(Corner)stones of Venice:
Targeting the Island Advantage
in the Topological Representation of the City

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Abstract: We investigate the spatial structure of Venice from the viewpoint of the pedestrian, distinguishing and taxonomizing various types of blocks, and contrasting blocks with islands. Pedestrians' Venice has a shape that differs in interesting ways from that of Venice for the sailor. The duality of islands and blocks is introduced and discussed. An "island advantage" may bias the spatial representation of the structure of the city. We provide a tentative large scale block map of downtown Venice that points to some inferential advantages of a block representation.

Keywords: maps, Venice, space representation, topology, island advantage

1. Islands and blocks

The complexity of cities is a challenge for any modelling endeavour. There exist attempts at providing formal analyses (Blanchard and Volchenkov, 2009). Here we are interested in the interface between the underlying topological structure and the cognitive representation that could lead improving existing orientation artefacts. Our case study is Venice, which superpose a network of canals and a network of pedestrian paths. The complex spatial network of Venice is somewhat hard to master and represent, as many a non-native discovers when visiting the town; repeated visits provide some comfort, by improving both the mental representation and the ability to navigate, but a sense of disorientation remains. Graphical representations of the city (Guerra and Scarso, 1999), such as maps, are typically hard to decipher, and many are not even accurate at a level that matters for pedestrian navigation. The irregular shape of the city, its sheer size, and the tortuous paths through it certainly contribute to the difficulty. Last but not least, a complex numbering address system creates further confusion (Denis et al., 1999.)

However, it may be that the main difficulty is related to the geographic idiosyncrasies of Venice. The spatial "atoms" or basic objects of Venice are islands, but these do not correspond to the mental spatial "atoms" or basic objects of the pedestrian. The ontology of Venice is not in line with the grain of the ontology used by a pedestrian visiting it. Whoever takes a gondola tour has the impression of visiting a different city than the one she visited walking.

Indeed, excluding the mainland portion of the municipality, "prototypical" downtown Venice is an archipelago composed of more than one hundred island-like entities. "Real" islands – the likes of Torcello or San Servolo – lie outside the downtown area. Downtown Venice is a tight set of would be islands – would be only, insofar as this portion of the city is connected to the mainland through a 4–km long bridge (*Ponte della Libertà*), carrying car and railway traffic, and insofar as each of the component islands is connected to the other islands by one or more bridges.

In the past, canals held a different status (Howard and Quill, 2004). Canals were the ways of upper class and the tiny streets on the ground were used by servants. This explains why majestic entrances are facing canals whereas pedestrians can hardly find where a building is. Presently, canals are mostly used for transportation of goods, public transportation and sightseeing tours on gondolas. In the past, Canal Grande was the equivalent of Main Street. Now, people stroll and meet in tiny streets between the train station and the Piazza San Marco. This partially explains why on the maps of Venice islands rather than blocks are traditionally dominating; canals in the past were simply more important.

For the sake of our project, we shall concentrate here on the islands that compose downtown Venice. Local toponomastics endorses the island representation; the building elements of Venice are called 'Isole', such as *Isola di Rialto*. In general, there is a large variance of sizes.

A strict definition of an island may request barring pieces of land that although surrounded by water and such that it is possible to circumnavigate them, are connected to another piece of land by a bridge. The strict definition would exclude almost all "isole" of Venice downtown. A weaker definition, one that allows circumnavigation as main criterion, seems to conform more to common sense categorization. No matter what a final decision about their ontological status, it is quite straightforward to represent an island as some portion of land that can be circumnavigated, at least at high tide. Bridges do not hinder circumnavigation, provided your boat is sufficiently small. This representation of the city is, however, the sailor's point of view. What about the pedestrian's viewpoint?

