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Homework H05
MATH 3110/5110 (Barsamian)
Due at the start of class Fri Feb 28, 2020

Problem:	1	2	3	4	5	Total	Rescaled
Your Score:							
Possible:	20	20	20	20	20	100	10

Suggested Exercises for the seventh week. (The whole list of suggested exercises for the course can be found on the web page.These exercises are not to be turned in and are not graded, but you should write down solutions for as many of them as possible and keep your solutions in a notebook for study.)

3.4 # 1, 2, 3, 4
4.1 # 1, 4, 5, 11, 13
4.2 # 1, 2, 4

[1] (Section 3.2 and 3.4 concepts.)
Given points $A = (5,8), B = (17,8), C = (29,8)$
(a) Consider A, B, C as points in the Euclidean Plane.
(i) Find $d_E(A,B), d_E(B,C), d_E(A,C)$. Does $d_E(A,B) + d_E(B,C) = d_E(A,C)$?
(ii) Are A, B, C collinear in the Euclidean Plane? Explain
(iii) Draw points A, B, C. If collinear, draw the Euclidean line they all lie on. If not, draw Euclidean ΔABC.
(b) Now consider A, B, C as points in the Taxicab Plane.
(i) Find $d_T(A,B), d_T(B,C), d_T(A,C)$. Does $d_T(A,B) + d_T(B,C) = d_T(A,C)$?
(ii) Are A, B, C collinear in the Taxicab Plane? Explain
(iii) Draw points A, B, C. If collinear, draw the Taxicab line they all lie on. If not, draw Taxicab ΔABC.
(c) Now consider A, B, C as points in the Poincaré Plane.
(i) Find $d_H(A,B), d_H(B,C), d_H(A,C)$. Does $d_H(A,B) + d_H(B,C) = d_H(A,C)$?
(ii) Are A, B, C collinear in the Poincaré Plane? Explain
(iii) Draw points A, B, C. If collinear, draw the Poincaré line they all lie on. If not, draw Poincaré ΔABC.
Now let $A = (5,8), B = (17,8), D = (19,6)$. Answer analogous questions (d),(e),(f) about points A, B, D.

[2] (Section 3.3 concepts) Prove the *Missing Theorem* about *Extreme Points of Rays*.
(a) Prove that if $P \in \overrightarrow{AB}$ and $P \neq A$, then P is a passing point of $\overrightarrow{AB}$.
(b) Prove that point A is not a passing point of $\overrightarrow{AB}$ (so therefore it is an extreme point.)
Hint: Model your proofs on the book's proof of Theorem 3.3.2 about *Extreme Points of Line Segments*.

[3] (Section 4.1 concepts) Let $\mathcal{P}_1 \subset \mathcal{P}$ and $\mathcal{P}_2 \subset \mathcal{P}$ be sets of points in a metric geometry.
(a) (This is book problem 4.1#1) Prove or disprove: If $\mathcal{P}_1$ and $\mathcal{P}_2$ are convex, then $\mathcal{P}_1 \cap \mathcal{P}_2$ is convex.
(b) (This is book problem 4.1#11) Prove or disprove: If $\mathcal{P}_1$ and $\mathcal{P}_2$ are convex, then $\mathcal{P}_1 \cup \mathcal{P}_2$ is convex.

[4] (Section 4.1 concepts) (a) Suppose that in some proof, you want to prove that two points A and B that do not lie on some line L are in the same half plane of line L. What should be your strategy?
(b) Suppose that in some proof, you want to prove that two points A and B that do not lie on some line L are not in the same half plane of line L. What should be your strategy?

[5] (Section 4.2 concepts) (book problem 4.2#2) Proposition 4.2.3 says that Euclidean Half Planes are Convex. In the book, the authors supply a proof that half plane H^+ is convex. They do not prove that H^- is convex. Your job is to prove that H^- is convex. (Hint: mimic the book's proof that H^+ is convex.)