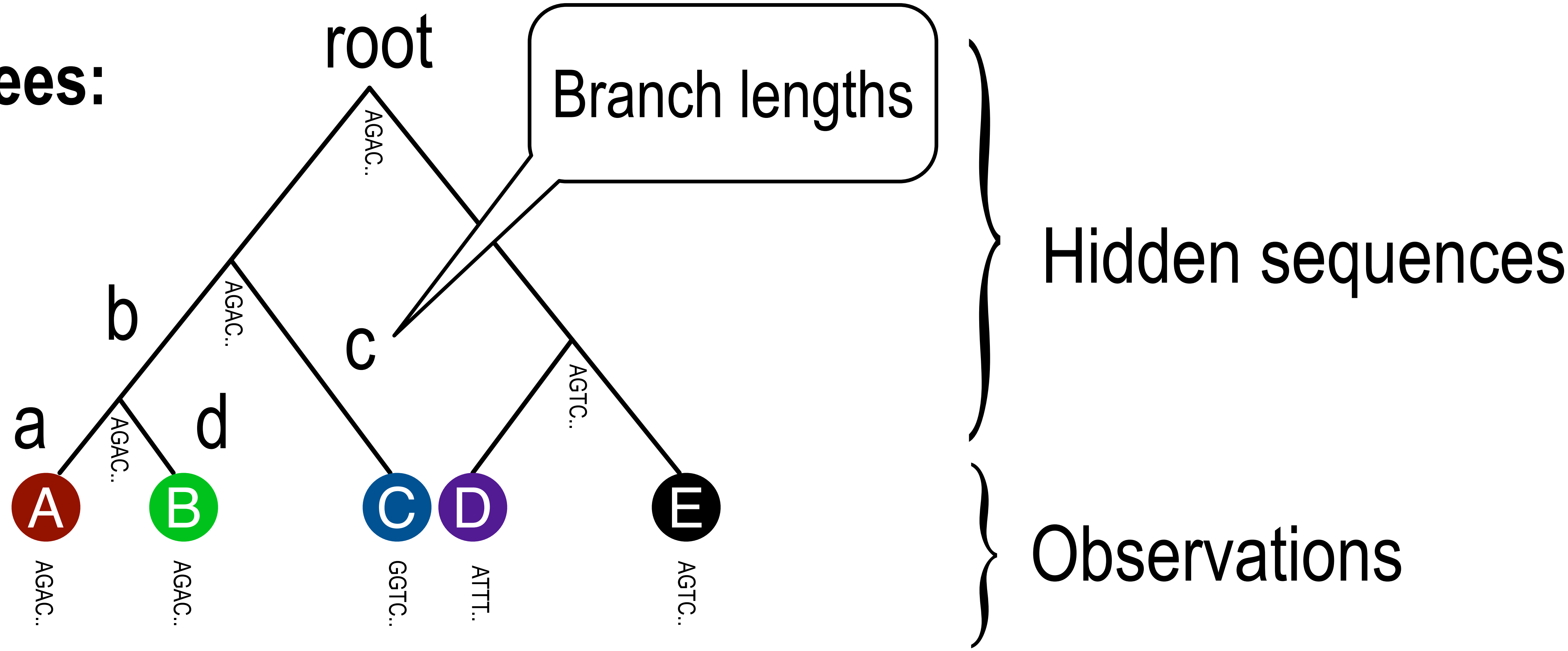
Notation/background on trees $\mathcal{T}$

Clock trees:

a+b = c
d+b = c
a = d
...



Notation/background on trees $\mathcal{T}$

Clock trees:

a+b = c
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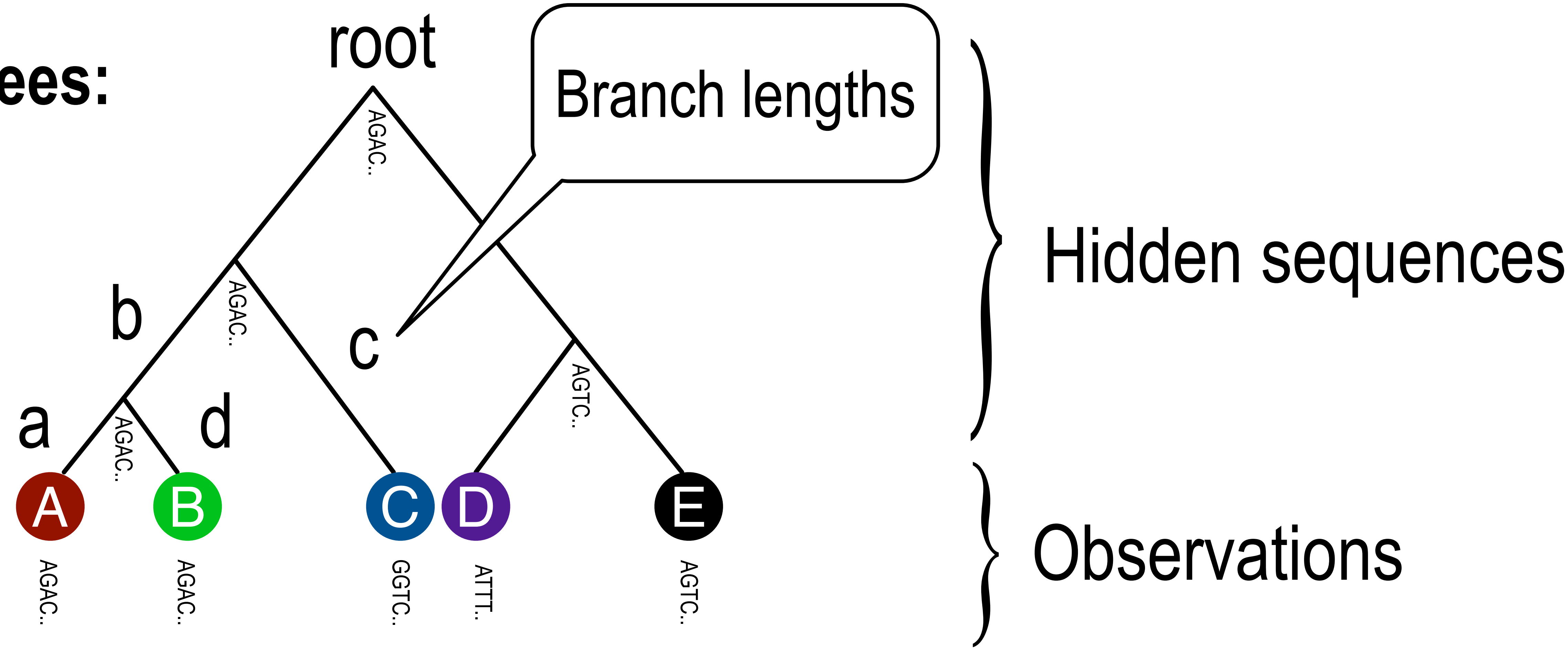
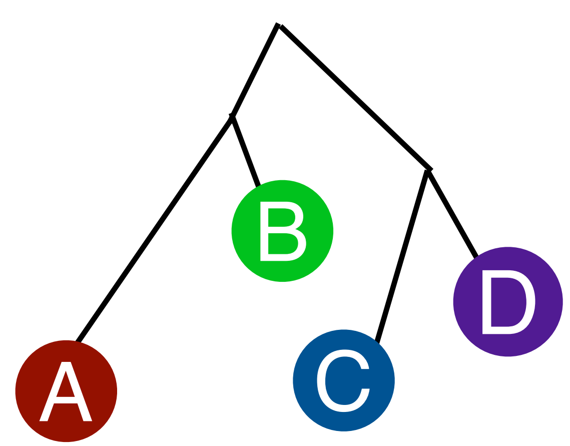


