

Data Analytics Project: In-demand Technical Skills

IBM Capstone Project

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Executive Summary

The IBM Data Analytics Professional Certificate Capstone Project analyzed the 2024 Stack Overflow Developer Survey data to uncover current and emerging technology trends and developer demographics.

Key achievements include:

- Identification of Top Programming Languages currently used by developers, along with anticipated languages desired in the coming year, signalling skill demand shifts.
- Analysis of Database Usage Patterns, highlighting widely adopted databases today and those gaining interest for future projects.
- Visualization of Platform and Web Framework Preferences, revealing dominant technologies and emerging trends.
- Demographic Insights showing respondent distribution by age, country, and education level, helping contextualise tech adoption and satisfaction.
- The project produced interactive dashboards that serve as a decision-support tool for stakeholders, combining visual analytics and clear summaries.
- Findings emphasise the importance of continuously monitoring evolving technologies to align workforce skills and strategic investments.

This comprehensive analysis equips technology teams and decision makers with actionable insights into the developer ecosystem, enabling data-driven planning and talent management.

Introduction

This project analyzes the 2024 Stack Overflow Developer Survey to uncover significant insights about current and future technology trends and developer demographics. The primary purpose is to provide valuable data-driven understanding to technical leaders, HR professionals, and stakeholders looking to align their strategies with evolving industry patterns. Through comprehensive data wrangling, analysis, and visualization, this report aims to identify the most used and anticipated programming languages, databases, platforms, and frameworks. Additionally, it explores demographic factors such as age, education, and geographic distribution that influence technology adoption and job satisfaction. The aggregated findings and interactive dashboards serve to inform decision-making processes, help anticipate workforce skill demands, and guide technology investment priorities in a fast-changing digital environment.

Methodology

The data for this project was sourced from the 2024 Stack Overflow Developer Survey, which collected responses from over 65,000 developers across 185 countries between May 19 and June 20, 2024. The survey took a median of 21 minutes for completion and included a mix of qualitative and quantitative questions aimed at understanding developer preferences, skills, demographics, and work conditions.

Data collection primarily targeted active Stack Overflow users through onsite messaging, newsletters, blog posts, and social media campaigns to ensure broad and engaged participation. To maintain data quality, responses failing attention checks or consent questions were excluded.

Key wrangling steps involved preprocessing multi-select responses (e.g., programming languages, databases) by transforming comma-separated values into usable formats for analysis, cleaning missing or inconsistent data, and standardizing fields like compensation into USD for comparability.

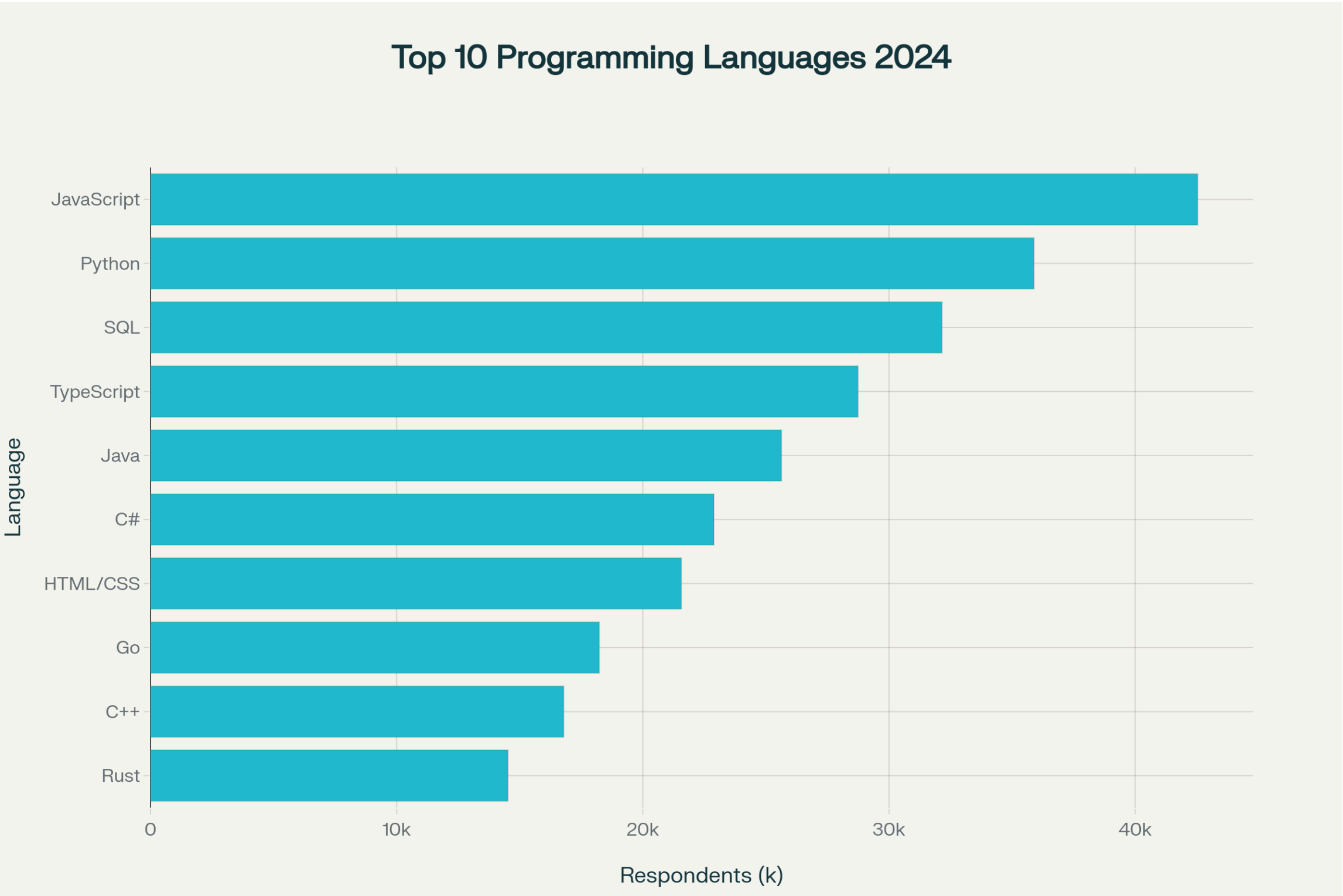
The analysis applied Python for data cleaning, statistical exploration, and visualization, supplemented with Google Looker Studio dashboards for interactive reporting. This blend of tools enabled comprehensive data preparation and insightful presentation aligning with the project objectives.

