

Imputing Missing Events in Continuous-Time Event Streams



Hongyuan Mei¹



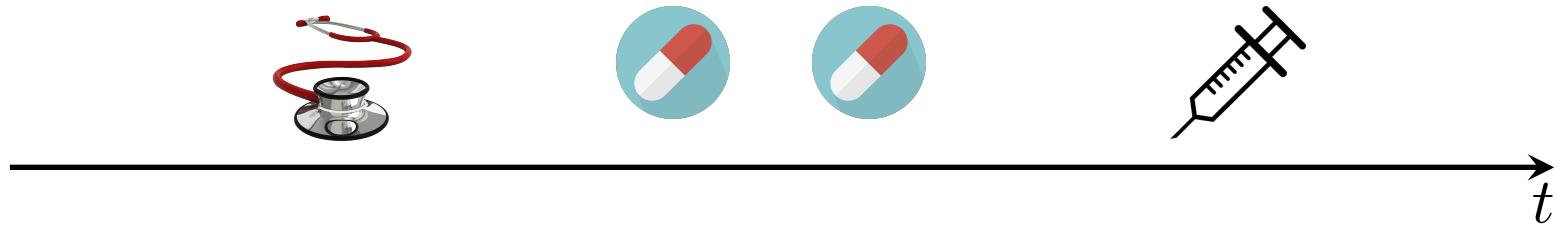
Guanghui Qin²



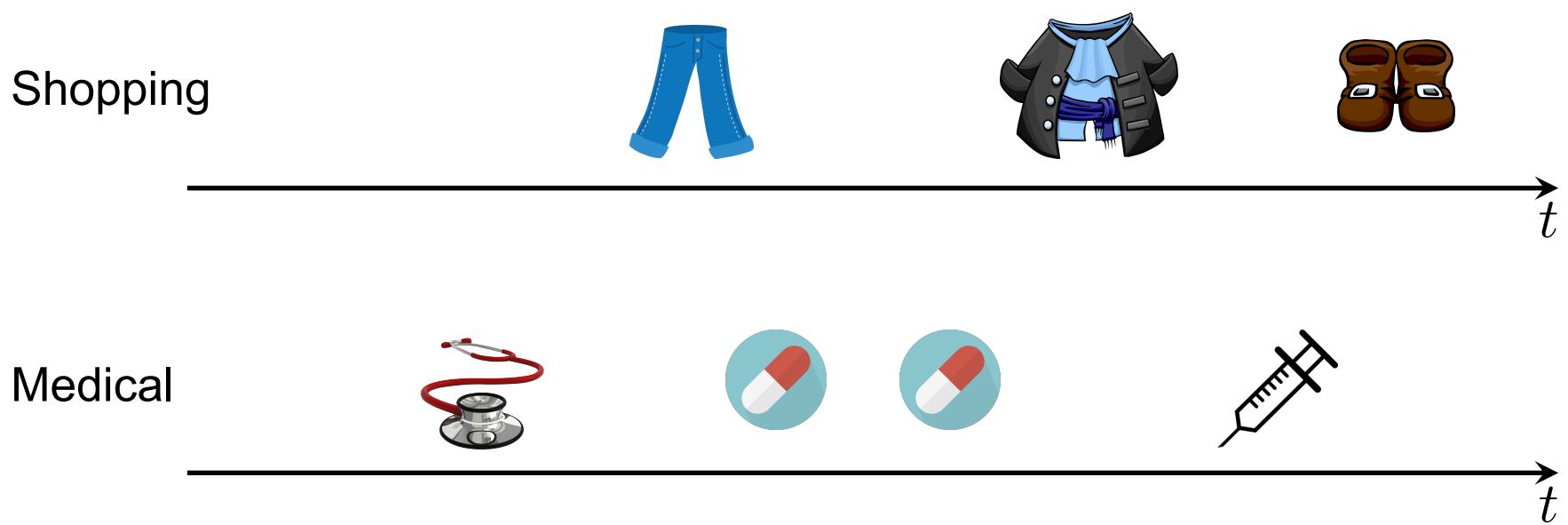
Jason Eisner¹

Event Streams

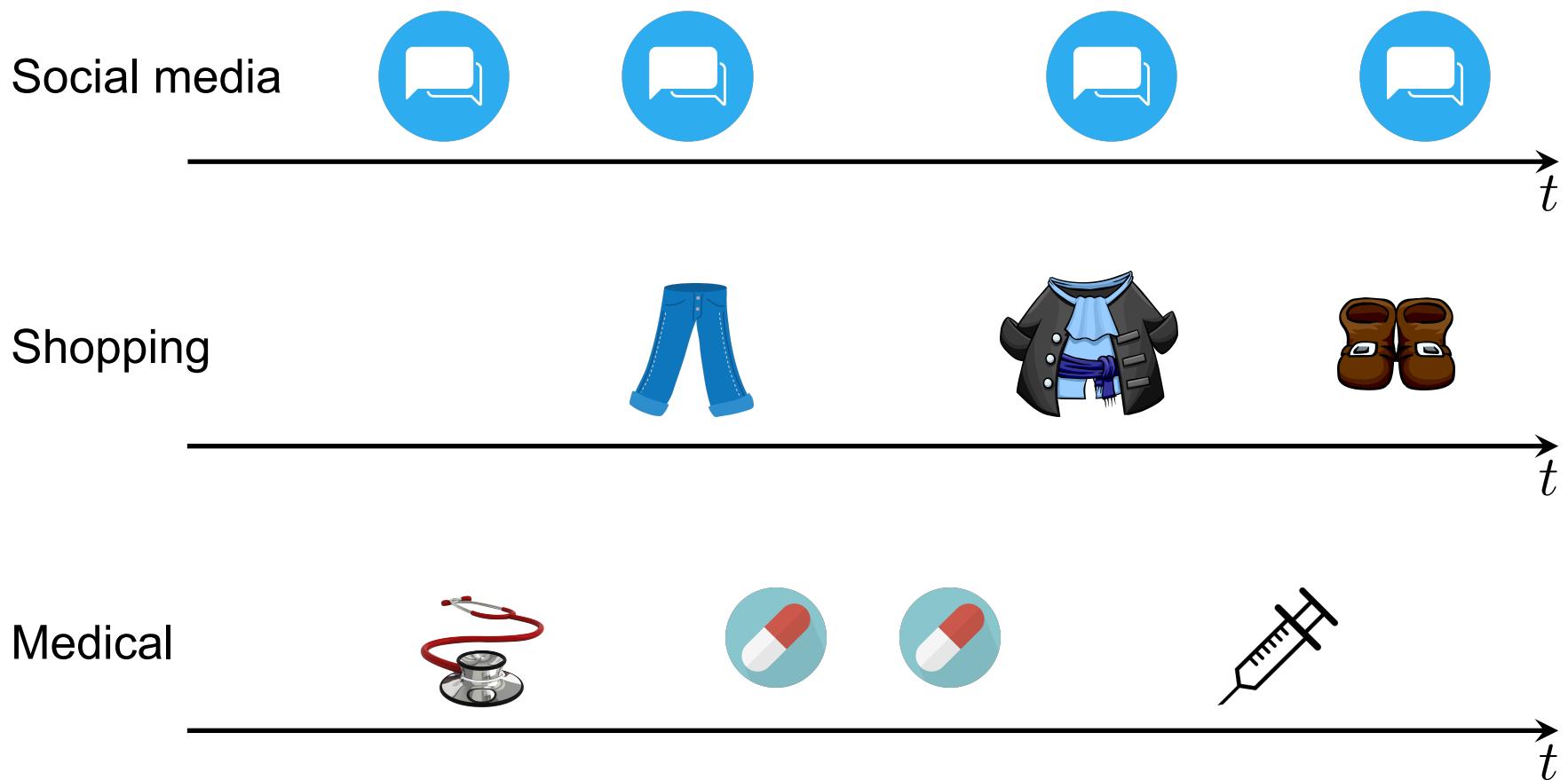
Medical



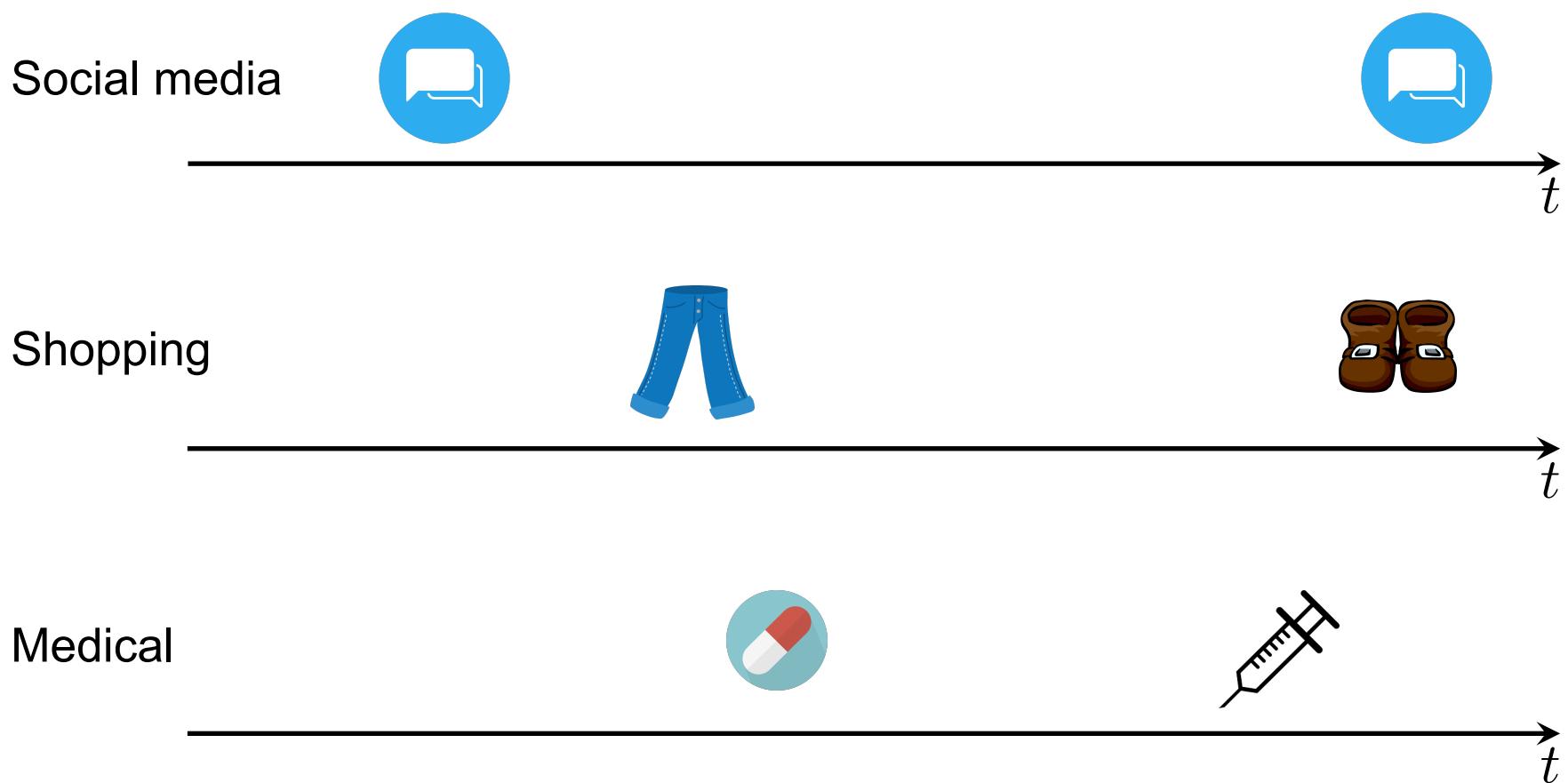
Event Streams



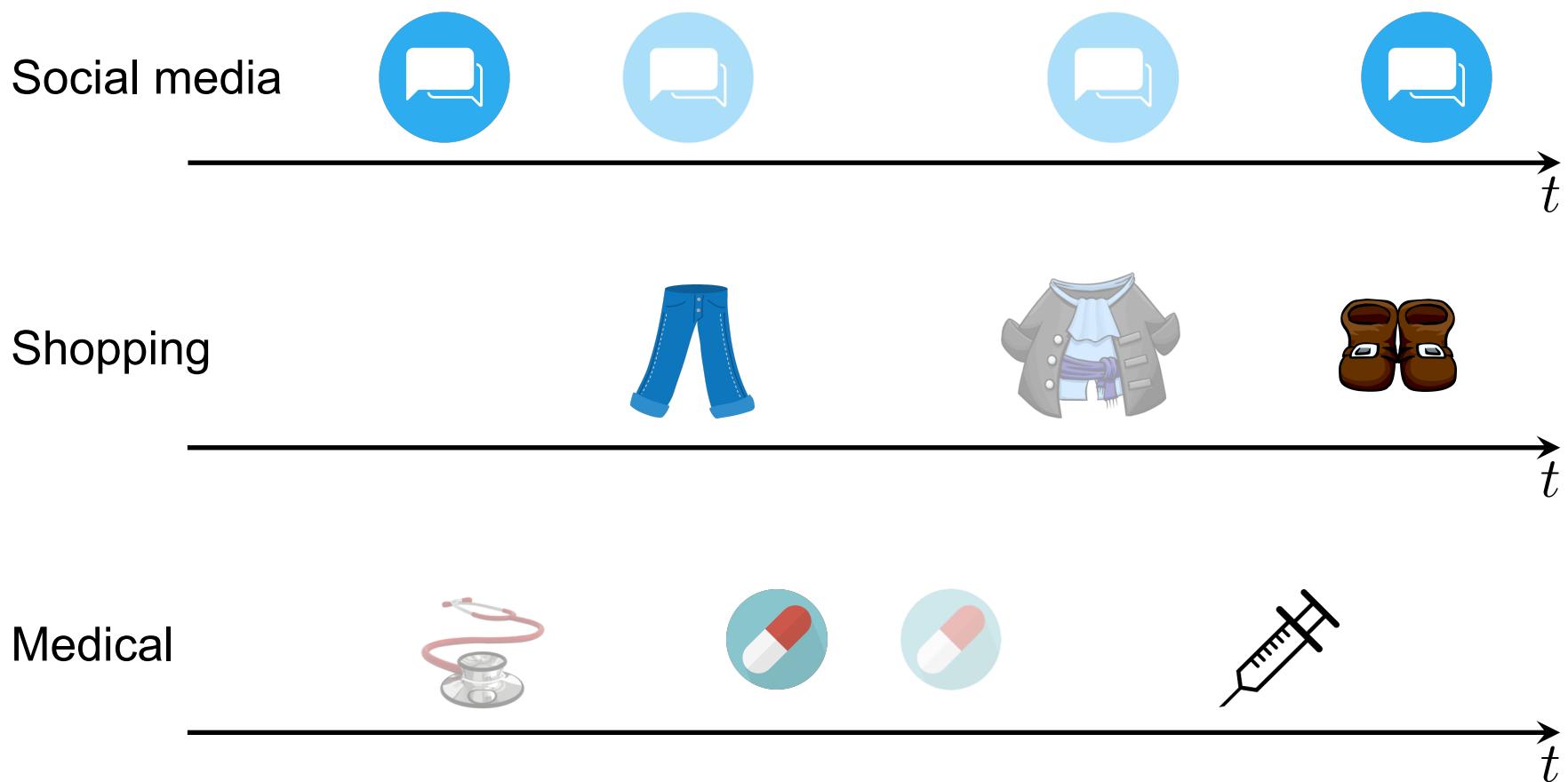
Event Streams



Event Streams



Event Streams



Let's Play a Battle Game



Let's Play a Battle Game



- Incomplete data

Let's Play a Battle Game



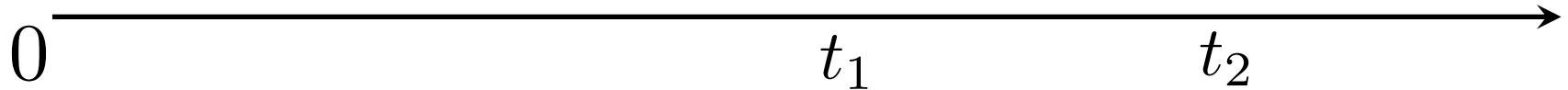
- Incomplete data
- Opponent tanks come

0

Let's Play a Battle Game



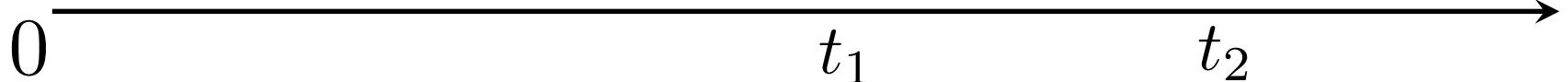
- Incomplete data
- Opponent tanks come



Let's Play a Battle Game



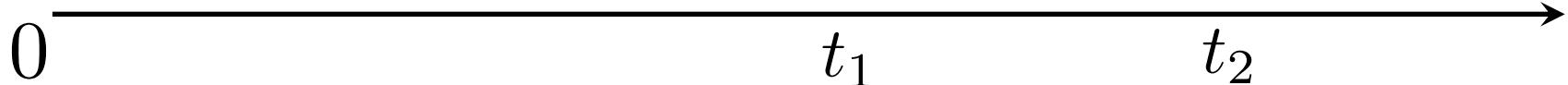
- Incomplete data
- Opponent tanks come
- Maybe a new factory was built to produce them?



Let's Play a Battle Game



- Incomplete data
- Opponent tanks come
- Maybe a new factory was built to produce them?
- When was it built?



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0

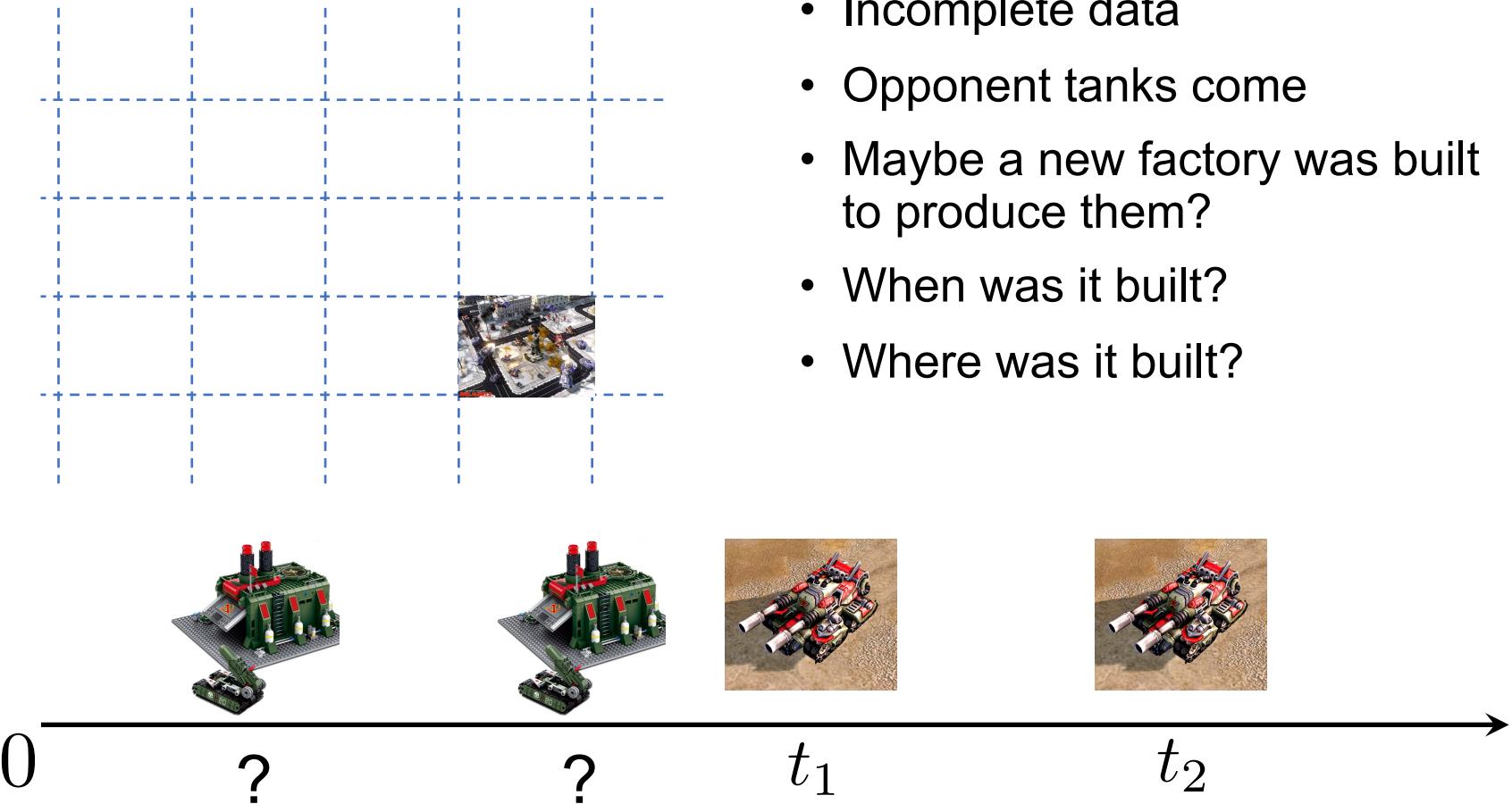
?

