

# A GENERIC FRAMEWORK FOR ASPECT-BASED SENTIMENT ANALYSIS

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Department of Industrial Engineering

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# The growth in user-generated data



456 000

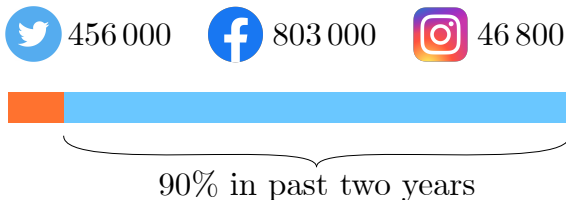


803 000

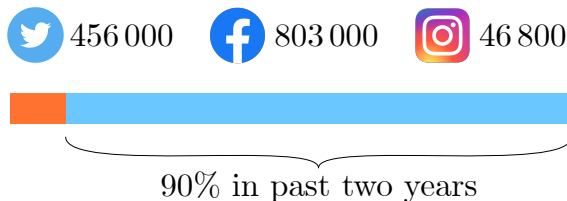


46 800

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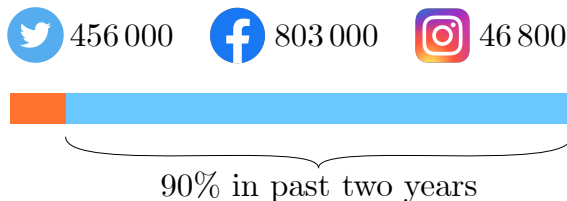


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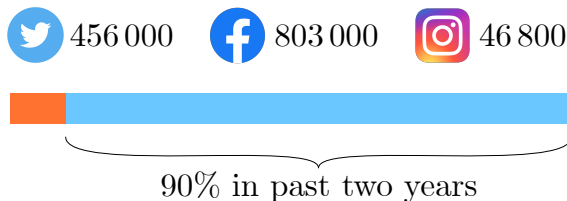
- contain much potential value

# The growth in user-generated data



- contain much potential value
- mostly *unstructured*

# The growth in user-generated data



- contain much potential value
- mostly *unstructured*
- too much to analyse manually

# A solution: Sentiment analysis

## Definition — Sentiment analysis

Form of *text analysis* that:

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- falls within broader scope of natural language processing, computational linguistics, and text mining



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Form of *text analysis* that:

- falls within broader scope of natural language processing, computational linguistics, and text mining
- computationally identifies *polarity* of a *sentiment* expressed by a writer in a given portion of text.

# Levels of sentiment analysis

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“The ice-cream was absolutely delicious! Unfortunately the service was very slow, but at least the music was good :)”

# Levels of sentiment analysis

“The ice-cream was absolutely **delicious!** Unfortunately the service was very **slow**, but at least the music was **good** :)”

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“The ice-cream was absolutely **delicious!** Unfortunately the service was very **slow**, but at least the music was **good** :)”



**Positive**

# Levels of sentiment analysis

“The ice-cream was absolutely **delicious!** Unfortunately the service was very **slow**, but at least the music was **good** :)”



**Positive**

*Document-level sentiment analysis*

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# Levels of sentiment analysis

“The ice-cream was absolutely **delicious!**” → **Positive**

“Unfortunately the service was very **slow**, but at least the music was **good** :)”



**Negative**

# Levels of sentiment analysis

“The ice-cream was absolutely **delicious!**” → **Positive**

“Unfortunately the service was very **slow**, but at least the music was **good** :)”



**Negative**

*Sentence-level sentiment analysis*

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*{ice-cream: Positive,  
service: Negative,  
music: Positive}*

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*Aspect-based sentiment analysis*

# Agenda



- Terminology & the tasks of ABSA

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- Contextualisation within the literature

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- High-level framework overview

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- Summary & conclusion

Review of Lienke's Ice-cream Shop:

“The ice-cream was absolutely delicious! Unfortunately the service was very slow, but at least the music was good :)”

*entity*

Review of **Lienke's Ice-cream Shop:**

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*entity*

Review of Lienke's Ice-cream Shop:

“The ice-cream was absolutely delicious! Unfortunately the service was very slow, but at least the music was good :)”

*aspect expression*

*entity*

Review of Lienke's Ice-cream Shop:

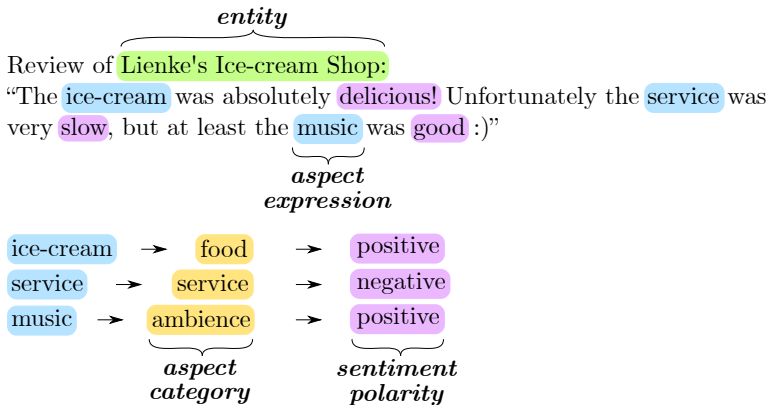
"The ice-cream was absolutely delicious! Unfortunately the service was very slow, but at least the music was good :)"

*aspect expression*

ice-cream → food

service → service

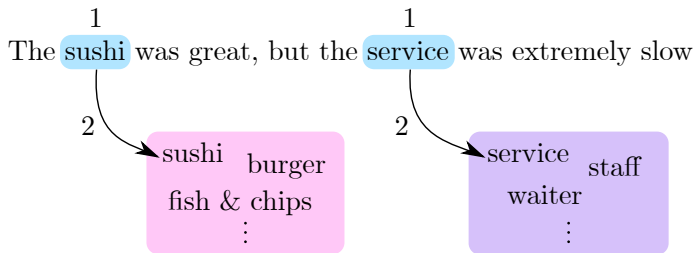
music → *aspect category*



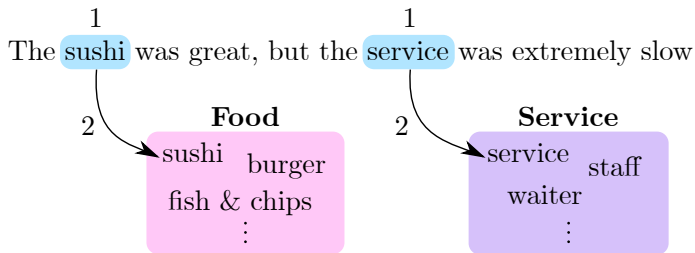
The sushi was great, but the service was extremely slow

