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Prolog Programming Assignment #2: A Favorite Pokémon KB plus Simple List Processing Exercises

ABSTRACT:

This project is focused on enhancing our understanding of the Prolog programming language and developing our skills in list processing. The project involves many different Pokémon characters. Through this project, we gained a greater appreciation for the sophistication and refinement of Prolog, and also improved our programming abilities.

Task 1: Pokémon

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Part 1: Initial Pokémon KB

```
% ----------------------------------------------------------------------
% ----------------------------------------------------------------------
% --- File: pokemon.pro
% --- Line: Just a few facts about pokemon
% ----------------------------------------------------------------------


% ----------------------------------------------------------------------
% --- 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)).

Part 2: Interaction demo with the Initial KB

```
?- cen(pikachu).
true.

?- cen(raichu).
false.

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

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

```
?- evolves(squirtle,wartortle).
true.

?- evolves(wartortle,squirtle).
false.

?- evolves(squirtle,blastoise).
false.

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

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

```
?- evolves(P,Q), evolves(Q,Z),write(P), write('->'), write(Z), nl, fail.
bulbasaur->venusaur
caterpie->butterfree
charmander->charizard
poliwag->poliwrath
squirtle->blastoise
false.

?- pokemon(name(N),_,_,_), write(N), 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(N), fire,_,_), write(N),nl,fail.
charmander
charmeleon
charizard
vulpix
ninetails
false.

?- pokemon(name(N),T,_,_), write('nks(name('), write(N), write('), kind('), write(T), write('))'), 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,_)),write('N = '), write(N), nl, fail.
N = wartortle
false.

?- pokemon(name(N),_,_,attack(poison-powder,_)),write('N = '), write(N), nl, fail.
N = venusaur
false.

?- pokemon(name(N), water,_, attack(A,_)),write(A), nl, fail.
water-gun
amnesia
dashing-punch
bubble
waterfall
hydro-pump
slap
star-freeze
false.

?- pokemon(name(poliwhirl),_,hp(H),_), write('HP = ' ), write(H), nl, fail.
HP = 80
false.

?- pokemon(name(butterfree),_,hp(H),_), write('HP = ' ), write(H), nl, fail.
HP = 130
false.

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

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

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

Part 3: KB Extension

% ---

% -------------------Additional Predicates------------------------------

% ---

display_cen :- (cen(P), write(P), nl, fail).

```prolog
display_not_cen :- (evolves(_, P), write(P), nl, fail).

generator(Name, T) :- (pokemon(name(Name), T, _, _)).

display_names :- (pokemon(name(P), _, _, _), write(P), nl, fail).

display_attacks :- (pokemon(_, _, _, attack(A, _)), write(A), nl, fail).

display_cen_attacks :- (cen(P), pokemon(name(P), _, _, attack(A, _))), write(A), nl, fail.

indicate_attack(N) :- (pokemon(name(N), _, _, attack(A, _)), write(N), write(' --> '), write(A)).

indicate_attacks :- (pokemon(name(N), _, _, attack(A, _)), write(N), write(' --> '), write(A), nl,
fail).

powerful(Name) :- (pokemon(name(Name), _, _, attack( _, D)), D > 55).

tough(Name) :- (pokemon(name(Name), _, hp(H), _), H > 100).

awesome(Name) :- (pokemon(name(Name), _, hp(H), attack( _, D)), H > 100, D > 55).

powerful_but_vulnerable(Name) :- (pokemon(name(Name), _, hp(H), attack( _, D)), H =< 100, D
> 55).

type(Name, Type) :- (pokemon(name(Name), Type, _, _)).

dump_kind(Type) :- (pokemon(name(N), Type, hp(H), attack(M, D))), write(pokemon(name(N),
Type, hp(H), attack(M, D))), nl, fail.
```

family(Name) :- (evolves(Name, N), write(Name), write(' '), write(N), write(' '), evolves(N, P), write(P)).