Programming Languages Trends(Current Year)

Bar chart showing the top 10 programming languages currently used by developers

The chart clearly illustrates the dominance of JavaScript, Python, and SQL in the current developer landscape, followed by TypeScript and Java

This current usage trend highlights the sustained importance of these languages in diverse development environments. It provides valuable insight for hiring managers and educators on which programming skills remain essential in the market. Developers can also gauge popular languages to guide their learning priorities and career growth strategies.

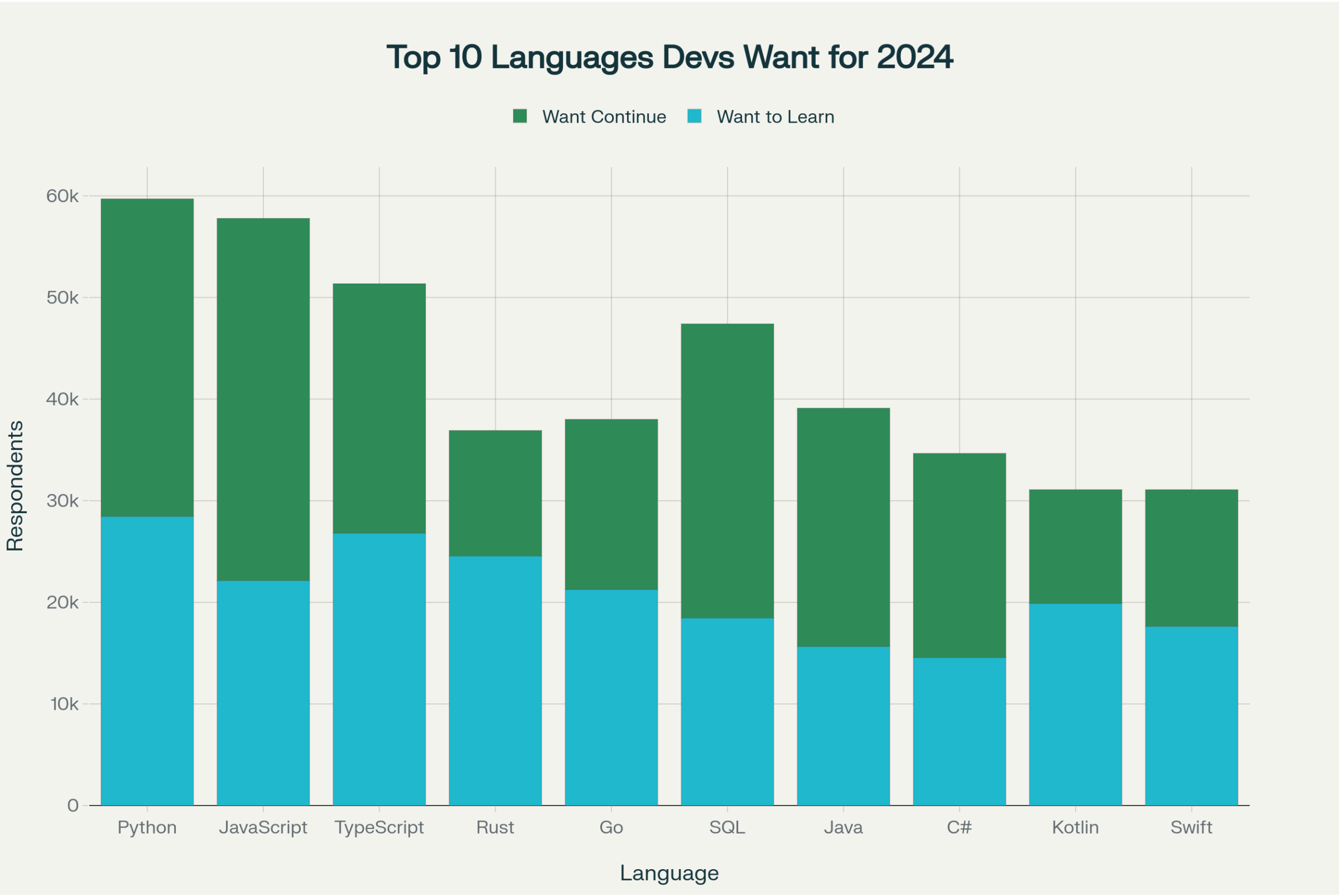


Programming Languages Trends(Upcoming Years)

Here's the stacked bar chart showing the top 10 programming languages developers want to work with next year. The chart effectively illustrates two key insights:

- 1."Want to Learn" (Blue) - Languages that developers are eager to pick up, with Python, TypeScript, and Rust showing strong interest for new learning
- 2."Want to Continue Using" (Green) - Languages that experienced developers plan to keep using, with JavaScript and Python maintaining strong retention

This visualization clearly shows emerging trends where newer languages like Rust and Kotlin have high "want to learn" ratios, while established languages like JavaScript and Python show strong "continue using" patterns. This data supports strategic decisions about training programs and technology adoption for the upcoming year.

