

Multimodal annotation scheme for online written conversation analysis

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1 Introduction

1.1 Objects and definitions

The objects of our study are computer-mediated - or "online" - written conversations. This includes conversations taking place through a number of mediums, such as web forums, message boards, mailing lists, chatrooms, and website comment sections. It excludes all forms of oral speech, as well as their transcripts. It also excludes all forms of offline written speech, such as the dialogues between characters in a book, journalistic interviews or messages written in a guestbook.

1.1.1 Participants, messages and subjects

The conversations as we define them have three main characteristics:

- Multiple *participants*: a conversation is interactive by definition, and we define participants as human beings (bots are not participants) taking actively part in the conversation by contributing new content.
- Multiple *messages*: a conversation is built of several messages from various participants, and we define messages as the smallest technical unit of communication handled by the given medium (e.g. in a forum, posts are messages, in a mailing list, emails are messages, etc.).
- A *subject*: conversations revolves around defined subjects, which are *not* necessarily the formally defined subject lines or forum thread names (easily extracted from metadata), but rather the underlying motivation behind the conversation: i.e., what it is *about*.

1.1.2 Dialogues, polylogues and roles

We make the distinction between *dialogues*, conversations between two participants, and *polylogues*, conversations between two participants *or more*.

Usually, in corpora constituted exclusively of dialogues, each participant has a well defined *role*. For example, one may be a customer service agent and the other one a customer. In these scenarios, roles are static and remain the same through many conversations. Moreover, these conversations are often private: no one can "jump in" and send messages. But in other, more general corpora, where anyone can participate in a conversation, roles are not as well defined and can fluctuate during a conversation. It is however true in most cases that the conversation initiator (i.e. the first participant

to send a message) is likely to be the one with the problem and thus the only one who can define it, acknowledge solutions for it and actually act on it in the real world.

1.1.3 Problems and solutions

We are more specifically interested in a more particular kind of conversation: functional conversations, i.e. conversations that are designed to convey information in order to help achieve an goal. When the motivation behind a conversation is to find solutions to a stated problem, we consider them to be problem/solution oriented conversations. They have a clearly stated goal and can be *resolved*. These are at the heart of our research goals.

We define problems and solutions as follows:

- Problem: an unwelcome matter or situation affecting one or several participants, that is considered harmful or needs to be resolved or worked around.
- Solution: a way of solving or working around a specific problem previously introduced in the conversation, usually in the first message of the thread.

1.2 Goals

Our goal is to develop an annotation scheme and protocol for the classification of message sentences in problem/solution oriented conversations. The scheme should facilitate the problem/solution oriented analysis of message text, which, in turn, can be used for a number of applications:

- Problem/solution oriented information retrieval (e.g. finding relevant documentation for a problem stated in natural language)
- Solution finding (e.g. the proposal of previous solutions that worked for a similar problem)
- Cross-modal analysis (e.g. using data from different sources to improve the efficiency of other tasks)
- Modality/channel relevance estimation (e.g. assisting users in finding the best place to find help)
- Etc.

A further objective is to use such annotated data to produce a sample segmentation of our email corpus so that we can test the validity of the hypotheses made in [Hernandez and Salim, 2014].

2 Background and Bibliography

In this section we introduce the concept of dialog act (DA) and provide details concerning a few works related to the field of speech act recognition and email segmentation.

2.1 Speech Acts

Speech act theory [Austin, 1975] attempts to describe utterances in terms of communicative function (e.g. question, answer, thanks...). Indeed, utterances are not limited to their semantic content, they also have a communicative function : a goal, and an effect. For Austin, they can be analyzed at three levels: locutory (the linguistic characteristics of the utterance), illocutory (the intention of the speaker) and perlocutory (the real-world effects of the utterance). When we refer to speech acts¹, we are interested in the illocutory level of utterance analysis.

Thus, in most works, it is in terms of speech acts that interactions between participants of a conversation are modeled. Austin considers utterances as actions performed by a speaker ; this is based on the idea that every enunciation is the realization of a social act. Verbs that specify these actions are called *performative verbs*, such as when someone says "I grant you the title of captain". But speech acts are not only constituted by these kinds of verbs. [Searle, 1976] offers five classes of dialog acts : assertives (assertion...), directives (order, request, advice, etc.), commissives (promise, invitation, etc.), expressives (congratulations, thanks, etc.) and declarations (war declaration, nomination, baptism, etc.).