Non-clock tree:
remove additivity restrictions on branch lengths



Notation for our goals

Given a model (joint)...: $\gamma_t(\mathbf{x}_t) = p(\mathbf{x}_t, \mathbf{y}_t)$

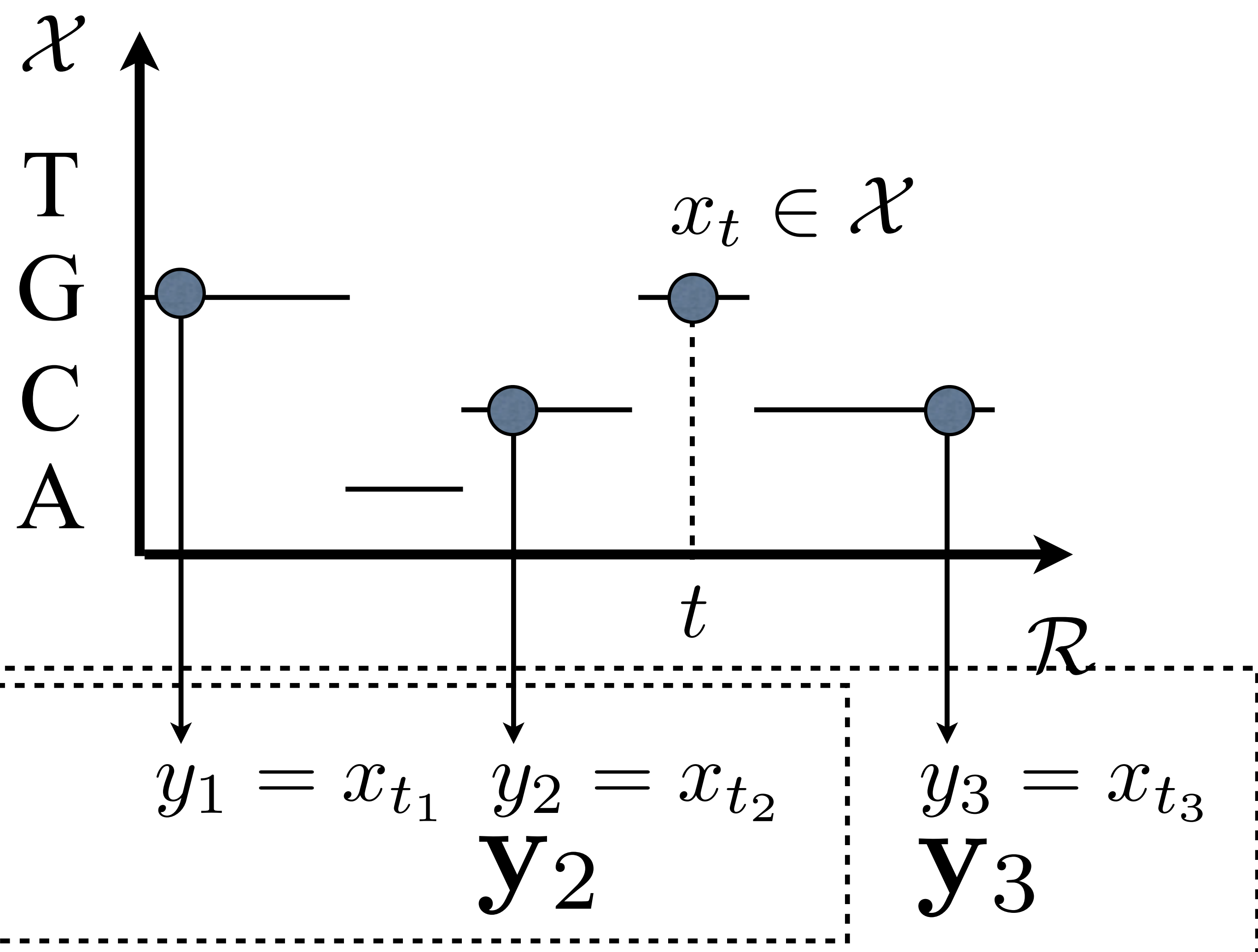
Sample from a *target distribution*: $\pi_t(\mathbf{x}_t) = p(\mathbf{x}_t | \mathbf{y}_t)$

