

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

Learning Abstract

Task 1 involves establishing and interacting with a Pokémon knowledge base, and then extending the KB in a number of ways and interrogating the extended KB. Task 2 affords you an opportunity to engage in a variety of list processing exercises.

Task 1: Pokémon

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

```
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).
```

```
?- consult('Desktop/pokemon.pl').
true.
```

```
?- 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(wartorle,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.
charmander
charmeleon
charizard
vulpix
ninetails
false.

?- pokemon(name(Name),Kind,_,_),write(nks(name(Name),kind(Kind))),nl,
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 .

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

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

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

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

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

```

```
?- pokemon(name(Name),_,_,attack(_,D)),D>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 3: KB Extension

```
% Predicate1
display_cen_names :-
pokemon(name(Name),_,_,_),cen(Name),write(Name),nl,fail.

% Predicate2
display_not_cen_names :-
pokemon(name(Name),_,_,_),not(cen(Name)),write(Name),nl,fail.

% Predicate3
generator(Name,Type) :- pokemon(name(Name),Type,_,_).

% Predicate4
display_names :- pokemon(name(Name),_,_,_),write(Name),nl,fail.

% Predicate5
display_attacks :- pokemon(_,_,_,attack(Attack,_)),write(Attack),nl,fail.

% Predicate6
display_cen_attacks :-
pokemon(name(Name),_,_,attack(Attack,_)),cen(Name),write(Attack),nl,fail.

% Predicate7
indicate_attack(Name) :-
pokemon(name(Name),_,_,attack(Attack,_)),write(Name -> Attack),nl,fail.

% Predicate8
indicate_attacks :- pokemon(name(Name),_,_,attack(Attack,_)),write(Name -
> Attack),nl,fail.

% Predicate9
powerful(Name) :- pokemon(name(Name),_,_,attack(_,D)),D>55.

% Predicate10
tough(Name) :- pokemon(name(Name),_,hp(HP),_),HP>100.

% Predicate11
awesome(Name) :- pokemon(name(Name),_,hp(HP),attack(_,D)),D>55,HP>100.

% Predicate12
powerful_but_not_vulnerable(Name) :-
pokemon(name(Name),_,hp(HP),attack(_,D)),D>55,HP<100.
```

```

% Predicate13
type(Name,Type) :- pokemon(name(Name),Type,_,_) .

% Predicate14
dump_kind(Kind) :-
pokemon(Name,Kind,HP,A),write(pokemon(Name,Kind,HP,A)),nl,fail.

% Predicate15
family(Name) :- cen(Name),evolves(Name,X),(evolves(X,Y)-
>write(Name),write(' '),write(X),write(' '),write(Y);

cen(Name),evolves(Name,X),write(Name),write(' '),write(X)).

% Predicate16
families :- family(Name),nl,fail.

% Predicate17
lineage(Name) :- pokemon(name(Name),Type,HP,Attack),
write('pokemon(name('),write(Name),write('),'),
write(Type),write(', '),write(HP),write(', '),write(Attack),write(')'),
evolves(Name,X), nl, lineage(X).

```

Part 4: Interaction demo with the Augmented KB

```

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

?- display_not_cen_names.
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,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  
false.
```

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

```
?- 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_not_vulnerable(Name).
Name = raichu ;
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(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(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
true.

?- 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

```
% 12 New Pokemon
pokemon(name(zombon), grass, hp(30), attack(bite, 20)).
pokemon(name(vineper), grass, hp(80), attack(lash, 40)).
pokemon(name(trunket), grass, hp(150), attack(stomp, 70)).

pokemon(name(whizlet), electric, hp(40), attack(zap, 15)).
pokemon(name(static), electric, hp(60), attack(flash, 60)).
pokemon(name(whiplash), electric, hp(100), attack(thunderclap, 90)).

pokemon(name(vala), fire, hp(30), attack(spark, 40)).
pokemon(name(firelord), fire, hp(60), attack(magma-storm, 80)).
pokemon(name(tansa), fire, hp(70), attack(hellfire, 120)).

pokemon(name(aqualas), water, hp(60), attack(rain, 40)).
pokemon(name(droplett), water, hp(100), attack(wavesplash, 80)).
pokemon(name(giganquid), water, hp(180), attack(tsunami, 100)).
```

