



Department of Computer Science & Engineering  
IIT Indore

# Aspect Based Sentiment Analysis using Deep Learning Techniques

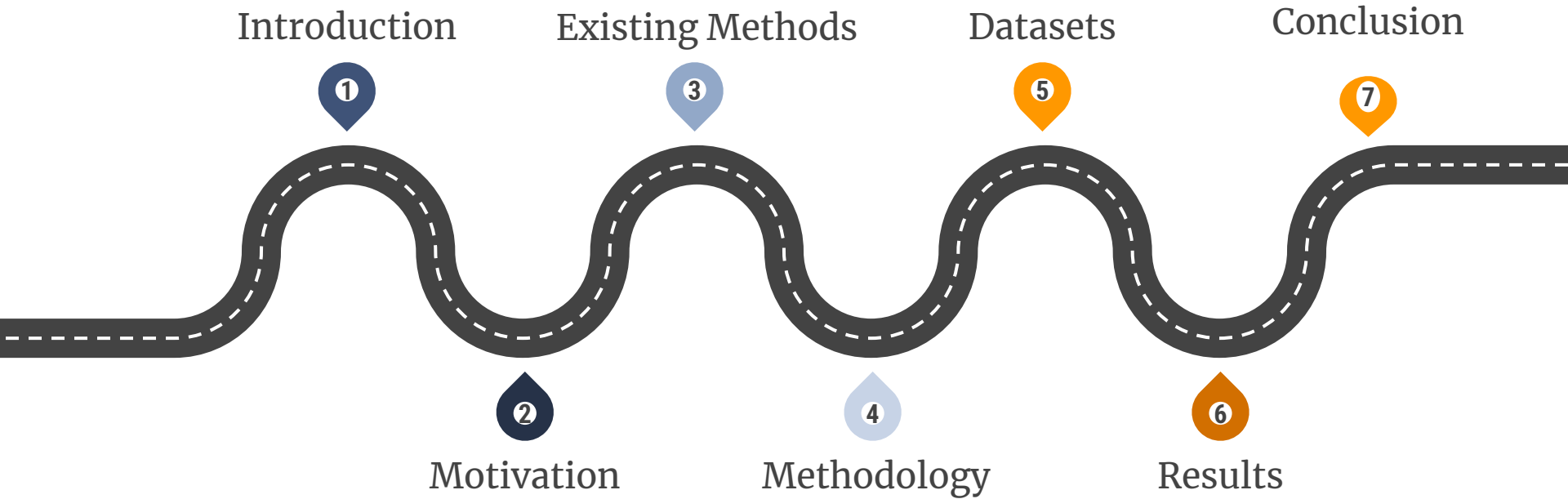
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# Roadmap



# 1

## Introduction

What is Aspect Based Sentiment Analysis?

# Aspect Based Sentiment Analysis

- ❑ Natural language processing task
- ❑ A fine-grained sentiment analysis
- ❑ **Identify** and **extract** the sentiment of specific aspect
- ❑ Categorizes data by aspect and identifies the sentiment attributed to each one



Figure 1: Levels of Sentiment Analysis<sup>[1]</sup>

# Key components of ABSA System

It mainly consists of two key components:

- ❑ **Aspect Term Extractor**
  - ❑ Similar to Named Entity Recognition (NER)
  - ❑ **Goal:** Identify aspect terms in the text
  - ❑ **Input Format:** Tokenized text with IOB labels
  
- ❑ **Aspect Polarity Classification**
  - ❑ **Goal:** Determine sentiment for each aspect (positive/negative/neutral)
  - ❑ **Input Format:** Tokenized text with identified aspect terms

