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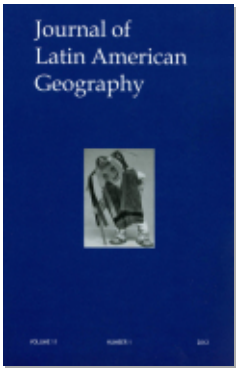

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Abstract
There exists an important tradition in the formulation of urban models to describe and study urban socio-economic structure. From the initial contributions of the 1920s until the 1950s these have emphasized the determination of specific spatial configurations (rings, sectors, multiple nuclei) and later integrative proposals were generated. In the case of Latin American cities these basic configurations were combined, with new specific adjustments. The present study defines the social map of Greater Buenos Aires using census variables and incorporating the spatial distribution of other located spatial entities of extreme socio-economic characteristics (new closed urbanizations and marginal settlements). The results obtained reveal the manner in which the large metropolis' interior presents a combination of modeling aspects of various periods and traditions of research, which mark its historical development and current form.
Keywords: *social maps, urban models, socio-spatial urban structure, Buenos Aires*

Resumen
Existe una importante tradición en la formulación de modelos urbanos para describir y estudiar la estructura socioespacial urbana. Desde los iniciales aportes de la década de 1920 hasta mediados de siglo pasado éstos han puesto énfasis en la determinación de configuraciones espaciales específicas (anillos, sectores, núcleos múltiples) y a partir de allí, durante la segunda mitad del siglo XX se generan propuestas integradoras. Se combinan las configuraciones básicas, surgen nuevas y existen ajustes específicos realizados para el caso de las ciudades de América Latina. El presente trabajo define el *mapa social* de la Gran Buenos Aires mediante el uso de variables censales e incorporando la distribución espacial de entidades espaciales puntuales de características socio-económicas extremas (nuevas urbanizaciones cerradas y asentamientos precarios). A partir de los resultados obtenidos se verifica de que manera esta gran metrópolis presenta en su interior la combinación de aspectos modelísticos de variadas épocas y tradiciones de investigación, las cuales enmarcan su desarrollo histórico y su configuración actual.
Palabras clave: *Mapas sociales, modelos urbanos, estructura socioespacial urbana, Buenos Aires*

Introduction

The present study aims to undertake an analysis of the social map of Greater Buenos Aires (GBA) applying the technical methods of multivariate analysis and spatial association by thematic superposition, and using as a conceptual frame modeling aspects of the socio-spatial structure of large Latin American cities.

To achieve this objective, as well as the analysis of urban models (Buzai 2003), variables of the most recent available data are selected —the 2001 Census— that clearly present a dichotomy between positive and negative situations, and a methodology of standardization (comparability) that derives spatial classification points as a synthesis of relations.

In this manner partial results are obtained that present contrasting situations, which are combined with the location of entities such as closed communities (*clubes de campo*) and marginal settlements (*villas miseria*), representing contrasted socioeconomic levels.[1] Lastly, attention will be paid to the possibility that the social map of GBA offers elements that permit the analysis of its different periods of expansion and, with that, the modeling elements that could assist the clearest description of its socio-spatial configuration.

The Study Area

The study area is that of GBA which, following the physical criteria implicitly used by the Argentine censuses until 1960 and explicitly afterwards (Toro Labe 1996), is the largest urban center of Argentina that has as its nucleus the Autonomous City of Buenos Aires (*Ciudad Autónoma de Buenos Aires*, CABA) and its limits extend to where the built-up area is continuous (Vapñarsky, C. 1995; 2000).[2]

The agglomeration is thus the principal support of the functional urban space and approximates to the definition of urban entity when the daily displacements of the population are measured, especially pendular movements between residence and workplace (Torres 2001).

In 2001 the population involved included the CABA and the total or partial portions of 32 *Partidos* of the Province of Buenos Aires.

Jurisdictions Whose Population Completely Fell within GBA

- *Ciudad Autónoma de Buenos Aires*
- *14 partidos*: Avellaneda, General San Martín, Hurlingham, Ituzaingó, José C. Paz, Lanús, Lomas de Zamora, Malvinas Argentinas, Morón, Quilmes, San Isidro, San Miguel, Tres de Febrero and Vicente López

Partidos Whose Population is Partially Included in GBA

18 partidos: Almirante Brown, Berazategui, Esteban Echeverría, Ezeiza, Florencio Varela, La Matanza, Merlo, Moreno, San Fernando, Tigre, Cañuelas, Escobar, General Rodríguez, La Plata, Marcos Paz, Pilar, Presidente Perón and San Vicente.

