

Euclid's Elements

Book I

*If Euclid did not kindle your youthful enthusiasm, you
were not born to be a scientific thinker.*

Albert Einstein

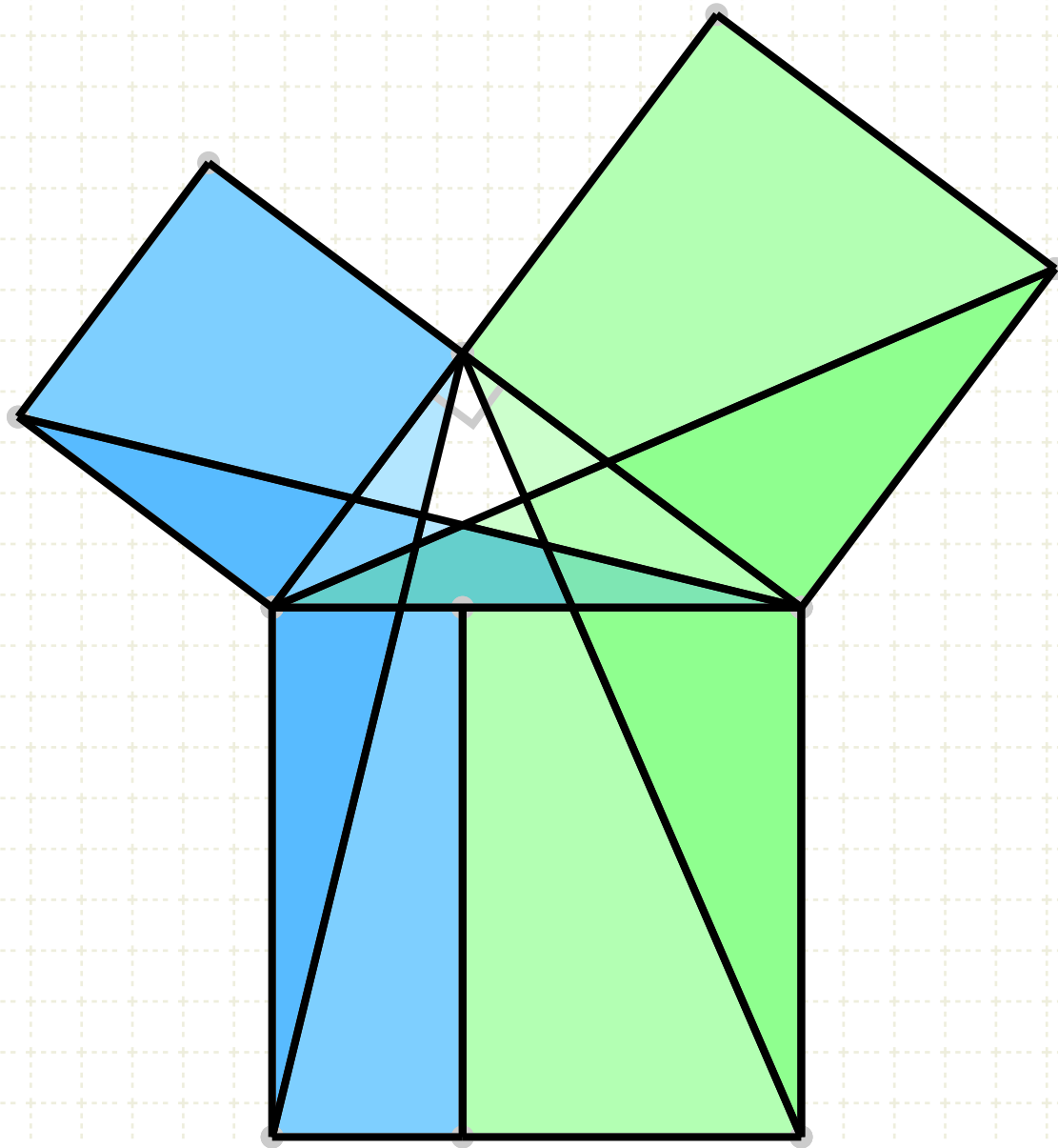


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Proposition 12 of Book I

To draw a straight line perpendicular to a given infinite straight line from a given point not on it.

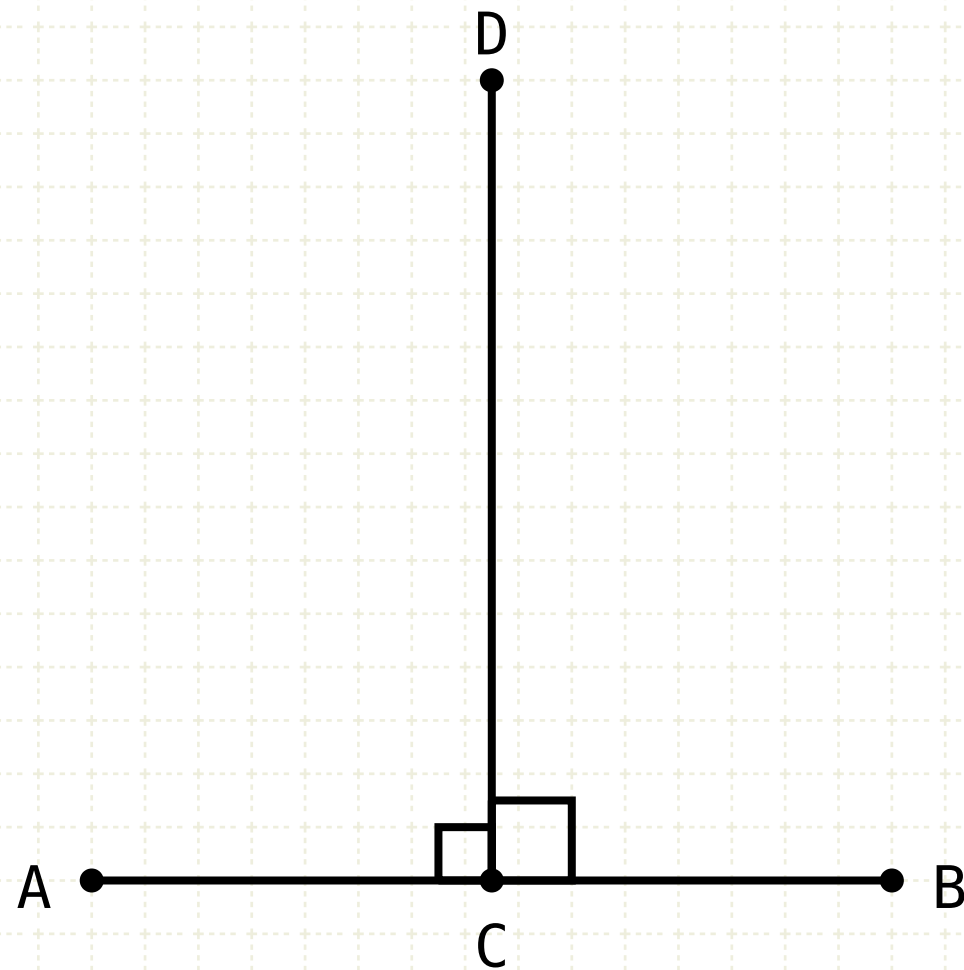


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Definition - Right Angle

When a straight line standing on a straight line makes the adjacent angles equal to one another, each of the equal angles is right, and the straight line standing on the other is called a perpendicular to that on which it stands.



