Readme File for KNN HW

Dataset:

The dataset used is a list of animal instances which I created based on their attributes in real life. The instances are identified by the animal name and there are 5 features in total: Habitat, Diet, Number of Limbs, Covering and Primary Movement Method. The label to be determined by the KNN using the features is the class and there are four possible values for this: Mammal, Bird, Fish and Insect. There are 16 instances in total, 4 from each of the 4 possible classes.

Animal Name	Habitat	Diet	Number of Limbs	Covering	Primary Movement Method	Class
Lion	Land	Carnivore	Four	Fur	Crawl	Mammal
Human	Land	Omnivore	Four	Skin	Walk	Mammal
Platypus	Both	Carnivore	Four	Fur	Crawl	Mammal
Deer	Land	Herbivore	Four	Fur	Crawl	Mammal
Eagle	Land	Carnivore	Two	Feathers	Fly	Bird
Chicken	Land	Omnivore	Two	Feathers	Walk	Bird
Swan	Both	Herbivore	Two	Feathers	Swim	Bird
Penguin	Both	Carnivore	Two	Feathers	Walk	Bird
Clownfish	Water	Herbivore	None	Scales	Swim	Fish
Shark	Water	Carnivore	None	Scales	Swim	Fish
Catfish	Water	Omnivore	None	Skin	Swim	Fish
Mudskipper	Both	Carnivore	Two	Scales	Crawl	Fish
Beetle	Land	Omnivore	More tha...	Exoskeleton	Crawl	Insect
Wasp	Land	Omnivore	More tha...	Exoskeleton	Fly	Insect
Centipede	Land	Carnivore	More tha...	Exoskeleton	Crawl	Insect
Waterbug	Water	Herbivore	More tha...	Exoskeleton	Crawl	Insect

Metric for the KNN:

The metric used for the KNN is an integer value determined by the total scores of whether or not the features are different from the experimental instance and the instance in the table. Each feature is weighted differently:

- Different Habitats = 2 Points
- Different Diets = 1 Point
- Different Number of Limbs = 3 Points
- Different Coverings = 2 Points
- Different Primary Movement Method = 2 Points

The lower the score is for an instance in the table, the closer the distance is to the experimental instance. Here is a sample metric calculation:

(Next Page)

***Note:** In case there is a tie of labels after the nearest neighbors are determined, this priority queue determines the winner: [Mammal, Bird, Fish, Insect]

Test Case: Hippo	Land	Omnivore	Four	Skin	Crawl	Mammal	
Animal Name	**Habitat**	**Diet**	**Number of Limbs**	**Covering**	**Primary Movement Method**	Class	**Score**
Human	0	0	0	0	2	Mammal	2
Lion	0	1	0	2	0	Mammal	3
Deer	0	1	0	2	0	Mammal	3
Platypus	2	1	0	2	0	Mammal	5
Beetle	0	0	3	2	0	Insect	5
Centipede	0	1	3	2	0	Insect	6
Chicken	0	0	3	2	2	Bird	7
Catfish	2	0	3	0	2	Fish	7
Wasp	0	0	3	2	2	Insect	7
Eagle	0	1	3	2	2	Bird	8
Mudskipper	2	1	3	2	0	Fish	8
Waterbug	2	1	3	2	0	Insect	8
Swan	2	1	3	2	2	Bird	10
Penguin	2	1	3	2	2	Bird	10
Clownfish	2	1	3	2	2	Fish	10
Shark	2	1	3	2	2	Fish	10

K-Values:

The chosen K-values are 1, 4, 5 and 7.

Program Documentation:

The programming language used for the implementation of the KNN algorithm is Java and utilizes OOP concepts for the database. The Animal class is the class used to represent the database, with the fields habitat, diet, limbs, covering, movement and classification to hold the values for the features and label. There are 16 animal objects in total, one for each instance in the database. The currscore field and derivescore method keeps track of the animal's metric distance to the current experimental instance so this field is reset with the resetscore method each time a new KNN is done. There are also various getter methods for general purposes.

```java
public class Animal{


    //fields
    private String name;
    private String habitat;
    private String diet;
    private String limbs;
    private String covering;
    private String movement;
    private String classification;
    private Integer currScore;

    //constructor
    public Animal(String n, String h, String d, String l, String c, String m, String cl){
        name = n;
        habitat = h;
        diet = d;
        limbs = l;
        covering = c;
        movement = m;
        classification = cl;
        currScore = 0;
    }
```