families :- (cen(Name), evolves(Name,N), nl, write(Name), write(' '), write(N), evolves(N,P), write(' '), write(P), fail).

lineage(Name) :- (pokemon(name(Name), Type, hp(H), attack(M, D)),
write(pokemon(name(Name), Type, hp(H), attack(M, D))), nl,
evolves(Name, N), pokemon(name(N), Type1, hp(H1),
attack(M1, D1)), write(pokemon(name(N), Type1, hp(H1), attack(M1, D1))), nl,
evolves(N, P), pokemon(name(P), Type2, hp(H2), attack(M2,
D2)), write(pokemon(name(P), Type2, hp(H2), attack(M2, D2))), nl, fail).

Part 4: Interaction demo with the Augmented KB

```
Welcome to SWI-Prolog (threaded, 64 bits, version 9.0.4)
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/e_rro/OneDrive/Documents/pokemon.pl compiled 0.00 sec, 59 clauses
?- display_cen.
pikachu
bulbasaur
caterpie
charmander
vulpix
poliwag
squirtle
staryu
false.

?- display_not_cen.
raichu
ivysaur
venusaur
metapod
butterfree
charmeleon
charizard
ninetails
poliwhirl
poliwrath
wartortle
blastoise
starmie
false.

?- generator(Name,fire).
Name = charmander ;
Name = charmeleon ;
Name = charizard ;
Name = vulpix ;
Name = ninetails.

?- generator(Name,water).
Name = poliwag ;
Name = poliwhirl ;
Name = poliwrath ;
Name = squirtle ;
Name = wartortle ;
Name = blastoise ;
Name = staryu ;
Name = starmie.

?- generator(Name,electric).
Name = pikachu ;
Name = raichu.

?- generator(Name,grass).
Name = bulbasaur ;
Name = ivysaur ;
Name = venusaur ;
Name = caterpie ;
Name = metapod ;
Name = butterfree.
```

```
?- 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.

?- display_cen_attacks.
gnaw
leech-seed
gnaw
scratch
confuse-ray
water-gun
bubble
slap
false.
```

```
?-  indicate_attack(charmander).
charmander --> scratch
true ndicate_attack(bulbasaur).
Unknown action: i (h for help)
Action?  .

?- indicate_attack(bulbasaur).
bulbasaur --> leech-seed
true  .
```

```
?- indicate_attacks.
pikachu --> gnaw
raichu --> thunder-shock
bulbasaur --> leech-seed
ivysaur --> vine-whip
venusaur --> poison-powder
caterpie --> gnaw
metapod --> stun-spore
butterfree --> whirlwind
charmander --> scratch
charmeleon --> slash
charizard --> royal-blaze
vulpix --> confuse-ray
ninetails --> fire-blast
poliwag --> water-gun
poliwhirl --> amnesia
poliwrath --> dashing-punch
squirtle --> bubble
wartortle --> waterfall
blastoise --> hydro-pump
staryu --> slap
starmie --> star-freeze
false.

?-
|     powerful(Name).
Name = raichu ;
Name = venusaur ;
Name = butterfree ;
Name = charizard ;
Name = ninetails ;
Name = wartortle ;
Name = blastoise ;
false.

?- tough(Name).
Name = venusaur ;
Name = butterfree ;
Name = charizard ;
Name = poliwrath ;
Name = blastoise ;
false.

?- awesome(Name).
Name = venusaur ;
Name = butterfree ;
Name = charizard ;
Name = blastoise ;
false.

?- powerful_but_vulnerable(Name).
Name = raichu ;
Name = ninetails ;
Name = wartortle ;
false.
```

```
?-  type(squirtle,Type).
Type = water.

?- type(caterpie,Type).
Type = grass.

?- type(Name,fire),write(Name),nl,fail.
charmander
charmeleon
charizard
vulpix
ninetails
false.

?- dump_kind(water).
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))
false.

?- dump_kind(grass).
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))
false.

?- family(pikachu).
pikachu raichu
false.

?- family(bulbasaur).
bulbasaur ivysaur venusaur
true.

?-  family(caterpie).
caterpie metapod butterfree
true.

?-  families.

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

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

```
?- lineage(squirtle).
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))
false.

