Does Secure Time-Stamping Imply Collision-Free Hash Functions

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Topics

- background about hash functions and their security
- timestamping and backdating attack
- what is blackbox reduction
- how to prove that blackbox reduction is not possible
- show that time-stamping doesn't require CHFH

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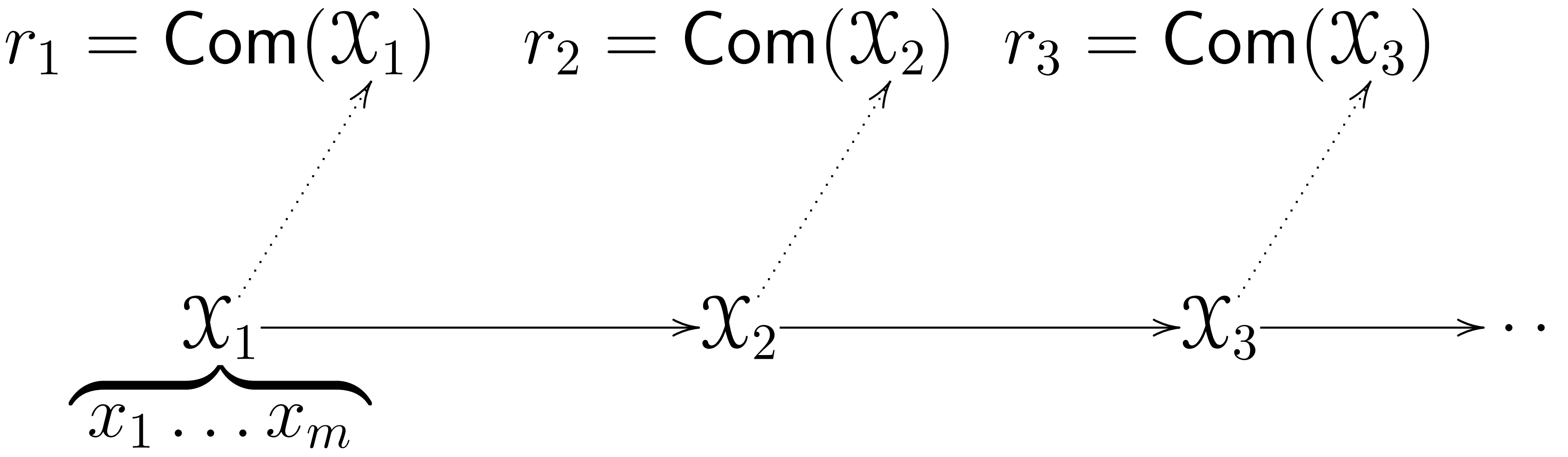
- is this *collision freedom* really required in applications (for example in timestamping)?
- Buldas and Saarepera in 2004: collision freedom is *insufficient*.
- Buldas and Laur in 2006: collision freedom is *unneccessary*.

