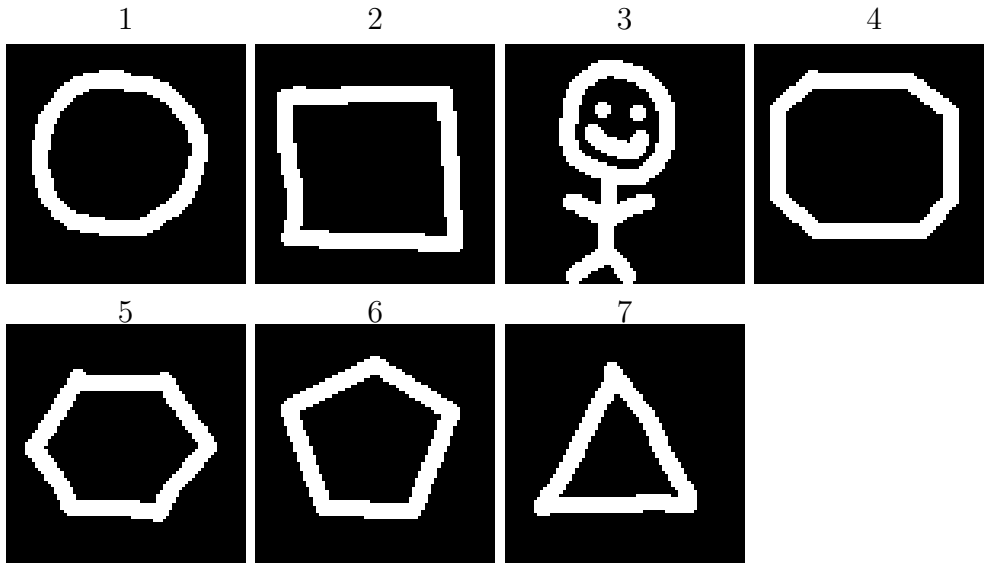
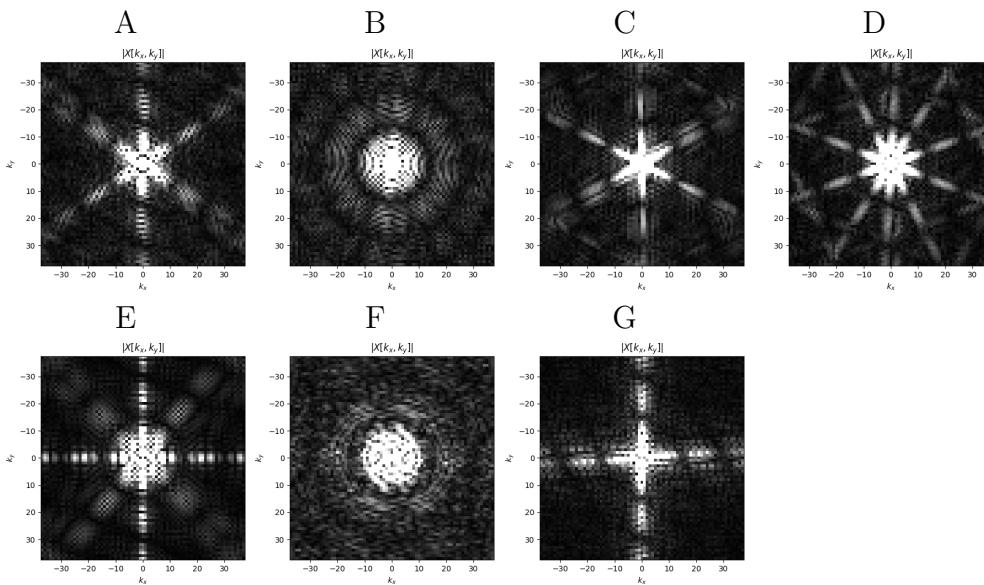


Fourier Matching

In each of the following images, white represents a value of 1 and black represents a value of 0. The origin ($n_x = n_y = 0$) is in the lower left corner of each image.



Each of the following 7 panels represents the magnitudes of the DFT coefficients associated with one of the above panels. Notice that the origin ($k_x = k_y = 0$) is in the center of each of these images.



Which transform (A-G) matches each image (1-7). Briefly explain your reasoning.

1. This circle is radially symmetric in space, so we expect the transform to be radially symmetric. There are two images (1 and 3) with circles, and two transforms with radial symmetry: B and F. The additional features in 3 (arms, legs, eyes, mouth) add additional features to its transform. Therefore, the transform of 1 is B (and the transform of 3 is F).
2. The horizontal lines of the square contribute a vertical line through the origin of the transform. Similarly the vertical lines of the square contribute a horizontal line through the origin of the transform. Both

of these features are seen in E and G, however, E has additional diagonal features that don't have counterparts in 1. Therefore the answer is G.

3. The stickman includes a prominent circle plus other features (see description in part 1). Therefore its transform is F.
4. The octagon has vertical and horizontal lines plus diagonal lines. The answer is E.
5. This six-sided figure is composed of horizontal lines as well as lines at angles approximately $\pi/3$ and $-\pi/3$ from the horizontal. These features are shared with image 7 (the triangle). Image 5 contains two horizontal lines, while image 7 has just one. Since the horizontal lines in image 5 are not exactly parallel to each other, the vertical line in its transform will be blurrier relative to the vertical line in the transform of 7. Similar arguments hold for the lines at $\pi/3$ and $-\pi/3$. Therefore the transform of image 5 is A.
6. The five-fold symmetry of image 6 will generate 5-fold symmetry of the transform, which is therefore D (which is both 5-fold and 10-fold symmetric).
7. The base of the triangle contributes a vertical line through the origin of its transform. The left edge of the triangle contributes a line that is rotated approximately $\pi/6$ radians clockwise to the horizontal line. The right edge of the triangle contributes a line that is rotated approximately $\pi/6$ radians counterclockwise to the horizontal line. These features suggest transforms A or C. Notice however that the right edge of the triangle has two parts at slightly different angles. This generates two lines at slightly different angles, which is only seen in C.