# Homework 9

*Homework 9 for MATH 128A.*

**MATH 128A: Homework 9** **Due date: Thursday, June 4**

**Instructions.** You will submit your solutions on Gradescope, which you can access through our Canvas course page by clicking on the assignment.

You are welcome to submit your homework either handwritten or in LaTeX. If you choose to submit handwritten work, please use pen rather than pencil, and make sure that both your handwriting and your scans are as readable as possible in order to facilitate grading.

I encourage you to attend office hours if you would like hints on the homework or if you would like to discuss more advanced material. Also, you are highly encouraged to work in groups!

### Problem 1 *(20 points) Calculations in the projective plane.*

*In this problem, we work in the real projective plane* $\mathbb{P}^2(\mathbb{R})$*. Recall that a point has homogeneous coordinates*

$$[x : y : z],$$

*where* $(x, y, z) \neq (0, 0, 0)$ *and*

$$[x : y : z] = [\lambda x : \lambda y : \lambda z]$$

*for every nonzero real number* $\lambda$*.*

*A projective line is given by an equation*

$$ax + by + cz = 0,$$

*where* $a, b, c \in \mathbb{R}$ *are not all zero.*

*One way to find the line through two distinct projective points*

$$P = [p_1 : p_2 : p_3] \qquad \text{and} \qquad Q = [q_1 : q_2 : q_3]$$

*is to use the determinant formula*

$$\det \begin{pmatrix} x & y & z \\ p_1 & p_2 & p_3 \\ q_1 & q_2 & q_3 \end{pmatrix} = 0.$$

Author(s):

*This works because a point $[x : y : z]$ lies on the projective line through $P$ and $Q$ exactly when the three vectors*

$$(x, y, z), \qquad (p_1, p_2, p_3), \qquad (q_1, q_2, q_3)$$

*are linearly dependent.*

(a) ***(5 points)*** *Find an equation for the projective line passing through*

$$A = [1 : 0 : 2] \qquad \text{and} \qquad B = [0 : 1 : 3].$$

(b) ***(5 points)*** *Find an equation for the projective line passing through*

$$C = [1 : 1 : 1] \qquad \text{and} \qquad D = [2 : 1 : 0].$$

(c) ***(5 points)*** *Find the intersection point of the two projective lines*

$$\ell : \ x + 2y - z = 0 \qquad \text{and} \qquad m : \ 2x - y + z = 0.$$

(d) ***(5 points)*** *Find the intersection point of the two projective lines*

$$\ell : \ x + y - z = 0 \qquad \text{and} \qquad m : \ x + y + z = 0.$$

**Problem 2** ***(80 points) Reviewing, correcting, and completing past homework.***

*This problem is graded for completion. The purpose of this question is to push you to review your past homework and submit regrade requests where appropriate. This should do three useful things at once:*

- *improve your understanding of the material;*
- *help you prepare for the final exam;*
- *and, when appropriate, improve your final grade.*

*Choose one question from a previous homework assignment on which you struggled, lost points, or felt uncertain. Then write a short reflection answering the following questions.*

(a) *Which homework problem did you choose?*

(b) *What was the main mathematical idea of the problem?*

(c) *What did you do wrong, or what did you find confusing?*

(d) *After reading the solution, do you now understand the correct argument? Explain the key step in your own words.*

(e) *Correct your mistake. This can mean rewriting the full solution, rewriting the part where your argument went wrong, or clearly explaining how your original solution should be fixed.*

*Once you are done, submit your corrected exercise to Mike and I by email, and make a regrade request for the corresponding question.*

*If you earned full credit on every previous homework assignment, challenge yourself and attempt one of the challenge problems from a past homework assignment instead.*

**Problem 3** ***Weekly reflection (2 bonus points).***

*Please fill in the SETS survey using this link:*

*blue.ucsc.edu*.

*You will receive **2 bonus points** if the class response rate reaches at least **80%**.*

*Your feedback will be very beneficial to me. It will help me understand what worked well, what did not work well, and what I should change next time I teach this class. Thank you in advance!*