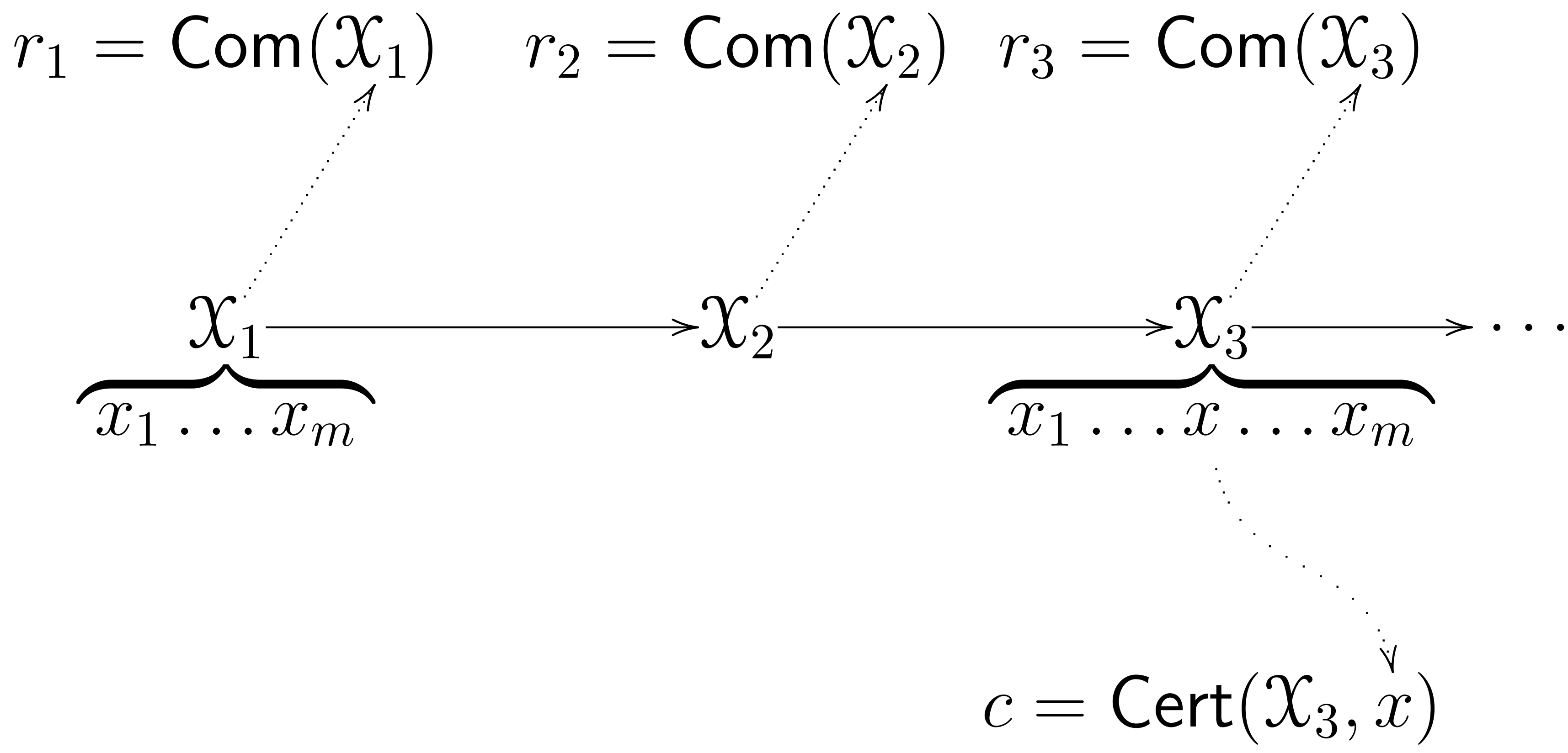
Timestamping scheme

$$\underbrace{\mathcal{X}_1}_{x_1 \ldots x_m} \longrightarrow \mathcal{X}_2 \longrightarrow \mathcal{X}_3 \longrightarrow \cdots$$

Timestamping scheme



Timestamping scheme



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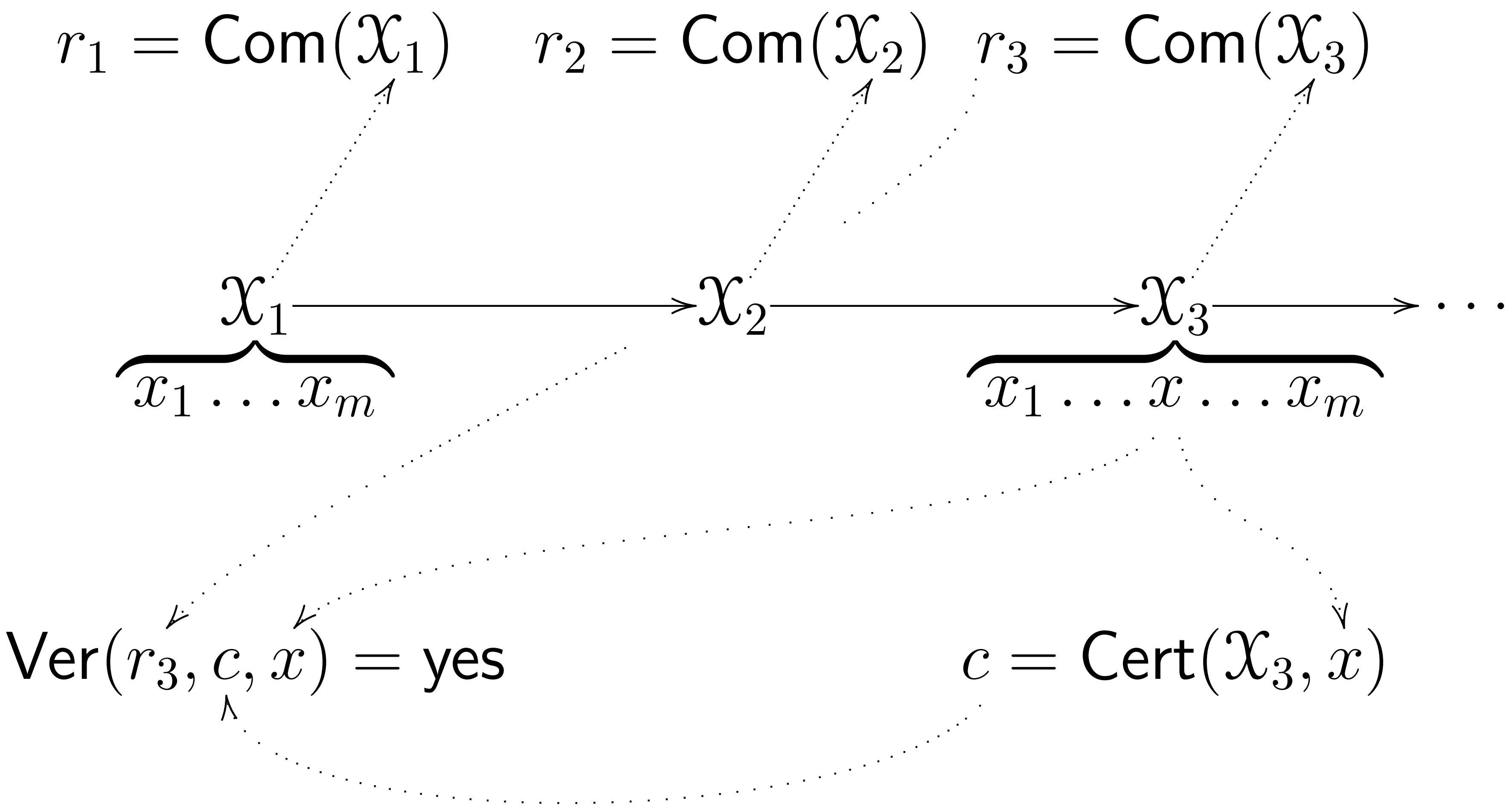

