GitHub Trending Data Crawler

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[59]:
```python
import requests
from bs4 import BeautifulSoup
import sqlite3
import time
import random
from datetime import datetime, timedelta
import re
import json
import csv
from collections import defaultdict, Counter

try:
    import matplotlib.pyplot as plt
    MATPLOTLIB_AVAILABLE = True
    plt.rcParams['figure.figsize'] = (12, 8)
    plt.rcParams['font.size'] = 12
except ImportError:
    MATPLOTLIB_AVAILABLE = False

import logging
logging.basicConfig(level=logging.INFO, format='%(asctime)s - %(levelname)s -␣
 ↪%(message)s')
logger = logging.getLogger(__name__)

class DataFrameReplacement:
    """Simple replacement for pandas DataFrame."""

    def __init__(self, data=None, columns=None):
        if data is None:
            self.data = []
            self.columns = columns or []
        elif isinstance(data, list) and data and isinstance(data[0], dict):
            self.data = data
            self.columns = list(data[0].keys()) if data else []
        else:
            self.data = data if isinstance(data, list) else []
            self.columns = columns or []
    def __len__(self):
        return len(self.data)

    def __getitem__(self, key):
        if isinstance(key, str):
            return [row.get(key) for row in self.data]
        return self.data[key]

    @property
    def empty(self):
        return len(self.data) == 0

    def head(self, n=5):
        return DataFrameReplacement(self.data[:n])

    def iterrows(self):
        for i, row in enumerate(self.data):
            yield i, row

    def groupby(self, column):
        groups = defaultdict(list)
        for row in self.data:
            key = row.get(column)
            groups[key].append(row)
        return DataFrameGroupBy(groups)

    def mean(self, column=None):
        if column:
            values = [row.get(column, 0) for row in self.data if isinstance(row.
 ↪get(column), (int, float))]
            return sum(values) / len(values) if values else 0
        return None


class DataFrameGroupBy:

    def __init__(self, groups):
        self.groups = groups

    def agg(self, agg_dict):
        results = []
        for key, group_data in self.groups.items():
            result = {'group_key': key}
            for column, operations in agg_dict.items():
                if isinstance(operations, str):
                    operations = [operations]
                for op in operations:
                    if op == 'count':
                        result[column] = len(group_data)
                    elif op == 'sum':
                        values = [row.get(column, 0) for row in group_data if␣
↪isinstance(row.get(column), (int, float))]
                        result[column] = sum(values)
                    elif op == 'max':
                        values = [row.get(column, 0) for row in group_data if␣
↪isinstance(row.get(column), (int, float))]
                        result[column] = max(values) if values else 0
                    elif op == 'first':
                        result[column] = group_data[0].get(column) if␣
↪group_data else None
            results.append(result)

        return DataFrameReplacement(results)


class GitHubTrendingCrawler:

    def __init__(self, db_path='github_trending.db'):
        self.db_path = db_path
        self.base_url = 'https://github.com/trending'
        self.headers = {
            'User-Agent': 'Mozilla/5.0 (Windows NT 10.0; Win64; x64)␣
↪AppleWebKit/537.36 (KHTML, like Gecko) Chrome/91.0.4472.124 Safari/537.36',
            'Accept': 'text/html,application/xhtml+xml,application/xml;q=0.
↪9,image/webp,*/*;q=0.8',
            'Accept-Language': 'en-US,en;q=0.5',
            'Connection': 'keep-alive',
        }
        self.session = requests.Session()
        self.session.headers.update(self.headers)
        self.init_database()

    def init_database(self):
        try:
            with sqlite3.connect(self.db_path) as conn:
                cursor = conn.cursor()

                cursor.execute('''
                    CREATE TABLE IF NOT EXISTS trending_repos (
                        id INTEGER PRIMARY KEY AUTOINCREMENT,
                        repo_name TEXT NOT NULL,
                        author TEXT NOT NULL,
                        description TEXT,
                        language TEXT,
                        total_stars INTEGER,
                        total_forks INTEGER,
                        today_stars INTEGER,
                        repo_url TEXT,
                        crawl_date DATE,
                        created_at TIMESTAMP DEFAULT CURRENT_TIMESTAMP,
                        UNIQUE(repo_name, author, crawl_date)
                    )
                ''')

                # Add growth tracking table
                cursor.execute('''
                    CREATE TABLE IF NOT EXISTS daily_growth (
                        id INTEGER PRIMARY KEY AUTOINCREMENT,
                        repo_name TEXT NOT NULL,
                        author TEXT NOT NULL,
                        date DATE NOT NULL,
                        stars_gained INTEGER DEFAULT 0,
                        forks_gained INTEGER DEFAULT 0,
                        growth_rate REAL DEFAULT 0.0,
                        UNIQUE(repo_name, author, date)
                    )
                ''')

                # Add language trends table
                cursor.execute('''
                    CREATE TABLE IF NOT EXISTS language_trends (
                        id INTEGER PRIMARY KEY AUTOINCREMENT,
                        language TEXT NOT NULL,
                        date DATE NOT NULL,
                        project_count INTEGER DEFAULT 0,
                        total_stars INTEGER DEFAULT 0,
                        avg_stars REAL DEFAULT 0.0,
                        momentum_score REAL DEFAULT 0.0,
                        UNIQUE(language, date)
                    )
                ''')

                indexes = [
                    'CREATE INDEX IF NOT EXISTS idx_growth_date ON␣
    ↪daily_growth(date)',
                    'CREATE INDEX IF NOT EXISTS idx_trends_date ON␣
    ↪language_trends(date)',
                    'CREATE INDEX IF NOT EXISTS idx_repo_date ON␣
    ↪trending_repos(repo_name, author, crawl_date)',
                    'CREATE INDEX IF NOT EXISTS idx_language ON␣
↪trending_repos(language)',
                ]

                for index_sql in indexes:
                    cursor.execute(index_sql)

                conn.commit()

            print("Enhanced database initialized successfully")

        except sqlite3.Error as e:
            print(f"Database initialization failed: {e}")
            raise

    def extract_number(self, text):
        if not text:
            return 0

        text = re.sub(r'[^\d.km]', '', text.lower().strip())
        if not text:
            return 0

        try:
            if 'k' in text:
                return int(float(text.replace('k', '')) * 1000)
            elif 'm' in text:
                return int(float(text.replace('m', '')) * 1000000)
            else:
                return int(float(text))
        except (ValueError, TypeError):
            return 0

    def crawl_trending_page(self, date_range='daily'):
        url = f"{self.base_url}?since={date_range}"
        print(f"Crawling GitHub trending: {url}")

        try:
            response = self.session.get(url, timeout=30)
            response.raise_for_status()

            soup = BeautifulSoup(response.content, 'html.parser')
            repositories = []

            repo_items = soup.find_all('article', class_='Box-row')

            for item in repo_items:
                try:
                    repo_data = self._parse_repository_item(item)
                    if repo_data:
                        repositories.append(repo_data)
                except Exception as e:
                    print(f"Error parsing repository item: {e}")
                    continue

            print(f"Successfully extracted {len(repositories)} repositories")
            return repositories

        except requests.RequestException as e:
            print(f"Network request failed: {e}")
            return []
        except Exception as e:
            print(f"Crawling error: {e}")
            return []

    def _parse_repository_item(self, item):
        try:
            title_element = item.find('h2', class_='h3')
            if not title_element:
                return None

            link = title_element.find('a')
            if not link:
                return None

            repo_path = link.get('href', '').strip('/')
            if '/' not in repo_path:
                return None

            author, repo_name = repo_path.split('/', 1)
            repo_url = f"https://github.com/{repo_path}"

            desc_element = item.find('p', class_='col-9')
            description = desc_element.get_text(strip=True) if desc_element␣
↪else ""

            lang_element = item.find('span', {'itemprop':␣
↪'programmingLanguage'})
            language = lang_element.get_text(strip=True) if lang_element else␣
↪"Unknown"

            stats = item.find_all('a', class_='Link--muted')
            total_stars = 0
            total_forks = 0
            for stat in stats:
                text = stat.get_text(strip=True)
                href = stat.get('href', '').lower()

                if 'star' in href:
                    total_stars = self.extract_number(text)
                elif 'fork' in href:
                    total_forks = self.extract_number(text)

            # Enhanced today stars extraction
            today_stars = 0
            today_elements = item.find_all('span', class_='d-inline-block')
            for elem in today_elements:
                text = elem.get_text(strip=True)
                if 'star' in text.lower() and ('today' in text.lower() or␣
↪any(char.isdigit() for char in text)):
                    today_stars = self.extract_number(text)
                    break

            return {
                'repo_name': repo_name,
                'author': author,
                'description': description,
                'language': language,
                'total_stars': total_stars,
                'total_forks': total_forks,
                'today_stars': today_stars,
                'repo_url': repo_url,
                'crawl_date': str(datetime.now().date())
            }

        except Exception as e:
            print(f"Failed to parse repository item: {e}")
            return None

    def save_to_database(self, repositories):
        if not repositories:
            print("No repository data to save")
            return

        try:
            with sqlite3.connect(self.db_path) as conn:
                cursor = conn.cursor()
                today = str(datetime.now().date())

                saved_count = 0
                for repo in repositories:
                    # Save main repository data
                    try:
                        cursor.execute('''
                            INSERT OR REPLACE INTO trending_repos
                            (repo_name, author, description, language,␣
↪total_stars,
                             total_forks, today_stars, repo_url, crawl_date)
                            VALUES (?, ?, ?, ?, ?, ?, ?, ?, ?)
                        ''', (
                            repo['repo_name'], repo['author'],␣
↪repo['description'],
                            repo['language'], repo['total_stars'],␣
↪repo['total_forks'],
                            repo['today_stars'], repo['repo_url'],␣
↪repo['crawl_date']
                        ))

                        # Track daily growth
                        if repo['today_stars'] > 0:
                            growth_rate = (repo['today_stars'] /␣
↪max(repo['total_stars'] - repo['today_stars'], 1)) * 100
                            cursor.execute('''
                                INSERT OR REPLACE INTO daily_growth
                                (repo_name, author, date, stars_gained,␣
↪growth_rate)
                                VALUES (?, ?, ?, ?, ?)
                            ''', (
                                repo['repo_name'], repo['author'], today,
                                repo['today_stars'], growth_rate
                            ))

                        saved_count += 1
                    except sqlite3.Error as e:
                        print(f"Failed to save repository {repo['repo_name']}:␣
↪{e}")

                # Update language trends
                self._update_language_trends(cursor, repositories, today)

                conn.commit()

            print(f"Successfully saved {saved_count} repositories to database")

        except sqlite3.Error as e:
            print(f"Database operation failed: {e}")
```

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    def _update_language_trends(self, cursor, repositories, date):
        lang_stats = {}

        for repo in repositories:
            lang = repo['language']
            if lang not in lang_stats:
                lang_stats[lang] = {'count': 0, 'total_stars': 0}
            lang_stats[lang]['count'] += 1
            lang_stats[lang]['total_stars'] += repo['total_stars']

        for lang, stats in lang_stats.items():
            avg_stars = stats['total_stars'] / stats['count'] if stats['count']␣
↪> 0 else 0

            cursor.execute('''
                INSERT OR REPLACE INTO language_trends
                (language, date, project_count, total_stars, avg_stars)
                VALUES (?, ?, ?, ?, ?)
            ''', (lang, date, stats['count'], stats['total_stars'], avg_stars))

    def collect_multi_day_data(self, days=14):
        print(f"Starting enhanced {days}-day data collection")

        for day in range(days):
            try:
                print(f"Collecting data for day {day + 1}/{days}")
                repositories = self.crawl_trending_page()
                self.save_to_database(repositories)

