

Classification of Fingerprints

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Brief History on Fingerprint Classification

- Fingerprint characteristics studied as far back as mid-1600s.
 - Used as a means of identification mid-1800s.
- Sir William James Herschel (1859)
 - FPs remain stable over time, unique across individuals
 - 1877 - Instituted use as a means of identification, signing legal documents, and authenticated transactions.



Sir William James Herschel
1858



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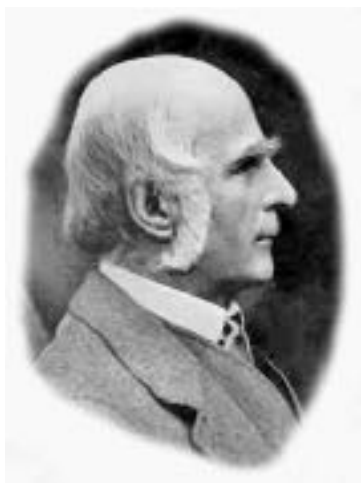
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Sir William James Herschel
1858



Dr. Henry Faulds
1880



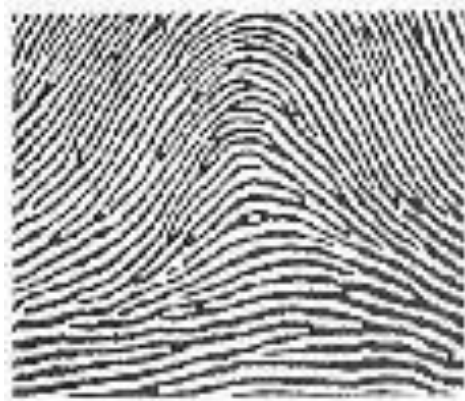
Sir Francis Galton
1888



All images can be found at:
<http://onin.com/fp/fphistory.html>



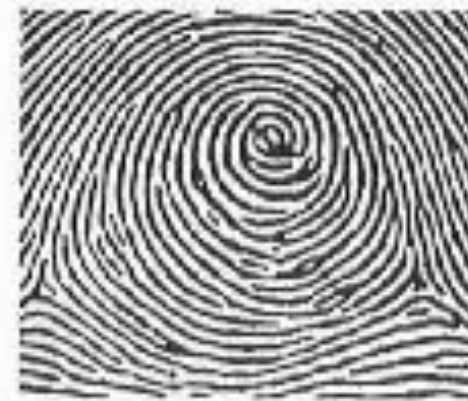
- No two fingerprints have ever been found to be the same.
 - Identical twins will have same DNA but 20 different FPs.
- Each FP contains **minutiae**, or ridge characteristics.
- Dr. Henry Faulds (1880)
 - First European to publish notion of scientific use of FPs in identification
- Sir Francis Galton (1892)
 - Highly influential book: *Finger Prints*



Arch



Loop



Whorl

Galton Classification

The letters for the right hand's index, middle, and ring fingers were grouped together, followed by the letters for the left hand's index, middle, and ring fingers. After this string of letters, the letters for the right thumb and right little finger were recorded, followed by the letters for the left thumb and left little finger.

Right Thumb	Right Index	Right Middle	Right Ring	Right Little
Double Loop	Double Loop	Central Pocket		
Whorl	Whorl	Loop	Plain Whorl	Ulnar Loop
		Whorl		
Left Thumb	Left Index	Left Middle	Left Ring	Left Little
Ulnar Loop	Radial Loop	Radial Loop	Ulnar Loop	Central Pocket
				Loop Whorl

WWWLLEWLLW

GALTON
CLASSIFICATION



Fingerprint Classification

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Why might this be a good idea?

- **Input:** 10 fingerprint impressions from an individual.
- If database consists of 100 FPs and we have 5 classes, then:
 - Search space without classification: 100^{10}
 - Search space with classification: $\left(\frac{100}{5}\right)^{10} = 20^{10}!$

