Ajani Mnyandu Exercise 10

1. Changes in dx:

    - Bigger dx: This leads to decreased resolution because the distance between adjacent grid points is larger. As a result, spatial features are represented less accurately, leading to a simulation which resolves features in a much more coarse manner.
    - Smaller dx: A smaller dx results in higher resolution because there are more grid points within the same spatial domain. This allows for finer representation of spatial features, resulting in a more accurate simulation. The pulse peak becomes sharper with straighter edges because the finer resolution captures the spatial variations more effectively.

    Changes in c:

    - Bigger c: With a higher advection speed, the pulse progresses through the domain more rapidly. This means that the temperature disturbance covers a larger distance in a given time interval, resulting in faster propagation.
    - Smaller c: Conversely, a smaller advection speed leads to slower progression of the pulse. It takes longer for the temperature disturbance to travel through the domain, resulting in slower propagation.
    - Interaction with dx and dt: When dx and dt are both small, the pulse has higher resolution, but if c is large, the pulse progresses rapidly. While the spatial features are better resolved due to small dx and dt, the rapid progression of the pulse may lead to a coarse resolution in time, as you might not capture the changes in the pulse accurately at each time step due to its fast movement.

2. Changes in σ

    - When σ is small, the Gaussian pulse is narrower, resulting in a steeper wave profile. This means there is a sharp transition or strong gradient between the temperature within the pulse and the surrounding temperature. The temperature changes more rapidly from the peak of the pulse to its surroundings, leading to a sharper and more pronounced temperature gradient. Conversely, when σ is large, the Gaussian pulse is wider, resulting in a smoother wave profile. The slope on either side of the pulse becomes gentler, meaning that the transition between the temperature within the pulse and the surrounding temperature is more gradual. This results in a smoother temperature gradient and a more gradual change in temperature from the peak of the pulse to its surroundings.