

# Resumen T- $k^2$ raster

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Related work

# Rank y select en bitmaps

- ▶ Bitmap  $B[0 \dots n]$
- ▶  $rank_a(B, i)$
- ▶  $select_a(B, i)$

# Quadtree

	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	1	0
7	0	0	0	0	1	0	0	0

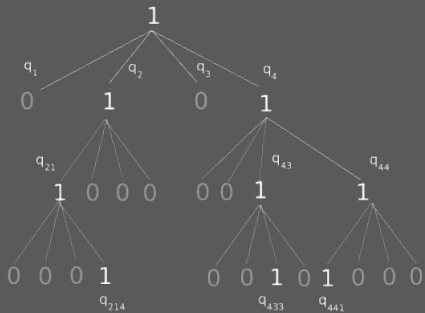


Figure 1: A binary raster and its corresponding quadtree.

# $k^2$ tree

- ▶ Region quadtree.
- ▶ Dos arreglos,  $L$  y  $T$ .
- ▶  $p_{hijos} = rank_1(T, p) \cdot k^2$
- ▶ Si  $p_{hijos} > |T| \implies L[p_{hijos} - |T|]$

# $k^3$ tree

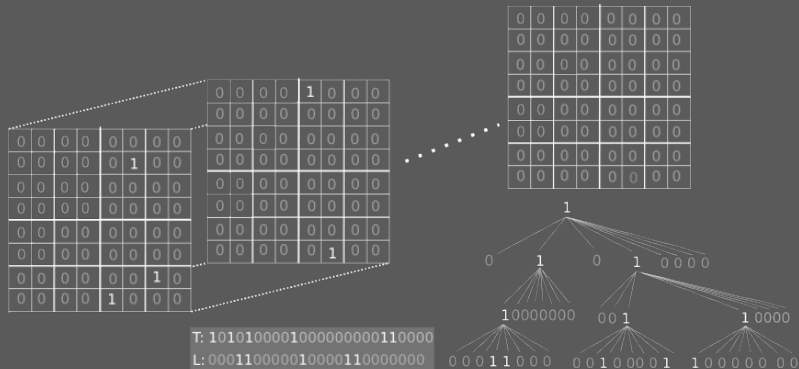


Figure 2: A sequence of binary rasters and the corresponding  $k^3$ tree.

# Representación compacta de rasters

# $k^2$ raster

- ▶ Matrices de enteros.
- ▶ Nodos almacenan máximos y mínimos.
- ▶ Subdivisión hasta que max y min sean iguales, o hasta llegar a una celda.
- ▶ Arreglo de bits  $T$ .
- ▶ Codificación diferencial.
- ▶  $L_{max}$  y  $L_{min}$ .



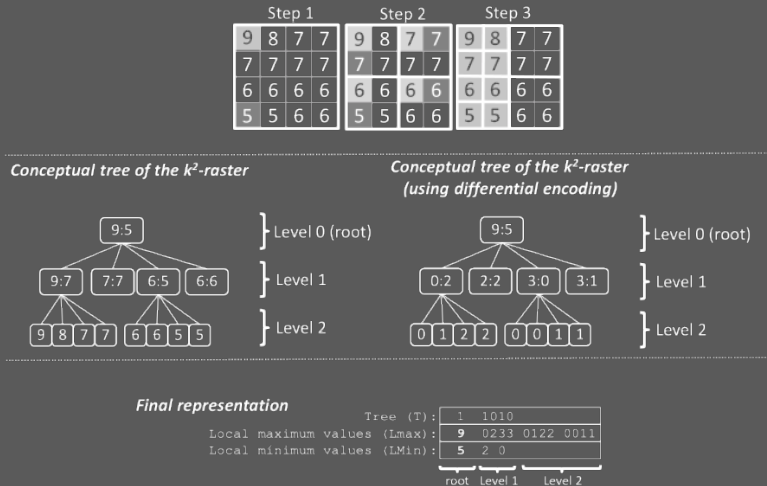


Figure 3: Example (using  $k = 2$ ) of integer raster matrix (top), conceptual tree of the  $k^2$ -raster, conceptual tree with differential encoding, and final representation of the raster matrix.

# 3D2D-mapping

- Matriz raster → matriz binaria.

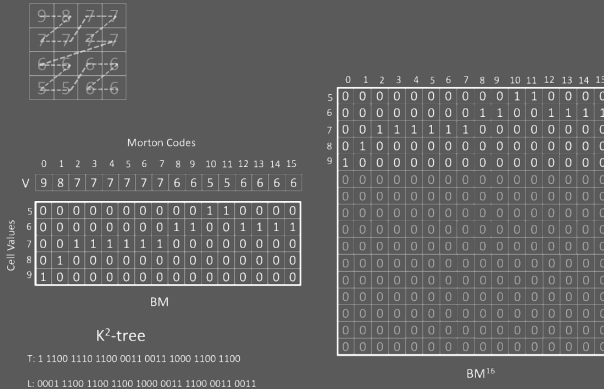


Figure 5: 3D2D-mapping of the matrix of Figure 3.

