

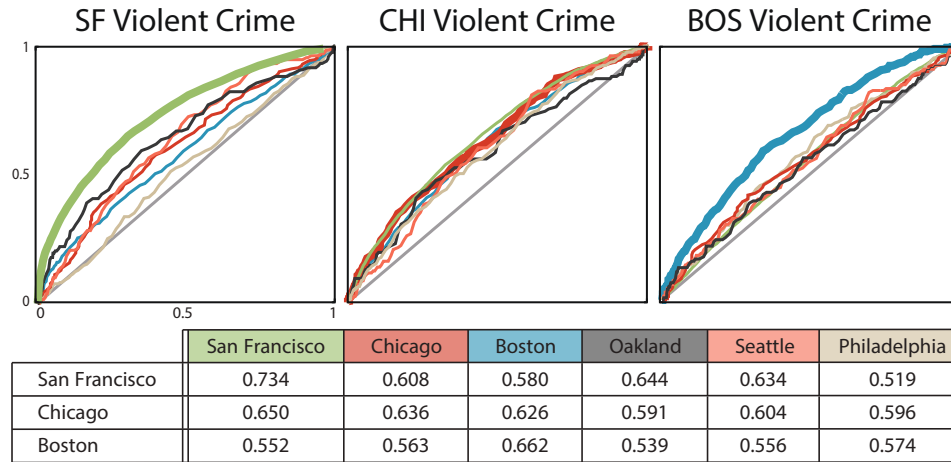
City Forensics: Using Visual Elements to Predict Non-Visual City Attributes

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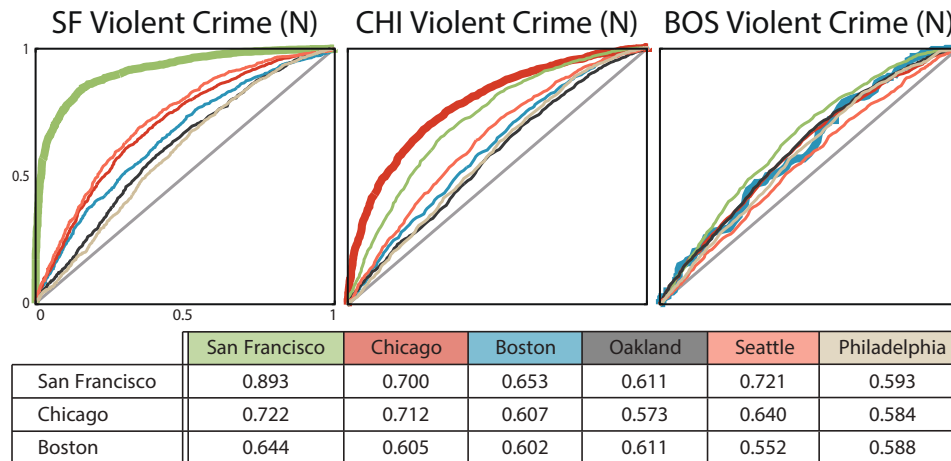
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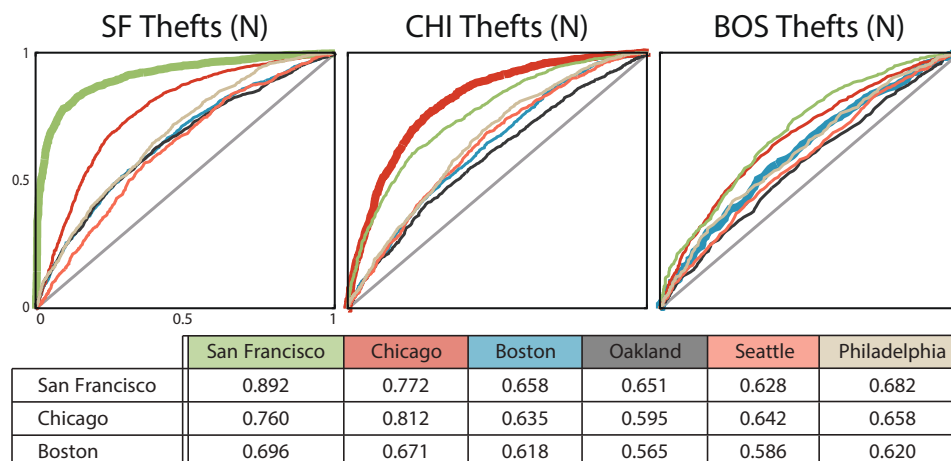
Maneesh Agrawala