$$\angle ACD = \angle BCD = \text{L (right angle)}$$

DC is perpendicular to AB

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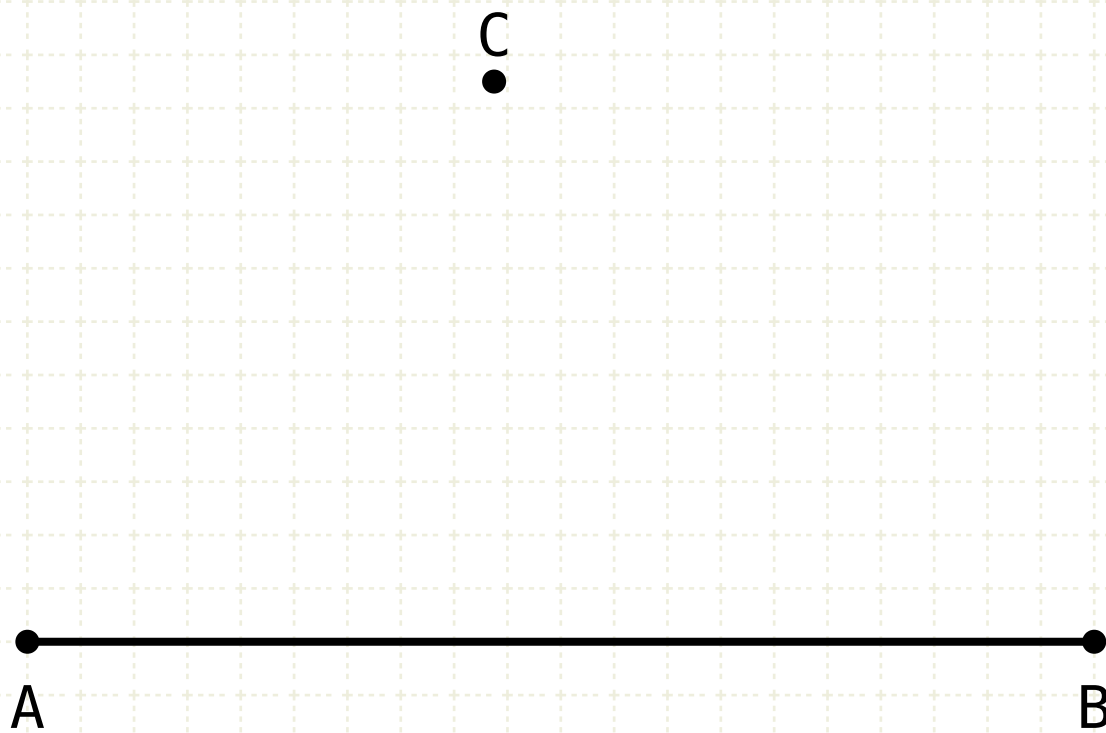


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Construction:

Start with an arbitrary line segment AB and an arbitrary point C not on the line



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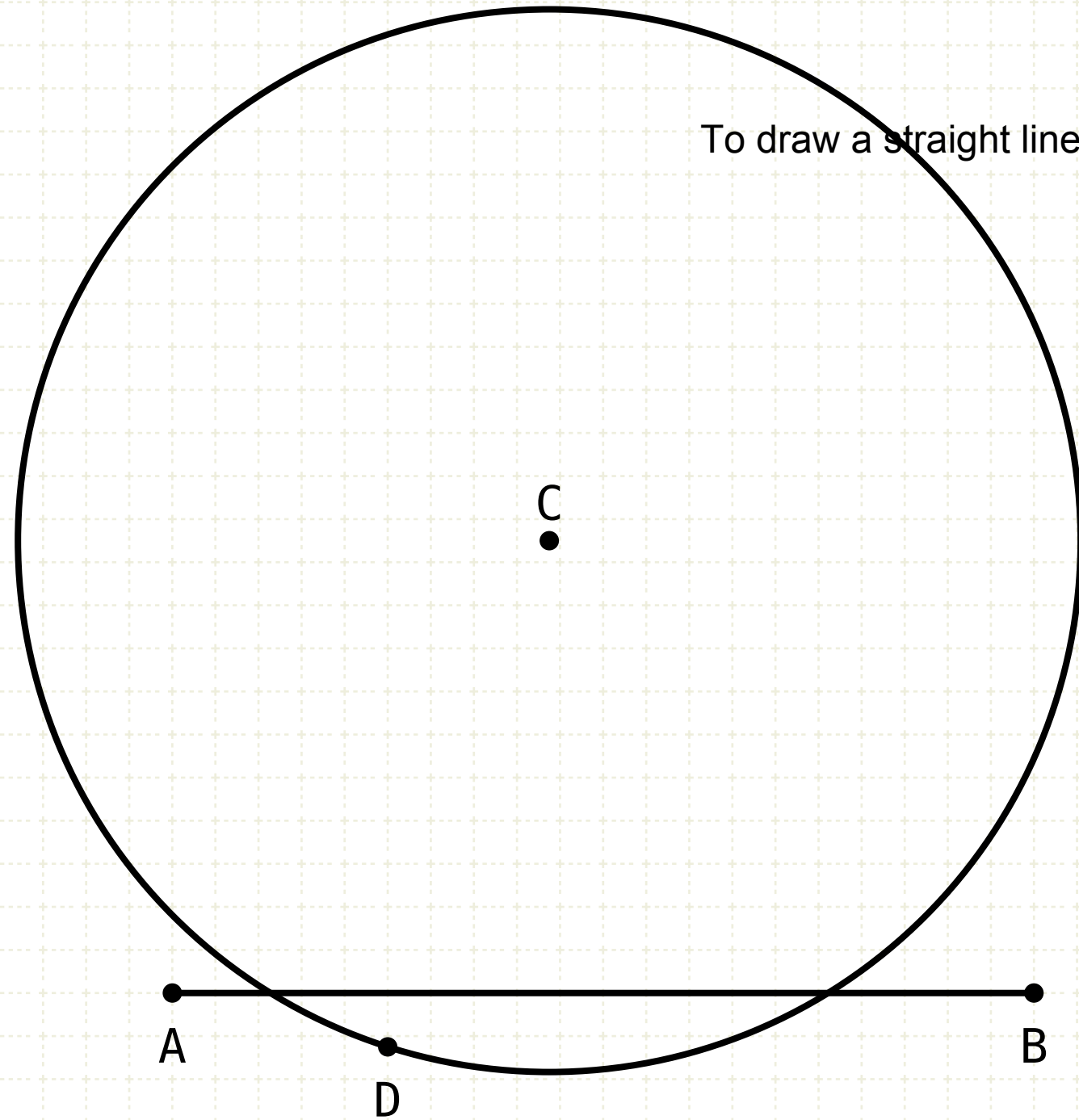
Define another point D on the other side of the line