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- $x = H(\mathcal{D}'_{\mathrm{A}})$, $\mathsf{Ver}(r, x, c) =$ yes

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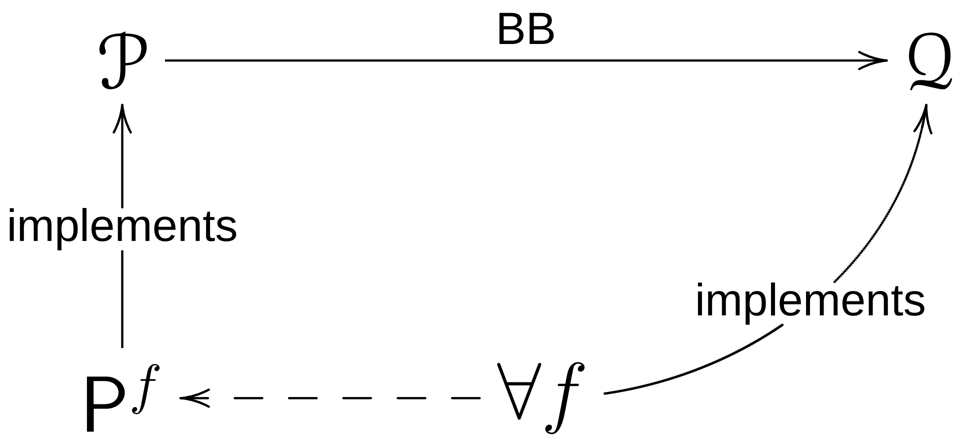
BlackBox reduction

$$\mathcal{P} \xrightarrow{\text{BB}} \mathcal{Q}$$

P

S

BlackBox reduction



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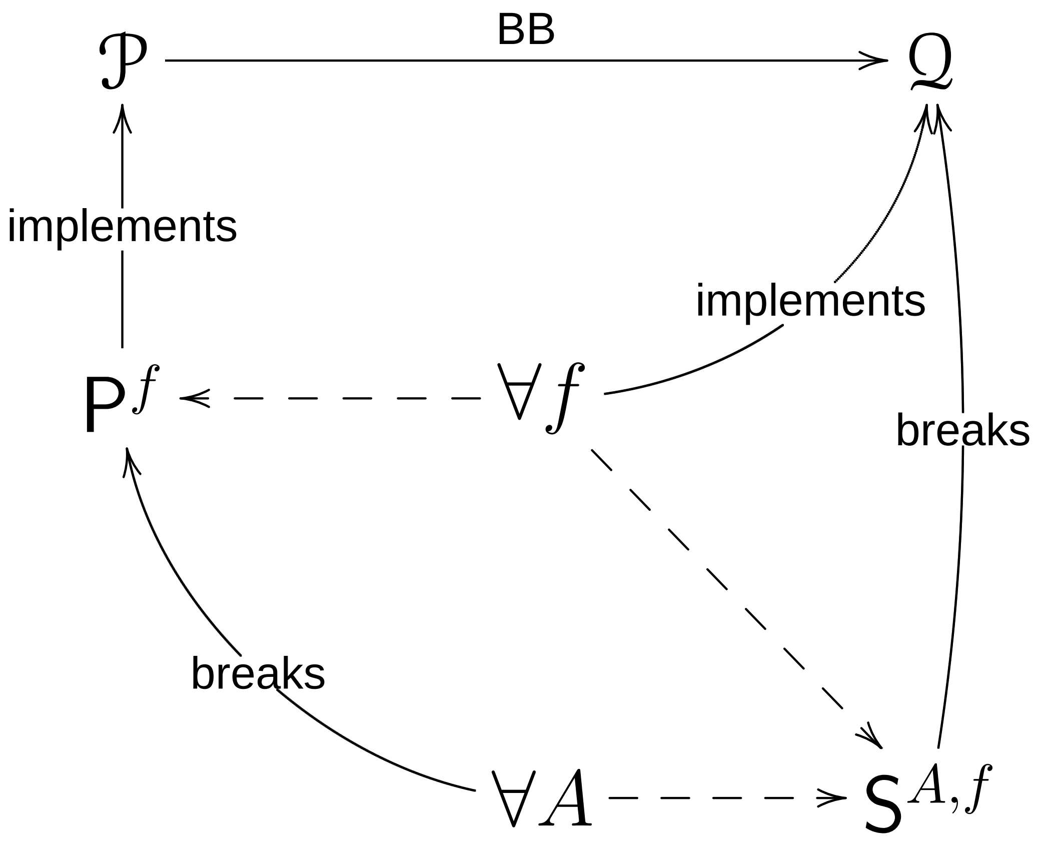
BlackBox reduction



