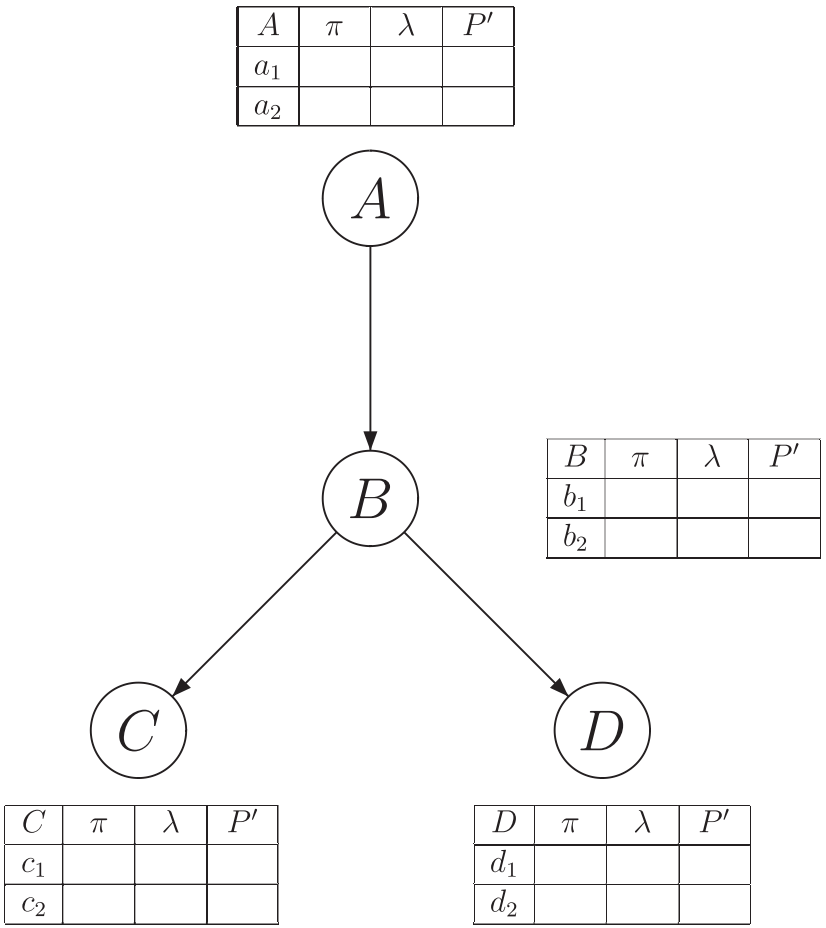
Pre-Initialization Stage



A	π	λ	P'
a_1			
a_2			

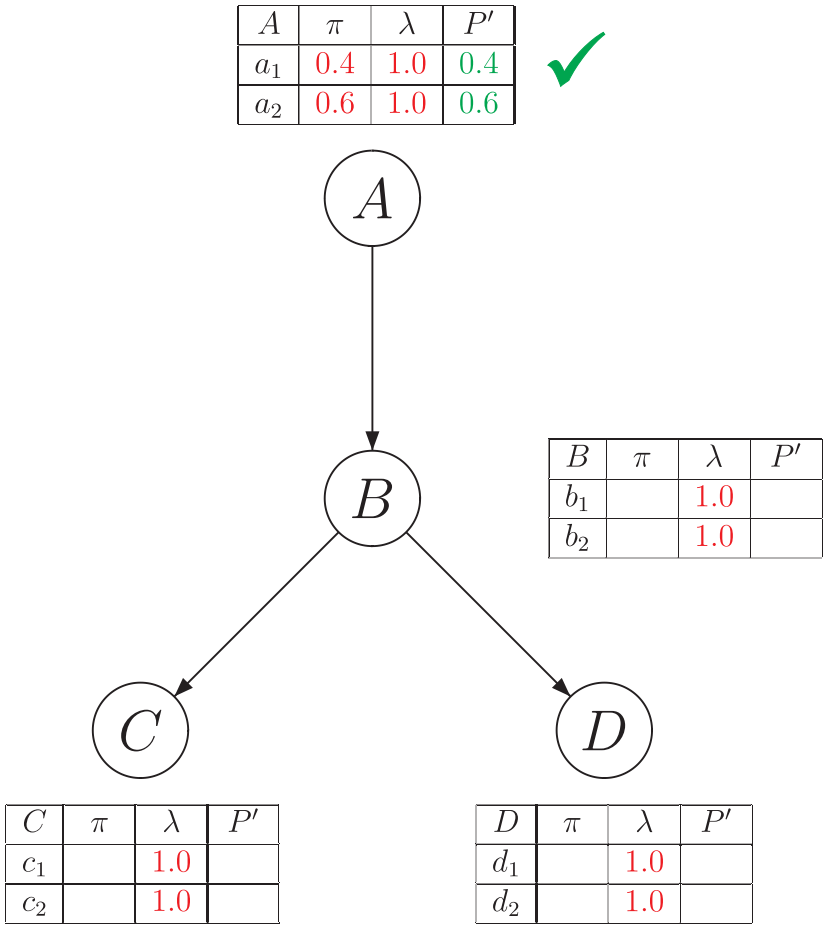
B	π	λ	P'
b_1			
b_2			

C	π	λ	P'
c_1			
c_2			

D	π	λ	P'
d_1			
d_2			

Big goal: calculate all P'-values

Initialization Stage



