Technische Universität München (I7) — **Winter term 2017/2018**
Dr. M. Luttenberger / S. Jaax — **2018/12/13**

Solution

Cryptography – Questionnaire 3

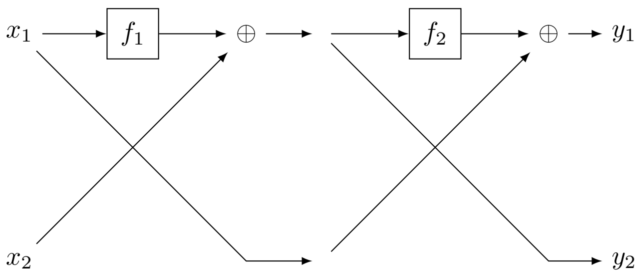
Name: ______________________________

Matr.: ______________________________

"One-liners"

Exercise 3.1 **Feistel-Networks** **1P+1P+1P = 3P**

Consider the two-round Feistel-Network drawn below, with $f_1, f_2 : \{0,1\}^n \to \{0,1\}^n$.



(a) Compute the outputs y_1, y_2 of the network for $x_1 = 0^n$ and $x_2 = 0^n$
Answer:______________________________ $y_1 = f_2(f_1(0^n))$, $y_2 = f_1(0^n)$

(b) Compute the outputs y_1, y_2 of the network for $x_1 = 0^n$ and $x_2 = f_1(0^n)$
Answer:______________________________ $y_1 = f_2(0^n)$, $y_2 = 0^n$

(c) Does the two-round Feistel-Network realize a PRP if used with two PRFs f_{k_1}, f_{k_2}? Why/why not?
Answer:______________________________ No.
We can build a distinguisher by querying x_1, x_2 from a). Then we know $f_{k_1}(0^n)$. This allows us to pose the query in b). If the result ends with 0^n we output 1. This gives us a huge advantage over guessing: the probability for a random oracle to output 0^n as the last bits is negligible (2^{-n})!

Exercise 3.2 **PRG from PRF** **2P**

Let F be a PRF with $l_{\text{in}}(n) = l_{\text{out}}(n) = n$. Construct from F a PRG G of stretch $2n$.

Answer: $G(k) :=$ ______________________________ $F_k(\lfloor 1 \rceil)||F_k(\lfloor 2 \rceil)$

Questions– 1P each = 5P

	true	false
Let F be a PRP, F-rCBC is computationally secret.	☒	☐
Let G be a PRG of stretch $s \cdot n$, then $F_k : \{0,1\}^{sn} \to \{0,1\}^{sn}$ defined by $F_k(x) = G(k) \oplus x$ is a PRF.	☐	☒
Let F be a PRF of block length $l(n) = n$. We define $\widetilde{F}$ for every $n \in \mathbb{N}$, $k \in \{0,1\}^n$ and $x_1 \dots x_{2n} \in \{0,1\}^{2n}$ by using F in a one-round Feistel-network: $$\widetilde{F}_k(x_1 \dots x_{2n}) = \mathsf{FN}_{F_k}(x_1 \dots x_n, x_{n+1} \dots x_{2n}).$$ $\widetilde{F}$ is a PRP of block length $2n$.	☐	☒
Let RO be a random function oracle of input and output length n. Then $G(k) := \mathsf{RO}(k)\|\mathsf{RO}(k)$ is a PRG of stretch $2n$.	☐	☒
Let F be a PRF. Then F-rCTR is CCA-secure.	☐	☒