The newAnimal class is the class that is used to create an animal object for an experimental instance when the KNN is done. It basically has the same fields and methods as the Animal class except for the scorekeeping fields and methods.

```
public class NewAnimal {


    //fields
    private String name;
    private String habitat;
    private String diet;
    private String limbs;
    private String covering;
    private String movement;

    //constructor
    public NewAnimal(String n, String h, String d, String l, String c, String m){
        name = n;
        habitat = h;
        diet = d;
        limbs = l;
        covering = c;
        movement = m;
    }
```

The KnnMain module is where the KNN algorithm is done. Here, the instances of all the Animal and newAnimal classes are created, to populate the database and create experimental instances.

```
import java.util.ArrayList;
import java.util.Arrays;
import java.util.Comparator;
import java.util.Scanner;

public class KnnMain {

    static Animal lion = new Animal(n:"Lion", h:"Land",d:"Carnivore",l:"Four",c:"Fur",m:"Crawl", cl:"Mammal");
    static Animal human = new Animal(n:"Human",h:"Land", d:"Omnivore", l:"Four", c:"Skin", m:"Walk", cl:"Mammal");
    static Animal platypus = new Animal(n:"Platypus",h:"Both", d:"Carnivore", l:"Four", c:"Fur", m:"Crawl", cl:"Mammal");
    static Animal deer = new Animal(n:"Deer",h:"Land", d:"Herbivore", l:"Four", c:"Fur", m:"Crawl", cl:"Mammal");
    static Animal eagle = new Animal(n:"Eagle",h:"Land", d:"Carnivore", l:"Two", c:"Feathers", m:"Fly", cl:"Bird");
    static Animal chicken = new Animal(n:"Chicken",h:"Land", d:"Omnivore", l:"Two", c:"Feathers", m:"Walk", cl:"Bird");
    static Animal swan = new Animal(n:"Swan",h:"Both", d:"Herbivore", l:"Two", c:"Feathers", m:"Swim", cl:"Bird");
    static Animal penguin = new Animal(n:"Penguin",h:"Both", d:"Carnivore", l:"Two", c:"Feathers", m:"Walk", cl:"Bird");
    static Animal clownfish = new Animal(n:"Clownfish",h:"Water", d:"Herbivore", l:"None", c:"Scales", m:"Swim", cl:"Fish");
    static Animal shark = new Animal(n:"Shark",h:"Water", d:"Carnivore", l:"None", c:"Scales", m:"Swim", cl:"Fish");
    static Animal catfish = new Animal(n:"Catfish",h:"Water", d:"Omnivore", l:"None", c:"Skin", m:"Swim", cl:"Fish");
    static Animal mudskipper = new Animal(n:"Mudskipper",h:"Both", d:"Carnivore", l:"Two", c:"Scales", m:"Crawl", cl:"Fish");
    static Animal beetle = new Animal(n:"Beetle",h:"Land", d:"Omnivore", l:"More than Four", c:"Exoskeleton", m:"Crawl", cl:"Insect");
    static Animal wasp = new Animal(n:"Wasp",h:"Land", d:"Omnivore", l:"More than Four", c:"Exoskeleton", m:"Fly", cl:"Insect");
    static Animal centipede = new Animal(n:"Centipede",h:"Land", d:"Carnivore", l:"More than Four", c:"Exoskeleton", m:"Crawl", cl:"Insect");
    static Animal waterbug = new Animal(n:"Waterbug",h:"Water", d:"Herbivore", l:"More than Four", c:"Exoskeleton", m:"Crawl", cl:"Insect");

    static Animal[] existingAnimals = { lion, human, platypus, deer, eagle, chicken, swan, penguin,
        clownfish, shark, catfish, mudskipper, beetle, wasp, centipede, waterbug };

    static ArrayList<Animal> animalPlacing = new ArrayList<Animal>();

    static int mammalScore = 0;
    static int birdScore = 0;
    static int fishScore = 0;
    static int insectScore = 0;
    static String verdict;

    static Scanner scanner = new Scanner(System.in);
    static String a;

    static void findScores(NewAnimal na){
```