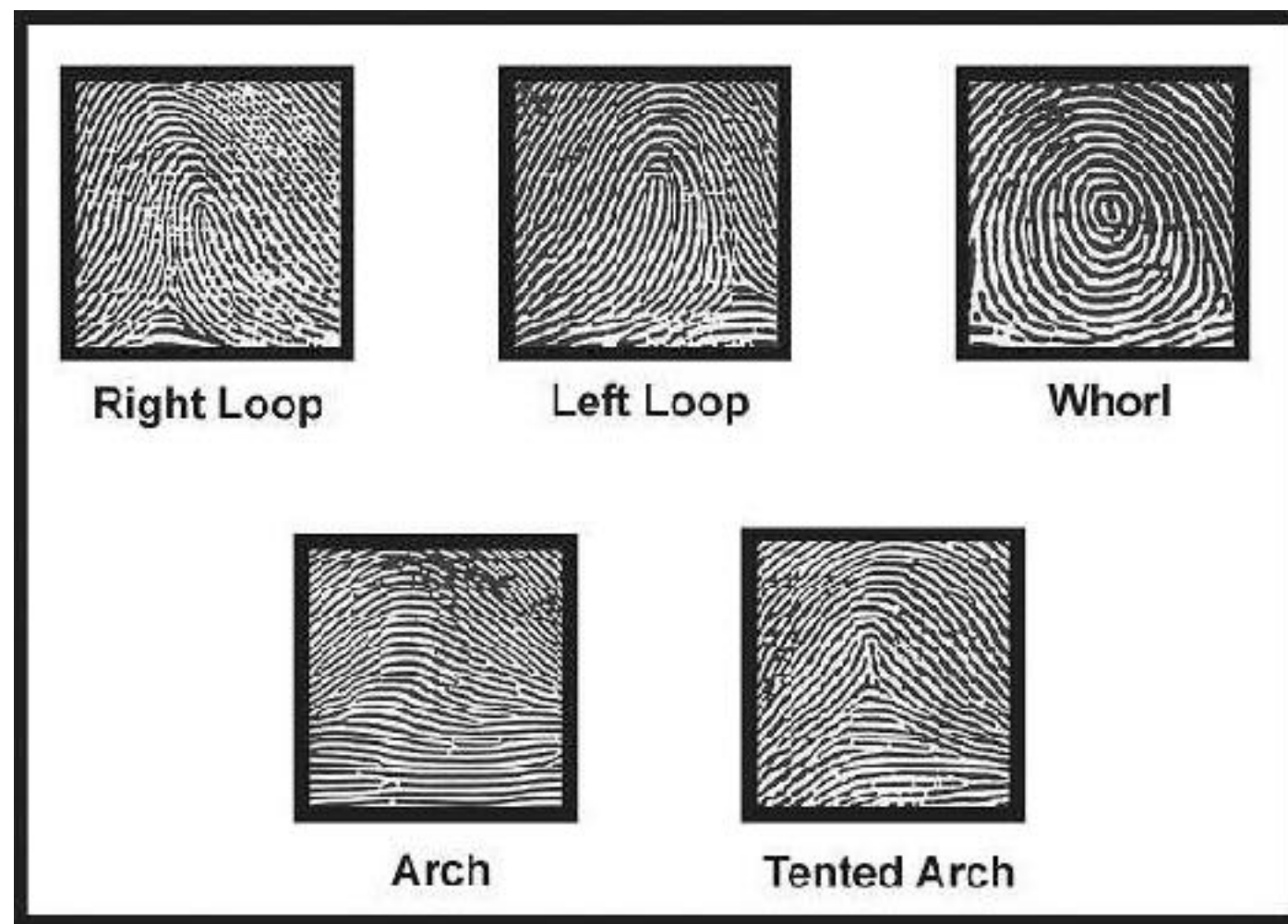


Two Generally Accepted Methods: **Henry**
and **National Crime Information Center**
(NCIC) Classification



