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Anna Marta Barańska[1]
https://orcid.org/0000-0002-6426-4115

Konrad Eckes[2]
https://orcid.org/0000-0002-0220-2277

ALGORITHMIZATION OF THE DESCRIPTION THE RELATIONSHIP TO THE LOCAL SPACE IN DAILY LIFE – SOCIAL EXPERIENCE

[1] AGH University of Krakow,
Faculty of Mining Surveying and Environmental Engineering, Krakow, Poland
abaran@agh.edu.pl
[2] State Academy of Applied Sciences, Jaroslaw, Poland
keckes@agh.edu.pl

Abstract

In daily life there are many relationships between human being and the local space. A typical feature of the state register (cadastre) is stability in time. But in other relationships to the local space – the role of time can be crucial.

In this paper the task of defining the relationships to the space in a formal way was undertaken. The method of making the conditions (facts) for the selected examples of relations was applied, and then the procedures (algorithms) were carried out, building the relationships to the local space, making it active for an individual or a group.

As examples, at first the relationships to 2D objects was presented, regarding the addressed fragment of the local space and the defined time when the relationship is active. Then the hierarchic structure of the space was taken into account by dividing it into smaller final units using a developed address recorded in the set of base conditions.

A reverse case was discussed – hierarchic increase of the area in subsequent steps of the procedure of defining the relationships between the activity and space. In this case the access to the subsequent larger and larger areas is the function of the eligibilities of individuals or social groups to the subsequent stage of extending the area up to its final maximal form. Such relationships take place in industrial companies, where the gradation of eligibilities is a form of protecting the production details.

Another relationship to the space is the relationship of the individual or group to linear objects, for example to the network of roads and marked trails. The example of the relationship to the network of trails and the complex case of the relationship, regarding additional conditions were presented.

The next section developing direct relationships to multistep relationships is discussed. It extends the feature only for the sequence of pedestrian movements combined with the traffic. In this case two relationships occur: the relationship to a spatial object and relationship to a linear object (the route of the vehicle).

In almost all the cases the time factor plays an important role in the relation to space, which is defined as one of the conditions in the set of base facts.

The contemporary time is the era of digitalisation of data and processes. The space we live, is a unique good. This good should be managed in a sustainable way Hence the need to explore, analyse and formalise various relationships to the space.

Keywords: algorithmization of the description the relationship to the local space, formal records of relationships, base conditions (facts), procedures of developing relationships

ALGORYTMIZACJA OPISU RELACJI DO PRZESTRZENI LOKALNEJ W CODZIENNYCH DOŚWIADCZENIACH SPOŁECZNYCH

Abstrakt

W codziennym życiu społecznym istnieje wiele relacji między człowiekiem a przestrzenią lokalną. Typową cechą rejestru państwowego, który opisuje tego typu relacje (np. kataster), jest stabilność względem czasu. W innych relacjach do przestrzeni lokalnej – czas ogrywa kluczową rolę.

Celem niniejszej pracy jest wykazanie relacji do przestrzeni i nadanie tym relacjom postaci formalnej. Zastosowano metodykę tworzenia bazy warunków (faktów) dla wybranych, przykładowych relacji, a następnie sformułowano procedury (algorytmy), które budują relację do lokalnej przestrzeni, czyniąc ją aktywną dla jednostki lub grupy społecznej.

W pierwszej kolejności rozpatrzono relacje do obiektów powierzchniowych, uwzględniając określony fragment przestrzeni lokalnej oraz czas aktywności tych relacji. Następnie uwzględniono strukturę hierarchiczną tej przestrzeni poprzez podział na mniejsze jednostki docelowe, korzystając z rozbudowanego adresu zapisanego w zbiorze warunków bazowych. Przedyskutowano również przypadek odwrotny – hierarchiczne narastanie pola powierzchni w kolejnych krokach procedury ustalania relacji aktywności do przestrzeni. W tym przypadku dostęp do coraz większych obszarów jest funkcją uprawnień jednostki lub grupy społecznej do kolejnego stopnia rozszerzenia zakresu obszaru aż do jego maksymalnej, docelowej postaci. Takie relacje występują w zakładach przemysłowych, gdzie gradacja uprawnień jest formą ochrony szczegółów produkcji.

Innym rodzajem relacji do przestrzeni jest relacja jednostki lub grupy do obiektów liniowych, takich jak sieci dróg i wytyczone szlaki. Rozpatrzono przypadek relacji do sieci szlaków oraz bardziej złożony przypadek relacji, uwzględniający dodatkowe warunki.