C



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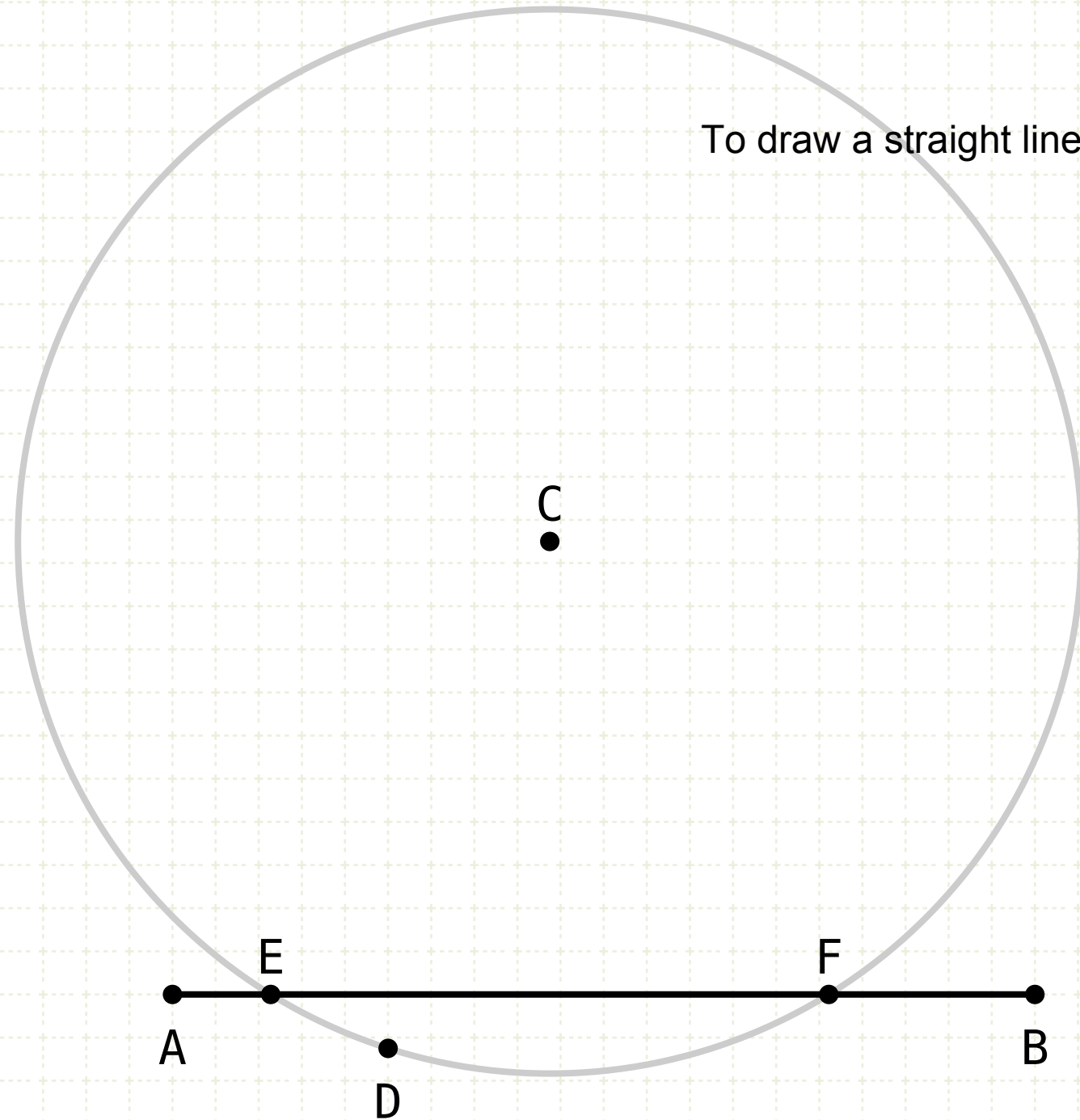
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Construct a circle with center C, and radius CD



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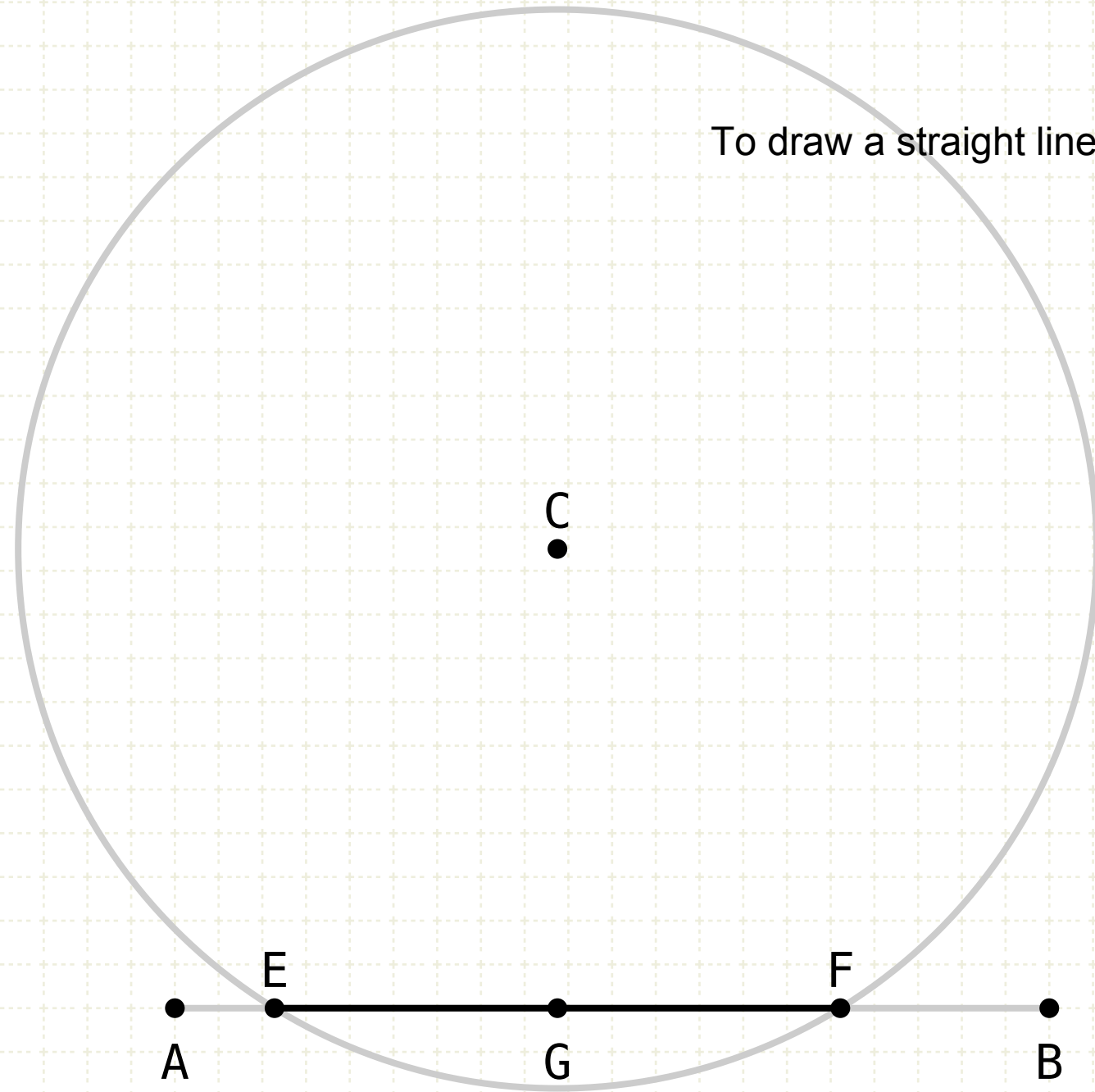
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Define points E and F as the intersection between line and the circle



