Semantics of Spatio-Directional Geometric Terms of Indian Languages

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Abstract

This paper examines widely prevalent yet little-studied expressions in Indian languages which are known as geometrical terms because “they engage locations along the axes of the reference object”. These terms are andara (inside), bāhara (outside), āge (in front of), sāmone (in front of), pīche (back), āpara (above/over), nīce (under/below), dāyen (right), bāyen (left), pāsa (near), dāra (away/far) in Hindi. The way these terms have been interpreted by the scholars of Hindi language and handled in the Hindi Dependency treebank is misleading. This paper proposes an alternative analysis of these terms focusing on their triple – nominal, modifier and relational - functions and presents abstract semantic representations of these terms following the proposed analysis. The semantic representation will be explicit, unambiguous abstract and therefore universal in nature. The correspondence of these terms in Bangla and Kannada are also identified. Disambiguation of geometric terms will facilitate parsing and machine translation especially from Indian Language to English because these geometric terms of Indian languages are variedly translated in English depending on context.

1 Introduction

Geometric terms that “engage locations along the axes of the reference object” (Landau, 2017) play multiple roles - relational, nominal, modifier - in Indian languages and their equivalents in English can vary based on their functional role. For example, the geometric term nīce in (1-a) and (1-b) is translated differently into English depending on the function of the word in the given two contexts:

\[
\begin{align*}
(1) & \quad \text{a. meja ke nīce petī mem} \\
& \quad \text{table.SG GEN under box.SG LOC} \\
& \quad \text{cyūmgama} \\
& \quad \text{Chewing gum.SG.3.NOM} \\
& \quad \text{cipakī hai} \\
& \quad \text{stick.PR.SG.3} \\
& \quad \text{‘There is a chewing gum stuck under the table’}. \\
& \quad \text{b. nīce jāo down go.IMP.SG} \\
& \quad \text{‘Go down’}.
\end{align*}
\]

In (1-a), the term nīce indicates a spatio-directional¹ relation between meja (table) and cyūmgama (chewing gum) while in (1-b), nīce denotes downward location. Thus, in (1-a), nīce (under) is a relational marker that specifies the geometric position of ‘chewing gum’ with respect to the ‘table’ while in (1-b) nīce (down) indicates location, thus fulfilling a nominal function. Interestingly there are contexts where these terms inadvertently appear to be relational markers which they are not. For such cases we attribute a third role to them, the role of a modifier. For example, in (2) the term nīce is a spatial modification of the location peṭī (box). The location of ‘books’ is the box and the position of the box is specified by the geometric term nīce. The reference object meja (table) with respect to which nīce has to be interpreted is present in (2-a). In (2-b), we show that nīce can even take the adjectival suffix, thus making its modifier role clearer.

\[
\begin{align*}
(2) & \quad \text{a. meja ke nīce petī mem} \\
& \quad \text{table.SG GEN under box.SG LOC} \\
& \quad \text{pustaka} \\
& \quad \text{book.SG.NOM keep.PR.SG.3} \\
& \quad \text{‘The book is kept in the box under the table.’} \\
& \quad \text{b. meja ke nīcevālī petī mem} \\
& \quad \text{table.SG GEN under.ADJ box.SG LOC} \\
& \quad \text{pustaka} \\
& \quad \text{book.SG.NOM keep.PR.SG.3} \\
& \quad \text{‘The book is kept in the box that is under the table.’}
\end{align*}
\]

¹Spatio-directional refers to spatial cum directional semantics
Thus, we identify three roles of the geometric terms in Indian languages:

1. A spatial noun denoting a place as in (1-b)
2. A geometric spatio-directional relation marker as in (1-a).
3. A geometric spatio-directional modifier of a noun as in (2-a).

In this paper, we propose semantic interpretation of geometric terms and present an abstract semantic representation for them. The semantic representation will be explicit, unambiguous, abstract and therefore universal in nature. Such enquiry is significant not just for Natural Language Understanding, but also in the context of language transfer. We have shown in (1) that English, for example, uses a preposition when the geometric term is a relational marker, otherwise the language uses adverbs as in (1-b) while Hindi and other Indian languages such as Bangla and Kannada use the same lexical item in both (1-a) and (1-b).

