

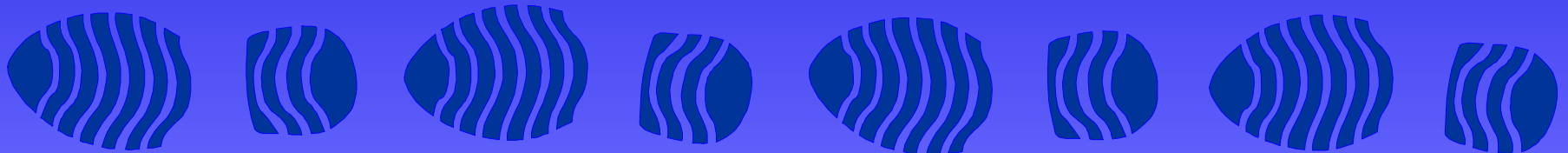
PATTERN RECOGNITION OF WEAR, CLASS AND IDENTIFYING CHARACTERISTICS IN FOOTWEAR IMPRESSION EVIDENCE



Hoosain M Ebrahim

Department of Medical Illustration

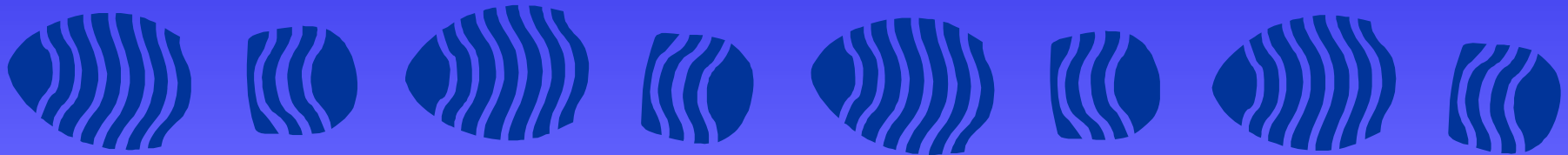
University of Limpopo, Medunsa Campus



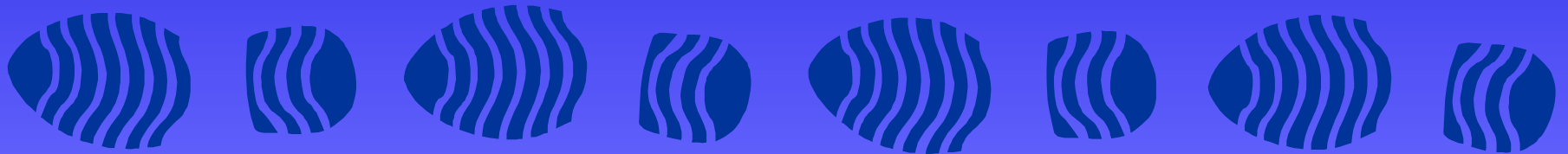


IMPRESSION EVIDENCE

Objects or materials which have retained the characteristics of other objects or materials which have been impressed against them

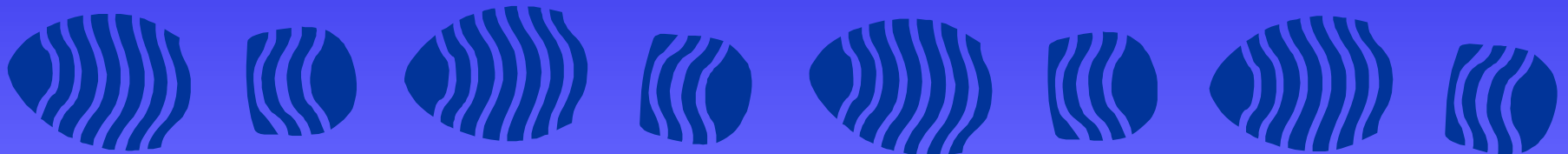


Footwear impressions can be **positively identified** as having been made by a specific shoe



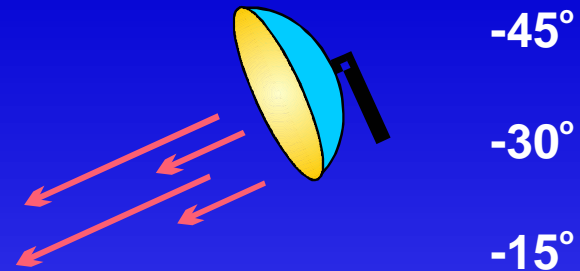
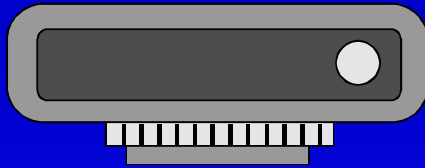
PHOTOGRAPHY OF FOOTWEAR IMPRESSIONS

