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Worksheet 10
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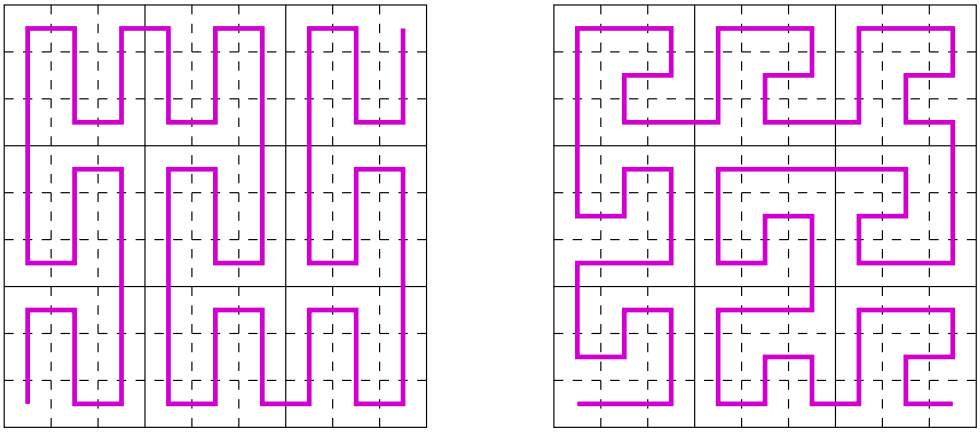
Algorithms of Scientific Computing

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, as shown in the lecture.



(a) Peano curve (b) Meander-type Peano curve

Figure 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 Python program. A skeleton of the program can be found in `sheet10_template.py` or on your IPython notebook accout in `Worksheet_10_empty.ipynb`.

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.

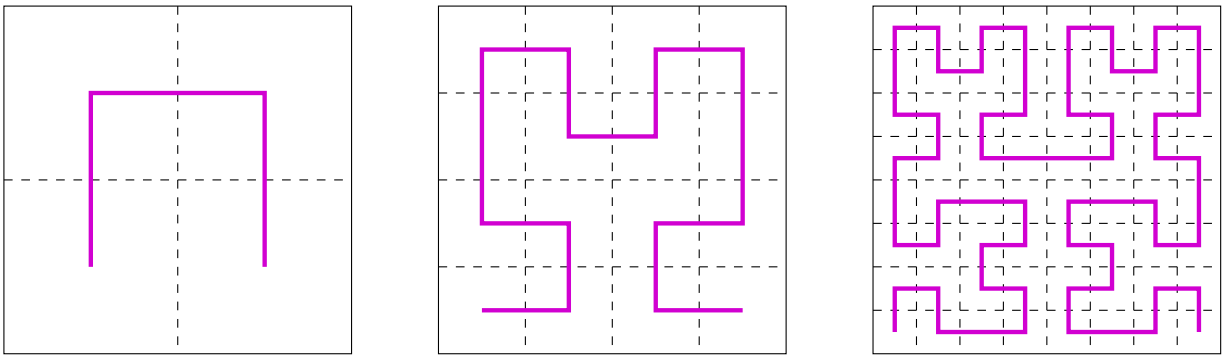


Figure 2: Construction of the Hilbert Curve

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° to the right.
- Turn the travel direction by 90° 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° at the same spot).

Implement the grammar again in a Python program.

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