Attribute-Based Cryptography

Lecture 18

And Pairing-Based Cryptography

Identity-Based Encryption

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- Without pairing: Using QR, Lattices, ...

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  - Required to be not degenerate: $e(g,g) \neq 1$

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- Decisional Bilinear DH assumption: (g^a,g^b,g^c,g^{abc}) is indistinguishable from (g^a,g^b,g^c,g^z). (a,b,c,z random)

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- Ciphertexts can be created (by anyone) by incorporating attributes/policies

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- Application: End-to-End privacy in Attribute-Based Messaging

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  - For efficiency need a small matrix

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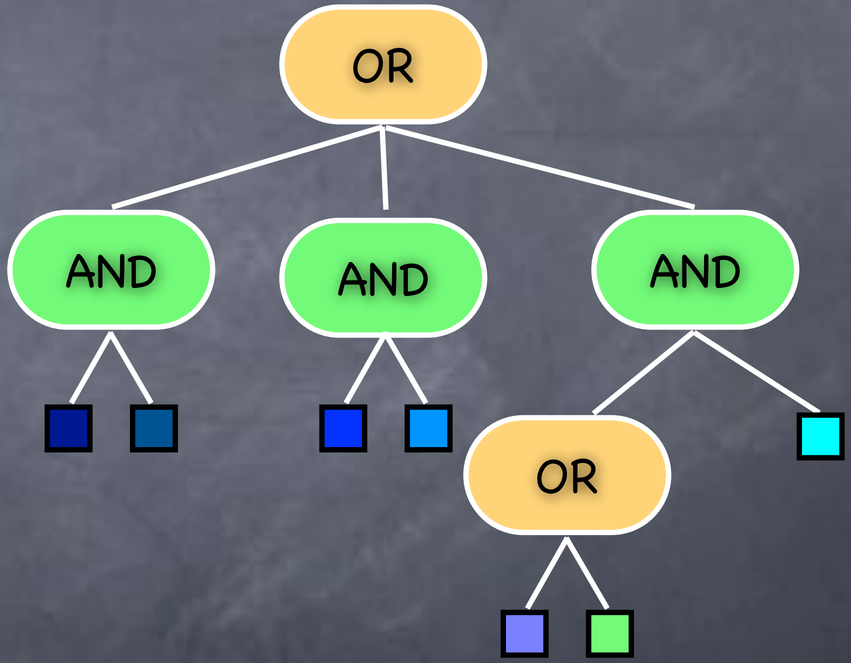

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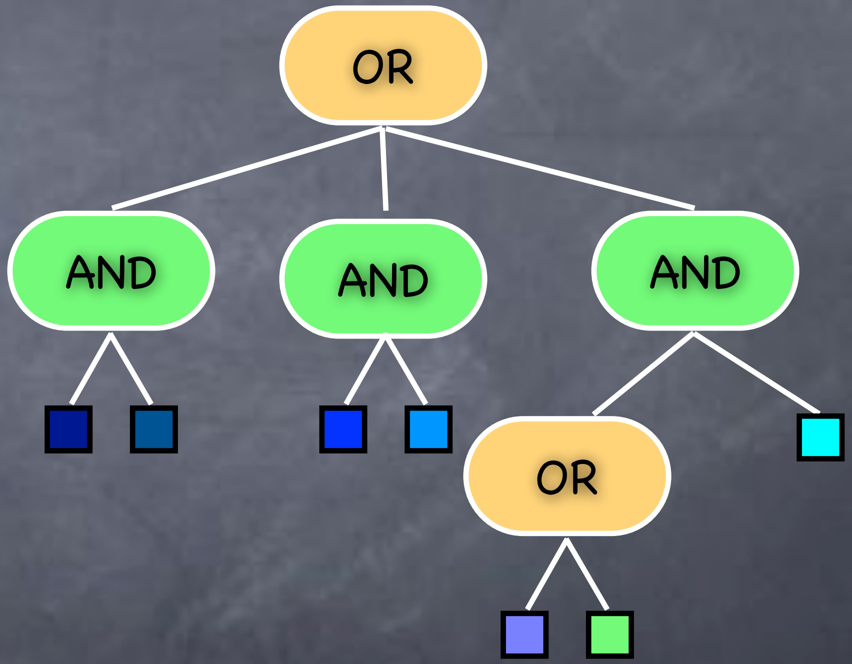

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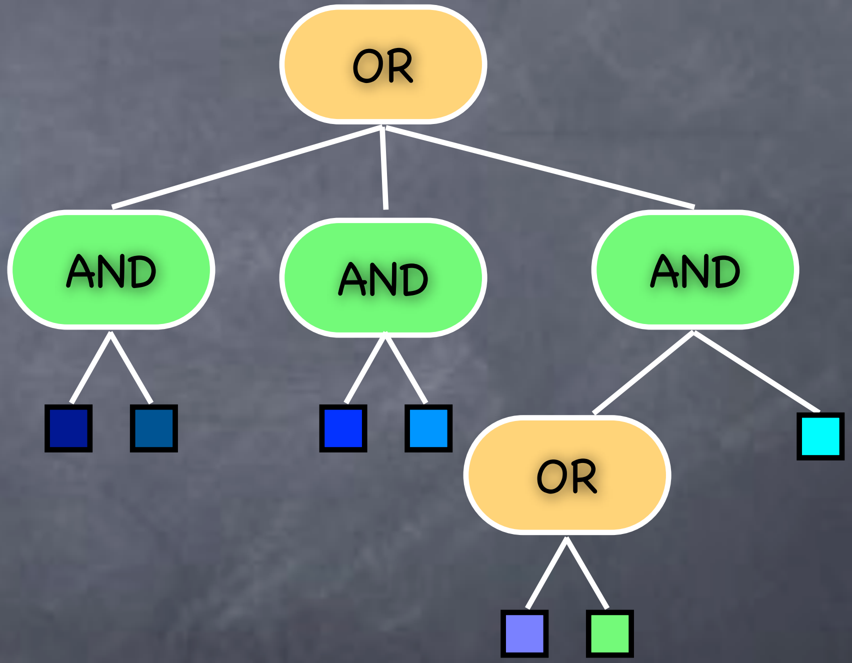

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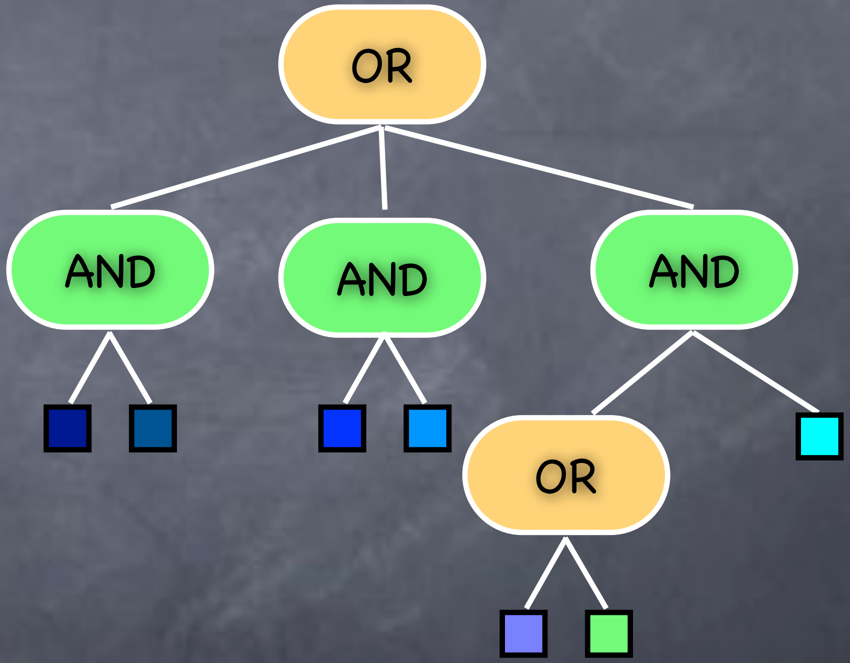

- Can allow threshold gates too

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A KP-ABE Scheme

- MPK: g, $Y=e(g,g)^y$, $T = (g^{t1},\ldots, g^{tn})$ (n attributes)
- MSK: y and t_a for each attribute a
- $\mathrm{Enc}(m,A;s) = (A, \{ T_a^s \}_{a\in A}, M.Y^s)$
- SK for policy L (with d rows): Let $u=(u_1 \ldots u_d)$ s.t. $\Sigma_i\ u_i = y$. For each row i, let $x_i = \langle L_i,u\rangle/t_{\mathrm{label}(i)}$. Let Key $X = \{ g^{x_i} \}_{i=1 \text{ to } d}$
- Dec ($(A,\{Z_a\}_{a\in A},c); \{X_i\}_{\mathrm{row}\ i}$) : Get $Y^s = \Pi_{i:\mathrm{label}(i)\in A}\ e(Z_{\mathrm{label}(i)},X_i)^{v_i}$ where $v = [v_1 \ldots v_d]$ s.t. $v_i=0$ if $\mathrm{label}(i) \notin A$, and $vL=[1\ldots1]$
- CPA security based on Decisional-BDH
  - Choosing a random vector u for each key helps in preventing collusion

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- Constructions based on the Decision Linear assumption
  - (f,g,h,f^x,g^y,h^{x+y}) and (f,g,h,f^x,g^y,h^z) indistinguishable for random f, g, h, x, y, z.

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- Using conventional tools. More efficiently using bilinear pairings.

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