The <sup>1</sup>sushi was great, but the <sup>1</sup>service was extremely slow

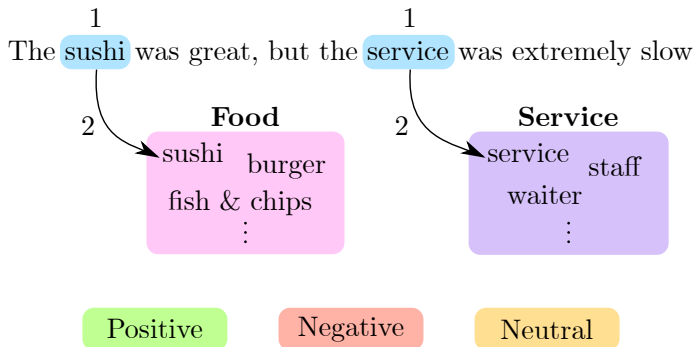
# The tasks



# The tasks

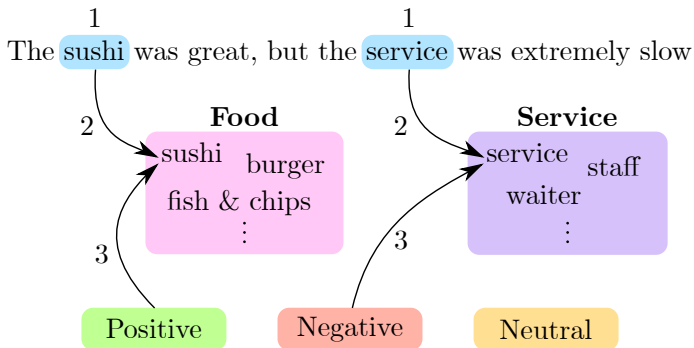


# The tasks





# The tasks



The sushi was great, but the service was extremely slow

The sushi was great, but the service was extremely slow

Food

Ambience

Service

# The tasks

The sushi was great, but the service was extremely slow

Food

Ambience

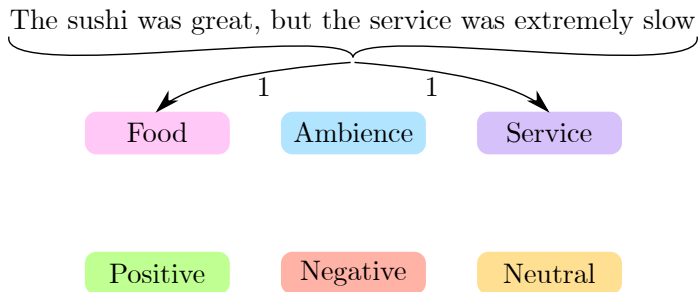
Service

Positive

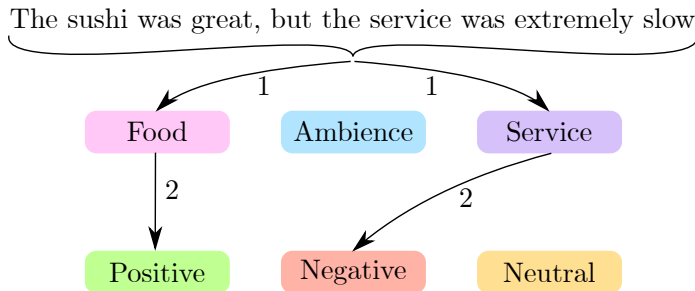
Negative

Neutral

# The tasks



# The tasks



# Contextualisation within the literature

Shortcomings of current approaches:



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- Focus on a *subset of the tasks*
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- Quantity and complexity of the literature form a *barrier-to-entry*

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- guide the entire development process
- afford flexibility to configure as desired
- provide guidance on the analysis of model results.

## Secondary aim

Implement the proposed framework in the form of a computer program, and apply it to a variety of data sets in order to demonstrate its working.

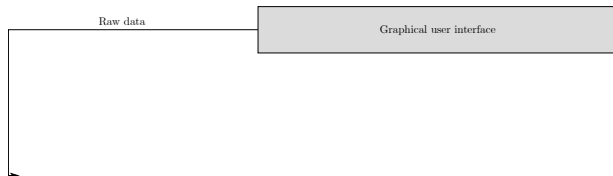
# High-level framework

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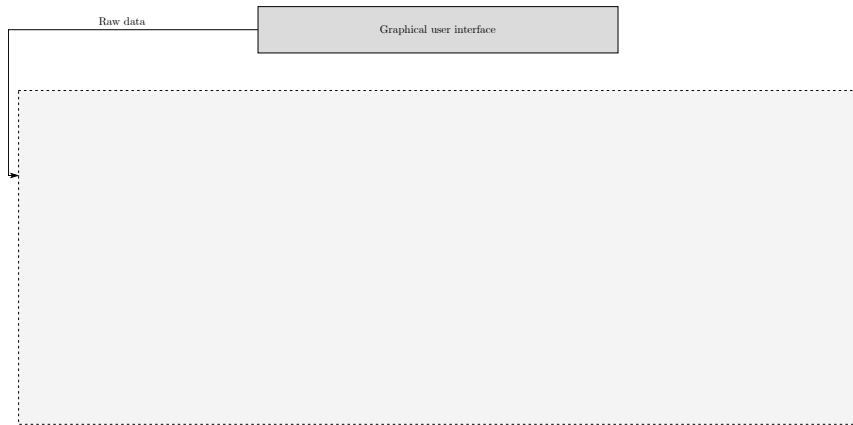