Spatial Units and Variables

1. Cartographic base, polygonal geometry

The digital cartographic base was prepared in vector format (spatial units: census radii and census fractions)[3] by the Instituto Nacional de Estadística y Censos (INDEC) of Argentina. Its extent includes the CABA, 30 *partidos* of the Province of Buenos Aires and urban census radii in the *partidos* of Cañuelas and La Plata. By an analysis of the

spatial distribution of the variables it was decided to work at the spatial disaggregation level of the census fraction (*fracción*), since the radii, as a more detailed sub-unit, loses the generalization necessary for a view of the entire GBA.[4] From that basis a series of technical tasks had to be performed in order to use the cartographic base oriented to the objectives of the application.

Consultations with logical operators in the alphanumeric database permitted the determination of which of the census radii should be included in the study zone; these were adjusted from the graphic point of view, and were united in the base of the census fraction to which they belonged. In this manner the final result is the map of census fractions adjusted to the limits of the GBA (Figure 1), an area of 2,076.2 km^2, a population of 12,046,799, and a density of 5,802.2 per km^2.

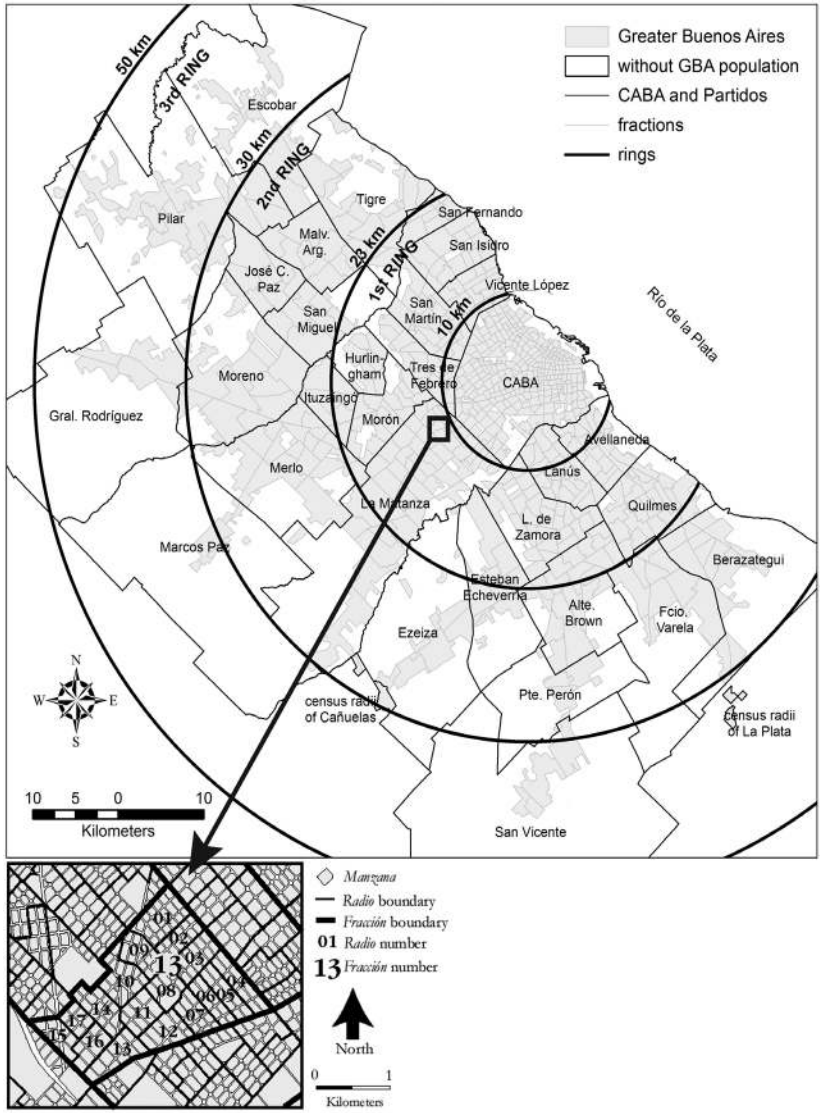
2. Variables—alphanumeric attributes

The selection of variables was performed taking as the basis the proposal outlined in Buzai (2003) oriented to the study of the socio-demographic and housing dimensions, and from that point a selection of those variable that theoretically permit the best discrimination among the socio-spatial levels of the population was made, and the corresponding indicators were constructed.

