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 38 of Book I

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A   D

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AD ∥ BF

BC = EF

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Given two parallel lines

Let ABC and DEF be triangles with equal bases, and on the same parallels

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The area ABC is equal to DEF

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BC = EF
ΔABC = ΔDEF

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Triangles which are on equal bases and in the same parallels equal one another.

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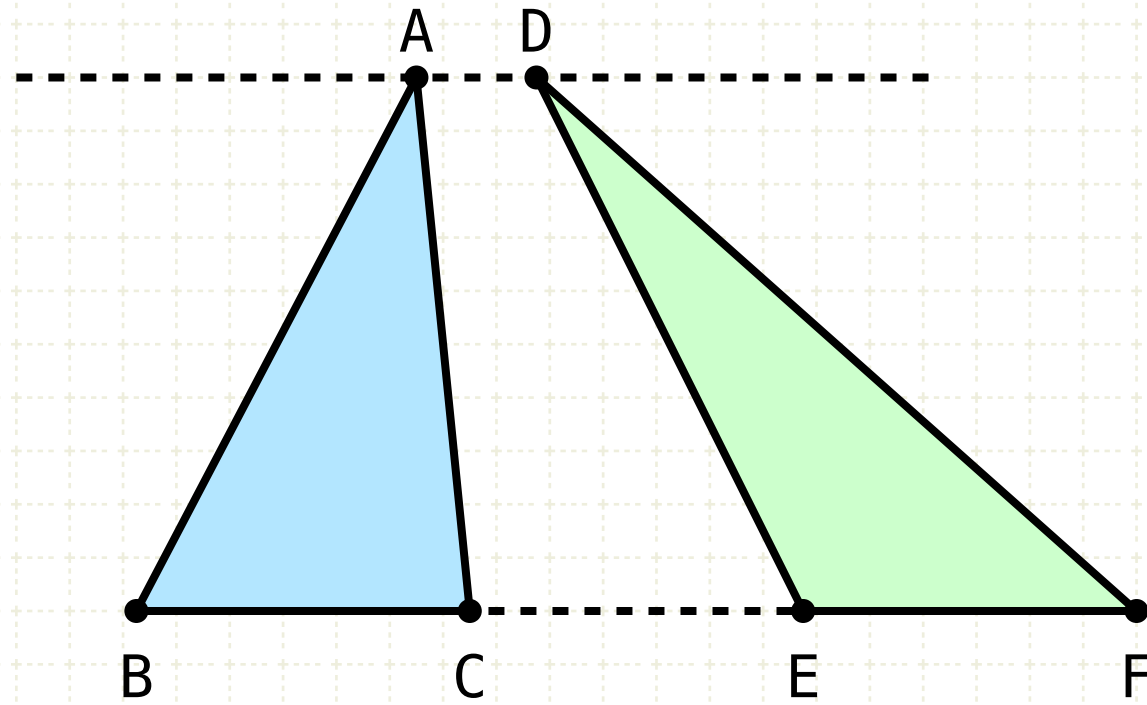Triangles with equal base and height have the same area

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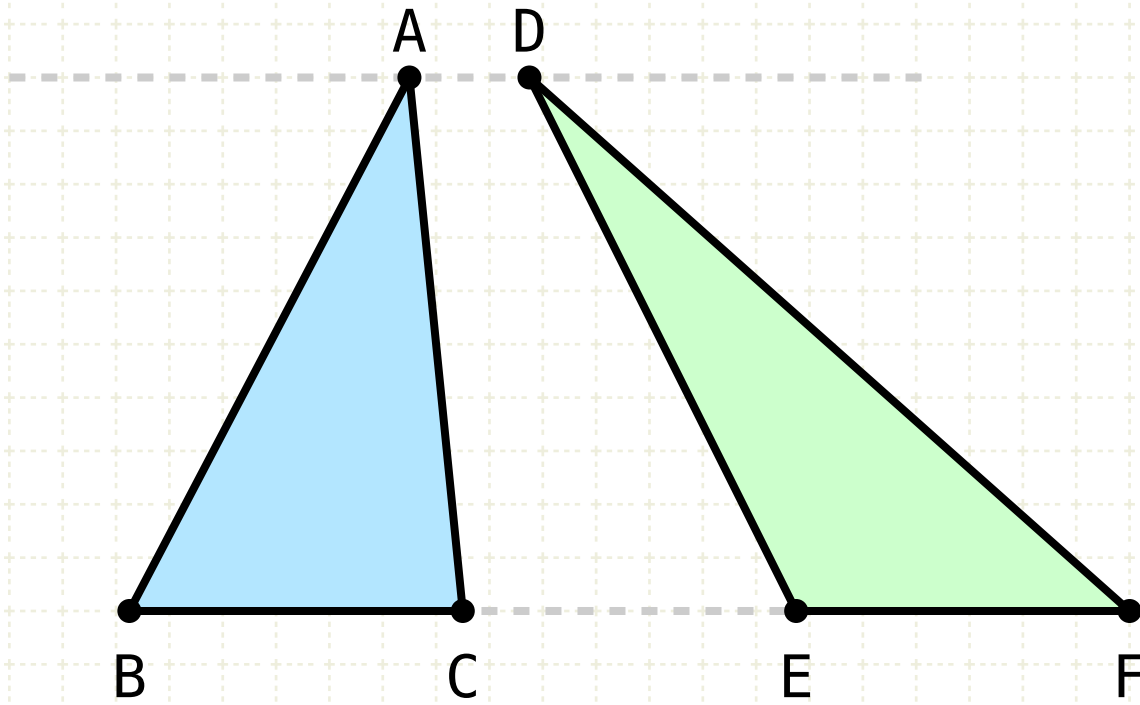Given two parallel lines