?

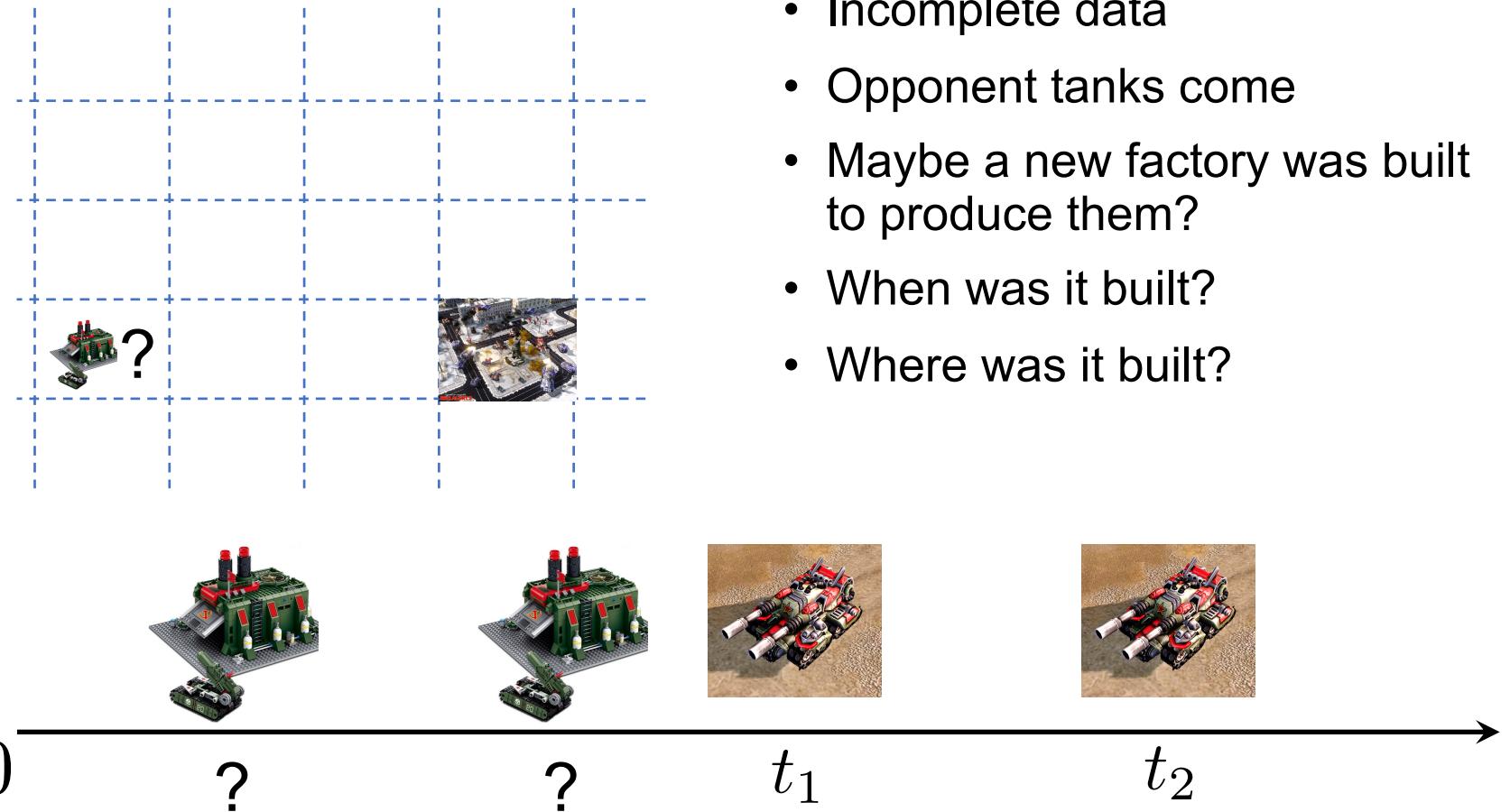
t_1

t_2

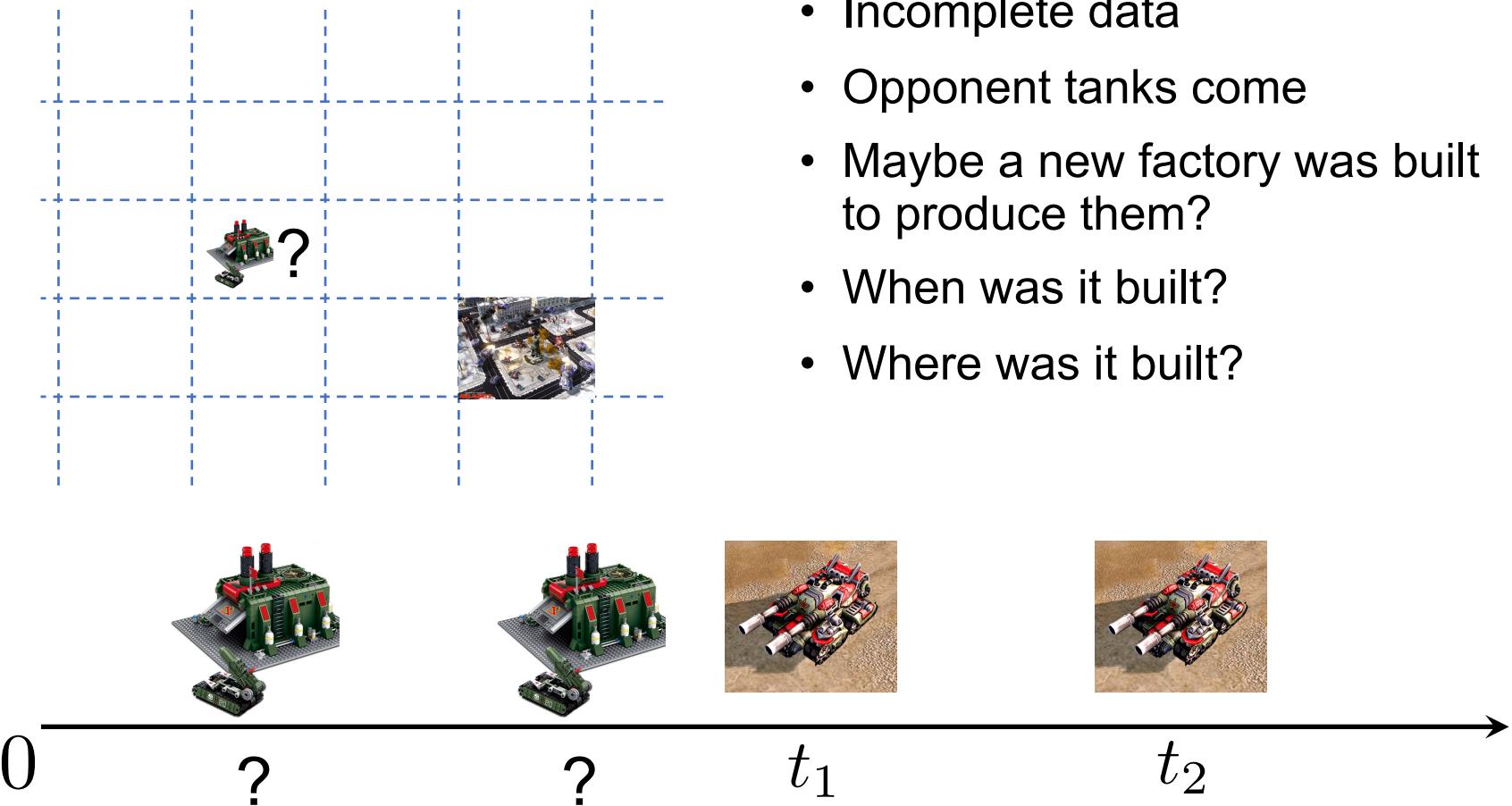
Let's Play a Battle Game



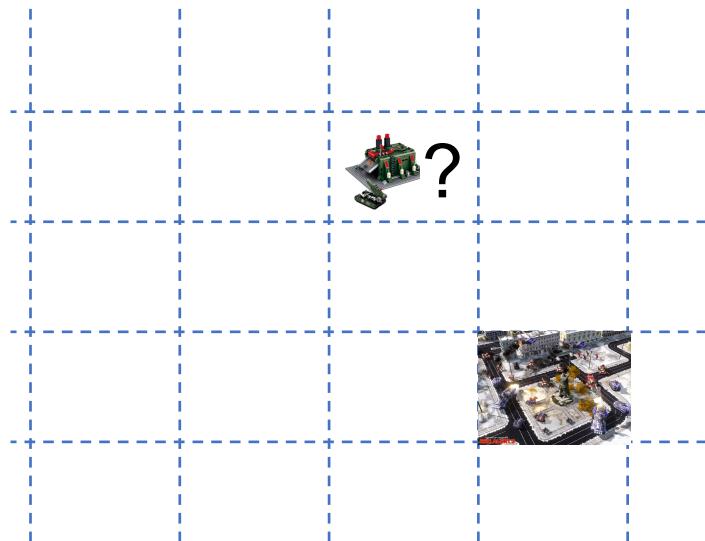
Let's Play a Battle Game



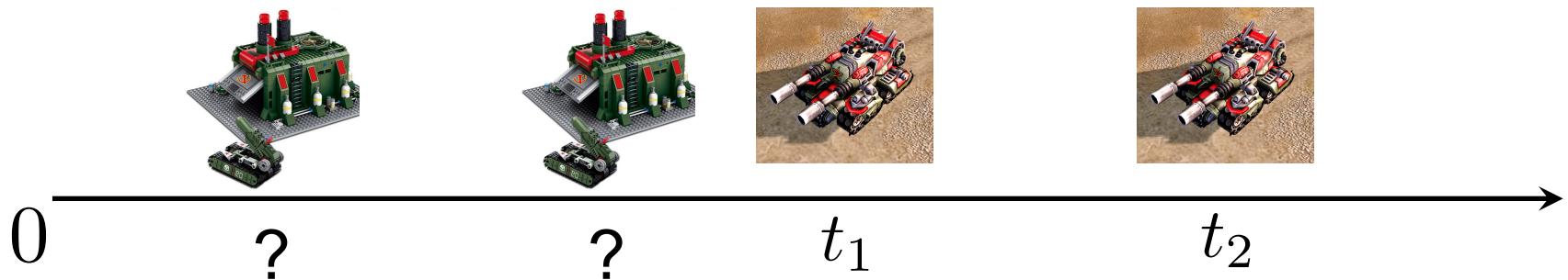
Let's Play a Battle Game



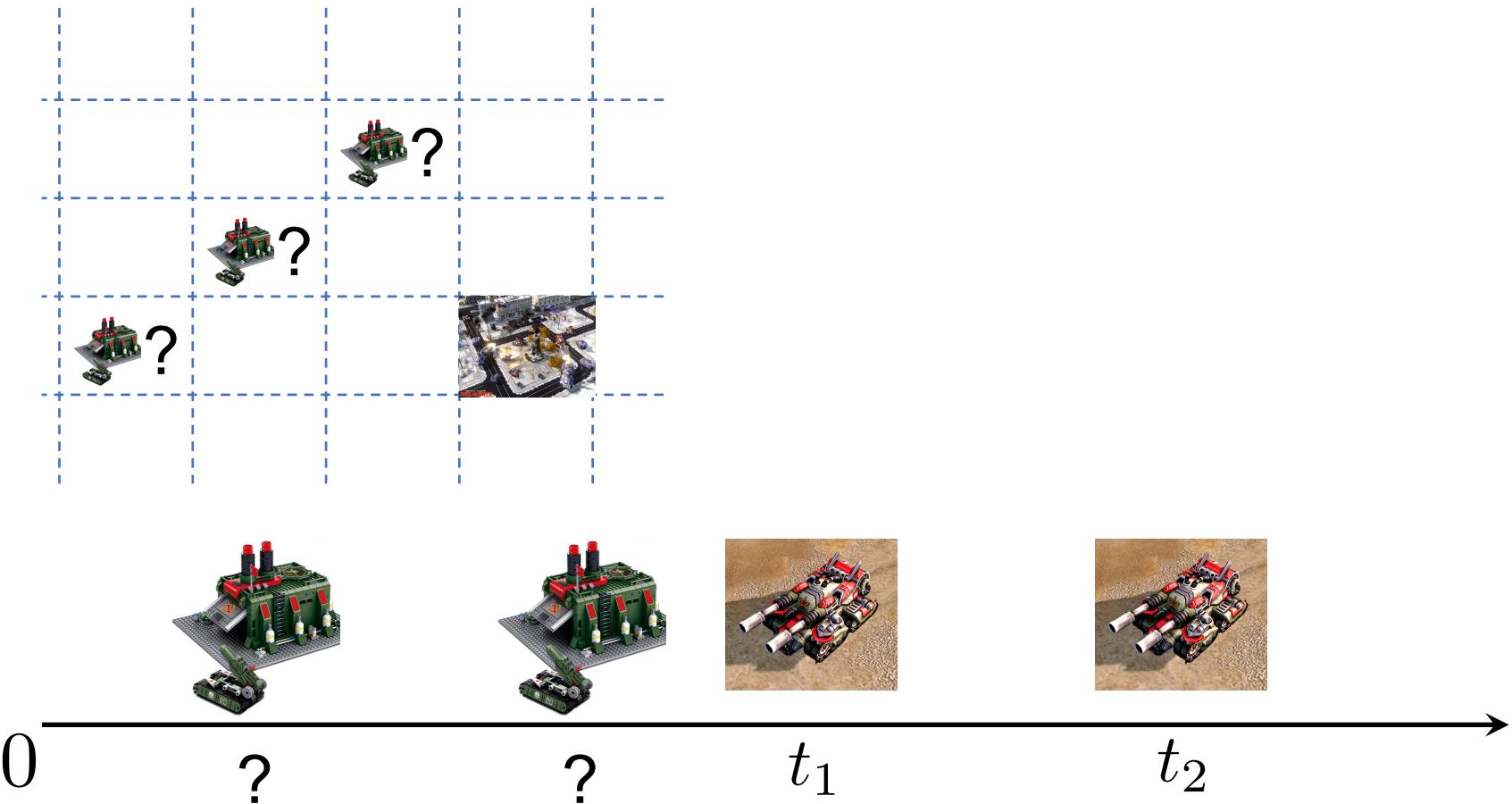
Let's Play a Battle Game



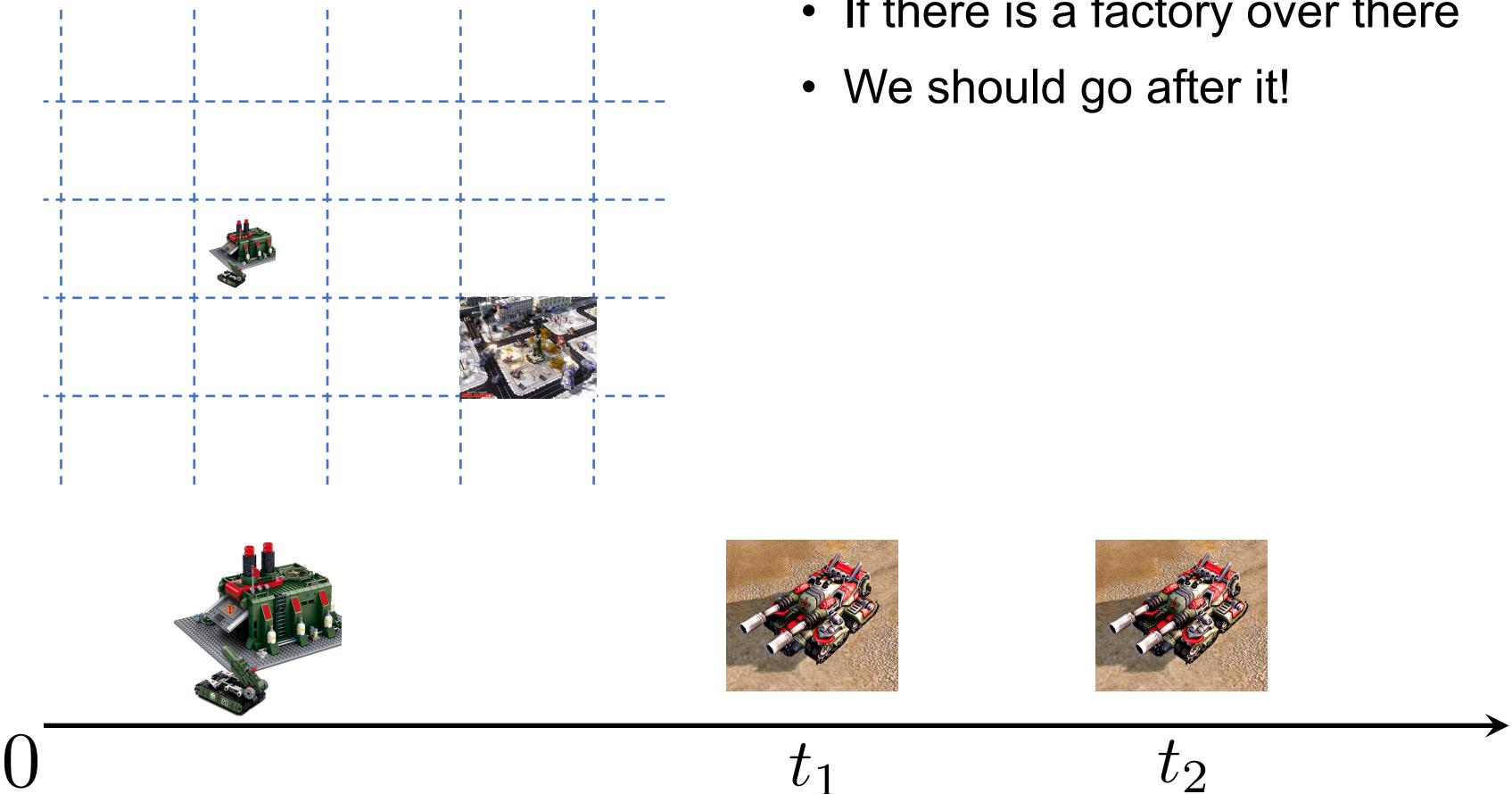
- Incomplete data
- Opponent tanks come
- Maybe a new factory was built to produce them?
- When was it built?
- Where was it built?