?- lineage(wartortle).
pokemon(name(wartortle),water,hp(80),attack(waterfall,60))
pokemon(name(blastoise),water,hp(140),attack(hydro-pump,60))
false.

?- lineage(blastoise).
pokemon(name(blastoise),water,hp(140),attack(hydro-pump,60))
false.

?- lineage(charmander).
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))
false.
```

Part 5: KB Augmented by 12 Pokémon

% ---

% ---

% --- File: pokemon.pro

% --- Line: Just a few facts about pokemon

% ---

% ---

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

cen(pikachu).

cen(voltorb).

cen(pawmi).

cen(bulbasaur).

cen(oddish).

cen(caterpie).

cen(charmander).

cen(vulpix).

```
cen(ponyta).

cen(poliwag).

cen(squirtle).

cen(staryu).

cen(psyduck).


% ----------------------------------------------------------------------

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


evolves(pikachu,raichu).

evolves(voltorb,electrode).

evolves(pawmi,pawmo).

evolves(pawmo,pawmot).

evolves(bulbasaur,ivysaur).

evolves(ivysaur,venusaur).

evolves(oddish,gloom).

evolves(gloom,vileploom).

evolves(caterpie,metapod).

evolves(metapod,butterfree).

evolves(charmander,charmeleon).

evolves(charmeleon,charizard).

evolves(vulpix,ninetails).

evolves(ponyta,rapidash).

evolves(poliwag,poliwhirl).

evolves(poliwhirl,poliwrath).

evolves(squirtle,wartortle).

evolves(wartortle,blastoise).

evolves(staryu,starmie).

evolves(psyduck,golduck).
```

```
% ------------------------------------------------------------------
% --- 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(voltorb), electric, hp(40), attack(self_destruct, 200)).
pokemon(name(electrode), electric, hp(60), attack(spark, 65)).
pokemon(name(pawmi), electric, hp(45), attack(nuzzle, 20)).

pokemon(name(pawmo), electric, hp(60), attack(dig, 80)).
pokemon(name(pawmot), electric, hp(75), attack(discharge, 80)).

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(oddish), grass, hp(45), attack(absorb, 20)).
pokemon(name(gloom), grass, hp(60), attack(mega-drain, 40)).
pokemon(name(vileplum), grass, hp(75), attack(giga-drain, 75)).

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(ponyta), fire, hp(50), attack(flame-charge, 50)).

pokemon(name(rapidash), fire, hp(65), attack(megahorn, 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)).

pokemon(name(psyduck), water, hp(50), attack(zen_headbutt, 80)).

pokemon(name(golduck), water, hp(80), attack(aqua-tail, 90)).

% ---

% ------------------Additional Predicates------------------------------

% ---

```prolog
display_cen :- (cen(P), write(P), nl, fail).

display_not_cen :- (evolves(_, P), write(P), nl, fail).

generator(Name, T) :- (pokemon(name(Name), T, _, _)).

display_names :- (pokemon(name(P), _, _, _), write(P), nl, fail).

display_attacks :- (pokemon(_, _, _, attack(A, _)), write(A), nl, fail).

display_cen_attacks :- (cen(P), pokemon(name(P), _, _, attack(A, _))), write(A), nl, fail.

indicate_attack(N) :- (pokemon(name(N), _, _, attack(A, _)), write(N), write(' --> '), write(A)).

indicate_attacks :- (pokemon(name(N), _, _, attack(A, _)), write(N), write(' --> '), write(A), nl,
fail).

powerful(Name) :- (pokemon(name(Name), _, _, attack( _, D)), D > 55).

tough(Name) :- (pokemon(name(Name), _, hp(H), _), H > 100).

awesome(Name) :- (pokemon(name(Name), _, hp(H), attack( _, D)), H > 100, D > 55).

powerful_but_vulnerable(Name) :- (pokemon(name(Name), _, hp(H), attack( _, D)), H =< 100, D
> 55).

type(Name, Type) :- (pokemon(name(Name), Type, _, _)).

dump_kind(Type) :- (pokemon(name(N), Type, hp(H), attack(M, D))), write(pokemon(name(N),
```

