Constant-Rate Oblivious Transfer from Noisy Channels

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From our point of view, an ideal communication line is a sterile, cryptographically uninteresting entity. Noise, on the other hand, breeds disorder, uncertainty, and confusion. Thus, it is the cryptographer's natural ally.

Claude Crépeau & Joe Kilian, 1988.

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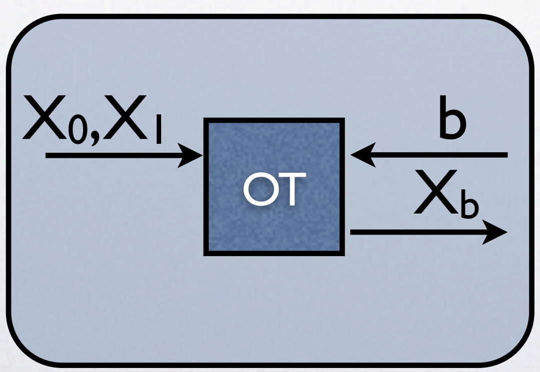

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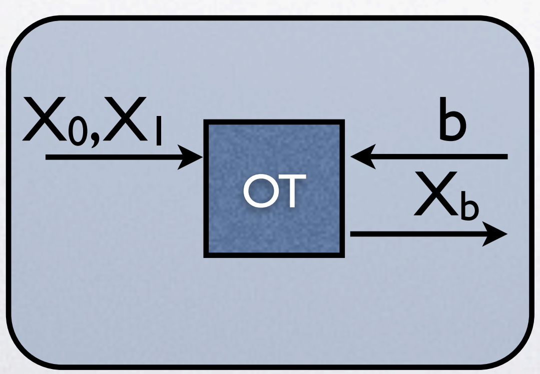

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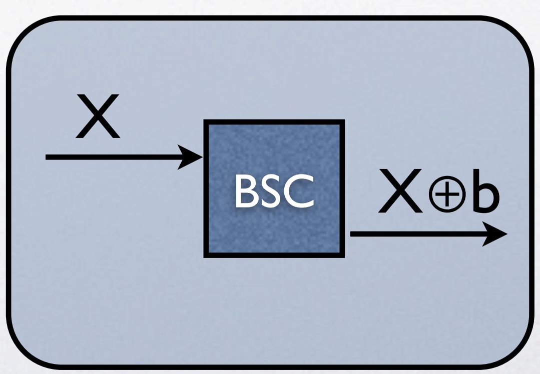

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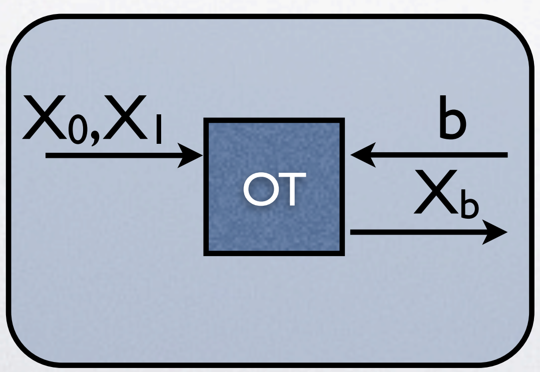
  - OT is complete for secure computation [K'88]



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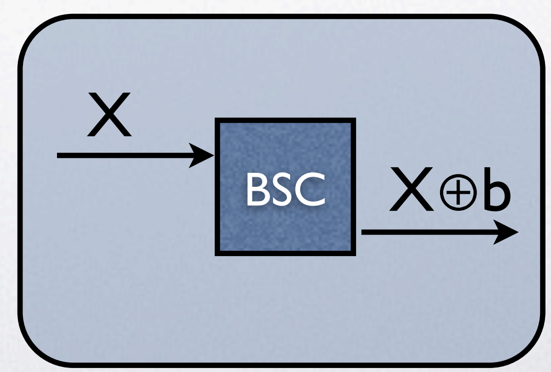

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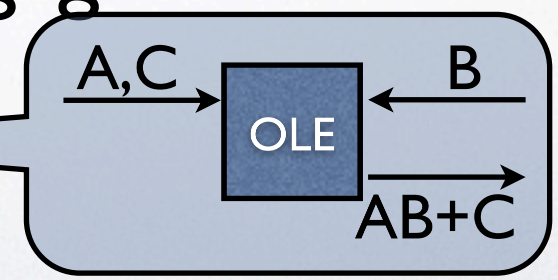

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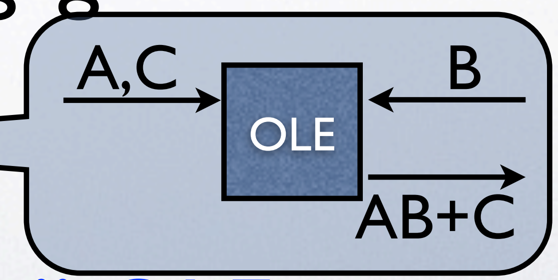

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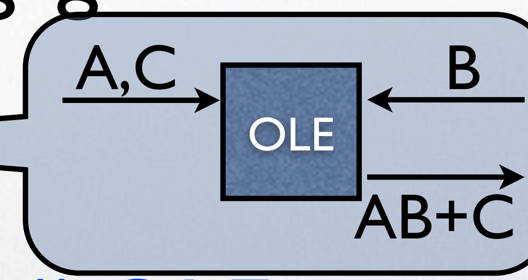

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  - As a composition theorem: Running n copies of an ε-fuzzy protocol gives about $(1\text{-}\sigma)n$ good copies of F (randomly chosen)

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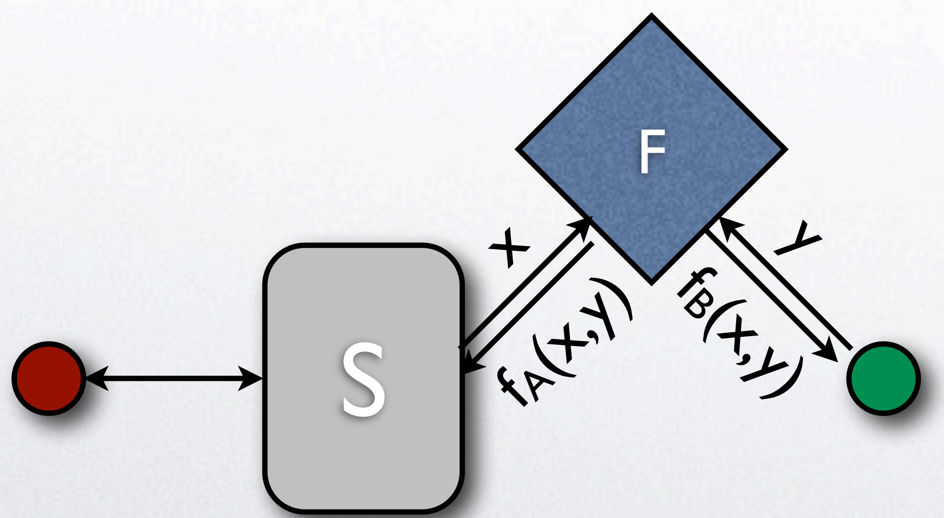

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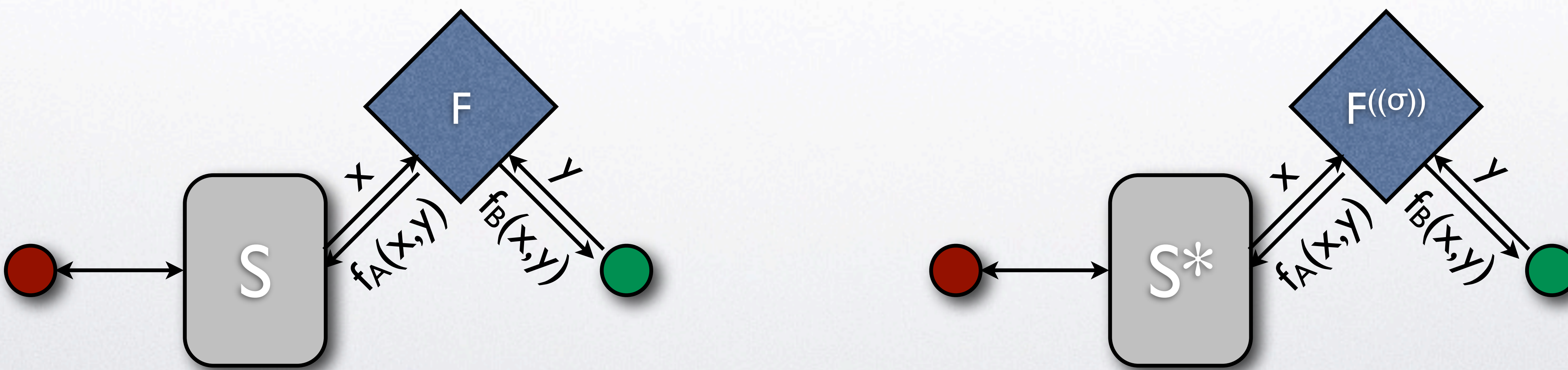