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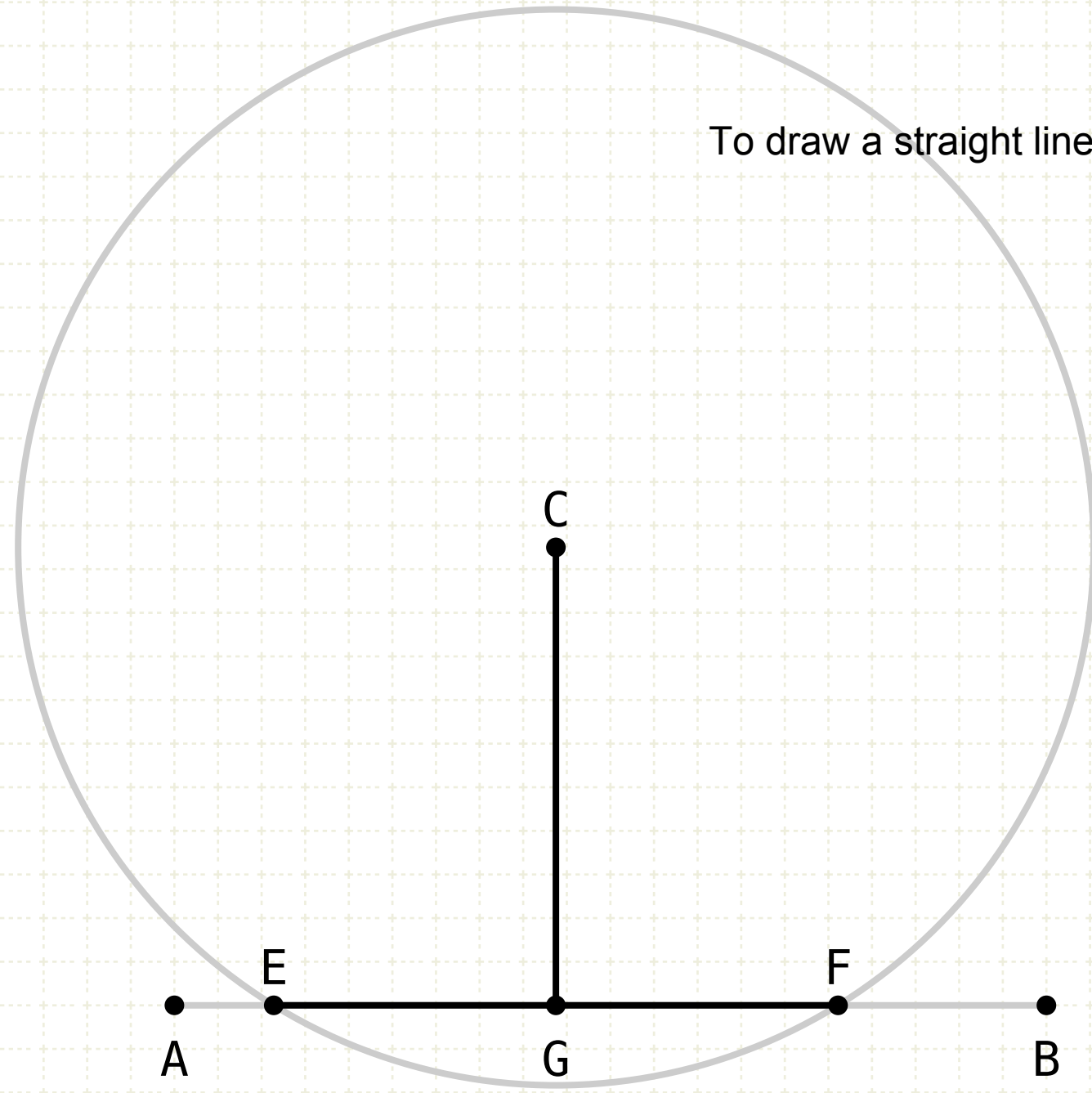
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Bisect line EF at point G (I-9)



