A SURVEY ON ASPECT-BASED SENTIMENT ANALYSIS: TASKS, METHODS, AND CHALLENGES

JULIA KAZNOWSKA

PATRYK RAKUS

FILIP SZYMPLIŃSKI

MICHAŁ TOMCZYK

ABOUT THE ARTICLE

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- Authors: Wenxuan Zhang, Xin Li, Yang Deng, Lidong Bing, and Wai Lam
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ASPECT-BASED SENTIMENT ANALYSIS (ABSA)

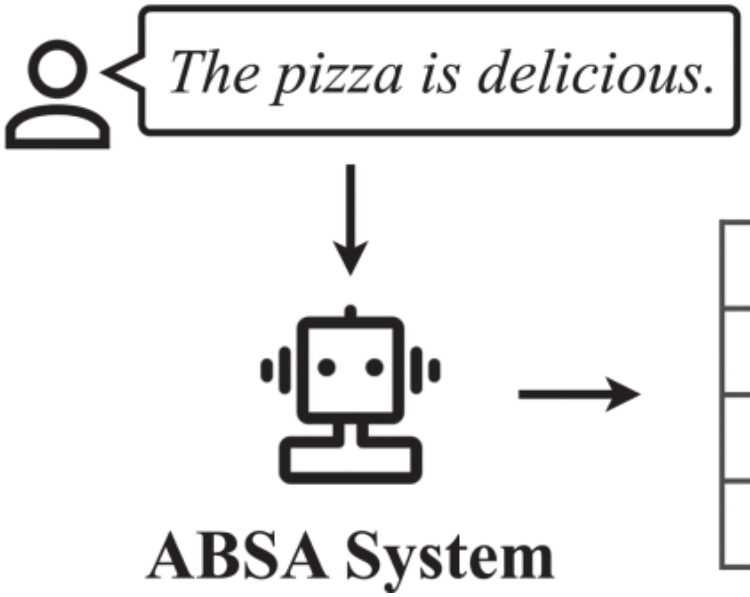
Aspect-based sentiment analysis (ABSA) is the problem to identify sentiment elements of interest for a concerned text item, either a single sentiment element, or multiple elements with the dependency relation between them.

ASPECT-BASED SENTIMENT ANALYSIS (ABSA)

- Subdivision of Sentiment Analysis, focusing on specific aspects, instead of predictions at the sentence or document level
- Shifting the prediction target from the whole text to granulated, specific aspects
- Example: *The pizza in the Italian restaurant was tasty, but the service was terrible*

SENTIMENT ELEMENTS OF ABSA

- Aspect category
- Aspect term
- Opinion term
- Sentiment polarity



Aspect Term	*pizza*
Aspect Category	`food`
Opinion Term	*delicious*
Sentiment Polarity	`POS`

CHALLENGES

- For full understanding of aspect-based opinions, recognizing the dependency and correspondence between them is necessary
- It is not easy to find high quality and challenging datasets, corresponding to real-life scenarios
- ABSA consists of several components, developing a model tackling tchem at once is demanding
- The need for multimodal solution, not relying solely on opinionated text (e.g. when posting a review, users often attach photos)

SINGLE ABSA TASKS

Aspect Term Extraction (ATE) – determining explicits aspects on which opinions are presented. Depending on the availability of data, this is a supervised, semi-supervised or unsupervised technique

Aspect Category Detection (ACD) – assigning one of pre-determined categories to terms, formulated as multi-label classification or clustering problem

SINGLE ABSA TASKS

Opinion Term Extraction (OTE) – identifying opinion expressions towards an aspect, divided into two approaches:

- Aspect opinion co-extraction (AOCE) – predicting aspect and opinion terms together, modeling a dependency relations between them (e.g using dependency-tree based or attention-based models)
- Target-oriented opinion words extraction (TOWE) – extracting corresponding opinion terms given a specific aspect term

Aspect Sentiment Classification (ASC) – predicting the sentiment polarity of the given aspect in a sentence. Finding the answer to the question: how to exploit the connection between the aspect and the context to classify the sentiment?

COMPOUND ABSA TASKS

Tasks involving multiple sentiment elements are a prominent part of ABSA. Their goal is not solely the extraction of multiple elements, but rather coupling them and predicting in pairs, triplets, or even quads, which raises the necessity of developing a single integrated solution but approaches where results from single ABSA tasks are combined are also present.

