# Discovering Underground Maps from Fashion

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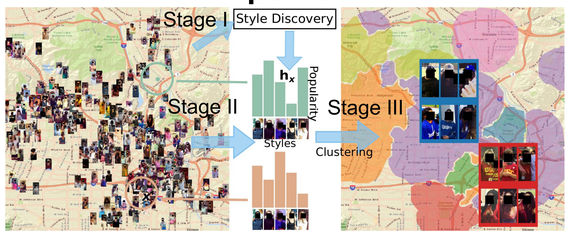
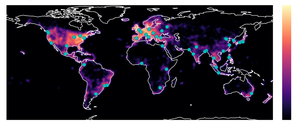
## Contributions


- Discovering neighborhood maps with **similar fashion sense**.
- These **underground** maps capture how a neighborhood is perceived and experienced.
- Using these underground maps for various applications:
  - Finding **unique** neighborhoods.
  - Finding **similar/analogical** neighborhoods.

## Pipeline




Stage I - Style Discovery

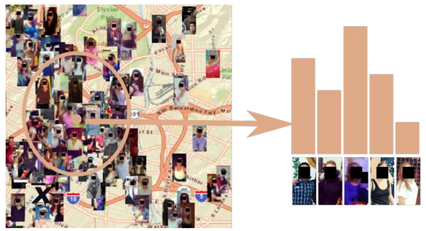


37 cities
3 years (June 2013-May 2016)
7.7 million images

- Use fashion attribute model to get **features** for images.
- Find unique styles by **clustering** with these features.

Stage II - Creating Style Histograms

- We characterize a location using images from its close surrounding.
- Images are binned into styles and the histogram is used as a feature.



Stage III - Grouping Neighborhoods

- Locations are clustered using k-means over style histograms.
- Overlap in information of proximal histograms leads to smoother neighborhood maps.

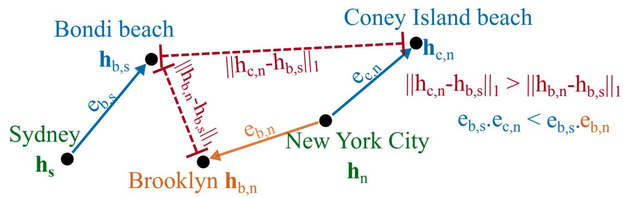
## Applications

Finding Unique neighborhoods

$$n_{\text{unique}} = \arg\max_{n} \min_{m \in N, m \neq n} ||\boldsymbol{h_{n,c}} - \boldsymbol{h_{m,c}}||_1$$

- Neighborhood most **distinct** from all other neighborhoods in a city.

Finding Analogical neighborhoods




- Comparing histogram does not work if cities are very different.
- Instead finding analogy in relation to cities.
- Bondi beach : Sydney:: Coney Island : NYC

$$e_{n,c} = \text{sgn}(\boldsymbol{h}_{n,c} - \boldsymbol{h}_c)$$

## Results

Our method can capture how a **neighborhood is perceived**.

| Method | HM Benchmark | | |
|---|---|---|---|
| | NMI | Purity | MMIoU |
| Traditional | 0.235 | 0.570 | 0.256 |
| **Underground** | **0.291** | **0.652** | **0.281** |

- HM (HoodMaps) benchmark has similarity maps based on how people perceive a neighborhood.

Our method can capture the **activities of a neighborhood**.

| Method | BD Benchmark | | |
|---|---|---|---|
| | NMI | Purity | MMIoU |
| Traditional | 0.282 | 0.686 | 0.260 |
| **Underground** | **0.323** | **0.742** | **0.281** |

- BD (Business Density) benchmark contains similarity maps based on the activities one can do at a place.

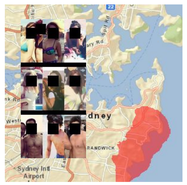


Unique neighborhoods.

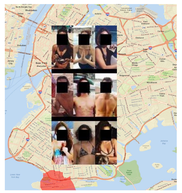


Similar neighborhoods.






Beaches




## Take-away

- Our underground maps can capture information different from traditional maps.
  - people's perception of a neighborhood (HM Benchmark)
  - activities in a neighborhood (BD Benchmark)
- Our method can be used for various use cases.

## Acknowledgment

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