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Representation of Characters' Directed relationships in Comics with Speech-roles

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Abstract

This paper describes a novel way to represent characters' relationships in comics: as edges of directed graphs labeled with speech-role frequency distribution. In comics, the story progresses through characters' actions and speeches. The relationships of characters are usually represented as non-directed: e.g., they are "lovers," or "friends." However, directionality is an essential component of complicated relationships; the combination of directed relationships often determines the attractiveness of a story. In this study, relationships between characters are assumed to be directed, and are further specified using speech roles: the types of speech that pass between two characters can typify their relationship. This idea has been realized experimentally, and its accuracy has been verified against subjective evaluation by readers. We also suggest the use of directed relationships for analogy retrieval of characters. These methods should be applicable in fields other than comics.

Keywords: Comic computing; Story analysis; Relationship of characters;

1. Introduction

Comics are increasingly prominent in entertainment, industry, culture, and the arts. The research targeting comics have also been reported in several fields of research, e.g., computer vision, natural language processing, and interfaces. Such research is named as **comic computing** [**?**], and an international workshop has been continuously held: MANPU[1].

In the field of comic computing, varied tasks for computing comics are tackled, e.g., generation and recomposition of images and interface for reading comics [**?**]. This paper focuses on understanding the storylines of comics.

Many and varied relationships are shown in comics, and these dynamics may even constitute the main attraction of the story. Existing fan sites for comics have shown the relationships between characters such as "lovers," "friends" and "enemies," etc. These terms are useful for easily verbalizing the relationships between characters, but they are

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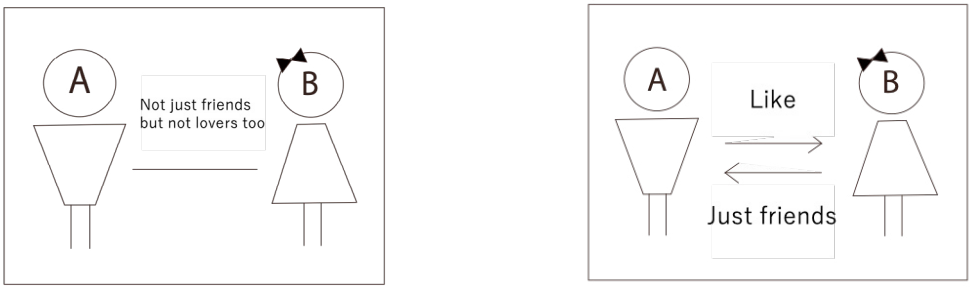

(a) Expression of non-directed relationship. (b) Expression of directed relationship.

Fig. 1. Examples of non-directed and directed expressions for a common relationship: not just friends, but also not yet lovers.

symmetric and lack directionality. However, relationships are not always symmetric. For example, in romance comics, the main character often has a crush that is unrevealed or unreciprocated.

Fig. 1 shows the difference between non-directed and directed expressions for a common relationship. The two characters A and B have a non-directed relationship like Fig. 1(a), while they have directed relationships like Fig. 1(b) as well. To detail the story, it should be better to express the relationships as *"A loves B" but "B still feels A is a friend of her"* than just *They are not just friends, but also not lovers*. For example, in the comic "*Karakai jozuno Takagi-san*," *Takagi* often teases *Nishikata* as she realizes her own love for him. However, *Nishikata* is not sure about his own heart and feels *Takagi* is just a friend of him; actually, he is attracted to her too. This complicated relationships, especially often happened in teenagers, makes the title very attractive to readers. As a non-directed relationship, this relationship is just shown as "not just friends but not yet lovers," though their different feelings toward each partner should be a directed one.

If a reader likes this kind of relationship, the comic "*Ijiranaide Nagatoro-san*" should be a good title where almost the same interaction between a boy and a girl appeared. In "*Ijiranaide Nagatoro-san*," *Nagatoro* also teases and makes fun of *Senpai*, although she actually loves to him as same as *Takagi* for *Nishikata* in "*Karakai jozuno Takagi-san*."

On the other hand, the comic "*Aoharaido*" featured entirely different relationship between a boy and a girl (The examples above will be discussed quantitatively in Section 4). Directed relationships should express how a character thinks of another character. It is considered that the expression is useful to link the characters in comics as meta-data too. Of course, relationships among people are also directed in the real world; thus, expressing directed relationships is useful not only in the comic-computing research but also in other fields, such as human-computer interaction and sociology.

