Department of Computer Science & Engineering

Title: **Artificial Intelligence System & Expert System Lab**

Course Code: **CSE 404**

Name Of Project: **Animal Classification System**

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Problem Title:

Animal Classification System

Problem Description:

The Prolog-based Animal Classification system is designed to represent and analyze the hierarchical classification of animals based on biological taxonomy. It organizes animals into seven levels: **Kingdom, Phylum, Class, Order, Family, Genus, and Species**, and it allows users to explore relationships within this system's taxonomy. The system enables logical queries to determine various relationships between different classifications. Everyone can check **parent-child** relationships to see how classifications are structured (Mammalia belongs to Chordata) and (Phylum belongs to Animalia). It also supports **sibling relationships**, identifying classifications that share the same parent (Reptilia and Aves both belong to Chordata). Additionally, the system provides insights into **grandparent and great-grandparent** relationships, allowing an understanding of ancestral connections. One of the key features of the system is **ancestor tracking**, where users can query and trace an animal's lineage across multiple hierarchical levels. By defining logical rules and facts, this system simplifies the study of biological classification and serves as a valuable tool for education, research, and AI-driven knowledge systems.

Tools and Languages Used:

- Programming Language: Prolog
- Diagram Design Tool: Canva
- Text Editor: Prolog, Vs Code
- Operating System: Windows

Diagram/Figure:

The classification hierarchy is a **tree structure** where **Animalia** is the root, branching into **Phyla**, then **Classes**, **Orders**, **Families**, **Genera**, and **Species** at the leaf nodes. The relationships between these levels are **parent-child**, meaning each classification is derived from the level above. Additionally, **sibling relationships** exist within the same classification level (e.g., Mammalia and Reptilia are siblings under Chordata). The diagram visually illustrates the hierarchical structure and logical connections in the Prolog Animal Classification System.

