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PyGress: Tool for Analyzing the Progression of Code Proficiency in Python OSS Projects

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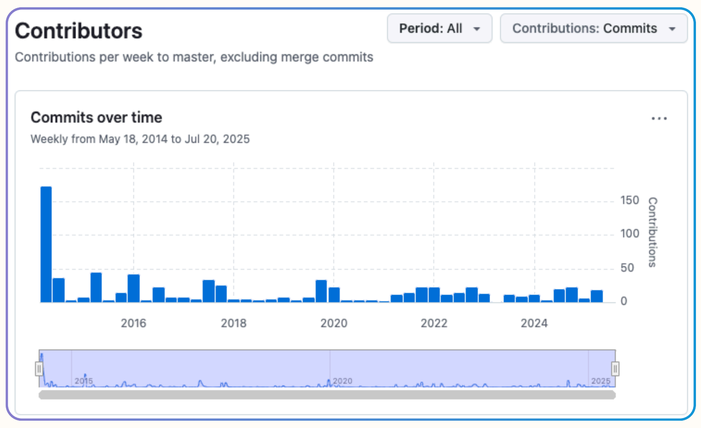
ABSTRACT

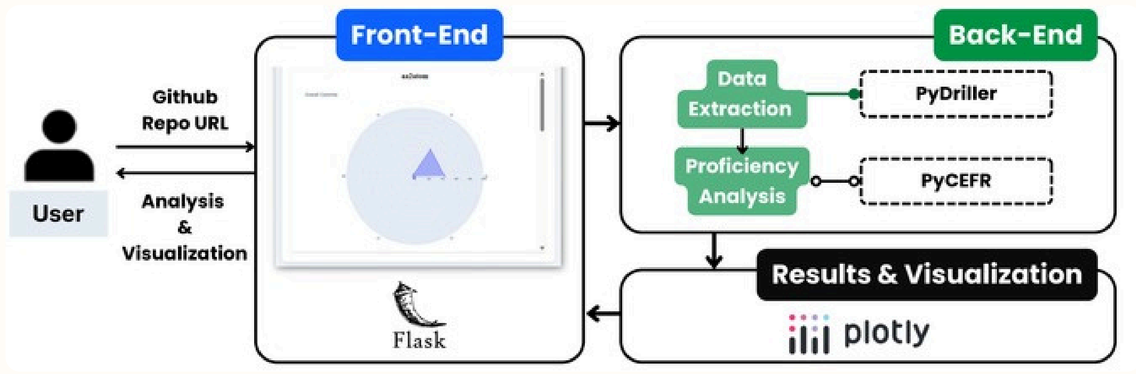
Assessing developer proficiency in open-source software (OSS) projects is essential for understanding project dynamics, especially for expertise. This paper presents **PyGress**, a web-based tool designed to automatically evaluate and visualize Python code proficiency using pycefr, a Python code proficiency analyzer. By submitting a GitHub repository link, the system extracts commit histories, analyzes source code proficiency across CEFR-aligned levels (A1–C2), and generates visual summaries of individual and project-wide proficiency. The PyGress tool visualizes per-contributor proficiency distribution and tracks project code proficiency progression over time. PyGress offers an interactive way to explore contributor coding levels in Python OSS repositories.

PROBLEM STATEMENT

- No existing tool evaluates and visualizes Python code proficiency in OSS projects.
- Current studies focus on contribution volume or activity, not coding competency.



SYSTEM ARCHITECTURE



FRAMEWORK (PYCEFR)

What is CEFR?

