Mathemetical Morphology

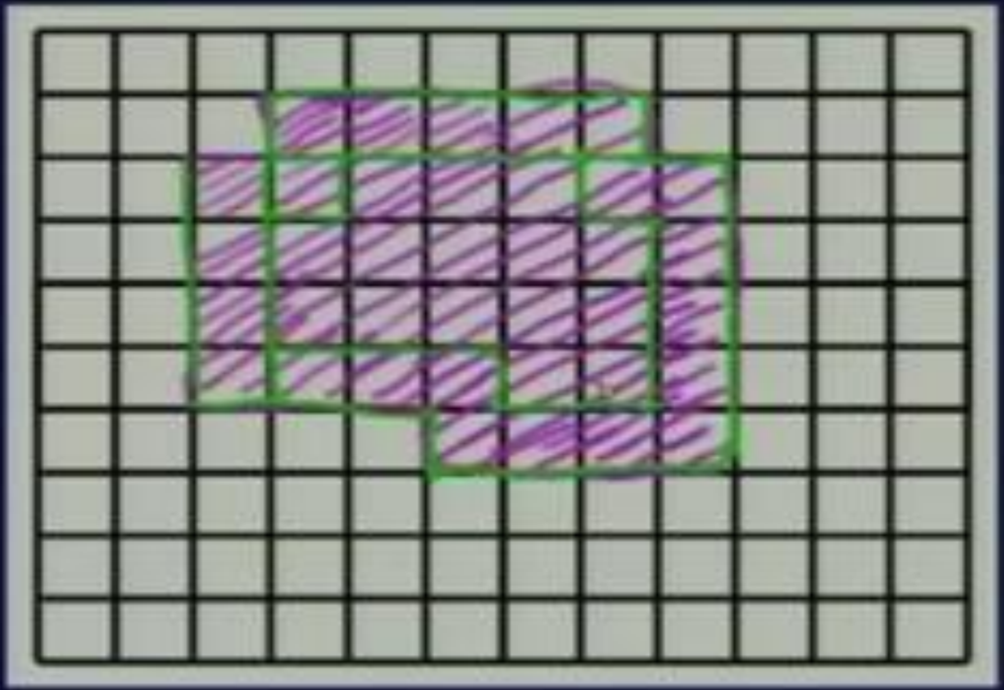
- On completion the students will learn and be able to implement

  Applications of Morphological techniques

  - Boundary extraction
  - Region filling
  - Extraction of connected components
  - Convex hull
  - Thinning
  - Thickening