- General crime-scene photographs
- Examination quality photographs

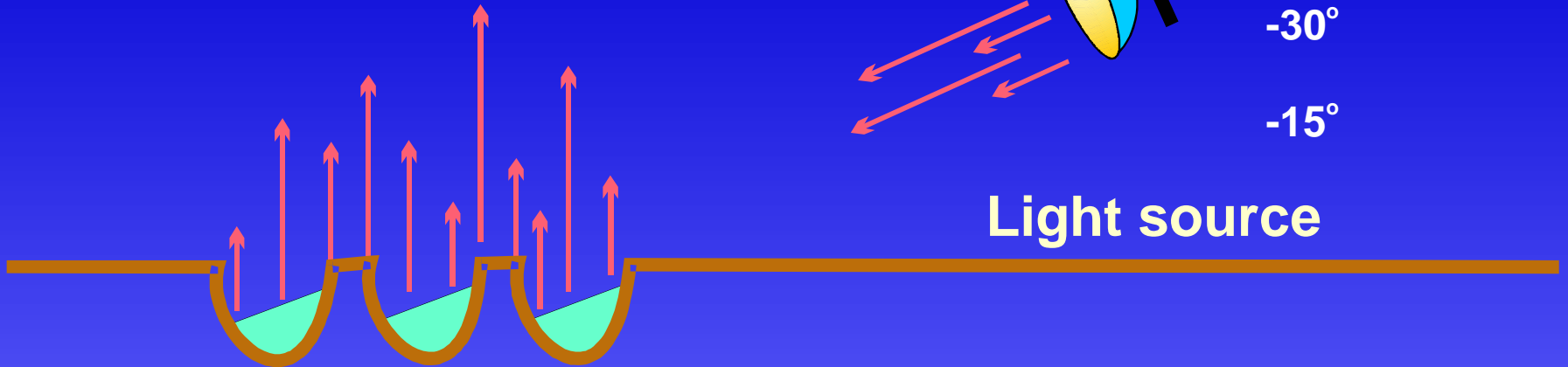


OBLIQUE LIGHT PHOTOGRAPH OF THREE-DIMENSIONAL IMPRESSIONS

Camera



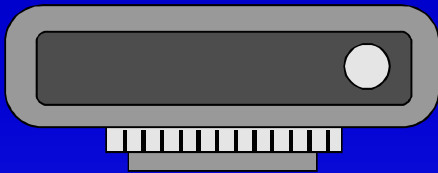
Light source



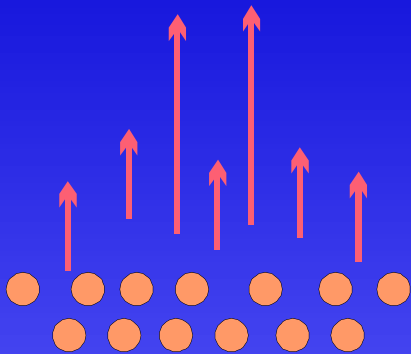
(Impression)

OBLIQUE LIGHT PHOTOGRAPH OF TWO-DIMENSIONAL IMPRESSION

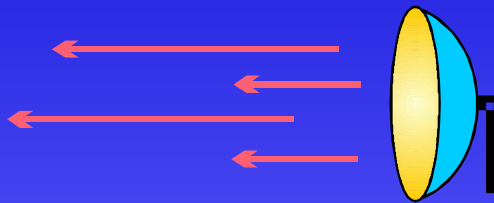
Camera



Light is reflected off dust particles and into camera



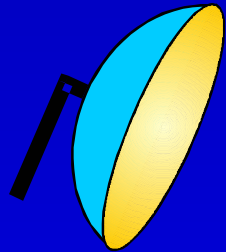
(Impression)



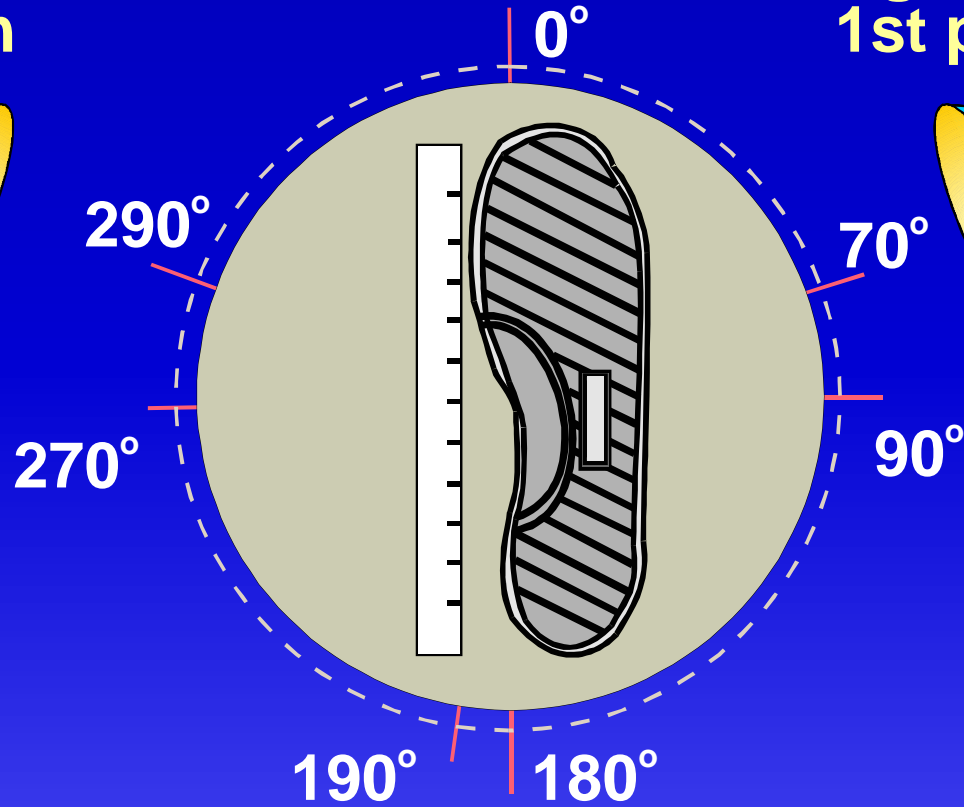
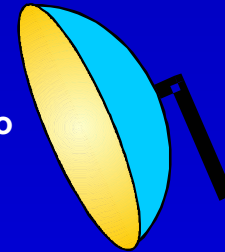
Light source

LIGHTING

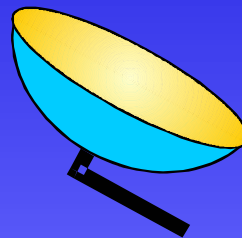
Light source
3rd position



Light source
1st position

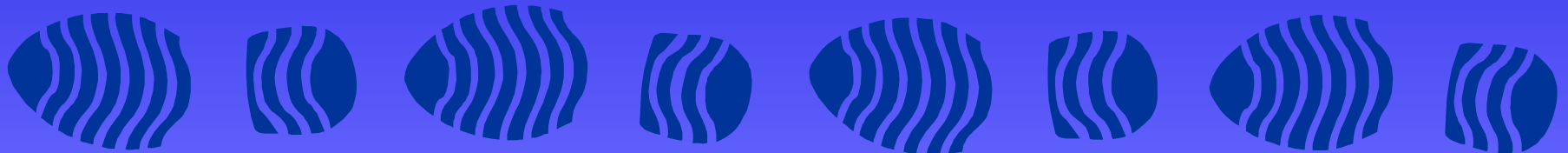


Light source
2nd position

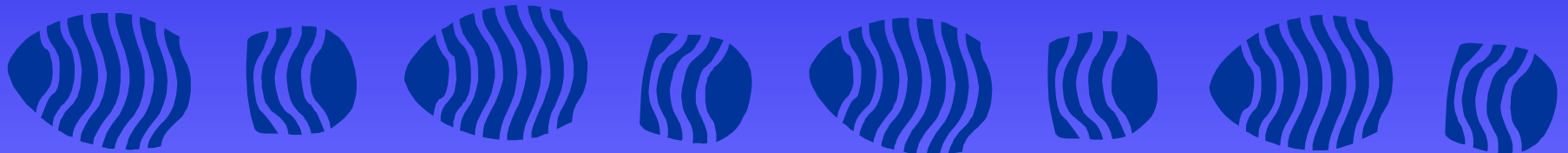


WEAR OF THE SHOE

- Position of wear
- Degree of wear



Wear - The erosion of the outsole due to frictional and abrasive forces that occur between the outsole and the ground