There are a number of different speech act taxonomies [Traum, 2000]. Two of them can be considered foundational: first Austin's and then Searle's. Both contain five classes of speech acts, that can be defined as such:

- Assertives: speech acts that commit a speaker to the truth of the expressed proposition, e.g. reciting a creed.

¹Also known as dialog acts

Réécrire définitions
(en l'état copié/collé
Wikipédia)

[Austin, 1975]	[Searle, 1976]	Examples
Verdictives	Declarations	To condemn, decree...
Exercitives	Directives	To command, order, forgive...
Commissives	Commissives	To promise, guarantee, bet, swear...
Behabitives	Expressives	To apologize, thank, criticize...
Expositives	Assertives	To assert, deny, postulate...

Table 1: Foundational taxonomies for speech acts categorization

- Directives: speech acts that are to cause the hearer to take a particular action, e.g. requests, commands and advice.
- Commissives: speech acts that commit a speaker to some future action, e.g. promises and oaths.
- Expressives: speech acts that express the speaker’s attitudes and emotions towards the proposition, e.g. congratulations, excuses and thanks.
- Declaratives: speech acts that change the reality in accord with the proposition of the declaration, e.g. baptisms, pronouncing someone guilty or pronouncing someone husband and wife.

Table 1 gives verb examples of these two taxonomies. Table 2 presents a few more recent taxonomies specifically used in the context of online conversation analysis.

2.2 Verbal Response Modes

Ajouter quelques paragraphes sur les VRM

2.3 Bibliography

Ajouter un paragraphe introductif + tableau qui restitue les différents travaux entre eux (par domaine, corpus, schéma, tâche, approche...)

2.3.1 Sentence classification in message board posts

Here we explain the work of [Qadir and Riloff, 2011]. Their research is relevant to our work because of their goal - to classify sentences as speech acts

Act	Corpus	Reference
Disclosure Edification Advisement Confirmation Question Acknowledgment Interpretation Reflection	Multi-domain	[Lampert et al., 2006]
Direct request Question-request Open question First person commitment First person expression of feeling First person other Other statements	Corporate email	[De Felice et al., 2013]
Accept response Acknowledge and appreciate Action motivator Polite mechanism Rhetorical question Open-ended question Or/or-clause question Wh-question Yes-no question Reject response Statement Uncertain response	BC3	[Ulrich et al., 2008]
À enrichir		

Table 2: Examples of speech act taxonomies specific to online conversation analysis

Class	Definition
Expository Sentence	Presents or explain information to the reader
Commissive	Contains a stated commitment from the author
Directive	Contains an expectation that readers will do something as a response
Expressive	Contains a statement of the author’s psychological state
Representative	Commits the author to the truth of a certain proposition

Table 3: Taxonomy used in [Qadir and Riloff, 2011]

in online messages, because of their data - web forum posts, and because of their taxonomy - which is based on speech acts.

Goals:

The authors work with message board posts. They consider that not all sentences carry a speech act. Their primary goal is to distinguish between those that do and those that don’t (which they call *expository sentences*). Their second goal is to classify speech act sentences into four types: *commissives*, *directives*, *expressives* and *representatives*. These four classes are derived from the work of [Searle, 1976]. Searle’s fifth type of speech acts, *declarations*, was omitted because the authors found almost no examples of it in their corpus. This taxonomy is further explained in Table 3.

Their ultimate objective is to develop a system capable of classifying sentences in a topic-independent manner (the data they worked with was extracted from forums dealing with veterinary medicine).

Mieux définir "expository", positionner le terme par rapport aux expositives d’Austin et les assertives de Searle

Expliquer dans le texte pas dans une table

Message board specificities:

According to the authors, speech acts occur differently in message board posts than in spoken dialog.

They found that while the most common everyday occurrences of *commissives* are promises and threats, it is not so in forum data. Most occurrences of this type of speech act correspond to confirmations that the participant will perform some action in the future. The authors also consider that declarations from the participant that they will not do something are sentences carrying such a speech act.