Type, hp(H), attack(M, D))), nl, fail.

family(Name) :- (evolves(Name, N), write(Name), write(' '), write(N), write(' '), evolves(N, P), write(P)).

families :- (cen(Name), evolves(Name,N), nl, write(Name), write(' '), write(N), evolves(N,P), write(' '), write(P), fail).

lineage(Name) :- (pokemon(name(Name), Type, hp(H), attack(M, D)),
write(pokemon(name(Name), Type, hp(H), attack(M, D))), nl,
evolves(Name, N), pokemon(name(N), Type1, hp(H1),
attack(M1, D1)), write(pokemon(name(N), Type1, hp(H1), attack(M1, D1))), nl,
evolves(N, P), pokemon(name(P), Type2, hp(H2), attack(M2,
D2)), write(pokemon(name(P), Type2, hp(H2), attack(M2, D2))), nl, fail).

Part 6: Interaction demo with the KB Augmented by 12 Pokémon

```
?- display_cen.
pikachu
voltorb
pawmi
bulbasaur
oddish
caterpie
charmander
vulpix
ponyta
poliwag
squirtle
staryu
psyduck
false.

?- display_not_cen.
raichu
electrode
pawmo
pawmot
ivysaur
venusaur
gloom
vileploom
metapod
butterfree
charmeleon
charizard
ninetails
rapidash
poliwhirl
poliwrath
wartortle
blastoise
starmie
golduck
false.

?- generator(Name,fire).
Name = charmander ;
Name = charmeleon ;
Name = charizard ;
Name = vulpix ;
Name = ninetails ;
Name = ponyta ;
Name = rapidash.

?- generator(Name,water).
Name = poliwag ;
Name = poliwhirl ;
Name = poliwrath ;
Name = squirtle ;
Name = wartortle ;
Name = blastoise ;
Name = staryu ;
Name = starmie ;
Name = psyduck ;
Name = golduck.
```

```
?- generator(Name,electric).
Name = pikachu ;
Name = raichu ;
Name = voltorb ;
Name = electrode ;
Name = pawmi ;
Name = pawmo ;
Name = pawmot.

?- generator(Name,grass).
Name = bulbasaur ;
Name = ivysaur ;
Name = venusaur ;
Name = oddish ;
Name = gloom ;
Name = vileplum ;
Name = caterpie ;
Name = metapod ;
Name = butterfree.

?- display_names.
pikachu
raichu
voltorb
electrode
pawmi
pawmo
pawmot
bulbasaur
ivysaur
venusaur
oddish
gloom
vileplum
caterpie
metapod
butterfree
charmander
charmeleon
charizard
vulpix
ninetails
ponyta
rapidash
poliwag
poliwhirl
poliwrath
squirtle
wartortle
blastoise
staryu
starmie
psyduck
golduck
false.
```

```
?- display_attacks.
gnaw
thunder-shock
self_destruct
spark
nuzzle
dig
discharge
leech-seed
vine-whip
poison-powder
absorb
mega-drain
giga-drain
gnaw
stun-spore
whirlwind
scratch
slash
royal-blaze
confuse-ray
fire-blast
flame-charge
megahorn
water-gun
amnesia
dashing-punch
bubble
waterfall
hydro-pump
slap
star-freeze
zen_headbutt
aqua-tail
false.

?- display_cen_attacks.
gnaw
self_destruct
nuzzle
leech-seed
absorb
gnaw
scratch
confuse-ray
flame-charge
water-gun
bubble
slap
zen_headbutt
false.
```

```
?- indicate_attack(charmander).
charmander --> scratch
true .

?-  indicate_attack(bulbasaur).
bulbasaur --> leech-seed
true .

?- indicate_attacks.
pikachu --> gnaw
raichu --> thunder-shock
voltorb --> self_destruct
electrode --> spark
pawmi --> nuzzle
pawmo --> dig
pawmot --> discharge
bulbasaur --> leech-seed
ivysaur --> vine-whip
venusaur --> poison-powder
