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Divison of a Segment in the Golden Section with Ruler and Rusty Compass

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Abstract. We give a simple 5-step division of a segment into golden section, using ruler and rusty compass.

In [1] we have given a 5-step division of a segment in the golden section with ruler and compass. We modify the construction by using a *rusty* compass, *i.e.*, one when set at a particular opening, is not permitted to change. For a point P and a segment AB, we denote by $P(AB)$ the circle with P as center and AB as radius.

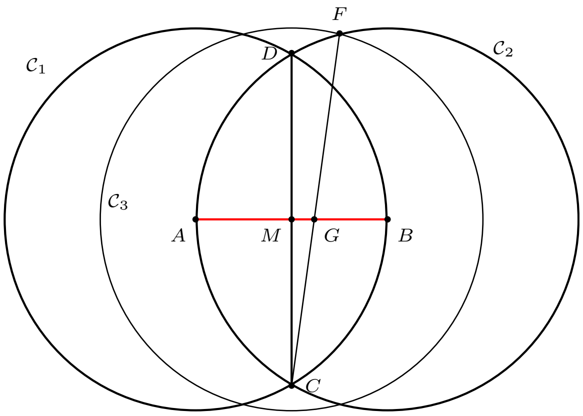

Figure 1

Construction. Given a segment AB, construct

(1) $\mathcal{C}_1 = A(AB)$,
(2) $\mathcal{C}_2 = B(AB)$, intersecting $\mathcal{C}_1$ at C and D,
(3) the line CD to intersect AB at its midpoint M,
(4) $\mathcal{C}_3 = M(AB)$ to intersect $\mathcal{C}_2$ at F (so that C and D are on opposite sides of AB),
(5) the segment CF to intersect AB at G.

The point G divides the segment AB in the golden section.

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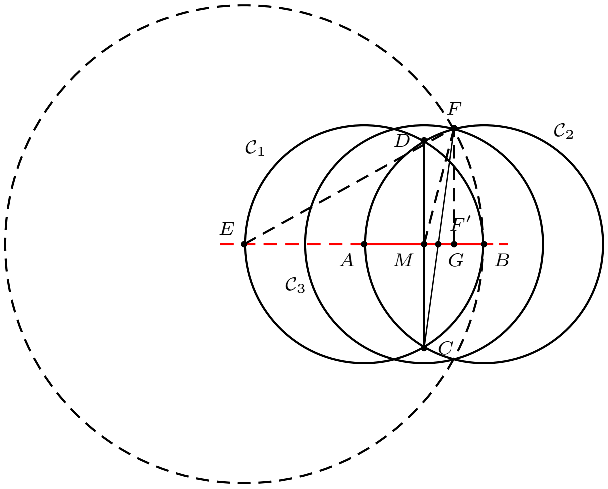

Figure 2

Proof. Extend BA to intersect $\mathcal{C}_1$ at E. According to [1], it is enough to show that $EF = 2 \cdot AB$. Let F' be the orthogonal projection of F on AB. It is the midpoint of MB. Without loss of generality, assume $AB = 4$, so that $MF' = F'B = 1$ and $EF' = 2 \cdot AB - F'B = 7$. Applying the Pythagorean theorem to the right triangles EFF' and MFF', we have

$$\begin{aligned} EF^2 =& EF'^2 + FF'^2 \\ =& EF'^2 + MF^2 - MF'^2 \\ =& 7^2 + 4^2 - 1^2 \\ =& 64. \end{aligned}$$

This shows that $EF = 8 = 2 \cdot AB$. $\square$

References

[1] K. Hofstetter, Another 5-step division of a segment in the golden section, *Forum Geom.*, 4 (2004) 21–22.

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