The variables incorporated in the original data matrix (ODM) containing their frequencies by fraction are: 1) population over age 25; 2) population in homes[5]; 3) population in houses[6]; 4) population age 25 and above without education or primary incomplete; 5) population age 25 and above with tertiary or university education completed; 6) population in apartments; 7) population in rented shacks, *casilla*, *pieza*, in hotel or pension, locales not constructed for habitation, mobile homes or on the street; 8) population in homes with water from public mains; 9) population in homes with Convergent Material Deprivation;[7] 10) population in homes with toilets connected to public drains; 11) population in homes without toilet or with toilet not connected.

Indicators were then constructed that clearly represent positive and negative variables which, in their maximum scores respectively showed good and poor situations. The positive variables are 1) percent of population over 25 with tertiary or university education completed; 2) percent of population in housing counted in apartments; 3) percent of population in homes with water from public mains; 4) percent of population in homes with toilets connected to public drains.

The negative variables are: 1) percent of population 25 and older without education or primary incomplete; 2) percent of population in rented shacks, *casilla*, *pieza* in hotel or pension, locales not constructed for habitation, mobile home or on the street; 3) percent of population in homes with PMC; 4) percent of population in homes without toilet or with toilet not discharged into public main. Descriptive information at the fraction level of the census is provided in Table 1.



of manzanas and minor census sub-divisions: *radii* of *fracción* 13 of La Matanza *partido* (Source: Marcos 2011).

Table 1. Indicators: descriptive information for the GBA and census fractions

Indicators	GBA	Census fractions			
		Mean	Minimum	Maximum	Standard deviation
percent of population over 25 with tertiary or university education completed	12.6	15.7	0.6	49.0	12.0
percent of population 25 and older without education or primary incomplete	20.2	18.5	7.6	46.1	7.2
percent of population in housing counted in apartments	21.9	34.4	0.0	99.4	33.5
percent of population in rented shacks, *casilla*, *pieza* in hotel or pensiones, locales not constructed for habitation, mobile homes, or on the street	6.6	5.7	0.0	55.7	6.5
percent of population in homes with water from public mains	71.0	81.1	0.0	100.0	34.1
percent of population in homes with Convergent Material Deprivation	14.0	9.3	0.0	58.9	12.9
percent of population in homes with toilets connected to public drains	46.7	62.9	0.0	100.0	41.3
percent of population in homes without toilet or with toilet not discharged into public main.	17.2	11.4	0.0	72.3	15.8

(Source: the authors)

3. Point elements

The graphical database of the project was completed with the inclusion of two spatial distributions of population settlement types: 1) closed urbanizations, and 2) marginal settlements. Both are entities are readily locatable and their qualities empirically identifiable, but neither are included within the census of GBA. For this reason both are simply superimposed on the cartographic base of the polygonal geometry.[8]

The closed urbanizations correspond to population settlements of medium-high and high socio-economic status, whereas the marginal settlements, on the contrary, correspond to population settlements of low or very low socio-economic status. It is not possible, in this instance, to undertake as statistical treatment of internal attributes of both entities, but simply consider them as superimposed elements that complicate the spatial patterns. The superimposition of these points permits the analysis of their immediate contexts and in this manner verify modeling questions in a more advanced analysis of the spatial structures of large cities.

Methodology

The securing of spatial classification points (SCP) is a methodology of simple multivariate analysis based on the standardization of the variables utilized for the analysis

and the generation of a summary point system for their mapping and consequent spatial distribution analysis.

