What does *was* mean?

$was(Fl, Val, T_1, T)$ is true if fluent Fl was assigned a value at time T_1, and this was the latest time it was assigned a value before time T:

$$
\begin{aligned}
&was(Fl, Val, T_1, T) \leftarrow \\
&\quad assign(Fl, Val, T_1) \wedge \\
&\quad T_1 < T \wedge \\
&\quad \sim reset\_between(Fl, T_1, T).
\end{aligned}
$$

where $reset\_between(Fl, T_1, T)$ is true if fluent Fl was assigned a value in the interval (T_1, T).

reset_between

reset_between(Fl, T_1, T) is true if fluent Fl was assigned a value in the interval (T_1, T):

$$
\begin{aligned}
&\mathit{reset\_between}(Fl, T_1, T) \leftarrow \\
&\quad \mathit{assign}(Fl, V_2, T_2) \wedge \\
&\quad T_1 < T_2 \wedge \\
&\quad T_2 < T.
\end{aligned}
$$

Implementing *was*

If you store the *assigns* in reverse temporal order, the previous value at time T, is the first one in the database before T:

$$
\begin{aligned}
&was(Fl, Val, T1, T) \ :- \\
&\quad assigned(Fl, V1, T1), \\
&\quad T1 < T, !, \\
&\quad Val = V1.
\end{aligned}
$$

We can exploit the fact that we step forward in time. At each time step, for each fluent we prove:

$$
\begin{aligned}
&assign(Fl, V1, T), \\
&asserta(assigned(Fl, V1, T))
\end{aligned}
$$

Integration

$$assign(compass, C, T) \leftarrow$$

$$was(compass, C1, T1, T) \wedge$$

$$compass\_deriv(DC, T) \wedge$$

$$C \text{ is } (C1 + DC * (T - T1)) \bmod 360.$$

Differentiation

For any fluent F, we can approximate its derivative at time T:

$$val(deriv(F), Df, T) \leftarrow$$
$$val(F, V, T) \wedge$$
$$was(F, V_1, T_1, T) \wedge$$
$$Df \text{ is } (V - V_1)/(T - T_1).$$