To Mine, or Not to Mine

Data Analysis of the Works of William Shakespeare

[redacted] Text Mining

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[redacted] Brian Hogan

William Shakespeare

- Lived 1564 – 1616, England
- Wrote or co-wrote 39 plays, 154 sonnets
- “Widely regarded as the greatest writer in the English language and the world's greatest dramatist” – encyclopedia entry

Shakespearean Musings…

- Text Mining Pursuits:
  - How does vocabulary of comedies differ from tragedies?
  - How does vocabulary differ by character? Hero, heroine, villain…
  - What characters are similar or different?
  - Can algorithms predict if a sentence belongs to a comedy or tragedy?

COMEDIES

[All's Well That Ends Well]()
[As You Like It]()
[Comedy of Errors]()
[Love's Labour's Lost]()
[Measure for Measure]()
[Merchant of Venice]()
[Merry Wives of Windsor]()
[Midsummer Night's Dream]()
[Much Ado about Nothing]()
[Taming of the Shrew]()
[Tempest]()
[Twelfth Night]()
[Two Gentlemen of Verona]()
[Winter's Tale]()

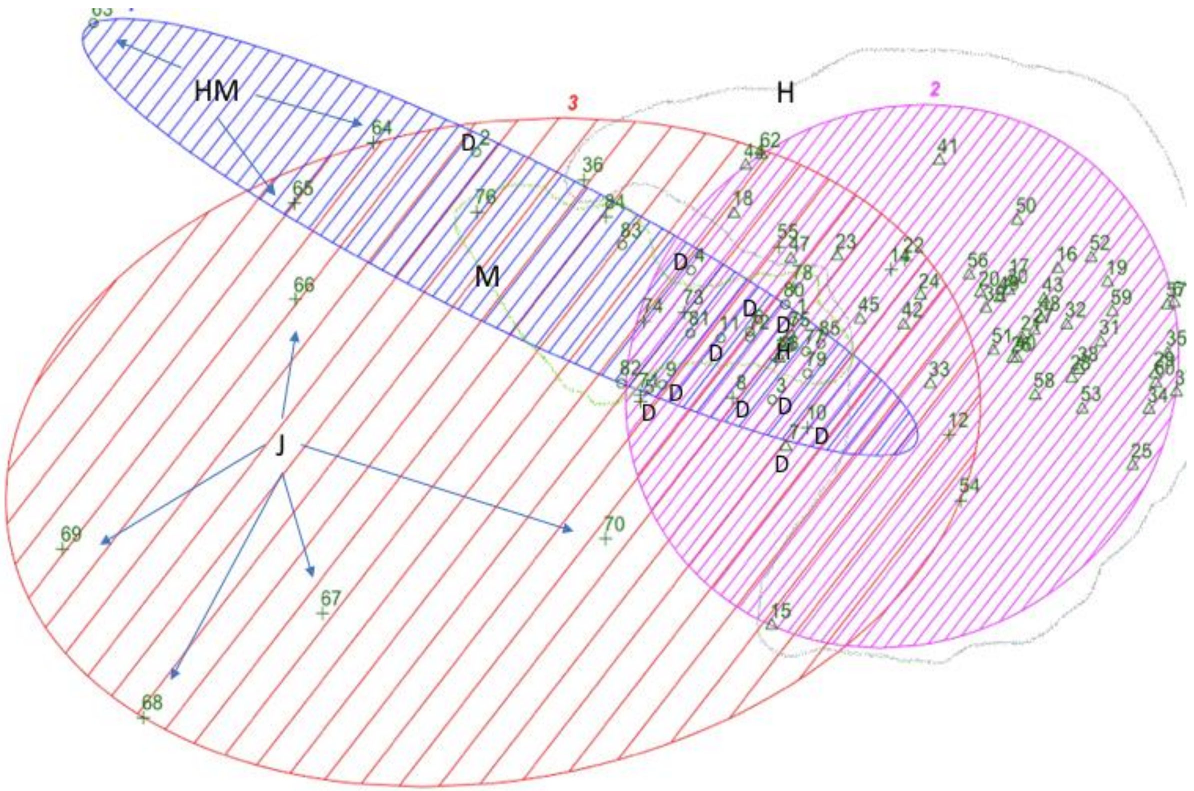
HISTORIES

[Henry IV, Part I]()
[Henry IV, Part II]()
[Henry V]()
[Henry VI, Part I]()
[Henry VI, Part II]()
[Henry VI, Part III]()
[Henry VIII]()
[King John]()
[Pericles]()
[Richard II]()
[Richard III]()

