

Procesamiento y Análisis de Imágenes

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Créditos por slides: José M. Saavedra



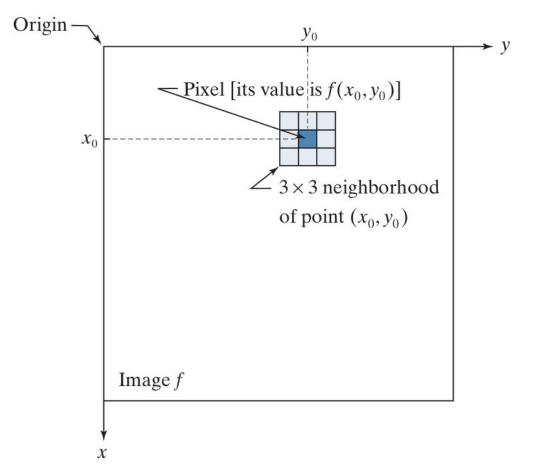
Actividad de diagnóstico

 ¿Cómo definirías una imagen digital en escala de grises?



TIPOS DE OPERACIONES

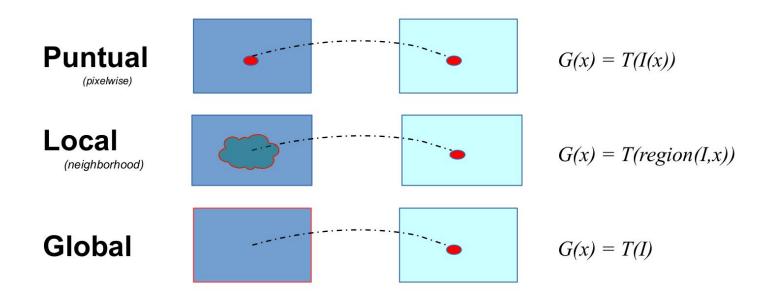




Créditos: Digital Image Processing, Gonzalez & Woods, 4th Edition, GE, 2018

OPERACIONES

- . Una operación T sobre una imagen I permite generar otra imagen G procesando los pixeles de I.
- . Tipos de Operación





Negativo (imagen negativa)

$$G(\mathbf{x}) = M - I(\mathbf{x})$$

 $M = m\acute{a}ximo valor del espectro (255 en grises, 1 en b/w)$







Blending

$$G(\mathbf{x}) = \alpha I_1(\mathbf{x}) + (1 - \alpha)I_2(\mathbf{x})$$

im1 0.4



im2 0.6



blended





. Blending







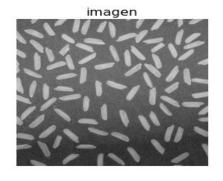




Warping + Blending



Binarización (Thresholding)



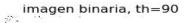




imagen binaria, th=120

imagen binaria, th=150

- ·Objetivo : Separar el objeto de interés del fondo de la imagen
- •Entrada: Imagen en escala de grises
- Salida: Imagen Binaria
- •Imagen Binaria : Imagen con sólo dos tonos de gris presentes (negro y blanco \rightarrow 0 y 255)
- •Valor UMBRAL θ

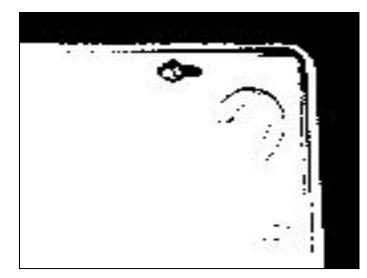
$$G_{ij} = \begin{cases} 0 & \text{si } I_{ij} \leq \theta \\ 1 & \text{si } I_{ij} > \theta \end{cases}$$

entonces

$$\begin{bmatrix} I_{ij} \end{bmatrix}_{1 \le i \le N, 1 \le j \le M} \overline{\text{BINARIZACION}} \begin{bmatrix} G_{ij} \end{bmatrix}_{1 \le i \le N, 1 \le j \le M}$$