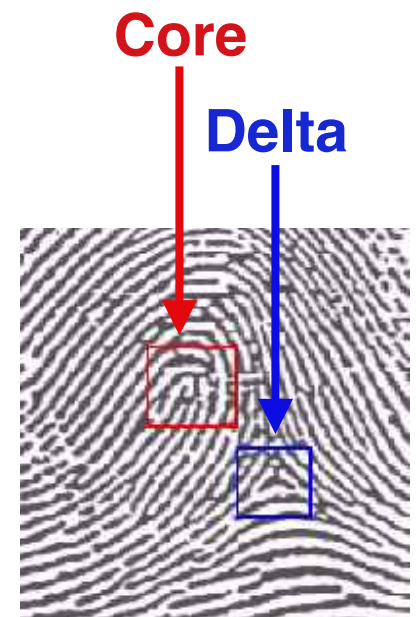
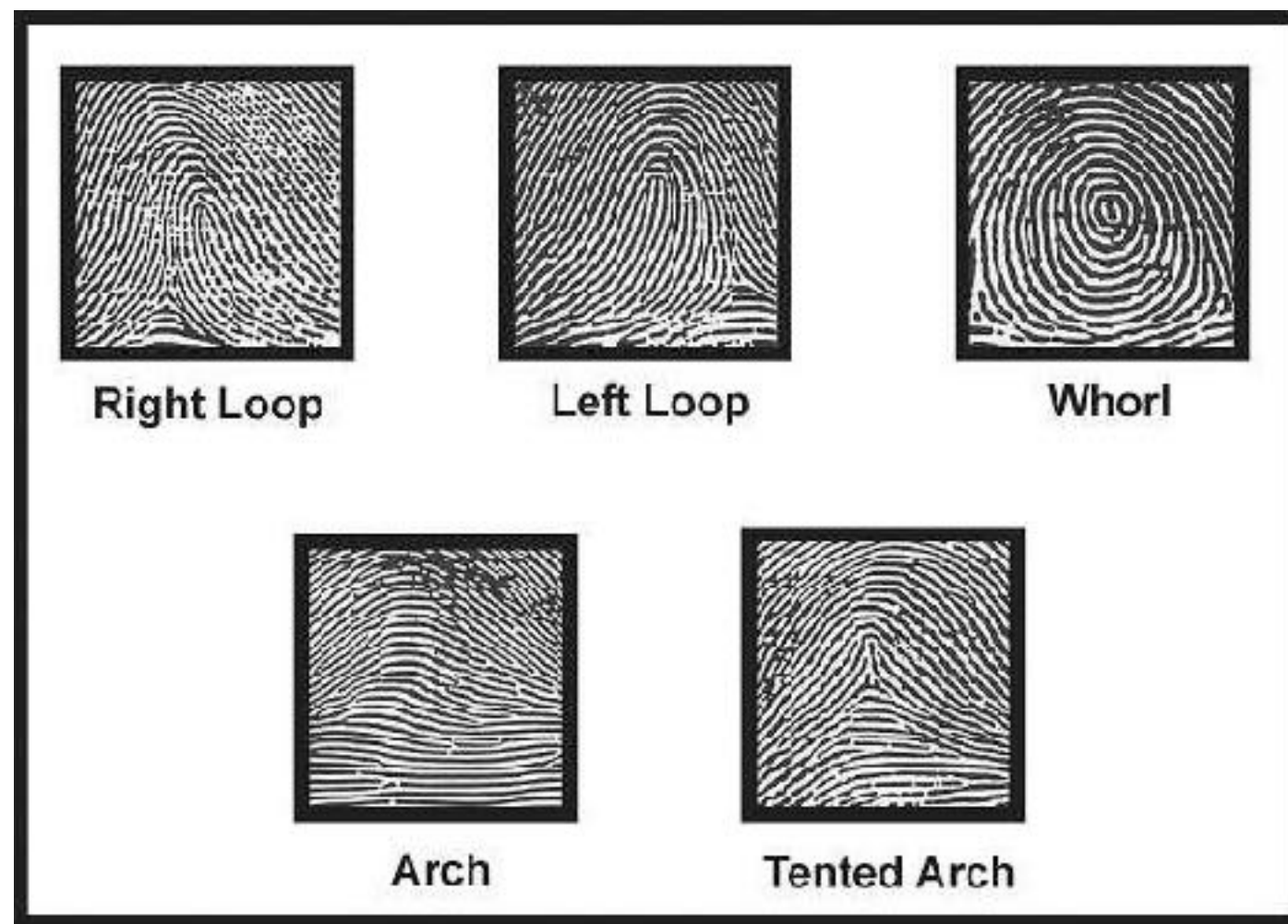
Henry Classification:

- Henry (1900) indexed fingerprints into 5 classes



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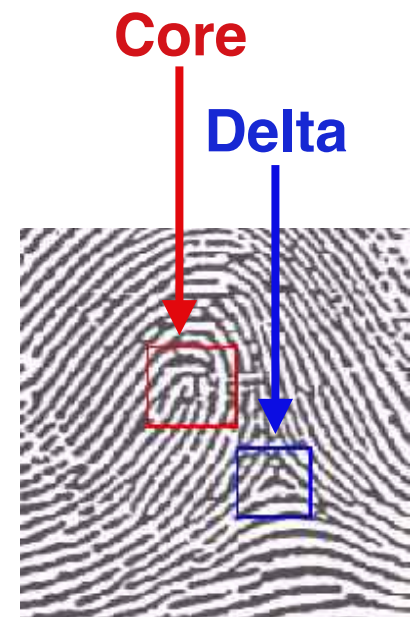
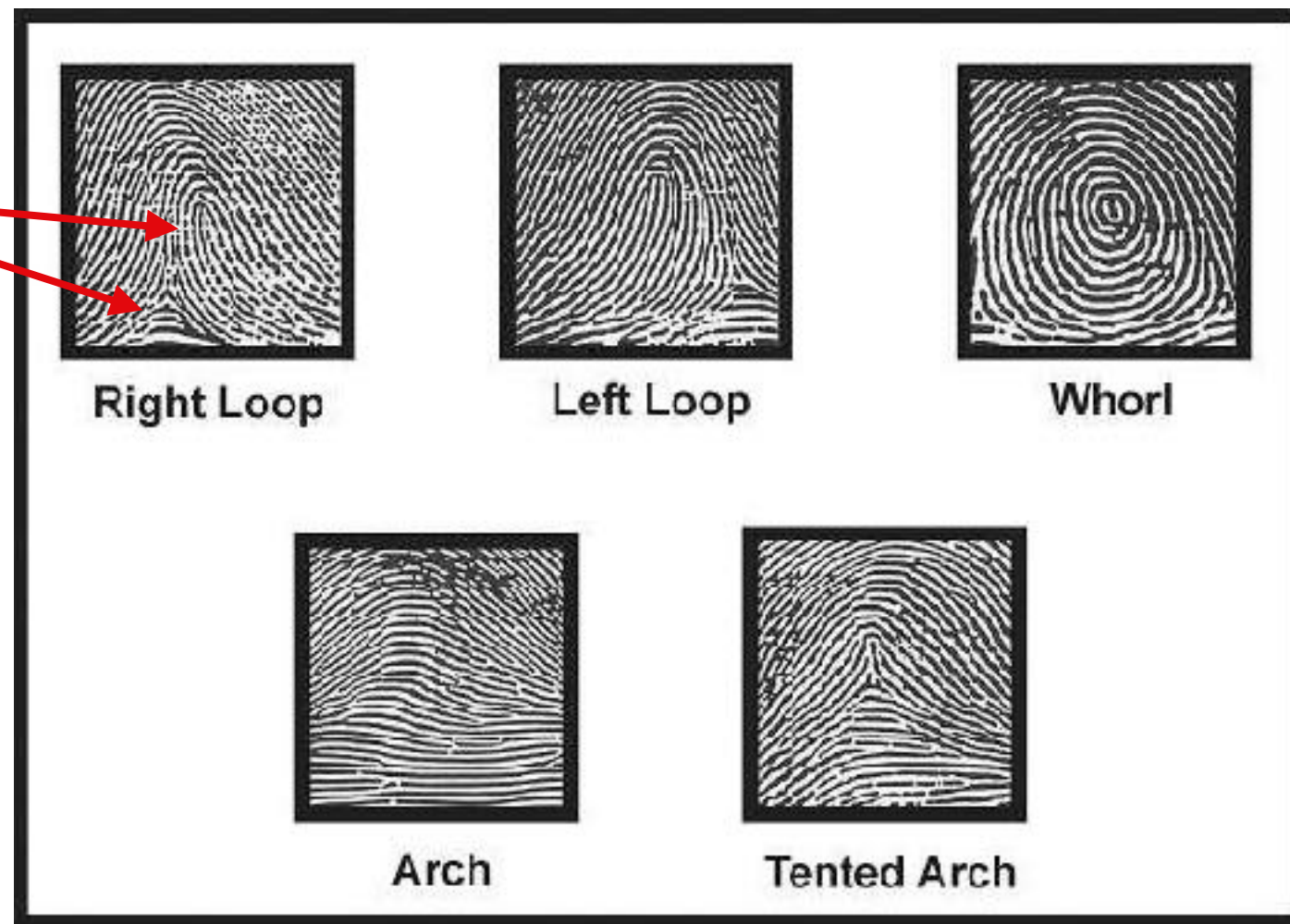
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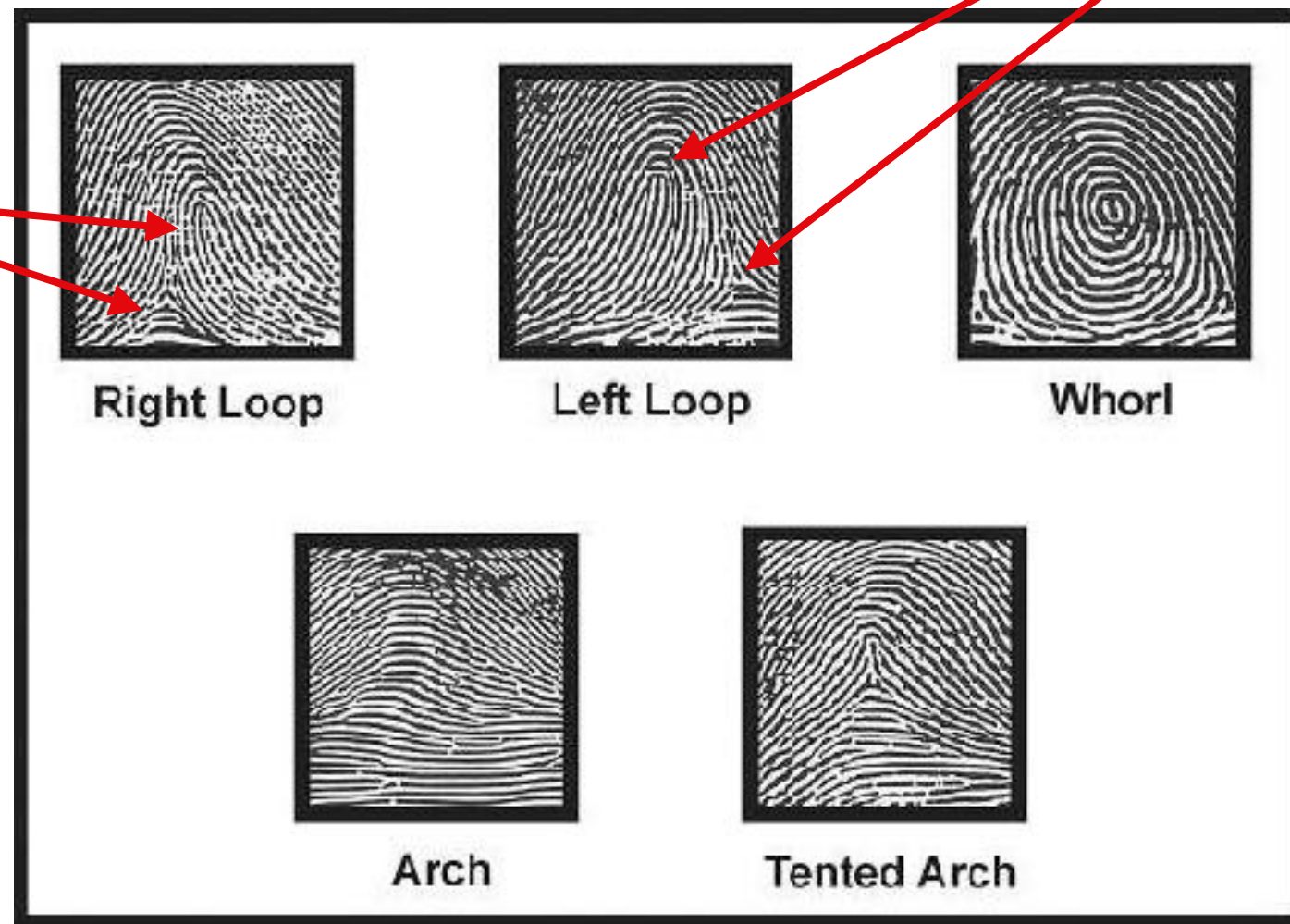
Exactly one core and one delta. Core is to right of delta.