Part 6: Interaction demo with KB Augmented by 12 Pokémon

```
?- display_cen_names.  
pikachu  
bulbasaur  
caterpie  
charmander  
vulpix  
poliwag  
squirtle  
staryu  
false.  
  
?- display_not_cen_names.  
raichu  
ivysaur  
venusaur  
metapod  
butterfree  
charmeleon  
charizard  
ninetails  
poliwhirl  
poliwraith  
wartortle  
blastoise  
starmie  
zombon  
vineper  
trunket  
whizlet  
static  
whiplash  
vala  
firelord  
tansa  
aqualas  
droplett  
giganquid  
false.  
  
?- generator(Name,fire).  
Name = charmander ;  
Name = charmeleon ;  
Name = charizard ;  
Name = vulpix ;  
Name = ninetails ;  
Name = vala ;  
Name = firelord ;  
Name = tansa.  
  
?- generator(Name,water).  
Name = poliwag ;  
Name = poliwhirl ;  
Name = poliwraith ;  
Name = squirtle ;  
Name = wartortle ;  
Name = blastoise ;  
Name = staryu ;  
Name = starmie ;  
Name = aqualas ;  
Name = droplett ;  
Name = giganquid.
```

```
?- generator(Name,electric).  
Name = pikachu ;  
Name = raichu ;  
Name = whizlet ;  
Name = static ;  
Name = whiplash.
```

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

```
?- display_names.
```

```
pikachu  
raichu  
bulbasaur  
ivysaur  
venusaur  
caterpie  
metapod  
butterfree  
charmander  
charmeleon  
charizard  
vulpix  
ninetails  
poliwag  
poliwhirl  
poliwrath  
squirtle  
wartortle  
blastoise  
staryu  
starmie  
zombon  
vineper  
trunket  
whizlet  
static  
whiplash  
vala  
firelord  
tansa  
aqualas  
droplett  
giganquid  
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  
bite  
lash  
stomp  
zap  
flash  
thunderclap  
spark  
magma-storm  
hellfire  
rain  
wavesplash  
tsunami  
false.  
  
?- display_cen_attacks.  
gnaw  
leech-seed  
gnaw  
scratch  
confuse-ray  
water-gun  
bubble  
slap  
false.  
  
?- indicate_attack(charmander).  
charmander->scratch  
false.  
  
?- indicate_attack(bulbasaur).  
bulbasaur->leech-seed  
false.
```

```
?- 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  
poliwhirl->water-gun  
poliwhirl->amnesia  
poliwrath->dashing-punch  
squirtle->bubble  
wartortle->waterfall  
blastoise->hydro-pump  
staryu->slap  
starmie->star-freeze  
zombon->bite  
vineper->lash  
trunket->stomp  
whizlet->zap  
static->flash  
whiplash->thunderclap  
vala->spark  
firelord->magma-storm  
tansa->hellfire  
aqualas->rain  
droplett->wavesplash  
giganquid->tsunami  
false.
```

```
?- powerful(Name).  
Name = raichu ;  
Name = venusaur ;  
Name = butterfree ;  
Name = charizard ;  
Name = ninetails ;  
Name = wartortle ;  
Name = blastoise ;  
Name = trunket ;  
Name = static ;  
Name = whiplash ;  
Name = firelord ;  
Name = tansa ;  
Name = droplett ;  
Name = giganquid.
```

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

```
?- awesome(Name).  
Name = venusaur ;  
Name = butterfree ;  
Name = charizard ;  
Name = blastoise ;  
Name = trunket ;  
Name = giganquid.
```

```
?- powerful_but_not_vulnerable((Name)).
Name = raichu ;
Name = wartortle ;
Name = static ;
Name = firelord ;
Name = tansa ;
false.

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

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

?- type(Name,fire),write(Name),nl,fail.
charmander
charmeleon
charizard
vulpix
ninetails
vala
firelord
tansa
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(aqualas),water,hp(60),attack(rain,40))
pokemon(name(droplett),water,hp(100),attack(wavesplash,80))
pokemon(name(giganquid),water,hp(180),attack(tsunami,100))
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))
pokemon(name(zombon),grass,hp(30),attack(bite,20))
pokemon(name(vineper),grass,hp(80),attack(lash,40))
pokemon(name(trunket),grass,hp(150),attack(stomp,70))
false.

?- family(pikachu).
pikachu raichu
true.

?- 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
poliwhirl 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).
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 2: List Processing

Head/Tail Exercises

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).`

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