Boundary Extraction

Boundary Extraction

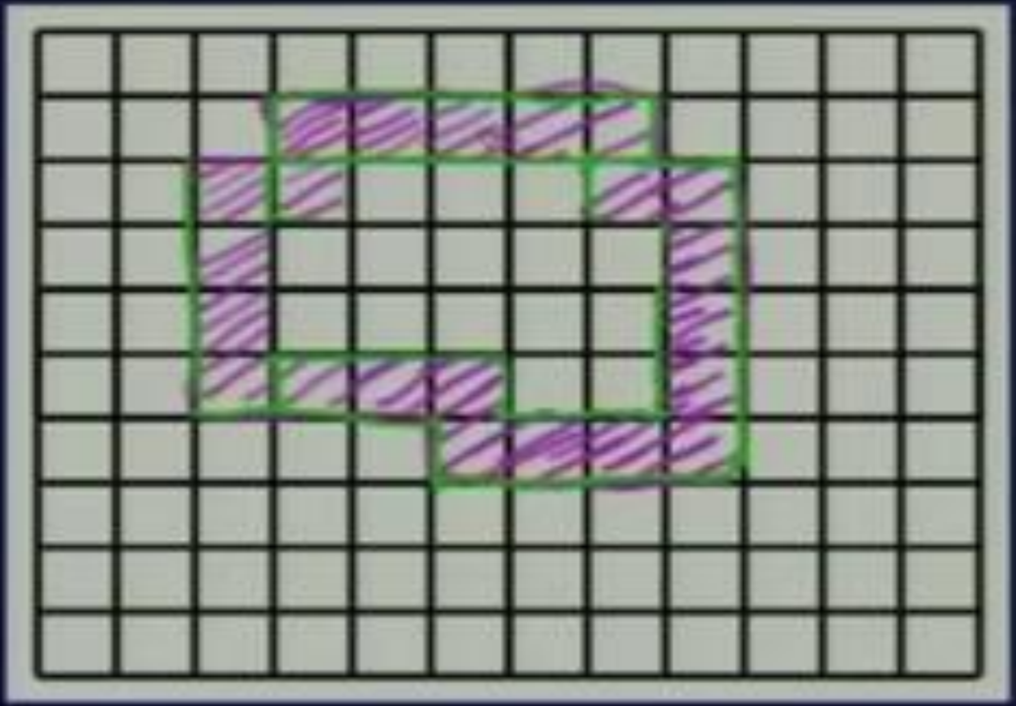


$A \Longrightarrow \beta(A)$

$\beta(A) =$

$A - (A \ominus B)$

Boundary Extraction

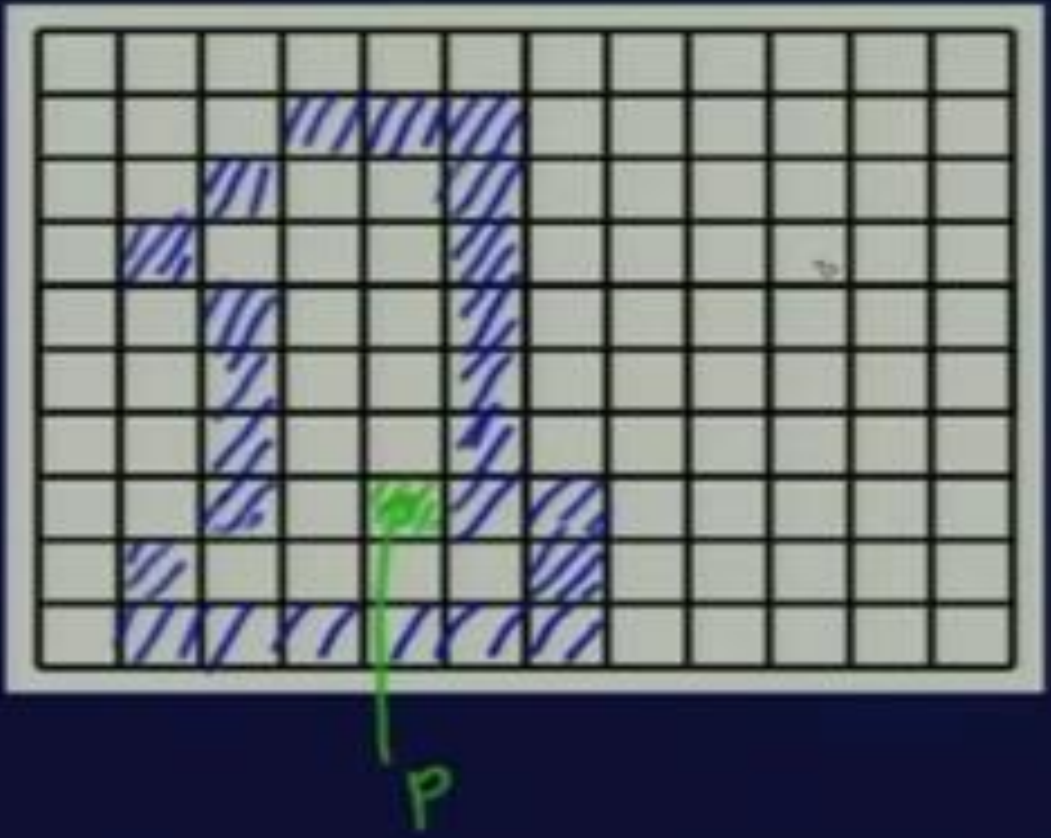


$A \Rightarrow \beta(A)$

$\beta(A) =$

$A - (A \ominus B)$

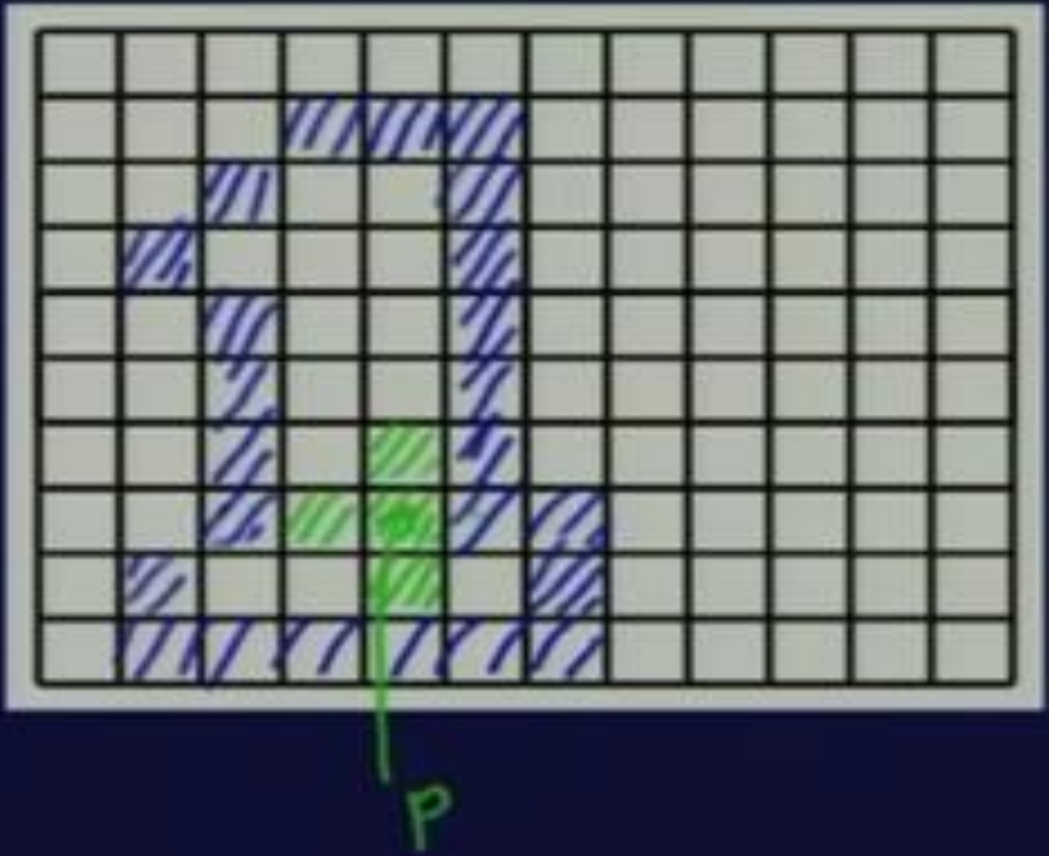
Region Filling



$$X_0 = p$$

$$X_k = (X_{k-1} \oplus B) \cap A^c$$

Region Filling



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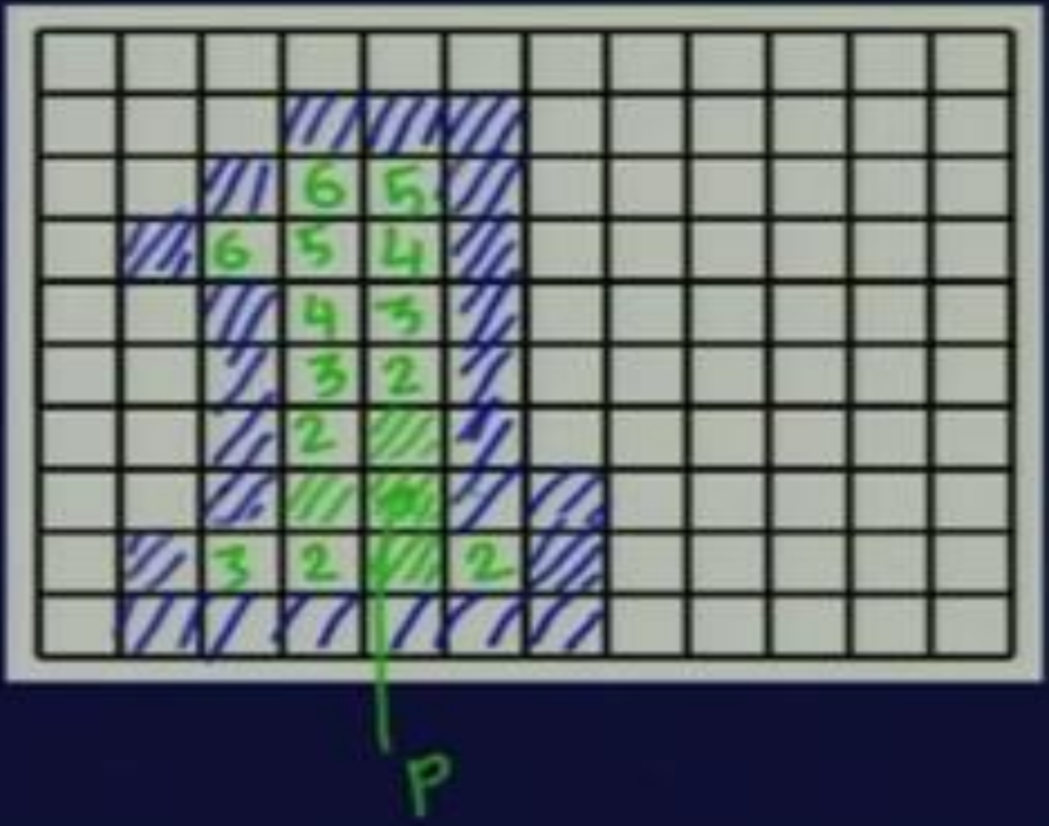
Region Filling



$$X_0 = p$$

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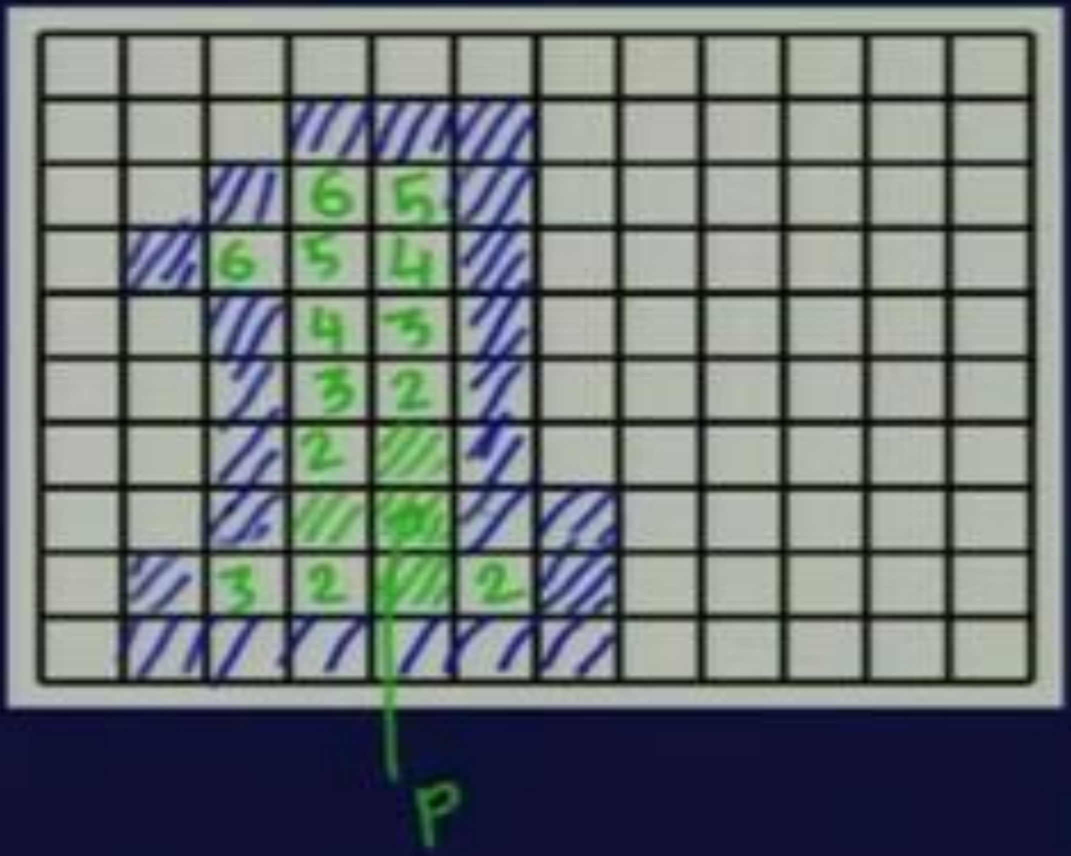
Region Filling