Arguably, pedestrians think in terms of *blocks*. In an ordinary town, a block is simply a portion of land you can *walk* around, or (to coin a new word) that can be *circumpaced*. Not any walkable path around a portion of land defines a block. Blocks are defined in terms of minimally enclosed areas that can be circumpaced but cannot be crossed. A square ('campo', in local terminology) can be circumpaced, but it can also be crossed, hence a closed walk on a square does not include a block. A block is typically articulated by cornerstones. Some borderline cases of block should be excluded, such as those defined by paths around a statue on a pedestal, or around a tree. When relatively trivial exceptions are dealt with, Venice has a number of blocks that fit the definition. Interestingly, some blocks straddle islands; some are included in islands; some – not many – coincide with islands. However, some blocks are anomalous and idiosyncratic to Venice and to other water towns.

2. Some salient cases of blocks

With this characterization of blocks in mind, let us provide a first, rough taxonomy of basic geographical entities in Venice, based on the topological interactions between islands and blocks.

The first cases we encounter are relatively simple insofar as they do not encompass overlaps between blocks and islands.

2.1 Blocks that coincide with an island
"Fondamenta" is the local term for water "bank". On an island that is totally surrounded by

fondamenta strollers can circumpace the island without losing sight of a sailor who is circumnavigating it (fig. 1). Interestingly enough, there is only one such configuration in downtown Venice, and an imperfect one at that, as it is further divided into several blocks (at Fondamenta dei Cereri in Dorsoduro.)
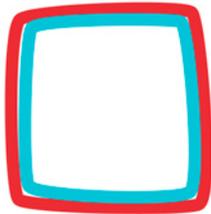

Fig. 1   An island completely surrounded by a bank ("fondamenta"). In this and the subsequent figures, black lines are the contours of islands and gray lines are the contours of blocks.

2.2 Islands that have no bank

These provide, as if it were, the negative image of the previous category. Some islands may have no walkable contour at all (fig. 2). Bridges connecting them, if any, take you to the hearth of the island. Pedestrians walking on the island never border water; they never see a sailor.

Fig. 2   An island with no pedestrian access to water

2.3 Internal blocks

Some blocks have no connection with water. They are completely internal to an island (fig. 3). Islands with no bank may still have an internal block. A quasi-perfect case is provided by the island on which the Fenice theater is built.
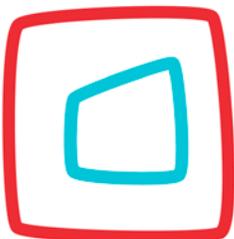
Fig. 3   An internal block

Now, in the norm blocks straddle islands:

2.4 Blocks that straddle islands (no bank involved)

In order to get back to the starting point of a walk (fig. 4), a pedestrian would have to get out of the island she is on, and of course get back in. But she would never border water (she would only see water when she arrives at a bridge).
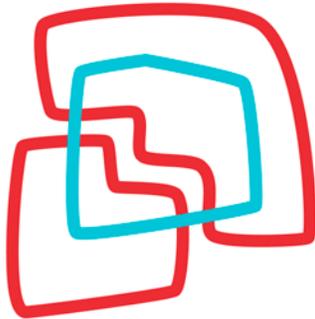
Fig. 4   A block that straddles two or more islands. The path never borders with water.

2.5 Blocks that straddle islands (no minimal bank involved)

The block straddles two or more islands (fig. 5) and at some point the pedestrian borders water. However, the bank belongs to the island which is inside the block you are circling. Call a 'minimal bank' a bank on island A that only connects to a path on island B. The type of block in question here does not encompass a minimal bank.
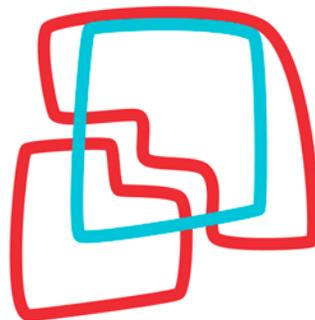
Fig. 5   A block that straddles two or more islands and encompasses buildings on each of them

