Secure Computation of Fingerprint Alignment and Matching

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Motivation

❑ Fingerprint images are one of the most accurate type of biometry used biometric verification and identification.

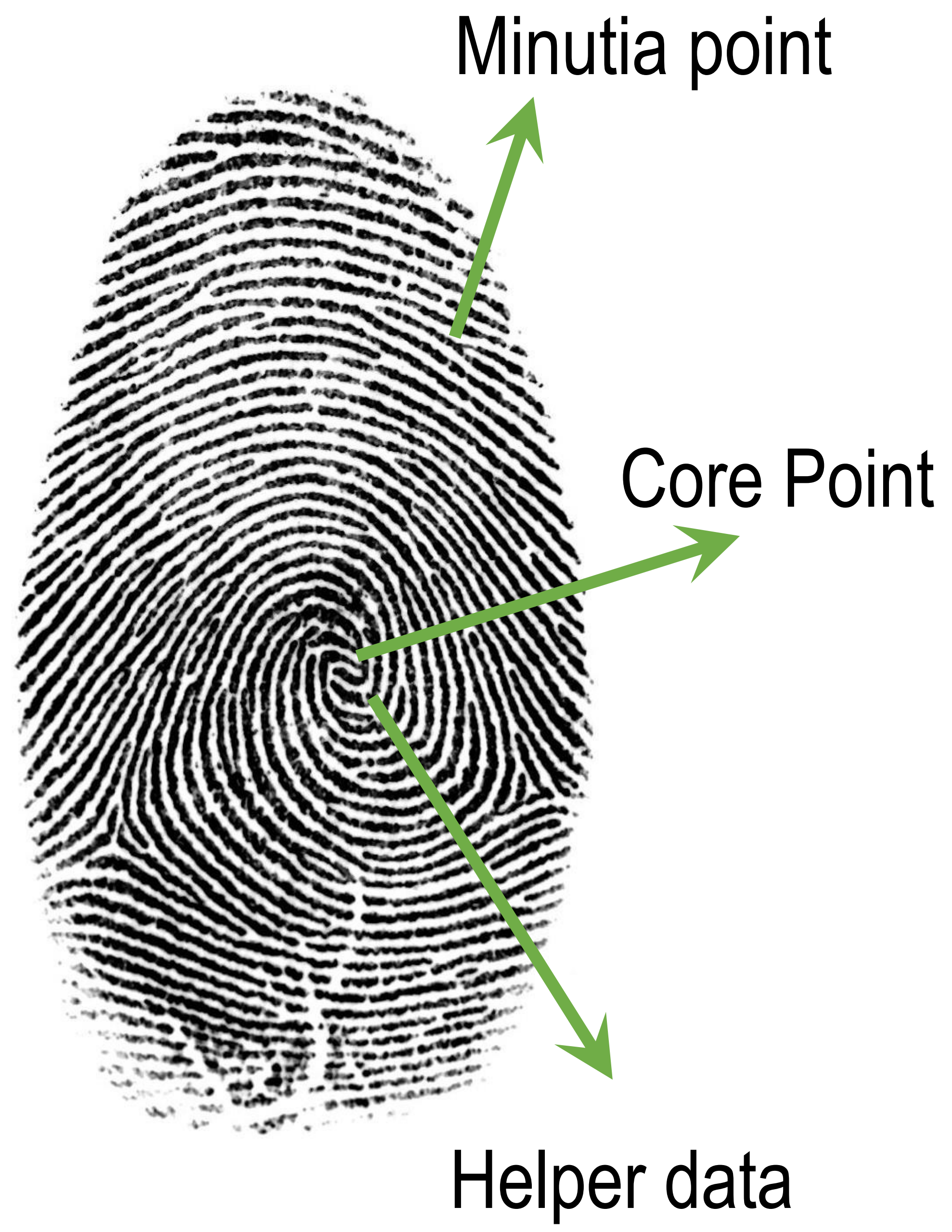
❑ Fingerprint images are highly sensitive due to their ability to uniquely identify the data owner .

Goals

❑To build secure protocols for fingerprint **alignment** (first time) and matching based on the most precise or efficient algorithms in the biometric literature.

❑To develop secure computation techniques based on garbled circuit evaluation and linear secret sharing.

Extracted Features



Extracted features are represented by the following elements:

1) an x-coordinate,
2) a y- coordinate,
3) orientation in radians denoted by θ.

Fingerprint Recognition

❑ *Fingerprint matching based on minutiae alignment: Consider all possible alignments between two fingerprint images S and T and select the alignment that maximizes the matching score.*

$$\textit{Matching score} = \frac{\#matched\ minutia\ points}{\#minutia\ points\ S \times \#minutia\ points\ T}$$

❑ *Fingerprint matching based on trimmed iterative closest point algorithm: Align two sets of 3-D points of helper data S and T based on trimmed iterative closest point (TICP) to find matching score.*

❑ *Fingerprint matching based on spectral minutiae representation: Modify the representation of minutia points by* using Fourier transform and then reduce feature size to make recognition process faster without losing precision. At the end, consider different alignment and compute similarity score.

Problem Setup

1- Two entities would like to compare fingerprints they respectively possess, without revealing any information about their data to the other party.

2- One or more the data owners are computationally limited and would like to securely offload their work to more powerful servers or cloud providers

Security Model

1- Secure two-party computation in presence of semi-honest or fully malicious participants.

2- Secure multi-party computation in presence of semi-honest or fully malicious participants.

Building Security Solutions

❑ Standard Building Blocks such as addition/subtraction, multiplication, comparison, and compaction.

❑ More complicated building blocks such as division, **square root** (new for secure two-party computation), **sine** (totally new), and **cosine** (totally new).

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