Graphical user interface

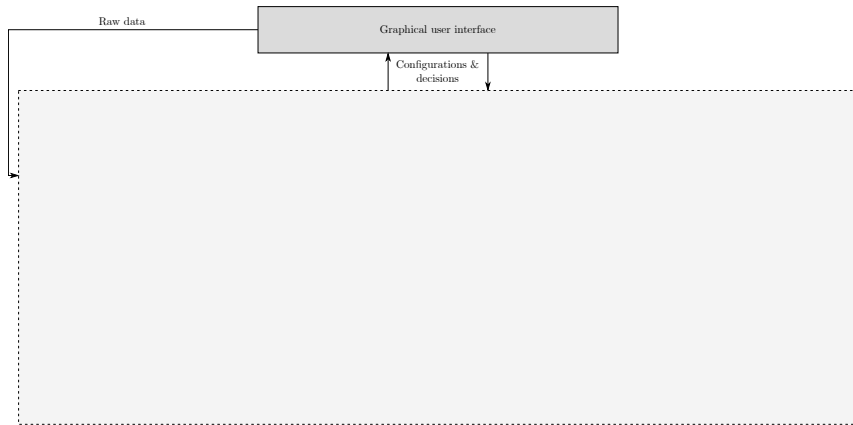
# High-level framework



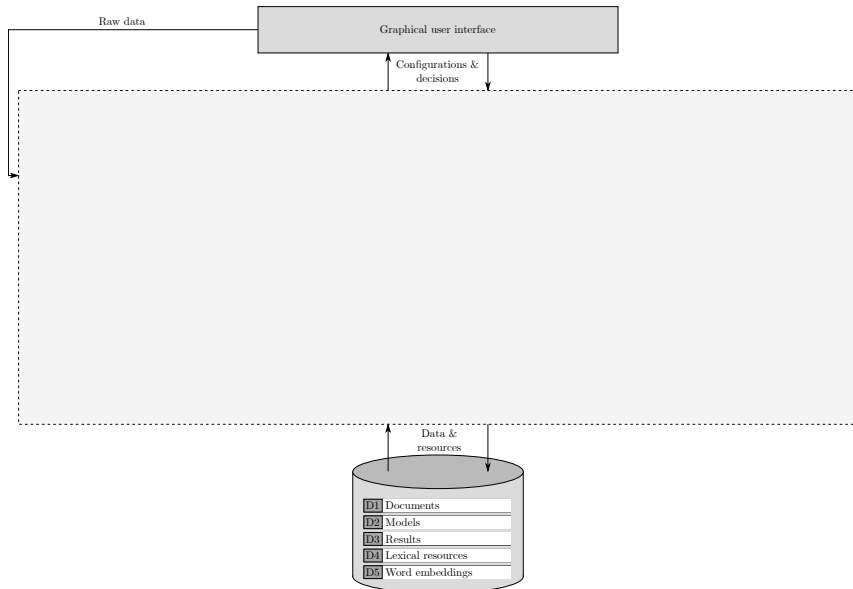
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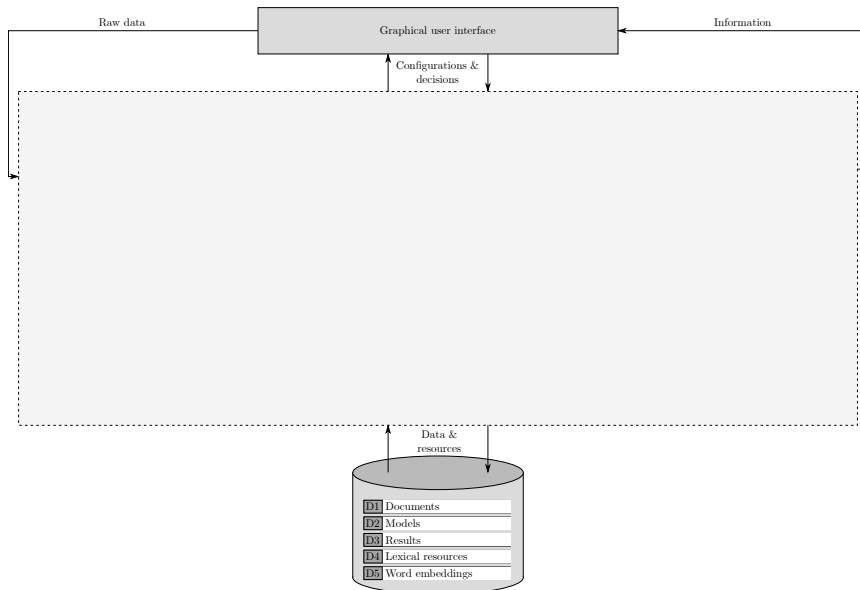


