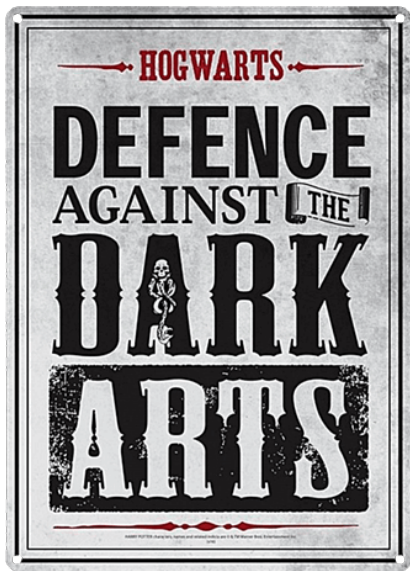


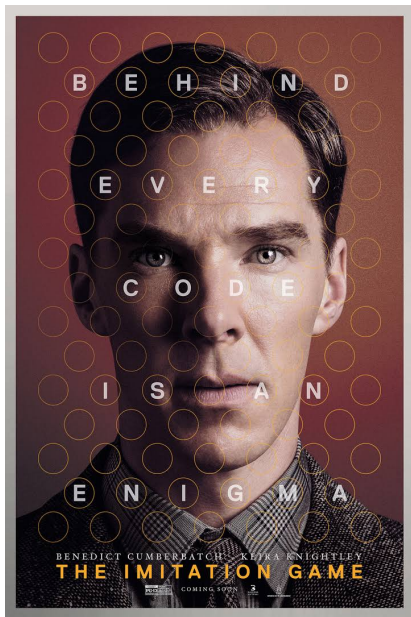
CS 553

CRYPTOGRAPHY

Welcome

Instructor
Dr. Dhiman Saha



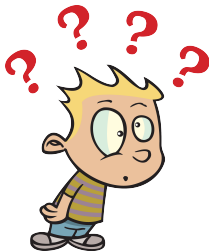


CS 553

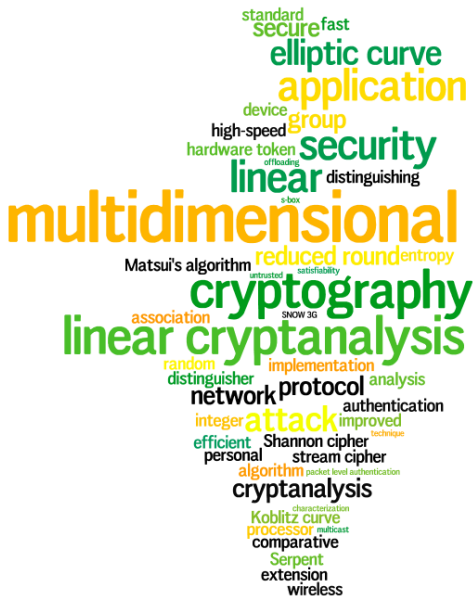
CRYPTOGRAPHY

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Dr. Dhiman Saha

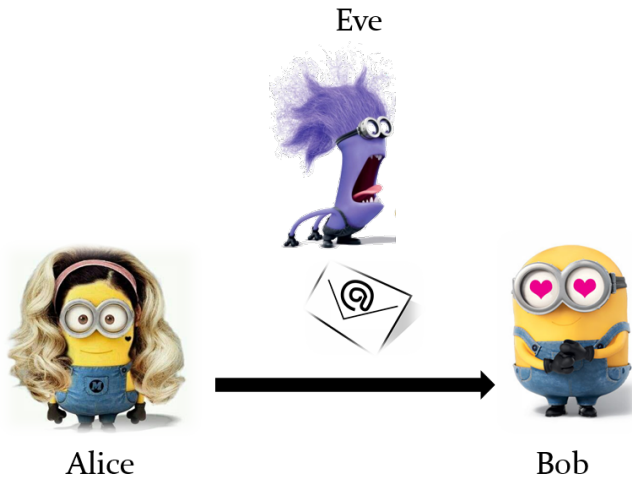




- ▶ What is Crypto?
- ▶ Why is it needed?
- ▶ Why should I study it?
- ▶ Is it difficult?
- ▶ Will I pass?