A	π	λ	P'
a_1	0.4	1.0	0.4
a_2	0.6	1.0	0.6

B	π	λ	P'
b_1		1.0	
b_2		1.0	

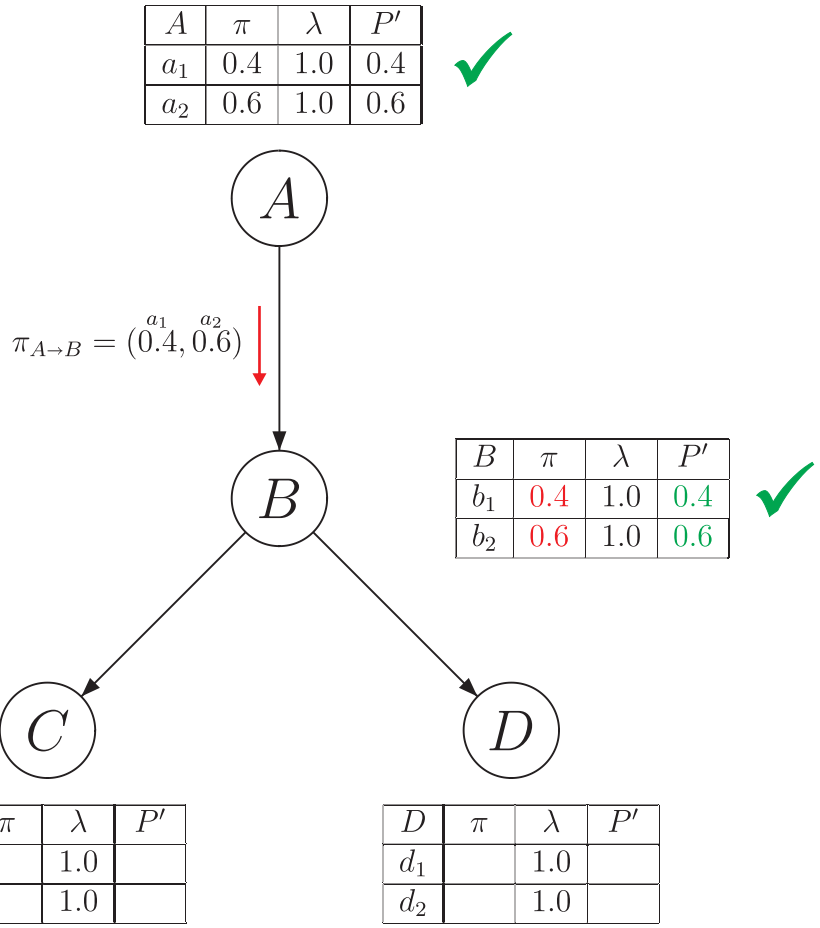
C	π	λ	P'
c_1		1.0	
c_2		1.0	

D	π	λ	P'
d_1		1.0	
d_2		1.0	

- Setting all λ-values to 1.0
- Set root node A's π-values to marginal probability