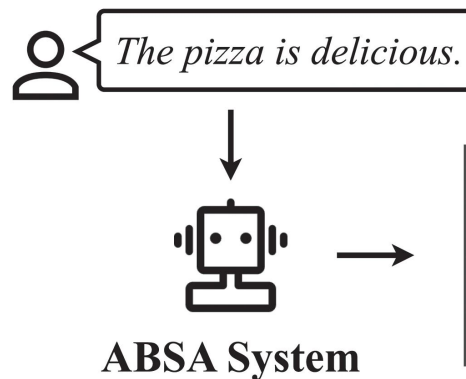


Figure 2: Aspect Based Sentiment Analysis (ABSA) System<sup>[2]</sup>

# 2

## Motivation

Importance of Aspect Based Sentiment Analysis

# Why Aspect-Based Sentiment Analysis ?

## ❑ Beyond Traditional Sentiment Analysis

- ❑ ABSA focuses on these finer details, giving a more nuanced view of opinions

## ❑ Capturing Specific Insights for Better Decisions

- ❑ ABSA helps differentiate between an overall positive review and the individual aspects that may still need improvement

## ❑ Applications that Drive Real-World Impact

- ❑ Examples: Customer Satisfaction Monitoring, Competitive Analysis, Employee Feedback Analysis

### Ratings & Reviews

Rate Product

4.3 ★

129 Ratings &  
18 Reviews

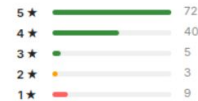


Figure 3: Laptop Ratings by Aspect and Overall Score<sup>[3]</sup>

# 3

## Existing Methods

Literature Review



# Literature Review

S.No.	Title	Publication	Remarks
1.	Aspect-based sentiment analysis using smart government review data[1]	Applied Computing and Informatics, 2024	Aspect-based sentiment analysis using lexicon and rule-based models improves feedback understanding, highlighting areas for government app enhancement and innovation
2.	WordTransABSA: enhancing Aspect-based Sentiment Analysis with masked language modeling for affective token prediction[2]	Expert Systems with Applications, 2024	WordTransABSA leverages PLM fine-tuning for ABSA by converting masked LM tasks to sentiment-polarity prediction, improving performance in data-limited scenarios.
3.	Atlantis: Aesthetic-oriented multiple granularities fusion network for joint multimodal aspect-based sentiment analysis[3]	Information Fusion, 2024	Atlantis is a trident framework for joint multimodal sentiment analysis, combining textual-vision alignment, sentiment-aware aesthetics, and multi-granular fusion

Table 1: Literature Survey

# Literature Review

S.No.	Title	Publication	Remarks
4.	Adversarial training for aspect-based sentiment analysis with bert[7]	International conference on pattern recognition (ICPR) IEEE, 2021	Adversarial training improves BERT performance in aspect extraction and sentiment classification, with future work exploring other adversarial examples
5.	Enhancing BERT Representation With Context-Aware Embedding for Aspect-Based Sentiment Analysis[8]	IEEE Access, 2020	GBCN uses gating and context-aware embeddings for improved (T)ABSA, outperforming other models, with future work on other sentiment tasks
6.	Adapt or Get Left Behind: Domain Adaptation through BERT Language Model Finetuning for Aspect-Target Sentiment Classification[9]	Language Resources and Evaluation, 2020	Fine-tuned domain-specific BERT models achieve state-of-the-art performance on Aspect-Target Sentiment Classification, transferring effectively across domains

Table 1: Literature Survey (cont.)

