

Fingerprint Recognition IV

COMP 388-002/488-002 Biometrics

Daniel Moreira

Fall 2026



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UNIVERSITY CHICAGO

Today we will...

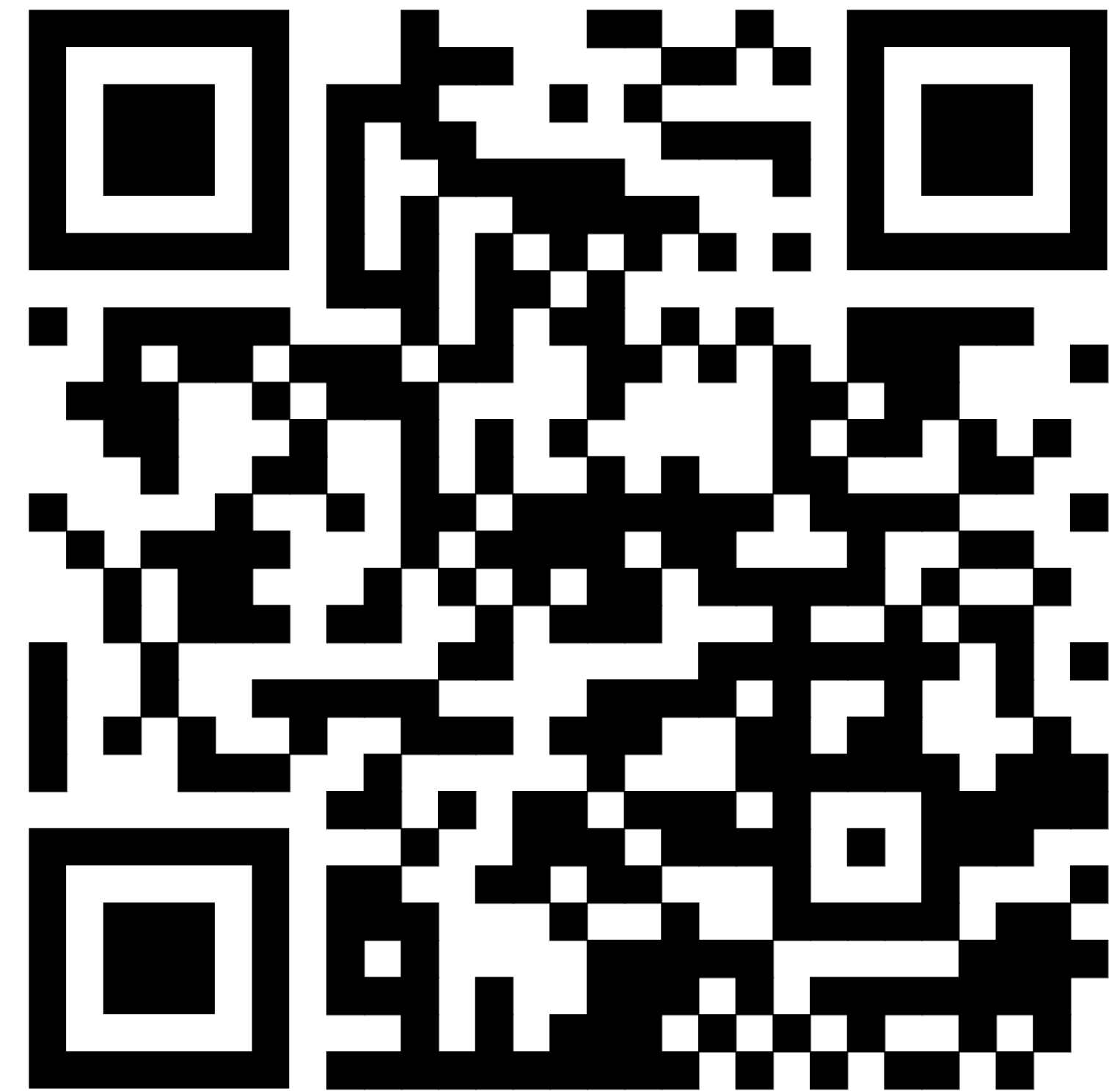
Collect fingerprints.

Inspect an implementation of fingerprint recognition.

Today's Attendance

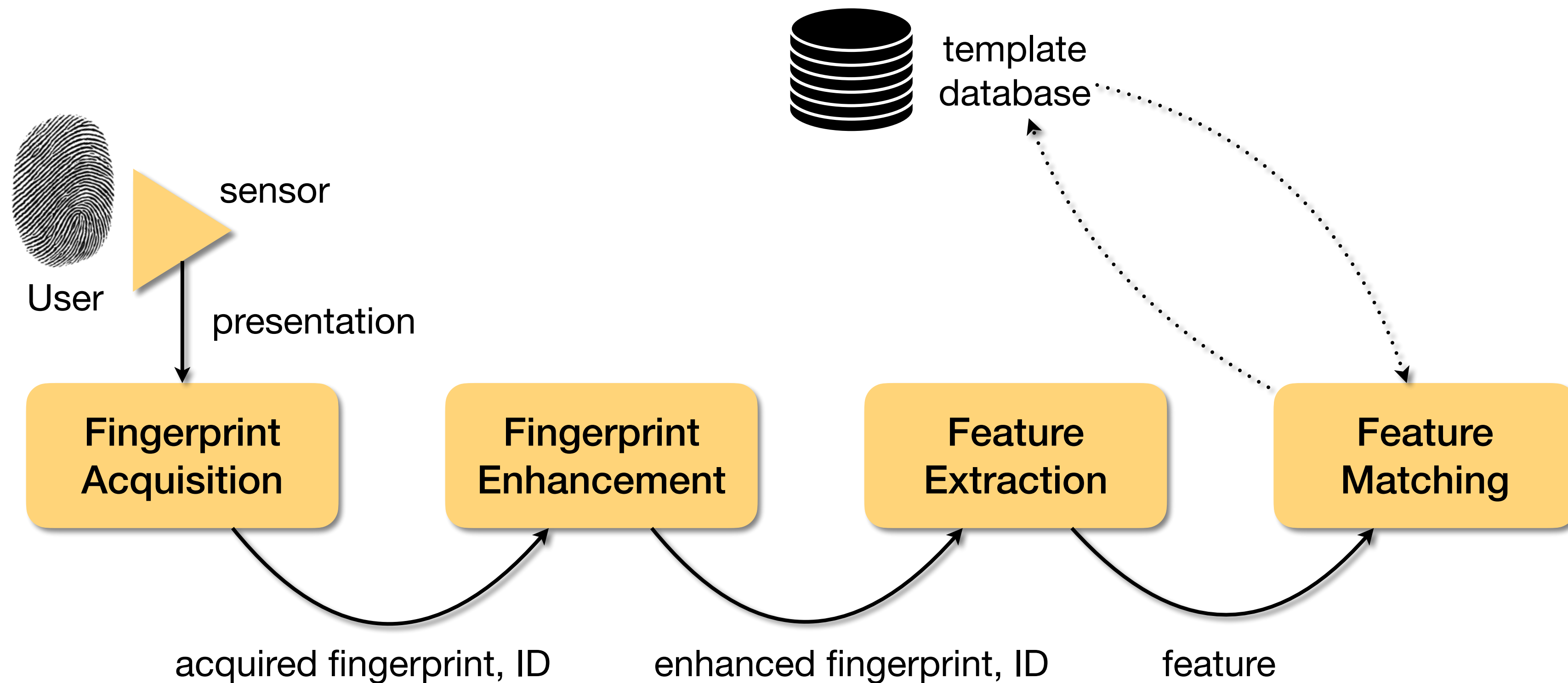
Please fill out the form

forms.gle/v5HY37ejCKnuLe4BA



Fingerprint Recognition

RECAP

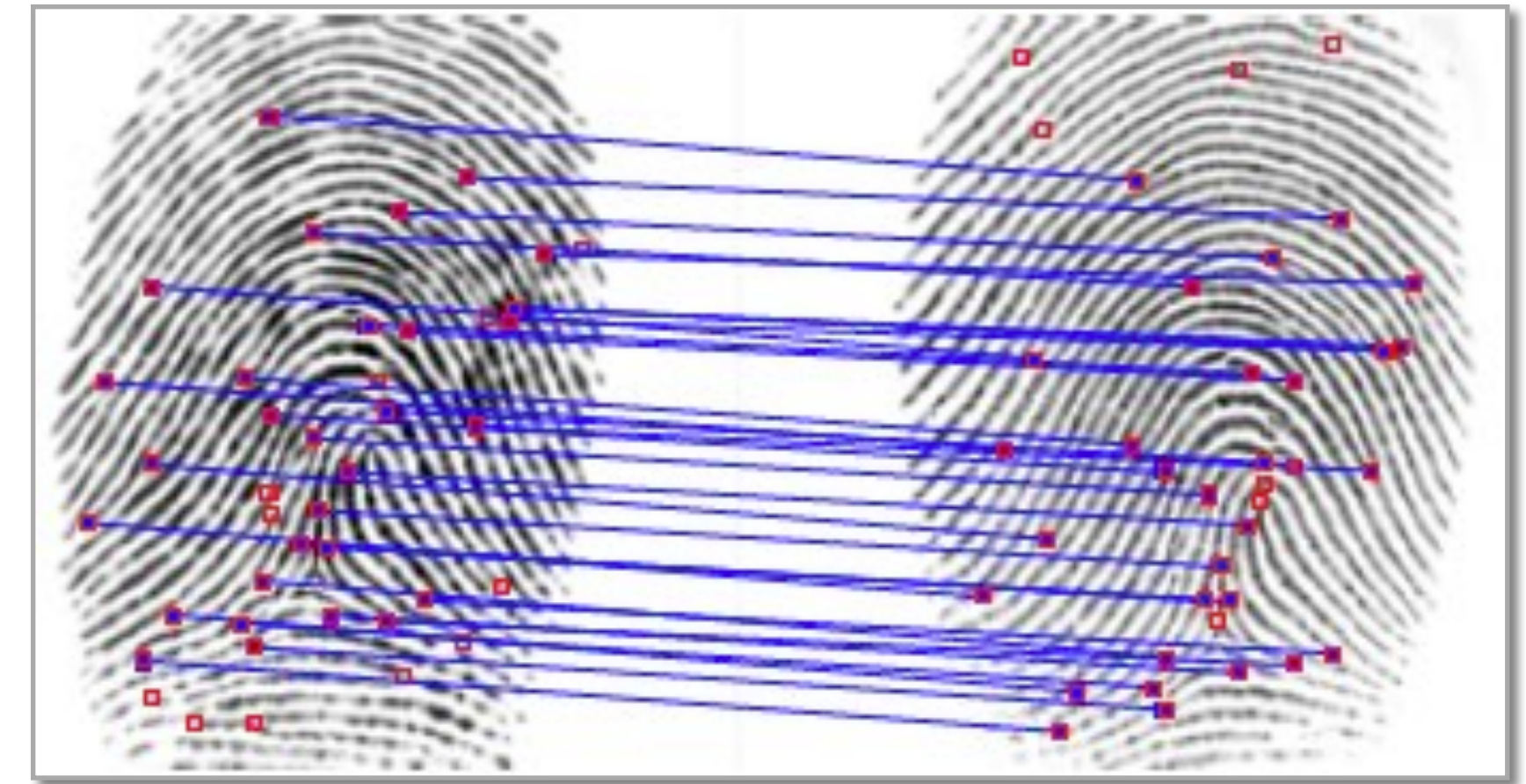


Feature Matching

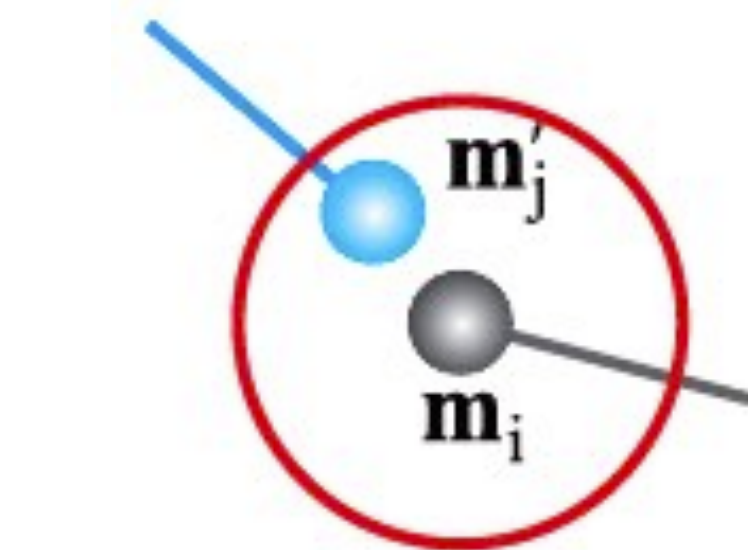
RECAP

How to establish pairs of corresponding minutiae between two samples?