The paper is divided into the following sections. Section 2 introduces the equivalents of Hindi spatio-directional geometric terms in Bangla and Kannada. Section 3 presents the semantic interpretation of these terms. Section 4 presents semantic representation of these terms and shows how such representation captures information explicitly and unambiguously, which are the characteristic features of any efficient semantic representation system. Finally, we will present the design of a Geometric terms Search Interface with annotation facility integrated in section 5.

2 Geometric Terms in Hindi, Bangla and Kannada

Geometric terms under considerations are andara (inside), bāhara (outside), āge (in front of), sāmane (in front of), pīche (back), upāra (above/over), nice (under/below), dāyem (right), bāyem (left), pāsa (near), dāra (away/far) in Hindi. There are some more geometric terms which are used in Hindi such as āra-pāra (across), ora (towards) which are purely relational markers and hence we keep them out of scope of this paper.

Table-1 presents equivalent lexical terms in Hindi, Bangla, Kannada and English for the relational variant of these terms and their morpho-lexical properties. Most of the English terms apart from ‘right’, ‘left’, ‘inside’ and ‘outside’ are spatial prepositions which are indeclinable.

Table-2 gives a quick comparative study of these lexical items in Hindi, Bangla and Kannada. The gloss for each example given in Table-2 is given in Appendix-1.

Fortis and Fagard following Levinson et al. have shown that relational nouns (spatial nominals) in Japanese and Korean follow a structure [Ground-GEN Spatial_Nominal-PostP] which, we see, is quite similar to Indian languages.

3 Semantic Interpretation of Geometric Terms

Talmy (1983) has introduced Figure-Ground geometric sense 6 “to refer to the located vs locating entity”. Figure is “the object which is considered as moving or located with respect to another object” and Ground is “the object with respect to which a first is considered as moving or located” (Talmy, 1983) in the context of spatial configuration. Ground is alternatively referred to as a Reference object.

In Indian Grammatical Tradition, the relation is described between adhāra (Ground) and adheya (Figure). Two kinds of relations between adhāra and adheya have been identified in the literature which is very much relevant for our interpretation of geometric terms. This analysis also explains data recorded by Talmy in a different light that fits to our multirole analysis of these terms. The two relations are sanyoga-sambandha (contact by touch) and sāmipyaya-sambandha (contact by proximity) Shastri (1926); Subramania Iyer (1971). When there is a temporary physical contact (sanyoga) between the adhāra and the adheya then the spatial relationship is said to have a sanyoga-sambandha.

The concept of Figure and Ground are borrowed from gestalt psychology to linguistics.
| Hi. form | Ba. form | Ka. form | En. | Example | Transl. |
|----------|----------|----------|-----|---------|---------|
| andara   | bhitaré  | olage    | inside | dihba thaile ke andara hai. | The box is inside the bag. |
| bāhara   | bāhirā, bāire | hora +akke | outside | ghara ke bāhara nāma paṭṭi lagī hai. | The nameplate is outside the house. |
| āge      | āga + e  | mumde    | In front of | gāḍī ke āge nambra pleṭa nahīm hai. | There is no number plate in front of the car. |
| sāmane   | sāmane   | Indcl edhuru | Indcl | In front of | ye pirāmiḍa itihāsa kī eka alaga hī duniyā ko hamāre sāmane rakhte haiṁ. | These pyramids put a different kind of world before us. |
| pīche    | pichane  | himdhe   | behind | gāḍī ke pīche nambra pleṭa nahīm hai. | There is no number plate behind the car. |
| ūpara    | opara, opore | mele    | Above/on | meja ke ūpara kapa hai | The cup is on the table. |
| nīce     | nīce + e | keḷage   | under | meja ke nīce cyūṃgama cipāki hai. | The chewing gum is stuck under the table. |
| dāyem    | dāine    | balakke  | right | paidala yātri sadaka ke dāyīṁ ora calem | Pedestrians should walk on the right side of the road. |
| bāyem    | bāmye    | edakke   | left  | gāḍiyāṁ sadaka ke bāyīṁ ora calem | Cars should go on the left side of the road. |
| cāromora | cāradike, cāridike | suttal +alu | around | ribana moma-battī ke cārom ora bāṃdhā huā hai. | The ribbon is tied around the candle. |
| bīca     | mājha- khāne | madhya | between | nāva samudra ke bīca taira rahī hai. | The boat is floating in the middle of the ocean. |
| pāsa     | pāše, kāche | hattira | near | hara mausama mem govā ke pāsa āpako parosane ke lie kucha khāsa hai. | In every weather Goa has something special to serve you. |
| dūra     | dūre + e | dūra     | far   | - | - |

