

November 29, 2017

Towards Bootstrapping a **Polarity Shifter Lexicon** using Linguistic Features

Marc Schulder
Michael Wiegand

Spoken Language
Systems

Saarland University



Josef Ruppenhofer

Institute for German
Language

Mannheim



Benjamin Roth

Center for Information and
Language Processing

LMU Munich



What are Polarity Shifters?

Shifters, like negation words, move the **polarity of a phrase** towards the **opposite** of the **polar term** they contain.

Negation

Peter [did not [pass]⁺ the exam]⁻.
They [did not [destroy]⁻ the temple]⁺.

Verbal Shifter

Peter [failed to [pass]⁺ the exam]⁻.
They [failed to [destroy]⁻ the temple]⁺.

Overview

- Motivation
- Bootstrapping a Lexicon
 - Features
 - Classification
 - Output Verification
- Extrinsic Evaluation
- Conclusion



Negation VS Verbal Shifters

	Negation	Verbal Shifters
Word Type	Function words	Content Words

Negation VS Verbal Shifters

	Negation	Verbal Shifters
Word Type	Function words	Content Words
Vocabulary Size	Small	Large <i>(15% of verbs)</i>

Negation VS Verbal Shifters

	Negation	Verbal Shifters
Word Type	Function words	Content Words
Vocabulary Size	Small	Large <i>(15% of verbs)</i>
Individual Frequency	High	Low

Negation VS Verbal Shifters

	Negation	Verbal Shifters
Word Type	Function words	Content Words
Vocabulary Size	Small	Large <i>(15% of verbs)</i>
Individual Frequency	High	Low
Full Coverage	Yes	No

Negation VS Verbal Shifters

	Negation	Verbal Shifters
Word Type	Function words	Content Words
Vocabulary Size	Small	Large <i>(15% of verbs)</i>
Individual Frequency	High	Low
Full Coverage	Yes	No