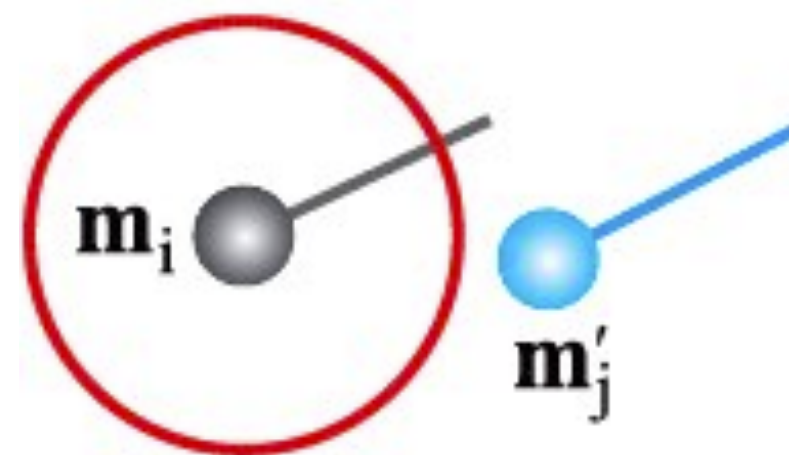
Check for agreements between both (x, y) **positions** and θ **angles**.



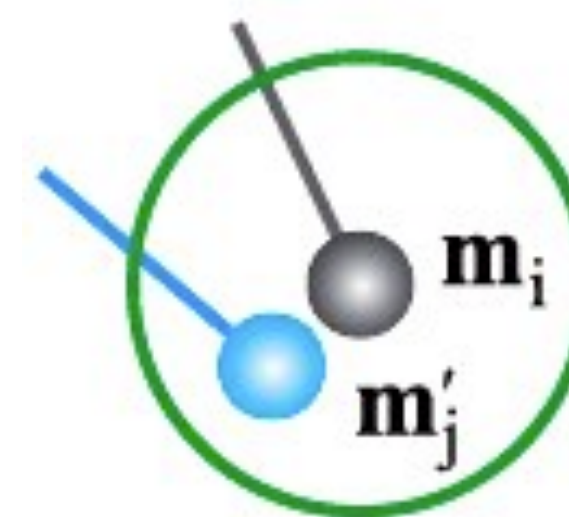
Jain, Ross, and Nadakumar
Introduction to Biometrics
Springer Books, 2011



X Positions agree,
but angles do not.



X Angles agree, but
positions do not.



✓ Both angles and
positions agree.

m_i : i-th minutiae from image i .
 m'_j : j-th minutiae from image j .
Source: Dr. Adam Czajka



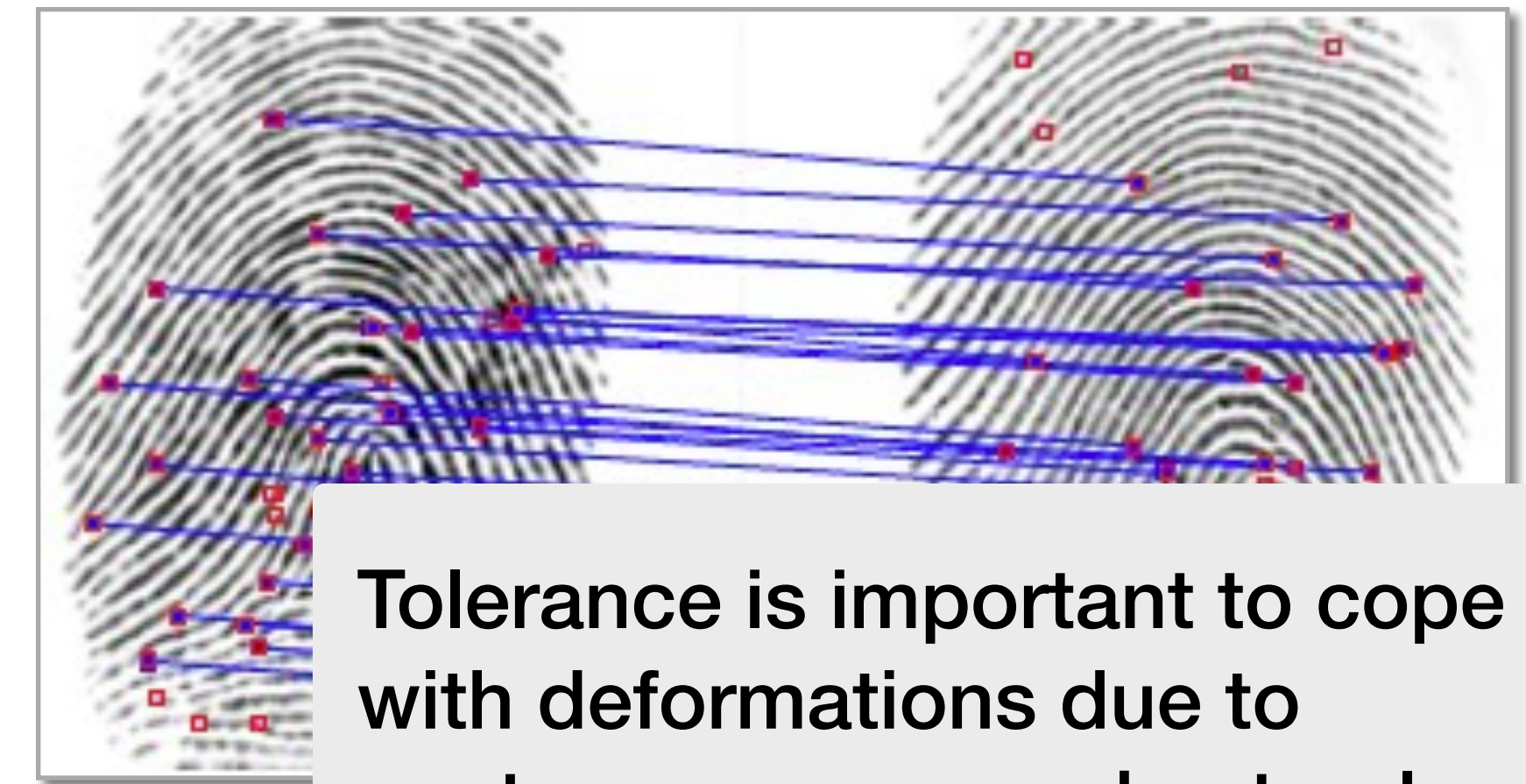
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Feature Matching

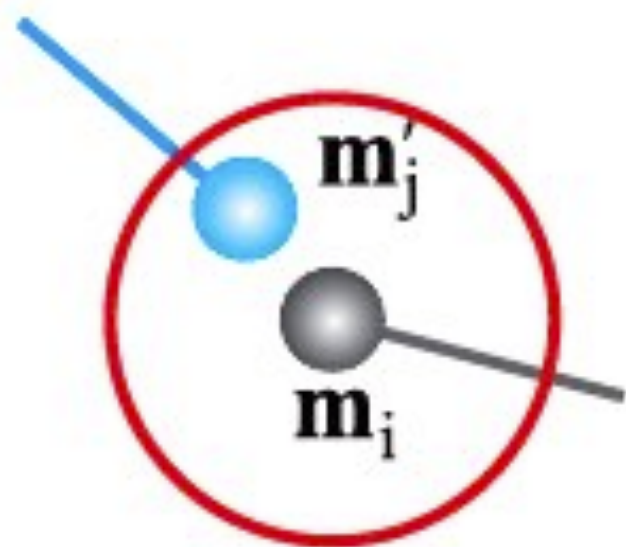
RECAP

How to establish pairs of corresponding minutiae between two samples?

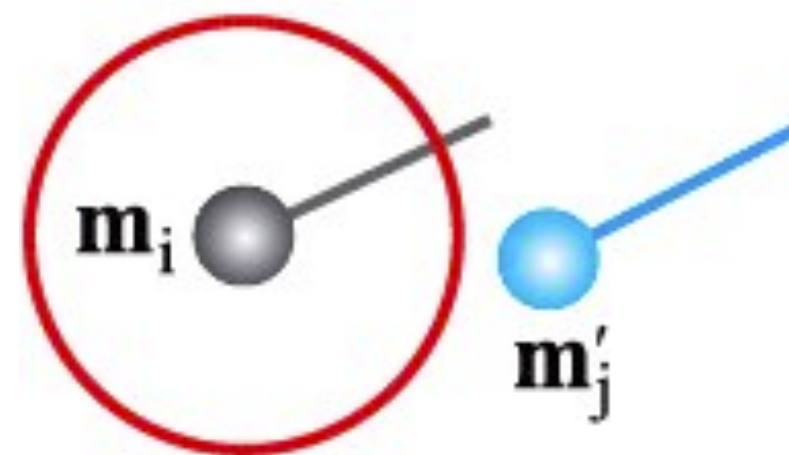
Check for agreements between both (x, y) **positions** and θ **angles**.



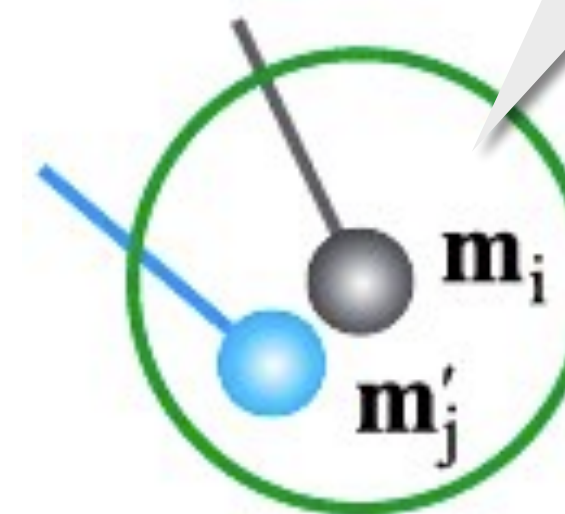
Tolerance is important to cope with deformations due to capture process and natural skin deformations.



✗ Positions agree, but angles do not.



✗ Angles agree, but positions do not.



✓ Both angles and positions agree.

m_i : i -th minutiae from image i .
 m'_j : j -th minutiae from image j .

Source: Dr. Adam Czajka



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Feature Matching

RECAP

Hough Transform

Objective: find scale, rotation, and translation transformations that maximize the number of agreeing minutiae (a.k.a, **matches**).

Jain, Ross, and Nadakumar
Introduction to Biometrics
Springer Books, 2011



query



template

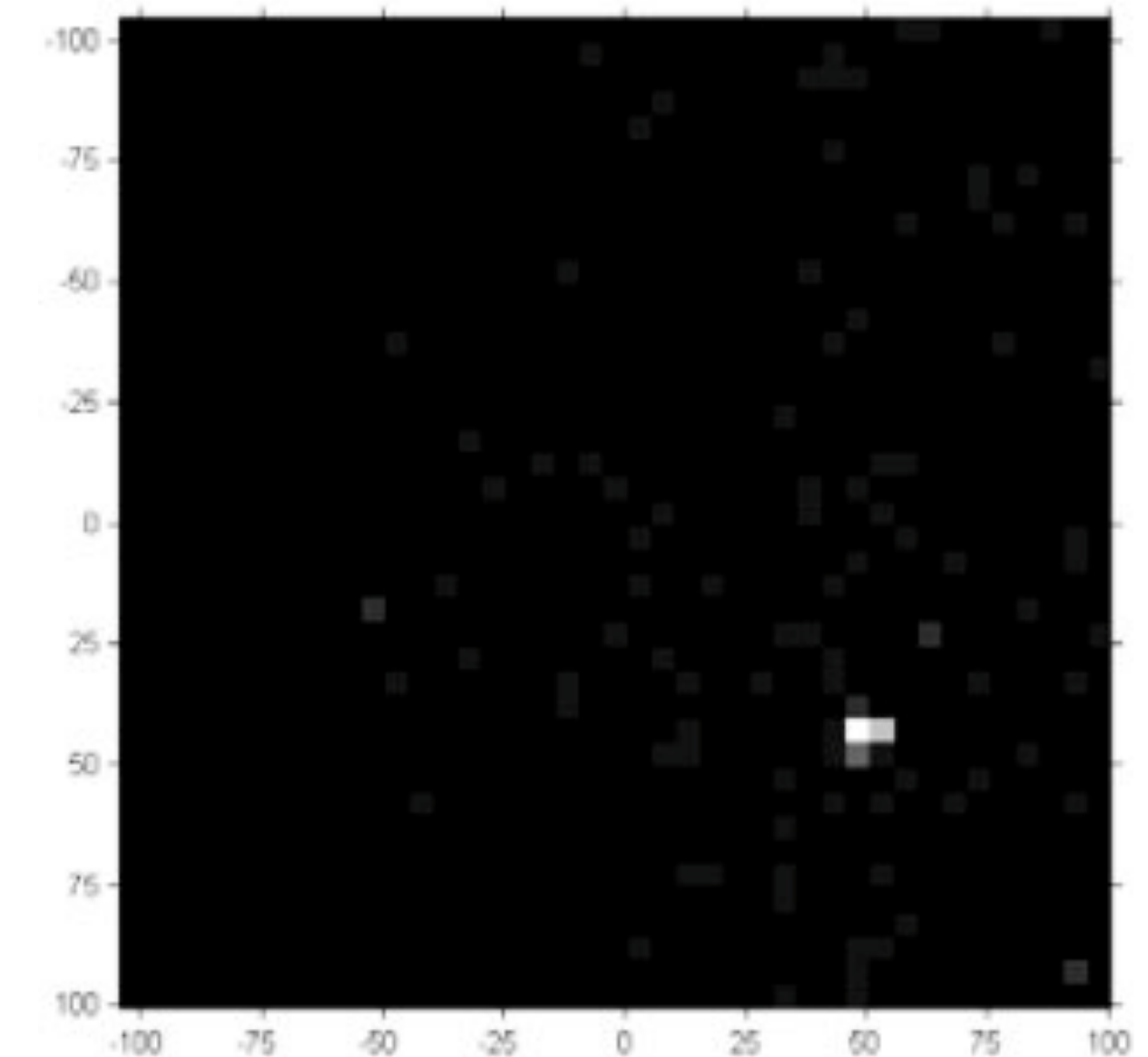
Feature Matching



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Introduction to Biometrics
Springer Books, 2011