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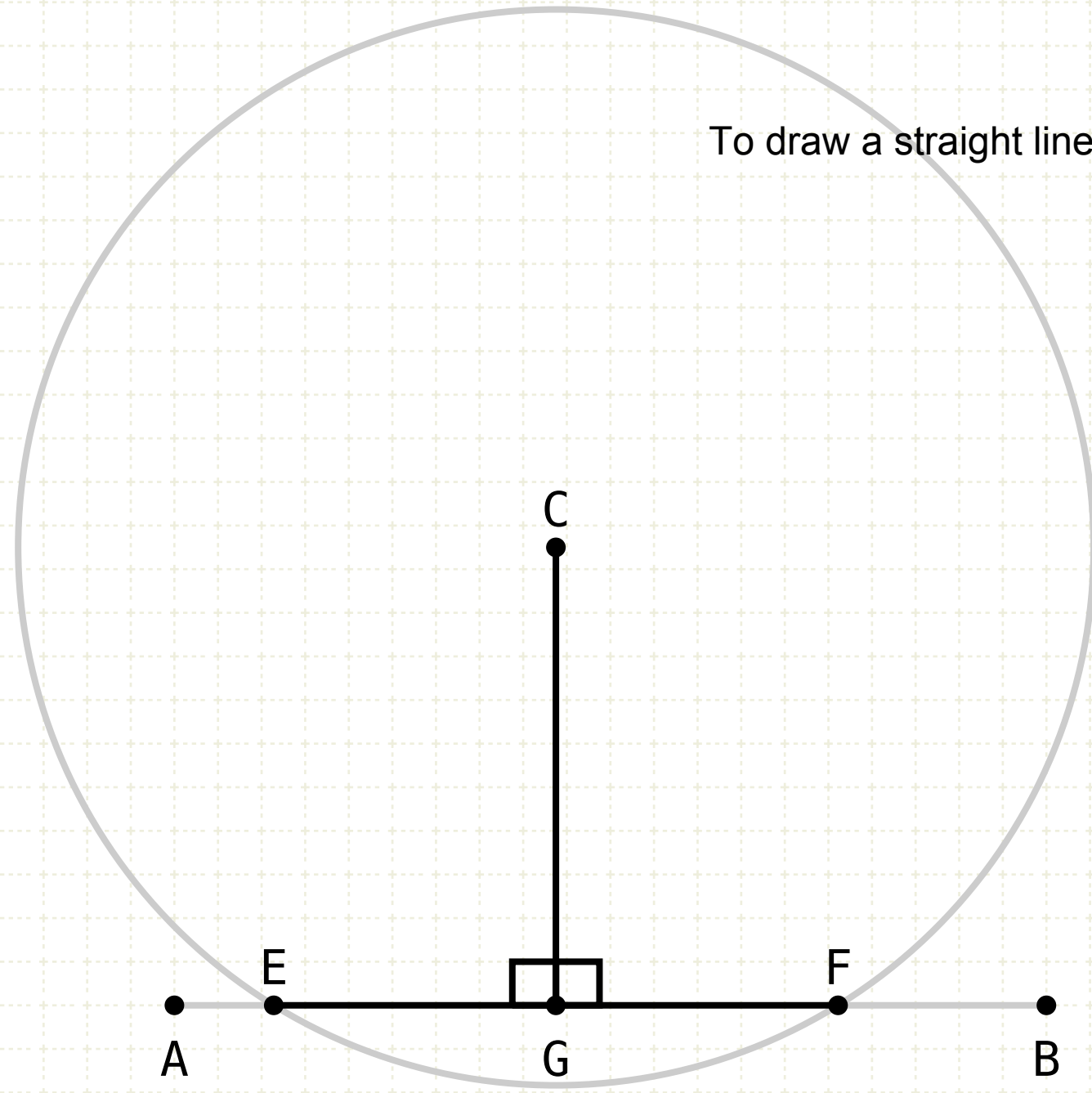
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Create line CG



