Identifying Contradictory and Contrastive Relations between Statements to Outline Web Information on a Given Topic

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Abstract

We present a method for producing a bird's-eye view of statements that are expressed on Web pages on a given topic. This method aggregates statements that are relevant to the topic, and shows contradictory and contrastive relations among them. This view of contradictions and contrasts helps users acquire a top-down understanding of the topic. To realize this, we extract such statements and relations, including cross-document implicit contrastive relations between statements, in an unsupervised manner. Our experimental results indicate the effectiveness of our approach.

1 Introduction

The quantity of information on the Web is increasing explosively. Online information includes news reports, arguments, opinions, and other coverage of innumerable topics. To find useful information from such a mass of information, people generally use conventional search engines such as Yahoo! and Google. They input keywords to a search engine as a query and obtain a list of Web pages that are relevant to the keywords. They then use the list to check several dozen top-ranked Web pages one by one.

This method of information access does not provide a bird's-eye view of the queried topic; therefore it can be highly time-consuming and difficult for a user to gain an overall understanding of what is written on the topic. Also, browsing only top-ranked Web pages may provide the user with biased information. For example, when a user searches for information on "agaricus," claimed to be a health food, using a conventional search engine, many commercial pages touting its health benefits appear at the top of the ranks, while other pages remain low-ranked. The user may miss an existing Web page that indicates its unsubstantiated health benefits, and could be unintentionally satisfied by biased or one-sided information.

direct contrastive statement	"A is more P than B"
contrastive keyword pair	(A, B)
contradictory relation	"A is P" $\Leftrightarrow$ "A is not P"
contrastive relation	"A is P" $\leftrightarrow$ "B is P (not P)"

Table 1: Overview of direct contrastive statements, contrastive keyword pairs and contradictory/contrastive relations. Note that "P" is a predicate.

This paper proposes a method for producing a bird's-eye view of statements that are expressed on Web pages on a given query (topic). In particular, we focus on presenting contradictory/contrastive relations and statements on the topic. This presentation enables users to grasp what arguing points exist and furthermore to see contradictory/contrastive relations between them at a glance. Presenting these relations and statements is thought to facilitate users' understanding of the topic. This is because people typically think about contradictory and contrastive entities and issues for decision-making in their daily lives.

Our system presents statements and relations that are important and relevant to a given topic, including the statements and relations listed in Table 1. *Direct contrastive statements* compare two entities or issues in a single sentence. The contrasted entities or issues are also extracted as *contrastive keyword pairs*. In addition to them, our

