Name: **Student ID**:

Quiz 12

1. **Intersection over Union (IoU).** Define a box using its two corners (upper left and lower right): (x1, y1, x2, y2). If we need to calculate the area of a rectangle, we multiply its height (y2 - y1) by its width (x2 - x1). To find the the intersection of two boxes, it is useful to define the following coordinates

   - xi1 = maximum of the x1 coordinates of the two boxes
   - yi1 = maximum of the y1 coordinates of the two boxes
   - xi2 = minimum of the x2 coordinates of the two boxes
   - yi2 = minimum of the y2 coordinates of the two boxes

   Please express IoU in terms of (xi1, yi1, xi2, yi2).

   Hint. Please refer pp. 12–17 of Lecture 14.

2. **Non-Maximum Suppression (NMS).** Please show the steps of NMS.

   Hint. Please refer pp. 53–56 of Lecture 14.

   The key steps are:

   (a) Select the box that has the highest score.

   (b) Compute its overlap with all other boxes, and remove boxes that overlap it more than `iou_threshold`.

   (c) Go back to step 1 and iterate until there's no more boxes with a lower score than the current selected box.

   This will remove all boxes that have a large overlap with the selected boxes. Only the "best" boxes remain.

3. Please show how to calculate mAP and illustrate the meaning of mAP.

   Hints.

   (a) Precision measures how well you can find true positives (TP) out of all positive predictions (TP+FP).

   (b) Recall measures how well you can find true positives (TP) out of all predictions (TP+FN).

   (c) Average Precision (AP) is calculated as the weighted mean of precisions at each threshold; the weight is the increase in recall from the prior threshold.