Hough Transform

Solution: define the **Hough Space** -
a space with all the meaningful
(*scale, rotation, translation*) solutions.
Take the sample from the space
that maximizes the number of matches.



Hough-space 2D simplification with
the number of matches expressed as
gray scale (the more the matches, the
whiter the space).

Feature Matching

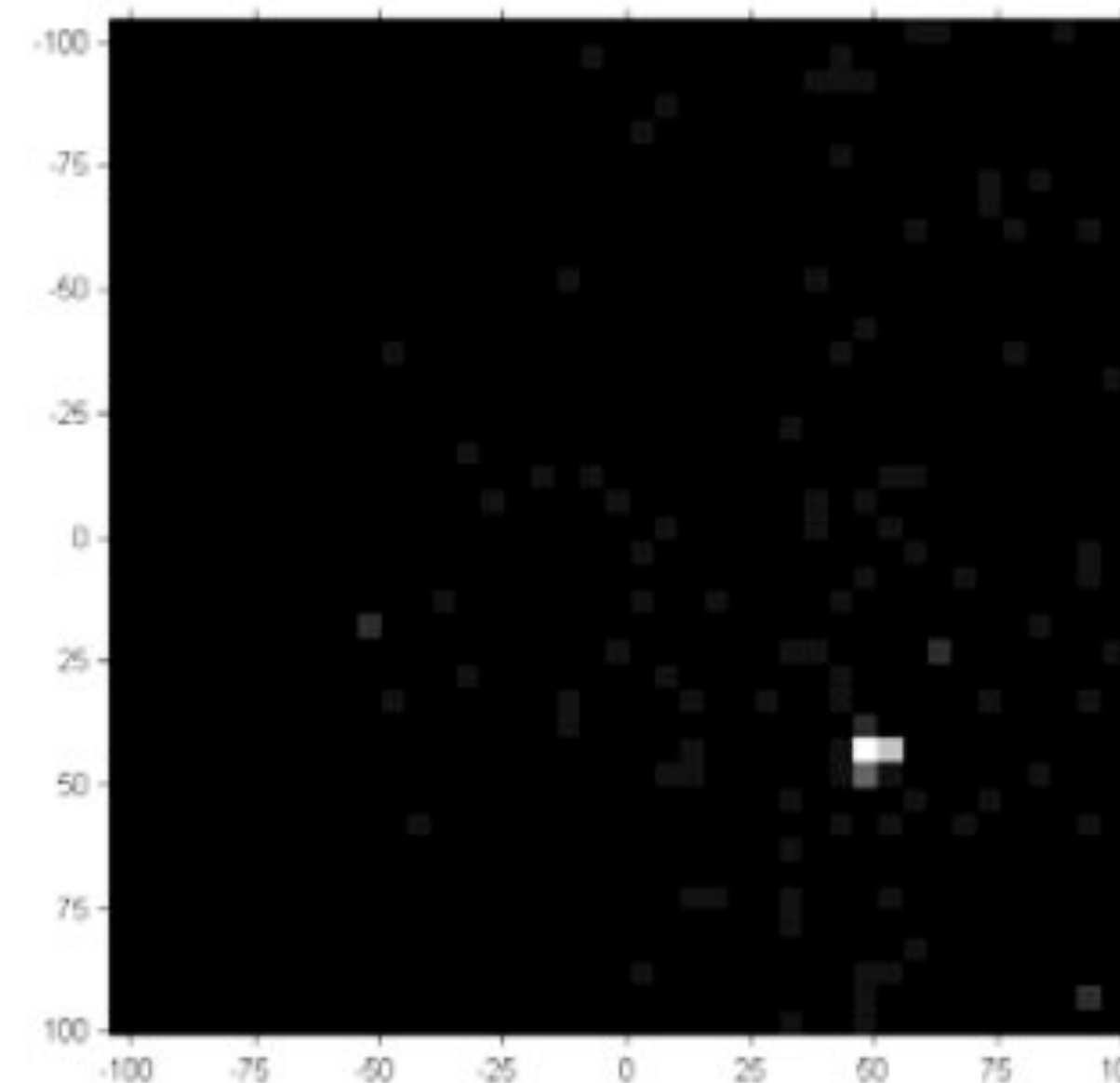
RECAP

Hough Transform



query

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Introduction to Biometrics
Springer Books, 2011



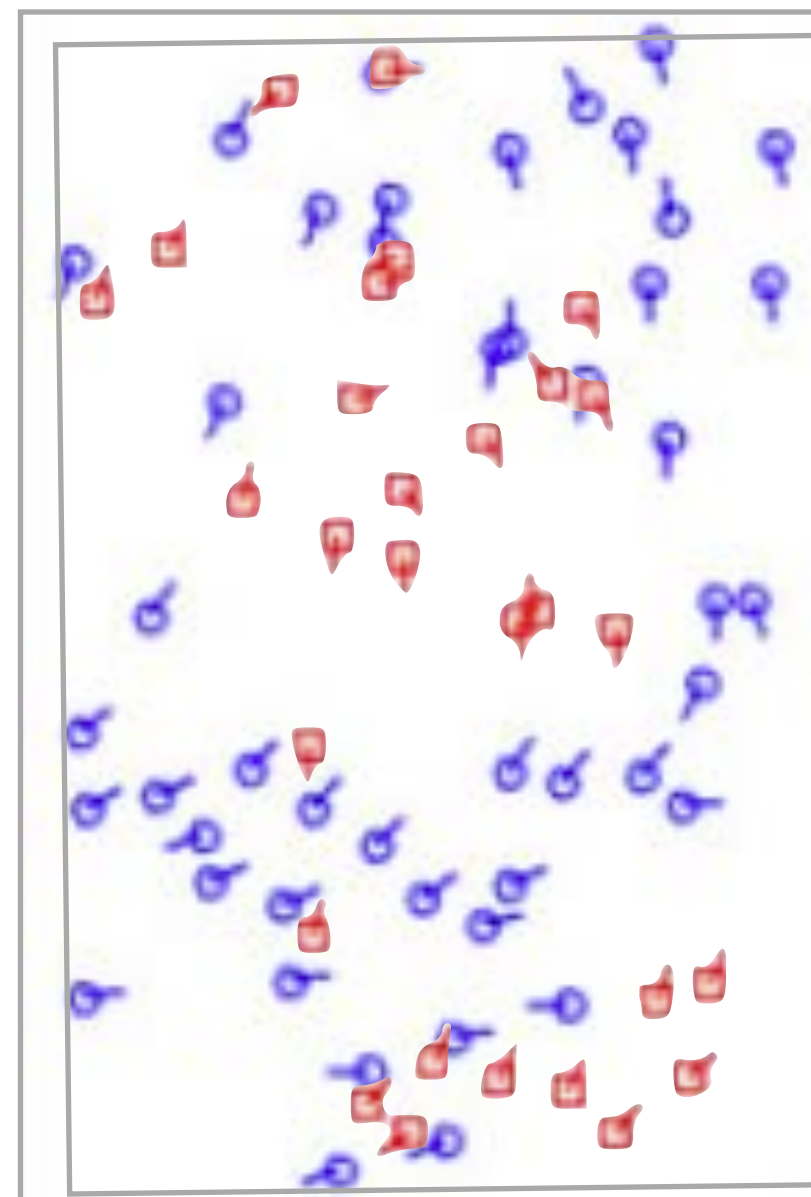
Hough-space 2D simplification with the number of matches expressed as gray scale (the more the matches, the whiter the space).

Feature Matching

RECAP

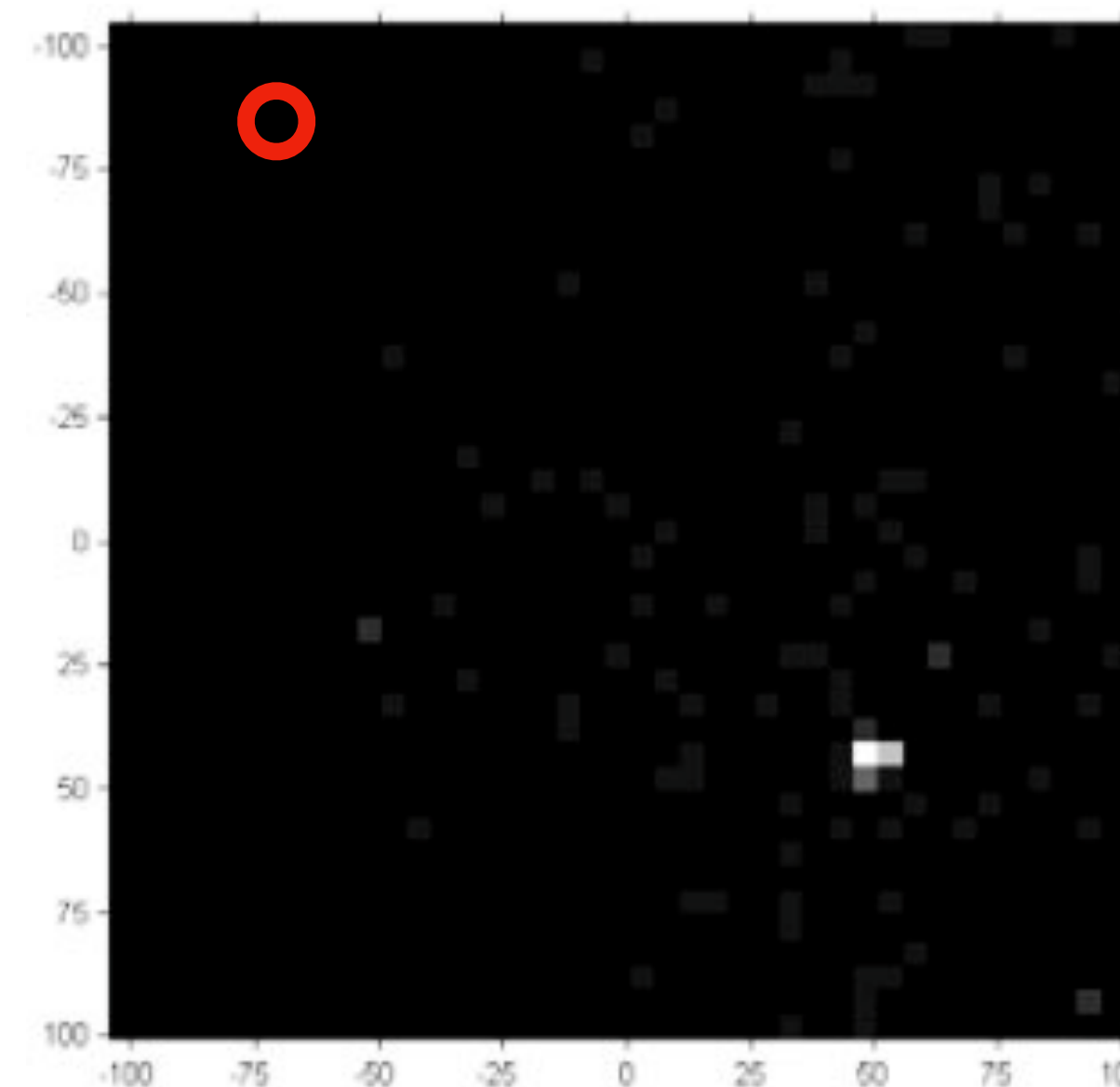
Hough Transform

template



query

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Introduction to Biometrics
Springer Books, 2011

