



Figure 1: Seymur Efendi and his favourite tortoise Abdullah

Seymur Efendi carefully dipped his reed pen into the inkwell. Then he lifted it and watched as a few excess black drops fell onto the ink slab. Sitting cross-legged on the divan beside him, İğdişbaşı Yakup Bey glanced first at the dripping ink, then at the verse inscribed on the stretched parchment within the wooden frame above Seymur Efendi's desk. It was a verse from Surah An-Naml, speaking of Prophet Solomon's dominion over animals.

"Wasting ink on tortoises that could be used to write many such verses..." Yakup Bey thought to himself. "I trust him because he is a learned man, but such wastefulness..."

Seymur Efendi bent down and sat on the floor. He picked up Abdullah, the tortoise that had been his companion for nearly five years, and inspected the contraption on its shell. Rising from the very center of its shell was a wooden pole, about half a cubit in length. A horizontal wooden piece was nailed to the top of this pole, extending along the length of the tortoise's head. On this piece, there was a hook designed to hold a reed pen in place. As the tortoise walked, the pen, positioned about half a span in front of its head, would touch the ground and draw shapes.

Abdullah was a thick-shelled, old tortoise, but compared to Seymur Efendi's other tortoises, he moved with greater speed. When commanded to draw a shape, he would waddle forward with a determined expression, though somewhat unsteadily. Yet, when his task was complete and Seymur Efendi placed him back in the fenced-off corner of the study, he would sit still, dignified and weary.

A tortoise like that had never been seen in the area before. Seymour Efendi had come across him by chance. One evening, upon returning home, he noticed that there were not four, but five tortoises in the fenced-off section of his study. The other four stood in a row, glaring at this newcomer as if he were an intruder. Abdullah, however, paid them no mind, calmly pulling a bowl of rue closer to himself and eating.

Seymur Efendi had no idea where this tortoise had come from. But seeing how he commanded the other tortoises and had found his way into the house, he concluded that the creature was intelligent. His admiration only grew once he began training him. In honor of this remarkable intelligence, he gave the tortoise his father's name.

And so, for the long-widowed Seymur Efendi, who had only his daughter Lale, there was now another child in the household.

...and here started the journey of Abdullah the Tortoise!

Hilbert Curves

Abdullah the Tortoise was famous for drawing Hilbert curves of different orders on the floor. A Hilbert curve is a type of continuous, space-filling fractal. Some examples of Hilbert curves of different orders are given in Figure 2.

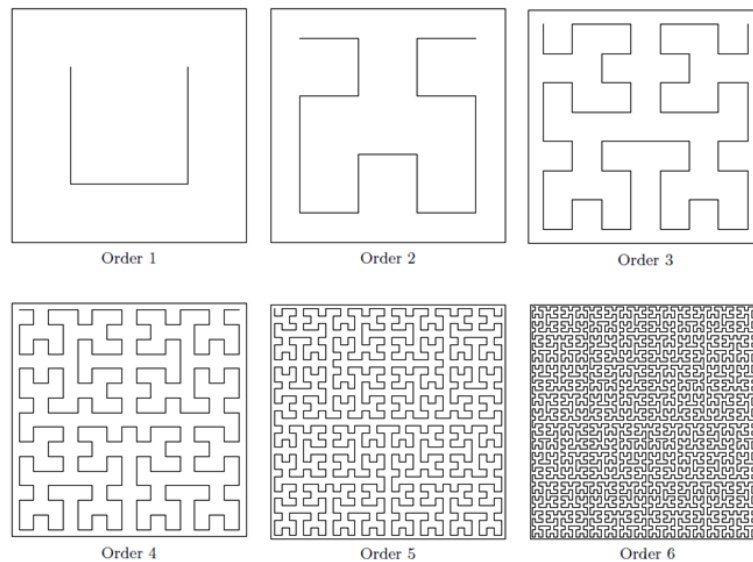


Figure 2: Hilbert Curves of different orders

As its order increases, the curve's length grows exponentially and gradually fills the entire square it is bounded within. The curve can be constructed through recursive decomposition, where it is divided into four smaller sub-curves of lower order that must be oriented correctly.

With the homework document, I also share a skeleton code which creates a line segment and saves as an STL file. Any line segment is represented using a tuple of type $(Point, Point, Float)$ where the first parameters represent start and end points of the line segment and the last parameter represent the thickness. Change the *hilbertcurve* function to create a Hilbert curve of given order. You may use CloudCompare to visualize the STL files. Some examples are as given in Figure X.

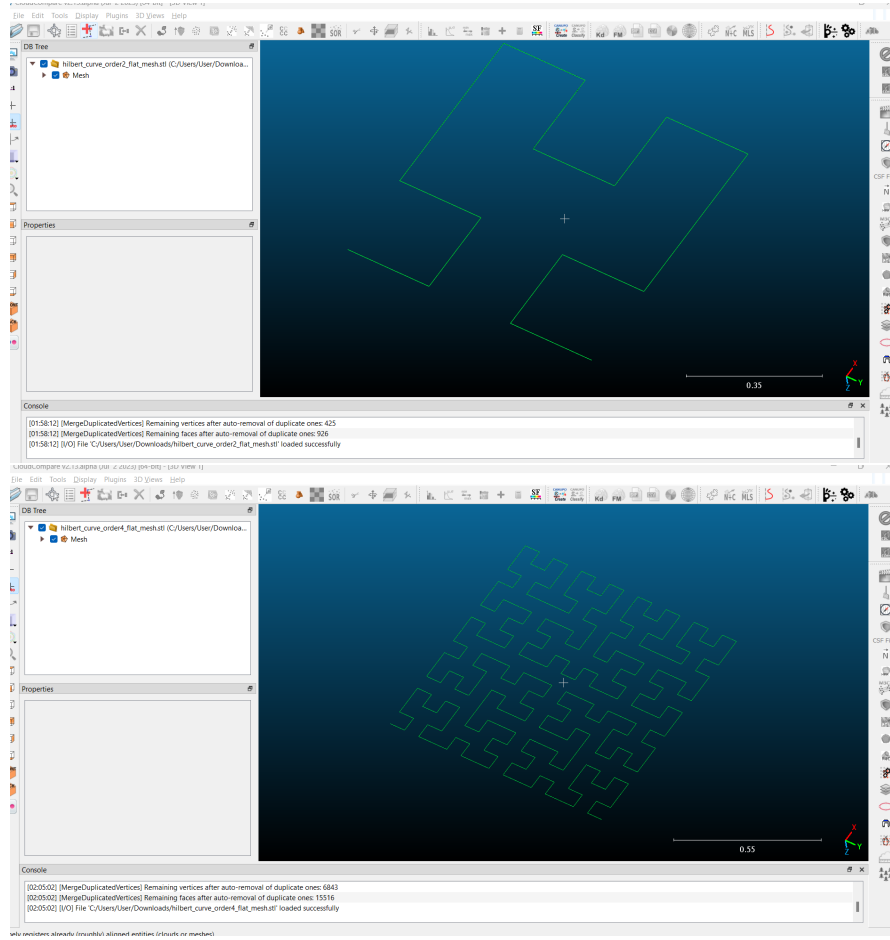


Figure 3: Hilbert figures of order 2 and 4 in 3D space