A Rule Based Approach for Analysis of Comparative or Evaluative Questions in Tourism Domain

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Abstract

Comparative or evaluative questions are the non-factoid class of questions that contain comparative or evaluative keywords, which may or may not be directly quantifiable. This entails the need for extraction of comparative and evaluative features, identification of semantic meaning of those features and converting them to quantifiable criteria before data can be obtained from the source text. This paper presents the study of the comparative or evaluative questions along with a rule based approach to syntactically extract and semantically analyze comparative or evaluative features, and give a basic idea to generate the answer.

1 Introduction

Answering of the Comparative or Evaluative questions needs some extra effort mainly because of two reasons. The first reason is the extraction of the Comparative or Evaluative keywords and features (CEF) from the question and syntactically and semantically analyzing them. Secondly, the non-quantifiable Comparative or Evaluative expressions have to be transformed into quantifiable criteria so that appropriate answer can be generated.

The Comparative or Evaluative expressions mainly belong to the adjective (like good, better, best) or the adverbs followed by the adjective (like more popular, most popular). The expression depicts the degree of comparison (e.g. general or positive/ negative, comparative, superlative). The Comparative or Evaluative expression may (for example, cheapest hotel to stay in Las Vegas where 'cheapest' is the comparative expression) or may not be (for example, best hotel to stay in Las Vegas where 'best' is comparative expression) directly quantifiable. So, a mechanism is necessary to convert all the Comparative or Evaluative expressions into quantifiable criteria. The Comparative and Evaluative Features (CEF) include the entity upon which comparison is done (e.g. all hotels in Las Vegas) and the constraints, which are used to choose the most appropriate entity. In brief, the task of question analysis part can be divided into 3 basic operations.

1. Extraction of Comparative or Evaluative Expression and CEFs.
2. Classification of question according to user information need.
3. Transforming the Comparative or Evaluative expression into quantifiable criteria.

Another issue with the comparative or evaluative question is that, it requires great deal of domain knowledge to transform comparative or evaluative keywords into quantifiable criteria. For example, if 'best' is the comparative keyword and used as 'best hotel' (e.g., what are the best hotels in Las Vegas?) in tourism domain and 'best insurance policy' (e.g. what are the best insurance policy for my child education?) in business domain then system has different set of paradigms to transform 'best' into quantifiable criteria. The topic is elaborately discussed in section 3.

In the next section, the related works of the Comparative or Evaluative questions are described. The challenges are described in Section 3. In the next section 4, the degree of comparison is described. The decomposition of non-quantifiable expressions is described in Section 5. Section 6 elaborates our approach to build the question analyzer. System evaluation is described in Section 7. Future works are discussed in Section 8.

2 Related works

Friedman (1989) presents a general approach to process comparative expressions by syntactically treating them to conform to a standard form containing the comparative operator and the clauses that are involved in the comparison. Another ap-

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proach would be to automatically extract comparative relations in sentences via machine learning.

Olawsky (1989) attempts to study the semantic context by generating a set of candidate interpretations of comparative expressions. Then, the user is prompted to choose among these to specify his intent.

Kennedy (2006) proposed that comparisons may be in relation to properties within the same object, degree of comparisons of the same property between different objects, or different properties of different objects. The properties at stake in the comparison are embedded in the semantics of the words in the question, and possibly in the context that comes with the question. To date, there is obviously no widely available lexical resource containing an exhaustive list of comparative predicates, applied to precise terms, together with the properties involved. These can possibly be derived, to a limited extent, from existing resources like Frame-Net or from ontology where relationships between concepts and terms can be mapped. However, this is tractable for very simple situations, and in most cases, identifying those properties is a major challenge.

Nathalie et al (2009) have proposed the technique to handle comparative and evaluative question answering for business domain. They have proposed the procedure to identify the terms in the question based on which comparison or evaluation can be done.

This paper gives the idea of a question answering system which is capable of handling comparative and evaluative questions related to tourism domain and attempts to resolve the challenges identified by Patrick et al (2009).