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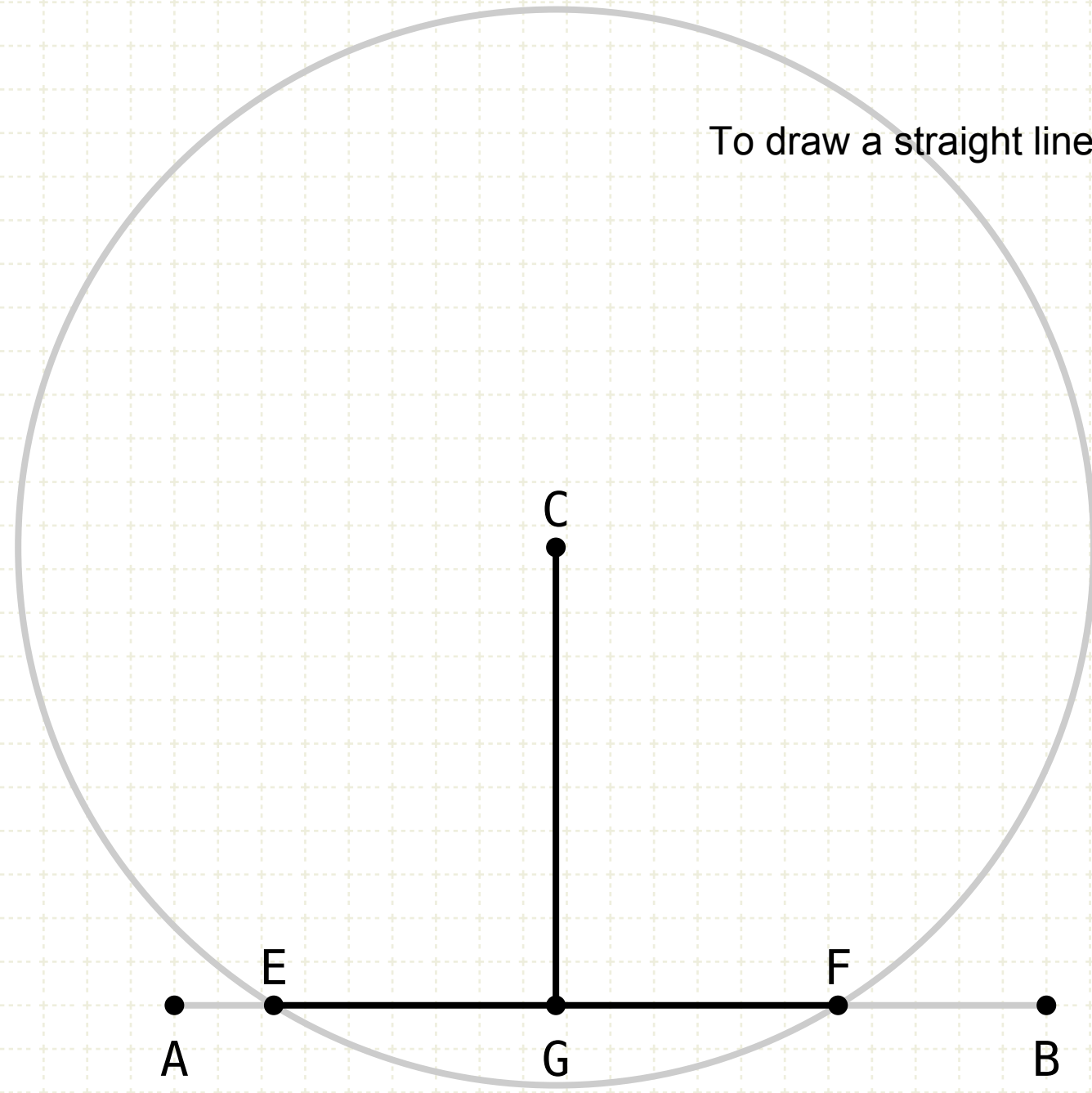
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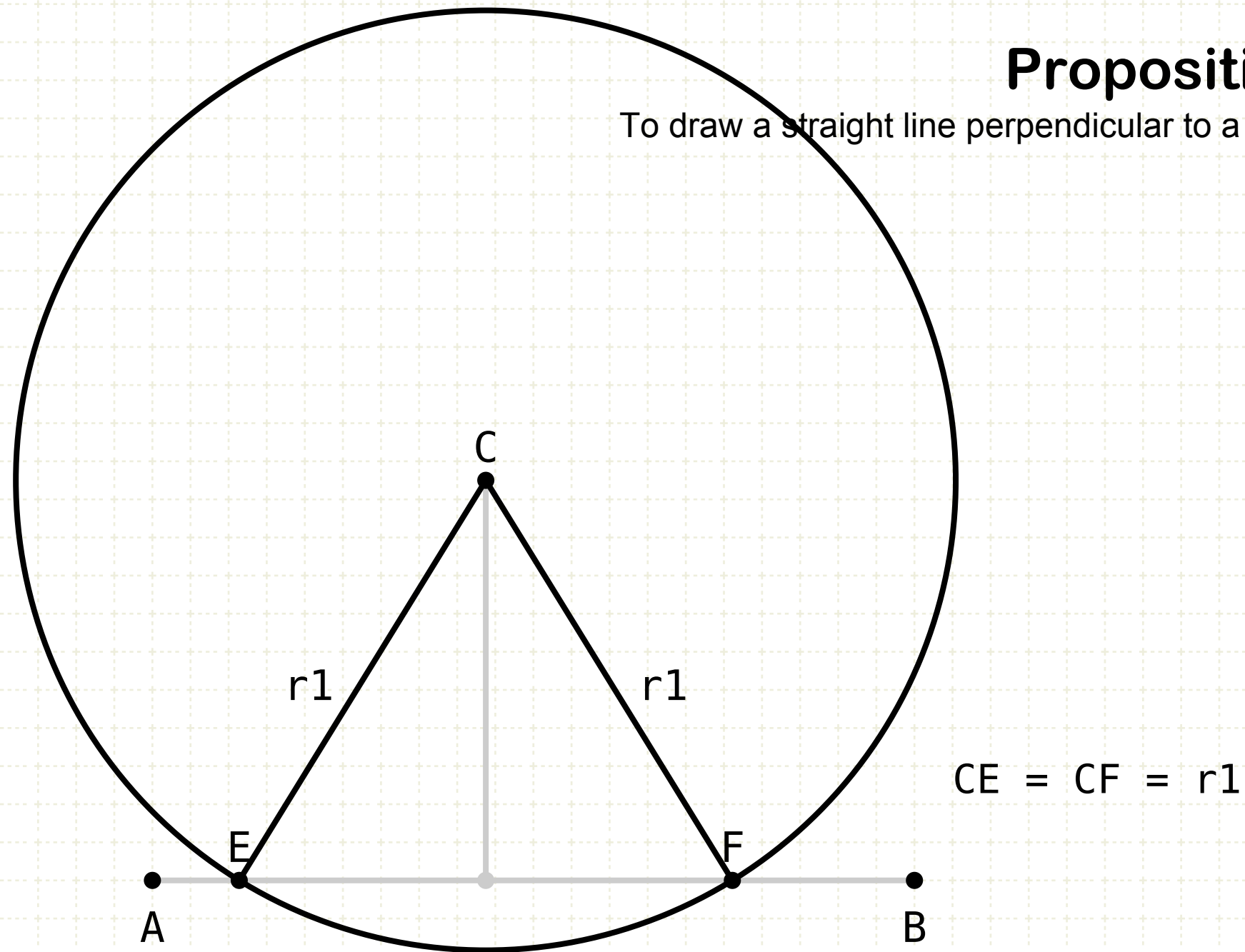
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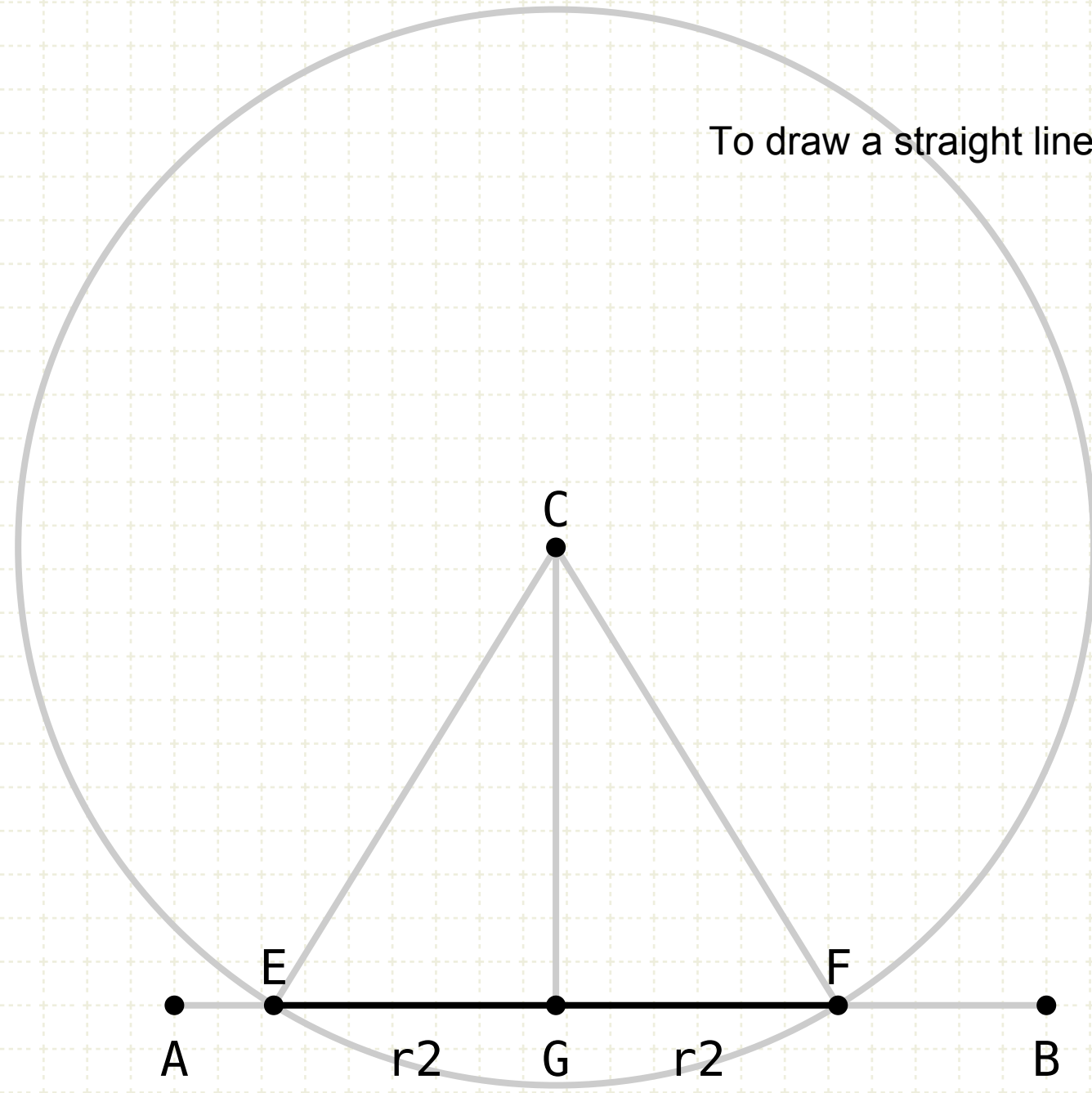
Create lines CE and CF