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Proof

Draw BG parallel to AC (I·31)

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BC = EF
BG ∥ AC

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Triangles which are on equal bases and in the same parallels equal one another.

G   D   H

E   F

AD ‖ BF
BC = EF
BG ‖ AC

FH ‖ DE

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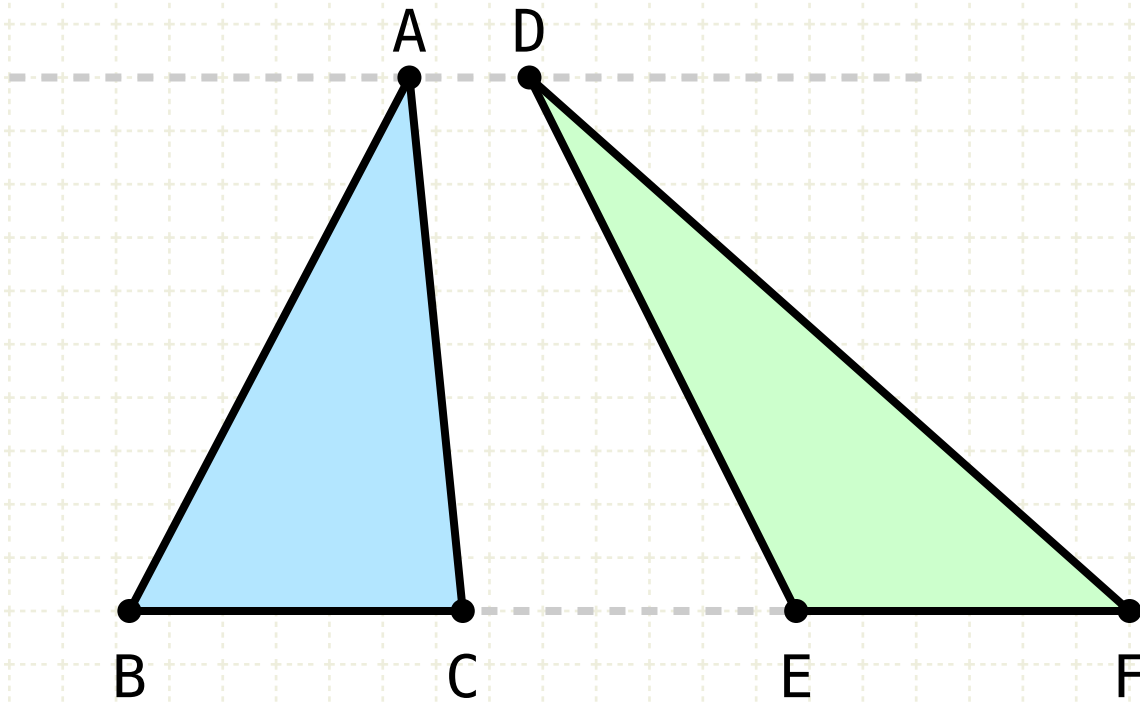
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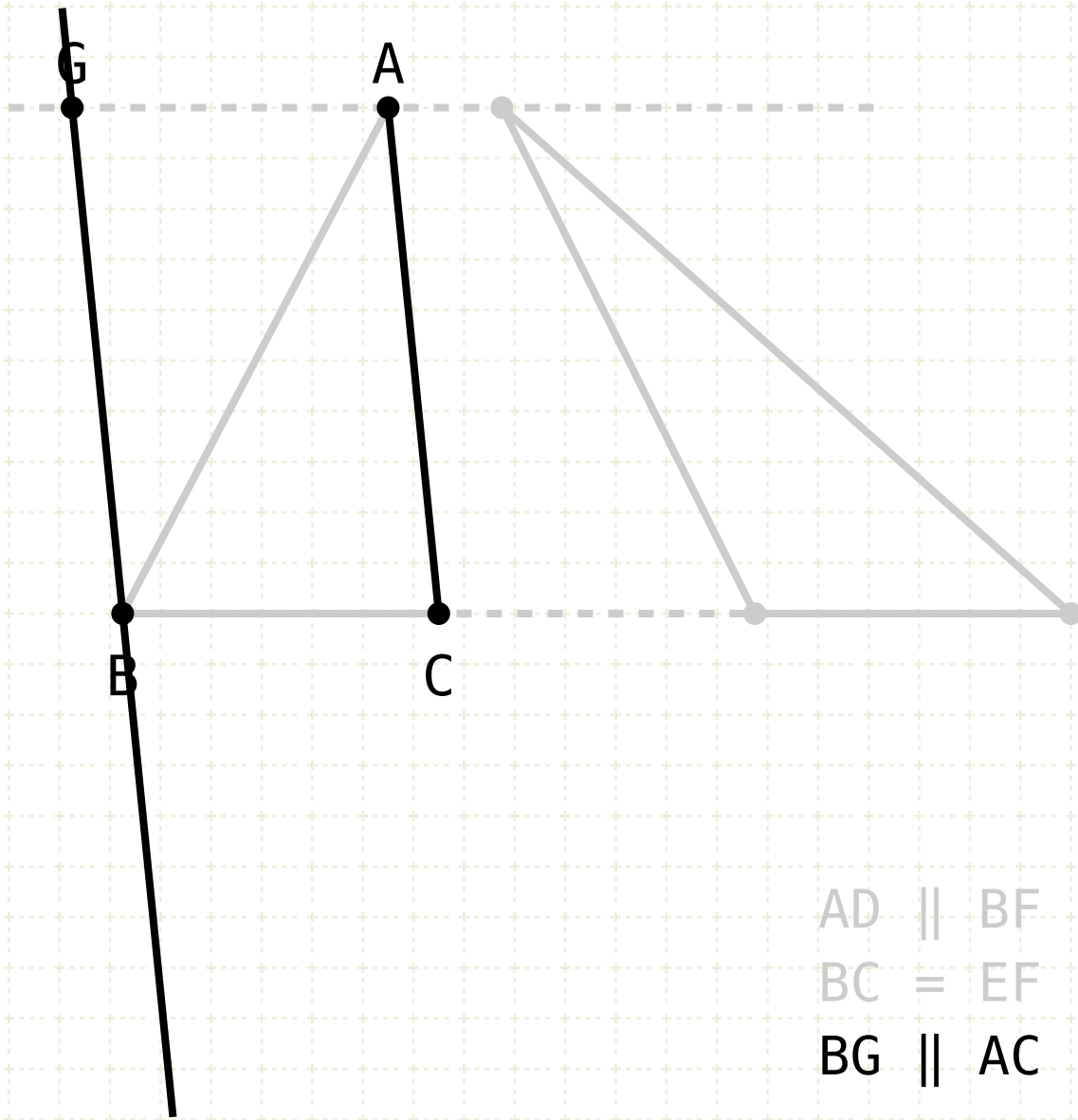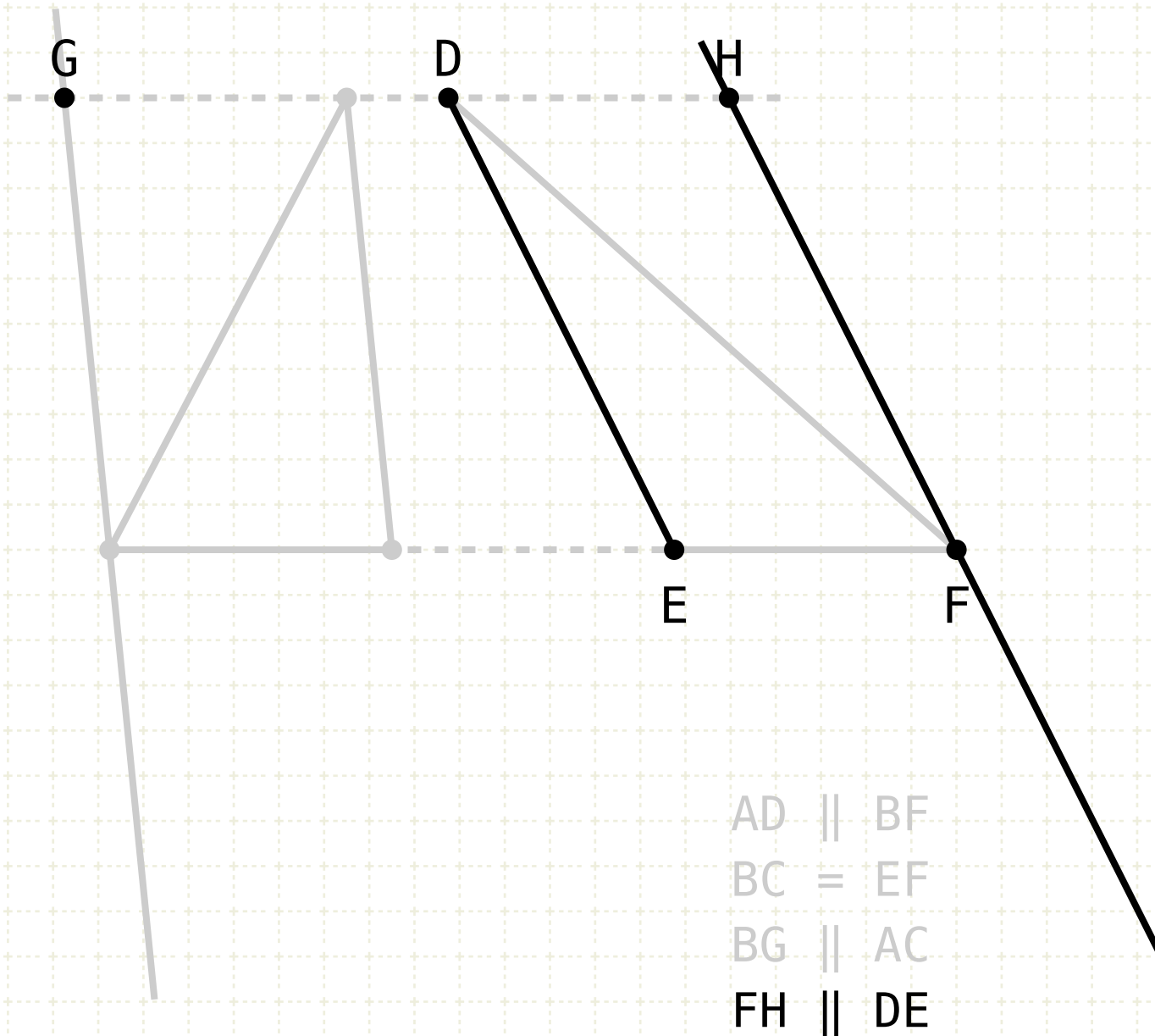Let ABC and DEF be triangles with equal bases, and on the same parallels