Coling 2010: Poster Volume, pages 534–542,
Beijing, August 2010

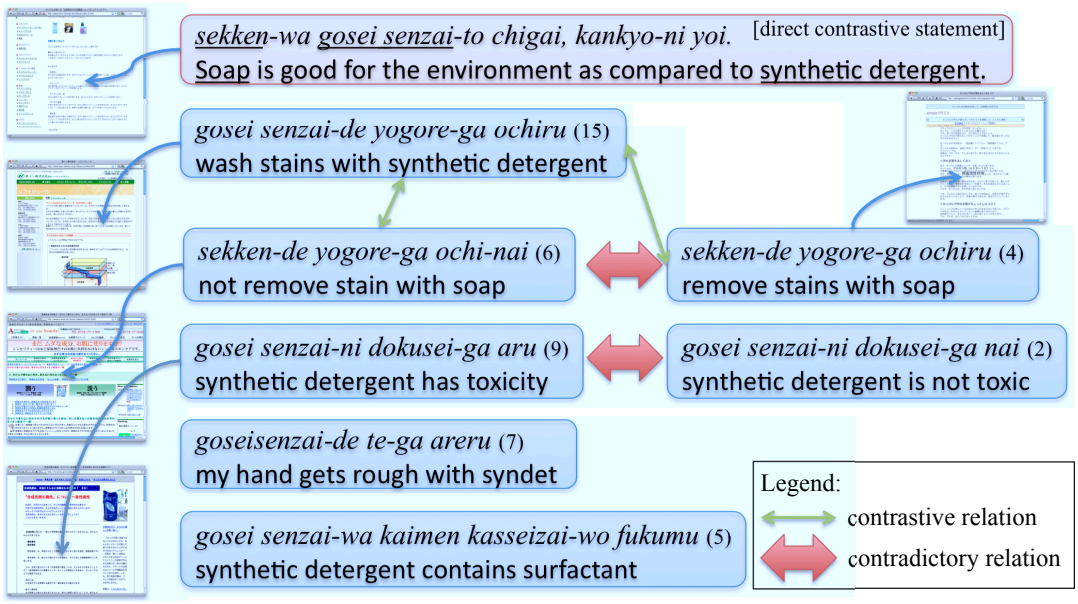

Figure 1: Examples of statements on "*gosei senzai*" (synthetic detergent), which are represented by rounded rectangles. Each statement is linked with the pages from which it is extracted. The number in a parenthesis represents the number of pages.

system shows *contradictory and contrastive relations* between statements. Contradictory relations are the relations between statements that are contradictory about an entity or issue. Contrastive relations are the relations between statements in which two entities or issues are contrasted.

In particular, we have the following two novel contributions.

- We identify contrastive relations between statements, which consist of in-document and cross-document implicit relations. These relations complement direct contrastive statements, which are explicitly mentioned in a single sentence.
- We precisely extract direct contrastive statements and contrastive keyword pairs in an unsupervised manner, whereas most previous studies used supervised methods (Jindal and Liu, 2006b; Yang and Ko, 2009).

Our system focuses on the Japanese language. For example, Figure 1 shows examples of extracted statements on the topic "*gosei senzai*" (synthetic detergent). Rounded rectangles represent statements relevant to this topic. The first statement is a direct contrastive statement, which refers to a contrastive keyword pair, "*gosei senzai*" (synthetic detergent) and "*sekken*" (soap). The pairs of statements connected with a broad arrow have contradictory relations. The pairs of statements connected with a thin arrow have contrastive relations. Users not only can see what is written on this topic at a glance, but also can check out the details of a statement by following its links to the original pages.

2 Related Work

Studies have been conducted on automatic extraction of direct contrastive sentences (comparative sentences) for English (Jindal and Liu, 2006b) and for Korean (Yang and Ko, 2009). They prepared a set of keywords that serve as clues to direct contrastive sentences and proposed supervised techniques on the basis of tagged corpora. We propose an unsupervised method for extracting direct contrastive sentences without constructing tagged corpora.

From direct contrastive sentences, Jindal and Liu (2006a) and Satou and Okumura (2007) proposed methods for extracting quadruples of (target, basis, attribute, evaluation). Jindal and Liu (2006a) extracted these quadruples and obtained an F-measure of 70%-80% for the extraction of "target" and "basis." Since this extraction was

not their main target, they did not perform error analysis on the extracted results. Satou and Okumura (2007) extracted quadruples from blog posts. They provided a pair of named entities for "target" and "basis," whereas we automatically identify such pairs. Ganapathibhotla and Liu (2008) proposed a method for detecting which entities ("target" and "basis") in a direct contrastive statement are preferred by its author.

There is also related work that focuses on non-contrastive sentences. Ohshima et al. (2006) extracted coordinated terms, which are semantically broader than our contrastive keyword pairs, using hit counts from a search engine. They made use of syntactic parallelism among coordinated terms. Their task was to input one of coordinated terms as a query, which is different from ours. Somasundaran and Wiebe (2009) presented a method for recognizing a stance in online debates. They formulated this task as debate-side classification and solved it by using automatically learned probabilities of polarity.

To aggregate statements and detect relations between them, one of important modules is recognition of synonymous, entailed, contradictory and contrastive statements. Studies on rhetorical structure theory (Mann and Thompson, 1988) and recognizing textual entailment (RTE) deal with these relations. In particular, evaluative workshops on RTE have been held and this kind of research has been actively studied (Bentivogli et al., 2009). The recent workshops of this series set up a task that recognizes contradictions. Harabagiu et al. (2006), de Marneffe et al. (2008), Voorhees (2008), and Ritter et al. (2008) focused on recognizing contradictions. For example, Harabagiu et al. (2006) used negative expressions, antonyms and contrast discourse relations to recognize contradictions. These methods only detect relations between given sentences, and do not create a bird's-eye view.

