- 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 co-$\mathcal{C}$, and vice versa.
-

$$sdfasdfqweasdfs$$

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

$$\begin{tikzcd} \text{P} \arrow[rrrrrr, bend left, dash, "\neq"] & \subseteq & \text{NP} & \subseteq & \text{PS}\textsc{pace} & \subseteq & \text{E}\textsc{xp}\text{T}\textsc{ime} \end{tikzcd}$$

P		
$\subseteq$		
NP	$PL_{Sat} = \mathbf{S5}_{Sat}$: NP-complete	PL_{Valid}: co-NP-comple
$\subseteq$		
PSpace	$\mathbf{K}_{Sat} = \mathbf{T}_{Sat} = \mathbf{S4}_{Sat} = QBF_{Sat} = QBF_{Valid}$: PSPACE-complete	
$\subseteq$		
ExpTime	$PDL_{Sat} = PDL_{Valdi}$: 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, $\mathbf{S5}, \mathbf{KD45}$	$\mathbf{K}_n, \mathbf{T}_n, \mathbf{S4}_n$, $n \geq 1$	$\mathbf{K}_n^C, \mathbf{T}_n^C$, $n \geq 1$
	$\mathbf{S5}_n, \mathbf{KD45}_n$, $n \geq 2$	$\mathbf{S4}_n^C, \mathbf{S5}_n^C, \mathbf{KD45}_n^C$, $n \geq 2$
$\mathbf{S4.3+}$	$\mathbf{QBF}$	$\mathbf{PDL}$
		$\mathbf{K}^{\mathsf{E,A}}$
	$\mathbf{S5} \times \mathbf{S5}$	

- 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.
- $\mathbf{S4.3+}$: any (consistent) normal extension of $\mathbf{S4.3}$.
  Hemaspaandra's Theorem: every normal logic extending $\mathbf{S4.3}$ is NP-complete.
- $\mathbf{K}^{\mathsf{E,A}}$: the expansion of modal logic $\mathbf{K}$ with the universal modality.