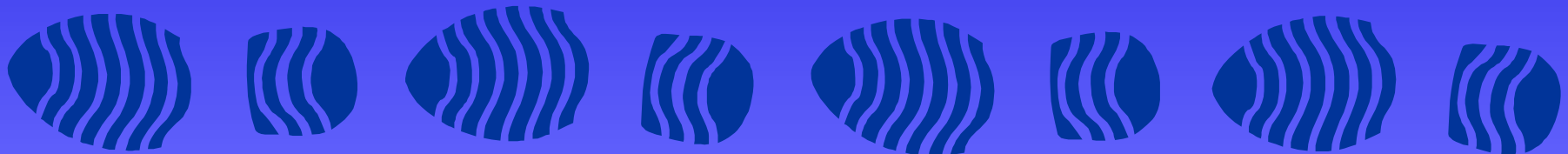


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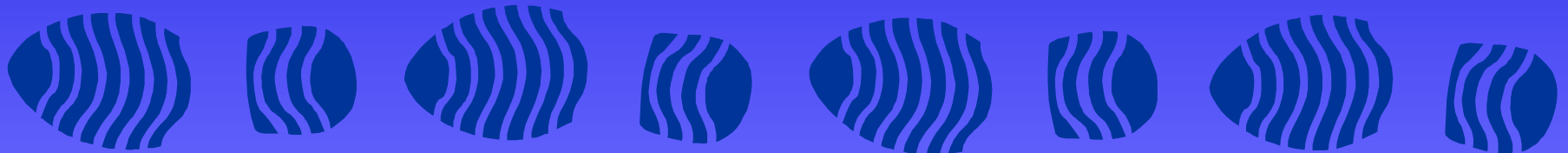
INFLUENCES ON THE WEAR OF SHOE OUTSOLES

- Foot type and function
- Occupation
- Habits
- Body type
- Shoe style
- Shoe materials
- Walking surfaces



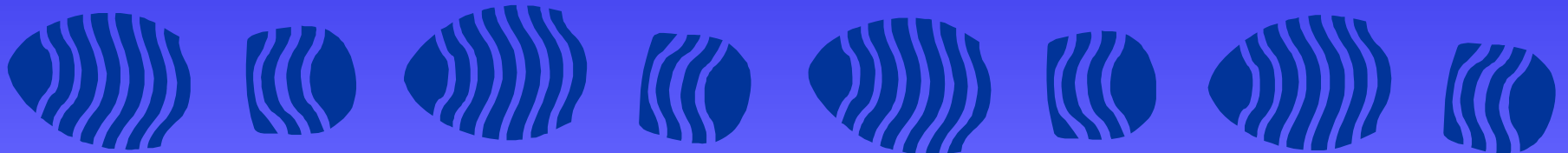
Wear pattern

Refers to the wear on the entire shoe or a portion of the shoe

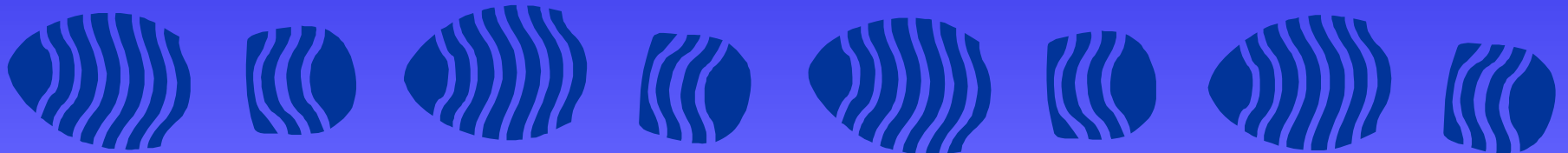


Wear pattern

Anatomical wear pattern

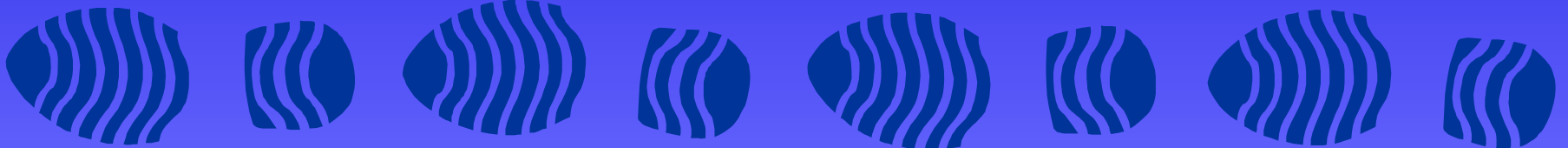


**Wear characteristics alone are
not accepted as a means of
positive identification**



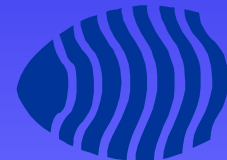
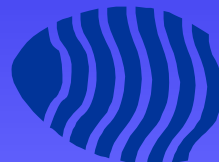
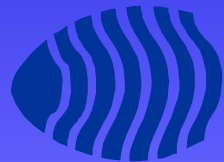
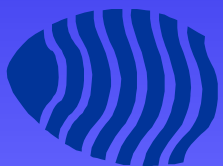
CLASS AND IDENTIFYING CHARACTERISTICS

- Knowledge
- **Pattern recognition**
- Assessment



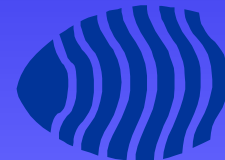
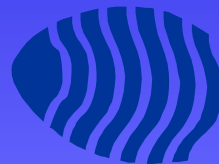
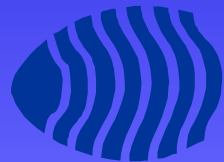
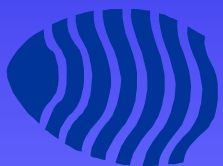
CLASS CHARACTERISTICS