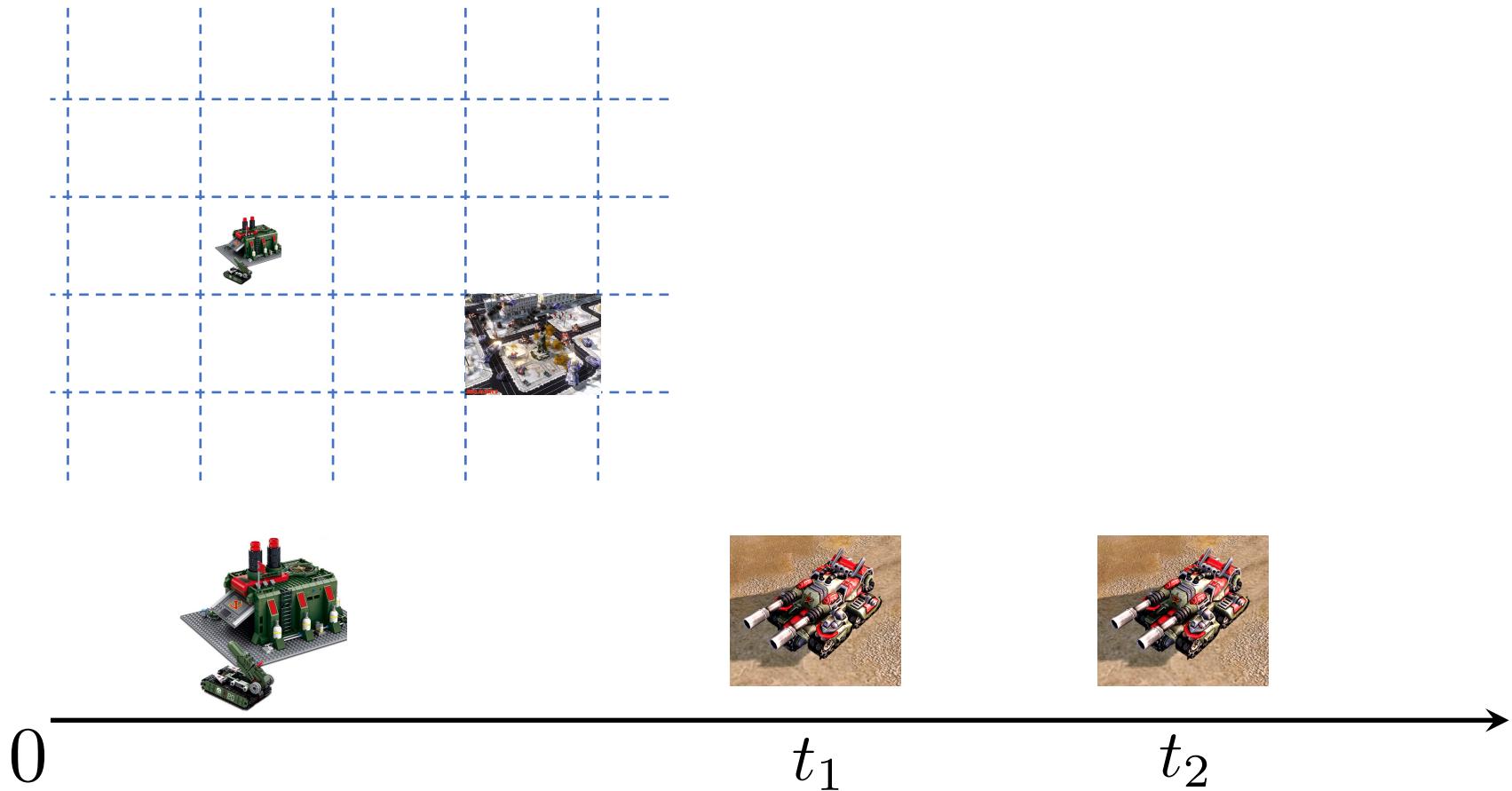
Why to Impute?



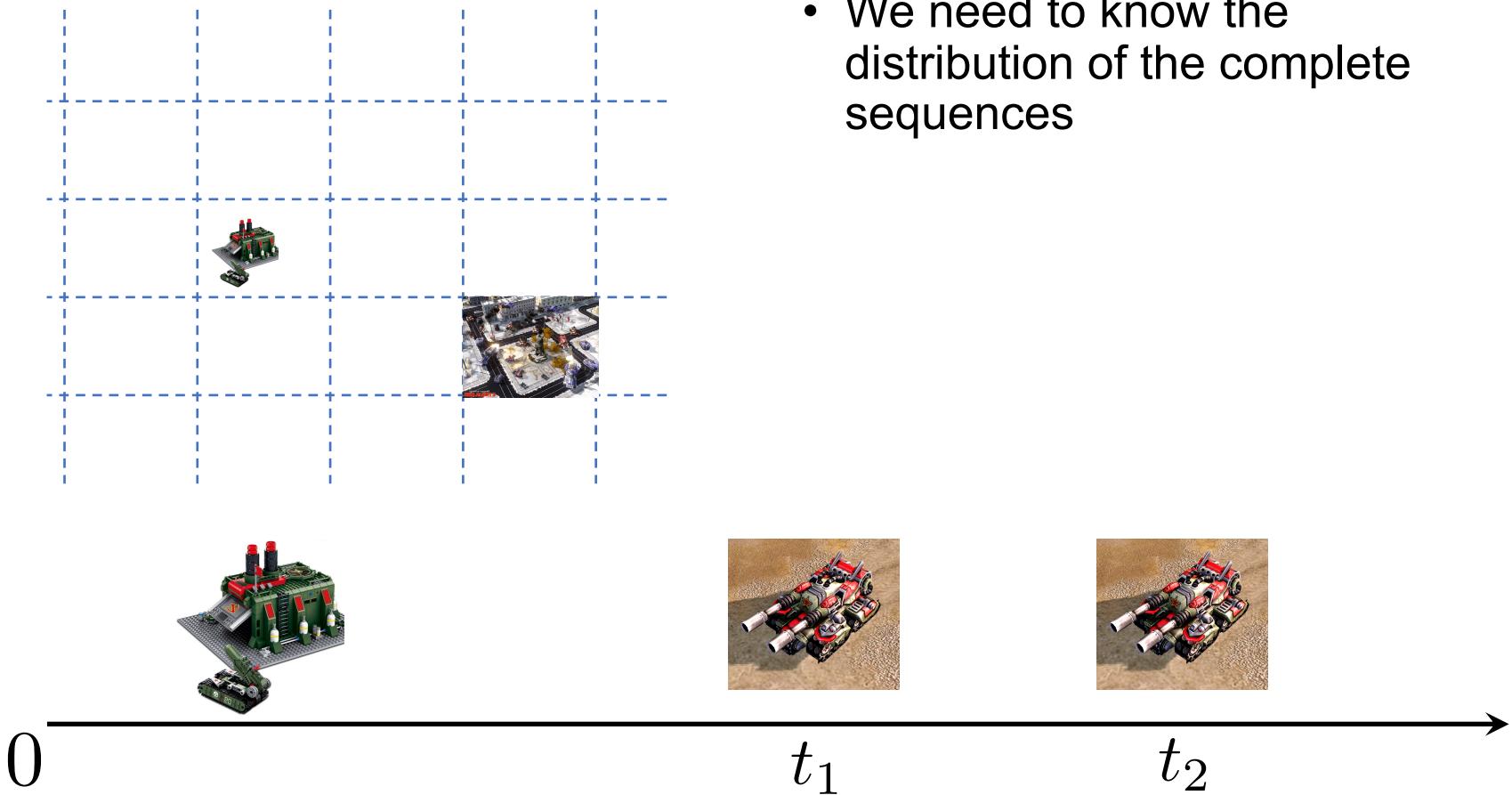
Why to Impute?



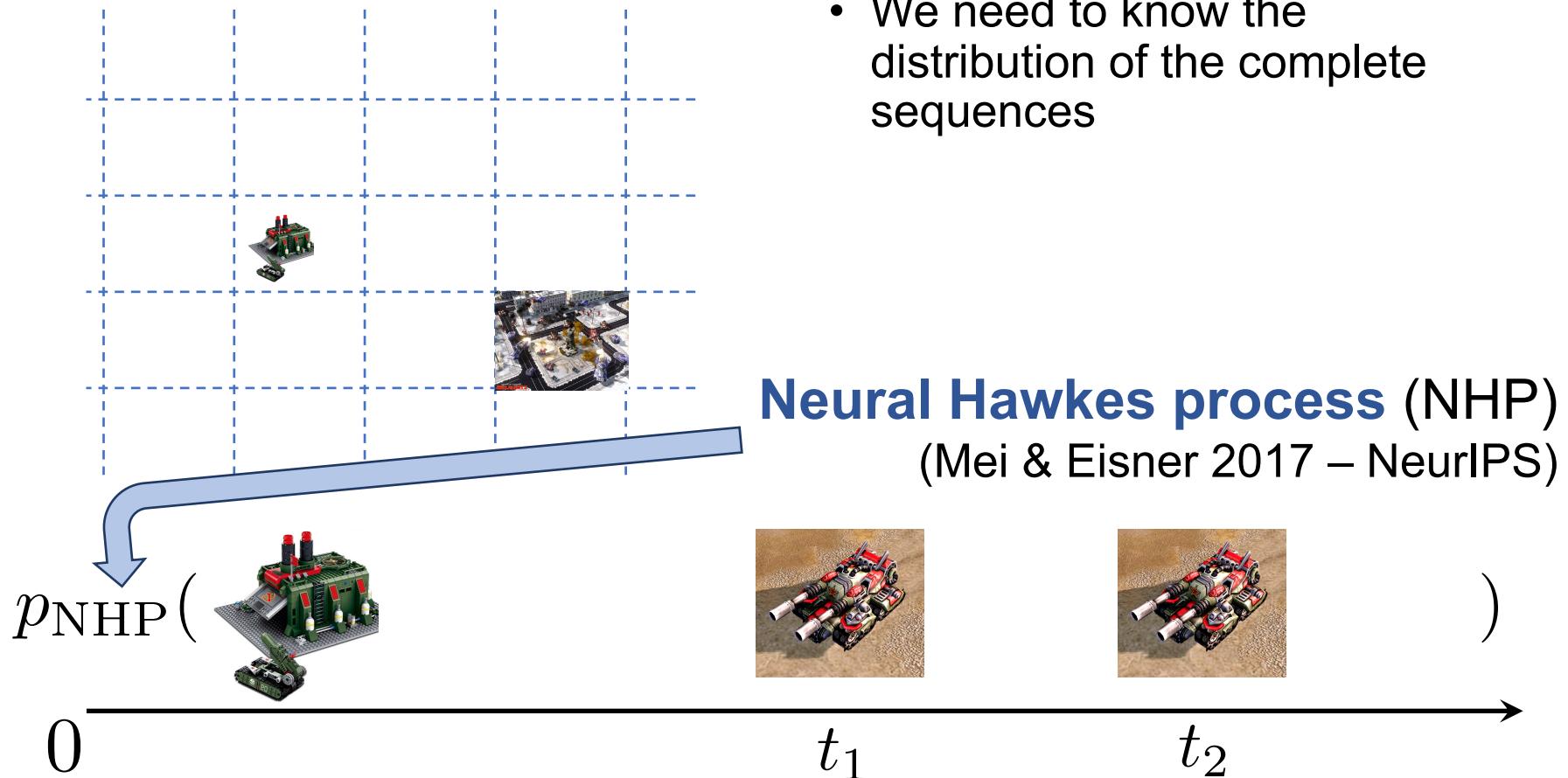
To Impute the Missing Events...



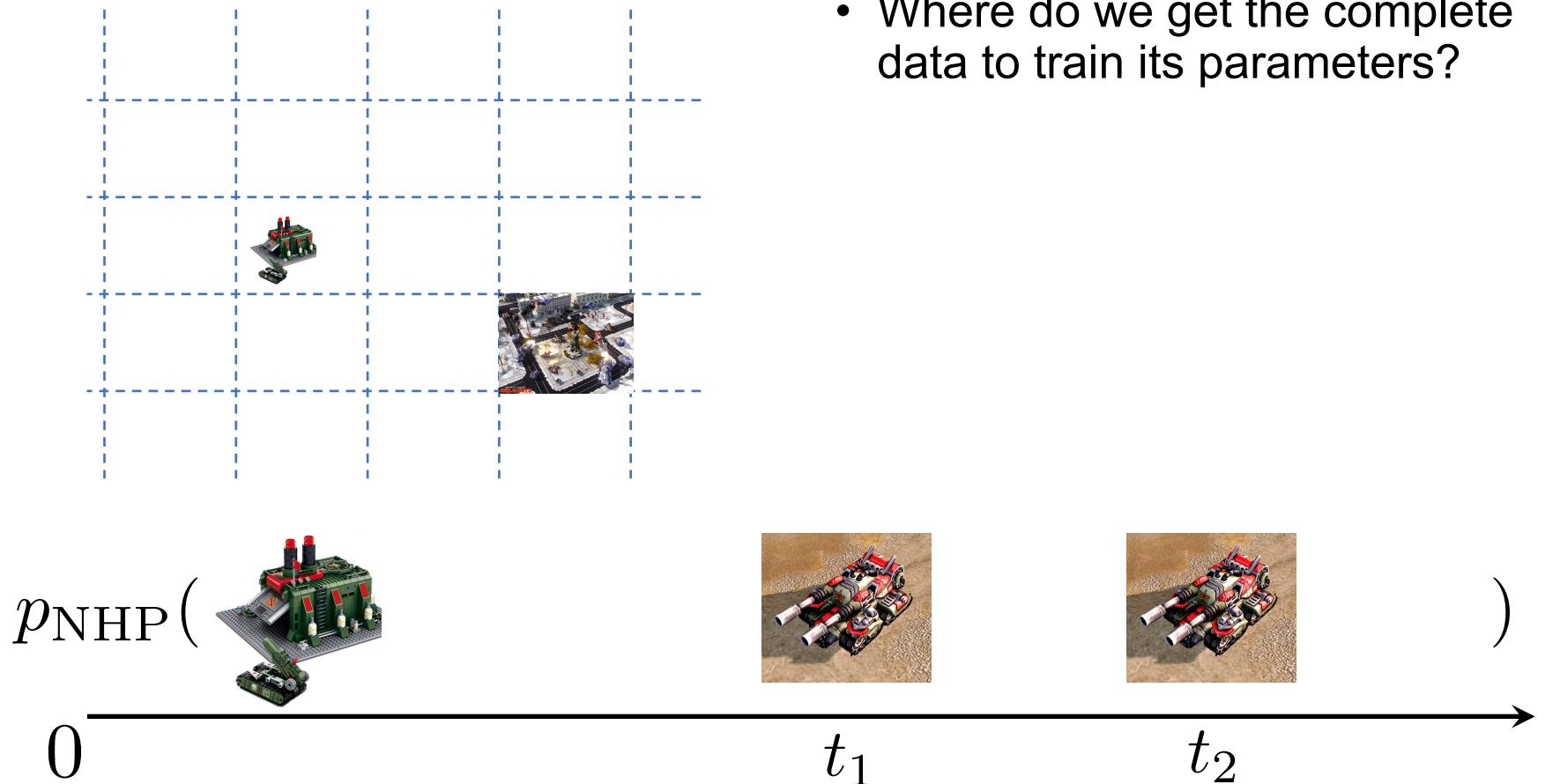
To Impute the Missing Events...



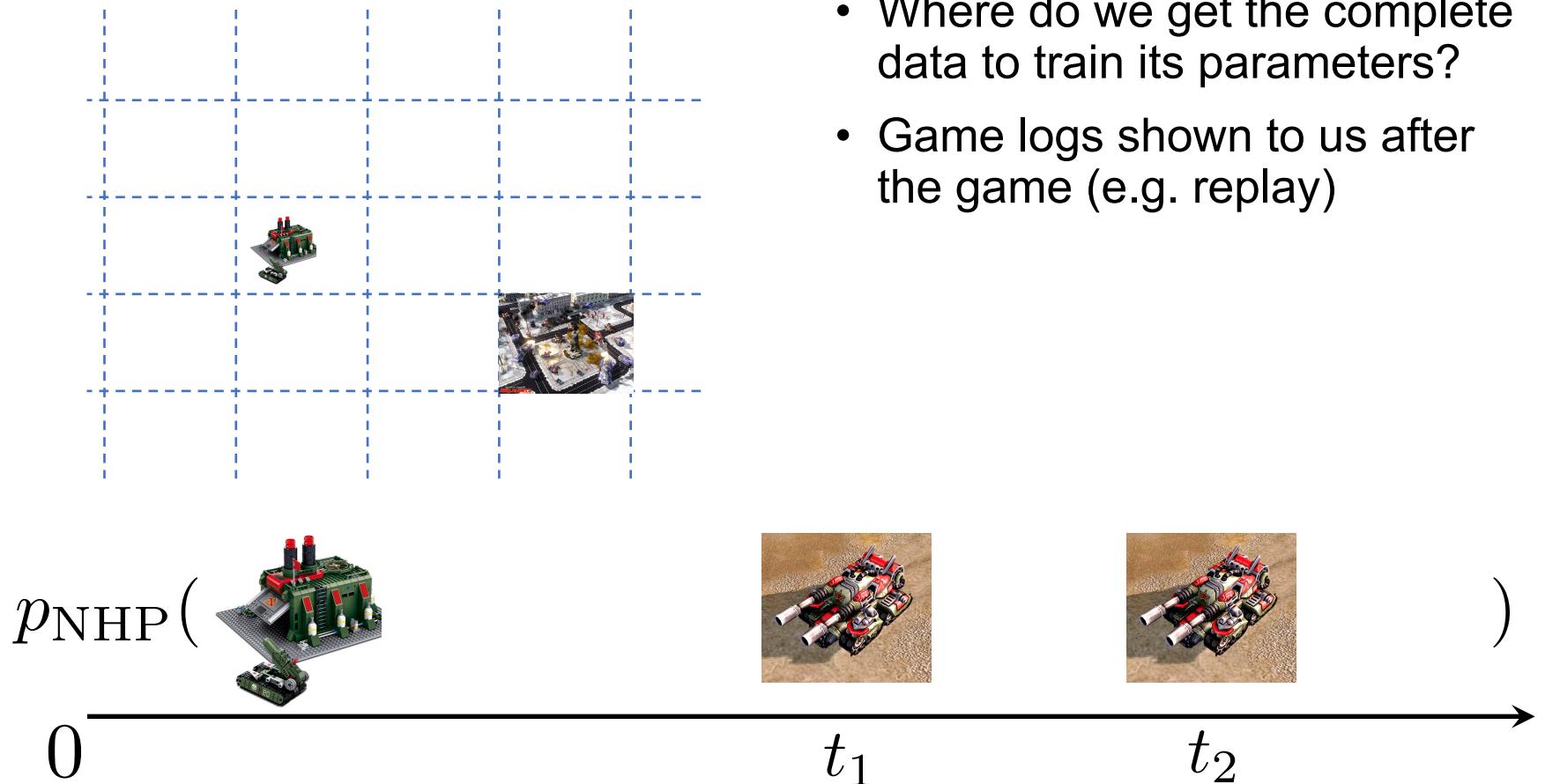
To Impute the Missing Events...



