Multiple Forking: Deconstructed, Unified

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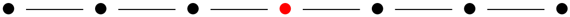
Elementary Forking (1 RO, 1 Fork)



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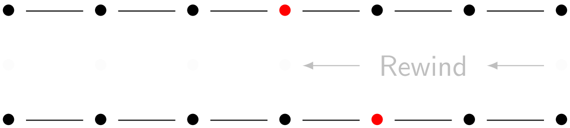

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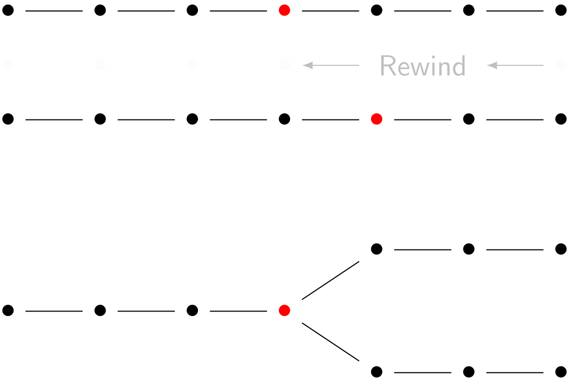

Cost: $\mathrm{O}(q)$

Multiple Forking (2 ROs, 1 Fork)

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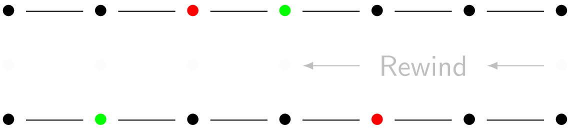
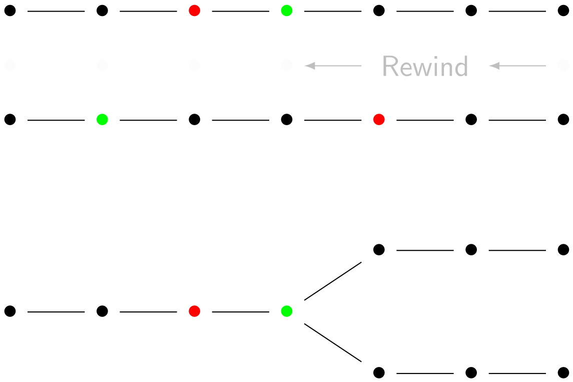
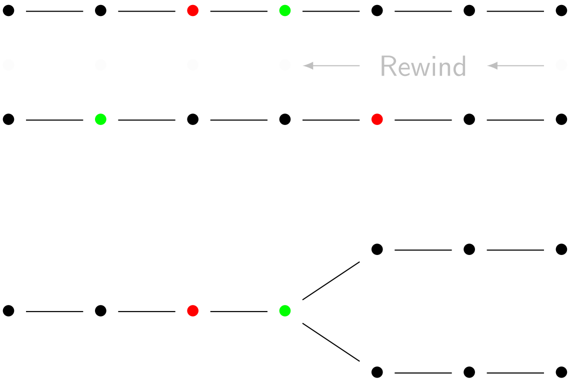


Multiple Forking (2 ROs, 1 Fork)

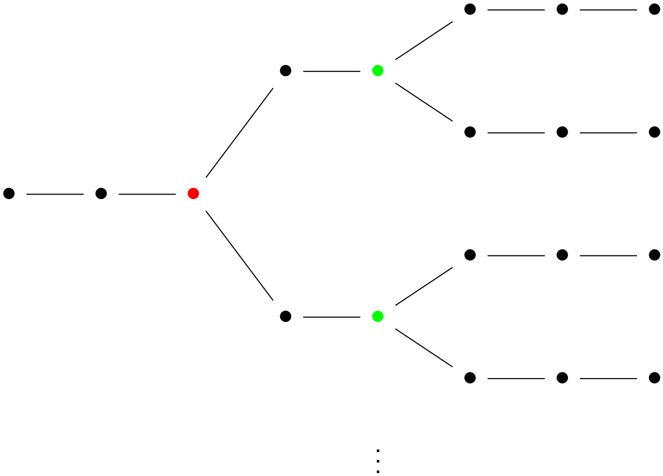


Multiple Forking (2 ROs, 1 Fork)

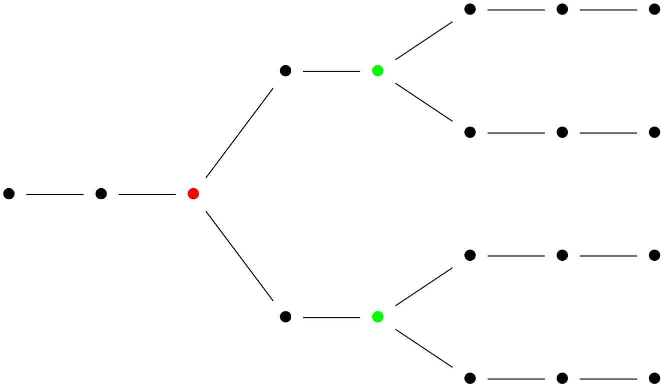


Cost: $O\left(q^2\right)$

Multiple Forking (2 ROs, *n* Forks)



Multiple Forking (2 ROs, *n* Forks)



⋮

Cost: $O\left(q^{2n}\right)$

Applications

1. Proxy Signatures [BPW12]
2. Identity-Based Signatures [GG09]
3. ZK Arguments [CMW13]

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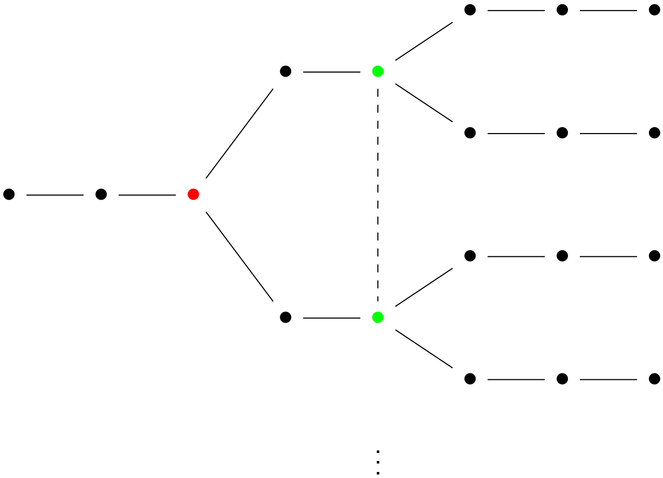
Reduced to $\mathrm{O}\left(q^{n}\right)$

Observation 1: Index Independence



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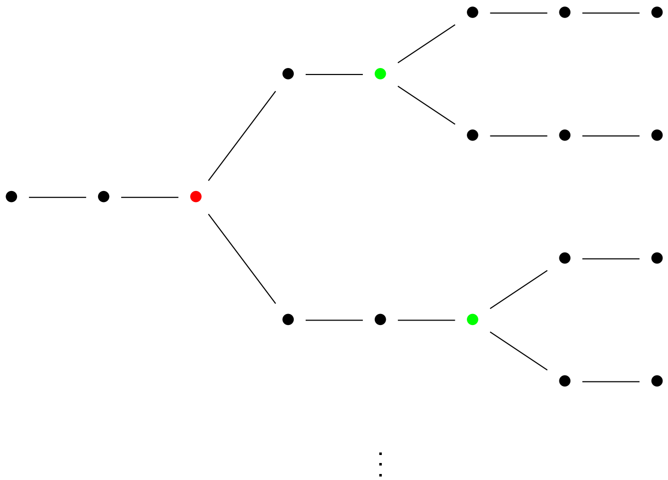
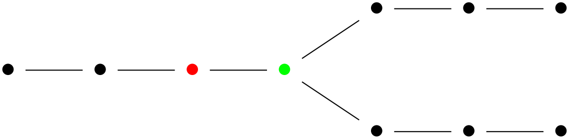
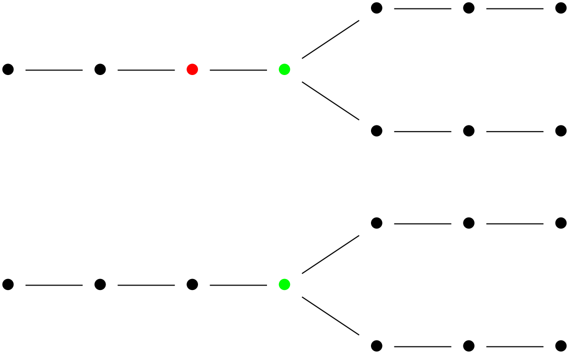


Observation 2: R-O Dependence



Observation 2: R-O Dependence



“R-O binding”

Result

Index Independence + RO Dependence

Cost *per* fork: down from $\mathrm{O}\left(q^2\right)$ to $\mathrm{O}\left(q\right)$
Total cost: down from $\mathrm{O}\left(q^{2n}\right)$ to $\mathrm{O}\left(q^n\right)$

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Optimal, can be extended to arbitrary r ROs
Unified Model for Multiple Forking

Thank you!

What did the annoyed forking algorithm tell the adversary?

Thank you!

What did the annoyed forking algorithm tell the adversary?

Fork you.

Thank you!

What did the annoyed forking algorithm tell the adversary?

Fork you.

Well, let me get my coat.