- Size
- Pattern design
- Contour of imprint
- Shape



COMBINED CLASS CHARACTERISTICS

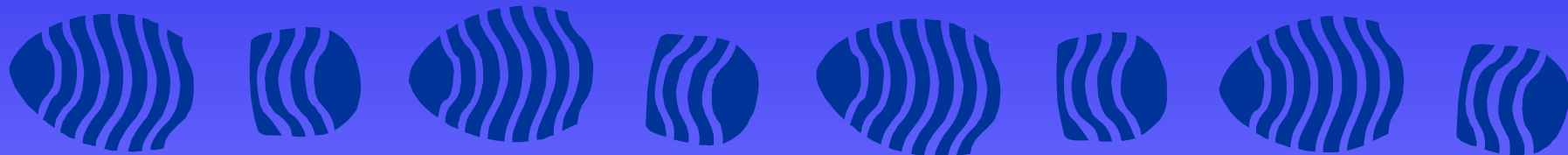
- Size
- Design

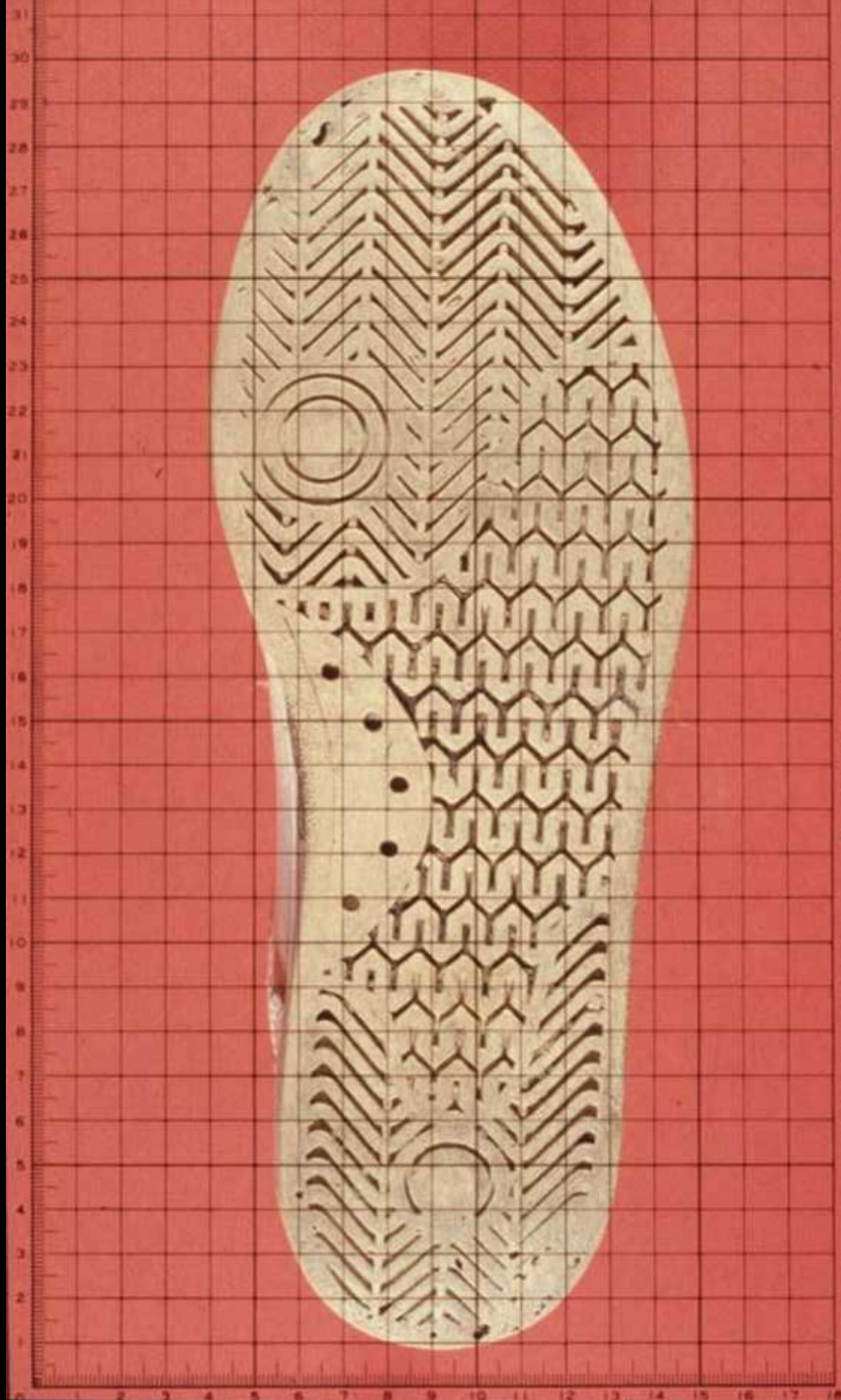




IDENTIFYING CHARACTERISTICS

Result when something is randomly added to or taken away from a shoe outsole that either causes or contributes to making that shoe outsole unique