Kolejny rozdział rozbudowuje relacje bezpośrednie do relacji wielostopniowych. Rozszerza on cechę wyłącznie ruchu pieszego o sekwencyjne połączenie ruchu pieszego z ruchem pojazdu. W tym przypadku występują dwie relacje składowe: relacja do obiektu przestrzennego i relacja do obiektu liniowego (trasy pojazdu).

W prawie wszystkich przypadkach ważną rolę odgrywa czynnik czasu relacji do przestrzeni, który jest definiowany jako jeden z warunków w zbiorze faktów bazowych.

Czasy współczesne to epoka cyfryzacji danych i procesów. Przestrzeń, w której żyjemy, jest dobrem niepowtarzalnym. Tym dobrem musimy gospodarować w sposób racjonalny. Stąd wynika postulat poznawania, analizowania i formalizowania różnych relacji do przestrzeni.

Słowa kluczowe: algorytmizacja opisu relacji do przestrzeni lokalnej, zapisy formalne relacji, warunki bazowe (fakty), procedury budujące relacje

LIST OF SYMBOLS USED

(arranged in the order of appearance in the text)

$F = \{f_1, f_2, \ldots, f_m\}$ – set of base conditions (facts)

$F_1 = \{f_k, f_l, \ldots, f_v\}$ – subset made of set F, which activates the relationship to the local space

$F_2 = \{f_1, f_2, \ldots, f_n\}$ – set of base conditions (facts) extended by additional conditions

L – set of the participants in a given relation to the space (individual person, group of people or institution), containing elements l_q

P_i – space being a subject of the relationship between elements making subset F_1

P_j – subspace being a subject of the relationship between combinations of elements, extended by additional conditions, subset F_2

U – set of eligibilities, its elements u_r are attributed to individuals (or groups of people) l_q from set L – in building a hierarchic relationship

A – initial bus stop (public transport), focus on multi-step relationship

B – final bus stop (public transport), focus on multi-step relationship

X – symbolic city bus number between bus stops A and B

1. INTRODUCTION

The space we live in has been described through the inventory of land and buildings. Inseparable attribute of the inventory is the relationship between individuals, groups of people or institutions to elementary fragments of this space, such as real estates – pieces of land marked unambiguously in legal terms. The state register of land and buildings plays a crucial role in multi-task land management.

A typical feature of the state register (cadastre) is its stability in terms of time. Obviously, there are changes made in this register, but they require strict procedures.

Apart from the formal relationship of individuals, groups or institutions to the surrounding space – there are numerous local relationships in daily life. They are so obvious and so close to our daily experience that they do not require thinking about the procedure. But due to common digitalization of data and engaging artificial intelligence in more and more areas of everyday life – the relationships of individuals or groups to local space should become a subject of studies.

As mentioned before, basic characteristic of state registers is their stability in time. However, in everyday life many relationships are characterised by changeability in time; they are a function of time in highly differentiated ranges.

The topic of ad hoc spatial relations of law and their formal notation has already been signalled in the publication [1]. It was also considered, taking into account the hierarchical structure of the division of space and the links to the objects of this structure, in [2]. The authors of the publication [3] also focus on hierarchical structures in the context of spatial-temporal data visualisation. On the other hand, the author of the paper [4] analyses the so-called temporal topology, noting the similarity between time and space, which transfers many philosophical issues concerning time to their counterparts in space.

An interesting concrete proposal, in the form of a dashboard, addressing the need to present a large amount of time-varying data that has its own 'history', is discussed in publication [5].

In this article, we take on the task of presenting the relationships between individuals or groups and the local space in the 2D or linear form and writing these relationships in a formal way. In this paper a two-stage procedure of making relationships will be applied: base conditions (facts) will be formed, then the procedures will be created making the relationships to the local space active for individuals or social groups.

2. METHODS OF ALGORITHMIZING

The first attempts to formalize legal rules date back to the 1970s and 1980s, when the first expert systems in law were developed. Key works in this area are [6] and [7]. Work [6] is a pioneering analysis of corporate law using logical systems. Position [7], on the other hand, is one of the first books on the applicability of expert systems in law. The author of article [8] writes about the formalization of legal argumentation within a dialogical structure.

Data structures and types of algorithms, which are the basis of algorithmic (programming) procedures, have been widely discussed in the literature, including in popular, comprehensive books [9, 10, 11] and [12]. Related to the issue of solving problems by means of an algorithm is the question of its computational complexity, efficiency, to which the authors pay special attention. Similarly, there are many publications discussing the basic legal conceptual apparatus, concepts and institutions of modern law, types of legal norms and rules, and law conceived as a system of norms. These include, among others [13] and [14].

