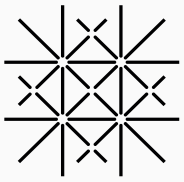
Landmark Progression in Heuristic Search

Clemens Büchner[1] Thomas Keller[1,2] Salomé Eriksson[1] Malte Helmert[1]

[1]University of Basel

[2]University of Zürich

July 12, 2023



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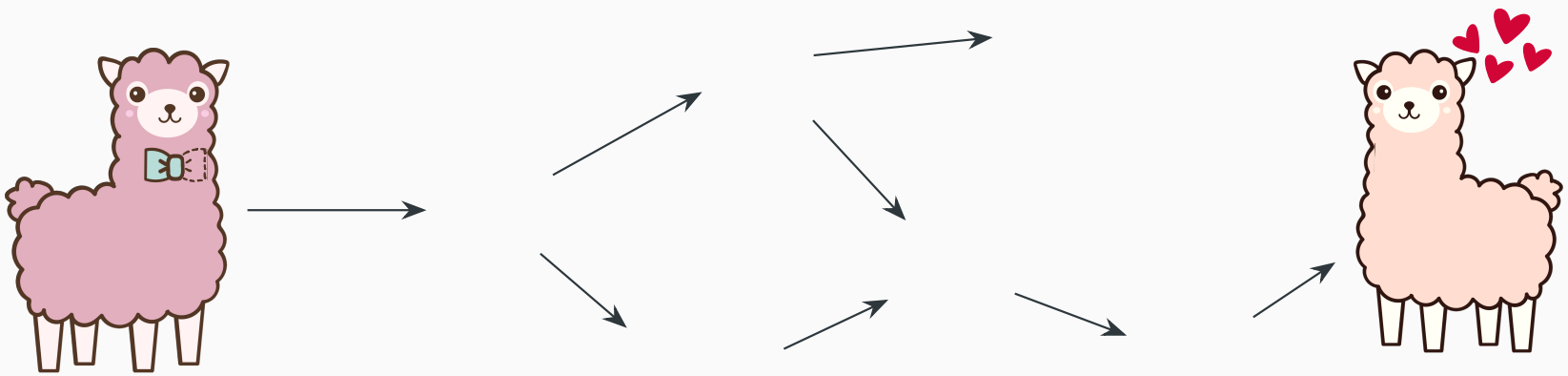
Thinking like LAMA



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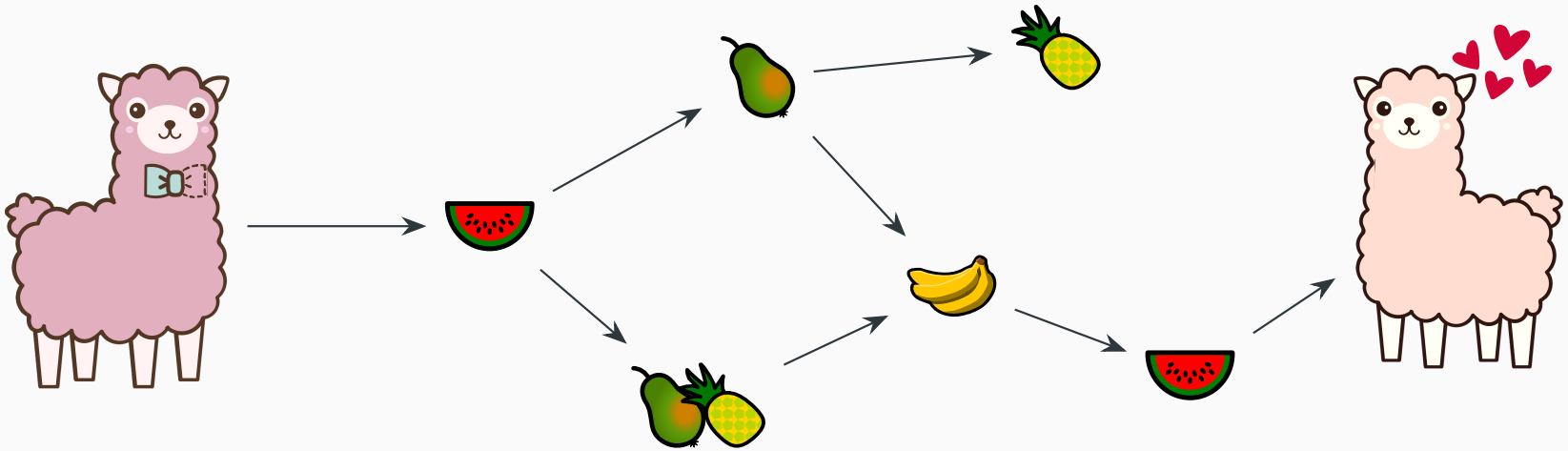

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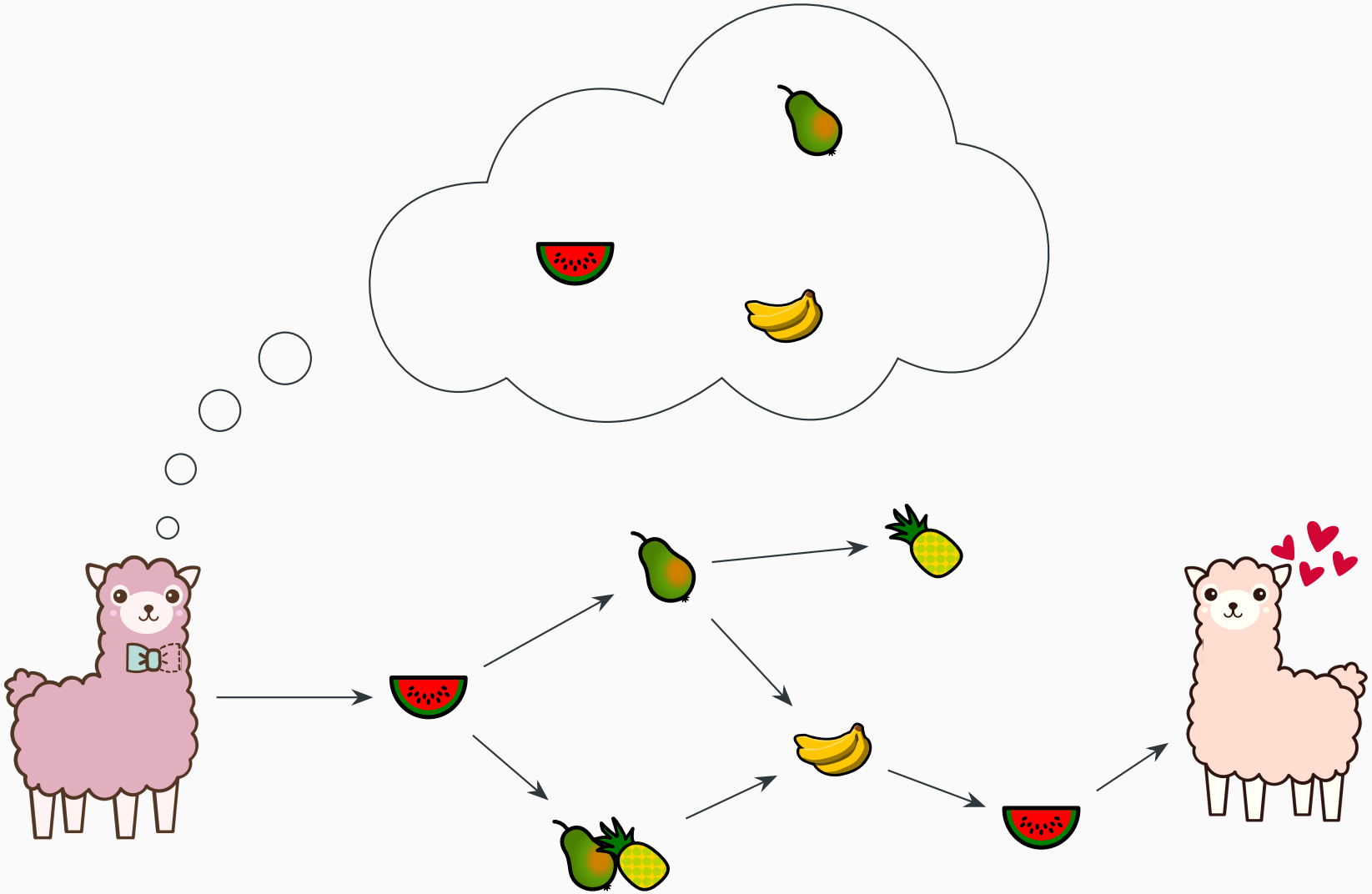

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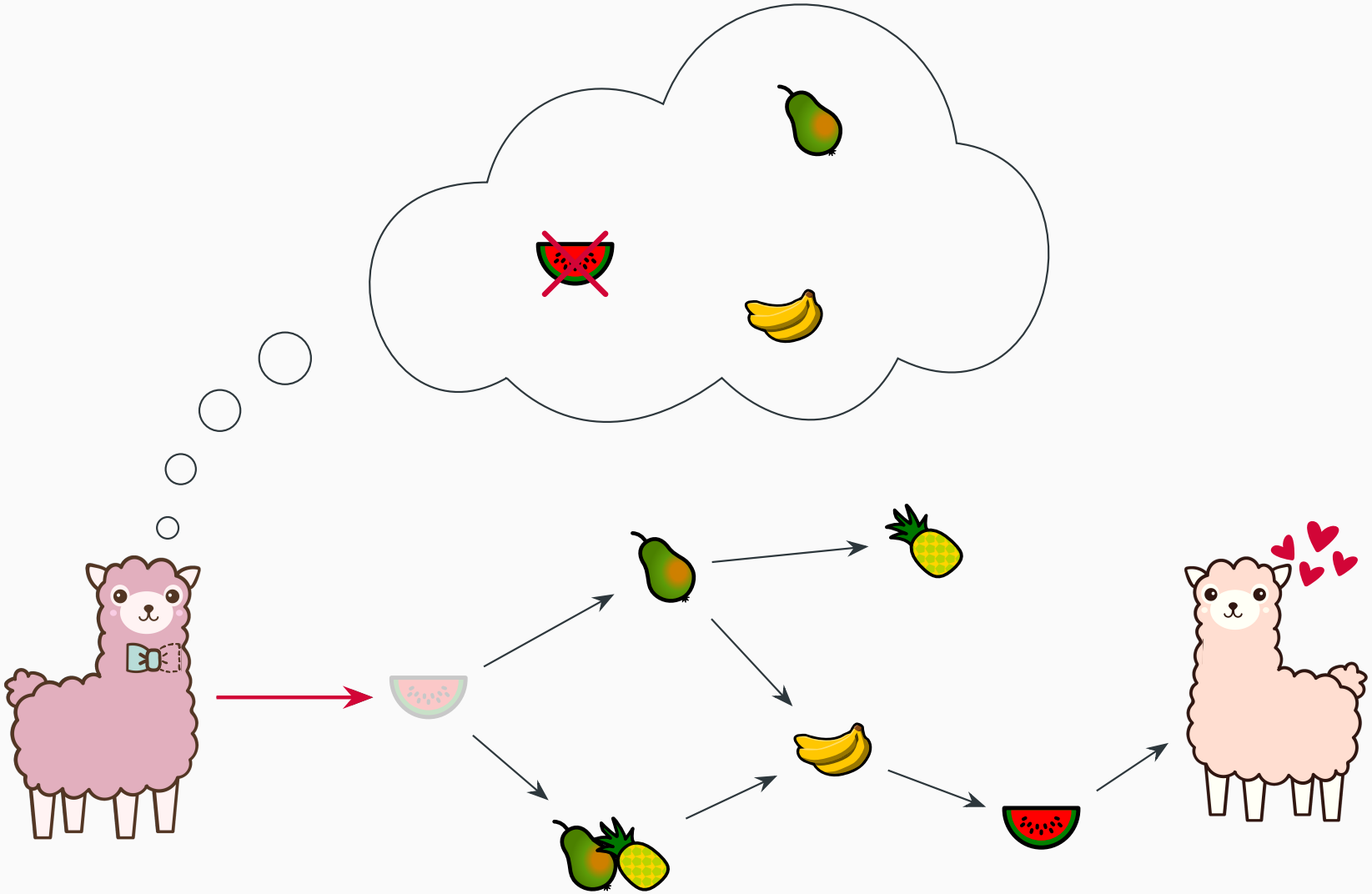