Imagen Original



Umbral $\theta = 150$

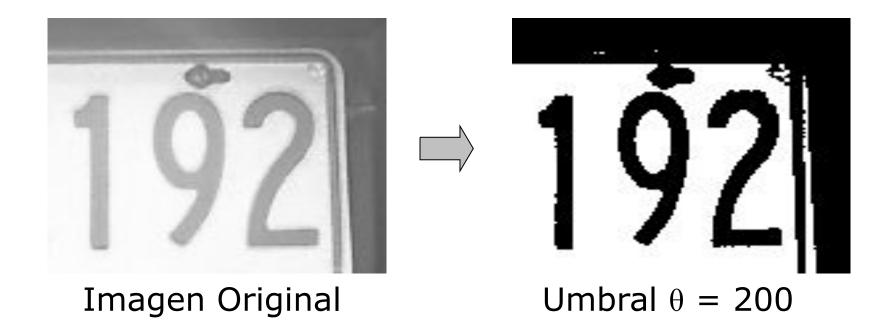
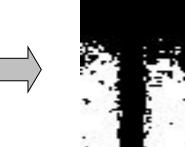
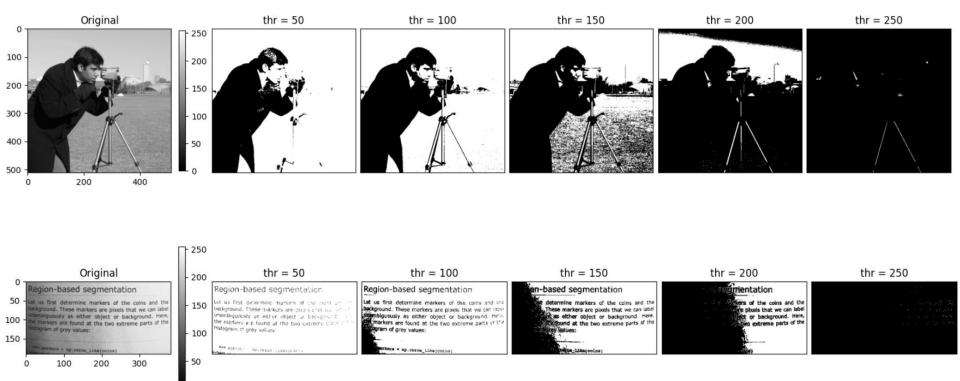




Imagen Original

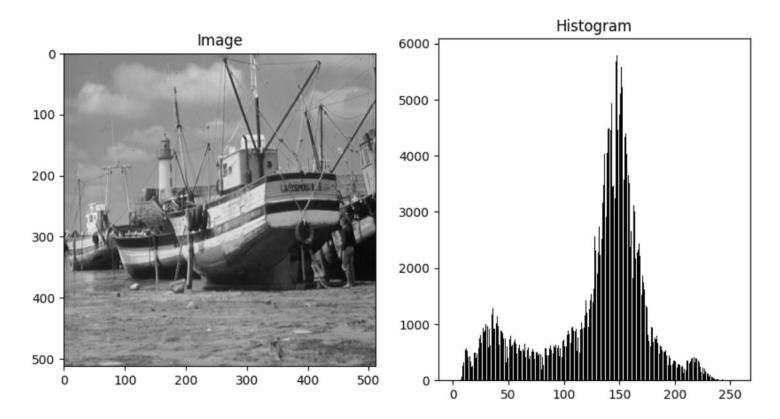


Umbral $\theta = 250$



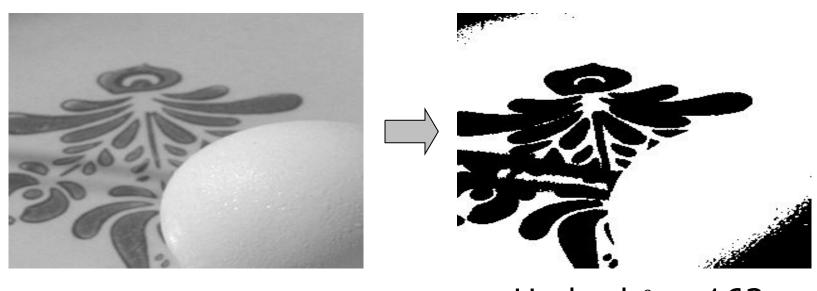
- ¿Cómo encontrar el valor umbral adecuado?
- Usando el histograma de la imagen
- Existen varios métodos globales y locales