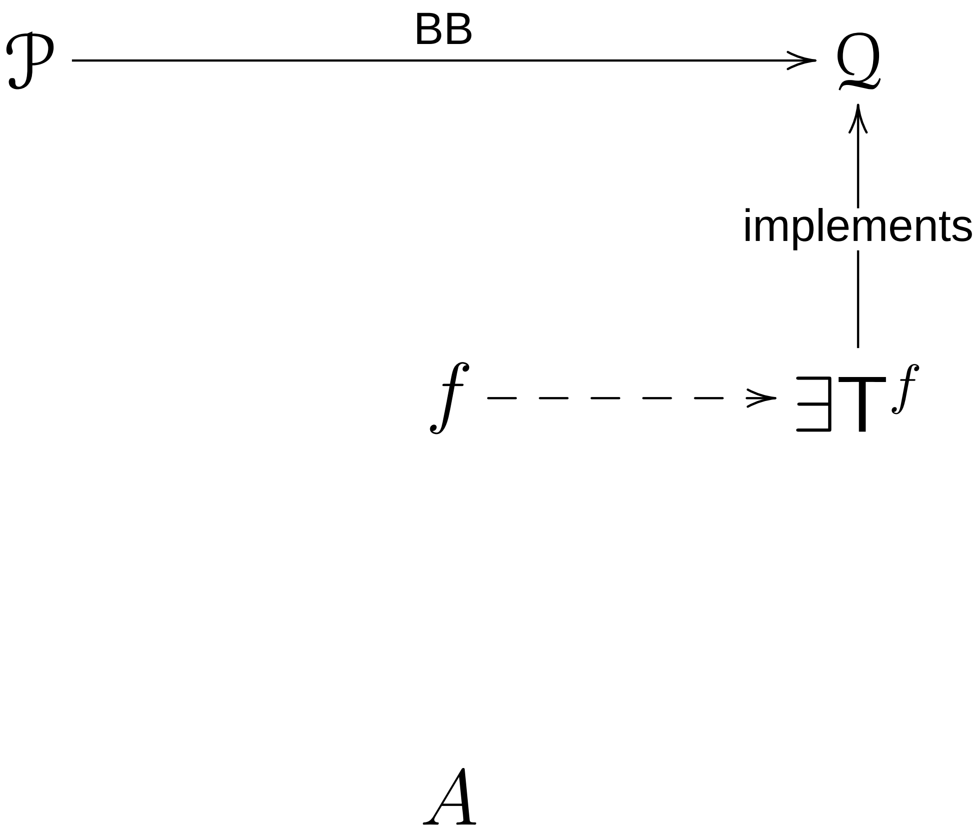
Oracle separation

$$\mathcal{P} \xrightarrow{\text{BB}} \mathcal{Q}$$

$$f$$

$$A$$

Oracle separation



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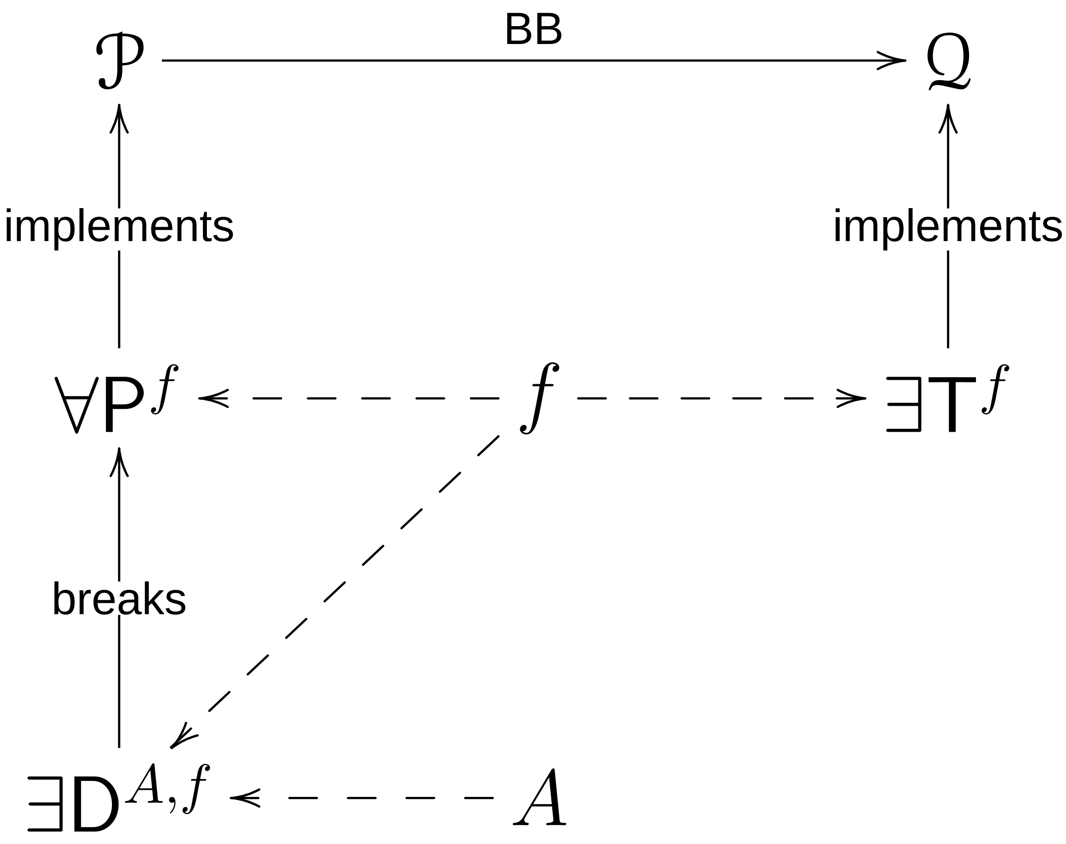