2.6 Blocks that straddle islands (minimal bank involved)

These provide an interesting case. As in the previous case, you cross a bridge in order to complete a block, but you immediately make a turn on a bank. The bank you walk on is the only portion of the island you are on that belongs to the "block" (fig. 6).
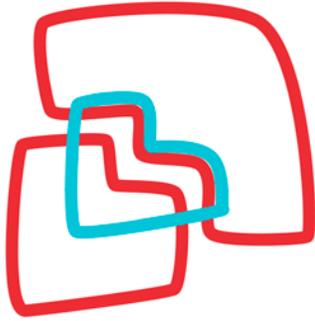
Fig. 6   A block that straddles islands without encompassing buildings on some of them

2.7 Blocks that straddle islands (minimal bank only involved)

This is clearly a degenerate yet nontrivial case of a block. You walk on a bank, cross the canal on a first bridge, walk back on the opposite bank, again cross the canal on a second bridge, and you are home (fig. 6). The "block" you circled only contains water! Fondamenta Venier and Bragadin in Dorsoduro provide an example.
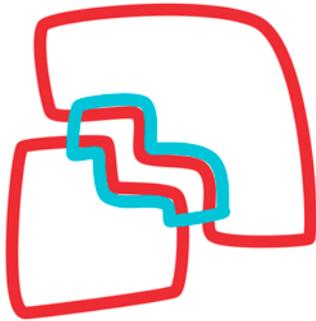

Fig. 7   A block that straddles two islands but surrounds an internal water

There are more complex cases that hybridize these relatively basic examples. Many examples of hybrid features involving minimal banks are to be found in the Cannaregio quarter, where they make certain economy in building possible; for any given house, it has a bank on its front, and a canal on the rear.
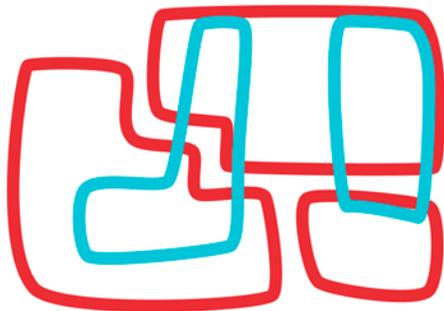

Fig. 8   Two hybrid blocks

Blocks in Venice can be very large. The Grand Canal is crossed by four bridges only. If you cross the Canal at the Accademia bridge, in order to get back to your starting point on a minimal route you have to go to the Rialto bridge. You'll have walked on at least 13 islands.

Conversely, some very large islands can comprise many blocks. Some islands count 50 or more internal blocks, and a number of straddling blocks of various types.

The foregoing discussion indicates that blocks, the ingredient of the spatial representation of the pedestrian, have a status that is different from that of islands. Circumnavigation and circumpacing define different types of objects. Islands are paradigmatic examples of geographic objects [1]. They are connected, uniform and maximal pieces of land. Blocks, on the other hand, can be disconnected (as they can straddle several islands). There is a sort of *island advantage* in geographic mental representation.
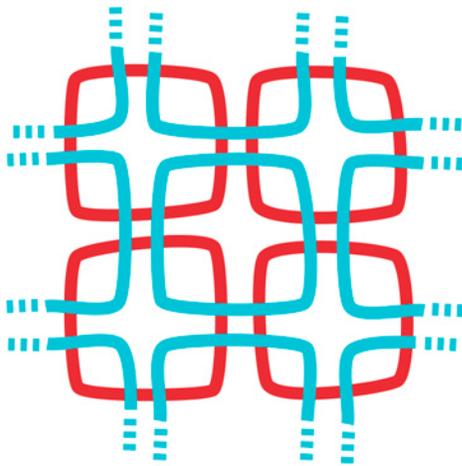

Fig. 9   The topological duality of islands and blocks

The island advantage introduces non-topological aspects into geographic representation. Indeed, considered purely topologically, there is a perfect duality of islands and blocks. Fig. 9 represents an idealized model in which each island straddles four blocks and, conversely, each block straddles four islands. Dual as the notions of island and block may be from a functional point of view, they certainly differ as to non-functional aspects. Islands are monocomposite, in a way; they are made of earth only. Blocks are in general pluricomposite: they can comprise both water and earth. Thus, topology and in general purely spatial features are not the end of the story in geographic representation.