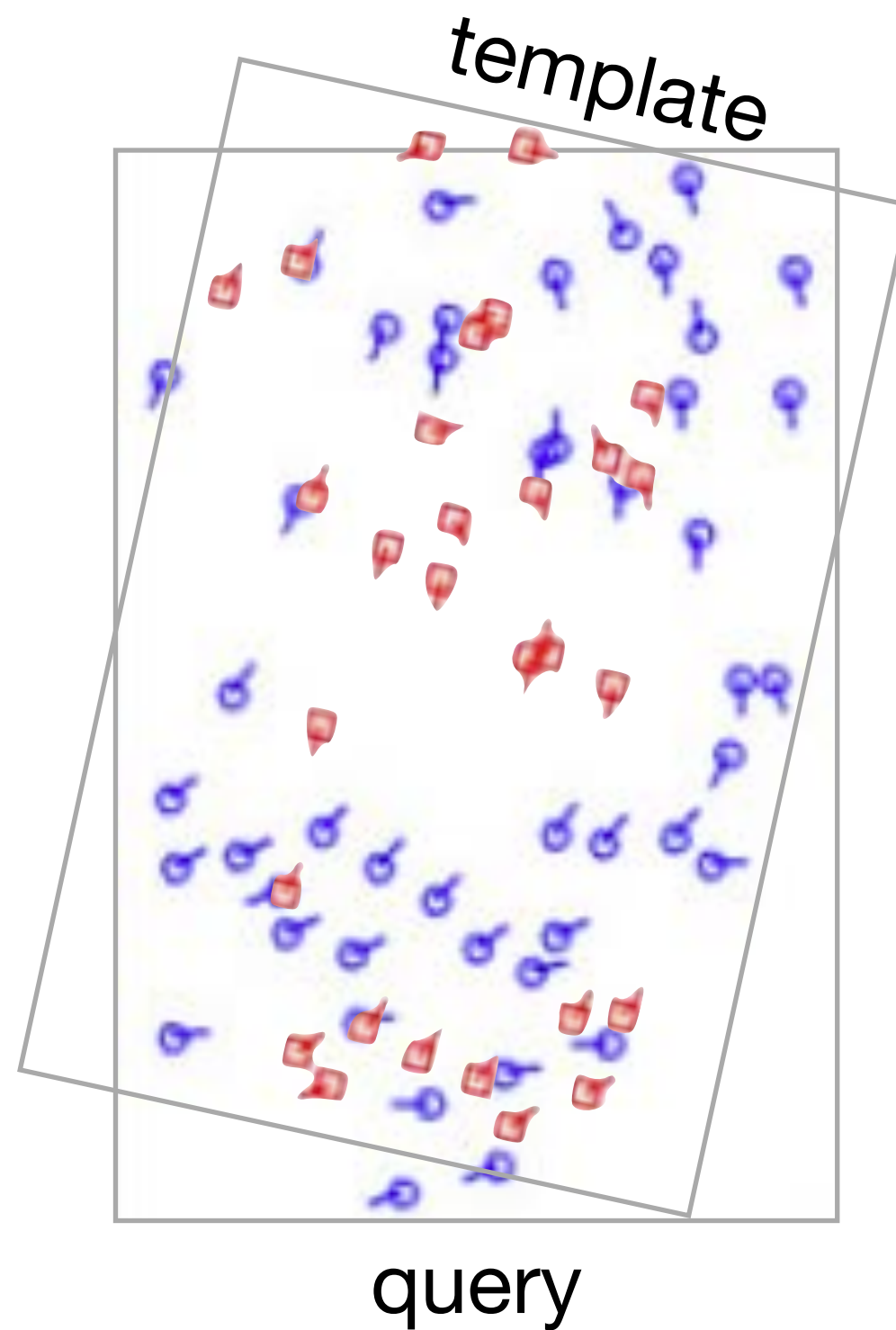


Hough-space 2D simplification with the number of matches expressed as gray scale (the more the matches, the whiter the space).

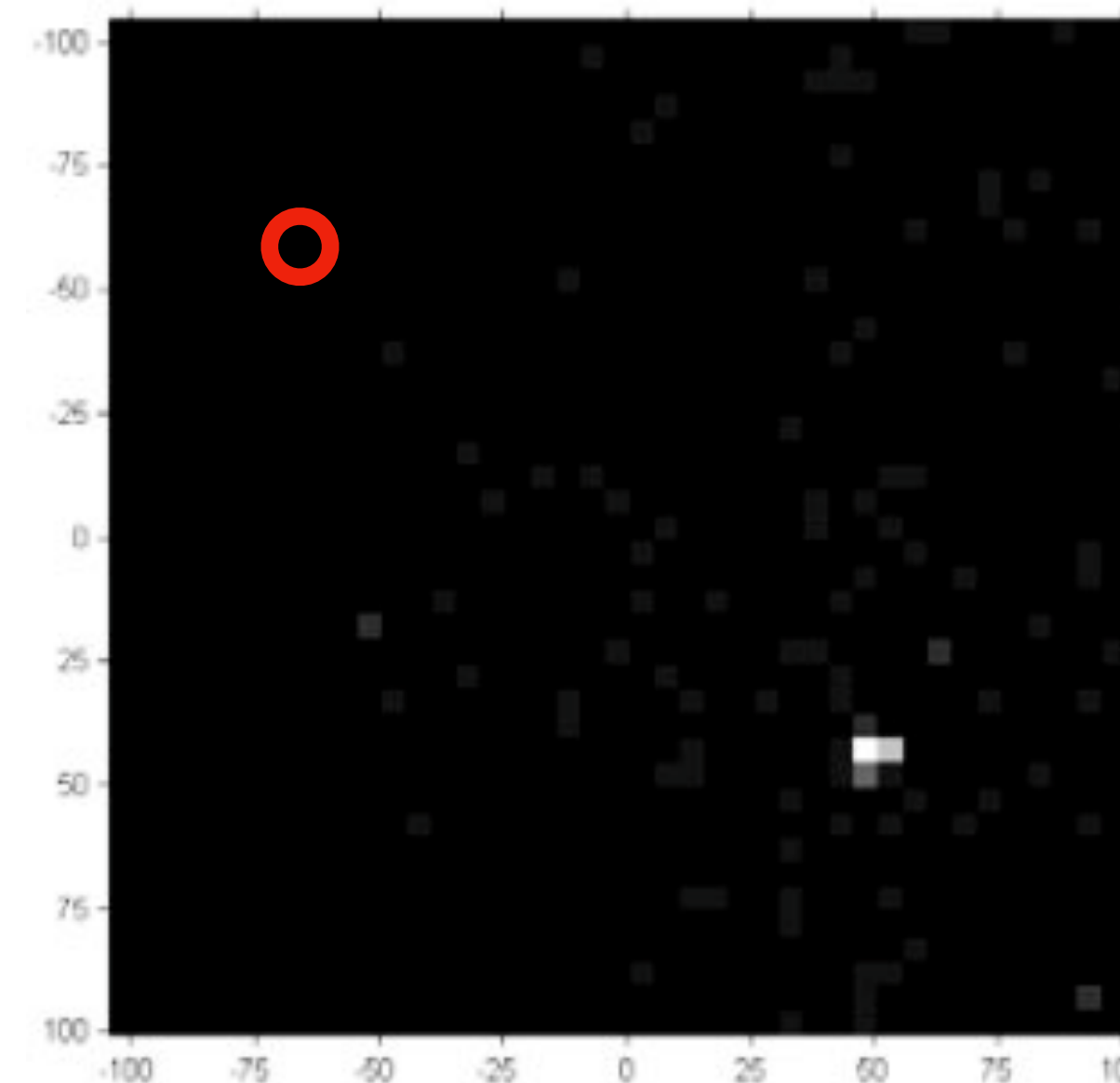
Feature Matching

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Hough Transform



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Springer Books, 2011

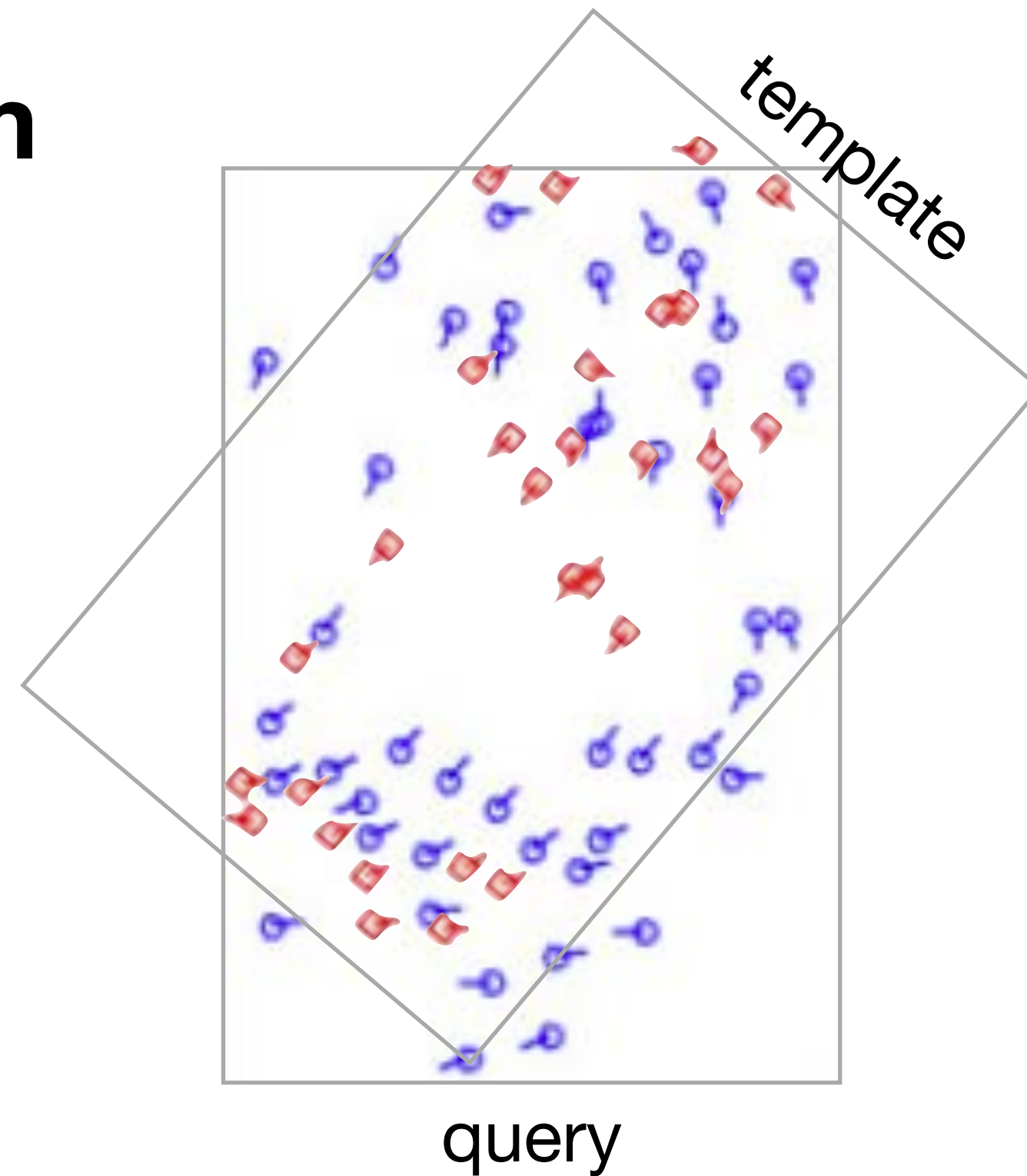


Hough-space 2D simplification with the number of matches expressed as gray scale (the more the matches, the whiter the space).