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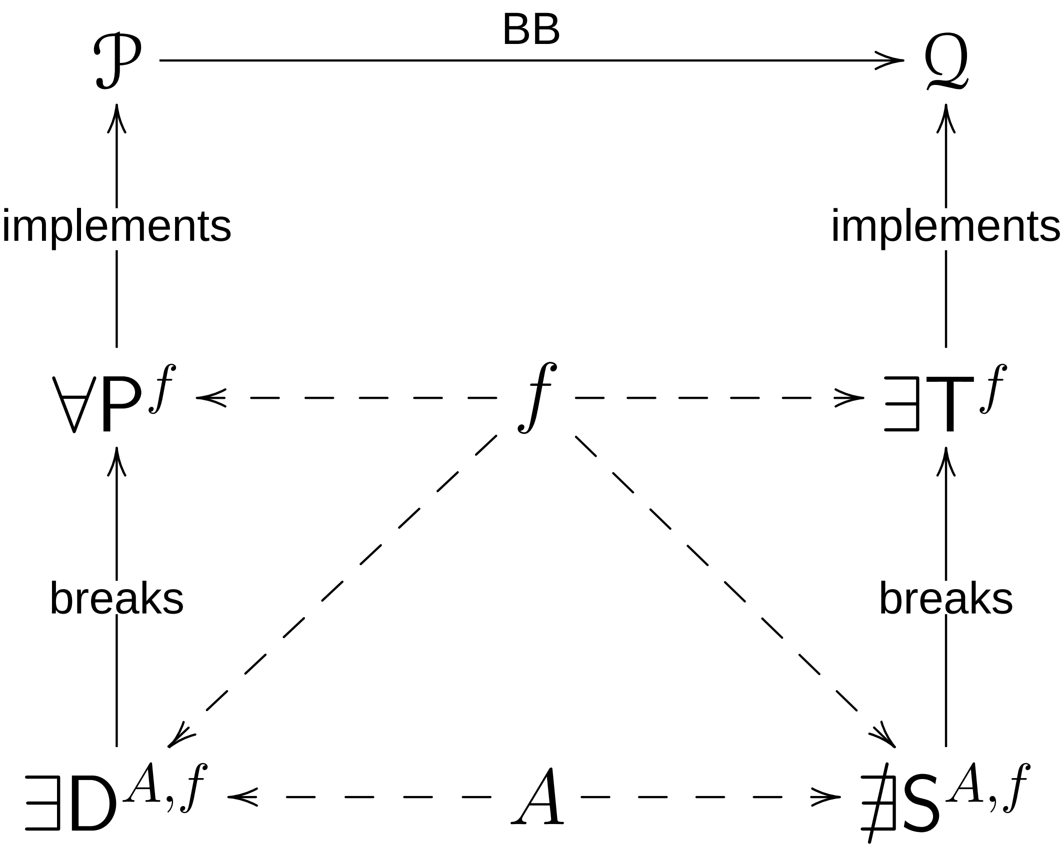