Table 1: Morpho-lexical properties of relational variants of Geometric Terms in Hindi, Bangla, Kannada and English

3Indeclinable: indcl
4All the roots to which -e suffix has been added has an independent nominal occurrence in present Bangla
5-e is the locative marker in Bangla
6bāira | bāhira (sadhu form of Bangla) does not have lexical
When the ādhēya does not touch the ādhihāra but stays in proximity with ādhihāra then that spatial relation is said to have sāmīpya-sambandha.

(5) peda ke āpara cāmāda
     tree.SG GEN above moon.SG.NOM
     ā cukā hai
     appear.PR.SG.3
     ‘The moon has appeared above the tree.’

In order to localize a Figure with reference to Ground, Talmy has identified three kinds of expressions:

1. The expression indicates the Figure in touch with the Ground – same as samyoga-sambandha. Talmy observes that “the part of the Ground thus named is treated a regular noun” and usually occurs after ‘the’ in such cases,

(6) The mosaic is on the back of the church.

(7) The boy is in the front of the line.

2. The expression indicates the Ground’s part to indicate ‘immediate adjacency’ – similar to sāmīpya-sambandha. Talmy has observed that in such cases in English, there is no ‘the’ before the geometric terms:

(8) The bike is in back of/behind the church.

(9) The police officer is in front of the line.

We omit the third type of expression here because they are poorly represented in English as Talmy has pointed out and do not come under the scope of this paper.

Given the above understanding, we propose two possible situations:

1. The Figure is located in a locus that is in ‘part-whole’ relation with the reference object,

(10) peda ke āpara pakṣī hai
     tree GEN on bird.NOM be.PR.SG
     ‘The bird is on the tree.’

(11) The bike is behind the church (sentence (8) is repeated here)

2. The Figure is located in a locus that indicates a space denoted by the geometric term with respect to the reference object.

(12) peda ke āpara cāmāda
     tree GEN above moon.SG.NOM
     hai
     be.PR.SG
     ‘The moon is above the tree.’

(13) The mosaic is on the back of the church (sentence (6) is repeated here)
In case of 1, the geometric term mainly denotes the spatio-directional relation between the Figure and the reference object. The directional configuration of the Figure ‘bike’, for example in (8), with respect to the reference object ‘church’ can be front/back/behind/ near and so on. Hence, this is the relational marker interpretation of the geometric terms.

In case of 2, on the other hand, the geometric term specifies a location. The location, although underspecified, indicates either directional or spatial position of the Figure. For example, the position of ‘cānda’ (moon) in (12) is in a space which is above the ‘peḍa’ (tree). This is the nominal use of the geometric terms. Such terms can be modified just like any other noun as shown in (14)-(17).

(14) peḍa ke thīka ūpara cānda tree.SG GEN right above moon.NOM hai be.PR.SG ‘The moon is right above the tree.’

(15) ghara se 4 kilomīṭara dūra eka house.SG ABL 4 kilometre away a mandīra hai temple.NOM be.PR.SG ‘There is a temple 4 kilometres away from the house.’

(16) mandaūra se eka mila nīce eka mandaūra.NNP a mile below a chōta saṁgha hai, small saṁgha.NOM be.PR.SG ‘There is a small saṁgha a mile below the mandaūra.’

(17) kāṃkera se 22 kilomīṭara āge Kanker.NNP ABL 22 kilometre ahead śūrī hoṭī hai keśaḵāla kī manorāma start.PR.SG Keshkal.NNP GEN charming ghāṭī valley.NOM ‘The charming valley of Keshkal starts 22 kilometres ahead of Kanker.’

