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

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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

```
 ?- consult("pokemon.pro").
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(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), write(' --> '), write(Z), nl, fail.
bulbasaur --> venusaur
caterpie --> butterfree
charmander --> charizard
poliwag --> poliwrath
squirtle --> blastoise
false.

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

 ?- pokemon(name(X), Y, _, _), write('nks(name('), write(X), write('), kind('), write(Y), 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,_)).
N = wartortle ;
false.

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

 ?- pokemon(_, water, _, attack(A, _)), write(A), nl, fail.
```

```
water-gun
amnesia
dashing-punch
bubble
waterfall
hydro-pump
slap
star-freeze
false.

 ?- pokemon(_, water, _, attack(A, 30)), write(A), nl, fail.
water-gun
amnesia
false.

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

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

 ?- pokemon(name(N), _, hp(HP),_), HP > 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.

 ?- pokemon(name(N), _, hp(HP), _), cen(N), write(N), write(': '), write(HP), nl, fail.
pikachu: 60
bulbasaur: 40
caterpie: 50
charmander: 50
```

vulpix: 60
poliwag: 60
squirtle: 40
staryu: 40
false.

Part 3: KB Extension

% --- extended

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

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

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

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

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

display_cen_attacks :- cen(X), pokemon(name(X),_,_,attack(Y,_)), write(Y), nl, fail.

indicate_attack(Name) :- pokemon(name(Name), _, _, attack(Y,_)), write(Name), write(' --> '), write(Y), nl, fail.

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

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

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

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

powerful_but_not_vulnerable(Name) :- pokemon(name(Name), _, hp(HP), attack(_, Y)), HP < 100, Y > 55.

dump_kind(T) :- pokemon(name(Name), T, hp(HP), attack(A, B)), write(pokemon(name(Name), T, hp(HP), attack(A,B))), nl, fail.

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

family(Name) :- write(Name), write(' '), evolves(Name, X), write(X), write(' '), evolves(X,Y), write(Y).

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

lineage(Name) :- pokemon(name(Name), Type, hp(HP), attack(A, B)), write(pokmon(name(Name), Type, hp(HP), attack(A, B))), nl,evolves(Name, X), pokemon(name(X), Type2, hp(HP2), attack(A2, B2)), nl,evolves(X,Y), pokemon(name(Y), Type3, hp(HP3), attack(A3, B3)), write(pokemon(name(Y), Type3, hp(HP3), attack(A3, B3))).

Part 4: Interaction demo with the Augmented KB

1 ?- consult("pokemon.pro").

true.

2 ?- display_cen_names.

pikachu

bulbasaur

caterpie

charmander

vulpix

poliwag

squirtle

staryu

false.

3 ?- display_not_cen.

raichu

ivysaur

venusaur

metapod

butterfree

charmeleon

charizard

ninetails

poliwhirl

poliwrath

wartortle

blastoise

starmie

false.

4 ?- generator(Name,fire).

Name = charmander ;

Name = charmeleon ;

Name = charizard ;

Name = vulpix ;

Name = ninetails.

5 ?- generator(Name,electric).

Name = pikachu ;

Name = raichu.

6 ?- generator(Name,grass).

Name = bulbasaur ;

Name = ivysaur ;

Name = venusaur ;

Name = caterpie ;

Name = metapod ;

Name = butterfree.

7 ?- display_names.

pikachu

raichu

bulbasaur

ivysaur

venusaur

caterpie

metapod

butterfree

charmander

charmeleon

charizard

vulpix

ninetails

poliwag

poliwhirl

poliwrath

squirtle

wartortle

blastoise

staryu

starmie

false.

8 ?- 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.

9 ?- display_cen_attacks

.

gnaw

leech-seed

gnaw

scratch

confuse-ray

water-gun

bubble

slap

false.

10 ?- indicate_attack(charmander).

charmander --> scratch

false.

11 ?- indicate_attack(bulbasaur).

bulbasaur --> leech-seed

false.

12 ?- 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.

13 ?- powerful(Name).

Name = raichu ;

Name = venusaur ;

Name = butterfree ;

Name = charizard ;

Name = ninetails ;

Name = wartortle ;

Name = blastoise ;

false.

14 ?- tough(Name).

Name = venusaur ;

Name = butterfree ;

Name = charizard ;

Name = poliwrath ;

Name = blastoise ;

false.

15 ?- awesome(Name).

Name = venusaur ;

Name = butterfree ;

Name = charizard ;

Name = blastoise ;

false.

17 ?- powerful(Name).

Name = raichu ;

Name = venusaur ;

Name = butterfree ;

Name = charizard ;

Name = ninetails ;

Name = wartortle ;

Name = blastoise ;

false.

18 ?- type(caterpie,Type).

Type = grass.