In this paper, we propose a method of expressing directed relationships using conversations between the selected characters, in agreement with the idea [**?**] that "the relationships between humans can be found in their talk." Talk between humans consist of "proposition" which is an objective fact and "attitude" which includes speech intentions. One speech has directed roles from speaker to the partner such as emotion and intention. From these facts, the proposed method uses speech-roles to express the directed relationships between characters. In the proposed method, each speech is classified into speech roles and the speech is modeled as a vector which denotes the distribution of speech roles from a character to another. It is expected that the feeling for each directed relationship can be modeled by the proposed method, and the model should be useful to apply in the retrieval and understanding of comics.

In this preliminary study, we verify the effectiveness of the proposed method as a feature expression of directed relationships. The appropriateness between directed relationships is studied by comparing the cosine similarity of pairs of vectors modeled by the proposed method with human feelings. It is expected that the detailed representation should benefit the estimation of human feelings towards the relationships between different pairs of characters.

[1] http://manpu2020.imlab.jp/ (Retrieved May 25, 2021)

2. Related work

This paper is positioned at an analysis of comics and feature representation. Many feature representation methods have been proposed, such as distributed representations of words in natural language processing [**? ? ?**] and deep neural network (DNN)-based features (e.g., ResNet [**?**]) in computer vision.

Multimedia information in comics (e.g., images, text, and transition of frames) affects the reading and understanding of comics. To read and understand comics, humans naturally recognize the multimedia information cooperatively presented on a single page. How humans handle such information has been not clearly investigated yet. The analysis and understanding of comics are not only for end-users who are readers of comics but also assumed as a kind of science where it reveals how humans read comics. As unraveling such a mechanism to read comics, a system that is capable of reading comics would support readers to find their favorite comics and creators to make their composition of stories and multimedia art presented in comics. To develop a system or service to *read* comics like humans, it is necessary to analyze both comics themselves and the reading behavior of humans. Some research has tried these approachable but tough problems. Aizawa et al. collected and annotated the number of comics commercially published in Japan [**?**], producing the "Manga 109" dataset. They have also proposed applications from computer-vision aspects such as object recognition [**? ?**], retrieval [**?**], and synthesis [**?**] to the dataset. Reading behavior has also been a target of research: the relationships between reading content and physiological signals have been investigated [**? ?**] and an interface [**?**] has been developed based on this investigation. Their focus was on the visible content of the comics; in the present work, we focus on the story. Some previous research considered the story in comics [**? ?**], but has dealt with it broadly, in terms of genres and patterns. This paper focuses on the detailed relationships between characters.

In media processing, feature representation is an extremely important and popular topic. Human-crafted features such as SIFT [**?**] have been popular for representing image features. DNN-based approaches [**? ? ?**] have outperformed several tasks nowadays. In either case, image features are represented as vectors describing how objects are visually characterized. For language features, continuous-valued vector representations have shown better outcomes in machine translation [**?**] and document classification [**?**] than discretized scalar-based representations such as tags and labels. However, the DNN-based features are not easy for humans to understand how it works and what they mean semantically. Therefore, this paper proposes a vector representation of characters' relationships that is still semantically understandable by humans.

3. Proposed Idea

The proposed idea is to represent the directed relationship between characters in comics as a vector consisting of speech roles. These vectors can then be used to calculate the similarity of the directed relationships.

3.1. Speech-roles for vector representation

Every spoken utterance can be described by the roles that it fulfills. In a study of friendship [**?**], speech roles were defined and 23 types were identified. Friendships among people were estimated using the distribution of the defined speech roles in conversations.

These speech roles could in principle be used to describe the relationships between characters in comics as well. However, we consider the resolution of the "sentimental" speech-role defined in the original study to be too low for the representation of characters' relationships in comics, where sentimental conversations are common and the differences in sentimental conversation may affect the story. Thus, we reclassify the sentimental speeches into detailed classes such as "affectionate," "sarcastic" and "agree." Table 1 lists the speech-roles used in this study. The speech roles 1–22 are taken from the existing study [**?**]; the others are newly defined by the second author of this paper after considering the conversational features in comics and some research on affection and emotional speech [**?**].

Table 1. Speech-roles for the representation of directed relationships between characters in comics.