CE and CF are equal since they are radii of the same circle



Proposition 12 of Book I

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$$\begin{aligned} CE &= CF = r_1 \\ EG &= GF = r_2 \end{aligned}$$

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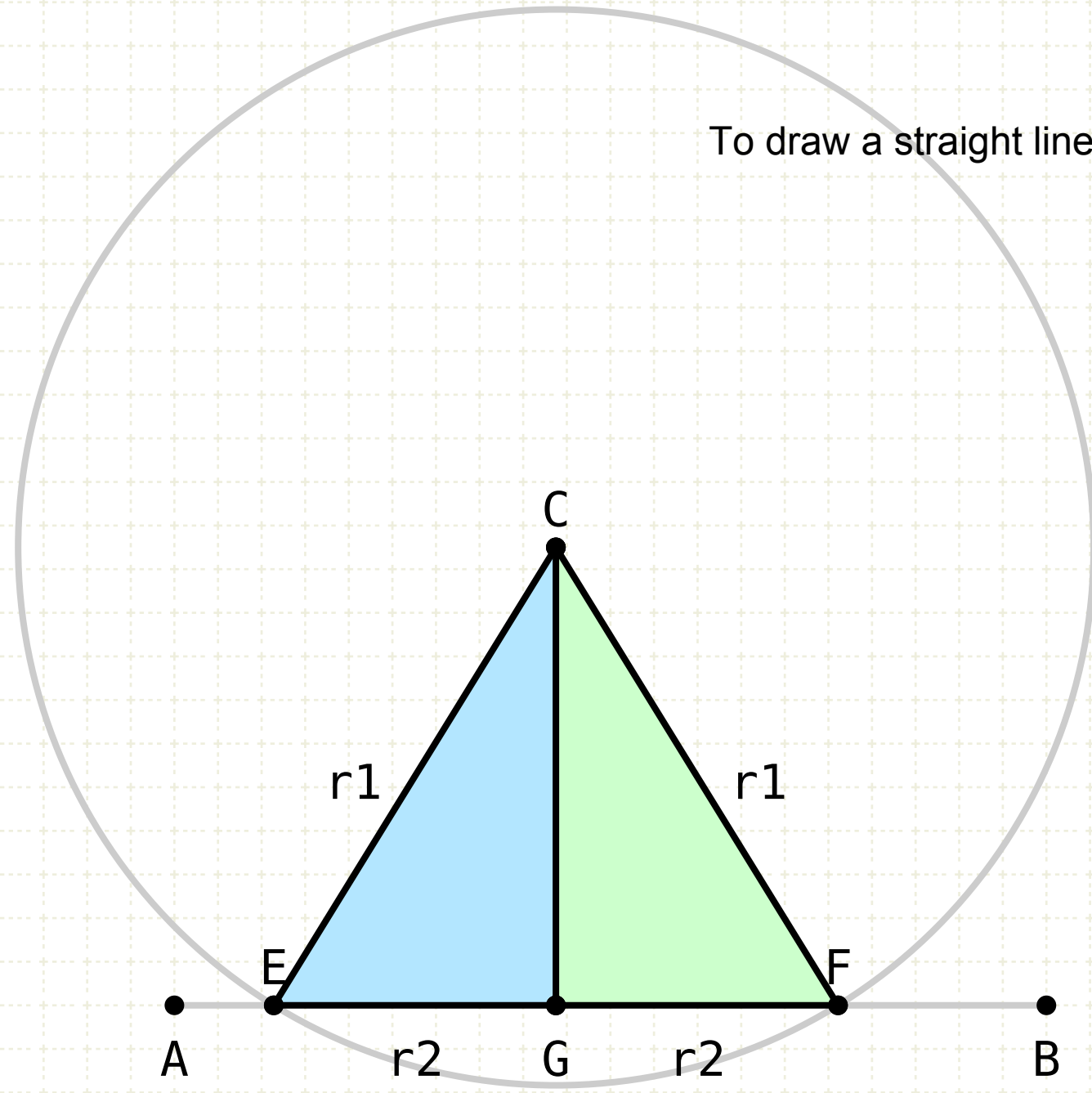
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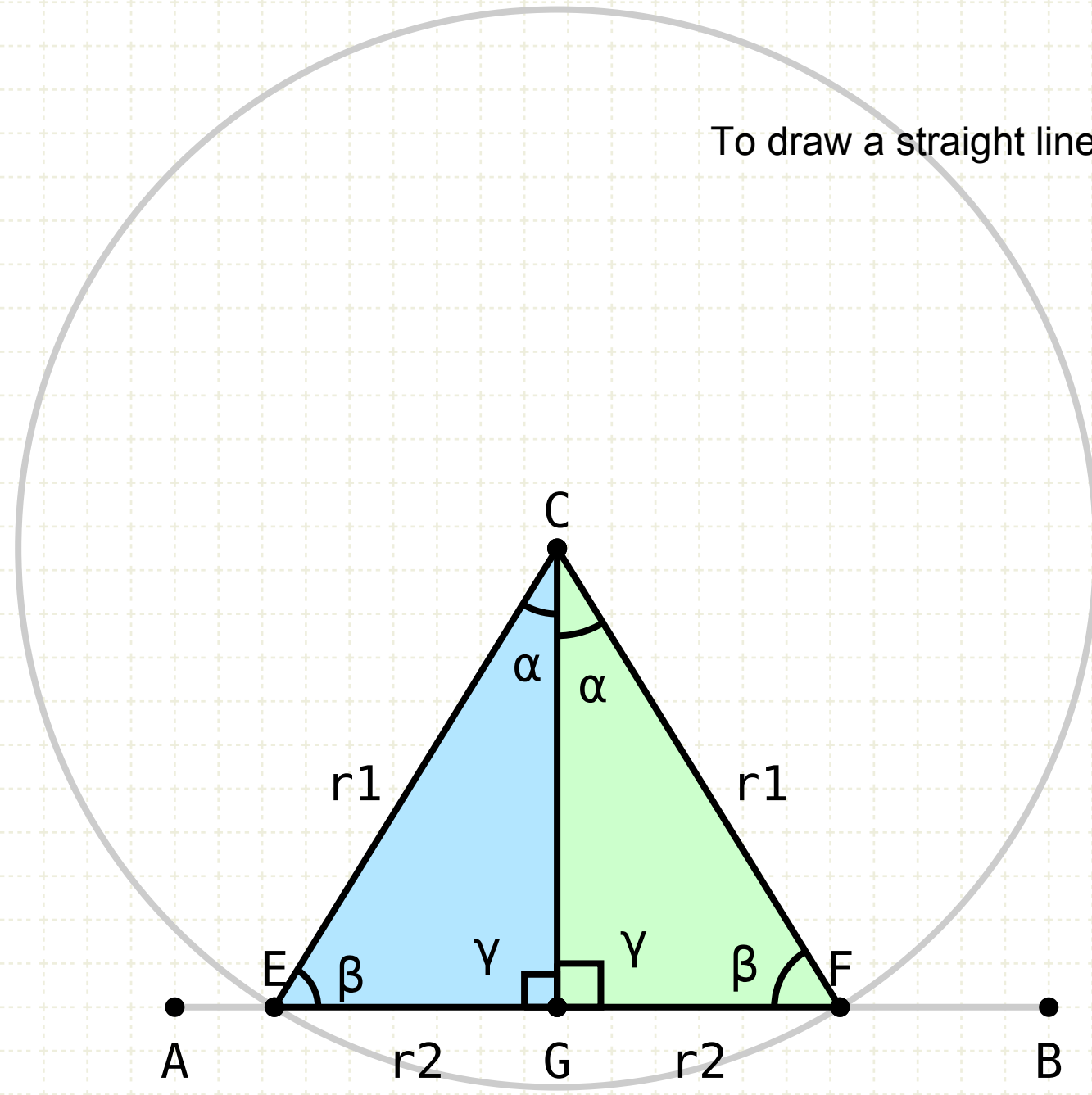
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Triangles ECG and FCG have three congruent sides