4 Abstract Semantic Representation of expressions with Geometric terms

Keeping in tune with our analysis given in section 3, we will present here an abstract semantic representation of the geometric terms. Before we present our representation, we will examine how these terms have been represented in the Hindi dependency treebank. In Hindi grammar, these geometric terms have been considered as part of complex post-positions (Bharati et al., 1995; Kachru, 2006; Koul, 2008; Bharati et al., 2009). In Hindi dependency treebank, however, they are lexically marked as Noun-Space-Time (NST) thus distinguishing them from other post-positions which are tagged as PSP \(^7\) (Bharati et al., 2007). The tag NST indicates that these lexical items are nouns denoting space and time, but their role in the context is not that of a noun. The semantic relation that has been annotated for the sentence “laḍakā ghara ke bāhara khaḍā hai.” where ‘bāhara’ is an NST as shown in Figure-1.

\[
\begin{align*}
\text{khaḍā hai} & \quad \text{laḍakā} \\
\text{ghara} & \quad \text{k1/doer} \\
\text{Kanker} & \quad \text{ghara} \quad \text{k7p} \\
\end{align*}
\]

Figure 1: Basic dependency tree for sentence: laḍakā ghara ke bāhara khaḍā hai.

In dependency tree structures the content words are represented as nodes, the verb is the head of the tree (in case of simple sentences) and relational markers are all semantic labels on the edges connecting the nodes as shown in Figure-1. The convention of Hindi Dependency treebank is that the syntactico-semantic relations are marked among the chunks. Each chunk has a head and the relation is to be understood between the heads of the chunk. The meaning of this structure is that ‘ke bāhara’ (which is annotated as PSP_NST at the POS level) is a relational marker and conveys ‘desādhikaran. a’ (locative) information. This analysis implies ‘ghara’ (house) the location where the boy stands. This is a misleading analysis because the boy does not stand at the house rather he stands in a place which is outside the house. ‘bāhara’ conveys that information but the analysis in the treebank does not explicitly capture that.

According to our interpretation of geometric terms, the representation of relational and nominal/modificational variants are postulated differently. Figure-2 presents the relational marker variant of geometric terms. For the sentence ‘pakṣī peḍa ke ūpara / para baithā hai’, both the reference object and the Figure are shown as dependents
of the sentential head which is the verb:

\[ \text{baithā hai} \]

\( \text{/} \text{V/abs} \quad \text{special on} \quad \text{paksī} \quad \text{peda} \)

Figure 2: Basic dependency tree for sentence (4)

The semantic label spatial\_on indicates that peda is a reference object for the action ‘sitting’ whose kartā is paksī (bird). The labels for geometric terms are given in Table-3. Semantic classes in terms of positive and negative values for features are also specified.

The nominal/modificational variant of geometric terms are represented in the form of constructions. Constructions in Construction Grammar (Fillmore, 1988) are linguistic patterns in which some aspect of its form or its meaning cannot be predicted from its component parts. In Indian Grammatical Tradition, it is called vr. tti. Vr. tti is defined as ‘parārthābhidhānam vr. ttih.’ – an aggregated word-form that gives a sense which is different from the literal sense of its constituents (Joshi et al., 1990; Sharma and Sharma, 1982).

In our construction, geometric terms entail a space which is not lexically expressed but whose geometric relation to the reference object is conveyed by the geometric terms. The linguistic patterns can be represented as a template and the template is assigned a meaning. For example, the following template defines the form-meaning pair for the nominal/modificational usage of the geometric terms:

\[
\begin{align*}
[X]_{\text{ref-obj}} & ke_\text{Term}_{\text{spatial/directional-ground}} [ke/vālā][Y]_{\text{loc}} \\
\end{align*}
\]

where X and the space denoted by the Term are not in a part-whole relationship.

The subscripts define the meaning and X, ke\_Term and Y are variables for physical expressions in 1.