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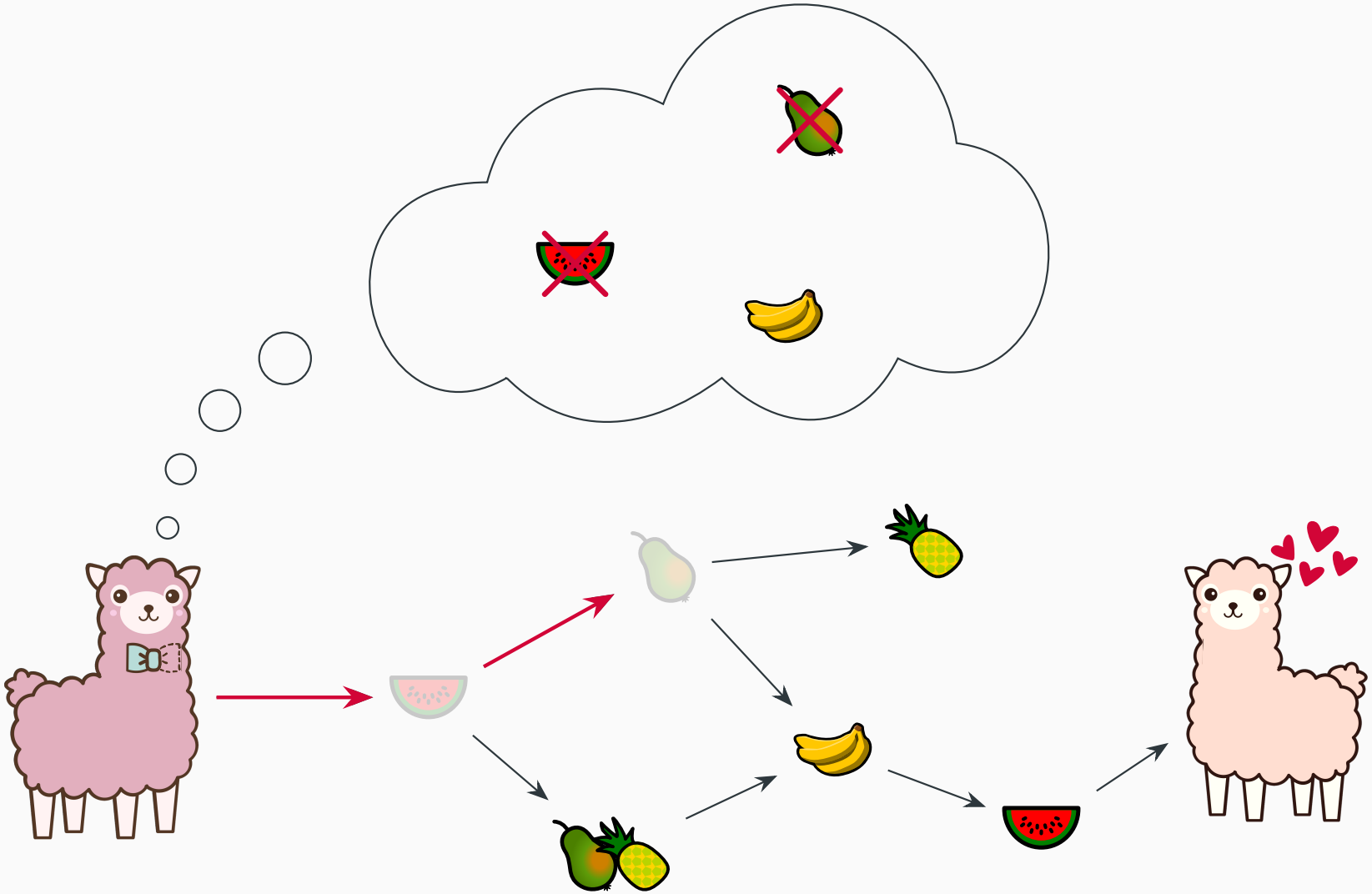

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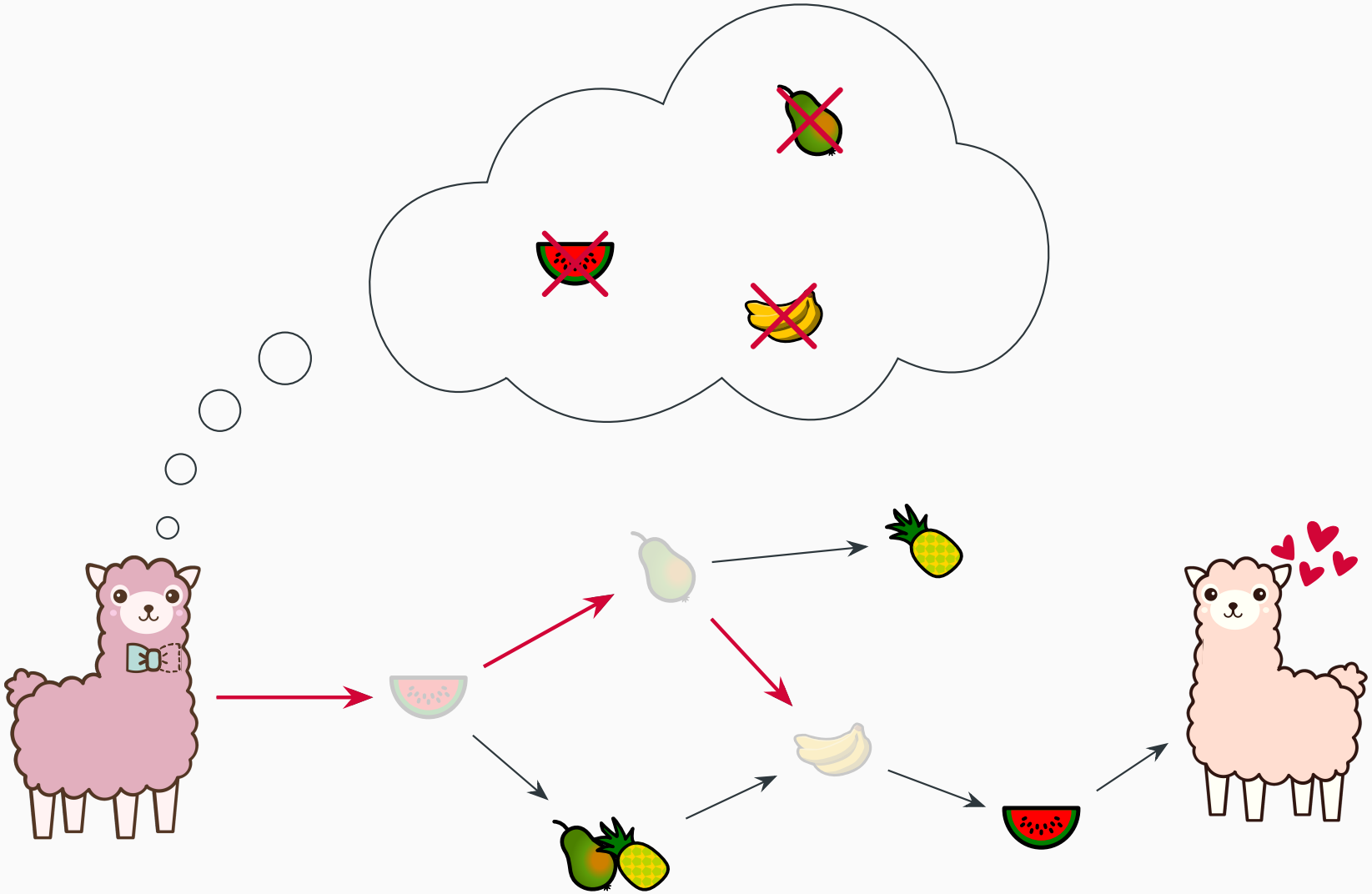
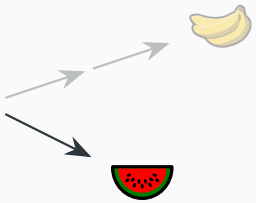


LAMA's Recipe for Success

Always try to improve yourself.

(anytime search)



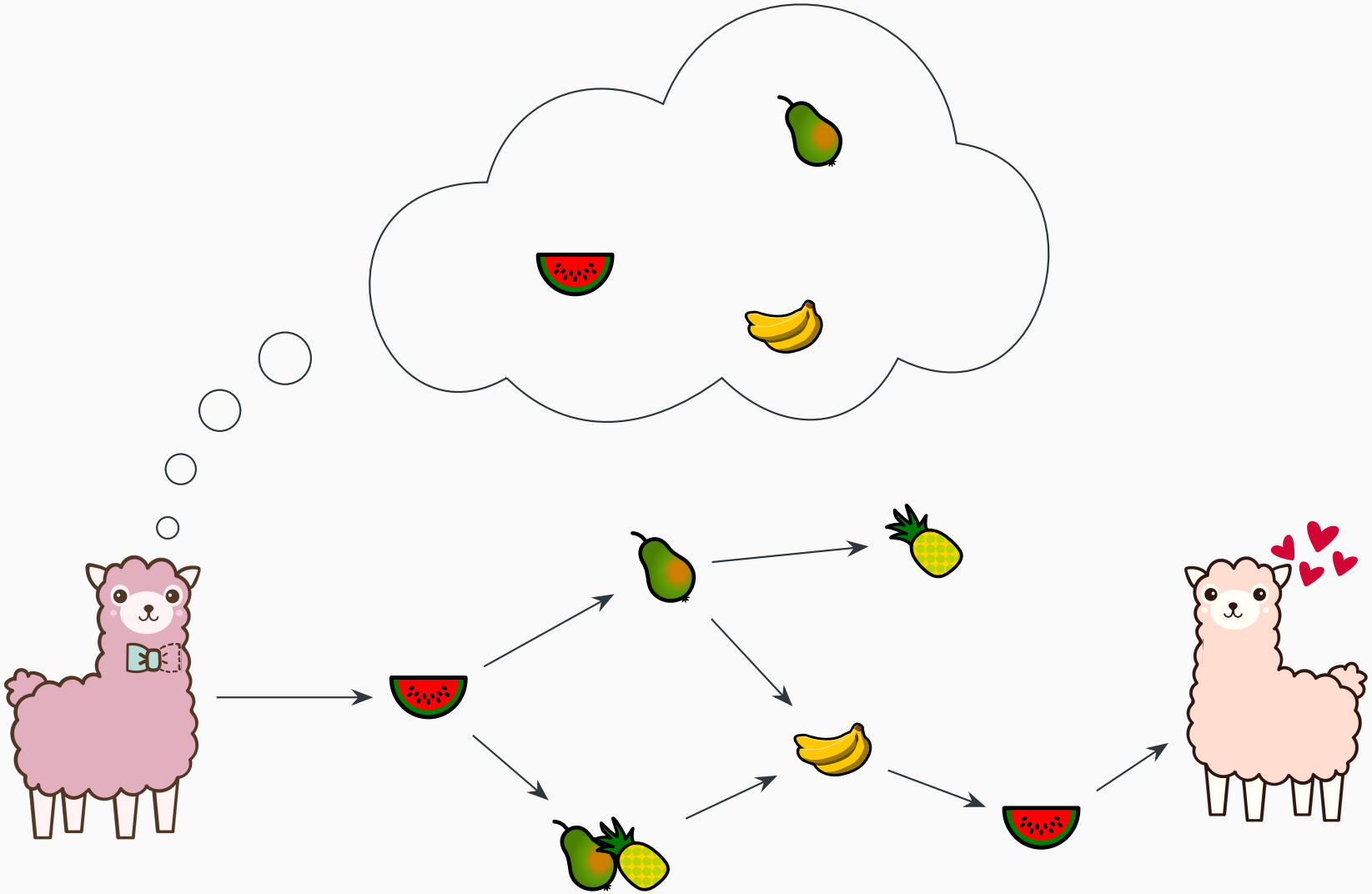
Follow strong smells.

(preferred operators)

Accept help from friends.