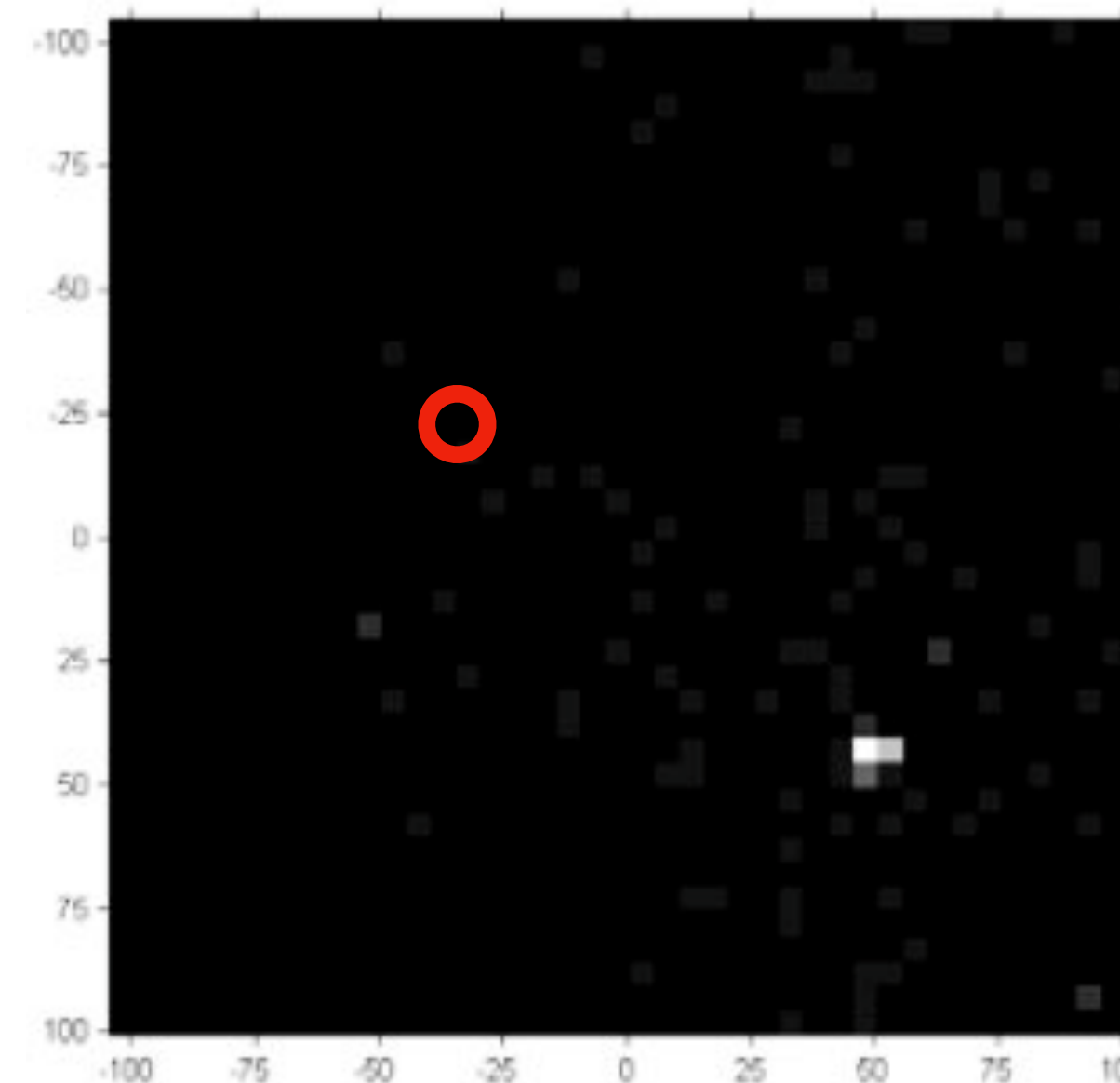
Feature Matching

RECAP

Hough Transform



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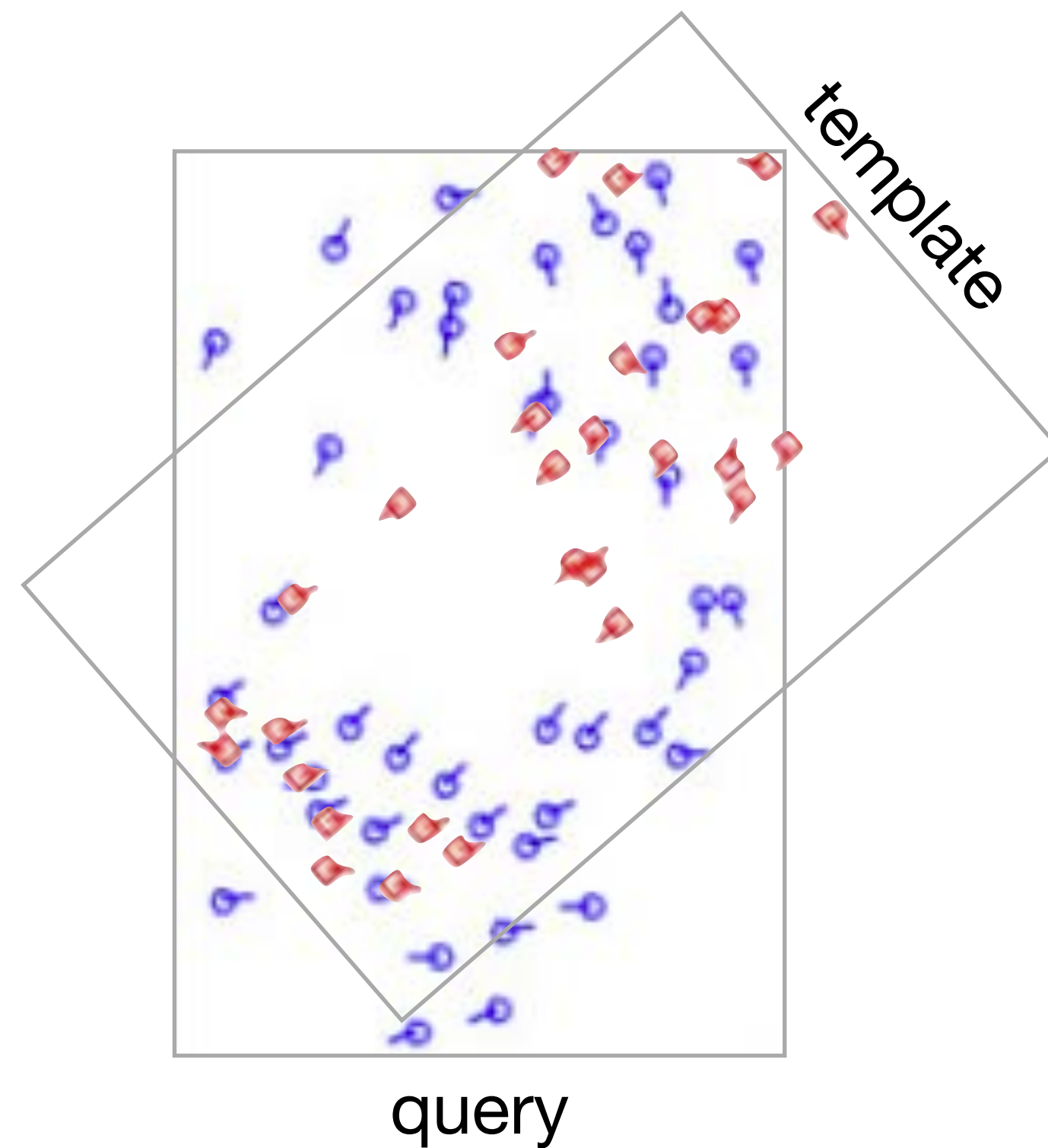


Hough-space 2D simplification with the number of matches expressed as gray scale (the more the matches, the whiter the space).