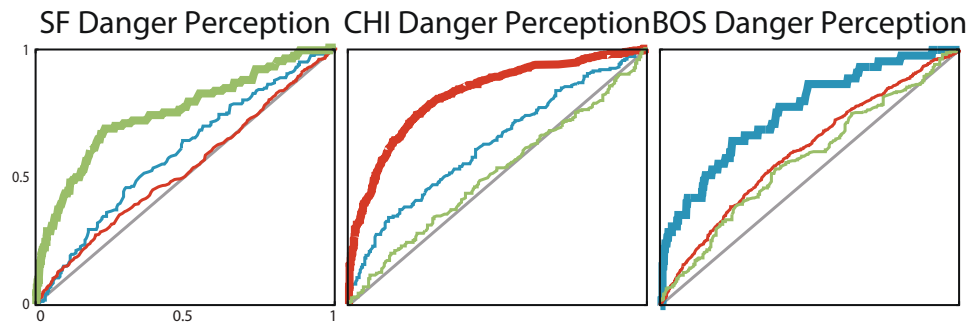
ROC Curves for Violent Crime



ROC Curves for Normalized Violent Crime



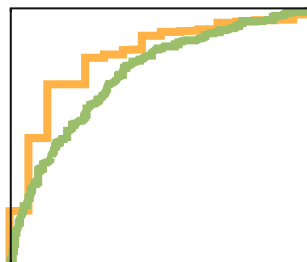
ROC Curves for Normalized Thefts



	San Francisco	Chicago	Boston
San Francisco	0.748	0.526	0.589
Chicago	0.513	0.823	0.629
Boston	0.570	0.602	0.756

