CS 344
Artificial Intelligence

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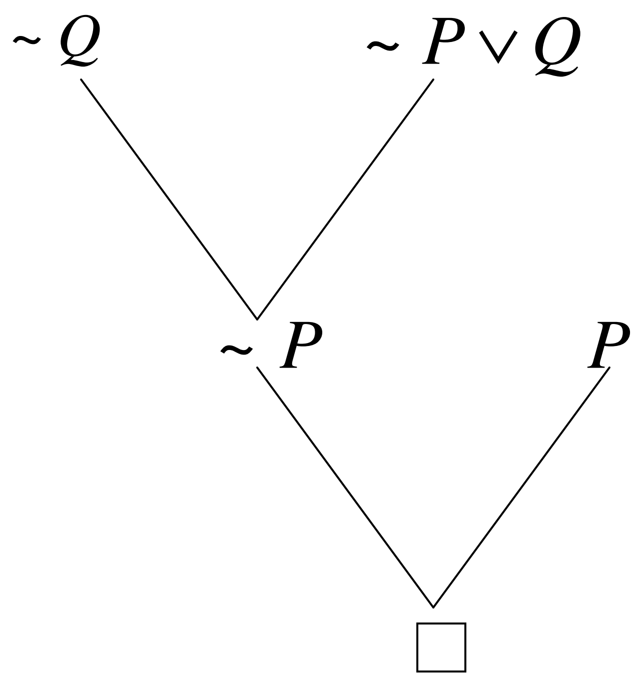
Inferencing in Predicate Calculus (Review)

- Forward chaining
  - Given P, $P \rightarrow Q$, to infer Q
  - P, match $L.H.S$ of $P \rightarrow Q$
  - Assert Q from $R.H.S$
- Backward chaining
  - Q, Match $R.H.S$ of $P \rightarrow Q$
  - assert P
  - Check if P exists
- Resolution – Refutation
  - Negate goal
  - Convert all pieces of knowledge into clausal form (disjunction of literals)
  - See if contradiction caused by null clause $\square$ can be derived

1. P
2. $P \rightarrow Q$ converted to $\sim P \vee Q$
3. $\sim Q$

Draw the resolution tree (actually an inverted tree). Every node is a clausal form and branches are intermediate inference steps.



Terminology

- Pair of clauses being <u>resolved</u> is called the <u>Resolvents</u>. The resulting clause is called the <u>Resolute</u>.
- Choosing the correct pair of resolvents is a matter of search.
- Illustration on next page.

Club example revisited

1. *member(A)*
2. *member(B)*
3. *member(C)*
4. $\forall x[member(x) \rightarrow (mc(x) \vee sk(x))]$
   - Can be written as $[member(x) \rightarrow (mc(x) \vee sk(x))]$
   - $\sim member(x) \vee mc(x) \vee sk(x)$
5. $\forall x[sk(x) \rightarrow lk(x, snow)]$
   - $\sim sk(x) \vee lk(x, snow)$
6. $\forall x[mc(x) \rightarrow \sim lk(x, rain)]$
   - $\sim mc(x) \vee \sim lk(x, rain)$
7. $\forall x[like(A, x) \rightarrow \sim lk(B, x)]$
   - $\sim like(A, x) \vee \sim lk(B, x)$