# High-level framework

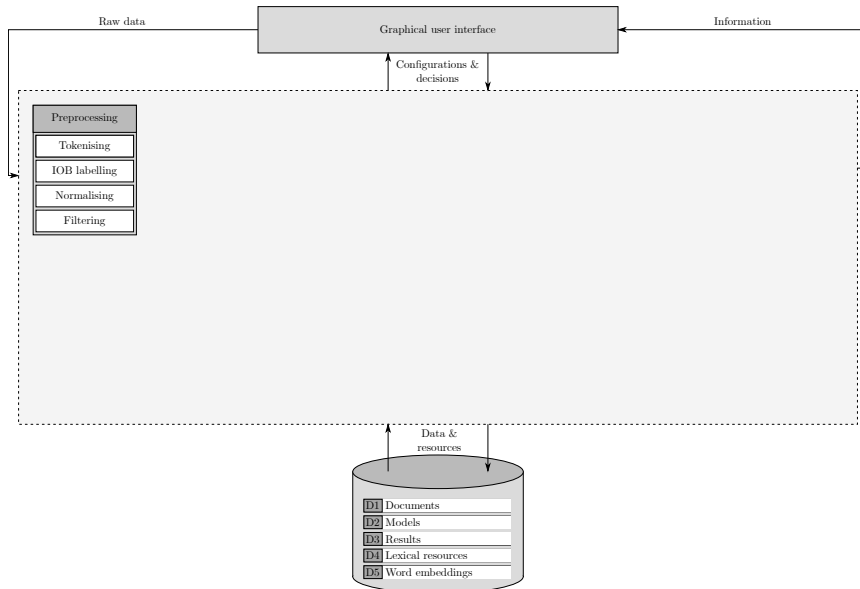




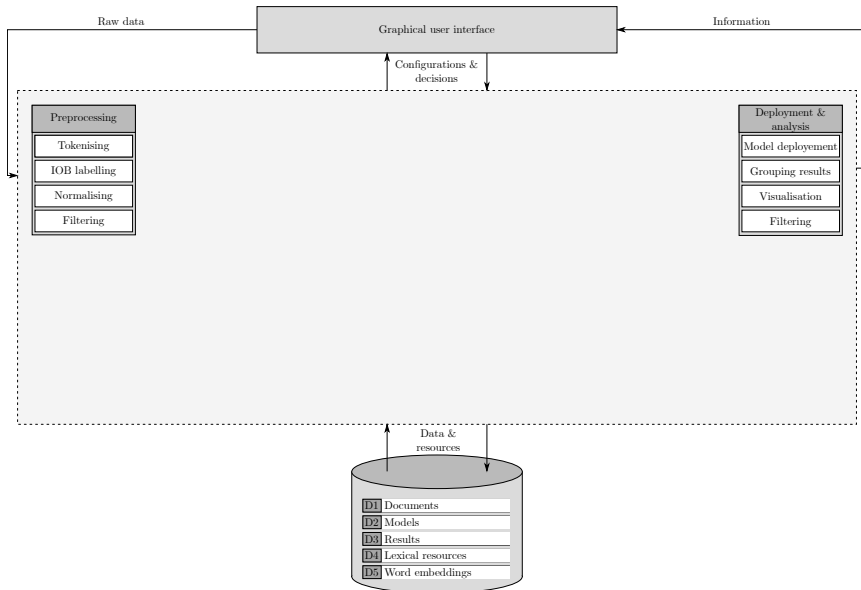
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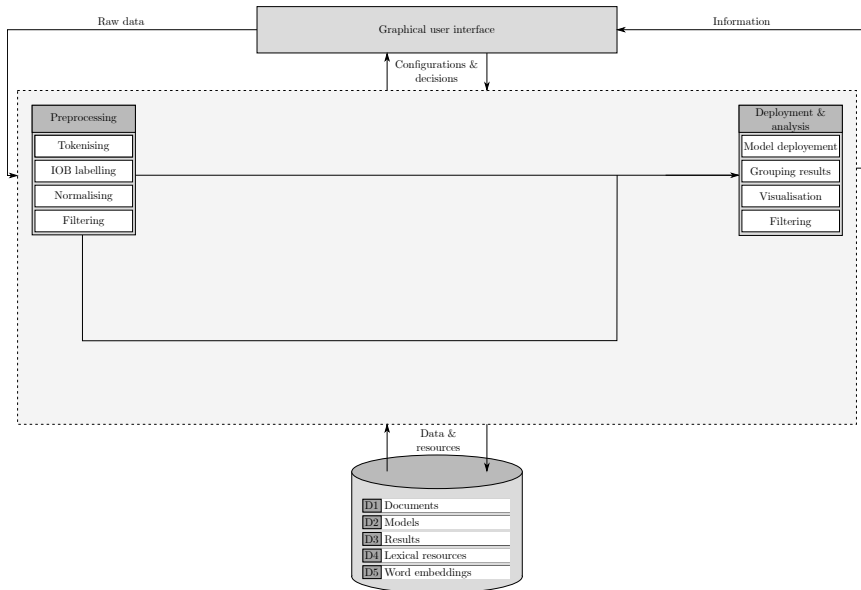
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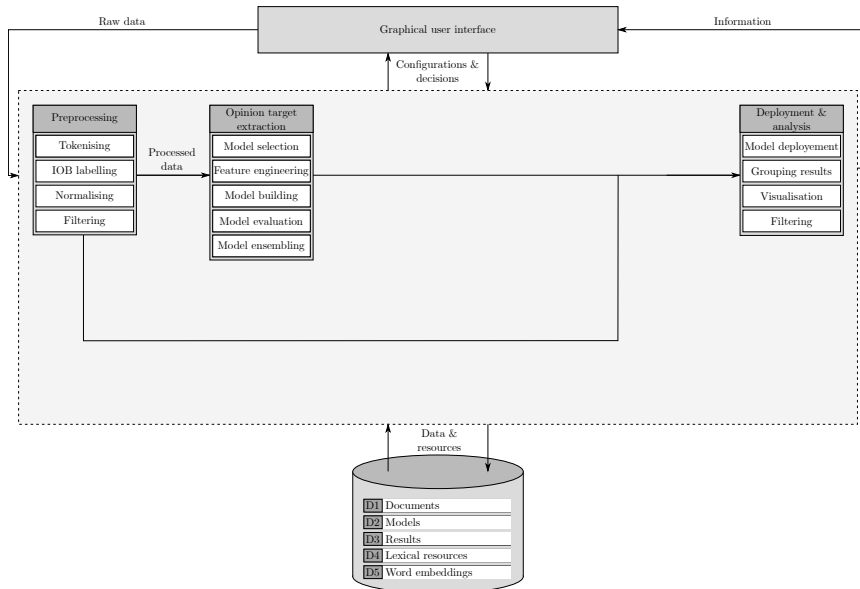
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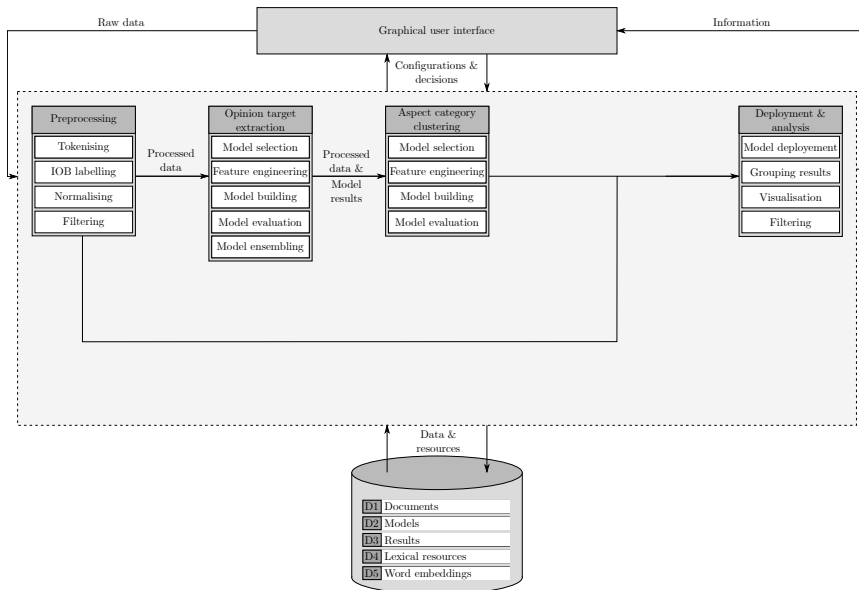
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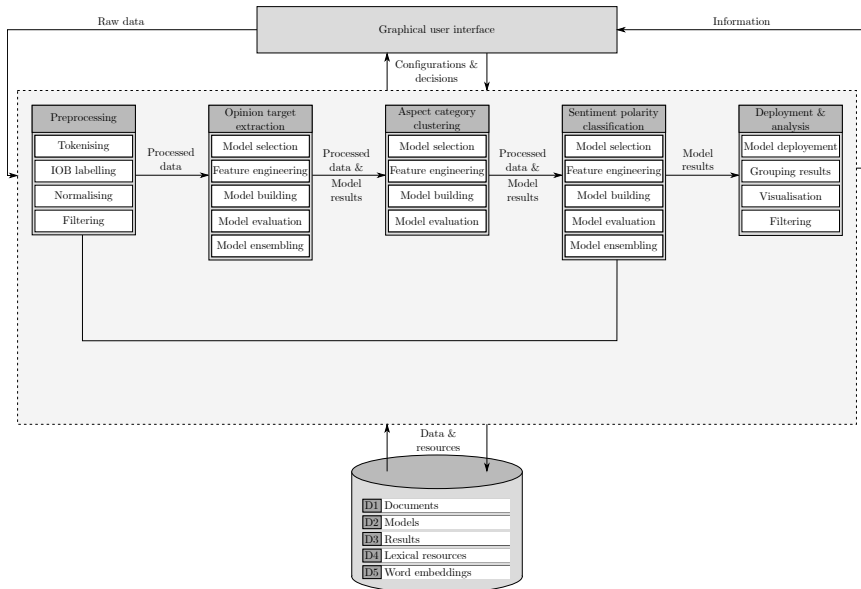
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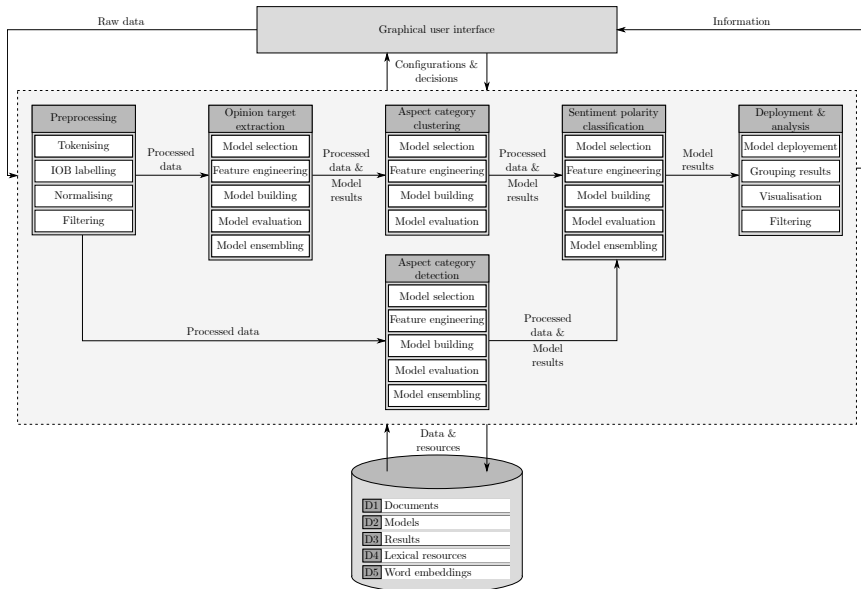
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## First stream

