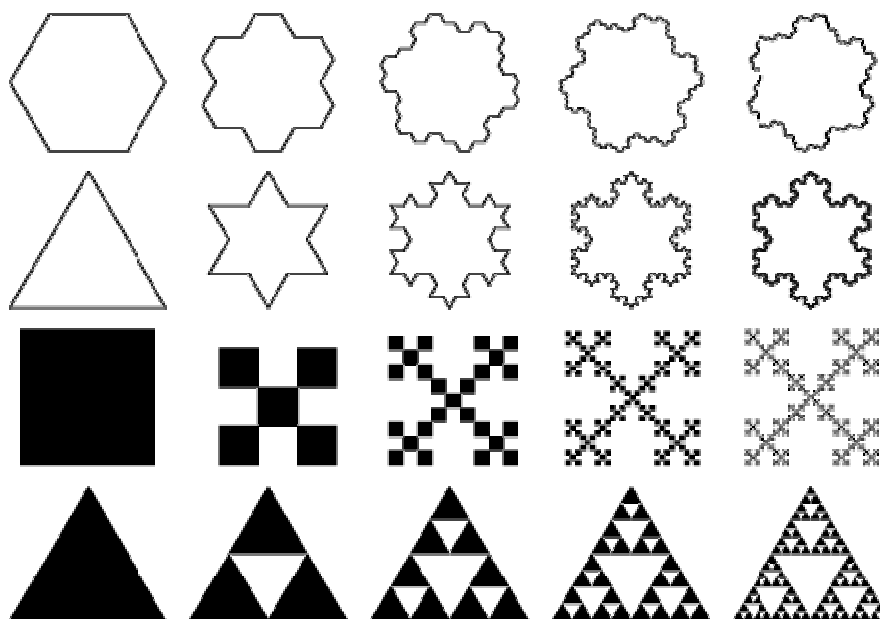


Art and Science United

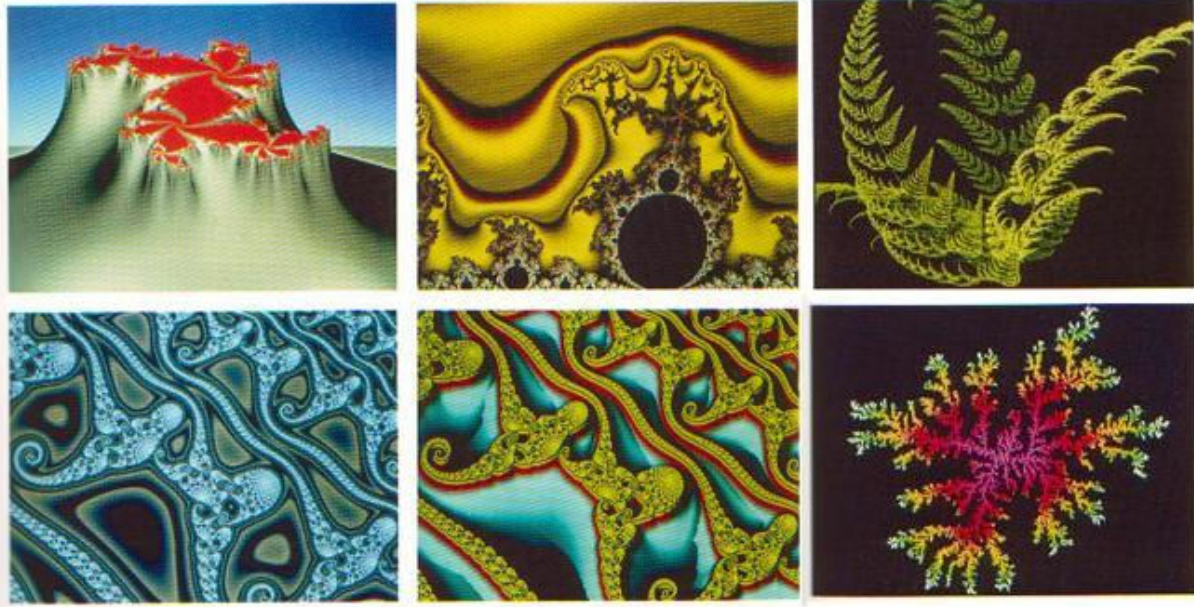
Doç. Dr. Haluk Berkmen

In the previous chapter we saw that order and disorder are closely related concepts. By making small changes in the order parameters it is possible to go from order to disorder and vice versa. Order is regular and predictable, while disorder is irregular and unpredictable. Physicists, in order to explain the behavior and time dependence of natural phenomena, dealt with smooth and regular functions, such as the sine and the cosine functions. But natural systems are neither smooth nor regular. We now have a new mathematical tool for dealing with natural structures and phenomena; this tool is called a **Fractal**.

