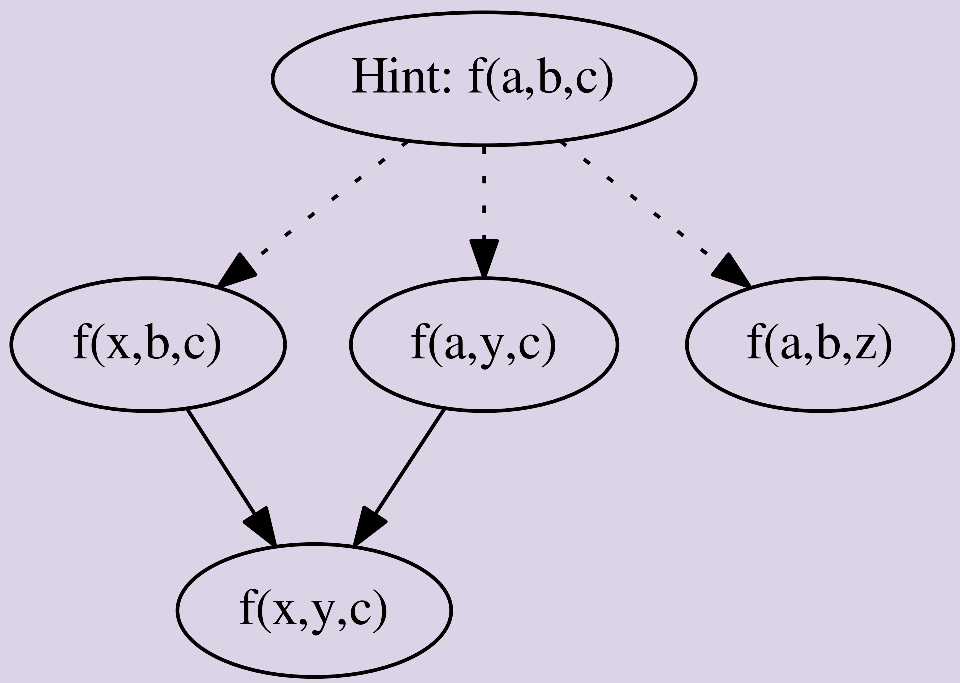
## *Overview*

- Methods
  - prioritizing hints
  - p9loop
- Applications
  - AIM
  - word problems

## *Prioritizing Hints: Theory*

- Hints: Subsumption based guidance (milestones, analogy, proof sketches)
- Hints management becomes an issue when there are “too many” hints.
- Prioritize hints
  - hints degradation
  - proof sketches
- Future work (machine learning / data mining)

*Hints Degradation (3rd Generation)*




Back subsumption of hint matchers (good enough vs. better)?

It was an oversight not to account for back subsumed hint matchers that are still waiting to be given.

## *Proof Sketches*

Consider a derivation as a sequence of clauses,

$$c_1, c_2, \ldots, c_i, \ldots, c_j, \ldots, c_n$$

where

- $c_i$ is an extra assumption for the target theory $A$
- derived clause $c_j$ has $c_i$ in its derivation history

$c_j$ either is derivable from $A$ or it is not.

- if yes, it suffices to find a new derivation of $c_j$
- if no, it suffices to "bridge the gaps" to the consequences of $c_j$

In either case, we have a partial proof that *might* be easier to complete than finding a proof from scratch.

## *New Selection Rule: Hint Age*

```
list(given_selection).

   part(Hha,high,hint_age,

      hint & weight < 500 & hint_age <= 5000) = 5000

end_of_list.
```

Selection criteria:

- hint matchers
- non degraded
- first 5000 input hints

Hint_age queues are ordered by the input order of the matched hints.

## *P9loop*

- Multiple runs with different settings.
  - Example: different term orderings for AIM problems
- Share information between runs?
- Assume matched hints as lemmas in future runs.
- "Unwinding" proofs has been surprisingly difficult.
- New utility p9derive helps (some).

## *Word Problems*

New project with Stepan Holub of Charles University in Prague.

Word problems over a nonempty alphabet $\Sigma$.

Theorem. Let $x^i y^j = z^k$, where $x, y, z \in \Sigma^+$ and $i, j, k \geq 2$. Then $x$, $y$ and $z$ commute (pairwise).

We have proved a special case:

$$xxyy = zz \Rightarrow xy = yx$$

Definition. $Period(x, y)$ iff $y$ is a prefix of some power of $x$.

Theorem (Lyndon-Schuzeng). Let $XY = Z$, where Period(x,X), Period(y,Y), Period(z,Z), $|X| \geq 2|x|$ and $|Z| \geq 2|z| + |y|$. Then $x$ and $z$ commute.