                # Show progress
                if repositories:
                    total_today_stars = sum(r['today_stars'] for r in␣
↪repositories)
                    print(f"    Collected {len(repositories)} repos with␣
↪{total_today_stars} total daily stars")

                if day < days - 1:
                    wait_time = random.randint(60, 180)
                    print(f"    Waiting {wait_time} seconds before next␣
↪request")
                    time.sleep(wait_time)

            except Exception as e:
                print(f"Data collection failed for day {day + 1}: {e}")
                continue
        print("Enhanced multi-day data collection completed")


class EnhancedGitHubAnalyzer:

    def __init__(self, db_path='github_trending.db'):
        self.db_path = db_path

    def load_data(self, days=14):
        """Load data with enhanced querying."""
        try:
            with sqlite3.connect(self.db_path) as conn:
                cursor = conn.cursor()
                end_date = datetime.now().date()
                start_date = end_date - timedelta(days=days-1)

                query = '''
                    SELECT * FROM trending_repos
                    WHERE crawl_date BETWEEN ? AND ?
                    ORDER BY crawl_date DESC, total_stars DESC
                '''

                cursor.execute(query, (start_date, end_date))
                rows = cursor.fetchall()
                columns = [description[0] for description in cursor.description]

                data = [dict(zip(columns, row)) for row in rows]

            print(f"Loaded {len(data)} records from database")
            return DataFrameReplacement(data)

        except Exception as e:
            print(f"Data loading failed: {e}")
            return DataFrameReplacement()

    def get_daily_growth_leaders(self, days=7):
        try:
            with sqlite3.connect(self.db_path) as conn:
                cursor = conn.cursor()

                query = '''
                    SELECT tr.repo_name, tr.author, tr.language, tr.total_stars,
                           dg.stars_gained, dg.growth_rate, dg.date
                    FROM daily_growth dg
                    JOIN trending_repos tr ON dg.repo_name = tr.repo_name
                                          AND dg.author = tr.author
                    WHERE dg.date >= date('now', '-{} days')
                    ORDER BY dg.stars_gained DESC
                    LIMIT 20
                '''.format(days)

                cursor.execute(query)
                results = cursor.fetchall()

                growth_data = []
                for row in results:
                    growth_data.append({
                        'repo_name': row[0],
                        'author': row[1],
                        'language': row[2],
                        'total_stars': row[3],
                        'stars_gained': row[4],
                        'growth_rate': row[5],
                        'date': row[6]
                    })

                return DataFrameReplacement(growth_data)

        except Exception as e:
            print(f"Growth analysis failed: {e}")
            return DataFrameReplacement()

    def analyze_language_momentum(self, days=30):
        try:
            with sqlite3.connect(self.db_path) as conn:
                cursor = conn.cursor()

                # Get language trends over time
                query = '''
                    SELECT language, date, project_count, avg_stars
                    FROM language_trends
                    WHERE date >= date('now', '-{} days')
                    ORDER BY language, date
                '''.format(days)

                cursor.execute(query)
                results = cursor.fetchall()

                # Calculate momentum for each language
                language_data = {}
                for lang, date, count, avg_stars in results:
                    if lang not in language_data:
                        language_data[lang] = []
                    language_data[lang].append({
                        'date': date,
                        'count': count,
                        'avg_stars': avg_stars
                    })

                momentum_analysis = {}
                for lang, data_points in language_data.items():
                    if len(data_points) >= 7:  # Need at least a week of data
                        # Calculate trend
                        recent_avg = sum(p['count'] for p in data_points[-7:]) /
↪ 7

                        older_avg = sum(p['count'] for p in data_points[:7]) / 7

                        momentum = ((recent_avg - older_avg) / max(older_avg,␣
↪1)) * 100

                        momentum_analysis[lang] = {
                            'momentum_percent': momentum,
                            'recent_avg': recent_avg,
                            'older_avg': older_avg,
                            'trend_direction': 'rising' if momentum > 5 else␣
↪'declining' if momentum < -5 else 'stable'
                        }

                return momentum_analysis

        except Exception as e:
            print(f"Momentum analysis failed: {e}")
            return {}

    def compare_time_periods(self, days1=7, days2=14):
        try:
            with sqlite3.connect(self.db_path) as conn:
                cursor = conn.cursor()

                # Recent period
                query1 = '''
                    SELECT language, COUNT(*) as count, AVG(total_stars) as␣
↪avg_stars
                    FROM trending_repos
                    WHERE crawl_date >= date('now', '-{} days')
                    GROUP BY language
                    ORDER BY count DESC
                '''.format(days1)

                cursor.execute(query1)
                recent_data = {row[0]: {'count': row[1], 'avg_stars': row[2]}␣
↪for row in cursor.fetchall()}

                # Older period
                query2 = '''
                    SELECT language, COUNT(*) as count, AVG(total_stars) as␣
↪avg_stars
                    FROM trending_repos
                    WHERE crawl_date BETWEEN date('now', '-{} days') AND␣
↪date('now', '-{} days')
                    GROUP BY language
                    ORDER BY count DESC
                '''.format(days2, days1)

                cursor.execute(query2)
                older_data = {row[0]: {'count': row[1], 'avg_stars': row[2]}␣
↪for row in cursor.fetchall()}

                # Calculate changes
                comparison = {}
                all_languages = set(recent_data.keys()) | set(older_data.keys())

                for lang in all_languages:
                    recent = recent_data.get(lang, {'count': 0, 'avg_stars': 0})
                    older = older_data.get(lang, {'count': 0, 'avg_stars': 0})

                    count_change = recent['count'] - older['count']
                    count_percent = (count_change / max(older['count'], 1)) *␣
↪100

                    comparison[lang] = {
                        'recent_count': recent['count'],
                        'older_count': older['count'],
                        'count_change': count_change,
                        'percent_change': count_percent,
                        'recent_avg_stars': recent['avg_stars'],
                        'older_avg_stars': older['avg_stars']
                    }

                return comparison

        except Exception as e:
            print(f"Time period comparison failed: {e}")
            return {}

    def get_highest_growth_today(self, limit=20):
        return self.get_daily_growth_leaders(days=1)
    def generate_predictions(self, days=30):
        momentum = self.analyze_language_momentum(days)
        comparison = self.compare_time_periods(7, 14)

        predictions = {
            'rising_languages': [],
            'declining_languages': [],
            'stable_high_volume': [],
            'emerging_languages': []
        }

        for lang, data in momentum.items():
            if data['momentum_percent'] > 15:
                predictions['rising_languages'].append((lang, data))
            elif data['momentum_percent'] < -15:
                predictions['declining_languages'].append((lang, data))
            elif data['recent_avg'] > 5 and abs(data['momentum_percent']) < 10:
                predictions['stable_high_volume'].append((lang, data))

        # Find emerging languages (languages with small counts but high growth)
        for lang, comp_data in comparison.items():
            if (comp_data['recent_count'] < 5 and
                comp_data['percent_change'] > 100 and
                comp_data['recent_avg_stars'] > 1000):
                predictions['emerging_languages'].append((lang, comp_data))

        # Sort by momentum/growth
        predictions['rising_languages'].sort(key=lambda x:␣
↪x[1]['momentum_percent'], reverse=True)
        predictions['declining_languages'].sort(key=lambda x:␣
↪x[1]['momentum_percent'])
        predictions['stable_high_volume'].sort(key=lambda x:␣
↪x[1]['recent_avg'], reverse=True)

        return predictions

    def generate_enhanced_report(self, days=14):
        print("Generating enhanced comprehensive analysis report...")

        # Load basic data
        df = self.load_data(days)
        if df.empty:
            print("No data available for analysis")
            return None, None, None, None

        # Basic analysis
        top_by_stars = self.get_top_repositories(df, 'total_stars', 20)
        top_by_forks = self.get_top_repositories(df, 'total_forks', 20)
        language_stats = self.analyze_programming_languages(df)

        # Enhanced features
        daily_growth_leaders = self.get_daily_growth_leaders(days)
        highest_growth_today = self.get_highest_growth_today()
        predictions = self.generate_predictions(days)
        time_comparison = self.compare_time_periods(7, 14)

        # Print enhanced report
        self._print_enhanced_report(
            df, language_stats, top_by_stars, top_by_forks,
            daily_growth_leaders, highest_growth_today, predictions,
            time_comparison, days
        )

        # Generate visualizations
        self.create_enhanced_visualizations(language_stats, predictions)

        print("Enhanced comprehensive report generated successfully")
        return df, language_stats, top_by_stars, top_by_forks

    def get_top_repositories(self, df, metric='total_stars', limit=20):
        if df.empty:
            return DataFrameReplacement()

        unique_repos = {}
        for row in df.data:
            key = (row['author'], row['repo_name'])
            if key not in unique_repos or row[metric] >␣
↪unique_repos[key][metric]:
                unique_repos[key] = row

        sorted_repos = sorted(unique_repos.values(), key=lambda x: x[metric],␣
↪reverse=True)
        return DataFrameReplacement(sorted_repos[:limit])

    def analyze_programming_languages(self, df):
        if df.empty:
            return DataFrameReplacement()

        lang_groups = df.groupby('language')
        lang_stats = lang_groups.agg({
            'repo_name': 'count',
            'total_stars': 'sum',
            'total_forks': 'sum'
        })

        results = []
        for row in lang_stats.data:
            results.append({
                'language': row['group_key'],
                'project_count': row['repo_name'],
                'total_stars': row['total_stars'],
                'total_forks': row['total_forks']
            })

        results.sort(key=lambda x: x['project_count'], reverse=True)
        return DataFrameReplacement(results)

    def _print_enhanced_report(self, df, language_stats, top_by_stars,␣
↪top_by_forks,
                              daily_growth, highest_growth_today, predictions,
                              time_comparison, days):
        unique_keys = set((row['author'], row['repo_name']) for row in df.data)
        unique_projects = len(unique_keys)

        print("=" * 100)
        print("ENHANCED GITHUB TRENDING ANALYSIS REPORT")
        print("=" * 100)
        print(f"Analysis Period: {days} days")
        print(f"Total Records: {len(df):,}")
        print(f"Unique Projects: {unique_projects:,}")
        print(f"Report Generated: {datetime.now().strftime('%Y-%m-%d %H:%M:
↪%S')}")
        print()

        print("  TOP 10 REPOSITORIES BY STARS")
        print("-" * 80)
        for i, row in enumerate(top_by_stars.data[:10], 1):
            print(f"{i:2d}. {row['author']}/{row['repo_name']:<30} "
                  f" {row['total_stars']:>7,}  {row['total_forks']:>6,}␣
↪[{row['language']}]")
        print()

        print("  TOP 10 REPOSITORIES BY FORKS")
        print("-" * 80)
        for i, row in enumerate(top_by_forks.data[:10], 1):
            print(f"{i:2d}. {row['author']}/{row['repo_name']:<30} "
                  f" {row['total_forks']:>6,}  {row['total_stars']:>7,}␣
↪[{row['language']}]")
        print()
        # NEW: Daily Growth Leaders
        print("  DAILY GROWTH LEADERS (Last 7 Days)")
        print("-" * 80)
        if not daily_growth.empty:
            for i, row in enumerate(daily_growth.data[:10], 1):
                print(f"{i:2d}. {row['author']}/{row['repo_name']:<25} "
                      f"+{row['stars_gained']:>4,} stars ({row['growth_rate']:
↪>5.1f}%) [{row['language']}]")
        else:
            print("No daily growth data available")
        print()

        print("  HIGHEST GROWTH TODAY")
        print("-" * 60)
        if not highest_growth_today.empty:
            for i, row in enumerate(highest_growth_today.data[:10], 1):
                if row['stars_gained'] > 0:
                    print(f"{i:2d}. {row['author']}/{row['repo_name']:<25} "
                          f"+{row['stars_gained']:>4,} stars today␣
↪[{row['language']}]")
        else:
            print("No growth data available for today")
        print()

        print("  TREND PREDICTIONS & MOMENTUM ANALYSIS")
        print("-" * 80)

        if predictions['rising_languages']:
            print("  RISING LANGUAGES (Strong upward momentum):")
            for lang, data in predictions['rising_languages'][:5]:
                print(f"   • {lang:<20} +{data['momentum_percent']:>6.1f}%␣
↪momentum")
            print()

        if predictions['declining_languages']:
            print("  DECLINING LANGUAGES (Losing momentum):")
            for lang, data in predictions['declining_languages'][:5]:
                print(f"   • {lang:<20} {data['momentum_percent']:>7.1f}%␣
↪momentum")
            print()

        if predictions['emerging_languages']:
            print("  EMERGING LANGUAGES (Small but growing fast):")
            for lang, data in predictions['emerging_languages'][:3]:
                print(f"   • {lang:<20} +{data['percent_change']:>6.1f}% growth")
            print()
        if predictions['stable_high_volume']:
            print("  STABLE HIGH-VOLUME LANGUAGES:")
            for lang, data in predictions['stable_high_volume'][:5]:
                print(f"   • {lang:<20} {data['recent_avg']:>6.1f} avg daily␣
↪projects")
            print()

        print("  RECENT vs PREVIOUS PERIOD COMPARISON (7 days vs prior 7 days)")
        print("-" * 80)
        if time_comparison:
            # Sort by percent change
            sorted_comparison = sorted(
                time_comparison.items(),
                key=lambda x: x[1]['percent_change'],
                reverse=True
            )

            print("Biggest gainers:")
            for lang, data in sorted_comparison[:5]:
                if data['count_change'] > 0:
                    print(f"   • {lang:<15} +{data['count_change']:>2} projects␣
↪(+{data['percent_change']:>5.1f}%)")

