

NLP Applications - Assignment 2 – PS-7

(PART B)

Group 39

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Problem : Literature Survey (5 Marks)

Conduct a literature survey on the following topic to gain insights into the current state of research.

Topic : **Sentiment Analysis in Opinion Mining**

Sentiment Analysis in Opinion Mining

1. Field Studies (scope + definitions)

Opinion mining (often used interchangeably with **sentiment analysis**) focuses on automatically identifying and summarizing people's **opinions, attitudes, and emotions** expressed in text (reviews, tweets, forums, surveys, etc.).

A foundational reference is the monograph by **Pang & Lee (2008)**, which framed the task and highlighted why sentiment is different from topic classification (e.g., "good/bad" cues can be subtle and context dependent).

A second classic reference, **Bing Liu (2012)**, formalized opinion mining tasks and described sentiment analysis at multiple granularities (document/sentence/aspect levels).

2. Levels of sentiment analysis in opinion mining

Research typically organizes problems into these levels:

Document-level sentiment: classify an entire review/post as positive/negative/neutral.

Sentence-level sentiment: classify individual sentences (useful when a document mixes opinions).

Aspect-based sentiment analysis (ABSA): identify *what aspect* is mentioned (battery, service, price) and *what sentiment* is expressed toward each aspect. ABSA became a major research direction because many real reviews contain mixed opinions ("Camera is great but battery is terrible"). ABSA was standardized through shared tasks like **SemEval-2014 Task 4**, which defined datasets and evaluation for aspect extraction and aspect sentiment.

3. Methodological evolution (major research directions)

3.1 Lexicon/rule-based approaches (early + still useful)

Early systems relied on sentiment lexicons (positive/negative word lists), negation rules, intensifiers ("very"), and syntactic heuristics. They are:

- **Transparent and explainable**
- Useful in **low-data** situations

But they struggle with **domain shift** ("unpredictable plot" vs "unpredictable steering") and compositional language (sarcasm, contrast).

Foundational surveys emphasize these limitations and why simple word lists plateau in accuracy.

3.2 Traditional machine learning (2010s)

A large body of work used:

- **Bag-of-words / n-grams, TF-IDF**
- Classifiers: **Naive Bayes, SVM, Logistic Regression**

These approaches performed well on benchmark datasets but required careful feature engineering and had limited context understanding.

3.3 Deep learning (CNN/RNN era → representation learning)

Deep learning reduced manual feature engineering using:

- **Word embeddings** (Word2Vec/GloVe)
- **CNNs** for local patterns
- **RNN/LSTM/GRU** for sequence modeling

This era improved sentence/document sentiment and enabled better modeling of composition and context.

A key example dataset for compositional sentiment is the **Stanford Sentiment Treebank (SST)**, introduced with a recursive model to capture phrase-level sentiment composition.

3.4 Transformers and pre-trained language models (current dominant paradigm)

Transformers and pre-training (e.g., **BERT**) became dominant because fine-tuning large pre-trained models substantially improves sentiment classification across tasks with less feature engineering.

In ABSA specifically, recent research heavily focuses on transformer-based models, often incorporating:

- syntax graphs / attention mechanisms,
- domain adaptation strategies,
- explainability methods.

Recent ABSA surveys and systematic reviews document taxonomies of ABSA subtasks and trends (e.g., aspect extraction, aspect category, aspect sentiment, opinion term extraction, end-to-end ABSA).

4. Aspect-Based Sentiment Analysis (ABSA): why it's central to opinion mining now

ABSA is often treated as the “opinion mining-ready” form of sentiment analysis because it supports actionable insights:

- “Service: negative; Food: positive; Price: neutral”

This matches how organizations consume feedback.

SemEval ABSA tasks (and later datasets) helped standardize evaluation and accelerated research.

Recent systematic reviews (e.g., 2024) map how ABSA methods evolved and how solution paradigms and datasets vary across domains.

5. Datasets and benchmarks frequently used

Common benchmarks include:

- **IMDb Large Movie Review Dataset** (binary sentiment, 25k train/25k test)
- **Stanford Sentiment Treebank (SST)** (fine-grained + compositional sentiment)
- **SemEval ABSA datasets** (aspect-level polarity and extraction tasks)

6. Key challenges highlighted across the literature

1. **Domain adaptation / domain shift**: sentiment words change meaning across domains.
2. **Negation, intensifiers, contrast**: “not bad”, “good but overpriced”.
3. **Sarcasm and irony**: major source of errors; often studied jointly with sentiment.
4. **Fine-grained sentiment**: ABSA requires identifying targets/aspects + sentiment jointly.
5. **Multimodal opinion mining**: opinions expressed via text + images/video/audio (e.g., product photos + captions). Surveys show this is growing and uses fusion architectures.
6. **Explainability and trust**: organizations often need to justify predictions; recent work investigates explainability for transformer-based ABSA.

7. Emerging trend: using Large Language Models (LLMs)

Newer work explores LLMs for sentiment tasks via:

- prompting / instruction following,
- few-shot sentiment classification,
- combining sentiment with summarization/topic extraction.

Broader LLM surveys and evaluation papers note LLMs' strong performance on text classification tasks (including sentiment), while emphasizing ongoing evaluation challenges (robustness, bias, consistency).

Applied studies also explore LLMs for sentiment in practical settings like customer satisfaction survey analysis.

8. Research gaps and future directions (good “survey conclusion” points)

- **Robustness**: handling sarcasm, code-mixed language, and adversarial phrasing consistently.
- **Generalization across domains**: training on reviews but deploying on social media/enterprise tickets.
- **Fine-grained + structured outputs**: moving from polarity labels to aspect-opinion-sentiment tuples and explanations (ABSA and beyond).
- **Multimodal sentiment**: integrating text with images/audio/video for richer opinion mining.
- **Explainability**: faithful rationales, attention reliability, and user-facing interpretability.
- **LLM governance**: evaluation standards and safety/quality concerns when LLMs are used as sentiment engines.

9. Short reference list (starter set you can cite in your assignment)

- Pang, B., & Lee, L. (2008). *Opinion Mining and Sentiment Analysis*.
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