3 Challenges

Patrick et al (2009) show the challenges that the comparative and evaluative question answering system face.

Type of comparison: Comparisons may be the relation to properties within the same object, or degree of comparisons of the same property between different objects, or different properties of different objects. In some simple situations, Jindal and Liu (2006) show that comparative relations in sentences can be extracted automatically via machine learning. Their approach determines whether the expression is non-equal gradable, equative, or superlative. In this paper a rule based technique is used to explore in depth semantic and conceptual issues and their dependence to context, users, and domains.

Determining semantic meaning and converting to quantifiable measures: The properties at stake in the comparison are embedded in the semantics of the words in the question, and possibly in the context that comes with the question. To date, there is obviously no widely available lexical resource containing an exhaustive list of comparative predicates, applied to precise terms, together with the properties involved. However, this is tractable for very simple situations, and in most cases, identifying those properties is a major challenge. Various ways to accurately identify these properties through different resources (like Generative Lexicon) in the tourism domain have been explored.

Ambiguity of Comparative Expression: The standard of comparison (i.e., the value) may be different based on the context, i.e., depending on the object that it is associated to and on the type of expression. Properties of expression may be underspecified and/or polysemous and would gain context only when associated with the object. One such predicate is 'best'.

Best Place to go: type of weather of the place, popularity to visit, number of famous tourist spots.

Best Hotel to stay: type of Hotel (1 star, 3 star,5 star), types of rooms (AC, Non AC, Double Bed etc) available, Fare of the room & Other facilities

Best way to reach: Type of communication (Train, Bus, Flight etc), duration of journey, fare of the journey etc.

To automatically determine the properties, including default values, to be used in the evaluation, other available sources indicating some range of values may be tapped, as is done in answer fusion. But rather than retrieving the partial answer, properties needed for evaluation must be retrieved or inferred. Values may be either numerical values (where comparisons are quite easy to handle) or textual values (that are often discrete). It is then necessary to define comparative scales along basic properties so that those values get ordered. This is a major challenge for our work.

Processing superlatives and other forms of quantification related to comparisons: Superlatives and other forms of quantifications in connection with comparative expressions can also be used on top of the basic evaluative expressions. Consider the question:

Which is the best hotel to stay in Delhi?

"Best hotel" entails different dimensions from being conservative. In the context of tourism, evaluation could be in terms of variety of room; rent of the hotel, satisfactory room service, availability of restaurant, bar, summing pool and other facilities. Also sometime it is not explicitly mentioned the boundary of the entity for superlative question (for example hotels). If a strict evaluation of all these criteria is done, the result may not be complete or accurate. So it may be the better approach to rank the result and show top 10 results than showing a single answer.

Domain dependency: Transformation of the comparative expression into quantifiable criteria needs domain knowledge. The comparative expression and associated features contain the semantic meaning of the question. The semantic meaning of the features is changed in different domain. So the same comparative expression can be translated into different quantifiable criteria depending on which domain question is raised. Domain dependency is a biggest problem in analysis of the comparative and evaluative questions.

4 Determine Degree of Comparison and Evaluation

It is observed that the Comparative Expressions may be either adjective (e.g., cheaper, best etc.) or adverb associated with adjective or another adverb (e.g. more/RB popular/JJ, most/RB comfortable/JJ, as/RB fast/RB as/IN, as/RB comfortable/JJ as/IN etc) or quantifiers. In a sentence the comparative expression is placed in adjective chunk preceded by either verb or noun chunk and followed by noun chunk (e.g. *what*/WP (VP (*are*/VBP *the*/DT (NP (*cheapest*/JJS *hotels*/NNS)) *in*/IN (NP (*Las*/NNP *Vegas*/NNP?))))) or (*what*/WP (VP (*are*/VBP (NP (*the*/DT *Las*/NNP *Vegas*/NNP)) (NP (*cheapest*/JJS *hotels*/NNS))))).

The comparative expression can be categorized into three classes according to the nature of comparison.

1. Positive/Negative or General: Positive /Negative or General comparative expression is basically not to compare between entities but to know whether the entity posses the criteria or not.