            print("\nBiggest declines:")
            for lang, data in sorted(sorted_comparison, key=lambda x:␣
↪x[1]['percent_change'])[:5]:
                if data['count_change'] < 0:
                    print(f"   • {lang:<15} {data['count_change']:>3} projects␣
↪({data['percent_change']:>6.1f}%)")
        print()

        print("  PROGRAMMING LANGUAGE STATISTICS (Top 10)")
        print("-" * 70)
        print(f"{'Language':<15} {'Projects':<8} {'Total Stars':<12} {'Total␣
↪Forks':<10}")
        print("-" * 70)
        for row in language_stats.data[:10]:
            print(f"{row['language']:<15} {row['project_count']:<8} "
                  f"{row['total_stars']:<12,} {row['total_forks']:<10,}")
        print()

        print("  ENHANCED STATISTICAL INSIGHTS")
        print("-" * 50)

        avg_stars = df.mean('total_stars')
        avg_forks = df.mean('total_forks')
        avg_today_stars = df.mean('today_stars')
        print(f"Average Stars per Project: {avg_stars:.0f}")
        print(f"Average Forks per Project: {avg_forks:.0f}")
        print(f"Average Daily New Stars: {avg_today_stars:.1f}")

        if language_stats.data:
            top_language = language_stats.data[0]
            print(f"Most Popular Language: {top_language['language']}␣
↪({top_language['project_count']} projects)")

        total_daily_growth = sum(row['today_stars'] for row in df.data)
        active_growth_projects = len([row for row in df.data if␣
↪row['today_stars'] > 0])

        print(f"Total Daily Stars Gained: {total_daily_growth:,}")
        print(f"Projects with Daily Growth: {active_growth_projects}␣
↪({active_growth_projects/len(df)*100:.1f}%)")
        print()

        print("  ENHANCED KEY FINDINGS & INSIGHTS")
        print("-" * 50)

        if language_stats.data:
            top_lang = language_stats.data[0]
            lang_percent = (top_lang['project_count'] / len(df) * 100)
            print(f"• {top_lang['language']} dominates with {lang_percent:.1f}%␣
↪of all trending projects")

        high_star_count = sum(1 for row in df.data if row['total_stars'] >=␣
↪1000)
        print(f"• {high_star_count} projects ({high_star_count/len(df)*100:.
↪1f}%) have 1000+ stars")

        mega_projects = sum(1 for row in df.data if row['total_stars'] >= 10000)
        print(f"• {mega_projects} projects ({mega_projects/len(df)*100:.1f}%)␣
↪are mega projects (10k+ stars)")

        engagement_ratios = [row['total_forks'] / max(row['total_stars'], 1)␣
↪for row in df.data]
        avg_engagement = sum(engagement_ratios) / len(engagement_ratios) if␣
↪engagement_ratios else 0
        print(f"• Average community engagement ratio (forks/stars):␣
↪{avg_engagement:.3f}")

        if not daily_growth.empty:
            rapid_growth = len([row for row in daily_growth.data if␣
↪row['growth_rate'] > 10])
            print(f"• {rapid_growth} projects showed rapid growth (>10% daily␣
↪increase)")

        if predictions['rising_languages']:
            rising_count = len(predictions['rising_languages'])
            print(f"• {rising_count} languages show strong upward momentum")

        if predictions['emerging_languages']:
            emerging_count = len(predictions['emerging_languages'])
            print(f"• {emerging_count} emerging languages detected with high␣
↪growth potential")

        print("\n" + "=" * 100)
        print("ENHANCED ANALYSIS COMPLETE")
        print("=" * 100)

    def create_enhanced_visualizations(self, language_stats, predictions):
        if not MATPLOTLIB_AVAILABLE:
            print("Matplotlib not available - skipping enhanced visualizations")
            return

        if language_stats.empty:
            print("No data available for enhanced visualizations")
            return

        fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(2, 2, figsize=(16, 12))

        top_languages = language_stats.head(8)
        others_count = sum(row['project_count'] for row in language_stats.
↪data[8:])

        languages = [row['language'] for row in top_languages.data]
        counts = [row['project_count'] for row in top_languages.data]

        if others_count > 0:
            languages.append('Others')
            counts.append(others_count)

        colors1 = plt.cm.Set3(range(len(languages)))
        wedges, texts, autotexts = ax1.pie(
            counts, labels=languages, autopct='%1.1f%%',
            colors=colors1, startangle=90, textprops={'fontsize': 9}
        )

        ax1.set_title('Programming Language Distribution', fontweight='bold')
        for autotext in autotexts:
            autotext.set_color('white')
            autotext.set_fontweight('bold')

        if predictions['rising_languages'] and␣
↪predictions['declining_languages']:
            rising_langs = [item[0] for item in␣
↪predictions['rising_languages'][:5]]
            rising_momentum = [item[1]['momentum_percent'] for item in␣
↪predictions['rising_languages'][:5]]

            declining_langs = [item[0] for item in␣
↪predictions['declining_languages'][:5]]
            declining_momentum = [abs(item[1]['momentum_percent']) for item in␣
↪predictions['declining_languages'][:5]]

            y_pos_rising = range(len(rising_langs))
            y_pos_declining = range(len(declining_langs))

            ax2.barh(y_pos_rising, rising_momentum, color='green', alpha=0.7,␣
↪label='Rising')
            ax2.barh([y + len(rising_langs) + 1 for y in y_pos_declining],
                    declining_momentum, color='red', alpha=0.7,␣
↪label='Declining')

            all_langs = rising_langs + [''] + declining_langs
            ax2.set_yticks(range(len(all_langs)))
            ax2.set_yticklabels(all_langs, fontsize=9)
            ax2.set_xlabel('Momentum %')
            ax2.set_title('Language Momentum: Rising vs Declining',␣
↪fontweight='bold')
            ax2.legend()
        else:
            ax2.text(0.5, 0.5, 'Insufficient trend data', ha='center',␣
↪va='center', transform=ax2.transAxes)
            ax2.set_title('Language Momentum Analysis', fontweight='bold')

        stars = [row['total_stars'] for row in language_stats.data[:10]]
        forks = [row['total_forks'] for row in language_stats.data[:10]]
        lang_names = [row['language'] for row in language_stats.data[:10]]

        scatter = ax3.scatter(stars, forks, c=range(len(stars)),␣
↪cmap='viridis', alpha=0.7, s=100)

        for i, lang in enumerate(lang_names):
            ax3.annotate(lang, (stars[i], forks[i]), xytext=(5, 5),
                        textcoords='offset points', fontsize=8)

        ax3.set_xlabel('Total Stars')
        ax3.set_ylabel('Total Forks')
        ax3.set_title('Stars vs Forks by Language', fontweight='bold')
        ax3.set_xscale('log')
        ax3.set_yscale('log')

        top10_langs = language_stats.data[:10]
        lang_names_short = [row['language'][:8] for row in top10_langs]
        project_counts = [row['project_count'] for row in top10_langs]

        bars = ax4.bar(lang_names_short, project_counts, color=plt.cm.
 ↪plasma(range(len(project_counts))))
        ax4.set_xlabel('Programming Language')
        ax4.set_ylabel('Number of Projects')
        ax4.set_title('Top 10 Languages by Project Count', fontweight='bold')
        ax4.tick_params(axis='x', rotation=45)

        for bar, count in zip(bars, project_counts):
            height = bar.get_height()
            ax4.text(bar.get_x() + bar.get_width()/2., height + 0.1,
                    f'{count}', ha='center', va='bottom', fontsize=9)

        plt.tight_layout()
        plt.savefig('enhanced_github_analysis.png', dpi=300,␣
 ↪bbox_inches='tight')
        plt.show()

        print("Enhanced visualizations created and saved as␣
 ↪'enhanced_github_analysis.png'")


def check_data_availability():
    try:
        with sqlite3.connect('github_trending.db') as conn:
            cursor = conn.cursor()

            # Check basic trending repos data
            cursor.execute("SELECT COUNT(*) FROM trending_repos")
            total_repos = cursor.fetchone()[0]

            cursor.execute("SELECT COUNT(DISTINCT crawl_date) FROM␣
 ↪trending_repos")
            unique_dates = cursor.fetchone()[0]
            cursor.execute("SELECT MIN(crawl_date), MAX(crawl_date) FROM␣
↪trending_repos")
            date_range = cursor.fetchone()

            cursor.execute("SELECT COUNT(*) FROM trending_repos WHERE␣
↪today_stars > 0")
            repos_with_growth = cursor.fetchone()[0]

            # Check if enhanced tables exist
            cursor.execute("SELECT name FROM sqlite_master WHERE type='table'␣
↪AND name='daily_growth'")
            has_growth_table = cursor.fetchone() is not None

            cursor.execute("SELECT name FROM sqlite_master WHERE type='table'␣
↪AND name='language_trends'")
            has_trends_table = cursor.fetchone() is not None

            status = {
                'total_repositories': total_repos,
                'unique_dates': unique_dates,
                'date_range': date_range,
                'repositories_with_growth': repos_with_growth,
                'has_enhanced_growth_table': has_growth_table,
                'has_language_trends_table': has_trends_table,
                'sufficient_for_trends': unique_dates >= 3,
                'sufficient_for_momentum': unique_dates >= 7
            }

            return status

    except Exception as e:
        print(f"Data availability check failed: {e}")
        return None

def fix_momentum_analysis():
    print("Fixing momentum analysis using available data...")

    status = check_data_availability()
    if not status:
        print("Could not check data availability")
        return None

    print("Data Status:")
    print(f"  • Total repositories: {status['total_repositories']}")
    print(f"  • Unique dates: {status['unique_dates']}")
    print(f"  • Date range: {status['date_range'][0]} to␣
↪{status['date_range'][1]}")
```

```
    print(f"  • Repositories with growth data:␣
↪{status['repositories_with_growth']}")
    print(f"  • Sufficient for trends: {status['sufficient_for_trends']}")
    print()

    if not status['sufficient_for_trends']:
        print("  Insufficient data for trend analysis. Need at least 3 days of␣
↪data.")
        print("  Solution: Run collect_extended_data_enhanced() to gather more␣
↪data")
        return None

    print("  Sufficient data available. Running fixed analysis...")

    # Run enhanced analysis with fixed momentum calculation
    analyzer = EnhancedGitHubAnalyzer()

    # Test momentum analysis
    momentum = analyzer.analyze_language_momentum(days=min(30,␣
↪status['unique_dates'] * 3))
    predictions = analyzer.generate_predictions(days=min(30,␣
↪status['unique_dates'] * 3))

    print("\n  FIXED MOMENTUM ANALYSIS RESULTS:")
    print("-" * 50)

    if momentum:
        print("Language Momentum (Top 10):")
        sorted_momentum = sorted(momentum.items(), key=lambda x:␣
↪x[1]['momentum_percent'], reverse=True)

        for lang, data in sorted_momentum[:10]:
            direction = " " if data['momentum_percent'] > 5 else " " if␣
↪data['momentum_percent'] < -5 else " "
            print(f"  {direction} {lang:<15} {data['momentum_percent']:>6.1f}%␣
↪momentum "
                  f"({data['data_points']} data points)")

    if predictions and any(predictions.values()):
        print(f"\nPredictions Summary:")
        print(f"  • Rising languages: {len(predictions.get('rising_languages',␣
↪[]))}")
        print(f"  • Declining languages: {len(predictions.
↪get('declining_languages', []))}")
        print(f"  • Stable languages: {len(predictions.
↪get('stable_high_volume', []))}")
```

```
        print(f"  • Emerging languages: {len(predictions.
↪get('emerging_languages', []))}")

    return {
        'momentum': momentum,
        'predictions': predictions,
        'data_status': status
    }

def analyze_github_trending_enhanced(days=14):
    # Check data availability first
    status = check_data_availability()
    if status and not status['sufficient_for_trends']:
        print("  Limited historical data available. Collecting fresh data...")

