

# The Concept of Geographic Relevance

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## INTRODUCTION

The almost ubiquitous access to geographic information has become a commodity owing to affordable and powerful mobile devices, widespread availability of mobile network connectivity, provision of spatial data sets, and services built upon them. Such mobile services employing geographic information, for instance location-based services (LBS) or mobile traffic and tourism related services are increasingly developed and deployed.

The acceptance and success though is still lagging behind expectations for different reasons (Reichenbacher 2009). The main hindering factor is the lack of utility due to information mismatch, inadequacy or irrelevance of information and unsatisfying usability because the presentation of information is not adapted to the mobile Internet and designed according to cognitive principles.

Missing in the majority of mobile services, including LBS is a broad and comprehensive and theoretically grounded concept of relevance. Although relevance has been studied for long in information science with respect to information retrieval, it has not been investigated under a geographic perspective that is indispensable if dealing with geographic information relevance. Such a notion of relevance is proposed here and termed geographic relevance.

## DEFINITION OF GEORAPHIC RELEVANCE

Geographic relevance (GR) is a quality of an entity in geographic space or its representation, i.e. an object, document, or image. This quality is expressed as the relation between the entity or its representation and the actual context of using the representation (Fig. 1). The elements in the geographic representation can be discrete objects, properties of the objects, relations between objects, or the structure of objects. The main dimensions of the usage context are theme, space, time, intention, and knowledge state.

Thus GR is the degree to which information in a representation of geographic space either matches a user's implicit or explicit (expressed as a query) information need and to which it supports decision-making or problem solving .

