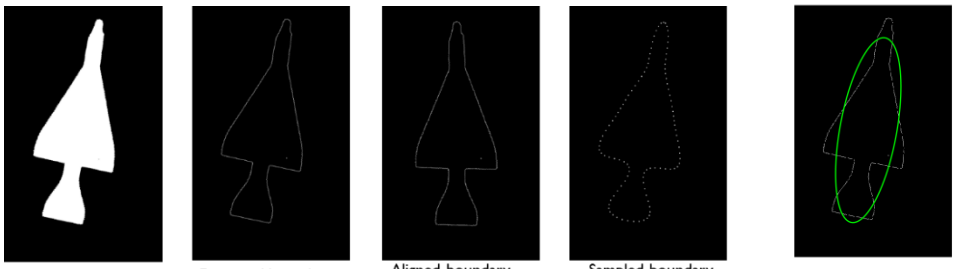
Project #6 Shape Representation

Part I: You are given one binary image, ('airplane.bmp'), do the following tasks:

- I.1 Extract the boundary and use the Hotelling transform to align the shape.
- I.2 Use the Fourier descriptors to reconstruct the boundaries with different orders (i.e., the number top non-zero DFT coefficients used). Discuss your findings in terms of the accuracy of shape reconstruction.
- I.3 Given the N-pixel boundary, create sampled boundaries with M points (e.g., M=N/50, N/20, N/10) by using the Fourier shape descriptors. Please note that you will need to apply a scaling factor (M/N) after IDFT to ensure the reconstructed boundary covers the same area. Moreover, you need the dilation to make the sampled boundaries more visible.
- I.4 Create an ellipse to fit the object.A test code ('test_ellipse.m') is provided for your reference along with two Matlab functions ('fitellipse.m' and 'plotellipse') for ellipse-based shape approximation.
- Bonus (+1): You can find a couple more binary images to repeat above shape analysis.



Part II: Researchers in plant science look for a quick and efficient method to measure tiny objects, such as wheat embryos. Four pictures of wheat embryos partly are given (with a dime, diameter 18mm)) which are scanned at the resolution of 600dpi (dots per inch), do the following tasks:

- II.1 For each image, segment each embryo by thresholding and morphological processing.
- II.2 In each image, use an ellipse to represent each embryo in an image (the figure below).
- II.3 Find the average area, length (the major axis) and width (the minor axis) of all embryos in terms of pixels and mm according to pixel counts and the ellipse representation.
- II.4 Find the average shape for all embryos in an image (PCA shape alignment is needed).
- Bonus (+1): The embryos can be further adjusted by having the narrow end on the top before averaging all shapes.