

# Preface

*Navigare necesse est*

(attributed to Gnaeus Pompeius Magnus)

Landmarks are a fascinating subject of research. On one hand they are ubiquitous in our thinking and speaking about our living environment. We refer to them when describing our internalized image of place or when describing where we are or where we will meet. Tourist brochures try to convey the image of a place by referring to its landmarks Paris is the Eiffel Tower, the Seine river, Notre Dame, and the Louvre. The first-time tourist arriving in Paris may not know more about that place than these landmarks. Experts call this *landmark knowledge* and see landmarks as building blocks of more complex spatial knowledge such as route or survey knowledge. But despite their fundamental role for spatial knowledge, landmarks are surprisingly difficult to define and characterize. As a consequence, they are also difficult to capture in formal models for computation and information services.

To put it bluntly there is a gap between the way how people memorize, think, and talk about their environments and the capacity of information services to store, analyze, or interact with people about environments. A landmark is neither a feature type in current spatial databases, nor do the database taxonomies reveal anything of the nature of landmarks. Let us just check with the above examples of landmarks. Instead of belonging to a single type *landmark* in a spatial database, they actually belong to very different types: in this case tower, river, church building, and museum, or, at higher levels of abstraction, man-made or natural objects. Databases are also restricted by their geometric approach to describe location, while landmarks would require a qualitative rather than quantitative approach. Natural language expressions such as “in front of the Louvre” or “not far from Notre Dame” are hard to interpret by means of a vector geometry used in current spatial databases. A rich number of similar examples can be cited to support that using current services is not intuitive in this sense or, put differently, that these services are not intelligent in the sense of Turing’s envisioned intelligent machine [6, 7]. And these services reach far into our lives by answering the fundamental *where* and *when* questions in any

context. They include services such as simple search, webmapping, mobile location-based services, mobile guides, car navigation services, public transport planners, and emergency call centers, as they involve more and more natural language interaction.

This book will address this gap. It is reporting on latest research on landmarks in geographic environments and practical applications of this research in information service provisions. It covers a spectrum of disciplinary fields encompassed by what has been called cognitive computation by some or spatial cognitive engineering by others. The disciplines involved are from life sciences (neurosciences), social sciences (psychology, cognitive science, linguistics), engineering (artificial intelligence, information systems), physical and mathematical sciences (geomatics), and humanities (geography, philosophy).

The reader can expect from this book a broad **scope** covering perceptual and cognitive aspects of natural and artificial cognitive systems, conceptual aspects of trying to define and formally model these insights, computational aspects with respect to identifying or selecting landmarks for various purposes, and communication aspects of human-computer interaction for spatial information provision. The **origin** of the book goes back to our own, originally separate work on computational issues of landmarks, which started about a decade ago, perhaps kicked off by one particular, frequently cited paper [4]. Of course, landmarks were by then already a well-studied topic in spatial cognition research (e.g., [2, 3, 5]). A rich body of work had been developed, which we will present in this book in a systematic manner, including outlining the still open questions. Portions of the presented ideas led also to the world-first commercial navigation service using landmarks selected based on cognitive principles [1].

Accordingly, the **purpose** of this book is to provide a review of this line of research, structured into cognitive, conceptual, computational, and communication aspects. This is in particular valuable because it represents a synopsis of research in different disciplines and thus not only addresses a breadth of topics but also bridges between different traditions of thinking. It is also timely since the research in these four areas has reached levels that allow for a first time a consistent synopsis.

The **intended audience** of this publication are certainly graduate or postgraduate students—they will profit from a compact reader summarizing and synthesizing a large number of research papers—but beyond that also the interested public, from the enthusiastic geeks maintaining crowd-sourced datasets like OpenStreetMap, over the early adaptors of novel tools such as navigation services, to the curious people being interested why certain things are so hard for computers ... such as thinking about our environments like we humans do.

Zurich, Switzerland  
Parkville, VIC, Australia  
March 22, 2014

Kai-Florian Richter  
Stephan Winter

## References

1. Duckham, M., Winter, S., Robinson, M.: Including landmarks in routing instructions. *J. Location-Based Serv.* **4**(1), 28–52 (2010)
2. Lynch, K.: *The Image of the City*. The MIT Press, Cambridge (1960)
3. Presson, C.C., Montello, D.R.: Points of reference in spatial cognition: stalking the elusive landmark. *Br. J. Dev. Psychol.* **6**, 378–381 (1988)
4. Raubal, M., Winter, S.: Enriching wayfinding instructions with local landmarks. In: Egenhofer, M.J., Mark, D.M. (eds.) *Geographic Information Science. Lecture Notes in Computer Science*, vol. 2478, pp. 243–259. Springer, Berlin (2002)
5. Sorrows, M.E., Hirtle, S.C.: The nature of landmarks for real and electronic spaces. In: Freksa, C., Mark, D.M. (eds.) *Spatial Information Theory. Lecture Notes in Computer Science*, vol. 1661, pp. 37–50. Springer, Berlin (1999)
6. Turing, A.M.: Computing machinery and intelligence. *Mind* **59**(236), 433–460 (1950)
7. Winter, S., Wu, Y.: Intelligent spatial communication. In: Navratil, G. (ed.) *Research Trends in Geographic Information Science*, pp. 235–250. Springer, Berlin (2009)

Landmarks

GIScience for Intelligent Services

Richter, K.-F.; Winter, S.

2014, XV, 223 p. 47 illus., Hardcover

ISBN: 978-3-319-05731-6