MA/CSSE 474   Day 15 Summary

1. **Showing that a language is *not* regular.**
2. Pumping theorem: **Informally**: If *L* is regular, then every long string in *L* is "infinitely pumpable (in and out)".

Formally (contrapositive)

($\forall k \geq 1$

($\exists$ a string $w \in L$

($|w| \geq k$ *and*

($\forall$ *x, y, z* **((**$w = xyz \wedge |xy| \leq k \wedge y \neq \varepsilon$**)** →

$\exists q \geq 0$ ($xy^qz \notin L$)**)))))**

→ L is not regular .

3. Hopcroft and Ullman's "adversary argument" is a good way to understand this. The "adversary" is trying to show that L is regular; we are showing that it is not.
   a. Adversary picks k, x, y, z. We pick w, q. We must have a strategy for picking w and q that will work for any k and for any legal x, y, z.

4. Example: $\{a^nb^n : n \geq 0\}$ Done last time:

5. Example: $\{a^nb^n : n \geq 0\}$ A different w. Details on slides. A place for notes:

6. Bal = $\{w \in \{\,),\, (\,\}^* :$ the parens are balanced$\}$

7. PalEven = $\{uu^R : u \in \{a, b\}^*\}$

8. $\{w \in \{a, b\}^* : \#_a(w) = \#_b(w)\}$ Can you use closure property to avoid pumping theorem altogether?

9. $\{aba^n b^n : n \geq 0\}$ You can make this one a LOT easier by using a closure property.

10. What is a decision procedure?

11. Given a DFSM M=(K,Σ, δ, s, A) and a string $w \in \Sigma^*$, is $w \in L(M)$?

12. Given an FSM M, is $L(M)$ finite?

13. Given an FSM M, is $L(M) = \Sigma_M{}^*$?