# A4 - sol
# (win. 2023)

(1) (a) Denote:

$s(x)$ = smart$(x)$
$h(x)$ = hard_working$(x)$
$g(x)$ = graduate_studies$(x)$

We have:

$$((s(x) \wedge h(x)) \rightarrow g(x)) \wedge ((s(x) \wedge \neg h(x)) \rightarrow \neg g(x))$$

$$\equiv (\neg(s(x) \wedge h(x)) \vee g(x)) \wedge (\neg(s(x) \wedge \neg h(x)) \vee \neg g(x))$$

$$\equiv (\neg s(x) \vee \neg h(x) \vee g(x)) \wedge (\neg s(x) \vee h(x) \vee \neg g(x))$$

one non-negated term

(b)

$$\equiv ((s(x) \wedge h(x)) \rightarrow g(x)) \wedge ((s(x) \wedge g(x)) \rightarrow h(x))$$

Prolog:

```
g(X) :- s(X), h(X).
h(X) :- s(X), g(X).
```

(2) (a)

```
1. insert(X, L, [X|L]).
2. insert(X, [H|L], [H|L1]) :- insert(X, L, L1).
3. permute([], []).
4. permute([H|T], P) :- permute(T, P1), insert(H, P1, P).
```

elem list.

permute ([a,b], Y).

④ | H = a, T = [b]

permute ([b], P1), insert(a, P1, Y).

④ | H = b, T = []

permute ([], P2), insert(b, P2, P1), insert(a, P1, Y).

③ | P2 = [] => then permute is finished.

insert(b, [], P1), insert(a, P1, Y).

① | X = b, L = [], P1 = [b] => [b|[]] = [b].

insert(a, [b], Y).

① | X = a, L = [b] → Y = [a, b] ;

② | X = a, H = b, L = [], Y = [b|L1]

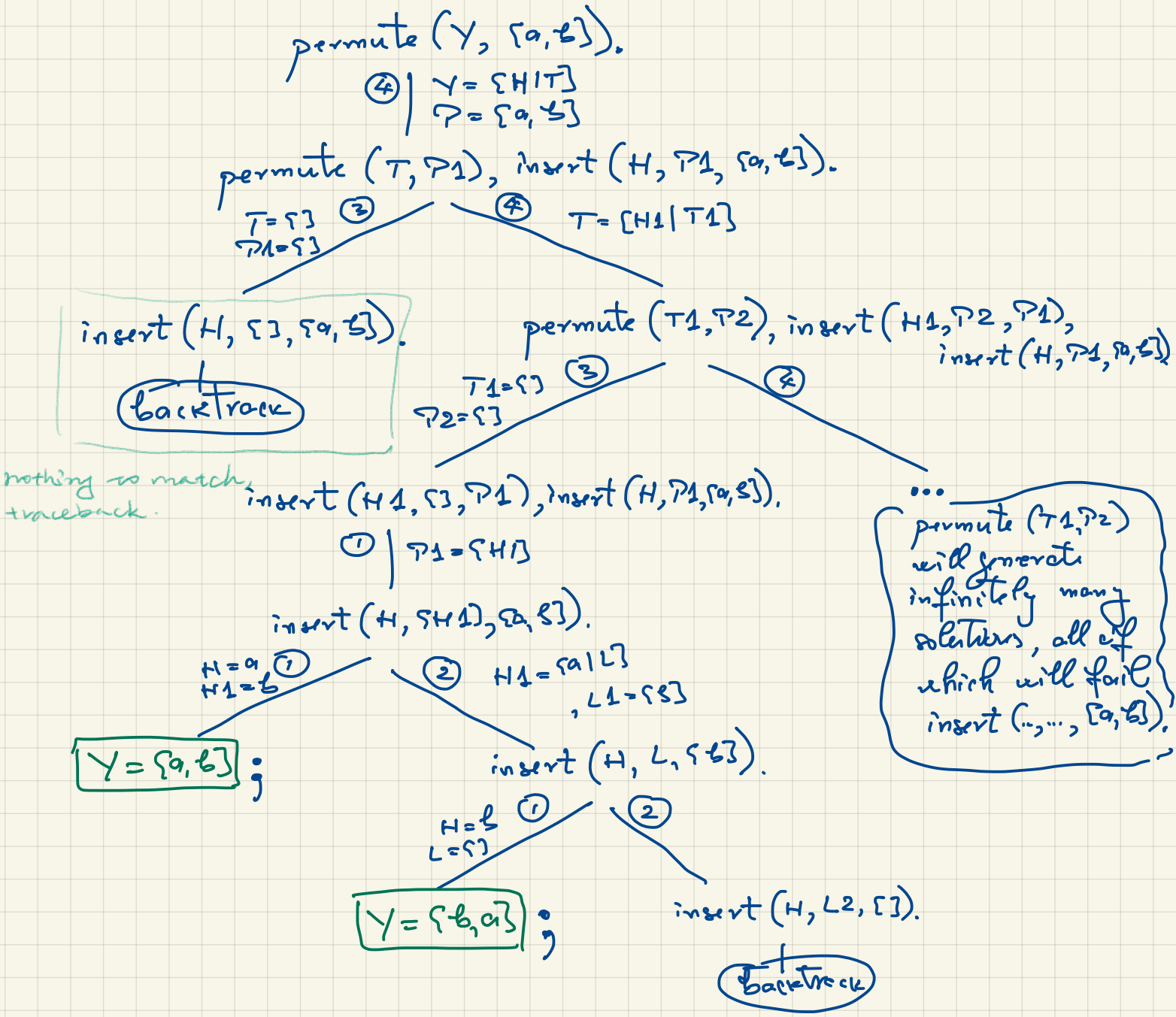
insert(a, [], L1).