(FF heuristic)

Ordered Landmarks



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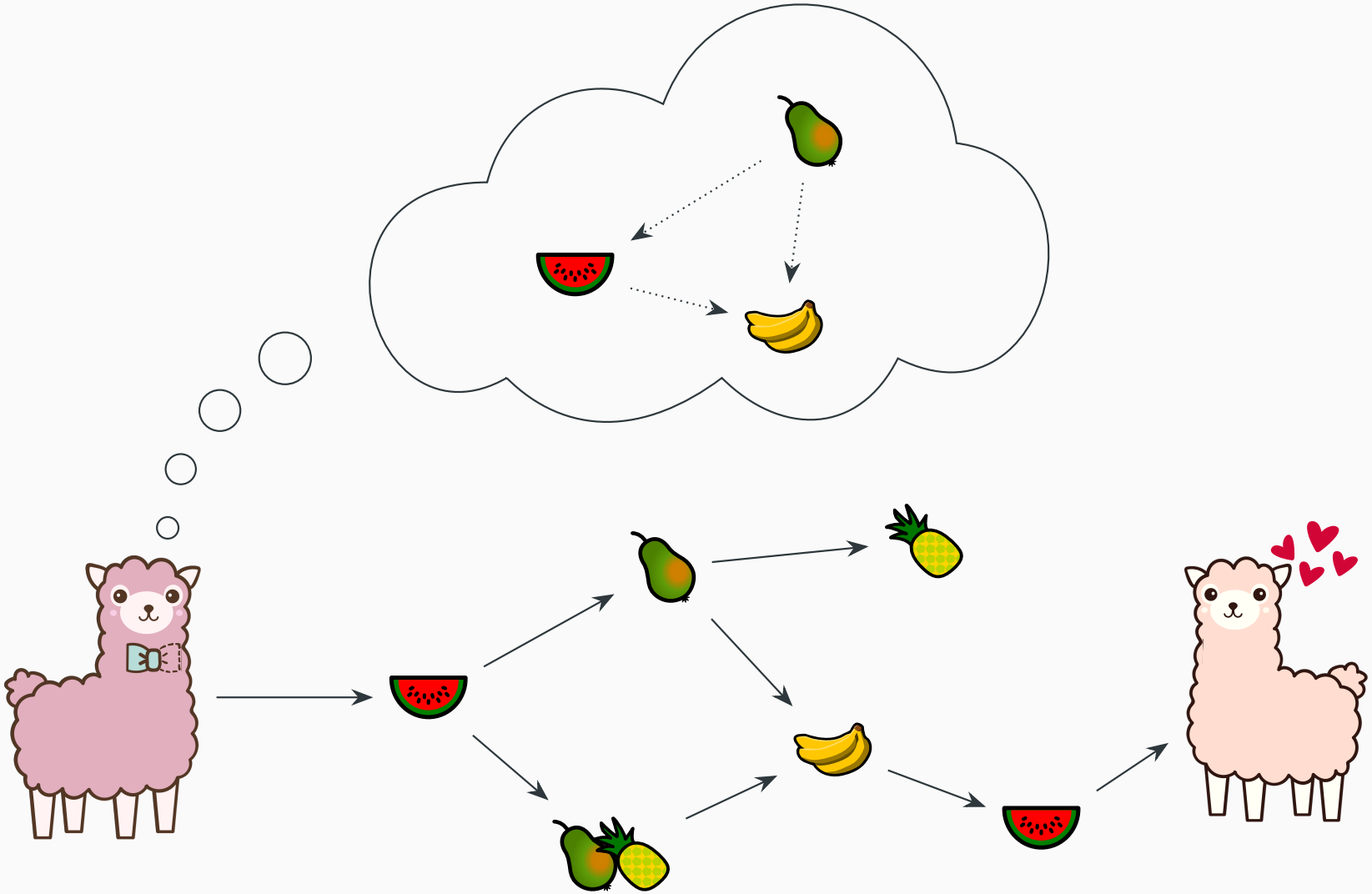

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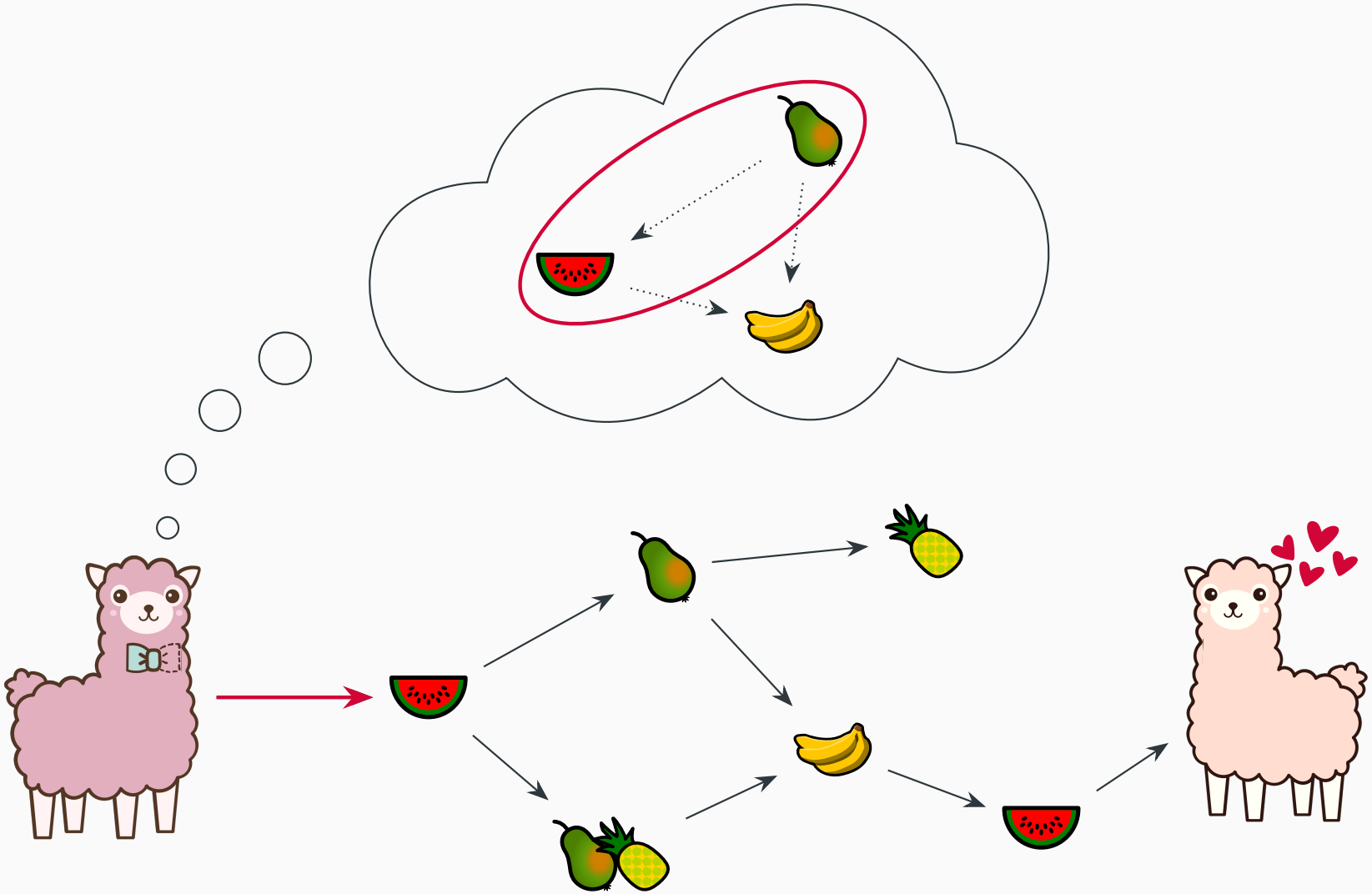

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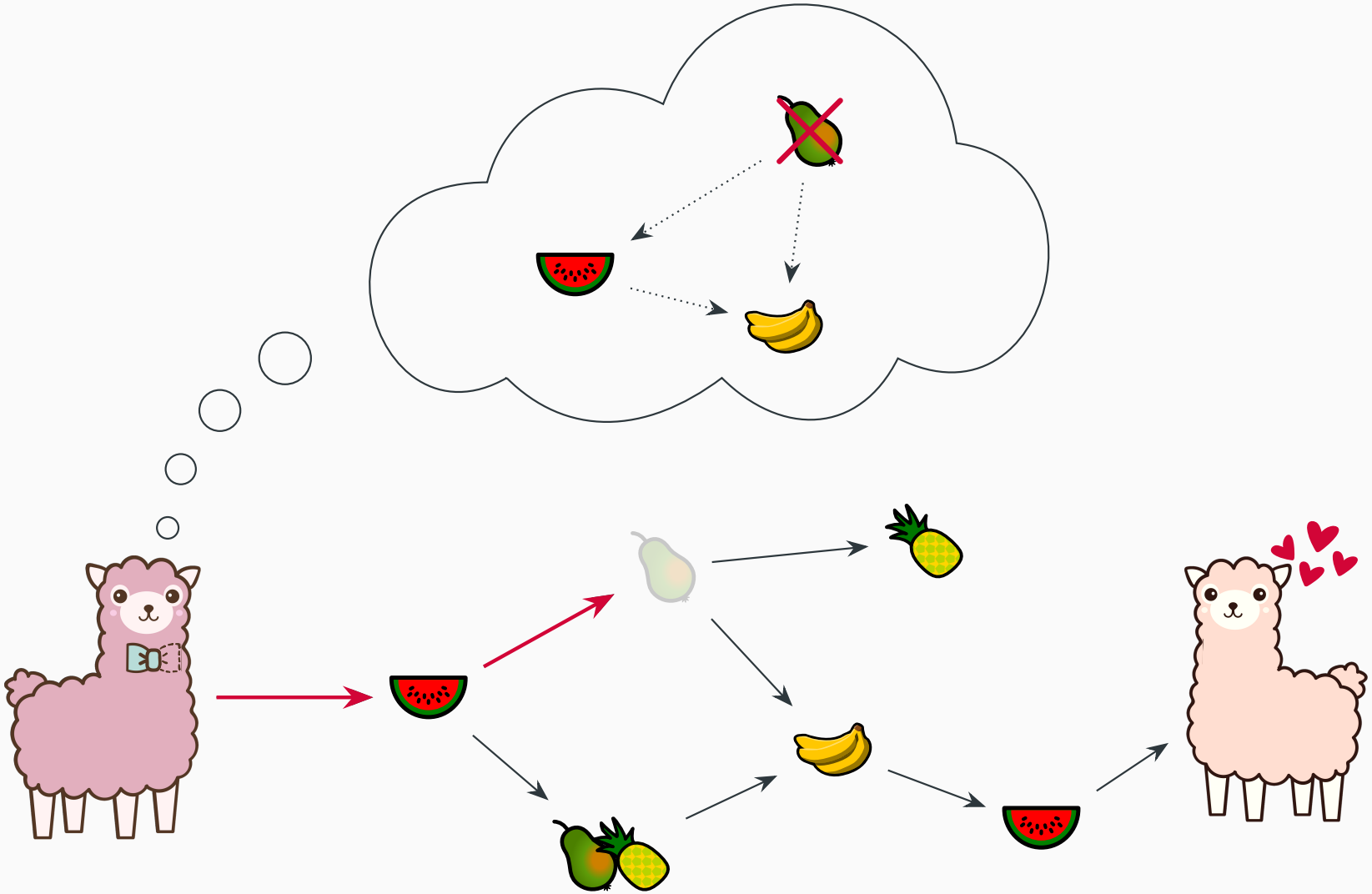