To create a kind of bird's-eye view, Kawahara et al. (2008), Statement Map (Murakami et al., 2009) and Dispute Finder (Ennals et al., 2010) identified various relations between statements including contradictory relations, but do not handle contrastive relations, which are one of the important relations for taking a bird's-eye view on a topic. Lerman and McDonald (2009) proposed a method for generating contrastive summaries about given two entities on the basis of KL-divergence. This study is related to ours in the aspect of extracting implicit contrasts, but contrastive summaries are different from contrastive relations between statements in our study.

3 Our Method

We propose a method for grasping overall information on the Web on a given query (topic). This method extracts and presents statements that are relevant to a given topic, including direct contrastive statements and contradictory/contrastive relations between these statements.

As a unit for statements, we use a predicate-argument structure (also known as a case structure and logical form). A predicate-argument structure represents a "who does what" event. Processes such as clustering, summarization, comparison with other knowledge and logical consistency verification, which are required for this study and further analysis, are accurately performed on the basis of predicate-argument structures. The extraction of our target relations and statements is performed via identification and aggregation of synonymous, contrastive, and contradictory relations between predicate-argument structures.

As stated in section 1, we extract direct contrastive statements, contrastive keyword pairs, relevant statements, contrastive relations and contradictory relations. We do this with the following steps:

1. Extraction and aggregation of predicate-argument structures
2. Extraction of contrastive keyword pairs and direct contrastive statements
3. Identification of contradictory relations
4. Identification of contrastive relations

Below, we first describe our method of extracting and aggregating predicate-argument structures. Then, we explain our method of extracting direct contrastive statements with contrastive keyword pairs, and identifying contradictory and contrastive relations in detail.

3.1 Extraction and Aggregation of Predicate-argument Structures

A predicate-argument structure consists of a predicate and one or more arguments that have a dependency relation to the predicate.

We extract predicate-argument structures from automatic parses of Web pages on a given topic by using the method of Kawahara et al. (2008). We apply the following procedure to Web pages that are retrieved from the TSUBAKI (Shinzato et al., 2008) open search engine infrastructure, by inputting the topic as a query.

1. Extract important sentences from each Web page. Important sentences are defined as sentences neighboring the topic word(s).
2. Obtain results of morphological analysis (JUMAN[1]) and dependency parsing (KNP[2]) of the important sentences, and extract predicate-argument structures from them.
3. Filter out functional and meaningless predicate-argument structures, which are not relevant to the topic. Pointwise mutual information between the entire Web and the target Web pages for a topic is used.

Note that the analyses in step 2 are performed beforehand and stored in an XML format (Shinzato et al., 2008).

Acquired predicate-argument structures vary widely in their representations of predicates and arguments. In particular, many separate predicate-argument structures have the same meaning due to spelling variations, transliterations, synonymous expressions and so forth. To cope with this problem, we apply "keyword distillation" (Shibata et al., 2009), which is a process of absorbing spelling variations, synonymous expressions and keywords with part-of relations on a set of Web pages about a given topic. As a knowledge source to merge these expressions, this process uses a knowledge base that is automatically extracted from an ordinary dictionary and the Web. For instance, the following predicate-argument structures are judged to be synonymous[3].

(1) a. *sekken-wo tsukau*
soap-ACC use

b. *sopu-wo tsukau*
soap-ACC use

c. *sekken-wo shiyou-suru*
soap-ACC utilize

We call the predicate-argument structures that are obtained as the result of the above procedure **statement candidates**. The final output of our system consists of direct contrastive statements (with contrastive keyword pairs), top-N statements (**major statements**) in order of frequency of statement candidates, and statements with contradictory/contrastive relations. Contradictory/contrastive relations are identified against major statements by searching statement candidates.

Another outcome of keyword distillation is a resultant set of keywords that are important and relevant to the topic. We call this set of keywords **relevant keywords**, which also include words or phrases in the query. Relevant keywords are used to extract contrastive keyword pairs.