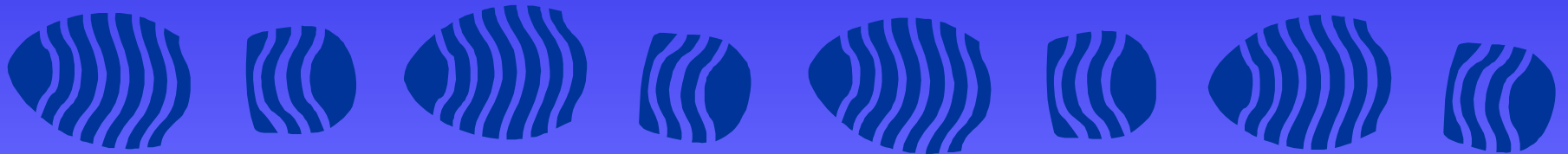




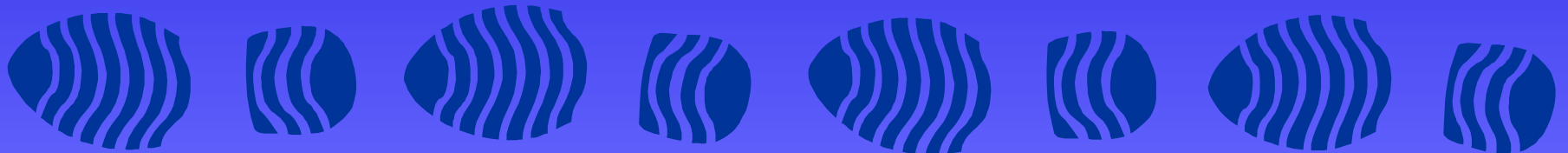
警察科学研究所

東京麹町區本町五丁目三番一號

Pattern Recognition Techniques used as searching criteria

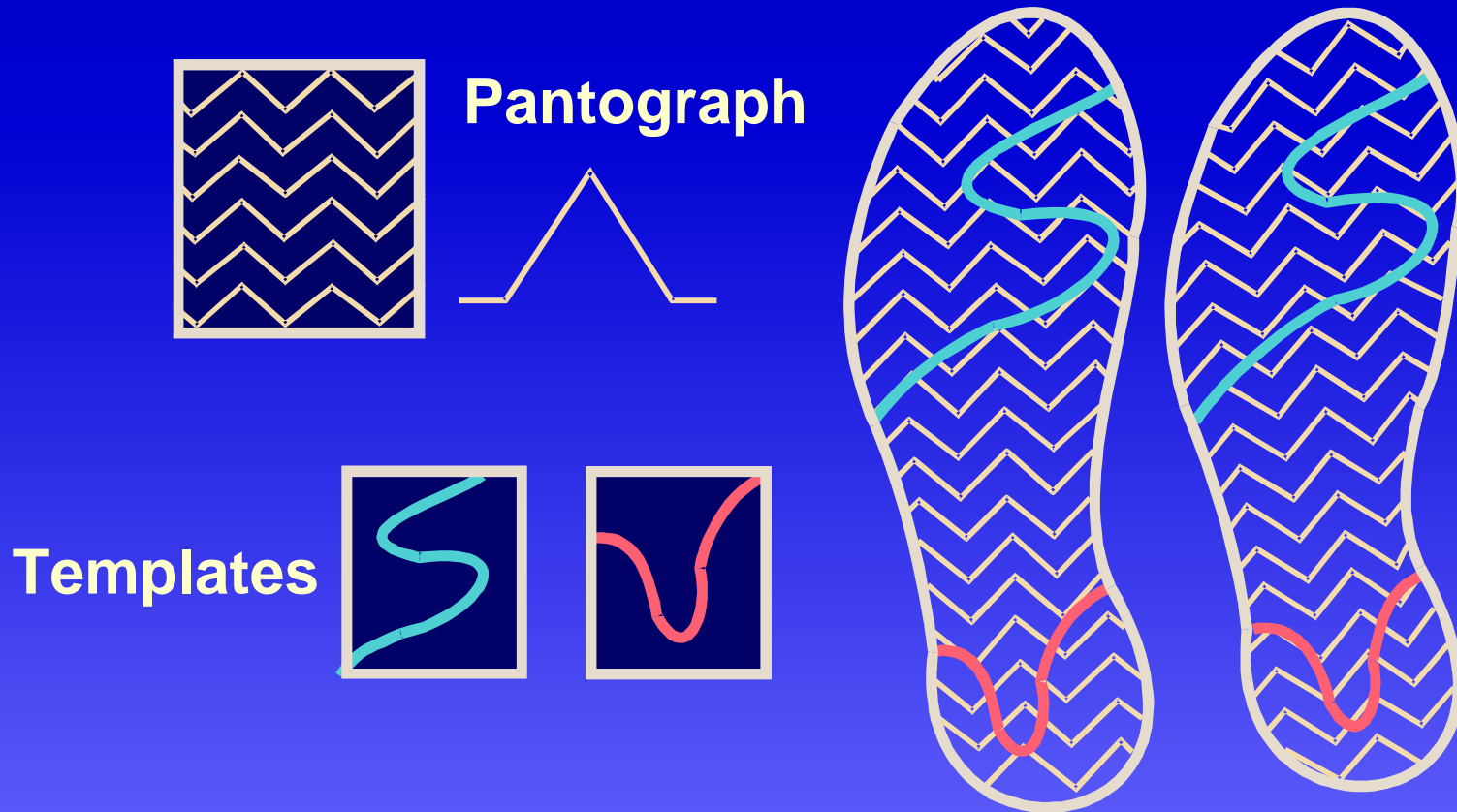


RECOGNITION OF MANUFACTURING METHODS

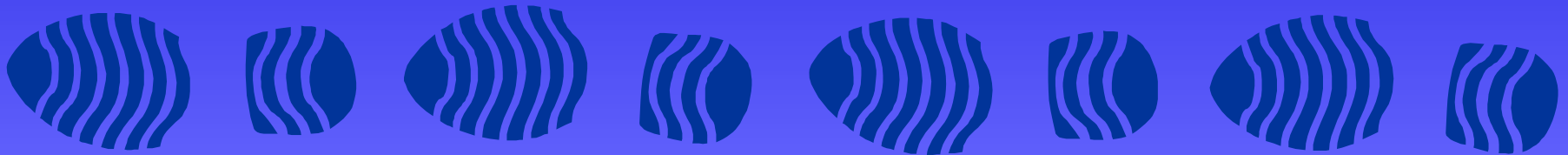


HAND ENGRAVED MOULD-MAKING

Two hand-engraved moulds using same templates and pantograph but resulting in different “gross designs”



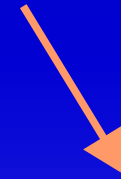
Types  **Preliminary classification**
Feature classification



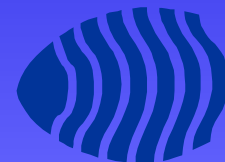
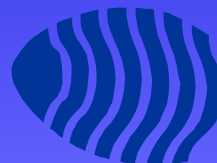
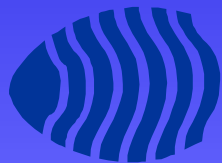
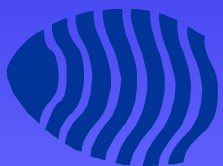
Shoe impressions