oddish --> absorb
gloom --> mega-drain
vileplum --> giga-drain
caterpie --> gnaw
metapod --> stun-spore
butterfree --> whirlwind
charmander --> scratch
charmeleon --> slash
charizard --> royal-blaze
vulpix --> confuse-ray
ninetails --> fire-blast
ponyta --> flame-charge
rapidash --> megahorn
poliwag --> water-gun
poliwhirl --> amnesia
poliwrath --> dashing-punch
squirtle --> bubble
wartortle --> waterfall
blastoise --> hydro-pump
staryu --> slap
starmie --> star-freeze
psyduck --> zen_headbutt
golduck --> aqua-tail
false.

?- powerful(Name).
Name = raichu ;
Name = voltorb ;
Name = electrode ;
Name = pawmo ;
Name = pawmot ;
Name = venusaur ;
Name = vileplum ;
Name = butterfree ;
Name = charizard ;
Name = ninetails ;
Name = rapidash ;
Name = wartortle ;
Name = blastoise ;
Name = psyduck ;
Name = golduck.
```

```
?- tough(Name).
Name = venusaur ;
Name = butterfree ;
Name = charizard ;
Name = poliwrath ;
Name = blastoise ;
false.

?-  awesome(Name).
Name = venusaur ;
Name = butterfree ;
Name = charizard ;
Name = blastoise ;
false.

?- powerful_but_vulnerable(Name).
Name = raichu ;
Name = voltorb ;
Name = electrode ;
Name = pawmo ;
Name = pawmot ;
Name = vileplum ;
Name = ninetails ;
Name = rapidash ;
Name = wartortle ;
Name = psyduck ;
Name = golduck.

?- type(squirtle,Type).
Type = water.

?- type(caterpie,Type).
Type = grass.

?-  type(Name,fire),write(Name),nl,fail.
charmander
charmeleon
charizard
vulpix
ninetails
ponyta
rapidash
false.

?- dump_kind(water).
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))
pokemon(name(psyduck),water,hp(50),attack(zen_headbutt,80))
pokemon(name(golduck),water,hp(80),attack(aqua-tail,90))
false.
```

```
?- dump_kind(grass).
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(oddish),grass,hp(45),attack(absorb,20))
pokemon(name(gloom),grass,hp(60),attack(mega-drain,40))
pokemon(name(vileplum),grass,hp(75),attack(giga-drain,75))
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))
false.

?-  family(pikachu).
pikachu raichu
false.

?- family(bulbasaur).
bulbasaur ivysaur venusaur
true.

?- family(caterpie).
caterpie metapod butterfree
true.

?- families.

pikachu raichu
voltorb electrode
pawmi pawmo pawmot
bulbasaur ivysaur venusaur
oddish gloom vileploom
caterpie metapod butterfree
charmander charmeleon charizard
vulpix ninetails
ponyta rapidash
poliwag poliwhirl poliwrath
squirtle wartortle blastoise
staryu starmie
psyduck golduck
false.

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

?-  lineage(squirtle).
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))
false.

?- lineage(wartortle).
pokemon(name(wartortle),water,hp(80),attack(waterfall,60))
pokemon(name(blastoise),water,hp(140),attack(hydro-pump,60))
false.

?- lineage(blastoise).
pokemon(name(blastoise),water,hp(140),attack(hydro-pump,60))
false.
```

```
?- lineage(charmander).
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))
false.
```

