

# CityInsights: Urban Feature Visualization Using OpenStreetMap Data

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## Abstract

**CityInsights** is a Python-based geospatial visualization tool that analyzes and maps key urban features including parks, libraries, museums, and road networks using OpenStreetMap data. The project provides urban planners, researchers, and policymakers with intuitive visualizations of city infrastructure across multiple global cities. Implemented with OSMnx, GeoPandas, and Matplotlib, it offers a comprehensive solution for urban feature analysis and comparative city studies.

## 1 Project Overview

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CityInsights enables the visualization and analysis of four critical urban elements:

- **Parks:** Green spaces and recreational areas
- **Libraries:** Public knowledge infrastructure
- **Museums:** Cultural and educational institutions
- **Major Roads:** Transportation networks

## 2 Supported Cities

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Currently implemented cities:

- **Boston, USA:** Historic city with mixed urban planning
- **Barcelona, Spain:** Famous for its grid-based Eixample district
- **Amsterdam, Netherlands:** Canal-based urban structure

## 3 Technical Implementation

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### 3.1 Core Dependencies

- **OSMnx** (0.16.0): For OpenStreetMap data retrieval
- **GeoPandas** (0.10.0): For geospatial data manipulation
- **Matplotlib** (3.5.0): For visualization

## 3.2 Installation

Listing 1: Installation commands

```
1 # Install core dependencies
2 pip install osmnx geopandas matplotlib
3
4 # Install CityInsights package
5 pip install CityInsight
```

## 4 Functionality

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### 4.1 City Visualization Functions

Each city has dedicated visualization functions:

Listing 2: Basic usage example

```
1 from CityInsight import (
2     plot_boston_roads_network,
3     plot_barcelona_roads_network,
4     plot_amsterdam_roads_network
5 )
6
7 # Generate visualizations
8 plot_boston_roads_network(show_plot=True)
9 plot_barcelona_roads_network(show_plot=False, save_path="barcelona.png")
```

### 4.2 Visualization Parameters

- `show_plot` (bool): Display interactive plot (default: True)
- `save_path` (str): Custom save location for output image
- `dpi` (int): Image resolution (default: 300)