19 ?- type(Name,fire),write(Name),nl,fail.

charmander

charmeleon

charizard

vulpix

ninetails

false.

20 ?- 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.

21 ?- 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.

22 ?- family(pikachu).
pikachu raichu
false.

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

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

27 ?- families.

pikachu raichu

bulbasaur ivysaur venusaur

caterpie metapod butterfree

charmander charmeleon charizard

vulpix ninetails

poliwag poliwhirl poliwrath

squirtle wartortle blastoise

staryu starmie

false.

28 ?- lineage(pikachu).

pokemon(name(pikachu),electric,hp(60),attack(gnaw,10))

pokemon(name(raichu),electric,hp(90),attack(thunder-shock,90))

false.

29 ?- 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.

30 ?- lineage(wartortle).

pokemon(name(wartortle),water,hp(80),attack(waterfall,60))

pokemon(name(blastoise),water,hp(140),attack(hydro-pump,60))

false.

31 ?- lineage(blastoise).

pokemon(name(blastoise),water,hp(140),attack(hydro-pump,60))

false.

32 ?- 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(bulbasaur).
cen(caterpie).
cen(charmander).
cen(vulpix).
cen(poliwag).
cen(squirtle).
cen(staryu).
cen(sizzlipede).
```

```
cen(oddish).
cen(boltund).
cen(wattrel).
cen(buizel).

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

evolves(sizzlipede,centiskorch).
evolves(buizel,floatzel).
evolves(oddish,gloom).
```

```
evolves(gloom,vileplume).
evolves(boltund,yamper).
evolves(yamper,zeraora).
evolves(wattrel,kilowattrel).



% ----------------------------------------------------------------------
% --- pokemon(name(N),T,hp(H),attack(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)).

% ------------------------------------------------------------------
% --- 12 more pokemon
pokemon(name(sizzlipede), fire, hp(50), attack(flame-burst, 70)).
pokemon(name(centiskorch), fire, hp(100), attack(flare-blitz, 120)).

pokemon(name(buizel), water, hp(55), attack(origin-pulse, 110)).
pokemon(name(floatzel), water, hp(85), attack(Steam Eruption, 110)).

pokemon(name(oddish), grass, hp(45), attack(snap-trap, 35)).
pokemon(name(gloom), grass, hp(60), attack(solar-beam, 120)).
```

```
pokemon(name(vileplume), grass, hp(75), attack(seed-flare, 120)).

pokemon(name(boltund), electric, hp(69), attack(spark,65)).
pokemon(name(yamper), electric, hp(59), attack(thunder-punch, 75)).
pokemon(name(zeraora), electric, hp(88), attack(thunder-fang, 65)).

pokemon(name(wattrel), electric, hp(40), attack(rising-voltage, 70)).
pokemon(name(kilowattrel), electric, hp(70), attack(parabolic-charge, 90)).




% ----------------------------------------------------------------------
% --- extended

display_cen_names :- cen(X), write(X), nl, fail.
display_not_cen :- evolves(_, X), write(X), nl, fail.
generator(Name,Type) :- pokemon(name(Name), Type, _, _).
display_names :- pokemon(name(X), _, _, _), write(X), nl, fail.
display_attacks :- pokemon(_, _, _, attack(X, _)), write(X), nl, fail.
display_cen_attacks :- cen(X), pokemon(name(X),_,_,attack(Y,_)), write(Y), nl, fail.
indicate_attack(Name) :- pokemon(name(Name), _, _, attack(Y,_)), write(Name), write(' --> '), write(Y), nl, fail.
indicate_attacks :- pokemon(name(X), _, _, attack(Y, _ )), write(X), write(' --> '), write(Y), nl, fail.
```

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

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

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

powerful_but_not_vulnerable(Name) :- pokemon(name(Name), _, hp(HP), attack(_, Y)), HP < 100, Y > 55.

dump_kind(T) :- pokemon(name(Name), T, hp(HP), attack(A, B)), write(pokemon(name(Name), T, hp(HP), attack(A,B))), nl, fail.

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

family(Name) :- write(Name), write(' '), evolves(Name, X), write(X), write(' '), evolves(X,Y), write(Y).

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

```
1 ?- consult("pokemon.pro").

true.