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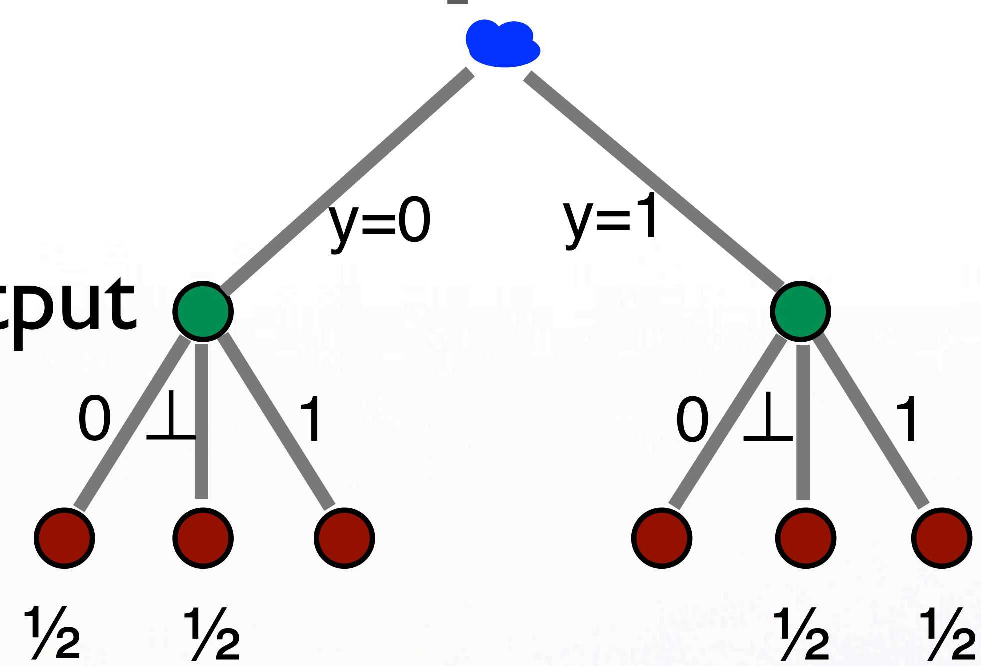

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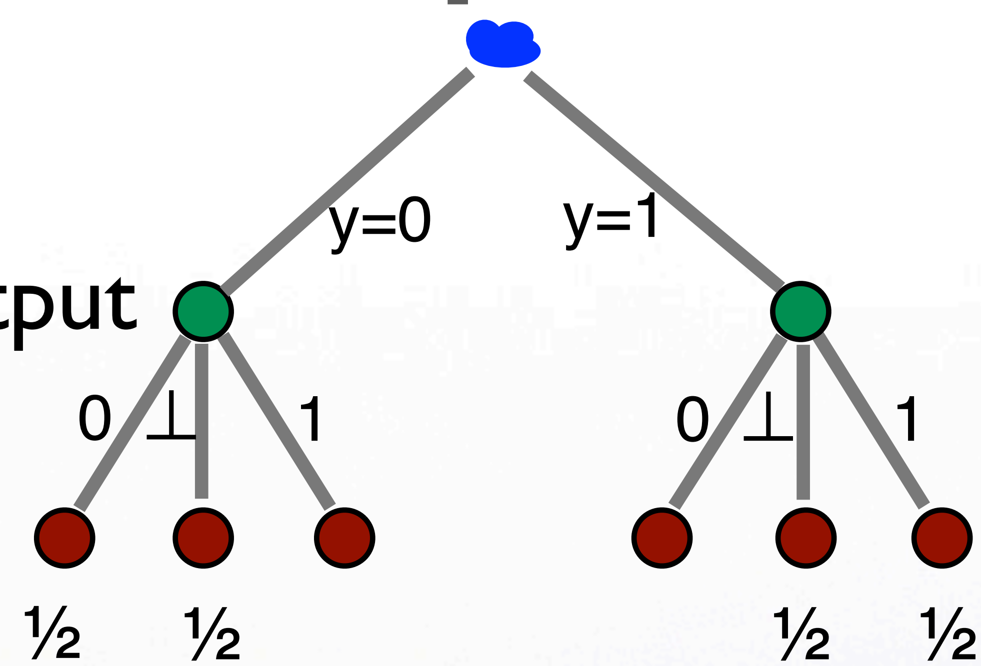

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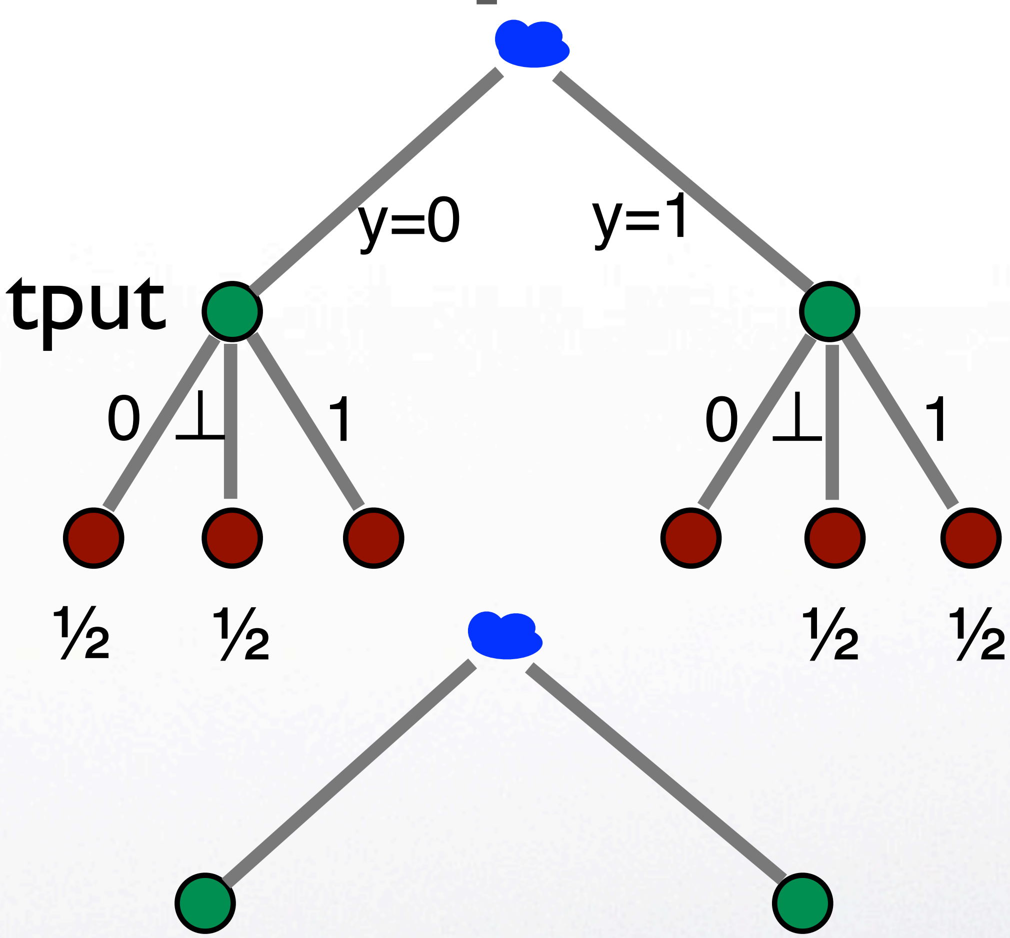

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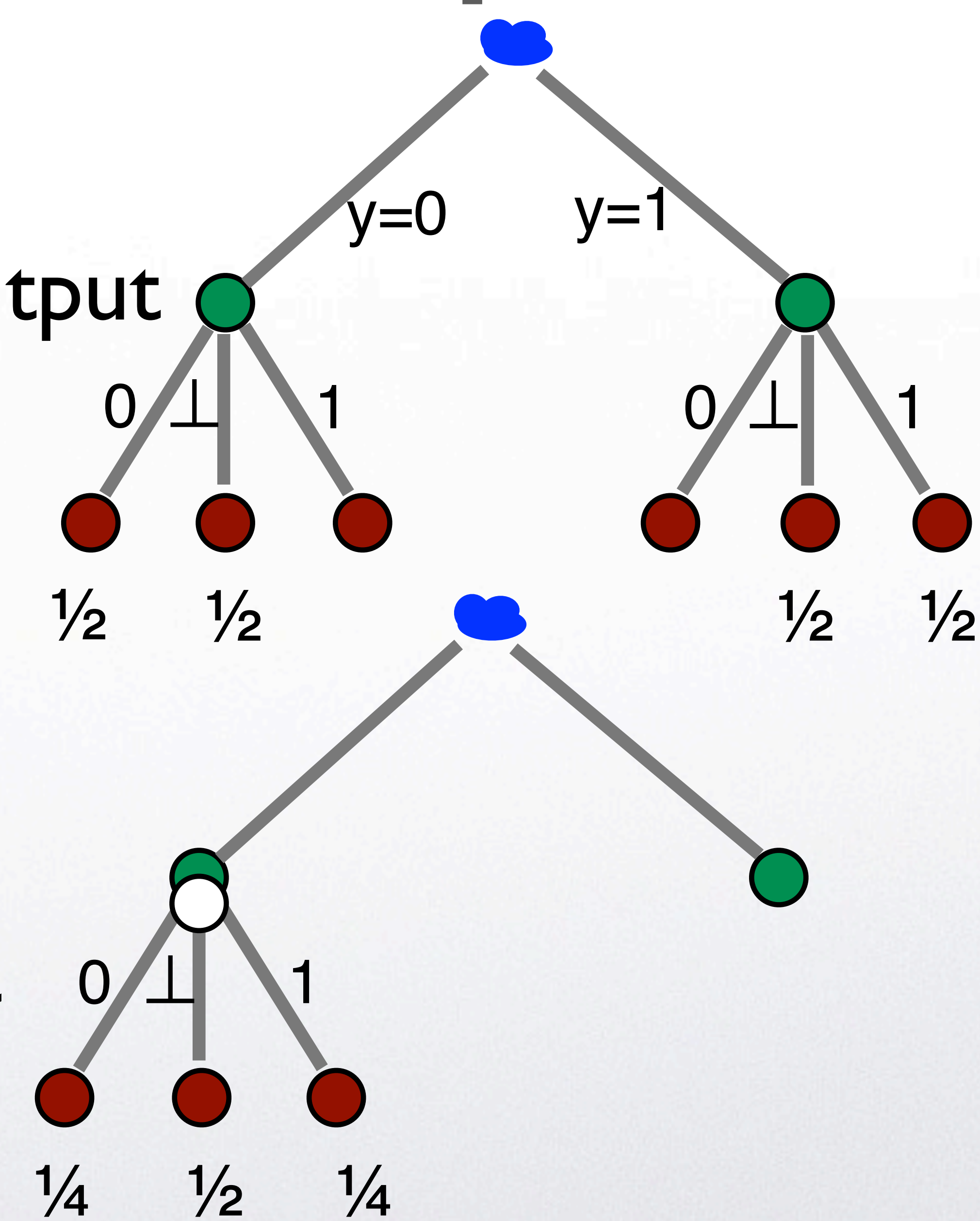

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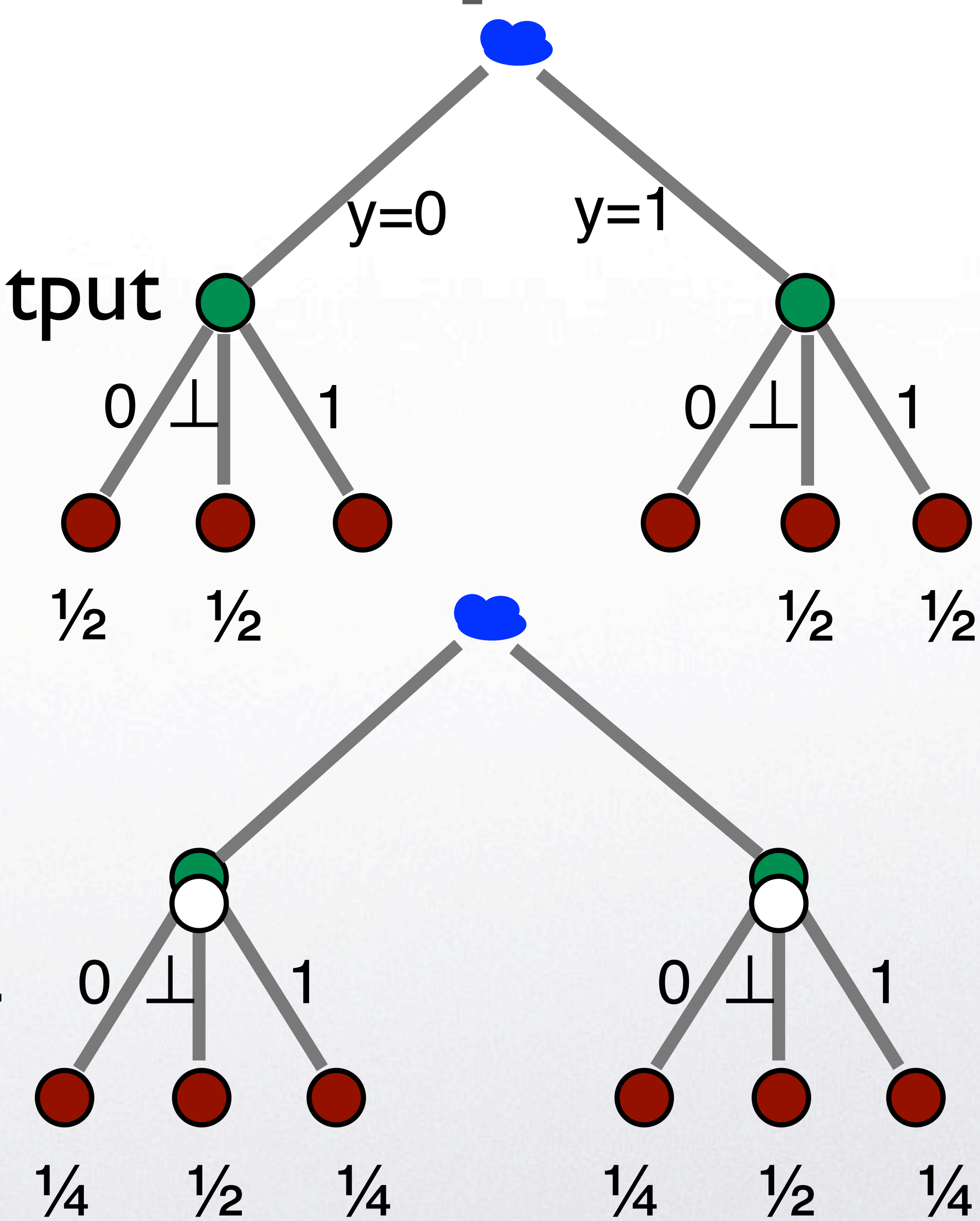

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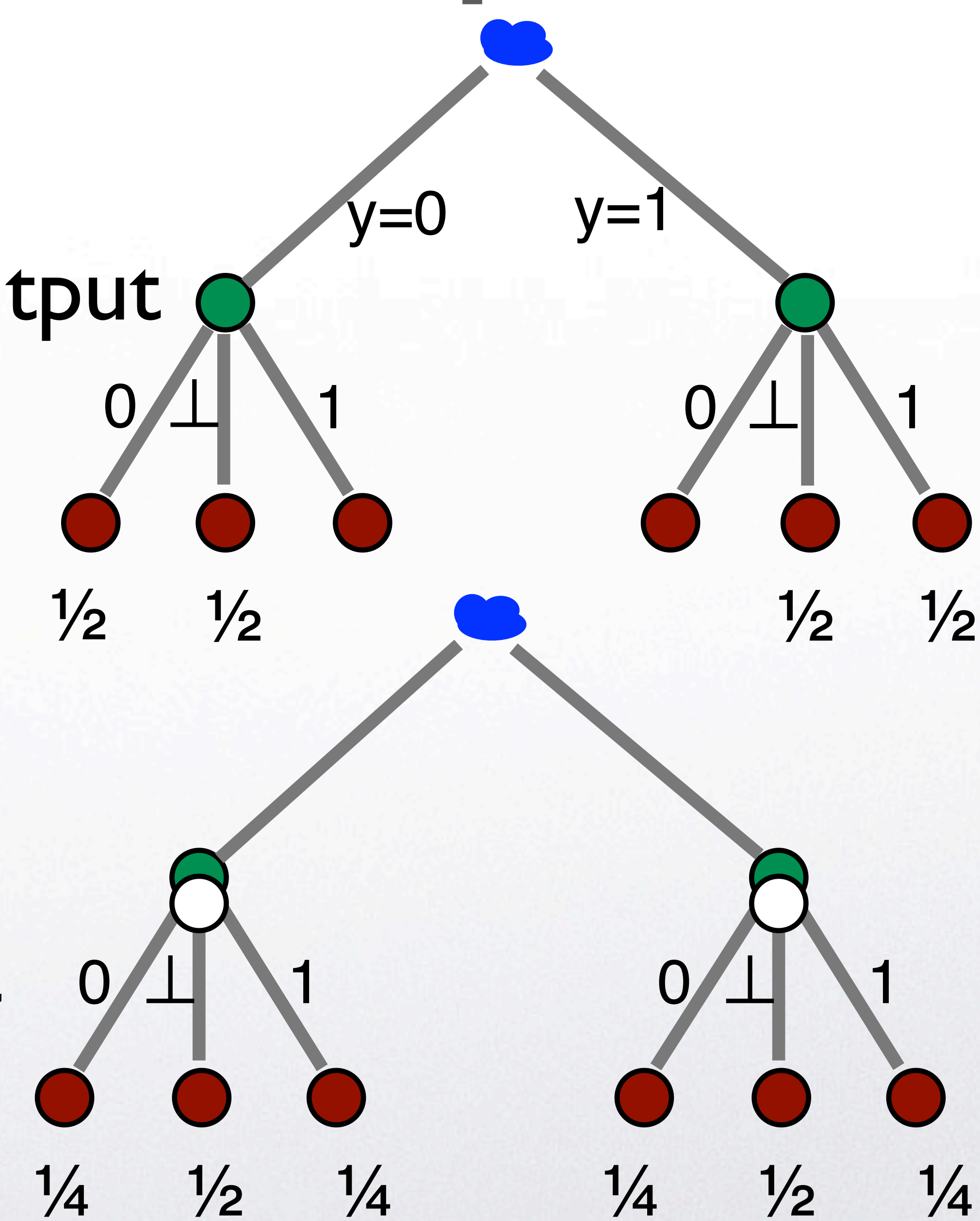

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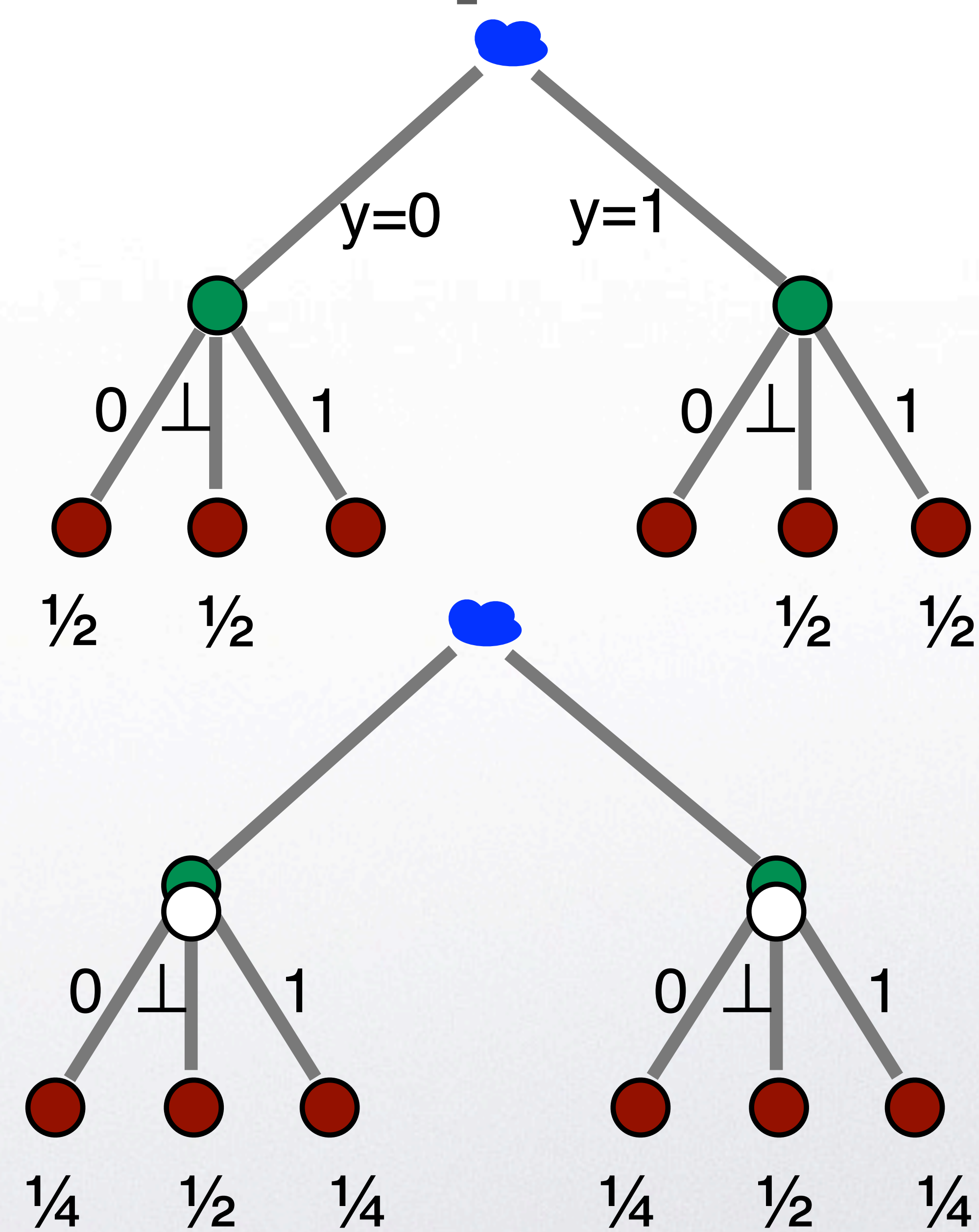

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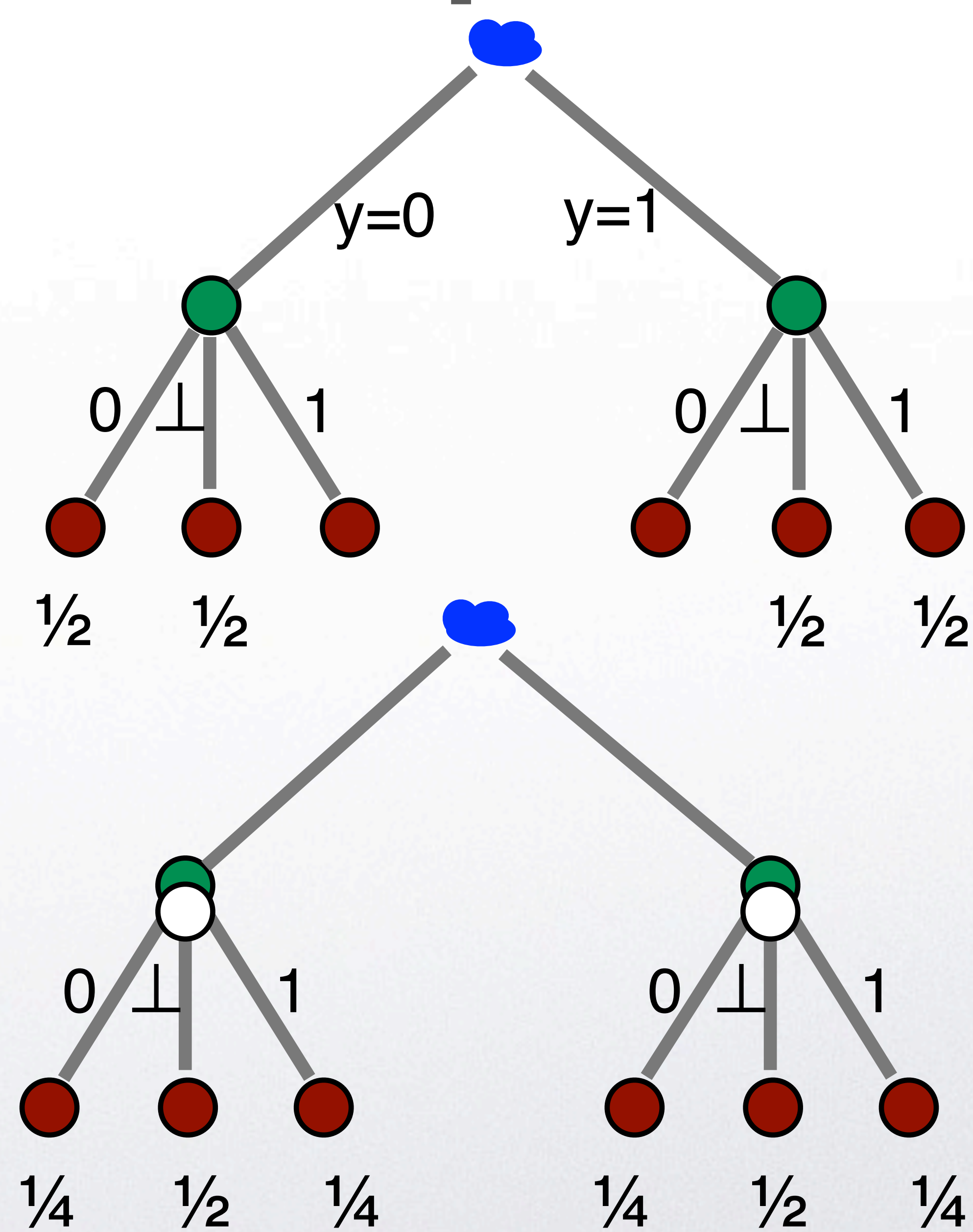

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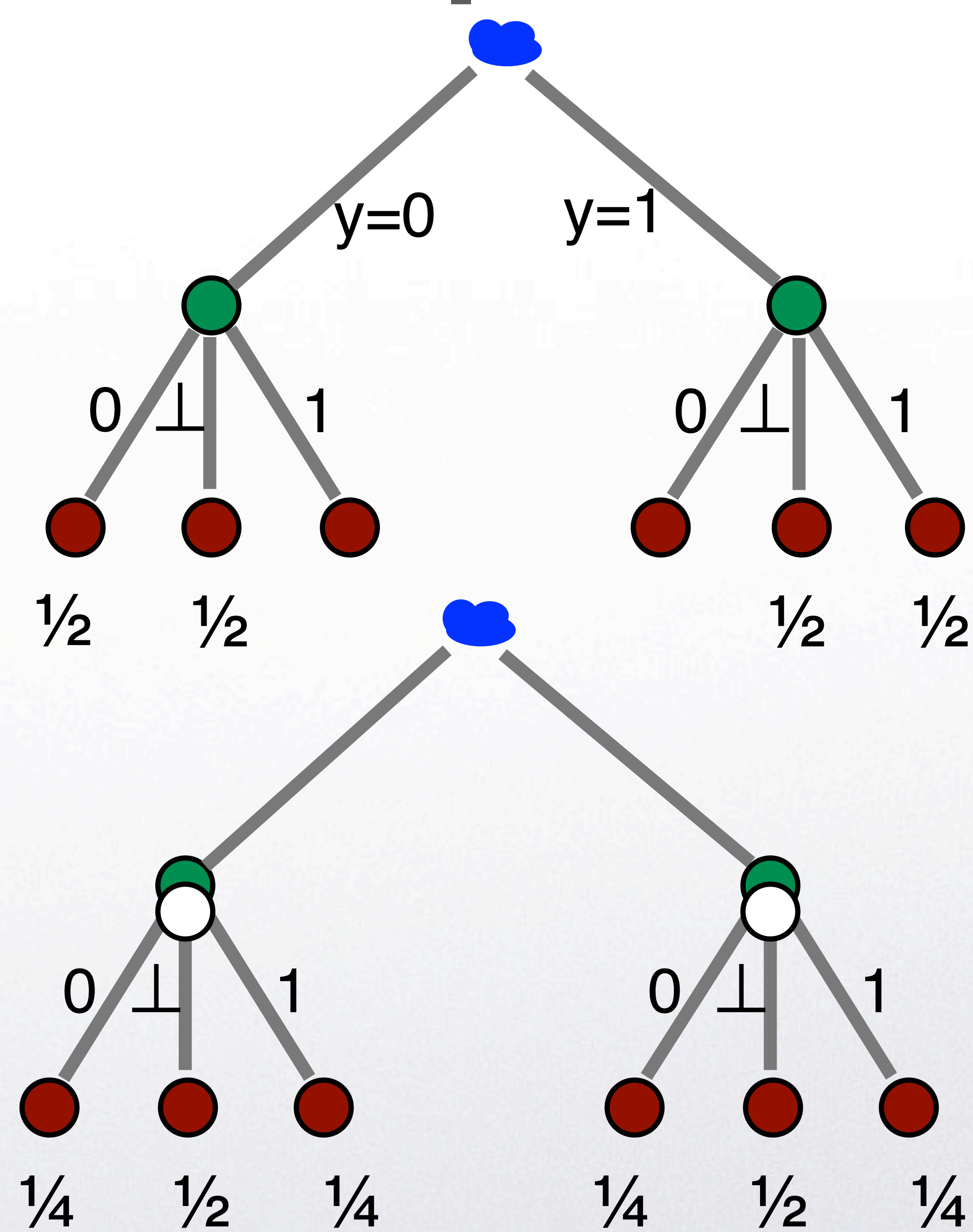

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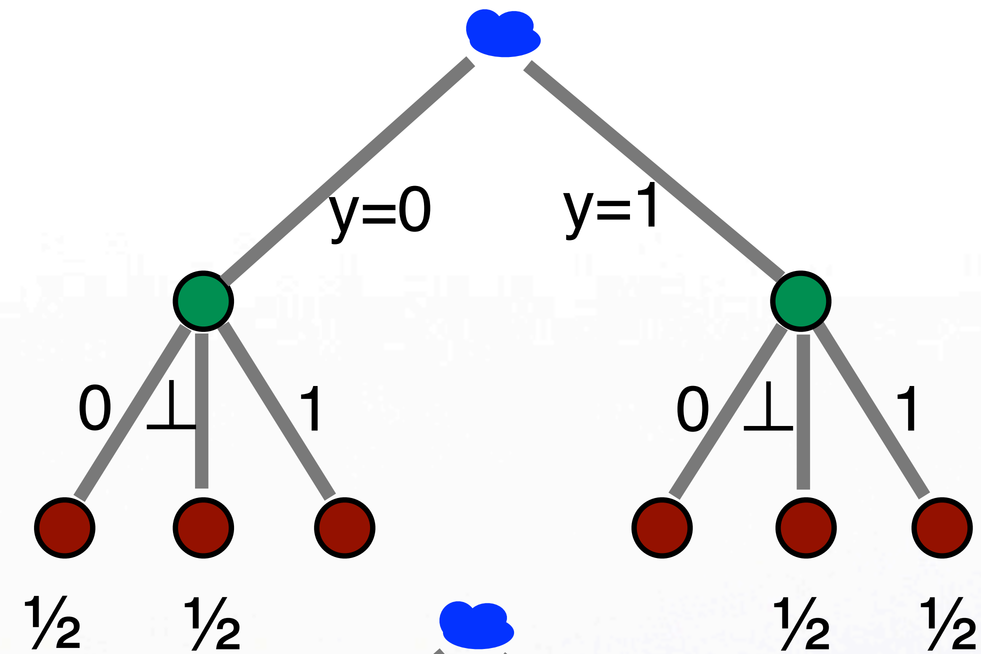

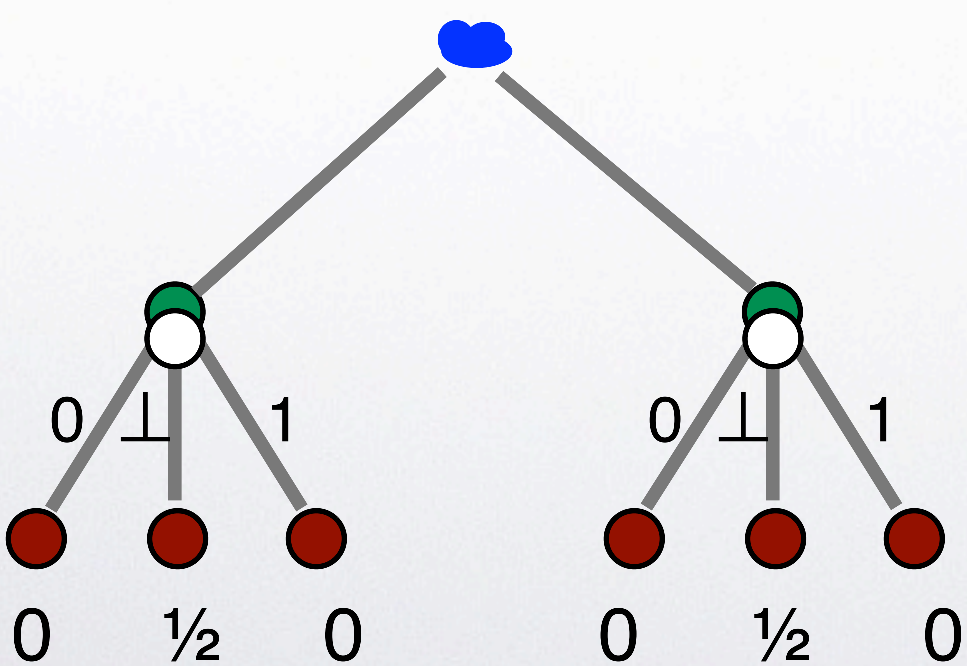

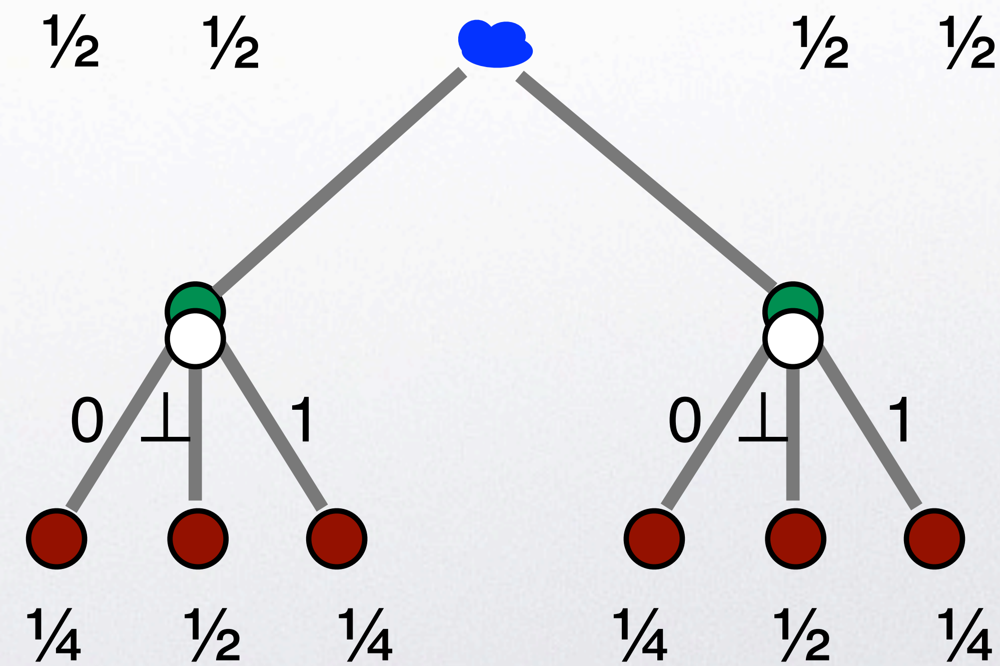

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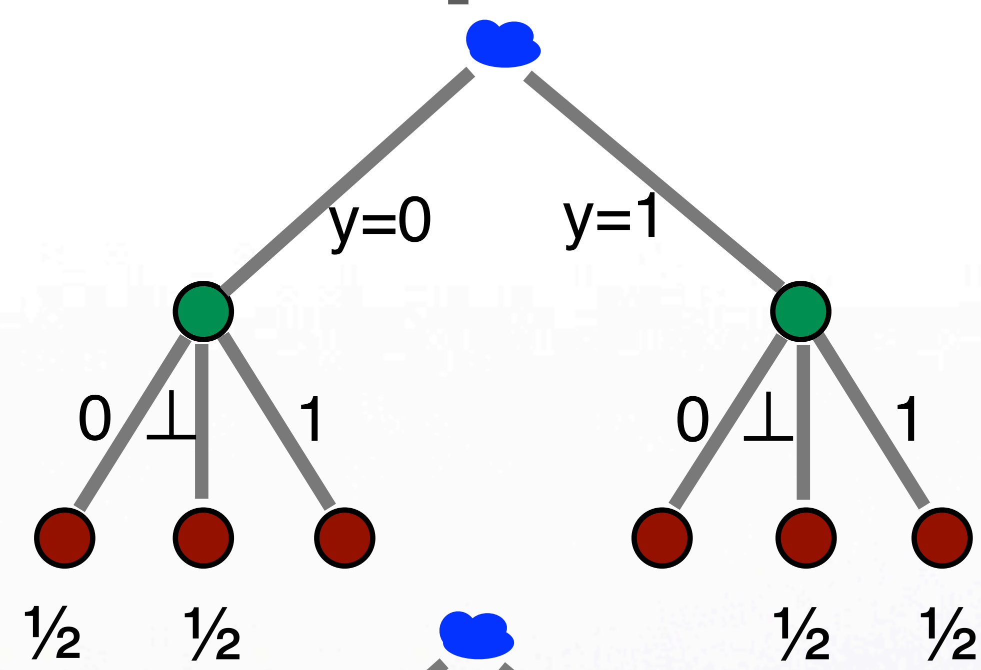

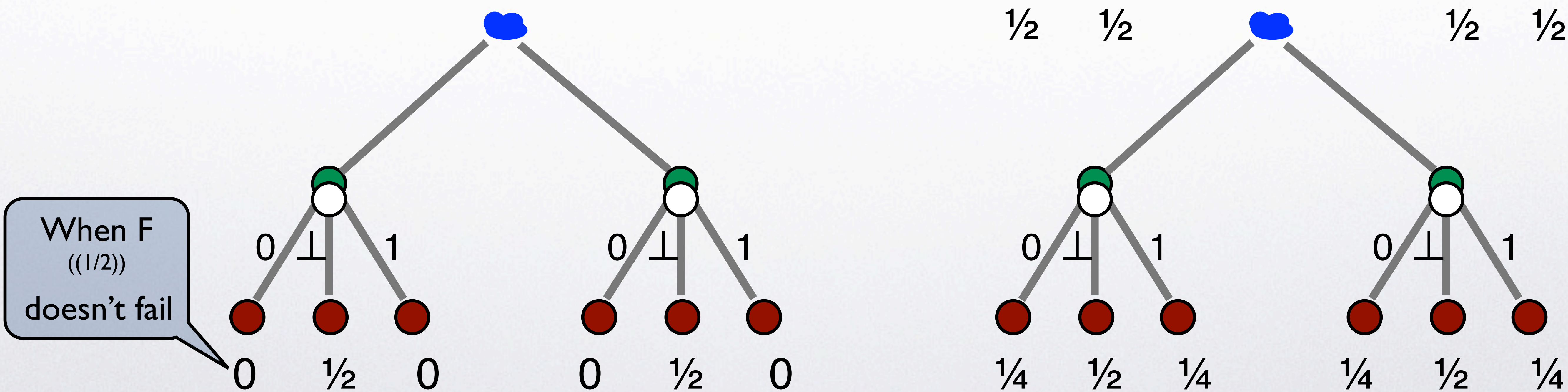

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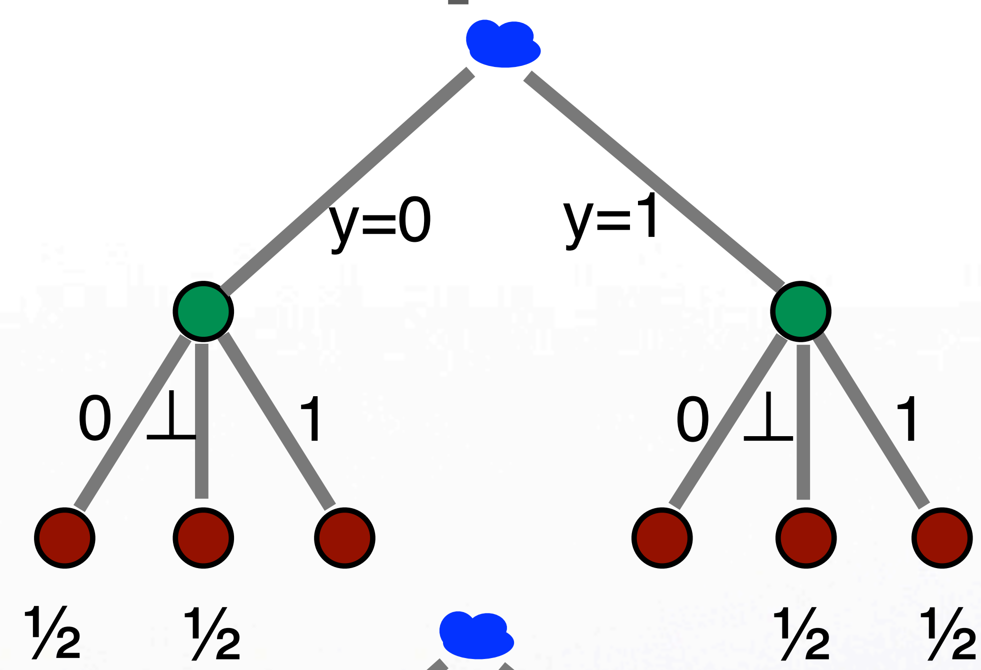

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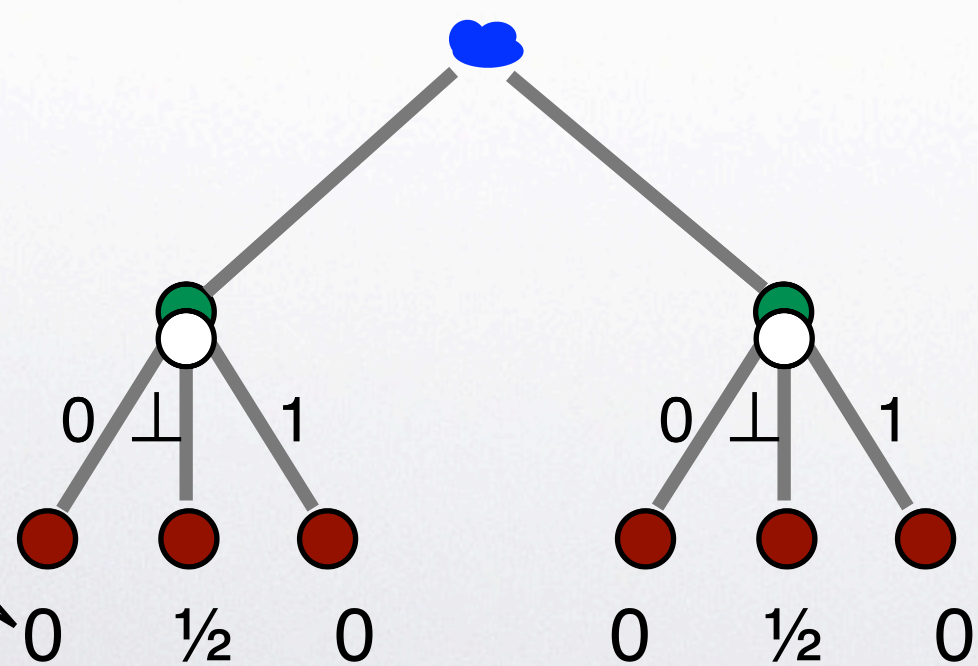

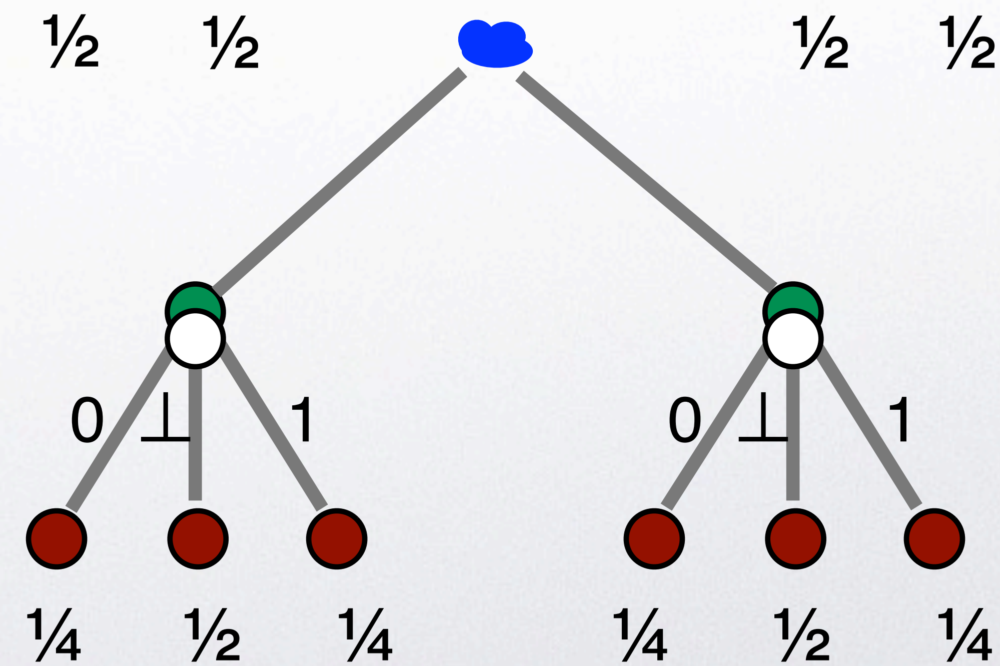

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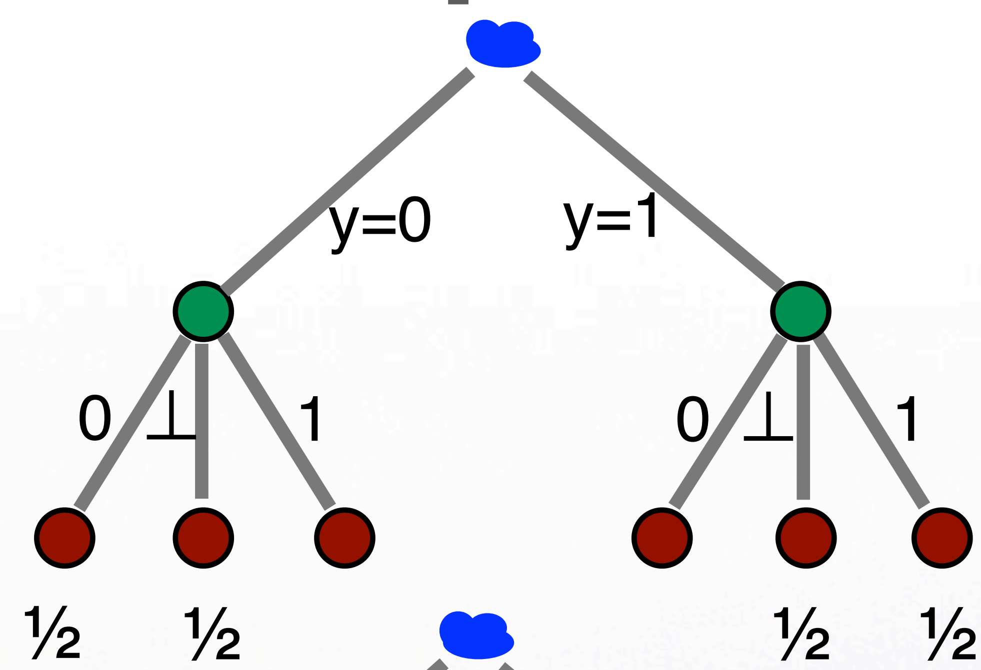

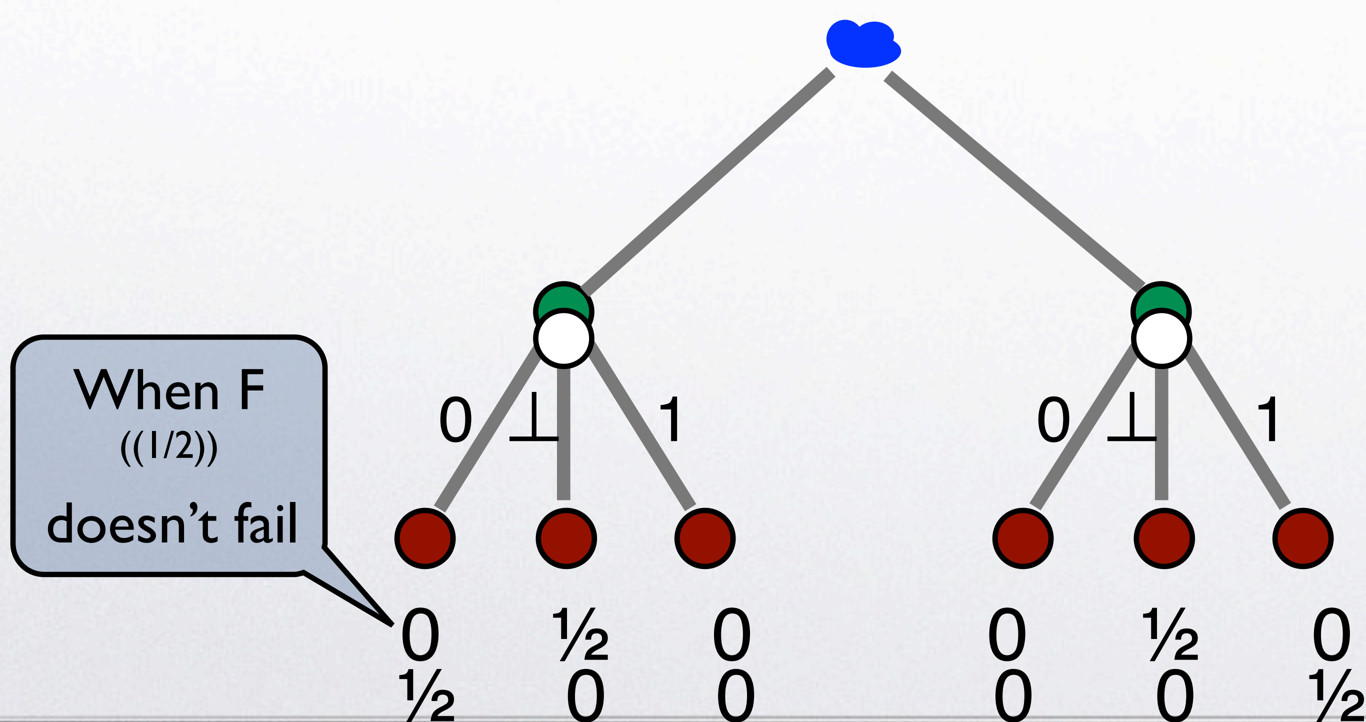

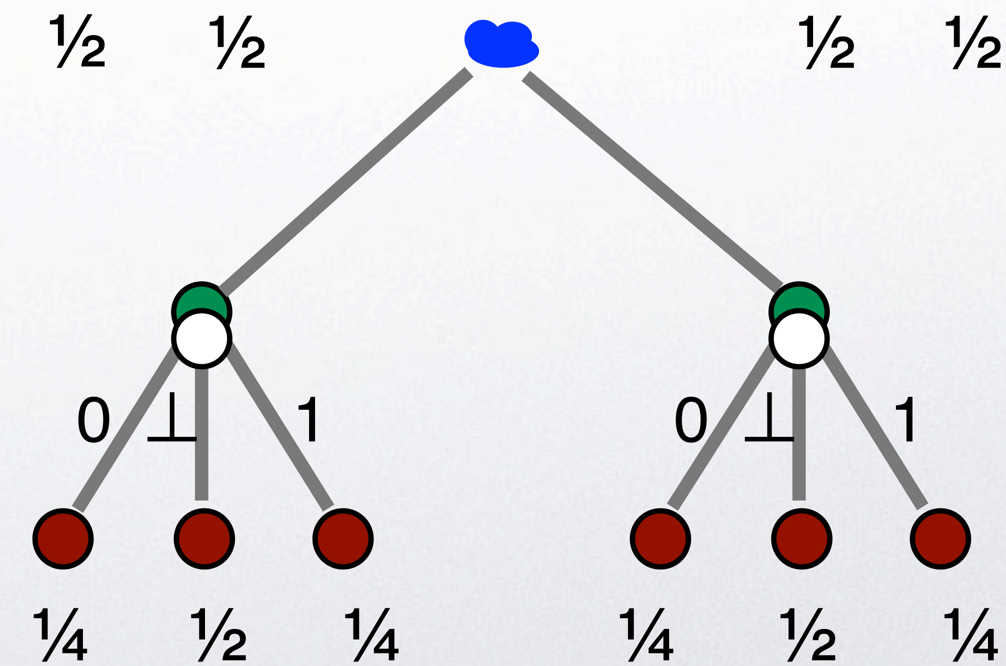

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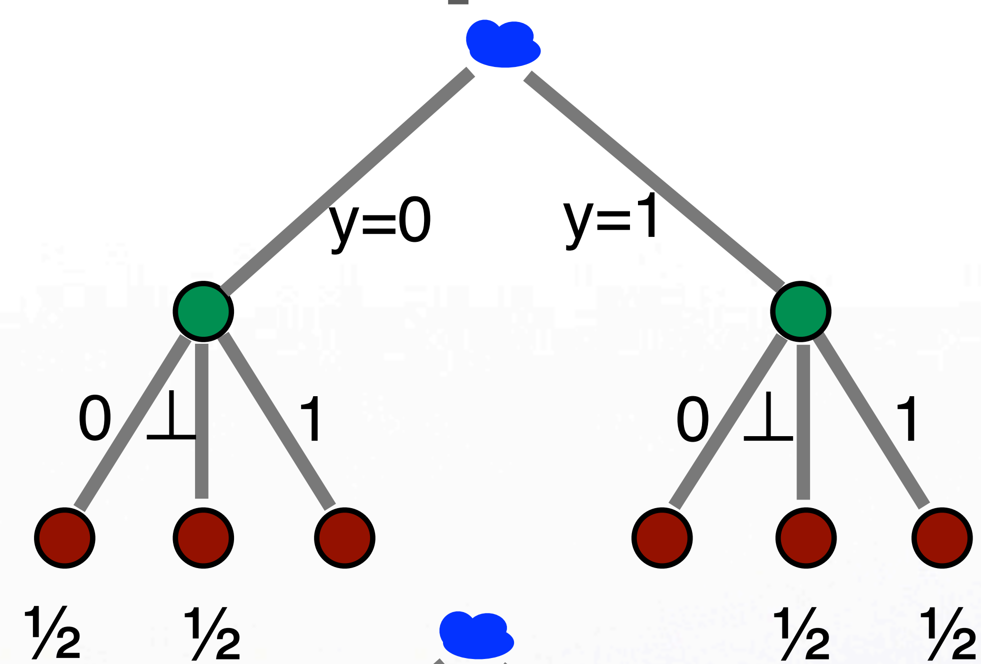

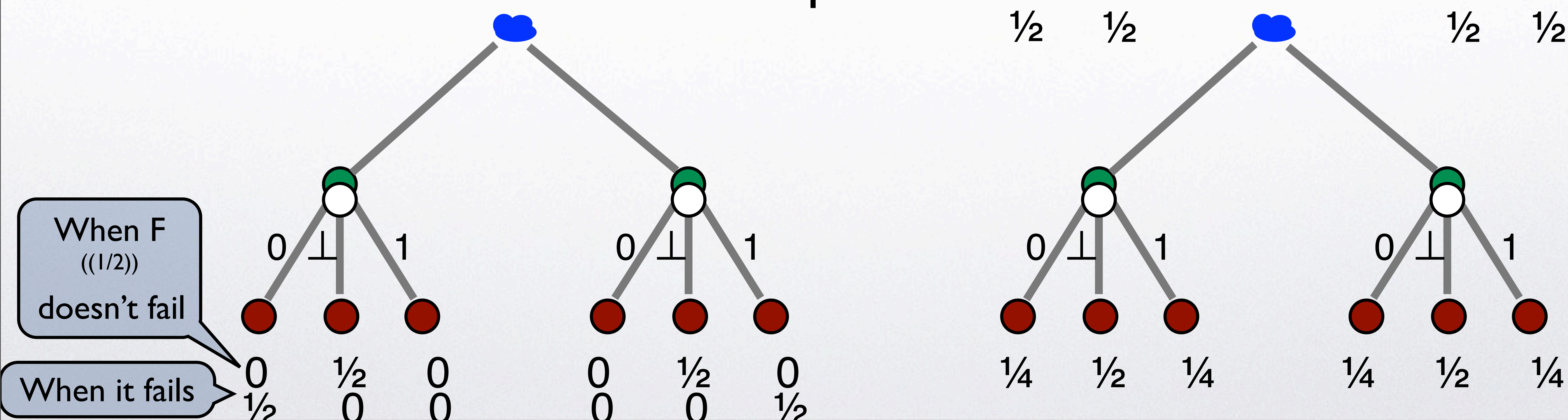

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  - But for us, this is a constant: fuzzy OLE is a (non-constant rate) OLE protocol instantiated with a constant security parameter

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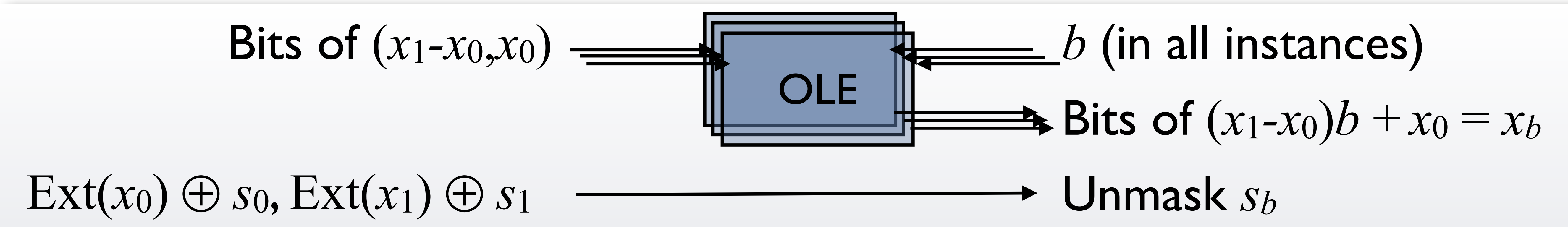
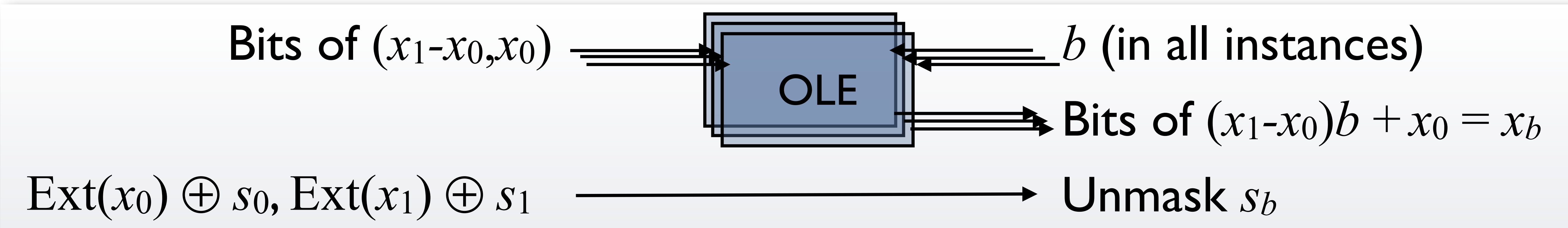


Shaky OLE to String-OT

- (Non-shaky) OLE to String-OT:



  - Alice "extracts" fewer than $n/2$ bits from each of x_0 and x_1 and sends $\mathrm{Ext}(x_0) \oplus s_0$ and $\mathrm{Ext}(x_1) \oplus s_1$ to Bob

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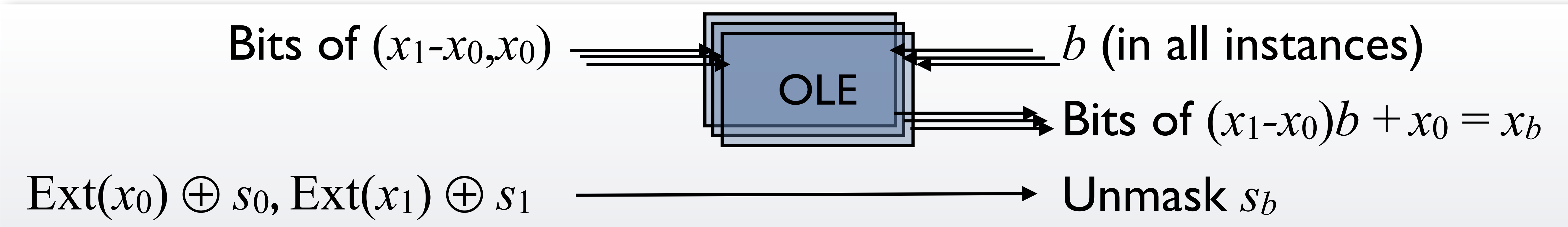

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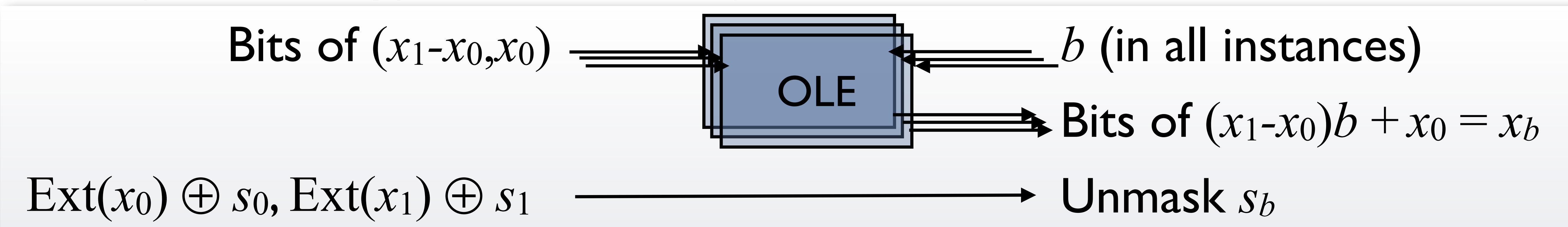

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- But with shaky OLE, Alice may learn Bob's input b (and Bob may learn more than $n/2$ bits each of x_0 and x_1)
- Fix: using a constant-rate encoding of x_0, x_1 and b

Shaky OLE to String-OT

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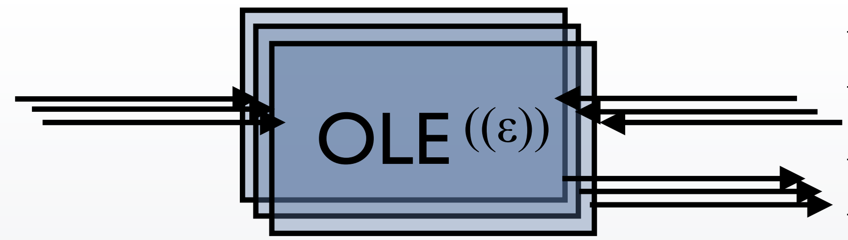
- Instantiated from an "MPC-friendly code" (a.k.a codex) of appropriate parameters [CC'06,IKOS'09, next talk]

Shaky OLE to String-OT

Shaky OLE to String-OT

Enc(x_1-x_0), Enc^2(x_0)



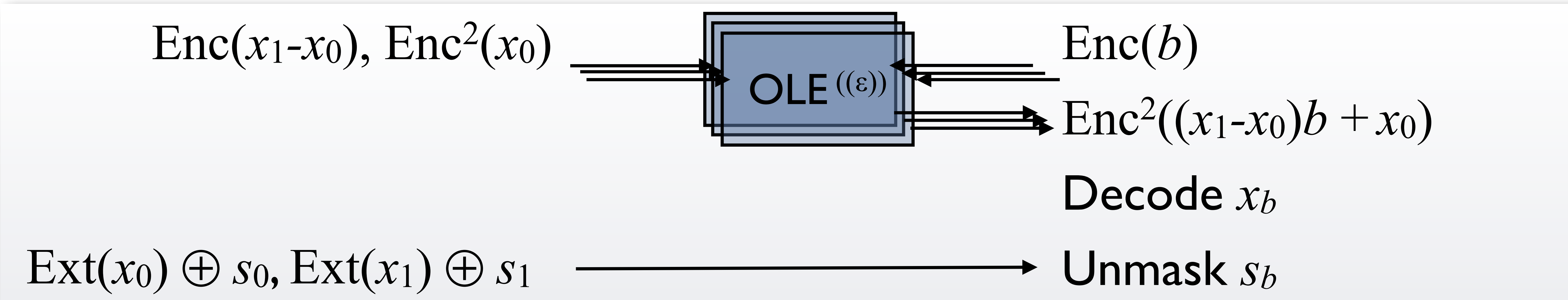
Enc(b)

Enc^2((x_1-x_0)b + x_0)

Decode x_b

Ext(x_0) $\oplus$ s_0, Ext(x_1) $\oplus$ s_1 → Unmask s_b

Shaky OLE to String-OT



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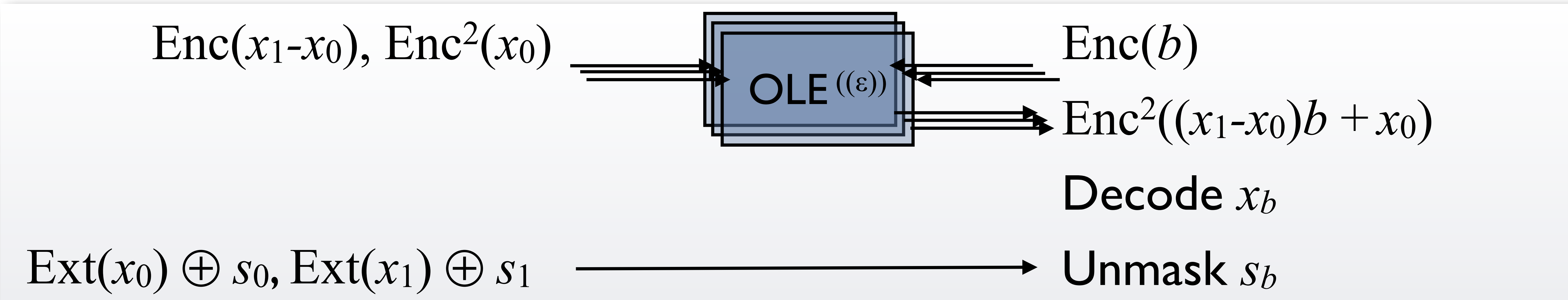

- Secure against Alice, since Bob can correct a constant fraction of errors, and since a small fraction of $\mathrm{Enc}(b)$ reveals nothing of b
- Secure against Bob, since he knows nothing of at least one of the extracted strings (even given the other one, and all that he gets in the protocol; relies on the randomization of $\mathrm{Enc}^2(x_0)$)

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Thank You!

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