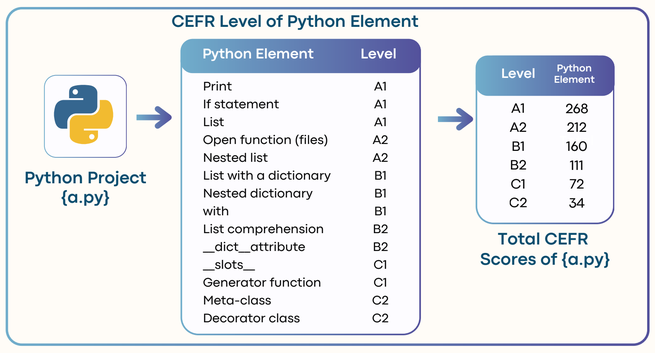
- An international standard for assessing language proficiency across six levels: A1–C2

Level Group	Level
A Basic	A1: Breakthrough or beginner
	A2: Waystage or elementary
B Independent	B1: Threshold or intermediate
	B2: Vantage or upper intermediate
C Proficient	C1: Effective operational proficiency
	C2: Mastery or proficiency

CEFR (Common European Framework of Reference for Languages)

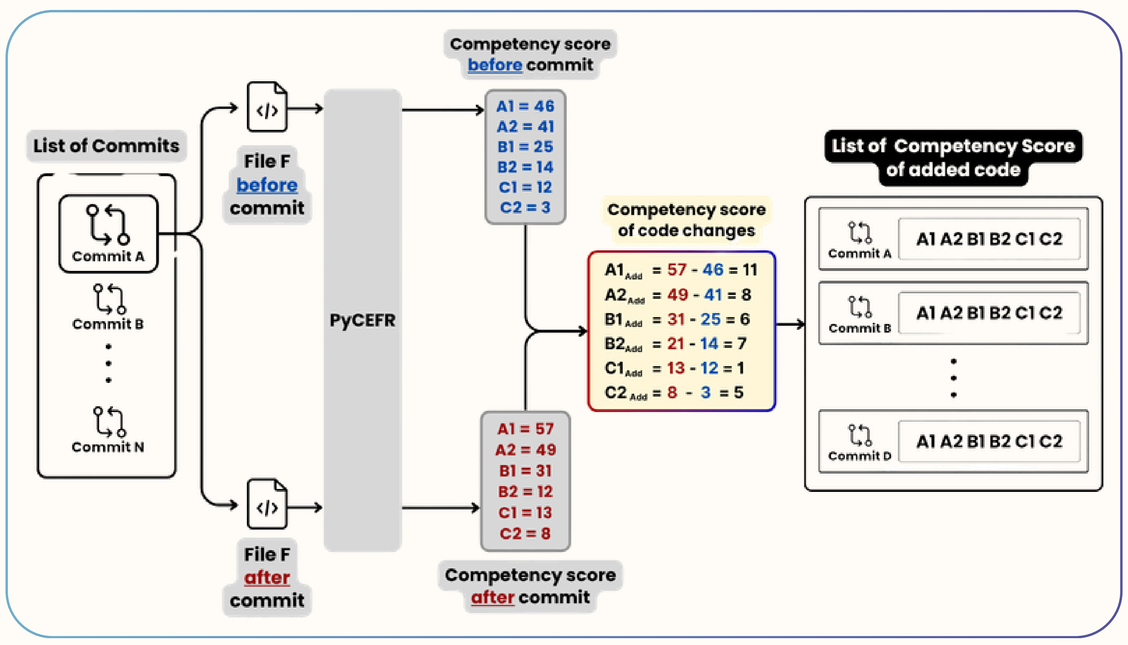
What is PyCEFR?

- A tool that categorizes Python code into 6 proficiency levels, aligning with the **CEFR (A1, A2, B1, B2, C1, and C2)**.



Python Project's CEFR Level Calculation (PyCEFR)

PROFICIENCY ANALYSIS



1) Repository Submission

- Users provide a GitHub repository link to PyGress. The tool automatically retrieves the **commit history** and associated **source code files**.

2) Code Proficiency Analysis

1. Python Code Extraction and Preprocessing
2. Proficiency Assessment Using PyCEFR
3. Calculating Proficiency Scores Per Contributor Over Time
4. Aggregating Project-wide Scores

3) Visualization and Interaction

- **PyGress generates interactive graphs for easy exploration:** Per-contributor proficiency distribution and Project-wide proficiency progression over time

FEATURES OF PYGRESS

Python Code Proficiency Evaluation

- Automatically analyzes Python code from GitHub repositories.
- Uses PyCEFR to classify code constructs into CEFR levels. (A1 to C2), reflecting developer skill levels.

