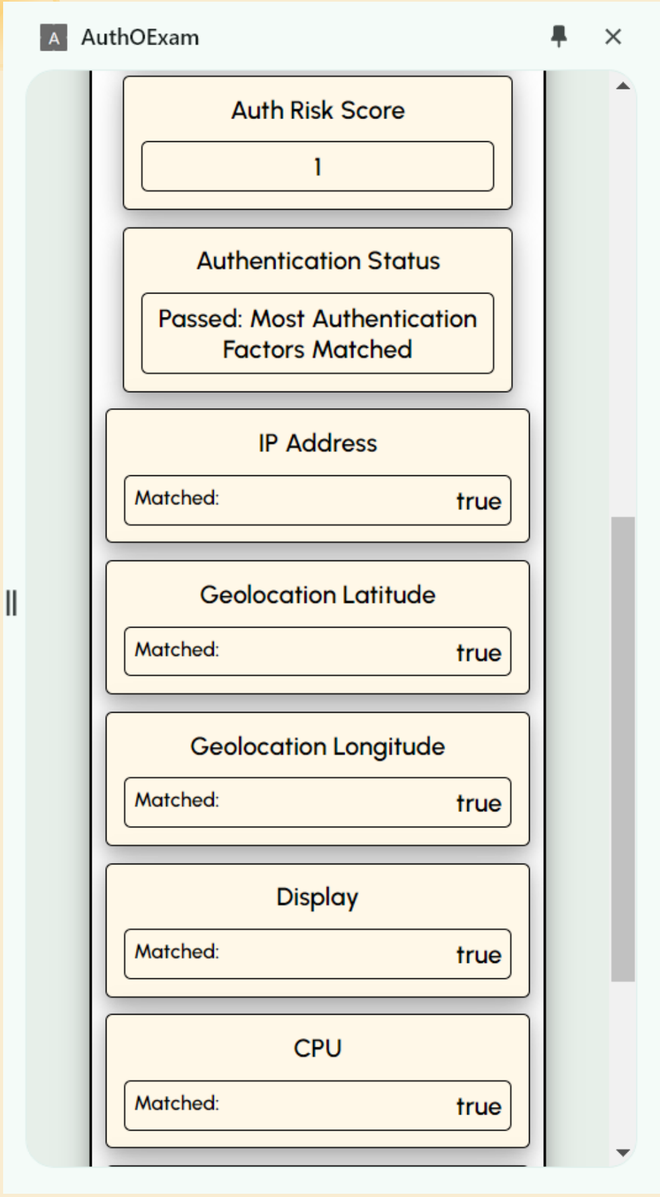
RESULTS AND DISCUSSION

Generated reports:

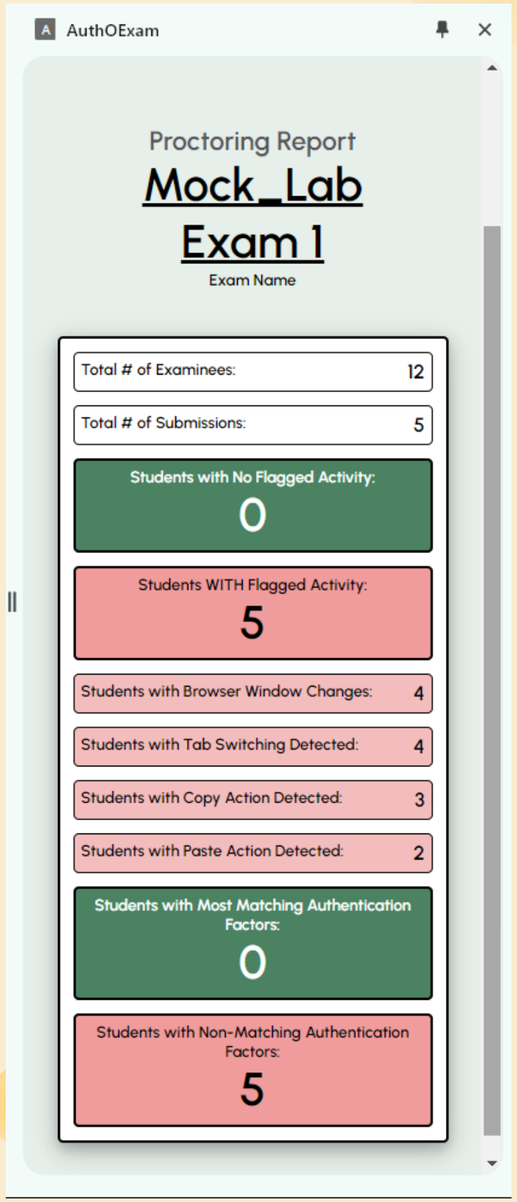
- Browser activity and authentication review for each student
- Summary report for each exam with:
  - Total number of examinees and submissions
  - Flagged activities
  - Matching and non-matching authentication factors based on digital identity