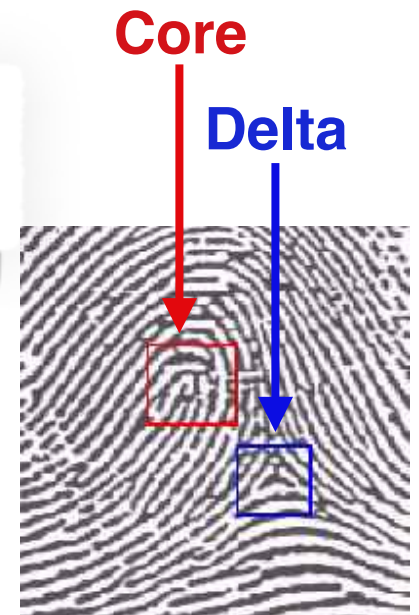
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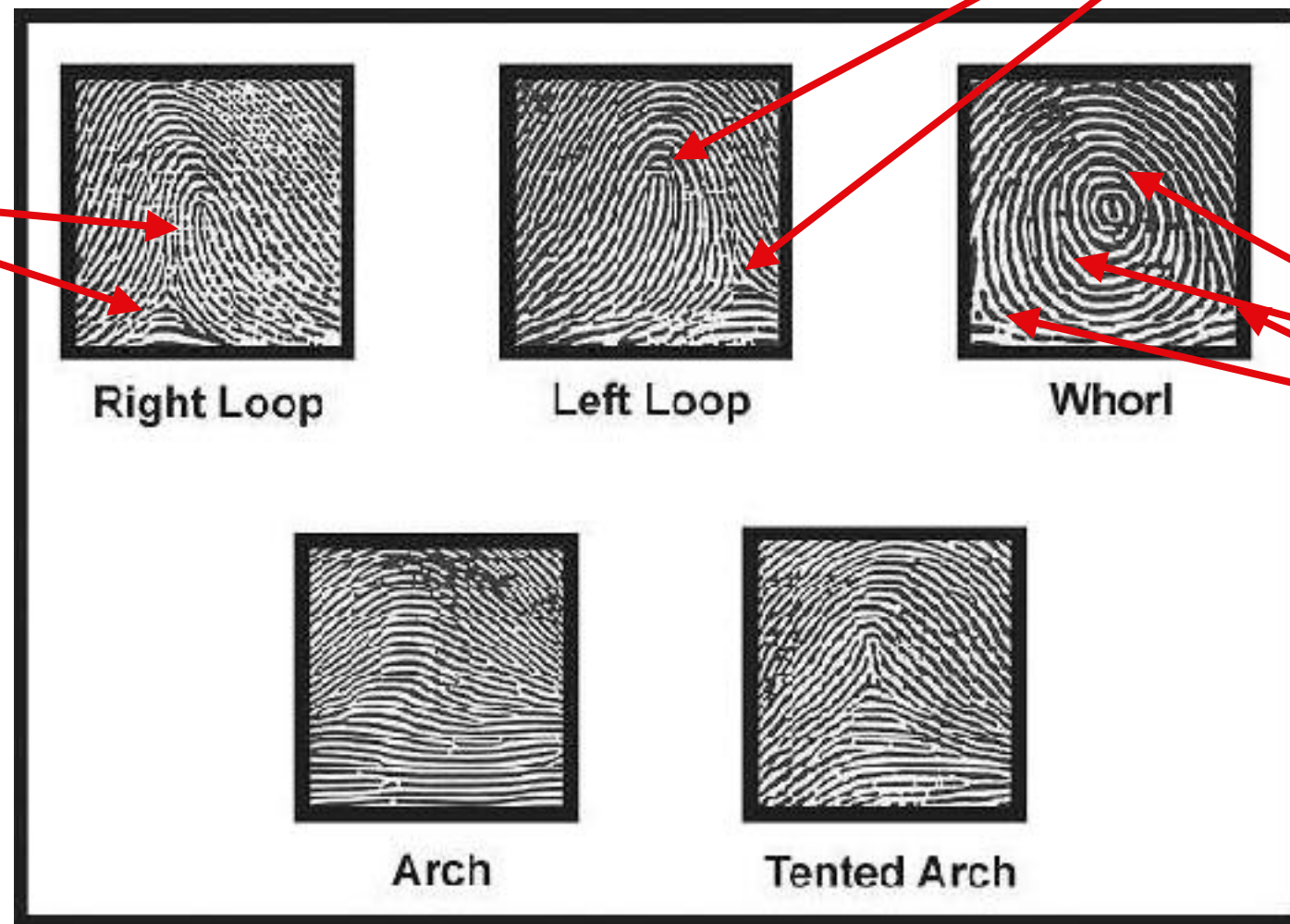
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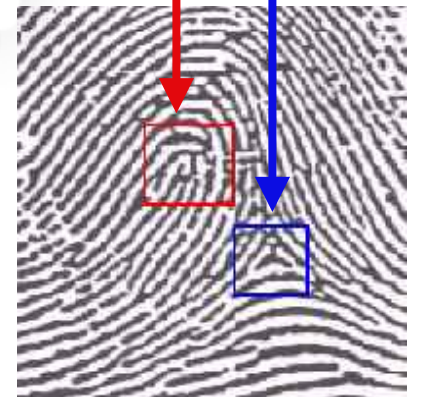
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Core
Delta