$$\pi_t(\mathbf{x}_t) = \frac{\gamma_t(\mathbf{x}_t)}{Z_t}$$

.. and/or evaluate the normalization: $Z = p(\mathbf{y}_t)$

Notation

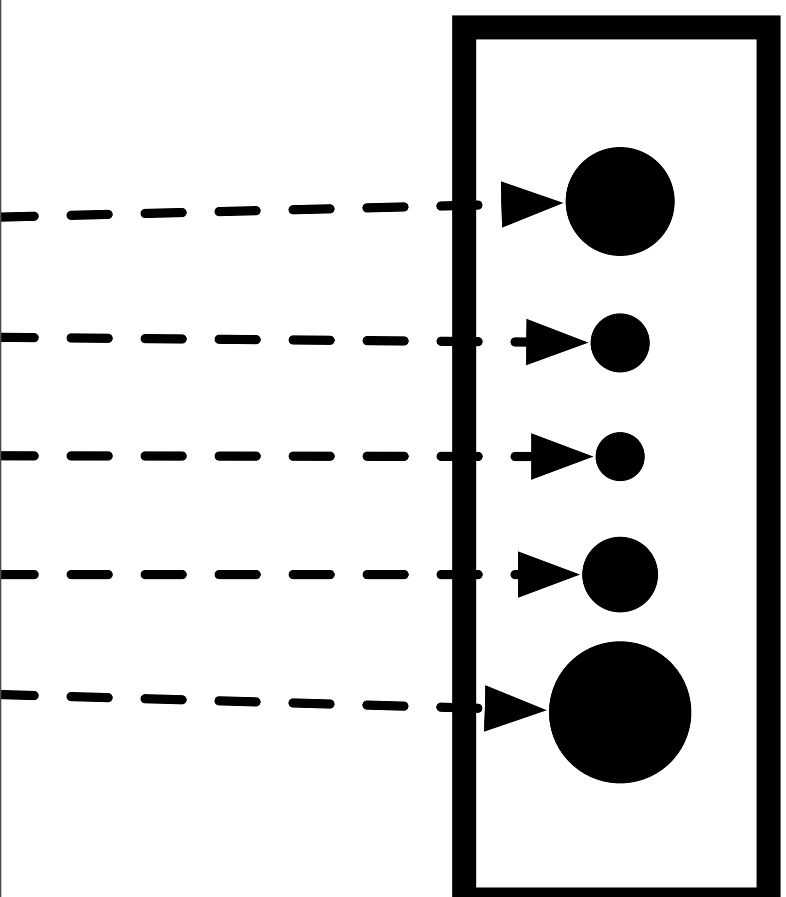
$\mathcal{X}$	State space
$x_t \in \mathcal{X}$	Point in that space
	Subscript: process index
$\mathbf{x}_t$	Many points in the state space
$\mathbf{y}_t$	Many observations