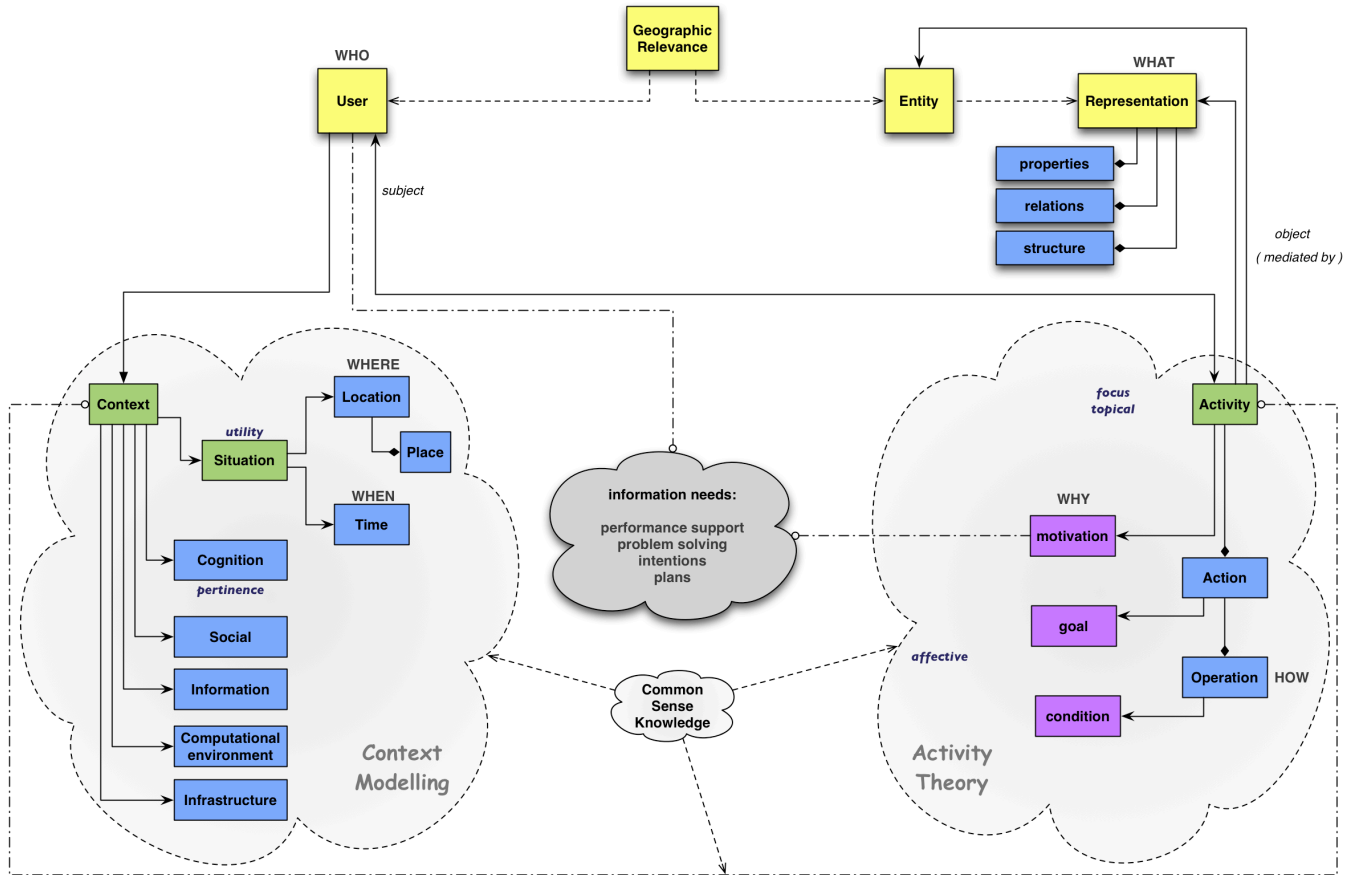


Figure 1: A conceptual model of geographic relevance

## A CONCEPTUAL MODEL OF GEOGRAPHIC RELEVANCE

Classic IR is not explicitly concerned with the spatial dimension of information and judges relevance only based on the match between query terms and the terms found in documents. Some of the shortcomings of classic information retrieval methods for geospatial applications have recently been addressed in many research projects and have led to an extension termed geographic information retrieval (GIR).

However, as for classic IR, GIR might be driven by geographic information needs, but is mainly concerned with retrieving documents (web pages or images). GR on the other hand is more closely tied to the physical world, than to the informational world and aims at supporting mobile user activities in addition to fulfilling spatial information needs. GR is associated with a geographic information need (Raper 2007), a spatial problem to solve, a goal to be achieved, or an activity to be supported.

In LBS the focus is on location only and often too simple spatial concepts (e.g. buffers around the user's position as a binary information filter) are employed to determine the relevance. Context-awareness is often reduced to determining the current position of a user. Yet, apart from spatial relations there are several other factors and challenges in mobile usage situations originating from physical environmental states, temporal constraints, mobile users' information

needs and activities, technical limitations and many more that give rise to contextual information needs (Fig. 1).

In a current research project on GR in mobile applications (GeoRel) we postulate a theoretic foundation for GR based on fundamental geographic concepts (e.g. spatio-temporal distances and constraints, spatial associations) and different theoretical threads, such as activity theory, time geography, and cognitive science.

The idea of current LBS is extended by shifting the location-based perspective to a relevance-based perspective, including time, topic, and motivations, i.e. geography is employed as a unifying framework by the nexus of location (where), time (when), and objects (what). Also, we suggest more sophisticated spatial concepts for filtering content than simple distance-buffer selections applied in most LBS.

Usage context in our model is subdivided in two main components (Fig. 1). The context model includes dimensions of the user environment (i.e., location, time, cognitive state, computational and infrastructural environment, etc.), habits and preferences. The user's actual mobile activity with its actions and operations as well as the corresponding motivations, goals, and conditions are modelled separately in activity model.

The reason for a separate activity model is that we approach GR under the perspective of activity theory (AT), since activities offer a structured and useful framework for the mobile usage context involving geographic (spatio-temporal), structural, and perceptual (visual) context. Furthermore, mobile activities trigger geographic information needs (Fig. 1) as well as questions or problems that should be supported by the concept of GR in providing relevant geographic information objects answering the where, what, and when aspects.

AT is a descriptive theory that aims to extract knowledge from the interactions of humans with their external world, with these interactions being mediated through the use of tools (Kaptelinin and Nardi 2006). Recently this theory has been successfully applied in Human Computer Interaction (HCI) research to model internal motivations of users for improved context modelling (Greenberg 2001). Studies into mobile map usage have also found AT to be a useful framework for highlighting relevant spatio-temporal context (Huang and Gartner 2008).

An initial stage in implementing AT for GR is to first build a typology of activities performed by mobile map users (Reichenbacher 2004). Analysis of academic papers and online documents resulted in a total of 22 primary activities that could benefit from a GR assessment:

Shopping for Goods<sup>i</sup>, Shopping for Services<sup>ii</sup>, Sight Seeing<sup>iii</sup>, Socialising<sup>iv</sup>, Playing<sup>v</sup>, Exercising<sup>vi</sup>, Hiking<sup>vii</sup>, Wildlife Spotting<sup>viii</sup>, Event Planning<sup>ix</sup>, Touring<sup>x</sup>, Local Information Seeking<sup>xi</sup>, Responding<sup>xii</sup>, Inspecting<sup>xiii</sup>, Tracking<sup>xiv</sup>, Networking<sup>xv</sup>, Delivering<sup>xvi</sup>, Driving<sup>xvii</sup>, Walking<sup>xviii</sup>, Train Travel<sup>xix</sup>, Flying<sup>xx</sup>, Travel by Wheelchair<sup>xxi</sup>, Cycling<sup>xxii</sup>.