ID	Type	Descriptions
1	Fact	Negation, confirm, question, addition, side by side, choice, indefinite, recitation, irony, degree, limitation, slight
2	Supplement	Distinction, addition, side by side, indefinite, recitation, emphasis
3	Value judgment	Not naturally, restless mind, reason
4	Gain	Confirm, doubt, question, hope, desire, restless mind, ask oneself
5	Knowledge provide	Emphasis, negation, assertion, value judgment
6	Knowledge teach	Analogy, guess, estimate, euphemistic, negation, emphasis
7	Be taught	Confirm, doubt, question, desire, request, restless mind, ask oneself
8	Request	Doubt, question, hope, desire, request, restless mind
9	Confirm	Restless mind, confirm
10	Request action	Hope, desire, request, appeal, prohibition, request agreement, invitation, restless mind, order, permission, cause
11	Request saying	Euphemistic, confirm, doubt, question, will, appeal, request agreement, invitation, order, ask oneself, permission
12	Propose	Distinction, irony, will, hope, emphasis
13	Thank	Respect, spontaneous
14	Apology	Respect, will, spontaneous
15	Agreement	Naturally, denial, affirmation
16	Opposite	Negation, will not to do, emphasize not, criticism, denial, affirmation, opposite
17	Accept action request	Negation, not naturally, confirm, question, will, spontaneous, possible, impossible, will not to do, desire, request, past
18	Accept saying request	Proportion, hearsay, example, illustration, guess, estimate, euphemistic, negation, not naturally, confirm, question
19	Satisfaction	Euphemistic, confirm, assertion, past
20	Reasoning	Reason, value judgment
21	Hold	Restless mind, confirm, recitation
22	Switch topic	Appeal, will, question
23	Diffident	Reserved, unobtrusive
24	Order	Command, bid, boss, wish
25	Regret	Feeling apologetic, feeling responsibility
26	Laugh	Smile, laughing
27	Confusion	Confused, wondering, puzzled
28	Protest	Object, against
29	Provoke	Challenge, bring out
30	Respect	Looking up, showing great regard, thinking highly
31	Jealous	Envious, feeling jealousy
32	Sarcastic	Irony, snide, snark
33	Attack	Disapprove, reprove, accusing
34	Affectionate	Grace, like, love
35	Balanced	Reposeful, calm, composure
36	Agree	Positive, affirm
37	Disagree	Negative, deny

3.2. Representation of directed relationships

The directed relationships between any two characters is associated with a speech-role vector. Suppose that character a is the speaker. Let a number of speeches in a given period characterized by speech role i in Table 1 be N_i. The corresponding component of the speech-role vector is then

$$x_i = \frac{N_i}{\sum_i^{37} N_i}. \tag{1}$$

Then, $dr_{a,b}$, the directed relationship from a to b, is characterized by the speech-vector

$$dr_{a,b} = (x_1, x_2, \ldots, x_{37}). \tag{2}$$

Table 2. List of target characters in the experiment. The two main characters in each comic were selected as the experimental targets.

Title ID	Title	Character name	Character ID
1	*Aoharaido*	*Futaba*	1F
1	*Aoharaido*	*Hikaru*	1M
2	*Hana nochi hare*	*Oto*	2F
2	*Hana nochi hare*	*Haruto*	2M
3	*Ore monogatari!!*	*Yamato*	3F
3	*Ore monogatari!!*	*Takeo*	3M
4	*Itazurana kiss*	*Kotoko*	4F
4	*Itazurana kiss*	*Naoki*	4M
5	*Namaiki zakari*	*Yuki*	5F
5	*Namaiki zakari*	*Sho*	5M
6	*L ♥ DK*	*Aoi*	6F
6	*L ♥ DK*	*Shusei*	6M
7	*Kimini Todoke*	*Sawako*	7F
7	*Kimini Todoke*	*Shota*	7M
8	*Sukitte i'inayo*	*Mei*	8F
8	*Sukitte i'inayo*	*Yamto*	8M
9	*Karakai jozuno Takagi-san*	*Takagi*	9F
9	*Karakai jozuno Takagi-san*	*Nishikata*	9M
10	*Ijiranaide Nagatoro-san*	*Nagatoro*	10F
10	*Ijiranaide Nagatoro-san*	*Senpai*	10M

which shows the relative rate of each speech role in the conversation. Thus, the rates for 'Sarcastic' and 'Opposite' should be higher if a dislikes b, whereas 'Affectionate' and 'Respect' should be higher if a loves b. Even if the relationships have the same label in non-directed descriptions, this representation is more detailed. For example, for characters described by the non-directed relationship "lovers," the distribution of values in the vector $dr_{a,b}$ reveals what kind of lovers the characters are and how character a treats his or her partner.

3.3. Similarity of directed relationships

The vector of speech roles, detailed in Section 3.2, can be used to calculate the similarity of relationships. The cosine similarity between $dr_{a,b}$ and $dr_{c,d}$, represented by $Sim(dr_{a,b}, dr_{c,d})$, is useful for studying the bidirectional relationships $Sim(dr_{a,b}, dr_{b,a})$ between arbitrary pairs of characters. The higher $Sim(dr_{a,b}, dr_{b,a})$ is, the more the relationship between the partners is symmetrical; the coordinated attitudes appear in the conversation between the characters. By focusing on each element of the vector, we can consider reasons that the relationships are similar to each other. A good relationship should have a high similarity score for 'Affectionate,' whereas a bad relationship should have a high similarity score for 'Attack' or 'Disagree.'

