Implementing $\mathcal{A}_0$: an example of hypothetical reasoning using SAT

- The Yale shooting example (D_1, O_1)
  - Notation: $a[n]$ and $f[n]$ correspond to propositions a_n and f_n respectively.
  - The meaning of $a[n]$ is that the action a occurs at time point n. The meaning of $f[n]$ is that the fluent f is true at time point n.
  - Translating O_1: $\neg loaded[1] \wedge alive[1]$
  - Translating D_1:
    - $loaded[N+1] \Longleftrightarrow (load[N] \vee loaded[N])$
    - $alive[N+1] \Longleftrightarrow (alive[N] \wedge (\neg shoot[N] \vee \neg loaded[N]))$
  - Query: $\neg alive$ **after** $load, shoot$
    - $load[1] \wedge \neg shoot[1] \wedge \neg load[2] \wedge shoot[2]$
    - Q: $\neg alive[3]$
- Generalize this to $\mathcal{A}_0$ with only observations about the initial state. (We refer to it as initial state complete $\mathcal{A}_0$.)

Detour: Propositional logic

- Alphabet: a set S of propositions $\{p_1, \ldots, p_n\}$; connectives: $\vee$, $\wedge$, $\neg$; and punctuation symbols: '(', ')'
- Propositional formula: Made up of propositions, connectives and balanced ( ).
- Propositional interpretation: Any subset of S.
- An interpretation satisfies a formula if it makes the formula true by using the following: (We then call it a model.)

F1	F2	F1 $\wedge$ F2	F1 $\vee$ F2	$\neg$ F1
T	T	T	T	F
T	F	F	T	F
F	T	F	T	T
F	F	F	F	T

- Any propositional formula can be expressed as a conjunction of disjunctions. $((\ldots \vee \ldots) \wedge \ldots \wedge (\ldots \vee \ldots))$
- Often by a propositional theory we refer to a set of propositional formulas. This theory corresponds to the cojunction of the formulas in that set.

- Shorthand notations: $p \Rightarrow q$ is same as $\neg p \vee q$. $p \Longleftrightarrow q$ is same as $(p \Rightarrow q) \wedge (q \Rightarrow p)$.
- Propositional entailment: $T \models F$ if F is true in all models of T.
- Example: $\{p, q, p \vee q \Rightarrow r\} \models r$.