

## Prolog Assignment 1

**Learning Abstract:** This assignment introduced prolog through four different tasks. From color coding regions, to interacting with a knowledge base and list-processing.

### **Task 1:**

Code:

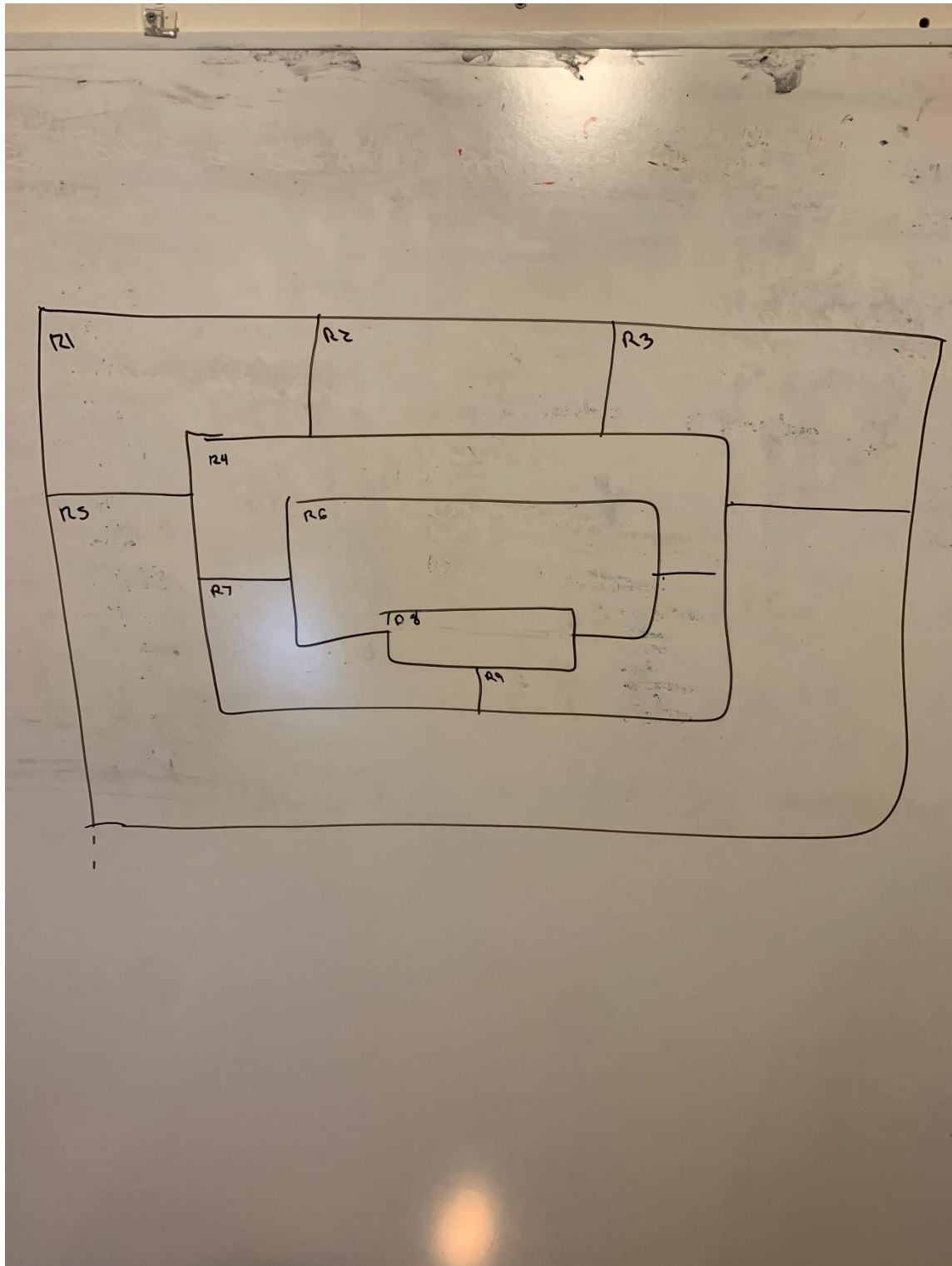
```
% different(X,Y) :: X is not equal to Y.

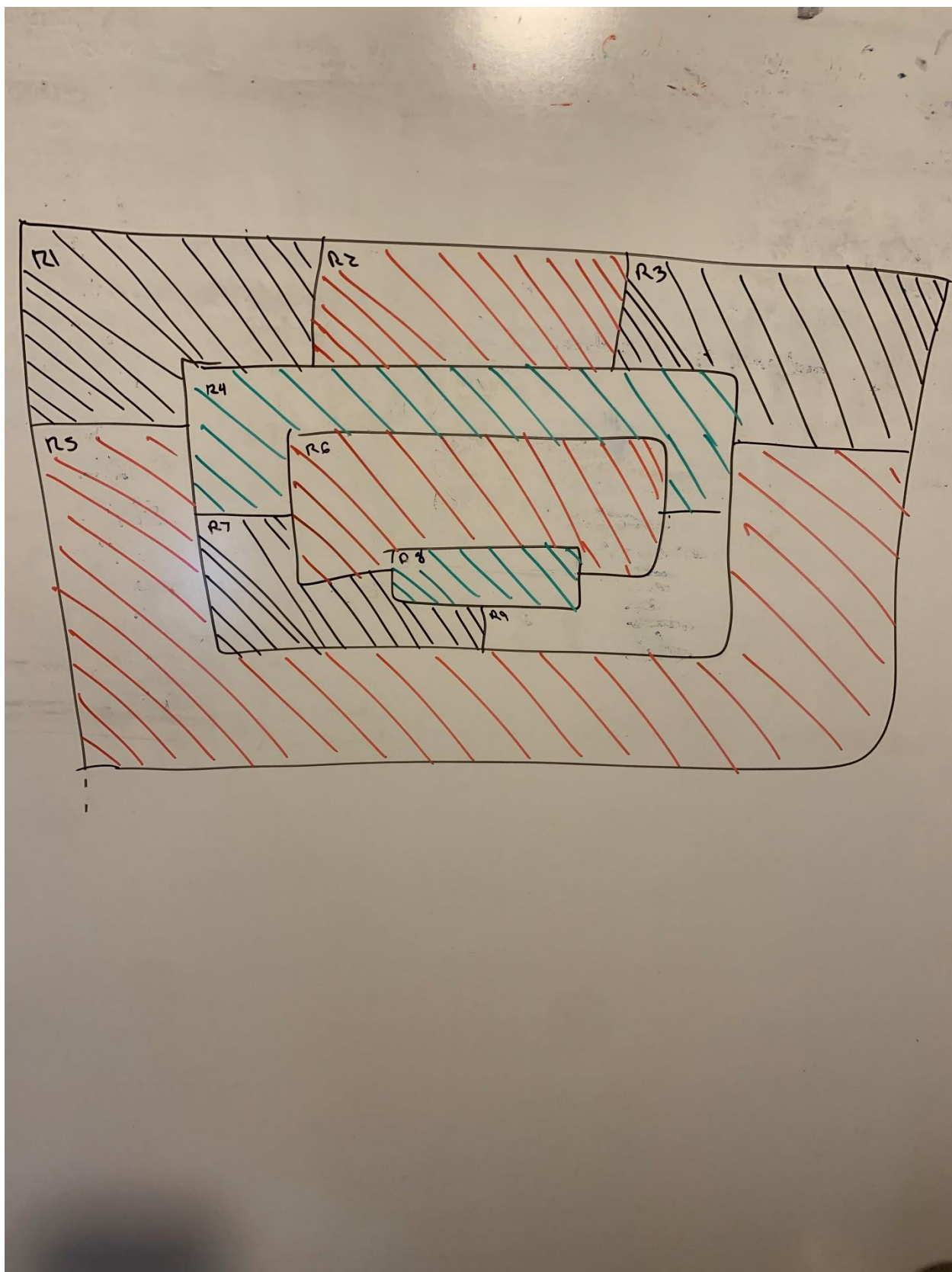
different(black, red).
different(black, green).
different(black, white).
different(green, black).
different(green, white).
different(green, red).
different(white, black).
different(white, green).
different(white, red).
different(red, green).
different(red, black).
different(red, white).

coloring(R1,R2,R3,R4,R5,R6,R7,R8,R9) :-
    different(R1,R2),
    different(R1,R4),
    different(R1,R5),
    different(R2,R1),
    different(R2,R3),
    different(R2,R4),
    different(R3,R2),
    different(R3,R4),
    different(R3,R5),
    different(R4,R1),
    different(R4,R2),
    different(R4,R3),
    different(R4,R5),
    different(R4,R6),
    different(R4,R7),
    different(R4,R9),
    different(R5,R1),
    different(R5,R4),
    different(R5,R7),
    different(R5,R9),
    different(R5,R3),
    different(R6,R4),
    different(R6,R7),
    different(R6,R8),
    different(R6,R9),
    different(R7,R5),
    different(R7,R4),
    different(R7,R6),
    different(R7,R8),
    different(R7,R9),
    different(R8,R6),
    different(R8,R7),
    different(R8,R9),
    different(R9,R4),
    different(R9,R6),
    different(R9,R7),
    different(R9,R8).
```