Recordatorio: Histograma

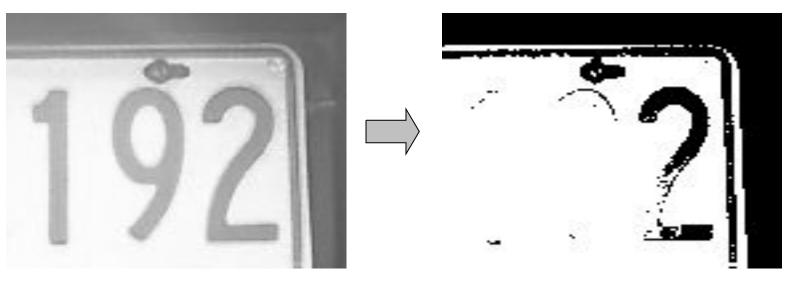


- Técnica iterativa cuyo proceso consiste en:
 - •Umbral inicial θ_0
 - •Valores promedio p_{objeto, 0} y p_{fondo, 0}
 - •Siguiente umbral θ_1 : promedio de p's
- Cuándo detenerse?

$$\theta_{i} = \theta_{i-1}$$

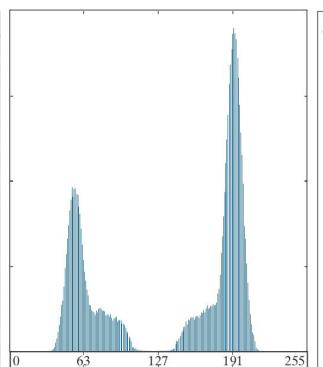


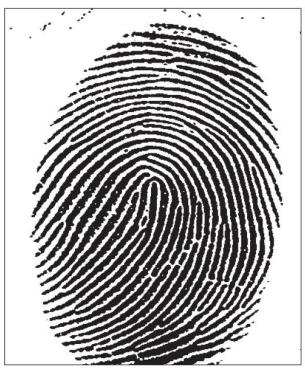
Umbral $\theta = 162$



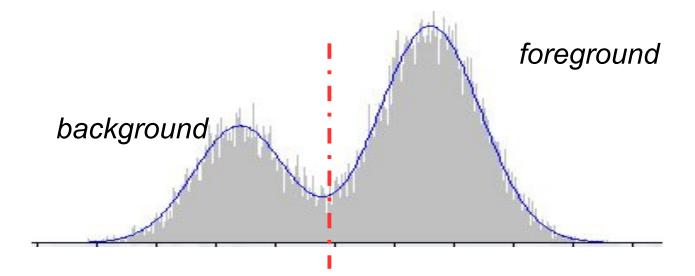
Umbral $\theta = 168$





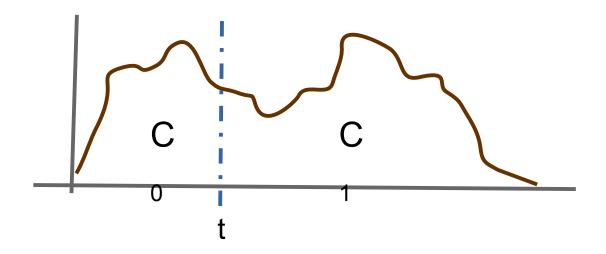


- Supuesto: Histograma bimodal (2 clases {C₀,C₁})
- Umbral [threshold]: Aquel valor que permita minimizar la dispersión intra-clase y maximizar la dispersión entre clases.



Objetivo

Maximizar varianza entre clases



- • $\lambda_1 \lambda_2 \lambda_3 \dots \lambda_L$: tonos de gris admisibles
- •Probabilidad Pv que (i,j) tenga λ_v es:

$$P(I_{ij} = \lambda_{\nu}) = P_{\nu} = \frac{\text{Nro. de puntos de la imagen con tono } \lambda_{\nu}}{\text{Nro. total de puntos de la imagen}}$$

•Tomando $\theta = \lambda_{\text{I}}$, resultan dos conjuntos inducidos por este valor

$${}^{l}\Omega_{1} = \left| I_{ij} : I_{ij} \leq \lambda_{l} \right| \quad \text{y} \quad {}^{l}\Omega_{2} = \left| I_{ij} : I_{ij} > \lambda_{l} \right|$$

•Probabilidad que un punto esté en uno de los conjuntos $^{|}\Omega_1$ o $^{|}\Omega_2$ es:

$$P({}^{l}\Omega_{1}) = \sum_{\nu=1}^{l} P_{\nu} \quad , \quad P({}^{l}\Omega_{2}) = 1 - P({}^{l}\Omega_{1})$$

- •Consideraciones:
 - Diferentes de cero
 - Diferencia absoluta de valores medios mayor posible