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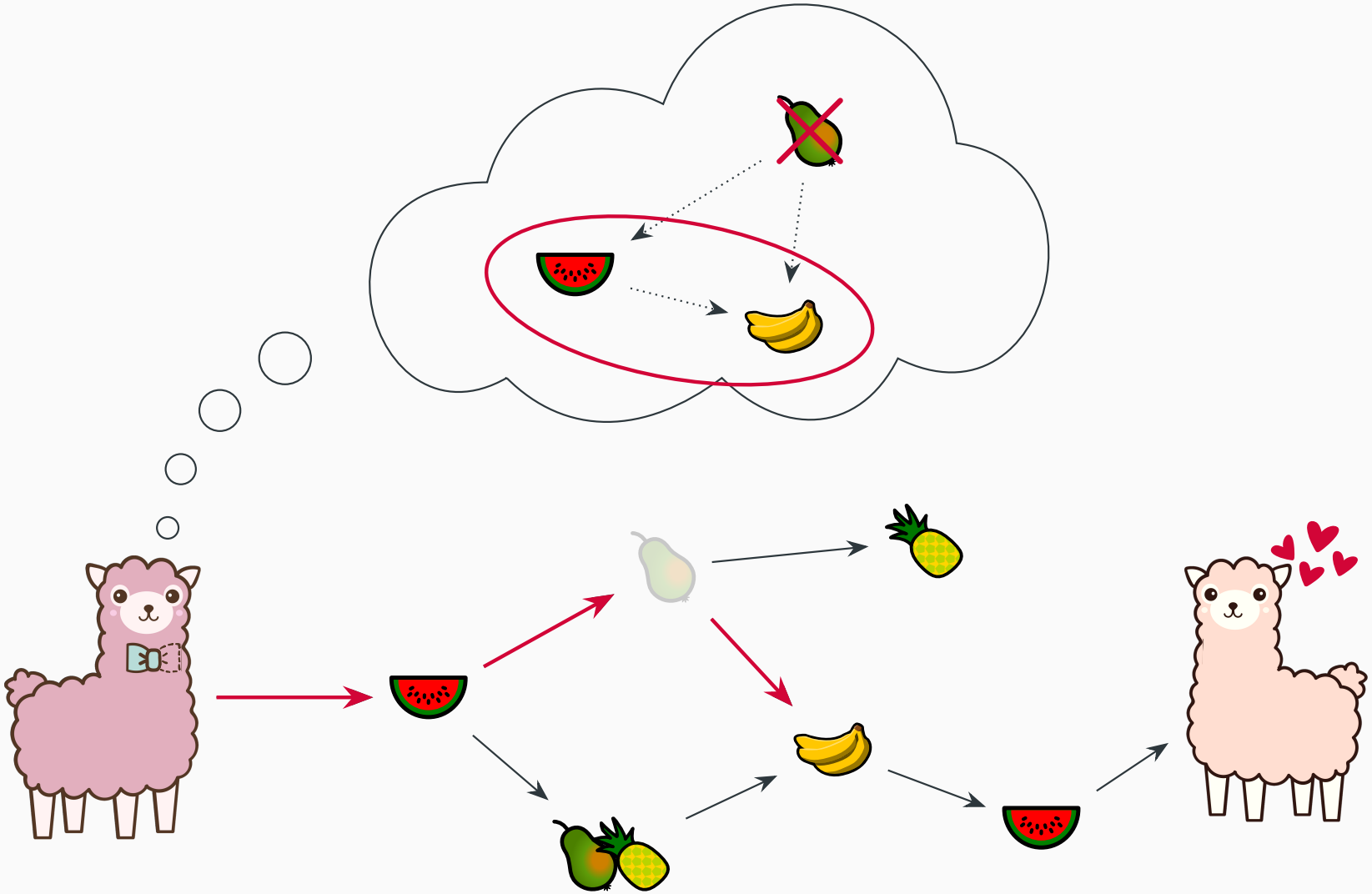

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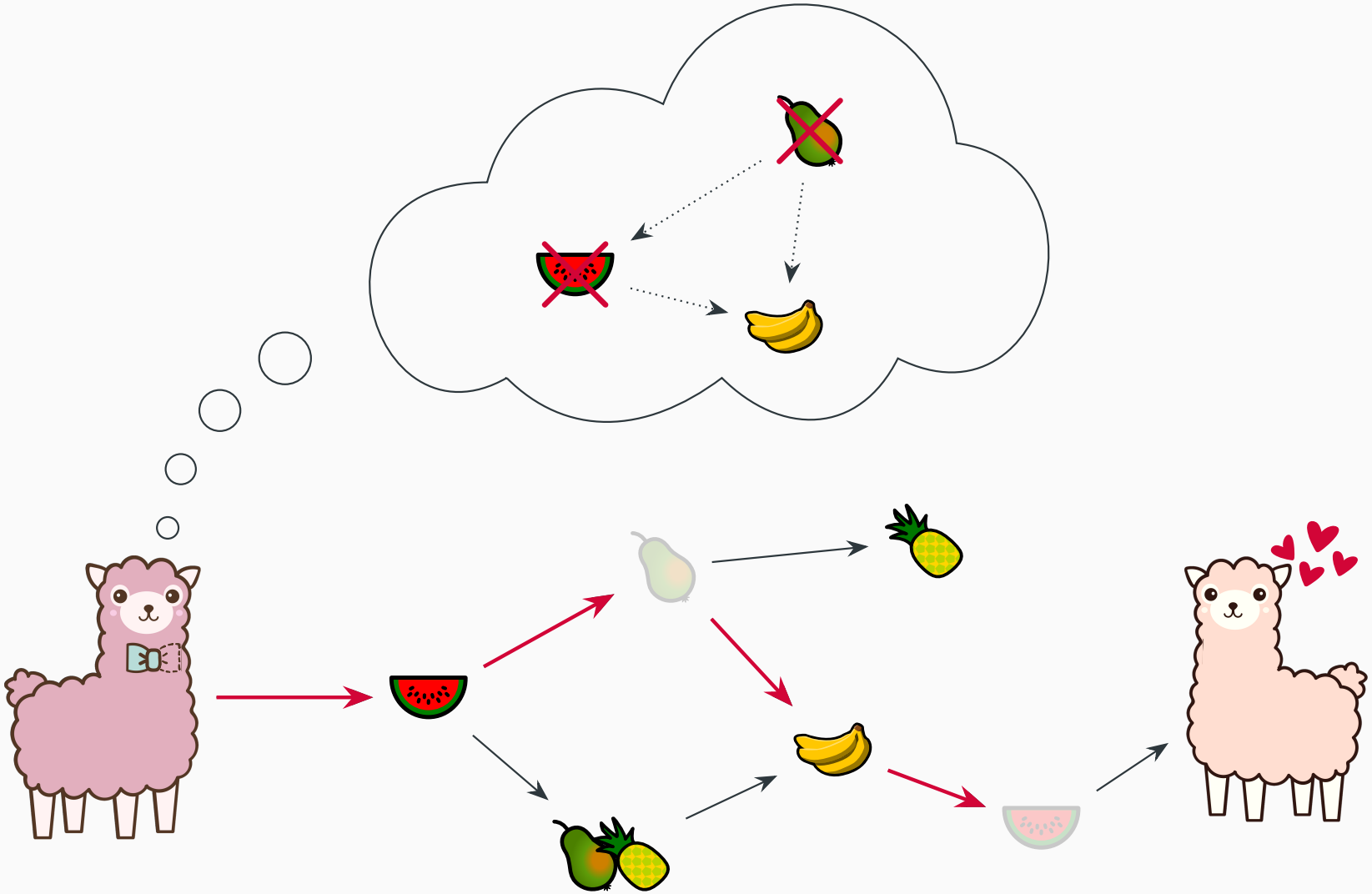

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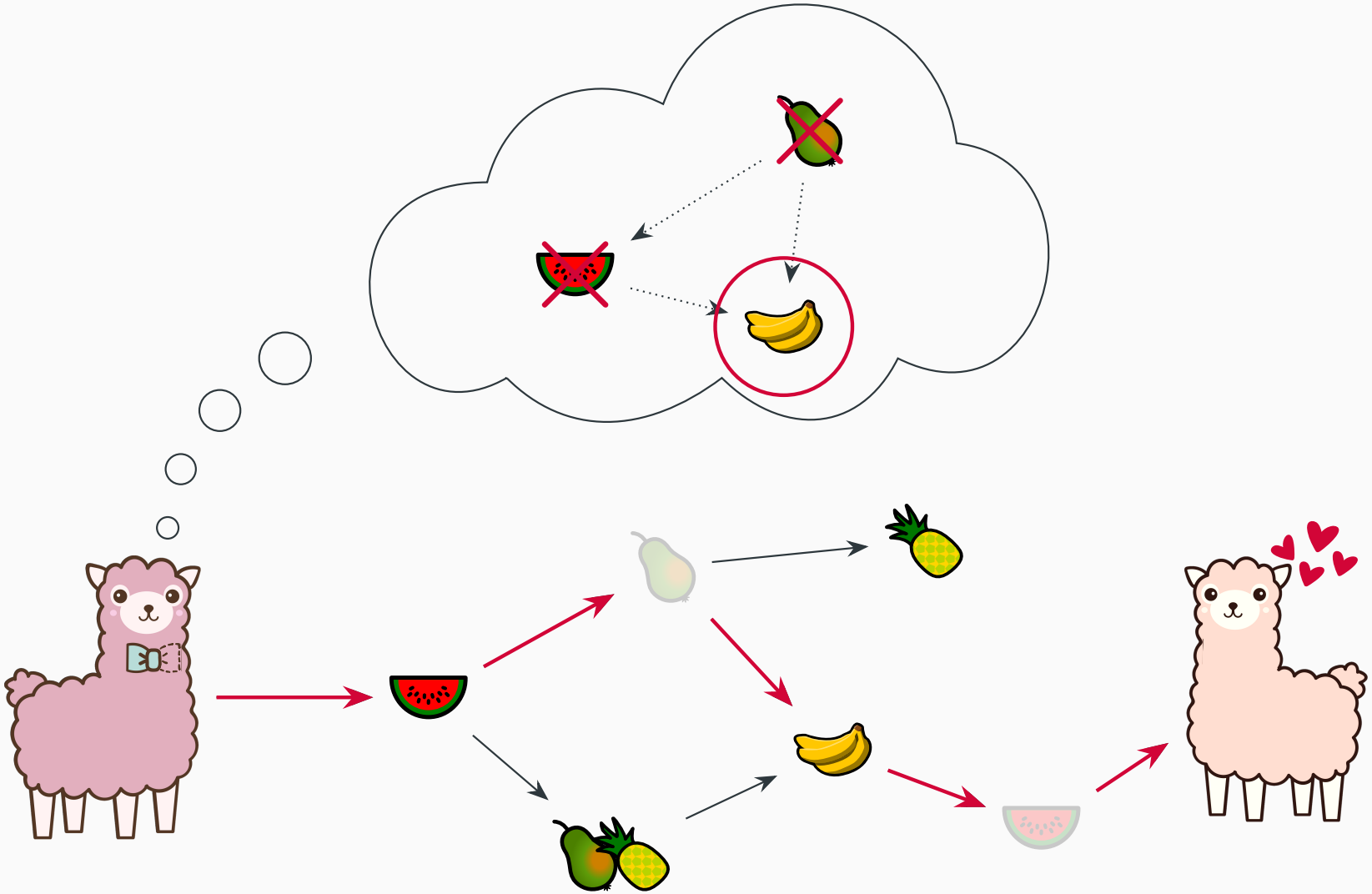