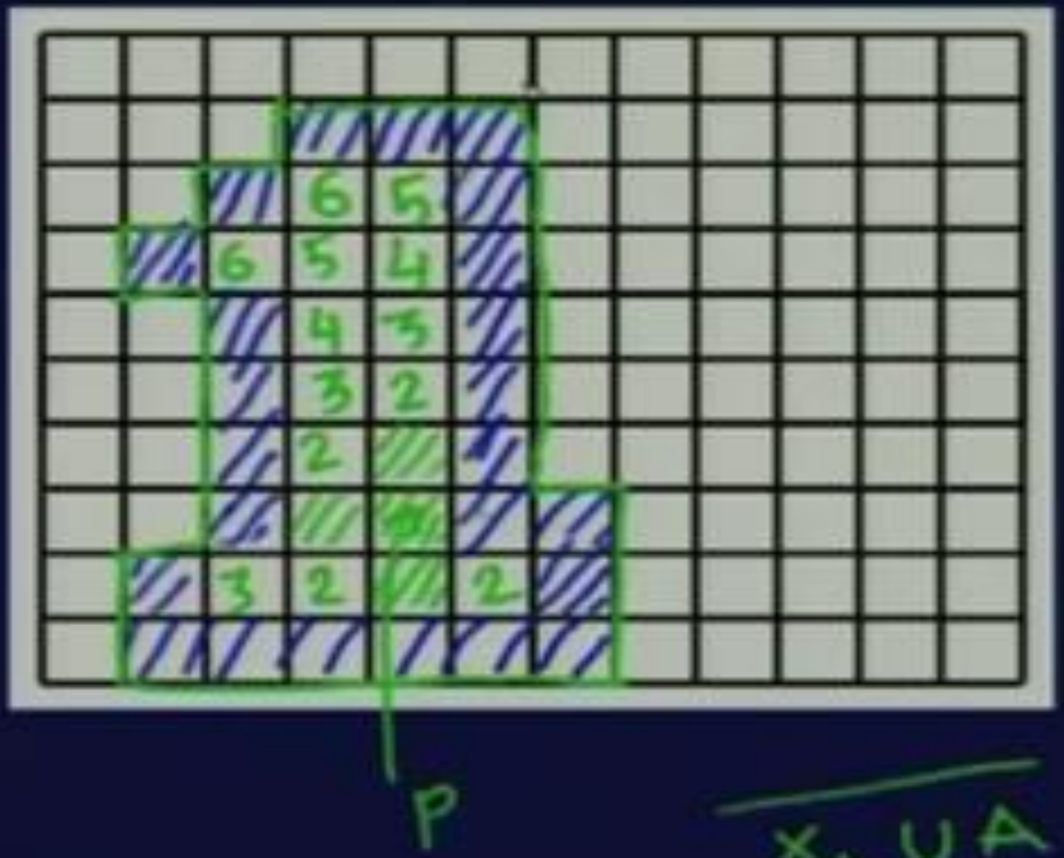


$X_0 = p$

$X_k = (X_{k-1} \oplus B) \cap A^c$

$X_k = X_{k-1}$

Region Filling



$$X_0 = p$$

$$X_k = (X_{k-1} \oplus B) \cap A^c$$

$$X_k = X_{k-1}$$

$$X_k \cup A$$

Connected Component Extraction

A $\quad Y$

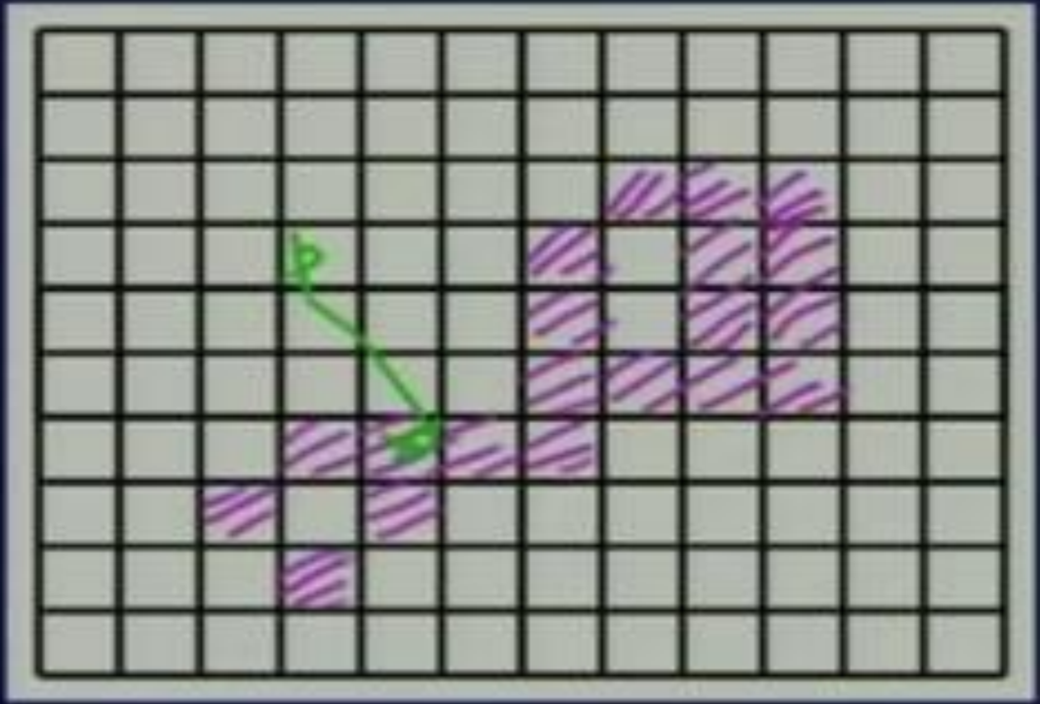
$$X_k = (X_{k-1} \oplus B) \cap A$$