Contributor and Project-Level Tracking

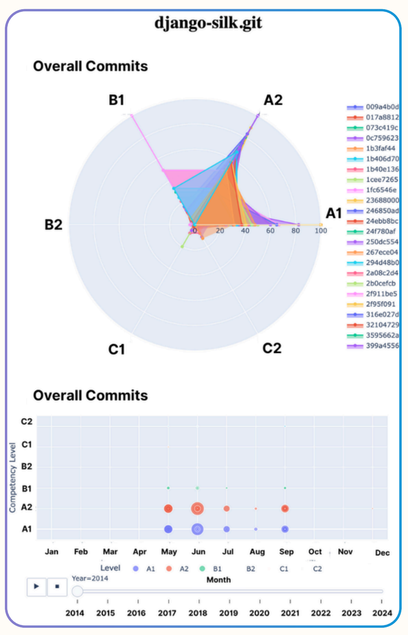
- Tracks proficiency progression for each contributor over time.
- Aggregates data to show project-level proficiency evolution.
- Helps identify key contributors and potential risks.

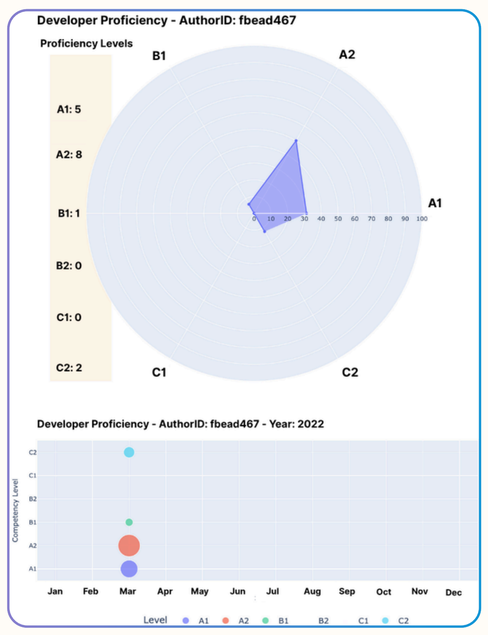
Interactive Visualization Interface

- Provides dynamic charts (spider and slider graphs) via a web-based UI.
- Enables maintainers to explore proficiency data easily and make informed decisions.

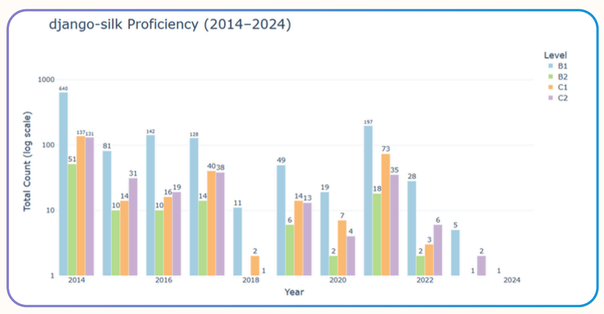
RESULTS

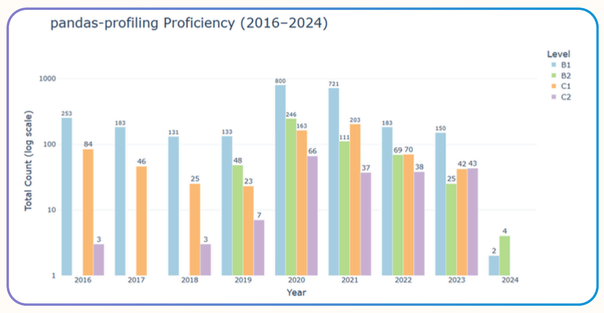
DJANGO-SILK: INDIVIDUAL CONTRIBUTOR'S PROFICIENCY





PYTHON PROFICIENCY PROGRESSION OF 2 OSS PROJECTS





DEMO & OTHERS

Pre-print:
Scan to get the pre-print of the paper on arXiv

Video demo:
Scan to watch the PyGress demo video

GitHub repo:
Scan to view the PyGress source code on GitHub