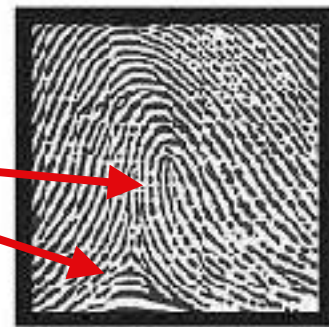
Two cores and two deltas



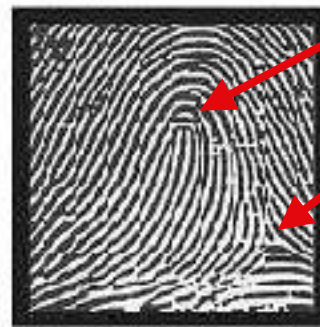
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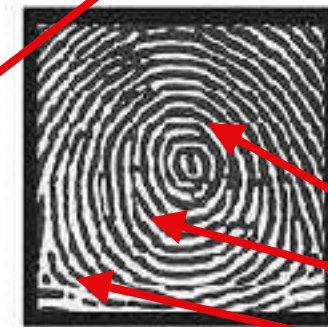
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Right Loop



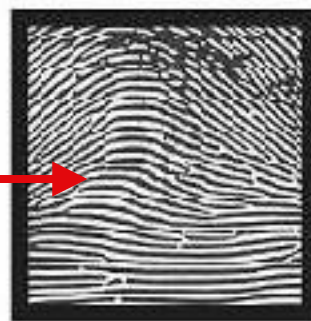
Left Loop



Whorl

Two cores and two deltas

No singular points (sharp changes in ridges)