(Next Page)

The following are the fields and methods used in this module to run the KNN and their descriptions:

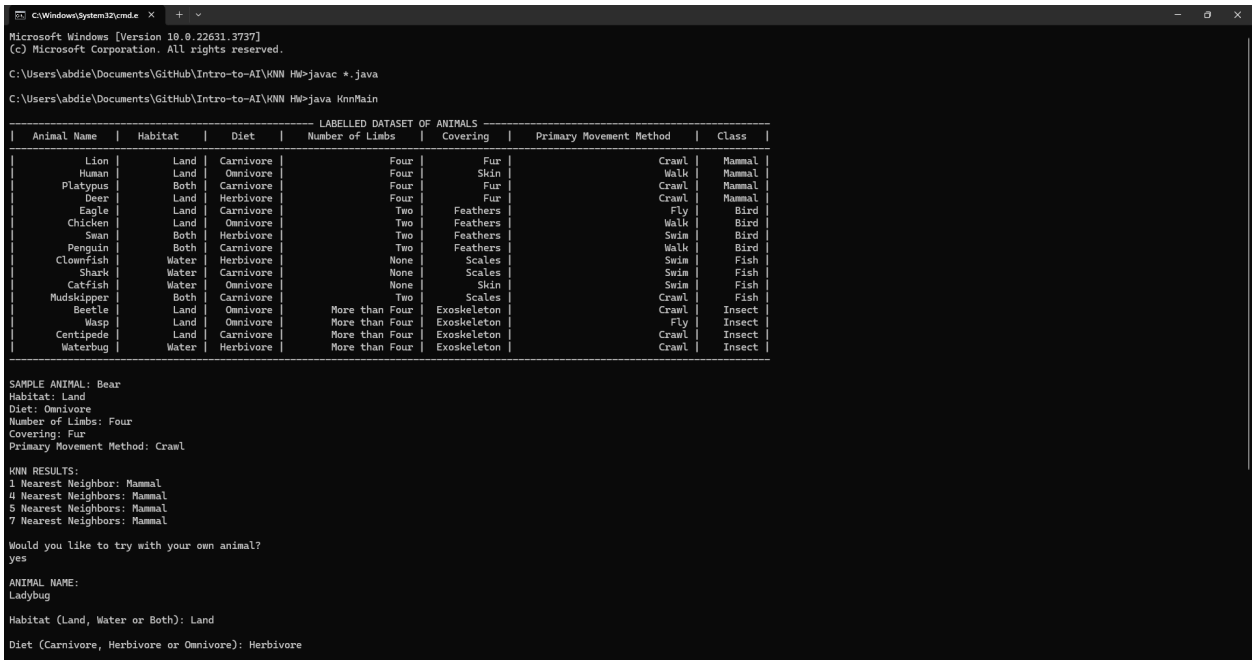
- **Array existingAnimals** - An array of Animal objects used to represent the database.
- **ArrayList animalPlacing** - An arraylist of Animal objects where Animal instances that qualify as nearest neighbors are added.
- **Integers classScore** - A tallying of the score of the labels used to determine the label of the experimental instance.
- **String verdict** - The winning class label for a KNN.
- **Method findScores** - Method used to calculate the metric score for each animal in a KNN.
- **Method addTies** - Method used to include Animal objects in the animalPlacing arraylist in case there is a tie in a KNN.
- **Method tallyScores** - Method used to calculate the classScores.
- **Method determineWinner** - Method used to compare classScores to determine the label of the KNN.
- **Method resetForNextK** - Method used to reset the classScores, animalPlacing and verdict for the next KNN.
- **Method resetForNextAnimal** - Method used to reset all fields for the next experimental label.
- **Method printTable** - Prints a table of the database at the start of the program.
- **Method KNN** - Methods that utilize all the above methods to perform the actual KNN.

With these fields and methods, the actual implementation of the program runs the KNN on the experimental instance Bear, with the following features: Habitat: Land, Diet: Omnivore, Number of Limbs: Four, Covering: Fur and Primary Movement Method: Crawl. As an added feature of the program, after the KNN is done on the bear, the user may also choose to create their own instance of an animal which the program will also perform KNN on. This is executed thanks to the methods, askLoop and inputAnimalKNN which utilizes the Java scanner for the user input and all the above fields and methods to perform KNN on custom cases.