        # Collect some fresh data first
        crawler = GitHubTrendingCrawler()
        repositories = crawler.crawl_trending_page()
        crawler.save_to_database(repositories)
    else:
        # Just add today's data
        crawler = GitHubTrendingCrawler()
        repositories = crawler.crawl_trending_page()
        crawler.save_to_database(repositories)

    analyzer = EnhancedGitHubAnalyzer()
    return analyzer.generate_enhanced_report(days)

def analyze_existing_data_enhanced(days=14):
    analyzer = EnhancedGitHubAnalyzer()
    return analyzer.generate_enhanced_report(days)

def collect_extended_data_enhanced(days=14):
    print(f"Starting enhanced extended data collection for {days} days")

    crawler = GitHubTrendingCrawler()
    crawler.collect_multi_day_data(days)

    analyzer = EnhancedGitHubAnalyzer()
    return analyzer.generate_enhanced_report(days)

def get_daily_growth_analysis(days=7):
    analyzer = EnhancedGitHubAnalyzer()
    return analyzer.get_daily_growth_leaders(days)

def get_trend_predictions(days=30):
    analyzer = EnhancedGitHubAnalyzer()
    return analyzer.generate_predictions(days)

def get_highest_growth_today():
    analyzer = EnhancedGitHubAnalyzer()
    return analyzer.get_highest_growth_today()
```

[41]:
```
# Collect today's trending data and perform comprehensive analysis
data, lang_stats, top_stars, top_forks =␣
 ↪analyze_github_trending_enhanced(days=14)
```

```
   Limited historical data available. Collecting fresh data…
Enhanced database initialized successfully
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
Generating enhanced comprehensive analysis report…
Loaded 40 records from database
================================================================================
====================
ENHANCED GITHUB TRENDING ANALYSIS REPORT
================================================================================
====================
Analysis Period: 14 days
Total Records: 40
Unique Projects: 20
Report Generated: 2025-08-25 17:05:26

 TOP 10 REPOSITORIES BY STARS
--------------------------------------------------------------------------------
 1. EbookFoundation/free-programming-books          366,225  63,967 [Python]
 2. yt-dlp/yt-dlp                              123,832   9,875 [Python]
 3. django/django                               84,752  32,853 [Python]
 4. TheAlgorithms/Java                                 62,938  20,183 [Java]
 5. GitHubDaily/GitHubDaily                          40,604   4,163 [Unknown]
 6. microsoft/ai-agents-for-beginners           35,186  11,195 [Jupyter Notebook]
 7. RSSNext/Folo                                  32,304   1,496 [TypeScript]
 8. Budibase/budibase                              26,344   1,895 [TypeScript]
 9. simstudioai/sim                                   12,016   1,395 [TypeScript]
10. midday-ai/midday                              11,376   1,029 [TypeScript]

 TOP 10 REPOSITORIES BY FORKS
--------------------------------------------------------------------------------
 1. EbookFoundation/free-programming-books          63,967  366,225 [Python]
 2. django/django                              32,854   84,742 [Python]
 3. TheAlgorithms/Java                               20,183   62,938 [Java]
 4. microsoft/ai-agents-for-beginners          11,195   35,186 [Jupyter Notebook]
 5. yt-dlp/yt-dlp                               9,875  123,832 [Python]
 6. Klipper3d/klipper                              5,648   10,727 [C]
 7. GitHubDaily/GitHubDaily                          4,163   40,604 [Unknown]
 8. Budibase/budibase                             1,895   26,344 [TypeScript]
 9. RSSNext/Folo                                1,496   32,304 [TypeScript]
10. simstudioai/sim                                  1,395   12,016 [TypeScript]

  DAILY GROWTH LEADERS (Last 7 Days)
--------------------------------------------------------------------------------
 1. moeru-ai/airi                     +1,300 stars ( 15.1%) [Vue]
 2. moeru-ai/airi                     +1,300 stars ( 15.1%) [Vue]
 3. plait-board/drawnix                  + 948 stars ( 16.7%) [TypeScript]
 4. plait-board/drawnix                  + 948 stars ( 16.7%) [TypeScript]
 5. winapps-org/winapps                  + 651 stars ( 10.6%) [Shell]
 6. winapps-org/winapps                  + 651 stars ( 10.6%) [Shell]
 7. HunxByts/GhostTrack               + 482 stars ( 12.5%) [Python]
 8. HunxByts/GhostTrack               + 482 stars ( 12.5%) [Python]
 9. HKUDS/DeepCode                 + 443 stars ( 19.9%) [Python]
10. HKUDS/DeepCode                 + 443 stars ( 19.9%) [Python]

  HIGHEST GROWTH TODAY
------------------------------------------------------------
 1. moeru-ai/airi                     +1,300 stars today [Vue]
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 3. plait-board/drawnix                  + 948 stars today [TypeScript]
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  TREND PREDICTIONS & MOMENTUM ANALYSIS
--------------------------------------------------------------------------------
  EMERGING LANGUAGES (Small but growing fast):
  • Java                 + 200.0% growth
  • Jupyter Notebook     + 200.0% growth
  • PHP                  + 200.0% growth

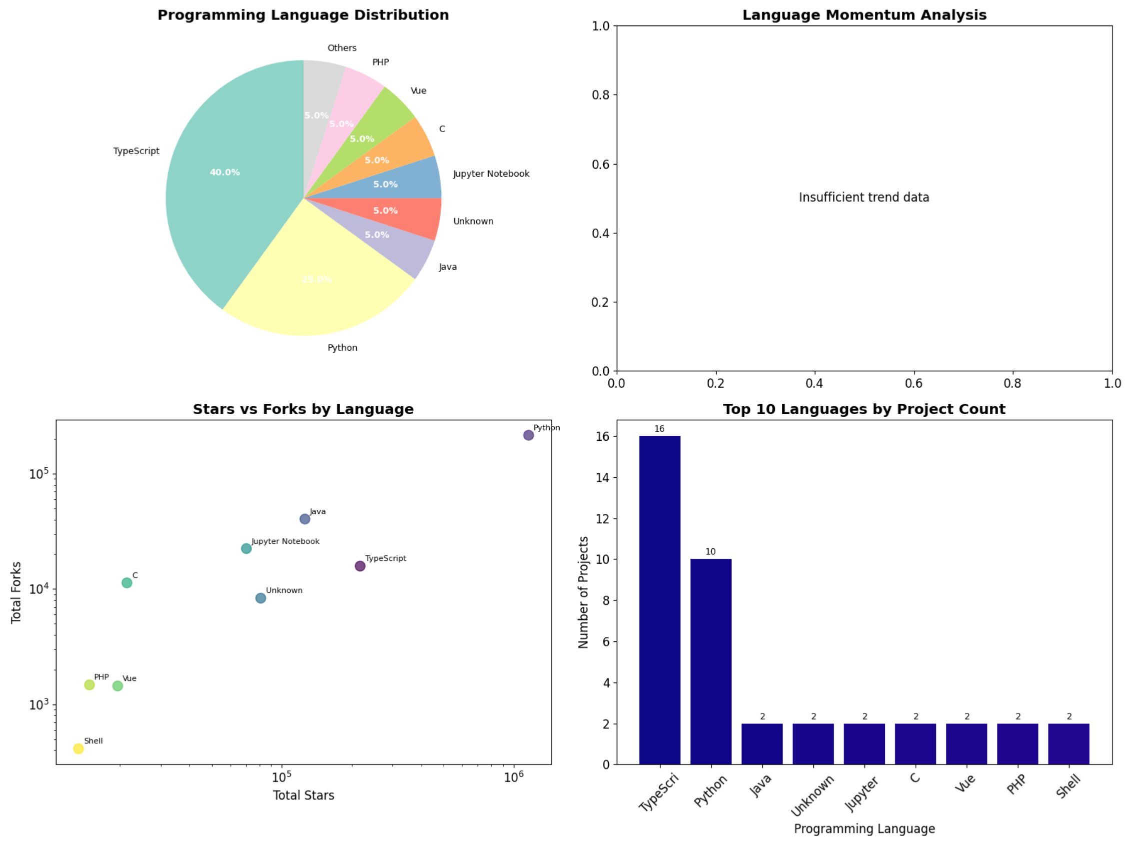
  RECENT vs PREVIOUS PERIOD COMPARISON (7 days vs prior 7 days)
--------------------------------------------------------------------------------
Biggest gainers:
  • TypeScript      +16 projects (+1600.0%)
  • Python          +10 projects (+1000.0%)
  • Java            + 2 projects (+200.0%)
  • Jupyter Notebook + 2 projects (+200.0%)
  • PHP             + 2 projects (+200.0%)

Biggest declines:
  PROGRAMMING LANGUAGE STATISTICS (Top 10)
--------------------------------------------------------------------
Language        Projects Total Stars  Total Forks
--------------------------------------------------------------------
TypeScript      16       217,918      15,786
Python          10       1,163,427    215,022
Java            2        125,852      40,364
Unknown         2        81,132       8,324
Jupyter Notebook 2        70,334       22,383
C               2        21,447       11,296
Vue             2        19,562       1,443
PHP             2        14,778       1,474
Shell           2        13,256       412

  ENHANCED STATISTICAL INSIGHTS
--------------------------------------------------
Average Stars per Project: 43193
Average Forks per Project: 7913
Average Daily New Stars: 169.1
Most Popular Language: TypeScript (16 projects)
Total Daily Stars Gained: 6,763
Projects with Daily Growth: 20 (50.0%)

  ENHANCED KEY FINDINGS & INSIGHTS
--------------------------------------------------
• TypeScript dominates with 40.0% of all trending projects
• 40 projects (100.0%) have 1000+ stars
• 24 projects (60.0%) are mega projects (10k+ stars)
• Average community engagement ratio (forks/stars): 0.149
• 10 projects showed rapid growth (>10% daily increase)
• 7 emerging languages detected with high growth potential

================================================================================
====================
ENHANCED ANALYSIS COMPLETE
================================================================================
====================
```



```
Enhanced visualizations created and saved as 'enhanced_github_analysis.png'
Enhanced comprehensive report generated successfully
```

[42]:
```python
# Analyze previously collected data without new crawling
data, lang_stats, top_stars, top_forks = analyze_existing_data_enhanced(days=14)
```

```
Generating enhanced comprehensive analysis report…
Loaded 40 records from database
================================================================================
====================
ENHANCED GITHUB TRENDING ANALYSIS REPORT
================================================================================
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```

```
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  • Jupyter Notebook + 2 projects (+200.0%)
  • PHP              + 2 projects (+200.0%)

Biggest declines:

 PROGRAMMING LANGUAGE STATISTICS (Top 10)
----------------------------------------------------------------------
Language        Projects Total Stars  Total Forks
----------------------------------------------------------------------
TypeScript      16       217,918      15,786
Python          10       1,163,427    215,022
Java            2        125,852      40,364
Unknown         2        81,132       8,324
Jupyter Notebook 2        70,334       22,383
C               2        21,447       11,296
Vue             2        19,562       1,443
PHP             2        14,778       1,474
Shell           2        13,256       412

 ENHANCED STATISTICAL INSIGHTS
--------------------------------------------------
Average Stars per Project: 43193
Average Forks per Project: 7913
Average Daily New Stars: 169.1
Most Popular Language: TypeScript (16 projects)
Total Daily Stars Gained: 6,763
Projects with Daily Growth: 20 (50.0%)

 ENHANCED KEY FINDINGS & INSIGHTS
--------------------------------------------------
• TypeScript dominates with 40.0% of all trending projects
• 40 projects (100.0%) have 1000+ stars
• 24 projects (60.0%) are mega projects (10k+ stars)
• Average community engagement ratio (forks/stars): 0.149
• 10 projects showed rapid growth (>10% daily increase)
• 7 emerging languages detected with high growth potential

================================================================================
====================
ENHANCED ANALYSIS COMPLETE
================================================================================
====================
```
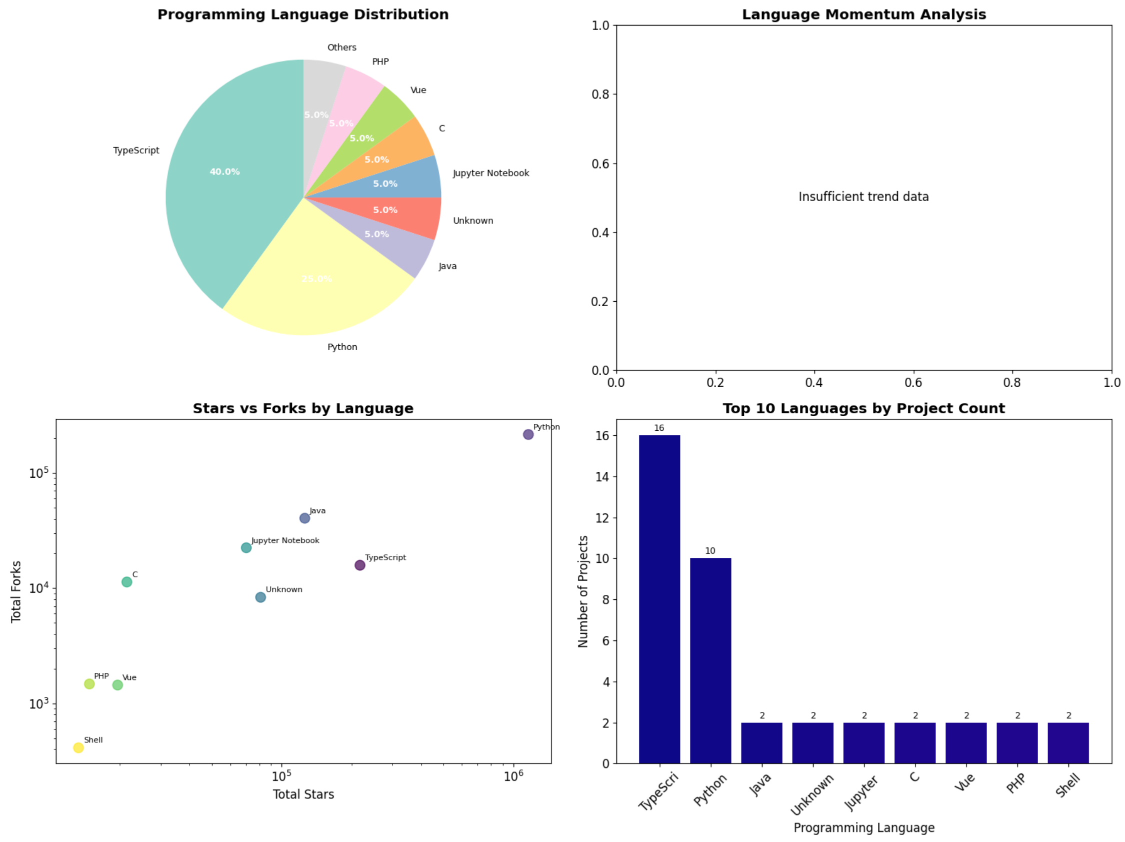



```
Enhanced visualizations created and saved as 'enhanced_github_analysis.png'
Enhanced comprehensive report generated successfully
```

