

Problems of the day:

1. Let $P = \{(a, ba), (aab, a), (b, cc), (c, abca)\}$

Prove that P has a match.

2. How many ways can aab be factored as

$x y z$ such that $|y| \geq 1$?

Write down all possibilities:

x	y	z
ε	a	ab

....

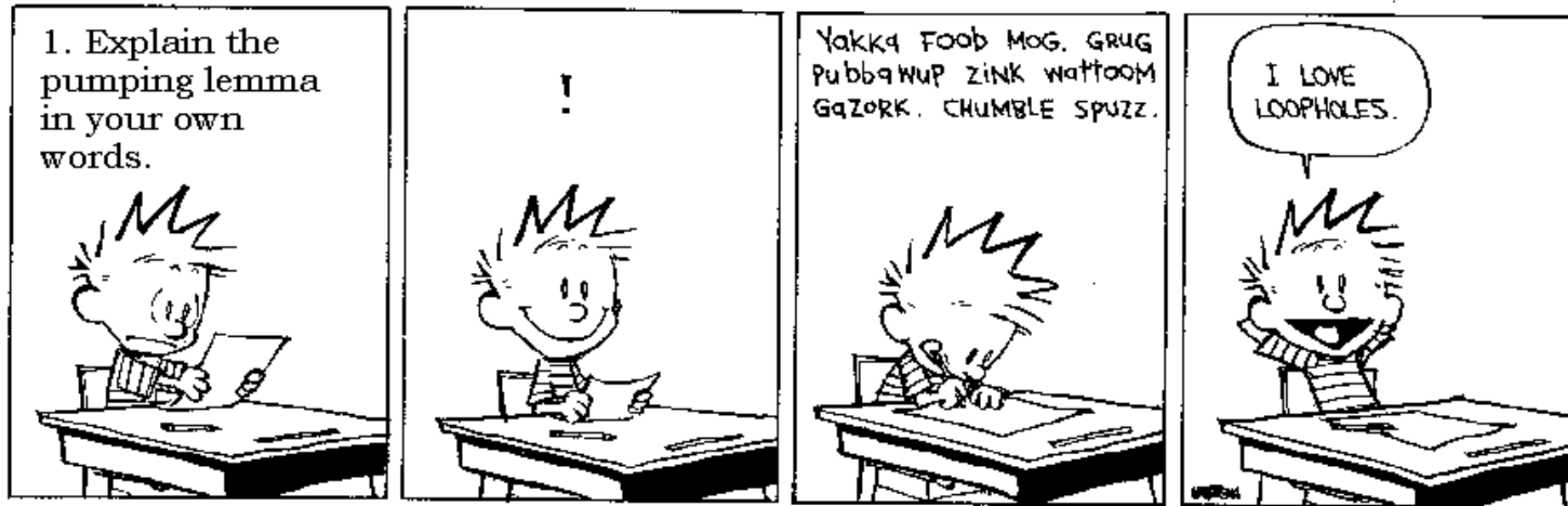
Announcements

Assignment #2: Due at beginning of class Friday June 8.

Midterm is in class on **Wed. June 27.**

Make sure you sign the attendance sheet every class when you arrive (once I have collected it, it is too late to sign in).

Pigeons and the Pumping Lemma



Outline:

1. Another elementary proof technique- the pigeonhole principle. This is critical for proving the Pumping Lemma for regular languages (a tool for proving that a language is not regular)
2. Introduction to the pumping lemma.

The Pigeonhole Principle



Given two natural numbers n and m with $n > m$, if n items are put into m pigeonholes, then at least one pigeonhole must contain more than one item.

Picture from: [Wikipedia, the free encyclopedia](#)

If there's only one place (the pigeonhole) to put a number (the pigeon), it must go there.

The number 6
must go in the
green square.

OPEN: are there
any uniquely
completable
squares with only
16 entries filled in?