Pipeline



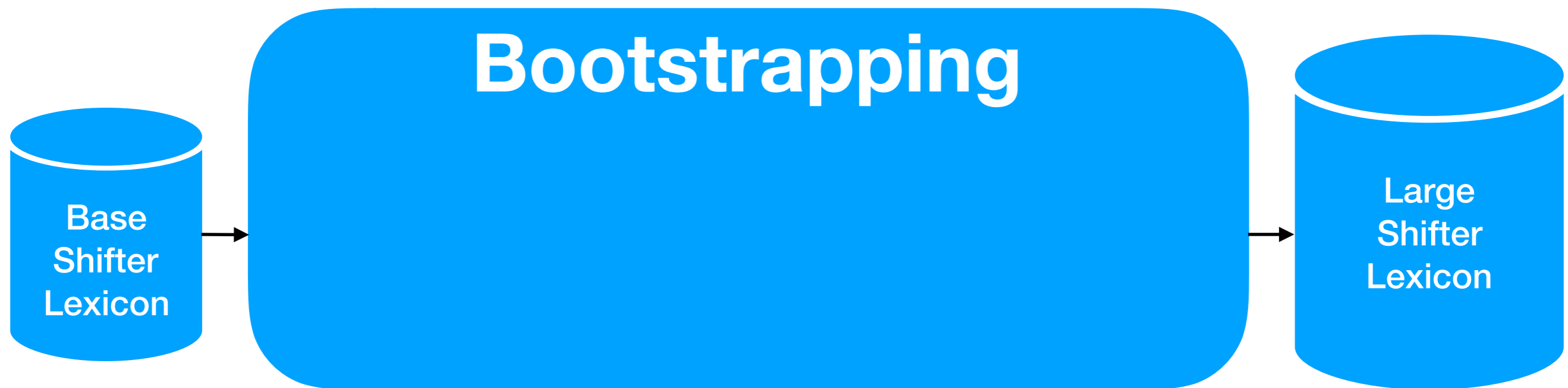
Pipeline



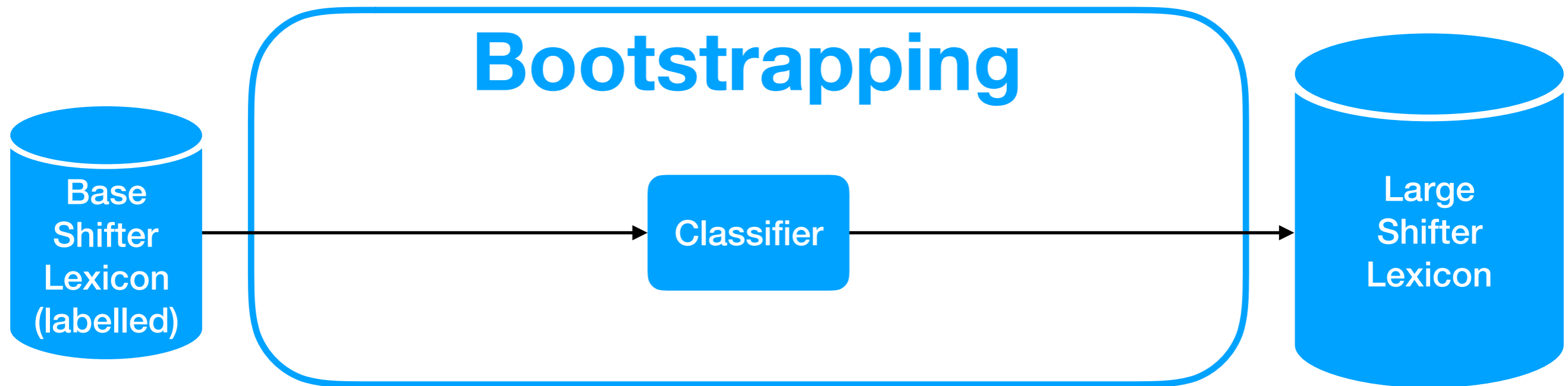
Pipeline



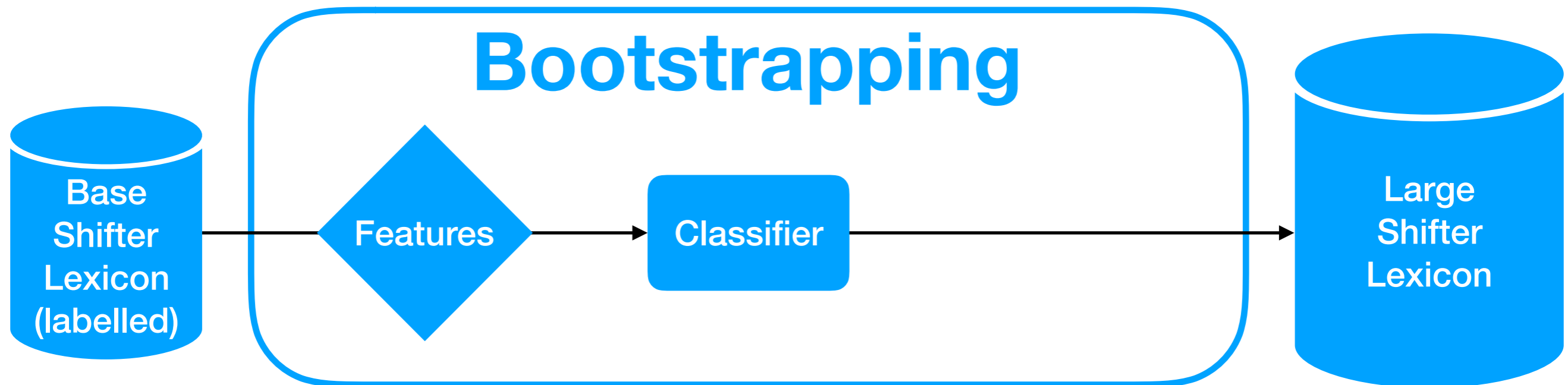
Pipeline



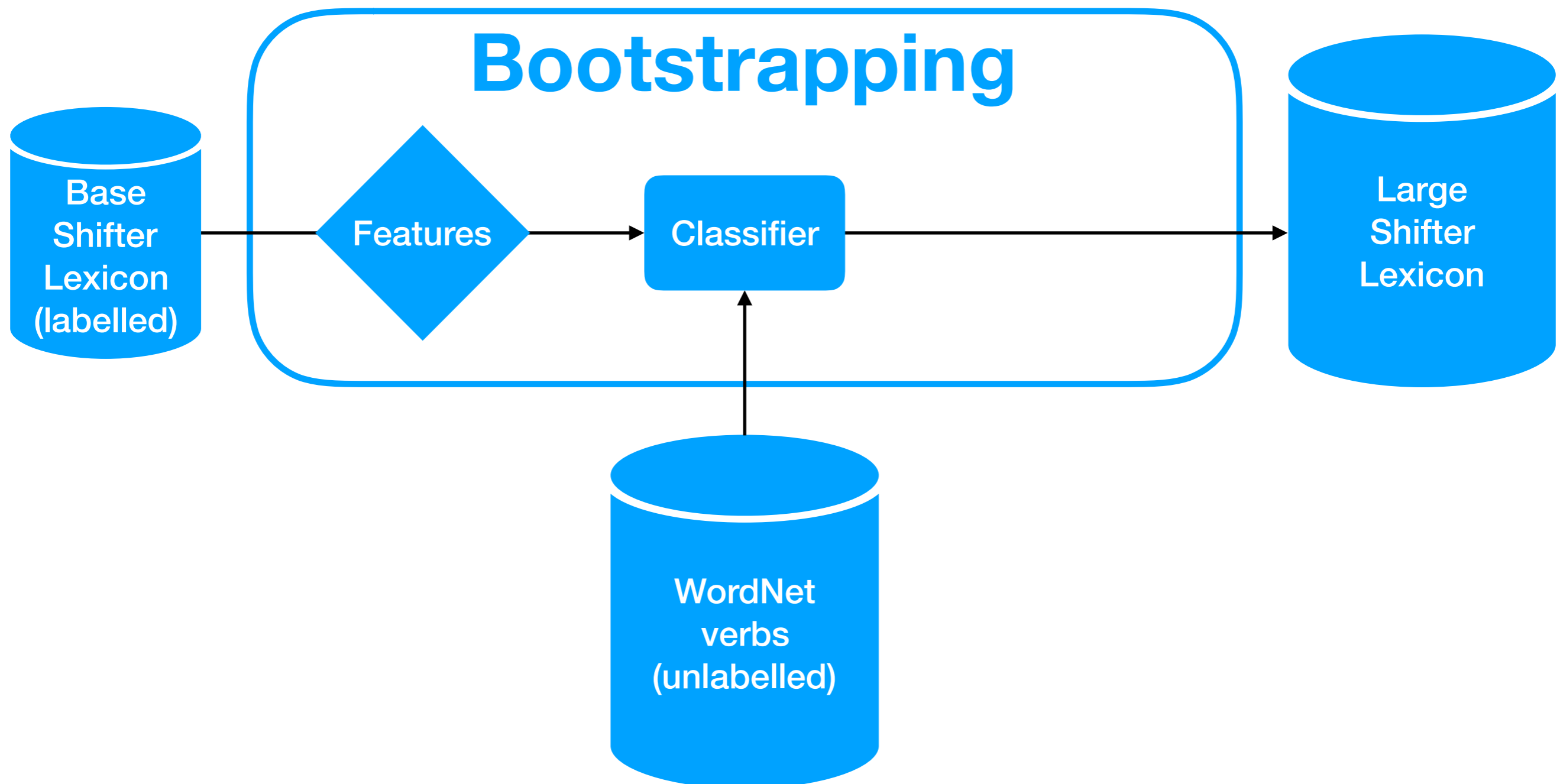
Pipeline



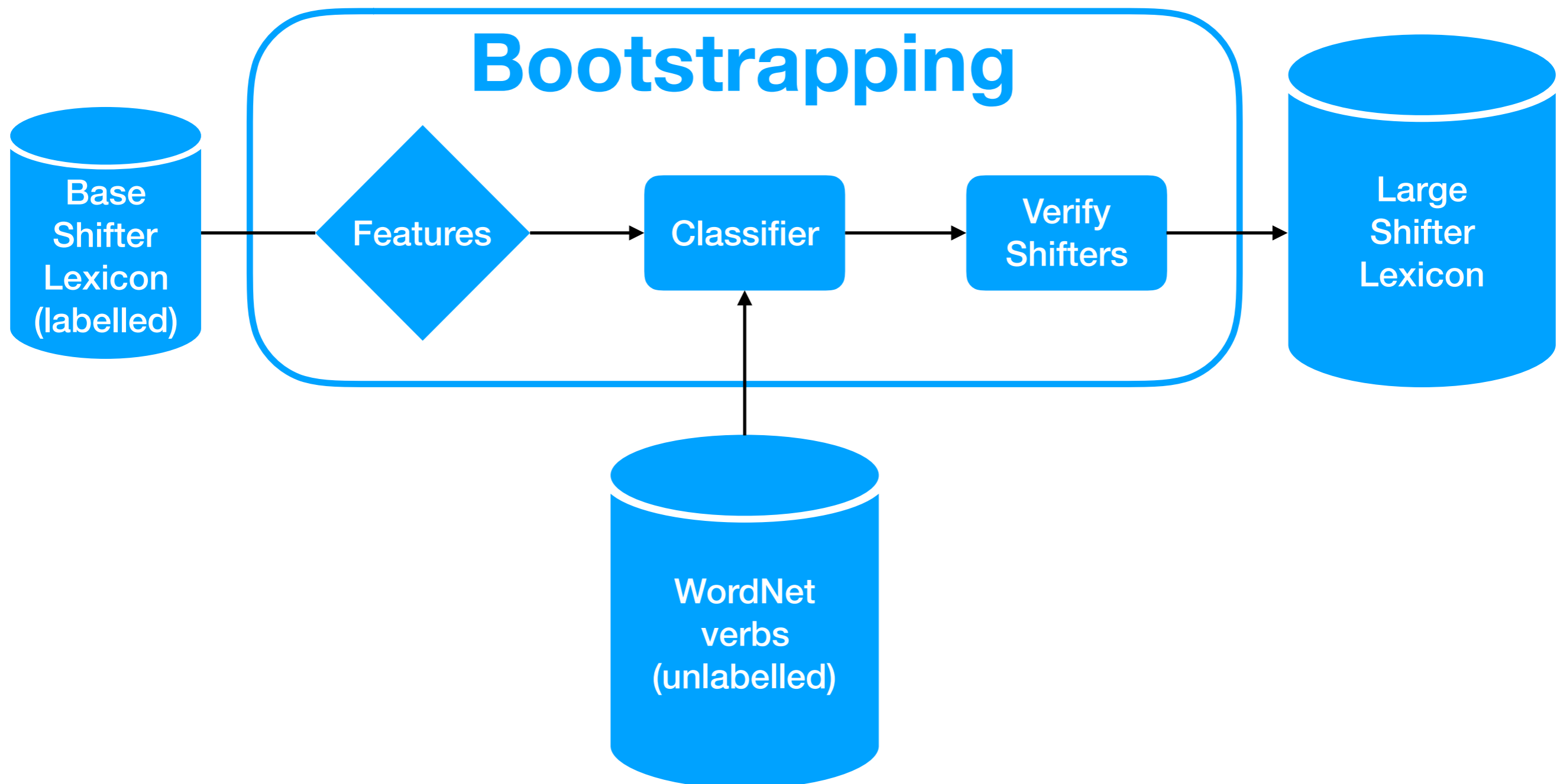
Pipeline



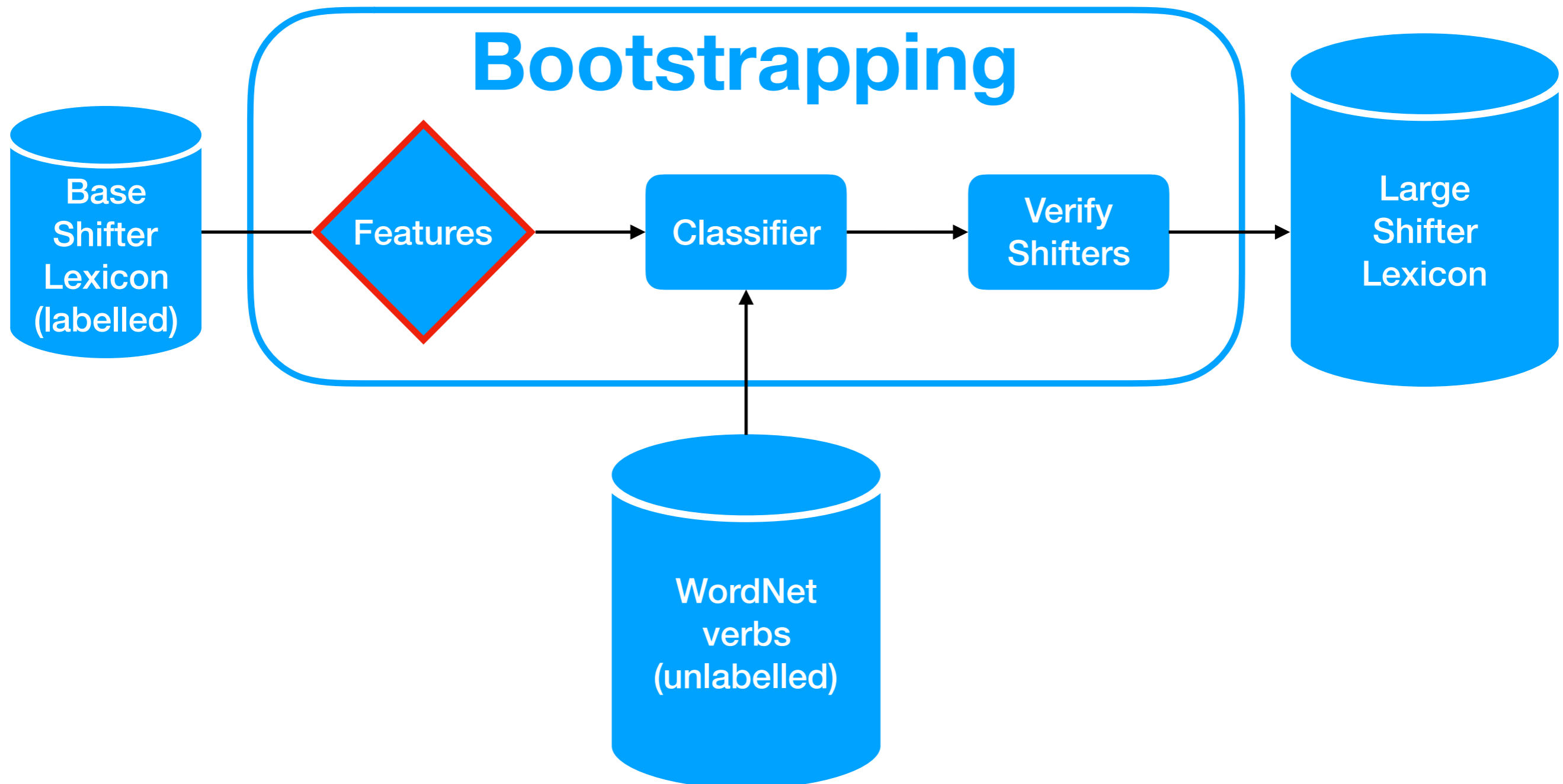
Pipeline



Pipeline



Pipeline



Generic Features

WordNet

- **Glosses:** Word definition (bag-of-words).
- **Hypernyms:** Words with more general meaning.
- **Supersenses:** Coarse semantic categories.

FrameNet

- **Verb Frames:** Semantic verb groups.
Frame AVOIDING: *desist, dodge, evade, shun, shirk,...*



Task-specific Features

1. Distributional Similarity

Choose verbs similar to negation words like *not*, *no*, etc.

2. Polarity Clash

Negative verb with positive object.

She [**lost** [hope]⁺]⁻.

3. Particle Verbs

Some particles indicate "loss" (e.g. *aside*, *down*, *off*,...).

Please [**lay aside** all your [worries]⁻]⁺.