3. Charting the complexity: two types of map

In order to visualize the complexity of the overlapping webs of blocks and islands, we first digitized a tourist map of downtown Venice, and deleted unnecessary information for the island (sailor's) and block (pedestrian's) representation, respectively. The software used was Adobe Illustrator. We implemented two methodological simplifications. Dead ends were removed, both for the pedestrian and the sailor representation. Ponte della Libertà was assumed to be severed, so as not to include the mainland into the calculations.

Under these assumptions, here are two cutouts of the Grand Canal area, on both island and block representation.
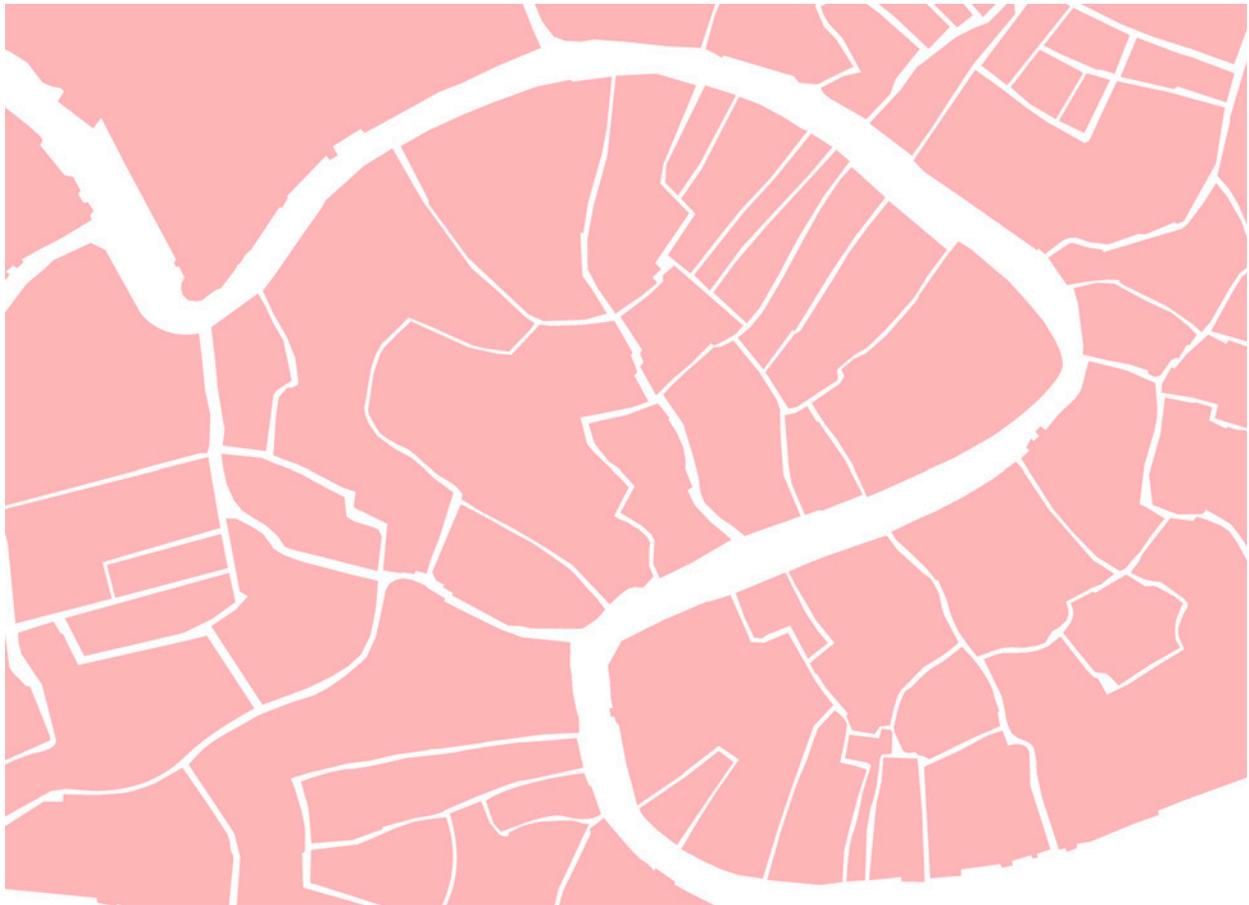
Fig. 10   A rather recognizable map of the heart of Venice. Pedestrian paths, including bridges, are not traced. Islands only are visible on this map.