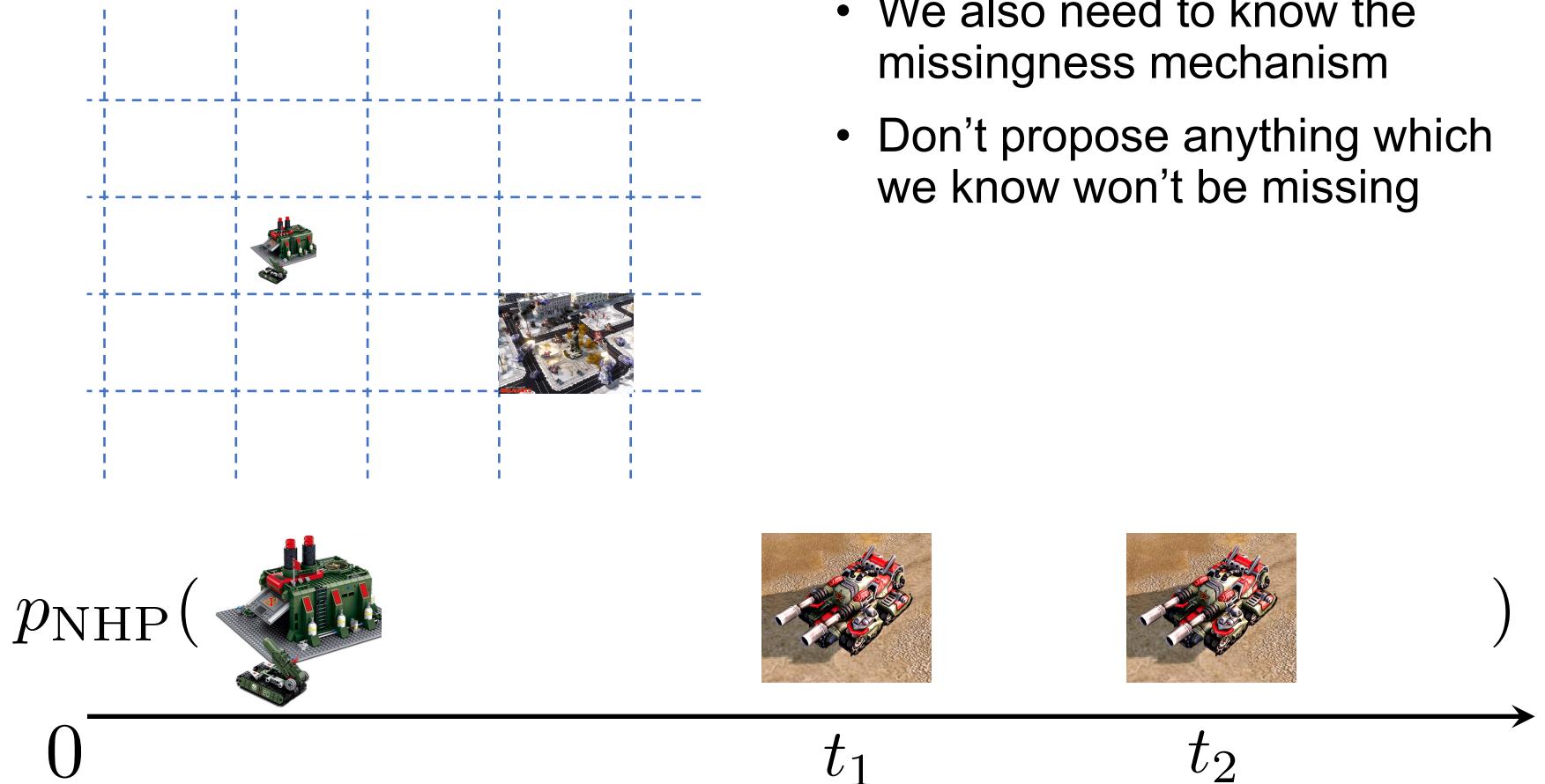
To Impute the Missing Events...



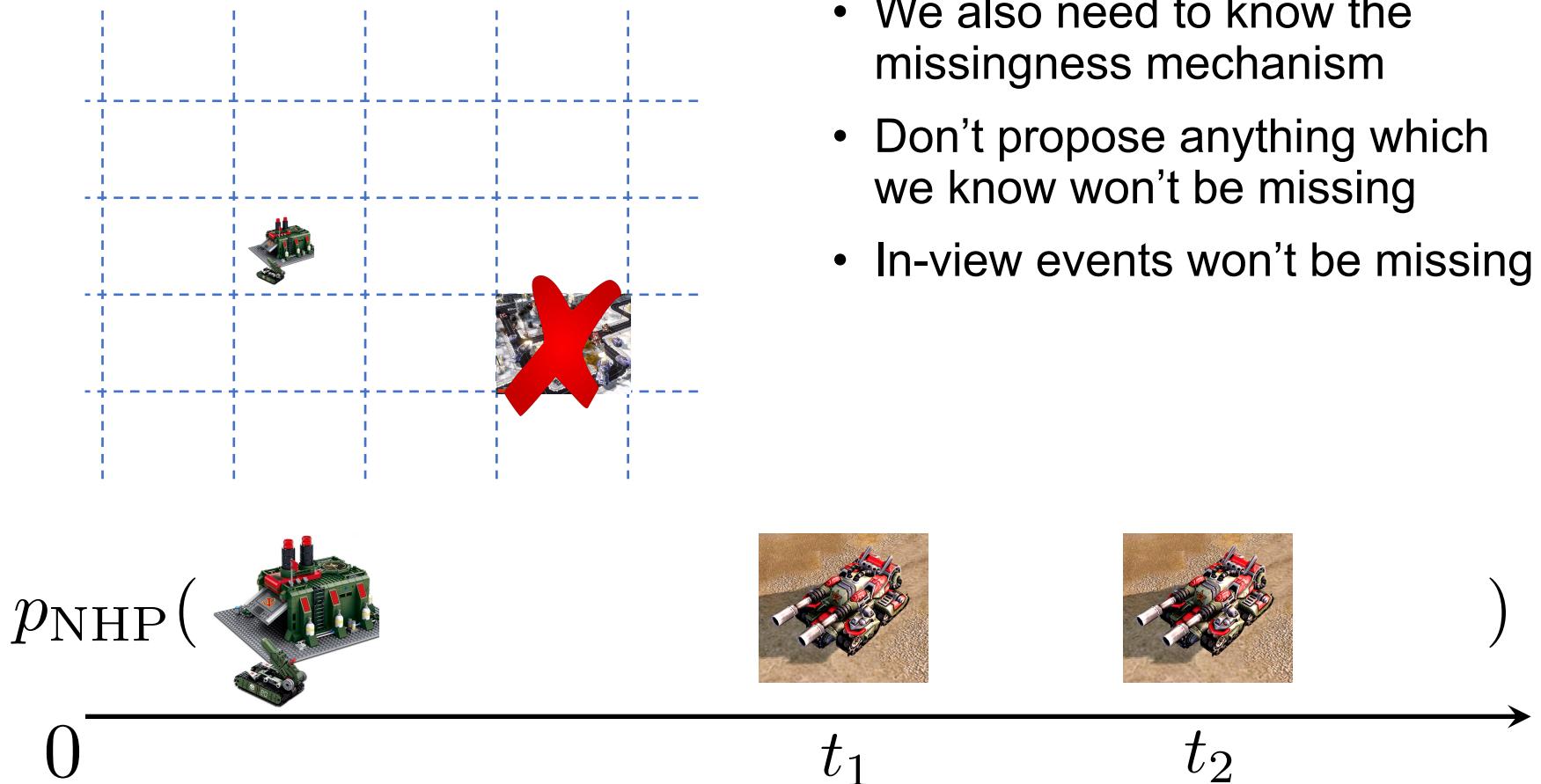
To Impute the Missing Events...



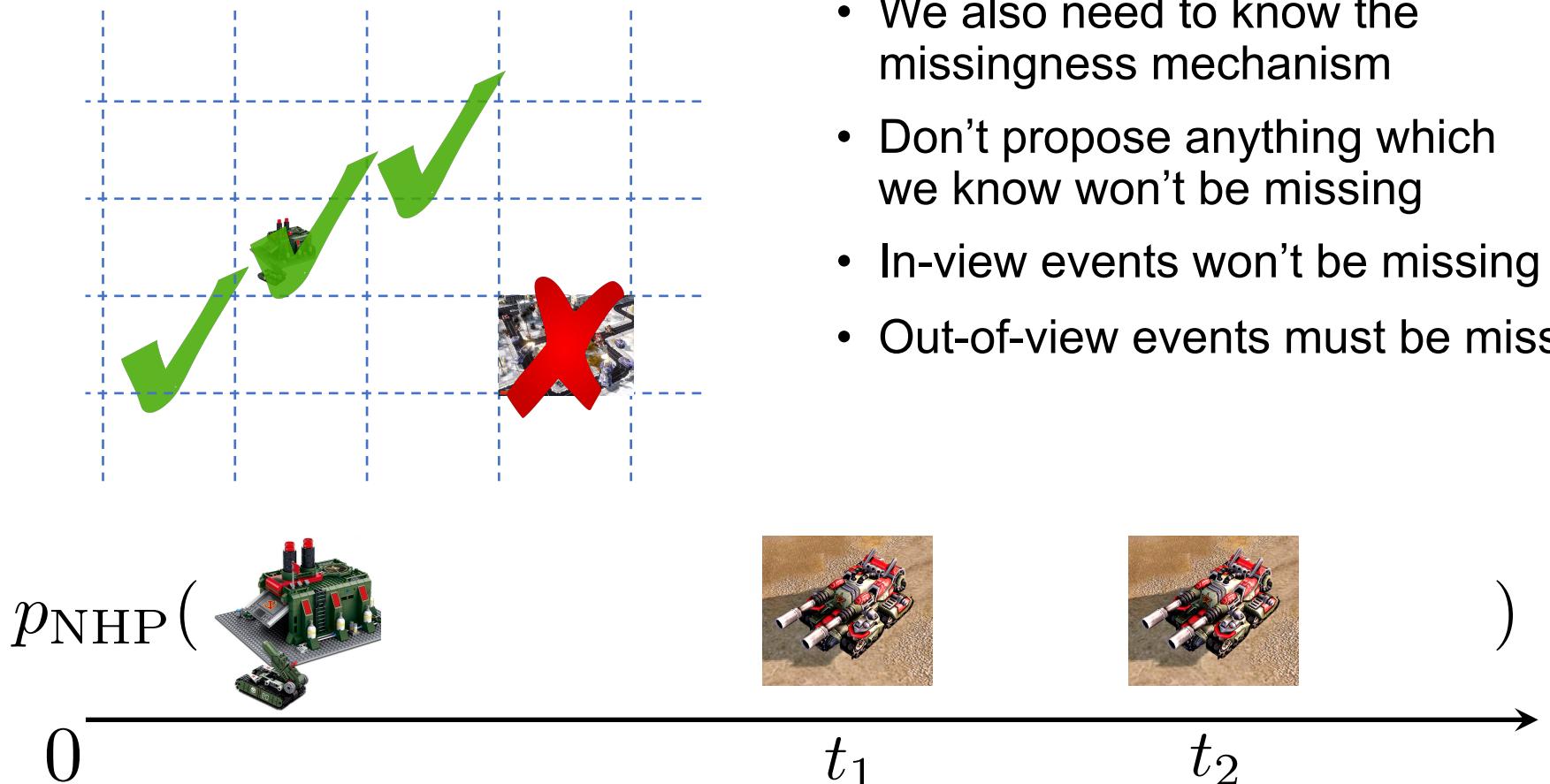
To Impute the Missing Events...



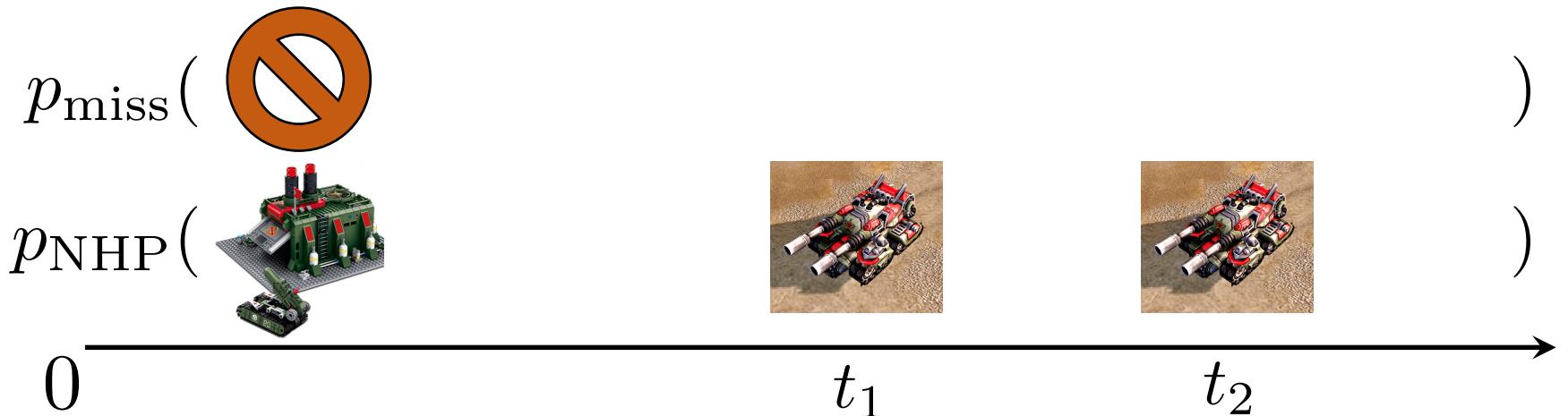
To Impute the Missing Events...



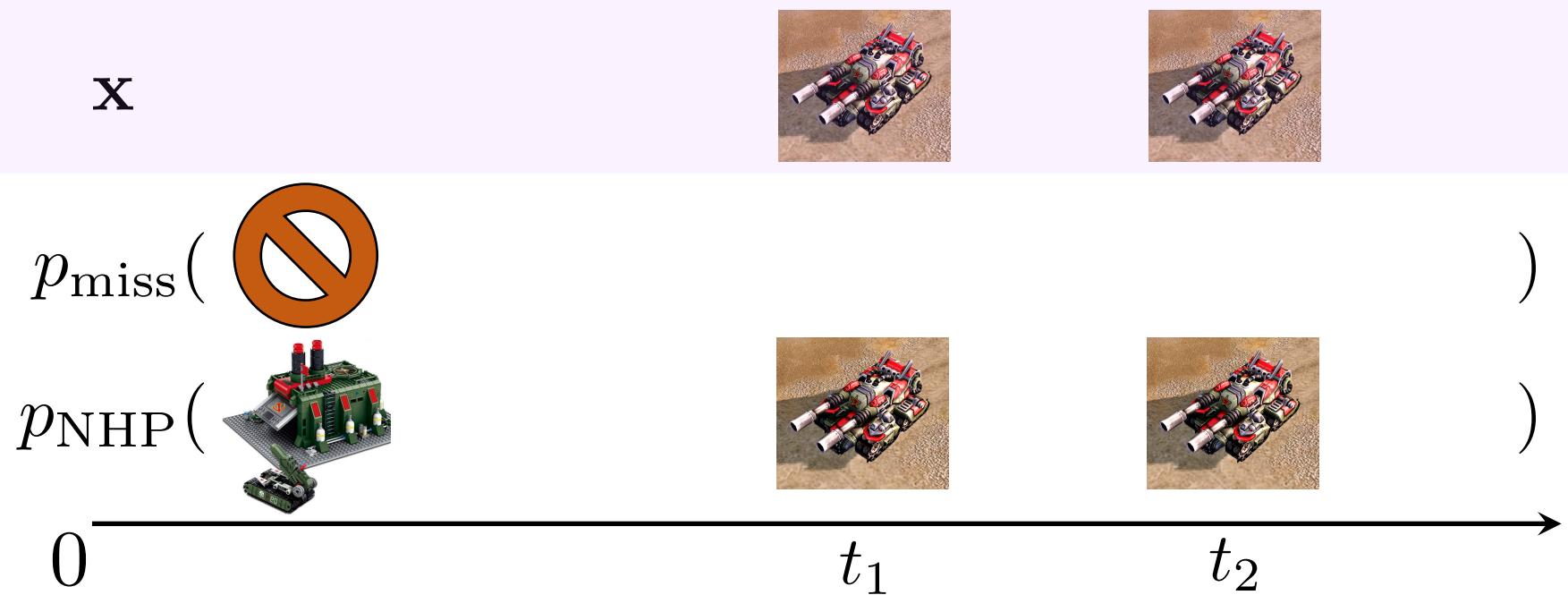
To Impute the Missing Events...



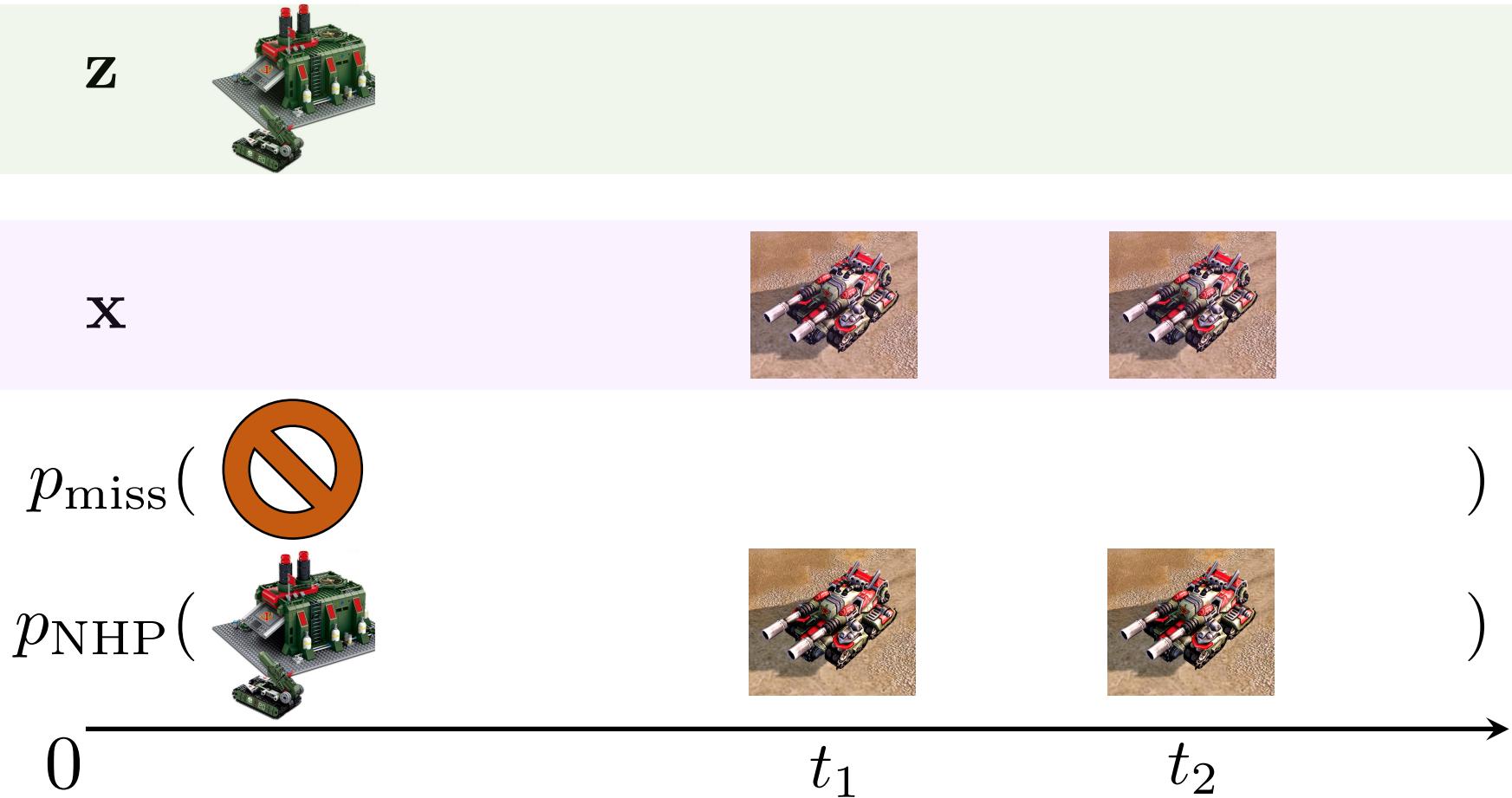
To Impute the Missing Events...