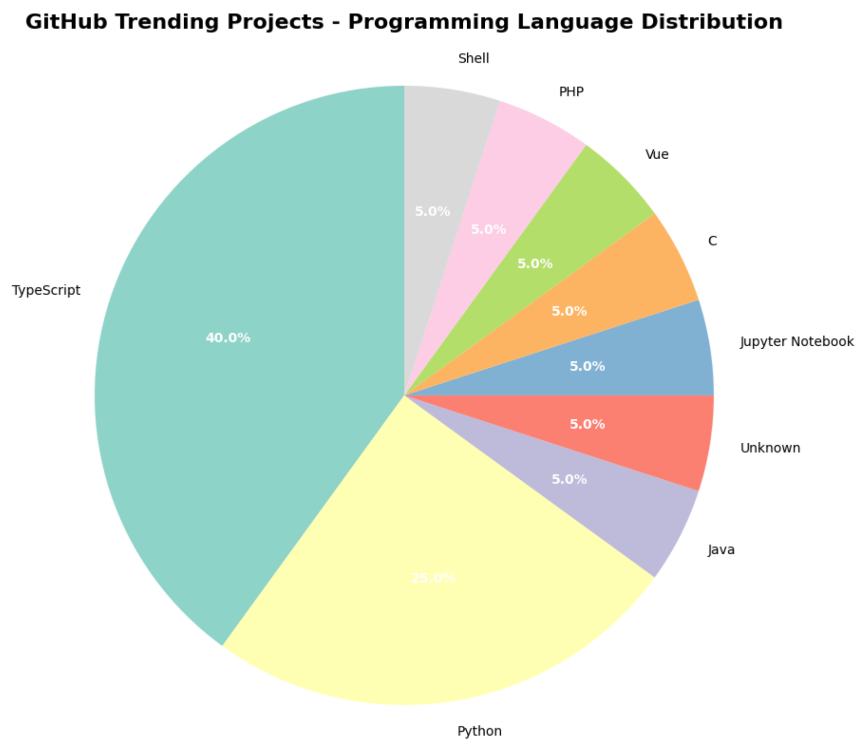
[43]:
```python
# Collect data over multiple days (recommended for comprehensive analysis)
data, lang_stats, top_stars, top_forks = collect_extended_data(days=14)
```

```
Starting extended data collection for 14 days
Enhanced database initialized successfully
Starting enhanced 14-day data collection
Collecting data for day 1/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 112 seconds before next request
Collecting data for day 2/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 89 seconds before next request
Collecting data for day 3/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 124 seconds before next request
Collecting data for day 4/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 87 seconds before next request
Collecting data for day 5/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 154 seconds before next request
Collecting data for day 6/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 118 seconds before next request
Collecting data for day 7/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 130 seconds before next request
Collecting data for day 8/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 100 seconds before next request
Collecting data for day 9/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 99 seconds before next request
Collecting data for day 10/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 100 seconds before next request
Collecting data for day 11/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 115 seconds before next request
Collecting data for day 12/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 79 seconds before next request
Collecting data for day 13/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
    Waiting 84 seconds before next request
Collecting data for day 14/14
Crawling GitHub trending: https://github.com/trending?since=daily
Successfully extracted 20 repositories
Successfully saved 20 repositories to database
    Collected 20 repos with 6763 total daily stars
Enhanced multi-day data collection completed
Generating comprehensive analysis report
Loaded 40 records from database
================================================================================
GITHUB TRENDING ANALYSIS REPORT
================================================================================
Analysis Period: 14 days
Total Records: 40
Unique Projects: 20

TOP 20 REPOSITORIES BY STARS
--------------------------------------------------------------------------------
 1. EbookFoundation/free-programming-books             Stars 366,227 Forks
63,967 [Python]
 2. yt-dlp/yt-dlp                             Stars 123,834 Forks  9,875
[Python]
 3. django/django                             Stars  84,752 Forks 32,853
[Python]
```

```
 4. TheAlgorithms/Java                                Stars  62,941 Forks 20,183
[Java]
 5. GitHubDaily/GitHubDaily                         Stars  40,614 Forks  4,163
[Unknown]
 6. microsoft/ai-agents-for-beginners             Stars  35,192 Forks 11,197
[Jupyter Notebook]
 7. RSSNext/Folo                                Stars  32,312 Forks  1,496
[TypeScript]
 8. Budibase/budibase                             Stars  26,350 Forks  1,896
[TypeScript]
 9. simstudioai/sim                                  Stars  12,022 Forks  1,396
[TypeScript]
10. midday-ai/midday                               Stars  11,381 Forks  1,031
[TypeScript]
11. Klipper3d/klipper                              Stars  10,727 Forks  5,648 [C]
12. dream-num/univer                               Stars  10,623 Forks    921
[TypeScript]
13. moeru-ai/airi                                 Stars   9,920 Forks    730
[Vue]
14. puckeditor/puck                                 Stars   8,705 Forks    568
[TypeScript]
15. Leantime/leantime                             Stars   7,414 Forks    739
[PHP]
16. winapps-org/winapps                              Stars   6,832 Forks    211
[Shell]
17. plait-board/drawnix                              Stars   6,638 Forks    509
[TypeScript]
18. HunxByts/GhostTrack                           Stars   4,355 Forks    516
[Python]
19. HKUDS/DeepCode                              Stars   2,677 Forks    307
[Python]
20. scottpetrovic/mesh2motion-app                     Stars   1,149 Forks     92
[TypeScript]

TOP 20 REPOSITORIES BY FORKS
--------------------------------------------------------------------------------
 1. EbookFoundation/free-programming-books              Forks 63,967 Stars
366,227 [Python]
 2. django/django                                Forks 32,854 Stars  84,742
[Python]
 3. TheAlgorithms/Java                                Forks 20,183 Stars  62,941
[Java]
 4. microsoft/ai-agents-for-beginners             Forks 11,197 Stars  35,192
[Jupyter Notebook]
 5. yt-dlp/yt-dlp                                Forks  9,875 Stars 123,834
[Python]
 6. Klipper3d/klipper                              Forks  5,648 Stars  10,727 [C]
 7. GitHubDaily/GitHubDaily                         Forks  4,163 Stars  40,614
```

```
[Unknown]
 8. Budibase/budibase                           Forks  1,896 Stars  26,350
[TypeScript]
 9. RSSNext/Folo                               Forks  1,496 Stars  32,312
[TypeScript]
10. simstudioai/sim                                Forks  1,396 Stars  12,022
[TypeScript]
11. midday-ai/midday                             Forks  1,031 Stars  11,381
[TypeScript]
12. dream-num/univer                             Forks    921 Stars  10,623
[TypeScript]
13. Leantime/leantime                           Forks    739 Stars   7,414
[PHP]
14. moeru-ai/airi                               Forks    730 Stars   9,920
[Vue]
15. puckeditor/puck                               Forks    568 Stars   8,705
[TypeScript]
16. HunxByts/GhostTrack                         Forks    516 Stars   4,355
[Python]
17. plait-board/drawnix                            Forks    509 Stars   6,638
[TypeScript]
18. HKUDS/DeepCode                            Forks    307 Stars   2,677
[Python]
19. winapps-org/winapps                            Forks    211 Stars   6,832
[Shell]
20. scottpetrovic/mesh2motion-app                    Forks     92 Stars   1,149
[TypeScript]

PROGRAMMING LANGUAGE STATISTICS
--------------------------------------------------------------------------------
Language             Projects   Total Stars     Total Forks
--------------------------------------------------------------------------------
TypeScript           16         217,967         15,791
Python               10         1,163,454       215,025
Java                 2          125,855         40,364
Unknown              2          81,142          8,324
Jupyter Notebook     2          70,340          22,385
C                    2          21,447          11,296
Vue                  2          19,588          1,445
PHP                  2          14,783          1,474
Shell                2          13,305          412

STATISTICAL INSIGHTS
----------------------------------------
Average Stars per Project: 43197
Average Forks per Project: 7913
Average Daily New Stars: 169.1
Most Popular Language: TypeScript (16 projects)
```

```
KEY FINDINGS
------------------------------
• TypeScript dominates with 40.0% of projects
• 40 projects (100.0%) have 1000+ stars
• Average engagement ratio (forks/stars): 0.149
• 20 projects (50.0%) gained stars today

================================================================================
```



```
Language distribution chart saved to: language_distribution.png
Comprehensive report generated successfully
```