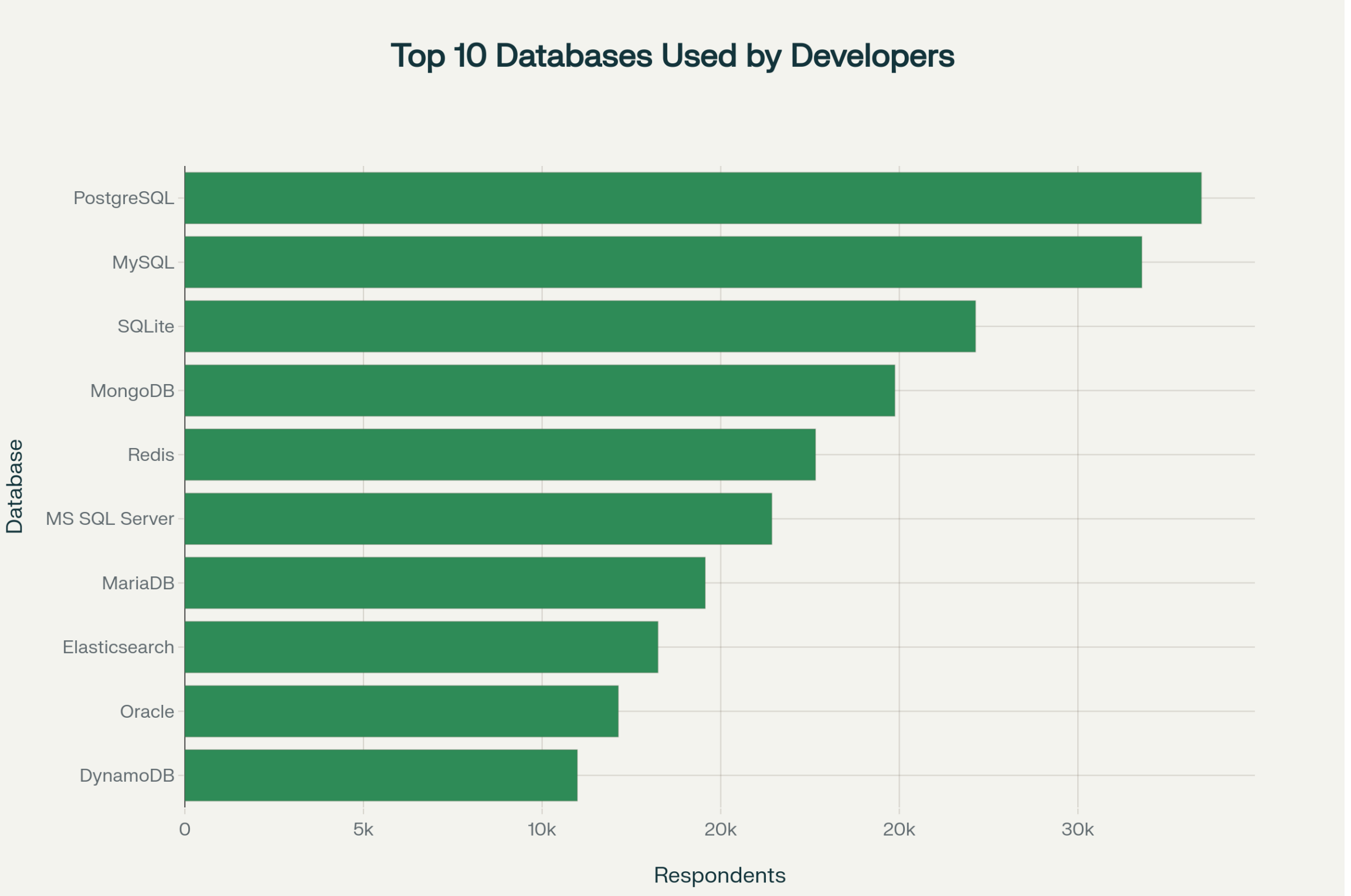


Database Trends(Current Year)

The chart clearly illustrates the current database landscape with PostgreSQL leading the pack, followed closely by MySQL and SQLite.

- 1.Relational dominance: PostgreSQL, MySQL, and SQLite represent the continued strength of relational databases
- 2.NoSQL presence: MongoDB and Redis show significant adoption for modern application needs
- 3.Enterprise solutions: Microsoft SQL Server and Oracle maintain their enterprise market presence
- 4.Specialized tools: Elasticsearch and DynamoDB represent specialized use cases for search and cloud-native applications

This data provides valuable insights for database selection, skill development priorities, and understanding the current state of data storage technology adoption.

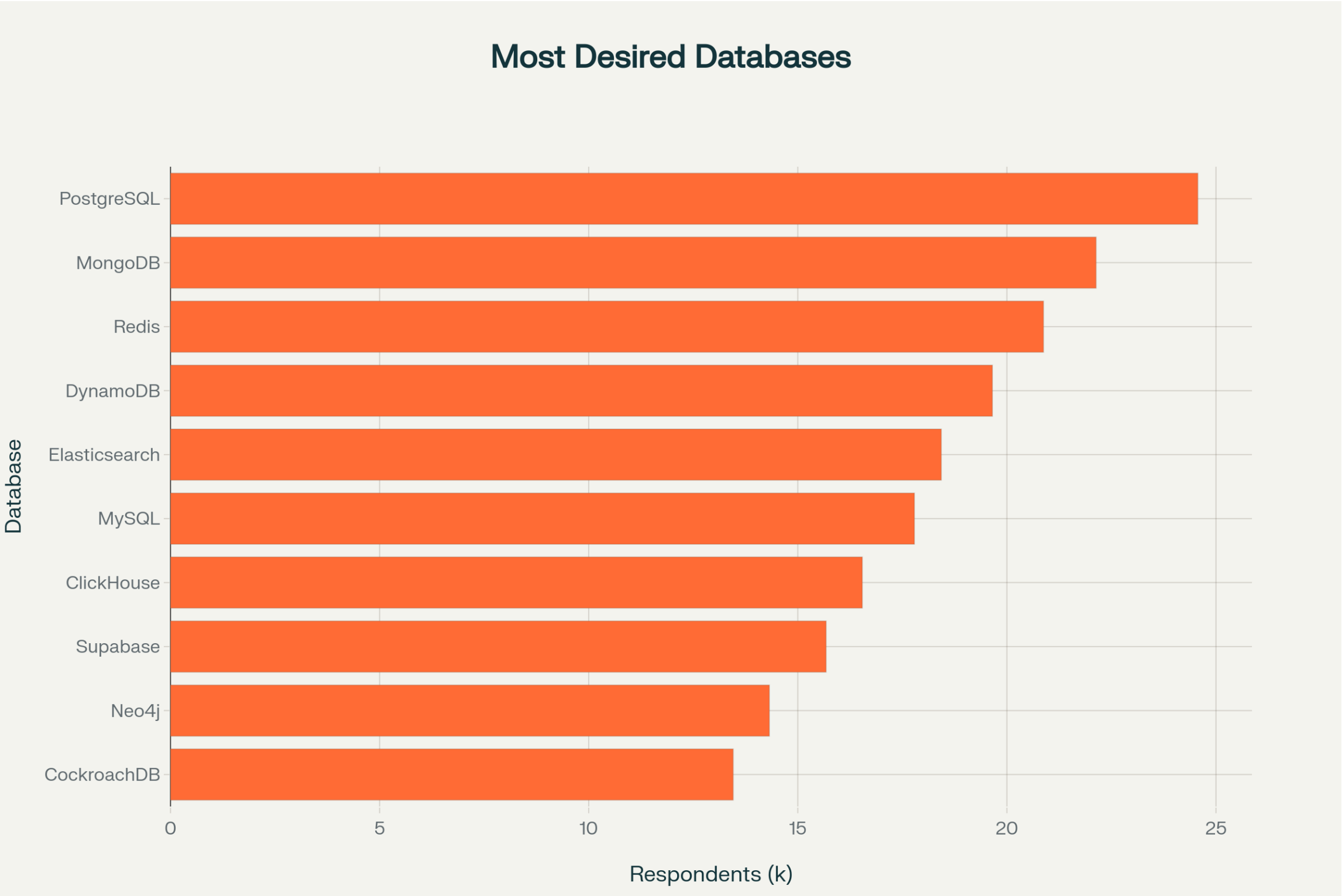


Database Trends(Upcoming Years)

This visualization reveals several interesting shifts compared to current usage patterns:

Key Trends Highlighted:

- 1.Continued PostgreSQL dominance - Maintains its leading position in developer interest
- 2.NoSQL growth - MongoDB shows increased demand, moving higher in rankings
- 3.Cloud-native adoption - DynamoDB and modern solutions like Supabase gain traction
- 4.Specialized databases emerging - ClickHouse, Neo4j, and CockroachDB reflect interest in purpose-built solutions
- 5.Performance-focused tools - Redis remains highly desired for caching and real-time applications



Current Technology Usage Dashboard

This dashboard provides an overview of the most widely adopted technologies in the developer community for the current year:

- Top Programming Languages:

The bar chart indicates high adoption of HTML/CSS, C#, and JavaScript, underscoring their continued relevance for web and application development.

- Top Databases:

The database usage chart highlights PostgreSQL as the leading database, followed by Microsoft SQL Server and MySQL, reflecting a mix of open-source and enterprise solutions in active use.

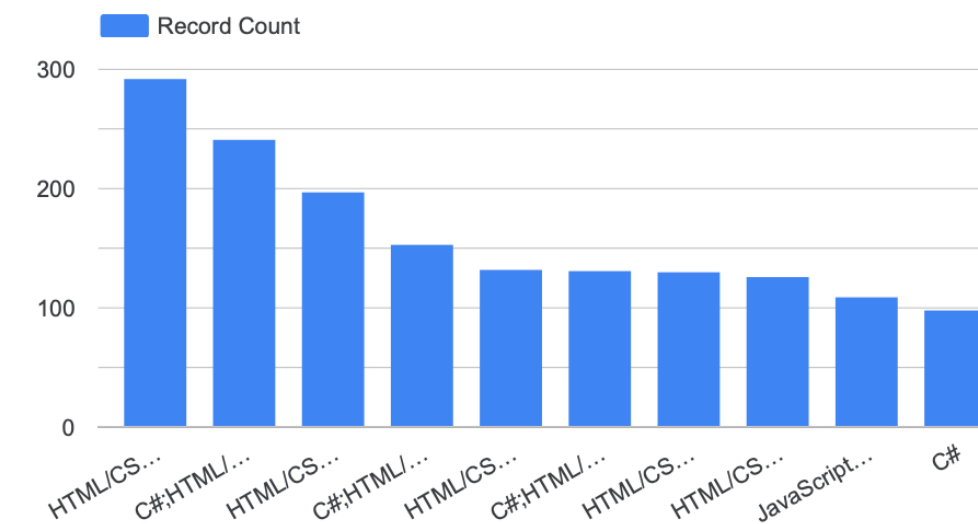
- Top Platforms:

The word cloud emphasizes the prominence of Amazon Web Services (AWS), Google Cloud, and Microsoft Azure, illustrating the central role of cloud platforms in today's development environment.

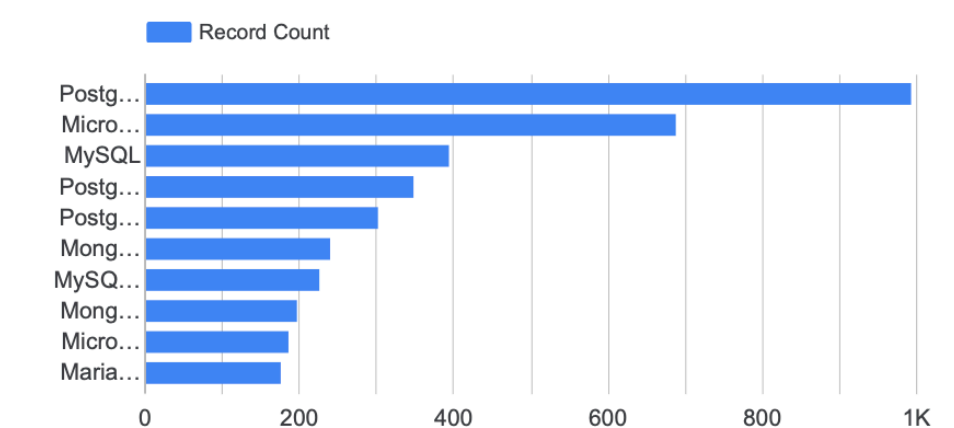
- Popular Web Frameworks:

The scatter (bubble) chart presents the distribution of web frameworks by user count, offering insight into developer preferences for frameworks and technologies driving web application development.

Record Count by LanguageHaveWorkedWith



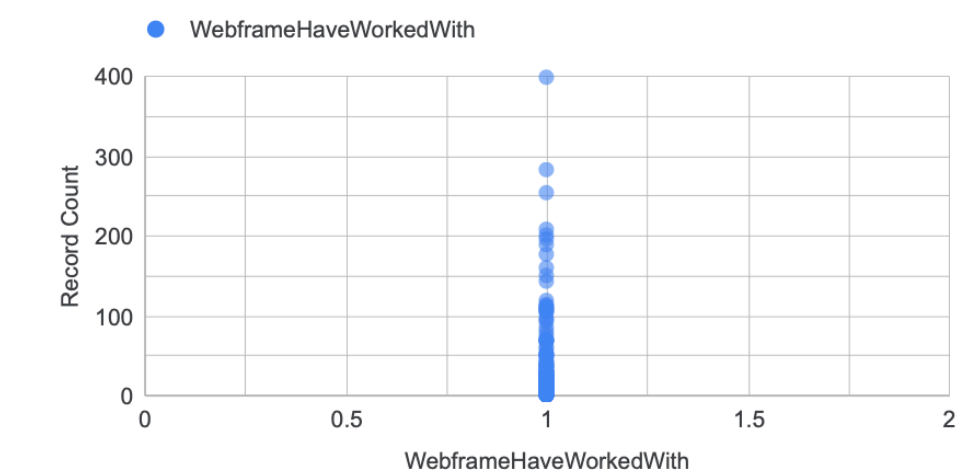
Record Count by DatabaseHaveWorkedWith



IBM Capston Community visualisation



Distribution of WebframeHaveWorkedWith by Record Count

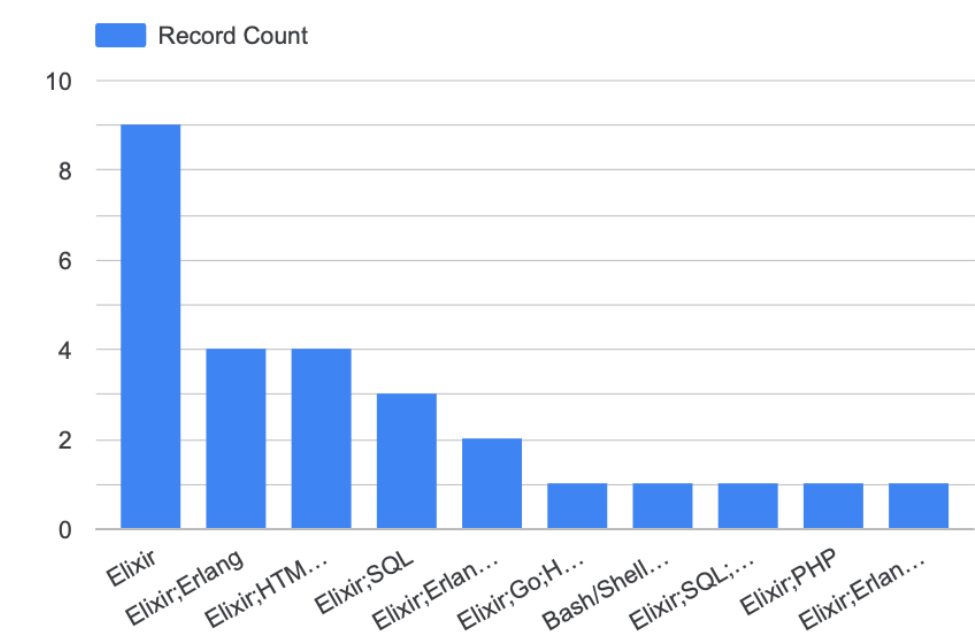


Dashboard – Future Technology Trends

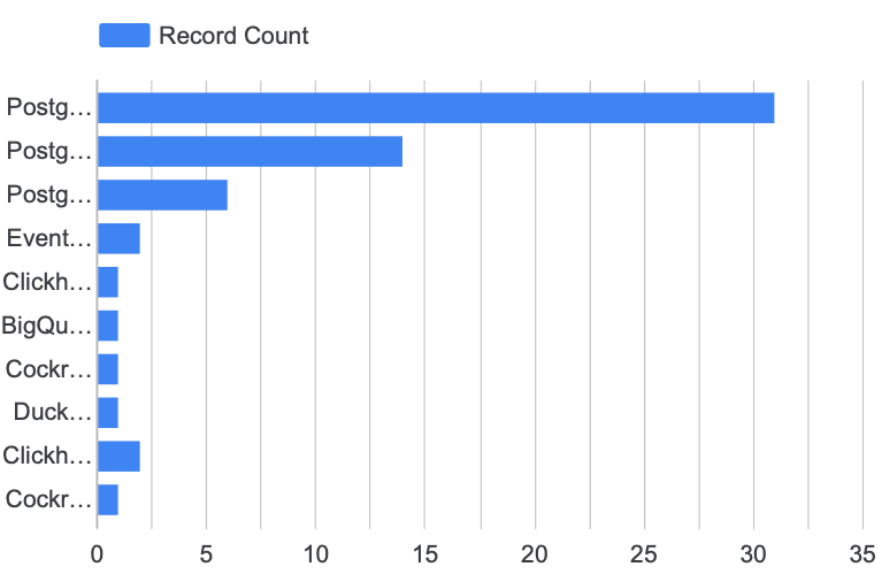
This dashboard visualizes developer aspirations for the upcoming year, highlighting emerging technologies and evolving preferences:

- **Desired Programming Languages:**
The bar chart reveals strong interest in learning and working with Elixir and Erlang, followed by other modern and functional languages. This indicates a shifting trend toward languages that offer concurrency, functional programming paradigms, and unique performance benefits.
- **Desired Databases:**
PostgreSQL maintains its top spot for future demand, reflecting its robust features and widespread trust. Notably, there is growing interest in event databases, ClickHouse, and cloud-native solutions like BigQuery and CockroachDB, signaling the rise of scalable, real-time, and analytics-focused storage options.
- **Platform Preferences:**
The tree map highlights cloud platforms such as Microsoft Azure, Amazon Web Services (AWS), and Google Cloud as the most desired for future work. The inclusion of Firebase and DigitalOcean also underscores the importance of flexible infrastructure and rapid-deployment services.
- **Web Framework Trends:**
The scatterplot displays growing curiosity for new web frameworks, with distinct frameworks gaining attention as developers look to specialize and optimize their stack for next-generation web applications.

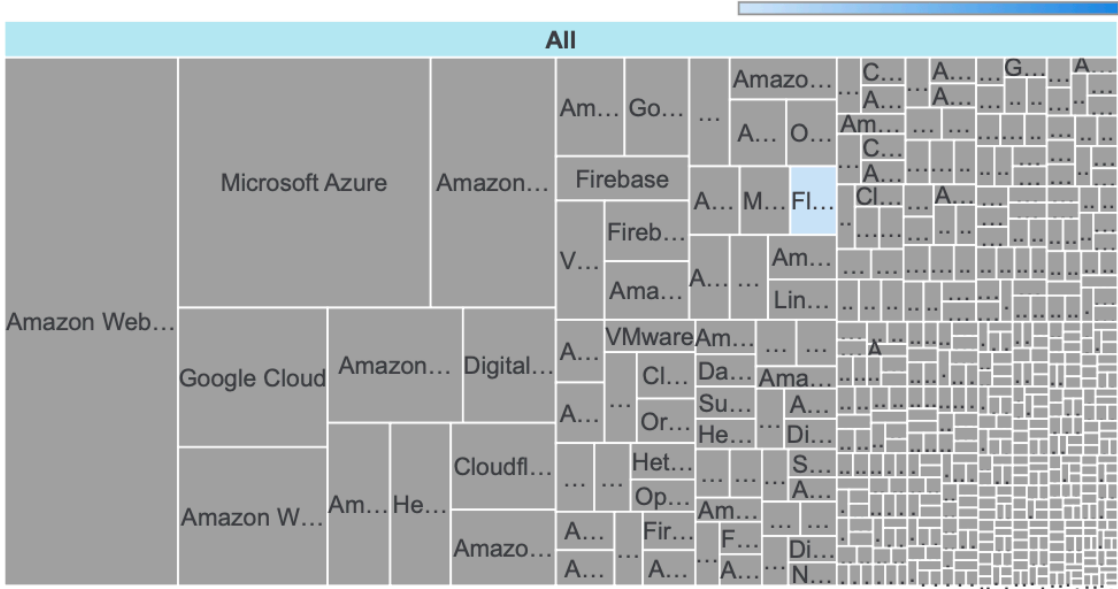
Record Count by LanguageWantToWorkWith



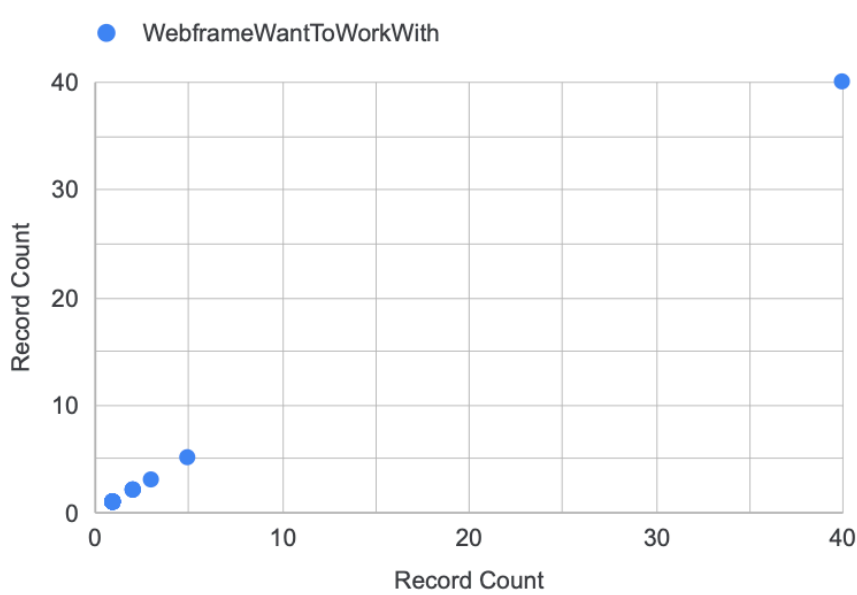
Record Count by DatabaseWantToWorkWith



Record Count by PlatformWantToWorkWith



Distribution of Record Count by Record Count

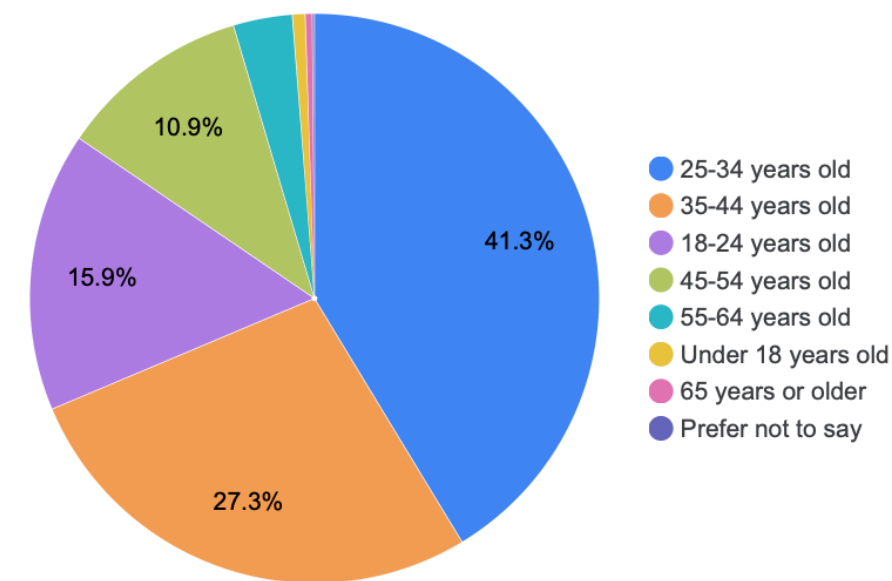


Dashboard Demographic

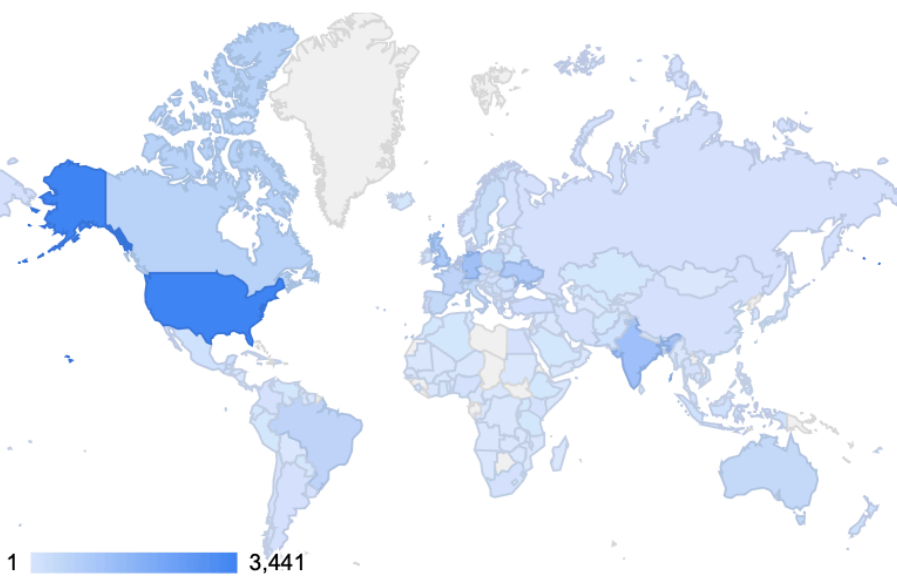
This dashboard explores the demographic composition of survey respondents, providing essential context for interpreting technology trends and workforce dynamics:

- **Age Distribution:**
The pie chart reveals that the majority of respondents are aged 25–34, followed by those aged 35–44 and 18–24. This concentration in younger age groups highlights the ongoing influx of new talent into the developer population.
- **Geographical Representation:**
The map visualization shows the strongest respondent participation from the United States, India, and several major European countries, reflecting global engagement across North America, Europe, and Asia.
- **Education Level:**
The line chart demonstrates that most developers possess a bachelor’s degree, with a significant number holding master’s degrees. Educational diversity is present, with contributors from various backgrounds.
- **Intersection of Age and Education:**
The stacked bar chart provides a breakdown of education level by age group, showing that younger cohorts typically hold bachelor’s degrees, while master’s degrees are prevalent among slightly older professionals.