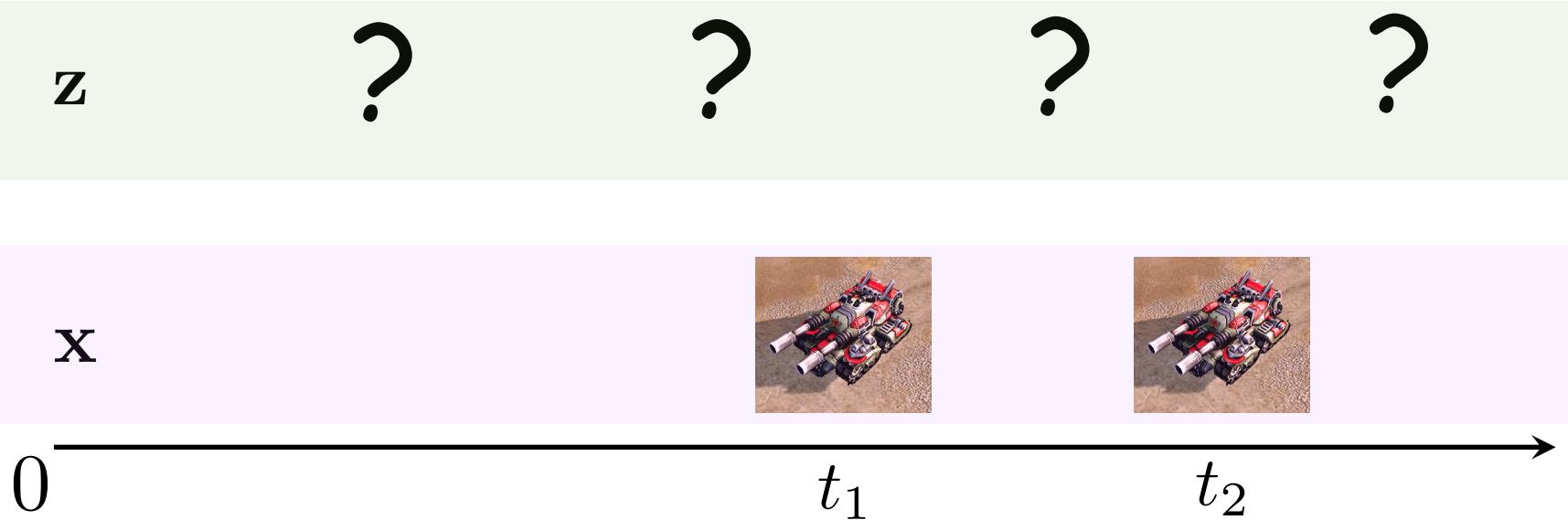
To Impute the Missing Events...



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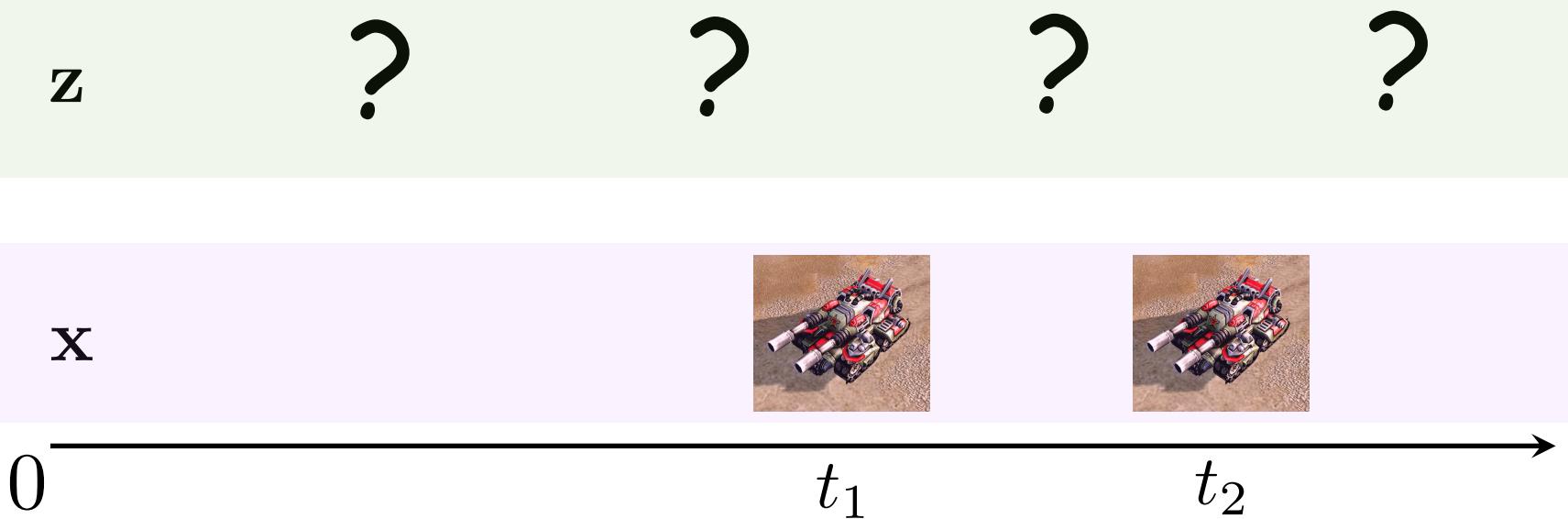


To Impute the Missing Events...



To Impute the Missing Events...

$$p(\mathbf{z} \mid \mathbf{x}) \propto p_{\text{NHP}}(\mathbf{x} \sqcup \mathbf{z}) p_{\text{miss}}(\mathbf{z} \mid \mathbf{x} \sqcup \mathbf{z})$$

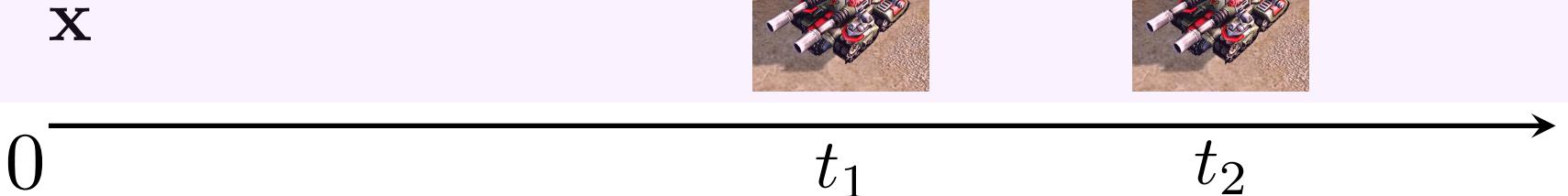


Challenge

$$p(\mathbf{z} \mid \mathbf{x}) = ?$$

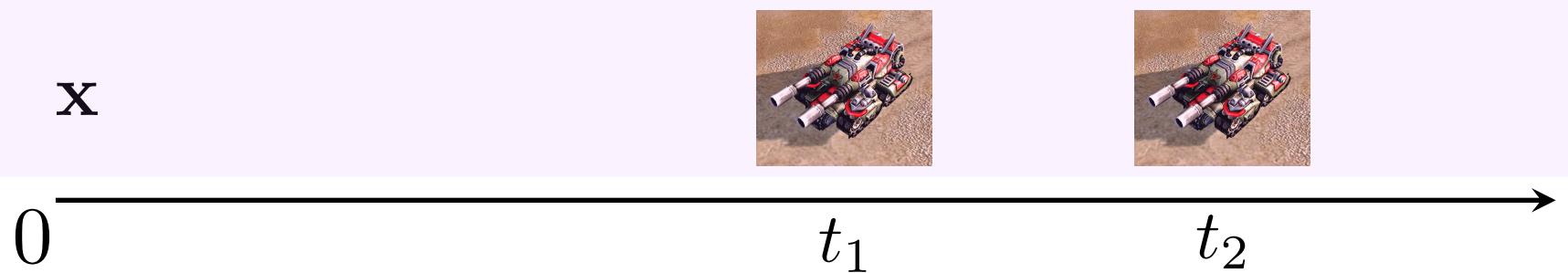
- Complicated p_{NHP}
- Exact inference is intractable
- How about Monte Carlo?

\mathbf{z} ? ? ? ?

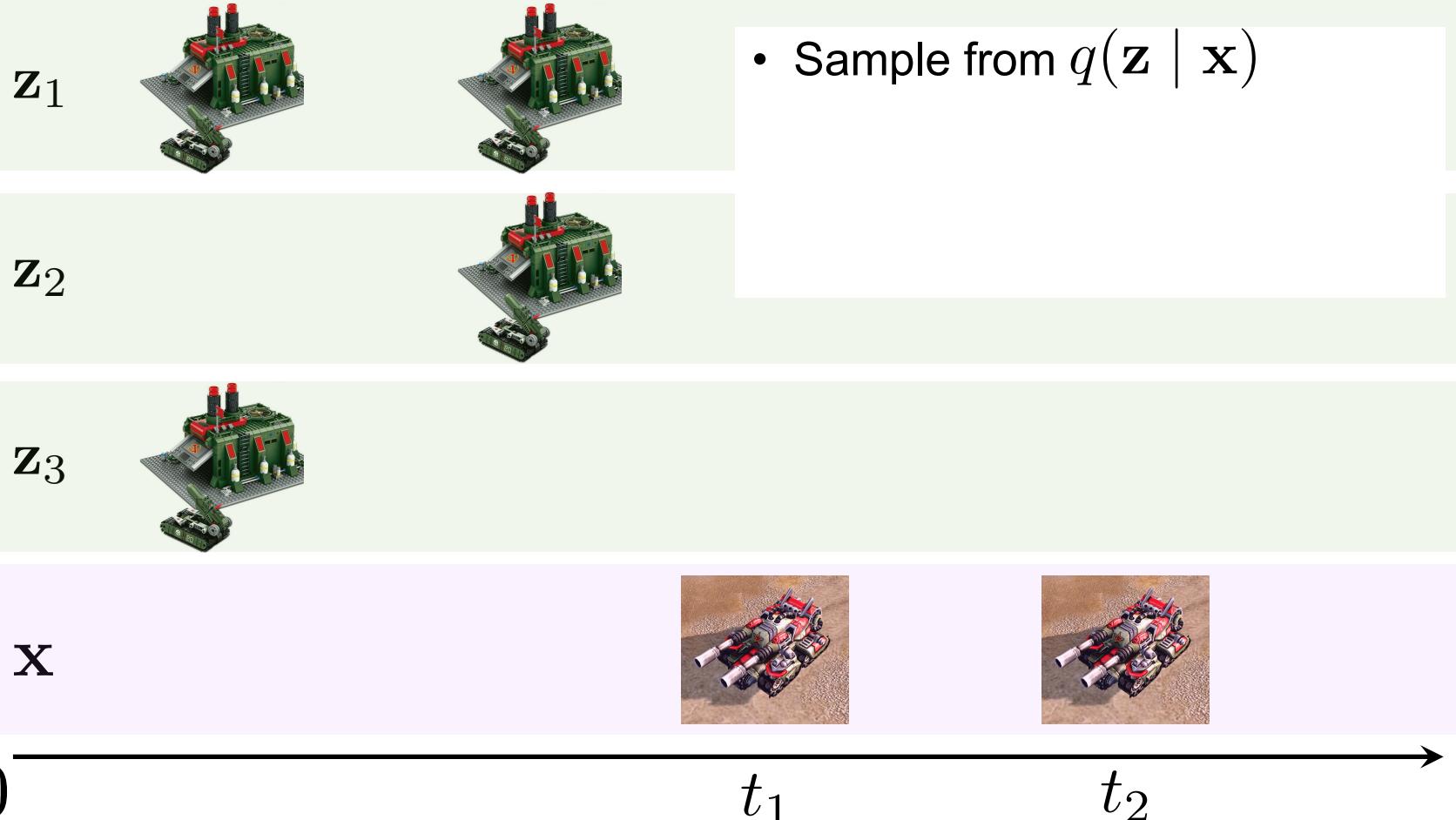


Sequential Monte Carlo

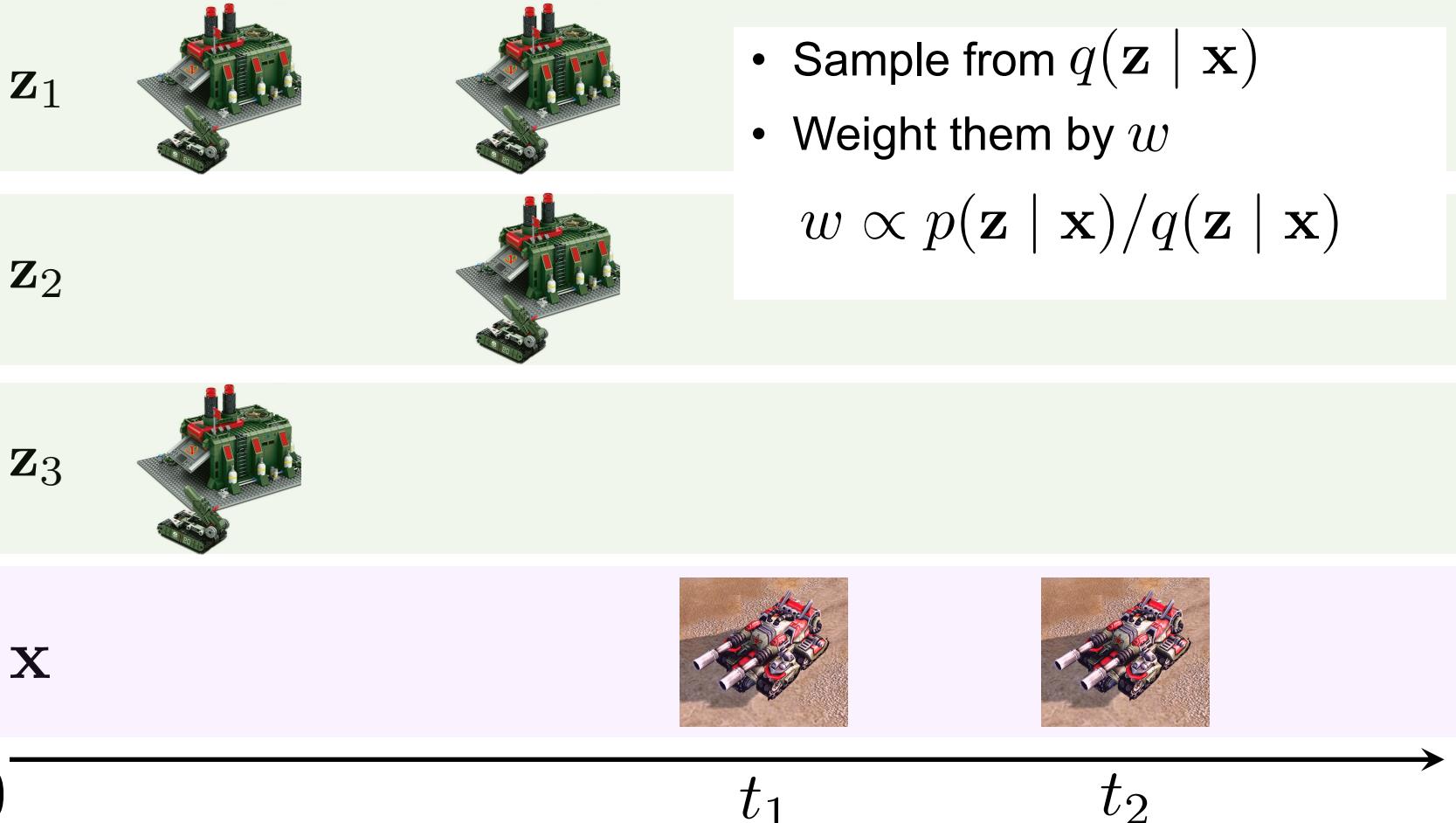
- Sample from $q(\mathbf{z} \mid \mathbf{x})$