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## Second stream

## First stream

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## Second stream

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## Second stream

- No aspect expression labels
- Predefined aspect categories

## First stream

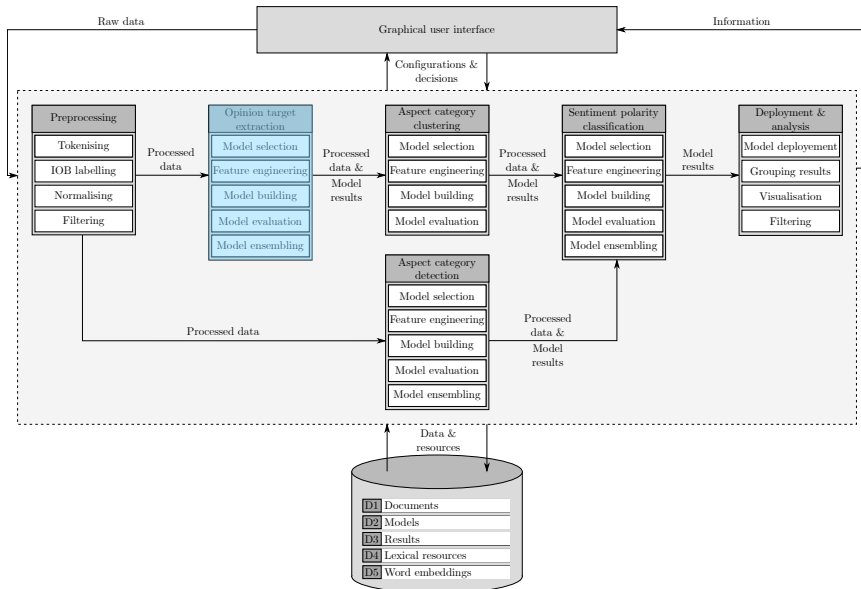
- Have aspect expression labels
- Free discovery of aspect categories
- Highest level of granularity

## Second stream

- No aspect expression labels
- Predefined aspect categories
- Slightly lower level of granularity



# High-level framework



# Opinion target extraction model development

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**Aspect expressions:** {view, room service}

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The	view	was	great,	but	the	room	service	was	slow.
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*Sequence labelling problem*

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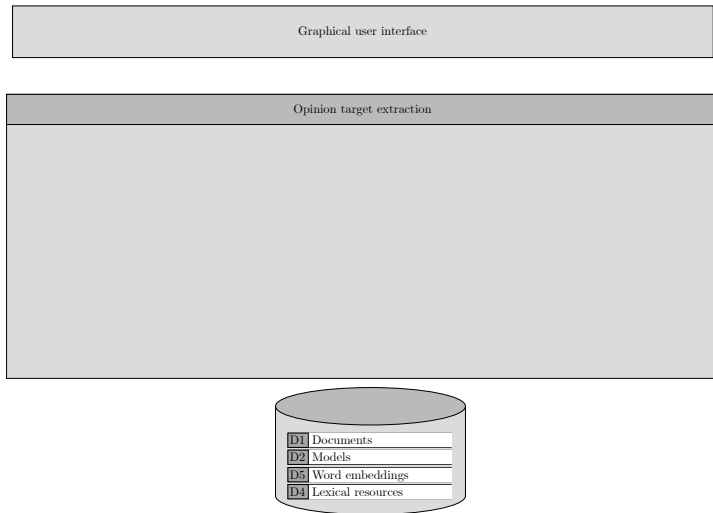
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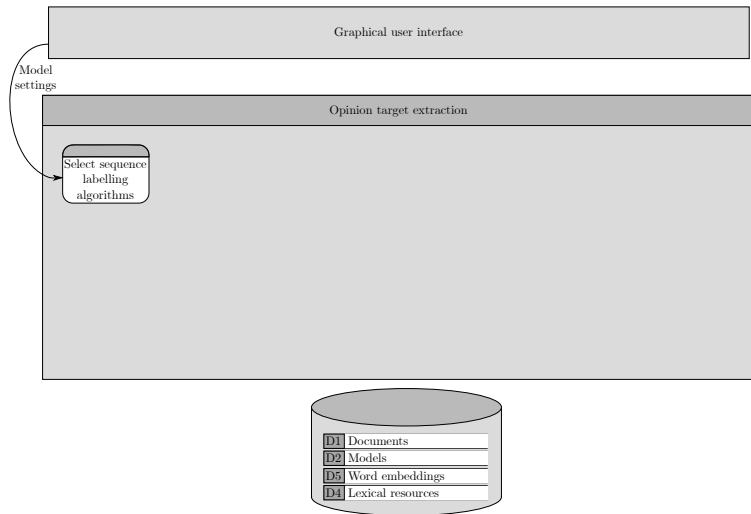
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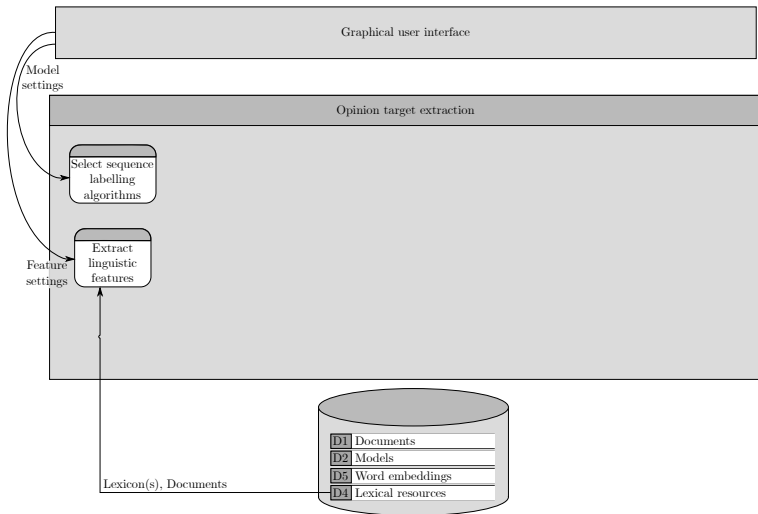
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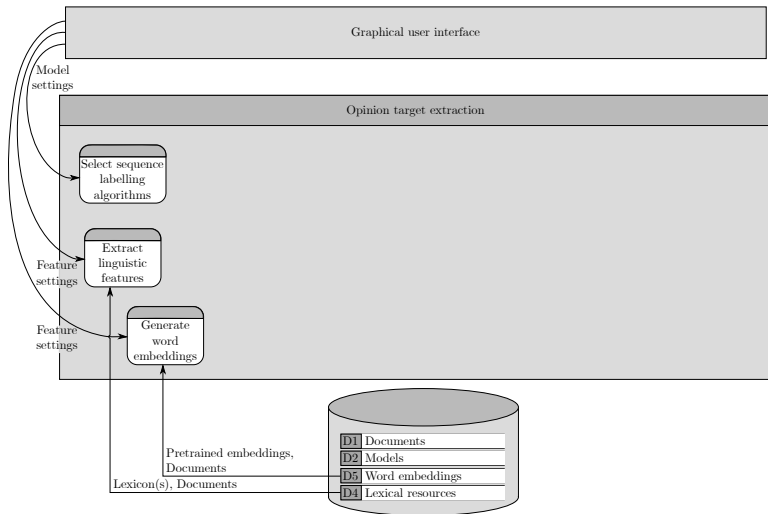
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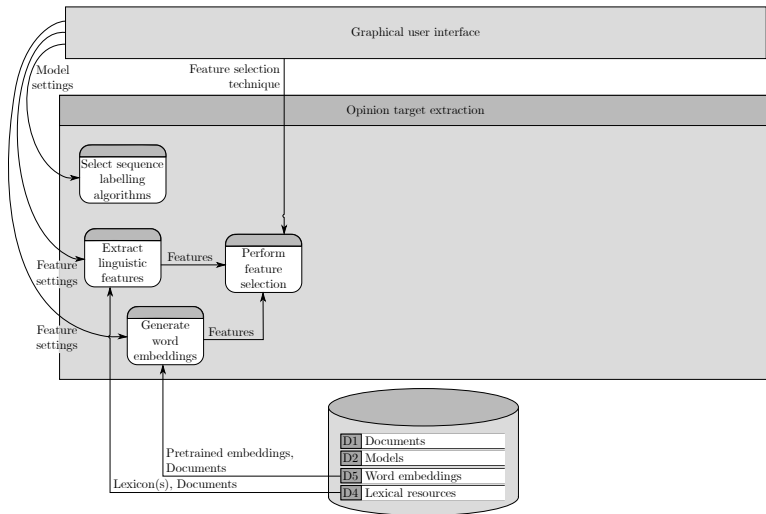