4. *any*-Heuristic

The word *any* co-occurs with negation/shifters.

They did [**not** give us any [help]⁺]⁻.

They [**denied** us any [help]⁺]⁻.



Best

Anti-Shifter Feature

Anti-Shifter:

Co-occurrence with adverbs that are

- attracted to verbs of creation;
- repelled by verbs of destruction.

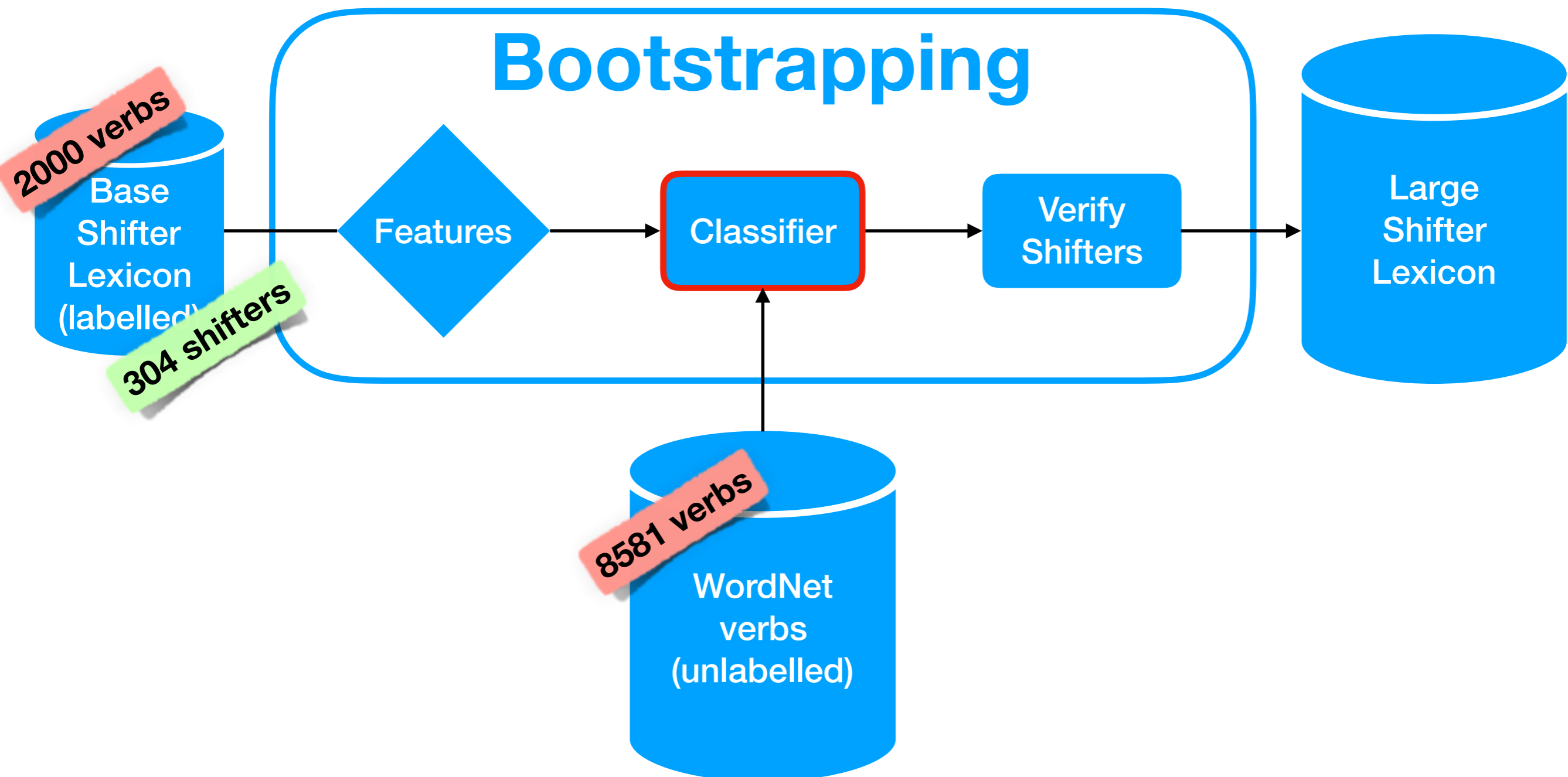
*Black bears exclusively **live**_{anti-shifter} on fish.*

*Keyboards on phones were first **introduced**_{anti-shifter} in 1997.*

*These buildings have been newly **constructed**_{anti-shifter}.*

*They specially **prepared**_{anti-shifter} vegan dishes for me.*

Pipeline



Classifier

Setup

SVM

- **Training:** Base Lexicon
2000 verbs, incl. 304 shifters
- **Labels:** Shifter, non-shifter
- **Evaluation:** 10-fold cross validation

Classifier Setup

SVM

- **Training:** Base Lexicon
2000 verbs, incl. 304 shifters
- **Labels:** Shifter, non-shifter
- **Evaluation:** 10-fold cross validation