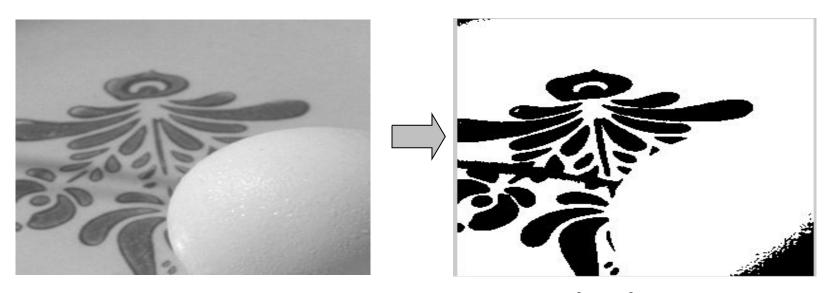
 Función objetivo que cumple con consideraciones:

$$J_{l} = P(^{l}\Omega_{1})P(^{l}\Omega_{2}) \left\{ \sum_{v=1}^{l} \frac{P_{v}\lambda_{v}}{P(^{l}\Omega_{1})} - \sum_{v=l+1}^{L} \frac{P_{v}\lambda_{v}}{P(^{l}\Omega_{2})} \right\}^{2}$$

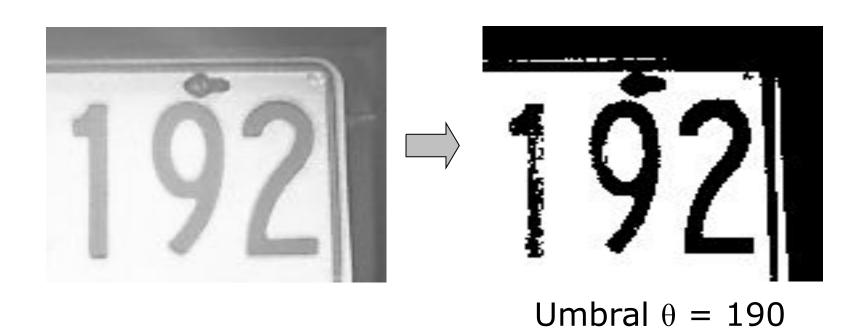
•F.O. debe maximimarse respecto de l:

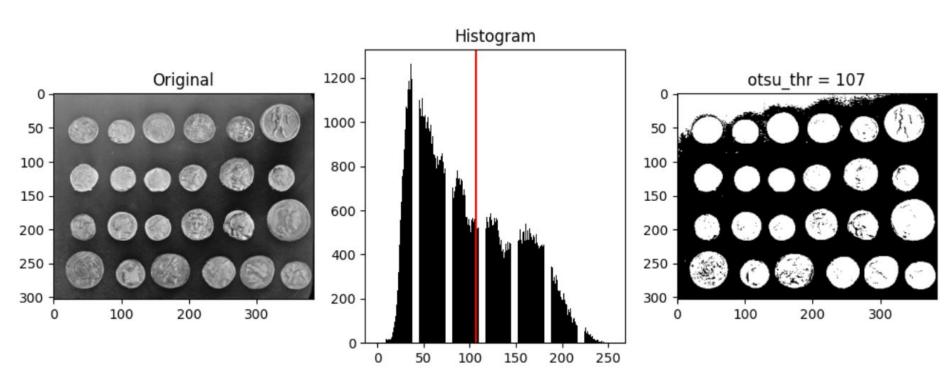
$$I = \underset{l'}{\operatorname{arg\,max}} J_{l'}$$