➞ root node A trivially done

Initialization Stage



A	π	λ	P'
a_1	0.4	1.0	0.4
a_2	0.6	1.0	0.6

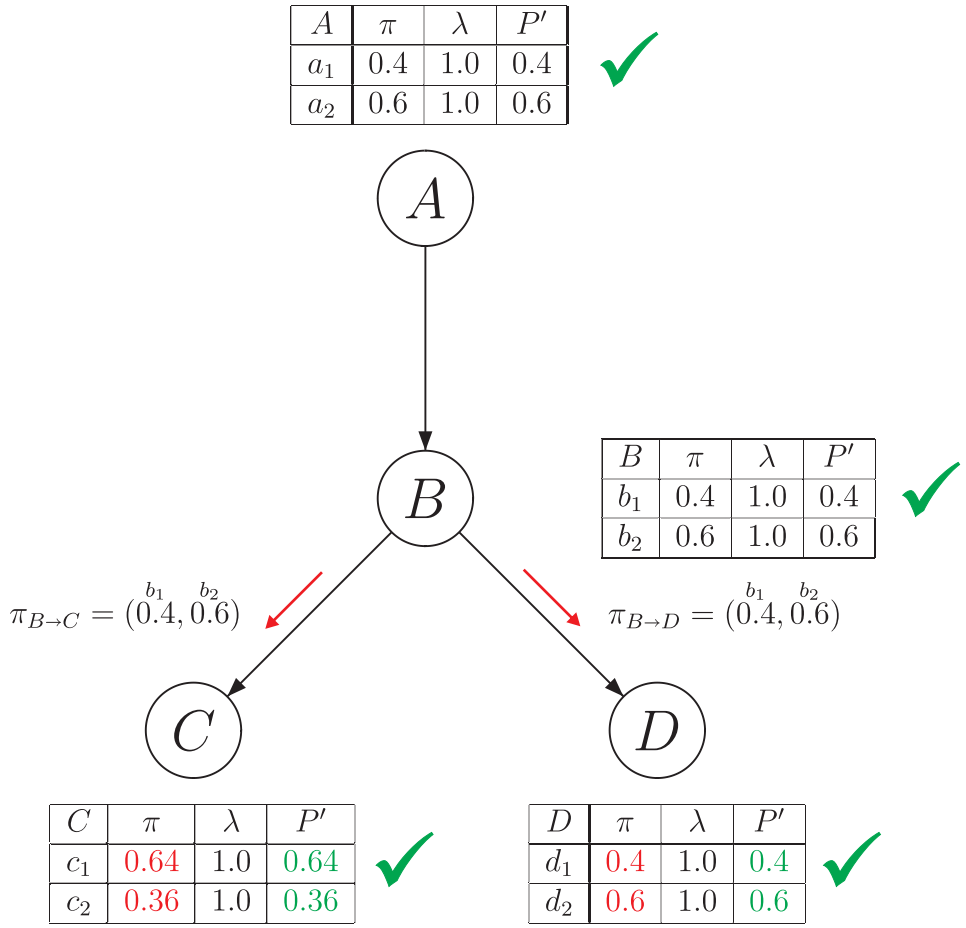
B	π	λ	P'
b_1	0.4	1.0	0.4
b_2	0.6	1.0	0.6

C	π	λ	P'
c_1		1.0	
c_2		1.0	

D	π	λ	P'
d_1		1.0	
d_2		1.0	

- A sends p-messages to all its children (here: only B)
- Having received the parent's p-message from A, B can now compute its p-value, which in turn leads to P'