3.2 Extraction of Contrastive Keyword Pairs and Direct Contrastive Statements

We extract contrastive keyword pairs from contrastive constructs, which are manually specified as patterns of predicate-argument structures. Statements that contain contrastive constructs are defined as direct contrastive statements.

For example, the following sentence is a typical direct contrastive statement, which contains a contrastive verb "*chigau*" (differ).

(2) *sekken-wa gosei senzai-to chigai, · · ·*
soap-TOP synthetic detergent-ABL differ

(soap differs from synthetic detergent, · · ·)

From this sentence, a contrastive keyword pair, "*sekken*" (soap) and "*gosei senzai*" (synthetic detergent), is extracted. The above sentence is extracted as a direct contrastive statement.

We preliminarily evaluated this simple pattern-based method and found that it has the following three problems.

[1] http://nlp.kuee.kyoto-u.ac.jp/nl-resource/juman-e.html

[2] http://nlp.kuee.kyoto-u.ac.jp/nl-resource/knp-e.html

[3] In this paper, we use the following abbreviations: NOM (nominative), ACC (accusative), DAT (dative), ABL (ablative), CMI (comitative), GEN (genitive) and TOP (topic marker).

- Keyword pairs that are mentioned in a contrastive construct are occasionally not relevant to the given topic.
- Non-contrastive keyword pairs are erroneously extracted due to omissions of attributes and targets of comparisons.
- Non-contrastive keyword pairs that have an is-a relation are erroneously extracted.

To deal with the first problem, we filter out keyword pairs that are contrastive but that are not relevant to the topic. For this purpose, we apply filtering by using relevant keywords, which are described in section 3.1.

As an example of non-contrastive keyword pairs (the second problem), from the following sentence, a keyword pair, "*tokkyo seido*" (patent system) and "*nihon*" (Japan), is incorrectly extracted by the pattern-based method.

(3) *amerika-no tokkyo seido-wa nihon-to*
America-GEN patent system-TOP Japan-ABL
kotonari, $\cdots$
different
(patent system of America is different from ϕ of Japan $\cdots$)

In this sentence, "*nihon*" (Japan) has a meaning of "*nihon-no tokkyo seido*" (patent system of Japan). That is to say, "*tokkyo seido*" (patent system), which is the attribute of comparison, is omitted.

In this study, in addition to patterns of contrastive constructs, we use checking and filtering on the basis of similarity. The use of similarity is inspired by the semantic parallelism between contrasted keywords. As this similarity, we employ distributional similarity (Lin, 1998), which is calculated using automatic dependency parses of 100 million Japanese Web pages. By searching similar keywords from the above sentence, we successfully extract a contrastive keyword pair, "*amerika*" (America) and "*nihon*" (Japan), and the above sentence as a direct contrastive statement.

Similarly, a target of comparison can be omitted as in the following sentence.

(4) *nedan-wa gosei senzai-yori takaidesu*
price-TOP synthetic detergent-ABL high
(price of ϕ is higher than synthetic detergent)

In this example, the similarity between "*nedan*" (price) and "*gosei senzai*" (synthetic detergent) is lower than a threshold, and this sentence and the extracts from it are filtered out.

As for the third problem, we may extract non-contrastive keyword pairs that have an is-a relation. From the following sentence, we incorrectly extract a contrastive keyword pair, "*konbini*" (convenience store) and "*7-Eleven*," which cannot be filtered out due to its high similarity.

(5) *7-Eleven-wa hokano konbini-to*
7-Eleven-TOP other convenience store-ABL
kurabete, $\cdots$
compare
(7-Eleven is $\cdots$ compared to other convenience stores)

To deal with this problem, we use a filter on the basis of a set of words that indicate the existence of hypernyms, such as "*hokano*" (other) and *ippanno* (general). We prepare six words for this purpose.

To sum up, we use the following procedure to identify contrast keyword pairs.