Example: Is the [Taj Bengal] (entity) [good] (Comparative Expression) [5 star hotel] (criteria)?

2. Comparative: Comparative expressions are those which compare between two entities or two set of entities.

Example: Is [ITC Sonar Bangla] (entity) [better] (Comparative Expression) than [Taj Begal] (entity)? or

Is [ITC Sonar Bangla] (entity) as [good] (Comparative Expression) *as* [*Taj Begal*] (entity)?

3. Superlative: Superlative expressions are those which compare an entity with set of entity based on certain criteria.

Example: Is [Taj Bengal] (entity) [best](Comparative Expression) [5 star hotel in Kolkata] (criteria)?

Sometimes it is seen that the entity is not explicitly defined. For example, the following question does not include the entity information: What are the [best] (Comparative Expression) [5 star hotel in Kolkata] (criteria)?

All relevant entities have to be identified for the above question and then compared according to criteria.

The rules to extract comparative expressions in the present work are discussed in Table 4.

Evaluative expressions: Evaluative expressions are not directly compared but checks whether the criteria are matched or not.

Example: *What are the* [*morning*] (Evaluative Expression) [*flights to Delhi from Kolkata*] (entity)?

It is also important that entity and expression can appear in many places in the sentence. User can also write the previous question in many different ways (like what are the Kolkata to Delhi morning flight? or what are the morning Kolkata to Delhi flight? etc.). So we extract the relevant important information in the form of Comparative and Evaluative Features (CEF).

5 Decompose Non-quantifiable criteria to quantifiable criteria

The comparative or evaluative expressions may not be directly quantifiable. It is the task of the question analyzer to decompose these non-quantifiable expressions to equivalent quantifiable criteria. In the earlier example question, the comparative expression "good 5 star hotels" is not a directly quantifiable expression. To solve this, we follow the human interpretation of answering whether the hotel is a good 5 star Hotel or not. For a human, a hotel is a good 5 Star Hotel if it has adequate rooms with good variety (like single bed, double bed, cottage, suit etc.),

quality food and other facilities like gym, swimming pool, disco, library, etc. so the comparative expression 'good' depends on the entity (5 star hotel) features or characteristic that are stated below.

1. Adequate Rooms
2. Varity of Rooms
3. Quality of Food Service
4. Availability of Gym
5. Availability of Summing Pool
6. Availability of Bar
7. Availability of Casino
8. Availability of Disco

So the non-quantifiable comparative expression can be evaluated by the linear combination of the weighted entity features. The entity feature values can be computed by the percentage of matching keywords/phrases for string valued features or the deviation from the range for numerical valued features. The weight of each feature represents user preferences.

6 Our Approach

As we have discussed earlier, our prime target is to extract all important properties (comparative or evaluative expression, its degree of comparison, entity and constraints) or features from the user given question. In this section, we describe the basic idea to analyze the comparative and evaluative questions raised in the tourism domain.

6.1 Why tourism domain?

We have used tourism related question because of two reasons.

1. Tourism is very popular domain where user frequently asked various types of question. So it has rich set of comparative or evaluative questions.
2. Tourism domain has large set of criteria for each entity. So comparison can be done appropriately.

Over 200 questions are collected from different tourism website Q&A section. Rules have been developed with 150 questions. These rules are applied on the rest 50 questions. Here are some questions[1]:

Q1: We plan to visit Andhra Pradesh in December. We live in Kolkata, and will start and end our journey at Vizag and have seven days in hand. We are three families with kids and our budget is moderate. Kindly suggest an itinerary, which must include Araku Valley.

Q2: My family is planning a trip to Khashmir in late October. We plan to spend six days there and will visit Srinagar, Gulmarg, and Pahalgam. Can you suggest good hotel in range of Rs 3000-4000?

Q3: My husband, son and I want to visit Stuttgart, Heidelberg, Salzburg and maybe Munich in May 2010. We live in Mumbai. Is it cheaper to fly to Frankfurt first or to Stuttgart?