Issue

Observation

some landmarks never accepted

$\rightsquigarrow$ worst case: LAMA finds no solution

Problem

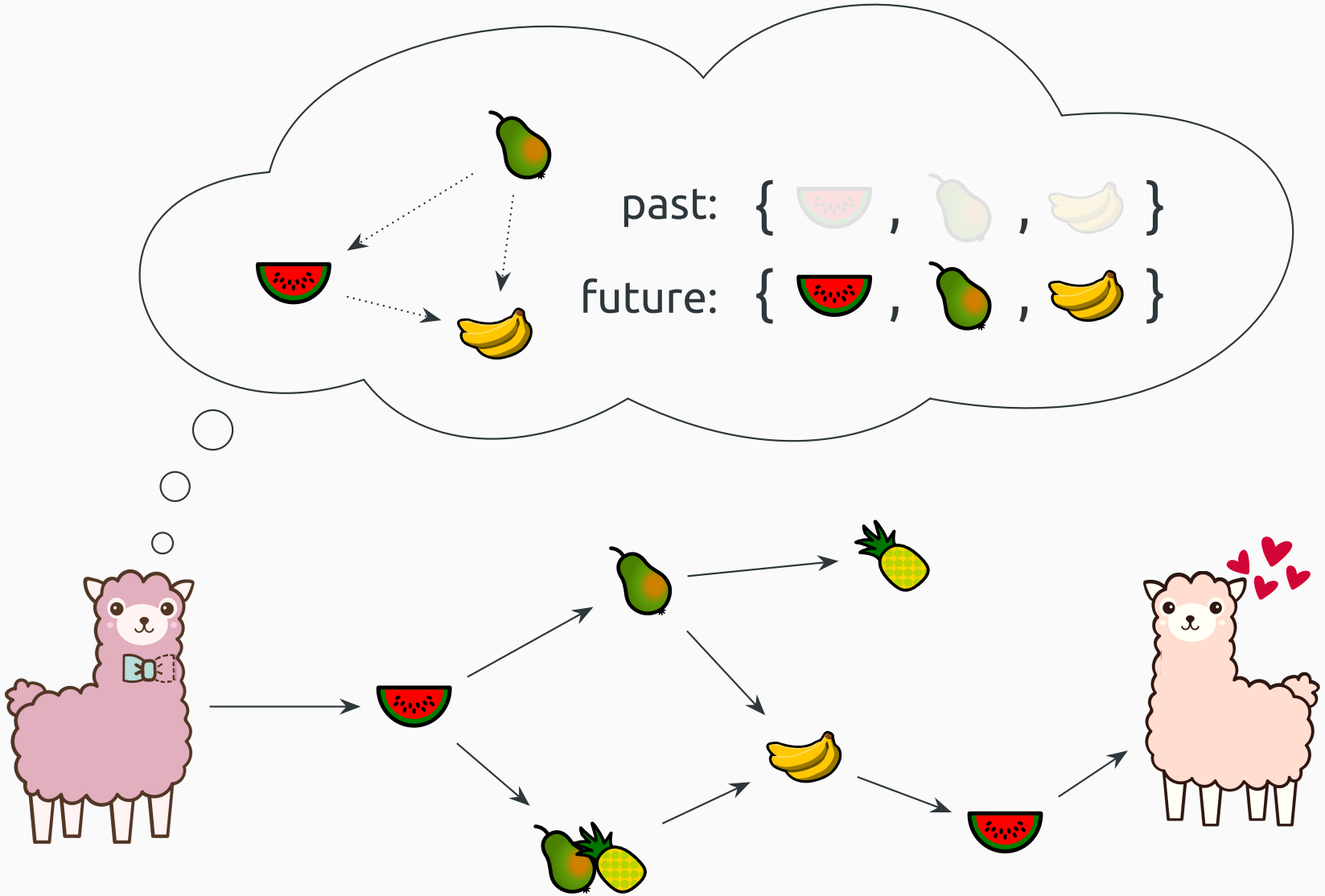
flawed landmark progression

$\rightsquigarrow$ unsound landmarks

Solution

Always eat fruit and track landmarks needed (again) in the future.

Valid Landmark Progression



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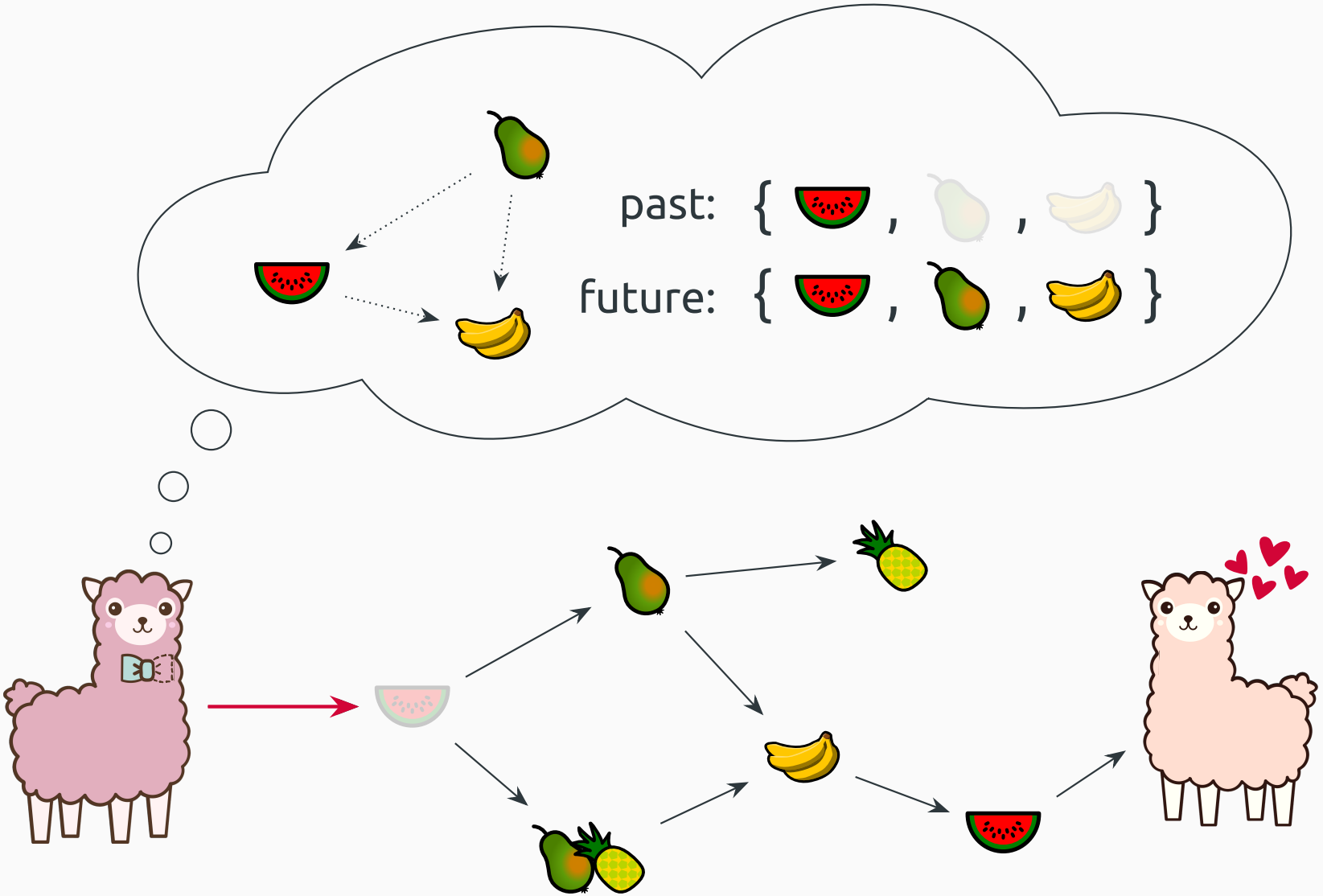

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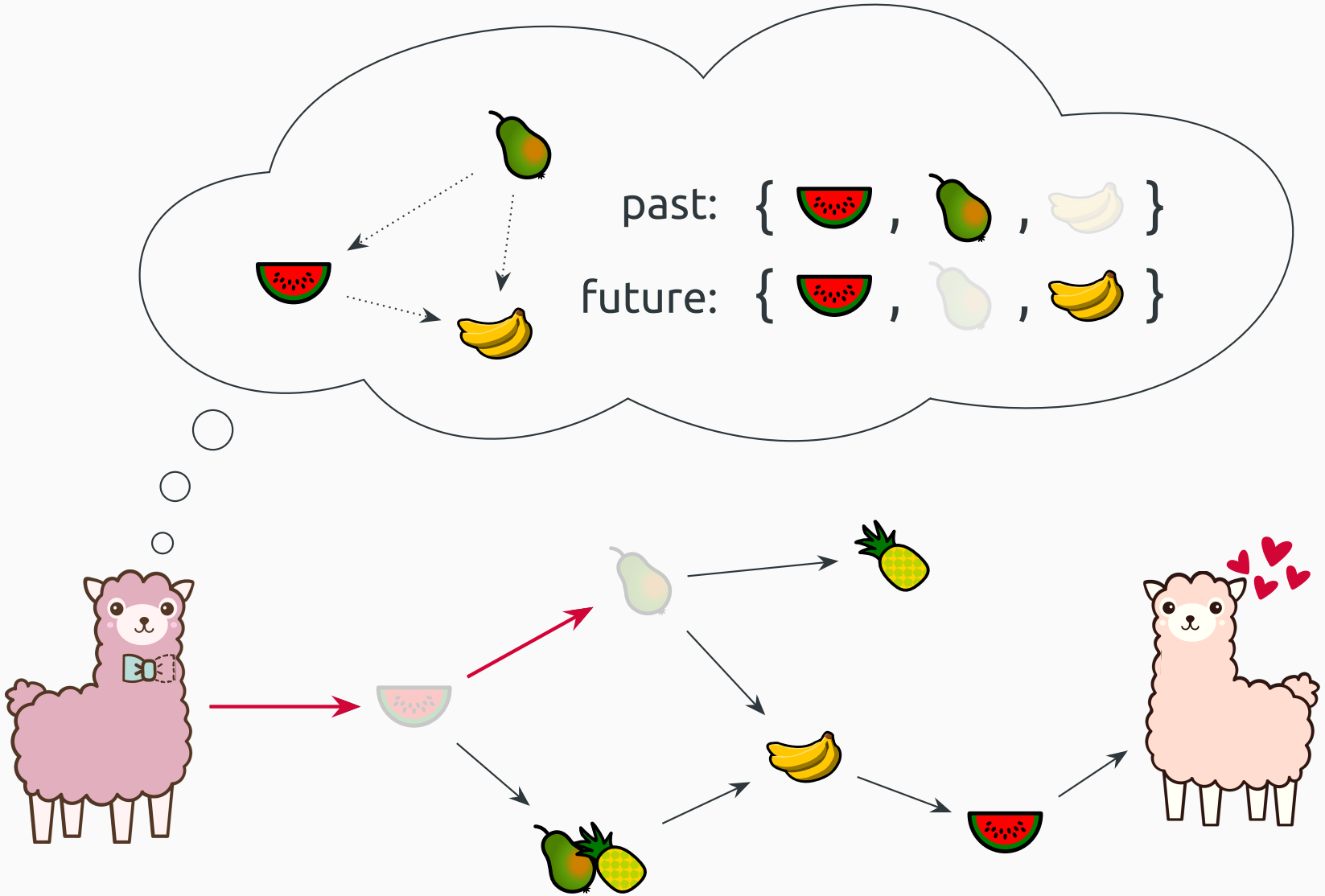

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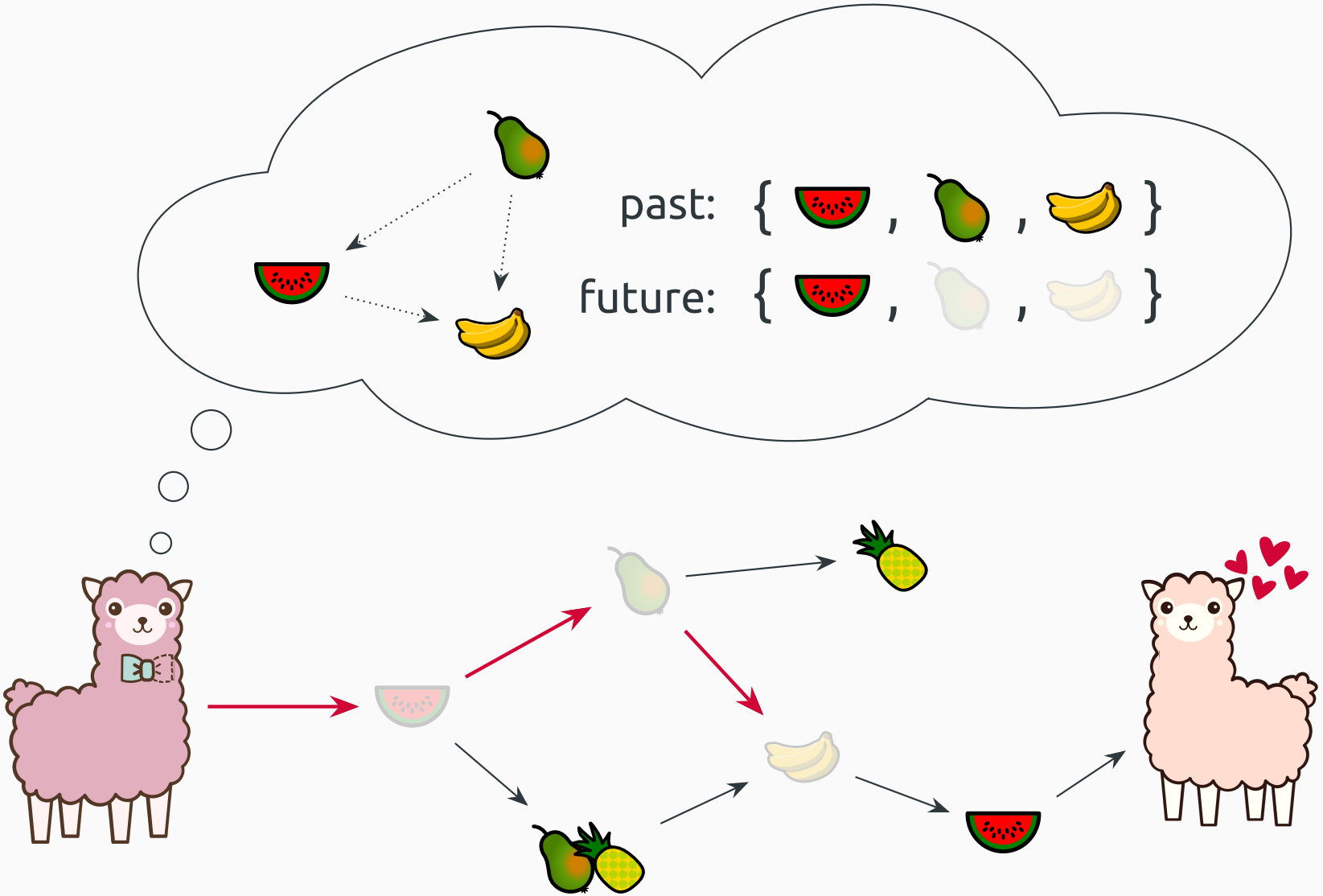

