**Part 1: WordNet Analysis of the Word "Dog"**

1. **Synsets, Lemma Names, Definitions, and Examples**

For the word "dog," I retrieved several synsets, each representing a different sense of the word. Below are the synsets and details for "dog":

* + **Synset: dog.n.01**
    - **Lemmas**: ['dog', 'domestic\_dog', 'Canis\_familiaris']
    - **Definition**: A member of the genus Canis (probably descended from the common wolf) that has been domesticated by man since prehistoric times; occurs in many breeds.
    - **Examples**: ['the dog barked all night']
  + **Synset: frump.n.01**
    - **Lemmas**: ['frump', 'dog']
    - **Definition**: A dull unattractive unpleasant girl or woman.
    - **Examples**: ['she got a reputation as a frump', "she's a real dog"]
  + **Synset: dog.n.03**
    - **Lemmas**: ['dog']
    - **Definition**: Informal term for a man.
    - **Examples**: ['you lucky dog']
  + **Synset: cad.n.01**
    - **Lemmas**: ['cad', 'bounder', 'blackguard', 'dog', 'hound', 'heel']
    - **Definition**: Someone who is morally reprehensible.
    - **Examples**: ['you dirty dog']
  + **Synset: frank.n.02**
    - **Lemmas**: ['frank', 'frankfurter', 'hotdog', 'hot\_dog', 'dog', 'wiener', 'wienerwurst', 'weenie']
    - **Definition**: A smooth-textured sausage of minced beef or pork usually smoked; often served on a bread roll.
  + **Synset: pawl.n.01**
    - **Lemmas**: ['pawl', 'detent', 'click', 'dog']
    - **Definition**: A hinged catch that fits into a notch of a ratchet to move a wheel forward or prevent it from moving backward.
  + **Synset: andiron.n.01**
    - **Lemmas**: ['andiron', 'firedog', 'dog', 'dog-iron']
    - **Definition**: Metal supports for logs in a fireplace.
    - **Examples**: ['the andirons were too hot to touch']
  + **Synset: chase.v.01**
    - **Lemmas**: ['chase', 'chase\_after', 'trail', 'tail', 'tag', 'give\_chase', 'dog', 'go\_after', 'track']
    - **Definition**: Go after with the intent to catch.
    - **Examples**: ['The policeman chased the mugger down the alley', 'the dog chased the rabbit']

**Analysis**: The word "dog" has a wide range of meanings, from the literal sense of a domesticated animal to abstract or colloquial senses like an unattractive person or an informal term for a man. These variations show how language evolves to accommodate different social and cultural contexts.

1. **Direct Hypernyms of dog.n.01**

The direct hypernyms (more general terms) of dog.n.01 are:

* + **Hypernym 1**: domestic\_animal.n.01 – Any of various animals domesticated by humans.
  + **Hypernym 2**: canine.n.02 – Any of various fissiped mammals with non-retractile claws and typically long muzzles.

**Analysis**: These hypernyms categorize the word "dog" within broader categories of "domestic animal" and "canine." This reflects how WordNet organizes words hierarchically, allowing us to see the broader groups a word belongs to.

1. **Hypernym Paths for dog.n.01**

I identified two hypernym paths from the synset dog.n.01 to the top of the hierarchy. These paths trace back to the most general category, "entity."

* + **Path 1**:

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entity.n.01 -> physical\_entity.n.01 -> object.n.01 -> whole.n.02 -> living\_thing.n.01 -> organism.n.01 -> animal.n.01 -> domestic\_animal.n.01 -> dog.n.01

* + **Path 2**:

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entity.n.01 -> physical\_entity.n.01 -> object.n.01 -> whole.n.02 -> living\_thing.n.01 -> organism.n.01 -> animal.n.01 -> chordate.n.01 -> vertebrate.n.01 -> mammal.n.01 -> placental.n.01 -> carnivore.n.01 -> canine.n.02 -> dog.n.01

**Analysis**: These paths demonstrate the structure of WordNet’s hierarchy, showing how "dog" is classified within different levels, from "entity" down to the specific sense of a "domesticated dog."

1. **Additional Relations for dog.n.01**
   * **Part Meronyms**: flag.n.07 (related to part of an object like a ratchet).
   * **Member Holonyms**: pack.n.06 (a group of dogs) and canis.n.01 (genus to which the dog belongs).

**Analysis**: Meronyms and holonyms add further layers of relationships. Meronyms express part-whole relationships (i.e., parts of a dog), while holonyms show membership in larger groups (i.e., dogs belonging to a pack or genus).

**Part 2: Sentiment Analysis Using SentiWordNet**

For the synset dog.n.01, I retrieved the following sentiment scores from SentiWordNet:

* **Positive Score**: 0.0
* **Negative Score**: 0.0
* **Objective Score**: 1.0

**Analysis**: The sentiment analysis indicates that dog.n.01 is purely objective with no inherent positive or negative sentiment. This is expected for a synset representing a factual entity (a domesticated dog). This neutrality in sentiment is common for objective terms, as they do not carry emotional weight on their own.

**Observations and Lessons Learned**

* **Lexical Semantics in WordNet**: WordNet provides a detailed framework for exploring the meanings of words and how they relate to each other. Hypernyms, meronyms, and holonyms reveal not only hierarchical relationships but also part-whole and membership relations. This helps in understanding the structure and richness of language.
* **Context-Dependent Meaning**: The multiple synsets of "dog" illustrate how words can carry different meanings depending on the context. This is a critical lesson in natural language processing (NLP) since computational systems must account for polysemy (multiple meanings of a word).
* **Sentiment in SentiWordNet**: The sentiment analysis performed with SentiWordNet showed that not all words have clear emotional connotations. Understanding when words are neutral versus emotionally charged can be crucial for tasks like opinion mining or sentiment analysis in text data.

**Conclusion**

This lab session provided valuable hands-on experience with WordNet and SentiWordNet, which are powerful tools in lexical semantics and sentiment analysis. Through the exploration of the word "dog," I gained insights into how words are organized in hierarchies, how they relate to other words, and how they can carry sentiment. This knowledge is essential for further work in natural language processing and computational linguistics.