6.2 Classification of questions according to information need

All the questions related to tourism domain can be classified into 7 classes according to their information need. The categories are stated below:

Itinerary: The questions where user asks for a suggested itinerary or schedule or planning for visiting a place fall into this category.

Accommodation: The questions where user asks for accommodation, i.e., Hotel detail, Cost to stay, etc for a place fall into this category.

How to Reach: The questions regarding how to visit or reach a place along with transportation details like travel by train, flight and cost of transportation fall into this category.

Best Time to Visit: User asks for the best time to visit a place or whether a specific time is best to visit that place or not.

Getting Around: User asks for details of seeing the tourist spot, buy something, eat/drink in a restaurant etc.

Cost Related Information: User asks for estimated cost to visit a place or per head cost to visit a place.

Miscellaneous: If the question does not classify into any of the above categories then it comes under miscellaneous category.

Table 1 shows the result of classifying 200 questions that are collected.

#	Type of Question	Percentage
1	Itinerary	18%
2	Accommodation	22%
3	Reach Destination	19%
4	Best Time To Visit	9%
5	Getting Around	20%
6	Cost Related Information	8%
7	Miscellaneous	4%

Table 1: % of question occurs in different class

[1]Questions are taken from Ask Marco of Outlook Travelers: http://travel.outlookindia.com/article.aspx?264509

Questions are classified into different classes using set of rules. Rules are nothing but matching string. If a string is present then the question is classified into the corresponding class. The rules are stated in Table 2.

#	Type of Question	Rules (Question Consist of following String)
1	Itinerary	itinerary, chalk out a [trip, tour]
2	Accommodation	[H,h]otels?, [a,A]ccommodations?
3	Reach Destination	travels?, transport
4	Best Time To Visit	[good, best, preferable, suitable] [time, season]
5	Getting Around	site screen, place to visit, tourism spot
6	Cost Related Information	cost per [day, week, head, living], per [day, week, head, living] cost
7	Miscellaneous	If any question was not classified in any of the above six classes then it will be classified as Miscellaneous.

Table 2: Rule for classifying questions into different classes.

6.3 Extraction of CEF

The comparative and evaluative features (CEF) are the features which play useful role to evaluate the answer of the question. CEFs are holding the semantic meaning of the phrases like time of visit, duration of visit, Number of people are going and their description like age (old, kids etc), relation (wife, friends, family, parent) etc. For example CEF holds the information of user opted tour places, his/her purpose of visiting those places, his/her family and relative information who will accompany the user, the time when user wants to go, the time span that user wants to spend, the budget of user, and other user specifications. So answers of the question are heavily dependent on the CEFs present in the question.

Sixteen types of CEF are identified. All of these 16 types of features may not occur in a single question. In these 16 types of CEFs, the place features like <Origin Place> and <Destination Place> etc are included. <Destination Place> is always required and must be present in the question. The various CEFs are now described.

Location Related feature: These features contain the place name where user wants to go/travel/stay etc or the place name from where he/she starts his/her journey or where he/she stays (Origin). Sometimes user also mentions the place name where he/she must want to visit.

Location To: Where user wants to go/visit/travel/see.

Extraction Rule: Location named entity words are preceded by preposition “to”, “include”, “at”

Location From: From where user wants to start his/her journey.

Extraction Rule: Location named entity words are preceded by preposition “from”, “in”.

Must Include Locations: Explicitly mentioned place name where user must visit.

Extraction Rule: Location named entity words are preceded by preposition “must”, “include”.

Similar Locations: User wants to visit the place that is similar (historically, geographically etc) with explicitly mentioned place.

Extraction Rule: Location named entity words are preceded by preposition “similar”, “Likely”.

Time Related Information: These features contain the time related phrase like the time when user wants to travel or duration of his/her travel.

Time to Go: When user plans to go/travel/stay on the place.

Extraction Rule: Noun Phrase consists of Month, Season and Day Expressions.