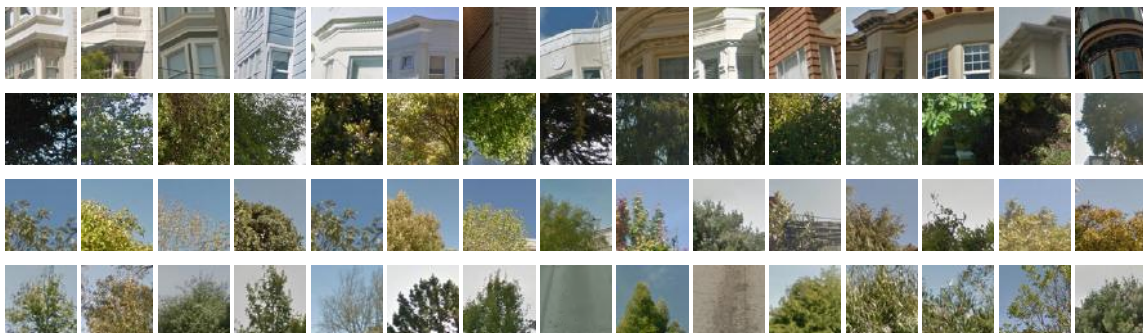
ROC Curves for Perception of Danger

SF Trees

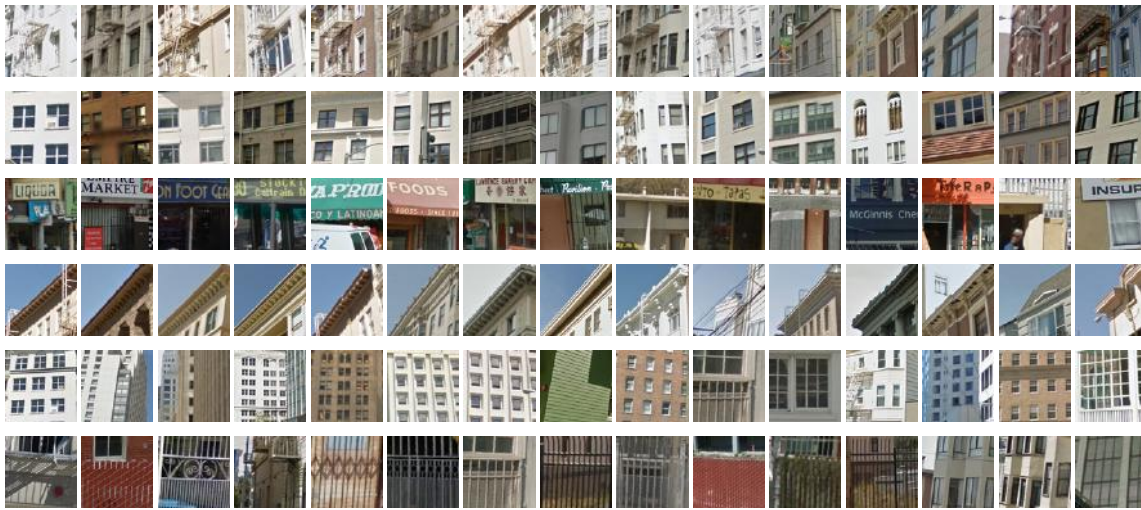


	Ground Truth	Mechanical Turk
San Francisco	0.750	0.811

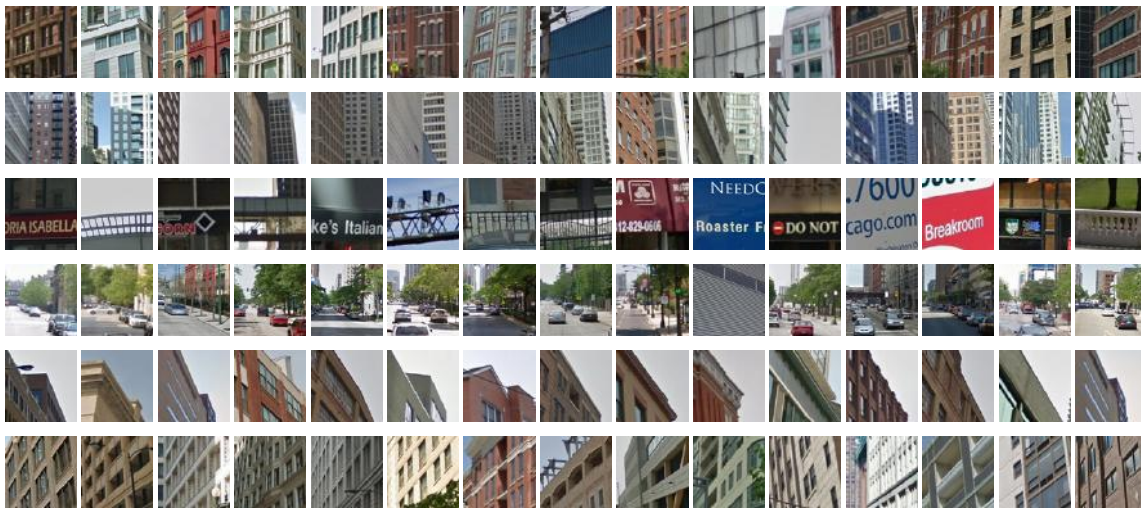
ROC Curves for Tree Presence



Visual Elements for Trees in San Francisco: Most of the visual elements for trees in San Francisco are simply examples of different styles of trees. One interesting note is that the first row is a visual element of an architectural style, likely specific to the presence of trees in San Francisco.



Visual Elements for Violent Crime in San Francisco: Our system finds that fire escapes on fronts of buildings, high-density apartment windows, dilapidated convenience store signs, metal gates, etc. relate to increased violent crime rates.