Legal language is undoubtedly a formal language. Thus, its algorithmic notation requires knowledge of the computer foundations of the theory of formal languages. The publishing position [15] was the first monograph on the theory of formal languages in Poland and the second in the world. One of the more recent items discussing the issues of computerisation of law and the perspectives of algorithmisation of its text production is [16].

At the level of Polish law, the rules for the creation and use of spatial information infrastructure are defined by law [17]. These rules relate to, inter alia: spatial data and metadata of spatial information infrastructure, spatial data services, interoperability of data sets and services, sharing of spatial data. Some problems related to the treatment of algorithms – used in automatic decision-making in the public sector – as information subject to the right of access to information, are pointed out by the author of the article [18].

To mark the relationship of individuals, groups of people or institutions to the local space – we must make a base of conditions (facts), which will be the base for making the relationships. The character of conditions can be spatial, temporal or contain the state, which is connected with building the relationship.

Let us assume that the set of base conditions (facts) is given

$$F = \{f_1, f_2, \ldots, f_m\}.$$

From the elements of this set subset F_1 can be formed

$$F_1 = \{f_k, f_l, \ldots, f_v\},$$

which, as a combination of elements in set F, activates a person or group of individuals l_q from set L in the relationship to the local space P_i.

Building the structure of the division of space P_i into subspaces – one should supplement the base set F with further conditions (facts), which develop the hierarchy of addresses on subsequent stages of the structure, to the final address. The extended set F will take form F_2

$$F_2 = \{f_1, f_2, \ldots, f_n\}.$$

The combination of conditions from extended base facts will now make the relationship to subspace P_j.

In this case adding new conditions and developing the combination activating the relationship is linked with subsequent diminishing the area of subspace P_j, up to the final border area. Gradual diminishing of the area simultaneously builds more and more accurate address in the real space. Such cases often occur in the social space.

Let us consider a case of a certain space closed for the general public, for example an industrial company. This space is available only for selected groups of people employed in this company. At the same time, the access to various sections of production is differentiated due to the organisation and authorisation – thus the structure is hierarchic.

Each group of employees is granted eligibilities u_r from the set of eligibilities U. The employees belonging to the lowest group of eligibilities are attributed to local zones of the range limited to the relevant area of work. The growth of the rank of group y u_r is connected with the right to the bigger area. For group y being the highest in the hierarchy of eligibilities u_r – the area means the whole space of the industrial company.

In this case the following correlation takes place: the growing rank of eligibilities u_r correlates with the growing space of relationships, up to its maximum value. One should emphasize that the relationship to the space does not necessarily correspond the structure of growing eligibilities, e.g. intervention in emergency situations. One should develop relationships to any areas, for example to the areas making difference of subsequent growing ranges – according to given attributed tasks in the structure of production. But it will always be the area smaller than the total space of the industrial company.

Talking about the relationships to the space we understand the relationships not only to 2D objects, but also to linear objects. Such objects can have a structure of a singular line or linear network.

The presented methods of algorithmization, in further part will be shown using the examples of daily life. In practical applications time will be a particularly important factor.

3. SPATIAL RELATIONSHIPS TO LOCAL 2D OBJECTS

Let us consider the example of a city sport stadium, open for the residents from Monday to Saturday free of charge from 8:00 a.m. till the dusk, while on Sunday paid events are organised. The stadium is open on Sunday during the events, but for the rest of the day it is closed.

Let us put together base conditions (facts) to make a relationship for an individual or group of people to the space of this stadium – for a weekday and for Sunday.

Base conditions (facts) – for procedures 1 and 2

- day of the week – weekday
- day of the week – Sunday
- time interval during the week – from 8:00 a.m. till the dusk
- time interval in 24 hours of a weekday – from midnight till 8:00 a.m. or from dusk till midnight
- time interval on Sunday – time of paid events
- time interval on Sunday – from midnight till the beginning of an event or from the end of the event till midnight
- fee for the paid event – paid
- fee for the paid event – unpaid

Procedure 1

Procedure building an active relationship to the space of the stadium during the week

IF day of the week = weekday
AND time interval during the week = from 8:00 a.m. till the dusk
THEN the state of the relationship to the space of the stadium = active relationship

Procedure 2

Procedure building active relationship do the space of the stadium on Sunday, during events

IF day of the week = Sunday
AND time interval on Sunday = time of a paid event
AND fee = paid
THEN the state of the relationship do the space of the stadium = active relationship

Let us consider the case when a person develops the relation not only to the space of the whole stadium, but also to the seat reserved for them. This seat is attributed during the process of payment. The ticket contains a detail description consisting of the indication of the sector, the number of the row and the number of the seat in the row.