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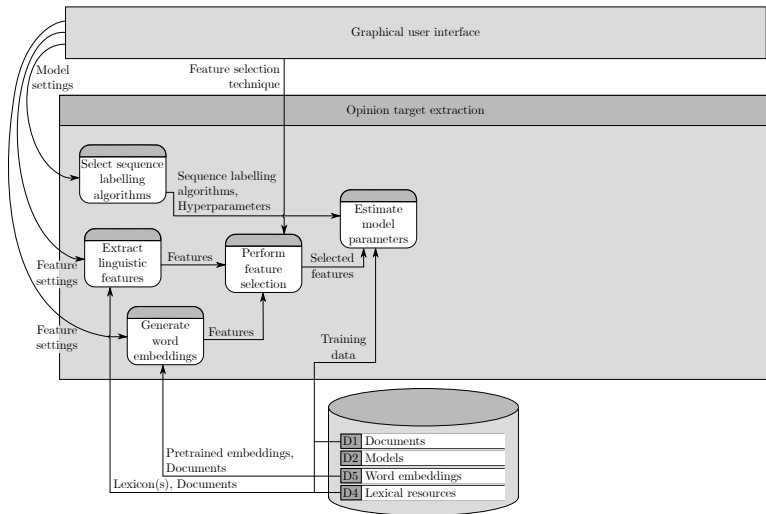




