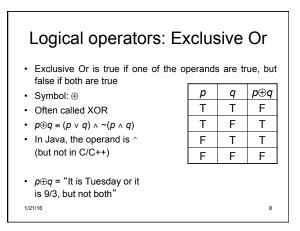


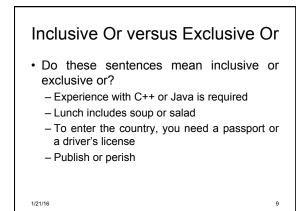
## Logical operators: Or

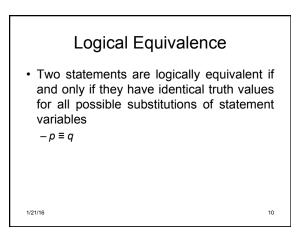
- Disjunction
- · Or is true if either operands is tr
- Symbol: v
- In C/C++ and Java, the operand is ||

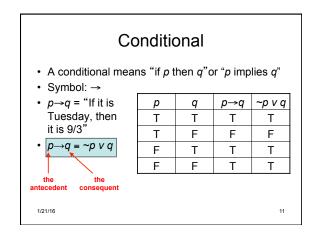
ue						
q	p∨q					
Т	Т					
F	Т					
Т	Т					
F	F					
	T F T					

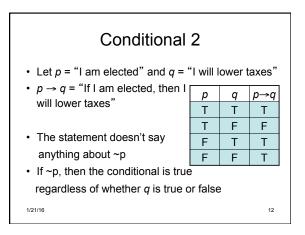
- p∨q = "It is Tuesday or 1/21jt6is 9/3 (or both)"



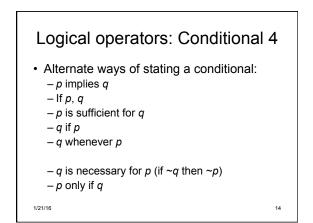


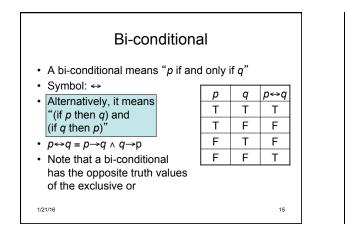


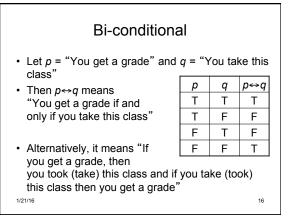


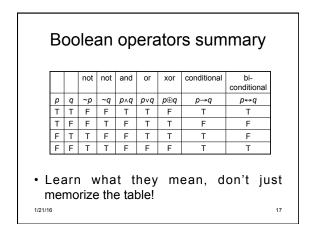


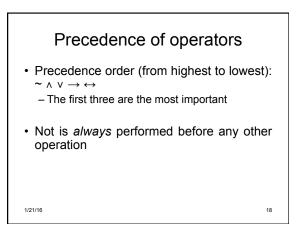
Conditional 3								
				Conditional	Inverse	Converse	Contra- positive	
р	q	~p	~q	p→q	~p→~q	q→p	~q→~p	
Т	Т	F	F	Т	Т	Т	Т	
Т	F	F	Т	F	Т	Т	F	
F	Т	Т	F	Т	F	F	Т	
F	F	Т	Т	Т	Т	Т	Т	
•	<ul> <li>The conditional and its contra-positive are equivalent</li> <li>So are the inverse and converse</li> </ul>							

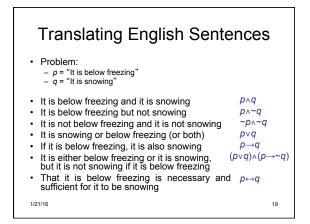


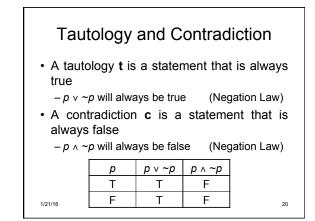


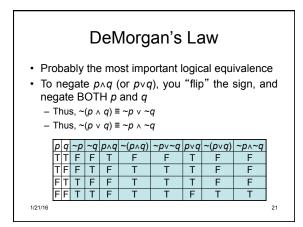






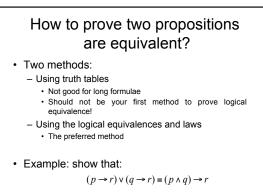






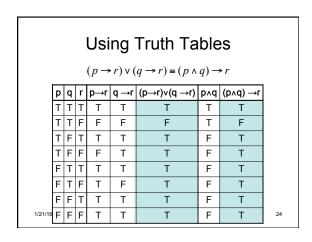
## Logical Equivalences

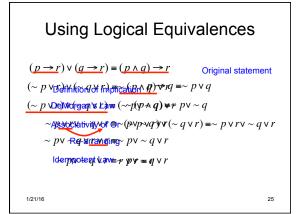
Communicative	$p \land q \equiv q \land p$	$p \lor q \equiv q \lor p$	
Associative	$(p \land q) \land r \equiv p \land (q \land r)$	$(p \lor q) \lor r \equiv p \lor (q \lor r)$	
Distributive	$p \land (q \lor r) \equiv (p \land q) \lor (p \land r)$	$p \lor (q \land r) \equiv (p \lor q) \land (p \lor r)$	
Identity	$p \wedge \mathbf{t} \equiv p$	$p \lor \mathbf{c} \equiv p$	
Negation	$p \lor \sim p \equiv \mathbf{t}$	<i>p</i> ∧ ~ <i>p</i> ≡ <b>c</b>	
Double Negative	~(~ <i>p</i> ) ≡ <i>p</i>		
Idempotent	$p \land p \equiv p$	$p \lor p \equiv p$	
Universal bound	<i>p</i> ∧ <b>c</b> ≡ <b>c</b>	$p \lor t \equiv t$	
De Morgan's	$\sim (p \land q) \equiv \sim p \lor \sim q$	$\sim (p \lor q) \equiv \sim p \land \sim q$	
Absorption	$p \lor (p \land q) \equiv p$	$p \land (p \lor q) \equiv p$	
Negation of t and c	~t ≡ c	~c = t 22	



1/21/16

23





## Using Logical Equivalences

```
(p \rightarrow r) \lor (q \rightarrow r) \equiv (p \land q) \rightarrow r(\sim p \lor r) \lor (\sim q \lor r) \equiv \sim (p \land q) \lor r(\sim p \lor r) \lor (\sim q \lor r) \equiv (\sim p \lor \sim q) \lor r\sim p \lor r \lor \sim q \lor r \equiv \sim p \lor \sim q \lor r\sim p \lor \sim q \lor r \lor r \equiv \sim p \lor \sim q \lor r\sim p \lor \sim q \lor r \equiv \sim p \lor \sim q \lor r
```

Original statement Definition of implication DeMorgan's Law Associativity of Or Re-arranging Idempotent Law

26

1/21/16