Initialization Stage



A	π	λ	P'
a_1	0.4	1.0	0.4
a_2	0.6	1.0	0.6

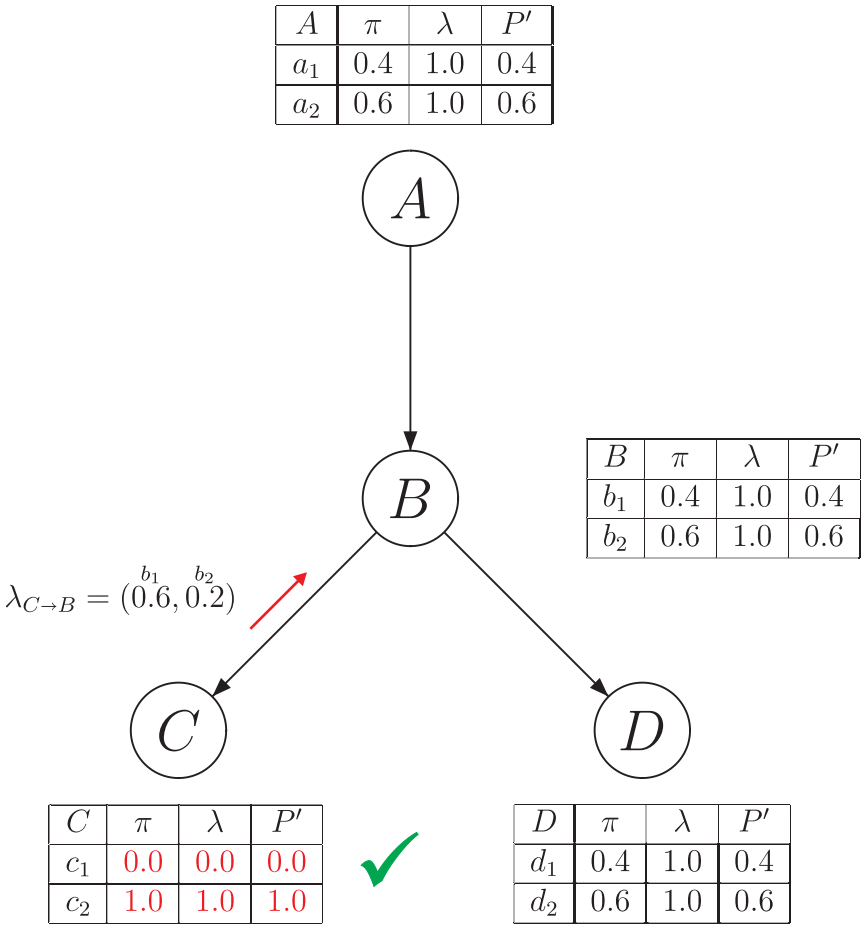
B	π	λ	P'
b_1	0.4	1.0	0.4
b_2	0.6	1.0	0.6

C	π	λ	P'
c_1	0.64	1.0	0.64
c_2	0.36	1.0	0.36

D	π	λ	P'
d_1	0.4	1.0	0.4
d_2	0.6	1.0	0.6

- With the updated P'-value, B can now compute p-messages for C and D
- Having received these messages, C and D will compute its p-values, which in turn leads to P' and thus completes the initialization phase