They found that *directive* speech acts are common in message board posts, in particular under the form of a question or a request for assistance or advice. They attempt to weed out rhetorical questions from sentences

classified as *directives*.

The authors found that typical examples of *expressive* speech acts occur when a participant thanks, welcomes or apologizes to a reader. They found this class to be very common in message board posts.

Representative speech acts were uncommon in the corpus they used. They chose to ignore most sentences stated as fact even though they might correspond to Searle’s definition of a representative speech act and label them as *expository sentences* instead. They considered that sentences belonged in that class only when a doctor explicitly presented an opinion or hypothesis as their own (such as sentences starting with “I suspect that...”).

Classification:

The authors chose to approach the problem as a supervised classification task. Instead of a single classifier, they chose to train four different binary models, one for each class, and run them against the data. Therefore a single sentence can contain several speech acts. A preliminary classifier was trained just to filter out sentences containing no speech act (*expository sentences*).

They use a number of different feature sets for the classification task. First, they consider lexical and syntactic features. Such features include: unigrams, personal pronouns, tense, modals, plan phrases, punctuation, sentence position, number of verbs, and others. Second, they consider speech act word clues. In [Searle, 1976], the author listed a number words that he considered to be indicative of speech acts. Here, the authors chose to discard a few that they considered too general and added new ones, such as a list of speech act verbs originally published by [Wierzbicka, 1987]. Their system recognize all derivations of these word clues.

The classifiers used were Support Vector Machines (SVMs).

Evaluation:

The data set used was constituted of 15,383 message board posts from the Veterinary Information Network (VIN)². These posts covered three topics: cardiology, endocrinology, and feline internal medicine. The preprocessing included number tokenization, the removing of html tags and “basic cleaning” (???). Experiments were performed on a random sample of 150 threads from the collection. These threads contained 1,956 sentences (13.04 sentences per post).

The gold standard was built from the manual annotation of message posts by two human annotators provided with detailed annotation guide-

²www.vin.com

Class	Proportion
None	71.42%
Directive	15.90%
Expressive	9.92%
Representative	2.91%
Commissive	2.61%

Table 4: Repartition of speech acts in [Qadir and Riloff, 2011] test data

lines. A sample of 50 posts was independently annotated by them in order to calculate the annotator agreement. However, the authors ran into the same problem [Kim et al., 2010] did, that is the fact that the standard Cohen’s Kappa is not applicable to multi-class annotation tasks. Since they found only a small number of sentences classified as containing several speech acts, these were discarded and the kappa was calculated for the rest. The result was a score of .95, an extremely high agreement. However the ”no speech act” class was by far the most predominant (70%), so the kappa score does not necessarily mean that annotators mostly agreed on speech act classification decisions. The authors therefore computed the kappa for each speech act class and found an average score of 87.25%, which is still very high. Table 4 shows the repartition of speech acts in their dataset.

The first classifier, the one filtering out sentences containing no speech act, recognized 83% of the speech act sentences with 86% precision, and 95% of the expository sentences with 93% precision. As for the speech act categorization task, the authors performed many experiments with a number of different feature combinations, for each speech act category. The authors found that many syntactic and lexical features had little impact on the classification results. Detailed results will not be presented here, but overall results were good for the identification of directive and expressive speech act sentences, less so for representative and commissive speech acts, which proved more difficult to detect.

2.3.2 Speech act classification applied to forum posts

Here we explain the work of [Kim et al., 2010]. Their research is relevant to our work because of their goal (to link and classify messages) and their corpus (email messages). Their taxonomy, however, is not based on dialog acts.

Class	Group
Support	Solution Type
Documentation	Solution Type
Install	Solution Type
Search	Solution Type
Hardware	Problem Source
Operating System	Problem Source
Software	Problem Source
Media	Problem Source
Network	Problem Source
Programming	Problem Source
Spam	Miscellaneous
Other	Miscellaneous

Table 5: Thread classes in [Kim et al., 2010]

Methodology:

The authors annotate both threads and posts in a corpus built from the CNET forums³. Two annotators use a dedicated tool⁴ for the annotation task. Before starting to annotate the overall data set, a pilot annotation was performed to ensure that both annotators had the same understanding of the taxonomy.

