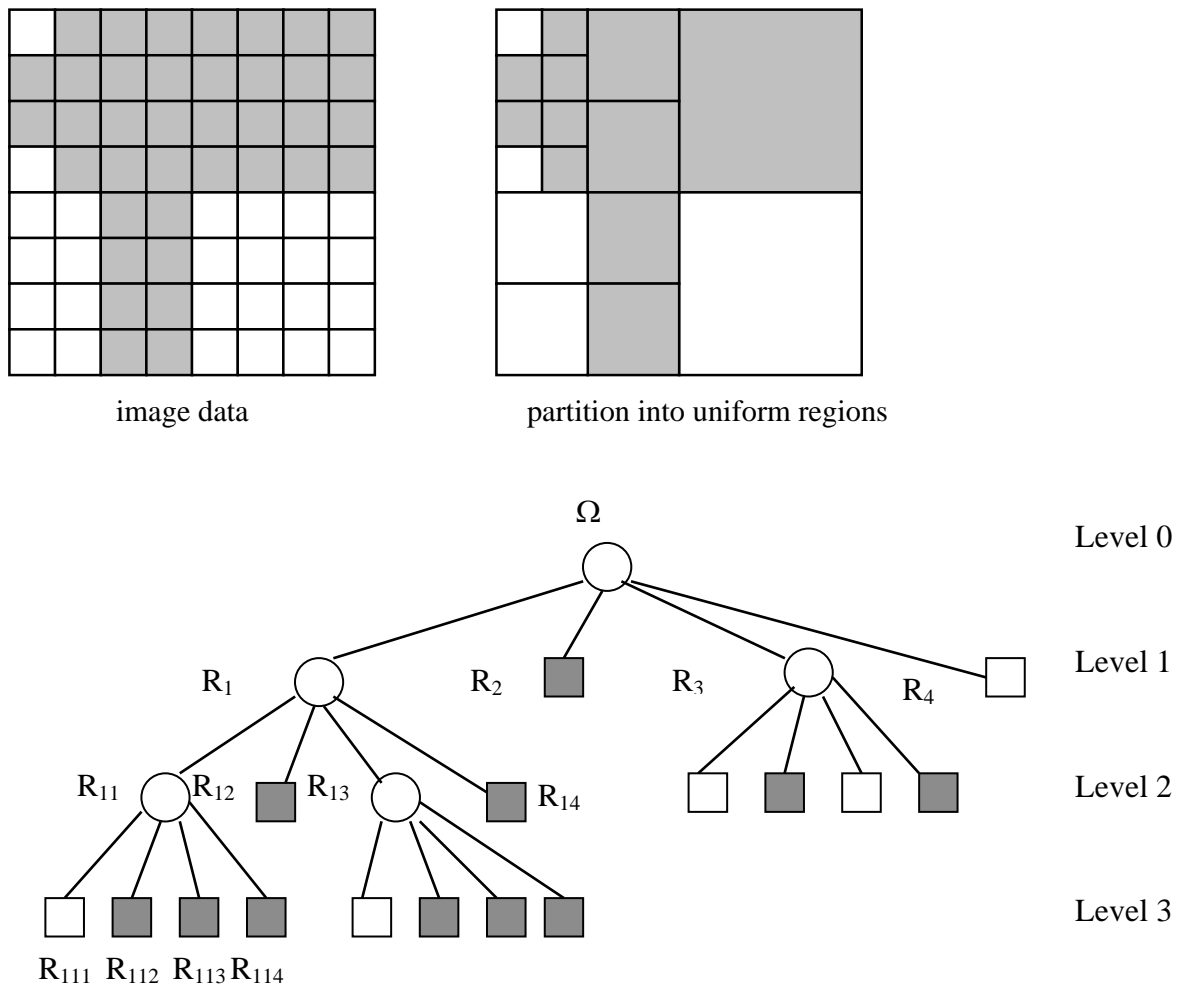


## 1. Quad Picture Tree

A quad picture tree (QPT) is a picture tree which starts with the original picture as the start region and progressively divides each region into four square sub regions with an equal number of pixels [Weeks, 1996, pp. 447] [Jain, Kasturi, and Schunck, 1995, pp. 89]. The following example show a QPT for an image. One disadvantage of the QPT is that nodes corresponding to adjacent regions may not be adjacent in the QPT. After the picture tree has been split one can consider merging regions that are connected and meet the predicate requirements. This procedure would be called splitting and merging. A difficult task is to define suitable predicates for the split and merge process.