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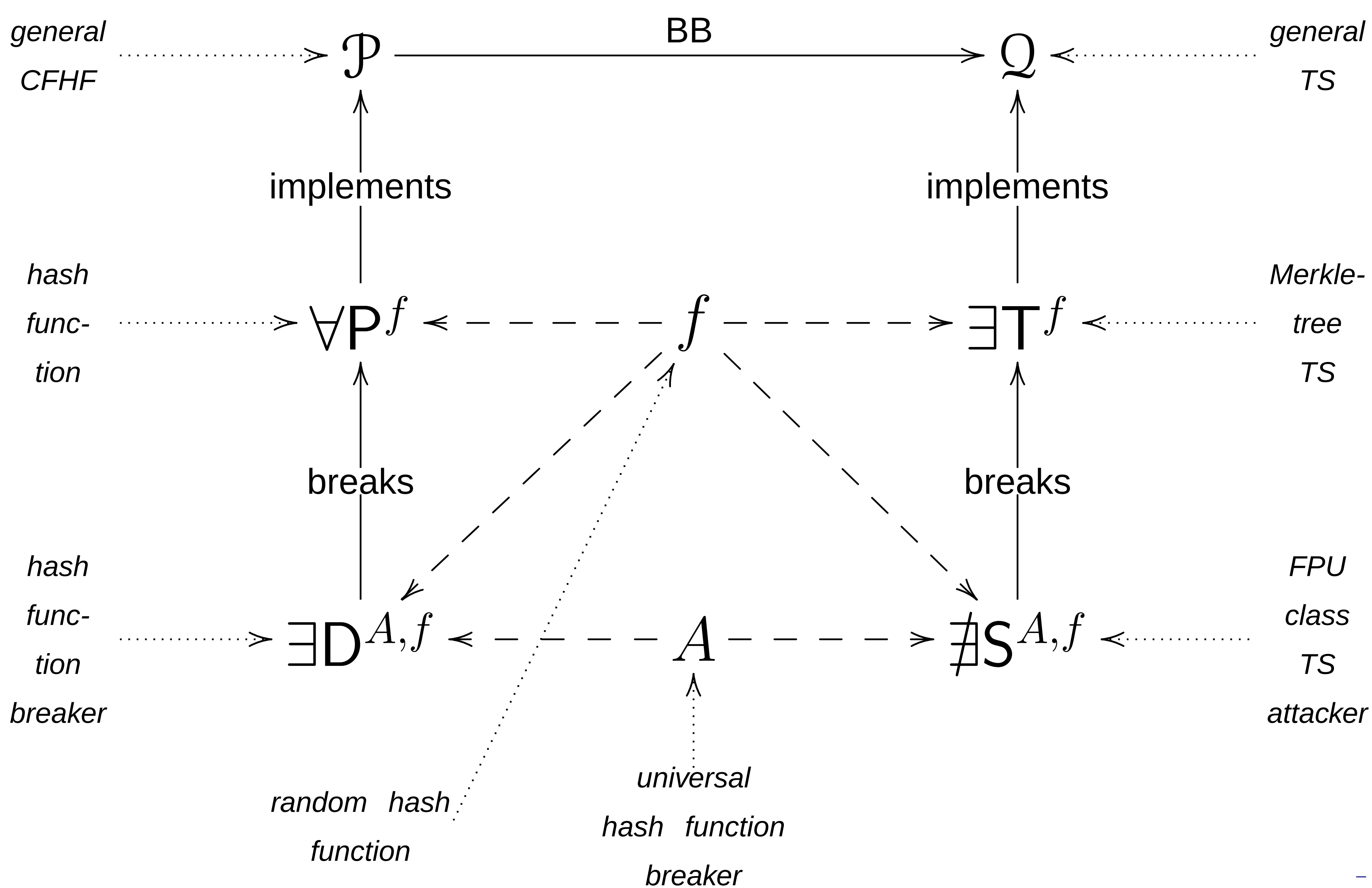
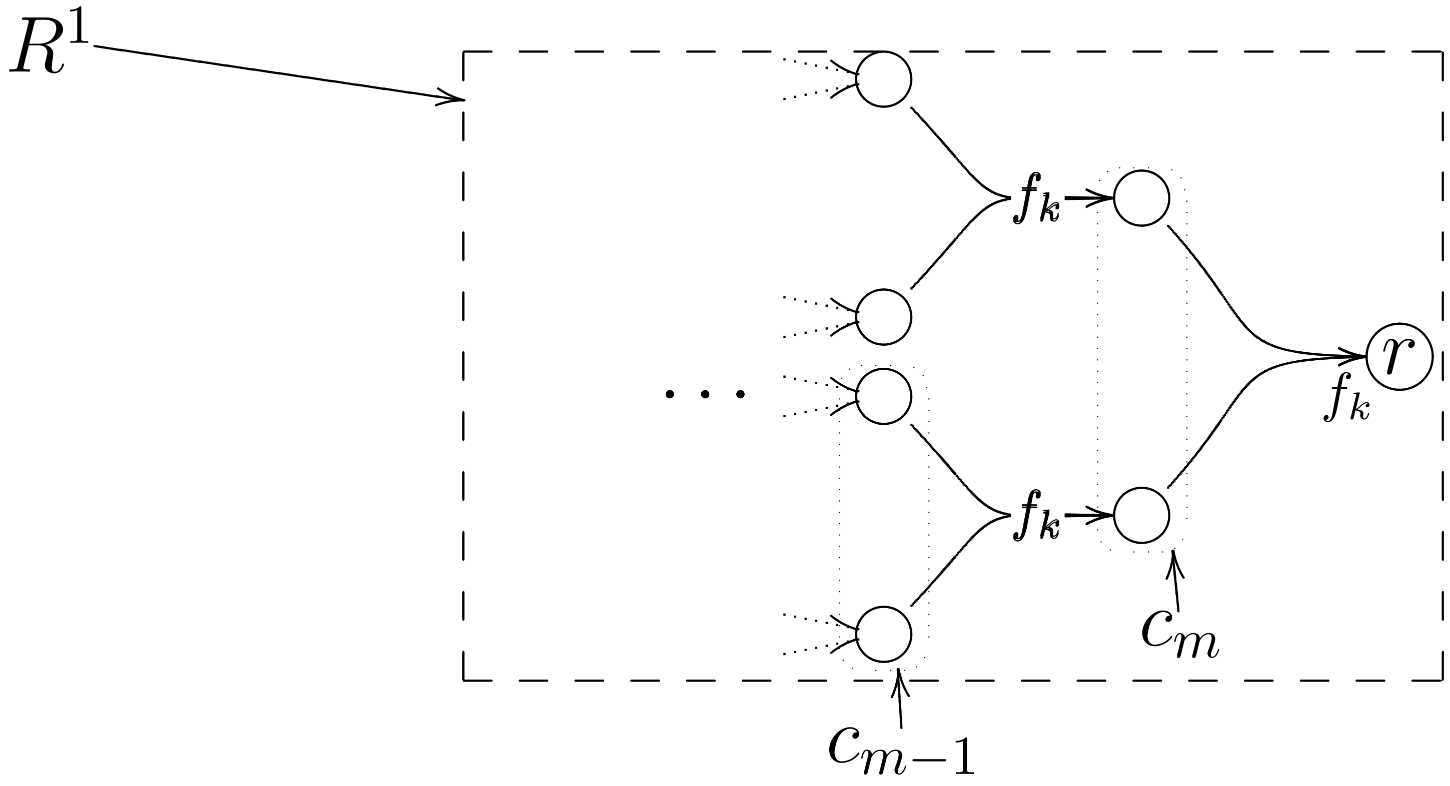