# Representación compacta de rasters time series

# 4D3D-mapping

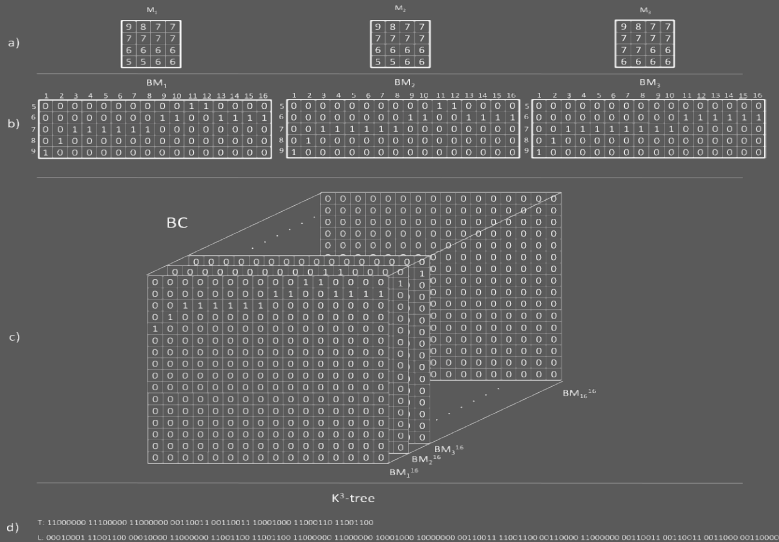


Figure 6: 4D3D-mapping for the top left submatrices in Figure 8.

# Problem definition

- Tenemos una secuencia de matrices raster para distintos instantes de tiempo  $\tau$ . Asumimos que cada celda de los raster almacena un entero.

# Querys

- ▶  $access(r, c, t)$
- ▶  $windowQuery(r_1, r_2, c_1, c_2, t_1, t_2)$
- ▶  $rangeQuery(r_1, r_2, c_1, c_2, t_1, t_2, rMin, rMax)$

# q-cols & q-rows

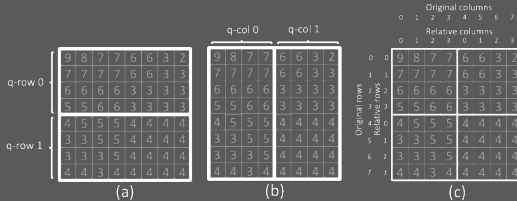


Figure 7: Definitions.

- Dada una q-row,  $q\text{-row}_i$  y la fila original  $r | r \in \{0, \dots, n-1\}$ , definimos  $relative\_row(q\text{-row}_i, r)$  de la siguiente forma:
  - Si  $r \in q\text{-row}_i$ , retorna la posición relativa de  $r$  dentro de  $q\text{-row}_i$ .
  - Si  $r$  está en una q-row anterior a  $q\text{-row}_i$ , retorna 0.
  - Si  $r$  está en una q-row posterior a  $q\text{-row}_i$ , retorna  $\frac{n}{k} - 1$ .
- La función  $relative\_col(q\text{-col}_i, r)$  funciona de manera análoga.

# T- $k^2$ raster

- ▶ Snapshots y logs.
- ▶ Matrices  $M_t$  y  $M_s$ .
- ▶  $s = i + 1 \cdot t_\delta, i \in [0, (\tau - 1)/t_\delta]$ .
- ▶  $t \in [s + 1, s + t_\delta - 1]$ .
- ▶ Para representar  $M_t$  se usa  $k^2$ raster'.



# $k^2$ raster'

- ▶ Codificado en base a las diferencias con  $M_s$ .
- ▶ Bitmap  $eqB$ .
- ▶ Sea  $\alpha \leftarrow maxval_t - maxval_s$ .
- ▶ Si llegamos a las celdas,  $Lmax[z_{tj}] \leftarrow \alpha$ .
- ▶ Si  $maxval_t == minval_t$ ,  $T_t[z_{tj}] \leftarrow 0$ ,  
 $eqB[rank_0(T_t, z_{tj})] \leftarrow 0$  y  $Lmax[z_{tj}] \leftarrow \alpha$ .
- ▶ Si  $q_{tj}$  y  $q_{ts}$  difieren por completo en  $\alpha$ ,  $T_t[z_{tj}] \leftarrow 0$ ,  
 $eqB[rank_0(T_t, z_{tj})] \leftarrow 1$  y  $Lmax[z_{tj}] \leftarrow \alpha$ .

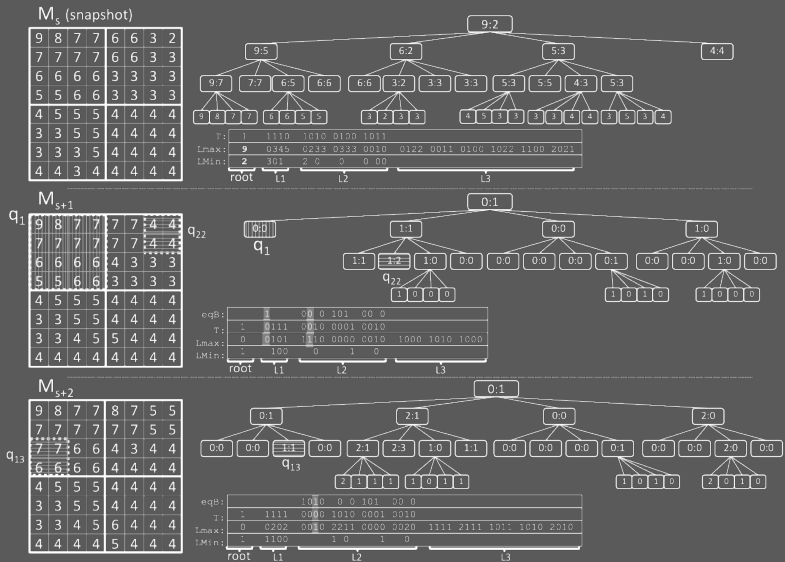


Figure 8: Structures involved in the creation of a  $T-k^2$  raster considering  $\tau = 3$ .