Demo:

```
?- coloring(R1,R2,R3,R4,R5,R6,R7,R8,R9).  
R1 = R3, R3 = R7, R7 = black,  
R2 = R5, R5 = R6, R6 = red,  
R4 = R8, R8 = green,  
R9 = white
```





## Task 2:

### Code:

```
% --- Facts
% --- square(N,side(L),color(C)) :: N is the name of a square with side L
% --- and color C

square(sera,side(7),color(purple)).
square(sara,side(5),color(blue)).
square(sarah,side(11),color(red)).

% --- circle(N,radius(R),color(C)) :: N is the name of a circle with
% --- radius R and color C
%
circle(carla,radius(4),color(green)).
circle(cora,radius(7),color(blue)).
circle(connie,radius(3),color(purple)).
circle(claire,radius(5),color(green)).

% Rules |
% --- circles :: list the names of all of the circles

circles :- circle(Name,_,_), write(Name),nl,fail.
circles.
% -----
% --- squares :: list the names of all of the squares

squares :- square(Name,_,_), write(Name),nl,fail.
squares.

% -----
% --- shapes :: list the names of all of the shapes
shapes :- circles,squares.

% -----
% --- blue(Name) :: Name is a blue shape

blue(Name) :- square(Name,_,color(blue)).
blue(Name) :- circle(Name,_,color(blue)).

% -----
% --- large(Name) :: Name is a large shape
%
large(Name) :- area(Name,A), A >= 100.

% -----
% --- small(Name) :: Name is a small shape

small(Name) :- area(Name,A), A < 100.

% -----
% --- area(Name,A) :: A is the area of the shape with name Name

area(Name,A) :- circle(Name,radius(R),_), A is 3.14 * R * R.
area(Name,A) :- square(Name,side(S),_), A is S * S.
```

## Demo:

```
File Edit Settings Run Debug Help
% c:/Users/kiera/OneDrive/Documents/Oswego/Fall '21/csc 344/prolog/project1/task2.pl cd
?- listing(squares).
squares :-
    square(Name, _, _),
    write(Name),
    nl,
    fail.
squares.

true.

?- squares.
sera
sara
sarah
true.

?- listing(circles).
circles :-
    circle(Name, _, _),
    write(Name),
    nl,
    fail.
circles.

true.

?- circles.
carla
cora
connie
claire
true.

?- listing(shapes).
shapes :-
    circles,
    squares.

true.

?- shapes.
carla
cora
connie
claire
sera
sara
sarah
true.

?- blue(Shape).
Shape = sara ;
Shape = cora.

?- large(Name, write(Name), nl, fail).
ERROR: Syntax error: Operator expected
ERROR: large(Name, write(Name), nl, fail
ERROR: ** here **
ERROR:
?- large(Name), write(Name), nl, fail.
cora
sarah
false.

?- small(Name), write(Name), nl, fail.
carla
connie
claire
sera
sara
false.

?- area(cora, A).
A = 153.86 .

?- area(carla, A).
A = 50.24 ■
```