### City of Boston Parks, Libraries, and Major Roads

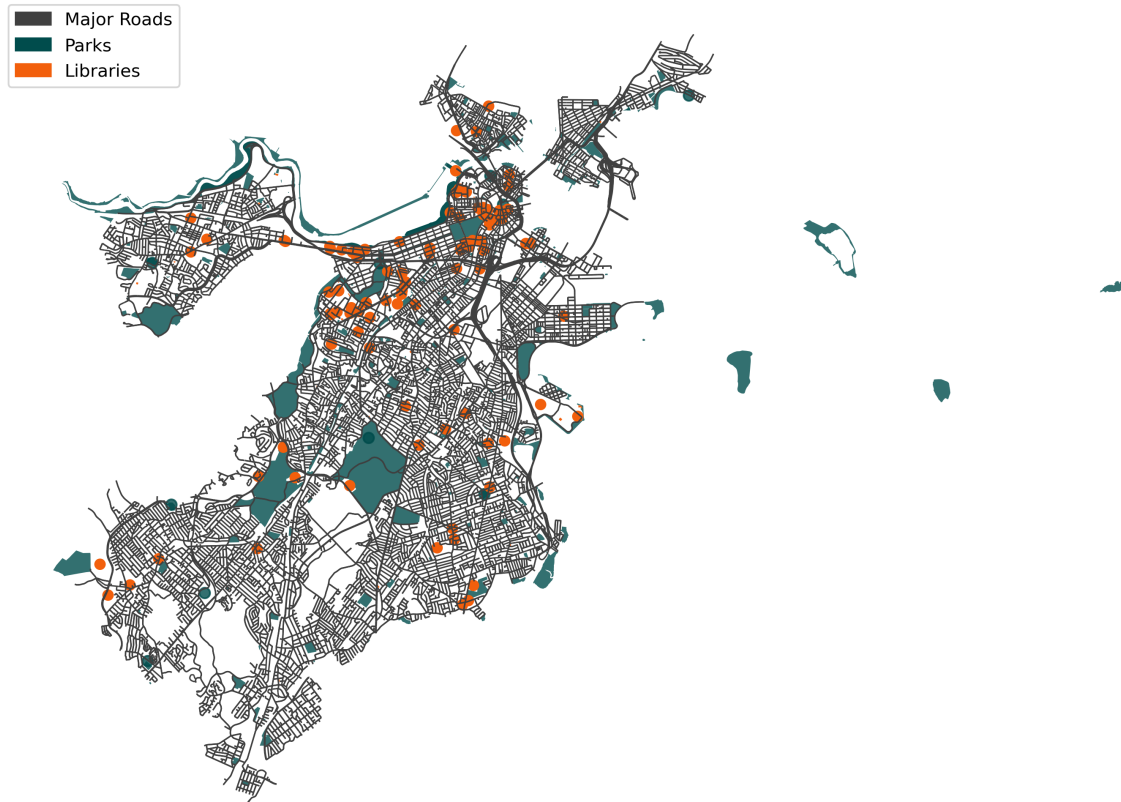


Figure 1: Boston Urban features

Figure 2: Boston urban feature visualization showing road network (gray), parks (green), libraries (orange), and museums (blue)