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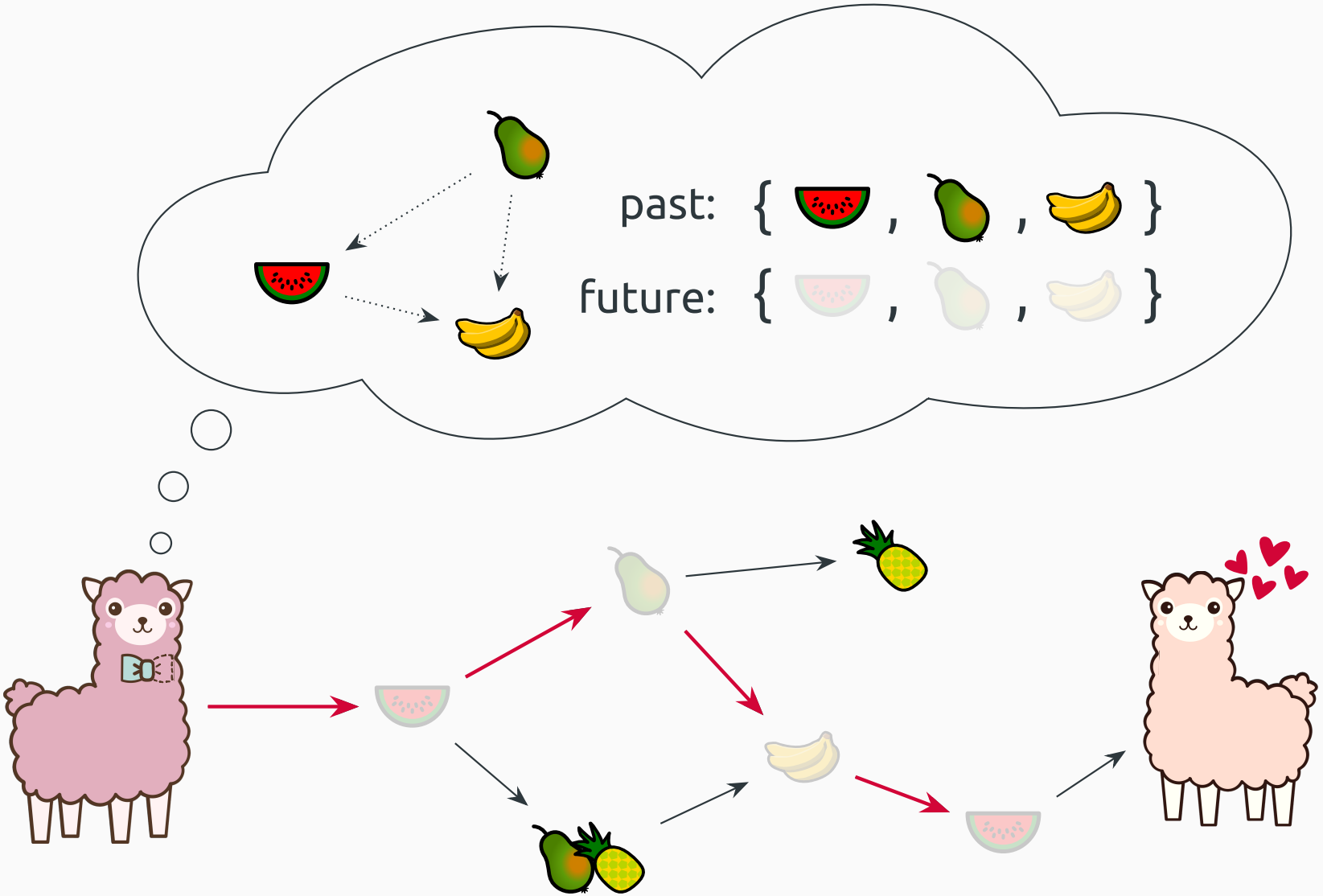

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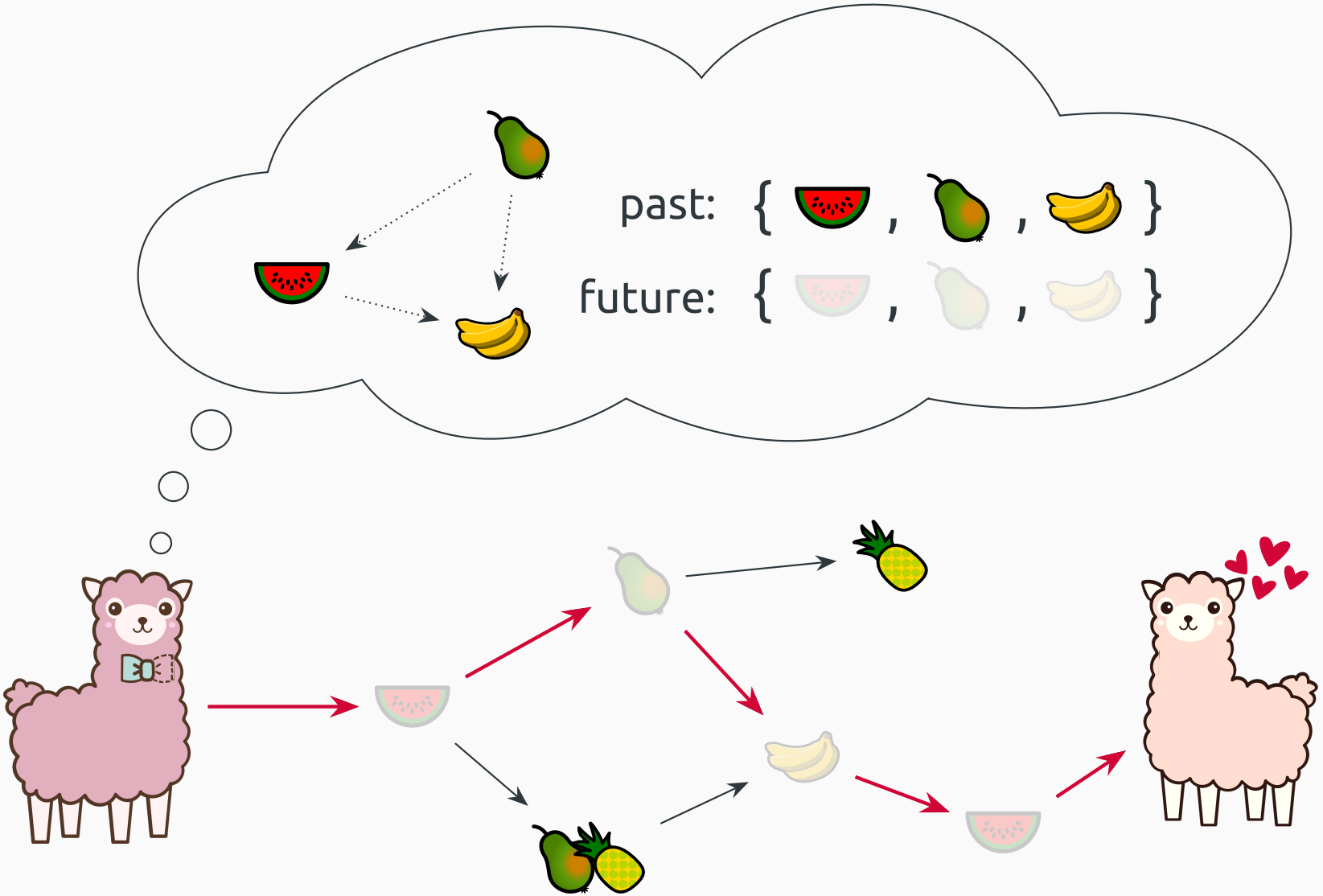

Consequences

– increased memory-footprint

– slower to evaluate

\+ information always sound

- heuristic safe and more accurate.

\+ no restrictions on landmark generation

- cycles allowed
- reasonable orderings for optimal planning

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- $-$ increased memory-footprint
- $-$ slower to evaluate

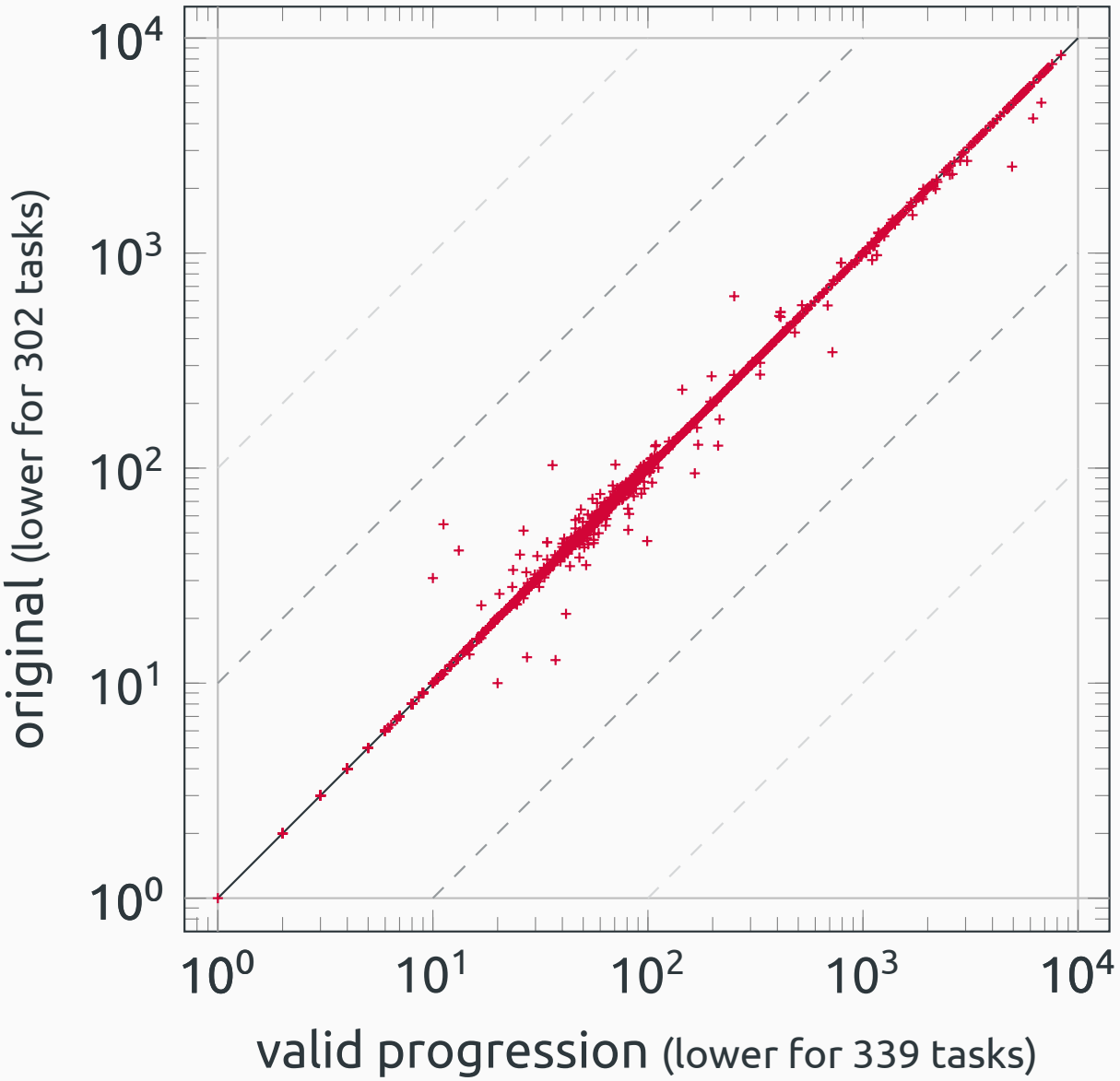
- $+$ information always sound
  - heuristic safe and more accurate.
- $+$ no restrictions on landmark generation
  - cycles allowed
  - reasonable orderings for optimal planning

Remark

For path-dependent heuristics:

$$\text{increased accuracy} \not\Longrightarrow \text{improved search behaviour}$$

LAMA Plan Cost



Reasonable Orderings for Optimal Planning

Summary

LAMA progresses invalid information.