The Story of Alice and Bob



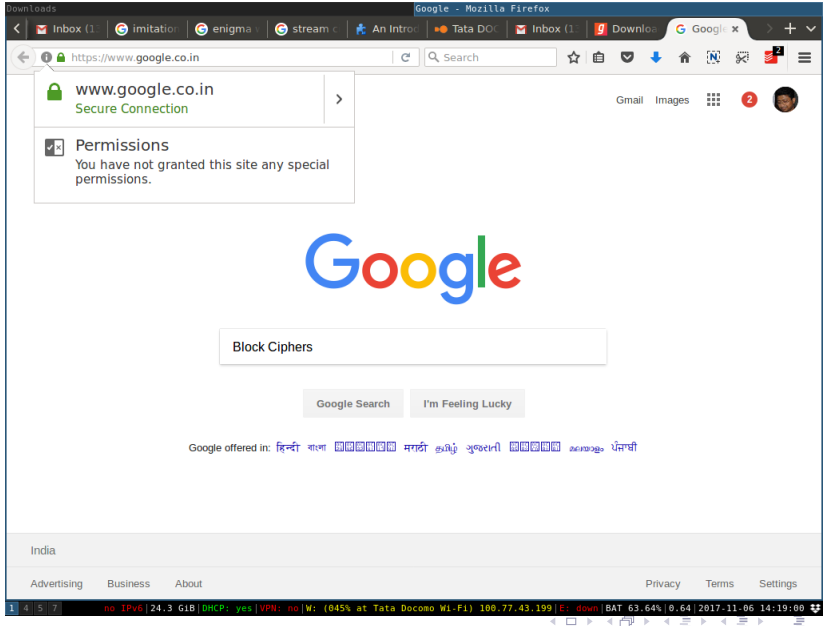
Cryptographic Goals





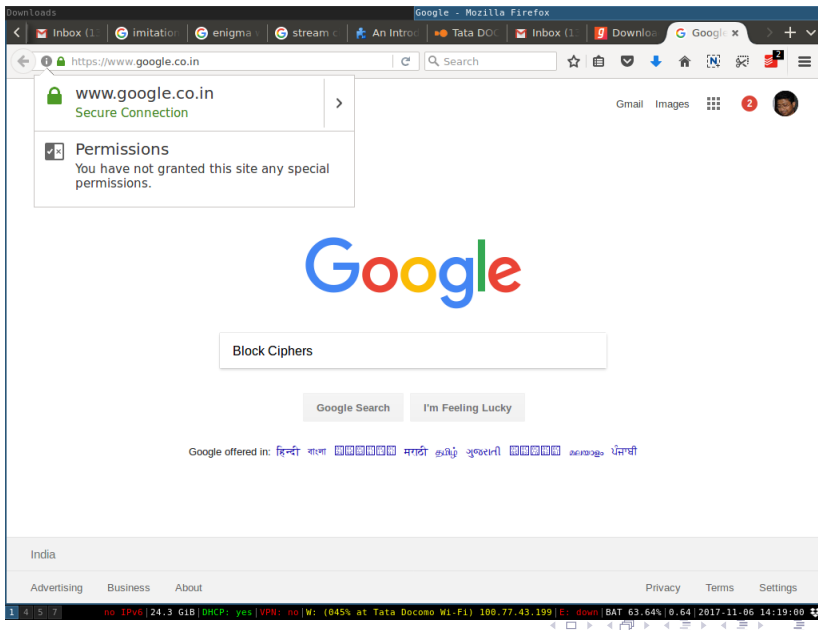
Your Favourite Search Engine

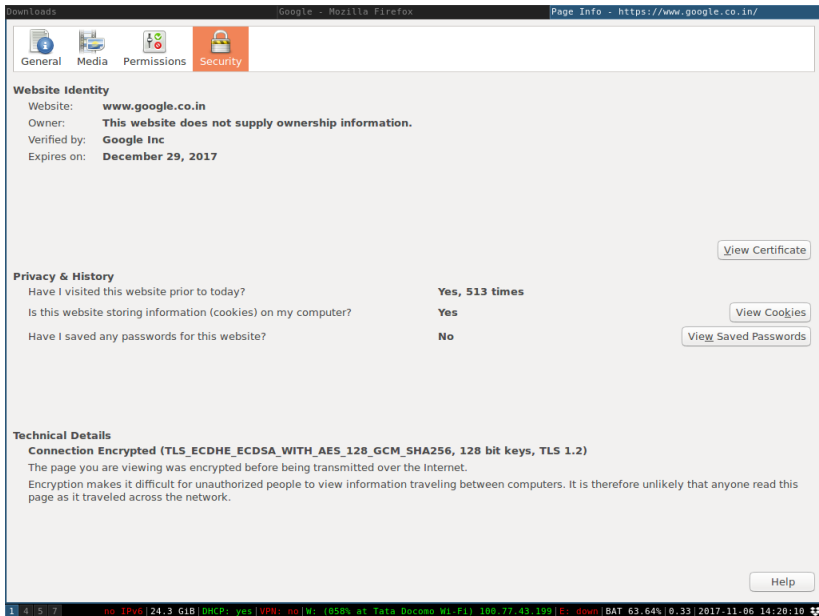
Uses HTTP**S**



Your Favourite Search Engine

Uses HTTPS





The screenshot shows the 'Page Info' window in Mozilla Firefox. The window has a title bar with 'Downloads', 'Google - Mozilla Firefox', and 'Page Info - https://www.google.co.in/'. Below the title bar is a navigation bar with four tabs: 'General', 'Media', 'Permissions', and 'Security'. The 'Security' tab is selected and highlighted in red. The main content area is divided into three sections: 'Website Identity', 'Privacy & History', and 'Technical Details'.

Website Identity

- Website: **www.google.co.in**
