

Automatic classification of incident reports based on examples of words: Using machine learning technique of natural language processing

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Objective:

Incident reports are very useful in order to know cause of risks. However it becomes a problem when we grasp risks from a statistical viewpoint, because major risk classification adapted incident reports is not quantitatively define. Thus, we propose the new approach using natural language processing technique based on calculating examples of words quantitatively.

Consequently, we could get correct answer (70.1%) by automatic classification method and indicate a current problem of classification for incident reports.

Methods:

An incident reporting system was implemented in March 2000 at Kyoto University Hospital. We have collected many reports up to this point. These reports were usually classified by 15 categories (Medication, Intravenous drip & injection, blood transfusion, moving, etc.). We used Term Frequency / Inverse Document Frequency (TF/IDF) heuristic which is now used commonly as information retrieval system technique, and we applied this method to automatic classification. This method is briefly that it calculates maldistribution of words. We used 2405 incident reports, and 1405 reports of them were used as teacher data for TF/IDF heuristic and 1000 reports were test data. We extracted important words from teacher data using this heuristic and tested how this method could classify the test data to correct category.

Results:

Table 1. Examples of important words and weights in some categories

Medication		IV & Injection		Examination		Blood transfusion	
word	weight	word	weight	word	weight	word	weight
internal med.	144.3	drip infusion	63.4	sample	103.1	transfusion	121
prescription	81.5	renewal	61.6	examination	74.6	FFP	89.1
after a meal	67.6	drop	61.4	urine collection	70.7	blood group	89.1
doubt	55.5	antibiotic	56.4	urine sampling	57.8	unit	60.5
inquiry	55.5	SOLITA	54.9	blood draw	52.2	platelet	50.9
dose	39.7	administration	46.4	order	41.6	incompatibility	38.2
handover	38.6	insulin	45.7	tube	38.6	MAP	37.9

We could extract these representative words and weight value from teacher data to each category. Next, we tested automatic classification with this knowledge. The result was shown as follows.

Table 2. Number of correct answers each nominate ranking by this method

Candidate ranking	1st	2nd	3rd
total 1000 reports	701	111	48
percentage	70.1%	11.1%	4.8%

(15 categories exist.)

This method could nominate all reports as any categories. There were 701 reports when this method nominated to the first was a correct answer. Correspondingly, number of second nominated correct answers was 111 reports and number of third was 48 reports. The probability that the correct answer of first three nominated were included was 82.6%.

Conclusions:

This method using TF/IDF heuristic could extract representative words from practical reports to each category obviously. This result shows that frequently appearance words make incident reports to be classified quantitatively. Therefore, we could correctly categorize the incident reports which were unknown category as test data. This method was able to categorize incident reports as correctly as a medical staff-member determined by himself or herself.