Month={"january","frebruary","march","april","may","june","july","august","september","october","november","december"};

Season={"summer", "rainy", "monsoon", "winter", "autumn"};

Day={"sunday","monday","tuesday","wednusday","thusday","friday","saturday"};

Time Limit: How many days user wants to spend.

Extraction Rule: Noun Phrase consists of Time Expression

TimeExp= {"day","days","month","months","week","weeks","nights","nights","fortnight","fortnights","week ends","weekend","week ends", "week end"};

Team Related Information: This type of feature contains the phrases that carry the information of the number of members with whom user wants to share his/her journey and their details.

Team Member: Number of people who will travel with the user

Extraction Rule: Noun Phrase consists of Team Expression

TeamExpression= {"families", "family", "couple", "men", "women", "man", "woman", "friends", "friend", "colleague"};

Team Details: The relation of other member with the user and their details like age, or disease/weakness etc.

Extraction Rule: Noun Phrase consists of Team Details Expression

TeamDetailsExpression = {"family" ,"husband", "wife", "father", "mother", "son", "daughter", "friends", "young", "old", "kids" etc};

Travel Related Information: These features contain useful information like the budget of travel and purpose of travel etc.

Budget: User may specify the expected budget of their journey.

Extraction Rule: Noun Phrase consists of keyword like "moderate", "cheapest", "budget" or "$", "USD", "`", "Rs", "INR", "£", "EUR", "€", "GBP" followed by Number Expression which consists tag "(CD".

Purpose of Travel: User may specify the purpose of his/her journey like tourism, business, honeymoon, study etc.

Extraction Rule: Noun Phrase consists of Visit Type Expression.

Visit Type= {tour, family tour, business, honeymoon, study, job}

Adjective Modifier: Adjective modifier plays an important role to evaluate the answer. Adjective modifiers like cheapest, best, suitable, affordable, comfortable etc. give different directions of evaluating the answer. User uses adjective modifier to specific their choices.

Extraction Rule: Noun Phrase contains Adjective phrases with JJ or JJS tag or ADJP Phrase.

Specific Type Related Information: Some features are dependent on the type of question.

Accommodation Related These features specify the choice of accommodation of the user. Sometime user specifies the special range of accommodation like government guesthouse, holiday home etc.

Hotel Type: User specifies the type of hotel he/she wants to stay.

Extraction Rule: Noun Phrase contains keyword like "Private Hotels", "Government Hotel", and "Guest House", "Hostel" etc

Hotel Specification: User specifies the criteria that should be met by a hotel, like, 3-star, 5-star, resort, etc.

Extraction Rule: Noun Phrase contains keyword like "hotel", "Inn", "Resort", "Darmasala" etc

Transportation: This feature specifies the choice of transportation of the user, like, flight, bus, train.

Transportation Mode: User may specify his/her liking or disliking of transportation mode while traveling.

Extraction Rule: Noun Phrase contains keyword like "train", "bus", "car", "flight", "fly" etc.

Getting Around: This feature specifies the choice or purpose of Getting Around like to see tourist spot or buy or see market place etc.

Extraction Rule:

Getting Around Choice: User may specify his/her choice to do (See tourist spot, or roam famous market place or eat foods in restaurant etc) while staying at the place.

Extraction Rule: Choice= {sight seen, buy, eat}

The CEFs identified in the three questions are now described.

Q1: We plan to visit [Andhra Pradesh]/*LOCATION_TO* in [December]/*TIME_TO_GO*. We live in [Kolkata]/*LOCATION_FROM*, and will start and end our journey at [Vizag]/*LOCATION_FROM* and have [seven days]/*TIME_LIMIT* in hand. We are [[three families]/*TEAM_MEMBER* with kids]/*TEAM_DETAILS* and our [budget is moderate]/*BUDGET*. Kindly suggest an itinerary, which must include [Araku Valley]/*MUST_INCLUDE_LOCATION*.