1. Extract predicate-argument structures that do not match the above is-a patterns and match one of the following patterns. They are extracted from the statement candidates.
   - X-*wa* Y-*to* {*chigau* | *kotonaru* | *kuraberu*}
     (X {differ | vary | compare} from/with Y)
   - X-*wa* Y-*yori* [adjective]
     (X is more $\cdots$ than Y)

   Note that each of X and Y is a noun phrase in the argument position.
2. Extract (x, y) that satisfies both the following conditions as a contrastive keyword pair. Note that (x, y) is part of a word sequence in (X, Y), respectively.
   - Both x and y are included in a set of relevant keywords.
   - (x, y) has the highest similarity among any other candidates of (x, y), and this similarity is higher than a threshold.

Note that the threshold is determined based on a preliminary experiment using a set of synonyms (Aizawa, 2007). We extract the sentence that contains the predicate-argument structure used in step 1 as a direct contrastive statement.

3.3 Identification of Contradictory Relations

We identify contradictory relations between statement candidates. In this paper, contradictory relations are defined as the following two types (Kawahara et al., 2008).

negation of predicate

If the predicate of a candidate statement is negated, its contradiction has the same or synonymous predicate without negation. If not, its contradiction has the same or synonymous predicate with negation.

(6) a. *sekken-ga kankyou-ni yoi*
soap-NOM environment-DAT good

b. *sekken-ga kankyou-ni yoku-nai*
soap-NOM environment-DAT not good

antonym of predicate

The predicate of a contradiction is an antonym of that of a candidate statement. To judge antonymous relations, we use an antonym lexicon extracted from a Japanese dictionary (Shibata et al., 2008). This lexicon consists of approximately 2,000 entries.

(7) a. *gosei senzai-ga anzen-da*
synthetic detergent-NOM safe

b. *gosei senzai-ga kiken-da*
synthetic detergent-NOM dangerous

To identify contradictory relations between statements in practice, we search statement candidates that satisfy one of the above conditions against major statements.

3.4 Identification of Contrastive Relations

We identify contrastive relations between statement candidates. In this paper, we define a contrastive relation as being between a pair of statement candidates whose arguments are contrastive keyword pairs and whose predicates have synonymous or contradictory relations. Contradictory relations of predicates are defined in the same way as section 3.3.

In the following example, (a, b) and (a, c) have a contrastive relation. Also, (b, c) has a contradictory relation.

(8) a. *gosei senzai-de yogore-ga ochiru*
synthetic detergent-CMI stain-NOM wash

Topic: bio-ethanol
(bio-ethanol fuel, gasoline)
(bio-ethanol car, electric car)
Topic: citizen judgment system
(citizen judgment system, jury system)
(citizen judgment system, lay judge system)
Topic: patent system
(patent system, utility model system)
(large enterprise, small enterprise)
Topic: Windows Vista
(Vista, XP)

Table 2: Examples of extracted contrastive keyword pairs (translated into English).

b. *sekken-de yogore-ga ochiru*
soap-CMI stain-NOM wash

c. *sekken-de yogore-ga ochi-nai*
soap-CMI stain-NOM not wash

The process of identifying contrastive relations between statements is performed in the same way as the identification of contradictory relations. That is to say, we search statement candidates that satisfy the definition of contrastive relations against major statements.

4 Experiments

We conducted experiments for extracting contrastive keyword pairs, direct contrastive statements and contradictory/contrastive relations on 50 topics, such as age of adulthood, anticancer drug, bio-ethanol, citizen judgment system, patent system and Windows Vista.

We retrieve at most 1,000 Web pages for a topic from the search engine infrastructure, TSUBAKI. As major statements, we extract 10 statement candidates in order of frequency.

Below, we first evaluate the extracted contrastive keyword pairs and direct contrastive statements, and then evaluate the identified contradictory and contrastive relations between statements.