For the sentence (5), the template-1 can be instantiated as follows:

\[ \text{peda}_{\text{ref-obj}} \text{ ke āpara}_{\text{spatial/directional-ground}} \text{ cāndā} \text{ āg ōo} \text{ hai} \]

Following are more examples:

\[ \text{sāmāne}_{\text{spatial/directional-ground}} \]

In the above sentences, ‘big trees’ are the Figure/ādhāya and the space denoted by the geometric terms sāmāne / pāsa / pīce is the Ground / ādhāra. In sentences (20) ghara is a reference point with respect to which ‘ādhā’ has to be interpreted. In (19), the reference point is not explicitly mentioned, and it is from the context the reference point has to be determined. For the above sentences the final part of the template [ke/vālā] [Y]_{\text{loc}} is null, and therefore they represent nominal variants. For (21) and (22) below, the construction is used as a modifier and the full template is instantiated as shown below:

\[ \text{ghara}_{\text{ref-obj}} \text{ ke sāmāne}_{\text{spatial/directional-ground}} \]

\[ \text{cāro} \text{ or}_{\text{spatial/directional-ground}} \text{ ke bagīce}_{\text{loc}} \text{ mem} \text{ āg ōo āg ōo peda āg ōo hai} \]

\[ \text{ghara}_{\text{ref-obj}} \text{ ke sāmāne}_{\text{spatial/directional-ground}} \]

\[ \text{cāro} \text{ or}_{\text{spatial/directional-ground}} \text{ ke bagīce}_{\text{loc}} \text{ mem} \text{ āg ōo āg ōo vālī bagīce}_{\text{loc}} \text{ mem} \text{ āg ōo āg ōo peda āg ōo hai} \]

5 Developing a Corpus Search cum Annotation Interface for Geometric Terms

From the above discussion, it has become clear that the semantics of geometric terms are quite chequered. We have done a corpus study to understand how these terms are translated into English. We present here example sentences for 4 geometric terms in Table-4.

From Table-4, we find that nice has been translated into as many as 5 different words while sāmāne into 4 different words. There is also one case of idiom and one phrasal verb attested in the data. We get the adjectival form of bāhara as bāhārī.

In order to be able to disambiguate the geometric terms so that we get appropriate translations into
### Table 3: Semantic Classification of the geometric terms. The binary feature ‘Con’ defines the physical ‘contact’ of the adheya with the adhara; ‘Dir’ and ‘Loc’ specify ‘direction’ and ‘location’ respectively.

| Hindi   | Bangla  | Kannada | Semantic Class                                                                 | Semantic Label       |
|---------|---------|---------|---------------------------------------------------------------------------------|----------------------|
| andara | bhitare | olage   | (R^9) Loc: Interior; Con +, (N/M^10) Loc: Interior; Con -                      | Spatial inside       |
| bāhara  | bāhira, bāire | horage | (R) Loc: Exterior; Con -, (N/M) Loc: Exterior; Con -                         | Spatial outside      |
| āge     | āge     | munide  | (R) Loc: Anterior; Dir +                                                   | directional ahead    |
| sāmane  | sāmane  | eduru   | (R) Loc: Anterior; Dir +                                                 | directional front facing |
| pīche   | pichane | hiṃde   | (R) Loc: Posterior; Dir +                                                   | directional behind   |
| ūpara   | opara, opore, upare | mēle  | (R) Loc: Superior; Dir +; Con +, (N/M) Loc: Superior; Dir +; Con -           | Directional on       |
| nīce    | nīce    | kelage  | (R) Loc: Interior; Dir +; Con +                                              | Directional under    |
| dāyem   | dāine   | balakke | (R) Loc: Right_side; Dir +; Con +, (N/M) Loc: Right_side; Dir +; Con -     | Directional left     |
| bāyem   | bāMye   | edakke  | (R) Loc: Left_side; Dir +; Con +, (N/M) Loc: Left_side; Dir +; Con -        | Directional right    |
| căroṣa  | căraḍik, căridike | suttalu | (R) Loc: Circumferential; Con +, (N/M) Loc: Circumferential; Con -        | Directional around   |
| bīca    | mājakhāne | madhya  | (R) Loc: Medial; Con +, (N/M) Loc: Medial; Con -                         | Spatial between      |
| pāsa    | pāse, kāche | hattira | (R) Approx Spatial Proximity: +; Con +, (N/M) Approx Spatial Proximity: +; Con - | Spatial near        |
| dūra    | dūre    | dūra    | (R) Approx Spatial Proximity: -; Con +, (N/M) Approx Spatial Proximity: -; Con - | Spatial far         |