4. Experiments

We conducted experiments to study the reasonableness of the proposed method. The bidirectional relationships between characters in a single comic title were studied, with the similarity calculated by using the proposed method could be applied to finding analogies between relationships of characters in different titles.

4.1. Experimental settings

In the experiment, 10 comics were used as the experimental samples. From each title, the two main characters were selected as the target characters. Table 2 shows the list of comics and the main characters of each title.

In this paper, as a preliminary study of the proposed idea, only comics in the "romance" genre were considered. In romance comics, the two main characters usually have the same non-directed relationship "lovers," but the details of relationship differ between them. This makes comics of romance especially well-suited to verifying the effectiveness

Table 3. Similarities of bidirectional relationships between characters in each title of comics.

Bidirectional relationship	Cosine similarity using proposed method
$Sim(dr_{1F,\,1M}, dr_{1M,1F})$	0.754
$Sim(dr_{2F,\,2M}, dr_{2M,2F})$	0.712
$Sim(dr_{3F,\,3M}, dr_{3M,3F})$	0.604
$Sim(dr_{4F,\,4M}, dr_{4M,4F})$	0.581
$Sim(dr_{5F,\,5M}, dr_{5M,5F})$	0.354
$Sim(dr_{6F,\,6M}, dr_{6M,6F})$	0.343
$Sim(dr_{7F,\,7M}, dr_{7M,7F})$	0.338
$Sim(dr_{8F,\,8M}, dr_{8M,8F})$	0.238
$Sim(dr_{9F,\,9M}, dr_{9M,9F})$	0.180
$Sim(dr_{10F,\,10M}, dr_{10M,10F})$	0.083

of the proposed method. The 10 titles of comics were subjectively selected by the second author; they are romance comics popular in Japan.

The conversations between the two main characters in one volume of each of the titles listed in Table 2 were annotated with the speech roles in Table 1.

A continuous speech by one character was regarded as a single speech, regardless of the number of speech balloons. The Japanese text in the speeches studied contained from 1 to 130 printed symbols. Monologues, in which the speaker has no speech partners, were not annotated. If one speech had multiple speech roles, all of the speech roles were annotated to the speech. The annotation was carried out by only the second author; in the future, it would be preferable to use multiple annotators, perhaps by crowdsourcing. Based on the annotation results, dr was calculated for each directed relationship.

4.2. Similarity of the bidirectional relationships between characters in each title of comics

For each comic title, we calculated the similarities of the bidirectional relationships between two characters $Sim(dr_{a,b}, dr_{b,a})$ as detailed in Section 3.3. Table 3 shows the results.

Characters in titles 1 and 2 showed the relatively higher similarity in their bidirectional relationships. On the other hand, for titles 9 and 10, the characters in these titles showed relatively lower similarity. These results indicate that the pairs of “1F and 1M” and “2F and 2M” should behave similarly for each other while the behavior observed in the pairs of “9F and 9M” and “10F and 10M” was dissimilar. In earlier approaches, both these relationships would be subsumed in the word “lovers,” but expressions of love by these two couples are markedly different.

We consider these results qualitatively. Titles 1 and 2 belong to the regular romance genre. In these stories, females and males show their emotions directly to their partners. Their speeches are similar, as was evident from the similarity calculated using the proposed method. The communication between characters in titles 9 and 10 has a different style: the female character teases the male character to cover her embarrassment, and the male character is confused by her behavior. Thus, the speeches from female to male and from male to female are totally different and it was the attractiveness of this type of story. This communicative asymmetry is clear from the similarity-value measurements.

That the similarity values calculated using the proposed method were reasonable based on the general nature of the comic title suggests that they might help us to identify the comics by the similarity of directed relationships between characters. The effectiveness of such retrieval will be verified objectively in our future work.

4.3. Analogy of directed relationships of characters in comics

In the field of information representation of words, the evaluation of word analogies is a common tasks. The word analogy task is defined as the question: of the form, a word A is to a word B as a word C is to a word D, where D is predicted by the model. We have incorporated this concept into our research as analogy retrieval for directed

Table 4. Comparison between similarity rank for directed relationships using the proposed method and using human judgment. There were 180 possible combinations.

