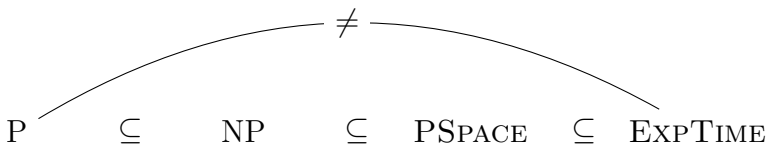


- For deterministic classes, $\mathcal{C} = \text{co-}\mathcal{C}$.
- P is considered the only *tractable* complexity class.
- **Satisfiability** and **validity** are complementary problems, hence determining that satisfiability is in \mathcal{C} immediately implies that validity is in $\text{co-}\mathcal{C}$, and vice versa.
-

sdfasdfqweasdfs

$$\begin{array}{ccccccc} \text{P} & \subseteq & \text{NP} & \subseteq & \text{PSPACE} & \subseteq & \text{EXPTIME} & \subseteq & \text{NEXPTIME} & \subseteq \\ & & \subseteq & \text{EXPSPACE} & \subseteq & \text{2EXPTIME} & \subseteq & \text{N2EXPTIME} & \dots & \text{ELEM} \end{array}$$



P	
⊃	
NP	$PL_{Sat} = \mathbf{S5}_{Sat}$: NP-complete PL_{Valid}: co-NP-complete
⊃	
PSPACE	$\mathbf{K}_{Sat} = \mathbf{T}_{Sat} = \mathbf{S4}_{Sat} = QBF_{Sat} = QBF_{Valid}$: PSPACE-complete
⊃	
EXPTIME	$PDL_{Sat} = PDL_{Valid}$: EXPTIME-complete

PL : propositional logic.
 QBF : the logic of quantified Boolean formulas.
 PDL : propositional dynamic logic.

PSPACE and EXPTIME are deterministic complexity classes, co-PSPACE is identical to PSPACE and co-EXPTIME is identical to EXPTIME

Table 1: The complexity of the satisfiability problem for modal logics.

NP-complete	PSPACE-complete	EXPTIME-complete
PL, S5 , KD45	$\mathbf{K}_n, \mathbf{T}_n, \mathbf{S4}_n, n \geq 1$ $\mathbf{S5}_n, \mathbf{KD45}_n, n \geq 2$	$\mathbf{K}_n^C, \mathbf{T}_n^C, n \geq 1$ $\mathbf{S4}_n^C, \mathbf{S5}_n^C, \mathbf{KD45}_n^C, n \geq 2$
S4.3+	QBF	PDL $\mathbf{K}^{E,A}$
	S5 \times S5	

- See [Halpern and Moses, 1992, Table 1, p. 350]
- C : the logic with common knowledge operator
- D : adding distributed knowledge (intersection operator) to the language does not affect the complexity
- in these cases of single-agent for $\mathbf{S4}^C$, $\mathbf{S5}^C$ and $\mathbf{KD45}^C$, common knowledge reduces to knowledge.
- **S4.3+**: any (consistent) normal extension of **S4.3**.
Hemaspaandra's Theorem: every normal logic extending **S4.3** is NP-complete.
- $\mathbf{K}^{E,A}$: the expansion of modal logic **K** with the universal modality.