Fractals come in two major variations. These are: the ***Deterministic Fractals*** and the ***Random Fractals***. Deterministic fractals are scaled down copies of themselves. Deterministic fractals are obtained by starting from a given figure and applying a certain rule recursively in a never ending iteration. Examples of deterministic fractals are shown below.

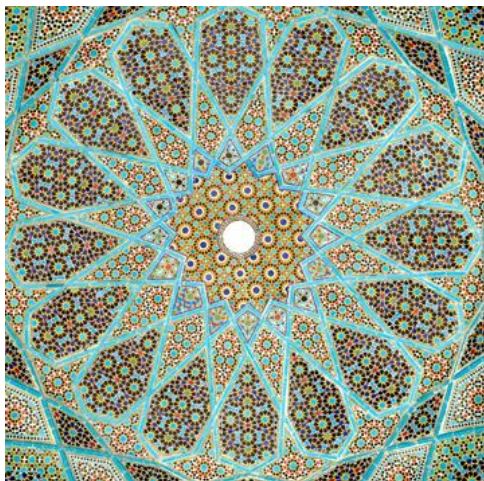


Although deterministic fractals are esthetic objects they cannot represent natural structures. Random fractals, on the other hand, have an additional element of randomness, allowing them to simulate natural structures and phenomena. With the advent of fast computers we can now enjoy the beauty of random fractals. Below we see some examples of random fractals.

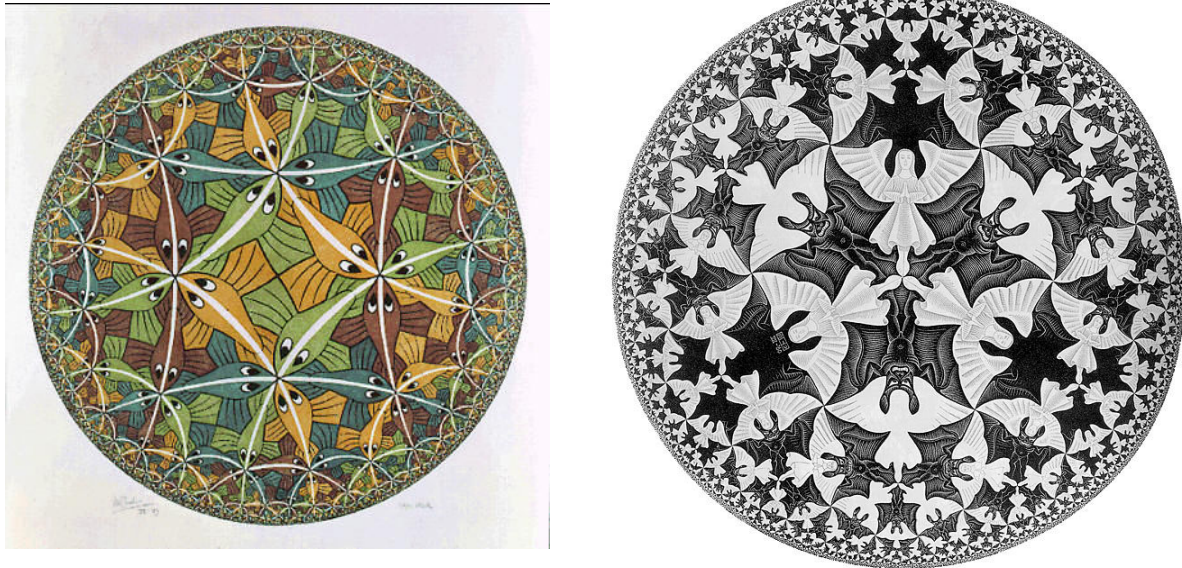


Both scientists and artists have always been keen observers of the natural world. Modern artists are more and more inclined to add an element of randomness in their work. They see the beauty and the hidden symmetry that exist at all scales in nature. Random fractals form a bridge between art and science. They are **mathematical objects** that can display the beauty of nature. We can now observe nature from a different perspective, not from making an explicit statement of what is the particular law or algorithm, but from an intuitive recognition that the fractal structure is inherently there.

Islamic artists have intuitively realized the hidden fractal structure of our universe, and reflected their feelings by creating intricate figures and patterns on the walls and ceilings of Islamic mosques. Below we see two examples.



The Dutch artist Maurits Cornelis Escher (1898-1972) was also interested in fractals. His work comprised many examples of regular divisions of the plane known as "**tessellations**", which are in fact deterministic fractals. Self similar figures intertwine and give the impression of an infinite space. Escher's interest on such forms which he called **metamorphoses** started on 1936, when he traveled to Spain and viewed the Islamic art of the Alhambra palace. Below we see two drawings of Escher.



Random fractals are not frequently seen in the western artistic culture. This is because logical thinking and perspective has overtaken the western mind. But the Sufi mind works differently. Rather than forcing the logical and deterministic will on his artwork, the Sufi (Islamic mystic person) prefers to add a component of randomness and indeterminism. This approach is clear in the Sufi Turkish **Ebru Art**. Below we see some examples of Ebru.