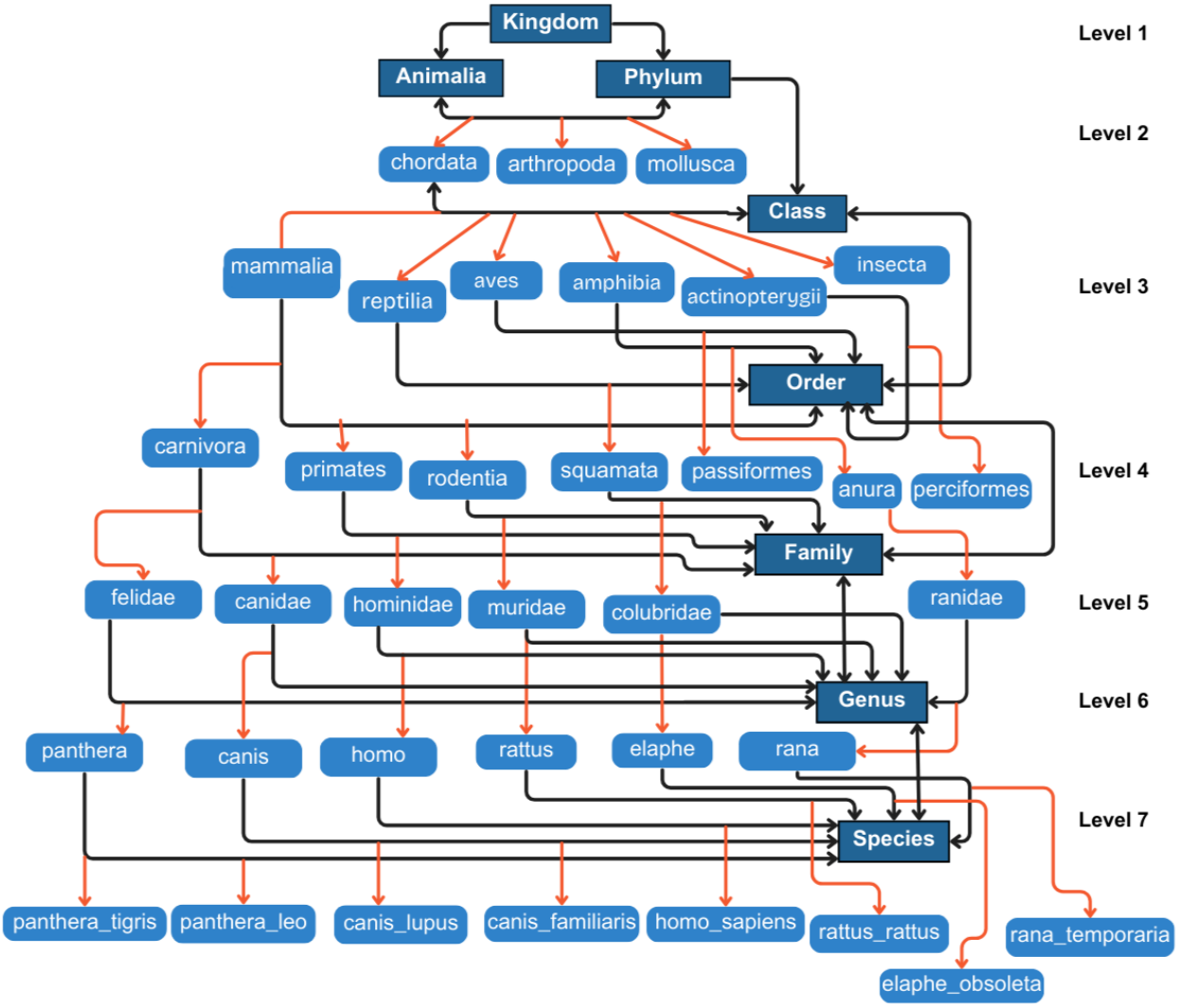


Figure: Animal Classification Tree Structure

Source Code:

```
 /* Level 1: Kingdom */

kingdom(animalia).

/* Level 2: Phylum */

phylum(chordata, animalia).
```

```
phylum(arthropoda, animalia).

phylum(mollusca, animalia).

/* Level 3: Class */

class(mammalia, chordata).

class(reptilia, chordata).

class(aves, chordata).

class(amphibia, chordata).

class(actinopterygii, chordata). /* Fish */

class(insecta, arthropoda).

/* Level 4: Order */

order(carnivora, mammalia).

order(primates, mammalia).

order(rodentia, mammalia).

order(squamata, reptilia).

order(anura, amphibia).

order(passiformes, aves). /* Songbirds */

order(perciformes, actinopterygii). /* Largest fish order */

/* Level 5: Family */

family(felidae, carnivora).

family(canidae, carnivora).

family(hominidae, primates).

family(muridae, rodentia).

family(colubridae, squamata). /* Non-venomous snakes */
```

```
family(ranidae, anura). /* True frogs */
/* Level 6: Genus */
genus(panthera, felidae).
genus(canis, canidae).
genus(homo, hominidae).
genus(rattus, muridae). /* Rats */
genus(elaphe, colubridae). /* Rat snakes */
genus(rana, ranidae). /* Large true frogs */
/* Level 7: Species */
species(panthera_tigris, panthera). /* Tiger */
species(panthera_leo, panthera). /* Lion */
species(canis_lupus, canis). /* Wolf */
species(canis_familiaris, canis). /* Dog */
species(homo_sapiens, homo). /* Human */
species(rattus_rattus, rattus). /* Black Rat */
species(elaphe_obsoleta, elaphe). /* Rat Snake */
species(rana_temporaria, rana). /* Common Frog */

/* A is parent of B if (A is a direct classification of B) */
parent(A, B):-
    phylum(B, A);
    class(B, A);
    order(B, A);
```

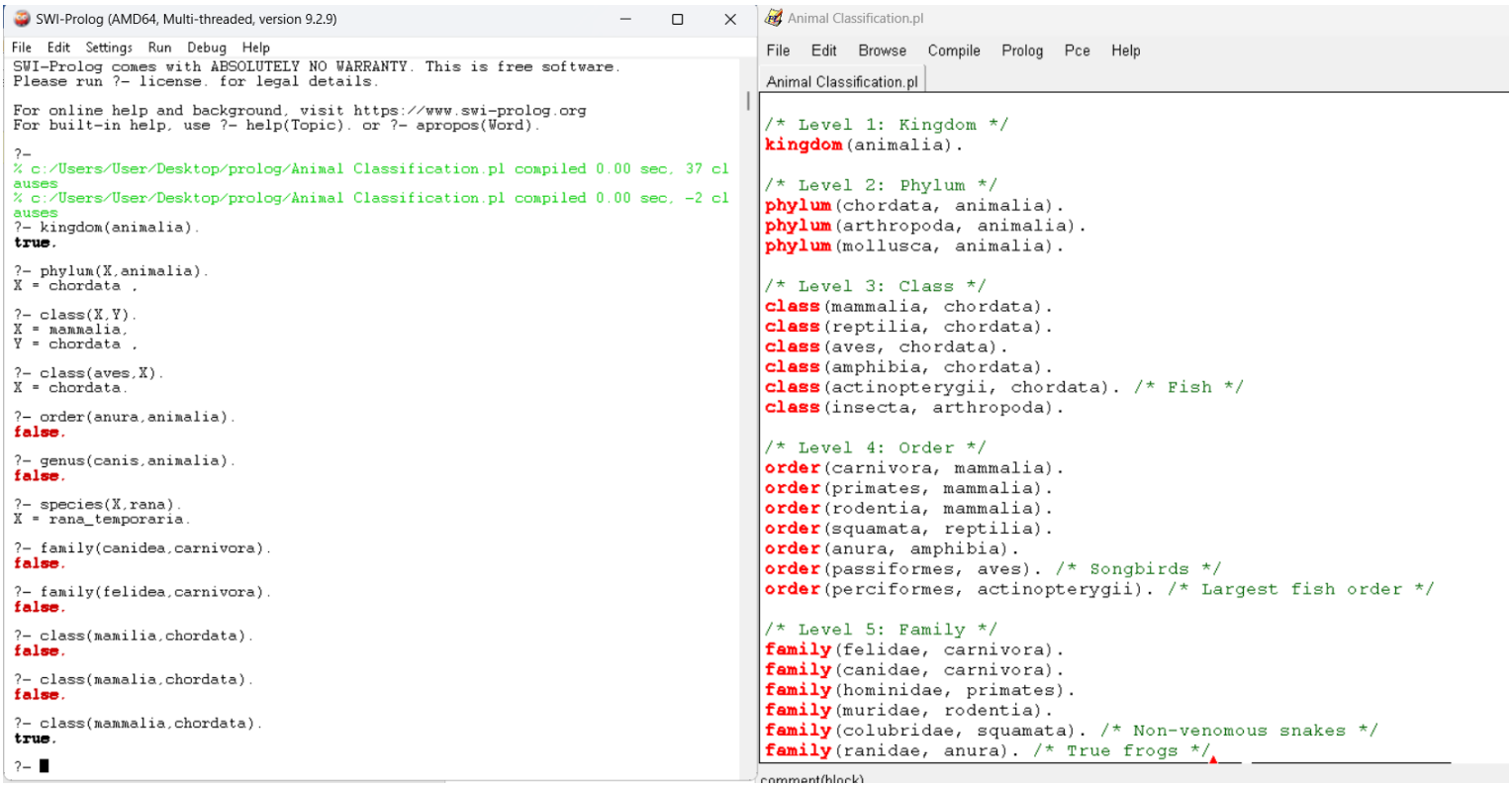
```
    family(B, A);
    genus(B, A);
    species(B, A).

/* A and B are siblings if they share the same parent */
sibling(A, B):-
    parent(C, A),
    parent(C, B),
    A \== B.
/* A is grandparent of B if C is parent of B and A is parent of C */
grandparent(A, B):-
    parent(C, B),
    parent(A, C).
greatgrandparent(A, B):-
    parent(C, B),
    parent(D, C),
    parent(A, D).

/* A is an ancestor of B recursively */
ancestor(A, B):-
    parent(A, B).
ancestor(A, B):-
    parent(A, C),
```