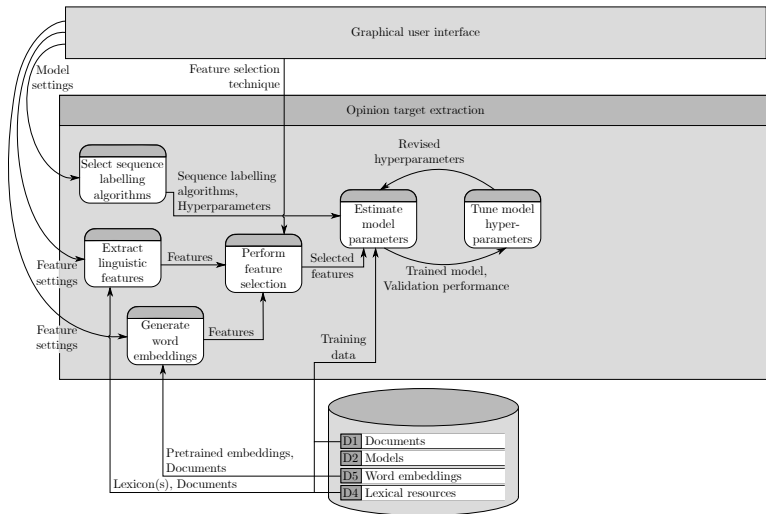
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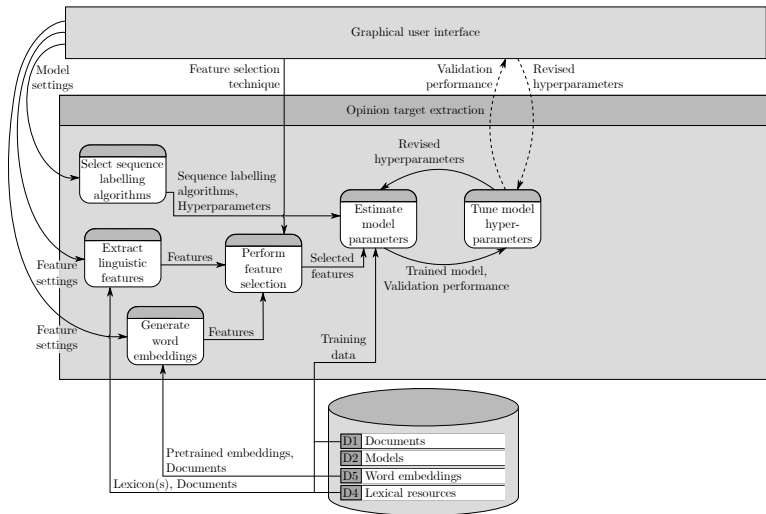
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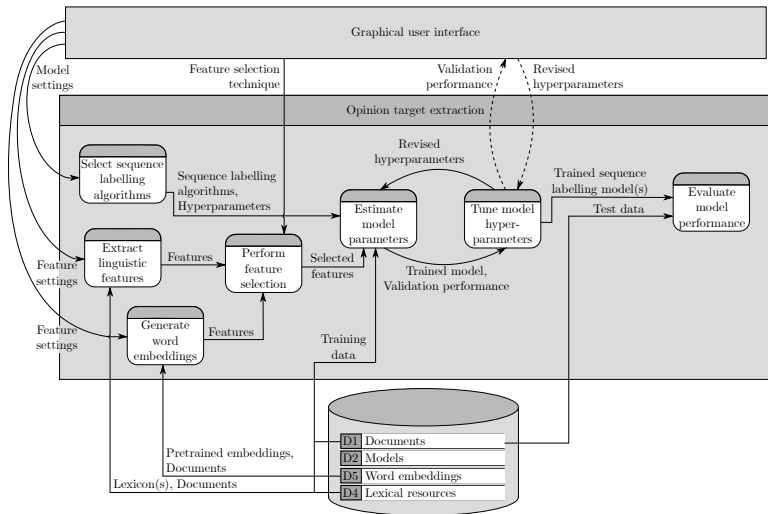
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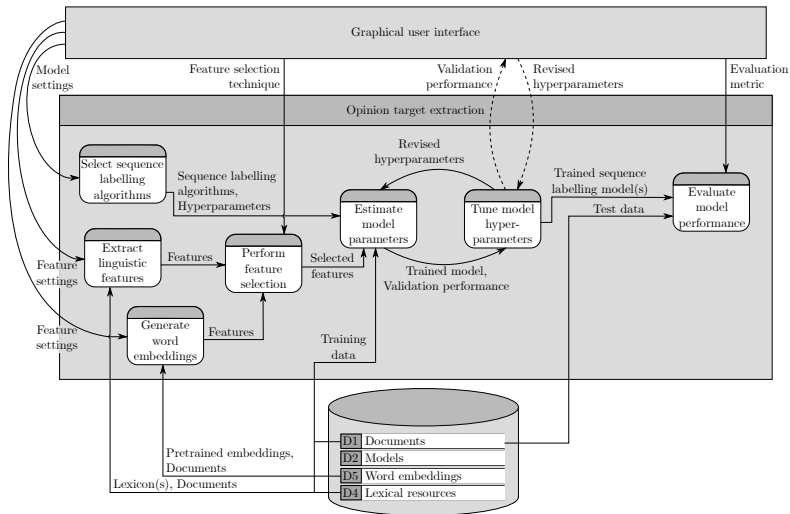
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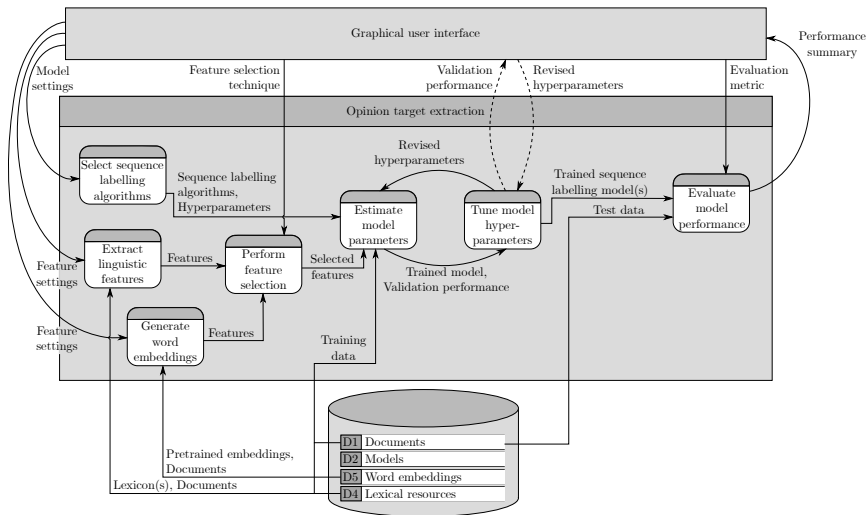
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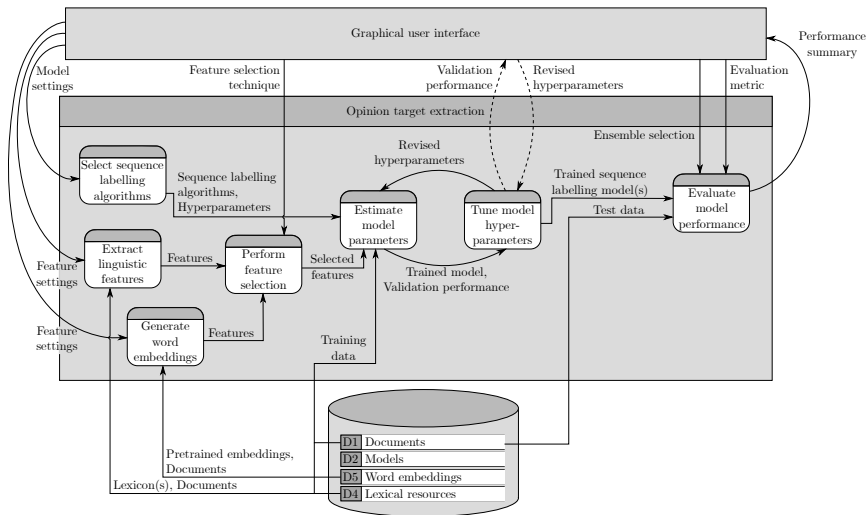
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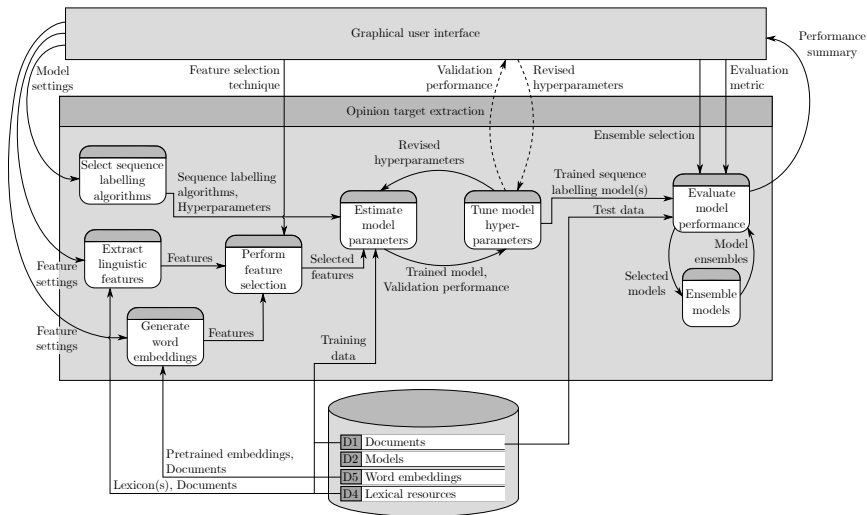