```

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

?- [_|S|_] = [red, yellow, blue, green].
ERROR: Syntax error: Operator expected
ERROR: [
ERROR: ** here **
ERROR: _[S|_] = [red, yellow, blue, green] .
?- [_|[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).
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).

```

```

% Additional code for List Processing Exercises
product([],1).
product([H|T],Result) :- product(T,Product), Result is H * Product.

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

make_list(0,_,[]).
make_list(N, M, [M|Result]) :- K is N - 1, make_list(K,M,Result).

but_first([_],[]). but_first([_|R],R).
but_last([_],[]).
but_last(List, R) :- reverse(List,RList),
but_first(RList,RListNoF), reverse(RListNoF,R).

is_palindrome([]).
is_palindrome([_]).
is_palindrome(List) :- first(List, First), last(List, Last), First =
Last,

but_first(List,ListNoF), but_last(ListNoF, ListMod),
is_palindrome(ListMod).

noun_phrase([the,Adj,Noun]) :-
pick([monotonous,tough,successful,beautiful,hard,joyful], Adj),
pick([painting,record,glasses,mouse,bugatti,bottle,mansion,decision],
Noun).

sentence(Sentence) :-
pick([failed,adjusted,drank,regretted,boycotted,traveled,punched],
Verb), noun_phrase(NP1), noun_phrase(NP2), add_last(Verb, NP1,
P1), append(P1,NP2,Sentence).

```

Demo for Example List Processors

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

?- iota(6,Iota5).
Iota5 = [1, 2, 3, 4, 5, 6] .

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

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

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

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

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

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

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

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

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

?- make_set([1,1,2,1,2,3,1,2,3,4],Set).
Set = [1, 2, 3, 4] .

?- make_set([bit,bot,bet,bot,bot,bit],B).
B = [bet, bot, bit] .

?-
```

Demo for List Processing Exercises

```
?- 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,f,f,o,c]).
true.

?- noun_phrase(NP).
NP = [the, tough, painting];
false.

?- noun_phrase(NP).
NP = [the, monotonous, painting].

?- noun_phrase(NP).
NP = [the, beautiful, glasses].

?- noun_phrase(NP).
NP = [the, tough, decision].

?- noun_phrase(NP).
NP = [the, monotonous, record].
```

```
?- sentence(S).
S = [the, hard, bugatti, punched, the, joyful, decision] .

?- sentence(S).
S = [the, monotonous, mansion, drank, the, hard, mansion] .

?- sentence(S).
S = [the, tough, painting, punched, the, monotonous, glasses] .

?- sentence(S).
S = [the, monotonous, record, punched, the, joyful, glasses] .

?- sentence(S).
S = [the, tough, painting, punched, the, tough, painting] .

?- sentence(S).
S = [the, tough, mouse, traveled, the, beautiful, painting] .

?- sentence(S).
S = [the, beautiful, decision, drank, the, tough, painting] .

?- sentence(S).
S = [the, hard, record, traveled, the, tough, decision] .

?- sentence(S).
S = [the, hard, decision, regretted, the, beautiful, mouse] .

?- sentence(S).
S = [the, joyful, painting, punched, the, joyful, mansion] .

?- sentence(S).
S = [the, successful, painting, failed, the, joyful, mouse] .

?- sentence(S).
S = [the, tough, record, punched, the, hard, painting] .

?- sentence(S).
S = [the, hard, decision, regretted, the, beautiful, bugatti] .

?- sentence(S).
S = [the, beautiful, bottle, regretted, the, tough, bugatti] .

?- sentence(S).
S = [the, monotonous, bottle, punched, the, joyful, painting] .

?- sentence(S).
S = [the, joyful, mansion, punched, the, hard, bottle] .

?-
```