TRAGEDIES

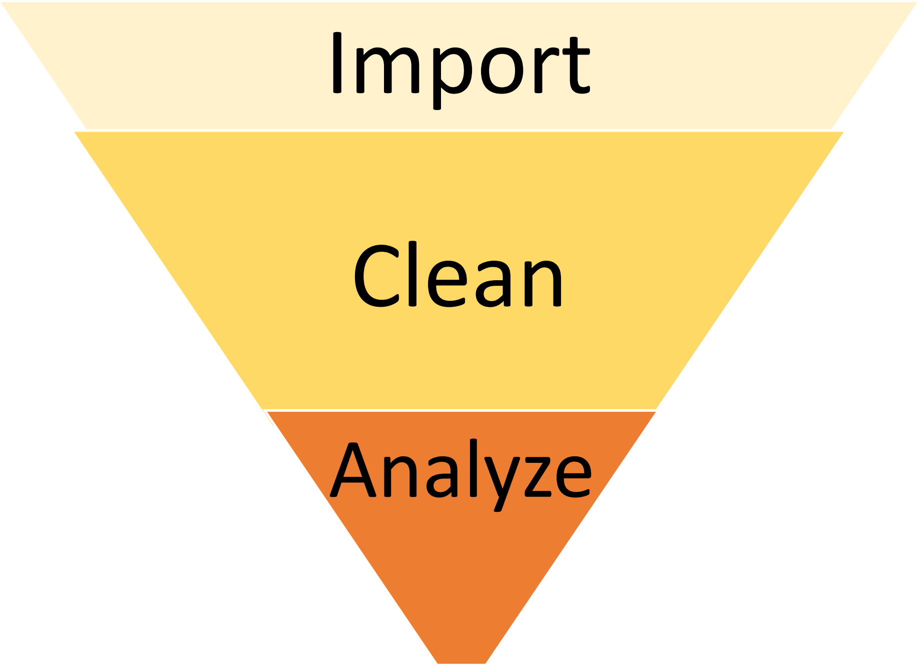
[Antony and Cleopatra]()
[Coriolanus]()
[Cymbeline]()
[Hamlet]()
[Julius Caesar]()
[King Lear]()
[Macbeth]()
[Othello]()
[Romeo and Juliet]()
[Timon of Athens]()
[Titus Andronicus]()
[Troilus and Cressida]()

Corpus



Data Preparation & Distributed Team Tasks

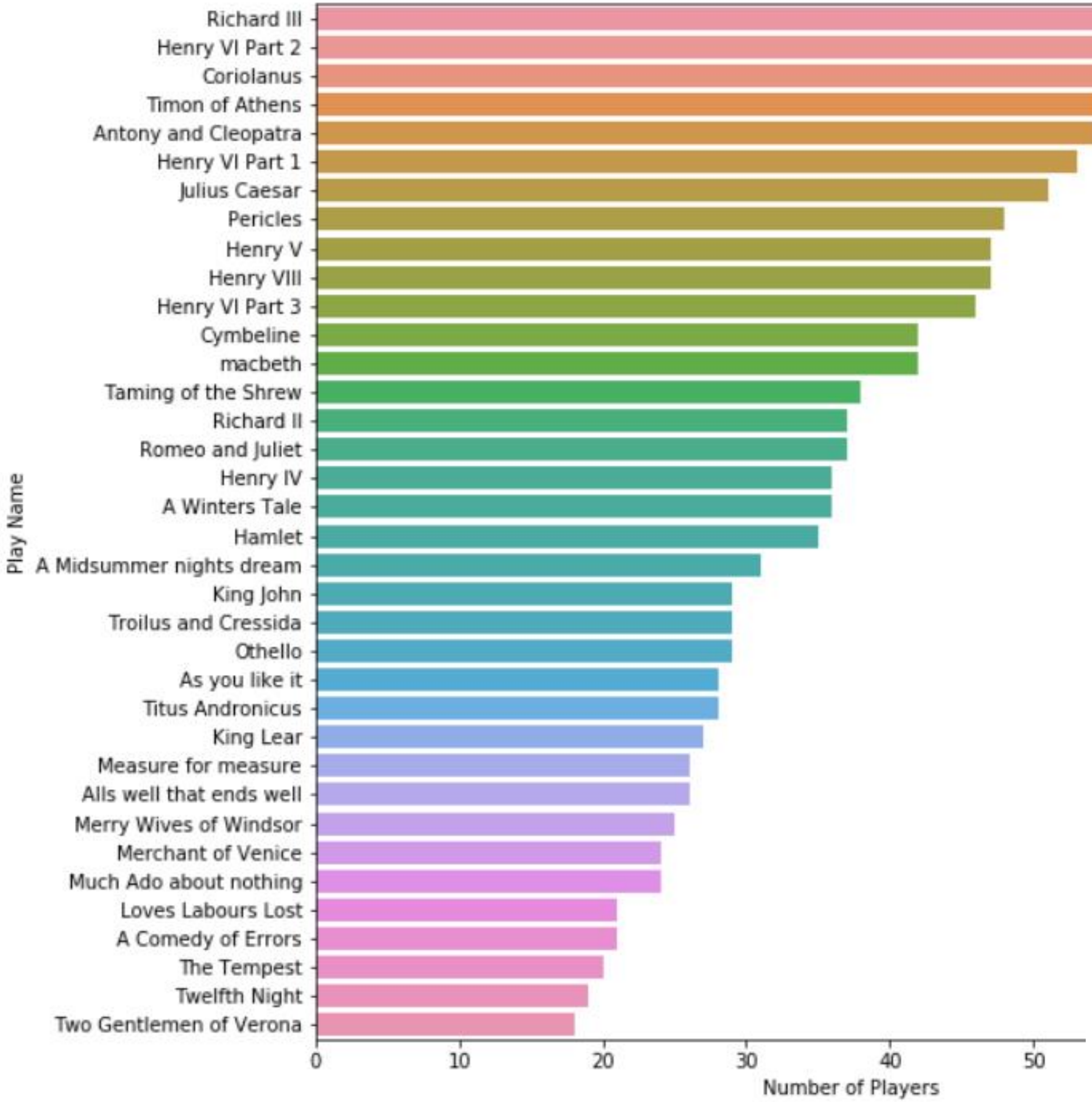
- Scripts ("data") available from MIT*
- Wrote a custom HTML parser which labeled each line of dialogue
- Team members independently answered their question, shared experience & findings
- Each team-member directed and performed analysis by algorithm assignment and interest