In this application the variables have been standardized using the omega points system calculated in a direct manner in positive variables [1] and the inverse form in negative variables [2]. In both cases the scores were raised to a range of 0 to 100.

$$[1] \quad \Omega_{PV} = \frac{x_i - x_m}{x_M - x_m} \times 100$$

where x_i is the value that variable x assumes in fraction *i*, *xm* is the minimum value y x_M is the maximum value

$$[2] \quad \Omega_{NV} = (1 - \Omega) \times 100$$

The use of each formula permits the calculation of unique spatial classification points (USCP) in averaging the totality of points (8 variables) and obtaining a summary result of the socio-spatial distribution of the population for its interpretation in the sense of benefit. The higher points are equivalent to social situations more favorable and appear on the map in higher shade (or color) intensities.

Results

The final result is presented in Figure 2. Its interpretation is divided in two parts: first, that which corresponds to the polygonal base from the analysis of the spatial distribution of the USCP, and the second, the analysis of the spatial superimposition of the point elements.

Spatial distribution of the USCP

The initial result obtained corresponds to the mapping of the USCP as a synthesis of the *social map*. The method of mapping selected was that of quartiles, by which a comparative result was obtained from incorporating the same quantity of spatial units in each of the class intervals. By this means the 694 spatial units are divided into five class intervals and based on their score are classified as very high, high, medium, low, and very low.[10] The intensity of the shading/colors generally diminishes from the center to the periphery which signifies that the negative situation diminishes in relation to distance from the center.

From the cartographic analysis the following elements of the socio-spatial structure of Greater Buenos Aires become clear:

1. USCP very high: this is developed on a sectoral structure that extends from the main center located in the central city (CBD). The axes of growth are towards the north, the waterfront, and towards the west from the center of the city. The USCP also has high values in the different intra-urban centers corresponding to certain *partidos* over which the GBA extends.
2. USCP high: spatially distributed in a form contiguous to the very high category. Completes the intermediary spaces between the aforementioned axes of growth and acts as an area of muffling between categories, covering approximately 70 percent of the surface of the GBA, some sections contiguous with the northern axis and others dispersed.
3. USCP medium: corresponds to the first ring of expansion of GBA in the *partidos* contiguous to the CABA. It has a ring-like nature in the north and west zone, and a sectoral aspect in the south. The expansion is produced by the southern coastal front

(the waterfront) towards Berazategui, and by the southern line towards Almirante Brown.

4. USCP low: appears principally associated with a second expansion ring which includes *partidos* that are not contiguous with the CABA and covers spaces between sectors of expansion in the southern zone. Therefore it represents the strong peripheral growth of GBA produced principally by the middle and lower-middle classes.

5. USCP very low: large spaces peri-urban and peripheral of GBA. In some sectors corresponds to unfavorable environmental interstices (flooding zones, sites of major contamination) and in others on the extreme socio-spatial frontier of distinct growth sectors.