Extended base conditions (facts) for Procedure 3 – containing conditions for procedures 1 and 2 and additional conditions, given below, describing in detail the seat and developing the relationship addressed in the space of the stadium

. . . .

– taking a seat in the sector indicated in the ticket
– taking a seat in the sector other than indicated in the ticket
– taking a seat in the row indicated in the ticket
– taking a seat in the row other than indicated in the ticket
– taking the specific seat in the row, the number of which is indicated in the ticket
– taking the specific seat in the row, the number of which is other than indicated in the ticket

Procedure 3

A procedure building an active relationship to the space of the stadium on Sunday, during events, extended, addressed to the specific individual seat in the space of the stadium

IF day of the week = Sunday
AND time interval on Sunday = the duration of a paid event
AND entrance fee = paid
AND taking a seat in the sector indicated in the ticket = yes
AND taking a seat in the row indicated in the ticket = yes
AND taking a seat with a number indicated in the ticket = yes
THEN the state of the relationship to the specific individual seat in the space of the stadium = active relationship

After taking the specific seat indicated in Procedure 3 – the relationship to this place is active. Taking this seat by a person developing this relationship is justified. The duration of the relationship theoretically equals the jest duration of the event. In practice we take into account the time needed to fill up the stadium and then empty it after the event. To be more precise: this extra time can also be considered in the procedures.

4. SPATIAL RELATIONSHIPS TO LINEAR OBJECTS

Let us consider the case of the relationship to an individual or a group to the linear space, taking an example of the network of marked trails in a national park with the features of a mountainous area, in the lower part covered by forests, in the upper – by the dwarf mountain pine (Pinus mugo). The park has marked trails of various levels of difficulty, making the network of paths. It is open for individuals and organized groups seven days a week from 7:00 a.m. till the dusk. There is a small entrance fee. In winter only some trails are open, the rest is closed. Visiting the national park by individual tourists is allowed without limitation, organized groups of youth should be accompanied by the guide.

Let us combine the base conditions (facts) to make relationship of an individual or a group to the linear network (marked trails) of a national park.

Base conditions (facts)

– time interval – from 7:00 a.m. till the dusk
– time interval – from midnight till 7:00 a.m. or from dusk till midnight
– entrance fee do the national park – paid
– entrance fee do the national park – unpaid
– guide person is required
– guide person is not required

Procedure 4

Procedure developing active relationship to the network of the paths in the national park when all the trails are available for individual tourists.

IF time interval = from 7:00 a.m. till the dusk
AND entrance fee to the national park = paid
AND hiring the guide for individual tourists = not required
THEN the state of the relationship to the network of paths in the national park = active relationship

Set of base conditions (facts) can be extended by subsequent facts – for example connected with open or closed part of paths in winter.

Let us consider another case relationship to a linear object. There is a historic underground mine open 7 days a week from 8:00 a.m. till 8:00 p.m. The admission is paid, visits have to be held in groups with the guide. The costs of the guide service are included in the price of the ticket. There is an option of hiring a guide in a foreign language for individual visitors – for an extra fee.

Let us combine base conditions (facts) to make relationship of a person or group of people visiting a historic mine to the linear network – the underground tourist route.

Base conditions (facts)

- time interval – from 8:00 a.m. till 8::00 p.m.
- time interval – from midnight do 8:00 a.m. or from 8::00 p.m. till 24:00
- entrance fee to the historic mine – paid
- entrance fee to the historic mine – unpaid
- visiting the historic mine in a group with the guide
- visiting the historic mine individually with a guide speaking a foreign language
- additional fee for hiring the guide speaking a foreign language – paid
- additional fee for hiring the guide speaking a foreign language – unpaid
- the guide speaking a foreign language is available from 2:00 p.m. till 6:00 p.m.
- time interval – from midnight to 2:00 p.m. or from 6:00 p.m. till midnight

Procedure 5

Procedure developing an active relationship to the underground route of the historic mine for a person visiting individually – with a guide speaking a foreign language within the time interval when the guide is available

IF time interval = from 8:00 a.m. till 8:00 p.m.
AND entrance fee to the historic mine = paid
AND form of visiting the historic mine = individually with a guide speaking a foreign language
AND additional fee for hiring a guide speaking a foreign language = paid
AND additional condition of the time interval available for visiting = from 2:00 p.m. to 6:00 p.m.
THEN the state of the relationship to the historic underground mine = active relationship

Making the sum of the presented examples one should emphasise that the relationships to linear objects are connected with the movements alongside linear objects, for example the movement alongside the visitors' tour in the historic mine or the movement alongside the edge of the linear network, for example the movement in the tourist routs. Like in the previous cases, an important role is played by the factor of time. In both presented cases pedestrian movement was considered.