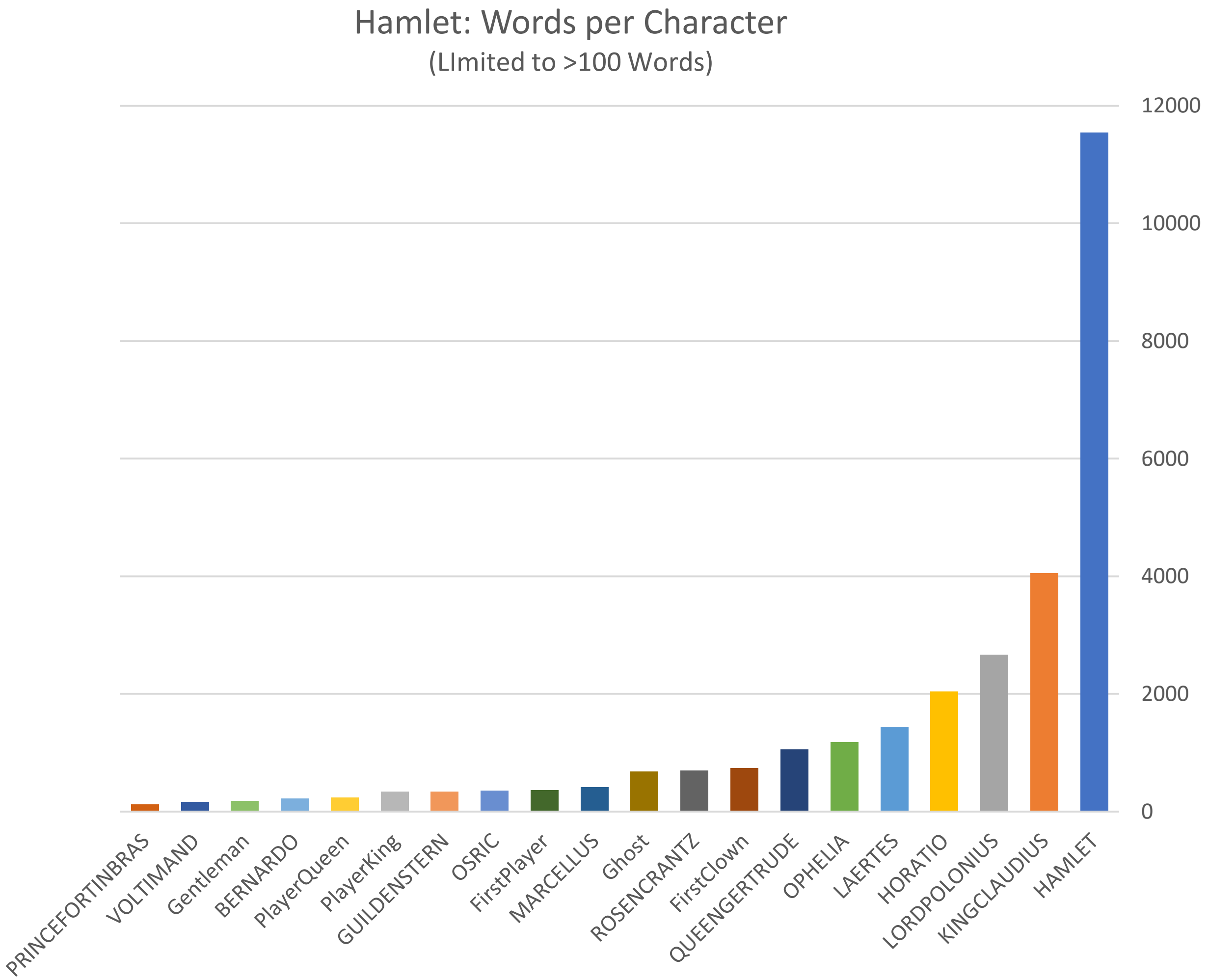


* http://mit.shakespeare.edu

Player and Dialogue Visualizations

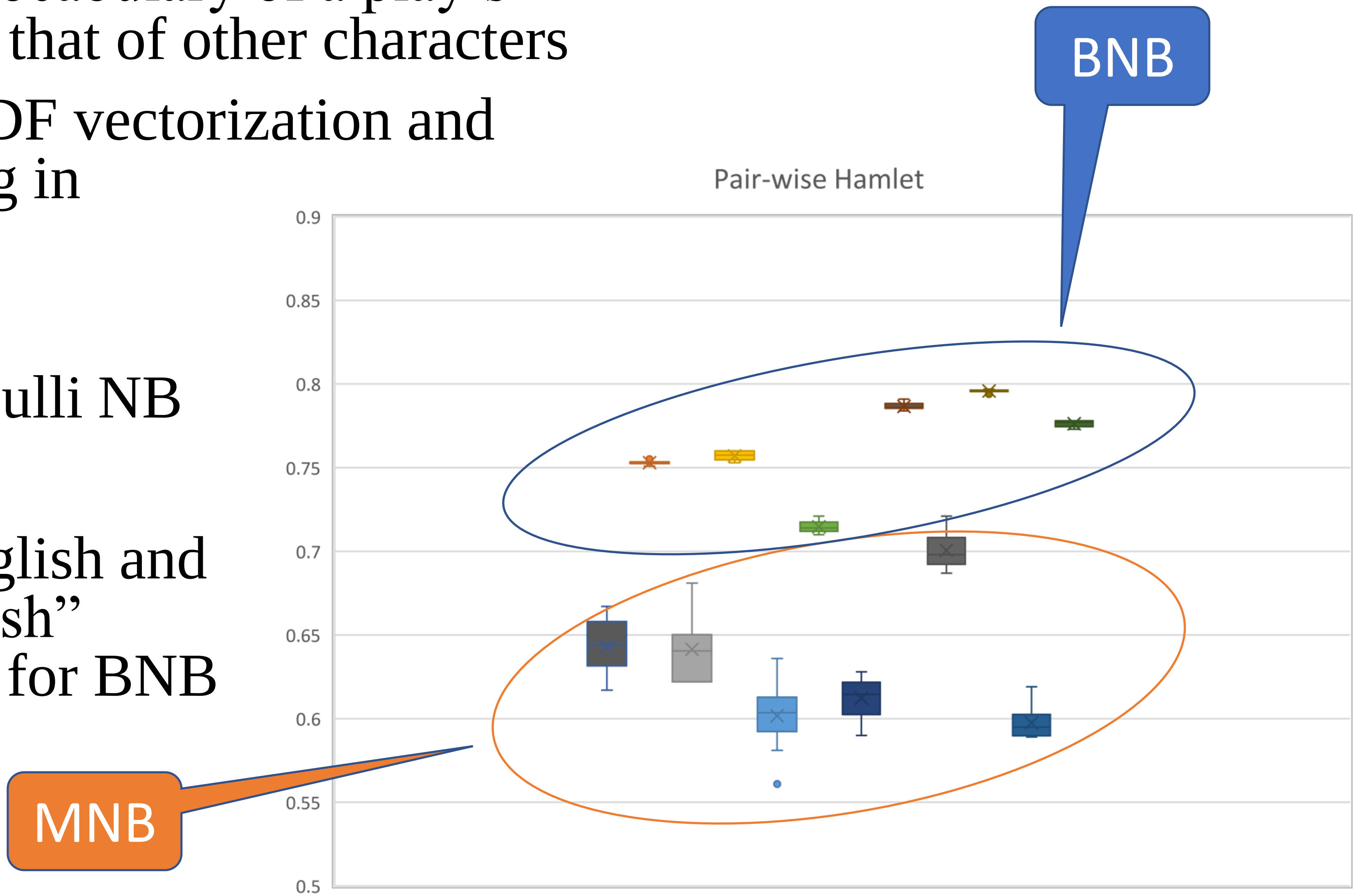
Frequency Distribution: Number of Players by Play