English, we need to understand the context of occurrence of these terms more thoroughly. One way of doing this is to study their usage in corpora, both monolingual and Indian language-English bilingual corpora. To facilitate this study we propose to design an interface for intelligent search of these terms in different contexts. For that purpose, we create a database of existing annotated monolingual corpora as well as a database of parallel corpora. For monolingual corpora, we use POS tags, actual lexical items and syntactic relations as cues for searching the database. When we set out to do that, we find that the geometric terms irrespective of their functional status are annotated as NST in the existing corpora (Jha, 2012). In order to make the search more meaningful, we have integrated an annotation facility to the search interface for annotating the geometric term for relation markers, nouns and modifiers. This will help in future to search these terms for their different functions.

### 6 Conclusion

The paper has examined the spatio-directional geometric terms and their semantics in a great detail mainly for Hindi and also for Bangla and Kannada. We have observed that even though these geometric terms have some morpho-syntactic differences in these three languages they are very much in alignment in terms of interpretations. This paper is the beginning of an in-depth study of geometric terms of Indian languages. There remains much work to be done in laying out systematically the subtler differences among apparently close terms such as āge, sāmane; bāhara, sāmane and so on. For example, we can almost interchangeably say the following two sentences:

---

9 R': Relational  
10 N': Nominal, M': Modifier
(23) ghara ke bāhara găḍī khadjī hai
house GEN outside car.NOM park.PR.SG
‘The car is parked outside the house.’

(24) ghara ke sāmane găḍī
house.SG GEN in front of car.NOM
khadjī hai
park.PR.SG
‘The car is parked in front of the house.’

But that is not true for the following pair of sentences:

(25) a. meja ke sāmane kursī
table GEN in front of chair.NOM
hai
be.PR.SG
‘A chair is kept in front of the table.’

b. *meja ke bāhara kursī
table GEN outside chair.NOM
hai
be.PR.SG
‘*A chair is kept outside the table.’

It appears that the semantics of reference objects are playing a role in licensing the geometric terms. This paper draws the conclusion that in Indian languages (at least for those under consideration), spatio-directional geometric terms play three roles: relational, nominal and modificational. We have proposed to design an interface for annotating geometric terms for their different interpretations. The information can be useful for Natural Language Understanding, Natural Language Generation and knowledge rich Machine Translation.

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A Appendix-1

Glosses for the Hindi, Bangla and Kannada examples given in Table-2.

Hindi: Nominal use:-

(26) ladakā piche se āyā
boy.SG.NOM behind ABL come.3.SG.PT
‘The boy came from behind.’

Bangla: Nominal use:-

(27) chele-tā pechon theke elo
boy.SG.NOM behind ABL come.3.SG.PT
‘The boy came from behind.’

Kannada: Nominal use:-
(28) huḍuga hiṁdininṁda bahdana
boy.SG.NOM behind.ABL come.3.SG.PT
'The boy came from behind.'

Hindi: Relational marker use:-

(29) meja ke nīc-e
table.SG GEN under
Chewing gum.SG.3.NOM stick.PR.SG.3
'There is a chewing gum stuck under the table.'

Bangla: Relational marker use:-

(30) tebid-er nīc-e
table.SG GEN under
Chewing gum.SG.3.NOM stick.PR.SG.3
'There is a chewing gum stuck under the table.'

Kannada: Relational marker use:-

(31) teba-lina kelage
table.SG GEN under+towards
Chewing gum.SG.3.NOM stick.PR.SG.3
'There is a chewing gum stuck under the table.'

Hindi: Modifier use:-

(32) gara ke pīche (ke) bāgiçe
house.SG GEN behind GEN garden.SG
mem baḍe baḍe
LOC big.PL.NOM big.PL.NOM
peḍa haim
tree.PL.3.NOM be.PR.3.PL
'There are big trees in the garden which is behind the house.'