4.1 Evaluation of Contrastive Keyword Pairs and Direct Contrastive Statements

Contrastive keyword pairs and direct contrastive statements were extracted on 30 of 50 topics. 99 direct contrastive statements and 73 unique contrastive keyword pairs were obtained on 30 topics. The average number of obtained contrastive keyword pairs for a topic was approximately 2.4. Ta-

Topic: "*tyosakuken hou*" (copyright law)		
"*syouhyouken-wa tyosakuken-yori zaisantekina kachi-wo motsu.*"		
The trademark right has more financial value than the copyright.		
"*tyosakuken hou-de hogo-sareru*" protected by the copyright law	⇔	"*tyosakuken hou-de hogo-sare-nai*" not protected by the copyright law
"*tyosakuken-wo shingai-suru*" infringe the copyright	⇔	"*tyosakuken-wo shingai-shi-nai*" not infringe the copyright
	↖↘	"*syouhyouken-wo shingai-shi-nai*" not infringe the trademark right
Topic: "*genshiryoku hatsuden syo*" (nuclear power plant)		
"*genshiryoku hatsuden syo-wa karyoku hatsuden syo-to chigau.*"		
Nuclear power plants are different from thermoelectric power plants.		
"*CO2-wo hassei-shi-nai*" not emit carbon dioxide	⇔	"*CO2-wo hassei-suru*" emit carbon dioxide
"*genpatsu-wo tsukuru*" construct a nuclear power plant	⇔	"*genshiryoku hatsuden syo-wo tsukura-nai*" not construct a nuclear power plant
	↖↘	"*karyoku hatsuden syo-wo tsukuru*" construct a thermoelectric power plant

Table 3: Examples of identified direct contrastive statements, contradictory relations and contrastive relations. The sentences with two underlined parts are direct contrastive statements. The arrows "⇔" and "↔" represent a contradictory relation and a contrastive relation, respectively.

ble 2 lists examples of obtained contrastive keyword pairs. We successfully extracted not only contrastive keyword pairs including topic words, but also those without them.

Our manual evaluation of the extracted contrastive keyword pairs found that 89% (65/73) of the contrastive keyword pairs are actually contrasted in direct contrastive statements. Correct contrastive keyword pairs were extracted on 28 of 30 topics. We also evaluated the contrastive keyword pairs extracted without similarity filtering. In this case, 190 contrastive keyword pairs on 41 topics were extracted and 44% (84/190) of them were correct. Correct contrastive keyword pairs were extracted on 31 of 41 topics. Therefore, similarity filtering did not largely decrease the recall, but significantly increased the precision.

We have eight contrastive keyword pairs that were incorrectly extracted by our proposed method. These contrastive keyword pairs accidentally have similarity that is higher than the threshold. Major errors were caused by the ambiguity of Japanese ablative keyword "*yori*."

(9) *heisya-wa* *bitWallet sya-yori*
our company-TOP bitWallet, Inc.-ABL

Edy gifuto-no gyomu itaku-wo ukete-imasu
Edy gift-GEN entrustment-ACC have

(Our company is entrusted with Edy gift by bitWallet, Inc.)

In this example, "*yori*" means not the basis of contrast but the source of action. The similarity filtering usually prevents incorrect extraction from such a non-contrastive sentence. However, in this case, the pair of "*heisya*" (our company) and "*bitWallet sya*" (bitWallet, Inc.) was not filtered due to the high similarity between them. To cope with this problem, it is necessary to use linguistic knowledge such as case frames.

4.2 Evaluation of Contradictory and Contrastive Relations

Contradictory relations were identified on 49 of 50 topics. For 49 topics, 268 contradictory relations were identified. The average number of identified contradictory relations for a topic was 5.5. Contrastive relations were identified on 18 of 30 topics, on which contrastive keyword pairs were extracted. For the 18 topics, 60 contrastive relations were identified. The average number of identified contrastive relations for a topic was 3.3.

Table 3 lists examples of the identified contradictory and contrastive relations as well as direct contrastive statements. We manually evaluated the identified contradictory relations and the contrastive relations that were identified for correct contrastive keyword pairs. As a result, we concluded that they completely obey our definitions.