---



### Task 3:

Code:

```
% -----
% --- cen(P) :: Pokemon P was "creatio ex nihilo"

cen(pikachu).
cen(bulbasaur).
cen(caterpie).
cen(charmander).
cen(vulpix).
cen(poliwag).
cen(squirtle).
cen(staryu).

% -----
% --- evolves(P,Q) :: Pokemon P directly evolves to pokemon Q

evolves(pikachu,raichu).
evolves(bulbasaur,ivysaur).
evolves(ivysaur,venusaur).
evolves(caterpie,metapod).
evolves(metapod,butterfree).
evolves(charmander,charmeleon).
evolves(charmeleon,charizard).
evolves(vulpix,ninetails).
evolves(poliwag,poliwhirl).
evolves(poliwhirl,poliwrath).
evolves(squirtle,wartortle).
evolves(wartortle,blastoise).
evolves(staryu,starmie).

% -----
% --- pokemon(name(N),T,hp(H),attach(A,D)) :: There is a pokemon with
% --- name N, type T, hit point value H, and attach named A that does
% --- damage D.

pokemon(name(pikachu), electric, hp(60), attack(gnaw, 10)).
pokemon(name(raichu), electric, hp(90), attack(thunder-shock, 90)).

pokemon(name(bulbasaur), grass, hp(40), attack(leech-seed, 20)).
pokemon(name(ivysaur), grass, hp(60), attack(vine-whip, 30)).
pokemon(name(venusaur), grass, hp(140), attack(poison-powder, 70)).

pokemon(name(caterpie), grass, hp(50), attack(gnaw, 20)).
pokemon(name(metapod), grass, hp(70), attack(stun-spore, 20)).
pokemon(name(butterfree), grass, hp(130), attack(whirlwind, 80)).

pokemon(name(charmander), fire, hp(50), attack(scratch, 10)).
pokemon(name(charmeleon), fire, hp(80), attack(slash, 50)).
pokemon(name(charizard), fire, hp(170), attack(royal-blaze, 100)).
```

```
pokemon(name(vulpix), fire, hp(60), attack(confuse-ray, 20)).
pokemon(name(ninetails), fire, hp(100), attack(fire-blast, 120)).
```

```
pokemon(name(poliwag), water, hp(60), attack(water-gun, 30)).
pokemon(name(poliwhirl), water, hp(80), attack(amnesia, 30)).
pokemon(name(poliwrath), water, hp(140), attack(dashing-punch, 50)).
```

```
pokemon(name(squirtle), water, hp(40), attack(bubble, 10)).
pokemon(name(wartortle), water, hp(80), attack(waterfall, 60)).
pokemon(name(blastoise), water, hp(140), attack(hydro-pump, 60)).
```

```
pokemon(name(staryu), water, hp(40), attack(slap, 20)).
pokemon(name(starmie), water, hp(60), attack(star-freeze, 20)).
```

```
display_names :- pokemon(name(Name),_,_,_), write(Name),nl,fail.
display_attacks :- pokemon(_,_,_,attack(Name,_)),write(Name), nl,fail.
powerful(Name) :- pokemon(name(Name),_,_,attack(_,DAM)), DAM > 55.
tough(Name) :- pokemon(name(Name),_,hp(HP),_), HP > 100.
type(Name,Kind) :- pokemon(name(Name),Kind,_,_).
dump_kind(Kind) :- pokemon(name(Name),Kind,hp(HP),attack(Atk,DAM)), write(pokemon
display_cen :- pokemon(name(Name),_,_,_), cen(Name),write(Name),nl,fail.
```

```
family(X) :- evolves(X,Y), write(X),write(' '), write(Y), evolves(Y,Z), write(' '
families :- cen(Name), family(Name),nl,fail.
```

```
lineage(Name) :-
    pokemon(name(Name),Kind,hp(HP),attack(Atk,DM)),
    write(pokemon(name(Name),Kind,hp(HP),attack(Atk,DM))),nl,
    evolves(Name,Y),

    pokemon(name(Y),KindY,hp(HPY),attack(AtkY,DMY)),
    write(pokemon(name(Y),KindY,hp(HPY),attack(AtkY,DMY))),nl,
    evolves(Y,Z),

    pokemon(name(Z),KindZ,hp(HPZ),attack(AtkZ,DMZ)),
    write(pokemon(name(Z),KindZ,hp(HPZ),attack(AtkZ,DMZ))),nl.
```