$\mathsf{S}^{A,f} = (\mathsf{S}_1, \mathsf{S}_2)$ in work



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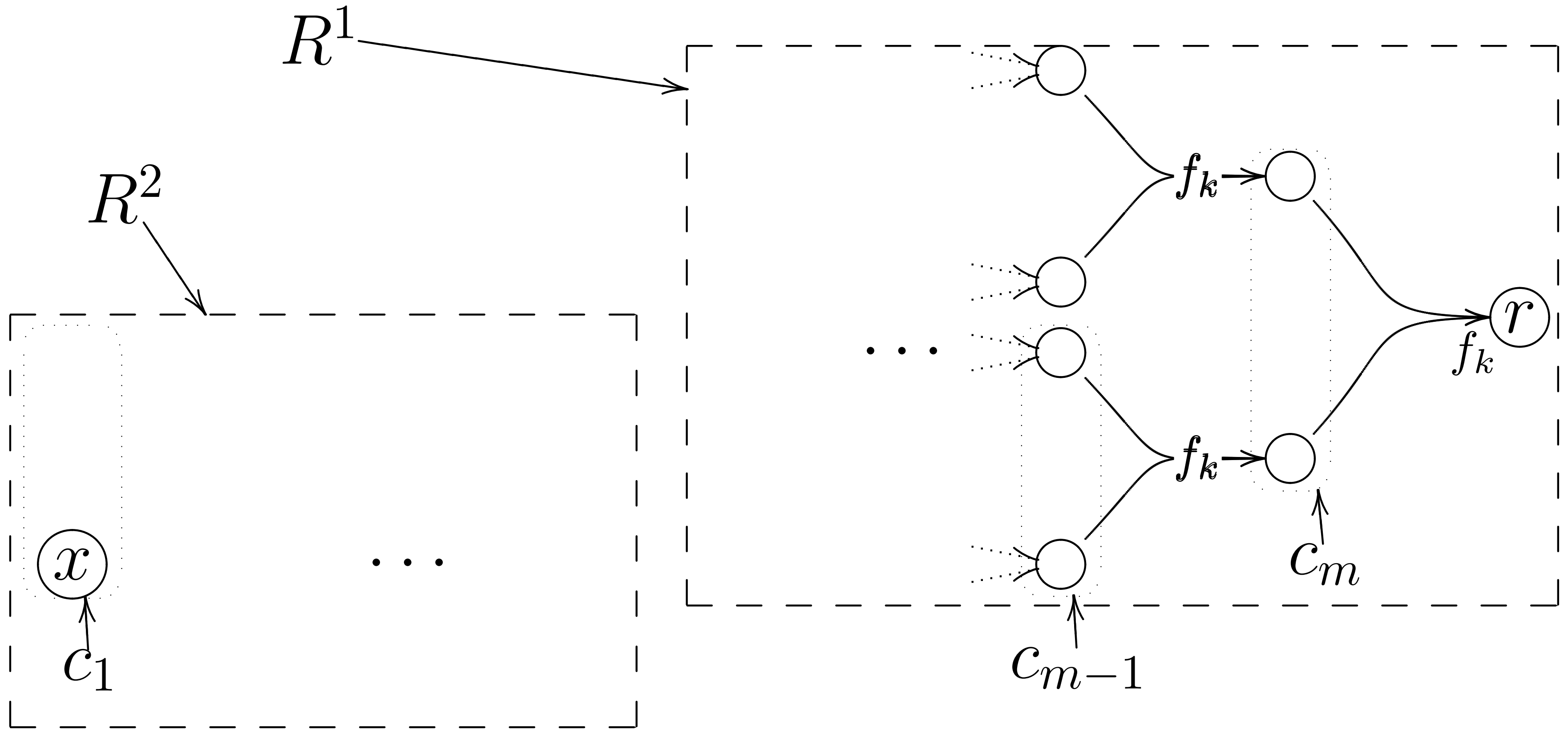

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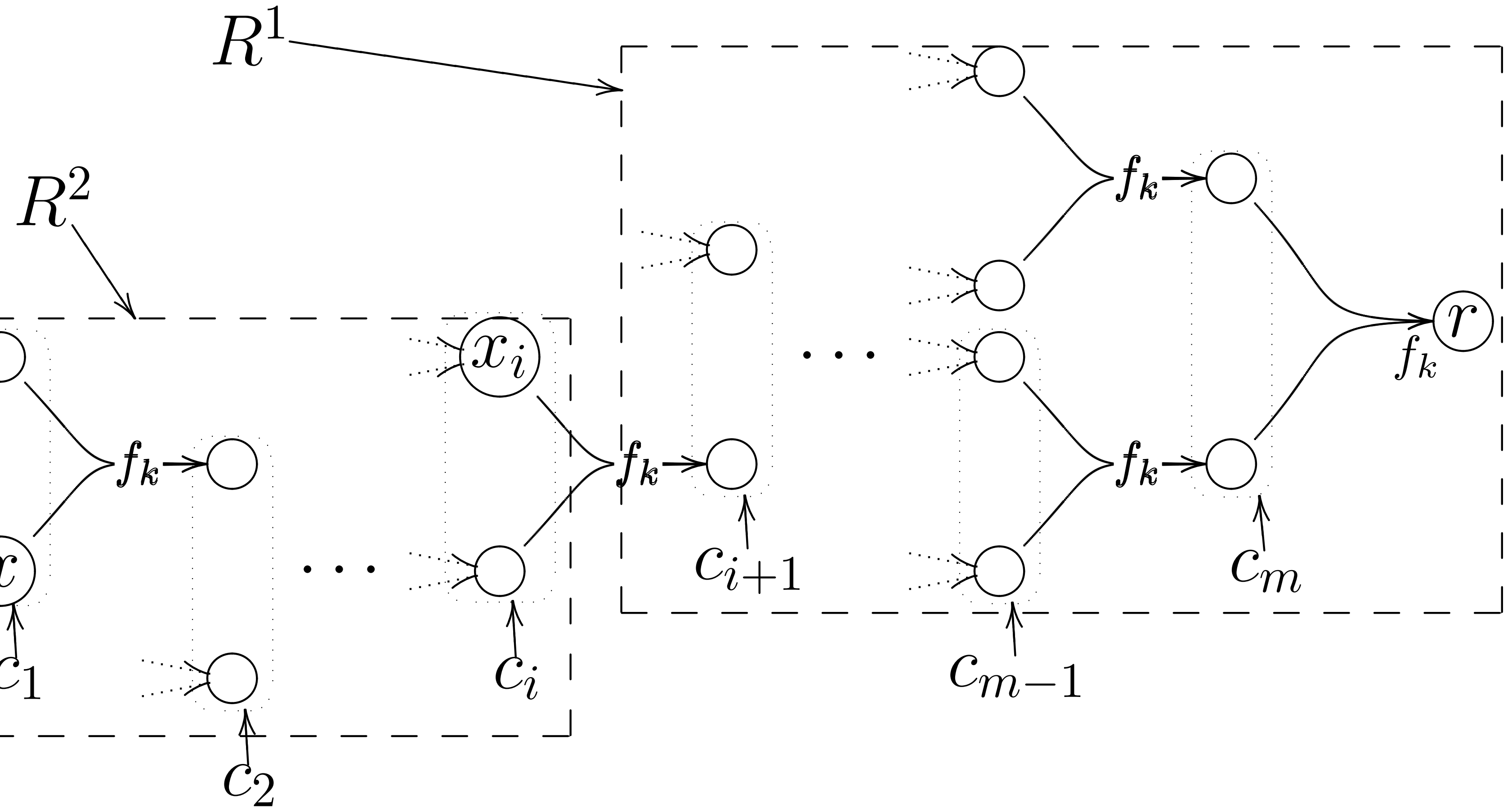

Conclusion

- $$\Pr\Big[(r,a) \leftarrow \mathsf{S}_1^{A,f}(1^k), (x,c) \leftarrow \mathsf{S}_2^{A,f}(r,a) : \mathsf{Ver}(x,c,r) = \mathsf{yes}\Big] = k^{-\omega(1)}$$
- blackbox reduction of CFHF to TS is not possible