Subsequent phases of the GeoRel project will involve focusing on a small number of these activities and breaking them down to lower level processes of actions and operations. These will then be used for accurate parameterisation and weighting of the GR model.

## DISTANCE AND GEOGRAPHIC RELEVANCE

Our approach to GR is guided by the basic assumption derived from the first law of geography (Tobler 1970). Other things being equal we assume the shorter the distance in any relevance dimension (space, time, property, etc.), the more relevant an information object is in a given usage context. This becomes intuitively obvious, if we think of the potential of nearer objects to be either perceived, reached (accessibility), to fit into existing knowledge, or to be efficiently used in solving a problem or to be supporting an activity.

Apart from spatial distances we propose to also use an abstraction of distance for capturing non-physical distances such as conceptual or semantic distances between the user's activity and the object itself. The combination of a set of "real" and "conceptual" distances should provide a more comprehensive relevance notion.

Recent developments in Artificial Intelligence and Data Mining techniques give us the opportunity to better understand the environment described by both spatio-temporal and semantic data. First, the analysis of spatio-temporal clusters and patterns could lead to a broader relevance evaluation, that would take into account not only a single geographic information object (GIO) but also its surroundings. Secondly, Common-Sense Knowledge Bases (Liebermann 2008) could contribute to fill up a part of the knowledge gap between humans and computer systems, i.e. the knowledge that is obvious for humans but missed by computers. These are huge databases that collect relationship between concepts, where this relationship describes some kind of knowledge usually common to everyone, such as "A tourist can visit a museum" or "A mall is for shopping".

## REPRESENTATION OF GEOGRAPHIC RELEVANCE

Following the relevance assessment each GIO will possess a value of relevance. A further question is how best to represent this information effectively for users of mobile systems. An overall aim of the representation will be to effectively communicate the concept of relevance to the user.

A good conceptual basis for the representation is important (Peuquet 1988). Experimentation has proved physical or conceptual phenomena are cognitively separated at a fundamental level and so representation of them must also be treated differently (MacEachren 1995). GR is a non-physical quality of a real-world entity and so any representation is best classified as conceptual.

Raper (2007) describes GR as extending over space. A further consideration is therefore whether this spatial extension is object (discrete) or field like (continuous). Recent research into conceptual theories of spatial representation have suggested that reality is more field like but human perception of the external world is more similar to the discrete view (Liu et al. 2008; Goodchild et al. 2007). There is also some evidence that these differing concepts can coexist (Cova and Goodchild 2002). It is expected that both discrete or continuous concepts will be necessary to fully realise the representation of GR. Which concept is most applicable will depend upon several contextual factors including activity type, real world characteristics of entity, conception of space, computational environment and spatial scale (Paay and Kjeldskov 2005). Theories of representation, activity, spatial cognition, cartography, information seeking behaviour and HCI will be used to fit the representation to the contextual factors.

## ACKNOWLEDGEMENTS

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<sup>i</sup> <http://searchenginewatch.com/3624179>

<sup>ii</sup> <http://www.urbanspoon.com/spin-widget>

<sup>iii</sup> <http://www.camineo.com/references-en.html>

<sup>iv</sup> <http://www.citysense.com/home.php>

<sup>v</sup> <http://www.pervasive-gaming.org/index.php>

<sup>vi</sup> <http://sportstracker.nokia.com>

<sup>vii</sup> <http://www.springerlink.com/content/v80247428j57m080/>

<sup>viii</sup> <http://www.geo.unizh.ch/~aje/pdf/WebPark%20lbs%20for%20species.pdf>

<sup>ix</sup> <http://web.orange.co.uk/p/glastonbury/glastonav>

<sup>x</sup> <http://www.spatialadventures.com/>

<sup>xi</sup> [http://www.similarity-blog.de/talks\\_and\\_papers/LocalNewsJanowiczSchoeningDraft.pdf](http://www.similarity-blog.de/talks_and_papers/LocalNewsJanowiczSchoeningDraft.pdf)

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- xii <http://www.esri.com/library/fliers/pdfs/cs-nchealth.pdf>
- xiii <http://www.sigmaseven.co.uk/geofield.htm>
- xiv <http://news.thomasnet.com/fullstory/540075>
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- xvi <http://www.ubisense.net/content/22.html>
- xvii <http://v3d2.tu-bs.de/V3D2/pubs.collection/Heron/hicss03.pdf>
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- xxi <http://www.spiegel.de/international/0,1518,467753,00.html>
- xxii <http://www.a-zmaps.co.uk/?nid=60&iid=3476>