Fractal Landscapes

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Description: Through the appropriate software we can generate landscapes with minimal starting information: One may start by giving a matrix with a rough approximation of the heights they want, then iteratively calculate the midpoints and displace them by some random amount, reflecting the 'randomic' nature of rock formations. This can later be refined by adding a 'water level' or other interesting features. What we obtain - at the limit of this process- is a fractal, thus possesses a fractal dimension that we can approximate by counting the proportion

$$-\lim_{\epsilon \to 0} \frac{\log(\#\{\texttt{boxes of side length } \varepsilon \texttt{ needed to cover the figure}\})}{\log(\varepsilon)}$$

Goal: Generate and visualize some interesting-looking fractal landscapes, calculate their dimensions, and show how their dimension varies based on the 'features' we show.

Tools: Wolfram Mathematica, SageMath, MatLab or any other software with graphical and numerical capabilities

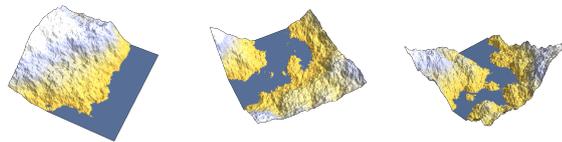**Level:** Suitable for students of semester 2 and 4.

Figure 1: Some examples of fractal landscapes with fixed water level (colored); The fractal dimension of the middle one was calculated to be approximately 2.48556