COMPOUND ABSA TASKS

Aspect-Opinion Pair Extraction (AOPE) - Extracts pair of aspect and its corresponding opinion.
"*The pizza is delicious*"→(pizza, delicious)

End-to-End ABSA (E2E-ABSA) - Jointly extract aspect and its sentiment polarity.
"*The pizza is delicious*"→(pizza, positive)

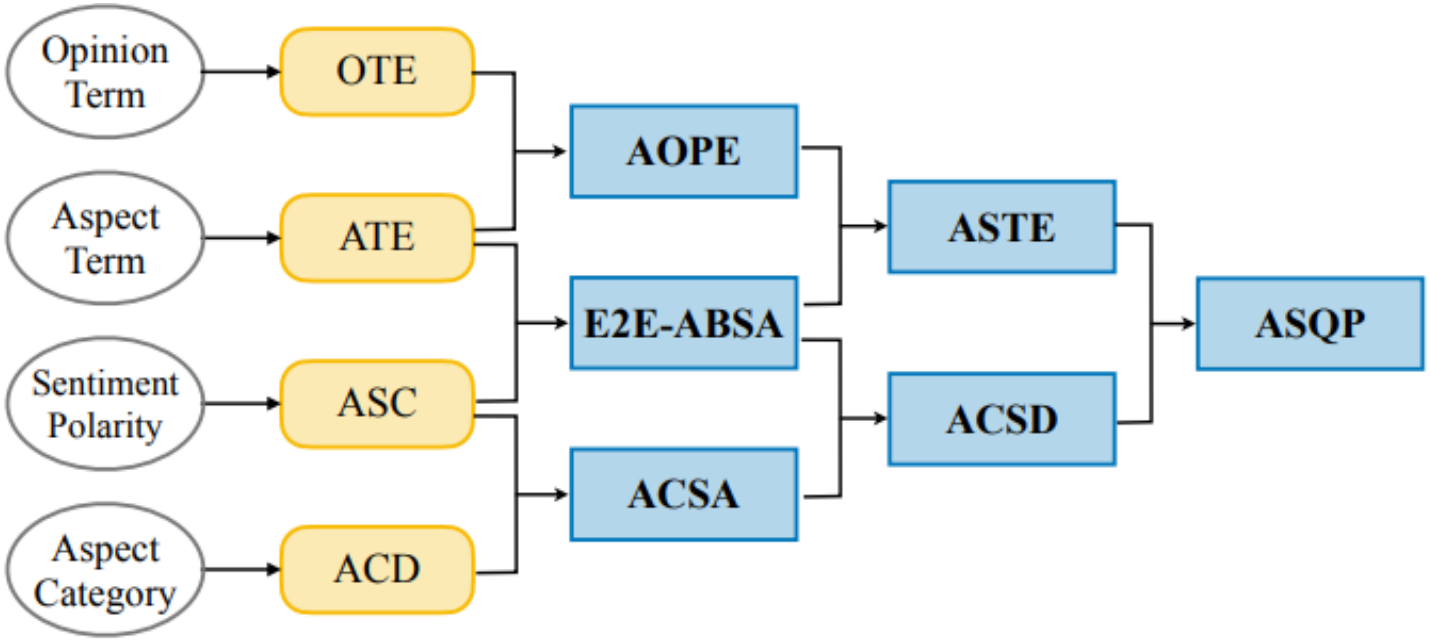
Aspect Sentiment Triplet Extraction (ASTE) - Extract triplets comprising aspects, opinion terms, and sentiment polarity.
"*The pizza is delicious but the service is terrible*"→(pizza, delicious, positive), (service, terrible, negative)

Aspect-Category-Sentiment Detection (ACSD) - Extract triplet comprising aspect category, aspect term, and sentiment polarity.
"*The pizza is delicious*"→(food, pizza, positive)

COMPOUND ABSA TASKS

Aspect Sentiment Quad Prediction (ASQP) - Predict all four sentiment elements—aspect category, aspect, sentiment polarity and opinion term.

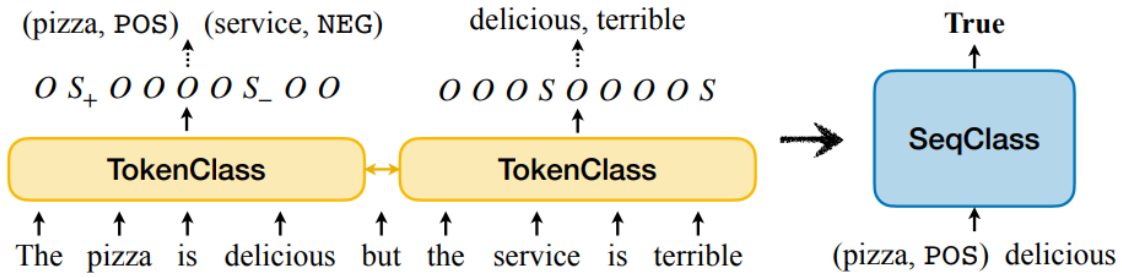
"*The pizza is delicious but the service is terrible.*"→(food, pizza, delicious, positive),
(service, service, terrible, negative)