Taxonomy:

First, they classify threads into two groups of classes: the basic group, which is further subdivided into *Solution Type* classes and *Problem Source* classes, as well as a miscellaneous group. The different classes are detailed in table 5. *Solution Type* and *Problem Source* classes can be used either separately or together, therefore there is an additional combined class set made of each combination of a *Solution Type* class and a *Problem Source* class (e.g. *Search-OS* or *Install-Network*). The combined class set being the superset of basic class sets, it was used to do the annotation.

Then, they annotate each individual post with one or several post classes. These classes are categorized into two groups, the answer group and the question group, plus three single classes. The different classes used are

³<http://forums.cnet.com>

⁴<http://mandrake.csse.unimelb.edu.au/~rbp/cgi-bin/su/Classify.py>

Class	Group
Answer-Answer	Answer
Answer-Add	Answer
Answer-Correction	Answer
Answer-Confirmation	Answer
Answer-Objection	Answer
Question-Question	Question
Question-Add	Question
Question-Correction	Question
Question-Confirmation	Question
Resolution	-
Reproduction	-
Other	-

Table 6: Post classes in [Kim et al., 2010]

detailed in table 6.

Annotator agreement:

The authors use Cohen’s Kappa to compute annotator agreement:

$$\kappa = \frac{P(a) - P(e)}{1 - P(e)}$$

Where $P(a)$ refers to the relative observed agreement between two annotators, and $P(e)$ is the hypothetical probability of chance agreement between two annotators.

However, as they write: ” *The standard Cohen’s Kappa cannot be used in multi-class annotation tasks. By the time the annotation process started, no standard methodology for calculating Cohen’s Kappa for multi-class tasks was found. Therefore, an extended method for calculating κ value was proposed to address this problem.*”

They propose an improved Cohen’s Kappa for a multi-class situation, but the methodology is not applicable to our case because it takes into account the link information for each class (a concept we do not consider at all).

Classification:

The authors use four different models for thread classification: 1 Nearest Neighbor, Naïve Bayes and Support Vector Machine. A majority class model (ZeroR) and a random model (RAND) are used as baselines. Features are weighed using four different schemes: Information Gain (IG), Term Frequency-Inverse Document Frequency (TF-IDF), raw count and simple binary. For post classification, the authors use a conventional Maximum Entropy learner⁵ as well as two structural learners : SVM-HMMs and CRFs (using *CRF++*⁶)

Features for threads are built by using the initial post or concatenating all posts in the thread to form the "text" of the thread. They then construct different bag-of-words feature sets by tuning different parameters such as input text, pre-processing, tokenization method, and n -gram length. For posts, features used include lexical, structural, contextual, and semantic features.

Evaluation:

Results for both thread classification and post classification are evaluated using micro-average precision (P_μ), recall (R_μ), F-score (F_μ) and macro-averaged precision (P_M), recall (R_M) and F1-score (F_M) on a stratified⁷ 10-fold cross-validation.

2.3.3 Segmentation of email message text

Here we explain the work of [Lampert et al., 2009]. It is relevant to our work because of their goal, which is to classify sentences or text fragments as belonging to such or such message zone, and because of the kind of data they work with: email messages.

Goals:

The authors attempt to segment emails into several prototypical areas, called *email zones*. They call their system "Zebra".

Email zones:

There are three superclasses containing nine different classes of email zones.

⁵<http://maxent.sourceforge.net/>

⁶<http://crfpp.sourceforge.net/>

⁷The authors make sure that "if a given post is contained in the test data for a given iteration, all other posts in that same thread are also in the test data (or more pertinently, not in the training data)"

Sender zones contain text written by the current sender. This superclass contains the following subclasses: *author* (new content by the sender), *greeting* (polite greetings at the beginning of a message), and *signoff* (closing words of a message).

Quoted conversation zones include content quoted from other messages. The subclasses for this superclass are: *reply* (content quoted from a previous message in the thread) and *forward* (content from an email outside the thread that has been forwarded by the current sender).

Boilerplate zones contain reusable message content, typically automatically appended to a message. Subclasses include: *signature* (contact information automatically appended at the end of a message), *advertising* (advertising material, typically found at the end of the message), *disclaimer* (legal disclaimers and privacy statements), and *attachment* (automated text indicating attached documents).

