**Module 2 Option 1: Primitives and Attributes**

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**Primitives and Attributes**

Primitives and attributes are the details that make up computer generated graphics. This could include the color, width, and length of individual lines within an image. Primitives and attributes can be changed depending on the use case. A great demonstration of these concepts is the Sierpinski gasket. The gasket demonstrates how some attributes may change but the overall image being created remains the same. Recursion can be utilized to easily create fractals like the Sierpinski gasket at a different scale each time the shape is recreated. Every developer needs a strong understanding of how to alter primitives and attributes in order to generate computer graphics.

**Uses of the Sierpinski Gasket**

The Sierpinski gasket is a great tool typically used to teach children about patterns. The Gasket can demonstrate the principles of fractals. Fractals are geometric shapes that can maintain great levels of detail no matter the scale of the shape. This could be especially useful in computer graphics. Having the ability to maintain detail regardless of size can help create realistic images that are indistinguishable from life (“Top 5 Applications of Fractals”, 2021). Fractals also have many uses outside of creating images, or art. Some of the most common are cities are built in a fractal pattern, and antennas utilize the concept of fractals to maintain the power of larger antennas in smaller profile builds.

Another use case for the gasket is in computer science and computer engineering. The gasket in computer science can be utilized as a test case to algorithms and data structures visually demonstrating how efficient an algorithm or data structure is. In computer engineering the gasket is utilized for the development of single transmitter oscillators. Though research has found a perfect gasket pattern is not ideal for development, the general concept could help future chips become more advanced (“The Splendid Generative Potential of the Sierpinski triangle”, 2018). Researchers also believe the concept of the gasket could explain many human brain functions.

**Recursion in Real Life**

In order to create detailed images recursion will most likely be utilized. Utilizing recursion allows for textures and details be programmed without having to manually create code for every pixel, line, or detail. In real life this can simply be any situation in which there is a large task that is broken down into small repeatable steps. One of the most common examples could be employees at grocery stores shopping for online orders. These employees are given the task of grabbing every product that customers order, and then that task can be broken down into individual steps for each item. The employee would find items repeatedly until the entire order is shopped. Finding the items would be the recursive method to completing the assignment. A situation that would not need recursive steps would be simple or unique problems. If the problem is small not many steps would be needed to complete the problem or repeat steps multiple times. If the problem is unique, every step to solve that problem may be unique and impossible to recursively solve.

Recursion also has many applications within computer science. Applications within computer science have unseen impacts in day-to-day lives. Many popular searching and sorting algorithms utilize recursion. This recursion could then be utilized by users to search for products, or sort items within a shopping cart by any criteria.

**Conclusion**

Computer graphics has many concepts that need to be understood to create any image, but no image can be created without a strong understanding of primitives and attributes, and all the concepts related to attributes. Fractals can be utilized to create the detail needed in modern computer graphics, and the easiest way to create fractals is recursively. Recursion can be used to create the same shape over and over, just at a different size scale. Primitives and attributes are the key to creating computer graphics at any level.

**References**

*Top 5 applications of Fractals*. Mathematics. (2021, October 1). Retrieved from <https://uwaterloo.ca/math/news/top-5-applications-fractals#:~:text=Fractals%20provide%20a%20systematic%20method,actively%20working%20on%20fractal%20geometry>.

Phys.org. (2018, December 14). *The splendid generative potential of the Sierpinski Triangle*. Phys.org. Retrieved from <https://phys.org/news/2018-12-splendid-potential-sierpinski-triangle.html>