Fig. 11   A much less recognizable map of the heart of Venice. Water paths are not traced. Blocks only
are visible on this map.

If the two layers are superposed, the result the graphical interpolation is a map in which light blue indicates water, grey indicates buildings together with dead end streets, "blind" squares and a lot of hidden private gardens, constructed areas such as buildings or more generally not accessible constructed areas, pink indicates walkable areas and open spaces, and white indicates bridges. Interestingly, private or dead end areas and bridges are a by-product of the superposition of the two maps. Once blocks and islands as primitives are given, some entities are represented in molecular, compositional fashion. Water is the complement of island and blocks are the complements of walkable spaces. Bridges are superpositions of the complements of blocks (i.e. walkable areas) and the complement of islands (i.e., water), and buildings are the superposition of islands and the complements of blocks (i.e. spaces that are not walkable).

Fig. 12 The superposition of the pedestrian's and the sailor's map generates a usable map of Venice.

Based on these construction principles, three large scale maps of downtown Venice have been designed: (The Appendix provides compressed images of these maps.)

In Map 1, we represented islands only. In Map 2, blocks only. In Map 3, the block map is superposed to the island map. The pedestrian's shape of Venice is fully displayed in Map 2. It shows impressive differences relative to an island map, to the point of making it difficult to recognize many familiar features of the city.

Some conceptual difficulties in drawing the maps based on the proposed categorization proved rather interesting and are listed in what follows.

First, islands and blocks evolve over time. With the marginalization of Venice on the economic scene, canals lost importance during the 19th century; some of them were filled with earth and paved, thus becoming streets or passages. A reminder of this process are some street names prefixed with "Rio térà..." ("filled canal"). Moreover, some islands have been added and the "fourth bridge" has been opened in 2008 at the beginning of the Grand Canal. These facts introduce dynamic elements in the configuration of islands and blocks.

Second, the original maps we used as starting point were not fully accurate. We used two standard tourist maps to get the information. Some parts in these maps were confusing and there were inconsistencies across them. We had thus to go on site to gather information. While doing this, we found out that in the maps many places are represented incorrectly. In particular the area behind the train station is in general very approximate. This area was built recently and it is like a labyrinth - there are many 'sottoportego' (covered passages) that create a number of very small blocks. Our final map still includes many areas that are not accurate wherever the representation is based only on the maps could use. Since our aim was to point out a pedestrian's point of view of Venice and not to make a new precise map of Venice, we didn't work further on correcting this sort of information.

Third, the division of the space between public and private is a complex issue. In Venice, more than in other cities, there are a lot of half-public spaces. We could consider dead ends and "blind" squares as half-public places. When pedestrians entered this type of streets/squares, they feel they are entering private space. In general, dead ends have been eliminated from the block representation.

Fourth, should car-only streets (of which Venice has some!) be considered as defining blocks? This question would be crucial in cities with cars. Highways are somewhat analogous to canals because pedestrians cannot walk through; they also divide the cities very dramatically. Possibly pedestrian can sense a Venice-like structure in cities that are otherwise very different from Venice.

Fifth, it is unclear whether the area of "Giardini di Biennale" should be considered as a block. During the summer it is a block (there is a fence around it), but otherwise it is open to cut-through walks. Either way, there is always a difficulty in dealing with the topology of a fence that is not completely closed. In many cases, it separates two publicly accessible places. The fence could be considered as a kind of degenerate block that consist of one line only (a line you can walk around). For the sake of this project, we considered this kind of space as an open space. In the case of a fence that is not publicly accessible by a pedestrian from the other side, we considered it as a part of a larger block. For example, on the fondamenta that is on the west side of the Stazione Marittima in the Santa Marta area, there is a fence that is hindering pedestrians to come to the edge of a water. This part of a fondamenta we depicted as a block and not as a bank.

