

Cryptography Principles

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What cryptography is and is not

Cryptography is:

- A tremendous tool
- The basis for many security mechanisms
- Secure communication:
 - web traffic: HTTPS (SSL/TLS)
 - wireless traffic: 802.11i WPA2 (and WEP), GSM, Bluetooth
 - encrypting files on disk: EFS, TrueCrypt
 - content protection: DVD (CSS), Blu-ray (AACs)
 - user authentication

Cryptography is **NOT**:

- The solution to all security problems
- Reliable unless implemented and used properly
- Something you should try to invent yourself

- Classic cryptography, Perfect Secrets
- Private Key Encryption, MAC, Block Cipher, OWF
- Number Theory, Factoring and Discrete Log
- Key Management, Public Key, Digital Signature
- TPD, Random Oracle Model
- Cryptographic Protocols (Many magics here)

We will learn to read comics [xkcd:177]

I'M SURE YOU'VE HEARD ALL ABOUT THIS SORDID AFFAIR IN THOSE GOSSIPY CRYPTOGRAPHIC PROTOCOL SPECS WITH THOSE BUSYBODIES SCHNEIER AND RIVEST, ALWAYS TAKING ALICE'S SIDE, ALWAYS LABELING ME THE ATTACKER.



YES, IT'S TRUE. I BROKE BOB'S PRIVATE KEY AND EXTRACTED THE TEXT OF HER MESSAGES. BUT DOES ANYONE REALIZE HOW MUCH IT HURT?



HE SAID IT WAS NOTHING, BUT EVERYTHING FROM THE PUBLIC-KEY AUTHENTICATED SIGNATURES ON THE FILES TO THE LIPSTICK HEART SMEARED ON THE DISK SCREAMED "ALICE."



I DIDN'T WANT TO BELIEVE. OF COURSE ON SOME LEVEL I REALIZED IT WAS A KNOWN-PLAINTEXT ATTACK. BUT I COULDN'T ADMIT IT UNTIL I SAW FOR MYSELF.



SO BEFORE YOU SO QUICKLY LABEL ME A THIRD PARTY TO THE COMMUNICATION, JUST REMEMBER: I LOVED HIM FIRST. WE HAD SOMETHING AND SHE TORE IT AWAY. SHE'S THE ATTACKER, NOT ME. NOT EVE.



We will learn from Turing Award recipients

- 1995 Manuel Blum
- 2000 Andrew Yao
- 2002 R. Rivest, A. Shamir, L. Adleman
- 2012 S. Micali, S. Goldwasser
- 2013 L. Lamport

Purposes

- Learn what the rigorous information security is
- Learn how to secure information rigorously
- Learn how mathematics interplays with engineering

Textbook: **Introduction to Modern Cryptography**, *Jonathan Katz and Yehuda Lindell*, Chapman & Hall/CRC.

MOOC: Stanford Dan Boneh's Cryptography @Coursera

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- Composition:

Homework: $4 \times 5 = 20\%$ (Homework 1~5)

Final Exam: 80%

Extra: 5% for outstanding homework (Homework 1~6)

- How to score high:

- Read the textbook IMC
- Do homework by yourself
- **No Plagiarism! Otherwise, -10 point penalty each time.**