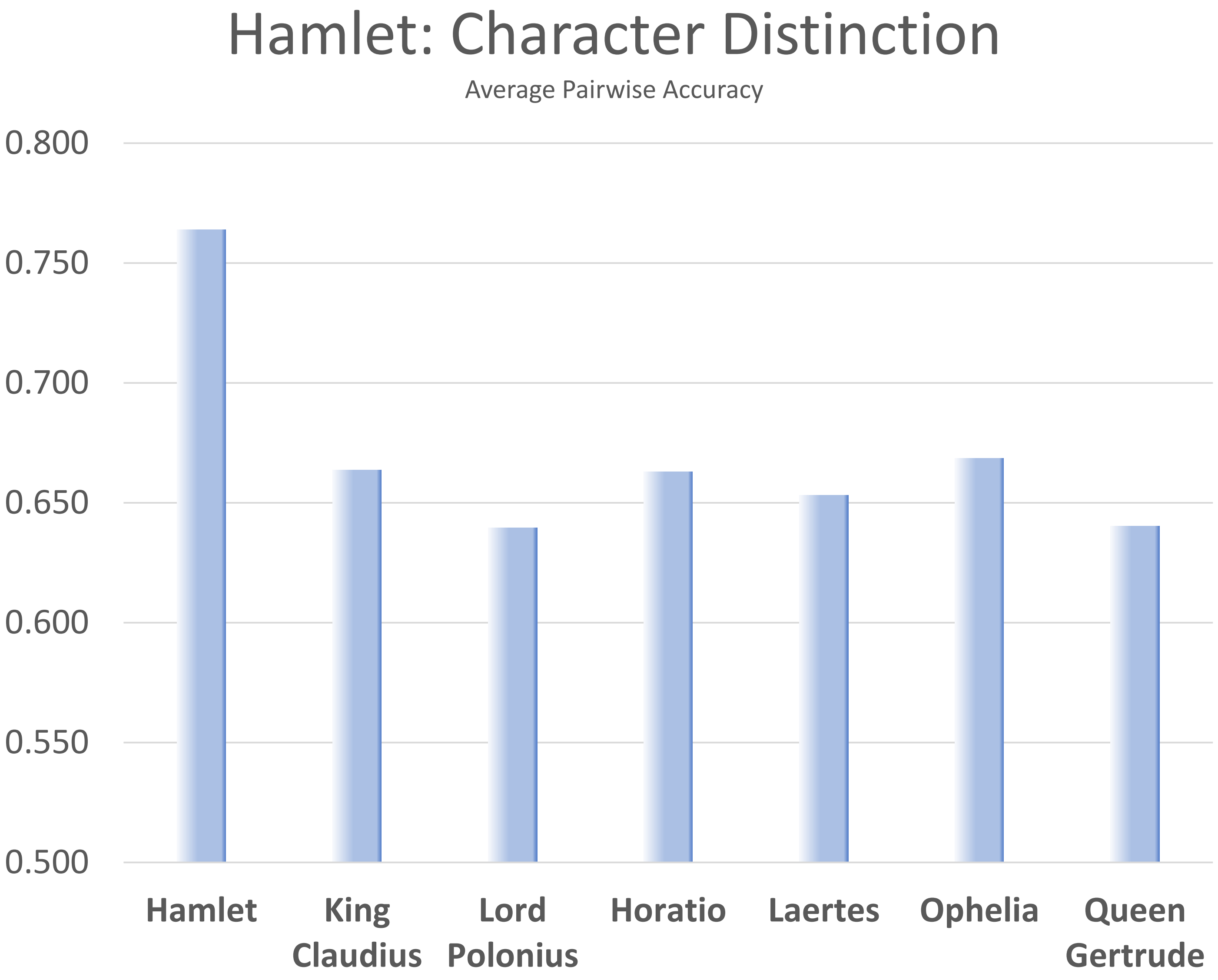


Character Distinction

- The amount that the vocabulary of a play's character differs from that of other characters
- Determined with TFIDF vectorization and Naïve Bayes modeling in pairwise comparisons
- Multinomial vs Bernoulli NB
- Tested removal of English and "Shakespearean English" stopwords: no benefit for BNB

