Part A

Q1: Which models got it right?
A1: sentence_transformer and openai_small got correct answer.

Q2: Why did some fail?
A2: Glove failed because it just averages words. It can't tell the relationship between words' sequence. For example, it can't distinguish "roses are red" and "red roses". It also filter words "are", "and", "is", diluting the color description meaning.
OpenAI Large failed because it overthinking, over-parameterized.

Q3: What does this reveal about word order?
A3: Word order can change meaning, eg. "Roses are red" describes color, but "Red roses" describes flowers. Words like "are", "is" amplify patterns.

Part B Model Comparison

	glove_25	glove_50	transformer	openai_small	openai_large
Although I love London's weather, I don't like its food.	22.2% Food	22.9% Food	23.5% Weather	22.9% Food	22.4% Weather
I love tulips, roses, and daisies in my garden	22.3% Flowers	22.1% Flowers	28.5% Flowers	26.4% Flowers	25.7% Flowers
Red rose	21.4% Colors	22% Colors	24.6% Flowers	25.3% Flowers	25.2% Flowers
Rose is red	20.8% Colors	20.8% Colors	24.5% Colors	22.6% Flowers	23.6% Flowers
I love chocolate milk	50.9% Milk	50.2% Milk	50.2% Milk	51.7% Milk	51.7% Milk
John bought milk chocolate yesterday	51.6% Milk	51.2% Milk	51.2% Chocolate	50.2% Milk	50.2% Milk
The movie was upsetting	52.1% Positive	51.2% Positive	50.7% Negative	52.7% Negative	52.3% Negative
This is terrible	52% Positive	51.8% Positive	51% Negative	53.1% Negative	52.5% Negative

model	accuracy	speed	order sensitivity
glove_25	50%	0.26	No
glove_50	50%	0.17	No
transformer	87.5%	295.20	Yes
openai_small	75%	660.02	No
openai_large	62.5%	299.32	No

Part C Real-World Applications

Group 1: Kitchen / Cleaning
kitchen sink cleaner → Category: Cleaning
cleaner for kitchen sink → Category: Kitchen / Cleaning

Explanation: In "kitchen sink cleaner", the head word is cleaner, so it's primarily a cleaning product. In "cleaner for kitchen sink", the focus shifts to kitchen sink as the target object.

Group 2: Outdoor / Clothing
outdoor winter jacket → Category: Clothing
winter jacket for outdoor activities → Category: Outdoor / Clothing

Explanation: "outdoor winter jacket" centers on jacket; "winter jacket for outdoor activities" emphasizes the use context - for outdoor activities.

Group 3: Furniture / Office
office desk lamp → Category: Furniture / Lighting
lamp for office desk → Category: Office / Accessories

Explanation: In "office desk lamp", the head noun is lamp, typically grouped with furniture or lighting. In "lamp for office desk", the phrase highlights office desk as the main context, so it feels more like an office accessory.

Deployed app

https://chloe-zhong-llm-2026-mini-proj1.streamlit.app/