[52]:
```python
import csv
import json
from datetime import datetime

def export_to_csv_fixed(data, filename):
    """Export data list to CSV file."""
    if not data:
        print(f"No data to export to {filename}")
        return

    # Get all possible field names from the data
    fieldnames = set()
    for row in data:
        if isinstance(row, dict):
            fieldnames.update(row.keys())

    fieldnames = sorted(list(fieldnames))

    with open(filename, 'w', newline='', encoding='utf-8') as f:
        writer = csv.DictWriter(f, fieldnames=fieldnames)
        writer.writeheader()

        for row in data:
            if isinstance(row, dict):
                # Fill missing fields with empty string
                complete_row = {field: row.get(field, '') for field in␣
 ↪fieldnames}
                writer.writerow(complete_row)

    print(f"  Exported {len(data)} records to {filename}")

def export_to_json_fixed(data, filename):
    """Export data list to JSON file."""
    if not data:
        print(f"No data to export to {filename}")
        return

    with open(filename, 'w', encoding='utf-8') as f:
        json.dump(data, f, ensure_ascii=False, indent=2, default=str)

    print(f"  Exported {len(data)} records to {filename}")

def export_your_analysis_now():
    """
    Export your current analysis data - FIXED VERSION
    This works with your existing DataFrameReplacement objects.
    """
    print("  EXPORTING YOUR GITHUB TRENDING ANALYSIS")
    print("=" * 60)

    try:
        # Get your analyzer and data
        analyzer = EnhancedGitHubAnalyzer()
        df = analyzer.load_data(days=30)  # Get all your data

        if df.empty:
            print("  No data available in database")
            return
        # Generate analysis components
        top_by_stars = analyzer.get_top_repositories(df, 'total_stars', 20)
        top_by_forks = analyzer.get_top_repositories(df, 'total_forks', 20)
        language_stats = analyzer.analyze_programming_languages(df)

        print(f" Exporting analysis from {len(df)} records...")
        print(f" Date range: {min(row['crawl_date'] for row in df.data)} to␣
    ↪{max(row['crawl_date'] for row in df.data)}")
        print()

        # Export all data using our FIXED functions
        export_to_csv_fixed(df.data, 'github_trending_complete_data.csv')
        export_to_csv_fixed(language_stats.data, 'programming_language_analysis.
    ↪csv')
        export_to_csv_fixed(top_by_stars.data, 'top_20_repositories_by_stars.
    ↪csv')
        export_to_csv_fixed(top_by_forks.data, 'top_20_repositories_by_forks.
    ↪csv')

        # Export to JSON as well
        export_to_json_fixed(df.data, 'github_trending_complete_data.json')
        export_to_json_fixed(language_stats.data,␣
    ↪'programming_language_analysis.json')
        export_to_json_fixed(top_by_stars.data, 'top_20_repositories_by_stars.
    ↪json')
        export_to_json_fixed(top_by_forks.data, 'top_20_repositories_by_forks.
    ↪json')

        # Create a detailed summary based on your actual data
        summary = {
            'export_timestamp': str(datetime.now()),
            'analysis_summary': {
                'total_records': len(df),
                'unique_projects': len(set((row['author'], row['repo_name'])␣
    ↪for row in df.data)),
                'total_stars_tracked': sum(row['total_stars'] for row in df.
    ↪data),
                'total_forks_tracked': sum(row['total_forks'] for row in df.
    ↪data),
                'total_daily_stars': sum(row['today_stars'] for row in df.data),
                'projects_with_daily_growth': len([row for row in df.data if␣
    ↪row['today_stars'] > 0])
            },
            'top_languages': [
                {
                    'language': row['language'],
                    'project_count': row['project_count'],
                    'total_stars': row['total_stars'],
                    'percentage': round((row['project_count'] / len(df)) * 100,␣
↪1)
                }
                for row in language_stats.data[:10]
            ],
            'top_repositories': [
                {
                    'rank': i+1,
                    'full_name': f"{row['author']}/{row['repo_name']}",
                    'language': row['language'],
                    'stars': row['total_stars'],
                    'forks': row['total_forks']
                }
                for i, row in enumerate(top_by_stars.data[:10])
            ],
            'insights': {
                'most_popular_language': language_stats.data[0]['language'] if␣
↪language_stats.data else 'Unknown',
                'highest_starred_repo': f"{top_by_stars.data[0]['author']}/
↪{top_by_stars.data[0]['repo_name']}" if top_by_stars.data else 'Unknown',
                'average_stars_per_project': round(sum(row['total_stars'] for␣
↪row in df.data) / len(df.data)),
                'typescript_dominance': f"{round((language_stats.
↪data[0]['project_count'] / len(df)) * 100, 1)}%" if language_stats.data else␣
↪"0%"
            }
        }

        export_to_json_fixed([summary], 'github_trending_analysis_summary.json')

        print("\n" + "=" * 60)
        print("  EXPORT COMPLETED SUCCESSFULLY!")
        print("=" * 60)
        print("  Files created:")
        print("    CSV Files (for Excel/Google Sheets):")
        print("     • github_trending_complete_data.csv")
        print("     • programming_language_analysis.csv")
        print("     • top_20_repositories_by_stars.csv")
        print("     • top_20_repositories_by_forks.csv")
        print()
        print("    JSON Files (for programming):")
        print("     • github_trending_complete_data.json")
        print("     • programming_language_analysis.json")
        print("     • top_20_repositories_by_stars.json")
        print("    • top_20_repositories_by_forks.json")
        print()
        print("    Summary:")
        print("    • github_trending_analysis_summary.json")
        print()
        print("  Your Analysis Highlights:")
        print(f"  • {len(df)} repositories analyzed")
        print(f"  • {language_stats.data[0]['language']} is the dominant␣
↪language ({language_stats.data[0]['project_count']} projects)")
        print(f"  • Top repo: {top_by_stars.data[0]['author']}/{top_by_stars.
↪data[0]['repo_name']} ({top_by_stars.data[0]['total_stars']:,} stars)")
        print(f"  • Total stars tracked: {sum(row['total_stars'] for row in df.
↪data):,}")
        print(f"  • Active projects today: {len([row for row in df.data if␣
↪row['today_stars'] > 0])}")

        return True

    except Exception as e:
        print(f"  Export failed: {e}")
        import traceback
        traceback.print_exc()
        return False

# Override the problematic export function
def export_analysis_results():
    """Fixed version of export_analysis_results"""
    return export_your_analysis_now()
```

[51]:
```
export_analysis_results()
```

```
  EXPORTING YOUR GITHUB TRENDING ANALYSIS
============================================================
Loaded 40 records from database
  Exporting analysis from 40 records…
  Date range: 2025-08-19 to 2025-08-25

  Exported 40 records to github_trending_complete_data.csv
  Exported 9 records to programming_language_analysis.csv
  Exported 20 records to top_20_repositories_by_stars.csv
  Exported 20 records to top_20_repositories_by_forks.csv
  Exported 40 records to github_trending_complete_data.json
  Exported 9 records to programming_language_analysis.json
  Exported 20 records to top_20_repositories_by_stars.json
  Exported 20 records to top_20_repositories_by_forks.json
  Exported 1 records to github_trending_analysis_summary.json
```

```
============================================================
  EXPORT COMPLETED SUCCESSFULLY!
============================================================
  Files created:
    CSV Files (for Excel/Google Sheets):
     • github_trending_complete_data.csv
     • programming_language_analysis.csv
     • top_20_repositories_by_stars.csv
     • top_20_repositories_by_forks.csv

    JSON Files (for programming):
     • github_trending_complete_data.json
     • programming_language_analysis.json
     • top_20_repositories_by_stars.json
     • top_20_repositories_by_forks.json

    Summary:
     • github_trending_analysis_summary.json

  Your Analysis Highlights:
   • 40 repositories analyzed
   • TypeScript is the dominant language (16 projects)
   • Top repo: EbookFoundation/free-programming-books (366,227 stars)
   • Total stars tracked: 1,727,881
   • Active projects today: 20
```