(Next Page)

How to Run the Program:

1. Open a terminal on the folder of the java source files
2. Compile all the files with the command: javac *.java
3. Run the main module: java KnnMain
4. The user may give their own animal for the program to perform KNN on by typing yes to the module's prompt and supplying the animal features. (Optional)
5. To exit the module, simply type no when the module asks if the user wants to try with their own animal again or type ctrl + c anytime during the program's runtime.



```
C:\Windows\System32\cmd.e
Microsoft Windows [Version 10.0.22631.3737]
(c) Microsoft Corporation. All rights reserved.

C:\Users\abdie\Documents\GitHub\Intro-to-AI\KNN HW>javac *.java

C:\Users\abdie\Documents\GitHub\Intro-to-AI\KNN HW>java KnnMain

------------------------------------------------ LABELLED DATASET OF ANIMALS ------------------------------------------------
|   Animal Name   |   Habitat    |    Diet    |    Number of Limbs    |   Covering   |    Primary Movement Method    |   Class   |
-----------------------------------------------------------------------------------------------------------------------------
|           Lion |        Land |  Carnivore |                Four |         Fur |                       Crawl |    Mammal |
|          Human |        Land |   Omnivore |                Four |        Skin |                        Walk |    Mammal |
|       Platypus |        Both |  Carnivore |                Four |         Fur |                       Crawl |    Mammal |
|           Deer |        Land |  Herbivore |                Four |         Fur |                       Crawl |    Mammal |
|          Eagle |        Land |  Carnivore |                 Two |    Feathers |                         Fly |      Bird |
|        Chicken |        Land |   Omnivore |                 Two |    Feathers |                        Walk |      Bird |
|           Swan |        Both |  Herbivore |                 Two |    Feathers |                        Swim |      Bird |
|        Penguin |        Both |  Carnivore |                 Two |    Feathers |                        Walk |      Bird |
|       Clownfish |       Water |  Herbivore |                None |       Scales |                        Swim |      Fish |
|          Shark |       Water |  Carnivore |                None |       Scales |                        Swim |      Fish |
|         Catfish |       Water |   Omnivore |                None |        Skin |                        Swim |      Fish |
|      Mudskipper |        Both |  Carnivore |                 Two |       Scales |                       Crawl |      Fish |
|          Beetle |        Land |   Omnivore |       More than Four |  Exoskeleton |                       Crawl |    Insect |
|           Wasp |        Land |   Omnivore |       More than Four |  Exoskeleton |                         Fly |    Insect |
|       Centipede |        Land |  Carnivore |       More than Four |  Exoskeleton |                       Crawl |    Insect |
|        Waterbug |       Water |  Herbivore |       More than Four |  Exoskeleton |                       Crawl |    Insect |
-----------------------------------------------------------------------------------------------------------------------------

SAMPLE ANIMAL: Bear
Habitat: Land
Diet: Omnivore
Number of Limbs: Four
Covering: Fur
Primary Movement Method: Crawl

KNN RESULTS:
1 Nearest Neighbor: Mammal
4 Nearest Neighbors: Mammal
5 Nearest Neighbors: Mammal
7 Nearest Neighbors: Mammal

Would you like to try with your own animal?
yes

ANIMAL NAME:
Ladybug

Habitat (Land, Water or Both): Land

Diet (Carnivore, Herbivore or Omnivore): Herbivore
```

```
Number of Limbs (None, Two, Four or More than Four): more than four

Covering (Skin, Fur, Scales, Feathers or Exoskeleton): exoskeleton

Primary Movement Method (Walk, Crawl, Swim or Fly): fly


------------------------------------------------ YOUR ANIMAL ------------------------------------------------
|   Animal Name   |   Habitat    |    Diet    |    Number of Limbs    |   Covering   |    Primary Movement Method    |
-------------------------------------------------------------------------------------------------------------
|         Ladybug |        Land |  Herbivore |       More than Four |  Exoskeleton |                         Fly |
-------------------------------------------------------------------------------------------------------------

KNN RESULTS:
1 Nearest Neighbor: Insect
4 Nearest Neighbors: Insect
5 Nearest Neighbors: Insect
7 Nearest Neighbors: Insect

Would you like to try again with a new animal?
no
```