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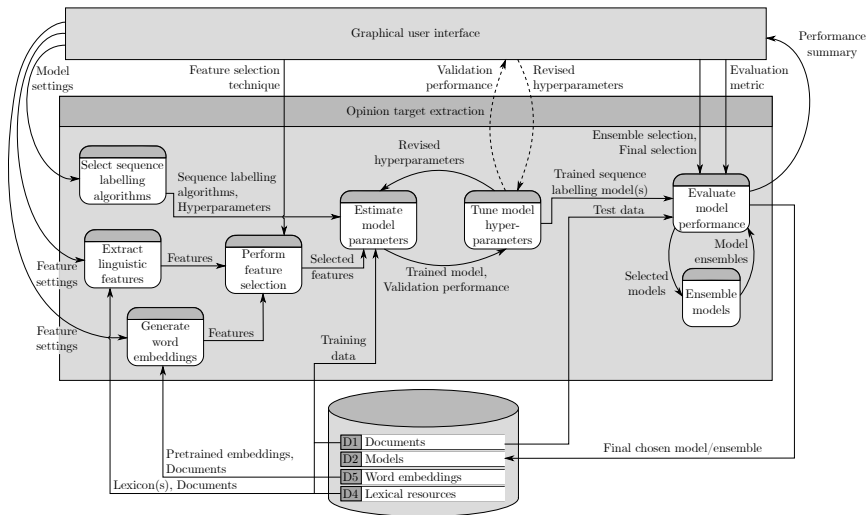




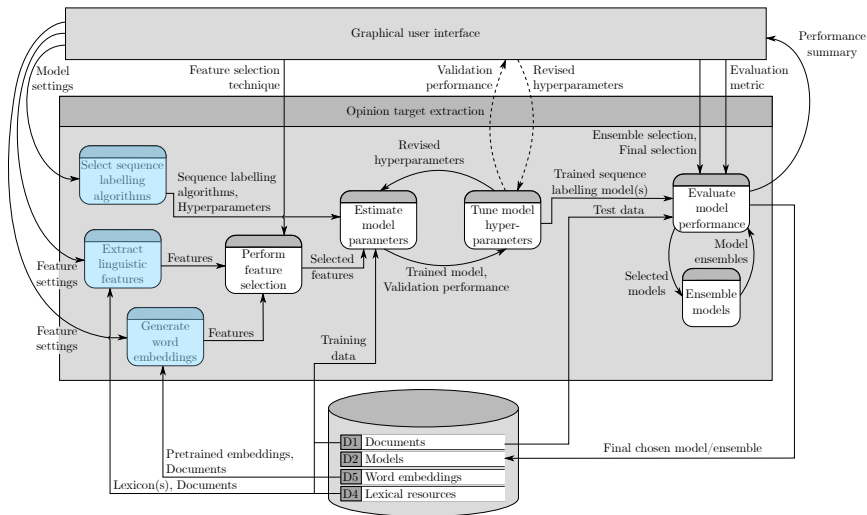
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# Case studies: The data sets

- Validation studies: SemEval 2014 data sets

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  - *Restaurant domain* — 3 841 documents, aspect term and category labels

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# The restaurant data set

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- hyperparameter tuning (grid search)
- ensembling of results (majority and weighted voting)

# The restaurant data set

Model	$F_1$ score
DLIREC	0.8401
XRCE	0.8398
Framework	0.8297
NRC-Canada	0.8018
Baseline	0.4715

Identifying aspect terms

Model	Acc
DCU	0.8095
NRC-Canada	0.8015
Framework	0.7954
UWB & XRCE	0.7768
Baseline	0.6428

Classifying sentiment (aspects)

Model	$F_1$ score
Framework	0.9052
NRC-Canada	0.8857
UNITOR	0.8526
XRCE	0.8228
Baseline	0.6389

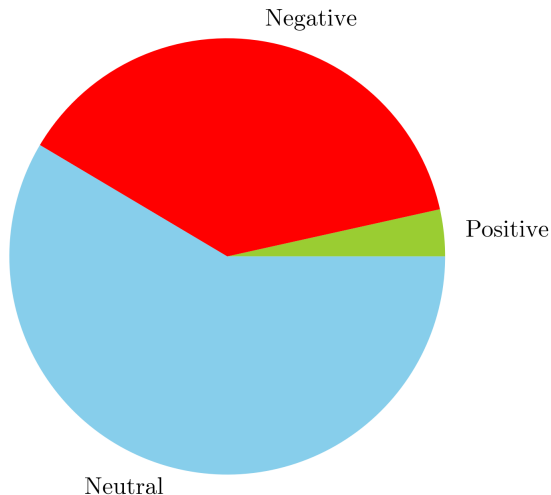
Detecting aspect categories

Model	Acc
NRC-Canada	0.8292
XRCE	0.7814
Framework	0.7727
UNITOR	0.7629
Baseline	0.6428

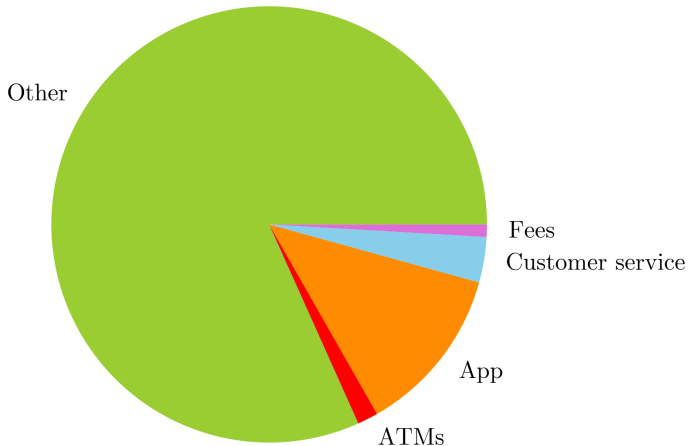
Classifying sentiment (categories)

# The retail bank data set

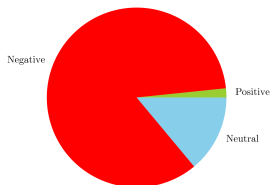
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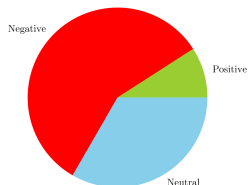
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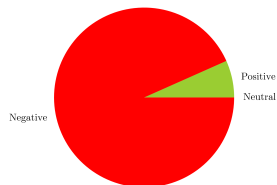
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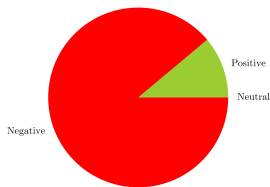
App



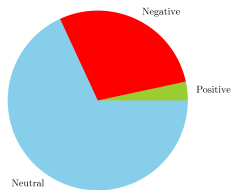
Service



ATMs



Fees



Other

# Conclusion

Presented a framework that:



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- guides a user through the development and deployment of an ABSA system

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- guides a user through the development and deployment of an ABSA system
- is agnostic to the specific methods/algorithms employed
- development of multiple models at once — comparison
- results in performance comparable with the literature across all tasks

-  KAZMAIER J, 2020, *A framework for evaluating unstructured text data using sentiment analysis*, PhD Dissertation, Stellenbosch University, Stellenbosch.
-  LIU B, 2020, *Sentiment analysis: Mining opinions, sentiments, and emotions*, 2<sup>nd</sup> Edition, Cambridge University Press, Cambridge.
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