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_12.ipynb. The Hilbert curve from this exercise
is encoded by the following stream of numbers:

```
[134,
  45,    1,    13,    1,    1,    5,    1,    1,    1,    5,    1,    1,     1,
 13,    5,    1,    1,    1,    1,    5,    1,    1,    1,    1,    5,    1,    1,    1,
 17,    5,    1,    1,    1,    5,    1,    1,    1,    1,    5,    1,    1,    1,    1,
 13,    5,    1,    1,    1,    1,    5,    1,    1,    1,    1,    5,    1,    1,    1,
 17,    5,    1,    1,    1,    5,    1,    1,    1,    1,    5,    1,    1,    1,    1,
 13,    5,    1,    1,    1,    1,    5,    1,    1,    1,    1,    5,    1,    1,    1,
 17,    5,    1,    1,    1,    1,    5,    1,    1,    1,    1,    5,    1,    1,    1,
 1,     37,    1,     17,    5,    1,    1,    1,    5,    1,    1,    1,    1,    5,    1,
 17,    5,    1,    1,    1,    5,    1,    1,    1,    1,    5,    1,    1,    1,    1]
```

The python plotting results in Figure 3, which is equivalent to Figure 1.
Exercise 2: Parallelization with Space-Filling Curves

a) For the implementation refer to worksheet_12.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.