## Demo:

```
?-
% c:/Users/kiera/OneDrive/Documents/Oswego/Fall '21/csc 344/prolog/project1/task3.pl compiled 0.00 sec.
?- cen(picachu).
false.

?- cen(pikachu).
true.

?- cen(raichu).
false.

?- cen(Name).
Name = pikachu ;
Name = bulbasaur ;
Name = caterpie ;
Name = charmander ;
Name = vulpix ;
Name = poliwag ;
Name = squirtle ;
Name = staryu.

?- cen(Name), write(Name), nl, fail.
pikachu
bulbasaur
caterpie
charmander
vulpix
poliwag
squirtle
staryu
false.

?- evolves(squirtle, wartortle).
true.

?- evolves(wartortle, squirtle).
false.

?- evolves(squirtle, blastoise).
false.

?- evolves(X, Y), evolves(Y, Z).
X = bulbasaur,
Y = ivysaur,
Z = venusaur ;
X = caterpie,
Y = metapod,
Z = butterfree ;
X = charmander,
Y = charmeleon,
Z = charizard ;
X = poliwag,
Y = poliwhirl,
Z = poliwrath ;
X = squirtle,
Y = wartortle,
Z = blastoise ;
false.
```

```

?- evolves(X,Y),evolves(Y,Z),write(X --> Z),nl,fail.
bulbasaur-->venusaur
caterpie-->butterfree
charmander-->charizard
poliwag-->poliwrath
squirtle-->blastoise
false.

?- pokemon(name(Name),_,_,_),write(Name),nl,fail.
pikachu
raichu
bulbasaur
ivysaur
venusaur
caterpie
metapod
butterfree
charmander
charmeleon
charizard
vulpix
ninetails
poliwag
poliwhirl
poliwrath
squirtle
wartortle
blastoise
staryu
starmie
false.

?- pokemon(name(Name,fire,_,_),write(Name),nl,fail.
ERROR: Syntax error: Operator expected
ERROR: pokemon(name(Name,fire,_,_),write(Name),nl,fail
ERROR: ** here **
ERROR:
?- pokemon(name(Name),fire,_,_),write(Name),nl,fail.
charmander
charmeleon
charizard
vulpix
ninetails
false.

?- pokemon(name(Name),Type,_,_),write(nks(name(Name),kind(Type)),nl,fail.
ERROR: Syntax error: Operator expected
ERROR: pokemon(name(Name),Type,_,_),write(nks(name(Name),kind(Type)),nl,fail
ERROR: ** here **
ERROR:
?- pokemon(name(Name),Type,_,_),write(nks(name(Name),kind(Type))),nl,fail.
nks(name(pikachu),kind(electric))
nks(name(raichu),kind(electric))
nks(name(bulbasaur),kind(grass))
nks(name(ivysaur),kind(grass))
nks(name(venusaur),kind(grass))
nks(name(caterpie),kind(grass))
nks(name(metapod),kind(grass))
nks(name(butterfree),kind(grass))
nks(name(charmander),kind(fire))
nks(name(charmeleon),kind(fire))
nks(name(charizard),kind(fire))
nks(name(vulpix),kind(fire))
nks(name(ninetails),kind(fire))
nks(name(poliwag),kind(water))
nks(name(poliwhirl),kind(water))
nks(name(poliwrath),kind(water))
nks(name(squirtle),kind(water))
nks(name(wartortle),kind(water))
nks(name(blastoise),kind(water))
nks(name(staryu),kind(water))
nks(name(starmie),kind(water))
false.

?-

```

```

?- pokemon(name(N),_,_,attack(waterfall,_)).
N = wartortle ;
false.

?- pokemon(name(N),_,_,attack(poison-powder,_)).
N = venusaur ;
false.

?-
|
|

ERROR: Stream user_input:150:6 Syntax error: Unexpected end of clause
?- pokemon(_,water,_,attack(Name,_)).write(Name),nl,fail.
water-gun
amnesia
dashing-punch
bubble
waterfall
hydro-pump
slap
star-freeze
false.

?- pokemon(poliwhirl,_,HP,_).
false.

?- pokemon(name(poliwhirl),_,HP,_).
HP = hp(80).

?- pokemon(name(poliwhirl),_,hp(HP),_).
HP = 80.

?- pokemon(name(butterfree),_,hp(HP),_).
HP = 130.

?- pokemon(name(Name),_,hp(HP),_).write(Name),nl,fail,HP > 85.
pikachu
raichu
bulbasaur
ivysaur
venusaur
caterpie
metapod
butterfree
charmander
charmeleon
charizard
vulpix
ninetails
poliwag
poliwhirl
poliwrath
squirtle
wartortle
blastoise
staryu
starmie
false.

?- pokemon(name(Name),_,hp(HP),_),HP>85,write(Name),nl,fail.
raichu
venusaur
butterfree
charizard
ninetails
poliwrath
blastoise
false.

?- pokemon(name(Name),_,_,attack(_,DAM)),DAM >60,write(Name),nl,fail.
raichu
venusaur
butterfree
charizard
ninetails
false.

?-