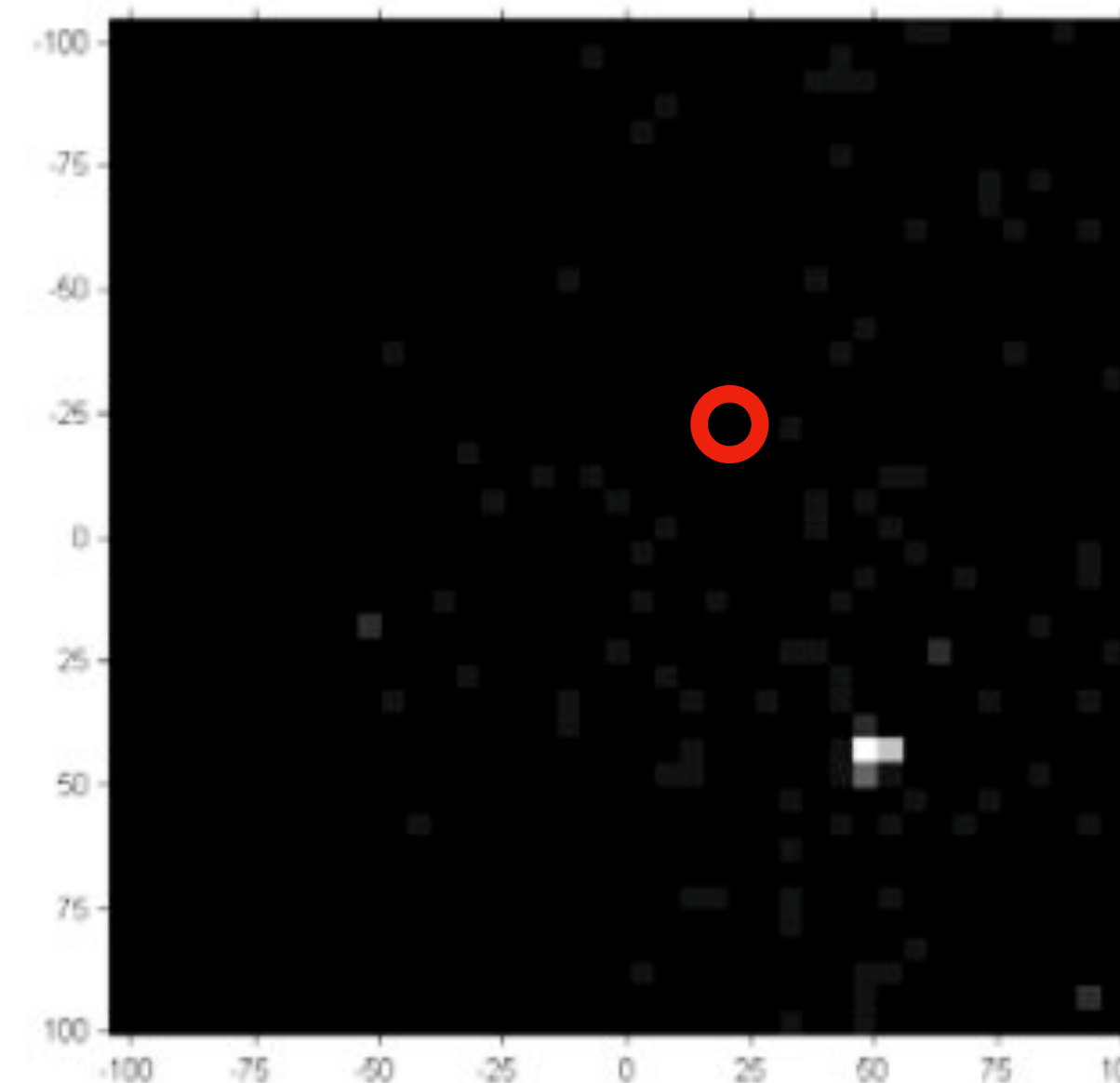
Feature Matching

RECAP

Hough Transform



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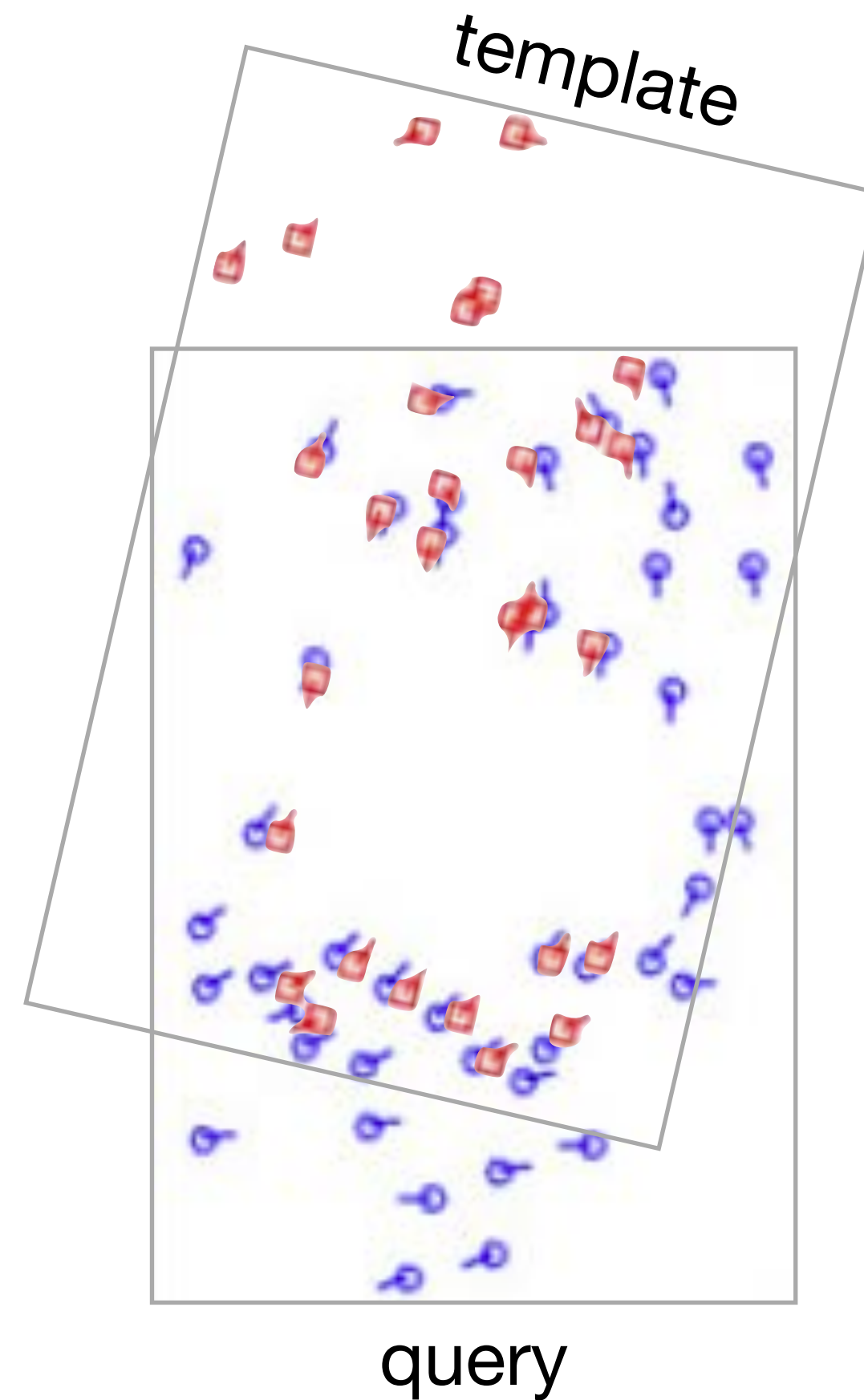


Hough-space 2D simplification with the number of matches expressed as gray scale (the more the matches, the whiter the space).

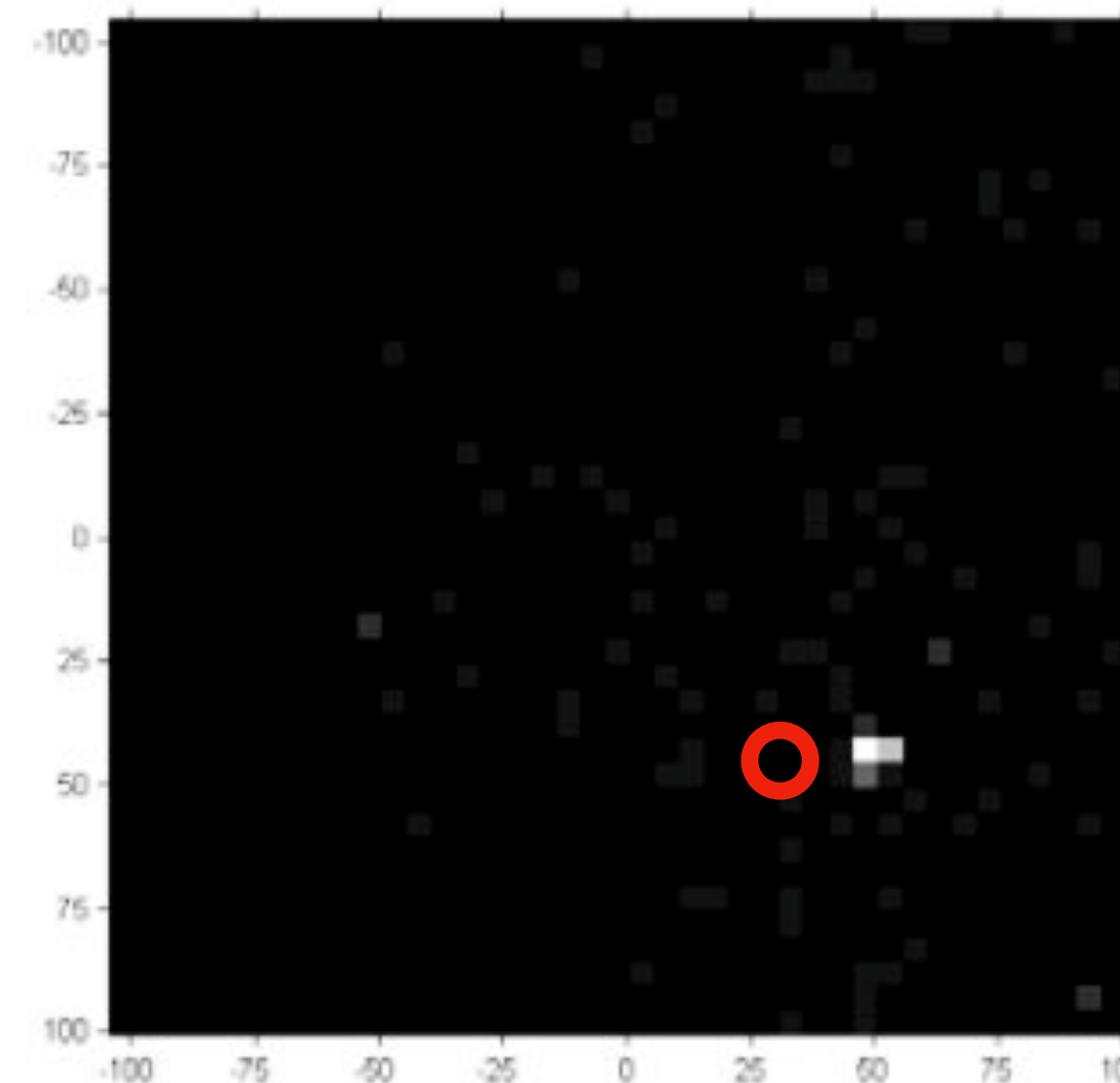
Feature Matching

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Hough Transform



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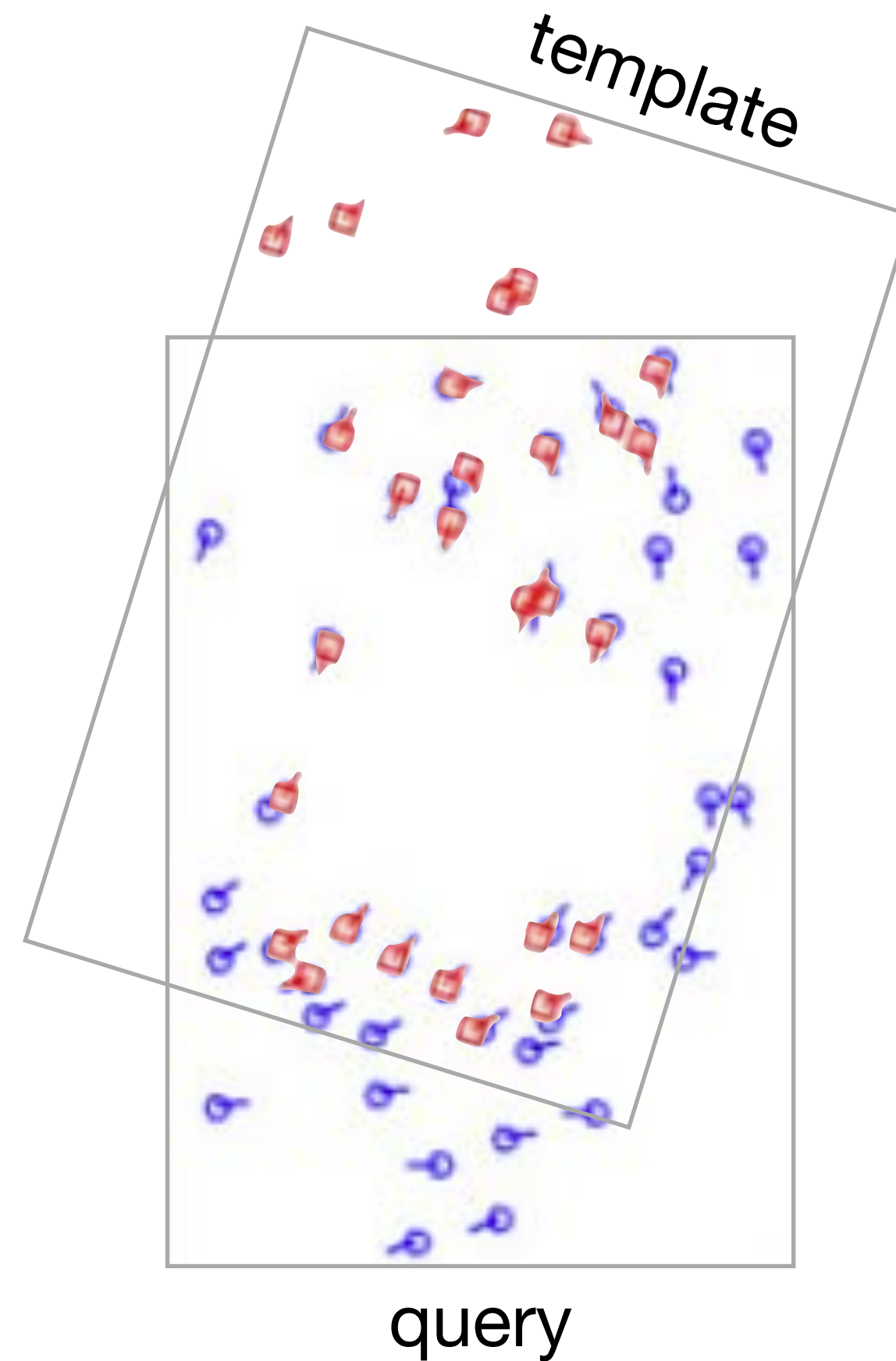


Hough-space 2D simplification with the number of matches expressed as gray scale (the more the matches, the whiter the space).