We also classified each of the obtained contradictory and contrastive relations into two classes: "cross-document" and "in-document." "Cross-

Topic: age of adulthood
lower the age of adulthood to 18
↔ lower the voting age to 18
Topic: anticancer drug
anticancer drugs have side effects
↔ anticancer drugs have effects

Table 4: Examples of unidentified contrastive relations (translated into English).

document" means that a contradictory/contrastive relation is obtained not from a single page but across multiple pages. If a relation can be obtained from both, we classified it into "in-document." As a result, 67% (179/268) of contradictory relations and 70% (42/60) of contrastive relations were "cross-document." We can see that many cross-document implicit relations that cannot be retrieved from a single page were successfully identified.

4.3 Discussions

We successfully identified contradictory relations on almost all the topics. However, out of 50 topics, we extracted contrastive keyword pairs on 30 topics and contrastive relations on 18 topics. To investigate the resultant contrastive relations from the viewpoint of recall, we manually checked whether there were unidentified contrastive relations among 100 statement candidates for each topic. We actually checked 20 topics and found six unidentified contrastive relations in total. Table 4 lists examples of the unidentified contrastive relations. Out of 20 topics, in total, 44 contrastive relations are manually discovered on 13 topics, but out of 13 topics, 38 contrastive relations are identified on eight topics by our method. Therefore, we achieved a recall of 86% (38/44) at relation level and 62% (8/13) at topic level. We can see that our method was able to cover a relatively wide range of contrastive relations on the topics on which our method successfully extracted contrastive keyword pairs.

To detect such unidentified contrastive relations, it is necessary to robustly extract contrastive keyword pairs. In the future, we will employ a bootstrapping approach to identify patterns of direct contrastive statements and contrastive keyword pairs. We will also use patterns of contrastive discourse structures as well as those of predicate-argument structures.

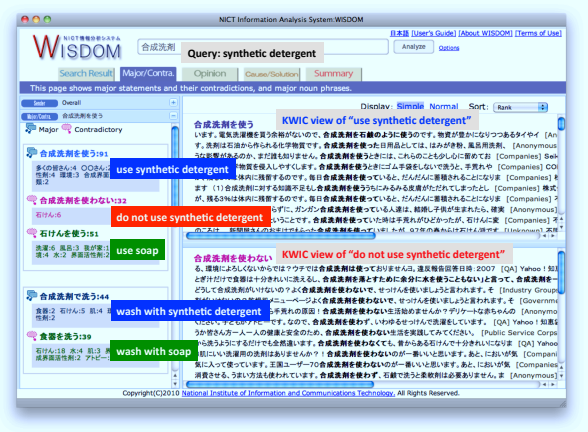

Figure 2: A view of major, contradictory and contrastive statements in WISDOM.

5 Conclusion

This paper has described a method for producing a bird's-eye view of statements that are expressed in Web pages on a given topic. This method aggregates statements relevant to the topic and shows the contradictory/contrastive relations and statements among them.

In particular, we successfully extracted direct contrastive statements in an unsupervised manner. We specified only several words for the extraction patterns and the filtering. Therefore, our method for Japanese is thought to be easily adapted to other languages. We also proposed a novel method for identifying contrastive relations between statements, which included cross-document implicit relations. These relations complemented direct contrastive statements.

We have incorporated our proposed method into an information analysis system, WISDOM[4] (Akamine et al., 2009), which can show multi-faceted information on a given topic. Now, this system can show contradictory/contrastive relations and statements as well as their contexts as a view of KWIC (keyword in context) (Figure 2). This kind of presentation facilitates users' understanding of an input topic.

[4]http://wisdom-nict.jp/

References

Aizawa, Akiko. 2007. On calculating word similarity using web as corpus. In *Proceedings of IEICE Technical Report, SIG-ICS*, pages 45–52 (in Japanese).

Akamine, Susumu, Daisuke Kawahara, Yoshikiyo Kato, Tetsuji Nakagawa, Kentaro Inui, Sadao Kurohashi, and Yutaka Kidawara. 2009. WISDOM: A web information credibility analysis system. In *Proceedings of the ACL-IJCNLP 2009 Software Demonstrations*, pages 1–4.

