Written Notes from 9/1/2020 COT 3100 Lecture

I mostly went over the .pdf file with the notes on bitwise operators first and explained a few pieces of base conversion typing things below:

2 x 2 x 2 x 2 x 0 = 2 x (2 x 2 x 2 x 0)

Taking any number, dividing 2 and looking at the remainder isolates the last bit of that number (this is how we get the last bit of the binary.

Then, dividing by 2 gets rid of the last bit, so now, we can repeat the process with this new number, until we peel off all the bits.

Now, converting from base b to base 10
3ac in base 16 = $3 \times 16^2 + 10 \times 16^1 + 12 \times 16^0$

Now, to convert back from base 10 to base b:

Divide by b and keep track of the remainder, repeat over and over again until the quotient is 0. Then read the remainders in opposite order.

940 in base 10 → base 16
16 | 940
16 |58 R 12 (c)
16 | 3 R 10 (a)
16 | 0 R 3 base 16 value is 3ac.

78 & 63 (bitwise and)

78 in the computer is really 1001110

63 0111111

0001110 = 14

Bitwise and looks at the b its in the two numbers and puts 1 in the corresponding place if the inputs are both 1s, then we reinterpret the result as a number.

45 | 27 (bitwise or)

45 = 101101

27 = 011011

111111

17 | 39

010001

100111

110111 = 55

45 ^ 27 (bitwise xor)

45 = 101101

27 = 011011

110110 = 54

I typed all of these in IDLE so students could see these operators being used in a programming language (Python)

Proof problem using the rules of inference

$(\neg p \vee q) \rightarrow r$

$r \rightarrow (s \vee t)$

$\neg s \wedge \neg u$

$\neg u \rightarrow \neg t$

$\therefore\ p$

1. $\bar{s} \wedge \bar{u}$	Premise
2. $\bar{u}$	Rule of Conjunctive Simplification with #1
3. $\bar{u} \rightarrow \bar{t}$	Premise
4. $\bar{t}$	Modus Ponens with #2 and #3
5. $\bar{s}$	Rule of Conjunctive Simplification with #1
6. $\bar{s} \wedge \bar{t}$	Rule of Conjunction with #4 and #5
7. $\overline{s \vee t}$	DeMorgan's Law with #6
8. $r \rightarrow (s \vee t)$	Premise
9. $\bar{r}$	Modus Tollens with #7 and #8
10. $(\bar{p} \vee q) \rightarrow r$	Premise
11. $\overline{\bar{p} \vee q}$	Modus Tollens with #9 and #10
12. $\bar{\bar{p}} \wedge \bar{q}$	De Morgan's Law with #11
13. $\bar{\bar{p}}$	Conjunctive Simplification with #12
14. p	Double Negation with #13

How can I derive the rules of inference?

(1) Truth Table
(2) Laws of Logic

$[p \wedge (p \rightarrow q)] \rightarrow q$

P	q	$p \rightarrow q$	$p \wedge (p \rightarrow q)$	$[p \wedge (p \rightarrow q)] \rightarrow q$
F	F	T	F	T
F	T	T	F	T
T	F	F	F	T
T	T	T	T	T

Use the laws of logic to show that the expression is a tautology, which is a statement that is always true.

$p \rightarrow q$ IS THE SAME AS $\bar{p} \vee q$

Show that $[p \wedge (p \rightarrow q)] \rightarrow q$ is a tautology.

$[p \wedge (p \rightarrow q)] \rightarrow q$

$[p \wedge (\bar{p} \vee q)] \rightarrow q$ Definition of Implication

$\overline{p \wedge (\bar{p} \vee q)} \vee q$ Definition of Implication

$(\bar{p} \vee \overline{\bar{p} \vee q}) \vee q$ <u>Demorgan's</u>

$(\bar{p} \vee (\bar{\bar{p}} \wedge \bar{q})) \vee q$ Demorgan's

$(\bar{p} \vee (p \wedge \bar{q})) \vee q$	Double Negation
$((\bar{p} \vee p) \wedge (\bar{p} \vee \bar{q})) \vee q$	Distributive Law
$(T \wedge (\bar{p} \vee \bar{q})) \vee q$	Inverse Law
$(\bar{p} \vee \bar{q}) \vee q$	Identity Law
$\bar{p} \vee (\bar{q} \vee q)$	Associative Law
$\bar{p} \vee T$	Inverse Law
T	Domination law