TECHNISCHE FAKULTÄT

Elektrotechnik, Elektronik und Informationstechnik
Chemie- und Bioingenieurwesen
Werkstoffwissenschaften
Maschinenbau
Informatik

Practical Secure Function Evaluation

Diplomarbeit of Thomas Schneider, Supervision: Prof. V. Strehl and V. Kolesnikov, PhD
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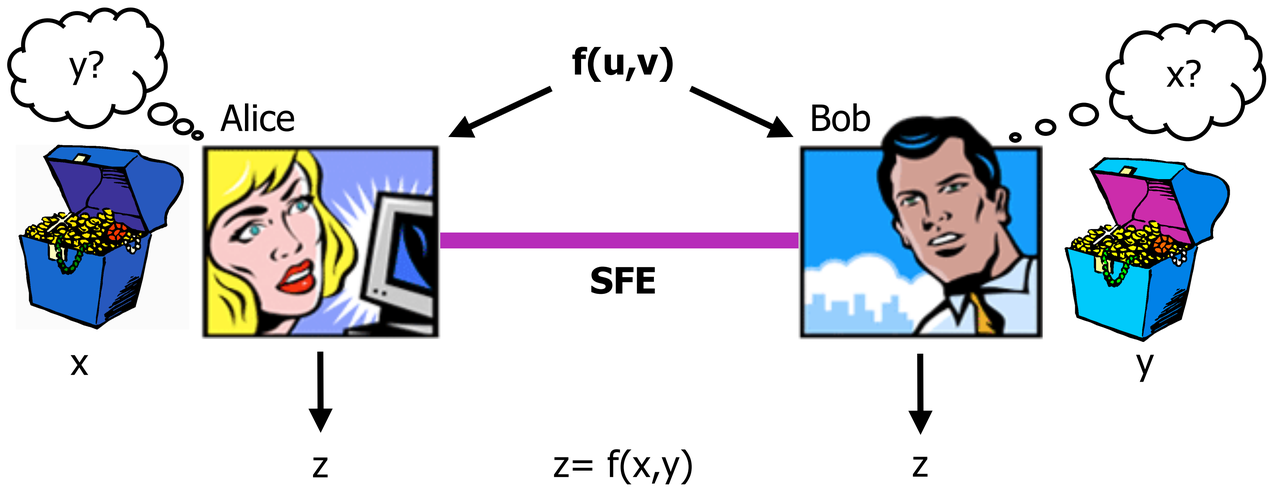
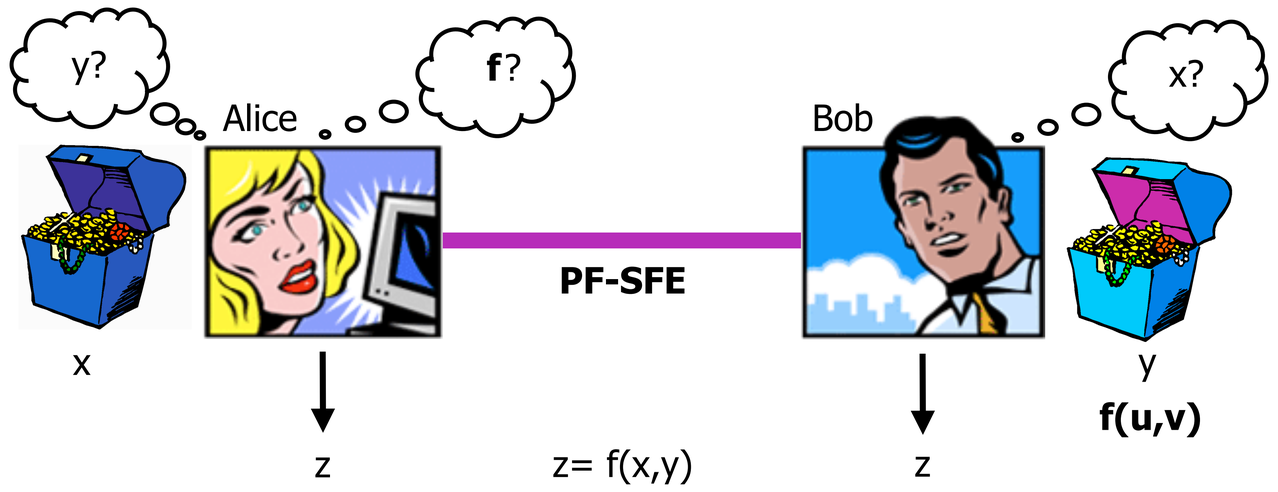
Secure Function Evaluation (SFE) allows two parties Alice and Bob to securely evaluate a function f(u,v) on their private inputs x and y:
- each party learns the result z = f(x,y)
- each party learns nothing about the other party's secret y resp. x



Practical Examples:
- Millionaires Problem (Maximum)
- Auctions
- Voting
- Keyed Database Search
- ...

Secure Function Evaluation of Private Functions (PF-SFE) - same as SFE with additionally f being private:
- f is known by Bob only
- Alice learns nothing about f (besides size, #inputs and #outputs)



Practical Examples:
- No-Fly-List Checking
- Privacy-Preserving Credit Report (or Medical History) Checking
- Mobile Code (executed in untrustworthy environment)
- Privacy-Preserving Database Querying (e.g. patent database)
- ...