$k = 1, 2, 3, \ldots$

$$X_k = X_{k-1}$$

$$Y = X_k$$

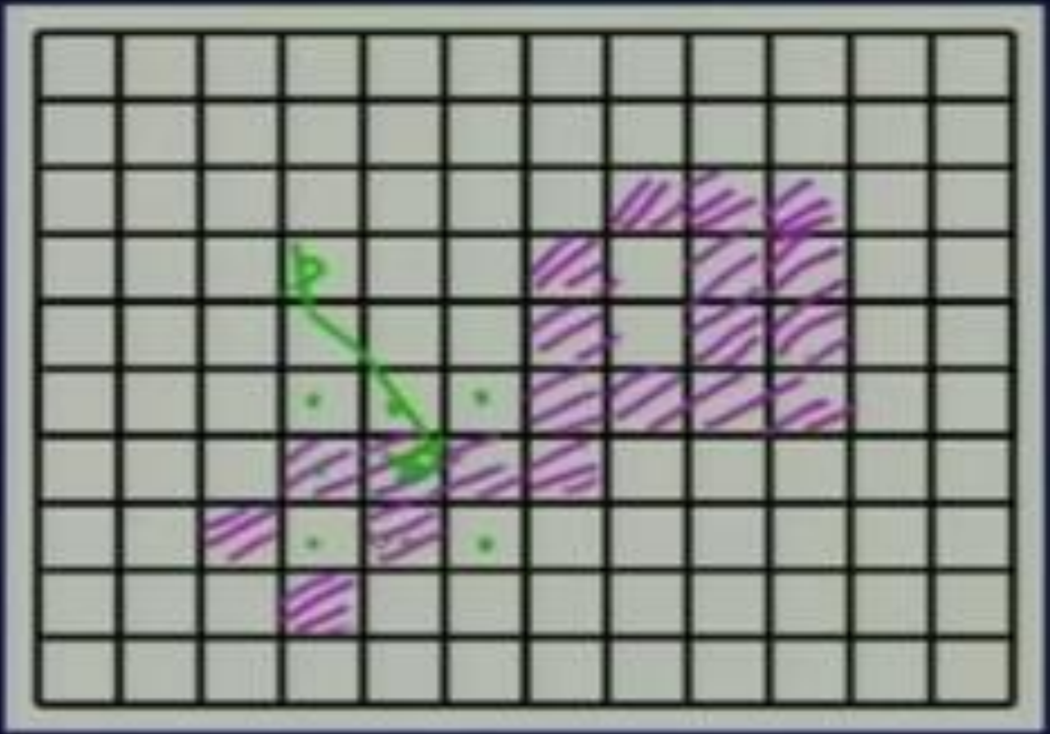
Connected Component Extraction



$$X_k = (X_{k-1} \oplus B) \cap A$$

$$X_0 = P$$

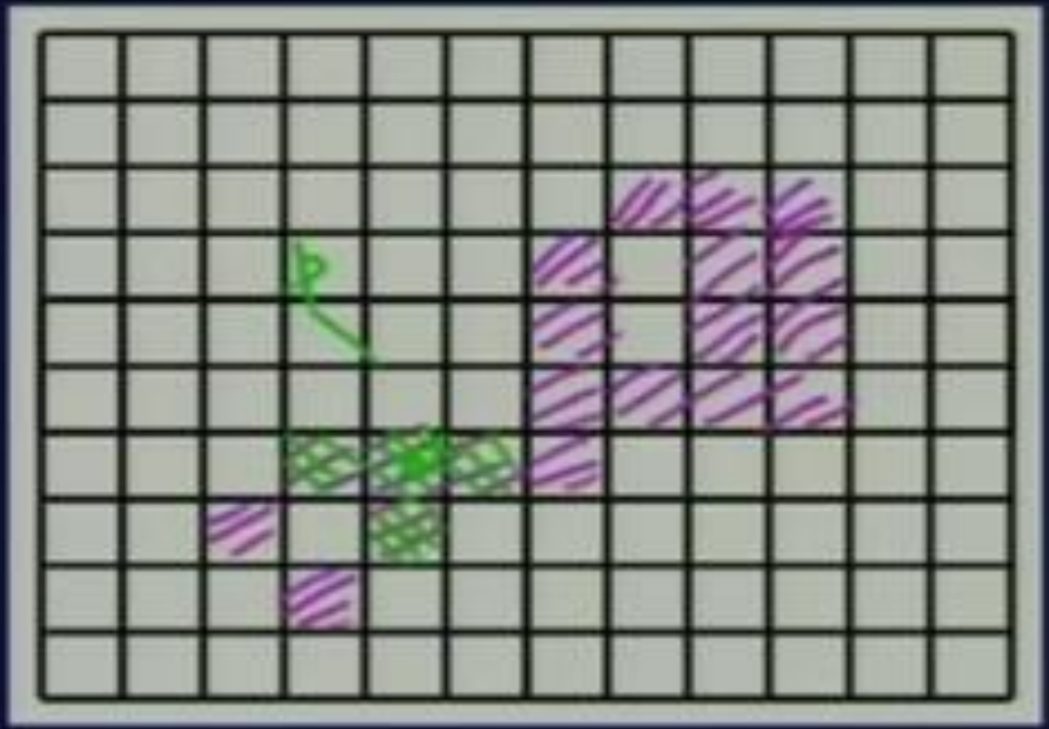
Connected Component Extraction



$X_k = (X_{k-1} \oplus B) \cap A$

$X_0 = P$

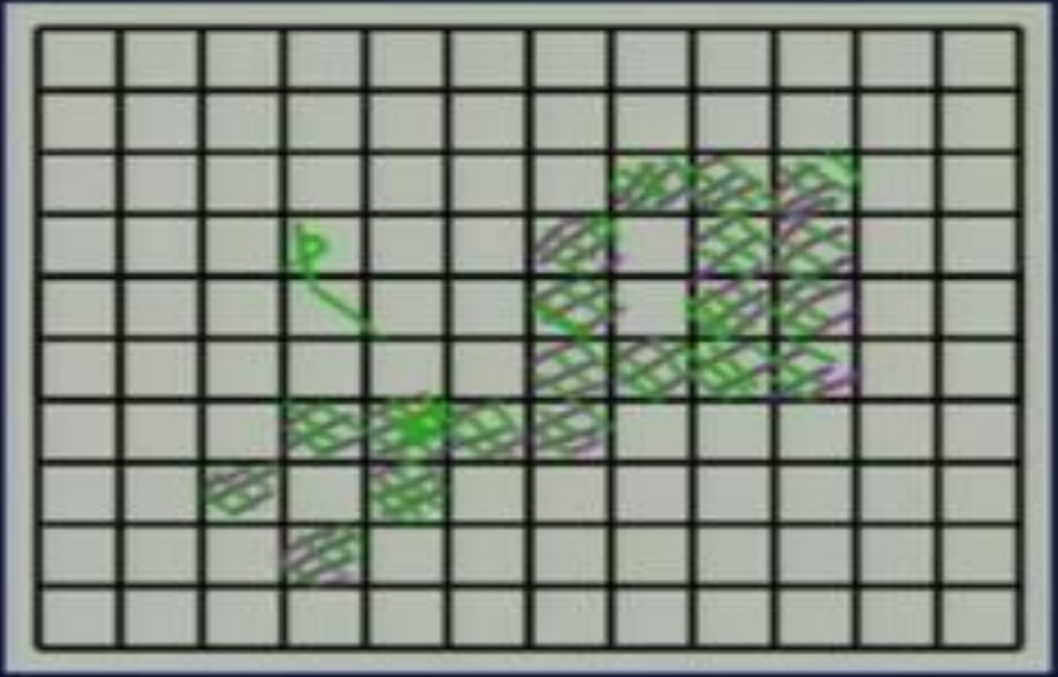