Classification:

The authors consider that each line of text in the body of a message belongs to one of these *email zones*. The authors tried two approaches: in the first one, a classifier segments a message into zone fragments and then attempts to classify the resulting fragments. In the second approach, the classifier simply works on a line-by-line basis.

In the first approach, the fragment-based one, the message is segmented based on detected *zone boundaries*. These boundaries are identified thanks to what the authors call "buffer lines", i.e. blank lines or lines containing only whitespace or punctuation characters.

The classifier is based on SVMs (Support Vector Machines) and uses graphic, orthographic and lexical features to categorize lines and text fragments.

Evaluation:

The training data for their classifier consists of almost 400 messages from the Enron email corpus [Klimt and Yang, 2004]. To build the gold standard, the authors chose to use only a single annotator since they believe the task to be relatively uncontroversial. Each line - blank lines excepted - was marked by the annotator as belonging to one of the nine zones. They used the resulting 7,922 annotated lines (out of 11,881) as training data for their classifier.

The results are calculated by 10-fold cross-validation.

The zone boundary detection system (used for the fragment based ap-

proach) reaches 90% accuracy.

Concerning zone classification, interestingly, the line-based approach outperformed the fragment-based one by a small margin, probably due to the 10% of inaccuracies in boundary detection. Zebra obtains a 91.53% accuracy for the classification of lines into the three superclasses, and 87.01% in all nine classes.

3 Proposal

Here we describe our findings and proposal.

3.1 Discourse Classes

These classes are mutually exclusive and must cover the entire text. Therefore each sentence belong to one and only one of these classes.

New Content

Sentences are considered to be “new content” if they were written expressly for the considered message.

- Speech Acts (see subsection 3.2 for details)
- Structure
 - Metadiscourse: sentences that comments on surrounding text
 - * Utterance introduction: sentences that introduces an upcoming sentence
 - Question introduction: sentence that introduces a question (e.g. *"the question f this mail is..."*)
 - Problem introduction: sentence that introduces a problem description (e.g. *"here's my problem"*)
 - Instructions introduction: sentence that introduces a series of instructions (e.g. *"do this:", "Then release them and press the F2 key."*)
 - Quote introduction: sentence that introduces a quote - may be automatic (e.g. *"On 20/02/07, Larry wrote:"*)
 - * Utterance qualifier: sentences that qualify a previous sentence (e.g. *"just a thought"*)
 - Structure marks: non-sentences bearing structural information

- * Non-verbal separator: non-linguistic character sequence separating two parts of a message (e.g. “–”)
- * Heading: title announcing a new section of the message (e.g. “****DISCLAIMER****”)
- Reference: sentences that mention or allude to something else
 - * post reference: the author references to another post in the thread (e.g. “*Earlier Dago said that...*”)
 - * item reference: the author references to a previously introduced item (e.g. “*what does that command do exactly?*”)
 - * channel reference: the author references to another communication channel (e.g. “*Check the forums, we just discussed this subject and procedures for both dd and rsync*”)
- Conversational information: information on the conversation’s flow
 - * Answer acknowledgment: the author confirms the good reception and understanding of an answer (e.g. “OK.”)
 - Answer confirmation: the sentence confirms that a proposed solution worked (e.g. “*Perfect!!*”)
 - Answer rejection: the sentence rejects an answer because the solution is inapplicable or didn’t work (e.g. “*Thanks. But the CD still doesn’t work*”)
 - * Thread closure: the sentence announces that the conversation is over or that the problem was resolved or cannot be resolved
- Edition artifact: formal element showing the message has been modified, by the author or a moderator for example (e.g. “[*snip*]”)
- Hyperlink: hypertext link pointing toward another document (e.g. “<https://lists.ubuntu.com/mailman/listinfo/ubuntu-users>”)

Quote

A sentence is a “quote” if it already appears in another message or if it is taken from an external source.

- Replied text: content quoted from a previous message in the thread
- Forwarded text: content from a message outside the current conversation that has been forwarded by the current message (email only)

- Quotation: quote from an outside source, such as a monologue document, a book, or a retranscription of famous spoken words

Boilerplate

Sentences are considered as “boilerplate” if they are intended to be reused by the author (or a group of authors). “Boilerplate” sentences frame the message.