- Owner: **This website does not supply ownership information.**
- Verified by: **Google Inc**
- Expires on: **December 29, 2017**

[View Certificate](#)

Privacy & History

Have I visited this website prior to today?	Yes, 513 times	
Is this website storing information (cookies) on my computer?	Yes	View Cookies
Have I saved any passwords for this website?	No	View Saved Passwords

Technical Details

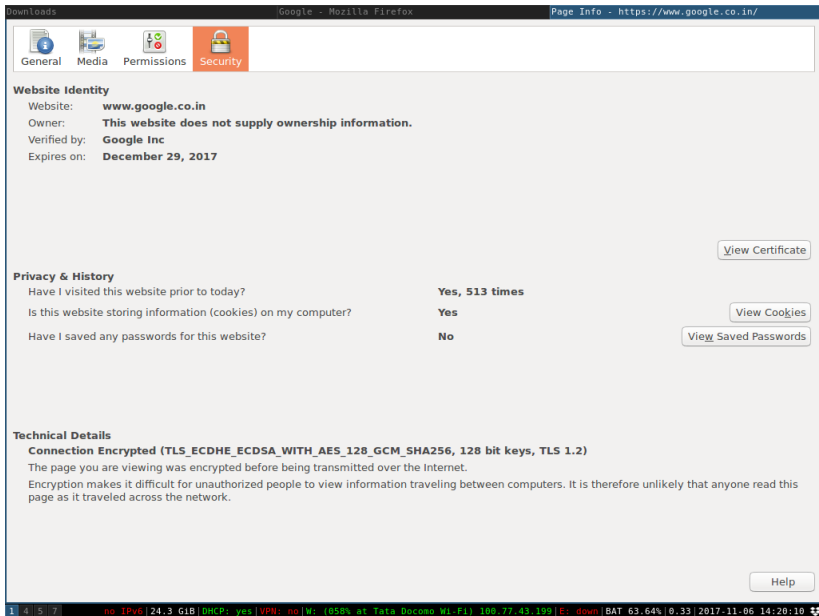
Connection Encrypted (TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256, 128 bit keys, TLS 1.2)

The page you are viewing was encrypted before being transmitted over the Internet.

Encryption makes it difficult for unauthorized people to view information traveling between computers. It is therefore unlikely that anyone read this page as it traveled across the network.