2 ?- display_cen_names.
```

pikachu

bulbasaur

caterpie

charmander

vulpix

poliwag

squirtle

staryu

sizzlipede

oddish

boltund

wattrel

buizel

false.

3 ?- display_not_cen.

raichu

ivysaur

venusaur

metapod

butterfree

charmeleon

charizard

ninetails

poliwhirl

poliwrath

wartortle

blastoise

starmie

floatzel

gloom

vileplume

yamper

zeraora

kilowattrel

false.

4 ?- generator(Name,fire).

Name = charmander ;

Name = charmeleon ;

Name = charizard ;

Name = vulpix ;

Name = ninetails ;

Name = sizzlipede ;

Name = centiskorch.

5 ?- generator(Name,electric).

Name = pikachu ;

Name = raichu ;

Name = boltund ;

Name = yamper ;

Name = zeraora ;

Name = wattrel ;

Name = kilowattrel.

6 ?- generator(Name,grass).

Name = bulbasaur ;

Name = ivysaur ;

Name = venusaur ;

Name = caterpie ;

Name = metapod ;

Name = butterfree ;

Name = oddish ;

Name = gloom ;

Name = vileplume.

7 ?- display_names.

pikachu

raichu

bulbasaur

ivysaur

venusaur

caterpie

metapod

butterfree

charmander

charmeleon

charizard

vulpix

ninetails

poliwag

poliwhirl

poliwrath

squirtle

wartortle

blastoise

staryu

starmie

sizzlipede

centiskorch

buizel

oddish

gloom

vileplume

boltund

yamper

zeraora

wattrel

kilowattrel

false.

8 ?- 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

flame-burst

flare-blitz

origin-pulse

snap-trap

solar-beam

seed-flare

spark

thunder-punch

thunder-fang

rising-voltage

parabolic-charge

false.

9 ?- display_cen_attacks

.

gnaw

leech-seed

gnaw

scratch

confuse-ray

water-gun

bubble

slap

flame-burst

origin-pulse

snap-trap

spark

rising-voltage
false.

10 ?- indicate_attack(charmander).
charmander --> scratch
false.

11 ?- indicate_attack(kilowattrel).
kilowattrel --> parabolic-charge
false.

12 ?- indicate_attack(oddish).
oddish --> snap-trap
false.

13 ?- 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

sizzlipede --> flame-burst

centiskorch --> flare-blitz

buizel --> origin-pulse

oddish --> snap-trap

gloom --> solar-beam

vileplume --> seed-flare

boltund --> spark

yamper --> thunder-punch

zeraora --> thunder-fang

wattrel --> rising-voltage

kilowattrel --> parabolic-charge

false.

14 ?- powerful(Name).

Name = raichu ;

Name = venusaur ;

Name = butterfree ;

Name = charizard ;

Name = ninetails ;

Name = wartortle ;

Name = blastoise ;

Name = sizzlipede ;

Name = centiskorch ;

Name = buizel ;

Name = gloom ;

Name = vileplume ;

Name = boltund ;

Name = yamper ;

Name = zeraora ;

Name = wattrel ;

Name = kilowattrel.

15 ?- tough(Name).

Name = venusaur ;

Name = butterfree ;

Name = charizard ;

Name = poliwrath ;

Name = blastoise ;

false.

16 ?- awesome(Name).

Name = venusaur ;

Name = butterfree ;

Name = charizard ;

Name = blastoise ;

false.

17 ?- powerful(Name).

Name = raichu ;

Name = venusaur ;

Name = butterfree ;

Name = charizard ;

Name = ninetails ;

Name = wartortle ;

Name = blastoise ;

Name = sizzlipede ;

Name = centiskorch ;

Name = buizel ;

Name = gloom ;

Name = vileplume ;

Name = boltund ;

Name = yamper ;

Name = zeraora ;

Name = wattrel ;

Name = kilowattrel.

18 ?- type(gloom,Type).

Type = grass.

19 ?- type(Name,fire),write(Name),nl,fail.

charmander

charmeleon

charizard

vulpix

ninetails

sizzlipede

centiskorch

false.

20 ?- 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(buizel),water,hp(55),attack(origin-pulse,110))
false.

21 ?- 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(oddish),grass,hp(45),attack(snap-trap,35))
pokemon(name(gloom),grass,hp(60),attack(solar-beam,120))
pokemon(name(vileplume),grass,hp(75),attack(seed-flare,120))
false.

25 ?- family(oddish).
oddish gloom vileplume
true.

26 ?- family(boltund).
boltund yamper zeraora
true.

27 ?- family(sizzlipede).
sizzlipede centiskorch

false.

30 ?- families.

pikachu raichu
bulbasaur ivysaur venusaur
caterpie metapod butterfree
charmander charmeleon charizard
vulpix ninetails
poliwag poliwhirl poliwrath
squirtle wartortle blastoise
staryu starmie
sizzlipede centiskorch
oddish gloom vileplume
boltund yamper zeraora
wattrel kilowattrel
false.

31 ?- lineage(boltund).
pokemon(name(boltund),electric,hp(69),attack(spark,65))
pokemon(name(yamper),electric,hp(59),attack(thunder-punch,75))
pokemon(name(zeraora),electric,hp(88),attack(thunder-fang,65))
false.

32 ?- lineage(oddish).

pokemon(name(oddish),grass,hp(45),attack(snap-trap,35))

pokemon(name(gloom),grass,hp(60),attack(solar-beam,120))

pokemon(name(vileplume),grass,hp(75),attack(seed-flare,120))

false.

34 ?- lineage(sizzlipede).

pokemon(name(sizzlipede),fire,hp(50),attack(flame-burst,70))

pokemon(name(centiskorch),fire,hp(100),attack(flare-blitz,120))

false.

35 ?- lineage(wattrel).

pokemon(name(wattrel),electric,hp(40),attack(rising-voltage,70))

pokemon(name(kilowattrel),electric,hp(70),attack(parabolic-charge,90))

false.

Task 2: List Processing

Head/Tail Exercise:

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

H = red,

T = [yellow, blue, green].

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

false.

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

F = red.

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

S = yellow.

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

F = red,

S = yellow,

R = [blue, green].

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

List = [this, and, that].

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

List = [this, and, that].

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

false.

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

true.

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

Row = Column, Column = 1,

Rest = [cell(3, 2), cell(1, 3)].

12 ?- [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).


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([beautiful,magnificent,plump,stocky,long,calm], Adjective),
pick([bass, lion, camel, otter, owl, parrot, monkey, magpie], Noun).
sentence(Sentence) :- pick([believe, understand, speak, wait, remember, grow,
stand, move], Verb),
noun_phrase(Phrase1), noun_phrase(Phrase2), add_last(Verb, Phrase1,
PhraseWthVerb),
append(PhraseWthVerb, Phrase2, Sentence).
```