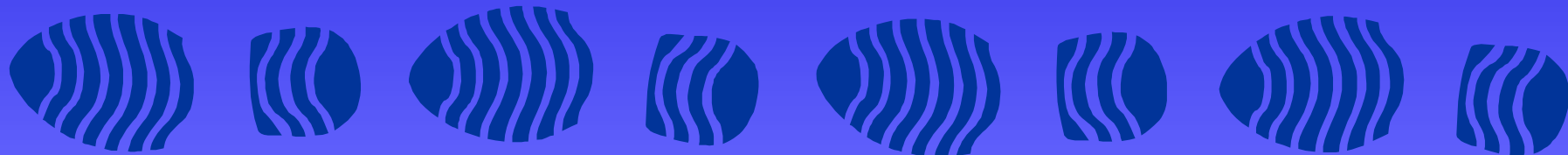
Partial



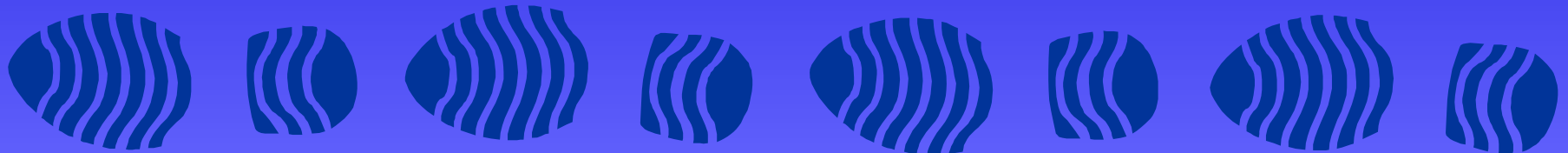
Complete



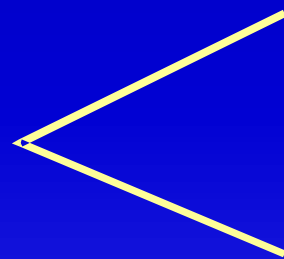
**Shoe sole collection systems
assist in determining the
classification of full shoe
impressions**



Different **pattern designs** and
possible small differences
within patterns

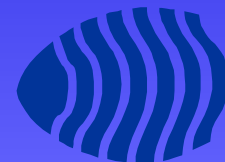
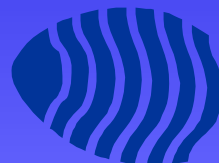
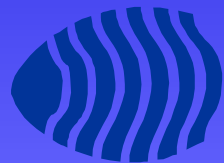
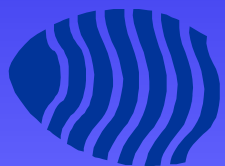


**Recorded
Impressions
(filed)**

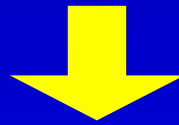


Pattern designs

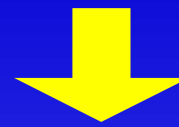
Features



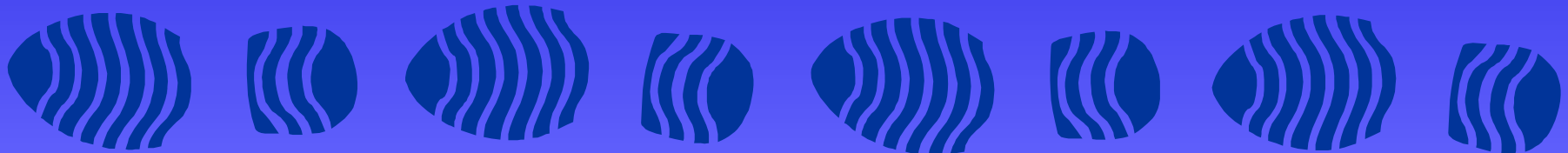
FOOTWEAR IMPRESSIONS



A valuable form of physical evidence



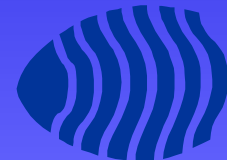
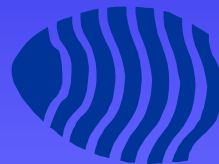
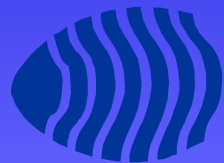
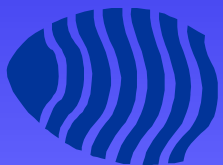
Provide an important link between
the criminal and the crime scene