```

```
?- pokemon(name(Name),_,hp(HP),_),cen(Name),write(Name: HP),nl,fail.  
pikachu:60  
bulbasaur:40  
caterpie:50  
charmander:50  
vulpix:60  
poliwag:60  
squirtle:40  
staryu:40  
false.  
  
?-
```

**Part 2 demo:**



```

% c:/Users/kiera/OneDrive/Documents/Oswego/Fall '21/csc 344/prolog/project1/task3.pl c
|   display_names.
pikachu
raichu
bulbasaur
ivysaur
venusaur
caterpie
metapod
butterfree
charmander
charmeleon
charizard
vulpix
ninetails
poliwag
poliwhirl
poliwrath
squirtle
wartortle
blastoise
staryu
starmie
false.

?- display_attacks.
gnaw
thunder-shock
leech-seed
vine-whip
poison-powder
gnaw
stun-spore
whirlwind
scratch
slash
royal-blaze
confuse-ray
fire-blast
water-gun
amnesia
dashing-punch
bubble
waterfall
hydro-pump
slap
star-freeze
false.

?- powerful(pikachu).
false.

?- powerful(blastoise).
true.

?- powerful(X), write(X), nl, fail.
raichu
venusaur
butterfree
charizard
ninetails
wartortle
blastoise
false.

?- tough(raichu).
false.

?- tough(venusaur).
true.

?- tough(Name), write(Name), nl, fail.
venusaur
butterfree
charizard
poliwrath
blastoise
false.

```

---

```

?- type(caterpie,grass).
true .

?- type(pikachu,water).
false.

?- type(N, electric).
N = pikachu ;
N = raichu.

?- type(N,water),write(N),nl,fail.
poliwag
poliwhirl
poliwrath
squirtle
wartortle
blastoise
staryu
starmie
false.

?- dump_kind(water).
pokemon(name(poliwag),water,hp(60),attack(water-gun,30))
pokemon(name(poliwhirl),water,hp(80),attack(ammnesia,30))
pokemon(name(poliwrath),water,hp(140),attack(dashing-punch,50))
pokemon(name(squirtle),water,hp(40),attack(bubble,10))
pokemon(name(wartortle),water,hp(80),attack(waterfall,60))
pokemon(name(blastoise),water,hp(140),attack(hydro-pump,60))
pokemon(name(staryu),water,hp(40),attack(slap,20))
pokemon(name(starmie),water,hp(60),attack(star-freeze,20))
false.

?- dump_kind(fire).
pokemon(name(charmander),fire,hp(50),attack(scratch,10))
pokemon(name(charmeleon),fire,hp(80),attack(slash,50))
pokemon(name(charizard),fire,hp(170),attack(royal-blaze,100))
pokemon(name(vulpix),fire,hp(60),attack(confuse-ray,20))
pokemon(name(ninetails),fire,hp(100),attack(fire-blast,120))
false.

?- display_cen.
pikachu
bulbasaur
caterpie
charmander
vulpix
poliwag
squirtle
staryu
false.

?- family(pikachu).
pikachu raichu
false.

?- family(squirtle).
squirtle wartortle blastoise
true.

?- families.
pikachu raichubulbasaur ivysaur venusaur
caterpie metapod butterfree
charmander charmeleon charizard
vulpix ninetailspoliwag poliwhirl poliwrath
squirtle wartortle blastoise
staryu starmie
false.

?- lineage(caterpie).
pokemon(name(caterpie),grass,hp(50),attack(gnaw,20))
pokemon(name(metapod),grass,hp(70),attack(stun-spore,20))
pokemon(name(butterfree),grass,hp(130),attack(whirlwind,80))
true .

?- lineage(metapod).
pokemon(name(metapod),grass,hp(70),attack(stun-spore,20))
pokemon(name(butterfree),grass,hp(130),attack(whirlwind,80))
false.

```

---

***Task 4:***

Code:

Demo: