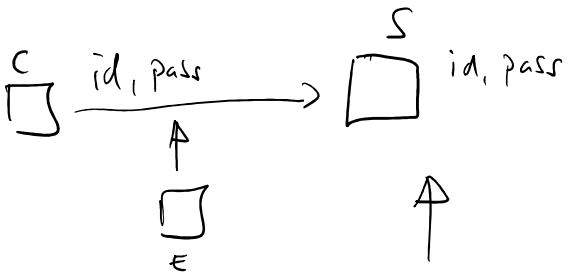
Tutorial XIII

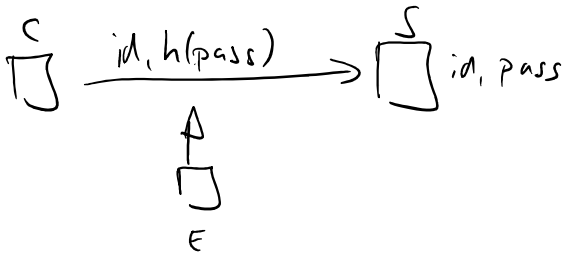
12 December 2019 10:02

identification - Kerberos protocol

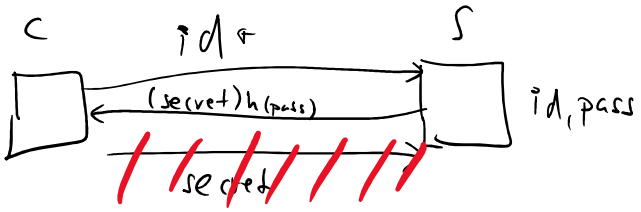
LFSR - linear feedback shift registers

Identification



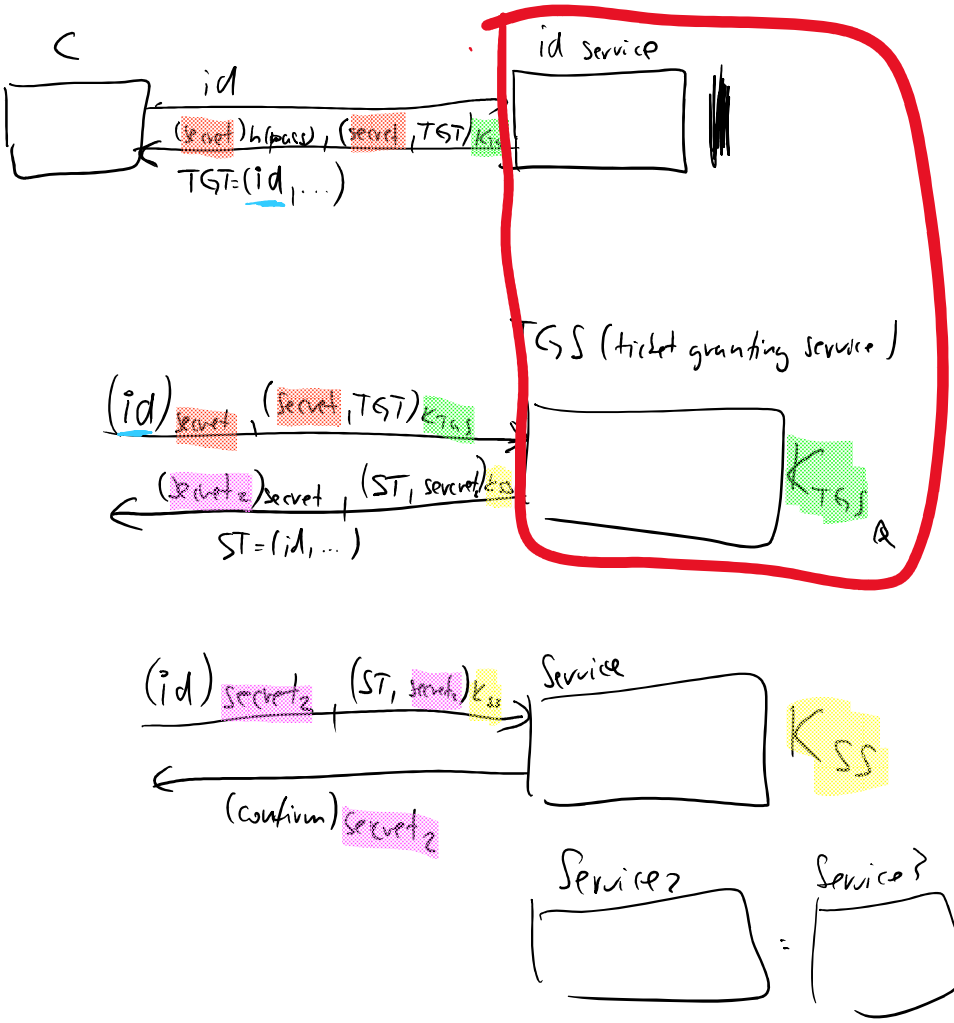


Basic idea



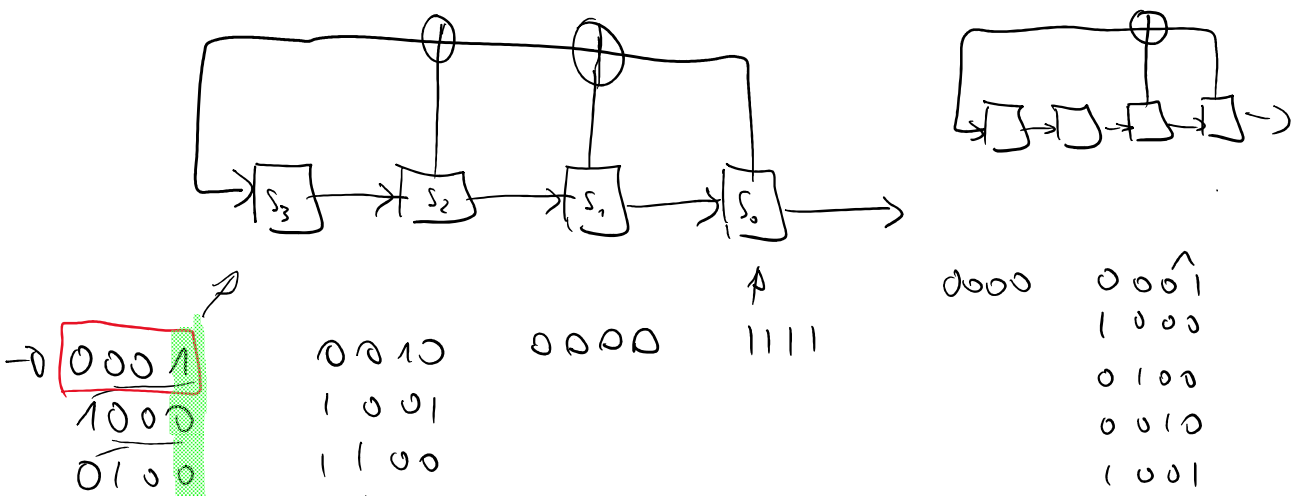
$h(pass) \sim h(pass, salt)$

Kerberos



LFSR - linear feedback shift register

(Pseudorandom number generators)



1000
0100
1010
1101
0110
0011
0001

1001
1100
1110
0111
1011
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0010