# 4

## Methodology

Steps Involved

# Proposed Methodology

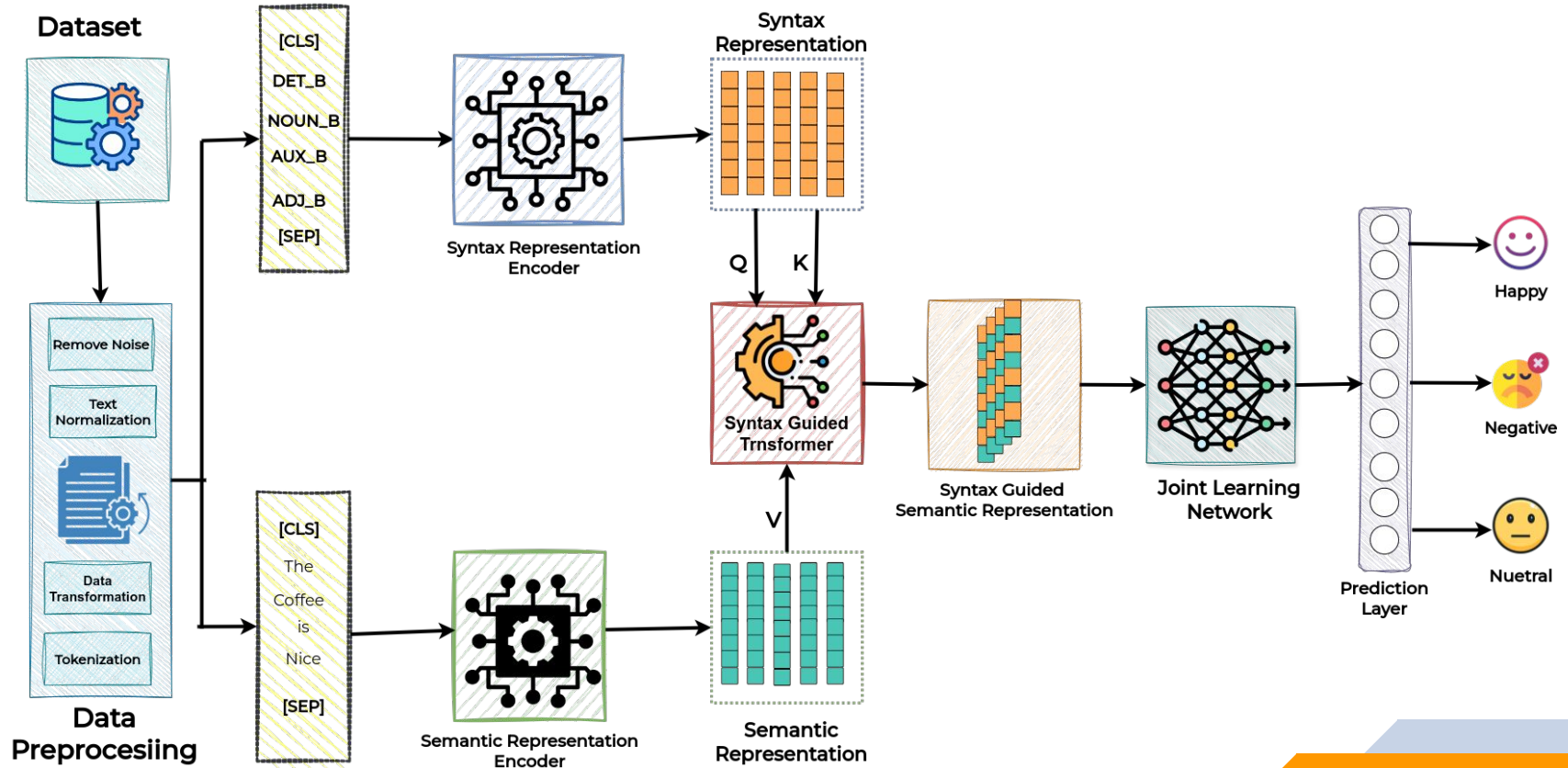


Figure 4: Number of Labels for each Category of the Restaurant Dataset

# Steps Involved

- ❑ **Data Preprocessing**
  - ❑ Clean and tokenize the text, normalizing it for analysis
- ❑ **Syntax representation encoder**
  - ❑ Basic syntax-aware layer (using POS labels and relative token distances)
- ❑ **Semantic representation encoder**
  - ❑ BERT generates the semantic representation from the tokenized sequence of text
- ❑ **Syntax-guided transformer**
  - ❑ Syntax-guided transformer uses syntax for Query and Key, and semantic representation for Value to compute attention
  - ❑ Combines syntax and semantic representations to generate syntax-guided semantic vectors
- ❑ **Syntax Guided Semantic Representation**
  - ❑ The aspect-based representation is obtained by concatenating syntax-guided and semantic-based aspect-aware representations
- ❑ **Joint Learning and Prediction**
  - ❑ Combines syntax-guided and semantic-based representations to output sentiment classifications as positive, negative, or neutral