Bangla: Modifier use:-

(33) bāriṭ pechone(r)
house.SG GEN behind.GEN
garden.SG.LOC big.PL.NOM big.PL.NOM
existe PR.3.PL
'There exist big trees in the garden which is behind the house.'

Kannada: Modifier use:-

(34) maneya hindina
house.SG GEN behind.GEN
existence
Tōtaḍali Dodda
garden.SG.LOC big.PL.NOM
maragalive
tree.PL.3.NOM, exist.PR.3.PL
| down, below, underground, under, underneath | nice | Tag |
|---------------------------------------------|------|-----|
| In the same fashion Son river falls **300 metres down.** | usī ṭarjā meṃ sona nādi 300 phīta nice girāṭī hai. | N |
| While going to Kedarnath snow mass are seen slipping **here and there below the feet.** | kedāranāṭha jāte samaya pairōm ke nice yatra-tatra hima rāśī khisakaṭi diṅkāi paḍaṭī hai. | M |
| In Bucharest city there are **underground trains** as ell which are called as ‘Metro’. | bukhāresta śahara meṃ jamīna ke nice calane väli releṃ bhī haim, jinheṃ ‘metro’ kahā jāṭā hai. | N |
| There are special kind of shoes for skiing, **under which** a long metal ski board is attached. | Skṛımga ke lie viśeṣa prakāra ke jūte hote haim, jinake nice dhāṭu kā banā lambā ski bledā lagā hotā hai. | R |
| Here **underneath a peepal tree**, Shree Krishna sat in a lugubrious pose. | yahāṃ eka pīpala ke peḍa ke nice śīrķṣna viśādamaya mudrā meṃ baiṭhe the. | N |
| ahead, forward | āge | |
| The charming valley of Keshkal starts **22 kilometres ahead of Kanker.** | kāṃkera se 22 kilomīṭara āge śūrī hotī hai keśakāla kī manorana ghāṭī | N |
| Taking deep breaths making our breath regular, we were **going forward.** | gahare svāsa bharakara apan śāṃsōṃ ko niyamita karate hue hama āge baḍha rahe the. | N |
| out, outer, outside | bāhāra | |
| Picnic spots adorned with cedars and rivers and streams are **out of population.** | ābāḍī se bāhāra nādināloṃ va devadāroṃ se saje pikanika sthala haim. | N |
| Installed in the Atishay Kshetra the **outer structure** of this temple is extremely grand. | Atiśaya kṣetra meṃ sthāpiṇa isa maṃdirā kā bāhari svarūpa atyaṃta bhavya hai. | M |
| Diwan-e-Khas looks like a one-storey building from **outside** but from inside it is double storied. | divāna-e-khāsa imārata bāhāra se dekhane meṃ eka maṃjilā praṭīṭa hotī hai magara amdara se domaṃjilā hai. | N |
| before, in front of, to the fore, out | sāmane | |
| Then Mahalaxmi had **appeared before him** with a lotus in her hand. | taba mahālakṣmī hāṭha meṃ kamala dhāraṇa kie hue unake sāmane prakaṭa huī thīm. | R |
| An extremely attractive pillar is installed **in front of the temple.** | maṃdirā ke sāmane eka atyaṃta ākarsaka stambha sthāpiṇa hai | N |
| During the excavation of Vaishali it **came to the fore** that it has had an impressive history. | vaśāli meṃ mili khudāi meṃ mile avasāṃṣōṃ se yaha bāta sāmane āi hai ke isakā eka prabhāvaśāli itihāsā raḥā hai. | Idiom |
| At the confluence place of the rivers which **is right before the temple** are beautiful but small falls. | nadiyoṃ ke saṅgama sthala para jo maṃdirā ke ṭhika sāmane haim sunḍara kintu chotā prapaṭa hai. | N |
| Although quarrying of the Stupa is still not complete yet its 104 ft high structure has **come out.** | stāpa kā utkhaṇa-kārya yadyapi abhī pūrā nāhim huī hai, tathāpi, isakī 104 phīta ūṃcī samrāccanā sāmāne ā cukī hai. | Phrasal verb |
| The **part in the front of it** has fallen. | inakā sāmāne kā hissā gira gayā hai. | M |

Table 4: Example sentences from the corpus for 4 geometric terms