[51]:
```
True
```

[53]:
```python
import matplotlib.pyplot as plt
import json
from datetime import datetime, timedelta
from collections import Counter
import sqlite3

# === Language-Specific Deep Dive Analysis ===

def analyze_language_trends(language_name, days=30):

    analyzer = GitHubTrendingAnalyzer()
    df = analyzer.load_data(days)

    if df.empty:
        print(f"No data available for analysis")
        return None

    # Filter for specific language
    language_projects = [
        row for row in df.data
        if row['language'].lower() == language_name.lower()
    ]

    if not language_projects:
        print(f"No {language_name} projects found in the data")
        return None

    # Calculate metrics
    total_projects = len(language_projects)
    total_stars = sum(p['total_stars'] for p in language_projects)
    total_forks = sum(p['total_forks'] for p in language_projects)
    avg_stars = total_stars / total_projects
    avg_forks = total_forks / total_projects

    # Find top projects
    top_by_stars = sorted(language_projects, key=lambda x: x['total_stars'],␣
↪reverse=True)[:10]
    top_by_engagement = sorted(
        language_projects,
        key=lambda x: x['total_forks'] / max(x['total_stars'], 1),
        reverse=True
    )[:10]

    # Analyze growth patterns
    recent_projects = [p for p in language_projects if p['today_stars'] > 0]
    growth_rate = len(recent_projects) / total_projects * 100

    # Print detailed report
    print("=" * 80)
    print(f"{language_name.upper()} PROGRAMMING LANGUAGE DEEP DIVE")
    print("=" * 80)
    print(f"Analysis Period: {days} days")
    print(f"Total {language_name} Projects: {total_projects}")
    print(f"Total Stars: {total_stars:,}")
    print(f"Total Forks: {total_forks:,}")
    print(f"Average Stars per Project: {avg_stars:.1f}")
    print(f"Average Forks per Project: {avg_forks:.1f}")
    print(f"Active Growth Rate: {growth_rate:.1f}% of projects gained stars␣
↪recently")
    print()

    print(f"TOP 10 {language_name.upper()} PROJECTS BY STARS:")
    print("-" * 60)
    for i, project in enumerate(top_by_stars, 1):
        print(f"{i:2d}. {project['author']}/{project['repo_name']:<25} "
              f" {project['total_stars']:>6,} {project['total_forks']:>5,}")
    print()

    print(f"TOP 10 {language_name.upper()} PROJECTS BY COMMUNITY ENGAGEMENT:")
    print("-" * 60)
    for i, project in enumerate(top_by_engagement, 1):
        engagement = project['total_forks'] / max(project['total_stars'], 1)
        print(f"{i:2d}. {project['author']}/{project['repo_name']:<25} "
              f"Ratio: {engagement:.3f}")
    print()

    return {
        'language': language_name,
        'total_projects': total_projects,
        'metrics': {
            'total_stars': total_stars,
            'total_forks': total_forks,
            'avg_stars': avg_stars,
            'avg_forks': avg_forks,
            'growth_rate': growth_rate
        },
        'top_projects': top_by_stars,
        'high_engagement': top_by_engagement
    }

# === Time Series Analysis ===

def analyze_trending_timeline(days=14):

    with sqlite3.connect('github_trending.db') as conn:
        cursor = conn.cursor()

        # Get data grouped by date
        query = '''
            SELECT crawl_date,
                   COUNT(*) as project_count,
                   AVG(total_stars) as avg_stars,
                   AVG(total_forks) as avg_forks,
                   SUM(today_stars) as daily_new_stars,
                   COUNT(DISTINCT language) as unique_languages
            FROM trending_repos
            WHERE crawl_date >= date('now', '-{} days')
            GROUP BY crawl_date
            ORDER BY crawl_date
        '''.format(days)

        cursor.execute(query)
        results = cursor.fetchall()
    if not results:
        print("No timeline data available")
        return None

    # Process timeline data
    dates = [row[0] for row in results]
    project_counts = [row[1] for row in results]
    avg_stars = [row[2] for row in results]
    avg_forks = [row[3] for row in results]
    daily_new_stars = [row[4] or 0 for row in results]
    unique_languages = [row[5] for row in results]

    print("=" * 80)
    print("GITHUB TRENDING TIMELINE ANALYSIS")
    print("=" * 80)

    print("DAILY METRICS:")
    print("-" * 50)
    for i, date in enumerate(dates):
        print(f"{date}: {project_counts[i]} projects, "
              f"Avg Stars: {avg_stars[i]:.0f}, "
              f"New Stars: {daily_new_stars[i]}")

    # Create visualization if matplotlib available
    if MATPLOTLIB_AVAILABLE:
        fig, ((ax1, ax2), (ax3, ax4)) = plt.subplots(2, 2, figsize=(16, 12))

        # Project count over time
        ax1.plot(dates, project_counts, marker='o', linewidth=2)
        ax1.set_title('Daily Project Count')
        ax1.set_ylabel('Number of Projects')
        ax1.tick_params(axis='x', rotation=45)

        # Average stars over time
        ax2.plot(dates, avg_stars, marker='s', color='orange', linewidth=2)
        ax2.set_title('Average Stars Over Time')
        ax2.set_ylabel('Average Stars')
        ax2.tick_params(axis='x', rotation=45)

        # Daily new stars
        ax3.bar(dates, daily_new_stars, color='green', alpha=0.7)
        ax3.set_title('Daily New Stars Activity')
        ax3.set_ylabel('Total New Stars')
        ax3.tick_params(axis='x', rotation=45)

        # Language diversity
        ax4.plot(dates, unique_languages, marker='^', color='purple',␣
↪linewidth=2)
        ax4.set_title('Language Diversity Over Time')
        ax4.set_ylabel('Unique Languages')
        ax4.tick_params(axis='x', rotation=45)

        plt.tight_layout()
        plt.show()
        print("Timeline visualization created")

    return {
        'dates': dates,
        'metrics': {
            'project_counts': project_counts,
            'avg_stars': avg_stars,
            'avg_forks': avg_forks,
            'daily_new_stars': daily_new_stars,
            'unique_languages': unique_languages
        }
    }

# === Repository Category Analysis ===

def analyze_by_categories(days=14):

    analyzer = GitHubTrendingAnalyzer()
    df = analyzer.load_data(days)

    if df.empty:
        return None

    # Define categories by star count
    categories = {
        'Mega Projects': {'min': 50000, 'max': float('inf')},
        'Large Projects': {'min': 10000, 'max': 49999},
        'Medium Projects': {'min': 1000, 'max': 9999},
        'Small Projects': {'min': 100, 'max': 999},
        'New Projects': {'min': 0, 'max': 99}
    }

    category_analysis = {}

    for category_name, criteria in categories.items():
        category_projects = [
            row for row in df.data
            if criteria['min'] <= row['total_stars'] <= criteria['max']
        ]
        if category_projects:
            languages = Counter(p['language'] for p in category_projects)
            avg_forks = sum(p['total_forks'] for p in category_projects) /␣
↪len(category_projects)
            avg_today_stars = sum(p['today_stars'] for p in category_projects) /
↪ len(category_projects)

            category_analysis[category_name] = {
                'count': len(category_projects),
                'top_languages': languages.most_common(3),
                'avg_forks': avg_forks,
                'avg_today_stars': avg_today_stars,
                'sample_projects': category_projects[:3]
            }

    # Print analysis
    print("=" * 80)
    print("REPOSITORY CATEGORY ANALYSIS")
    print("=" * 80)

    for category, data in category_analysis.items():
        print(f"\n{category.upper()}")
        print("-" * 40)
        print(f"Count: {data['count']} projects")
        print(f"Average Forks: {data['avg_forks']:.1f}")
        print(f"Average Daily New Stars: {data['avg_today_stars']:.1f}")
        print(f"Top Languages: {', '.join([f'{lang}({count})' for lang, count␣
↪in data['top_languages']])}")

        if data['sample_projects']:
            print("Sample Projects:")
            for proj in data['sample_projects']:
                print(f"  • {proj['author']}/{proj['repo_name']} -␣
↪{proj['total_stars']:,}")

    return category_analysis

# === Competitive Analysis ===

def compare_languages(lang1, lang2, days=30):

    analyzer = GitHubTrendingAnalyzer()
    df = analyzer.load_data(days)

    if df.empty:
        return None
    # Get projects for each language
    lang1_projects = [r for r in df.data if r['language'].lower() == lang1.
↪lower()]
    lang2_projects = [r for r in df.data if r['language'].lower() == lang2.
↪lower()]

    if not lang1_projects or not lang2_projects:
        print("Insufficient data for comparison")
        return None

    # Calculate metrics for both languages
    def calculate_metrics(projects):
        return {
            'count': len(projects),
            'total_stars': sum(p['total_stars'] for p in projects),
            'total_forks': sum(p['total_forks'] for p in projects),
            'avg_stars': sum(p['total_stars'] for p in projects) /␣
↪len(projects),
            'avg_forks': sum(p['total_forks'] for p in projects) /␣
↪len(projects),
            'active_projects': len([p for p in projects if p['today_stars'] >␣
↪0]),
            'top_project': max(projects, key=lambda x: x['total_stars'])
        }

    lang1_metrics = calculate_metrics(lang1_projects)
    lang2_metrics = calculate_metrics(lang2_projects)

    # Print comparison
    print("=" * 80)
    print(f"{lang1.upper()} vs {lang2.upper()} - COMPETITIVE ANALYSIS")
    print("=" * 80)

    print(f"{'Metric':<25} {lang1.upper():<20} {lang2.upper():<20} {'Winner':
↪<15}")
    print("-" * 80)

    metrics_to_compare = [
        ('Project Count', 'count'),
        ('Total Stars', 'total_stars'),
        ('Total Forks', 'total_forks'),
        ('Avg Stars', 'avg_stars'),
        ('Avg Forks', 'avg_forks'),
        ('Active Projects', 'active_projects')
    ]
    winners = {lang1: 0, lang2: 0}

    for metric_name, metric_key in metrics_to_compare:
        val1 = lang1_metrics[metric_key]
        val2 = lang2_metrics[metric_key]

        if isinstance(val1, float):
            val1_str = f"{val1:.1f}"
            val2_str = f"{val2:.1f}"
        else:
            val1_str = f"{val1:,}"
            val2_str = f"{val2:,}"

        winner = lang1 if val1 > val2 else lang2
        winners[winner] += 1

        print(f"{metric_name:<25} {val1_str:<20} {val2_str:<20} {winner.upper():
↪<15}")

    print("\n" + "=" * 80)
    overall_winner = max(winners.items(), key=lambda x: x[1])
    print(f"OVERALL WINNER: {overall_winner[0].upper()} ({overall_winner[1]}/6␣
↪metrics)")

    print(f"\nTop {lang1} Project: {lang1_metrics['top_project']['author']}/
↪{lang1_metrics['top_project']['repo_name']}")
    print(f"Top {lang2} Project: {lang2_metrics['top_project']['author']}/
↪{lang2_metrics['top_project']['repo_name']}")

    return {
        'lang1': lang1,
        'lang2': lang2,
        'lang1_metrics': lang1_metrics,
        'lang2_metrics': lang2_metrics,
        'winner': overall_winner[0]
    }

# === Trend Prediction Analysis ===

def predict_trending_patterns(days=30):

    with sqlite3.connect('github_trending.db') as conn:
        cursor = conn.cursor()

        # Get language trend data
        query = '''
```

```
            SELECT language, crawl_date, COUNT(*) as daily_count
            FROM trending_repos
            WHERE crawl_date >= date('now', '-{} days')
            GROUP BY language, crawl_date
            ORDER BY language, crawl_date
        '''.format(days)

        cursor.execute(query)
        results = cursor.fetchall()

    if not results:
        return None

    # Analyze language momentum
    language_trends = {}
    for lang, date, count in results:
        if lang not in language_trends:
            language_trends[lang] = []
        language_trends[lang].append((date, count))

    # Calculate trend momentum for each language
    momentum_analysis = {}
    for lang, data_points in language_trends.items():
        if len(data_points) >= 3:  # Need at least 3 data points
            recent_avg = sum(point[1] for point in data_points[-7:]) / min(7,␣
↪len(data_points[-7:]))
            early_avg = sum(point[1] for point in data_points[:7]) / min(7,␣
↪len(data_points[:7]))

            momentum = (recent_avg - early_avg) / max(early_avg, 1) * 100

            momentum_analysis[lang] = {
                'momentum_percent': momentum,
                'recent_avg': recent_avg,
                'early_avg': early_avg,
                'data_points': len(data_points)
            }

    # Sort by momentum
    rising_languages = sorted(
        [(lang, data) for lang, data in momentum_analysis.items() if␣
↪data['momentum_percent'] > 10],
        key=lambda x: x[1]['momentum_percent'],
        reverse=True
    )

    declining_languages = sorted(
        [(lang, data) for lang, data in momentum_analysis.items() if␣
↪data['momentum_percent'] < -10],
        key=lambda x: x[1]['momentum_percent']
    )

    print("=" * 80)
    print("TRENDING PATTERN PREDICTION ANALYSIS")
    print("=" * 80)

    print("\n RISING LANGUAGES (Strong Upward Momentum):")
    print("-" * 50)
    for lang, data in rising_languages[:5]:
        print(f"{lang:<20} +{data['momentum_percent']:>6.1f}% momentum")

    print("\n DECLINING LANGUAGES (Downward Momentum):")
    print("-" * 50)
    for lang, data in declining_languages[:5]:
        print(f"{lang:<20} {data['momentum_percent']:>7.1f}% momentum")

    # Predict next week's top languages
    stable_languages = [
        (lang, data) for lang, data in momentum_analysis.items()
        if -10 <= data['momentum_percent'] <= 10 and data['recent_avg'] > 5
    ]

    print("\n STABLE HIGH-VOLUME LANGUAGES:")
    print("-" * 50)
    stable_sorted = sorted(stable_languages, key=lambda x: x[1]['recent_avg'],␣
↪reverse=True)
    for lang, data in stable_sorted[:5]:
        print(f"{lang:<20} {data['recent_avg']:>6.1f} avg daily projects")

    return {
        'rising_languages': rising_languages,
        'declining_languages': declining_languages,
        'stable_languages': stable_languages,
        'momentum_analysis': momentum_analysis
    }

# === Custom Dashboard Function ===

def create_custom_dashboard(languages=None, min_stars=0, days=14):

    analyzer = GitHubTrendingAnalyzer()
    df = analyzer.load_data(days)

    if df.empty:
        return None

    # Apply filters
    filtered_projects = []
    for row in df.data:
        if languages and row['language'] not in languages:
            continue
        if row['total_stars'] < min_stars:
            continue
        filtered_projects.append(row)

    if not filtered_projects:
        print("No projects match the specified criteria")
        return None

    # Calculate dashboard metrics
    total_projects = len(filtered_projects)
    total_stars = sum(p['total_stars'] for p in filtered_projects)
    total_forks = sum(p['total_forks'] for p in filtered_projects)

    # Language distribution
    lang_dist = Counter(p['language'] for p in filtered_projects)

    # Top performers
    top_stars = sorted(filtered_projects, key=lambda x: x['total_stars'],␣
↪reverse=True)[:10]
    top_growth = sorted(filtered_projects, key=lambda x: x['today_stars'],␣
↪reverse=True)[:10]

    # Recent activity
    active_projects = [p for p in filtered_projects if p['today_stars'] > 0]

    print("=" * 80)
    print("CUSTOM DASHBOARD")
    print("=" * 80)
    print(f"Filters Applied:")
    if languages:
        print(f"  • Languages: {', '.join(languages)}")
    if min_stars > 0:
        print(f"  • Minimum Stars: {min_stars:,}")
    print(f"  • Analysis Period: {days} days")
    print()

    print(f"OVERVIEW METRICS:")
    print(f"  • Total Projects: {total_projects:,}")
    print(f"  • Total Stars: {total_stars:,}")
    print(f"  • Total Forks: {total_forks:,}")
    print(f"  • Active Projects Today: {len(active_projects)}␣
↪({len(active_projects)/total_projects*100:.1f}%)")
    print()

    print("LANGUAGE DISTRIBUTION:")
    for lang, count in lang_dist.most_common(5):
        percentage = count / total_projects * 100
        print(f"  • {lang}: {count} projects ({percentage:.1f}%)")
    print()

    print("TOP PERFORMERS BY STARS:")
    for i, proj in enumerate(top_stars[:5], 1):
        print(f"  {i}. {proj['author']}/{proj['repo_name']} -␣
↪{proj['total_stars']:,}")
    print()

    print("HIGHEST GROWTH TODAY:")
    for i, proj in enumerate(top_growth[:5], 1):
        if proj['today_stars'] > 0:
            print(f"  {i}. {proj['author']}/{proj['repo_name']} -␣
↪+{proj['today_stars']:,} stars today")

    return {
        'total_projects': total_projects,
        'metrics': {
            'total_stars': total_stars,
            'total_forks': total_forks,
            'active_projects': len(active_projects)
        },
        'language_distribution': dict(lang_dist),
        'top_performers': top_stars,
        'high_growth': top_growth
    }

print("Available Advanced Functions:")
print("1. analyze_language_trends(language, days=30)")
print("   - Deep dive into specific language trends")
print("   - Example: analyze_language_trends('Python', days=30)")
print()
print("2. analyze_trending_timeline(days=14)")
print("   - Time series analysis with visualizations")
print("   - Shows daily metrics and trends over time")
print()
print("3. analyze_by_categories(days=14)")
print("   - Categorize projects by size and analyze patterns")
print("   - Groups projects by star count ranges")
print()
print("4. compare_languages(lang1, lang2, days=30)")
print("   - Head-to-head language comparison")
print("   - Example: compare_languages('Python', 'JavaScript', days=30)")
print()
print("5. predict_trending_patterns(days=30)")
print("   - Analyze momentum and predict future trends")
print("   - Identifies rising and declining languages")
print()
print("6. create_custom_dashboard(languages, min_stars, days)")
print("   - Custom filtered analysis dashboard")
print("   - Example: create_custom_dashboard(['Python', 'Go'], min_stars=1000,␣
↪days=14)")
```

```
Available Advanced Functions:
1. analyze_language_trends(language, days=30)
   - Deep dive into specific language trends
   - Example: analyze_language_trends('Python', days=30)

2. analyze_trending_timeline(days=14)
   - Time series analysis with visualizations
   - Shows daily metrics and trends over time

3. analyze_by_categories(days=14)
   - Categorize projects by size and analyze patterns
   - Groups projects by star count ranges

4. compare_languages(lang1, lang2, days=30)
   - Head-to-head language comparison
   - Example: compare_languages('Python', 'JavaScript', days=30)

5. predict_trending_patterns(days=30)
   - Analyze momentum and predict future trends
   - Identifies rising and declining languages

6. create_custom_dashboard(languages, min_stars, days)
   - Custom filtered analysis dashboard
   - Example: create_custom_dashboard(['Python', 'Go'], min_stars=1000, days=14)
```