Connected Component Extraction



$$X_k = (X_{k-1} \oplus B) \cap A$$

$$X_0 = p$$

Connected Component Extraction



B

$$X_k = (X_{k-1} \oplus B) \cap A$$

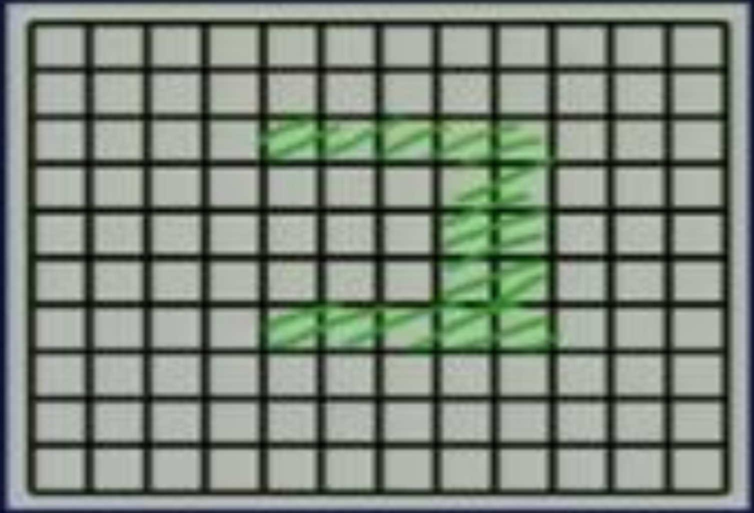
$$X_0 = P$$

$$\underbrace{X_6 = X_7}$$

$$Y = X_7, X_6$$

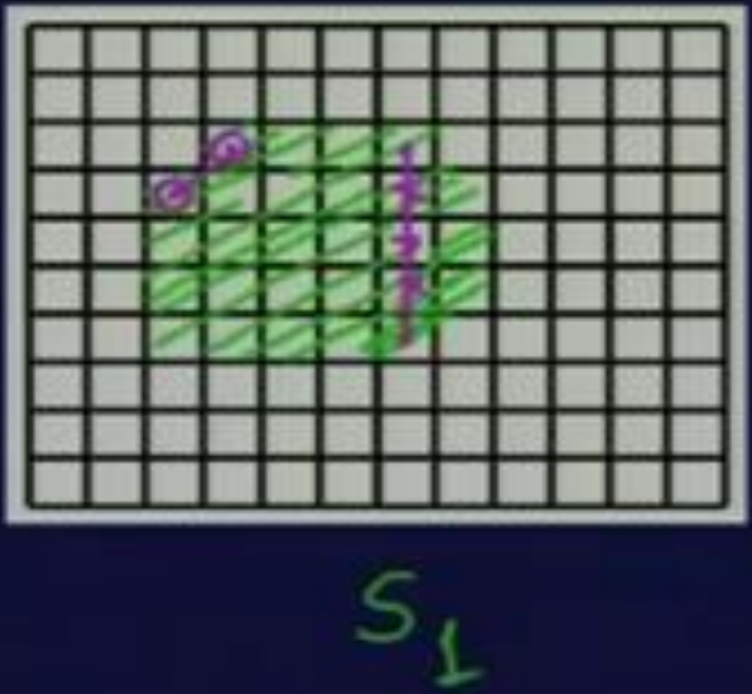
Convex Set

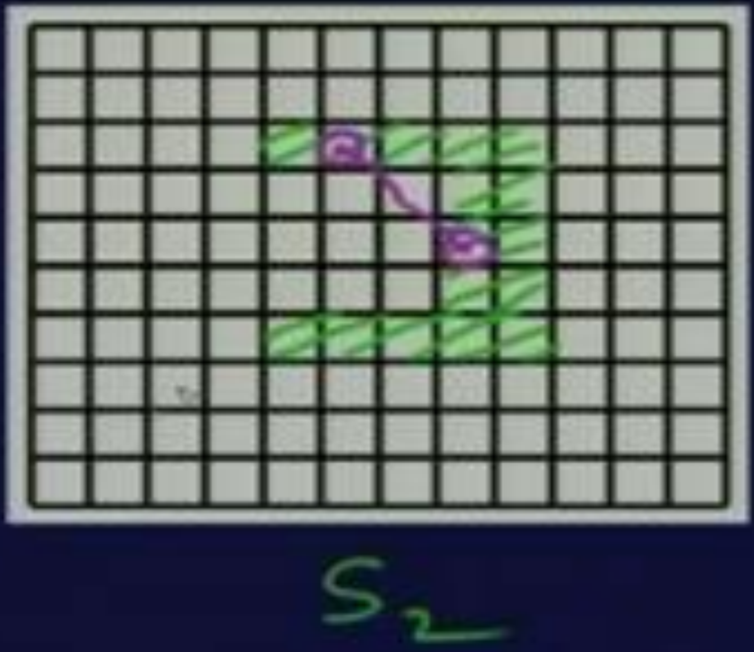