Task 1: Pokémon

_____

Head/Tail Exercises

```
% c:/Users/e_rro/OneDrive/Documents/head_tail.pl compiled 0.00 sec, 33 clauses
?- [H|T] = [red, yellow, blue, green].
H = red,
T = [yellow, blue, green].

?- [H,T] = [red, yellow, blue, green].
false.

?- [F|_] = [red, yellow, blue, green].
F = red.

?- [_|[S|_]] = [red, yellow, blue, green].
S = yellow.

?- [F|[S|R]] = [red, yellow, blue, green].
F = red,
S = yellow,
R = [blue, green].

?- List = [this|[and,that]].
List = [this, and, that].

?- List = [this,and,that].
List = [this, and, that].

?- [a,[b,c]]=[a, b, c].
false.

?- [a|[b,c]]=[a, b, c].
true.

?- [cell(Row,Column)|Rest] = [cell(1,1), cell(3,2), cell(1,3)].
Row = Column, Column = 1,
Rest = [cell(3, 2), cell(1, 3)].

?- [X|Y] = [one(un, uno), two(dos, deux), three(trois, tres)].
X = one(un, uno),
Y = [two(dos, deux), three(trois, tres)].
```

List Processing Code

first([H|_], H).

rest([_|T], T).

last([H|[]], H).

last([_|T], Result) :- last(T, Result).

nth(0,[H|_],H).

```prolog
nth(N,[_|T],E) :- K is N - 1, nth(K,T,E).

writelist([]).

writelist([H|T]) :- write(H), nl, writelist(T).

sum([],0).

sum([Head|Tail],Sum) :- sum(Tail,SumOfTail), Sum is Head + SumOfTail.

add_first(X,L,[X|L]).

add_last(X,[],[X]).

add_last(X,[H|T],[H|TX]) :- add_last(X,T,TX).

iota(0,[]).

iota(N,IotaN) :- K is N - 1, iota(K,IotaK), add_last(N,IotaK,IotaN).

pick(L, Item) :- length(L,Length), random(0,Length,RN), nth(RN,L,Item).

make_set([],[]).

make_set([H|T],TS) :- member(H,T), make_set(T,TS).

make_set([H|T],[H|TS]) :- make_set(T,TS).

product([],1).
```

product([H|T],Result) :- product(T,ProductOfT), Result is H * ProductOfT.

factorial(N,Result) :- iota(N, IotaN), product(IotaN, Result).

make_list(0, _, []).

make_list(N, Item, [Item|ResultR]) :- K is N - 1, make_list(K, Item, ResultR).

but_first([_],[]).

but_first([_|T],T).

but_last([_],[]).

but_last(List, RDC) :- reverse(List,ReversedList), but_first(ReversedList,ReversedX1),
reverse(ReversedX1,RDC).

is_palindrome([]).

is_palindrome([_]).

is_palindrome(List) :- first(List, First), last(List, Last), First = Last, but_first(List,ListX1),
but_last(ListX1, ListX2), is_palindrome(ListX2).

noun_phrase([the,Adjective,Noun]) :- pick([hardworking,tasty,silly,witty,rightous,calm], Adjective),
pick([man, woman, dog, cat, ninja, pirate, robot, student], Noun).

sentence(Sentence) :- pick([ran, walked, fought, punched, threw, mixed, ignited, jumped], Verb),

noun_phrase(Phrase1), noun_phrase(Phrase2), add_last(Verb, Phrase1, PhraseWthVerb),

append(PhraseWthVerb, Phrase2, Sentence).