https://www.youtube.com/watch?v=q1VgxohcCG4

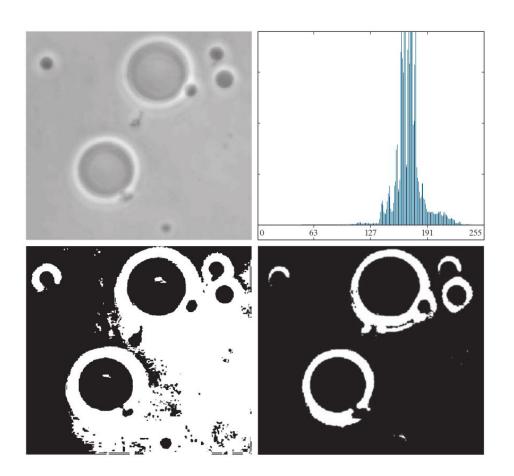


Umbral $\theta = 148$



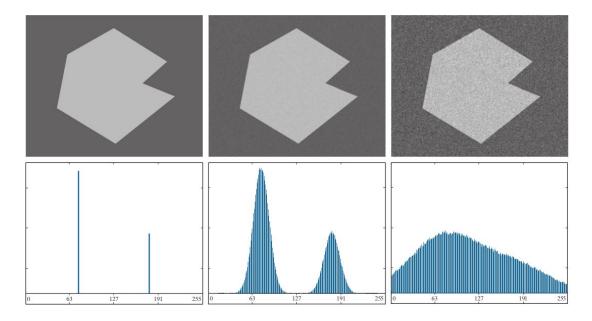


ISODATA VS OTSU



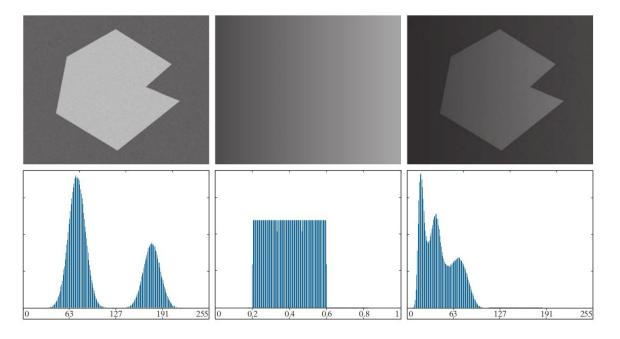
. BINARIZACIÓN ADAPTATIVA

• El ruido así como iluminación no-uniforme juega un rol importante en los algoritmo de binarización (thresholding).



. BINARIZACIÓN ADAPTATIVA

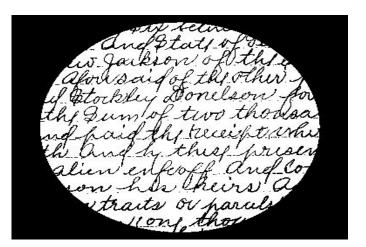
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BINARIZACIÓN ADAPTATIVA

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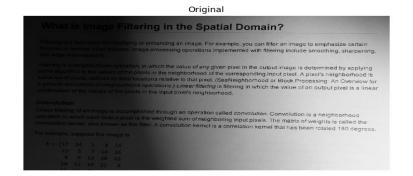
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Binarización con Otsu

. BINARIZACIÓN ADAPTATIVA

• El ruido así como iluminación no-uniforme juega un rol importante en los algoritmo de binarización.

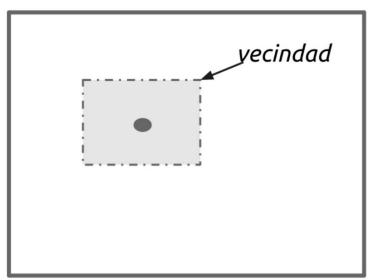




Binarización con Otsu

BINARIZACIÓN ADAPTATIVA

- ·Cambia umbral según la vecindad de cada pixel
- Cuál es el umbral para cada vecindad?
 - •Ej: valor promedio de tonos de gris
- •En general, se toman en cuenta propiedades locales (varianza y media de la vecindad)



---imagen

Propiedades Locales

 σ_p : Varianza local

 μ_p : Media local

$$T_p = a\mu_p + b\sigma_p$$

$$G(\mathbf{p}) = \begin{cases} 1 & I(\mathbf{p}) > T_p \\ 0 & \text{en otro caso} \end{cases}$$

Variantes

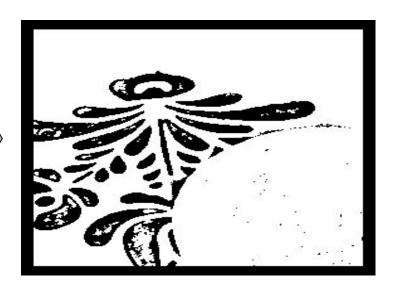
• b = 0

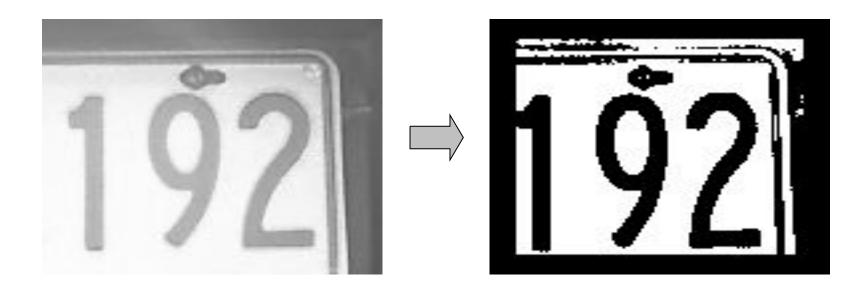
$$G(\mathbf{p}) = \begin{cases} 1 & I(\mathbf{p}) > T_p - C \\ 0 & \text{en otro caso} \end{cases}$$