S_1



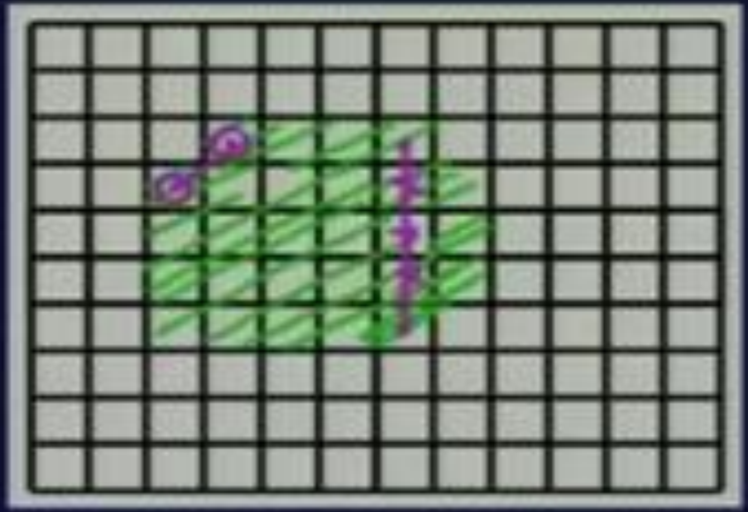
S_2

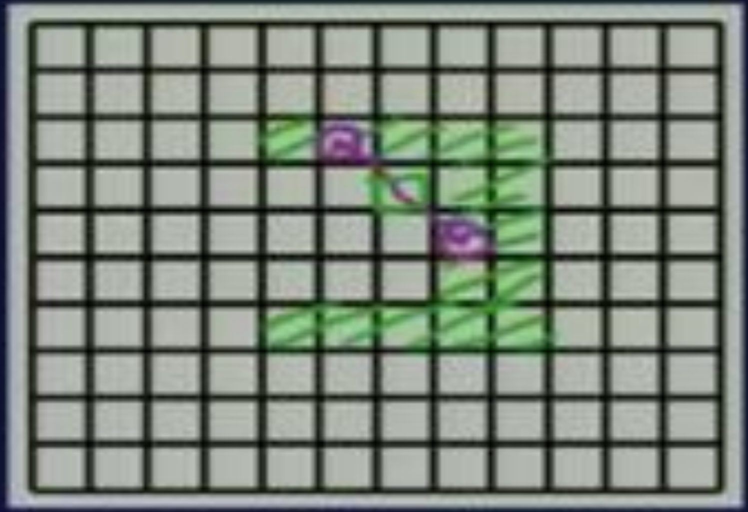
Convex Set





Convex Set

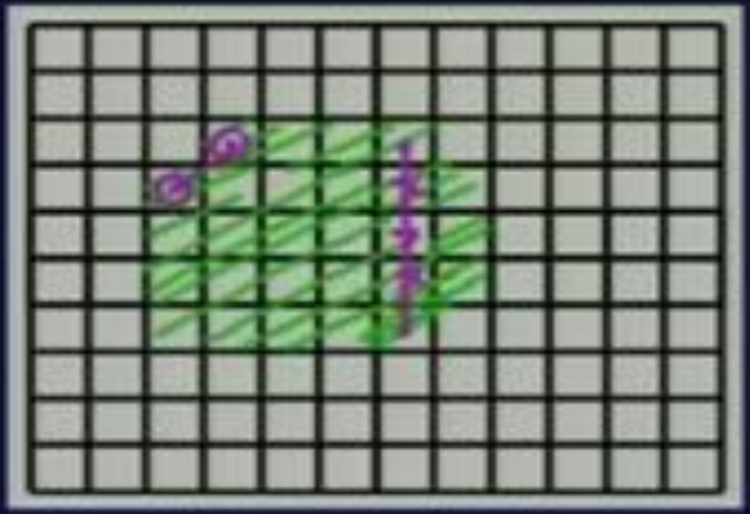


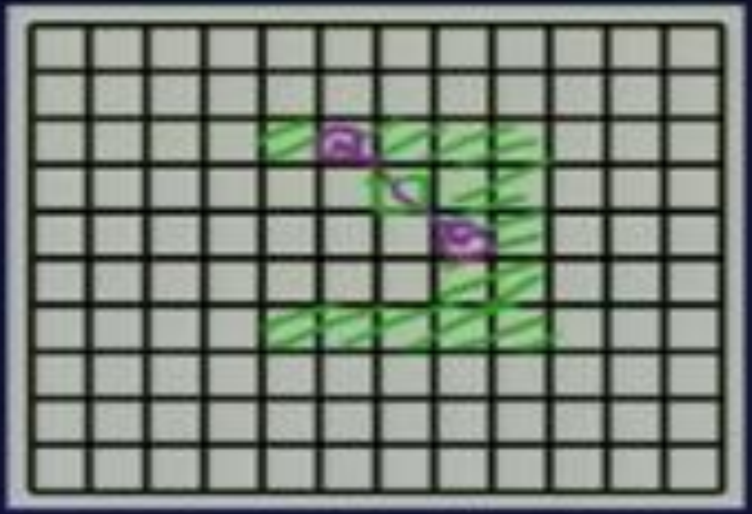


$S_1 \Rightarrow$ convex

$S_2 \Rightarrow$ not convex

Convex Set





$S_1 \Rightarrow$ convex

$S_2 \Rightarrow$ not convex

S