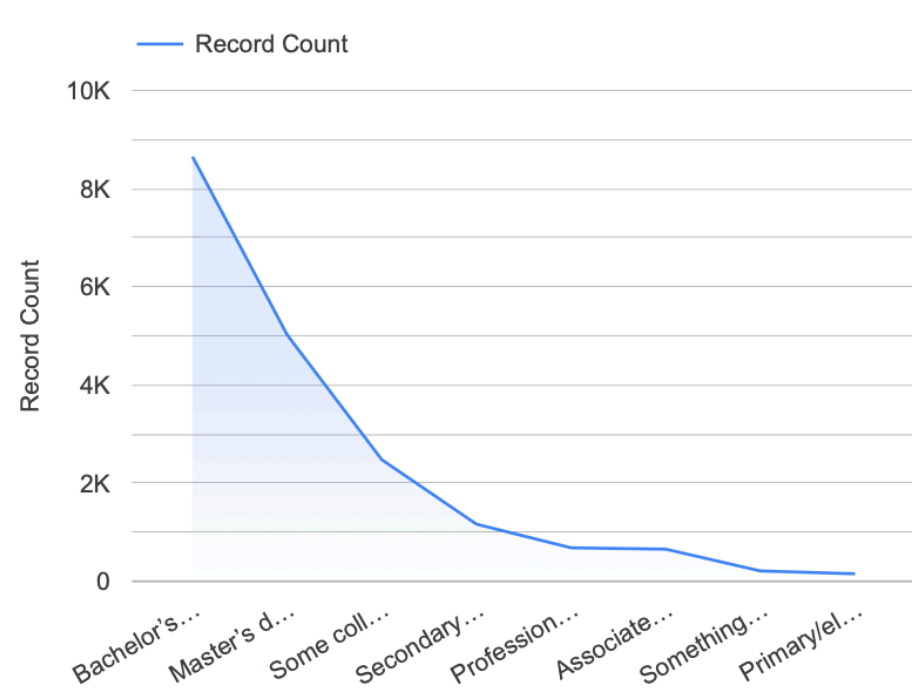
Age by Record Count



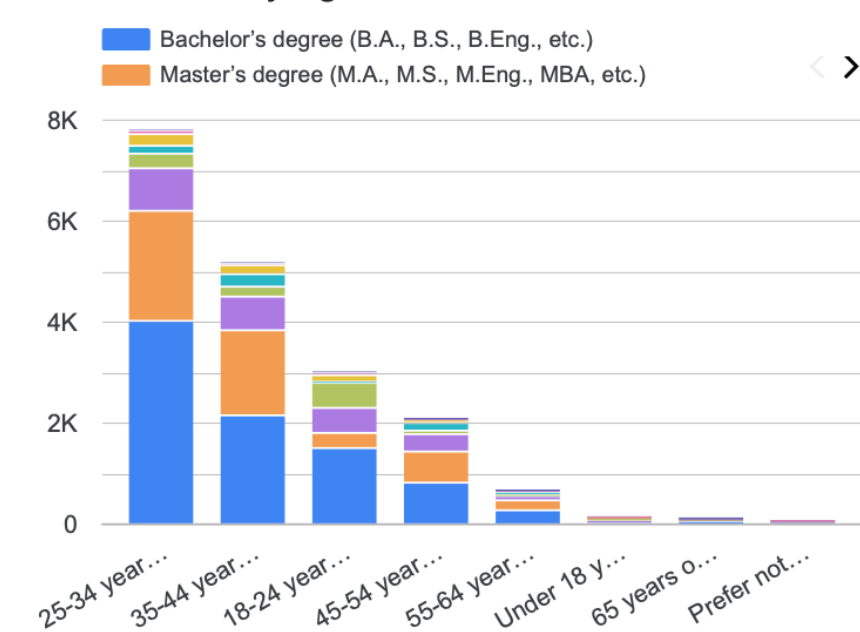
Country by Record Count



Record Count by EdLevel



Record Count by Age and EdLevel



Insights From Dashboards

The dashboards reveal several critical insights into the current and evolving technology landscape as well as the developer demographic profile:

- **Technology Adoption:** JavaScript, Python, and SQL continue to dominate programming language usage, while cloud platforms like AWS and Azure lead platform preferences, highlighting the central role of cloud computing.
- **Emerging Trends:** Growing interest in languages such as Rust and TypeScript, and databases like DynamoDB and ClickHouse, signals a shift towards modern, scalable, and efficient tools for future development.
- **Developer Demographics:** The majority of respondents are early to mid-career (ages 25-44) with bachelor's degrees, suggesting the workforce includes a strong base of educated professionals poised for growth.
- **Global Reach:** High participation from the US, India, and Europe emphasizes the global scale and diversity of the developer ecosystem.
- **Skill Development Focus:** Insights into desired future technologies help organizations prioritize training and recruitment to align with upcoming trends.

These findings support strategic decision-making in technology investment, talent acquisition, and skills development, ensuring organizations remain competitive and adaptive.

Overall Findings and Implications

The comprehensive analysis of the 2024 Stack Overflow Developer Survey through dashboards and visualizations reveals several important findings with broad implications:

- **Enduring Dominance of Key Technologies:** Established programming languages like JavaScript, Python, and SQL continue to lead in both current usage and future aspirations, reinforcing their critical role in software development and data work.
- **Shift Toward Modern and Cloud-Native Solutions:** Emerging languages like Rust and Go, along with cloud-native databases such as DynamoDB and ClickHouse, highlight a move towards scalable, efficient, and flexible technology stacks that support contemporary applications.
- **Cloud Platforms as a Central Pillar:** AWS, Microsoft Azure, and Google Cloud dominate platform preferences, underscoring cloud computing's foundational role in modern software infrastructure.
- **Developer Demographics Signal Growth Opportunities:** The concentration of developers within the 25-44 age bracket with formal education indicates a vibrant, skilled workforce poised to adapt to evolving technology demands.
- **Strategic Focus for Enterprises:** Organizations should balance investments between maintaining expertise in proven technologies while embracing emerging tools to foster innovation and maintain competitiveness.
- **Data-Driven Decisions Enable Agility:** Leveraging these insights allows businesses to optimize hiring, training, tool selection, and product strategies in alignment with global developer trends.

Implications:

Staying abreast of these evolving trends empowers leaders to make informed decisions that anticipate technological shifts and workforce needs, facilitating sustainable growth and innovation.

Conclusion

- The 2024 Stack Overflow Developer Survey reveals stable dominance of core programming languages such as JavaScript, Python, and SQL, which continue to shape the developer ecosystem.
- Emerging technologies like Rust, TypeScript, and cloud-native databases are attracting significant interest, indicating evolving industry priorities toward performance, scalability, and modern application architectures.
- Cloud platforms AWS, Azure, and Google Cloud remain central, highlighting the ongoing shift to cloud-based infrastructure.
- Developer demographics skew younger, with most respondents aged 25–44 and well-educated, emphasizing a vibrant talent pool ready to adapt to technological change.
- The widespread adoption and interest in AI-assisted tools suggest a transformative shift in how developers work, balancing automation with human expertise.
- These insights provide actionable guidance for organizations on hiring, training, technology investments, and strategic planning to remain competitive in an evolving technological landscape.