Continuing discussion regarding the pedestrian movement we can combine conditions (facts) and establish procedures for the network of pedestrian paths in the area of the city, made by pavements and pedestrian crossings, alleys in city parks, as well as procedures for pedestrian paths indoors. However, pedestrian movement alongside the edges of linear object is only one of many forms of the movement of individuals or groups. Thus in our discussions we should look at many other complex relationships to linear objects or networks.

5. MULTI-STEP (CASCADE) RELATIONSHIPS TO 2D OBJECTS AND LINEAR OBJECTS

Let us consider the case of going by bus in the public transport from point *A* to point *B*. We have the fact of entering a person or group to the space of the bus in point *A*, and then going by bus alongside the definite edges of the network of the public transport connections in the city. In this complex case to relationships occur: the relationship to a 2D object to the space of the bus and relationship between the vehicle and passengers to the linear object – the route of the bus *X* between points *A* and *B*. Such relationships will be treated as relationships multi-step or cascade relationships.

Let us consider the case of a two-step relationship for a person travelling from point *A* to point *B*. The bus of line X operates in weekdays from 5:00 a.m. till 10:30 p.m. The first segment contains the relationship of a person to the space of the bus on the start bus stop A and after entering the bus.

Base conditions (facts), segment 1

- day of the week – weekday, from Monday till Saturday
- day of the week – Sunday
- time interval – from 5:00 a.m. till 10:30 p.m.
- time interval – from midnight till 5:00 a.m. or from 10:30 p.m. till midnight
- fee for the travel by bus line X between stops A and B – paid
- fee for the travel by bus line X between stops A and B – unpaid

Procedure 6

Procedure developing active relationship of a person to the space of bus line X

IF day of the week = weekday, from Monday till Saturday

AND the current time is contained in the interval from 5:00 a.m. till 10:30 p.m. = yes

AND fee za for the travel by bus line X between stops A and B = paid

THEN the state of the relationship of a person to the space of the bus line X = active relationship

Base conditions (facts), segment 2

- day of the week – weekday, od from Monday till Saturday
- day of the week – Sunday
- time interval – from 5:00 a.m. till 10:30 p.m.
- time interval – from midnight till 5:00 or from 10:30 p.m. till midnight
- bus line X between stops A and B operates according to the timetable
- due to road incidents the bus reaches the bus stop B late

Procedure 7

Procedure building active relationship between the bus and passengers to the route line from A to B. Bus line X operates between stops A and B

IF day of the week = weekday, od from Monday till Saturday

AND the current time is contained in the interval from 5:00 a.m. till 10:30 p.m. = yes

AND the route of bus line X between the bus stops A and B = passable

THEN the state of the relationship of the bus to the linear space from A to B in the time according to the timetable = active relationship

Procedure 8

Result procedure of multi-step (in this case 2-step) relationship, made of segments 1 and 2

IF relationship of a person to the space of bus line X = active relationship

AND state relationship of the bus to linear space from A to B in time, according to the timetable = active relationship

THEN the relationship of a person to the route of bus line X from stop A to stop B in the time according to the timetable = active relationship

One cannot avoid repetitions in segments 1 and 2, referring to the days and hours when bus line X operates. Considering the task in the aspect of the organization of the public transport – the bus operates according to the timetable in definite hours and days of the week. While in the aspect of planning the journey – a person (potential passenger) must adjust to the days and the planned time interval of the journey.

The above example of the multi-step relationship has an elementary character, because it consists only of two steps. We could extend this relation by getting to stop A and achieve final destination after getting to stop B. Multi-step (cascade) relationships occur very often in daily life of the society.

6. CONCLUSIONS

In this paper the task of studying the relationship between individuals or groups and space as well as making a formal description of these relationships. The methods of making base conditions (facts) to selected examples of these relationships was presented, and then the procedures developing the relationship to the local space, making it active for individuals or social groups were formulated.

In formulating the conditions (facts) and procedures – in most cases the time factor plays a basic role.

The current times should be treated as an era of digitalization of various types of data and processes. Thus it is very desirable to study the processes of daily life and provide them a formal shape. Everyday life is full of examples of the relationships of individuals or social groups to the local space.

Apart from technical goals, leading to the rationalization of daily life, studying the processes can also bring benefits in social sciences as contribution to behavioural studies.

The space, we live in is a unique good. This good should be managed in a sustainable way, thus it is necessary to investigate, analyse and formalise the relationship to the local space.

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