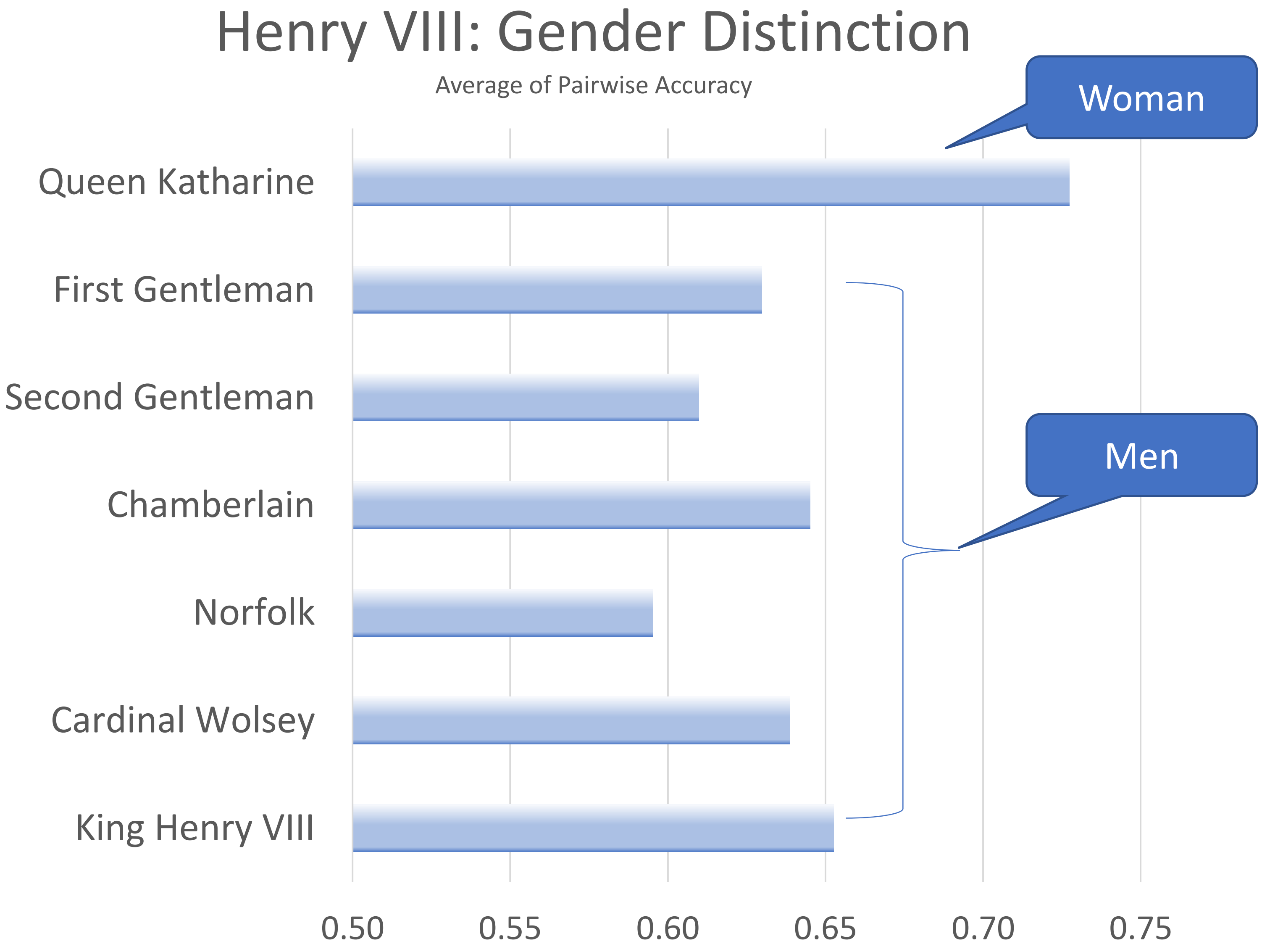


Only Hamlet’s word choices are distinctive

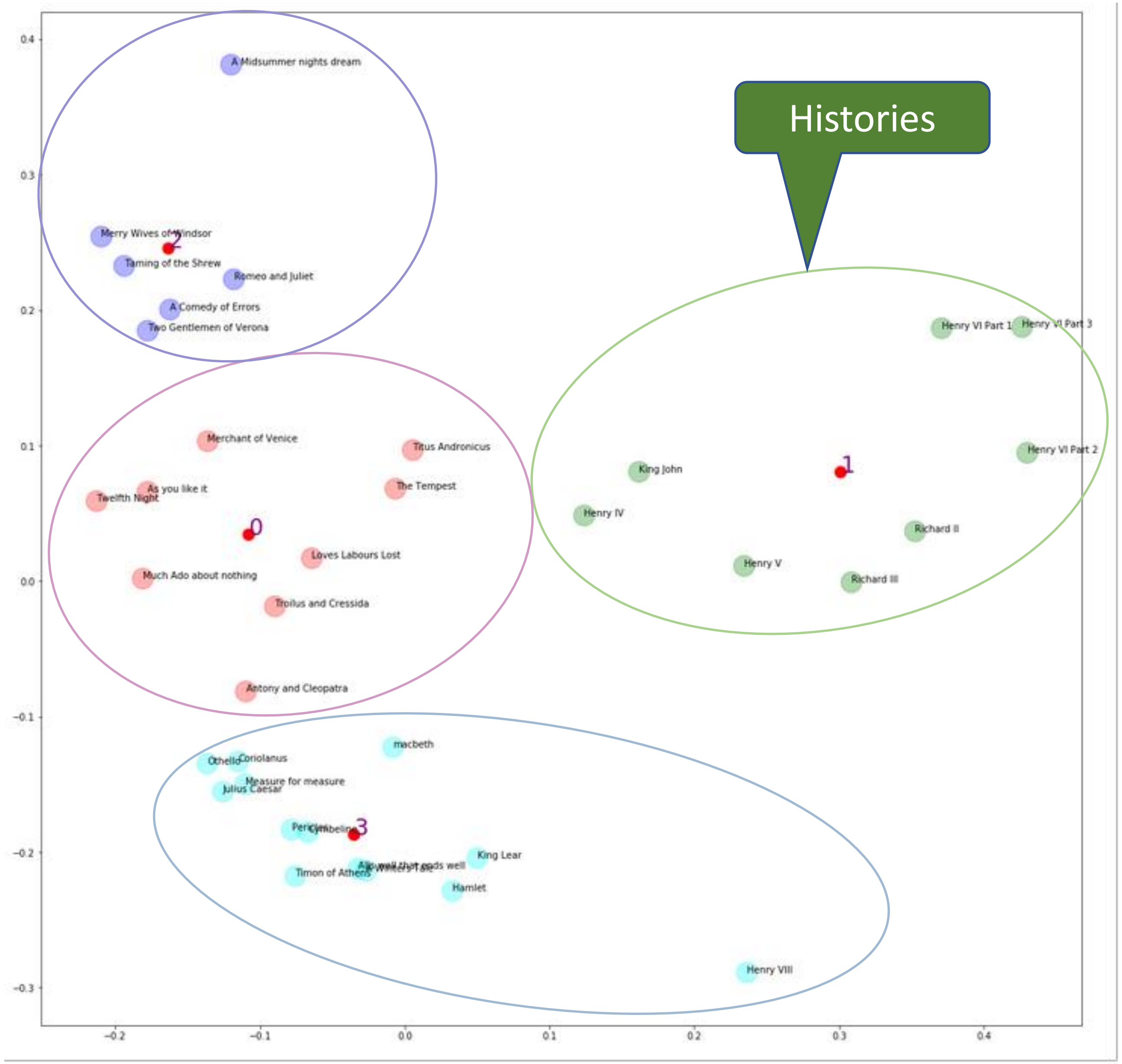


Henry VIII

Only the female character stood out



K-Means Clustering



Histories

Styles of Play

Number of Clusters (K)= 4

Cluster 0: As you like it, The Tempest, Merchant of Venice, Anthony and Cleopatra, Julius Caesar - Comedies, Tragedies, Romances