Demo for Example List Processors:

1 ?- consult("listprocessors.pro").

true.

2 ?- first([apple],First).

First = apple.

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

P = c.

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

Rest = [].

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

Rest = [d, e, f, g, a, b].

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

Last = peach .

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

P = b .

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

Element = zero .

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

Element = one .

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

red

yellow

blue

green

purple

orange

true.

11 ?- sum([],Sum).

Sum = 0.

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

SumOfPrimes = 28.

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

Result = [thing].

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

Languages = [racket, prolog, haskell, rust].

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

Result = [thing] ;
false.

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

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

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

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

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

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

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

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

Pie = cherry .

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

Pie = cherry .

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

Pie = blueberry .

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

Pie = apple .

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

Set = [1, 2, 3, 4] .

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

B = [bet, bot, bit] .

Demo for List Exercises

1 ?- consult("listprocessors.pro").

true.

2 ?- product([],P).

P = 1.

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

Product = 945.

4 ?- iota(9,Iota),product(Iota,Product).

Iota = [1, 2, 3, 4, 5, 6, 7, 8, 9],

Product = 362880 .

5 ?- make_list(7,seven,Seven).

Seven = [seven, seven, seven, seven, seven, seven, seven] .

6 ?- make_list(8,2,List).

List = [2, 2, 2, 2, 2, 2, 2, 2] .

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

X = [b, c].

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

X = [a, b, c, d].

9 ?- is_palindrome([x]).

true .

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

false.

11 ?-

is_palindrome([a,b,b,a]).

true .

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

false.

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

true .

14 ?- noun_phrase(NP).

NP = [the, long, magpie] ;

false.

15 ?- noun_phrase(NP).

NP = [the, beautiful, parrot] ;

false.

15 ?- noun_phrase(NP).

NP = [the, stocky, otter] ;

false.

15 ?- noun_phrase(NP).

NP = [the, calm, magpie] ;

false.

15 ?- noun_phrase(NP).

NP = [the, long, parrot] ;

false.

15 ?- sentence(S).

S = [the, plump, bass, remember, the, magnificent, parrot] .

16 ?- sentence(S).

S = [the, plump, lion, grow, the, calm, parrot] .

16 ?- sentence(S).

S = [the, stocky, camel, believe, the, magnificent, parrot] .

16 ?- sentence(S).

S = [the, stocky, camel, wait, the, plump, otter] .

16 ?- sentence(S).

S = [the, plump, camel, believe, the, long, lion] .

16 ?- sentence(S).

S = [the, long, parrot, believe, the, calm, parrot] .

16 ?- sentence(S).

S = [the, calm, otter, believe, the, long, monkey] .

16 ?- sentence(S).

S = [the, stocky, otter, speak, the, calm, owl] .

16 ?- sentence(S).

S = [the, long, owl, wait, the, plump, otter] .

16 ?- sentence(S).

S = [the, plump, lion, move, the, magnificent, bass] .

16 ?- sentence(S).

S = [the, stocky, camel, believe, the, plump, magpie] .

16 ?- sentence(S).

S = [the, long, camel, wait, the, stocky, monkey] .

16 ?- sentence(S).

S = [the, stocky, lion, move, the, calm, owl] .

16 ?- sentence(S).

S = [the, long, magpie, wait, the, stocky, parrot] .

16 ?- sentence(S).

S = [the, calm, owl, wait, the, plump, otter] .