① | X = a, L = [], L1 = [a] → Y = [b, a] ;

false

(b)

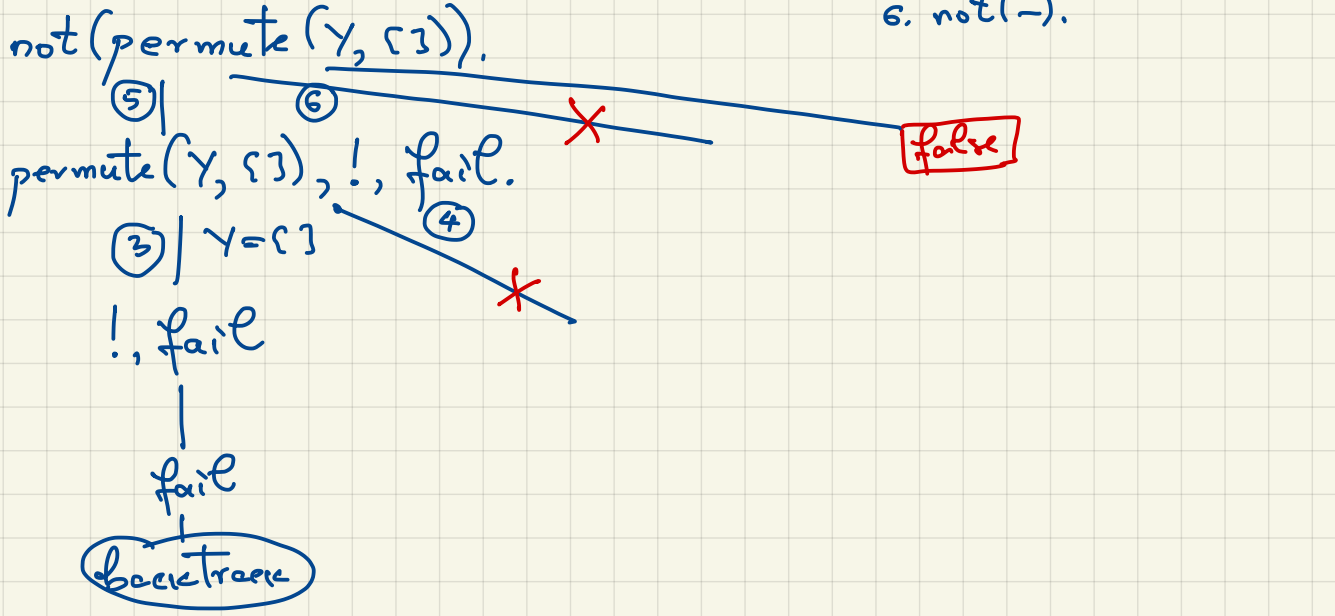
```
1. insert(X, L, [X|L]).
2. insert(X, [H|L], [H|L1]) :- insert(X, L, L1).
3. permute([], []).
4. permute([H|T], P) :- permute(T, P1), insert(H, P1, P).
```



(c)

```
1. insert(X, L, [X|L]).
2. insert(X, [H|L], [H|L1]) :- insert(X, L, L1).
3. permute([], []).
4. permute([H|T], P) :- permute(T, P1), insert(H, P1, P).
```

5. not(X) :- X, !, fail.
6. not(_).



③

```
magic_square(X) :- permutation([1,2,3,4,5,6,7,8,9],X),
          X = [X1,X2,X3,X4,X5,X6,X7,X8,X9],
          15 is X1+X2+X3,
          15 is X4+X5+X6,
          15 is X7+X8+X9,
          15 is X1+X4+X7,
          15 is X2+X5+X8,
          15 is X3+X6+X9,
          15 is X1+X5+X9,
          15 is X3+X5+X7.


?- magic_square(X).
X = [2, 7, 6, 9, 5, 1, 4, 3, 8] ;
X = [2, 9, 4, 7, 5, 3, 6, 1, 8] ;
X = [4, 3, 8, 9, 5, 1, 2, 7, 6] ;
X = [4, 9, 2, 3, 5, 7, 8, 1, 6] ;
X = [6, 1, 8, 7, 5, 3, 2, 9, 4] ;
X = [6, 7, 2, 1, 5, 9, 8, 3, 4] ;
X = [8, 1, 6, 3, 5, 7, 4, 9, 2] ;
X = [8, 3, 4, 1, 5, 9, 6, 7, 2] ;
false.
```