Evidence Propagation



A	π	λ	P'
a_1	0.4	1.0	0.4
a_2	0.6	1.0	0.6

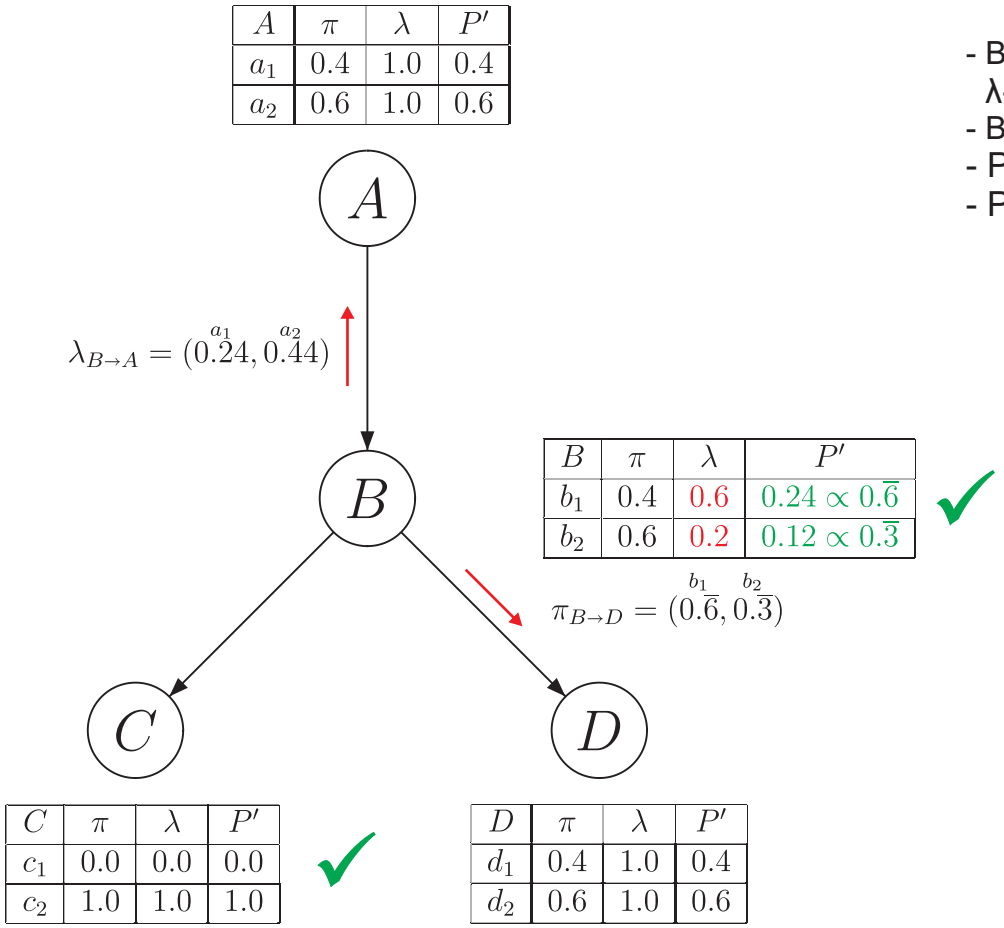
B	π	λ	P'
b_1	0.4	1.0	0.4
b_2	0.6	1.0	0.6

C	π	λ	P'
c_1	0.0	0.0	0.0
c_2	1.0	1.0	1.0

D	π	λ	P'
d_1	0.4	1.0	0.4
d_2	0.6	1.0	0.6

- Evidence C=c2 is reflected by setting P’ to the shown distribution
- λ-values do alike
- C sends λ-message to B