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The parallelograms GBCA and DEFH are equal since they have equal bases and are on two parallel lines. (I·36)

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Triangles which are on equal bases and in the same parallels equal one another.

$$AD \parallel BF$$
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$$BG \parallel AC$$
$$FH \parallel DE$$
$$GBCA = DEFH$$

$$\Delta ABC = \tfrac{1}{2}\, GBCA$$

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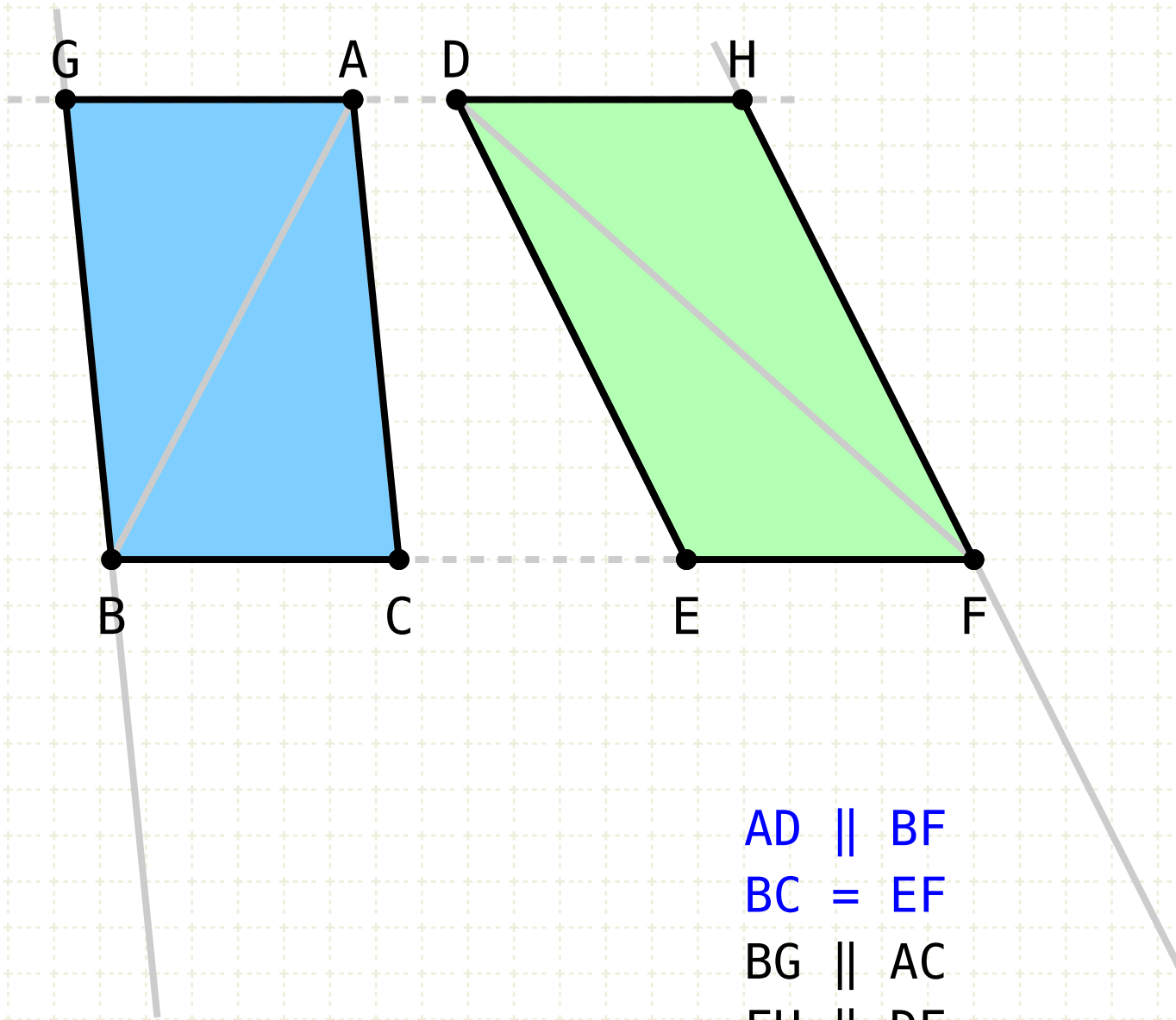
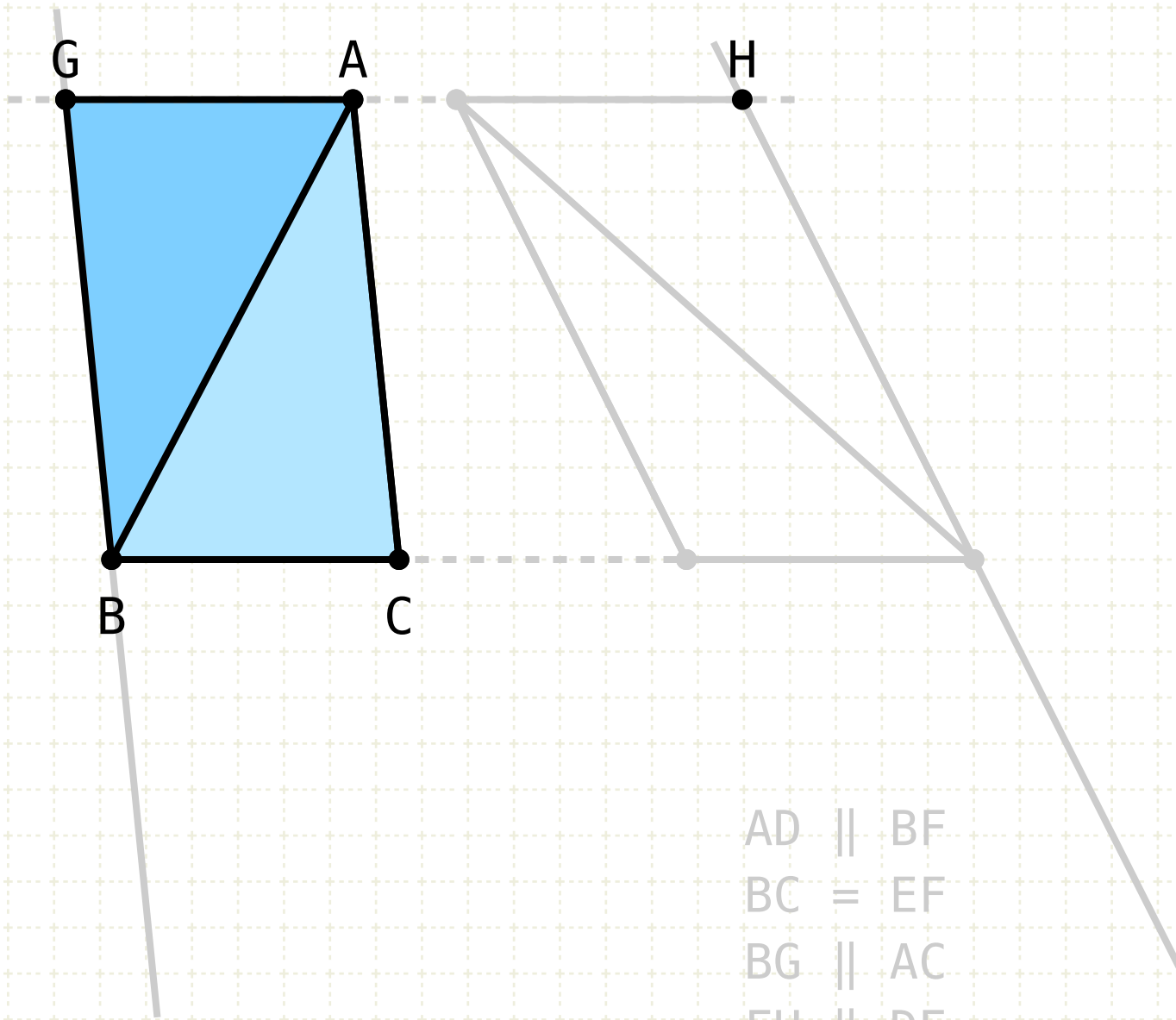The area ABC is equal to DEF

