Technische Universität München
Lehrstuhl für Informatik V
Univ.-Prof. Dr. M. Bader
M.Sc. A. Mo-Hellenbrand, M.Sc. A. Schwarz

SS 2016
Worksheet 12
06.07.2016

Algorithms of Scientific Computing

Refinement Trees and Parallelization with Space-Filling Curves

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.

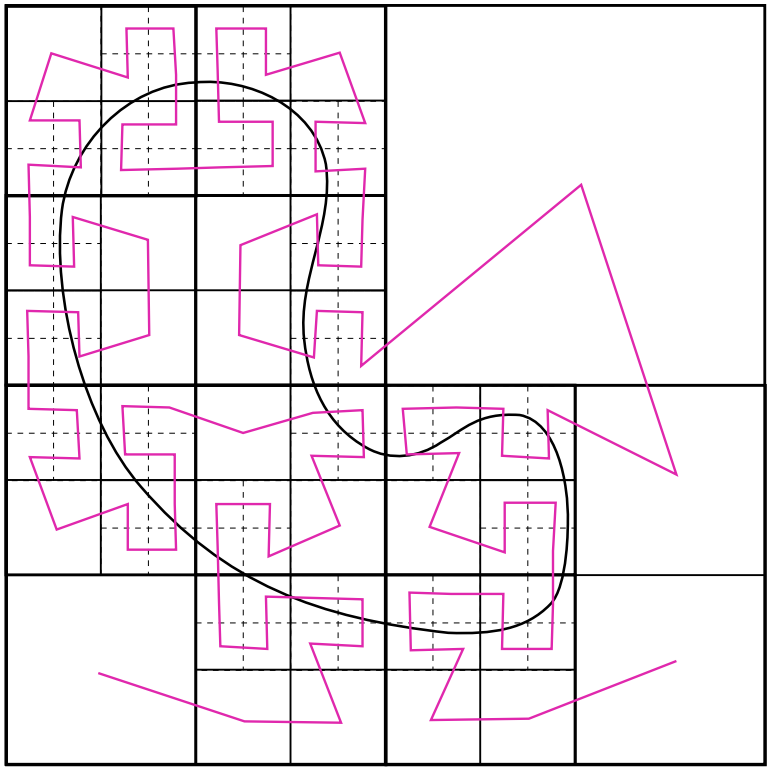

Figure 1: An adaptive spacetree grid with Hilbert curve.

The corresponding quadtree structure is provided in Figure 2.

d) For the implementation see the attached Python code. The Hilbert curve from this exercise

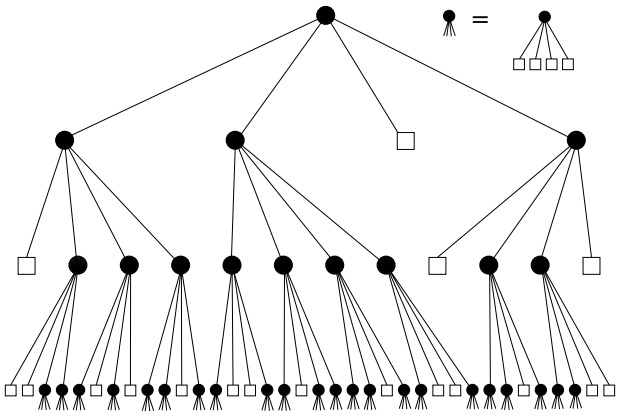

Figure 2: Quadtree representation of the refined grid.

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.

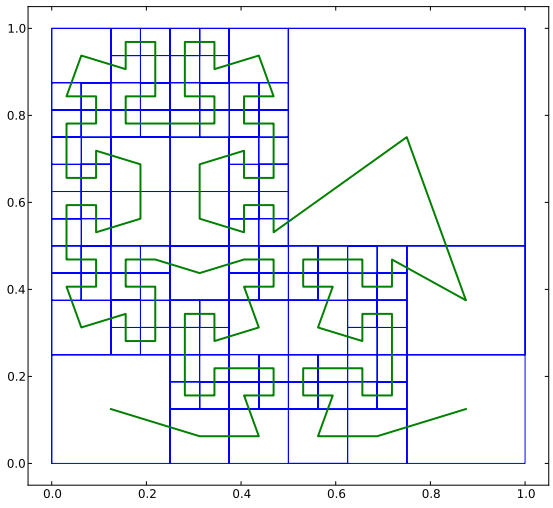

Figure 3: An adaptive spacetree grid with Hilbert curve generated by the python script.

Exercise 2: Parallelization with Space-Filling Curves

a) For the implementation see the attached Python code.

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

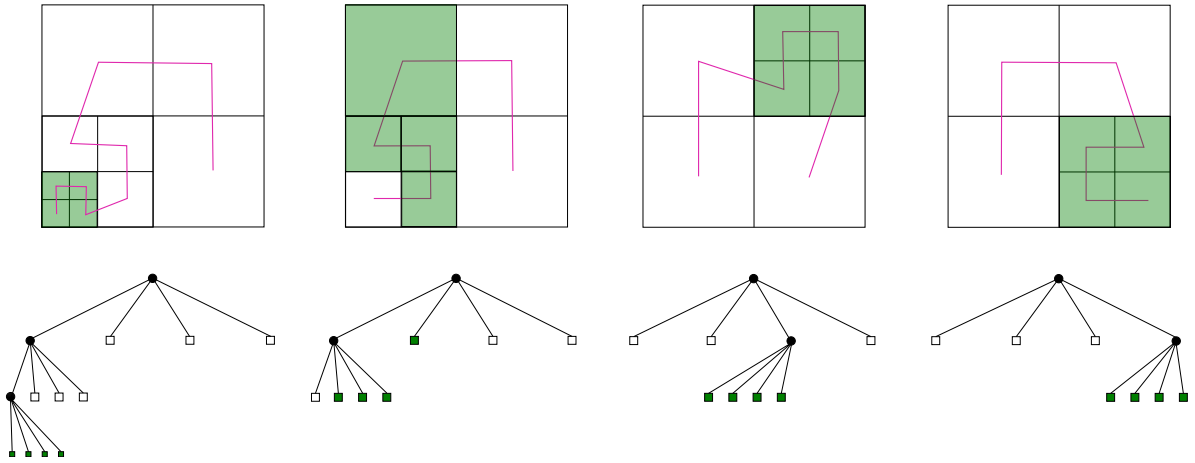

Figure 4: Four local adaptive grids and corresponding space-filling curves.