ASSIGNMENT – 3

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Performance Comparison between the Most Frequent Sense Model and Lesk Model:

From the output, the Most Frequent Sense (MFS) model achieves a precision of 0.5442, a recall of 0.5442, and an F1-score of 0.5442; whereas the Simplified Lesk algorithm performs slightly worse and achieves a precision of 0.476, a recall of 0.476, and an F1-score of 0.476.

This suggests that the Most Frequent Sense model performs better overall, while Lesk struggles with word sense disambiguation.

Analysis of Model Behaviors:

1. Most Frequent Sense (MFS) Model:

Strengths:

1) Baseline Model: Often correct because the most common sense of a word is statistically the most likely.
2) No Context Dependency: Does not rely on surrounding words, making it simple and efficient.

Weaknesses:

1) Fails on rare word senses: If a word is used in an uncommon sense, MFS always assigns the most frequent sense, leading to errors.
2) Context Ignorance: The model does not adapt to different sentence meanings.

Example Failure Case:

Sentence: "The bank of the river was eroded after the storm."

MFS Prediction: "bank.n.01" (financial institution)

Correct Sense: "bank.n.02" (side of a river)

Reason for this error: MFS always predicts the financial sense because it's more frequent in WordNet.

2. Simplified Lesk Algorithm

Strengths:

1) Uses Context: Tries to match the word's meaning with sentence context, making it more adaptable than MFS.
2) Handles Polysemy Better: If a word has multiple senses, it can select one based on overlapping words in definitions/examples.

Weaknesses:

1) Bag-of-Words Limitation: It only looks at word overlap, ignoring word order, semantics, and deep meaning.
2) Stopword Filtering May Remove Useful Words: Important words may get removed in stopword processing.
3) Short Definitions & Examples: If a sense's definition is too short, there may not be enough words to match, leading to random choices.

Example Failure Case:

Sentence: "She tied her hair with a bow."

Lesk Prediction: "bow.n.01" (a curved weapon for shooting arrows)

Correct Sense: "bow.n.02" (a decorative ribbon for tying hair)

Reason for this error: If "bow" in WordNet has more definitions/examples related to archery, the algorithm may pick that sense because of a small text overlap.

Conclusion: MFS is more accurate but cannot adapt to different contexts. Lesk tries to use context but is imperfect because word overlap is a weak heuristic. Overall, MFS is a strong baseline, but Lesk has the potential to improve with better text-processing techniques. Using Extended Lesk model might also provide a good improvement in the predictions of the Lesk model.