

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.

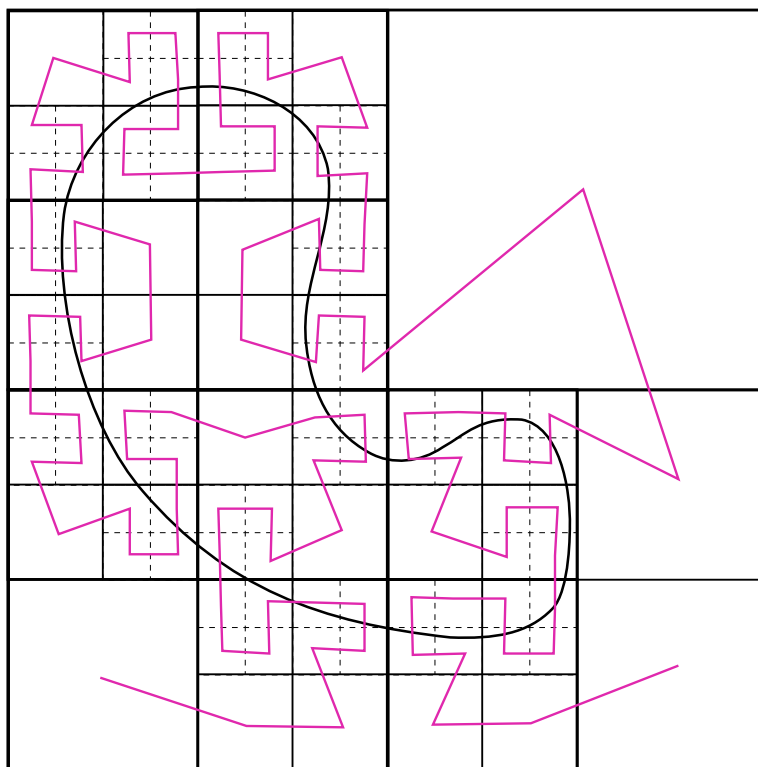


Figure 1: An adaptive spacetree grid with Hilbert curve.

The corresponding quadtree structure is provided in Figure 2.

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

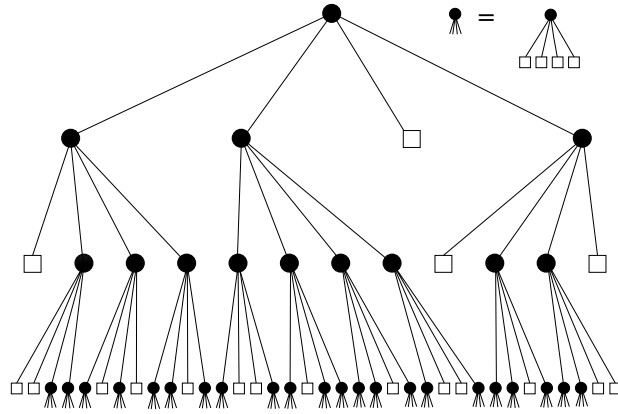


Figure 2: Quadtree representation of the refined grid.

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, 5,1,1,1,1,5,1,1,1,1,5,1,1,1,1,
 61,  13, 5,1,1,1,1,1,5,1,1,1,1, 17, 5,1,1,1,1,1,5,1,1,1,5,1,1,1,1,
 17, 5,1,1,1,1,5,1,1,1,1,5,1,1,1,1, 13, 5,1,1,1,1,1,5,1,1,1,1,
 1,
 33,  1, 17, 5,1,1,1,1,5,1,1,1,1,5,1,1,1,1, 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.

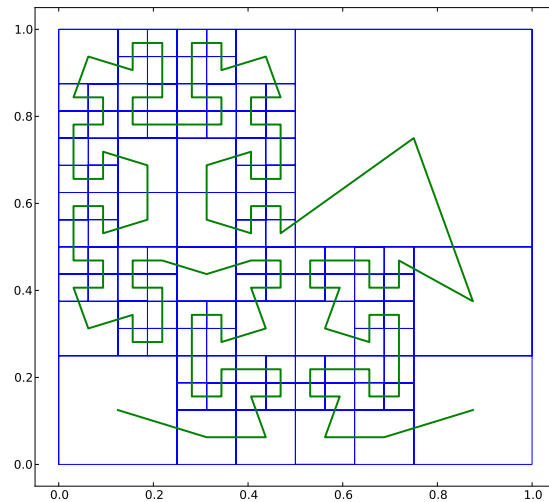


Figure 3: An adaptive spacetime grid with Hilbert curve generated by the python script.

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.

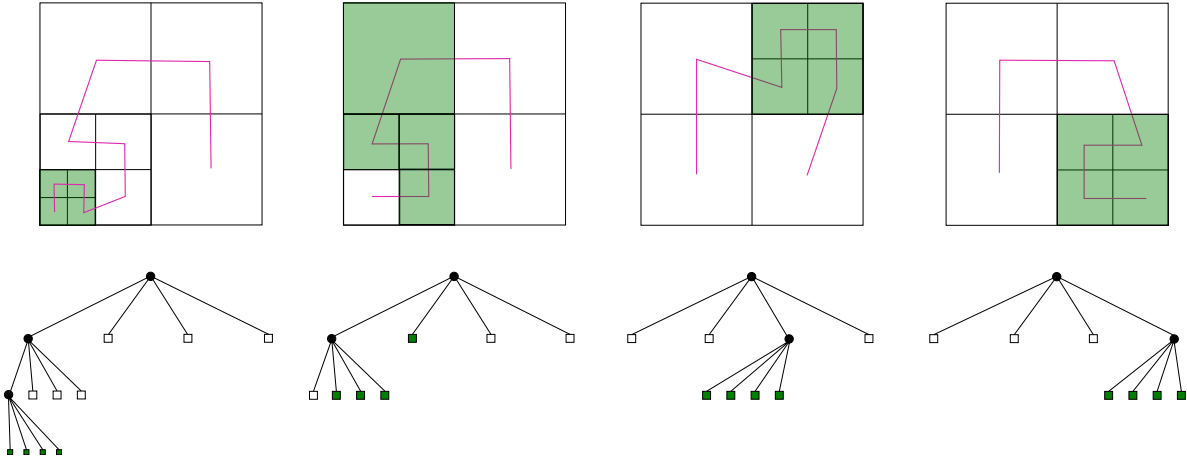


Figure 4: Four local adaptive grids and corresponding space-filling curves.