Analysing competitive relationships among Open Source Software Projects

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Throughout software history, evolution has been driven by cycles of competition, rise, and elimination. Open Source Software (OSS) is no exception, with these cycles accelerating, particularly in rapidly evolving domains such as web development and deep learning. However, the impact of competitive relationships between OSS projects on their survival remains unclear, and there exists an ongoing risk that currently adopted OSS may succumb to development competition from rivals. In this study, we define the future cessation of development due to the emergence of powerful competitors as a Rising Event (REV).

We propose and validate two methodologies: the Mutual Impact Analysis of OSS (MIAO), which quantifies competitive relationships between OSS projects, and the REV Predictive Model (RPM), which forecasts future REV occurrences. MIAO employs Structural Vector Autoregression (SVAR) models and impulse response functions, which are commonly used in macroeconomics, to calculate the cumulative mutual impacts among multiple OSS projects. This approach enables the quantification of OSS competitive relationships, which were previously only qualitatively assessable, allowing for the measurement of negative impacts from competitors on specific OSS projects. Furthermore, RPM extends MIAO to mechanically classify potential future REV occurrences.

In validation experiments across 66 groups, MIAO successfully identified REVs with 85% accuracy. While RPM achieved moderate accuracy at 73%, it demonstrated utility as a screening tool for evaluating future REV occurrence risks. These results suggest that MIAO and RPM could serve as valuable tools for understanding OSS ecosystem dynamics and predicting the rise and decline of OSS projects.