Evidence Propagation



A	π	λ	P'
a_1	0.4	1.0	0.4
a_2	0.6	1.0	0.6

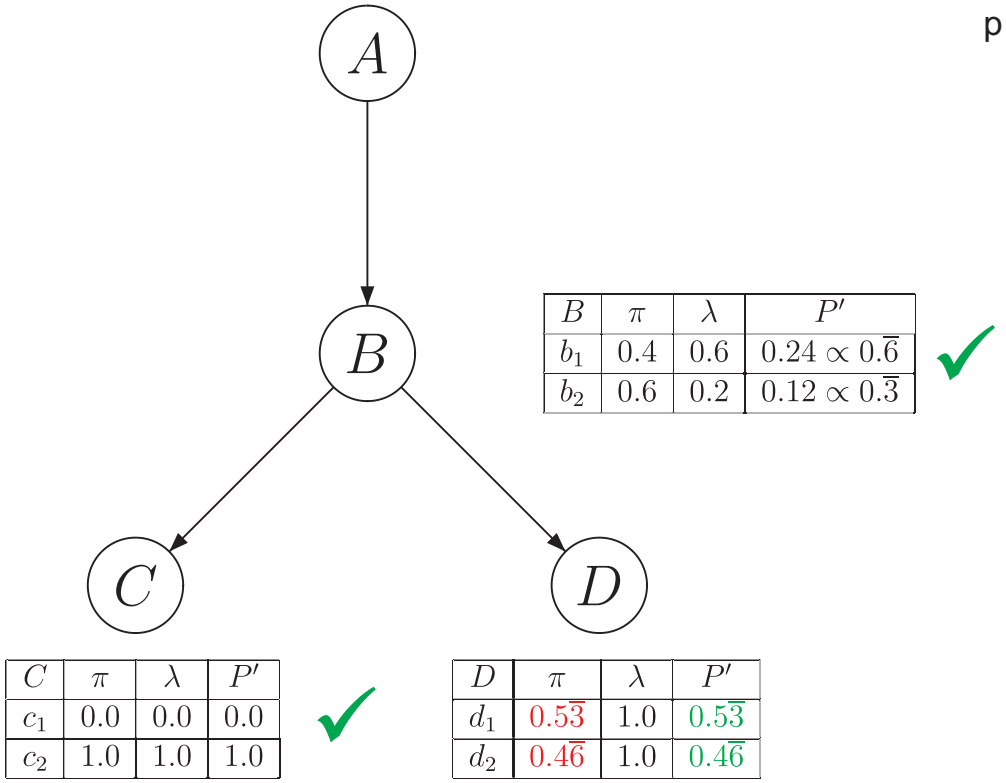
B	π	λ	P'
b_1	0.4	0.6	$0.24 \propto 0.\overline{6}$
b_2	0.6	0.2	$0.12 \propto 0.\overline{3}$

C	π	λ	P'
c_1	0.0	0.0	0.0
c_2	1.0	1.0	1.0

D	π	λ	P'
d_1	0.4	1.0	0.4
d_2	0.6	1.0	0.6

- B receives λ-message from C and updates its λ-values (using the unmodified λ-message of D)
- B updates P' (normalization necessary!)
- Post a p-message down to D
- Post a λ-message up to A

Evidence Propagation



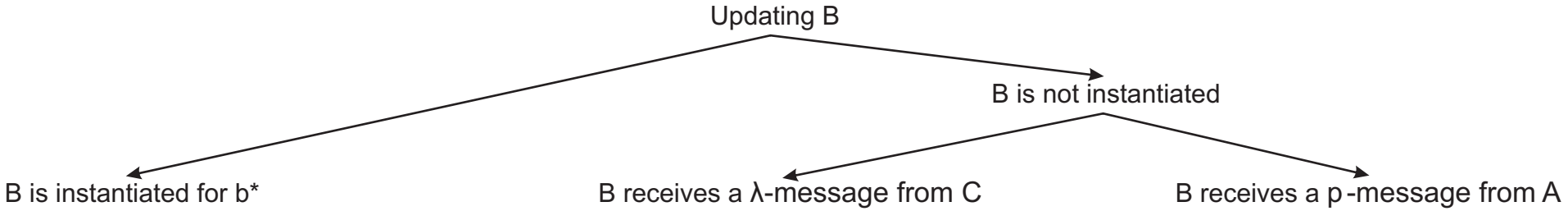
A	π	λ	P'
a_1	0.4	0.24	$0.096 \propto 0.2\overline{6}$
a_2	0.6	0.44	$0.264 \propto 0.7\overline{3}$

B	π	λ	P'
b_1	0.4	0.6	$0.24 \propto 0.\overline{6}$
b_2	0.6	0.2	$0.12 \propto 0.\overline{3}$

C	π	λ	P'
c_1	0.0	0.0	0.0
c_2	1.0	1.0	1.0

D	π	λ	P'
d_1	$0.5\overline{3}$	1.0	$0.5\overline{3}$
d_2	$0.4\overline{6}$	1.0	$0.4\overline{6}$