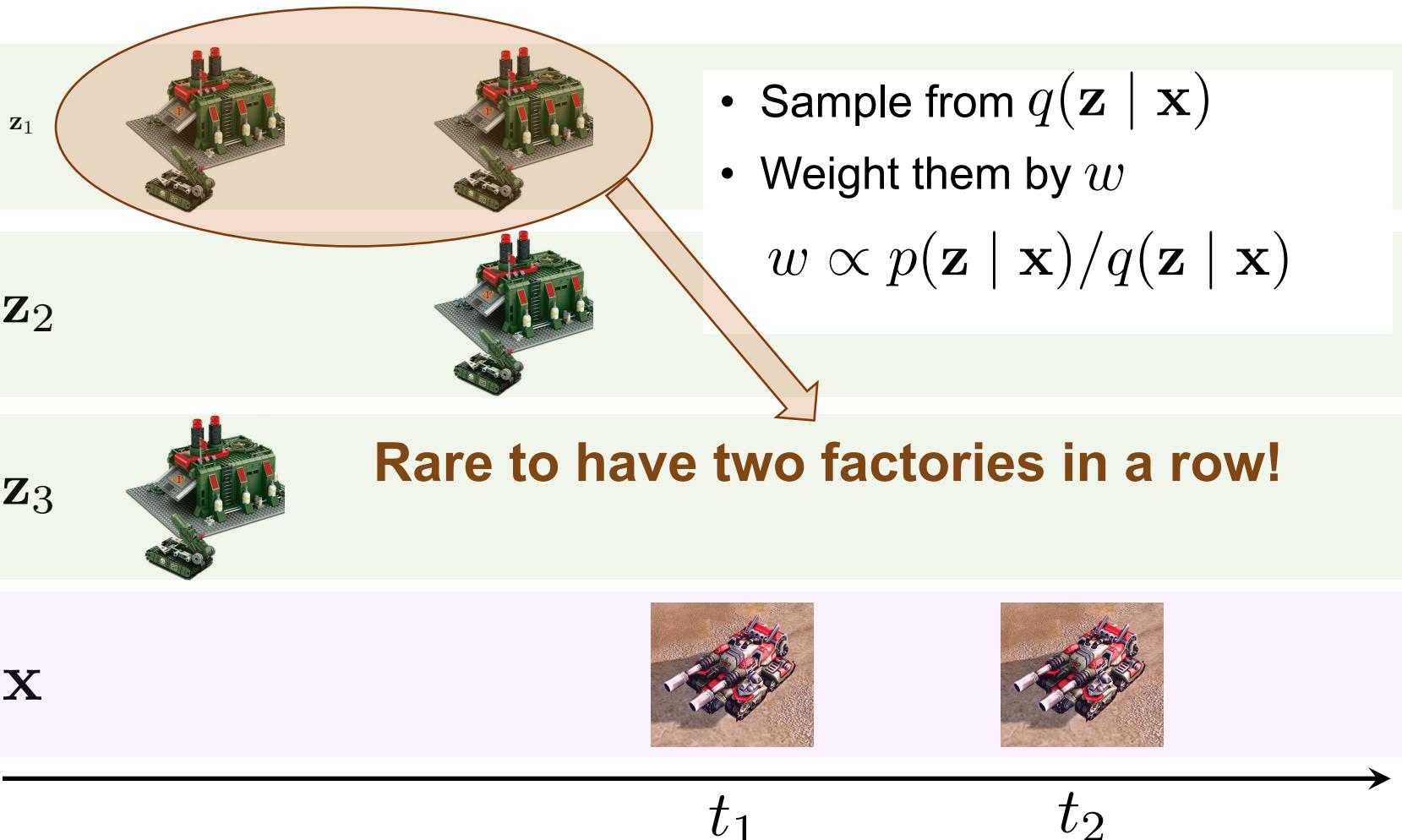
Sequential Monte Carlo



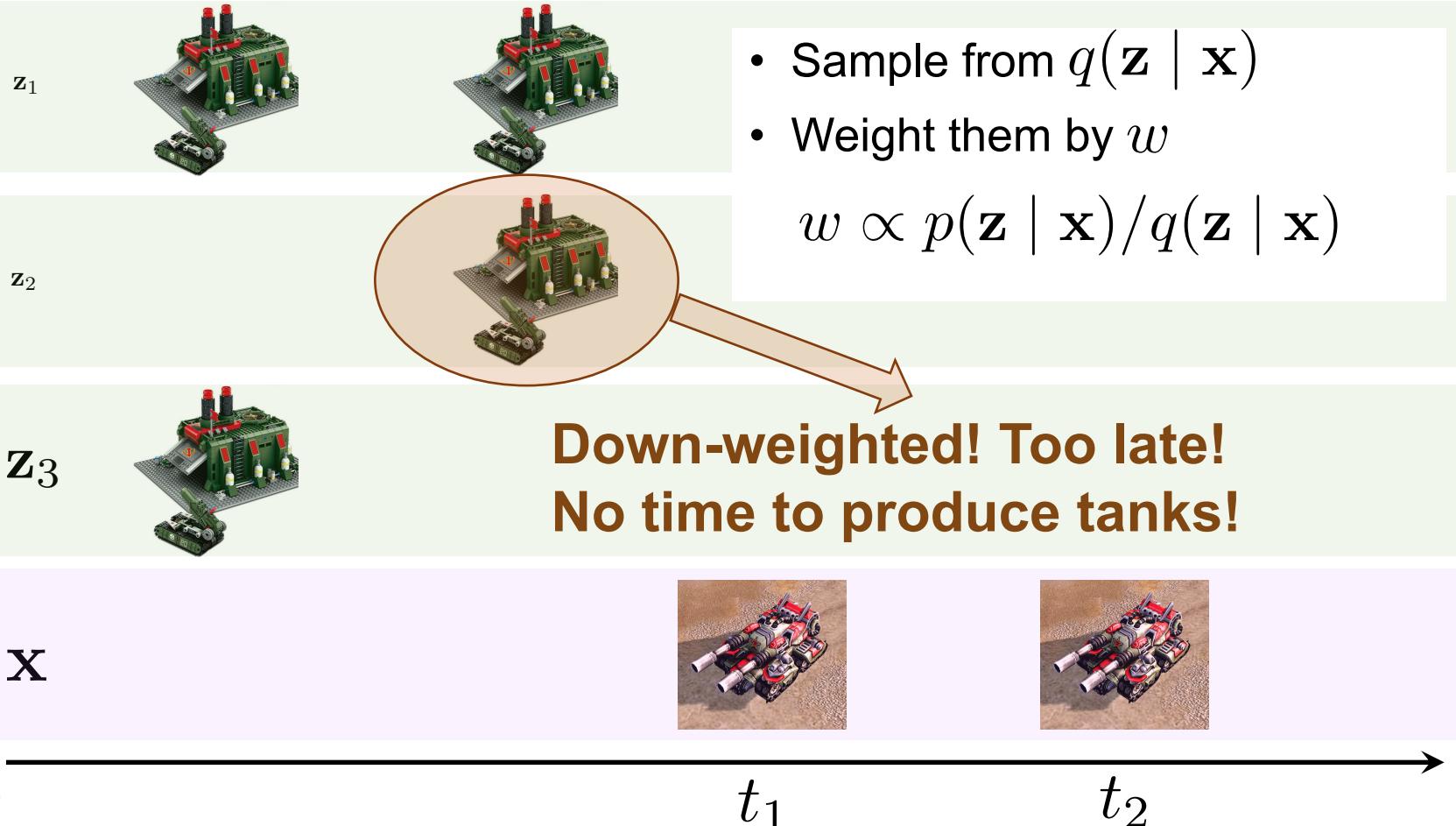
Sequential Monte Carlo



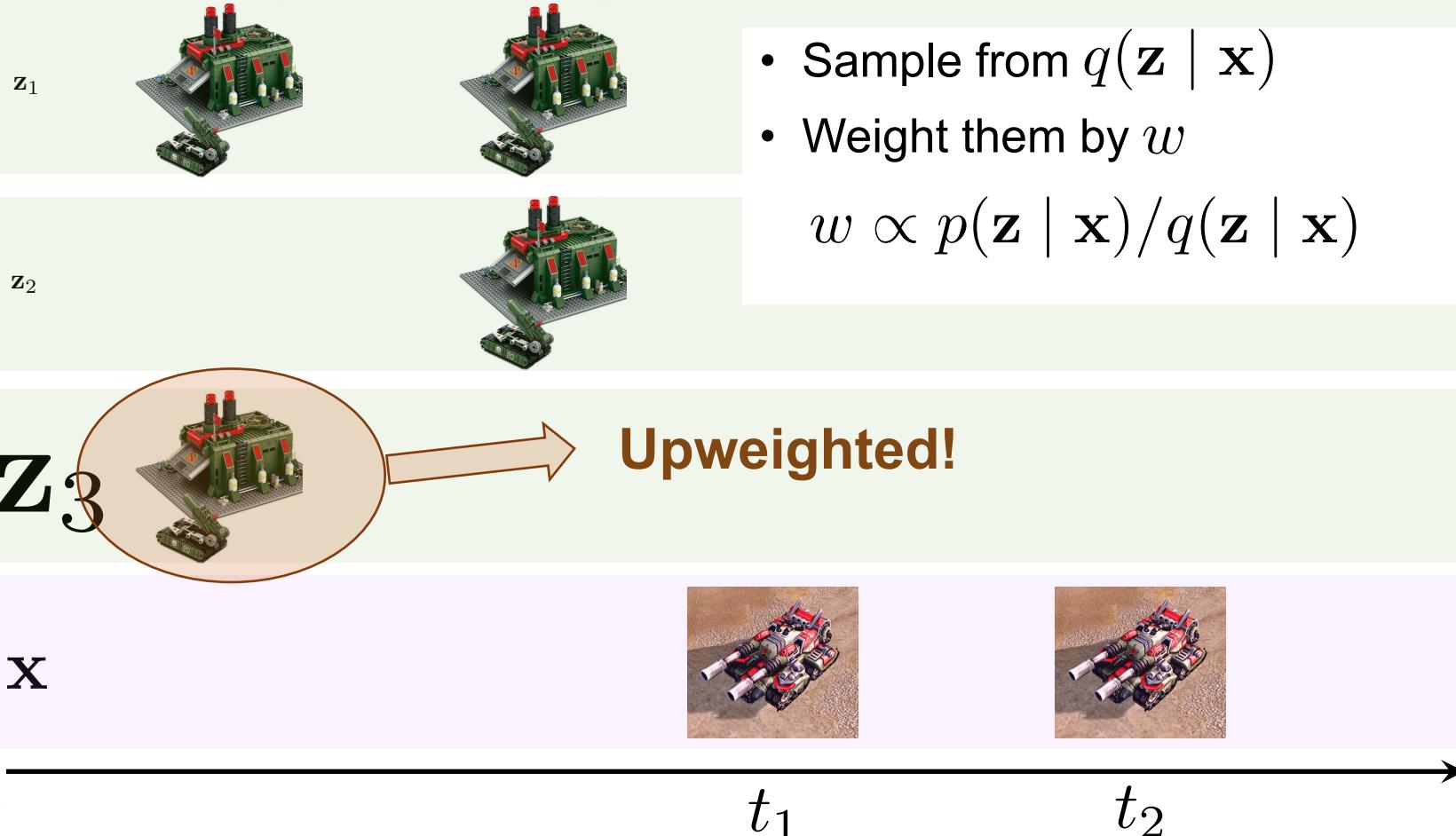
Sequential Monte Carlo



Sequential Monte Carlo

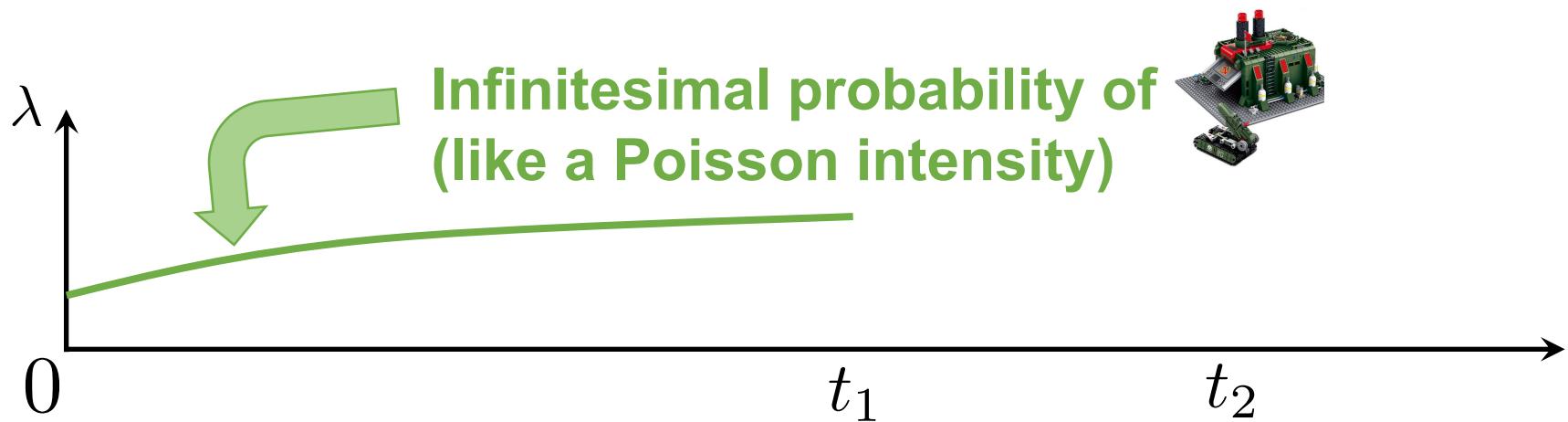


Sequential Monte Carlo



Sequential Monte Carlo

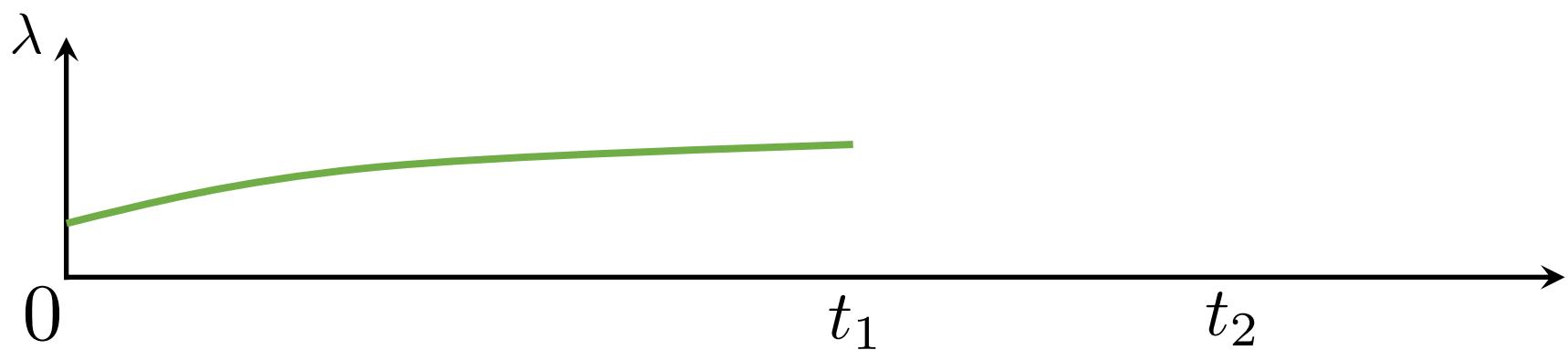
- Use the trained NHP



Sequential Monte Carlo

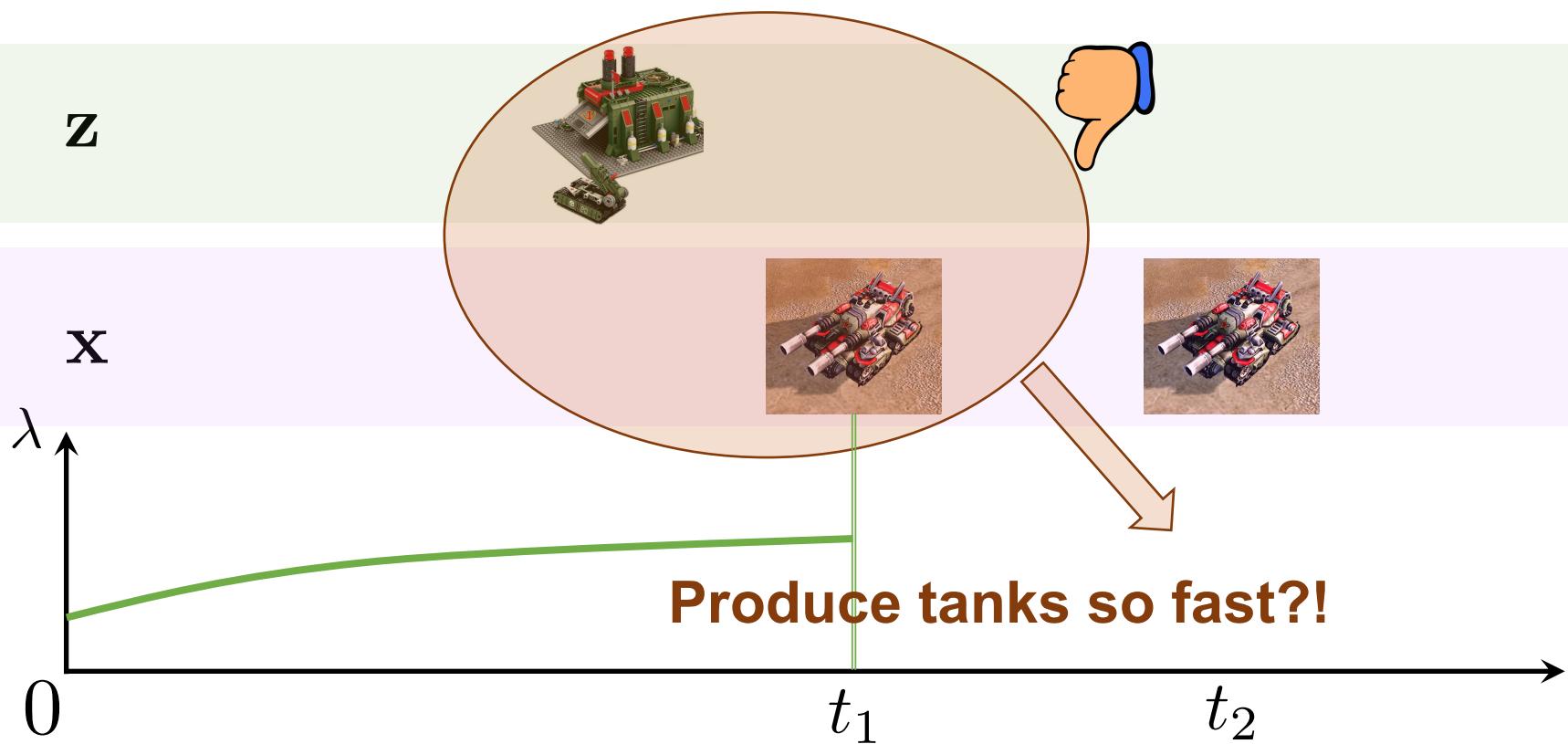
- Use the trained NHP

Z



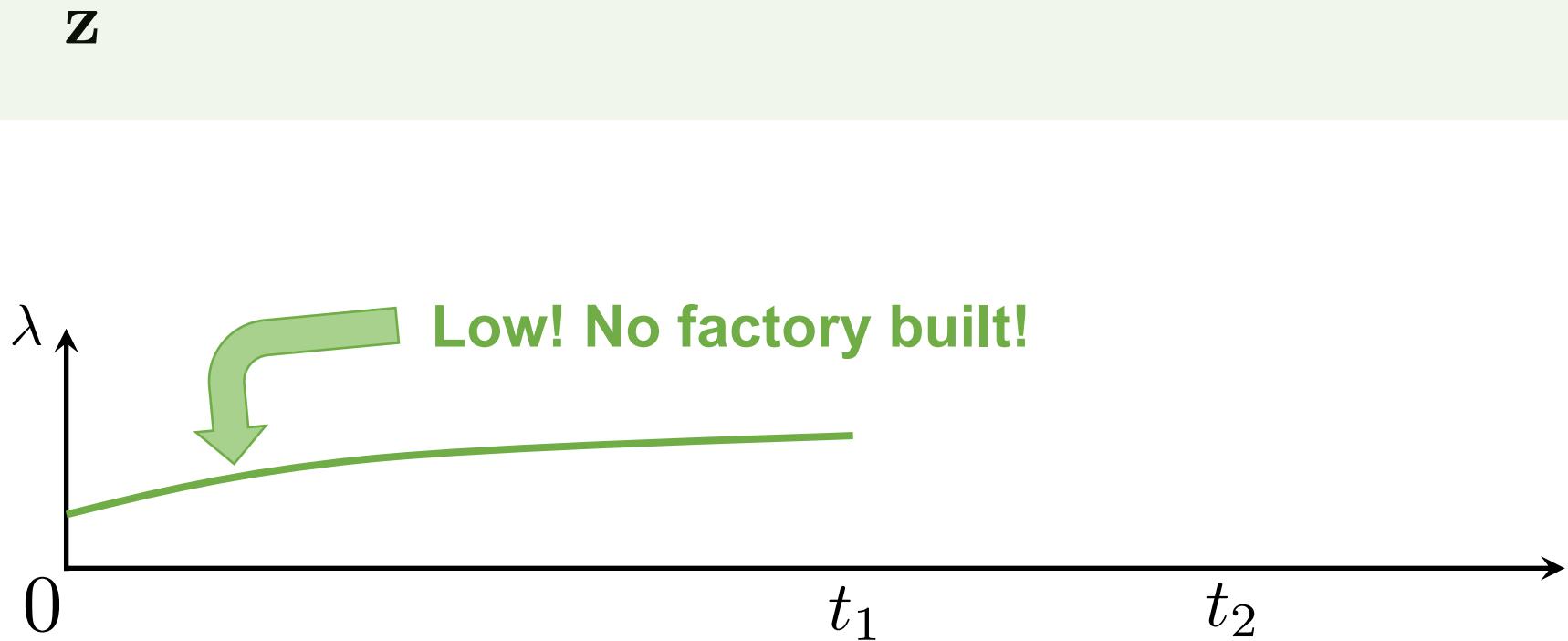
Sequential Monte Carlo

- Use the trained NHP



