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Worksheet 14
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Algorithms of Scientific Computing

Refinement Trees and Parallelization with Space-Filling Curves – Solution

Exercise 1: Hilbert-Order Encoding of a Quadtree

a), b), c) The refined grid and Hilbert space-filling curve for the domain with an obstacle are shown in Figure 1.

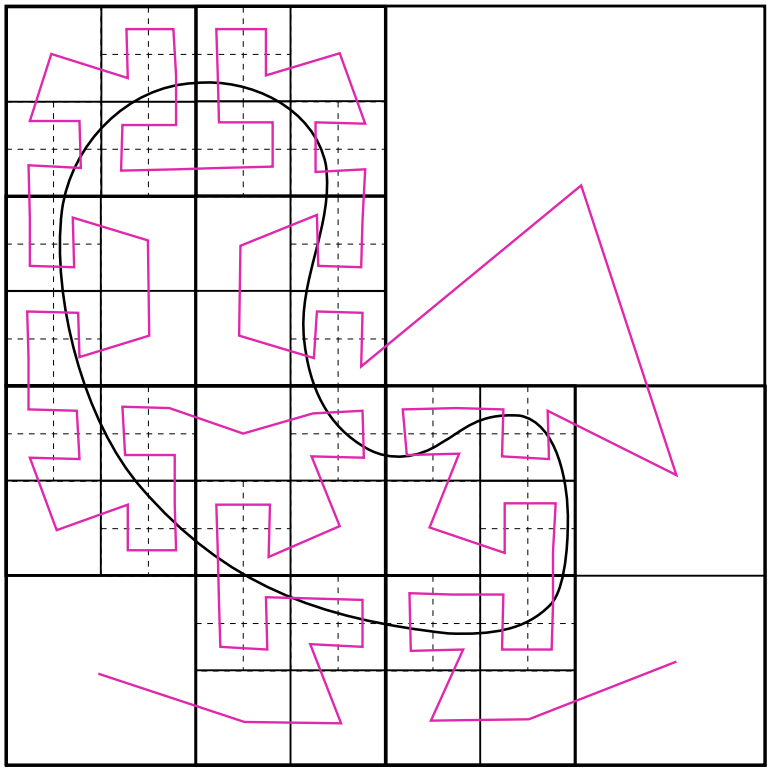

Figure 1: An adaptive spacetree grid with Hilbert curve.

The corresponding quadtree structure is provided in Figure 2.

d) For the implementation refer to `Worksheet_9.ipynb`. The Hilbert curve from this exercise

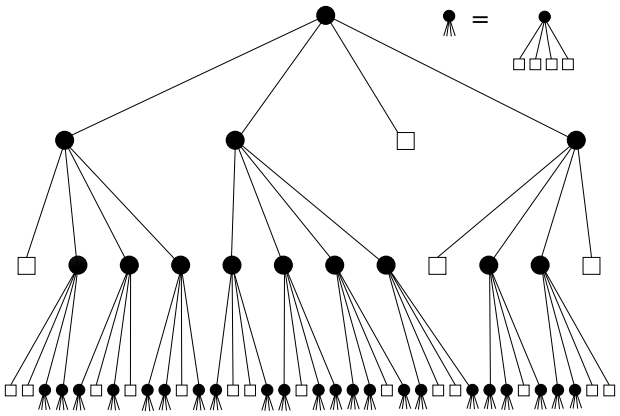

Figure 2: Quadtree representation of the refined grid.

is encoded by the following stream of numbers:

[141,
45, 1, 13, 1,1,5,1,1,1,1,5,1,1,1,1, 13, 5,1,1,1,1,1,5,1,1,1,1,1,
17, 5,1,1,1,1,5,1,1,1,1,1,5,1,1,1,1,
61, 13, 5,1,1,1,1,1,1,5,1,1,1,1, 17, 5,1,1,1,1,1,5,1,1,1,1,5,1,1,1,1,
17, 5,1,1,1,1,5,1,1,1,1,1,5,1,1,1,1, 13, 5,1,1,1,1,1,1,5,1,1,1,1,
1,
33, 1, 17, 5,1,1,1,1,5,1,1,1,1,1,5,1,1,1,1, 13, 5,1,1,1,1,5,1,1,1,1,1,1,1]

The python plotting results in Figure 3, which is equivalent to Figure 1.

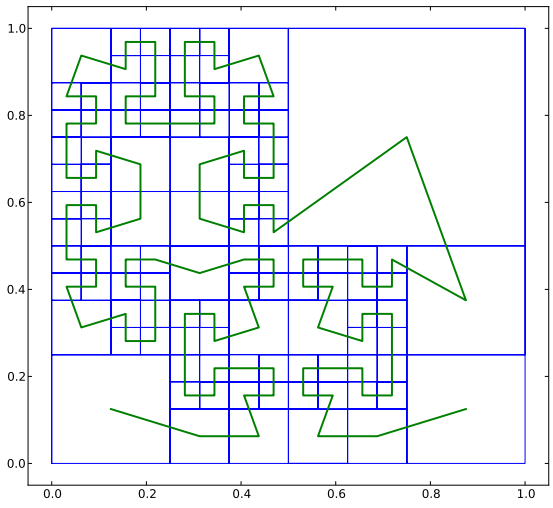

Figure 3: An adaptive spacetree grid with Hilbert curve generated by the python script.

Exercise 2: Parallelization with Space-Filling Curves

a) For the implementation refer to `Worksheet_9.ipynb`.

b) All four local grids with corresponding space-filling curves are shown in Figure 4.

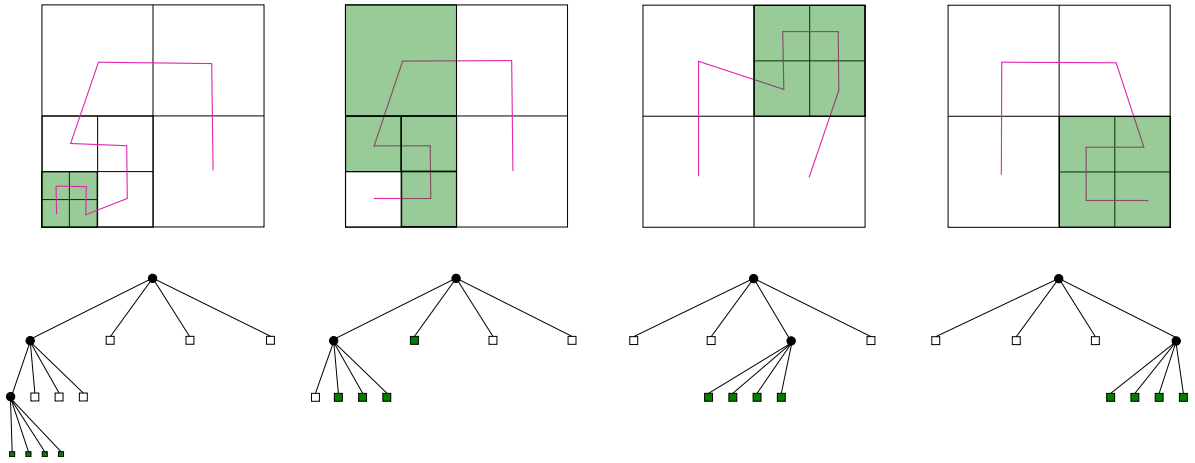

Figure 4: Four local adaptive grids and corresponding space-filling curves.