Solving discrete problems — Math 2020, Spring 2005

Schedule For Thursday, January 27, 2005.

1. Logic and truth tables.
   See 1.1 and 1.2 in the course book. If you don't have the book, see:
   http://www.math.csusb.edu/notes/logic/lognot/lognot.html
2. Logic and proofs .
   See 3.1 and 3.2 in the course book, or example in class.
3. Proof that $\sqrt{2}$ is irrational.
   reference: http://http://www.cut-the-knot.org/proofs/sq_ root.shtml
4. Proof that there are infinitely many primes.
   Page 125 in the course book. If you don't have the book, see:
   http://odin.mdacc.tmc.edu/∼krc/numbers/infitude.html
5. logic language quiz.

Break

6. Discussion of numbers of the form $2^m - 1$.
   This is the start of a discission about Mersenne primes. For more details, see:
   http://www.mersenne.org

Truth tables (1.1 and 1.2 in the book.)

For each connective $(\neg, \wedge, \vee, \rightarrow, \leftrightarrow)$, there is a corresponding **truth table**:

p	$\neg p$
T	F
F	T

p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

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

p	q	$p \leftrightarrow q$
T	T	T
T	F	F
F	T	F
F	F	T

Try each line with p and q statements like "Tom is tall", "Tom is thin", "Tom is rich", "Tom is good looking".

Homework Due Thursday February 3.

1. Find the prime factorisations of
$$2^{15} + 1,\ 2^{36} - 1,\ 3^{15} - 1,\ 3^{30} - 1$$
2. Find four prime divisors of $34^{110} - 1$.
3. For any positive integer m, the polynomial $(x - 1)$ divides $x^m - 1$. What is the quotient?
4. find a proof by contradiction for the statement "$x = \log_{10}(5)$ is irrational", using the following steps:
   o. Aiming for a contradiction, assume x is rational. (The opposite (or **negation**) of what we want to prove.)
   i. Use the **definition**: What does it mean for x to be rational?
   ii. Use the **definition**: What does it mean for $x = \log_{10}(5)$?
   iii. Put i and ii together, and use some **properties** of logatithms, e.g., $(a^{b/c})^c = a^b$, so that from the equality $x = \log_{10}(5)$ you get another equality, involving only integers, and using notation introduced in steps i and ii.
   iv. Use a **previous result**, in this case, apply unique prime factorisation.
   v. Derive a contradiction. This means that step o was wrong, so x is irrational. QED

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Also, remember that there is a "brush up your factoring skills" tutorial, 1:30 today, right after this class, same place.