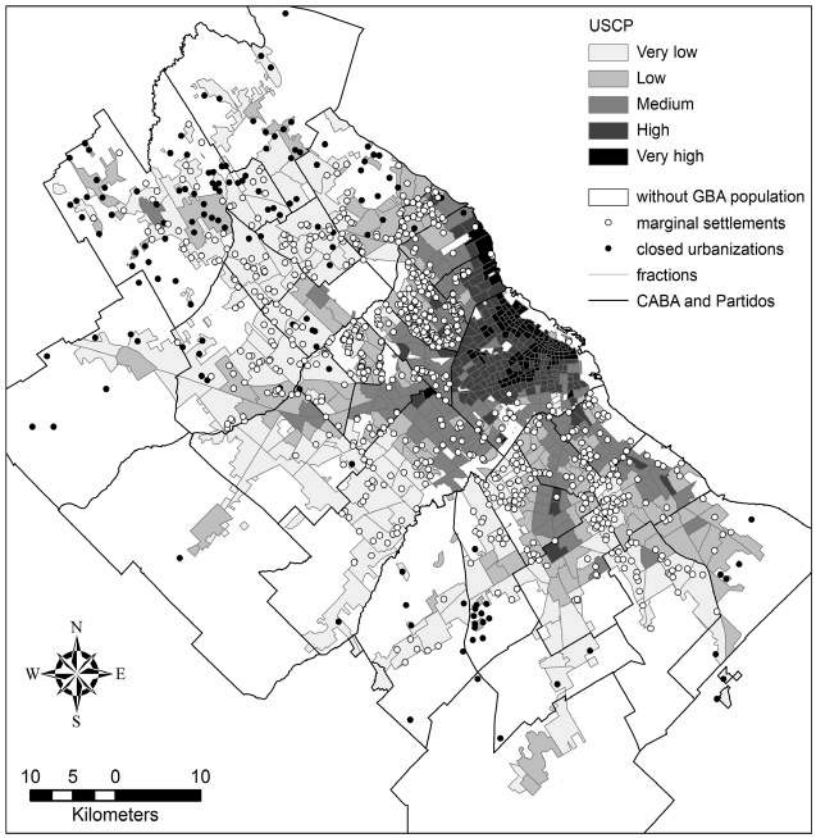


Figure 2. Socio-demographic and housing level by USCP and superimposition of located entities of extreme socioeconomic levels, Greater Buenos Aires, 2001.

Spatial Distribution of Located Entities

In order to complete the model the located elements were superimposed: closed urbanizations and marginal settlements. It is interesting to note in this case, the manner in which they generate an important socio-spatial fragmentation. The closed urbanizations are located on the extreme periphery of the GBA, in areas of negative conditions (lowest USCP), and thus show a strong spatial negative autocorrelation of black points in clear/white contexts (97.9 percent are located in the lowest USCP and

2.1 percent of medium USCP). The marginal settlements are principally located in the southern sector of the CABA and in all the rings of the GBA, and fall within the very low USCP (grey/light pink of the unfavorable conditions). One may also note a double pattern: a negative spatial autocorrelation of white points in darker areas of the first ring of the *partidos* of Buenos Aires (1.4 percent located in the highest USCP and 15.9 percent in medium USCP), and a positive autocorrelation in the external rings (98.6 located in lower USCP). The complete set of relationships is presented in Table 2.

Table 2: Spatial association of closed urbanizations and marginal settlements to the USCP of their fraction or the nearest one

USCP	**Closed urbanizations**		**Marginal settlements**	
	Absolute values	%	Absolute values	%
Very low	83	57.2	374	43.8
Low	59	40.7	332	38.9
Medium	3	2.1	136	15.9
High	0	0	10	1.2
Very high	0	0	2	0.2
Total	145	100	854	100

(Source: the authors)

In this manner we complete the model of the GBA and have identified visual elements that present spatial patterns in rings, sectors, multiple nuclei, and fragments. The first three patterns are the basis of the classif models of Burgess (1925), Hoyt (1939) and Harris and Ullman (1945), the fourth considered as characteristic of current metropolitan areas. For the large Latin American cities it has been demonstrated that these patterns occur in the order presented, as a result of different stages of evolution (Borgsdorf 2003).

The general configuration of the social map of GBA presents a clear diminution of positive characteristics from the center to the periphery, a characteristic proper to the model of the Latin American city according to the model of Griffin and Ford (1980), updated by Ford (1996, 1999), an inverse evolution to the ecological evolutionist model presented by Sjoberg (1960,[11] that's to say that the GBA is closer to the *industrial city model* with the suburban displacement of the elite when important de-industrialization began in the 1990s.[12]

During the last two decades an important expansion of socially high and medium-high classes have emerged related to the formation of new peripheral urbanizations denoted generically as "closed urbanizations" or "gated communities". At the same time the marginal settlements, in spite of constituting the traditional entities of urban poverty, also experienced important growth during that period, which appears to result from a deepening of social polarization.

While the favorable socio-economic conditions decline from the center to the periphery, the closed urbanizations abruptly appear, proper to the "city of islands" model of the city of privatization (Janoschka, 2002), empirically reflecting what is known as *islands of plenty in seas of poverty*. Evidence in the social map of Greater Buenos Aires clearly presents the characteristics that shape many large cities, and with it offers the possibility of linking different dimensions of urban phenomena in an empirical context of notable differentiation.

Acknowledgements

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Notes

[1] At present the emergence of a new form of "closure" is underway which, by agreement of a group of neighbors as individual initiatives not contemplated by the law, procedes in traditional urbanizations of several manzanas. This accelerating phenomenon has a variety of forms: with private guard posts, security cameras, access barriers, and in the most extreme cases, peripheral electric fences. The common denominator in this situation, though not reported in oficial data, is the coordinated action of the local community to achieve levels of security that government incapacity cannot guarantee. Urban insecurity is also an explanatory factor for the appearance of planned closed urbanizations, though it may not be the principal justification. It is a theme dealt with in detail in Janoschka y Borsdorf (2005).