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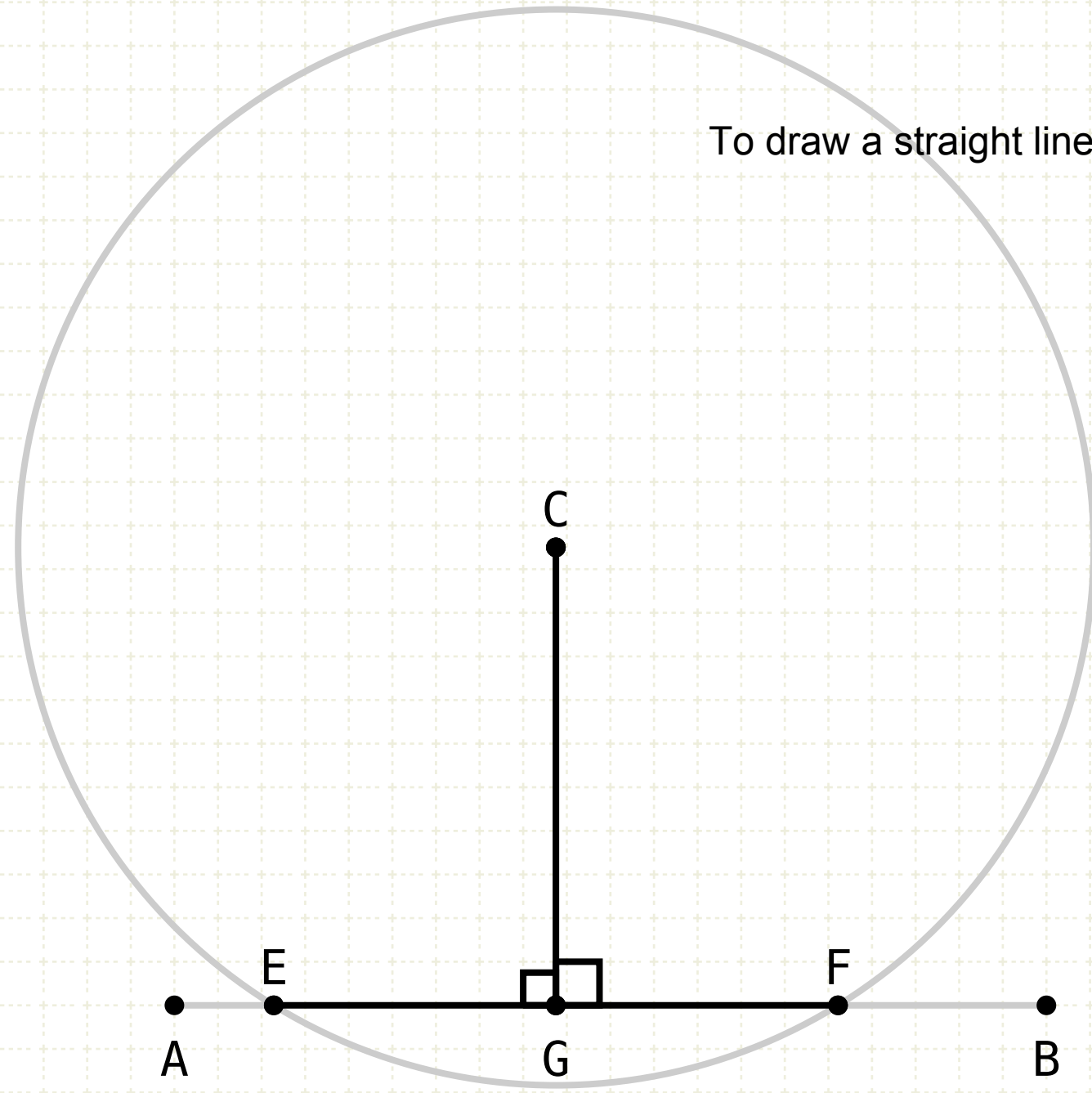
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Line CG is perpendicular to EF

Proof

Create lines CE and CF

CE and CF are equal since they are radii of the same circle

EG and GF are equal since G bisects EF

Triangles ECG and FCG have three congruent sides

hence the triangles are congruent, and all the angles are congruent

Since CGE and CGF are equal, and EF is a line, by definition the angles are right angles, and CG is perpendicular to EF



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