Demo for Example List Processors

```
% c:/Users/e_rro/OneDrive/Documents/head_tail.pl compiled 0.00 sec, 33 clauses
?- first([apple],First).
First = apple.

?- first([c,d,e,f,g,a,b],P).
P = c.

?- rest([apple],Rest).
Rest = [].

?- rest([c,d,e,f,g,a,b],Rest).
Rest = [d, e, f, g, a, b].

?- last([peach],Last).
Last = peach .

?- last([c,d,e,f,g,a,b],P).
P = b .

?- nth(0,[zero,one,two,three,four],Element).
Element = zero .

?- nth(3,[four,three,two,one,zero],Element).
Element = one .

?- writelist([red,yellow,blue,green,purple,orange]).
red
yellow
blue
green
purple
orange
true.

?- sum([],Sum).
Sum = 0.

?- sum([2,3,5,7,11],SumOfPrimes).
SumOfPrimes = 28.

?- add_first(thing,[],Result).
Result = [thing].

?- add_first(racket,[prolog,haskell,rust],Languages).
Languages = [racket, prolog, haskell, rust].

?- add_last(thing,[],Result).
Result = [thing] .

?- add_last(rust,[racket,prolog,haskell],Languages).
Languages = [racket, prolog, haskell, rust] .

?- iota(5,Iota5).
Iota5 = [1, 2, 3, 4, 5] .

?- iota(9,Iota9).
Iota9 = [1, 2, 3, 4, 5, 6, 7, 8, 9] .

?- pick([cherry,peach,apple,blueberry],Pie).
Pie = apple .

?- pick([cherry,peach,apple,blueberry],Pie).
Pie = cherry .
```

Demo for List Processing Exercises

```
% c:/Users/e_rro/OneDrive/Documents/head_tail.pl compiled 0.00 sec, 33 clauses
?- product([],P).
P = 1.

?-  product([1,3,5,7,9],Product).
Product = 945.

?-  iota(9,Iota),product(Iota,Product).
Iota = [1, 2, 3, 4, 5, 6, 7, 8, 9],
Product = 362880 ,

?- make_list(7,seven,Seven).
Seven = [seven, seven, seven, seven, seven, seven, seven] ,

?- make_list(8,2,List).
List = [2, 2, 2, 2, 2, 2, 2, 2] ,

?-  but_first([a,b,c],X).
X = [b, c].

?- but_last([a,b,c,d,e],X).
X = [a, b, c, d].

?- is_palindrome([x]).
true .

?-  is_palindrome([a,b,c]).
false.

?-
|     is_palindrome([a,b,b,a]).
true .

?-  is_palindrome([1,2,3,4,5,4,2,3,1]).
false.

?- is_palindrome([c,o,f,f,e,e,e,e,f,f,o,c]).
true .

?- noun_phrase(NP).
NP = [the, tasty, cat] ,

?- noun_phrase(NP).
NP = [the, rightous, pirate] ,

?- noun_phrase(NP).
NP = [the, witty, pirate] ,

?- noun_phrase(NP).
NP = [the, rightous, robot] ,

?- sentence(S).
S = [the, tasty, woman, punched, the, calm, woman] ,

?- sentence(S).
S = [the, calm, robot, ignited, the, calm, pirate] ,

?- sentence(S).
S = [the, witty, woman, jumped, the, calm, student] ,

?- sentence(S).
S = [the, calm, student, mixed, the, rightous, pirate] ,

?- sentence(S).
S = [the, hardworking, woman, ran, the, rightous, cat] ,
```

```
?- sentence(S).
S = [the, silly, ninja, mixed, the, witty, student] ,

?- sentence(S).
S = [the, silly, cat, mixed, the, tasty, man] ,

?- sentence(S).
S = [the, witty, ninja, threw, the, rightous, robot] ,

?- sentence(S).
S = [the, silly, dog, fought, the, silly, dog] ,

?- sentence(S).
S = [the, witty, robot, ignited, the, tasty, woman] ,

?- sentence(S).
S = [the, silly, man, punched, the, silly, ninja] ,
```