- Signature: the message author’s identity
 - Automatic signature: signature automatically appended to the message (e.g. *"Brian Lunergan Nepean, Ontario Canada"*)
 - Manual: signature written by the author for this specific message (e.g. *"Sean"*)
- Advertisement: advertising material automatically appended to the message (e.g. *"Novo Yahoo!"*)
- Disclaimer: legal disclaimers and privacy statements automatically appended to the message
- Contact: the author’s contact information (e.g. *"mns:renato4010591@hotmail.com"*)

3.2 Speech Act Classes

The **speech act** superclass contains four subclasses: **assertives**, **commissives**, **directives** and **expressives**.

They are derived from the five classes defined in [Searle, 1976] (the fifth class, “declarations”, was omitted because we assume it will almost never appear in our corpus: [Qadir and Riloff, 2011] found almost no example of it in their datasets).

Assertives

Assertives are sentences that commit a speaker to the truth of the expressed proposition.

- Subjective report: account of something the author has observed, heard, done, or investigated
 - Action report: reporting of actions taken (e.g. *"I did try apt-cache search geotiff but it didn't work"*, *"I upgraded my system to 10.04 via clean install"*)

- Result report: reporting of the results of actions taken (e.g. *"I did try apt-cache search geotiff but it didn't work", "No such luck"*)
 - * Solution research result report: specific type of result report pertaining to the search for a solution (e.g. *"I couldn't find anything on the forums"*)
- Observation: a remark, statement, or comment based on something one noticed ("It doesn't happen every time I move the cursor, it is completely random")
- Objective report: exact reporting of something without author interpretation
 - Computer text: copy-and-paste of code, log, or commands (e.g. *"usermod - G admin 2ndroot"*)
 - Quote: exact copy of a portion of text with an indication that one is not the original author
- Statement: definite and clear expression of the nature or truth of something
- Description: objective account of a system, person or event
 - Event description: description of an event
 - System description: retranscription of a system's settings or specifications (e.g. *"My ubuntu 1 bandwidth settings are set to -1", "I am using ubuntu 12.04"*)
 - Author profile: description of the author's identity, habits, experiences, preferences or skills (e.g. *"Coming from a Windows world, I've probably been spoiled but..."*)
- Assimilation: expression of a belief in the similarity or non-similarity of two things
 - Assertion: a confident and forceful statement of fact (e.g. *"DD will work over the network", "Even OS X has nothing close to it, unfortunately"*)
 - Guess: estimate or supposition without sufficient information to be sure of being correct (e.g. *" "*).
 - Correction: rectification of an alleged error or inaccuracy

Commissives

Commissives are sentences containing a stated commitment from the author.

- Acknowledgment-Commitment: a commitment to do something in reaction to a previous message in the thread (e.g. *"Ok thanks I'll try that as soon as I get home"*, *"Hopefully it's explained in detail in there, I will search..."*)
- Channel change: announcement that the author is going to switch or fork the conversation to a different communication channel (e.g. *"I'll file a wishlist bug for this"*)

Directives

Directives are sentences containing an expectation that readers will do something as a response.

- Question: a sentence worded or expressed so as to explicitly elicit information (e.g. *"Should I just change them by hand?"*, *"Is there anyway to recover these short of recreating everything from scratch and restoring from backup?"*)
- Clarification request: request for more specific information or confirmation that the author has correctly understood an utterance (e.g. *"do you mean the starterbar from gdesklets?"*, *"Which exact packages are you getting an error from?"*)
- Request for assistance: call for help (e.g. *"please help!"*, *"can anyone help me???"*, *"i could use some help"*)
- Suggestion: an idea submitted for consideration
- Instruction: information telling how something should be done (e.g. *"Open a terminal"*)

Expressives

Expressives are sentences containing a statement of the author's psychological state.

