MA/CSSE 474 Day 35 Summary

1) An example of a program for which it is difficult to tell whether it always halts.

2) **The language H** = {<*M*, *w*> : TM *M* halts on input string *w*} Is H decidable?
   a) Of course we can decide halting for specific simple TMs. Or can we? (Collatz conjecture, 1937, still no proof).
   b) It's easy to see that H is semidecidable.

      M'$_H$(<*M*, *w*>) =
        1. Run *M* on *w*.
        2. Accept.

      i) *M'*$_H$ accepts <*M*, *w*> iff M halts on input w.
      ii) *So M'*$_H$ semidecides H
      iii) Can there be a TM that decides H?

3) The language H = {<*M*, *w*> : TM *M* halts on input string *w*} is not decidable.
   a) Proof
   b) This proof can be viewed as a diagonalization argument

4) If H were in D, then SD would equal D

5) Every CF language is in D.

6) D is closed under complement

7) SD is *not* closed under complement.

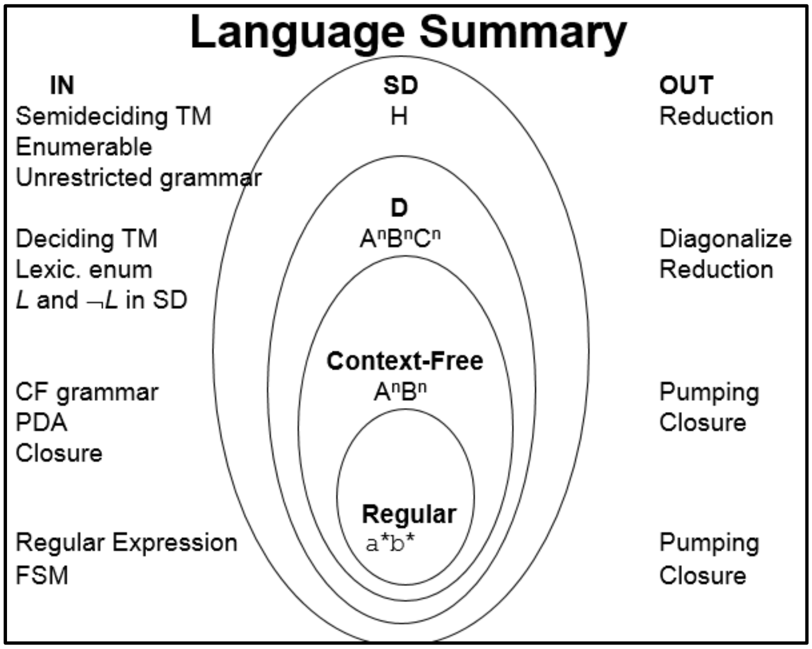
8) A language L is in D iff both L and its complement are in SD.

9) The language
¬*H* = {<*M*, *w*> : TM *M* does not halt on input string *w*}
is not in SD.

10) A language is **Turing-enumerable** iff there is a Turing machine that enumerates it.
    a) Another term that is often used is **recursively enumerable**.

11) A language is SD iff it is Turing-enumerable.

12) A language is in D iff it is lexicographically Turing-enumerable.


Language Summary
IN
Semideciding TM
Enumerable
Unrestricted grammar
Deciding TM
Lexic. enum
L and ¬*L* in SD
CF grammar
PDA
Closure
Regular Expression
FSM
SD
H
D
$A^nB^nC^n$
Context-Free
A^nB^n
Regular
a*b*
OUT
Reduction
Diagonalize
Reduction
Pumping
Closure
Pumping
Closure