8. $\forall x[\sim lk(A,x) \rightarrow lk(B,x)]$

– $lk(A,x) \vee lk(B,x)$

9. $lk(A,rain)$

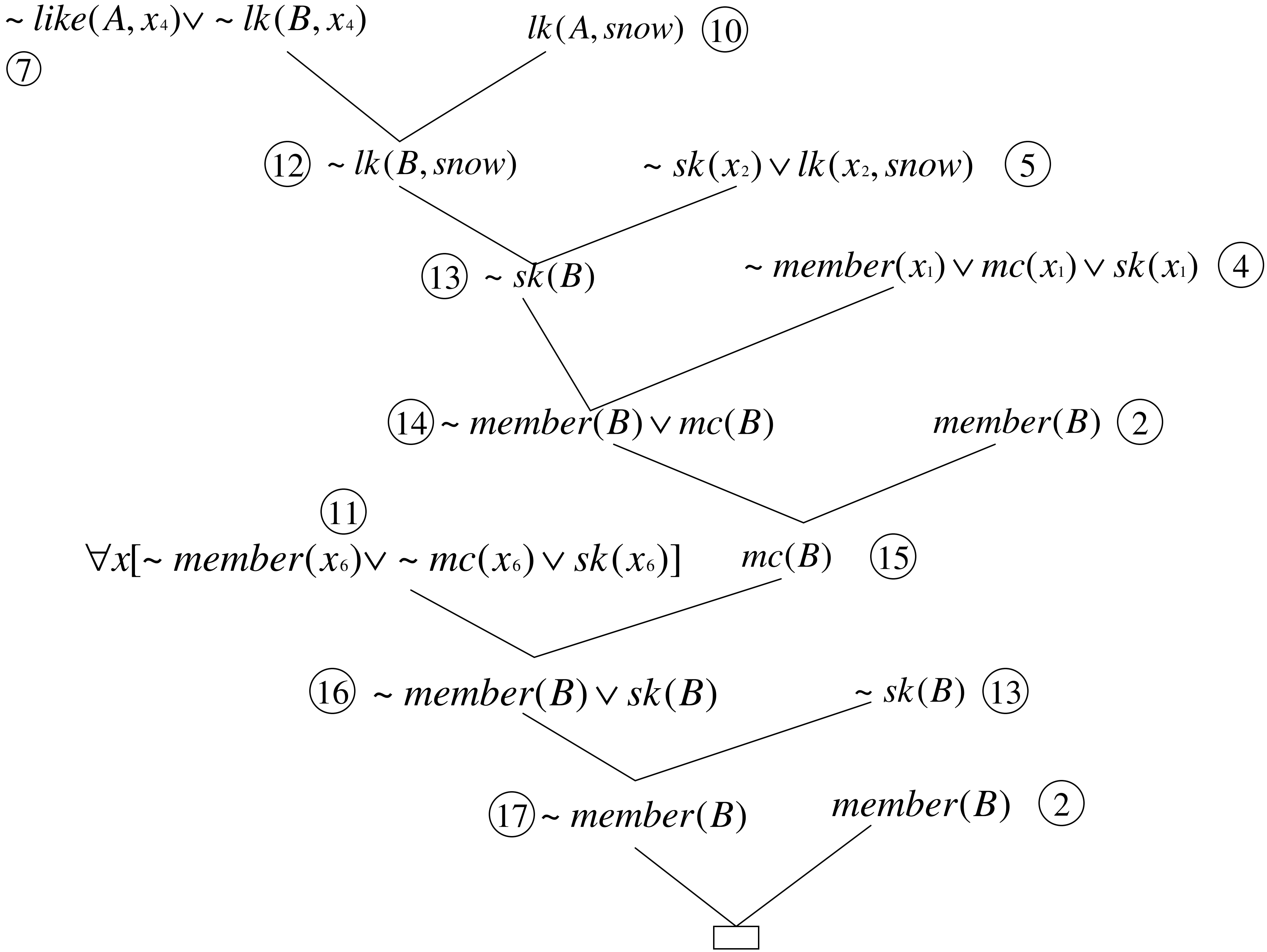
10. $lk(A,snow)$

11. $\exists x[member(x) \wedge mc(x) \wedge \sim sk(x)]$

– Negate– $\forall x[\sim member(x) \vee \sim mc(x) \vee sk(x)]$

- Now standardize the variables apart which results in the following

1. $member(A)$
2. $member(B)$
3. $member(C)$
4. $\sim member(x_1) \vee mc(x_1) \vee sk(x_1)$
5. $\sim sk(x_2) \vee lk(x_2, snow)$
6. $\sim mc(x_3) \vee \sim lk(x_3, rain)$
7. $\sim like(A, x_4) \vee \sim lk(B, x_4)$
8. $lk(A, x_5) \vee lk(B, x_5)$
9. $lk(A, rain)$
10. $lk(A, snow)$
11. $\forall x[\sim member(x_6) \vee \sim mc(x_6) \vee sk(x_6)]$



$\sim like(A, x_4) \vee \sim lk(B, x_4)$ 7
$lk(A, snow)$ 10
12 $\sim lk(B, snow)$
$\sim sk(x_2) \vee lk(x_2, snow)$ 5
13 $\sim sk(B)$
$\sim member(x_1) \vee mc(x_1) \vee sk(x_1)$ 4
14 $\sim member(B) \vee mc(B)$
$member(B)$ 2
11
$\forall x[\sim member(x_6) \vee \sim mc(x_6) \vee sk(x_6)]$
$mc(B)$ 15
16 $\sim member(B) \vee sk(B)$
$\sim sk(B)$ 13
17 $\sim member(B)$
$member(B)$ 2