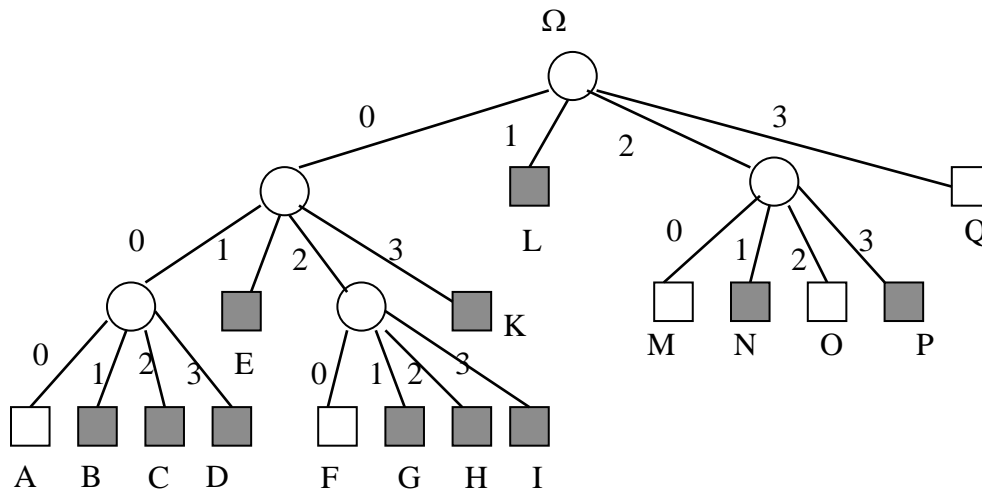


**Figure 1. Quad Picture Tree**

A cutset of a tree is a subset  $S$  of the nodes such that a.) no two nodes in  $S$  belong to a path from the root node to a leaf node and b.) the addition of any node destroys property a. Intuitively, a cutset divides the tree into two parts. A segmentation of an image corresponds to a cutset of the QPT.  $S$  is the segmentation set.

A QPT is a hierarchical data structure. Recursive methods are the most common manner of generating QPT's methods [Pavlidis, 1982, pp. 105]. Pointers are used as a programming structure to process the QPT. The pointers point to the descendants of a given node, four in this case. The most common database methods in use are relational database methods. In order to make better use of relational database methods (RDBMS) the linear quadtree was proposed [Wang, 1991].

The linear quadtree stores only the black nodes. A coding scheme is used to code the four descendents of a node. Each node is coded into the digits 0,1,2,3. The following example demonstrates this code. Common database operations such as set union and intersection can be performed with this code which make the representation viable.

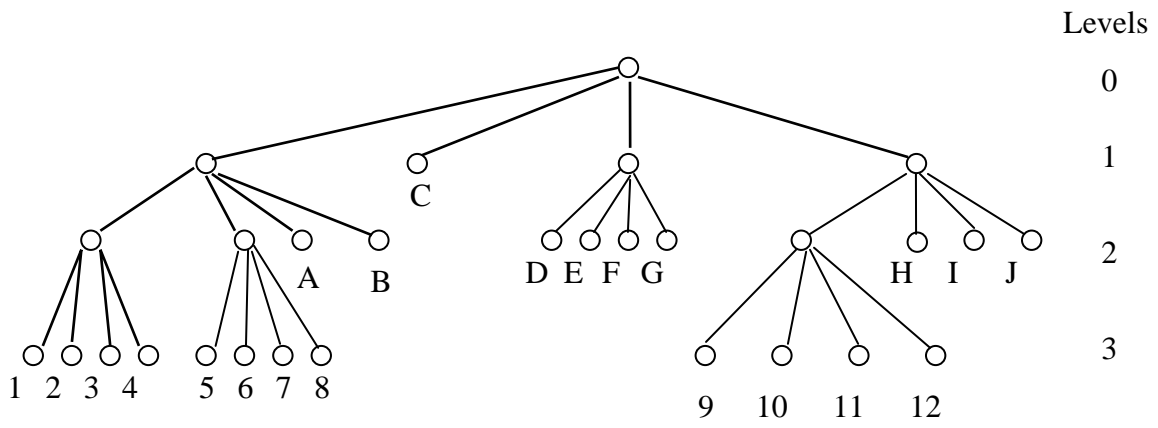


LQPT= {001, 002, 003, 01x, 021, 022, 023, 03x, 1xx, 21x, 23x)  
 B C D E G H I K L N P

**Figure 2. Linear Quadtree**

In forming the quad\_picture tree (QPT) one starts with the entire image at the top and then successively divides the regions into quarters. The QPT can be used to guide the search for regions with uniform gray-levels for gray-scale images by developing a measure of uniformity (homogeneity) to test the regions as candidates to be split. Notice that the QPT divides the analysis into levels of detail with the coarsest resolution at the top. It is therefore common to refer to different levels of the QPT.

1	2	A	C		
3	4				
5	6	B			
7	8				
D		E	9	10	H
			11	12	
F		G	I		J



Now consider the application of the QPT to region splitting. Measures of region uniformity are important in the process of region formation.