Cluster 1: King John, Henry VI Part 1-3, Henry IV, Henry V, Richard II, Richard III – The Histories

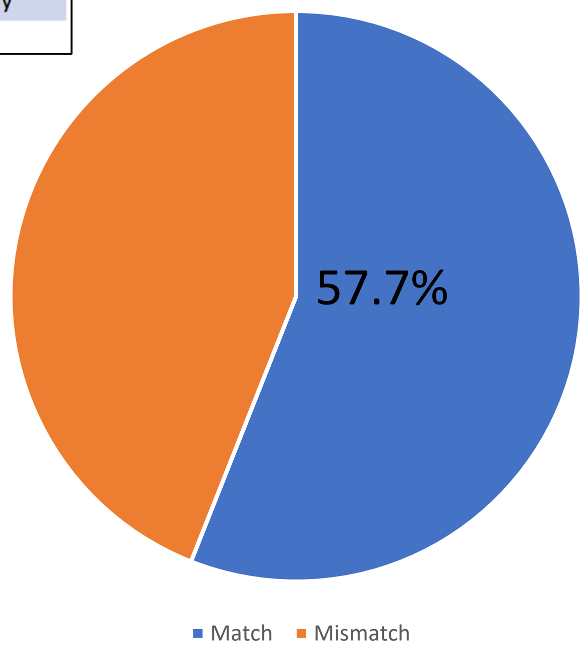
Cluster 2: Hamlet, King Lear, Othello, Winters Tale, Timon of Athens – Tragedies and a Comedy

Cluster 3: Romeo and Juliet, Merry Wives of Windsor, A Midsummer Night’s Dream, Titus Andronicus, Taming of the Shrew, Two gentleman of Verona - Comedies and Tragedies

Comedy vs Tragedy : Topic Modeling (LDA)

Play name	Category	LDA
All's Well That Ends Well	C	Tragedy
Antony and Cleopatra	T	Comedy
As You Like It	C	Tragedy
Comedy of Errors	C	Comedy
Coriolanus	T	Tragedy
Cymbeline	C	Tragedy
Hamlet	T	Tragedy
Julius Caesar	T	Tragedy
King Lear	T	Comedy
Love's Labour's Lost	C	Tragedy
Macbeth	T	Comedy
Measure for Measure	C	Tragedy
Merchant of Venice	C	Comedy
Midsummer Night's Dream	C	Comedy
Much Ado About Nothing	C	Comedy
Othello	T	Tragedy
Pericles	C	Comedy
Romeo and Juliet	T	Tragedy
Taming of the Shrew	C	Comedy
The Tempest	C	Tragedy
Timon of Athens	T	Comedy
Titus Andronicus	T	Tragedy
Troiles and Cressida	C	Tragedy
Twelfth Night	C	Comedy
Two Gentlemen of Verona	C	Comedy
Midsummer Night's Dream	C	Comedy

	LDA-Comedy	LDA-Tragedy
Comedy	9	7
Tragedy	4	6



Topic modeling Accuracy

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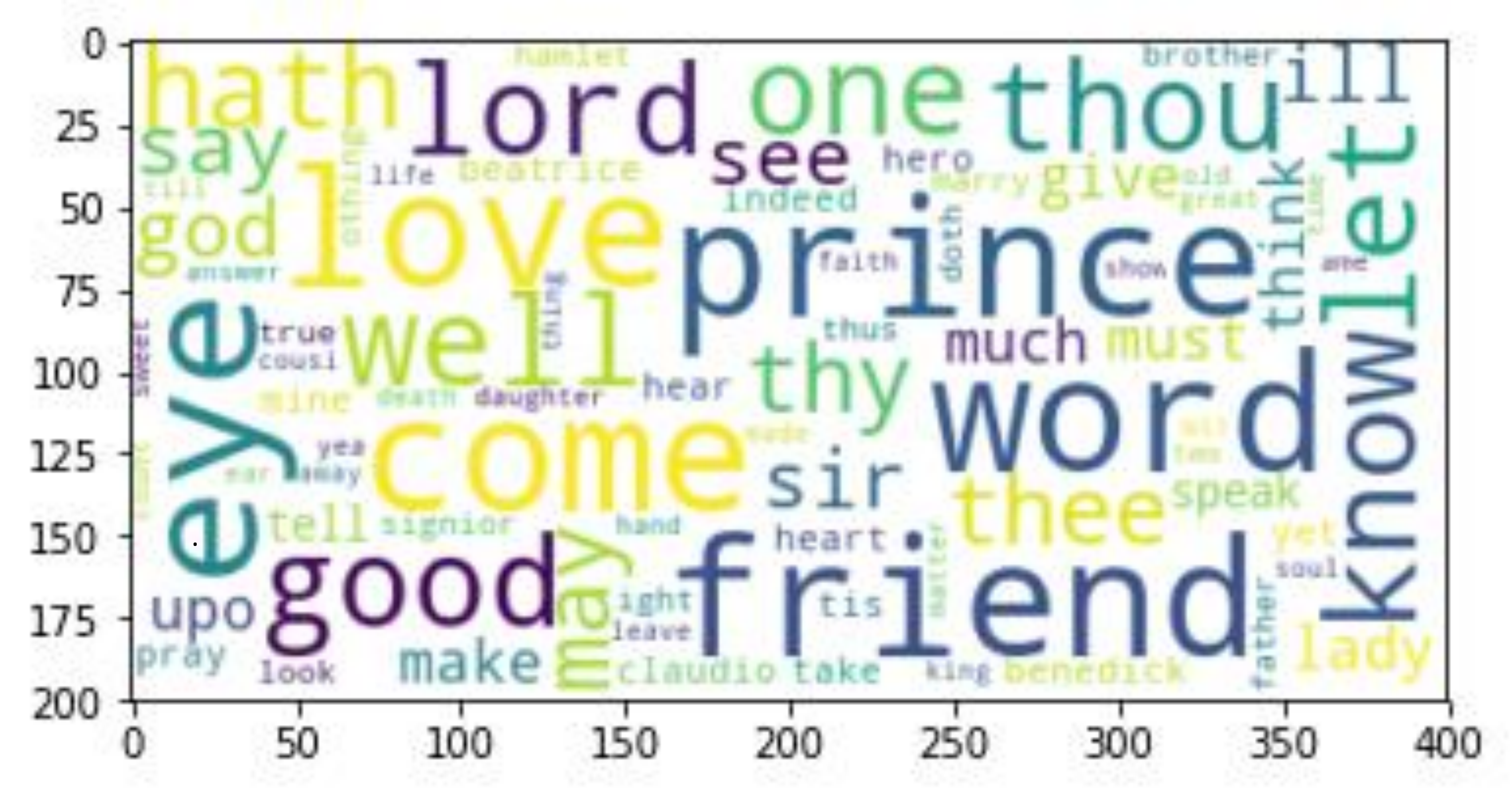
Much Ado… w “Lord, good and shall” top 3 frequency