- heuristic inaccurate
- planner incomplete

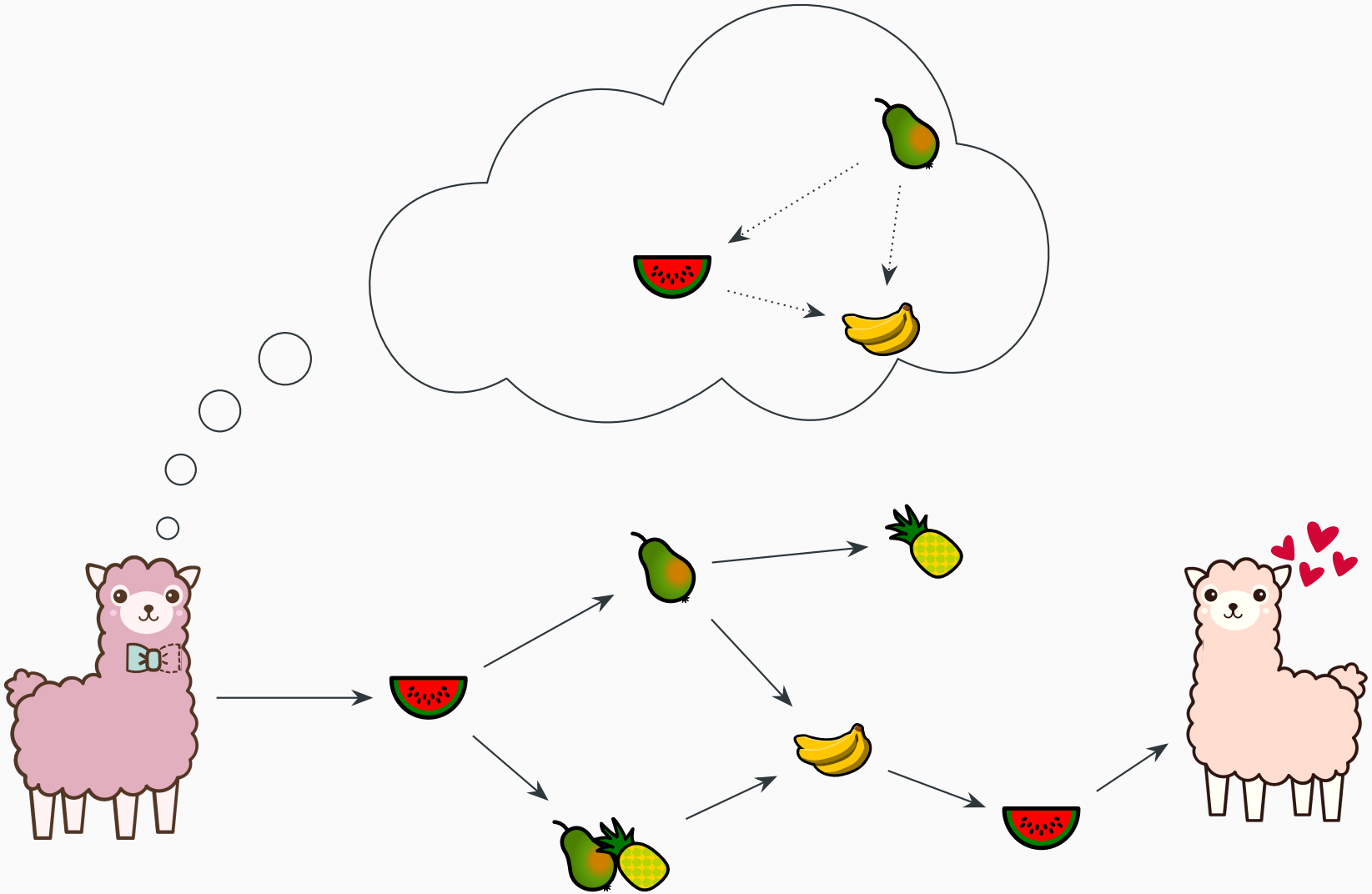
Store both past and future for valid landmark progression.

- information always sound

No more restrictions on landmark and ordering generation.

- clean framework

Incompleteness Example



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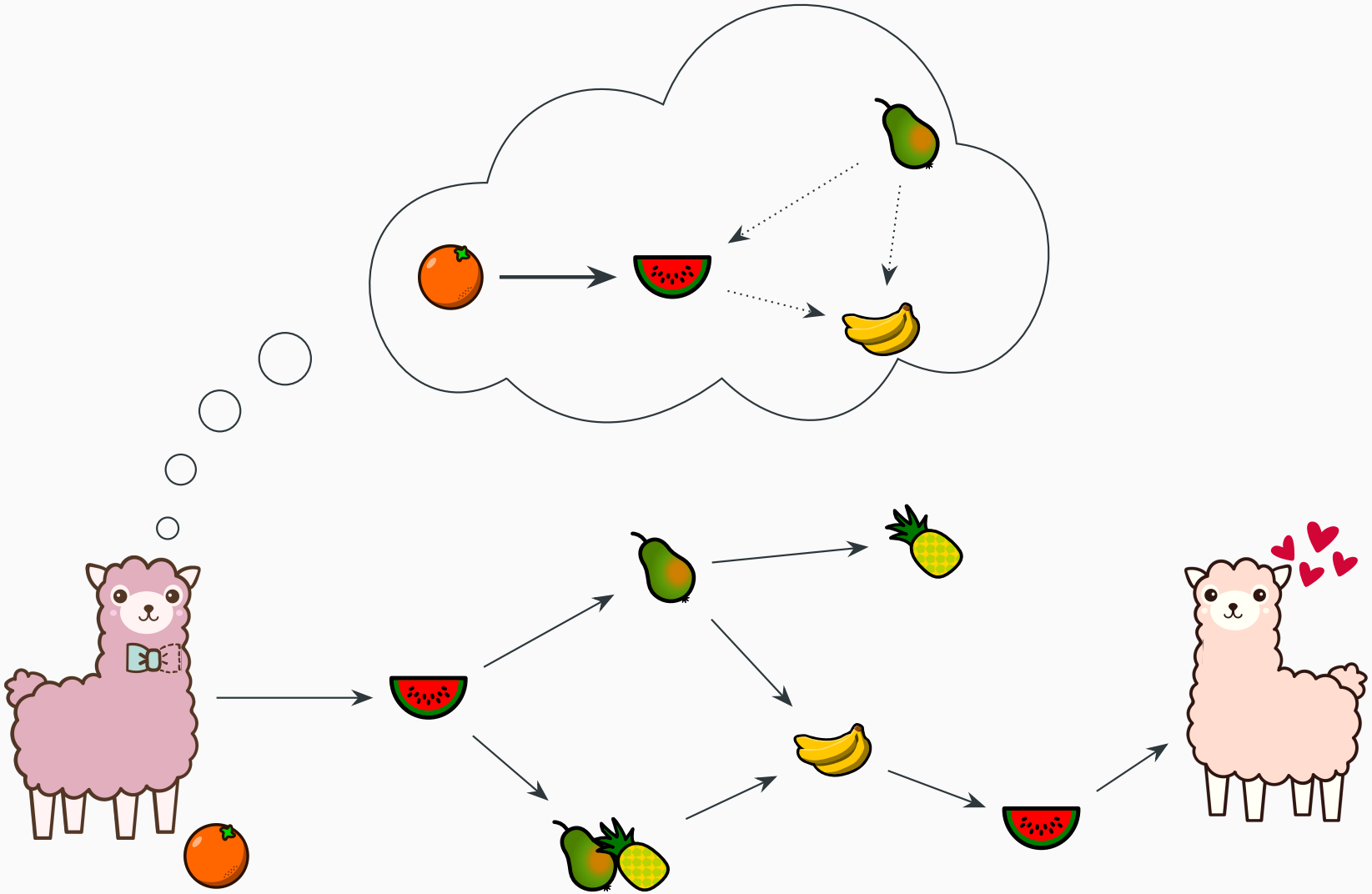

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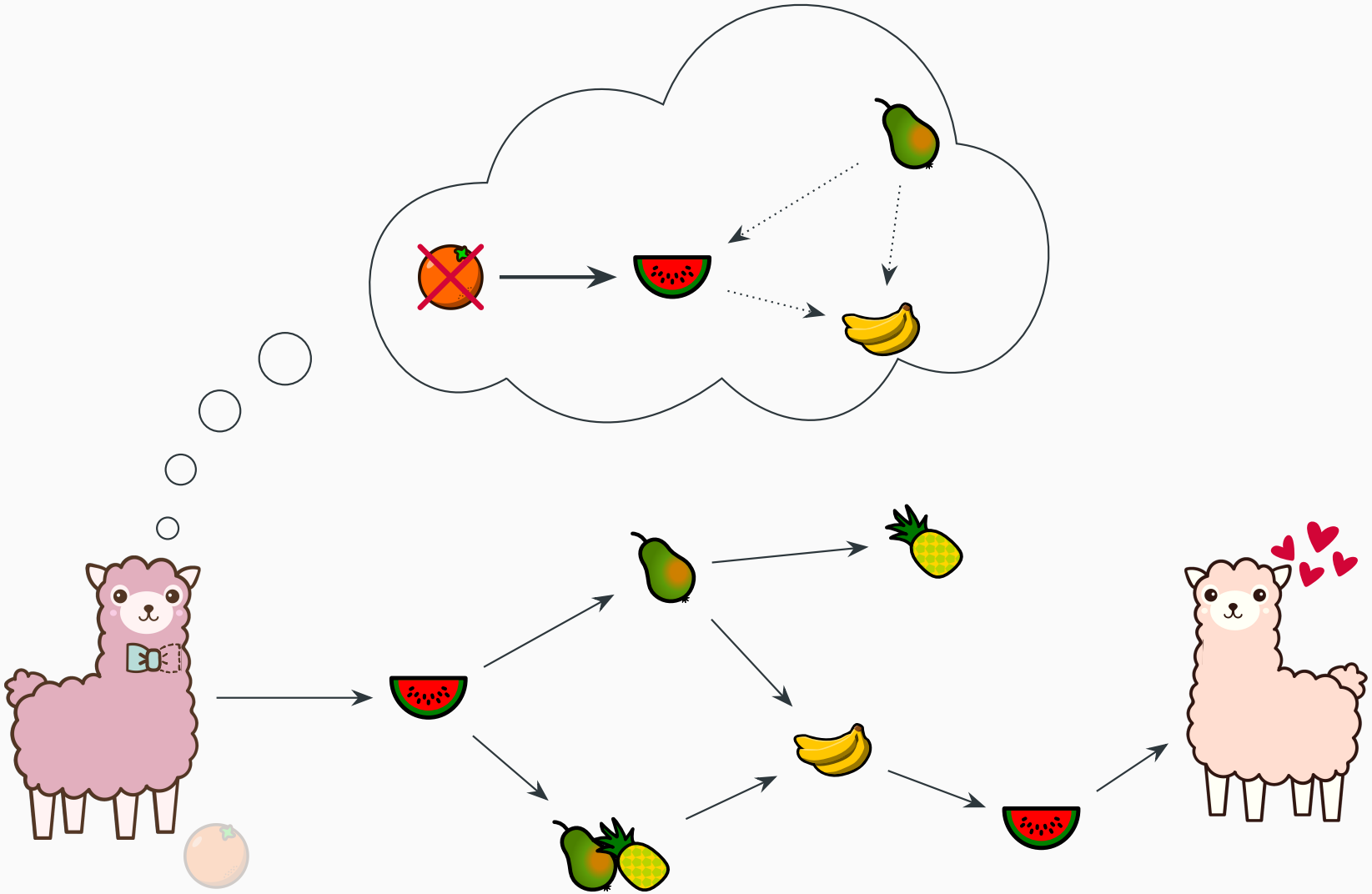