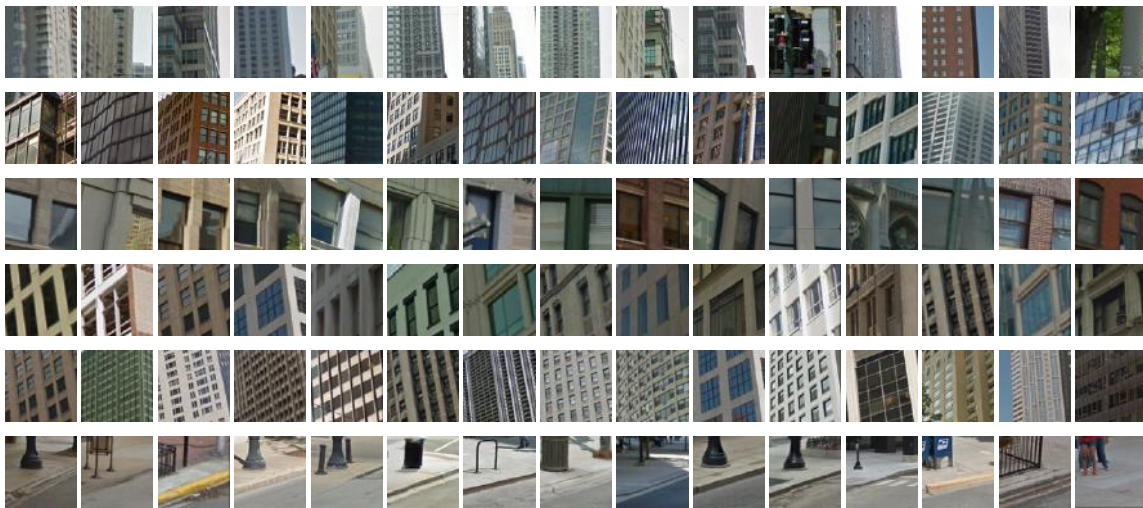
Visual Elements for Violent Crime in Chicago: Most of the visual elements for violent crime in Chicago are related to the visual appearance of the downtown area. However, there is also overlap with the visual elements for other cities such as the dilapidated signs.



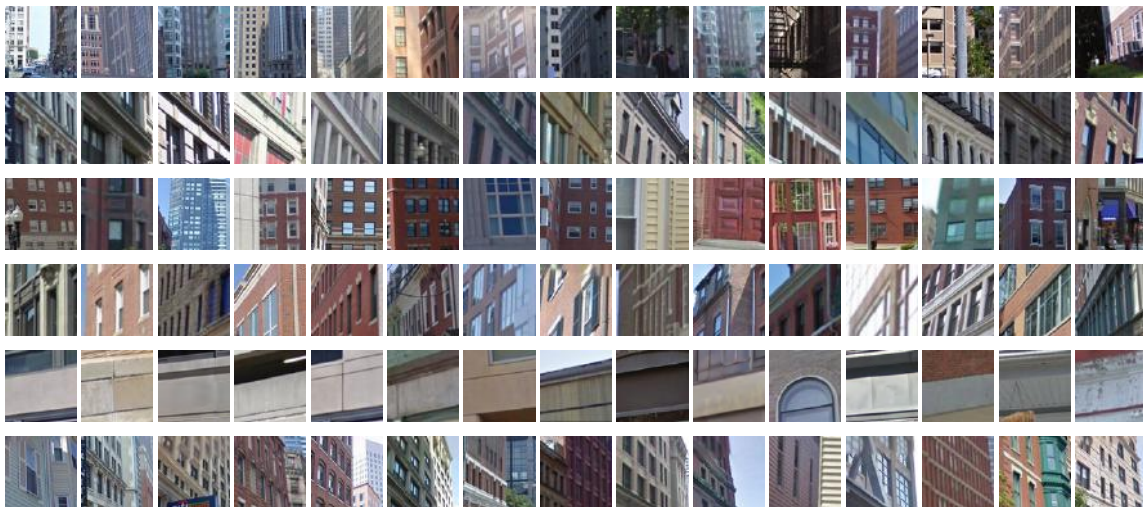
Visual Elements for Violent Crime in Boston: Overgrown trees, non-ornate windows, and the presence of vinyl siding are all discriminative visual elements for violent crime in Boston. These are notably different than the other cities, which explains the poor cross-city performance of the Boston predictor.