0010
1001
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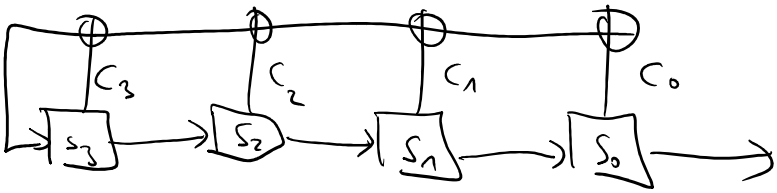
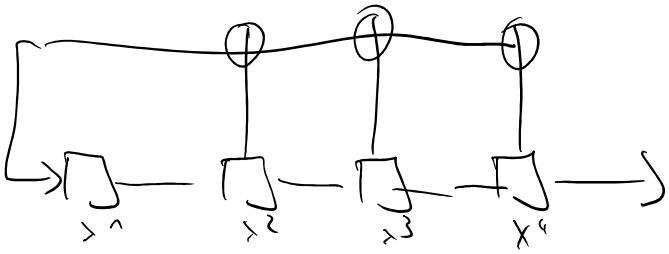
0011
0001

Characteristic polynomials



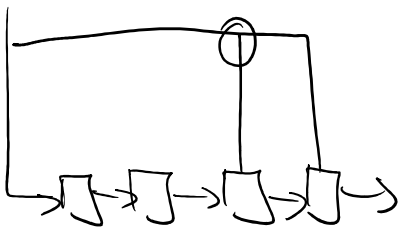
$c_i = 1$ iff s_i is used for feedback



$c_3 = 0 \quad c_2 = c_1 = c_0 = 1$

$f(x) = x^4 + x^3 + x^2 + 1$

$f(x) = \dots + \sum_{i}^{n} c_i x^i + 1$



$c_3 = c_2 = 0 \quad c_1 = c_0 = 1$

$f(x) = x^4 + x^3 + 1$

$$f(x) = \sum_{i=1}^{n} c_{n-i} x^i + 1$$

Thm

LFSR has a period $2^n - 1$ iff $f(x)$ is primitive in $\mathbb{Z}_2$.

irreducible polynomial – cannot be written as a product of 2 polynomials

Thm

each irreducible polynomial divides $x^k - 1$ for some k.
$\left(\deg(f) \le k \le 2^{\deg(f)} \right)$

primitive polynomial – irreducible of $\deg(f(x)) = n$,

divides $x^k - 1$ for $k = 2^{\deg(f(x))}$

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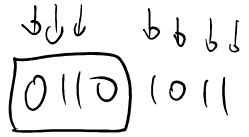
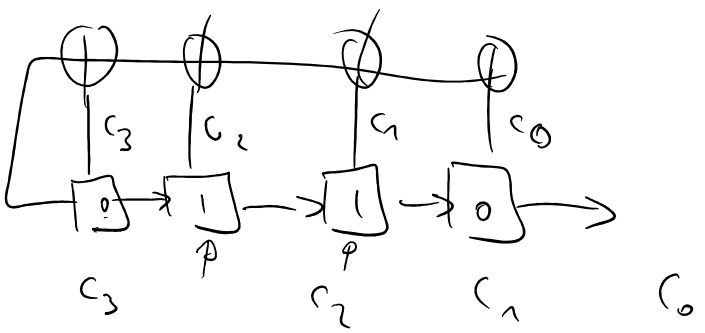
seed → LFSR → $2^{\text{seed}} - 1$ key to OTP

Susceptible to known plaintext attack ⇒ Attacker knows part of the key





$c_2 \oplus c_1 = 1$ 0 1 (1)

$c_3 \cdot (c_2 \oplus c_1) \oplus c_1 \oplus c_0$ $c_2 \oplus c_1$ 0 1

$c_3 \left(c_3 \cdot (c_2 \oplus c_1) \oplus c_1 \oplus c_0 \right) + \left((c_2 \oplus c_1) \cdot c_2 + c_0 \right)$ 1 $c_3 \cdot (c_2 \oplus c_1) \oplus c_1 \oplus c_0$ $c_2 \oplus c_1$ 0

$c_3 \cdot \left(c_3 \cdot \left[(c_2 + c_1) + c_1 + c_0 \right] + (c_2 + c_1) \cdot c_2 + c_0 \right) = 1$

Now we can solve 4 equations for $c_0 c_1 c_2 c_3$. We then have LFSR and it's initial vector $\Rightarrow$ whole key.