

# Algorithms of Scientific Computing (Algorithmen des Wissenschaftlichen Rechnens)

## Handling of the Peano Curve

Figure 1 shows two examples of the so-called Peano curve – a regular one and one of the meander type. In the following we will derive a description of these curves by grammars and arithmetization, as shown in the lecture.

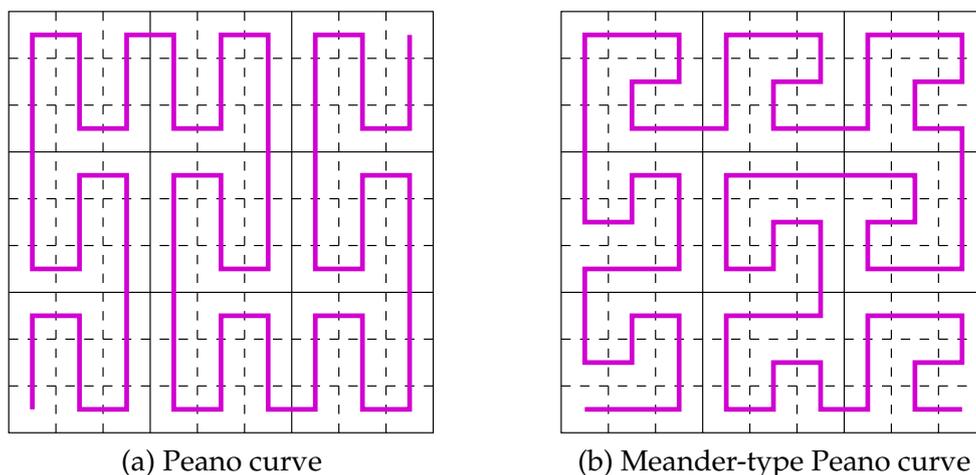


Abbildung 1: Two Peano-style space filling curves

### Exercise 1: Grammars for Peano curves

The construction principle of Peano curves is sketched in figure 1a, while figure 1b shows the same for the meander-type.

Formulate a grammar for each of the two types, that generates the iterations of the curves.

### Exercise 2

Implement both grammars of Exercise 1 in an appropriate program (in Maple).

### Exercise 3: Real Turtle for the Hilbert Curve

The type of grammars which has been created in Exercise 1, can be used to derive an algorithm, which defines the travel direction of the curve in a global coordinate system.

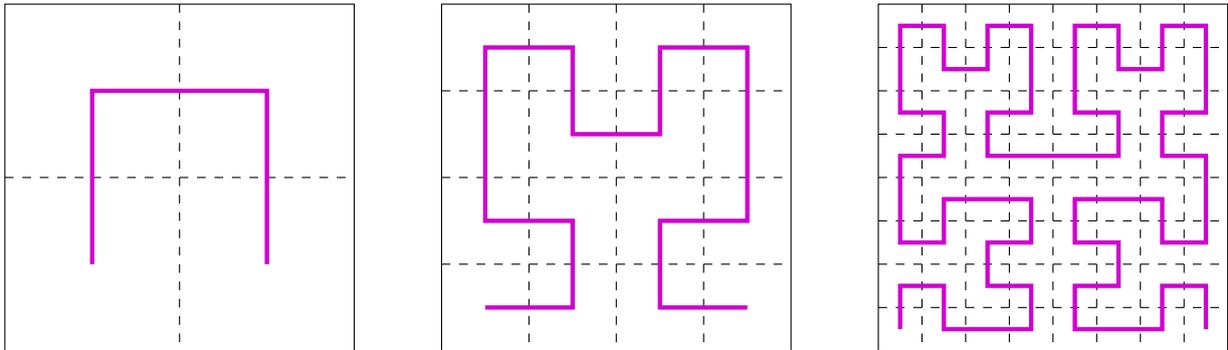


Abbildung 2: Construction of the Hilbert Curve

In this Exercise we will derive a "real" turtle graphics algorithm for the Hilbert Curve, that only uses the following commands:

- Go one step ahead.
- Turn the travel direction by  $90^\circ$  to the right.
- Turn the travel direction by  $90^\circ$  to the left.

Try to find an algorithm for which the turtle turns at most once after doing a step (so it shouldn't turn more than once by  $90^\circ$  at the same spot).

Implement the grammar again in a (Maple) program.

**Hint:** You can for example consider, where the curve enters and exit a sub-square. Try to think like the turtle: The next sub-square is always in front of you...