Standard SMC

Output: competing 'hypotheses' $\mathbf{x}_t^i$

$t =$ last time observed



Hypothesis
$i = 1$

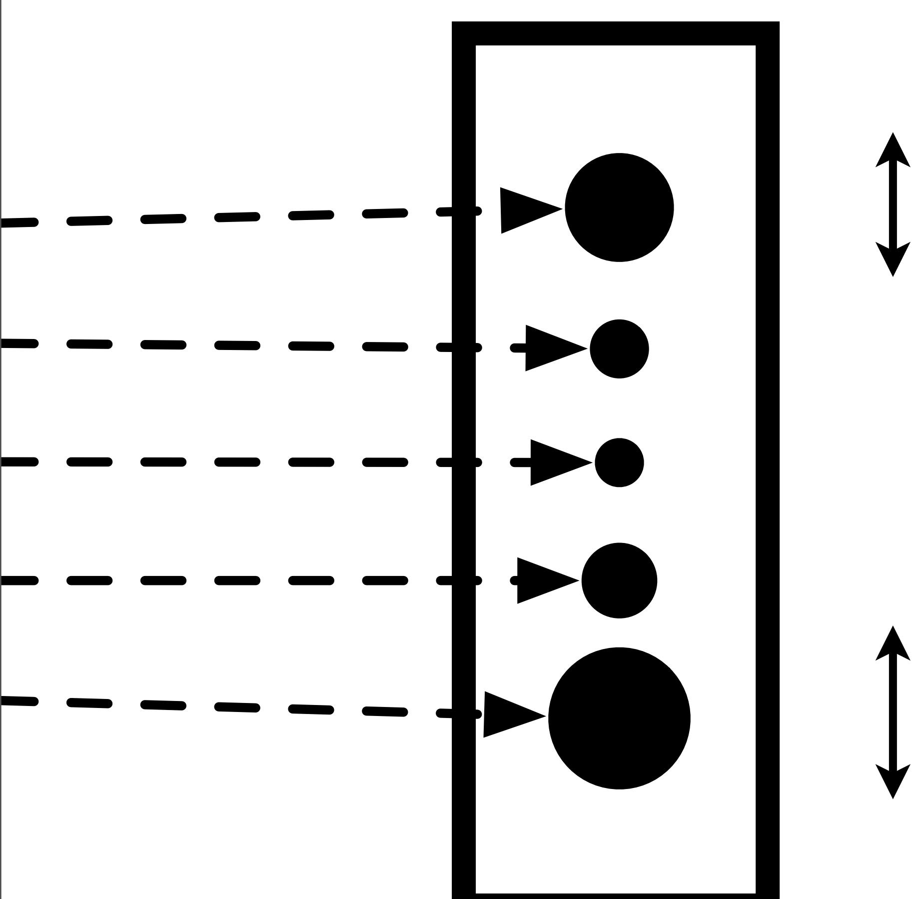
⋮

Hypothesis
$i = 5$

Standard SMC

Output: competing 'hypotheses' $\mathbf{x}_t^i$

weight for each of these w_t^i



weight of particle $i = 1$

⋮

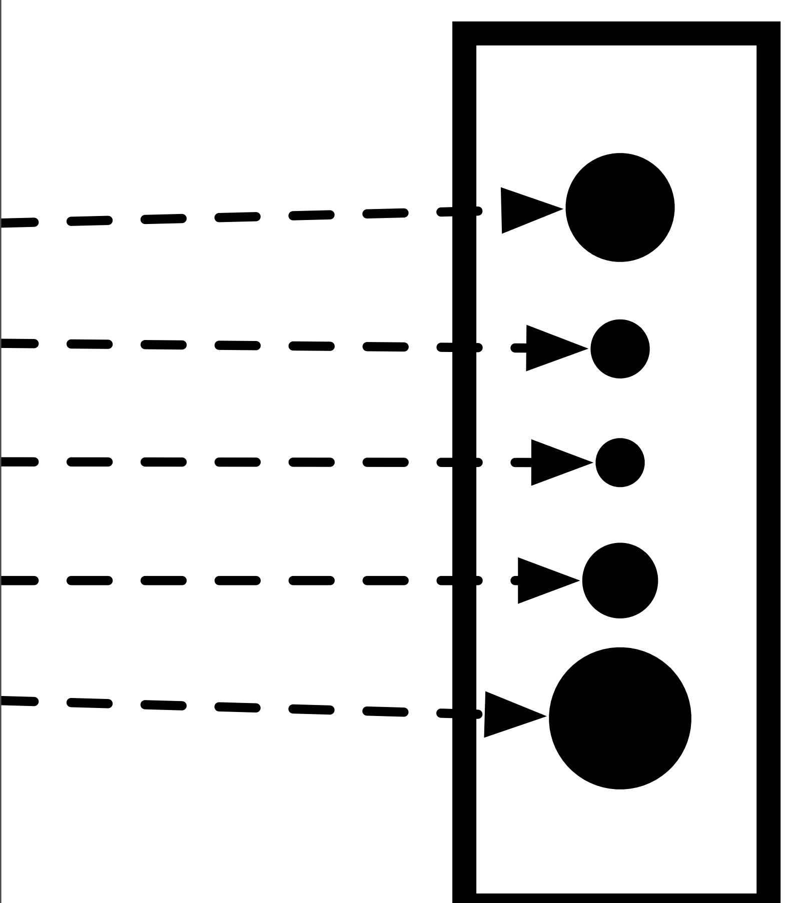
weight of particle $i = 5$

Standard SMC

Output: competing 'hypotheses' $\mathbf{x}_t^i$

weight for each of these w_t^i

Can view these as a (random) distribution



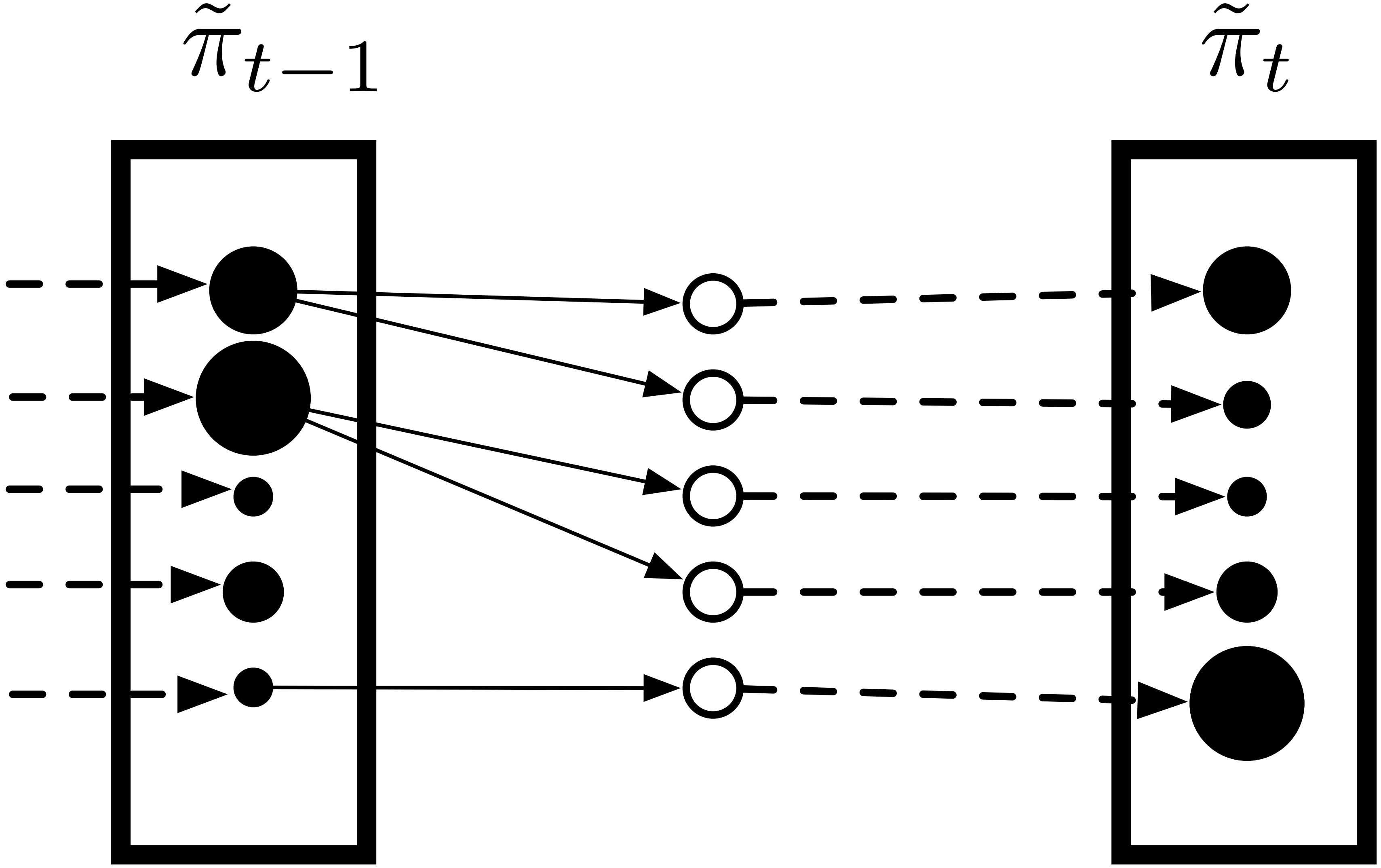
$$\tilde{w}_t^i = \frac{w_t^i}{\sum_j w_t^j}$$

$$\tilde{\pi}_t(\cdot) = \sum_i \tilde{w}_t^i \delta_{\mathbf{x}_t^i}(\cdot)$$

Standard SMC inner working:

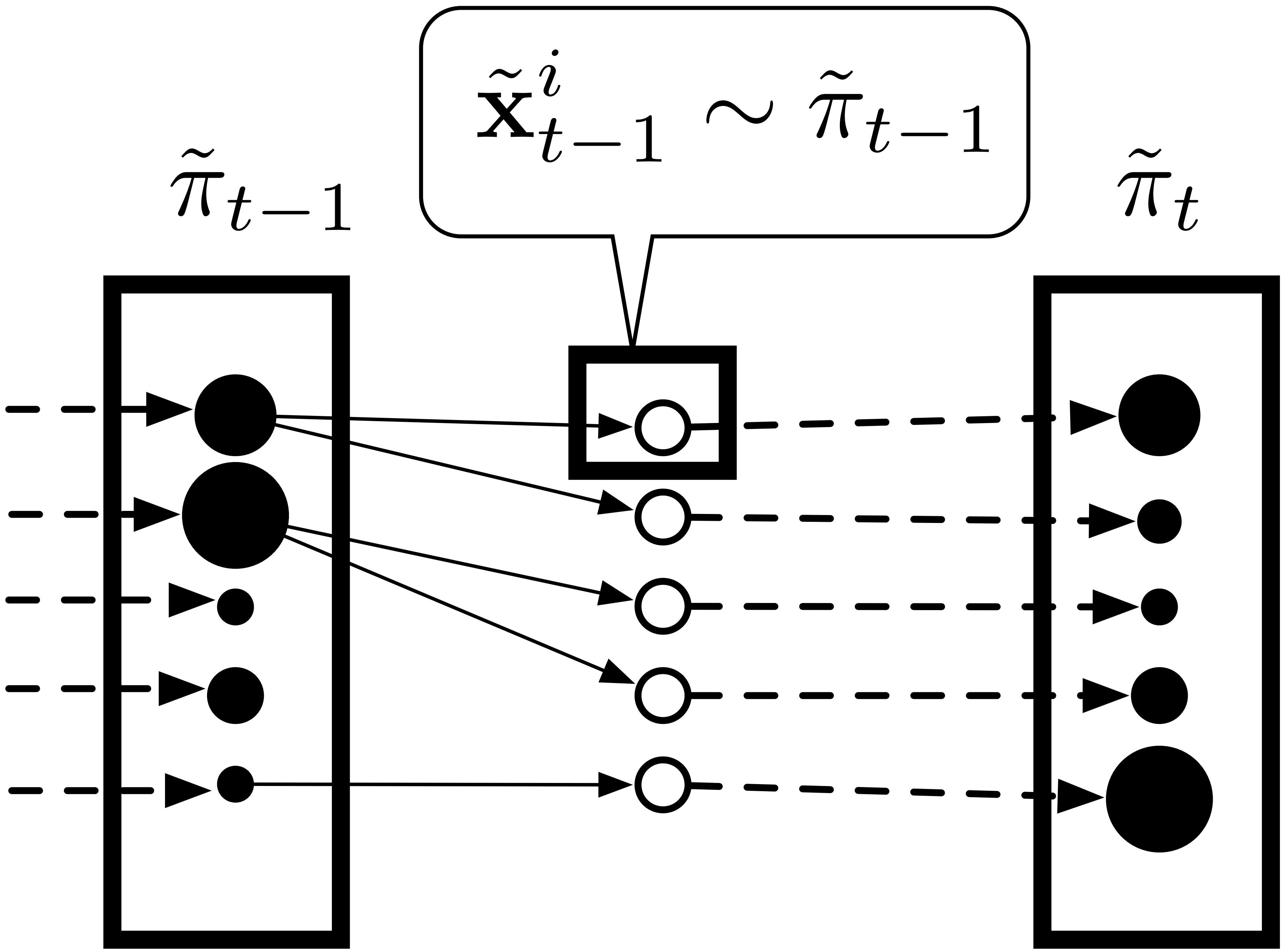
1. Assume inductively that we have computed approximation for:

$$\pi_{t-1}(\mathbf{x}_{t-1}) = p(\mathbf{x}_{t-1}|\mathbf{y}_{t-1})$$



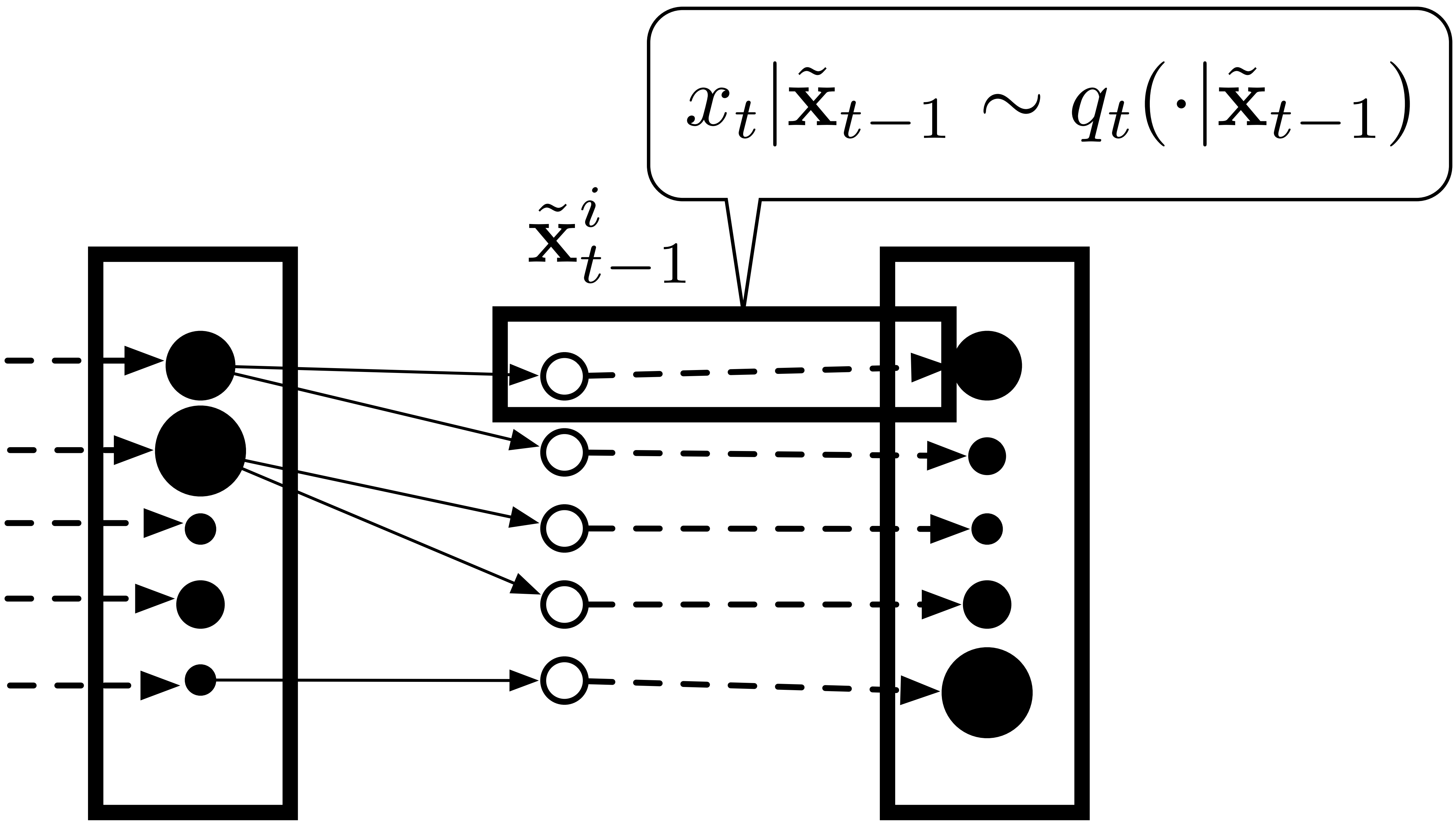
Standard SMC inner working:

1. Assume inductively...
2. Sample from $\tilde{\pi}_{t-1}$



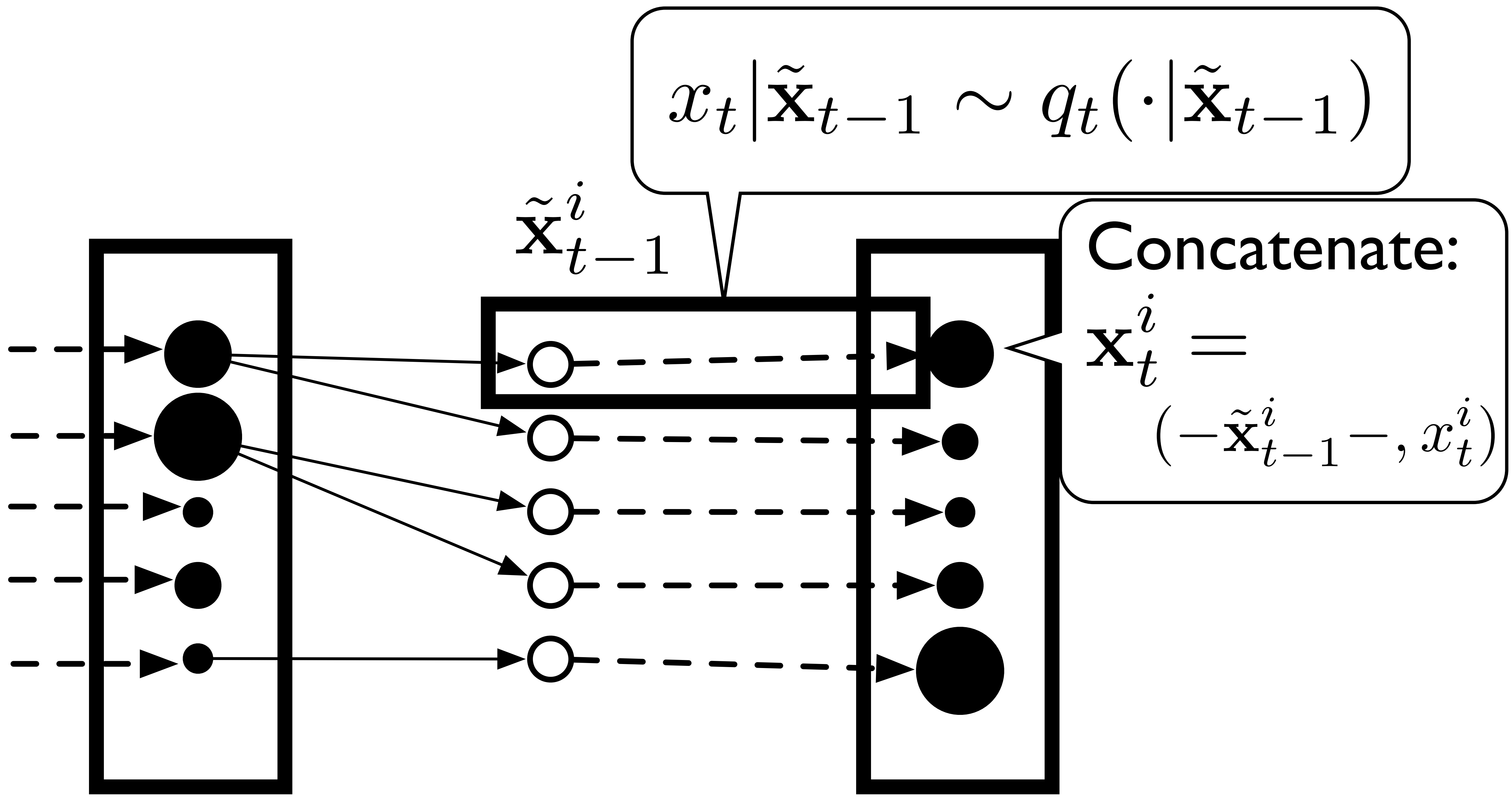
Standard SMC inner working:

1. Assume inductively...
2. Sample from $\tilde{\pi}_{t-1}$
3. Propose (extend):



Standard SMC inner working:

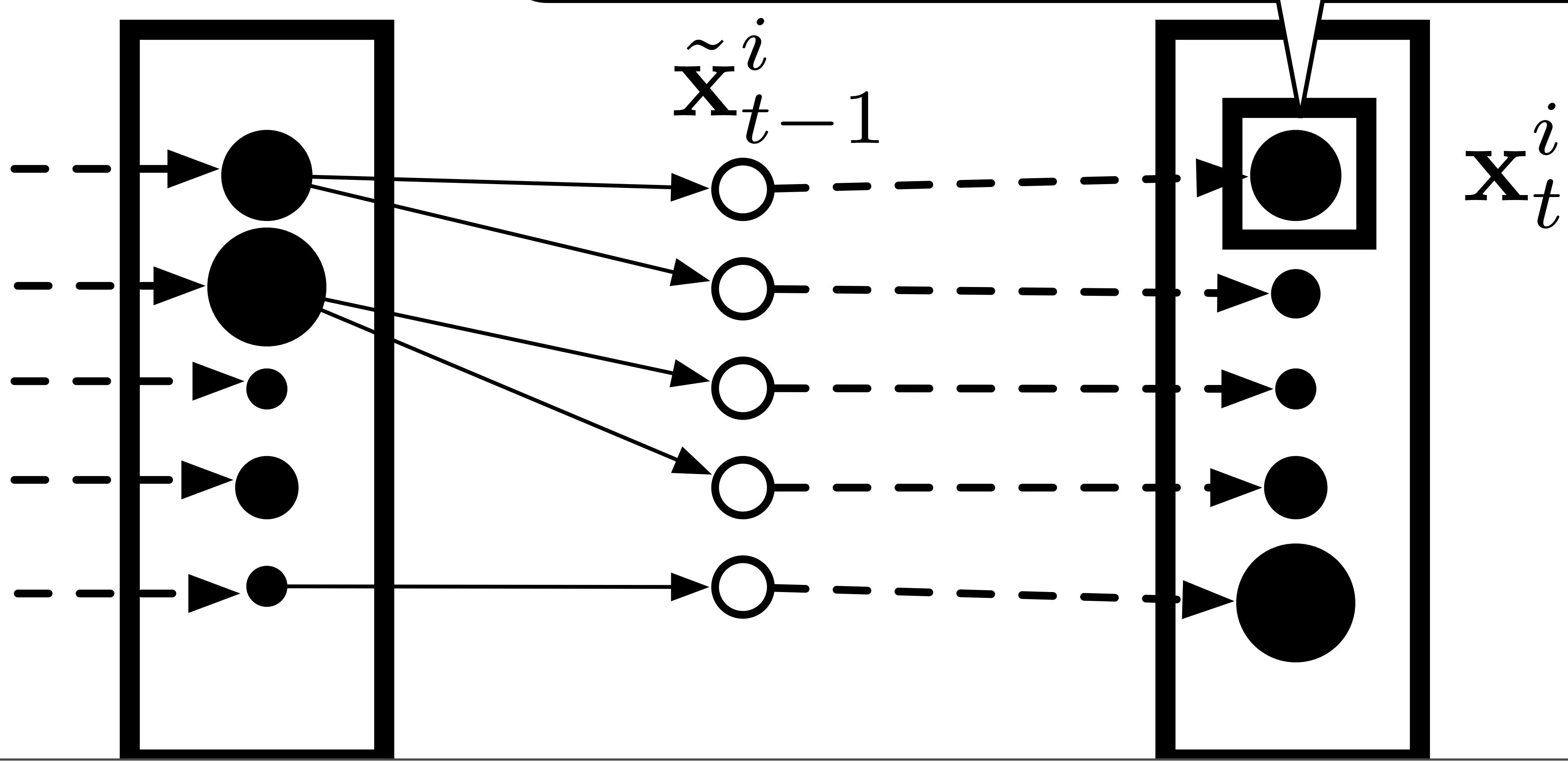
1. Assume inductively...
2. Sample from $\tilde{\pi}_{t-1}$
3. Propose (extend):



Standard SMC inner working:

1. Assume inductively...
2. Sample from $\tilde{\pi}_{t-1}$
3. Propose (extend)
4. Reweigh:

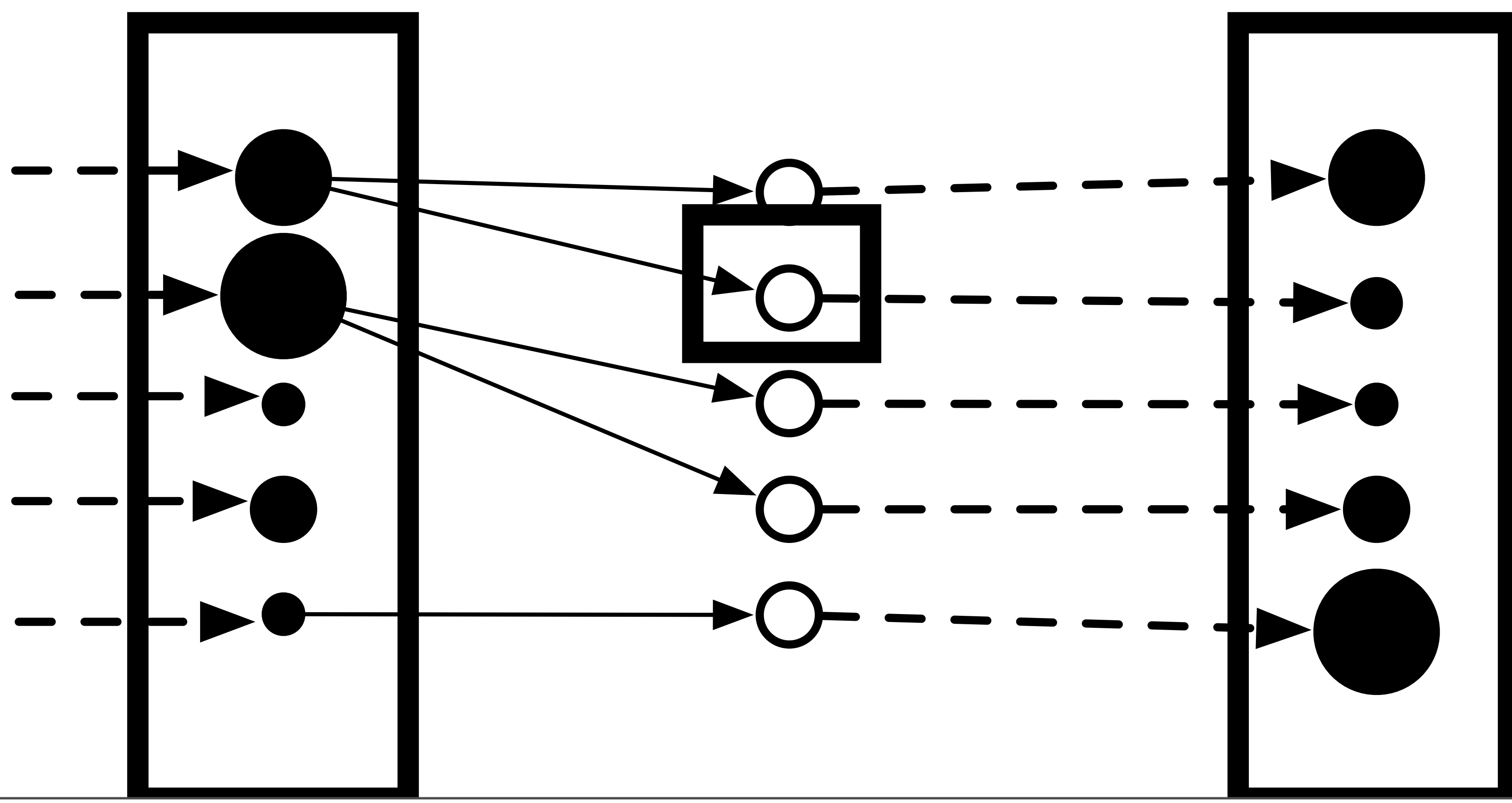
$$w_t^i = \frac{\pi_t(\mathbf{x}_t^i)}{\pi_{t-1}(\tilde{\mathbf{x}}_{t-1}^i)} \frac{1}{q_t(x_t^i|\tilde{\mathbf{x}}_{t-1}^i)}$$



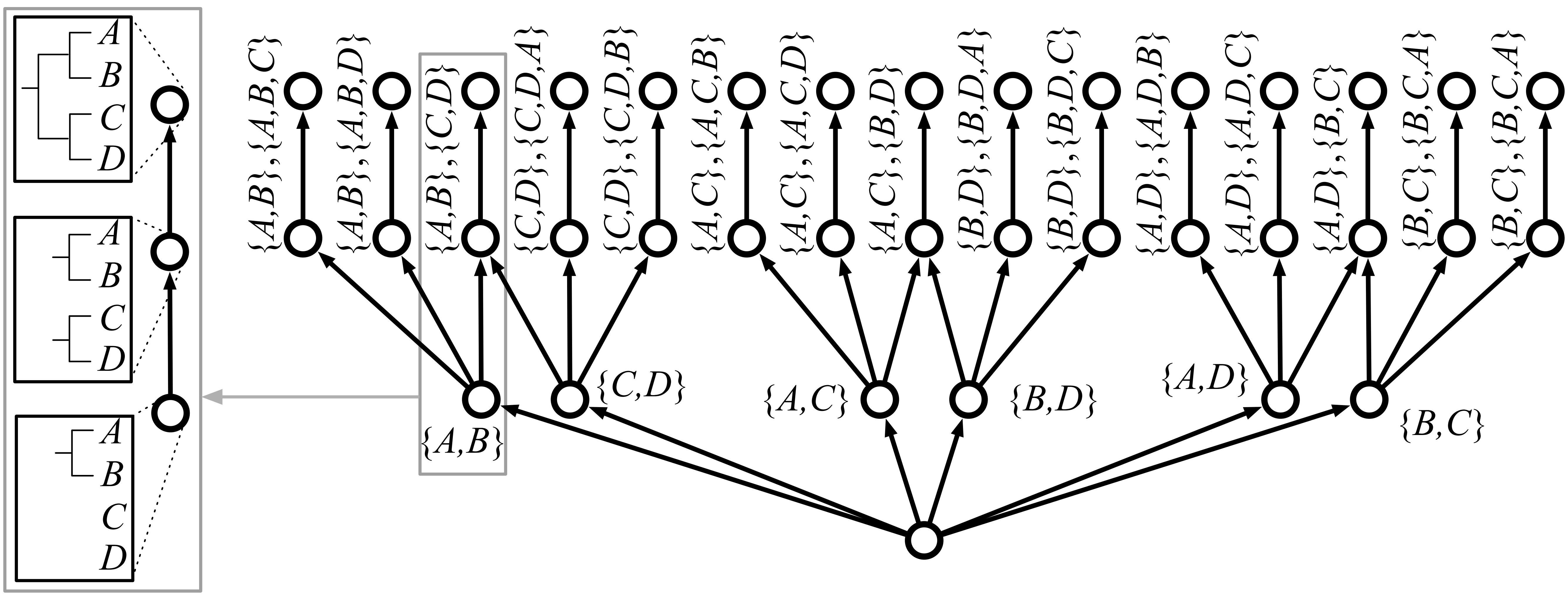
Standard SMC inner working:

1. Assume inductively...
2. Sample from $\tilde{\pi}_{t-1}$
3. Propose (extend)
4. Reweigh

Repeat for each particle (5 times)



Poset structure



Removing cycles with an auxiliary space