[2] The physical criteria consider the existence of a group of *manzanas* that contain *edificios* that are related to *calles*. This configuration generates a mancha urbana that the Argentine census defines as an *aglomeración*. For an aglomeración to be considered a ciudad it must contain a mínimum of 2,000 inhabitants.

[3] In the Argentine national censuses, several different levels of spatial units are considered in the publication of information: 1) country 2) province and 3) department and *partido*, as political-administrative divisions and subdivisions, and 4) *fracción* and 5) *radio*, as lesser census subdivisions created to operationally organize the census. The quantity of spatial units that are grouped together to form a higher level varies. Calculated average data in GBA indicate that a grouping of manzanas that contain 350 *viviendas* forms a *radio*, and 17 *radii* form a *fracción*, and 22 *fracciones* form a *partido*. The spatial configuration of manzanas, radii and fracciones can be seen in detail in the inset map of Figure 1.

[4] Marcos (2011) presents the theoretic-methodological work undertaken to obtain the cartographic base of the study área. It includes a series of maps that show the sequential technical task completed, among others that of the cartographic base undertaken by INDEC and the map of GBA by *radii*, an excessively detailed resolution level that impedes the modelling of general rules.

[5] *Hogar* (home): defined as a person or goup of persons who live under the same roof and share the costs of food (INDEC 2003).

[6] *Vivienda* (house): an enclosure of accomodation structurally separate and independent. Housing units include those: a) that have been constituted and adapted to be occupied by people, and b) units that, although not constructed or adapted for habitation by people, are used for that purpose at the time of the census (INDEC, 2003).

[7] The capacity to take into account socially negative situations of the indicators of poverty Unsatisfied Basic Necessities (UBN) and Index of Material Deprivation (IMD) were evaluated, correlating their different categories with the Spatial Benefit Score (SBS). Thus r (SBS-UBN) = -0.482 and r (SBS-CMD) = -0.785, and it can be established that the Convergent Material Deprivation index (CMD) has a better capacity to identify socially negative situations.

[8] Of eleven different centralities presented by Tella (2001), the closed urbanizations and marginal settlements are the two centralities related directly with residential questions, and for Vidal-Koppman (2009) correspond to the highest extremes of social and residential segregation, one elected by its inhabitants and the other as the only possibility, in the first and second case respectively. The *villas*, settlements and critical areas merit special interest in the formulation of strategic planning guidelines in the study area (Provincia de Buenos Aires, 2007).

[9] The Argentine national censuses do not provide specific data for each class of the housing units, although from the empirical evidence their socio-economic compositions are clearly known.

[10] A complete analysis on aspects related to the spatial distribution based on thematic cartography via Geographical Information Systems is available in Buzai and Baxendale (2006).

[11] This characteristic, currently verified, was first presented by Torres (1978) who considered it a distinctive aspect of Buenos Aires, taking the pre-industrial city model at the moment of maximum industrialization in the middle of the twentieth century. An important analysis of the work of Horacio Torres and his lines of research on the social map of Buenos Aires is analyzed by Abba (2010).

[12] A very recommendable historical synthesis from the foundation of Buenos Aires to this time phase (1580-1990) is found in the work of Keeling (1986) which takes the form of a general treatment of diverse sociopolitical, economic and environmental aspects that established the bases for the conformation of the current metropolis. From the viewpoint of GBA, Buzai and Baxendale (1998) have analyzed the urban expansion in census years (1869-1991) connected to economic and socio-demographic aspects and Morina *et al.* (2008) undertake for 2001 an analysis of the spatial distribution of variables of education, health, housing, urban equipment and environmental problems with which they determine a regionalization of the quality of life in the study area.

[13] *Closed urbanization* and *gated communities* are terms used in studies that focus on spatial and social problems respectively. Thuiller (2005) considers *gated communities* as a great challenge for urban management since they are continually generating differentiation. From the expansive point of view of Roitman y Giglio (2010) they have great symbolic power in the current process of segregation in large Latin American cities.

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