From: Dan Rice's
Sudoku Blog

9	2	×		×	×	×	×	3
			3		4		2	
1	3			2		9		6
5		1				3		4
				6				
3		2				8		5
		6		1			3	8
	5		8		6			
8							9	7

Application:

Show that in any group of people there are at least two people with the same number of acquaintances.

Note: we are assuming that if Sue is acquainted with Joe then Joe is acquainted with Sue.

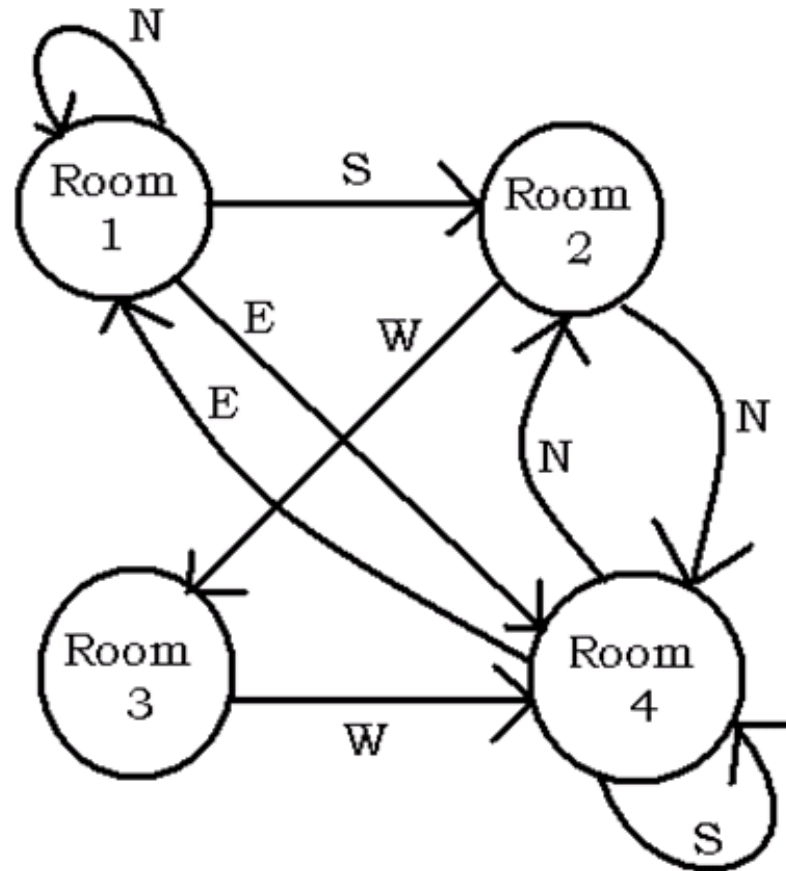
Colossal Cave Adventure (from Wikipedia)

In the mid 1970s, programmer, caver, and role-player William Crowther developed a program called *Colossal Cave Adventure*. The game used a text interface to create an interactive adventure through a spectacular underground cave system. Crowther's work was later modified and expanded by programmer Don Woods, and Colossal Cave Adventure became wildly popular among early computer enthusiasts, spreading across the nascent ARPANET throughout the 1970s.

A big fan of Tolkien, Woods introduced additional fantasy elements, such as elves and a troll. Adventure was the first game to feature objects that could be picked up, used, and dropped (and that could be carried by a non-player character).

You are in a maze of twisty little passages, all alike.

If the maze has n rooms and each one has trails exiting to the N, S, W, E. How many trails must be traversed before some room is visited more than once?



The Pumping Lemma for Regular Languages:

If L is a language accepted by a DFA with k states, and $w \in L$, $|w| \geq k$, then there exists

x, y, z such that

1. $w = x y z$,
2. $y \neq \varepsilon$,
3. $|x y| \leq k$, and
4. $x y^n z$ is in L for all $n \geq 0$.

Factor $a^r b^{3r}$ as $x y z$ in all possible ways
where $y \neq \varepsilon$.