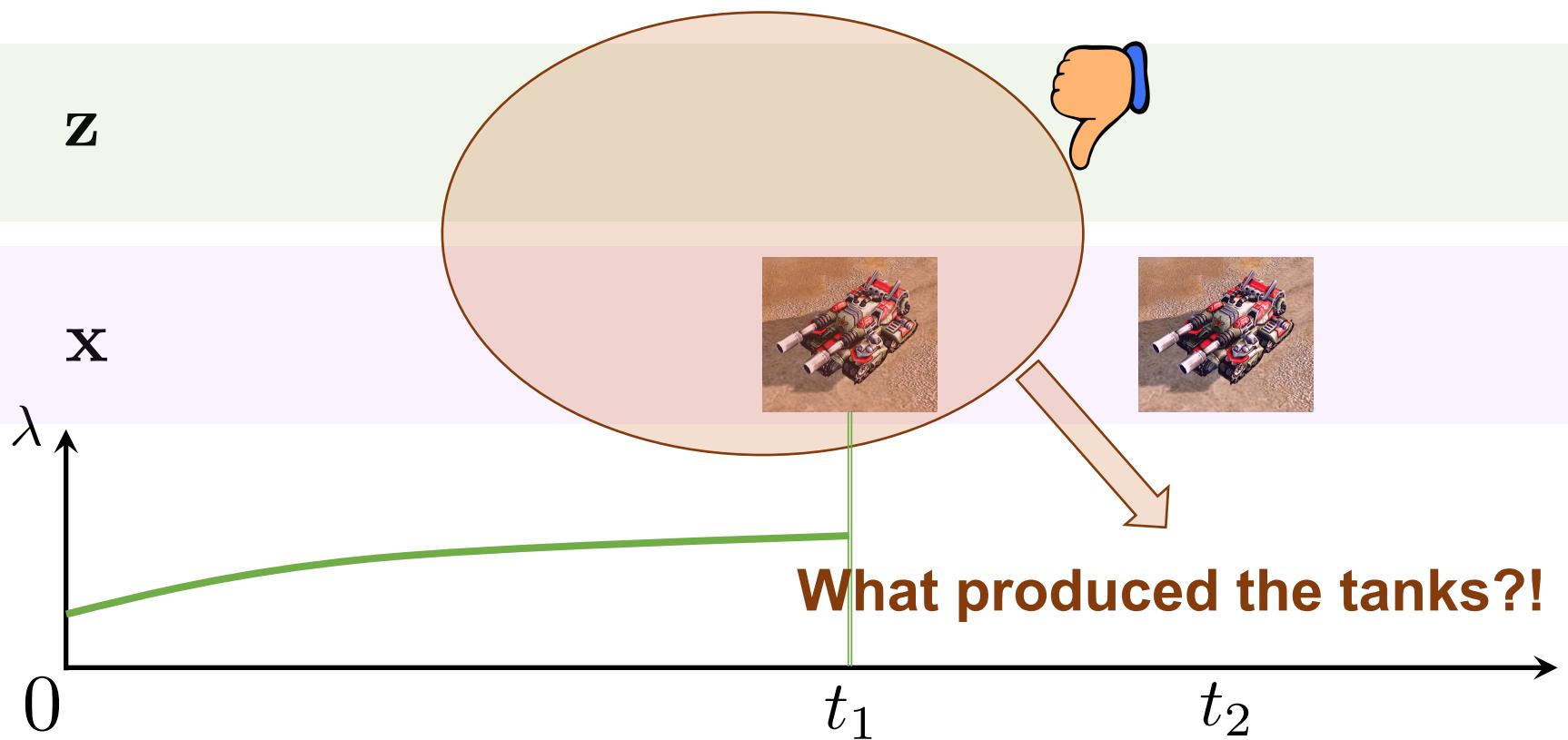
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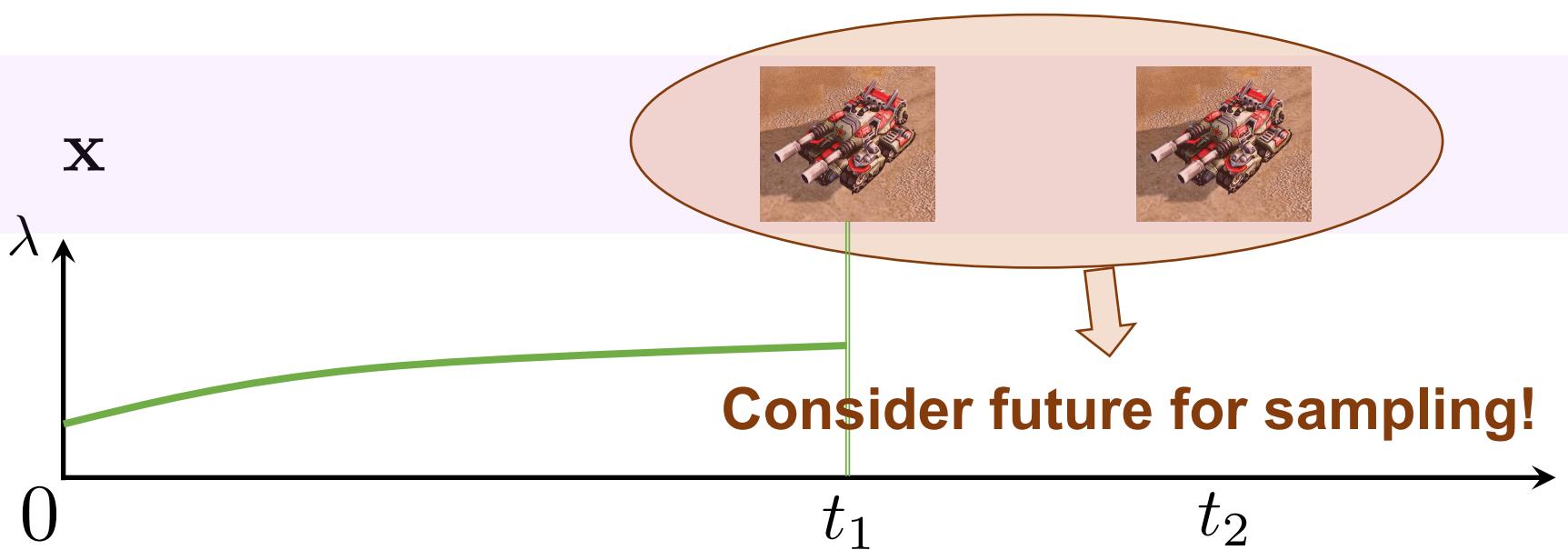
Sequential Monte Carlo

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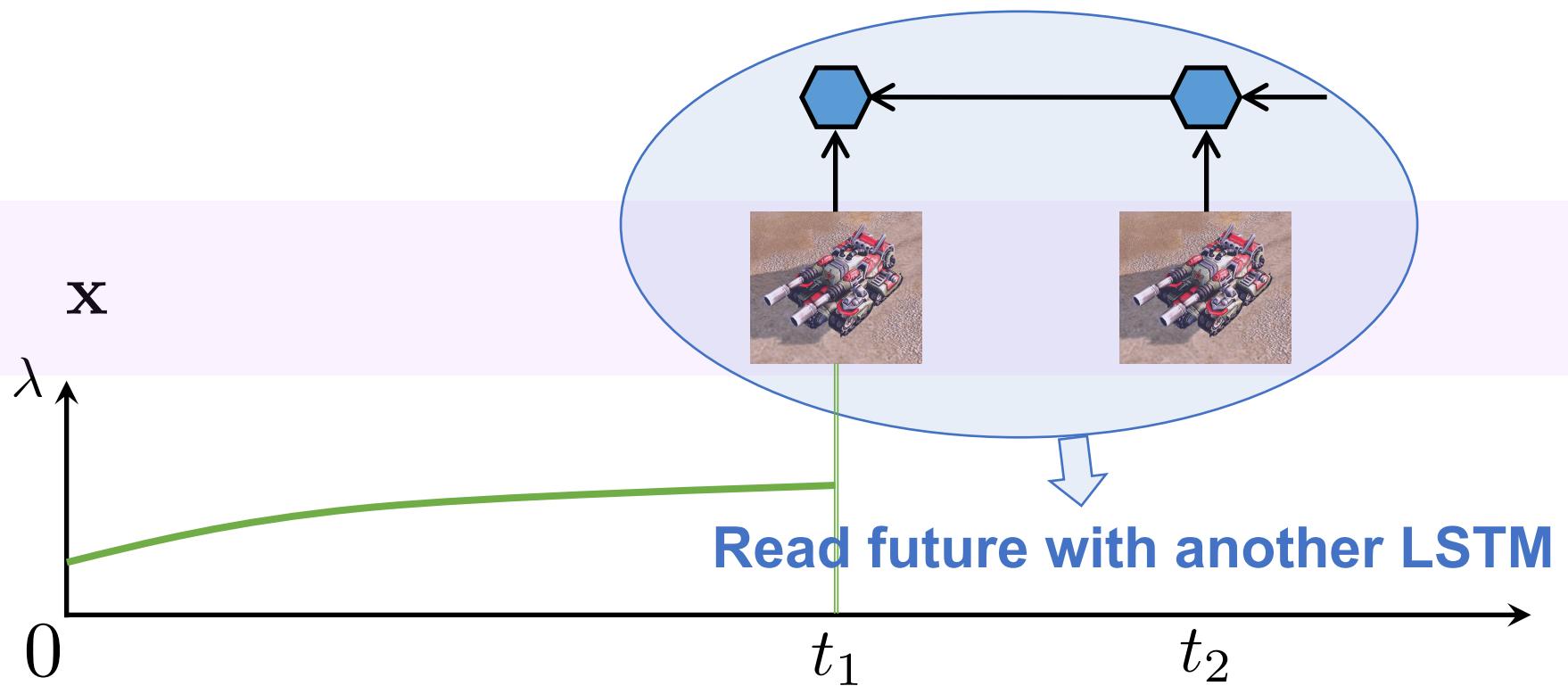
Sequential Monte Carlo

- Use the trained NHP
- Take future into account



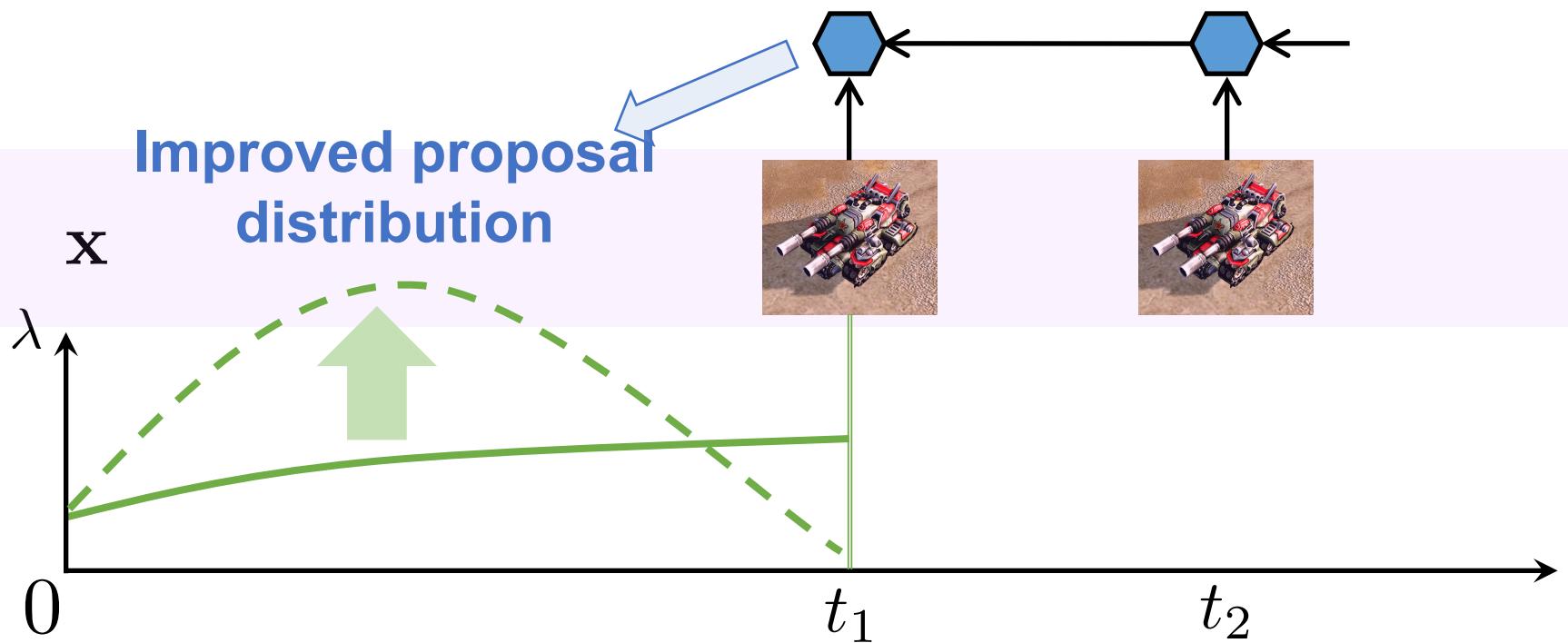
Sequential Monte Carlo

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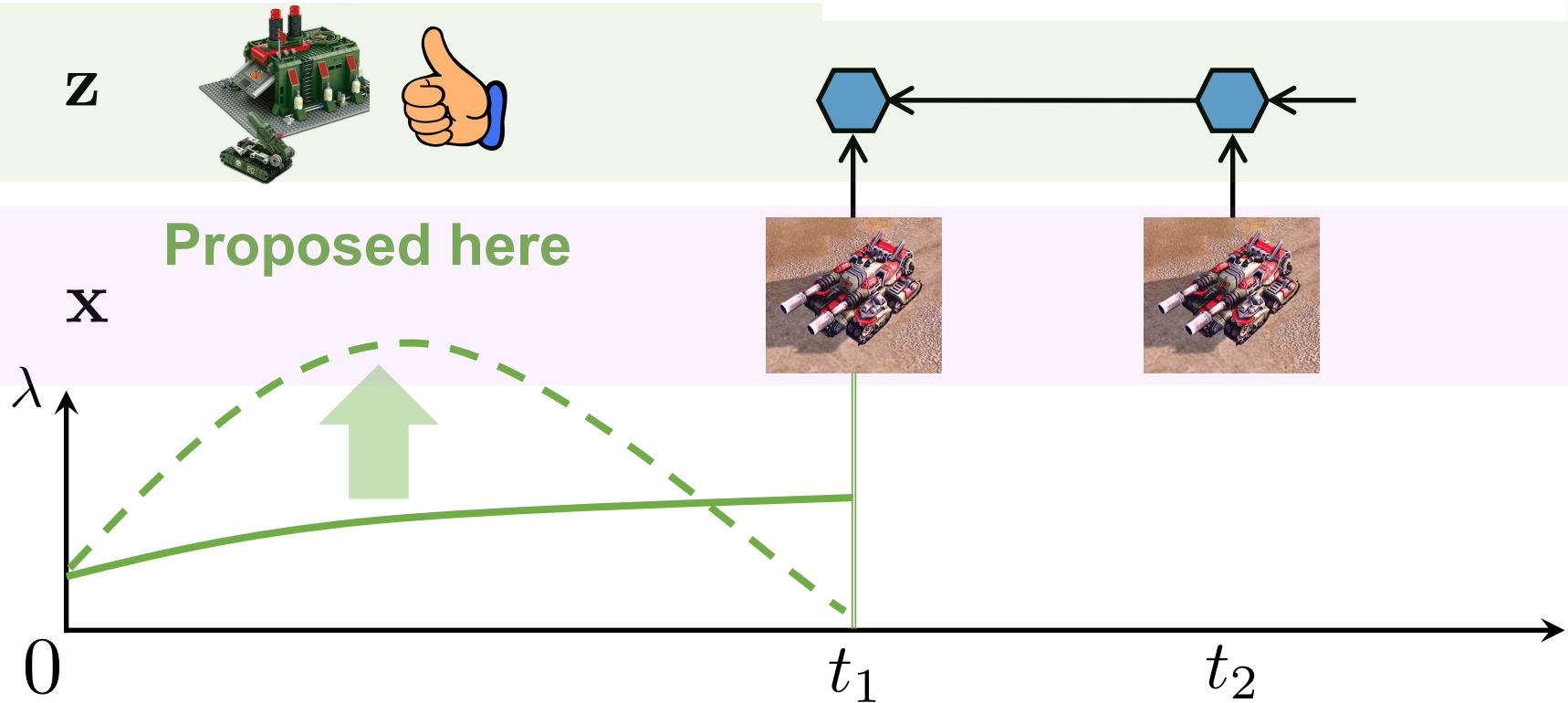
Sequential Monte Carlo

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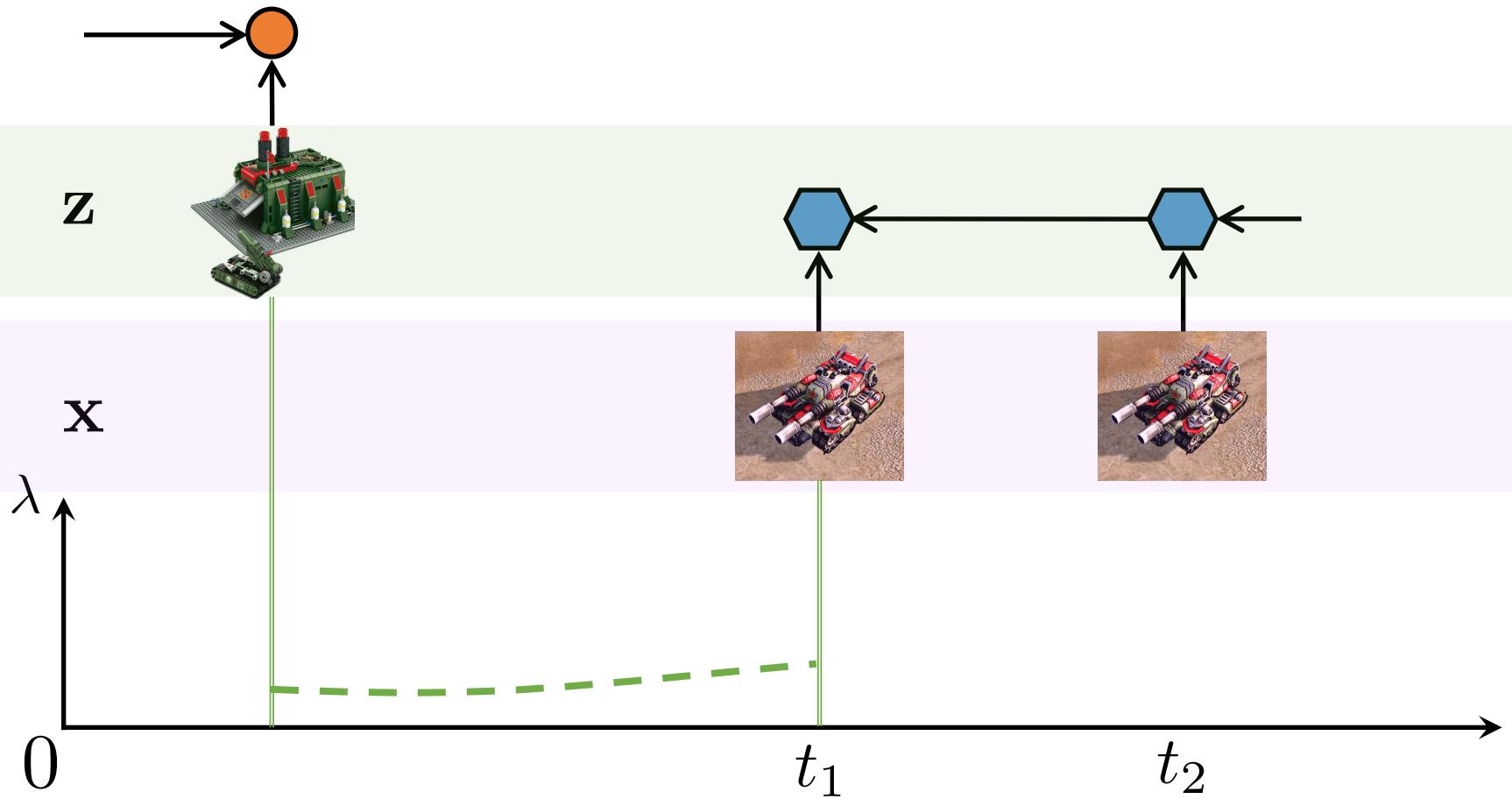