Contents and Contributions of this Thesis:

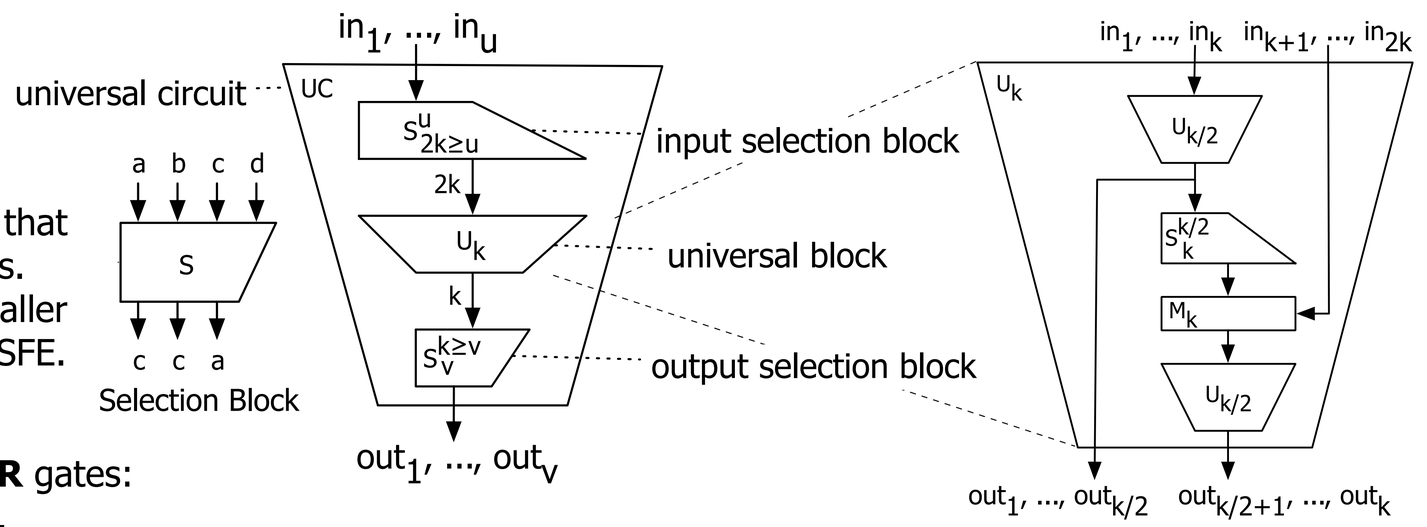
Summary and comparison of **known SFE protocols** with different representations of the boolean function f as boolean circuit or ordered binary decision diagram (OBDD).

parties follow protocol but try to learn additional information | parties may cheat arbitrarily | usage of Random Oracles

Function Represent.	SFE Protocol	Proof of Security: semi-honest	malicious	RO	Evaluation Speed (Encryption Scheme)
Circuit	Yao [Yao86]	X			slow (E_{spec})
	Fairplay [MNPS04]	X	X	X	medium (H)
	GESS [Kol05]	X			very fast (XOR)
	improved SFE	X	X	X	medium/very fast (H/XOR)
OBDD	OBDD SFE [KJGB06]	X			slow (E_{spec})
	improved OBDD SFE	X	X		fast (E)

Extension of OBDD-based SFE protocol [KJGB06] (secure in semi-honest model) to malicious model and **OBDD-based PF-SFE protocol** with small overhead.

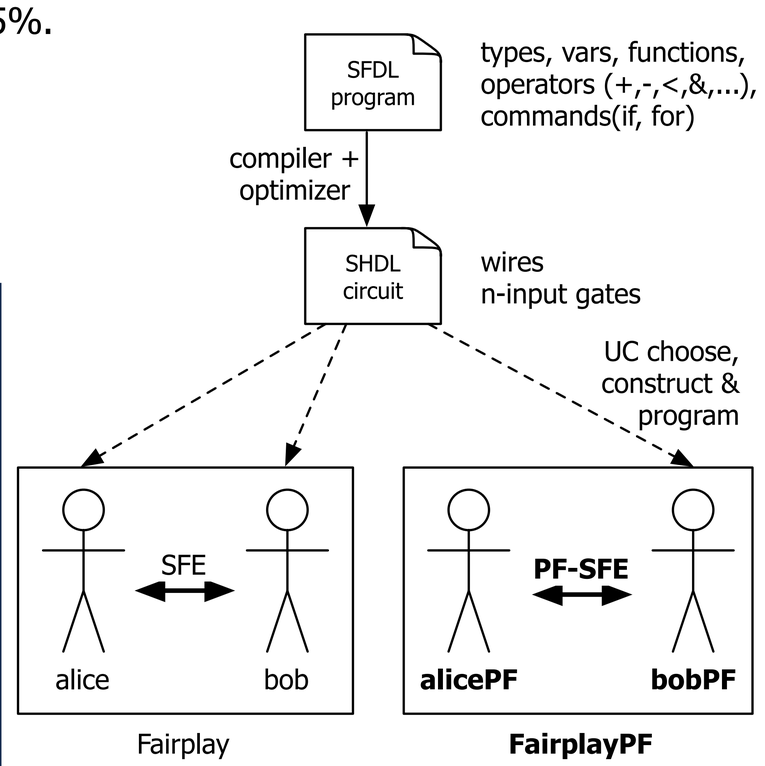
PF-SFE can be reduced to SFE of a Universal Circuit (UC) that can be programmed to compute any function f of size k gates. Our **practical UC construction*** [KS08] is up to 50% smaller than the best UC of Valiant [Val76] when used in today's PF-SFE.



Our **improved SFE protocol*** allows **free** evaluation of **XOR** gates:
- Based on SFE protocols Fairplay [MNPS04] & GESS [Kol05].
- Improves many important functions (e.g. addition, equality test) to 50%.
- UC-based PF-SFE protocols can be improved to even 25%.

Implementation of **FairplayPF**, an extension of the well-known Fairplay SFE system for practical PF-SFE.

http://thomaschneider.de/FairplayPF



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