[Help](#)

At the bottom of the window, there is a status bar with the following information: 1 | 4 | 5 | 7 | no IPv6 | 24.3 G1B | DHCP: yes | VPN: no | W: (058% at Tata Docomo Wi-Fi) 100.77.43.199 | E: down | BAT 63.64% | 0.33 | 2017-11-06 14:20:10



The screenshot shows the 'Page Info' window in Mozilla Firefox. The window title is 'Page Info - https://www.google.co.in/'. The window has a toolbar with icons for General, Media, Permissions, and Security. The 'Security' tab is selected, showing the following information:

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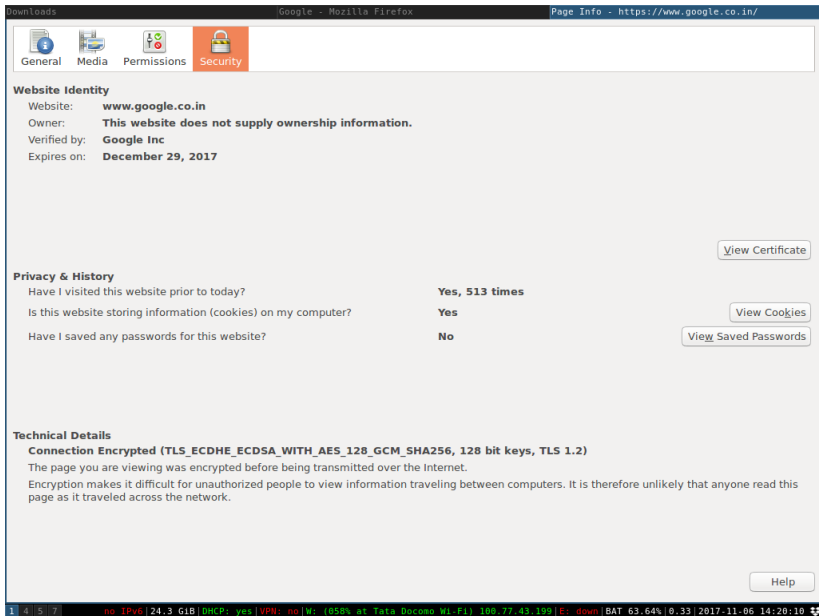
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The screenshot shows the 'Page Info' window in Mozilla Firefox, displaying details for the website <https://www.google.co.in/>. The window is divided into several sections: Website Identity, Privacy & History, and Technical Details.

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Downloads Google - Mozilla Firefox Page Info - https://www.google.co.in/

General Media Permissions **Security**

Website Identity

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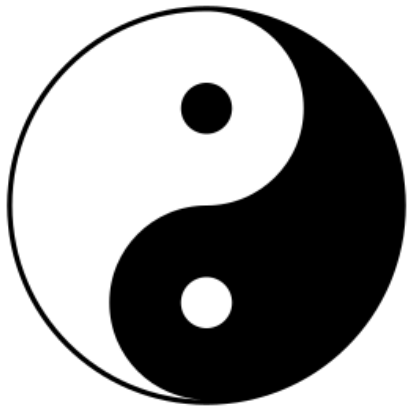
[Help](#)

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By Dutch cryptographer
Auguste Kerckhoffs

Everything about a cryptosystem, **except the key**, is public knowledge

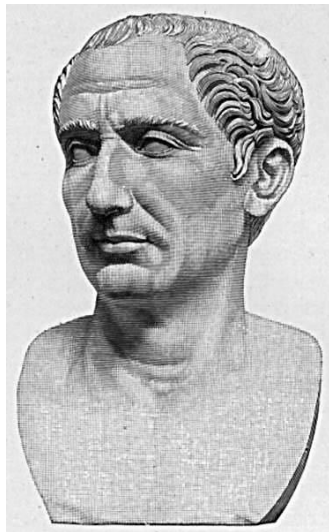
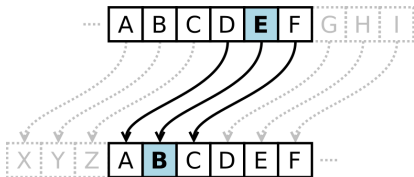
- ▶ ~~Security through obscurity~~
- ▶ However, some parameter must be **secret**
 - ▶ Known only to authorized entities: Alice, Bob
 - ▶ That parameter is the key
 - ▶ Distinguishes between Bob and Eve