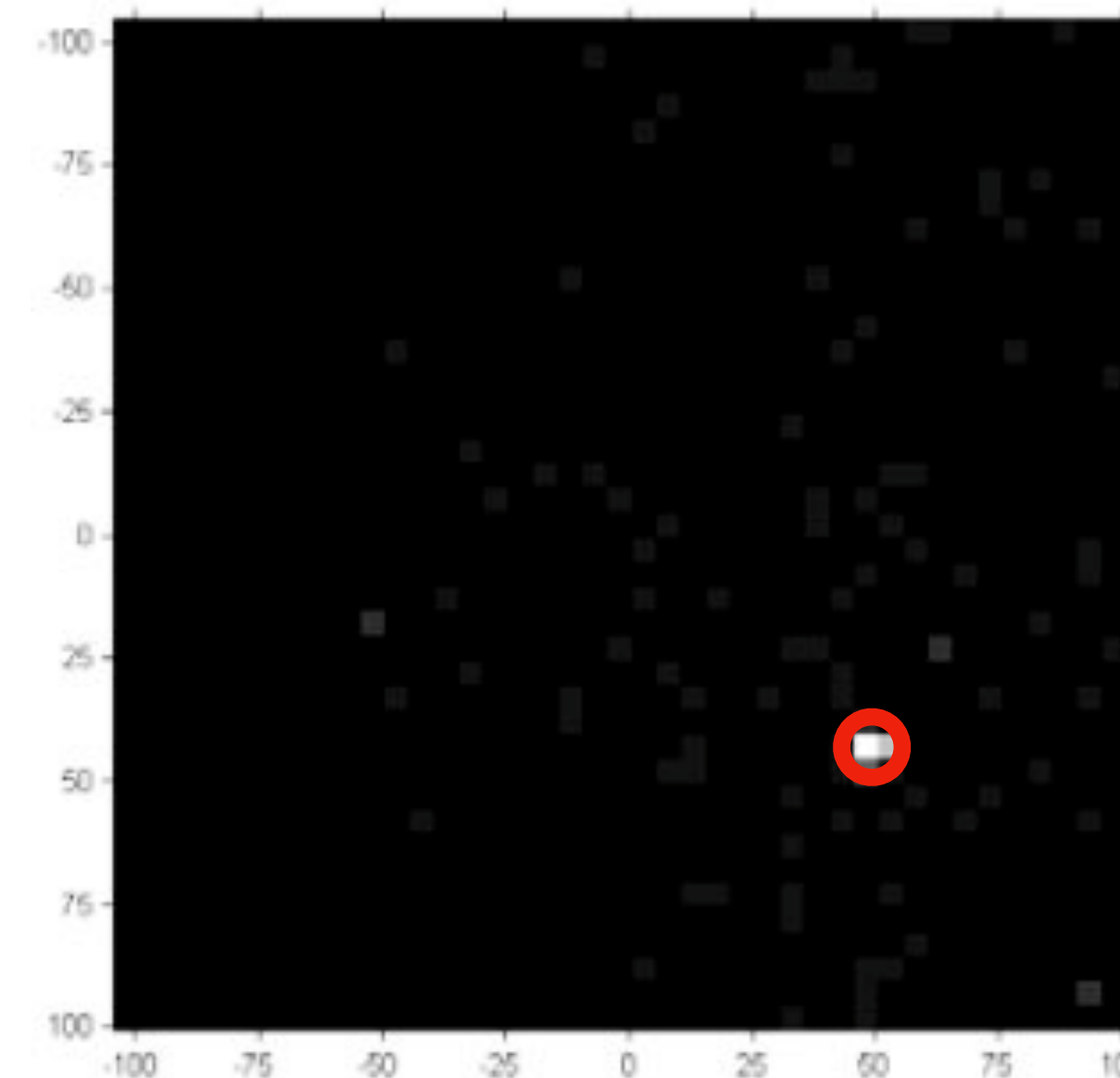
Feature Matching

RECAP

Hough Transform



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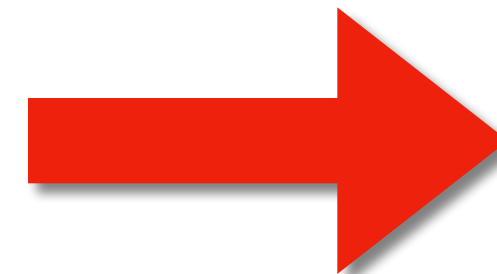
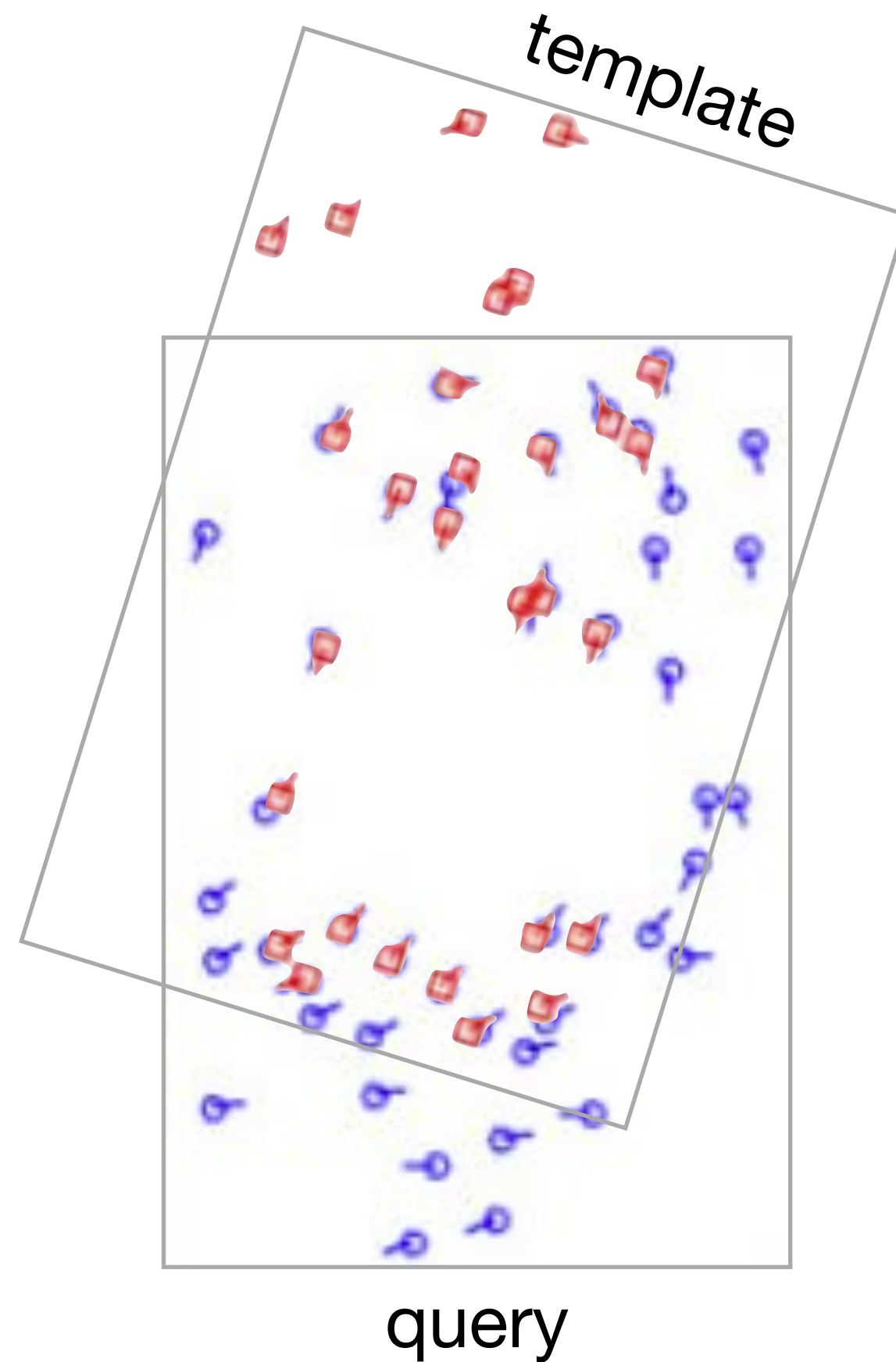


Hough-space 2D simplification with the number of matches expressed as gray scale (the more the matches, the whiter the space).

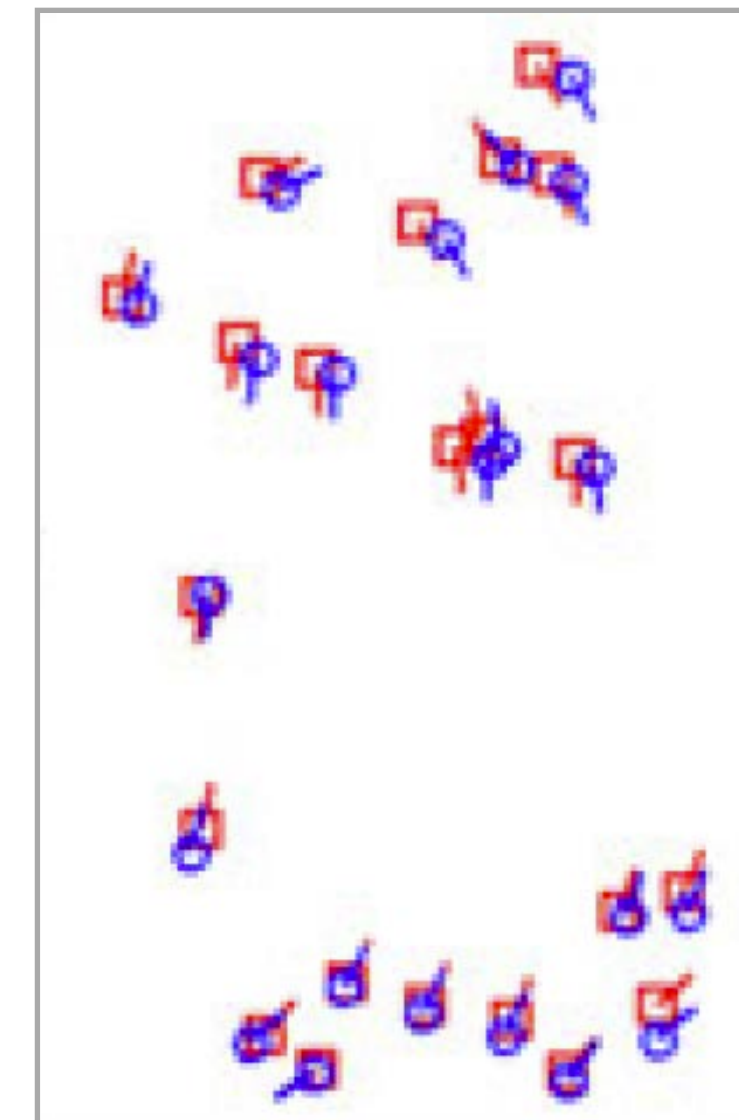
Feature Matching

RECAP

Hough Transform



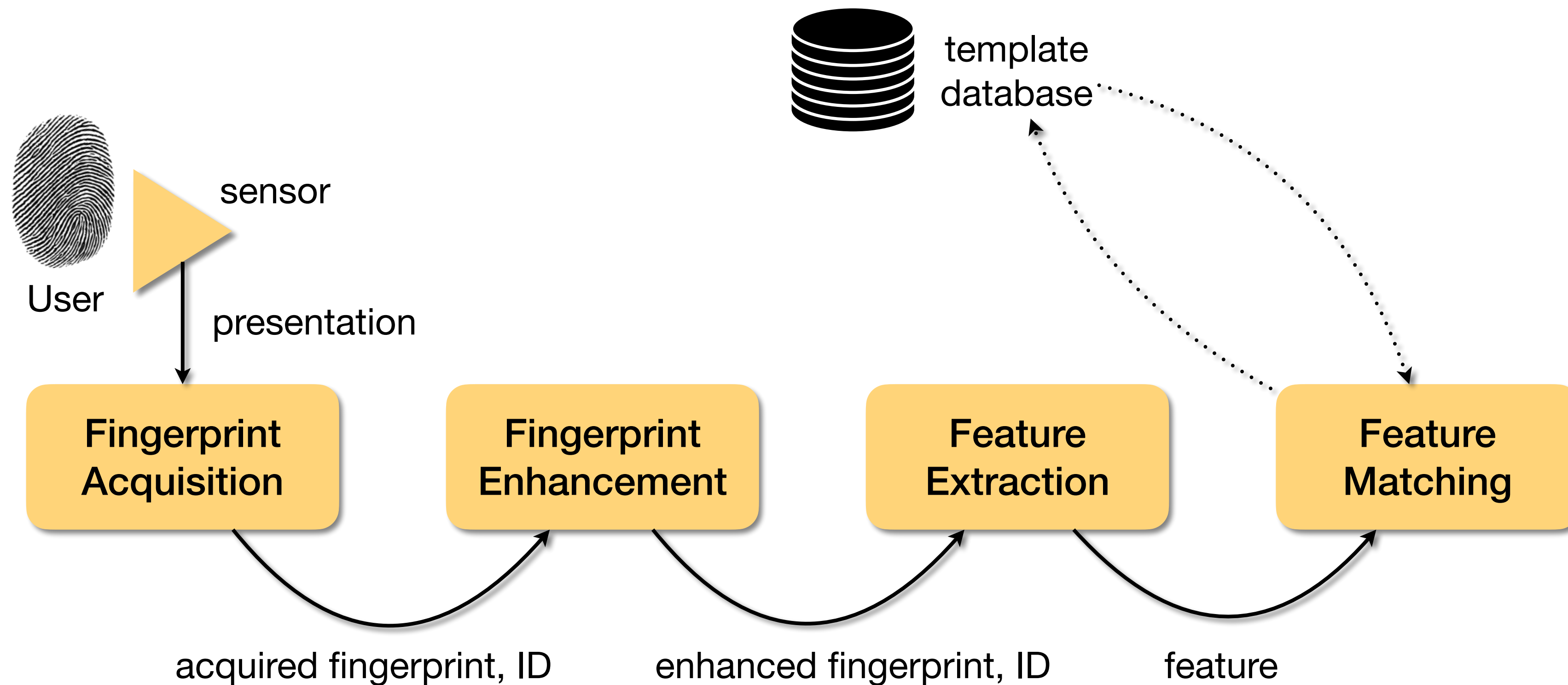
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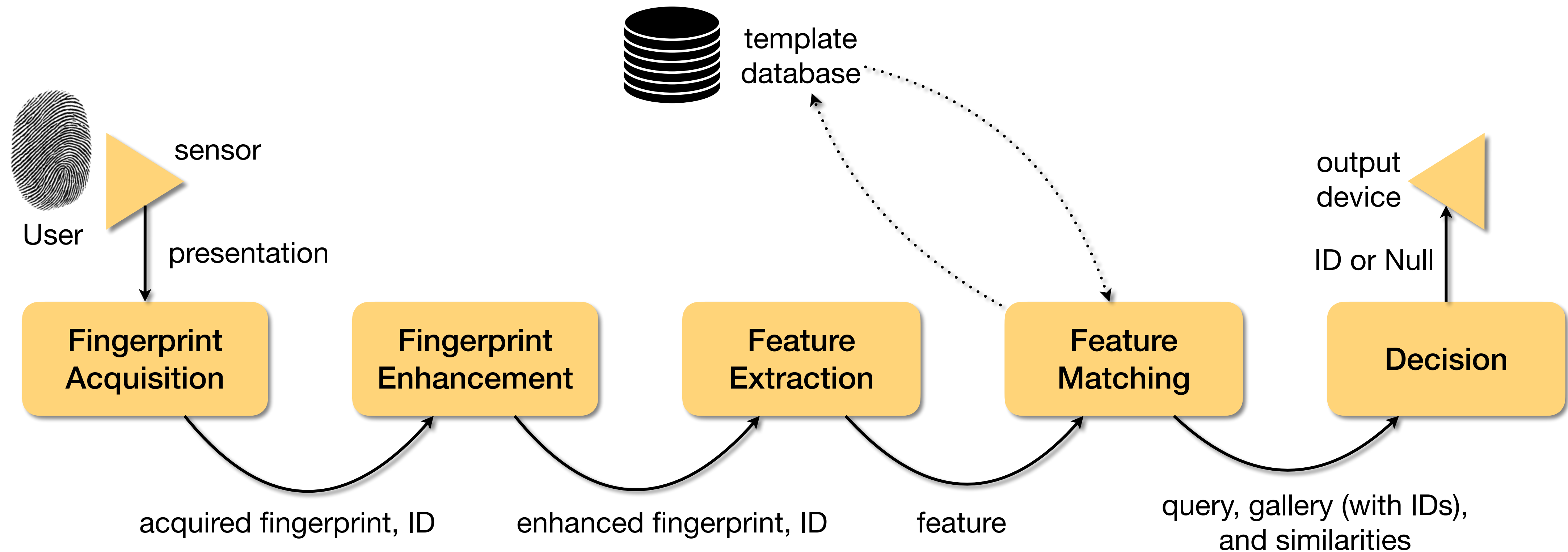
21 matches