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Draw BG parallel to AC (I·31)

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The parallelograms GBCA and DEFH are equal since they have equal bases and are on two parallel lines. (I·36)

The triangle ABC is half the area of GBCA since line AB bisects the parallelogram (I·34)

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G   D   H

E   F

AD ∥ BF
BC = EF
BG ∥ AC
FH ∥ DE
GBCA = DEFH
ΔABC = ½ GBCA
ΔDEF = ½ DEFH

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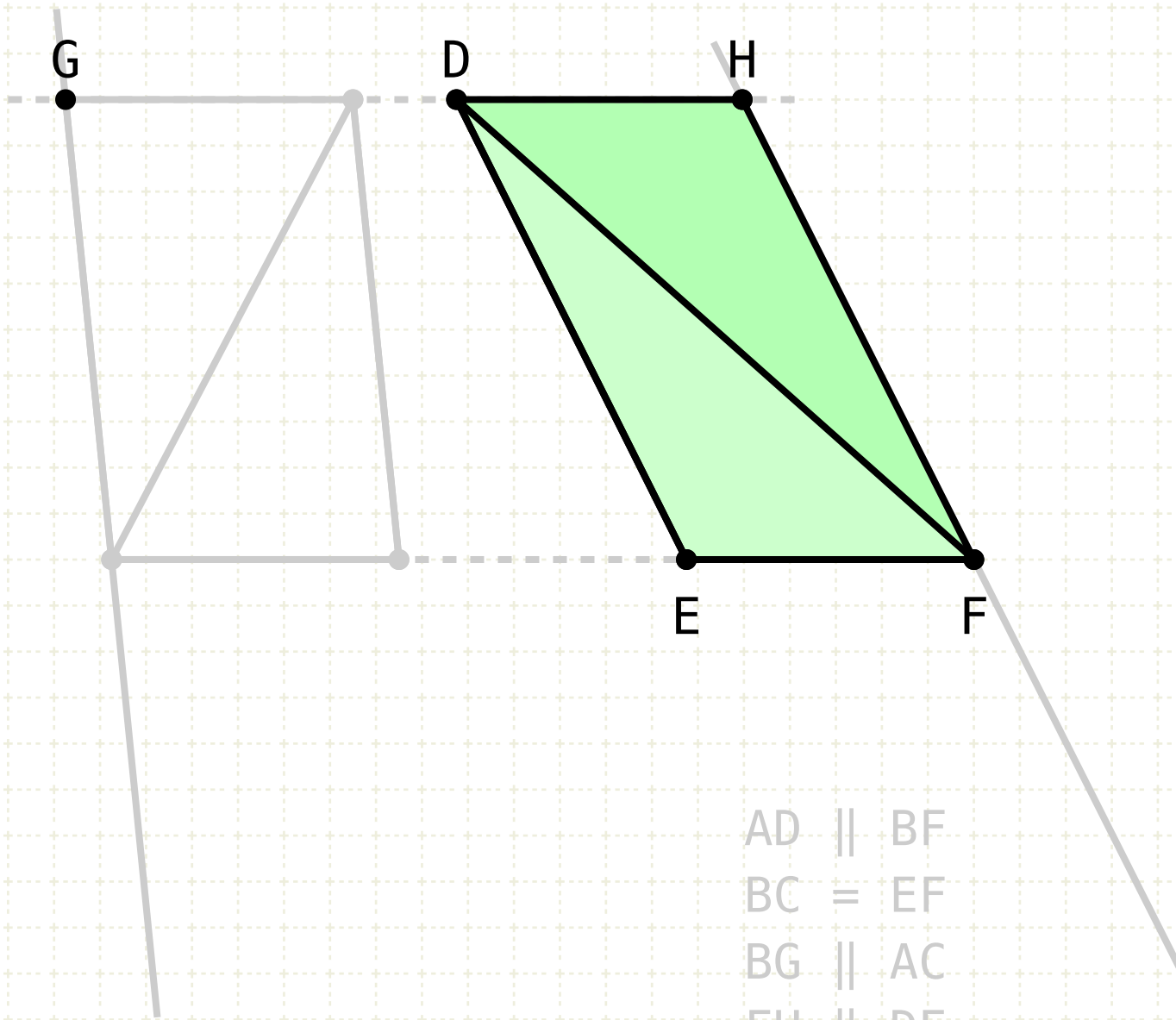The area ABC is equal to DEF