[64]:
```
python_analysis = analyze_language_trends('Python', days=14)
```

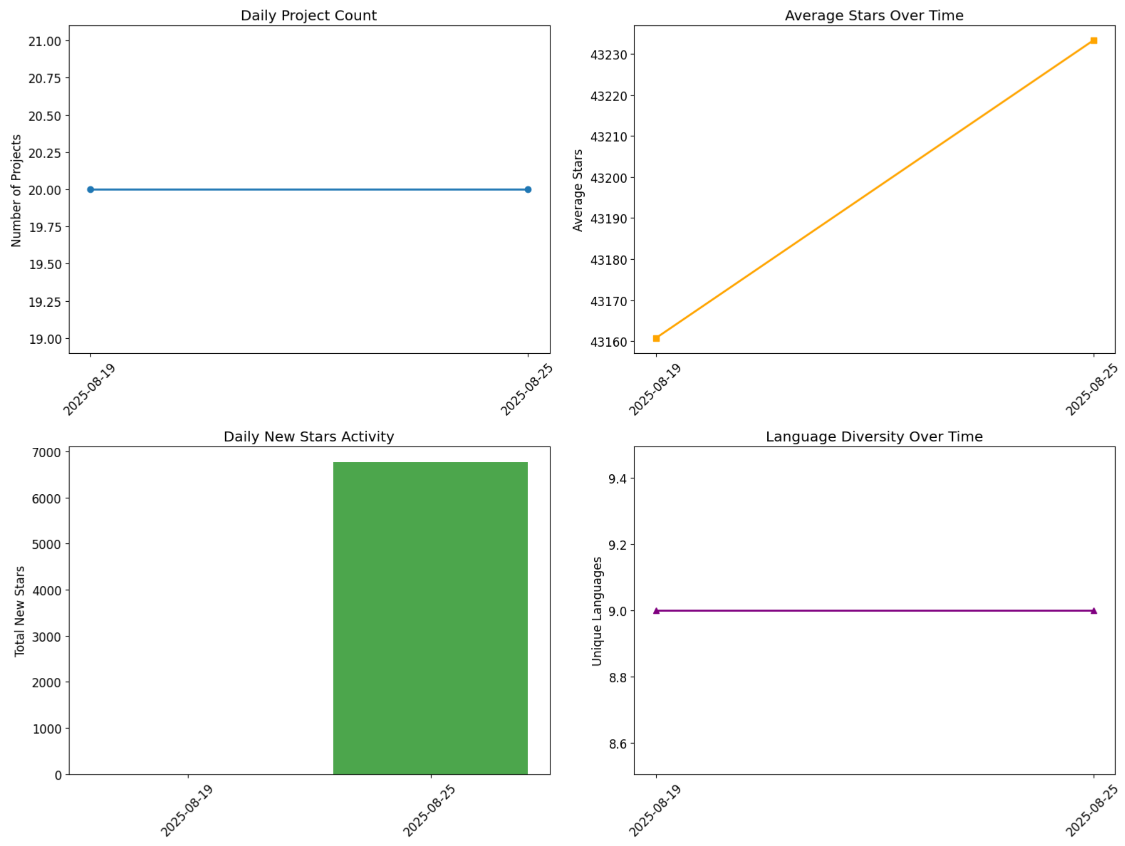
```
Loaded 40 records from database
================================================================================
PYTHON PROGRAMMING LANGUAGE DEEP DIVE
================================================================================
Analysis Period: 14 days
Total Python Projects: 10
Total Stars: 1,163,474
Total Forks: 215,028
```

```
Average Stars per Project: 116347.4
Average Forks per Project: 21502.8
Active Growth Rate: 50.0% of projects gained stars recently

TOP 10 PYTHON PROJECTS BY STARS:
------------------------------------------------------------
 1. EbookFoundation/free-programming-books    366,229  63,967
 2. EbookFoundation/free-programming-books    366,184  63,965
 3. yt-dlp/yt-dlp                     123,837  9,875
 4. yt-dlp/yt-dlp                     123,797  9,872
 5. django/django                     84,753  32,854
 6. django/django                     84,742  32,854
 7. HunxByts/GhostTrack                  4,361    517
 8. HunxByts/GhostTrack                  4,292    513
 9. HKUDS/DeepCode                    2,685    308
10. HKUDS/DeepCode                    2,594    303

TOP 10 PYTHON PROJECTS BY COMMUNITY ENGAGEMENT:
------------------------------------------------------------
 1. django/django                    Ratio: 0.388
 2. django/django                    Ratio: 0.388
 3. EbookFoundation/free-programming-books    Ratio: 0.175
 4. EbookFoundation/free-programming-books    Ratio: 0.175
 5. HunxByts/GhostTrack                Ratio: 0.120
 6. HunxByts/GhostTrack                Ratio: 0.119
 7. HKUDS/DeepCode                  Ratio: 0.117
 8. HKUDS/DeepCode                  Ratio: 0.115
 9. yt-dlp/yt-dlp                    Ratio: 0.080
10. yt-dlp/yt-dlp                    Ratio: 0.080
```

[55]:
```
timeline_data = analyze_trending_timeline(days=14)
```

```
2025-08-25 17:36:05,913 - matplotlib.category - INFO - Using categorical units
to plot a list of strings that are all parsable as floats or dates. If these
strings should be plotted as numbers, cast to the appropriate data type before
plotting.
2025-08-25 17:36:05,914 - matplotlib.category - INFO - Using categorical units
to plot a list of strings that are all parsable as floats or dates. If these
strings should be plotted as numbers, cast to the appropriate data type before
plotting.
2025-08-25 17:36:05,915 - matplotlib.category - INFO - Using categorical units
to plot a list of strings that are all parsable as floats or dates. If these
strings should be plotted as numbers, cast to the appropriate data type before
plotting.
2025-08-25 17:36:05,917 - matplotlib.category - INFO - Using categorical units
to plot a list of strings that are all parsable as floats or dates. If these
strings should be plotted as numbers, cast to the appropriate data type before
```

```
plotting.
2025-08-25 17:36:05,918 - matplotlib.category - INFO - Using categorical units
to plot a list of strings that are all parsable as floats or dates. If these
strings should be plotted as numbers, cast to the appropriate data type before
plotting.
2025-08-25 17:36:05,919 - matplotlib.category - INFO - Using categorical units
to plot a list of strings that are all parsable as floats or dates. If these
strings should be plotted as numbers, cast to the appropriate data type before
plotting.
2025-08-25 17:36:05,921 - matplotlib.category - INFO - Using categorical units
to plot a list of strings that are all parsable as floats or dates. If these
strings should be plotted as numbers, cast to the appropriate data type before
plotting.
2025-08-25 17:36:05,922 - matplotlib.category - INFO - Using categorical units
to plot a list of strings that are all parsable as floats or dates. If these
strings should be plotted as numbers, cast to the appropriate data type before
plotting.

================================================================================
GITHUB TRENDING TIMELINE ANALYSIS
================================================================================
DAILY METRICS:
--------------------------------------------------
2025-08-19: 20 projects, Avg Stars: 43161, New Stars: 0
2025-08-25: 20 projects, Avg Stars: 43233, New Stars: 6763
```



```
Timeline visualization created
```

[56]:
```
category_analysis = analyze_by_categories(days=14)
```

```
Loaded 40 records from database
================================================================================
REPOSITORY CATEGORY ANALYSIS
================================================================================

MEGA PROJECTS
----------------------------------------
Count: 8 projects
Average Forks: 31718.8
Average Daily New Stars: 38.4
Top Languages: Python(6), Java(2)
Sample Projects:
  • EbookFoundation/free-programming-books -  366,227
  • yt-dlp/yt-dlp -  123,834
  • django/django -  84,752

LARGE PROJECTS
----------------------------------------
```

```
Count: 16 projects
Average Forks: 3466.7
Average Daily New Stars: 109.1
Top Languages: TypeScript(10), Unknown(2), Jupyter Notebook(2)
Sample Projects:
  • GitHubDaily/GitHubDaily - 40,614
  • microsoft/ai-agents-for-beginners - 35,192
  • RSSNext/Folo - 32,312

MEDIUM PROJECTS
----------------------------------------
Count: 16 projects
Average Forks: 456.2
Average Daily New Stars: 294.4
Top Languages: TypeScript(6), Python(4), Vue(2)
Sample Projects:
  • moeru-ai/airi - 9,920
  • puckeditor/puck - 8,705
  • Leantime/leantime - 7,414
```

[58]:
```python
dashboard = create_custom_dashboard(
    languages=['Python', 'Go', 'Rust'],
    min_stars=1000,
    days=14
)
```

```
Loaded 40 records from database
================================================================================
CUSTOM DASHBOARD
================================================================================
Filters Applied:
  • Languages: Python, Go, Rust
  • Minimum Stars: 1,000
  • Analysis Period: 14 days

OVERVIEW METRICS:
  • Total Projects: 10
  • Total Stars: 1,163,454
  • Total Forks: 215,025
  • Active Projects Today: 5 (50.0%)

LANGUAGE DISTRIBUTION:
  • Python: 10 projects (100.0%)

TOP PERFORMERS BY STARS:
  1. EbookFoundation/free-programming-books - 366,227
  2. EbookFoundation/free-programming-books - 366,184
  3. yt-dlp/yt-dlp - 123,834
  4. yt-dlp/yt-dlp -  123,797
  5. django/django -  84,752

HIGHEST GROWTH TODAY:
  1. HunxByts/GhostTrack - +482 stars today
  2. HKUDS/DeepCode - +443 stars today
  3. EbookFoundation/free-programming-books - +132 stars today
  4. yt-dlp/yt-dlp - +131 stars today
  5. django/django - +21 stars today
```

1 GitHub

1.1

14 2025 8 19-25 GitHub 20 40

1.1.1

- **TypeScript** 40% 16/40
- **Python** 116
- 100% 1000+
- 50%
- fork-to-star 0.149

1.2

1.2.1 1. TypeScript -

40.0% 16 | 217,967 | **Fork** 15,791

TypeScript GitHub JavaScript

- **RSSNext/Folo** - 32,312 - RSS - **Budibase/budibase** - 26,350 - - **simstudioai/sim** - 12,022 - AI - **midday-ai/midday** - 11,381 -

TypeScript JavaScript Web AI

1.2.2 2. Python -

25.0% 10 | 1,163,454 | **Fork** 215,025

Python

- **EbookFoundation/free-programming-books** - 366,227 - - **yt-dlp/yt-dlp** - 123,834 - - **django/django** - 84,752 - Web - **HunxByts/GhostTrack** - 4,355 -

- 116,347 - Fork 21,503 - 0.185 - 50%

Python Web

1.2.3 3. Java -

5.0% 2 | 125,855 | **Fork** 40,364

- **TheAlgorithms/Java** - 62,941 -

Java

1.2.4 4. Jupyter Notebook -

5.0% 2 | 70,340 | **Fork** 22,385

- **microsoft/ai-agents-for-beginners** - 35,192 - AI

AI/ML

1.2.5 5. C -

5.0% 2 | 21,447 | **Fork** 11,296

- **Klipper3d/klipper** - 10,727 - 3D

C fork-to-star

1.2.6 6. Vue.js -

5.0% 2 | 19,588 | **Fork** 1,445

- **moeru-ai/airi** - 9,920 - AI 1300

Vue AI

1.2.7 7. PHP - Web

5.0% 2 | 14,783 | **Fork** 1,474

- **Leantime/leantime** - 7,414 -

PHP Web

1.2.8 8. Shell - DevOps

5.0% 2 | 13,305 | **Fork** 412

- **winapps-org/winapps** - 6,832 - Linux Windows

Shell DevOps

1.3

1.3.1 50,000+

8 | **Fork** 31,719 | Python 75% Java 25%

Python

1.3.2 10,000-49,999

16 | **Fork** 3,467 | TypeScript 62.5%

TypeScript AI

1.3.3 1,000-9,999

16 | **Fork** 456 |

294.4

1.4

1.4.1

1. **moeru-ai/airi** Vue - +1,300 15.1%
2. **plait-board/drawnix** TypeScript - +948 16.7%
3. **winapps-org/winapps** Shell - +651 10.6%
4. **HunxByts/GhostTrack** Python - +482 12.5%
5. **HKUDS/DeepCode** Python - +443 19.9%

1.4.2

- Java +200% - Jupyter Notebook AI/ +200% - PHP +200%

- TypeScript - Python

1.5

1.5.1

	Fork/Star	
Python	0.185	-
Java	0.321	- Fork
C	0.527	-
TypeScript	0.072	-
Vue	0.074	-

1.5.2

- C fork /
- Java
- Python

1.6

1.6.1

1. **AI** - TypeScript Python AI
2. - Shell
3. -
4. / - TypeScript

1.6.2

- **TypeScript** JavaScript
- **Python**
- C Java
- Vue PHP

1.7

1.7.1

TypeScript vs Python

- TypeScript 16 vs 10
- Python 116k vs 13k
- TypeScript
- Python

- **Web** TypeScript
-
- **AI** Python AI/ML TypeScript AI

1.8

1.8.1

1. TypeScript Web
2. Python
3. vs

1.8.2

1. TypeScript
2. C
3. **AI** AI

1.8.3

1. TypeScript Python
2.
3. AI

1.9

1.9.1

-
- Fork
-
-

1.9.2

- 14
- GitHub
-
- GitHub

1.10

1.10.1

1. **TypeScript** TypeScript
2. **Python** Python
3. C Vue PHP
4. **AI** AI

1.10.2

1. Web TypeScript Python
2. JavaScript TypeScript
3. TypeScript Python AI
4. AI

1.10.3

- TypeScript
- Python
- AI
-