Q2: My family is planning a trip to [Khashmir]/*LOCATION_TO* in [late October]/*TIME_TO_GO*. We plan to spend [six days]/*TIME_LIMIT* there and will visit [Srinagar]/*LOCATION_TO*, [Gulmarg]/*LOCATION_TO*, and [Pahalgam]/ *LOCATION_TO*. Can you suggest [good hotel]/*ADJECTIVE_MODIFIER* in range of [Rs 3000-4000]/*BUDGET*?

Q3: [My husband, son and I]/*TEAM_DETAILS* want to visit [Stuttgart]/*LOCATION_TO*, [Heidelberg]/*LOCATION_TO*, [Salzburg]/*LOCATION_TO* and maybe [Munich]/*LOCATION_TO* in [May 2010]/*TIME_TO_GO*. We live in

[Mumbai]/*LOCATION_FROM*. Is it [cheaper]/*ADJECTIVE_MODIFIER* to [fly]/*TRANSPOTATION_MODE* to [Frankfurt]/*LOCATION_TO* first or to [Stuttgart]/*LOCATION_TO*?

6.4 Determining degree of comparison and Entity Selection

The comparative or evaluative expressions, the entities and the constraints are extracted from the CEFs. Comparative or Evaluative Expression belong to Adjective Modifier. Entity and Constraints are different for different class of question. These are shown in Table 3.

#	Type of Question	Entity to be Compared	Constraints to be considered
1	Itinerary	Location To, Location From, Must Include Location, Location Preference,	Time to Go, Time Limit, Budget, Purpose of Visit
2	Accommodation	Hotel Type	Location To, Location From, Must Include Location, Team Details, Budget, Hotel Specification, Purpose of visit
3	Reach Destination	Transportation Mode	Location To, Location From, Time to Go, Team Details, Budget,
4	Time related Info.	Time to Go	Purpose of Visit, Location To, Must Include Location, Location Preference
5	Getting Around	Getting Around Preference	Time to Go, Team Details, Budget, Purpose of Visit
6	Cost Related Info.	Location To, Must Include Location, Location Preference	Budget, Purpose of Visit

Table 3: Entity and Constrains for different class

Now the degree of comparison is determined from the rules describe in table 4.

Table 5 shows the Comparative or Evaluative Expressions, type of comparison, Entities and Constraints of the questions Q1, Q2 & Q3.

#	Type of Comparison	Rules
1	General or Positive or Negative	1. Adjectives form the list {good, suitable, clean, new, appropriate, preferable, dirty, easy, happy, pretty, reasonable, bad, cheap, large, big, small. fast} appeared in noun chunk. 2. ADJP chunk staring with much or many
2	Comparative	1. Adjective with -er extention and appeared in ADJP chunk and followed by preposition than 2. Adjective or phrase inside as-as (like as soon as possible) 3. ADJP chunk staring with more 4. ADJP chunk containing too
3	Superlative	1. Adjective with -est extension appeared in Noun Chunk or ADJP chunk 2. ADJP chunk staring with most

Table 4: Rules to determine degree of comparison

#	Evaluative/ Type of Comparison	Entity	Constraints
Q1	Evaluative	Andra Pradesh, Vizag, Araku Vally,	December, Seven Days, Budget is moderate
Q2	General Expression: 'good hotel'	Srinagar, Pahelgram, Gulmarg, Hotel, Family tour	Family, six days, Late October, Rs 3000-4000
Q3	Comparative Expression: 'cheaper option'	Frankfrut, Stugart, Mumbai, Fly	May 2010, My husband, son & I,

Table 5: Extracted Entity, Comparative or Evaluative Expression & constrains.

6.5 Decomposing non-quantifiable expression into quantifiable criteria

Now we identify the list of comparative expression that are found in our test set and are not directly quantifiable. They are good, suit/suitable, comfortable, perfect, reasonable, appropriate, clean, safe etc. and their comparative and superlative forms.

Decomposition of non-quantifiable expression is done by the scoring of each feature of the entity. The score of the entity features are computed by the percentage of keyword/phrase matching between the keywords present in the entity feature value and the keywords present in the rules for the string valued features (e.g. variety of

rooms for hotel entity) or by the standard deviation from the range for numerical valued features (e.g. rent of the room for hotel entity). The rule set are developed for each non-quantifiable expression for each class of question which contains the keyword set for each entity features by human annotator. So the 'good hotel' comparative expression of Q2 can be evaluated by using the following hotel features.