Visual Elements for Theft in San Francisco: The visual elements for San Francisco relate high density windows, drab windows, parking meters, etc. Most of these elements are found in the downtown areas of cities, which explains the high cross-city performance of the resulting predictor.



Visual Elements for Theft in Chicago: Similar to San Francisco, the visual elements in Chicago relate to high density windows and repeated vertical bars. This similarity is likely the cause for the high prediction accuracy between these two cities for the theft predictors.



Visual Elements for Theft in Boston: Boston shares a similar trend with San Francisco and Chicago; all of the visual elements relate to appearance associated with downtown areas. One element not present in the other cities is concrete buildings (row 5).



Visual Elements for Housing Prices in San Francisco: Foliage is a strong indicator of high housing prices in San Francisco. In addition, gable roofs and garage doors also indicate high house prices, which are rare in San Francisco known for its Victorian and Edwardian architecture.



Visual Elements for Housing Prices in Chicago: Similar to San Francisco, foliage is important in predicting housing prices. Brick buildings are also indicative of high housing prices in Chicago, but are rarely found in San Francisco.



Visual Elements for Housing Prices in Boston: We attribute the high performance of our Boston housing prices predictor to the variation in the visual elements and their individual uniformity (all of the images in a row look visually similar). The presence of trees, rounded door and window thresholds, and bayview-style windows all intuitively relate to high housing prices.



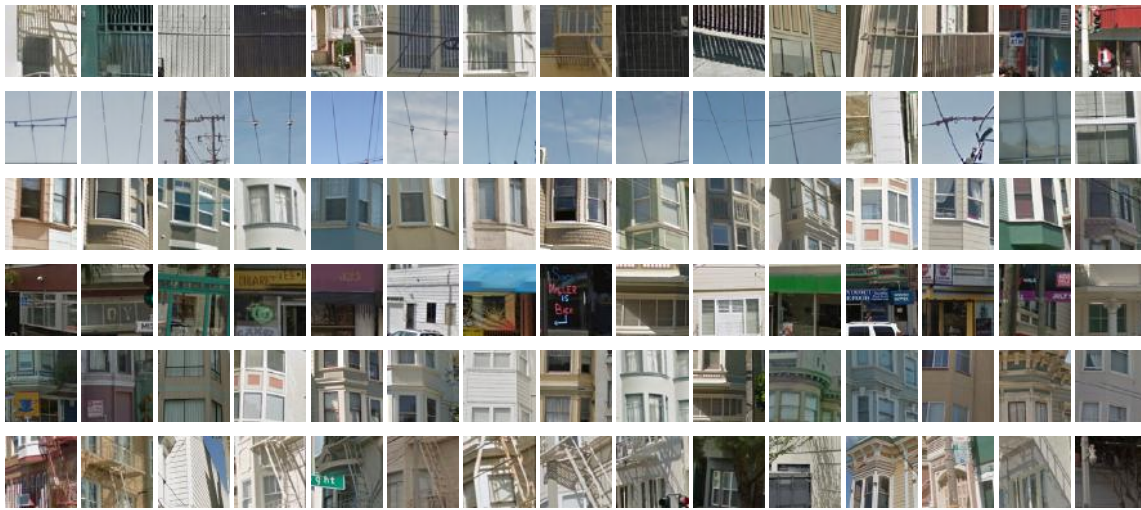
Visual Elements for Population in San Francisco: Although intuitively high density areas might be associated with downtown areas, population measured by the Census is more related to where people live. In San Francisco the high density residential areas are associated with the Mission district, which has a classic Victorian architectural look.