ancestor(C, B).

Sample Input/Output:



```
SWI-Prolog (AMD64, Multi-threaded, version 9.2.9)
File  Edit  Settings  Run  Debug  Help
SWI-Prolog comes with ABSOLUTELY NO WARRANTY. This is free software.
Please run ?- license. for legal details.

For online help and background, visit https://www.swi-prolog.org
For built-in help, use ?- help(Topic). or ?- apropos(Word).

?-
% c:/Users/User/Desktop/prolog/Animal Classification.pl compiled 0.00 sec, 37 cl
auses
% c:/Users/User/Desktop/prolog/Animal Classification.pl compiled 0.00 sec, -2 cl
auses
?- kingdom(animalia).
true.

?- phylum(X,animalia).
X = chordata ;

?- class(X,Y).
X = mammalia,
Y = chordata ;

?- class(aves,X).
X = chordata.

?- order(anura,animalia).
false.

?- genus(canis,animalia).
false.

?- species(X,rana).
X = rana_temporaria.

?- family(canidea,carnivora).
false.

?- family(felidea,carnivora).
false.

?- class(mamilia,chordata).
false.

?- class(mamalia,chordata).
false.

?- class(mammalia,chordata).
true.

?-
```

```
Animal Classification.pl
File  Edit  Browse  Compile  Prolog  Pce  Help
Animal Classification.pl

/* Level 1: Kingdom */
kingdom(animalia).

/* Level 2: Phylum */
phylum(chordata, animalia).
phylum(arthropoda, animalia).
phylum(mollusca, animalia).

/* Level 3: Class */
class(mammalia, chordata).
class(reptilia, chordata).
class(aves, chordata).
class(amphibia, chordata).
class(actinopterygii, chordata). /* Fish */
class(insecta, arthropoda).

/* Level 4: Order */
order(carnivora, mammalia).
order(primates, mammalia).
order(rodentia, mammalia).
order(squamata, reptilia).
order(anura, amphibia).
order(passiformes, aves). /* Songbirds */
order(perciformes, actinopterygii). /* Largest fish order */

/* Level 5: Family */
family(felidae, carnivora).
family(canidae, carnivora).
family(hominidae, primates).
family(muridae, rodentia).
family(colubridae, squamata). /* Non-venomous snakes */
family(ranidae, anura). /* True frogs */
comment(block)
```

Conclusion:

This Prolog-based classification system provides a structured way to represent and query biological relationships among animals. Using logic-based queries, users can explore different relationships between species and their hierarchical connections. The system is useful for educational purposes, biological research, and many other things.

Challenges Faced:

1. If I Add more species and classifications increases complexity and many problems.
2. With a larger dataset, recursive queries may slow down execution.
3. Structuring this biological taxonomy efficiently in Prolog requires careful planning so that it can be implemented properly.
4. When I check the output I mistake in spelling so that the quarries show me the error.