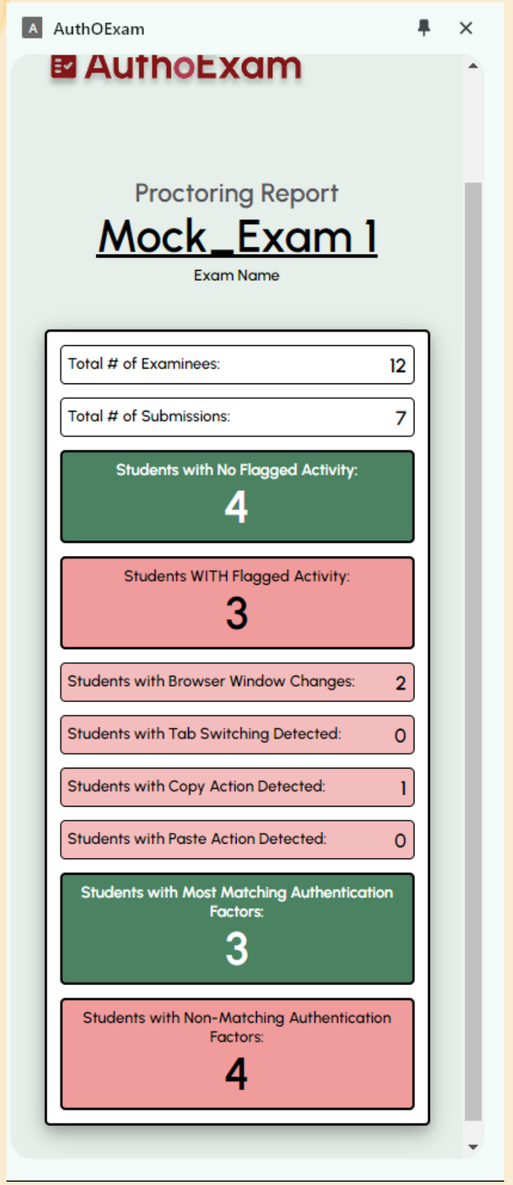
RESULTS AND DISCUSSION





RESULTS AND DISCUSSION





RESULTS AND DISCUSSION

The System Usability Scale (SUS)

- used to measure the usability of the proctoring tool
- consists of 10 statements with a five-point scale that ranged from "Strongly Disagree" to "Strongly Agree."
- Individual scores were calculated after the survey completion and were converted to scores within the 0-100 range.

RESULTS AND DISCUSSION

The System Usability Scale (SUS) - Computation

Respondent		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total Odd	Normalized Odd	Total Even	Normalized Even	Total Value	SUS Score
1		5	1	5	1	5	1	5	1	5	2	25	20	6	19	39	97.5
2		5	1	5	1	5	2	5	1	5	1	25	20	6	19	39	97.5
3		5	1	5	1	5	1	5	2	5	1	25	20	6	19	39	97.5
4		5	3	5	1	5	1	5	1	5	1	25	20	7	18	38	95
5		5	2	5	2	5	1	4	1	5	2	24	19	8	17	36	90
6		5	1	5	1	4	1	5	1	5	1	24	19	5	20	39	97.5
7		4	2	5	2	5	2	4	1	5	1	23	18	8	17	35	87.5
8		5	2	4	1	4	1	5	1	4	1	22	17	6	19	36	90
9		4	1	5	1	4	2	5	1	4	1	22	17	6	19	36	90
10		5	3	4	3	5	2	5	2	4	3	23	18	13	12	30	75
Mean SUS Score		91.75															

RESULTS AND DISCUSSION

The System Usability Scale (SUS)

- The average SUS score computed for this was 91.75, which is classified as Above Average (Sauro, 2011)
- Excellent and Acceptable according to the descriptive scale (Bangor et al., 2009).
- Users with experience in taking or scheduling online exams found the proctoring tool to be usable, meaning it was effective, efficient, and satisfactory to use.

Conclusion

CONCLUSION

- AuthoExam employs multi-factor authentication (MFA) for student identity verification.
  - using knowledge-based factors like ID numbers and access codes
  - Implements risk-based authentication by computing for the Weighted Risk Scoring to verify student digital identity
- Integrates Chrome Extension API for real-time monitoring.
  - Flags browser activity such as window minimization, tab switching and copy-pasting.
- Usability assessed using System Usability Scale (SUS), yielding an Above Average score of 91.75.

FUTURE WORK

- Recommend making the proctoring tool compatible with other browsers
  - Use a different multi-factor authentication and authorization method
  - Include additional MFA factors like One-time passwords or Inherence-based factors (e.g., keystroke dynamics)
- Feature Requests
  - Add "Auto Submit" to automatically submit and generate a report after an exam

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Thank You