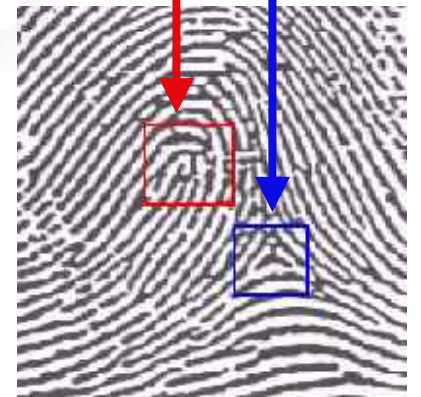
Arch



Tented Arch

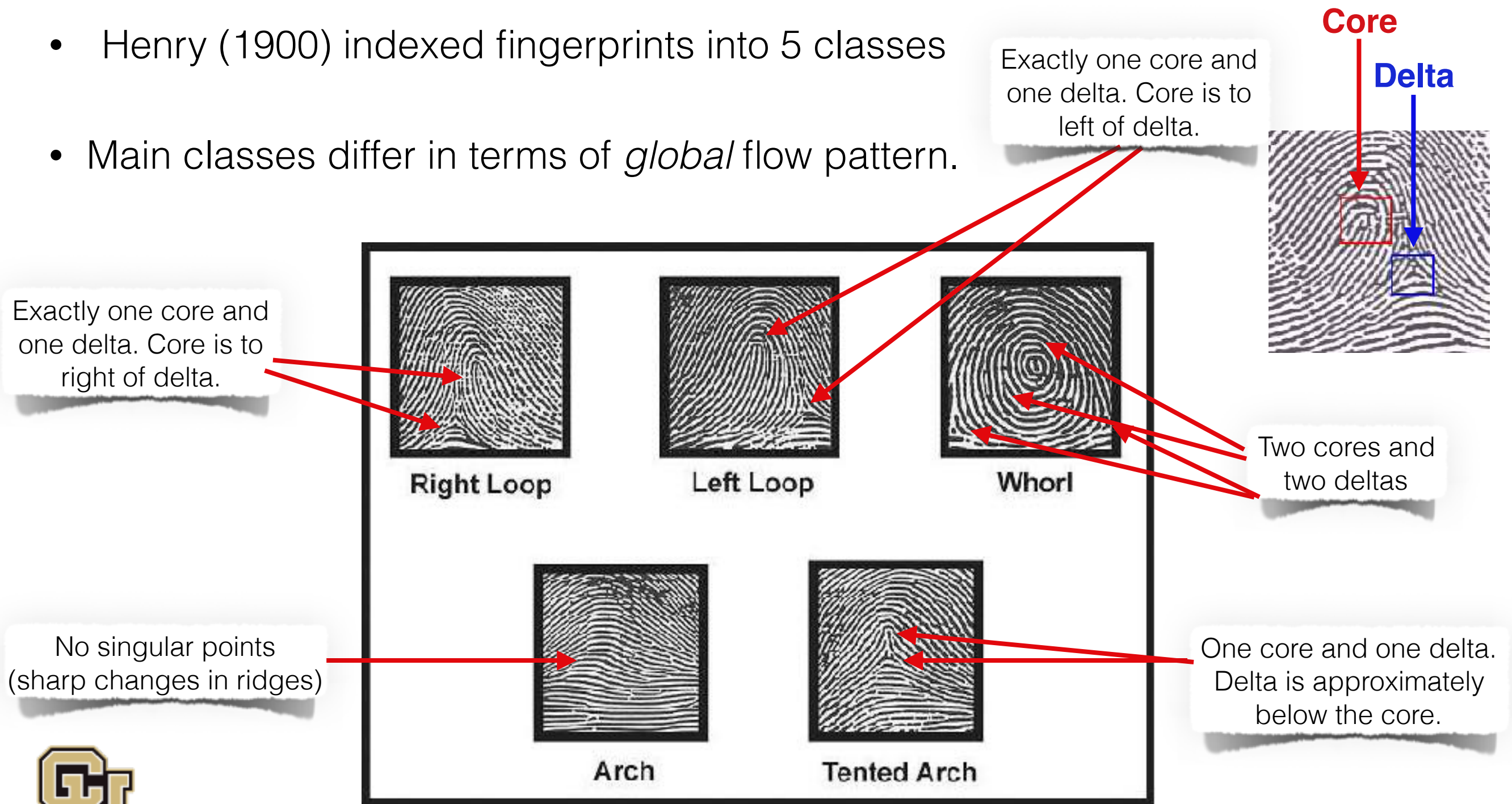
Exactly one core and one delta. Core is to left of delta.