Baselines

- **Majority Label:** All verbs are non-shifters

Classifier Setup

SVM

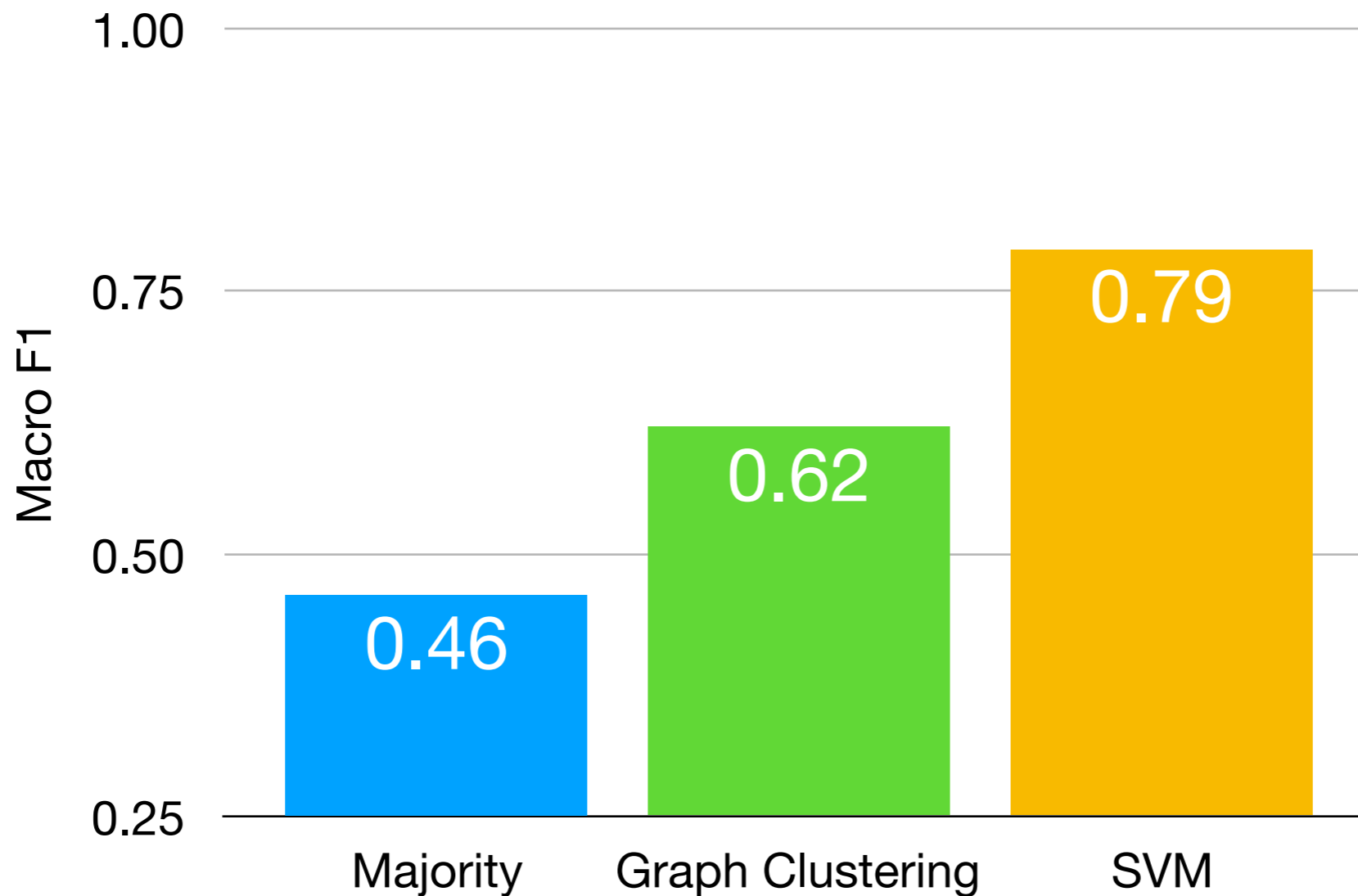
- **Training:** Base Lexicon
2000 verbs, incl. 304 shifters
- **Labels:** Shifter, non-shifter
- **Evaluation:** 10-fold cross validation

Baselines

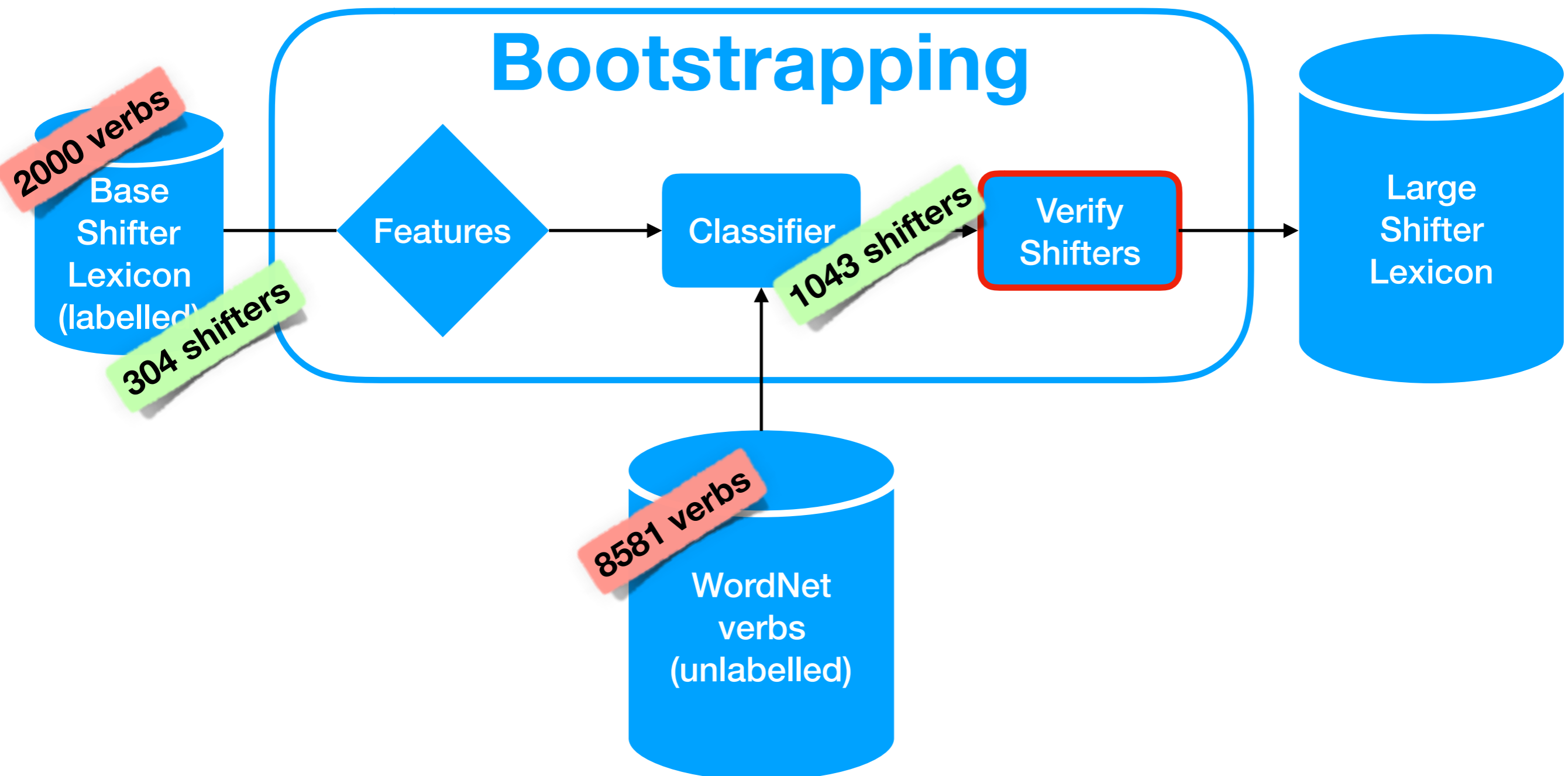
- **Majority Label:** All verbs are non-shifters
- **Graph Clustering** (Approach with no labelled training data)
 - **Input:** Word Embedding Graph + Seeds
 - **Positive Seeds:** ANY (best shifter feature)
 - **Negative Seeds:** ANTI