Much Ado About Stopwords with a k-means Assessment

- Research has shown the importance of stopwords in literary text classification.
- According to Dr. Bei Yu, extremely common words can influence machine learning algorithms. Sentimental novels and plays create complex storylines and words like “my” might be a common word in one collection but not another so they should not be readily excluded (Yu, p. 330).*
- Shakespearean corpuses possess a small inventory of stopwords ~3%.
- TF-IDF & cosine similarity were assessed.
- Excluding stopwords did not impact k-means and SVM algorithm classifications.

Character Grouping with k-means by Vocabulary Usage – 55 Total Characters with 5 Clusters

With Stopwords

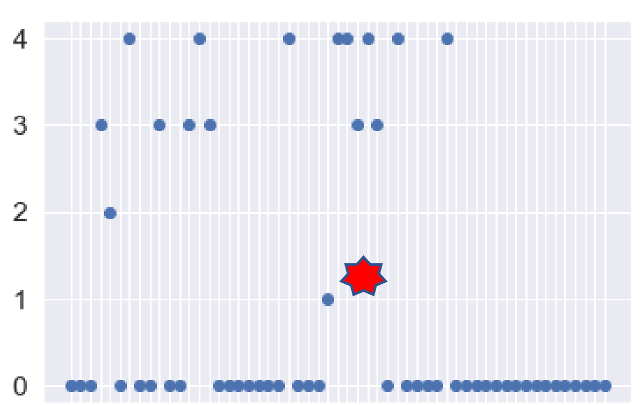
[8] Significant 2nd level cast (4)

[6] main family (3)

[1] Benedict – main character (2)

[1] Hamlet! – curious mistake distance math identified! (1)

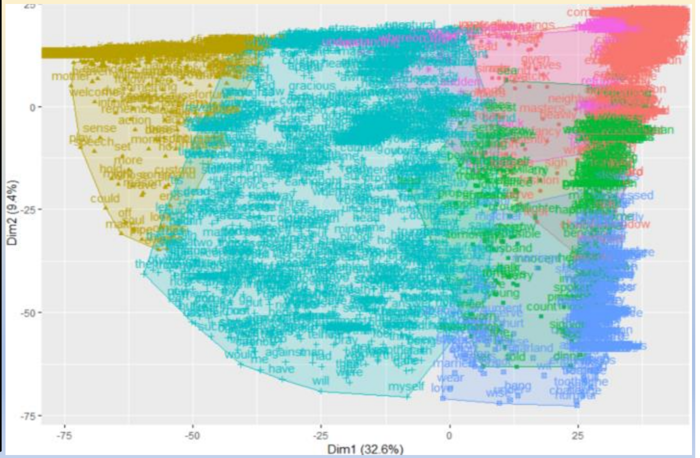
[39] Ensemble cast (0)



Without Stopwords

No change in cast grouping based on words.

K-means visualization by words instead of characters.



*Bei, Y. (2008). An evaluation of text classification methods for literary study. Literary and Linguistic Computing 23(3): 327-34

Conclusions

- Shakespeare *only occasionally* used different vocabularies between characters
- Word choice distinguished the Histories from the other genres, but not between the Comedies and Tragedies
- Multiple modeling techniques showed the vocabulary used in the Comedies and Tragedies do not differ significantly
- Reducing extremely common words with different techniques did not influence prediction outcomes