Development of footwear collection

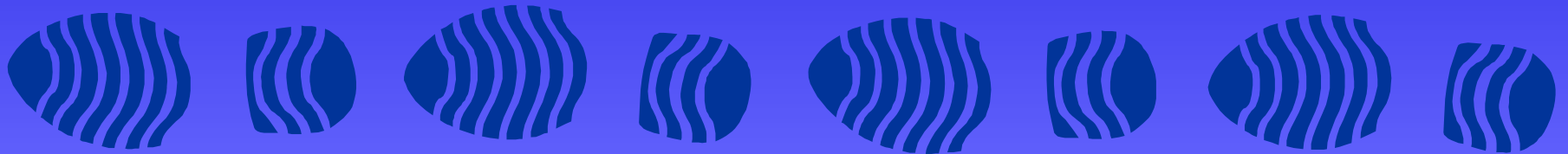
Known criminals

Shoe Stores



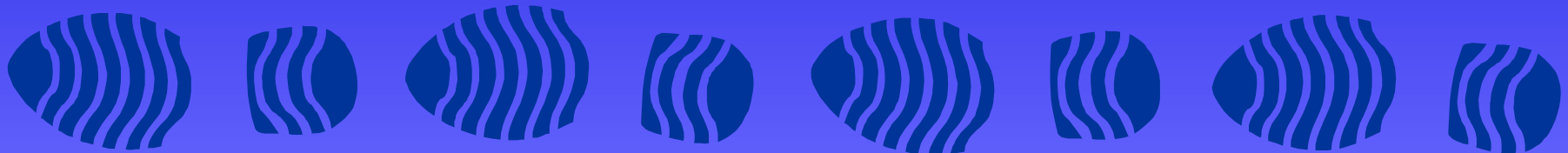
ESTABLISHMENT OF A DATABASE

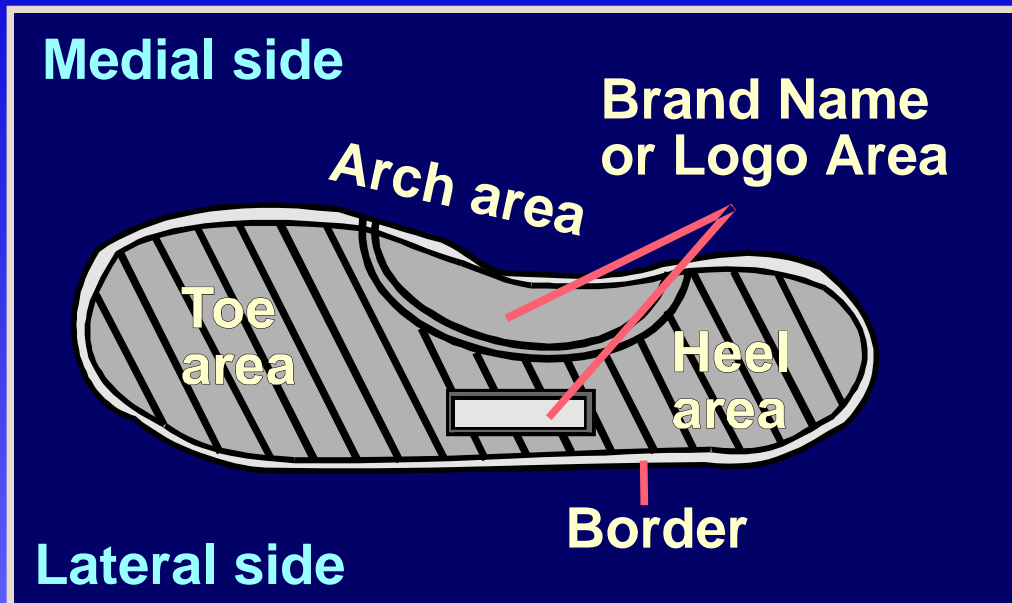
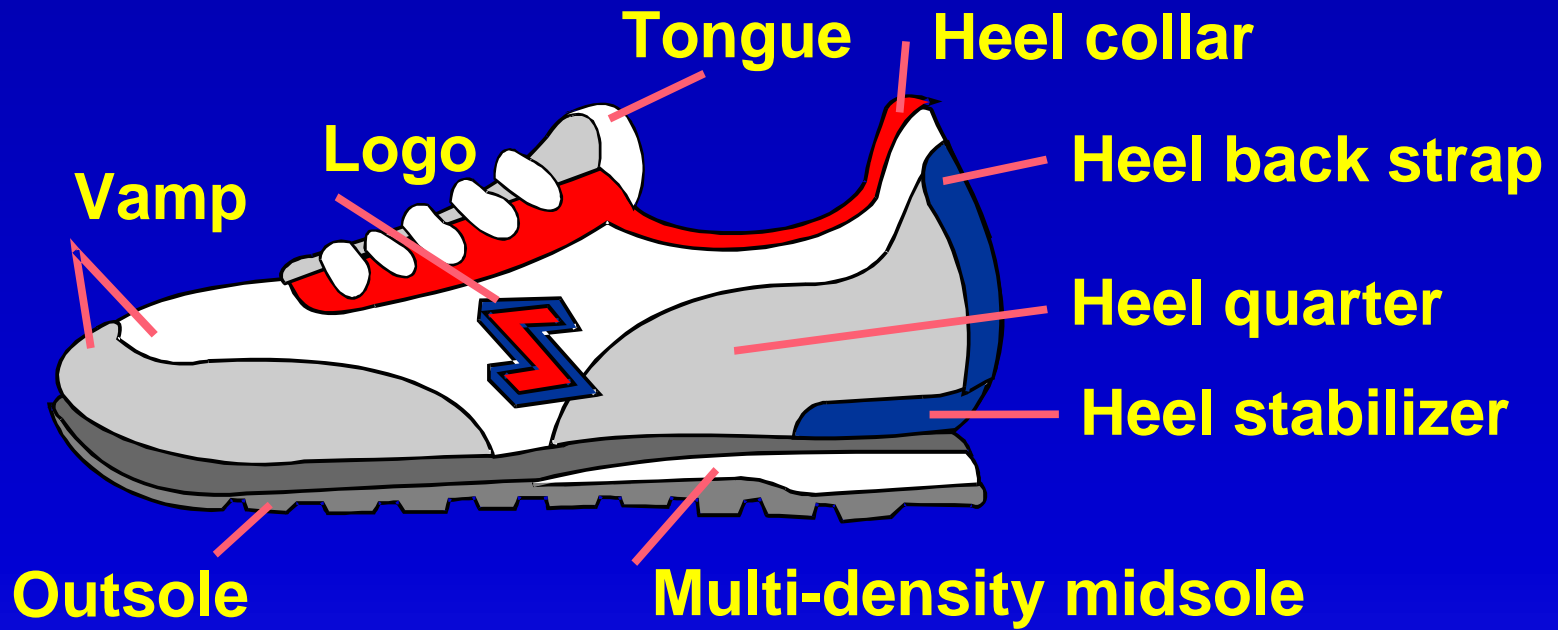
- Link crime scenes
- Possible suspect
- Brand name of shoe



FEATURE CLASSIFICATION

- Pattern on edge
- Toe area
- Heel area
- Circles
- Shapes within shapes
- Patterns surrounding motifs, letters, numbers

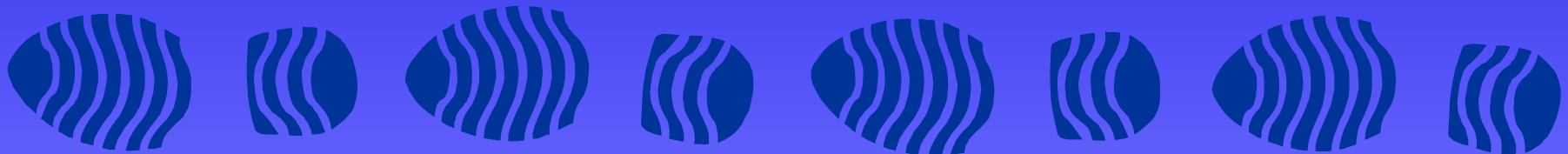






PATTERN DESIGNS

- A hollow circular area inside a circular shape
- Numerals inside a circular shape
- Unusual shaped studs on the edge of the sole
- Motif engraved in the border of the sole
- ETC

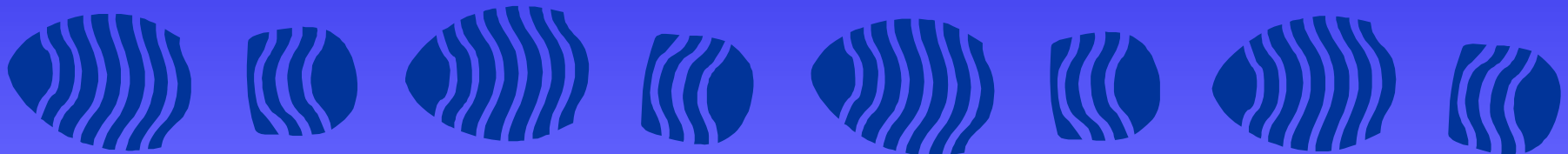






FEATURE CLASSIFICATION CATEGORIES

- The edge area
- Circular areas surrounded by a valley
- Certain features
- Patterns on sole
- A pattern/shape inside another pattern/shape
- The toe/back of heel area







