1. Motivation

The notion of “nearness” is a key feature used by location-based services, yet it has not received a rigorous treatment in the ubiquitous computing (ubicomp) literature. Usually, location-based services such as MapQuest address the nearness issue by assuming a fixed radius around a location, and treating all places within that radius as near. However, personal experience suggests that each person has their own perception of what places are “near” and that, when mapped out, these places would form a shape that is very different from a circle.

For example, one of the main entrances to the MIT campus is located at 77 Massachusetts Avenue (Mass Ave). My barber is located in Cambridge’s Central Square neighborhood, 0.8 miles from 77 Mass Ave. From 77 Mass Ave, I consider my barber near enough that I wouldn’t mind walking to his shop. On the other hand, there is a Virgin Music store located in the other direction along Mass Ave, across the Harvard Bridge in Boston. Yet, even though I know this store is also 0.8 miles away from 77 Mass Ave, I do not consider it near enough for me to walk to it.

This research investigates what factors influence a person’s perception of nearness. Specifically, I am looking at how nearness is influenced by a person’s familiarity with a neighborhood and shaped by the boundaries that define that neighborhood. My goal is to incorporate these factors into a model of an individual’s sense of nearness. My claim is that the features that are used as neighborhood boundaries — topography, major streets, demographics — are all identifiable and can be used to objectively explain individual differences in the seemingly subjective assessment of nearness. Moreover, I claim this holds as the scale space under consideration changes.

2. Approach

My research is divided into two major sub-areas. The first area is identifying where different neighborhoods are located and what features of the urban landscape people use to define neighborhood boundaries. I am particularly interested in how local neighborhoods, those without formally dictated boundaries (for example, Boston’s Back Bay, or Cambridge’s Harvard Square) are defined. The second area of work is to identify which of these features shape the area that a person considers to be nearby. I have just started this line of research, and in this abstract, I will focus the discussion on the second area.

As illustrated in the anecdotal example at the start of this abstract, I believe that nearness is in large part shaped by the number and type of boundaries between two places. A place $P$ that is $x$ miles from reference place $R$ and in the same neighborhood as $R$ may be considered near $R$. However, another place $P'$ that is also $x$ miles from $R$ but in another neighborhood may not seem near due to the number of boundaries separating $P'$ from $R$. However, nearness is also influenced by the places we frequent, and this would reduce the cumulative effect of boundary crossings on our perception of nearness and thus explain individual differences in the nearness perception.

As a first step in this research, I conducted a study in which I asked people to imagine they are at different subway stops. Then, without the aid of a map, I presented a list of places and asked “If a person comes up to you on foot and asks you which of these places are near the T stop where you are, how would you respond?” Figure 1 shows a map of one subway stop and some of the places on the list for that subway stop. After participants completed the survey, I then presented them a map of the Boston-Cambridge area and asked them to sketch the boundaries to a number of neighborhoods. The goal of this survey is to provide insight into a number of questions:

- Is there a consistent set of features that both define neighborhood boundaries and influence a person’s perception of nearness? Do neighborhood boundaries that are less distinct (such as the boundary between Central and Harvard Squares) have a different effect on our sense of nearness than those boundaries that are more distinct?
- For a given individual, can the criteria used to define what is near one particular location be used to determine what that person would consider to be near another location? Can this criteria be generalized across individuals?
3. Related Work

Denofsky proposed three different thresholds that could be applied when determining if two items are near one another (Denofsky, 1976). These thresholds are an absolute range threshold, that uses the maximum possible distance between two items; an object size threshold that takes into account the largest dimensions of the items under consideration; and a “standard” threshold that looks at the distance between “adjacent” pairs of items in the same area as the pair of items under consideration. Like Denofsky, I treat nearness as a context-sensitive metric, but instead of looking at relative distance as the influencing factor, I use a person’s familiarity with a region and the boundaries between regions as features that influence the sense of nearness.

The neighborhood boundary sketching part of my study is patterned after Montello’s study of vague spatial referents (Montello et al., 2003). This study investigated various behavioral methods for identifying informally defined areas such as “downtown.” In addition to developing various methodologies for determining the referents of such areas, Montello also found that some regions had a defining core location that was not necessarily located in the centroid of the region. Part of my future work will look into programmatically identifying the boundaries to neighborhoods like these and the core locations around which they are built.

4. Contribution

Despite the various computing infrastructures available for providing accurate and precise location information, ubicomp applications still need to account for a person’s perceived notion of nearness. Although these notions may be incorrect or based on incomplete information, having applications simply provide an objective ground truth with regards to distance is not sufficient. In order to provide personalized location-based recommendations, ubicomp applications need to understand the reasoning process a person uses to determine if something is nearby. Understanding this process allows us to do two things. First, it improves the relevance of suggestions produced by location-based applications. Second, by understanding the process, it makes it easier for applications to correct people’s spatial misconceptions.

References
