Chapter 3 outline:

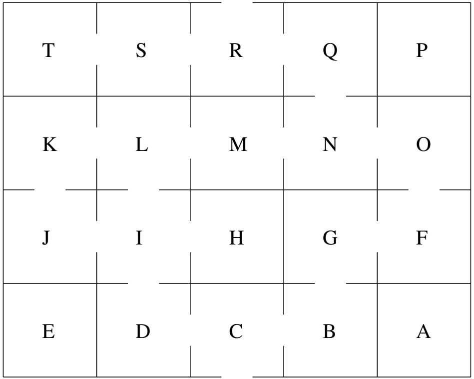
- Propositions, booleans, logical equivalence. §3.(1 & 2) (last week Friday)
- Conditional propositions, conditional expressions. §3.3 (**Today**)
- Arguments and predicates. §3.(5 & 6) (Wednesday)
- Predicates and quantification. §3.(6 & 7) (Friday)
- (Begin proofs next week)

Today:

- Highlight most important parts of conditionals
- Highlight most confusing parts of conditionals
- Observe programming connections
- Get a head start on arguments

p	q	$p \wedge q$	$p \vee q$	$\sim p$	$\sim p \vee q$	$p \rightarrow q$
T	T	T	T	F	T	T
T	F	F	T	F	F	F
F	T	F	T	T	T	T
F	F	F	F	T	T	T

	p		q
If	12 divides 36 evenly,	then	3 divides 72 evenly.
If	$3 < 72$,	then	3 divides 72 evenly.
If	12 divides 36 evenly,	then	$72 < 3$.
If	$72 < 3$,	then	3 divides 72 evenly.
If	$72 < 3$,	then	12 divides 3 evenly.



1. Bob passed through P.
2. Bob passed through N.
3. Bob passed through M.
4. If Bob passed through O, then Bob passed through F.
5. If Bob passed through K, then Bob passed through L.
6. If Bob passed through L, then Bob passed through K.

Based on example by Susanna Epp, 2006

"If Fred was at the dock at midnight, then he's the murderer."

"If it's raining at home and the windows are still open, then water is coming in."

"If I were John and John were me, then he'd be six and I'd be three." — A. A. Milne

"If the dryer is finished, then unload it."

"If you finish your spinach, then I will give you some cake."

"If it rains tomorrow, the zucchini will sprout."

An even degree is a necessary condition for a polynomial to have no real roots .
means
If a polynomial function has no real roots, then it has an even degree.

A positive global minimum is a sufficient condition for a polynomial to have no real roots
means
If a polynomial function has a positive global minimum, then it has no real roots.

Values all of the same sign is a necessary and sufficient condition for a polynomial to have no real roots.
means
A polynomial function has values all of the same sign if and only if the function has no real roots.

		(original) conditional	converse	inverse	contrapositive	negation	biconditional
p	q	$p \to q$	$q \to p$	$\sim p \to \sim q$	$\sim q \to \sim p$	$p \wedge \sim q$	$p \leftrightarrow q$
T	T	T	T	T	T	F	T
T	F	F	T	T	F	T	F
F	T	T	F	F	T	F	F
F	F	T	T	T	T	F	T

With respect to the conditional proposition

If the jar is open, then the cookies are gone.

identify each of the following propositions.

- The jar is open.
- The cookies are gone.
- If the cookies are gone, then the jar is open.
- If the jar is not open, then the cookies are not gone.
- If the cookies are not gone, then the jar is not open.

Valid argument

If it is Monday, then it is raining
It is Monday.
Therefore it is raining.

$p \to q$
p
$\therefore q$

p	q	$p \to q$	q	
premise		*premise*	*conclusion*	
T	T	T	T	*critical row*
T	F	F	F	
F	T	T	T	
F	F	T	F	

Invalid argument

If it is raining, then there are clouds
There are clouds.
Therefore it is raining.

$p \to q$
q
$\therefore\ p$

	premise	premise	conclusion	
p	q	$p \to q$	p	
T	T	T	T	critical row
T	F	F	T	
F	T	T	F	critical row
F	F	T	F	

Modus tollens

If it is spring, then the daffodils bloom.
The daffodils aren't blooming.
Therefore it is not spring.

p	q	$p \rightarrow q$	$\sim q$	$\sim p$
T	T	T	F	
T	F	F	T	
F	T	T	F	
F	F	T	T	T

Modus Ponens

$p \to q$

p

$\therefore q$

Modus Tollens

$p \to q$

$\sim q$

$\therefore \sim p$

Generalization

p

$\therefore p \vee q$

Specialization

$p \wedge q$

$\therefore p$

Elimination

$p \vee q$

$\sim p$

$\therefore q$

Transitivity

$p \to q$

$q \to r$

$\therefore p \to r$

Division into cases

$p \vee q$

$p \to r$

$q \to r$

$\therefore r$

Contradiction

$p \to F$

$\therefore \sim p$

For next time:

Do Exercises 3.4.(1-10), which is all of them.
Exercises 1-6 are on paper, Exercises 7-10 in a Jupyter notebook.

Read 3.(5 & 6)

Take quiz