Classifier Performance

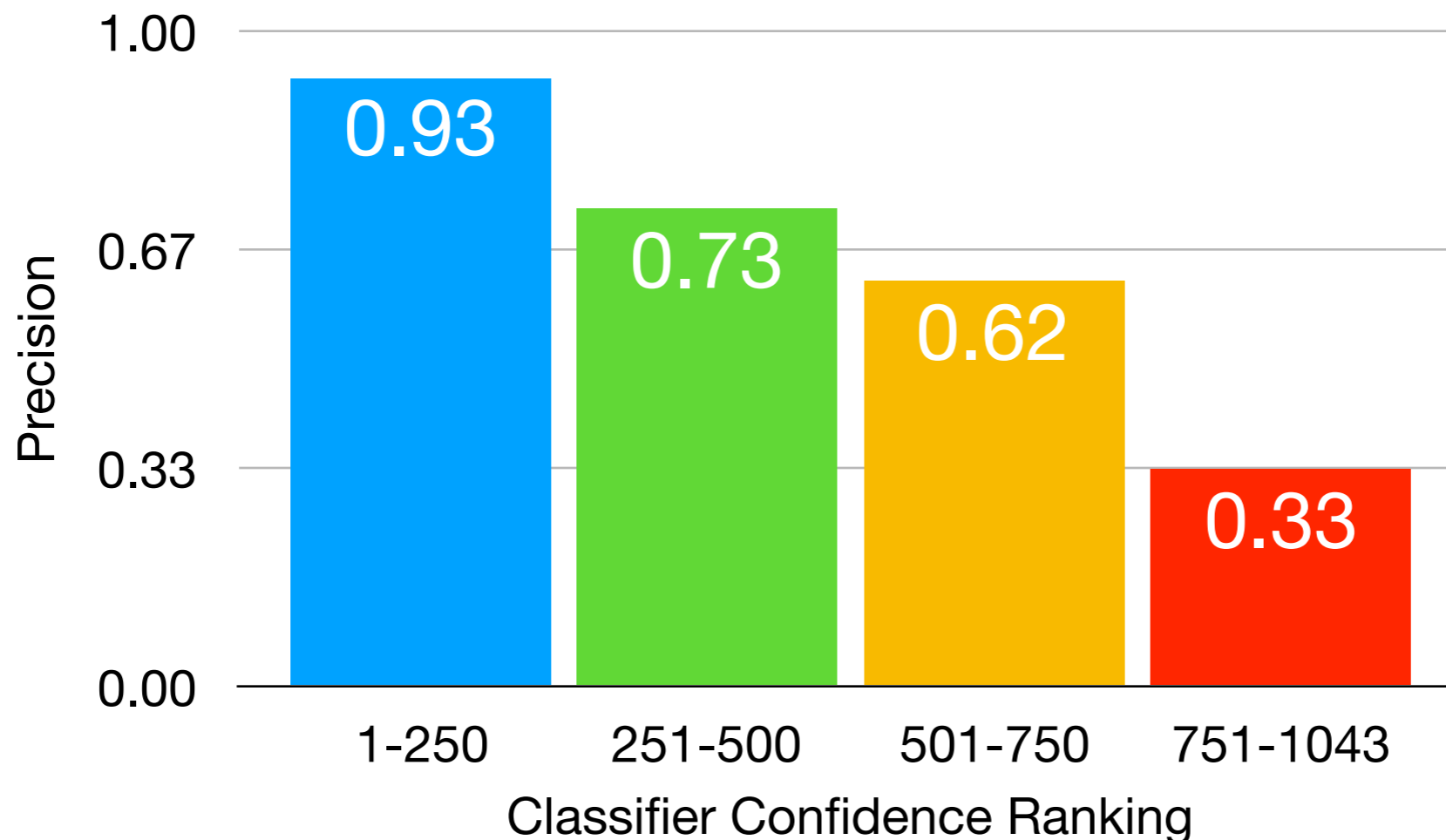


Pipeline

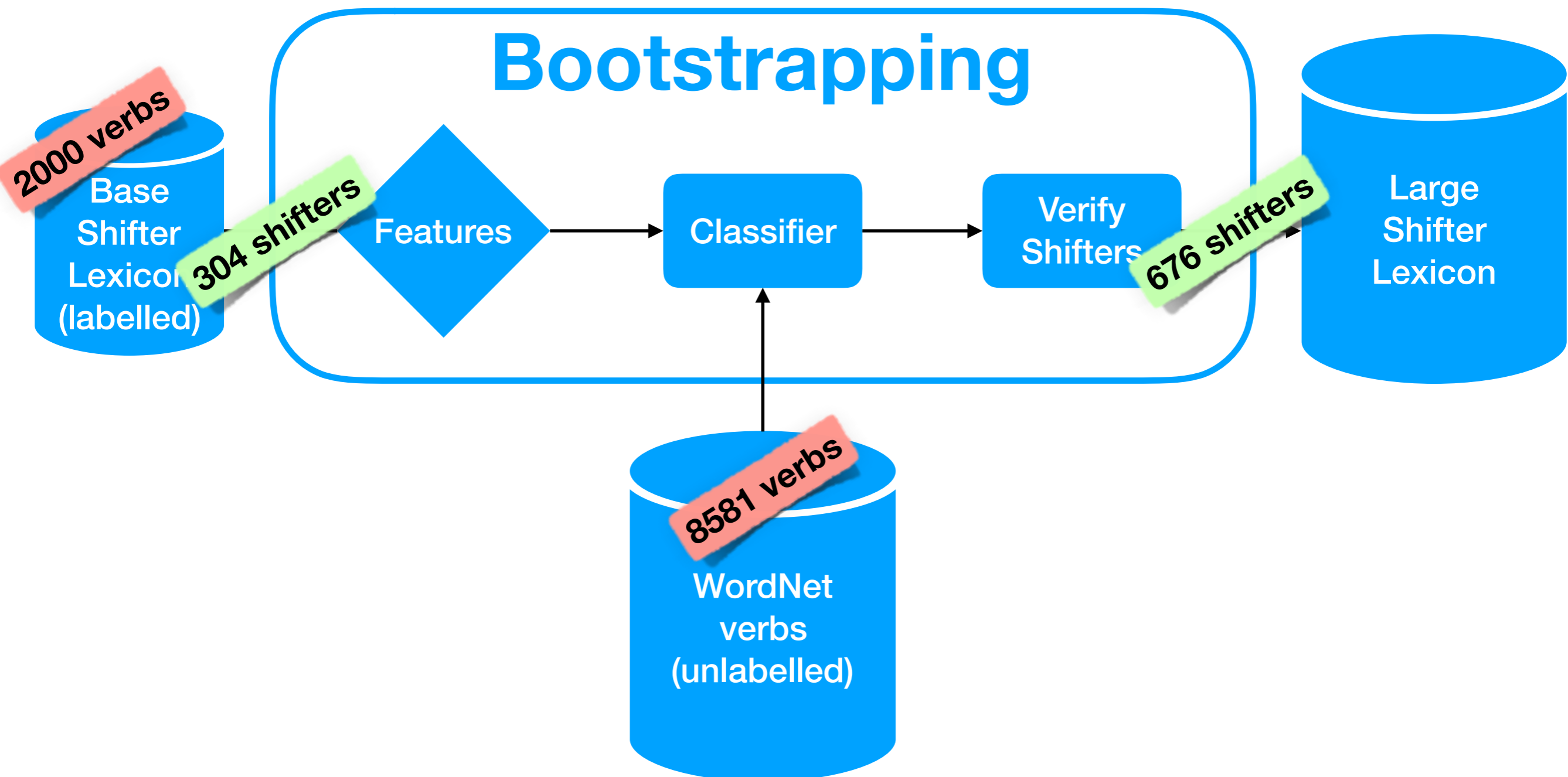


Shifter Verification

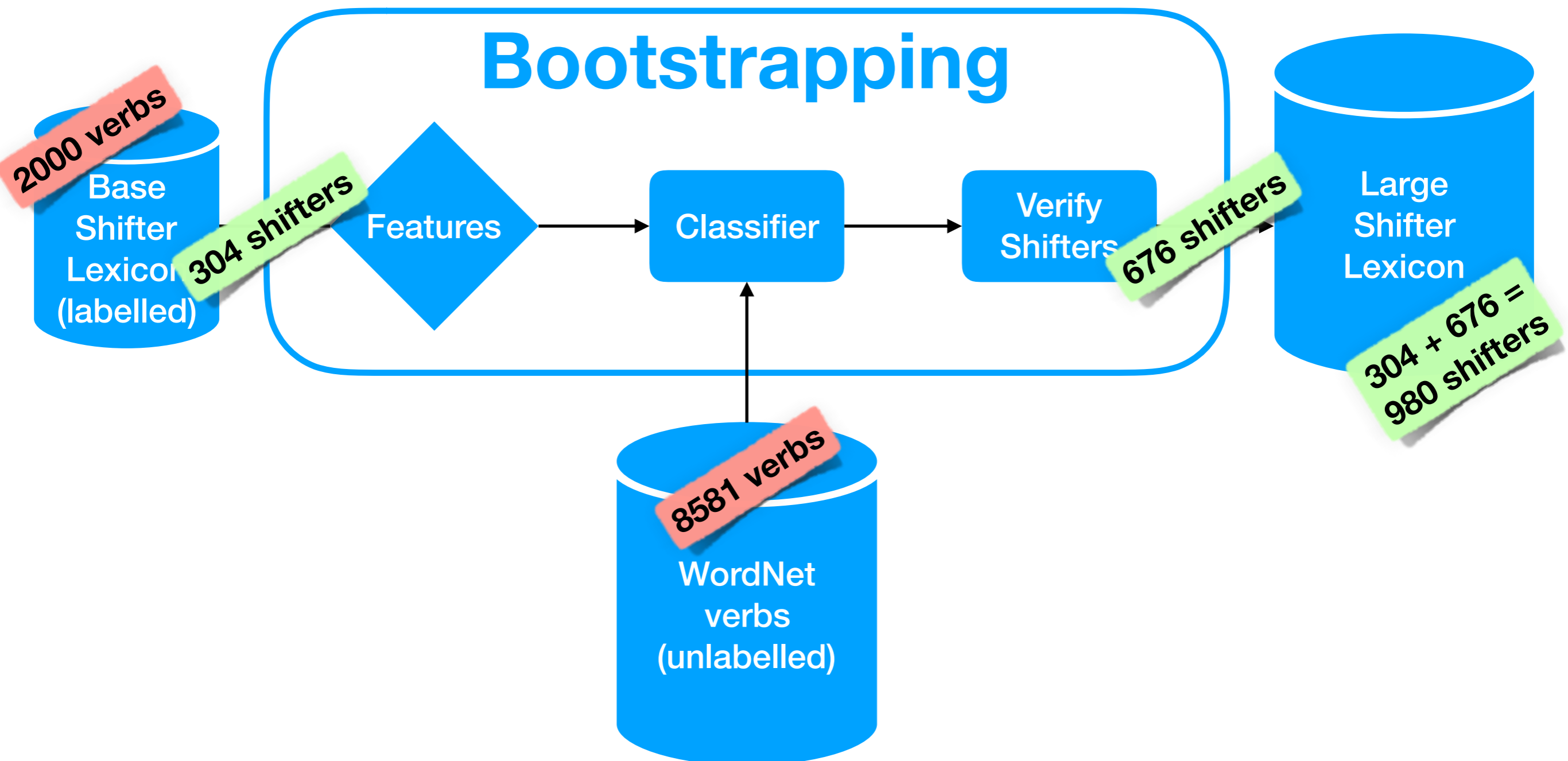
- **Task:** Human annotator verifies predicted shifters.
- **Input:** 1043 verbs predicted as shifters.
- **Output:** 676 verbs confirmed as shifters.



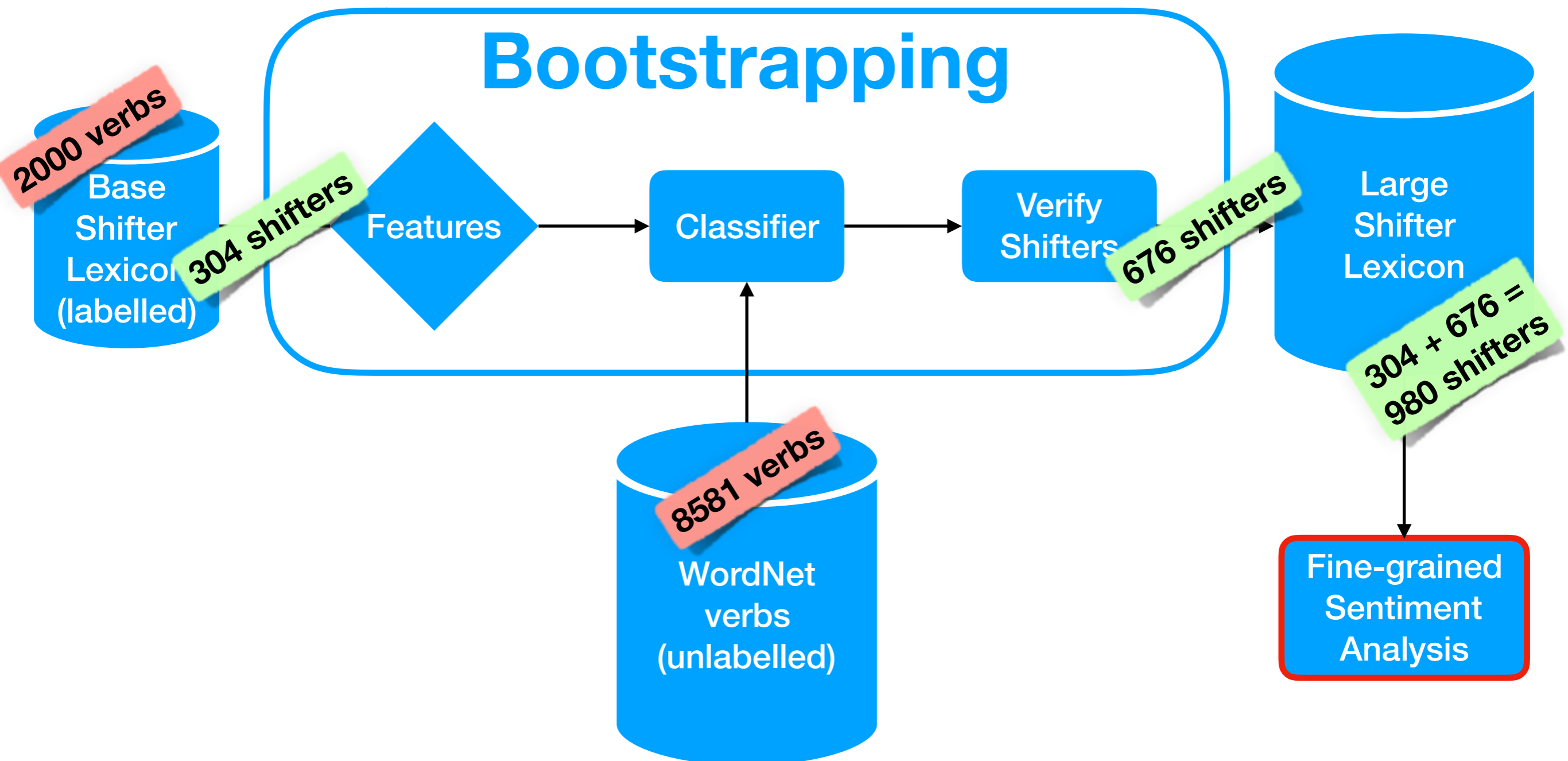
Pipeline



Pipeline



Pipeline



Extrinsic Evaluation

Sentiment Analysis

Task:

Given a verb phrase with a polar noun, decide whether **phrase polarity** has **shifted** from the **polarity of the noun**.

Input: *Norah Jones' smooth voice could*
[soothe_V any savage [beast_N]-]_{VP}?

Output Labels: Shifted, not shifted

Gold Data: Amazon Product Review Corpus (Jindal and Liu, 2008)
2631 phrases
Balanced for ratio of shifters among verbs.

Extrinsic Evaluation

Classifiers

Proposed Classifier using Bootstrapped Lexicon

- If verb in shifter lexicon \Rightarrow Shifted

Extrinsic Evaluation

Classifiers

Proposed Classifier using Bootstrapped Lexicon

- If verb in shifter lexicon \Rightarrow Shifted

Baselines

- **Majority Label:** All sentences are not shifted.