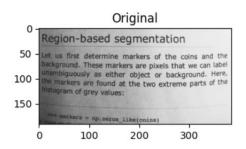
C es una constante que típicamente varía entre -20 y 20.











block size=5

Region-based segmentation

Let us first determine markers of the coins and the background. These markers are pixels that we can label unambiguously, as either object or background. Here, the markers are found at the two extreme parts of the histogram of grey values:

** Earkars - np. zeros_like(doins)

block size=15

Region-based segmentation

Let us first determine markers of the coins and the background. These markers are pixels that we can label unambiguously as either object or background. Here, the markers are found at the two extreme parts of the histogram of grey values:

>>> markers = mp. seros like(coins)

block size=35

Region-based segmentation

Let us first determine markers of the coins and the background. These markers are pixels that we can label unambiguously as either object or background. Here, the markers are found at the two extreme parts of the histogram of grey values:

>>> markers = ap.seros like(coins)

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Adaptive

What is image Filtering in the Spatial Domain?

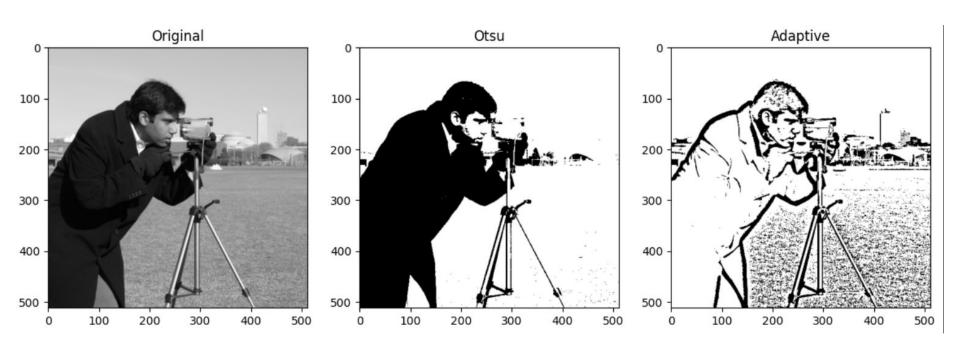
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Filtering is a midministrace accession in which the value of any given pixel in the augustrage is delicrated by applying Floring it a minimiserce occombine which have an order yether plant the super-mode is contaminated to supering the contamination of th

Convenient.

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* 117 44 3 8 25 12 5 7 14 15 6 6 13 28 12 16 12 79 20 3



- Para procesamiento de documentos:
 - Niblack's Thresholding

$$T_p = \mu_p + b\sigma_p$$
 b = -0.2

Sauvola's Thresholding

$$T_p = \mu_p \left[1 + b \left(\frac{\sigma_p}{R} - 1 \right) \right]$$

$$b = 0.5 \quad R = 128$$

Local

What is Image Filtering in the Spatial Domain?

Filling is a school, a for micharg an or harding unimage. For example, you can filter an image to emphasize contain matters or remove of an instead image arrangement on implemental with lateurs; include smoothing, sharploring,

If living it a uniquiprococcided with which the value of program play in the august race is continuing by a paying some a sortion in the evenes of the problem to no photomic or the corresponding upper stort. A play the unique the chaot is some expectation, a chaotic interest in the chaot is some expectations, and when the chaotic interest in the chaotic interest interest interest in the chaotic interest interest in the chaotic interest interes agency designations by a contract of contract of the second of the secon

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Niblack

What Is Image Filtering in the Spatial Domain? What is image Thorning in the Spatral Domain?

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Sauvola

What Is Image Filtering in the Spatial Domain?

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# - 117 44 8 8 35
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Evaluación formativa

• ¿Qué método utilizarías para binarizar la siguiente imagen y por qué?





Actividad de cierre

• ¿Qué aprendiste en la clase de hoy?