## City of Barcelona Parks, Libraries, Museums, and Roads

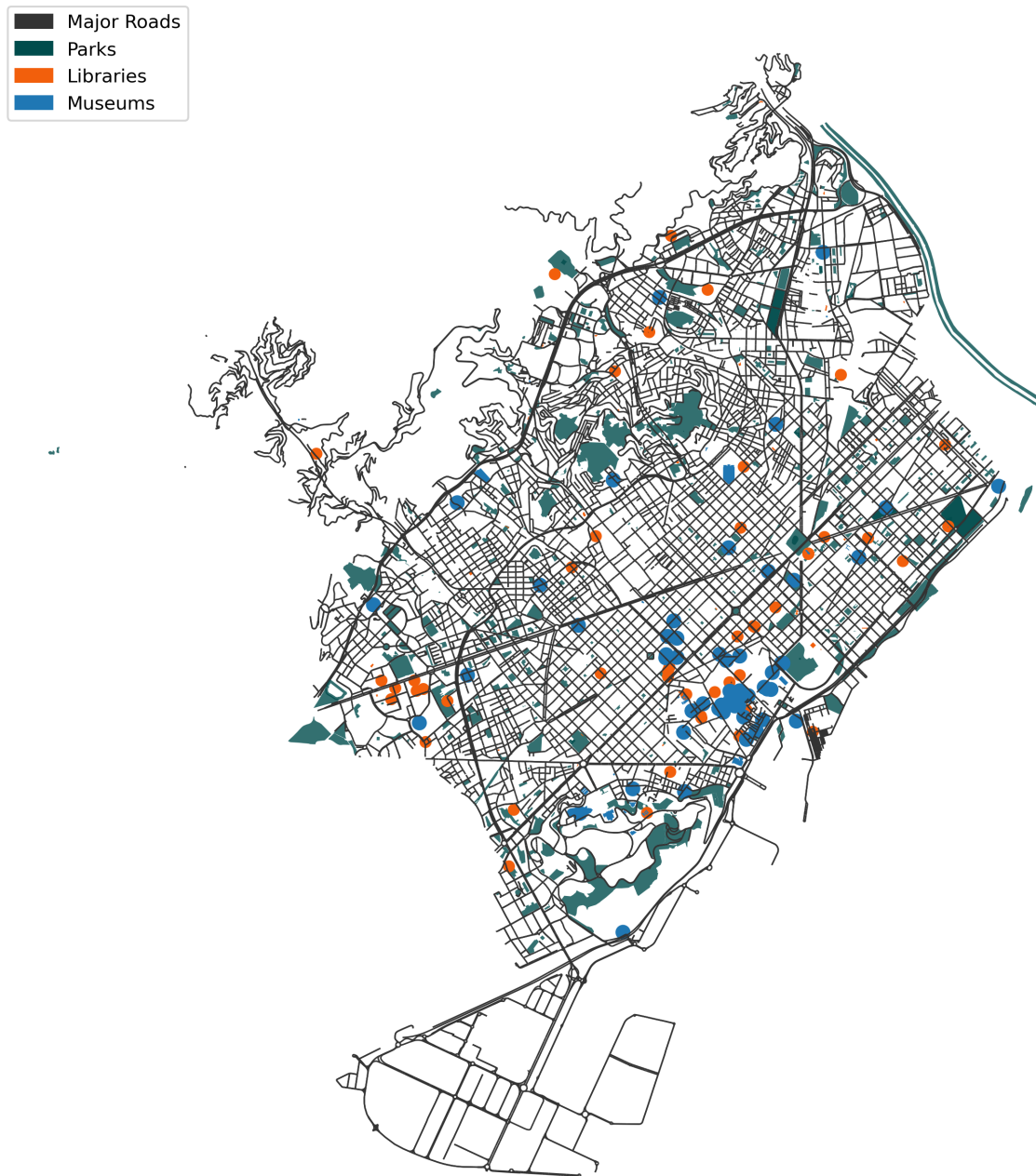


Figure 3: Barcelona Urban features

Figure 4: Barcelona street network analysis showing connectivity patterns

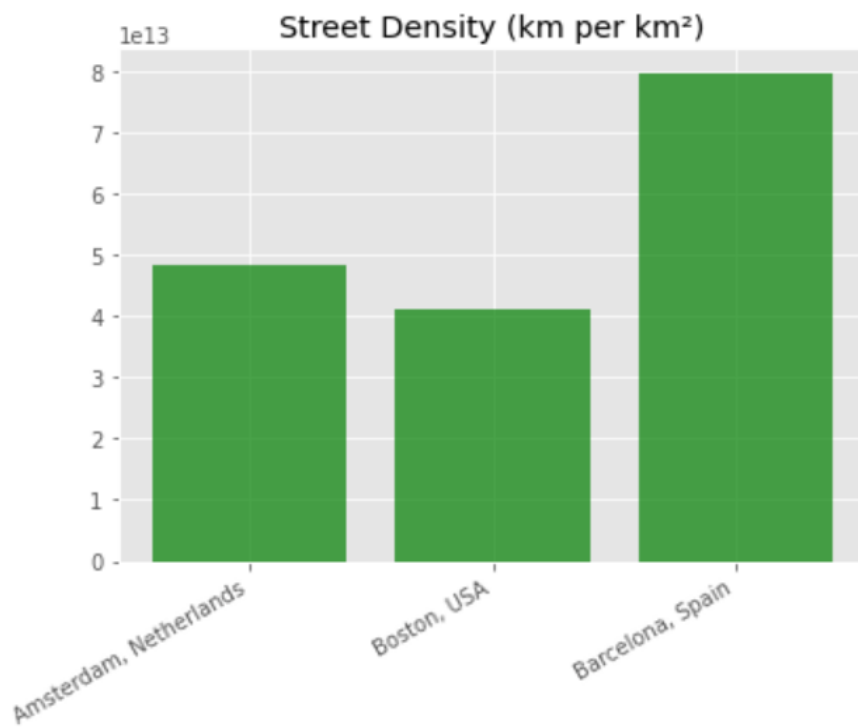


Figure 5: Street Density

Figure 6: Street density heatmap for urban form analysis

## 6 Advanced Metrics

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The project includes sophisticated urban analysis capabilities:

### 6.1 Network Analysis

- Street density calculations
- Intersection density mapping
- Circuity (average edge straightness) analysis