Extrinsic Evaluation

Classifiers

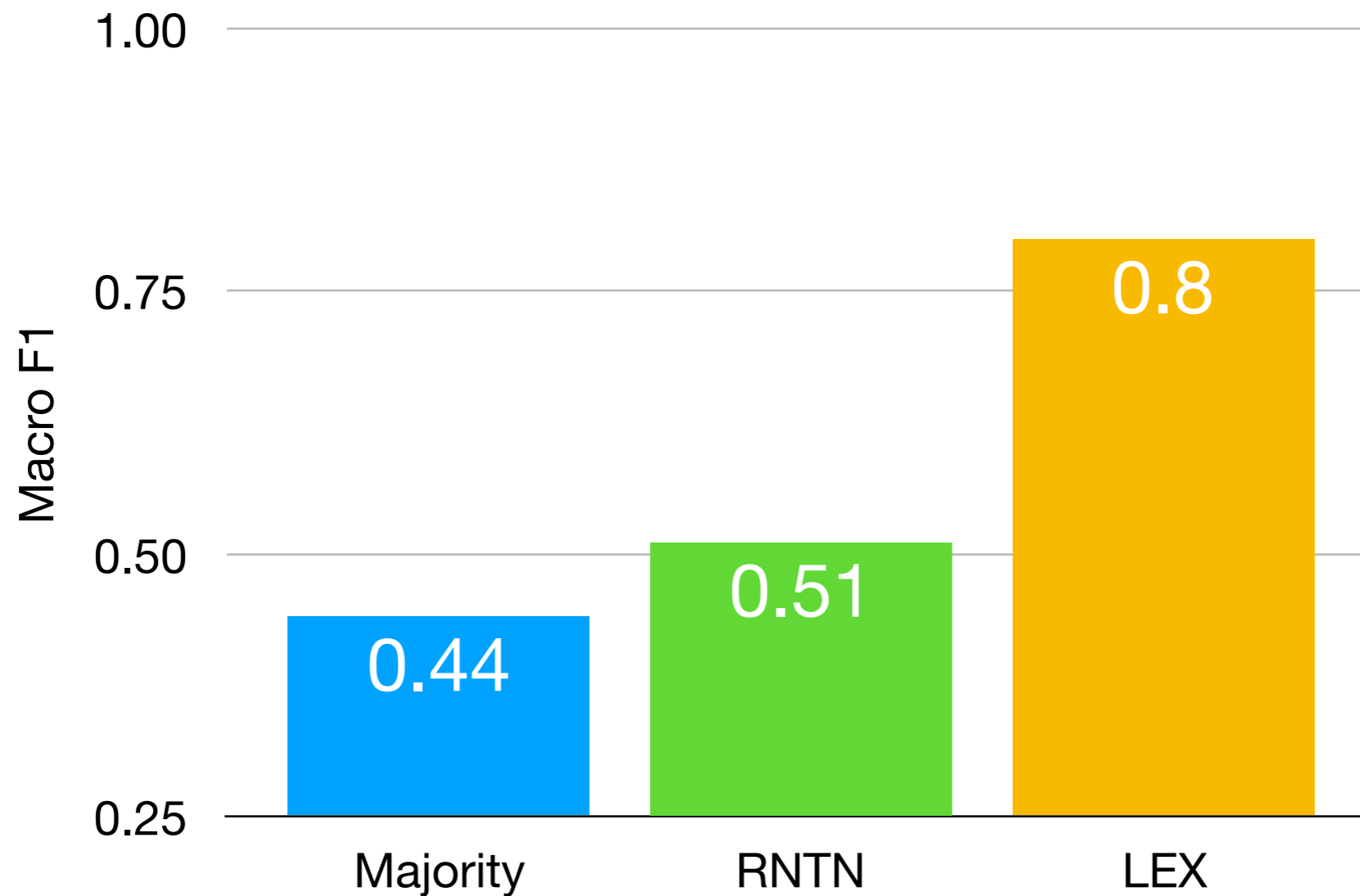
Proposed Classifier using Bootstrapped Lexicon

- If verb in shifter lexicon \Rightarrow Shifted

Baselines

- **Majority Label:** All sentences are not shifted.
- **Recursive Neural Tensor Network** (Socher et al., 2013)
 - Compositional sentence-level polarity classifier.
 - Provides polarities for each constituency tree node.
 - No explicit knowledge of shifters.

Extrinsic Evaluation Results



Conclusion

- Produced a **large lexicon** of 980 shifters.
Available at <https://github.com/marcschulder/ijcnlp2017>



Conclusion

- Produced a **large lexicon** of 980 shifters.
Available at <https://github.com/marcschulder/ijcnlp2017>
- Bootstrapping **reduces cost** of **high quality** annotation.

Conclusion

- Produced a **large lexicon** of 980 shifters.
Available at <https://github.com/marcschulder/ijcnlp2017>
- Bootstrapping **reduces cost** of **high quality** annotation.
- Explicit knowledge of shifters **improves fine-grained sentiment analysis**.



Conclusion

- Produced a **large lexicon** of 980 shifters.
Available at <https://github.com/marcschulder/ijcnlp2017>
- Bootstrapping **reduces cost** of **high quality** annotation.
- Explicit knowledge of shifters **improves fine-grained sentiment analysis**.
- Introduced **linguistic indicators** for polarity shifting:
 - *Any-Heuristic*
 - Verb Particles
 - Anti-Shifter Adverbs



Thank You

References

C. F. Baker, C. J. Fillmore, and J. B. Lowe. 1998. **The Berkeley FrameNet Project**. In *Proceedings of COLING/ACL*.

L. Brinton. 1985. **Verb Particles in English: Aspect or Aktionsart**. *Studia Linguistica*, 39:157–68.

Y. Choi and J. Wiebe. 2014. **+/-EffectWordNet: Sense-level Lexicon Acquisition for Opinion Inference**. In *Proceedings of EMNLP*.

C. Danescu-Niculescu-Mizil, L. Lee, and R. Ducott. 2009. **Without a ‘doubt’? Unsupervised Discovery of Downward-Entailing Operators**. In *Proceedings of HLT/NAACL*.

A. Giannakidou. 2008. **Negative and Positive Polarity Items: Licensing, Compositionality and Variation**. In *Semantics: An International Handbook of Natural Language Meaning*, pages 1660–1712. Mouton de Gruyter.

N. Jindal and B. Liu. 2008. **Opinion Spam and Analysis**. In *Proceedings of WSDM*.

G. Miller, R. Beckwith, C. Fellbaum, D. Gross, and K. Miller. 1990. **Introduction to WordNet: An Online Lexical Database**. *International Journal of Lexicography*, 3:235–244.

R. Socher, A. Perelygin, J. Y. Wu, J. Chuang, C. D. Manning, A. Y. Ng, and C. Potts. 2013. **Recursive Deep Models for Semantic Compositionality over a Sentiment Treebank**. In *Proceedings of EMNLP*.

M. Wiegand, A. Balahur, B. Roth, D. Klakow, and A. Montoyo. 2010. **A Survey on the Role of Negation in Sentiment Analysis**. In *Proceedings of NeSp-NLP*.

T. Wilson, J. Wiebe, and P. Hoffmann. 2005. **Recognizing Contextual Polarity in Phrase-level Sentiment Analysis**. In *Proceedings of EMNLP*.

H. Yu, J. Hsu, M. Castellanos, and J. Han. 2016. **Data-driven Contextual Valence Shifter Quantification for Multi-Theme Sentiment Analysis**. In *Proceedings of CIKM*.