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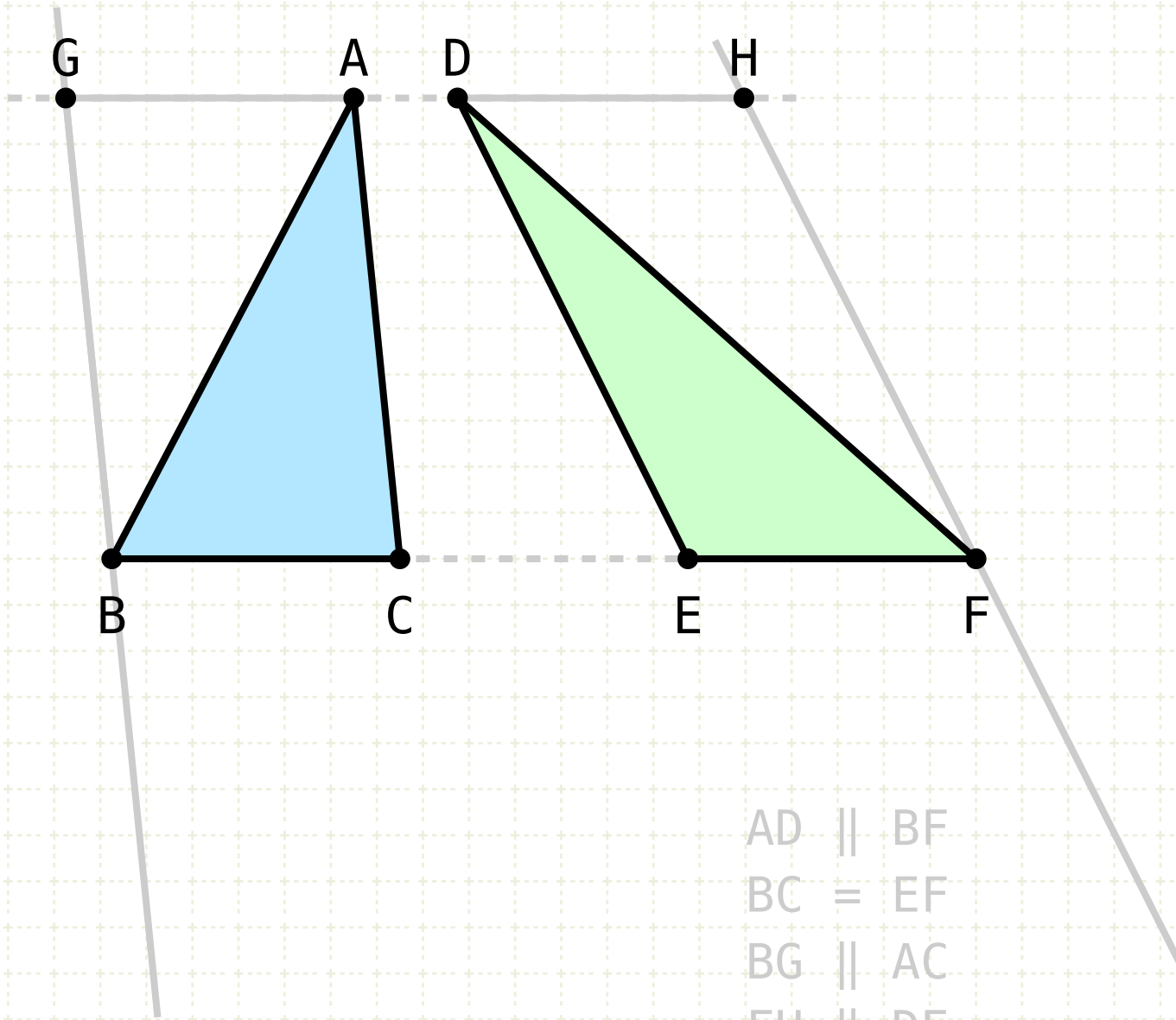
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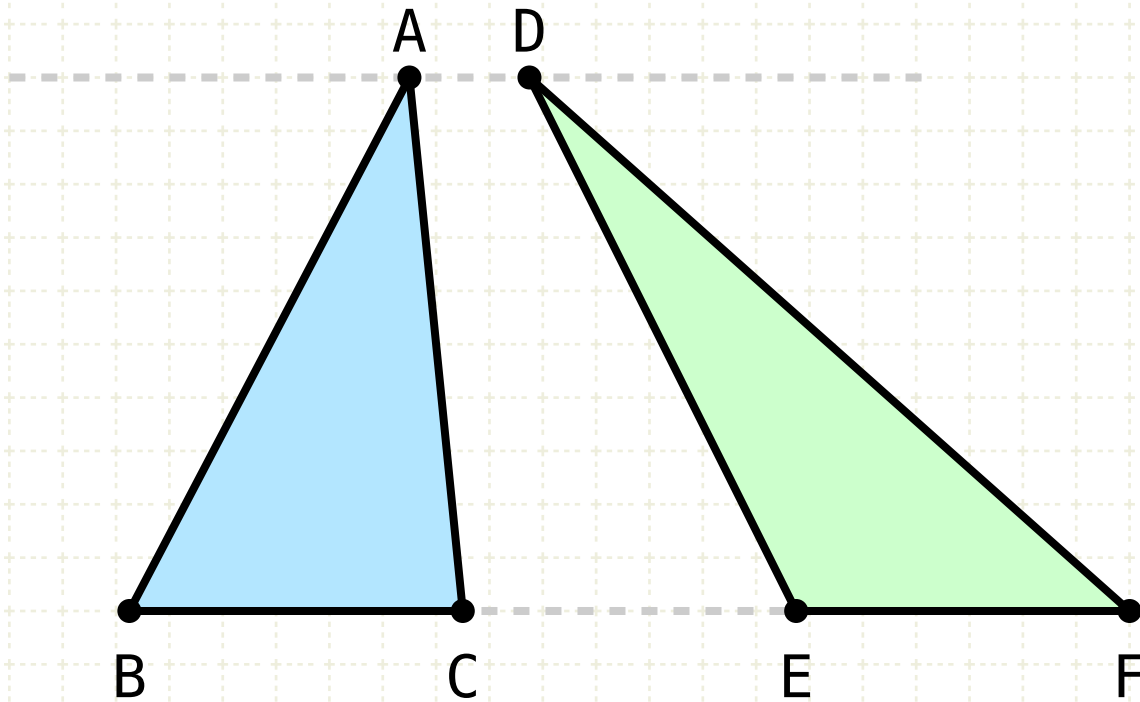The triangle ABC is half the area of GBCA since line AB bisects the parallelogram (I·34)

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Half of equals are equal, so ABC equals DEF

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