Yin and Yang

Cryptography & Cryptanalysis

- ▶ One of the earliest known ciphers
- ▶ Special case of substitution
- ▶ Shifts the letters by a constant number
- ▶ Allegedly used by Julius Caesar using a shift of 3



- ▶ Applies **modular arithmetic**
- ▶ Letter \leftrightarrow number translation

$$a \rightarrow 0, b \rightarrow 1, c \rightarrow 2, \dots, z \rightarrow 25$$

Encryption

$$e(x) = (x + k) \bmod 26$$

Decryption

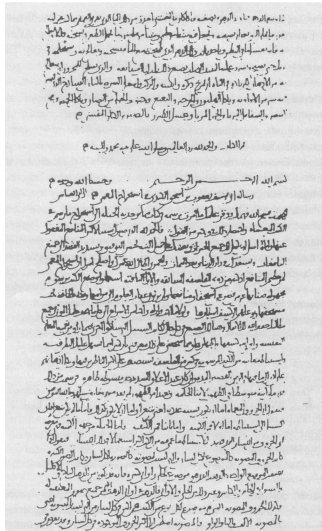
$$d(x) = (x - k) \bmod 26$$

- ▶ How many **possible keys**?
- ▶ Notion of brute-force attack
- ▶ Can we break it without **guessing the key**?
- ▶ What **if the key-space was "huge"** ?

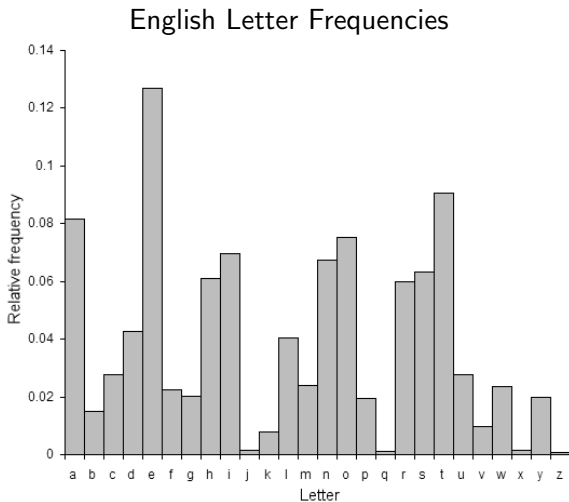
- ▶ Earliest reference on code-breaking
- ▶ 9th Century Arab scientist - **al-Kindi**
- ▶ Rediscovered in **1987 in Istanbul**

A Manuscript on Deciphering Encrypted Messages

- ▶ Explores idea of **output preserving input statistics**
- ▶ For e.g. **letter frequency analysis**



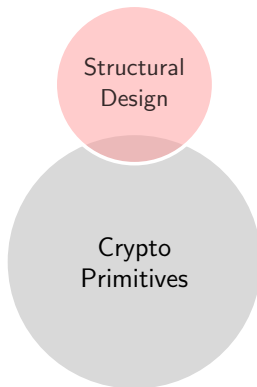
The first page of **al-Kindi's** manuscript
On **Deciphering Cryptographic Messages**

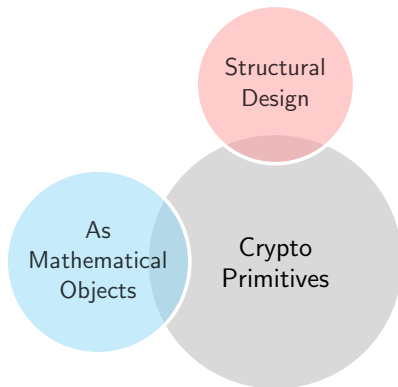


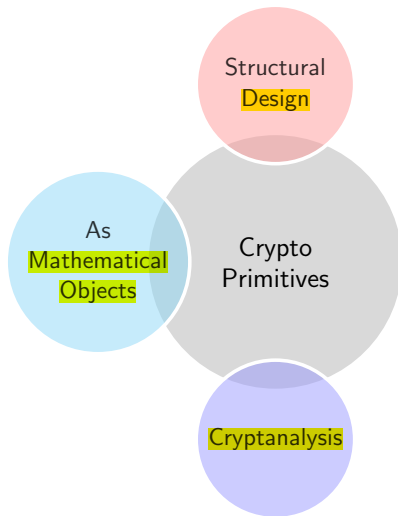
- Can be used to break Caesar Cipher. How?