# 5

## Dataset

*Analysis of Data*

# Dataset

- ❑ In order to train and test our models we use a dataset containing restaurant and laptop reviews
- ❑ Taken from a **preprocessed version of the SemEval-2014 ABSA Task**
- ❑ Data are organized in a csv file, with the following columns:
  - ❑ **Tokens:** tokenized sentence
  - ❑ **Tags:** list of tags associated to each token: '0' for non-aspect terms, '1' for beginning of terms and '2' for marks of terms
  - ❑ **Polarities:** list of polarities associated to each token: '0' for negative, '1' for neutral and '2' for positive and '-1' for non-aspect term

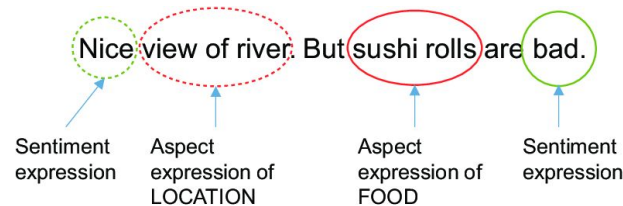


Figure 4: Raw Data sample

# Dataset Distribution

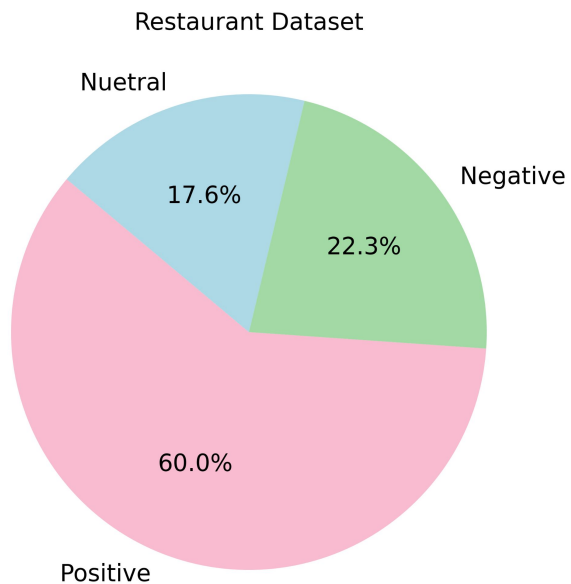


Figure 5: Number of Labels for each Category of the Restaurant Dataset

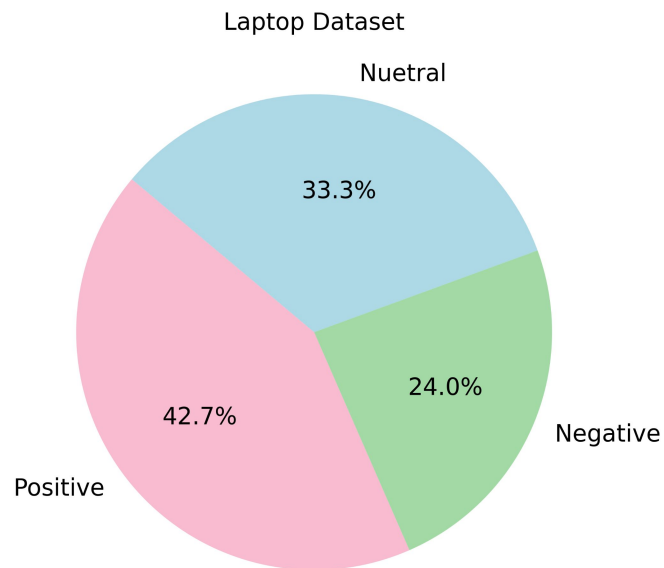


Figure 6: Number of Labels for each Category of the Laptop Dataset



# 6

## Results

### Effectiveness Comparison

# Effectiveness Comparison

S. No.	Methods	Dataset 1 (restaurant)		Dataset 2 (laptop)	
		Accuracy (%)	F1-Score (%)	Accuracy (%)	F1-Score (%)
1.	ATT-CNN	68.19	60.35	62.11	58.64
2.	ATT-LSTM	76.60	69.34	68.90	65.26
3.	ATAE-LSTM	77.20	69.86	68.70	65.43
4.	ASGCN	80.77	72.02	75.55	71.05
5.	BERT-BASE	85.97	81.72	79.72	76.91
6.	Proposed Method	86.21	83.22	82.29	78.68

