MA 323 **4/6/00**

Combinatorial Geometry
Lucky Problem Set Seven

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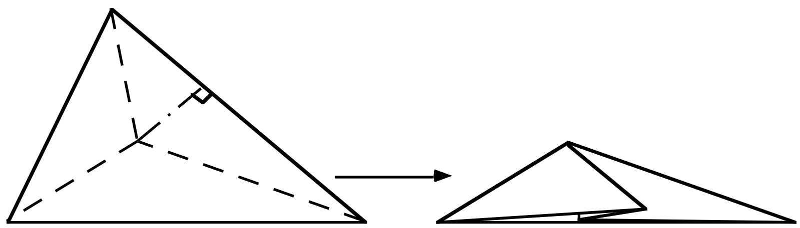
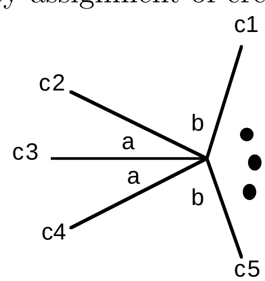
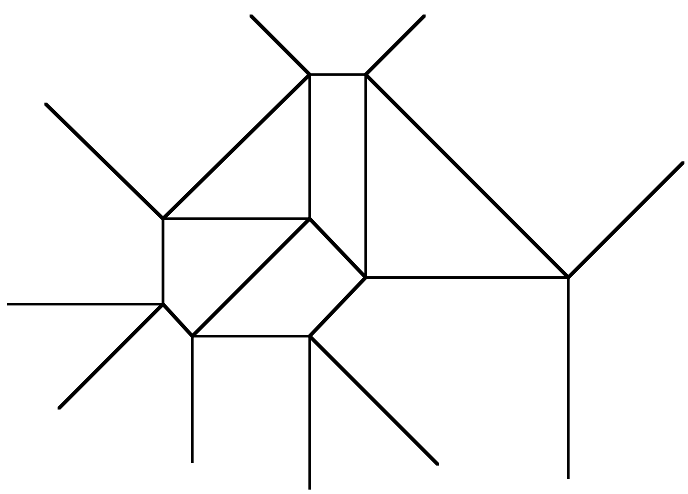
(1) Prove the **Rabbit-Ear Theorem:** Given a triangle ABC, the lines made by the angle bisectors and one line drawn from their point of intersection and perpendicular to one of the sides can be used as creases to fold the triangle flat. Furthermore, when folding the triangle flat in this way the sides of the triangle will all lie on a straight line.



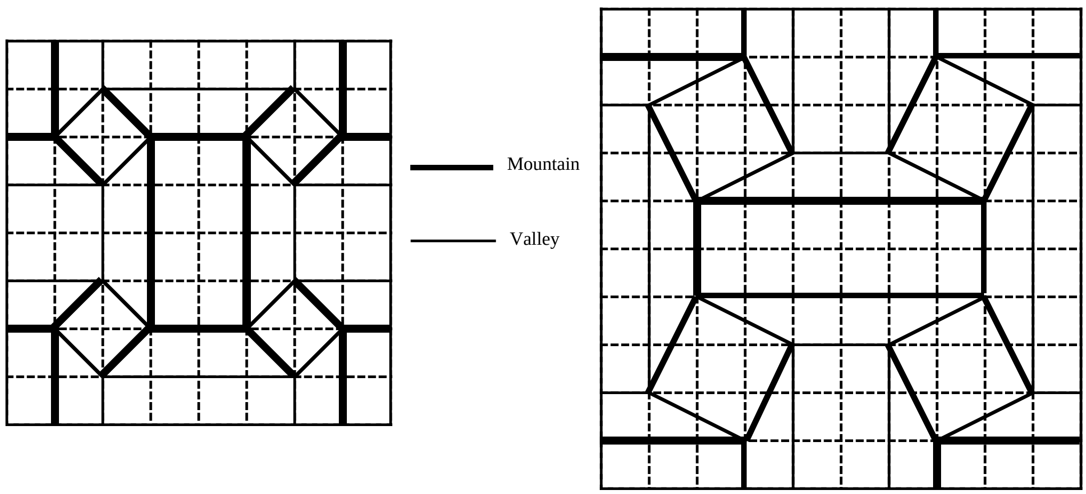
(2) Suppose you have a collection of creases that fold flat, and some of them are $c_1, ..., c_5$, shown below. Thus we have the angle a between c_2 and c_3 equals the angle between c_3 and c_4. Ditto for c_1, c_2 and c_4, c_5. Further angle $a <$ angle b. What must be true about the mountain-valley assignment of creases $c_1, ..., c_5$?



(3) Is it possible for the crease pattern shown below to fold flat? Why or why not? (Ignore the boundary of the paper. And yes, things that look like 45° angles really are.)



(4) Below are crease patterns for two different kind of square twist tessellations. The bold lines are mountain creases, the not-bold lines are valleys, and the dotted lines are merely guide lines to help make the fold. (You should fold the guide lines first and then make the other creases.) Try your hand at making these tessellations. How many other ways can their mountains and valleys be assigned to collapse flat?



(5) Imagine taking a bunch of squares and taping thread to them, so as to attach each square by the corners. (See below.) This would give you a grid of flexible squares, where the angle between the squares could be changed to whatever you want. Could this family of "square grids" be used for a flat origami crease pattern? Might some angles not work? How would you fold it, and what would it look like?