$H - S \Rightarrow$ convex deficiency

$B^i \qquad i = 1, 2, 3, 4$

$$B^i$$

$$X_k^i = (X_{k-1}^i \circledast B^i) \cup A$$

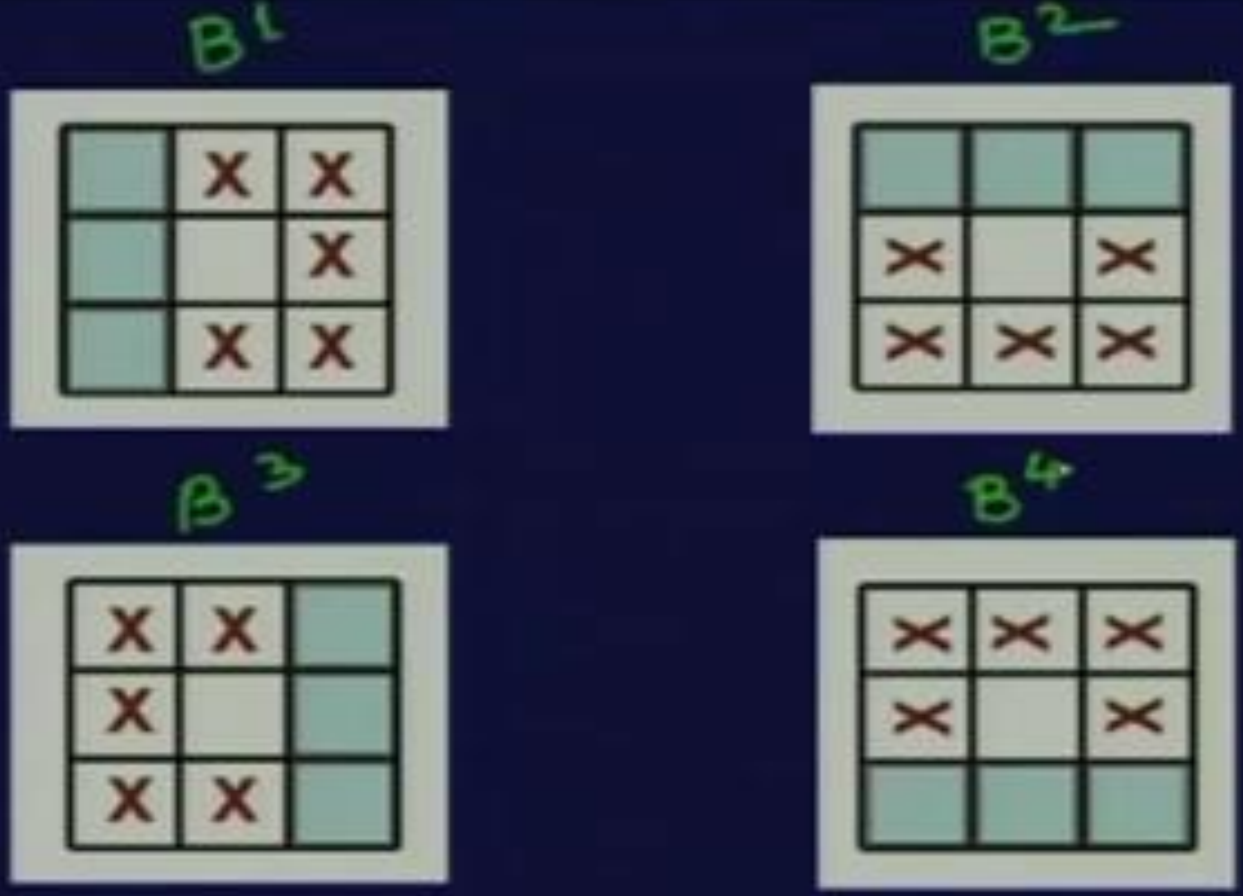
$$X_0^i = A$$

$$\underbrace{X_k^i = X_{k-1}^i}$$

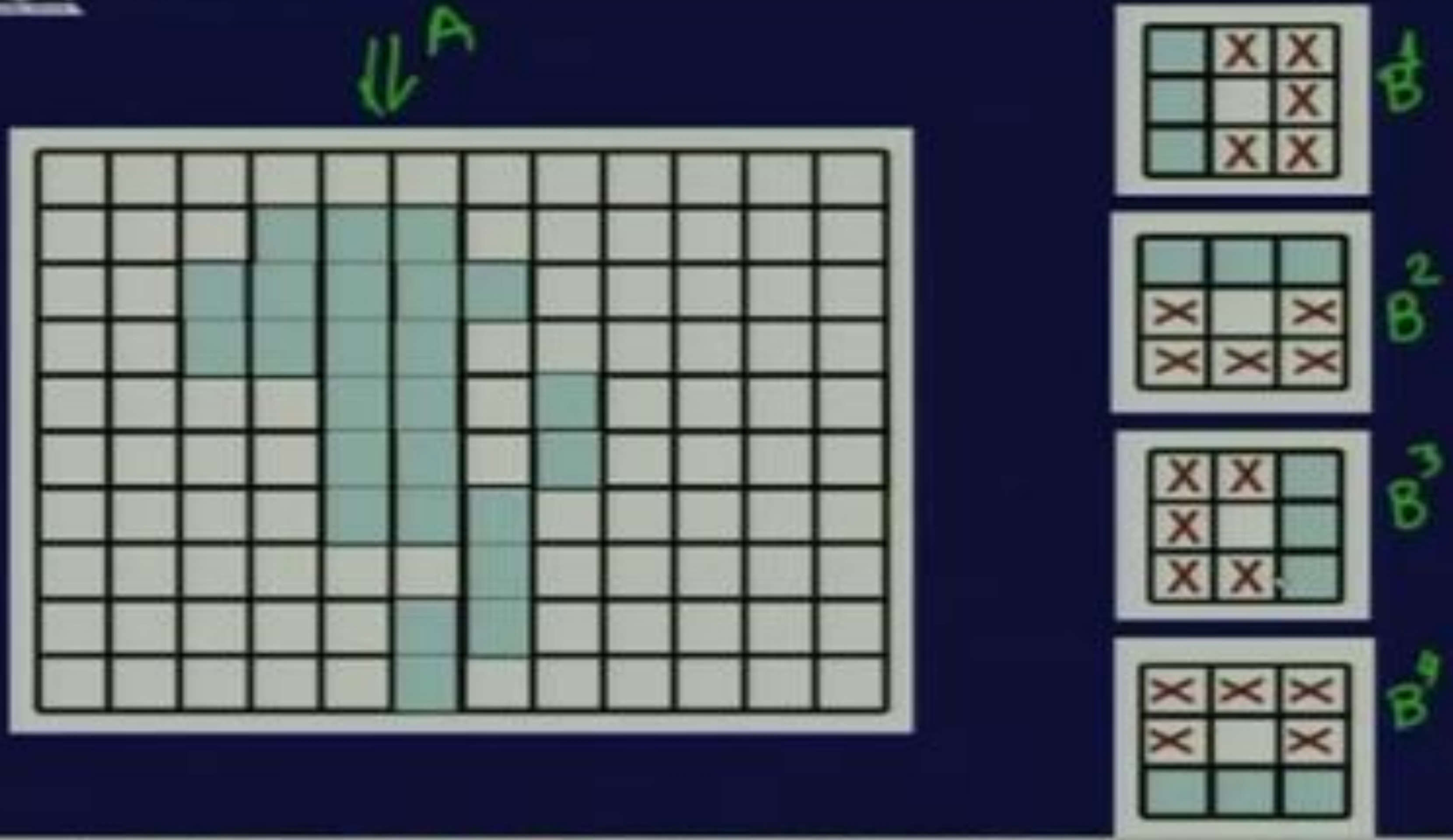
$$D^i = X_{conv}^i$$

$$C(A) = \bigcup_{i=1}^{4} D_i$$

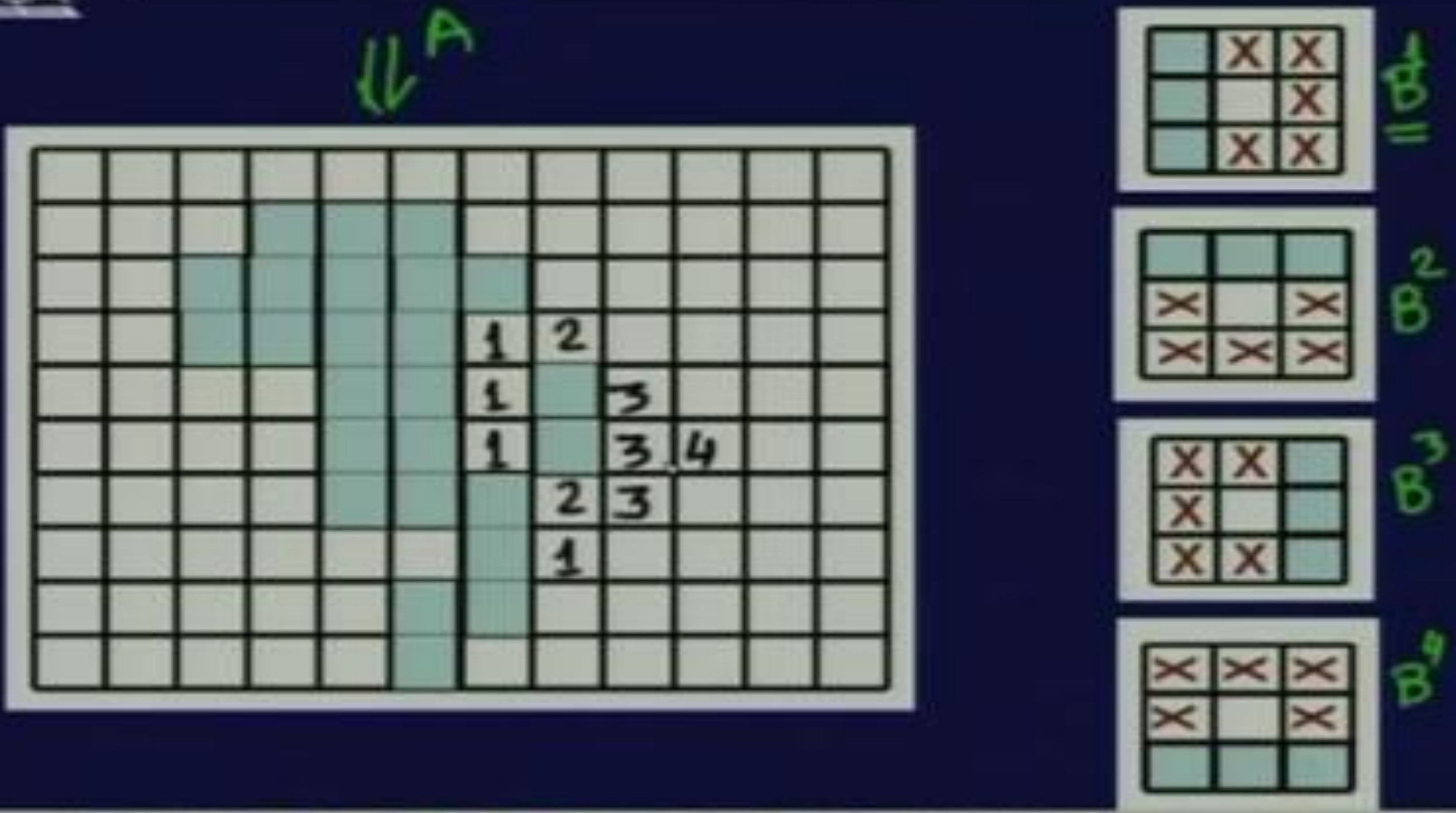