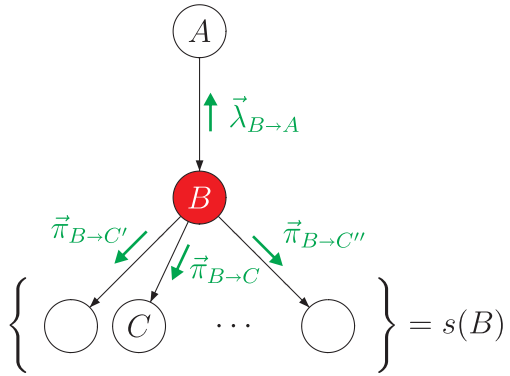
- A receives λ-message from B, updates its λ-values and finally P'
- D receives p-message from B, updates its p-values and finally P'

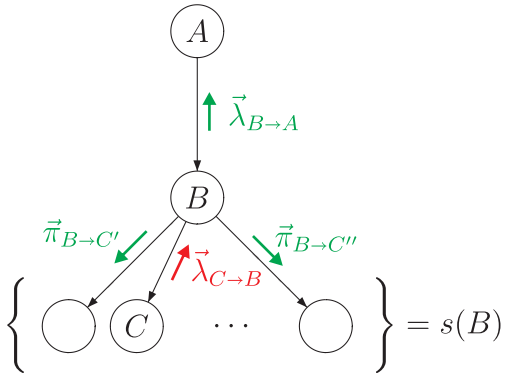


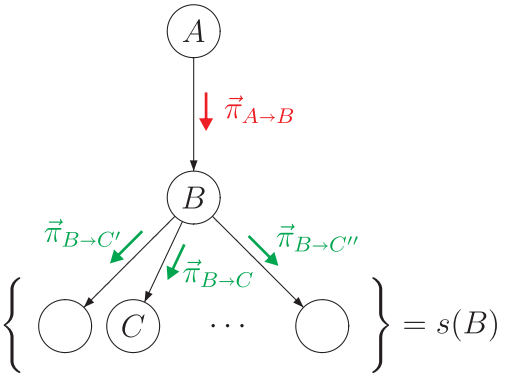
1. Set $\forall b \in \Omega_B : \; P'(b^*) = \begin{cases} 1 & b = b^* \\ 0 & b \neq b^* \end{cases}$
2. Compute new λ-values: $\forall b \in \Omega_B : \; \lambda(b)$
3. Post new λ-message $\vec{\lambda}_{B \to A}$
4. Post new π-messages $\forall C \in s(B) : \; \vec{\pi}_{B \to C}$

1. Compute new λ-values: $\forall b \in \Omega_B : \; \lambda(b)$
2. Compute new P'-values: $\forall b \in \Omega_B : \; P'(b)$
3. Post new λ-message $\vec{\lambda}_{B \to A}$ to A
4. Post new π-messages to the *other* children: $\forall C' \in s(B) : C' \neq C : \; \vec{\pi}_{B \to C'}$

1. Compute new π-values: $\forall b \in \Omega_B : \; \pi(b)$
2. Compute new P'-values: $\forall b \in \Omega_B : \; P'(b)$
3. Post new π-messages $\forall C \in s(B) : \; \vec{\pi}_{B \to C}$







$$\forall a \in \Omega_A : \quad \lambda_{B \to A}(a) = \sum_{\forall b \in \Omega_B} P(b \mid a) \cdot \lambda(b)$$

$$\forall b \in \Omega_B : \quad P'(b) = \alpha \lambda(b) \pi(b)$$

$$\forall a \in \Omega_A : \quad \pi_{A \to B}(a) = \begin{cases} 1 & \text{if } A \text{ is instantiated for } a \\ 0 & \text{if } A \text{ is instantiated, but not for } a \\ \frac{P'(a)}{\lambda_{B \to A}(a)} & \text{if } A \text{ is not instantiated} \end{cases}$$