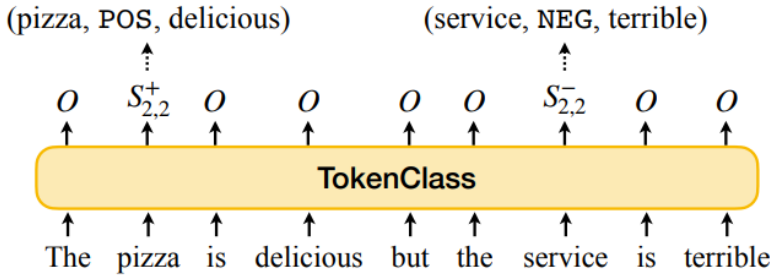
MODELLING PARADIGMS

- **Sequence-level classification** (SeqClass) - predict whole input text label, where input text might contain analyzed sentence and specific aspect. Usually the model feeds the input text into an encoder, and then a classifier is used for predictions.
- **Token-level classification** (TokenClass) - also called sequence labeling or sequence tagging. Assigns label to each token in the input text. Also firstly uses encoder, but then a decoder is used for predictions.
- **Machine reading comprehension** (MRC) - extracts continuous text spans from the input text conditioned on a given query (e.g. "What are the aspect terms?"). There are typically two classifiers used on top of the encoder.
- **Sequence-to-sequence** (Seq2Seq) - takes input sequence and aims to generate an output sequence (e.g. input: "The fish dish is fresh", output: "fish dish"). Used commonly in machine translation. Typically adopts encoder-decoder model.
- **Pipeline** - sequentially pipes multiple models to obtain the final result. Breaks the problem into smaller steps, e.g. in the task of finding which opinion is related to which aspect, one model is responsible for finding an aspect, and another is used for finding the corresponding opinion.

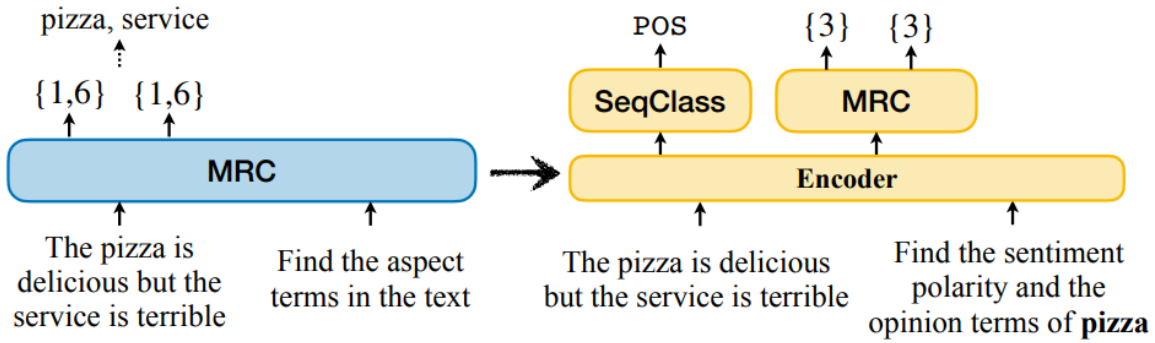
MODELLING PARADIGMS



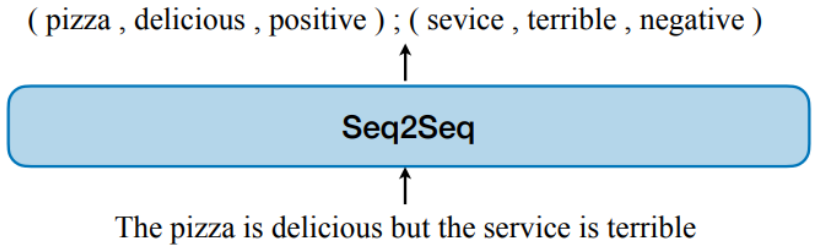
(a) pipeline



(b) TokenClass



(c) MRC (pipeline)



(d) Seq2Seq

PRE-TRAINED LANGUAGE MODELS FOR ABSA

Problem: Conventional neural ABSA models, coupled with pre-trained word embeddings (e.g. Word2Vec) hit a bottleneck due to the context-independence of embeddings and small size of existing ABSA datasets

Solution: Pre-trained Language Models (PLMs) (e.g. BERT, RoBERTa)

Approaches:

1. Train simple prediction layers on top of PLM.
2. Create auxillary sentences (e.g. in Targeted ABSA: „What do you think of [ASPECT] of [TARGET]?").
3. MRC paradigm, task is decomposed into query-answer processes to capture pairwise relationships.
4. Seq2Seq paradigm, transform the problem into a text-generation problem.
5. Use PLM embeddings in dependency trees.

FUTURE DIRECTIONS

- **Multimodal ABSA** - most ABSA research focuses on analyzing text-based opinions, like customer reviews or tweets. In reality though, people also share opinions using images, not just words. Since text and images are often connected, using both together can give a better understanding of what people actually think about different aspects.

- **Unified model for multiple tasks** - in ABSA research, many tasks are similar, and the ideas or models for one task can often be reused for another. It has also been found that knowledge from one task can help improve performance on other related tasks (called cross-task transfer) if they use the same setup.

- **Better datasets** – most of the datasets come from older competitions like SemEval and are usually pretty small (a few hundred sentences). It makes it hard to compare different models – as of now, models are trained several times on different seeds and the results are averaged. Bigger datasets would make comparison more reliable. There is also a need for more complex datasets, like multi-domain or multi-language datasets.

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