Table 3 : Effectiveness Comparison on Dataset

7

## Conclusion

# Conclusion

- ❑ **ABSA as a Growing Research Area**
  - ❑ Increasingly popular in NLP research
  - ❑ Promising results achieved using advanced ML and DL algorithms
- ❑ **Methodology used**
  - ❑ Text Preprocessing
  - ❑ Attention-Based Models for contextual understanding
  - ❑ Sentiment analysis
- ❑ **Applications of ABSA**
  - ❑ Analyzing Customer Feedback on Product/Service Reviews and providing Customer Support
  - ❑ Market research and analysis
  - ❑ Social Media Monitoring

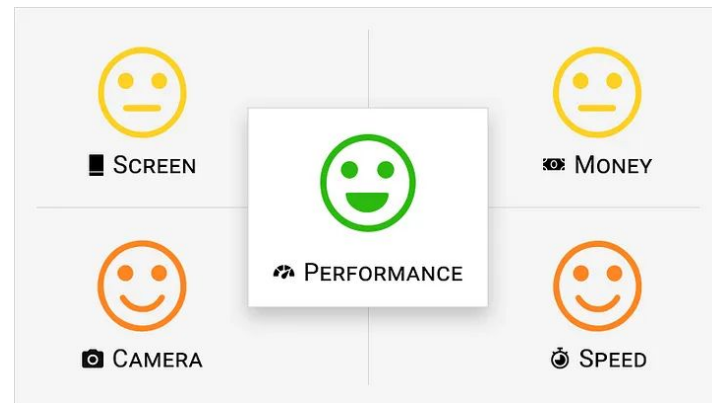


Figure 7: Aspect-Based Sentiment Analysis: Positive sentiment detected for Performance, while Screen, Camera, Speed, and Cost exhibit neutral to moderately positive sentiment<sup>[4]</sup>

[4] [https://miro.medium.com/v2/resize:fit:4800/format:webp/1\\*LzCclw8nHK\\_3YputAXzoA.jpeg](https://miro.medium.com/v2/resize:fit:4800/format:webp/1*LzCclw8nHK_3YputAXzoA.jpeg)

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- [1] Alqaryouti, Omar, et al. “Aspect-based sentiment analysis using smart government review data.”, Applied Computing and Informatics, 2024.
- [2] Jin, Weiqiang, et al. “WordTransABSA: enhancing Aspect-based Sentiment Analysis with masked language modeling for affective token prediction.”, Expert Systems with Applications 238, 2024.
- [3] Xiao, Luwei, et al. “Atlantis: Aesthetic-oriented multiple granularities fusion network for joint multimodal aspect-based sentiment analysis.” Information Fusion 106, 2024.
- [4] Y. Bie and Y. Yang, “A multitask multiview neural network forend-to-end aspect-based sentiment analysis,” in Big Data Mining and Analytics, 2021.
- [5] Yang, Heng, et al. “A multi-task learning model for chinese-oriented aspect polarity classification and aspect term extraction.” Neurocomputing 419, 2021.

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- [6] Karimi, Akbar, Leonardo Rossi, and Andrea Prati. “Adversarial training for aspect-based sentiment analysis with bert.” 25th international conference on pattern recognition (ICPR). IEEE, 2021.
- [7] J. Ma, X. Cai, D. Wei, H. Cao, J. Liu, and X. Zhuang, “Aspect-Based Attention LSTM for Aspect-Level Sentiment Analysis,” 2021 3rd World Symposium on Artificial Intelligence (WSAI), Guangzhou, China, 2021.
- [8] X. Li et al., “Enhancing BERT Representation With Context-Aware Embedding for Aspect-Based Sentiment Analysis” in IEEE Access, 2020.
- [9] Rietzler A, Stabinger S, Opitz P, Engl S. “Adapt or Get Left Behind: Domain Adaptation through BERT Language Model Finetuning for Aspect-Target Sentiment Classification.”, Language Resources and Evaluation, 2020.



# Thank you!