Convex Hull



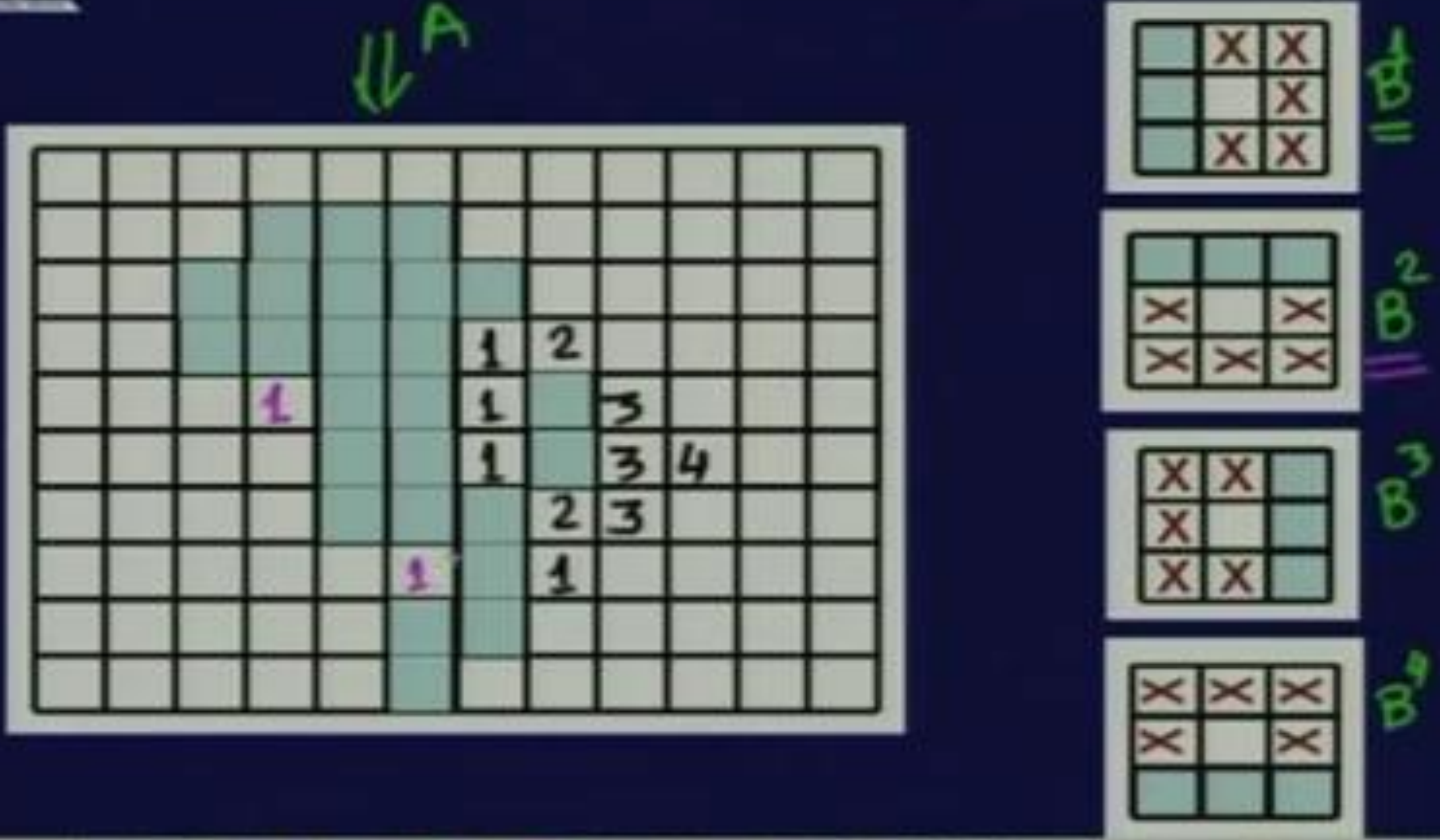
Convex Hull



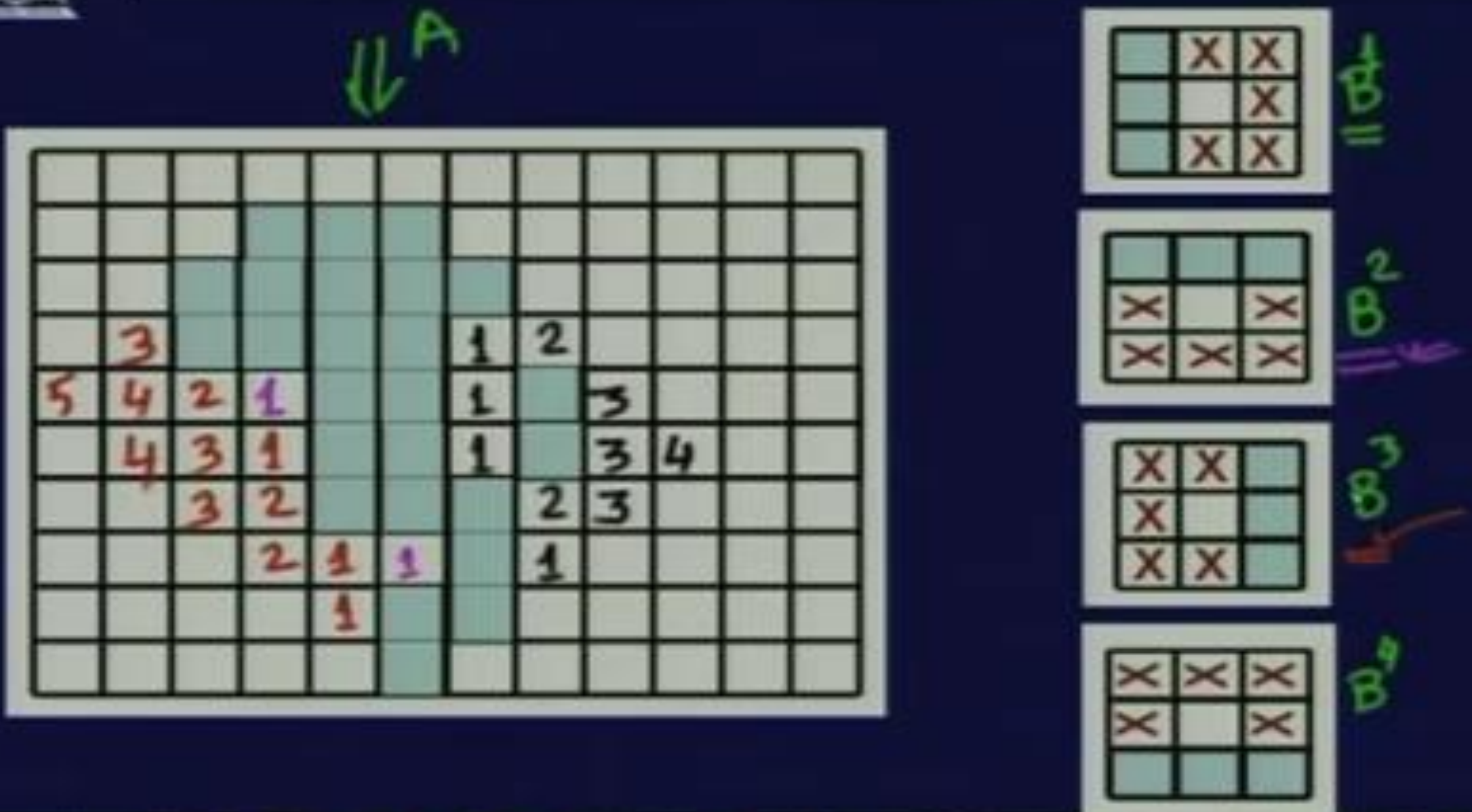
Convex Hull



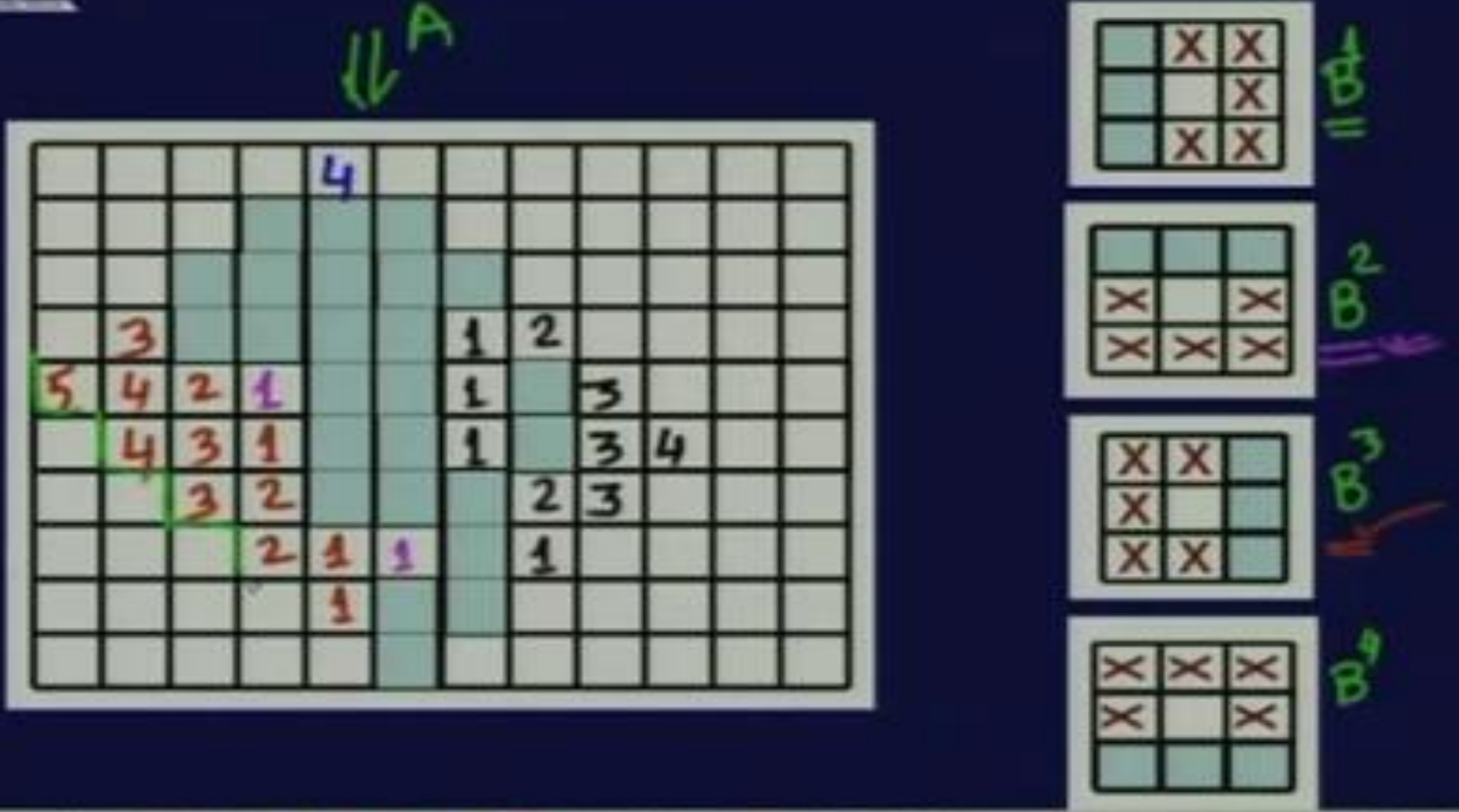
Convex Hull



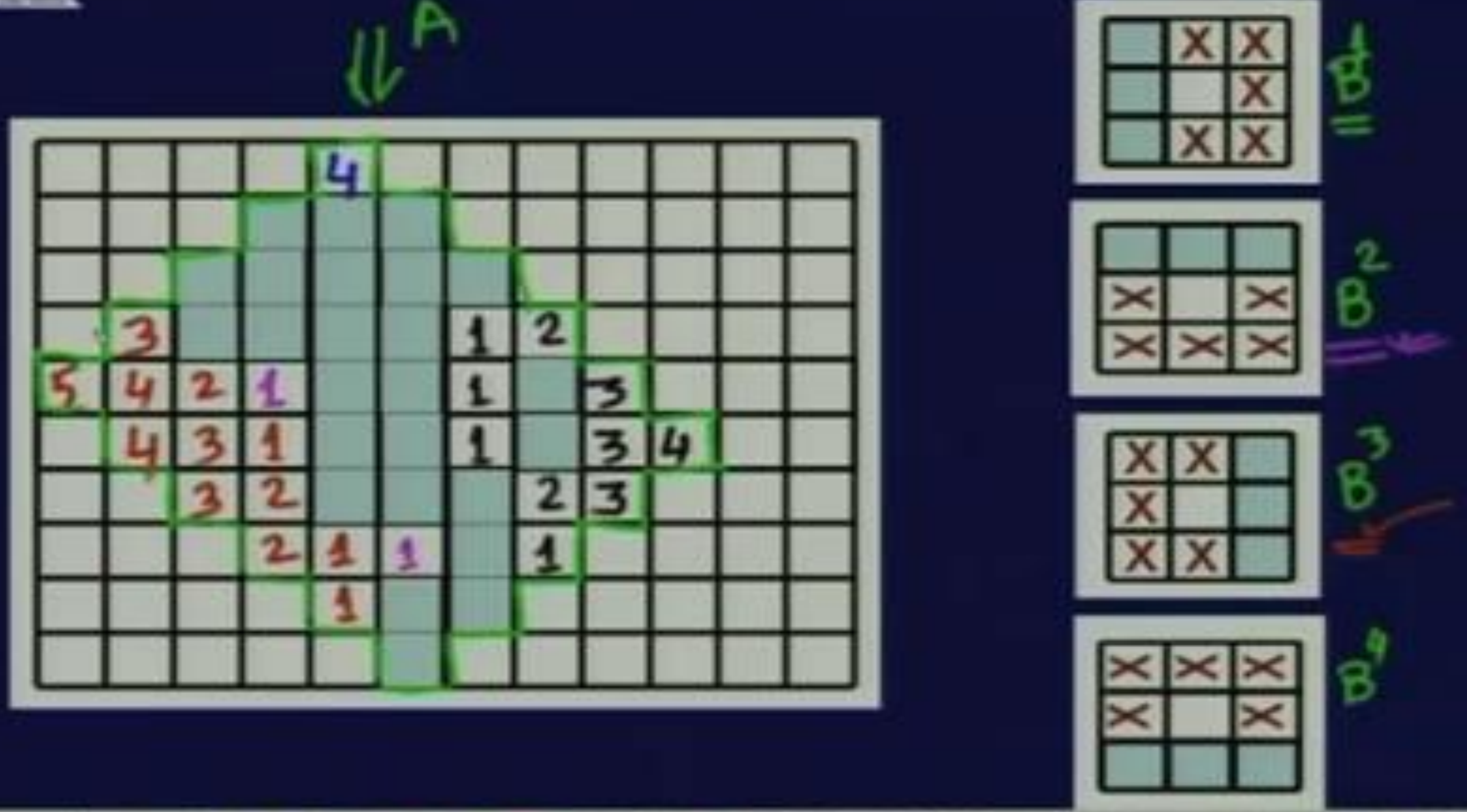
Convex Hull



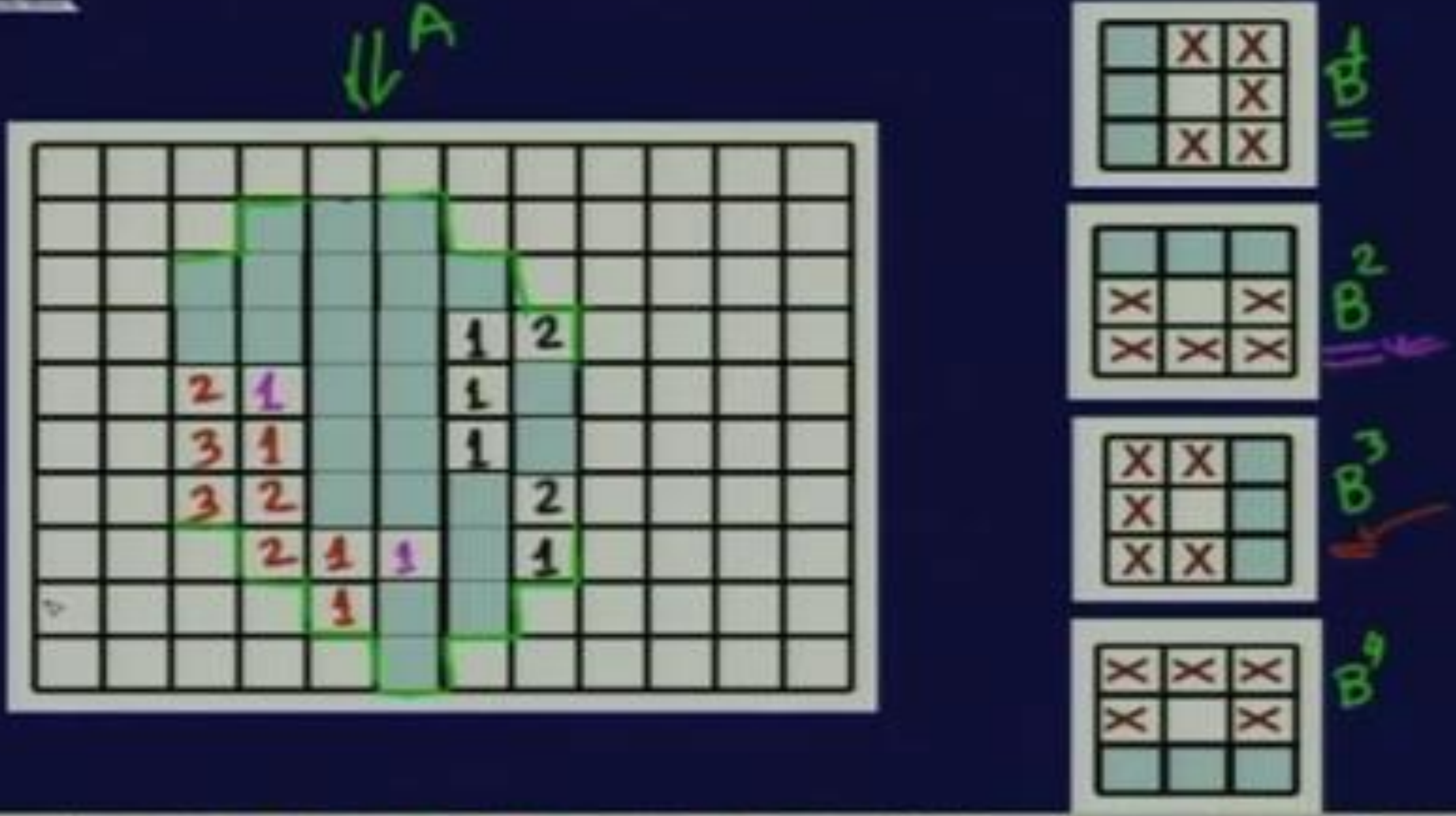
Convex Hull



Convex Hull



Convex Hull



Convex Hull