高级密码组件及其应用
教学大纲

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课程信息

课时/学分: 20/1

课程属性: 高级强化课

主讲教师：陈宇

中文名称: 高级密码组件及其应用

英文名称：Advanced Cryptographic Primitives and Their Applications

教学目的、要求

本课程重点介绍理论密码学中的高级密码组件, 旨在使学生精通若干高级密码组件 (包括各类高级单向函数、程序混淆和受限伪随机函数、不可延展非交互式证明、哈希证明系统等) 的概念和构造, 并掌握其在公钥密码学中的重要应用。本课程旨在帮助学生在《理论密码学》课程之上进一步拓宽加深密码理论基础, 追踪科研前沿进展.

预修课程: 理论密码学 (强烈建议选课同学课前阅读相关参考文献)

主要内容

第一讲: 高级单向函数 I(3 学时)

1. 有损陷门函数的概念
2. 有损陷门函数的构造
3. 有损陷门函数的应用

参考文献 [PW08]

第二讲: 高级单向函数 II(3 学时)

1. 相关积陷门单向函数的概念与构造
2. 自适应单向陷门函数的概念与构造
3. 自适应单向陷门函数的应用

参考文献 [RS09, KMO10]

第三讲: 非交互式零知识证明及其应用 (3 学时)

1. Naor-Yung 双重加密范式
2. Dolev-Dwork-Naor 构造
3. 不可延展非交互式零知识证明及其应用

参考文献 [NY90, DDN00, Sah99]

第四讲: 哈希证明系统及其应用 (3 学时)

1. 哈希证明系统的定义及构造
2. 哈希证明系统在 CCA 安全中的应用
3. 哈希证明系统在 KDM 安全和抗泄漏安全中的应用

参考文献 [CS02, QL13, Wee16]

第五讲: 可提取哈希证明系统及其应用 (3 学时)

1. 可提取哈希证明系统的定义及构造
2. 可提取哈希证明系统在 CCA 安全中的应用
3. 自适应单向陷门关系

参考文献 [Wee10]

第六讲: 程序混淆与受限伪随机函数 (3 学时)

1. 程序混淆的概念与构造
2. 受限伪随机函数的概念
3. 程序混淆与受限伪随机函数的应用

参考文献 [BGI+01, BW13, SW14]

第七讲: 可公开求值伪随机函数 (2 学时)

1. 可公开求值伪随机函数的概念与构造
2. 可公开求值伪随机函数的应用

参考文献 [CZ14]

参考文献

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[CS02] Ronald Cramer and Victor Shoup. Universal hash proofs and a paradigm for adaptive chosen ciphertext secure public-key encryption. In *Advances in Cryptology - EUROCRYPT 2002*, volume 2332 of *LNCS*, pages 45–64. Springer, 2002.

[CZ14] Yu Chen and Zongyang Zhang. Publicly evaluable pseudorandom functions and their applications. In *9th International Conference on Security and Cryptography for Networks, SCN 2014*, volume 8642 of *LNCS*, pages 115–134. Springer, 2014.

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[PW08] Chris Peikert and Brent Waters. Lossy trapdoor functions and their applications. In *Proceedings of the 40th Annual ACM Symposium on Theory of Computing, STOC 2008*, pages 187–196. ACM, 2008.

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[Sah99] Amit Sahai. Non-malleable non-interactive zero knowledge and adaptive chosen-ciphertext security. In *FOCS 1999*, pages 543–553. ACM, 1999.

[SW14] Amit Sahai and Brent Waters. How to use indistinguishability obfuscation: deniable encryption, and more. In *Symposium on Theory of Computing, STOC 2014*, pages 475–484. ACM, 2014.

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