Core
Delta



Henry Classification:

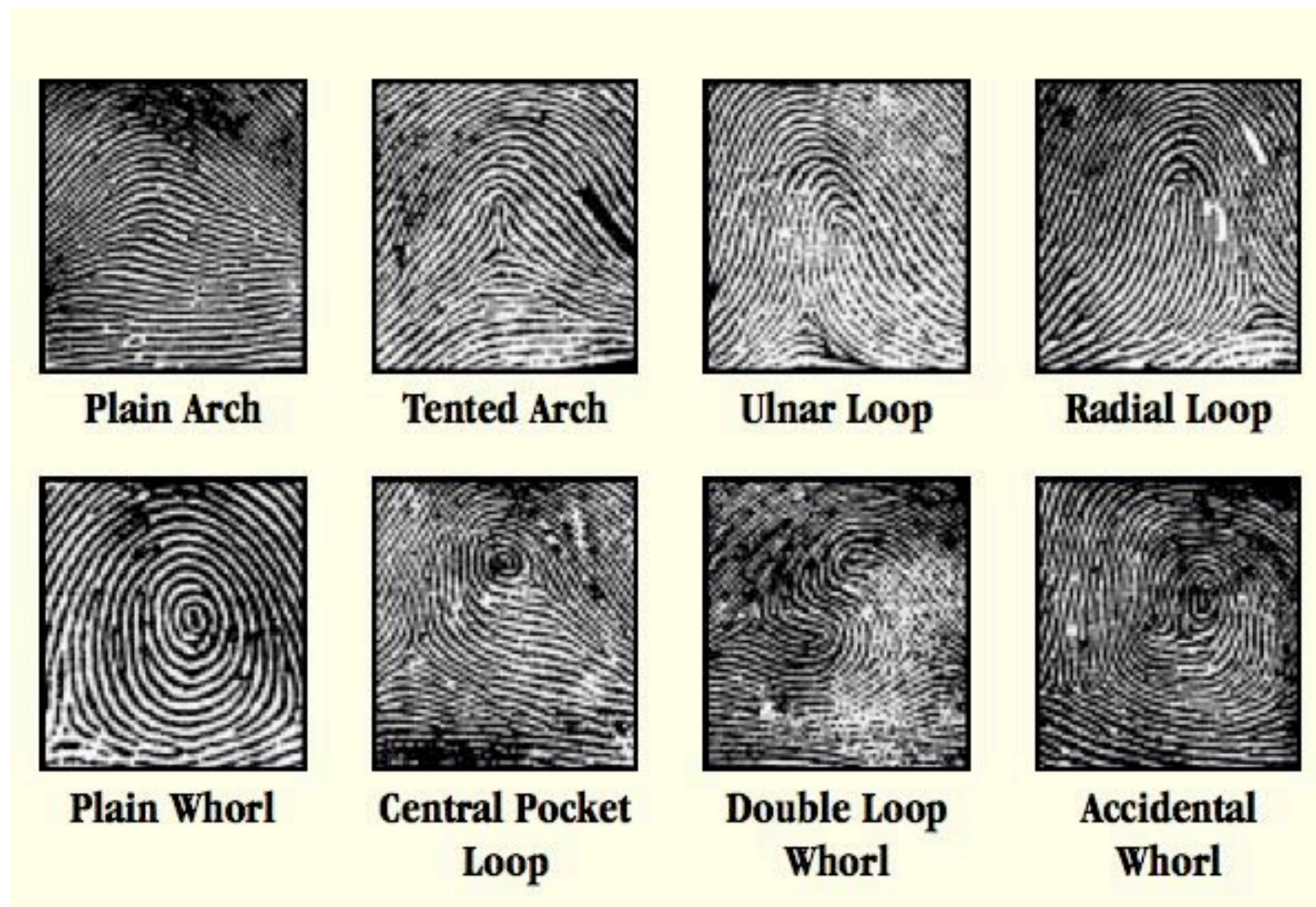
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Potential Downside: Involves combination of fingers

NCIC Classification:

- Computerized database used in the U.S.
- J. Edgar Hoover (1967)



Minutiae

Example

ridge ending



bifurcation



dot



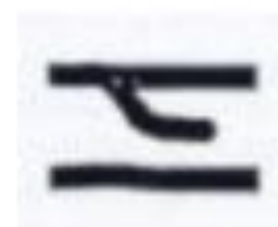
island (short
ridge)



lake
(enclosure)



hook (spur)



Minutiae

Example

bridge



double
bifurcation



trifurcation



opposed
bifurcations



ridge crossing



opposed
bifurcation/ridge
ending



Let's try for ourselves!