1. The letter E has a width and height of 25 mm, with each bar having a thickness of 5 mm. Suppose we want to make a 50 mm x 50 mm transmission mask where the white portions of the image represent a transmission of 1.0 (i.e. 100%) and the black portions of the image are opaque (transmission is 0.0). Using \( \text{rect}() \) functions, create a description of the mask transmission. There are multiple correct answers here. See if you can do it with just four \( \text{rect}() \) functions.

2. How does your answer to the previous question change if you want to create a complementary transmission mask where the background is opaque and the letter E is transparent?

3. Edmund Optics makes continuously variable Gaussian apodizing filters with specifications found at

https://www.edmundoptics.com/f/continuously-variable-apodizing-filters/13777/

Using our 2D special functions, create a description of the transmission profile of #64-385 filter. Note: The transmission \( T \) is related to the optical density \( (OD) \) by

\[
T = 10^{-OD}.
\]
4. Do the following

(a) Plot the following function

\[ \sin(x) \delta \left( x - \frac{\pi}{2} \right) \]

(b) Evaluate the integral

\[ \int_{-\infty}^{\infty} \sin(x) \delta \left( x - \frac{\pi}{2} \right) \, dx \]

(c) Show the following relationship is true and plot the result.

\[ \cos(\pi x) \text{comb}(x) = \frac{1}{2} \text{comb} \left( \frac{x}{2} \right) - \frac{1}{2} \text{comb} \left( \frac{x - 1}{2} \right) \]