Visual Elements for Population in Chicago: Most of the visual elements contain architectural features of high-density apartment buildings. The last row captures the appearance of a trees, which seems unrelated to population density. However, we found most of the detections are from a large neighborhood in northeast Chicago that contains tree-lined streets and densely-packed homes.



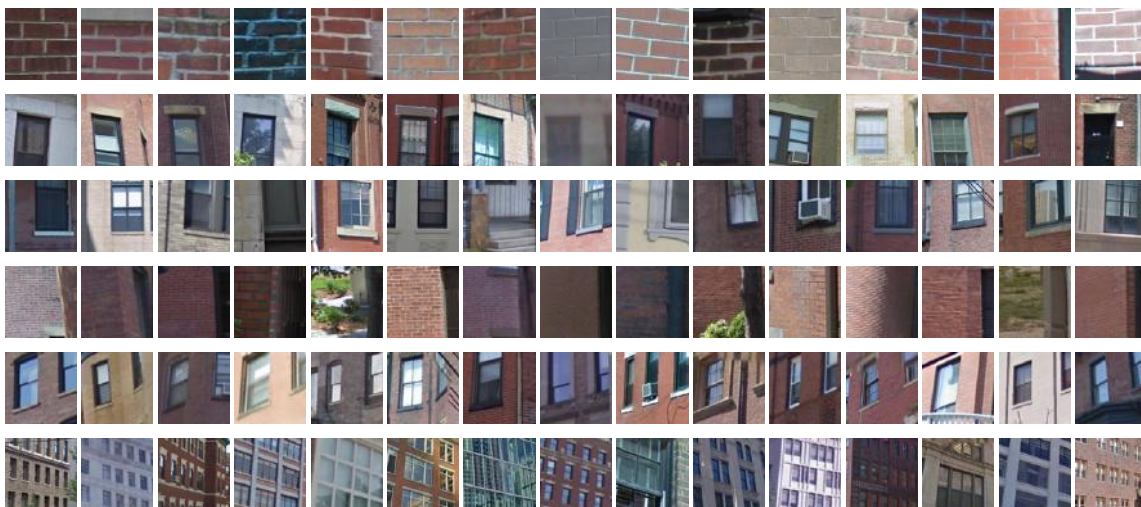
Visual Elements for Population in Boston: Unlike the other cities we trained in, Boston population has a stronger relationship to the appearance of neighborhoods than to general visual elements like high-density apartment buildings. Just as in Chicago, tree-lined streets are related to higher population density in Boston.



Visual Elements for Graffiti in San Francisco: Many of these visual elements correspond to architectural styles specific to certain locations in San Francisco (large bayview windows). Fire escapes (bottom row) are also indicative with graffiti.



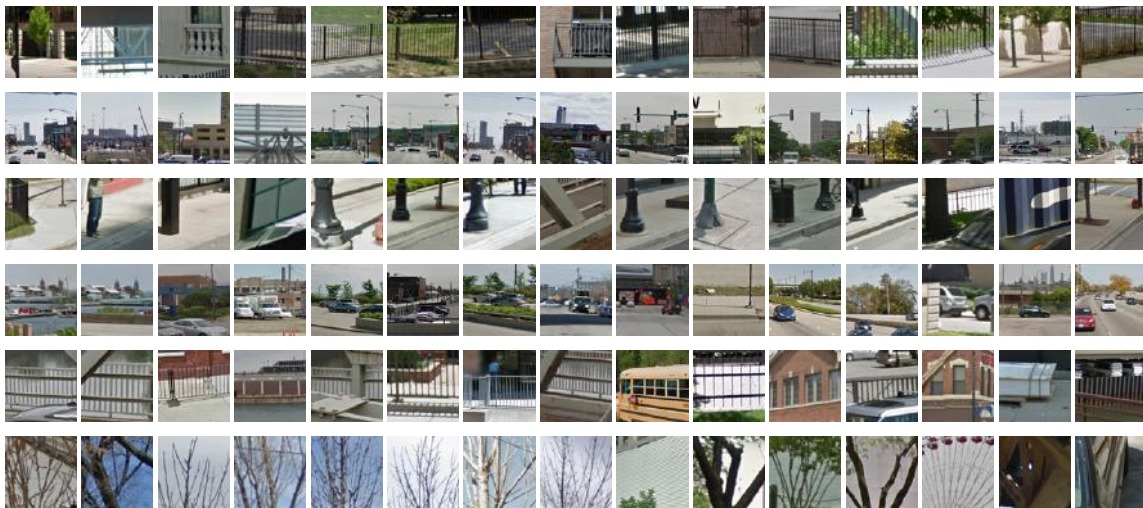
Visual Elements for Graffiti in Chicago: Drab windows set into brick, areas that have street lighting, and gated areas are all indicative of graffiti in Chicago. There is little overlap with the visual elements for graffiti in San Francisco. This is likely due to the fact that graffiti is correlated with buildings (where it typically appears) and the appearance of buildings in Chicago and San Francisco is quite different.



