

CIS 580, Machine Perception, Spring 2021

Homework 2

Due: Friday Feb 12 2021, 11:59pm

Instructions

- This is an individual homework and worth 100 points
- You must submit your solutions on [Gradescope](#), the entry code is 96JGNN. We recommend that you use \LaTeX , but we will accept scanned solutions as well.
- Start early! If you get stuck, please post your questions on [Piazza](#) or come to office hours!

Homework

1. (15 pts) For each of the following pairs of points, write down an equation for the line that passes through them (points are in P^2 and $a \neq b \neq c \neq d$):

(a) $[0, a, 0]$ and $[0, 0, a]$

(b) $[a, a, 1]$ and $[a, a, 2]$

(c) $[a, b, 0]$ and $[c, d, 0]$

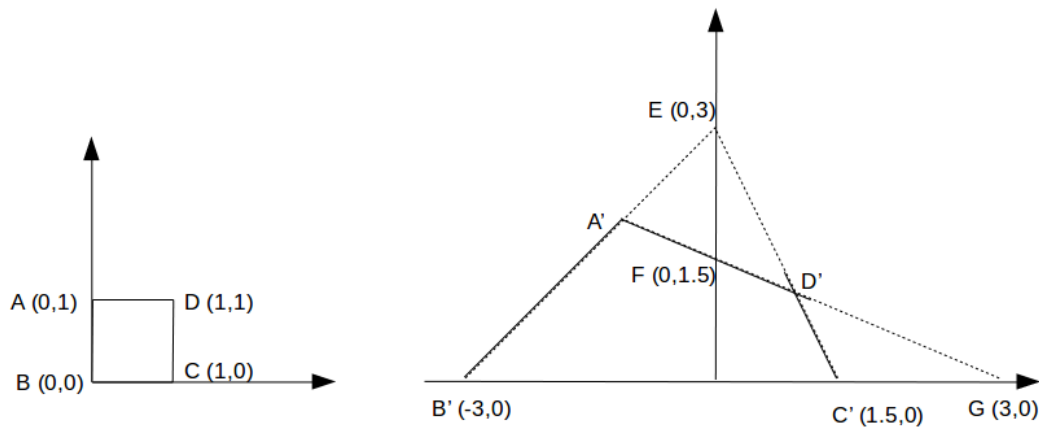
2. (15 pts) For each of the following pairs of lines in \mathbb{P}^2 , write down the point of their intersection.

(a) $x - y + w = 0$ and $w = 0$

(b) $3x - w = 0$ and $4y - w = 0$

(c) $x - y + 5w = 0$ and $x - y + 2w = 0$

3. (10 pts) Find λ such that the three lines of \mathbb{P}^2 , $w = 0$, $x + \lambda y + \lambda w = 0$, and $\lambda x + y + \lambda w = 0$ have a common intersection. Which point is the intersection?
4. (20 pts) Find a projective transformation A that preserves the points $p_1 = (1, 0, 0)$, $p_2 = (0, 1, 0)$, and the origin of the coordinate system O and will map the point $p_3 = (1, 1, 1)$ to the points $p'_3 = (3, 2, 1)$? Does the image of line at infinity still lie at infinity? Why?
5. (20 pts) Please find a projection transformation P such that $A' \sim PA$, $B' \sim PB$, $C' \sim PC$, $D' \sim PD$ as shown in the following figure. [**Hint:** it's a little tedious to calculate transformation using only A , B , C and D , try to use the intersection of parallel lines.]



6. (20 pts) A projective transformation A maps point $(-a, 0, 1)$ to point $(1, 0, 0)$, and maps point $(0, b, 1)$ to point $(0, 1, 0)$. However, it keeps the origin $(0, 0, 1)$ and $(1, 1, 1)$ fixed. Please find the transformation A .