Sixth, because of their internal complexity, the Giudecca and San Giorgio islands are included in the map. Other less complex islands, such as San Michele, San Servolo and San Lazzaro, aren't. Be noted that once a year or on special on occasions a temporary boat bridge is built connecting Giudecca to the downtown area.

4. The island and block count

The statistics of our classification, taken on the map, are as follows. We provide an island count and a block count. Note that some cross-categorization is possible within both islands and blocks, so that partial figures do not add up in the totals. (For instance, an island-block is counted as an island and as a block).

Type		*Number*
ISLANDS all together		123
Islands with banks		93
Islands with no banks		30
Block-islands		1

BLOCKS all together		1027
Internal blocks without bank		517
Internal blocks with bank		283
Blocks that straddle islands (no bank involved)		34
Blocks that straddle islands (no minimal bank involved)		12
Blocks that straddle islands (minimal bank involved)		46
Blocks that straddle islands (minimal bank only involved – lake-like entities made of encircled water)		24
Blocks that straddle islands - HYBRIDS		111

The world of the pedestrian is, relative to that of the sailor, quite complex. It is indeed surprising to see the number of islands with no banks, which means that one fourth of Venice islands are buildings you cannot walk around. Equally surprising is the fact that about half of the blocks are completely internal, with no bank, i.e. they do not provide access to water.

5. The world of the pedestrian

The block representation can be challenged because of its very high degree of abstraction. It may turn out not to be usable if the main purpose of a map is to provide an instrument for orienting oneself in the charted territory. As islands are not presented on the map, it is difficult to locate oneself on the map. One should use indirect strategies, such as counting the number of turns one takes. However, the block representation need not compete with the island cum block representation on all accounts. In particular, from the block representation it is possible to draw a number of interesting inferences about "walkability" that are hard to retrieve from the island cum block map:

- one can for instance at once see that there is a large sector of the city (the northern, Cannaregio area) that connects to the rest only on a couple of points
- one can see that it is easy to circulate within that area, but it will be hard to move to other areas. Furthermore, one can at once see that the path from the entry points in Venice (Railway station and Ponte della Libertà) and the eastern parts of the city is not straightforward.
- shortest paths between two points are immediately accessible
- "embargo" areas are immediately visible and one can see that they are generally larger than water areas

Future work should determine the usability of the block representation in absence of the island representation. Local enhancements can be foreseen, based on the proposed taxonomy. A slightly enhanced block representation would include an indication of water/ground interfaces, such as bridges. Yet another enhanced block representation could specify other water/ground interfaces, i.e. those parts of paths that are banks. A third type could indicate if the banks are minimal or not minimal. In none of these cases would islands be fully represented; only those of their contours that are relevant to pedestrians would appear on a map. Map 4. is an attempt at representing this possibility.

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We are not proposing that the block map or any of these enhanced maps should provide a substitute for a map that combines the island and the block representation under all circumstances. Our paper had mainly a taxonomical purpose. We wanted to investigate possible representational ingredients of a spatial representation of an environment that, in spite of its complexity, displays a number of important constraints, as well as the usability of a map that abstracts from other, more conventional elements.

If the effects of the "island advantage" are minimized, the ingredients of the pedestrian's representation in a world in which islands and blocks coexist are all topological. Size and shape of the blocks does not matter. What matters is the structure of the contacts between the paths open to the pedestrian and those open to the sailor. The block representation has, thus, two reasons to be commended. A purely island representation is not usable by a pedestrian. And an island cum block representation is less readable when it comes to seeing connections between salient points of the city.

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Appendix: Maps of Venice

islands

Map 3.
ISLANDS AND BLOCKS

from *(Corner)stones of Venice: Targeting the Island Advantage in the Topological Representation of the City*

islands
blocks

streets (without "dead ends")

banks (with an indication on which side is water)

bridges

blocks