Good Hotel= (1. Adequate Rooms; 2. Varity of Rooms; 3. Rent of the rooms; 4. Other facilities)

From Q2, the system has also extracted the other constraints (e.g. Team Details='Family', Time Limits='six days', Time to Go='Late October' & Budget='Rs 3000-4000'). So the rule for determining good hotel is shown below.

Good Hotel = (1. Adequate Rooms available in Late October; 2. Availability of Double bed Rooms, Double bed Ac room, family suit, cottage etc.; 3. Room Rent between Rs 3000-4000; 4. Availability of family restaurant, room service etc.)

So the entity features are scored by the percentage of matching keywords between the rule and feature value. The keywords in the rule are changed according to the constraints present in the question. Here we show how the keywords of the 'variety of room' features are changed for the 'good hotel' comparative expression with different constraints:

If team details consist of friends, colleague, etc and if travel limits are more than 7 days in a place then keywords are *dormitory, single bed, non-ac rooms*.

If team details consist businessman or purpose of travel is business and if a travel limit is less than 7 days in same place then keywords are *suit, cottage, villa* etc.

If team details include husband and wife, or newly married couple and the purpose of travel is honeymoon then keywords are *double bed ac/non ac, family suit, villa* etc.

The comparison is done by ordering the final score of each entity. The final score is evaluated by the weighted average of each entity feature score. Weight of entity features is between 0-5, which represents the user preference. For example if user explicitly mentioned his/her budget in numerical figure (e.g. Rs 3000-4000) then the entity features related with budget (e.g. room rent) has weight 5. If user mentioned its budget as moderate the entity features related with budget (e.g. room rent) has weight 3. If user does not explicitly mentioned his/her budget then the entity features related with budget (e.g. room rent) has weight 1.

Sometimes two or more comparative expressions are semantically close like 'good hotel' & 'appropriate hotel' or 'suitable hotel' so same rule can be followed for those expressions.

Quantifiable adjective are those which can quantify directly like cheap, fast, short, large, big small, high, low etc. So, 'cheapest hotel' means low cost hotel. We just sort the hotel rent in ascending order and show the top 5 results.

7 Evaluation

We have developed the rules with 150 distinct questions and tested it over 50 questions. The system is evaluated by the string matching technique between the system generated tagged questions and the corresponding human annotated tagged questions. The precision and recall are calculated by the formula (1) and (2). Table 6 shows the precision and recall of our system.

$$\text{Precision} = \frac{\text{Matched keywords/phrases}}{\text{System Generated tagged Output}} \quad \ldots (1)$$

$$\text{Recall} = \frac{\text{Matched keywords/phrases}}{\text{Human annotated tagged question/ Gold standard tagged question}} \quad \ldots (2)$$

Objective	Precision	Recall
Classification of Questions	86.5%	84.3%
Extraction of CEFs	86.1%	82.5%
Determine degree of comparison	84.3%	81.2%
Entity Recognition	76.2%	74.8%
Constraints Recognition	72.3%	68.4%
Decomposition of Non-quantifiable expression	71.3%	68.1%

Table 6: Precision and Recall of System

8 Conclusion and Future work

System is somewhat biased because all the rules are manually developed and it requires the great understanding of domain knowledge. In future machine learning technique will be used to extract the rules and to extract more comparative

and evaluative features from the question. Extraction of more features means extraction of more semantic information's from question. Sometime user gives unusual information that misleads the system and drives to wrong direction. If we extract semantically correct information from it and remove the unessential information then system performance will increase.

In future we have to identify the unusual information that mislead the system and try to remove this kind of noise from the question. In future, we will try to port our system in other domains like news, business intelligence etc. Also there is no good evaluation system to evaluate the performance of question answering system, so in future we would have planned to design automated evaluation scheme to evaluate the performance of question answering system.

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