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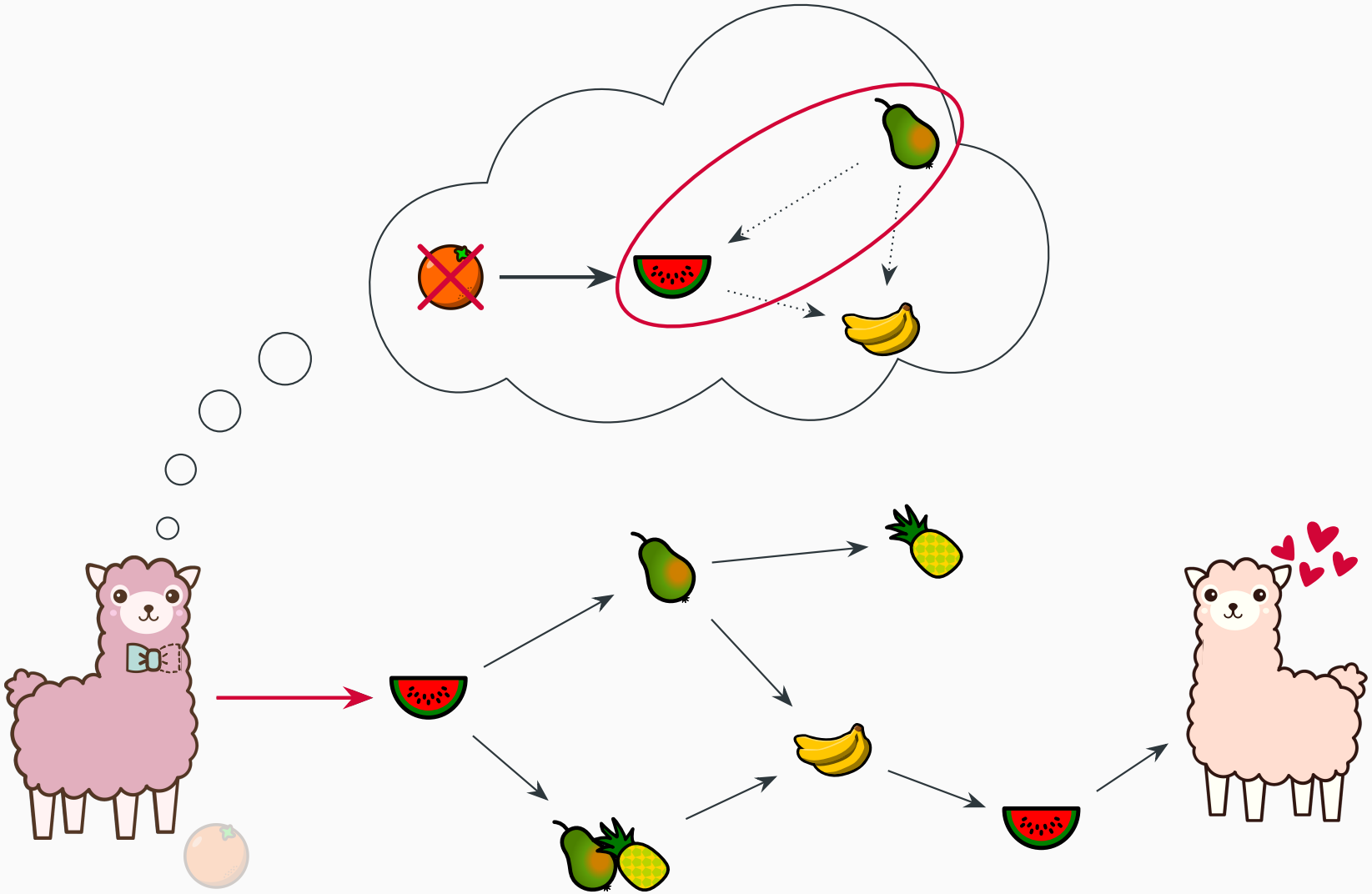

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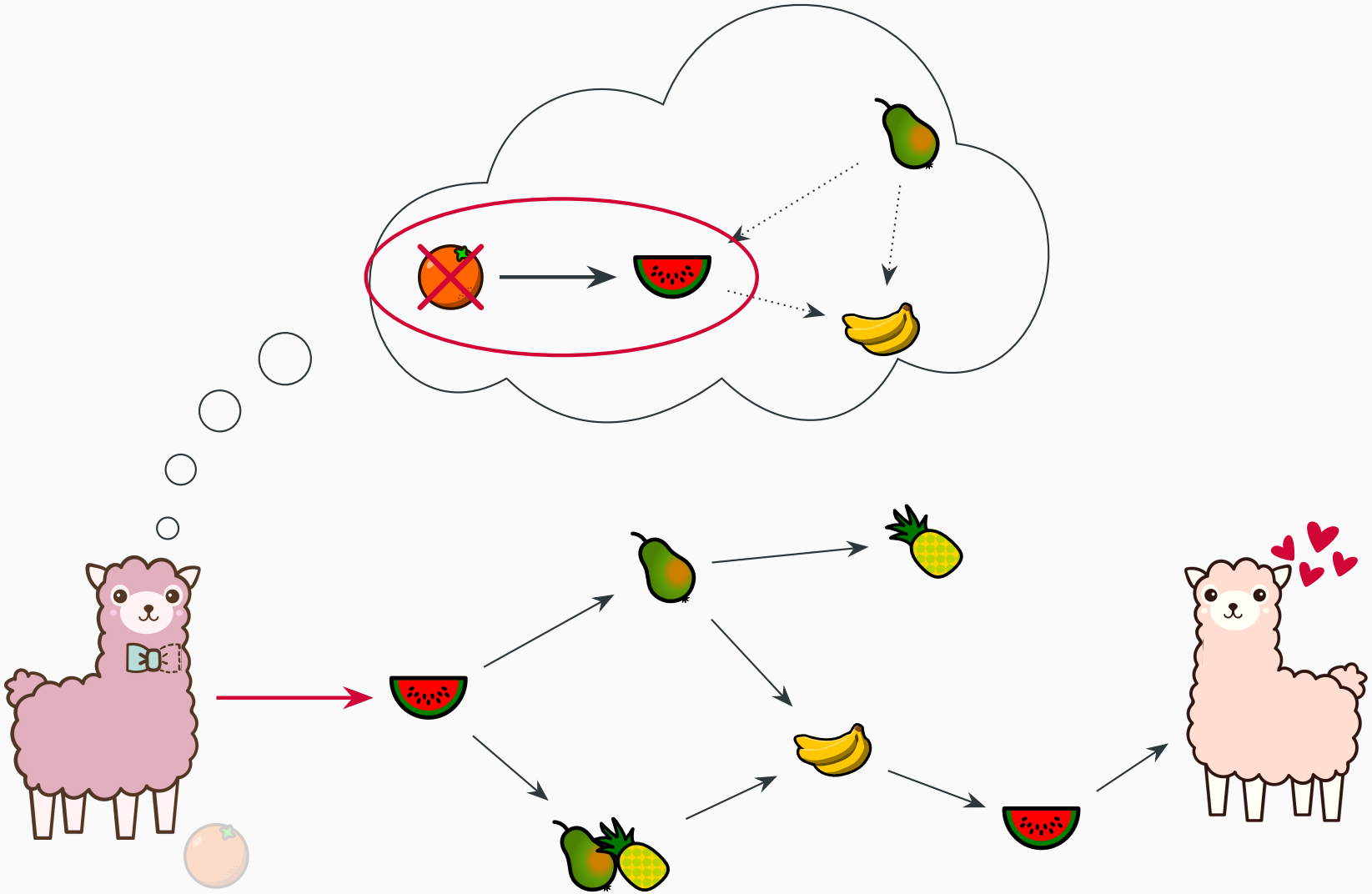
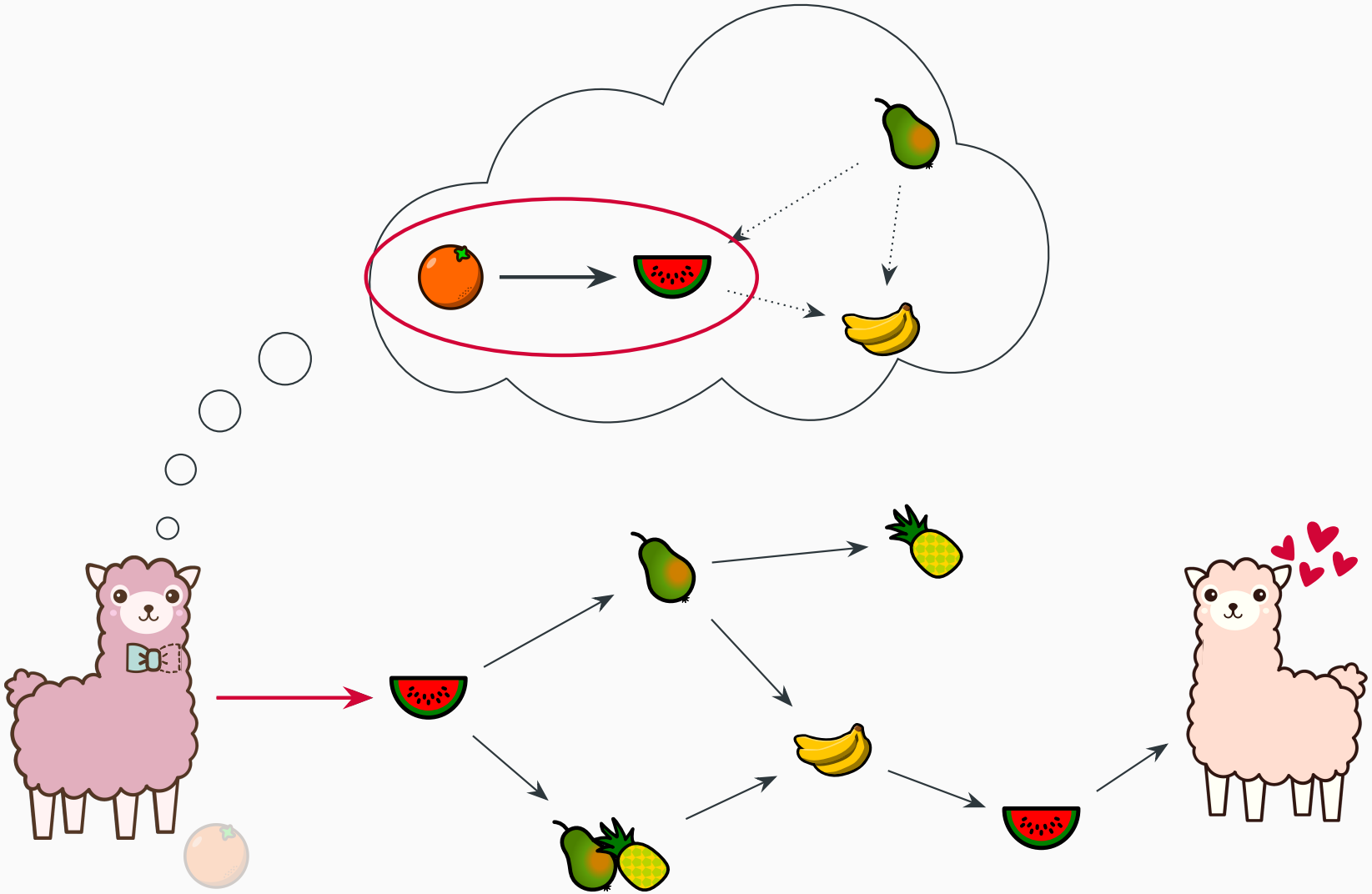
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