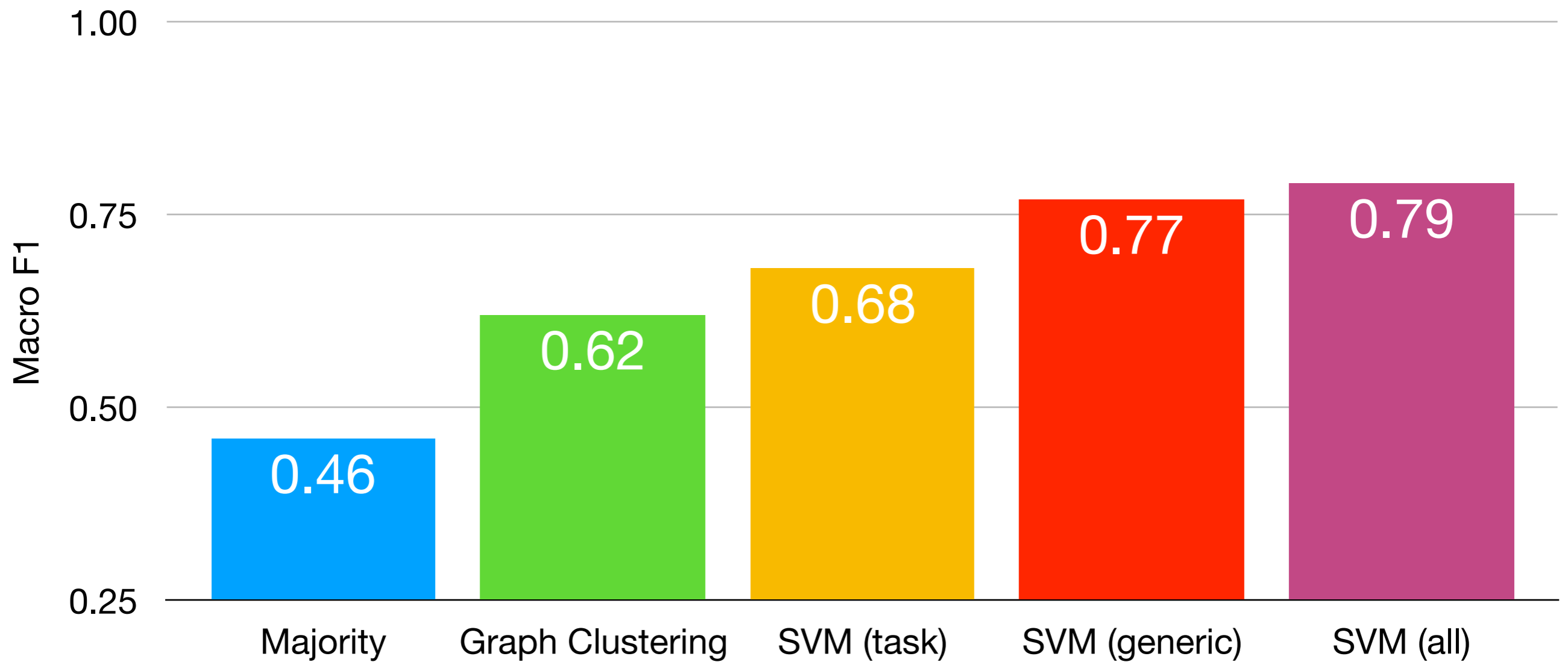


Conclusion

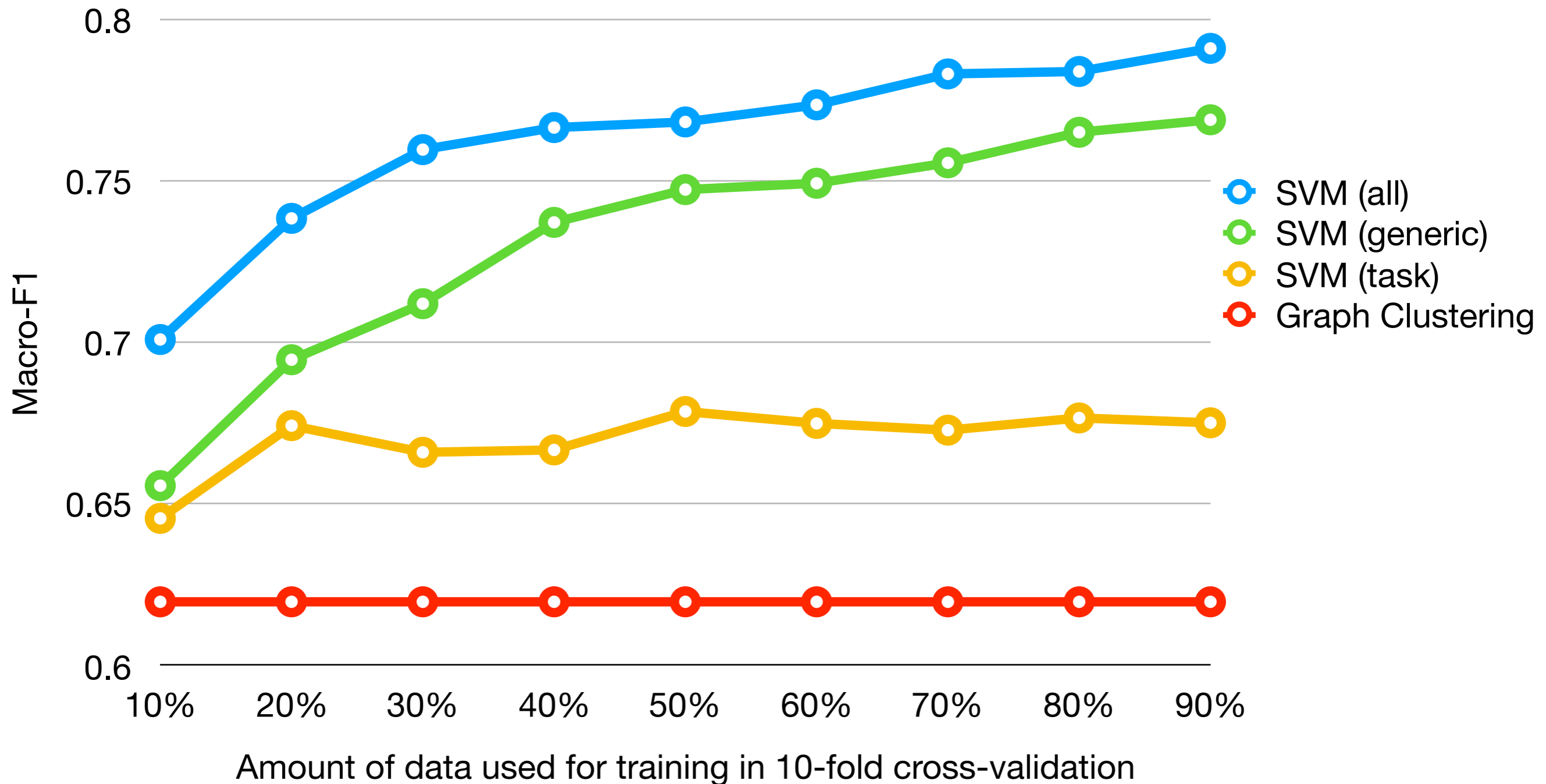
- Produced a **large lexicon** of 980 shifters.
Available at <https://github.com/marcschulder/ijcnlp2017>
- Bootstrapping **reduces cost** of **high quality** annotation.
- Explicit knowledge of shifters **improves fine-grained sentiment analysis**.
- Introduced **linguistic indicators** for polarity shifting:
 - *Any-Heuristic*
 - Verb Particles
 - Anti-Shifter Adverbs



Low Resource Languages



Low Resource Languages



Polarity Shifters

- Shifting can happen in either direction.
*She was **[denied]** the **[scholarship]⁺**-.*
*The new medication **[alleviated]** her **[pain]⁻**+.*
- Shifter words can have neutral polarity.
*Homework **[eats up][~]** all my **[free time]⁺**-.*
- Polarity of shifter word \neq direction of shifting.
*You should **[abandon]⁻** your **[fears]⁻**+.*



Data

Polarity Lexicon

- **Subjectivity Lexicon**(Wilson et al. 2005)

Word Embeddings

- **Tool: Word2Vec**(Mikolov et al., 2013)
- **Corpus: Amazon Product Review Corpus**(Jindal and Liu, 2008)
(also used for co-occurrence counts and extrinsic eval)

Graph Ranking:

- **Tool: Junto**(Talukdar et al., 2008)
- **Algorithm: Adsorption Label Propagation**(Talukdar et al., 2008)

Any Heuristic

Negative polarity items (NPI) like *any* occur in the context of negation. (Giannakidou, 2008) We hypothesise the same for shifters.

*They [did **not** give us any [help]⁺]-.*

*They [**denied** us any [help]⁺]-.*

Pattern

(VP **VERB** (NP any POLAR_NOUN))

Restriction: Noun must be polar

Ranking: Pattern Frequency / Verb Frequency

Re-Ranking: Personalised PageRank (Agirre and Soroa, 2009)

RNTN: Data Sparsity

Training: Sentiment Treebank (Socher et al., 2013)

Size: 11,855 sentences;

215,154 phrase nodes

Advantage: Explicit polarities for every tree node.

Disadvantage: Few or no instances of most verbs.
⇒ Difficult to learn shifter behaviour