Sequential Monte Carlo

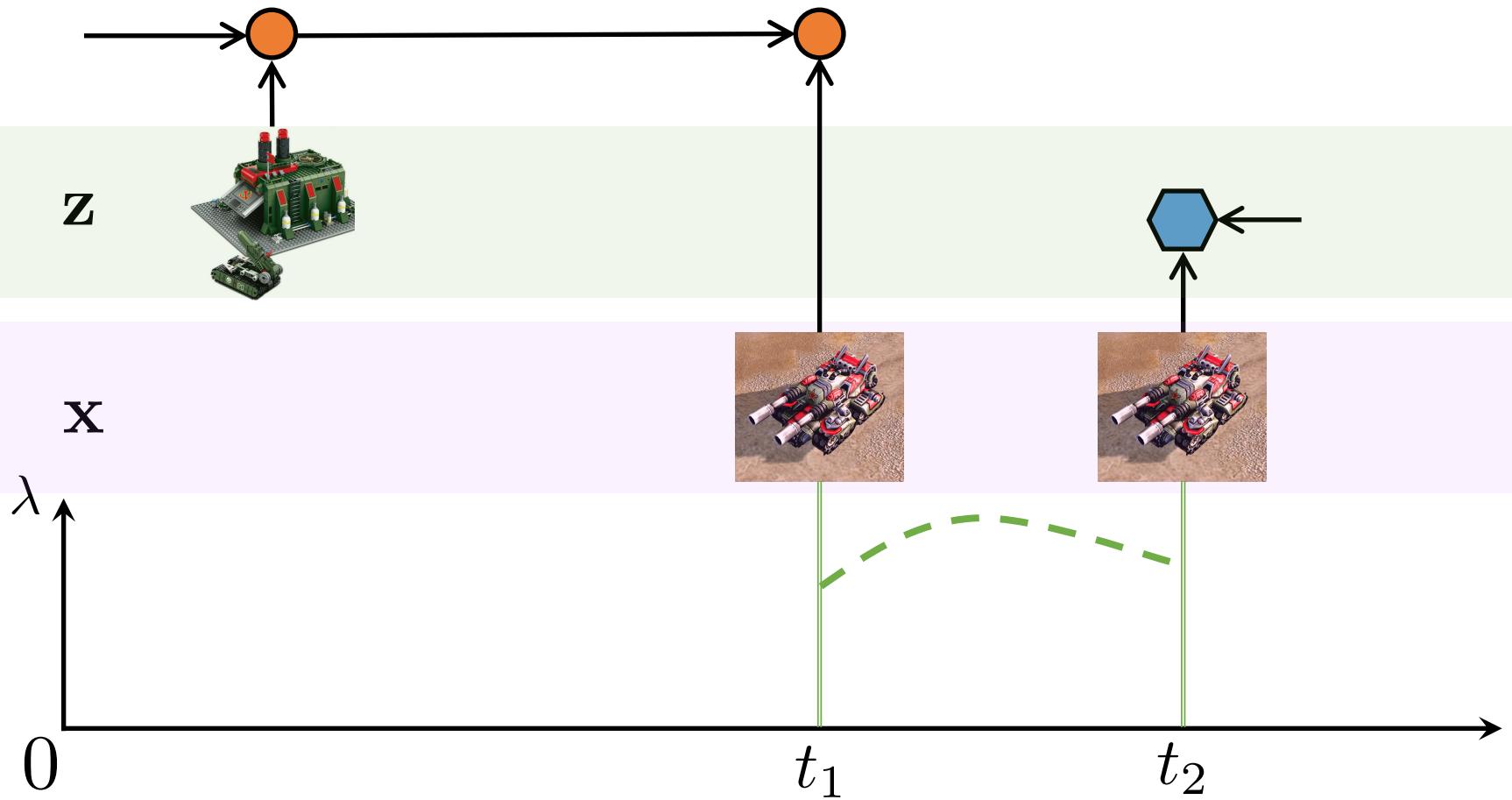
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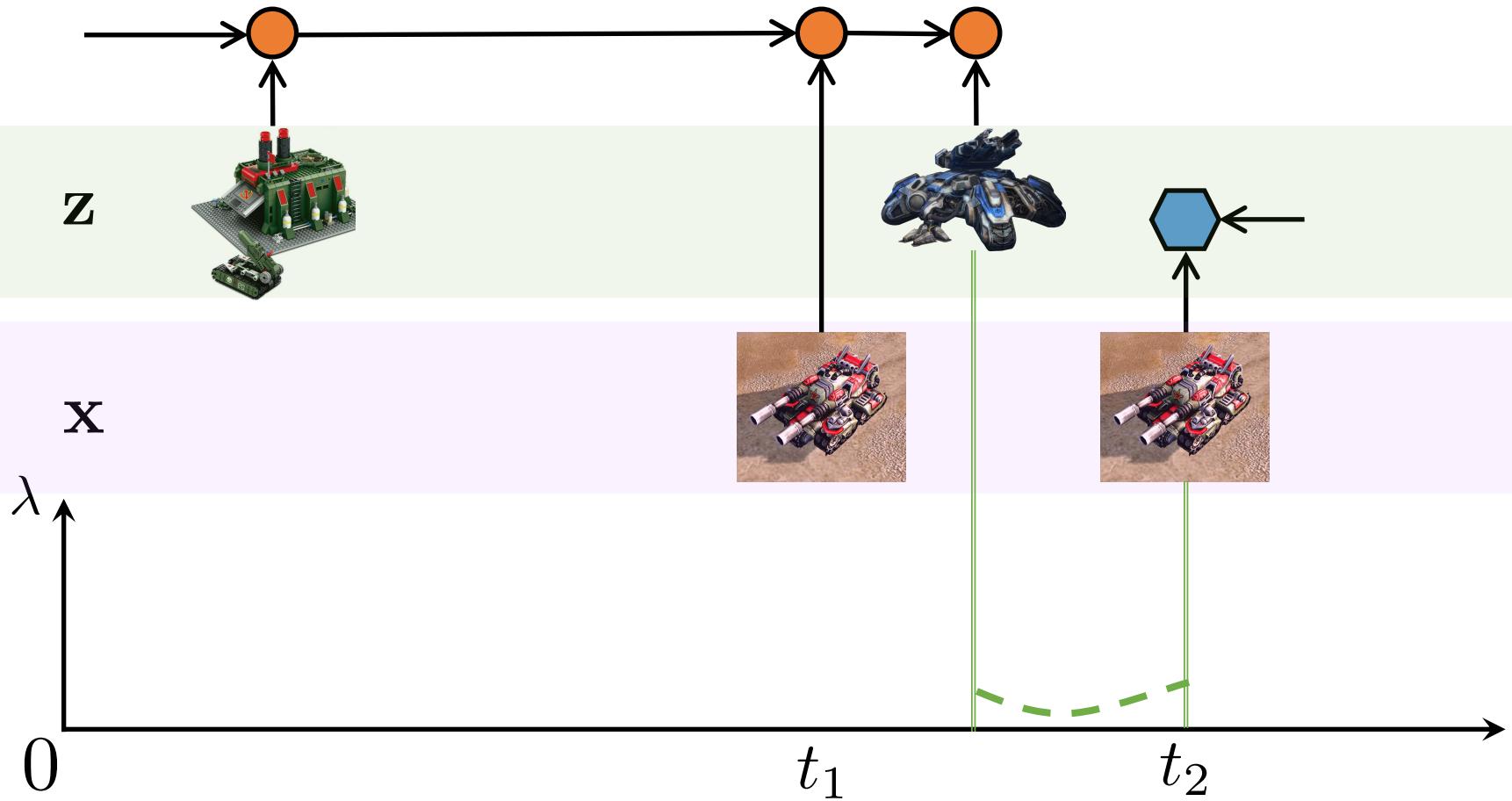
Sequential Monte Carlo



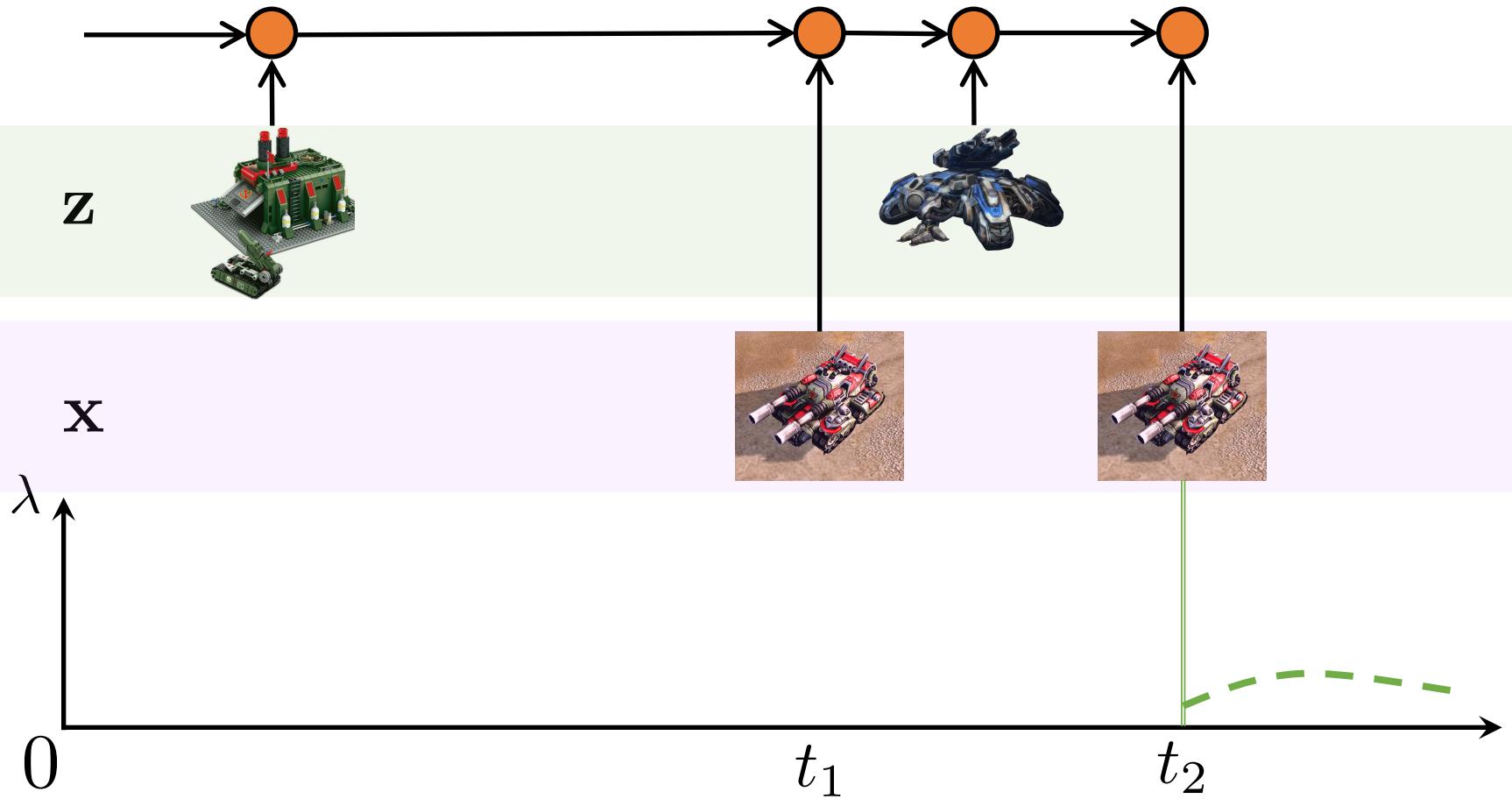
Sequential Monte Carlo



Sequential Monte Carlo

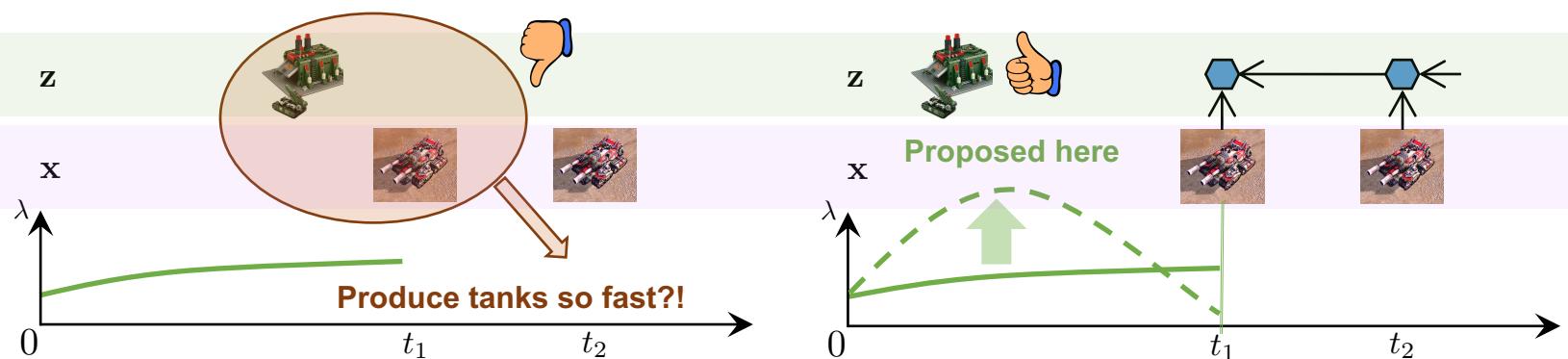


Sequential Monte Carlo



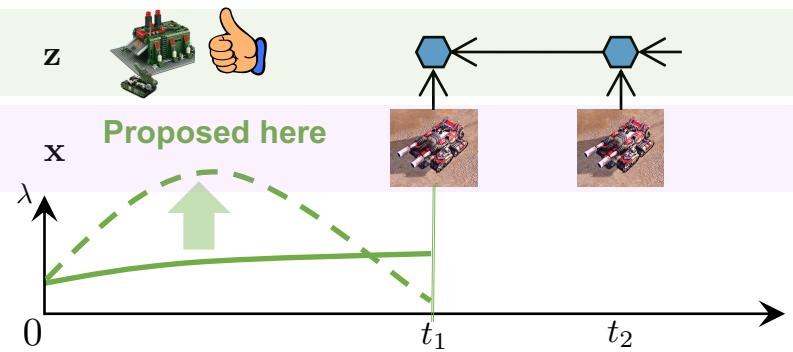
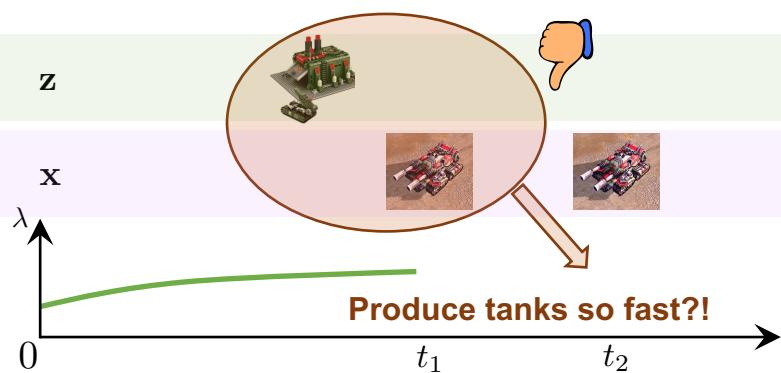
Sequential Monte Carlo

- Particle filtering
- Particle smoothing



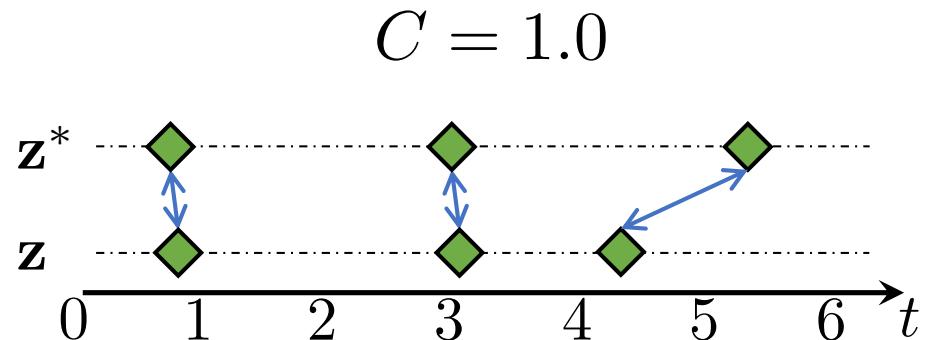
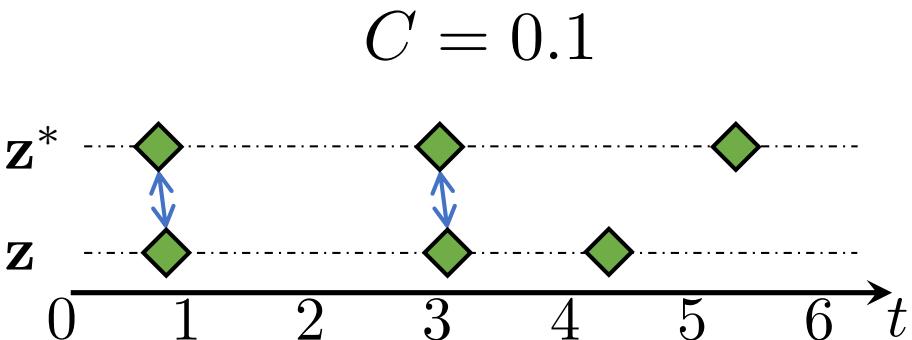
More in Our Paper

- How to train $q(\mathbf{z} \mid \mathbf{x})$ for particle smoothing



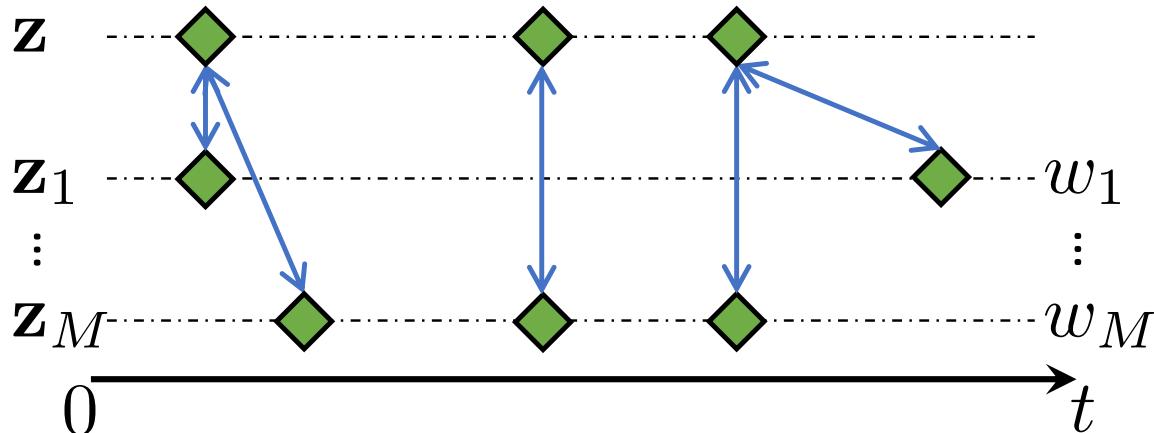
More in Our Paper

- How to train $q(\mathbf{z} \mid \mathbf{x})$ for particle smoothing
- Optimal transport distance



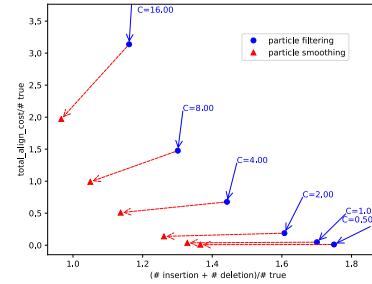
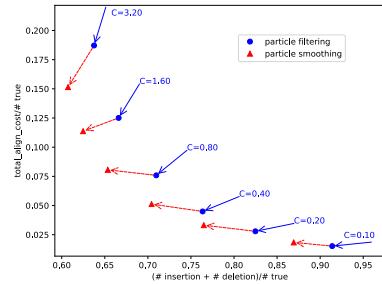
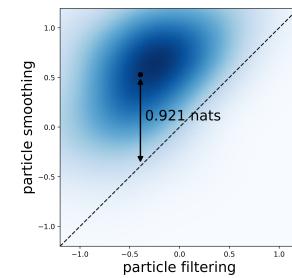
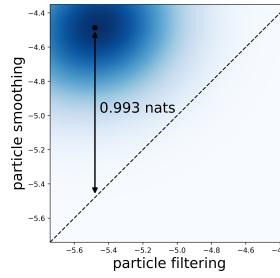
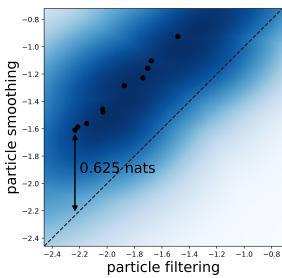
More in Our Paper

- How to train $q(\mathbf{z} \mid \mathbf{x})$ for particle smoothing
- Optimal transport distance
- Minimum Bayes risk decoding



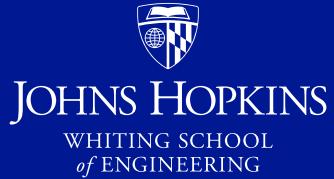
More in Our Paper

- How to train $q(\mathbf{z} \mid \mathbf{x})$ for particle smoothing
- Optimal transport distance
- Minimum Bayes risk decoding
- Positive experimental results



Imputing Missing Events in Continuous-Time Event Streams

Tue Jun 11th 18:30 – 21:00
Pacific Ballroom #257



Hongyuan Mei¹, Guanghui Qin², Jason Eisner¹

¹Department of Computer Science, Johns Hopkins University, USA

²Department of Physics, Peking University, China