## 6.2 Statistical Visualizations

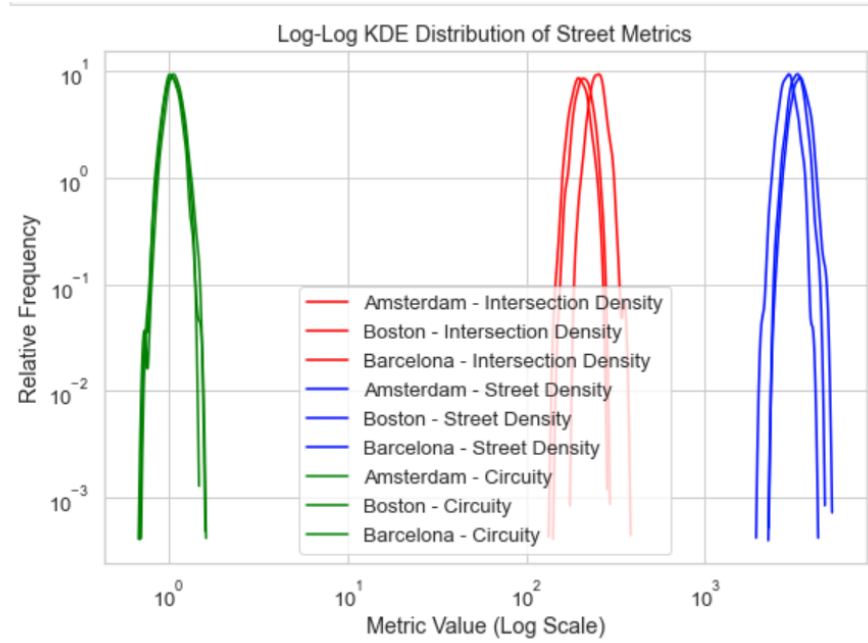


Figure 7: Distributions of the Streets metrics

Figure 8: Log-log distribution of street network metrics

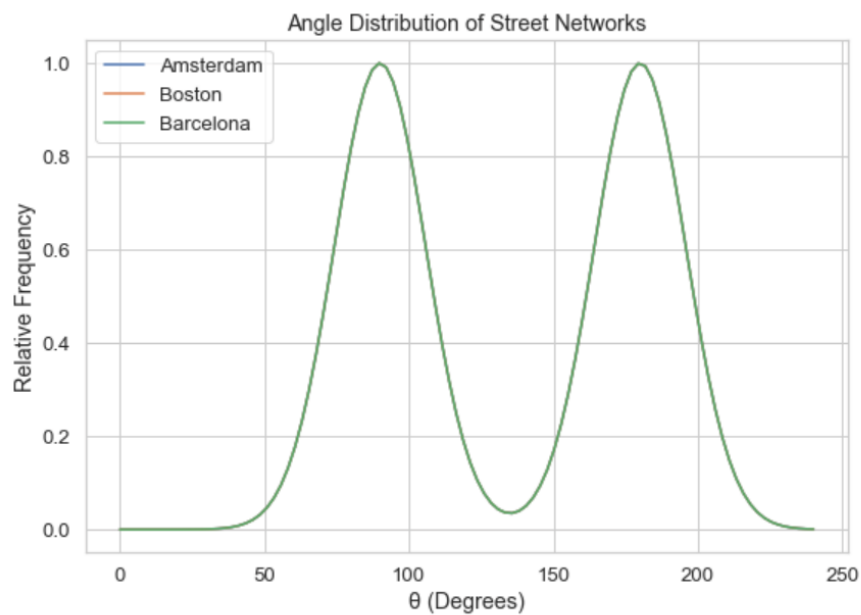


Figure 9: Streets distributions analysis

Figure 10: Street orientation analysis through angle distribution

## 7 Testing Framework

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The project includes comprehensive unit tests:

Listing 3: Running test suite

```
1 pytest tests/test_Boston_Roads_network.py
2 pytest tests/test_Barcelona_Roads_network.py
3 pytest tests/test_Amsterdam_Roads_network.py
```

Test coverage includes:

- Data fetching validation
- Plot generation verification
- Output file existence checks

## 8 Project Structure

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CityInsight/

```
CityInsight/
  __init__.py
  Boston_Roads_networks.py
  Barcelona_Roads_networks.py
  Amsterdam_Roads_networks.py

tests/
  test_Boston_Roads_network.py
  test_Barcelona_Roads_network.py
  test_Amsterdam_Roads_network.py

examples/
docs/
setup.py
README.md
```

## 9 Applications

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- **Urban Planning:** Infrastructure gap analysis
- **Academic Research:** Comparative city studies
- **Tourism Planning:** Cultural resource mapping
- **Accessibility Studies:** Service distribution analysis

## 10 Contributing Guidelines

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- Fork the repository and create feature branches
- Follow PEP 8 style guidelines
- Include tests for new functionality
- Update documentation accordingly
- Submit pull requests with clear descriptions

## 11 License

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This project is licensed under the **MIT License** - see the LICENSE file for complete details.

## 12 Contact Information

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