lecture 9:-

P62 / Ex7 :-

P1 $p \to q$

P2 $\neg p \to r$

P3 $r \to s$

C $\therefore \neg q \to s$.

C1:- $\neg p \vee q$ ✓

C2:- $p \vee r$ ✓

C3:- $\neg r \vee s$. ✓

C4:- $\neg q$ ✓

C5:- $\neg s$. ✓

$\neg q \to s = \neg(q \vee s)$

$= \neg q \wedge \neg s$.

For computing negation of Conclusion.

from C1, C2 $q \vee r$ — C6 ✓

from C3, C6 $q \vee s$ — C7 ✓

from C4, C7 s — C8 ✓

from C5, C8 □

PRACTICE :- ① $\forall x P(x)$ $x \in \{1, 2\}$.

$\wedge, \vee,$ $P(\cdot)$.

Expression ?

$\forall x P(x) =$ $P(1) \wedge P(2)$.

② $\neg \forall x P(x)$ $x \in \{1, 2\}$.

$\wedge, \vee,$ $P(\cdot)$.

$\neg \forall x P(x) = \exists x \neg P(x)$.

Expression. $\exists x \neg P(x)$.

$= \neg P(1) \vee \neg P(2)$.

③ $\forall x \forall y \; P(x, y)$. $x, y \in \{1, 2\}$.

$= \forall x \; (P(x, 1) \wedge P(x, 2))$.

$= \forall x P(x, 1) \wedge \forall x P(x, 2)$.

$= (P(1,1) \wedge P(2,1)) \wedge$

$(P(1,2) \wedge P(2,2))$.

(4) $\neg \forall x \overbrace{\neg \forall y \neg P(x,y)}^{P(x).}$. $\neg \forall x P(x) = \exists x \neg P(x)$.

$\exists x \neg \neg \forall y \neg P(x,y)$.

$\exists x \forall y \neg P(x,y)$.

A B C.

Knight & Knave. & Spy.

?

let P_1: A is a Knight. $\neg P_1$: A is not a Knight

P_2: A is a Knave. $\neg P_2$: " " a Knave.

P_3: A is a Spy. $\neg P_3$: " " not a Spy.

A Say "B is a Spy or J am a Knave.".

$q_3 \vee P_2$.

$\gamma_3 \vee \neg P_1$.

$P_2 \vee \neg \gamma_1$.

Knight, Spy, Knave.

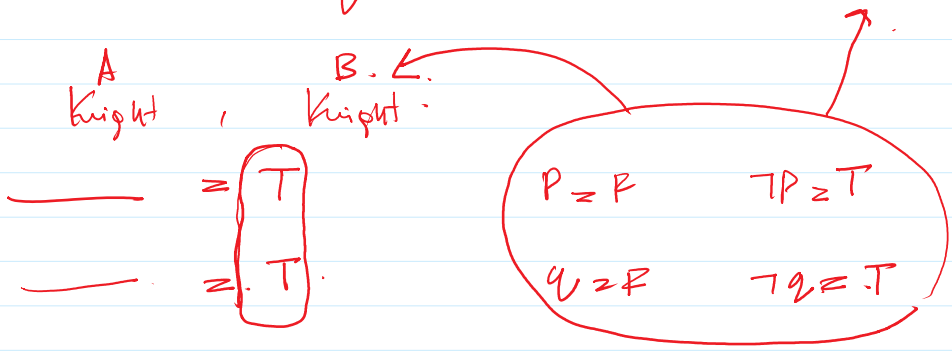
$q_3 \vee P_2$. $= T$

$P_2 \vee \neg \gamma_1 = ?$ X.

$\gamma_3 \vee \neg P_1$. $= F$.

p ≡ B is Knave.
q ≡ A is a Knave.

¬p ≡ B is a Knight.
¬q ≡ A is a Knight.



$p \rightarrow q$.

$\neg q \rightarrow \neg p$.

"If it is raining then we will not win the match."

Contrapositive.

Implicate ?

PROLOG:- PROLOG FACTS.
PROLOG RULES.

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instructor( chan, math 273).
instructor ( patel, ee222).
instructor( grossman, cs301).

enrolled ( Kevin , math273).←
enrolled ( juana, ee222).
enrolled ( juana, cs301).

enrolled ( kiko, math273).←
enrolled (kiko, cs301).
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? enrolled (X, math273).        ; hit it.
    X = Kevin ;
    X = kiko ;
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X = Kevin ;
X = Kiko ;

→.

logical conjunction.

teaches(P, S) (:-) instructor(P, C), enrolled(S, C).

teaches(chan, X)

X = Kevin ;
X = Kiko.

Ex 2:-

likes(mary, food).
likes(mary, mangos).
likes(john, mangos).
likes(john, mary).

John likes anything that mary likes.

likes(john, X), likes(mary, X).

John likes anyone who likes mango.

likes(john, X), likes(X, mango).
X = mary.

John likes anyone who likes themselves.
likes(john, X), likes(X, X)

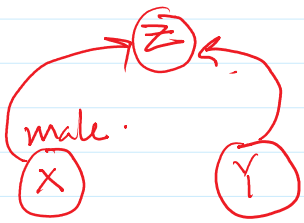
Ex:-

male(charles1).
male(charles2).
male(james2).
male(george1).

female(catherine).
female(elizabeth).
female(sophia).

parent(charles1, james1).
parent(elizabeth, james1).
" (charles2, charles1).
" (_, _)

female (Elizabeth).
female (Sophia).



mother (X, Y) :- female(X), parent(X, Y).

father (X, Y) :- male(X), parent(X, Y).

brother (X, Y) :- male(X), parent(Z, X), parent(Z, Y). ✓

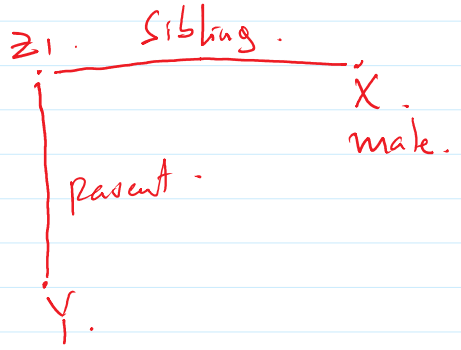
:- male(X), mother(Z, X), mother(Z, Y), father(Z, X), father(Z, Y). ✓

sister (X, Y) :- HW.

sibling (X, Y) :- parent(Z, X), parent(Z, Y).

Grandfather (X, Y) :- male(X), parent(X, Z), parent(Z, Y).

Grandmother (X, Y) :- HW.

Cousin (X, Y) :- parent(Z1, X),
parent(Z2, Y),
sibling(Z1, Z2).

Uncle (X, Y) :- ?