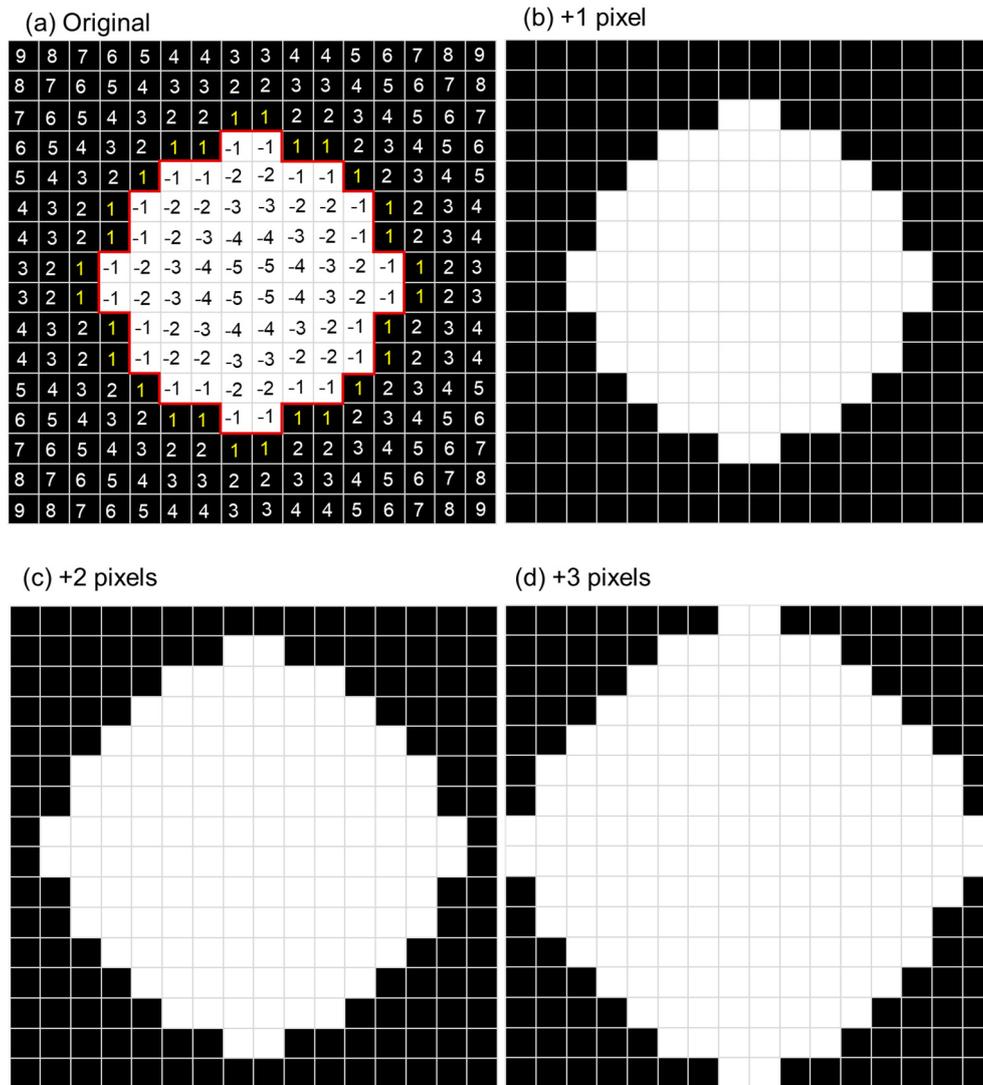


## Supplementary materials



**Figure S1.** Images showing the thickening behaviors during the persistent homology analysis: (a) original image and the images thickened by (b) +1 pixel, (c)+2 pixels, and (d) +3 pixels. The numbers in the pixels shown in (a) indicate the Manhattan distance from the red line.