12

13

14

15

16

17

MAIN GROUPS OF THE PATTERNS

Digit (first)

Pattern

0

Mesh

1

Stud

2

Wave

3

Zig-Zag

4

Bar

5

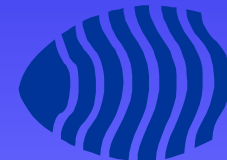
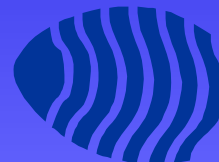
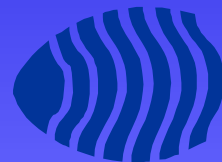
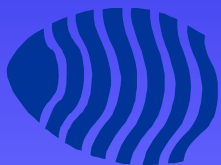
Complicated

6

Crepe and plain

7

Continuous border



PATTERN TYPES IN THE MAIN GROUPS

Digit (second)

Shape

0

Circular

1

Triangular

Wave or Zig-Zag

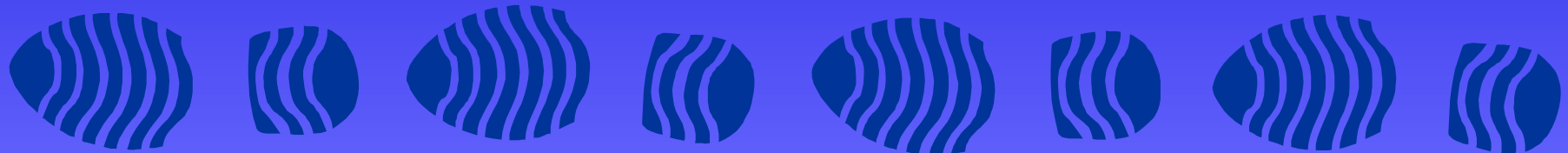
= Width of line/broken/continuous
high/low

Bar pattern

= width of line/broken/continuous

Continuous border

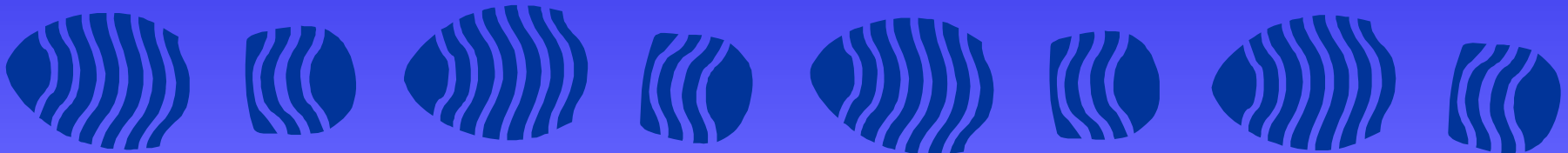
= continuous border of the shoe sole





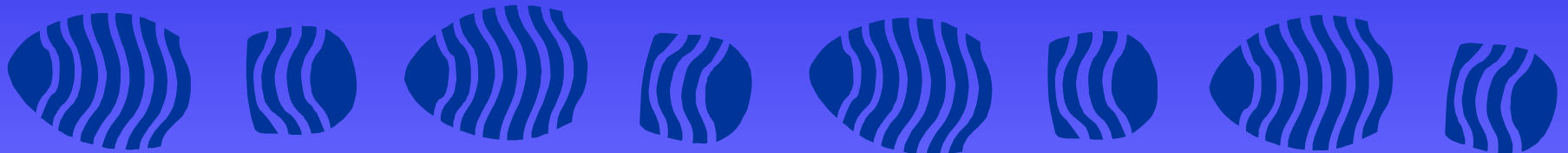
First Digit	Second Digit	Pattern	Shape
7	1	Continuous Border	Triangular

Thus 71 means that there are triangular studs in a continuous border



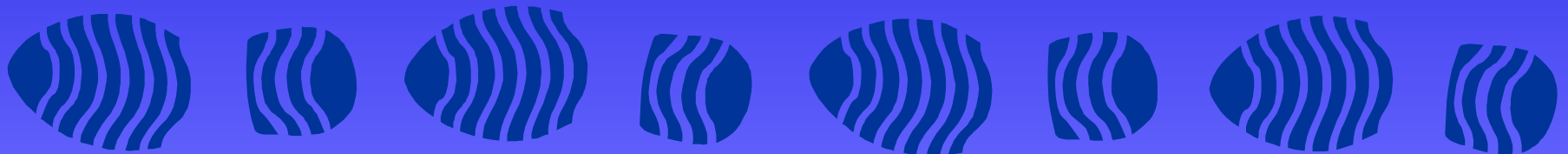
DEFINITION

Pattern recognition is the identification of normal structure and appearance on an image and those variations of appearances which may indicate a disordered state



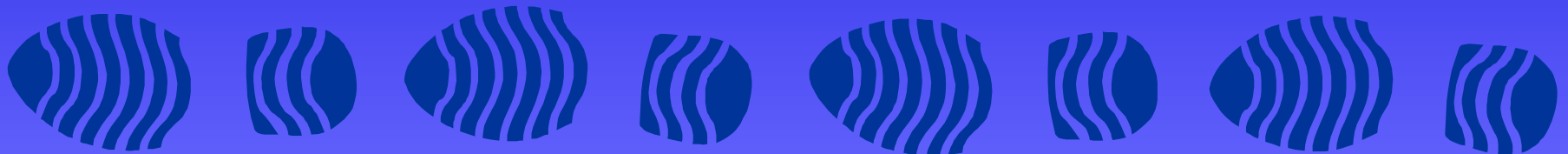
PHYSICAL PATTERNS IN IDENTIFICATION

Identification based on structural features is the recognition of a physical pattern



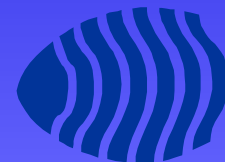
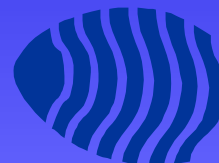
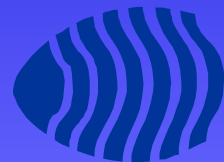
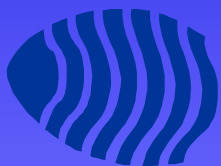
PHYSICAL PATTERNS IN IDENTIFICATION

- Physical matching
- Comparison of markings
- General shape or form comparison



Database of:

- **Shoeprints at scene of crime**
- **Shoes of suspects**
- **Shoes on the market**



NEURAL NETWORKS IN FORENSIC SCIENCE

