

15-453

FORMAL LANGUAGES,  
AUTOMATA AND  
COMPUTABILITY

REVIEW

Thursday, May 1



REGULAR  
LANGUAGES

**Can be decided  
by a DFA**

**Can be decided  
by an NFA**

**Can be expressed  
by a regular  
expression**

**Can be decided by  
a PDA**



REGULAR  
LANGUAGES

CFGs

A Venn diagram consisting of three concentric ellipses. The innermost ellipse is labeled 'REGULAR LANGUAGES'. The middle ellipse is labeled 'CFGs'. The outermost ellipse is labeled 'DECIDABLE'. The ellipses are nested, indicating that Regular Languages are a subset of CFGs, and CFGs are a subset of Decidable languages.

DECIDABLE

REGULAR  
LANGUAGES

CFGs

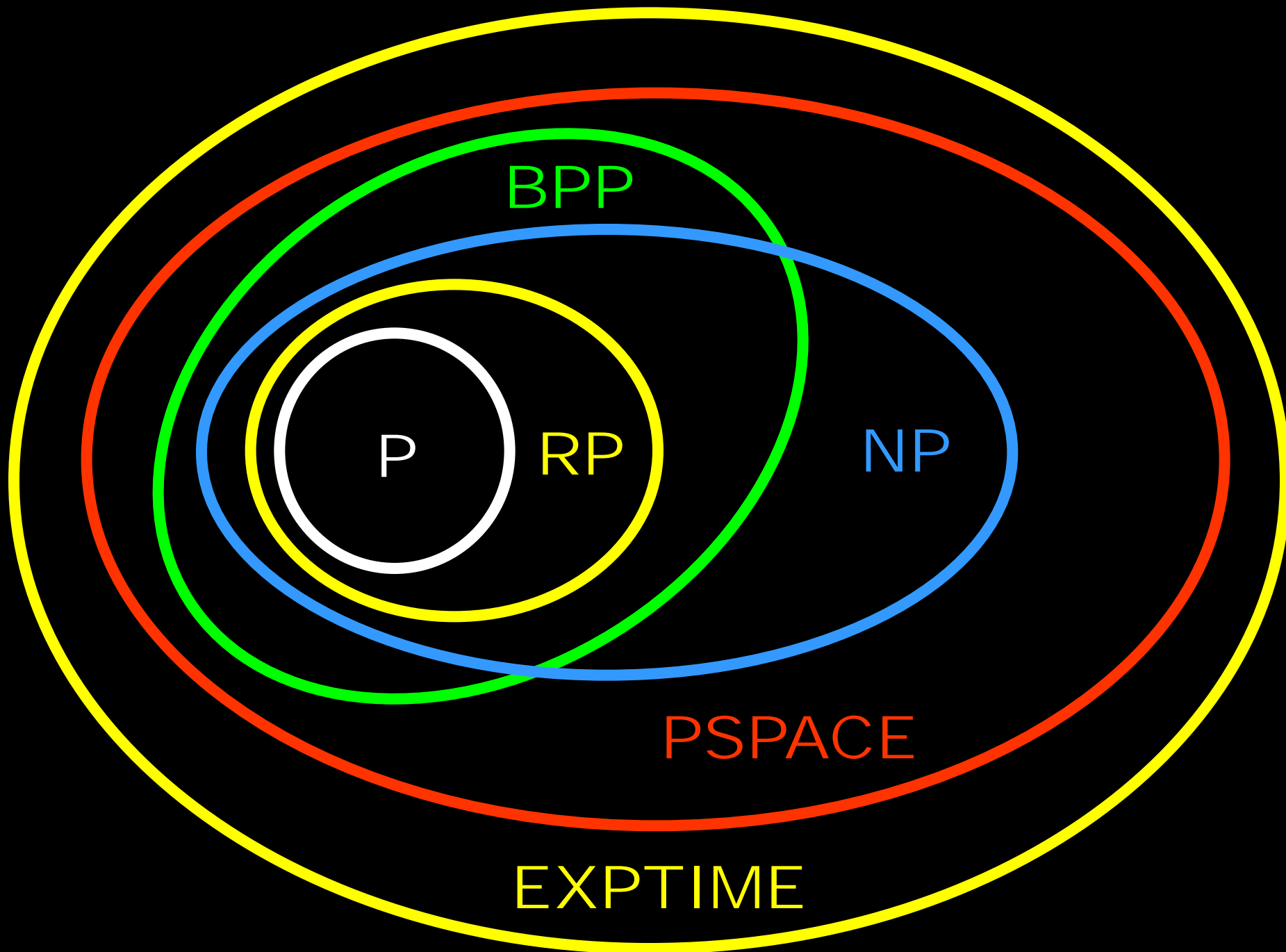
**Can be decided  
by a TM**

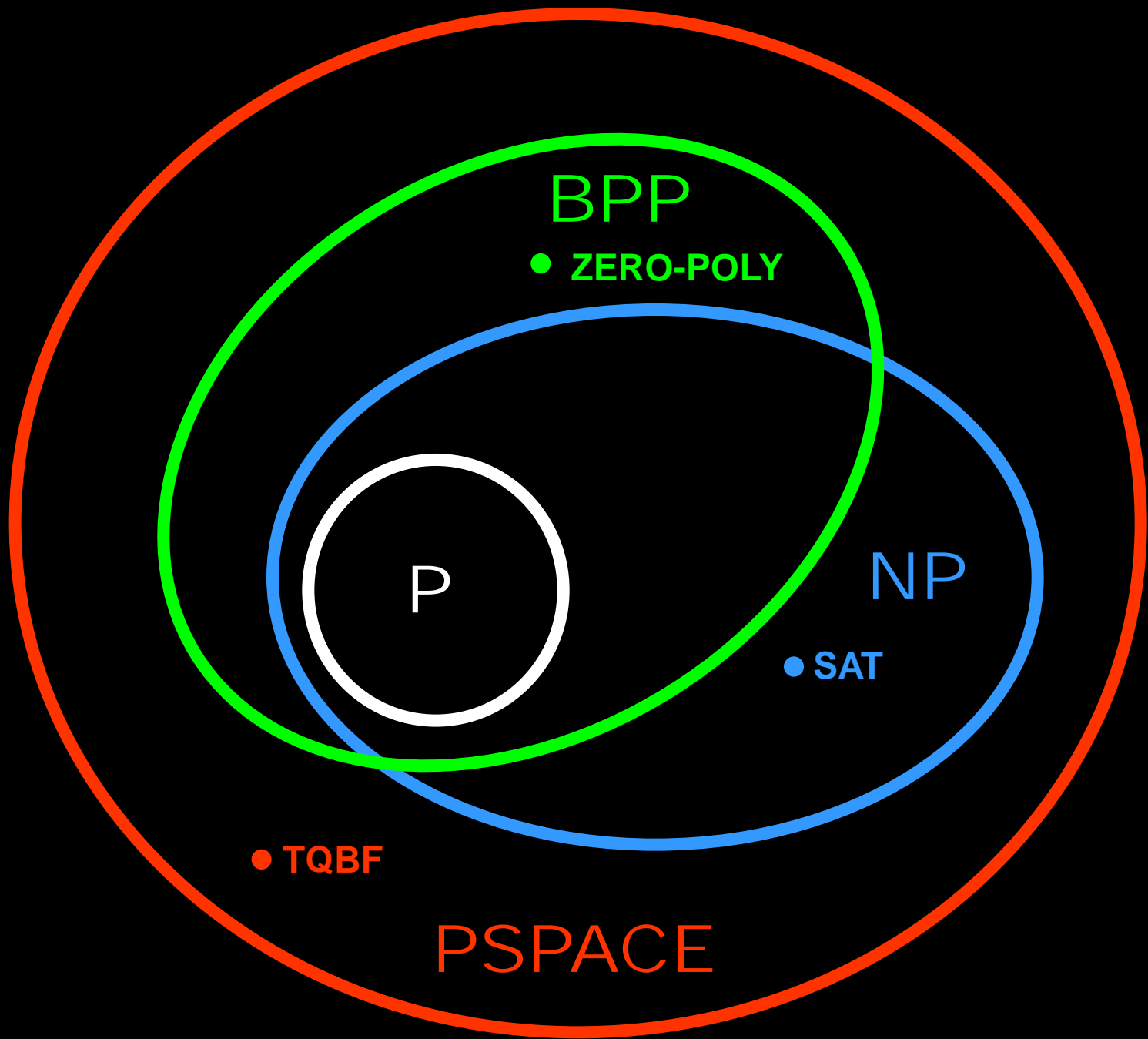
A diagram consisting of two concentric ellipses. The larger, outer ellipse is labeled "SEMI-DECIDABLE LANGUAGES". Inside it, the smaller, inner ellipse is labeled "DECIDABLE". This visualizes that all decidable languages are also semi-decidable, but not vice versa.

SEMI-DECIDABLE  
LANGUAGES

DECIDABLE

**A TM accepts strings  
in the language**







# Some other things you should know:

**Definitions (formal and intuitive):** DFA, NFA, CFG, PDA, TM, Oracle TM, Non-Deterministic TM, Polynomial Time TM, etc...

**Important Languages:**  $\{0^n1^n \mid n \geq 0\}$ ,  $A_{TM}$ ,  $HALT_{TM}$ , SAT, 3SAT, TAUT, TQBF

**Reductions:**  $\leq_m$ ,  $\leq_T$ ,  $\leq_P$

**Completeness:** NP-Completeness, PSPACE-Completeness, coNP-Completeness

# Important Theorems:

Pumping Lemma for Regular Languages

Pumping Lemma for CFGs

$A_{TM}$  is undecidable

Rice's Theorem

Cook-Levin Theorem

Savitch's Theorem

TQBF is PSPACE-Complete

May or May Not be on Final:

**Minimizing DFAs**

**The Arithmetic Hierarchy**

**Kolmogorov Complexity**

**The final will emphasize topics  
from the part of the course, but  
the rest is also fair game**

**FINAL**

**Friday, May 9**

**5:30pm-8:30pm**

**MM, A14**

**Good luck!!!**

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