- Greeting: polite words of salutation
 - General greeting: greeting directed to no one in particular (e.g. *"Hi all"*, *"Hello all"*)

- Targeted greeting: greeting directed at a specific participant or group of participants (e.g. *"Hey Steve"*)
- Signoff: the conclusion of a message (e.g. *"see you"*, *"-best - greg"*)
- Thanks: an expression of gratitude
 - Thanks in advance: an expression of anticipated gratitude (e.g. *"Thanks for any help,"*)
 - Thanks in reaction: an expression of gratitude for some specific assistance (e.g. *"Thanks I'll try that!"*)
- Opinion: expression of a subjective judgment on a thing or situation (e.g. *"what a nightmare"*, *"this is bullshit"*, *"this OS sucks"*)
 - Feedback: specific type of constructive opinion destined to be used as a basis for the improvement of a product or service
- False question: question whose function is not to elicit an answer
 - Rhetorical question: question asked in order to make a point (e.g. *"Are you seriously implying that he should reinstall Ubuntu because of a cosmetic issue?"*, *"Wow, CRTs to store data?"*)
 - Personal interrogation: question asked in order to express a sentiment (e.g. *"I wonder how it works?"*, *"Come on, how hard can this be?"*)
- Expression of solution confidence: expression of the author's level of confidence in a proposed solution (e.g. *"I don't know much about it, I just discovered it on gnomefiles.org"*, *"However, it may do what you need"*)
- Expression of solution preference: expression of the author's preferences (to varying degree) towards a specific type of solution

3.3 Problem/Solution Classes

The following taxonomy aims at capturing the way conversation participants introduce, explain and communicate about these problems and solutions.

The whole text doesn't have to be classified into these classes. Some sentences don't belong in any of them.

3.3.1 Primary Classes

In online conversations bearing expressions of need and attempts at answering to those needs, we consider that sentences may bear information on two types of abstract objects: problems, and solutions.

These two classes are mutually exclusive.

- Problem: an unwelcome matter or situation affecting one or several participants, that is considered harmful or needs to be resolved or worked around.
- Solution: a way of solving or working around a specific problem previously introduced in the conversation, usually in the first message of the thread.

3.3.2 Secondary Classes

These classes define the kind of information a sentence brings about a problem or a solution.

These classes are not mutually exclusive: a single sentence can belong into multiple classes.

- Definition: information about the nature of the object
 - Statement: brings new information on the object (for example, one of the steps of a solution, or the symptoms of a perceived problem)
 - * Problem statement: description of the issues that need to be addressed in order to consider the problem at hand resolved (e.g. *"The problem is (If its not clear from the picture), that the black area should be brown, or transparent or whatever as the background, but you probably guessed it."*)
 - * Goal statement: statement that describes future state of affairs and provides general direction, purpose or intent of what needs to be accomplished (e.g. *"I would like to be able to send the whole package via email to acquaintances in ISO form and let them make their own DVDs"*)
 - * Question: formulation of the problem as a question (e.g. *"Is there anyway to recover these short of recreating everything from scratch and restoring from backup?"*)

- * Expression of solution preference: expression of the author's preferences (to varying degree) towards a specific type of solution
- Correction: brings new information on the object while making some previously stated information obsolete
- Explanation: explains why the source of the problem, or why the solution is supposed to work; adds deeper level information
- Reception: information about the evolution and status of the object and the participants interactions about the object
 - Confirmation: confirms the existence or properties of the problem, or that a solution works
 - Assimilation: a claim that a problem or solution has been observed by a different participant, in a different context, or both
 - * Problem assimilation: assimilation of a given problem to another (e.g. *"I had a similar problem"*)
 - Acknowledgement: the action of expressing the good reception of new information and measures taken as a response
 - * Acknowledgment-Commitment: a commitment to do something in reaction to a previous message in the thread (e.g. *"Ok thanks I'll try that as soon as I get home"*, *"Hopefully it's explained in detail in there, I will search..."*, *"Thanks I'll try that!"*)
 - * Trial report: reporting of effects of a proposed solution (e.g. *"I did try apt-cache search geotiff but it didn't work"*, *"No such luck"*)
 - Refutal: claim that the problem is not solvable or that the solution cannot work
 - Appraisal: appraisal of the merits of the solution or the proper reporting of a problem
 - * Rhetorical question: objection formulated as a rhetorical question (e.g. *"Are you seriously implying that he should reinstall Ubuntu because of a cosmetic issue?"*, *"Wow, CRTs to store data?"*)
 - * Expression of solution confidence: expression of the author's level of confidence in a proposed solution (e.g. *"I don't know much about it, I just discovered it on gnomefiles.org"*, *"However, it may do what you need"*)

- Resolution: confirms that a solution works and/or that a problem has been resolved

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