Fingerprint Recognition

RECAP



Fingerprint Recognition



Decision

Similarity-based Decision

The number of minutiae matches express the **similarity** between two fingerprint samples.

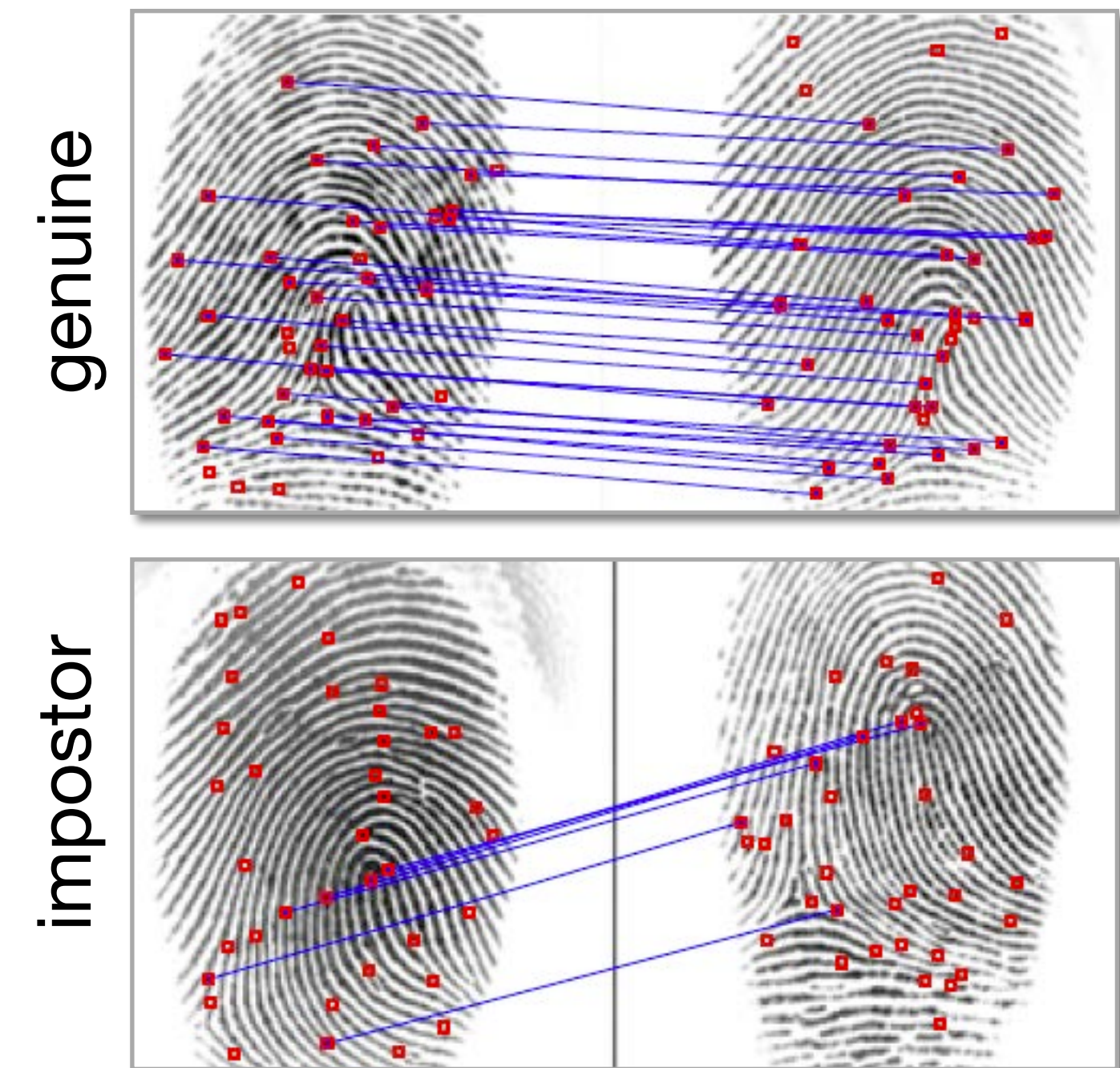
Simple score

Let M be the number of minutiae in image i .

Let N be the number of minutiae in image j .

$$sim_score = \frac{\#matches}{(M + N)/2}$$

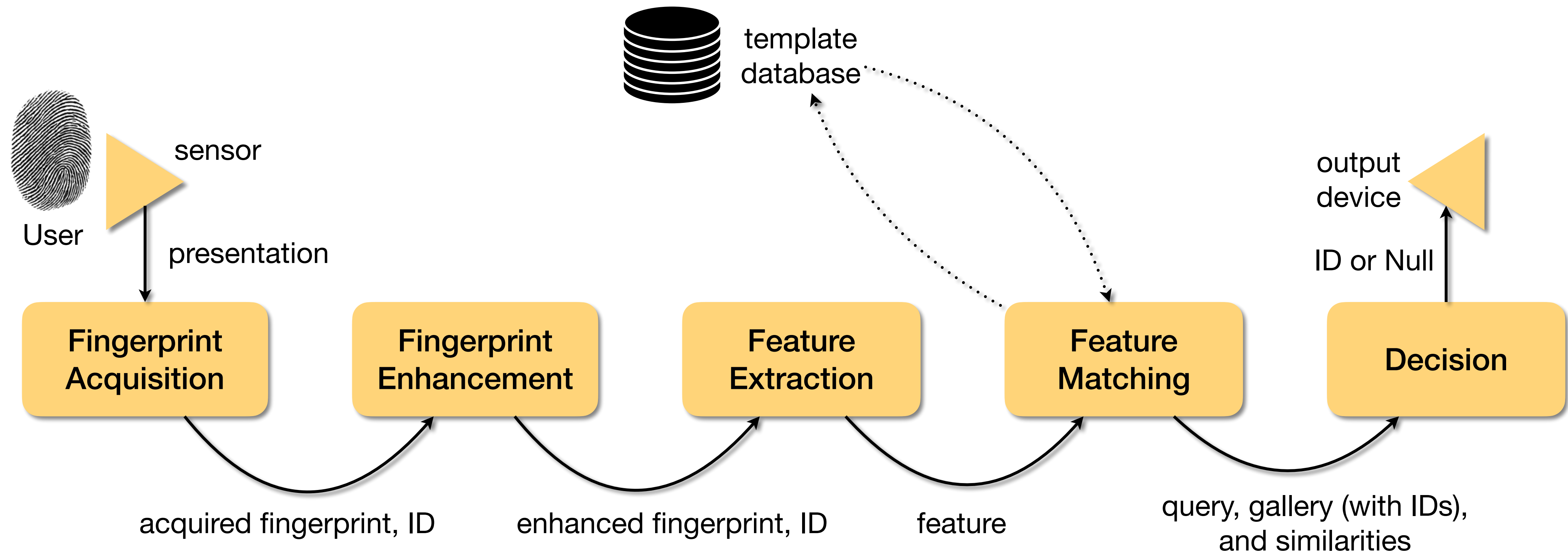
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Data Collection Time



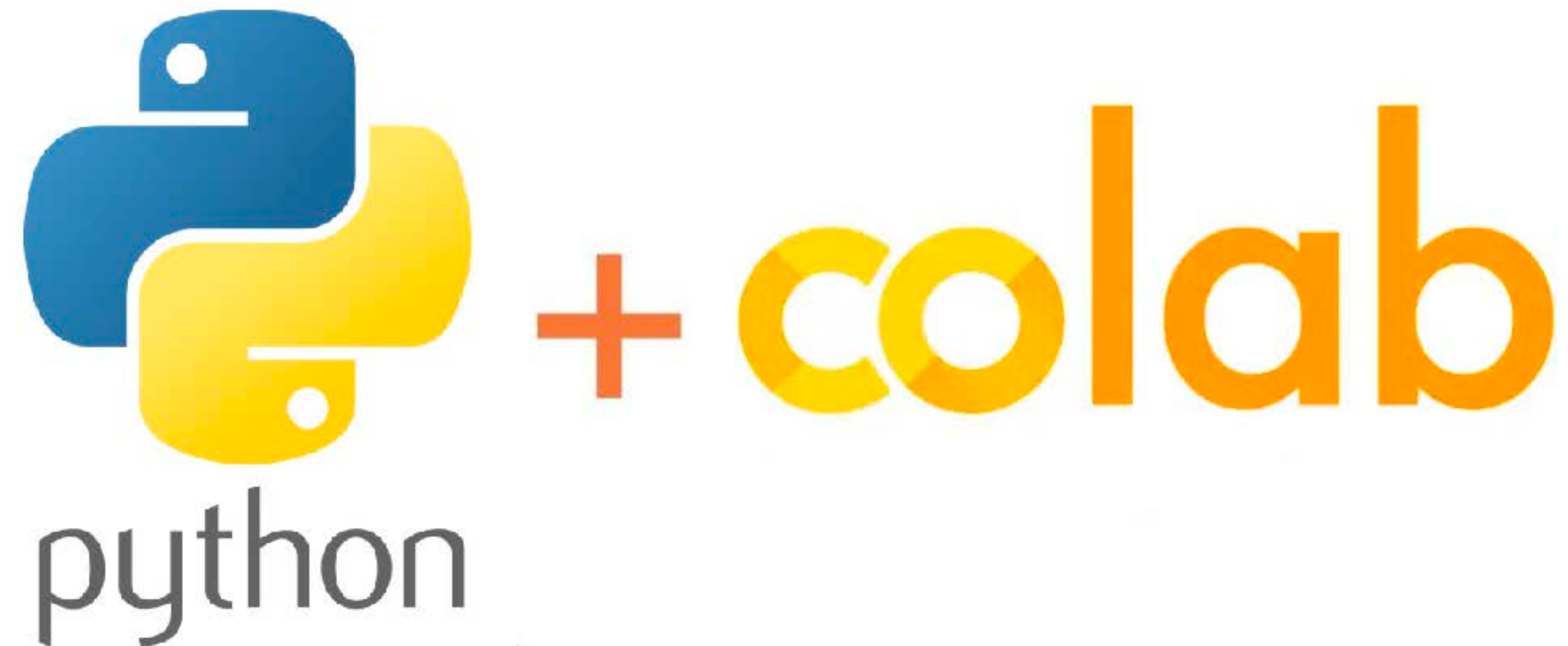
Fingerprint Recognition



Implementation

Please open

tinyurl.com/3xet5mwx



What's Next?

Second coding class

We'll experiment with a fingerprint recognition implementation.

Fill out your Today-I-missed Statement

Please visit sakai.luc.edu/x/Dv5DsU.