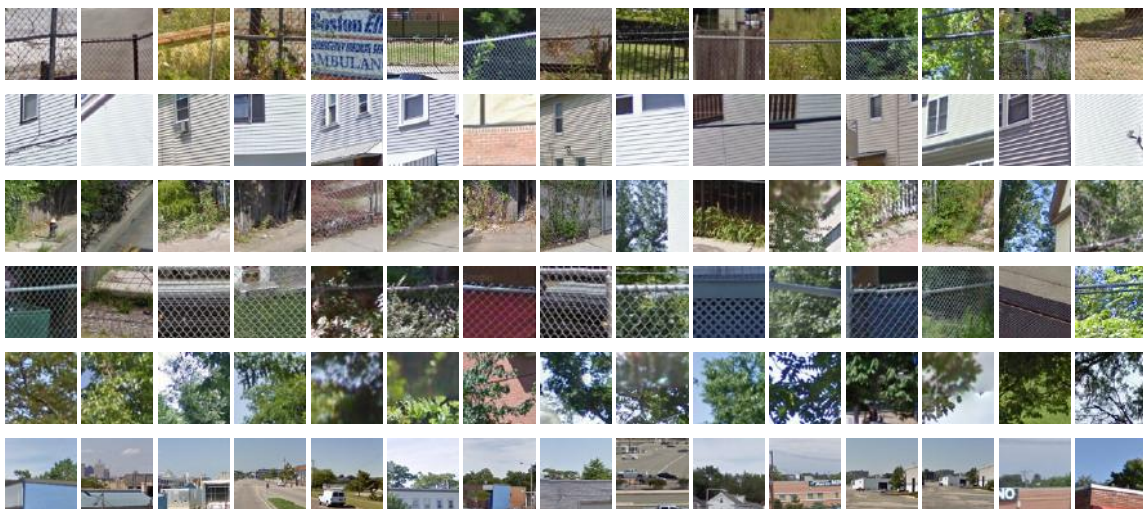
Visual Elements for Graffiti in Boston: As with San Francisco and Chicago, the visual elements that are discriminative of graffiti in Boston are relatively specific to the city. Like Chicago, the presence of brick is predictive of graffiti.



Visual Elements for Perception of Danger in San Francisco: Areas that have a lot of trees and open spaces are indicative of the perception of danger. In addition, overgrown sidewalks are also predictive of perceptually dangerous areas.



Visual Elements for Perception of Danger in Chicago: Wide-open spaces and fences are two of the most prominent visual elements for human perception of danger. Trees devoid of leaves also seem to be related to human perception of danger. Trees seem to be important as well, although the leaves of the trees are not present in the Google StreetView images.



Visual Elements for Perception of Danger in Boston: Like San Francisco, overgrown plants are a strong predictor of danger perception in Boston. Rundown buildings with vinyl siding and the presence of fences also indicate a perceptually dangerous location.