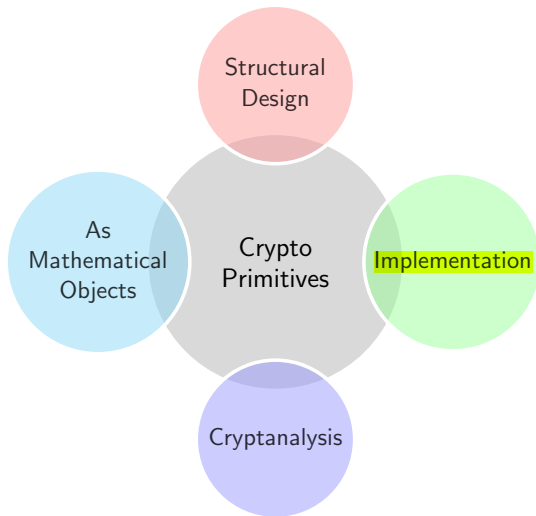


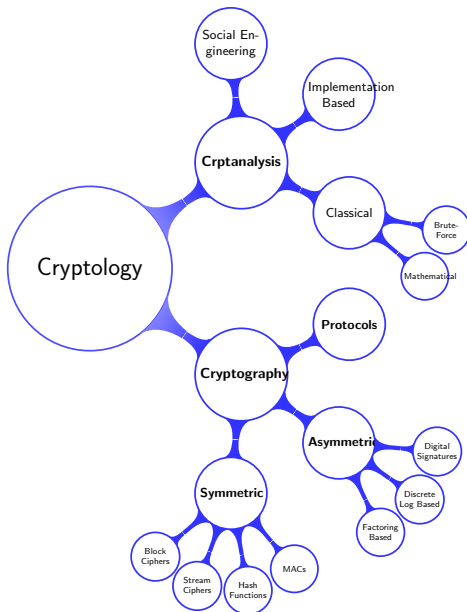
Crypto
Primitives











Home Assignment - Group Submission

- ▶ Find a historical cipher (say one that was used before 1980's)
- ▶ You will get extra marks if your cipher is unique.
- ▶ Some of them will be highlighted in next class.

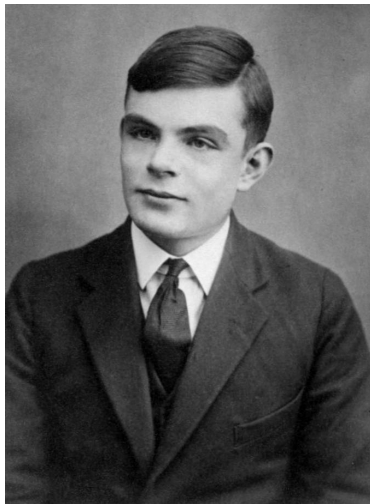
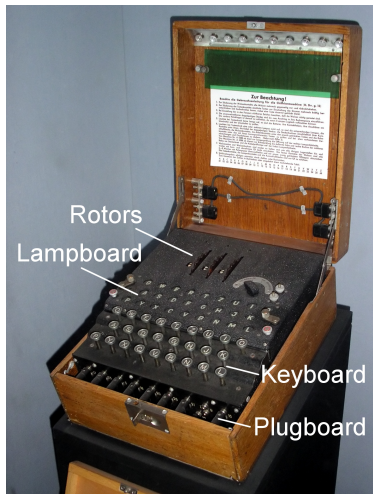
Note

Shift-Cipher and Enigma are already taken.

- ▶ Cryptography: Theory and Practice by Douglas R. Stinson.
- ▶ Understanding Cryptography by Christof Paar and Jan Pelzl
- ▶ Other references will be shared as and when required

Enigma!

Hail Crypto!



See you in next class.