Combination of directed relationships	Similarity using the proposed method	Similarity rank using the proposed method	Similarity rank by human judgment
$Sim(dr_{10M,10F}, dr_{5F,5M})$	0.932	1	30
$Sim(dr_{9M,9F}, dr_{10M,10F})$	0.845	2	8.5
$Sim(dr_{2F,2M}, dr_{9M,9F})$	0.838	3	158.5
$Sim(dr_{5M,5F}, dr_{8M,8F})$	0.808	4	2.5
$Sim(dr_{2F,2M}, dr_{4F,4M})$	0.733	8	14.5
$Sim(dr_{5F,5M}, dr_{8F,8M})$	0.729	9.5	4
$Sim(dr_{2M,2F}, dr_{4M,4F})$	0.729	9.5	58.5
$Sim(dr_{9F,9M}, dr_{10F,10M})$	0.715	12.5	2.5
$Sim(dr_{1F,1M}, dr_{4F,4M})$	0.661	20.5	8.5
$Sim(dr_{1M,1F}, dr_{6M,6F})$	0.575	36.5	1
$Sim(dr_{1M,1F}, dr_{4M,4F})$	0.523	43	5
$Sim(dr_{1F,1M}, dr_{6F,6M})$	0.124	144.5	8.5
$Sim(dr_{9F,9M}, dr_{6F,6M})$	0.026	177	158.5
$Sim(dr_{4M,4F}, dr_{3F,3M})$	0.005	180	158.5

relationships of characters in comics: the feasibility study of analogy retrieval for directed relationships between characters in comics. Analogy retrieval would enable us to explore comics using intuitive queries such as "In which other comics do communicate in a way similar to the way *a* and *b* do in this title of comics?" Such an intuitive retrieval based on the story contents should be effective not only in comics but in all affective multimedia arts; this will be explored in our future work.

We defined the analogy of directed relationships between characters as that of determining how similar the directed relationship of character *a* to character *b* is to that of character *c* to character *d*. We approached this problem using both the proposed method and subjective evaluation. The similarities between directed relationships were calculated for each pair of characters listed in Table 2: 180 combinations in total. For subjective evaluation, we asked 10 participants in their twenties and thirties to read the volumes used in this study and evaluate whether the given relationships were similar to each other. For "a character *a* is to a character *b*" in an arbitrary title of comics, the participants answered "a character *c* is to a character *d*" in another title of comics. If there were no appropriate options for "a character *a* is to a character *b*," the participants could answer "NA." The similarity of directed relationships between the proposed method and human understandings is determined by the counted numbers of a relationship selected as similar one to a questioned directed relationship by participants.

The Spearman's rank correlation [**?**] between the similarities using the proposed method and using human judgment was found to be 0.429, indicating a moderate correlation. Table 4 shows examples of the similarity ranks using the proposed method and human judgment. It was confirmed that the combinations of the directed relationships with higher similarity were evaluated as relatively similar combination of directed relationships by human judgment: for example, $Sim(dr_{9M,\,9F}, dr_{10M,\,10F})$, $Sim(dr_{5M,5F}, dr_{8M,\,8F})$, and $Sim(dr_{5F,\,5M}, dr_{8F,\,8M})$. These speeches had relatively high "affectionate" and "protest" scores; these kinds of speech-roles may let readers feel the similarity of the directed relationships. However, some of the combination of directed relationships with high similarity-rank according to the proposed method showed a relatively low rank based on human judgment: for example, $Sim(dr_{2F,\,2M}, dr_{9M,\,9F})$ and $Sim(dr_{2M,\,2F}, dr_{4M,\,4F})$. In such cases, their speech included extremely high value for "confusion." The feelings against the speeches of "confusion" might be different for each reader. When the characters had this kind of complicated conversation, the proposed method may not produce the same results as human judgment. In future work, we will attempt to re-design speech roles to represent the relationships between characters as understood by humans more accurately.

5. Conclusions

In this paper, we have proposed an idea to represent relationships between characters as directed relationships with speech roles in the conversation of them in comics. As the first step to verify the effectiveness of the proposed method, we have modeled the directed relationships between characters in the collected dataset and qualitatively studied the results. We have set this idea as one of the information representation problems and carried out the analogy tasks to verify the effectiveness of the proposed method, which has been known as one of the general tasks in the information representation. Through the analogy tasks for directed relationships, we have confirmed that the proposed method has shown a moderate correlation for similarities between the directed relationships. It has been considered that some speech roles might have influenced the effectiveness of predicting human judgment in analogy tasks for directed relationships.

For greater accuracy, the speech roles should be re-designed with this consideration in this paper. The annotation of speech roles, which has been subjectively conducted by one of the authors of this paper, should be made automatic and objective as well. These issues will be addressed in future work.

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