Bentivogli, Luisa, Ido Dagan, Hoa Dang, Danilo Giampiccolo, and Bernardo Magnini. 2009. The fifth PASCAL recognizing textual entailment challenge. In *Proceedings of TAC 2009 Workshop*.

de Marneffe, Marie-Catherine, Anna N. Rafferty, and Christopher D. Manning. 2008. Finding contradictions in text. In *Proceedings of ACL-08: HLT*, pages 1039–1047.

Ennals, Rob, Beth Trushkowsky, and John Mark Agosta. 2010. Highlighting disputed claims on the web. In *Proceedings of WWW 2010*.

Ganapathibhotla, Murthy and Bing Liu. 2008. Mining opinions in comparative sentences. In *Proceedings of COLING 2008*, pages 241–248.

Harabagiu, Sanda, Andrew Hickl, and Finley Lacatusu. 2006. Negation, contrast and contradiction in text processing. In *Proceedings of AAAI-06*.

Jindal, Nitin and Bing Liu. 2006a. Identifying comparative sentences in text documents. In *Proceedings of SIGIR 2006*.

Jindal, Nitin and Bing Liu. 2006b. Mining comparative sentences and relations. In *Proceedings of AAAI-06*.

Kawahara, Daisuke, Sadao Kurohashi, and Kentaro Inui. 2008. Grasping major statements and their contradictions toward information credibility analysis of web contents. In *Proceedings of WI'08, short paper*, pages 393–397.

Lerman, Kevin and Ryan McDonald. 2009. Contrastive summarization: An experiment with consumer reviews. In *Proceedings of NAACL-HLT 2009, Companion Volume: Short Papers*, pages 113–116.

Lin, Dekang. 1998. Automatic retrieval and clustering of similar words. In *Proceedings of COLING-ACL98*, pages 768–774.

Mann, William and Sandra Thompson. 1988. Rhetorical structure theory: toward a functional theory of text organization. *Text*, 8(3):243–281.

Murakami, Koji, Eric Nichols, Suguru Matsuyoshi, Asuka Sumida, Shouko Masuda, Kentaro Inui, and Yuji Matsumoto. 2009. Statement map: Assisting information credibility analysis by visualizing arguments. In *Proceedings of WICOW 2009*.

Ohshima, Hiroaki, Satoshi Oyama, and Katsumi Tanaka. 2006. Searching coordinate terms with their context from the web. In *Proceedings of WISE 2006*, pages 40–47.

Ritter, Alan, Stephen Soderland, Doug Downey, and Oren Etzioni. 2008. It's a contradiction – no, it's not: A case study using functional relations. In *Proceedings of EMNLP 2008*, pages 11–20.

Satou, Toshinori and Manabu Okumura. 2007. Extraction of comparative relations from Japanese weblog. In *IPSJ SIG Technical Report 2007-NL-181*, pages 7–14 (in Japanese).

Shibata, Tomohide, Michitaka Odani, Jun Harashima, Takashi Oonishi, and Sadao Kurohashi. 2008. SYNGRAPH: A flexible matching method based on synonymous expression extraction from an ordinary dictionary and a web corpus. In *Proceedings of IJCNLP 2008*, pages 787–792.

Shibata, Tomohide, Yasuo Banba, Keiji Shinzato, and Sadao Kurohashi. 2009. Web information organization using keyword distillation based clustering. In *Proceedings of WI'09, short paper*, pages 325–330.

Shinzato, Keiji, Tomohide Shibata, Daisuke Kawahara, Chikara Hashimoto, and Sadao Kurohashi. 2008. TSUBAKI: An open search engine infrastructure for developing new information access methodology. In *Proceedings of IJCNLP 2008*, pages 189–196.

Somasundaran, Swapna and Janyce Wiebe. 2009. Recognizing stances in online debates. In *Proceedings of ACL-IJCNLP 2009*, pages 226–234.

Voorhees, Ellen M. 2008. Contradictions and justifications: Extensions to the textual entailment task. In *Proceedings of ACL-08: HLT*, pages 63–71.

Yang, Seon and Youngjoong Ko. 2009. Extracting comparative sentences from korean text documents using comparative lexical patterns and machine learning techniques. In *Proceedings of ACL-IJCNLP 2009 Conference Short Papers*, pages 153–156.