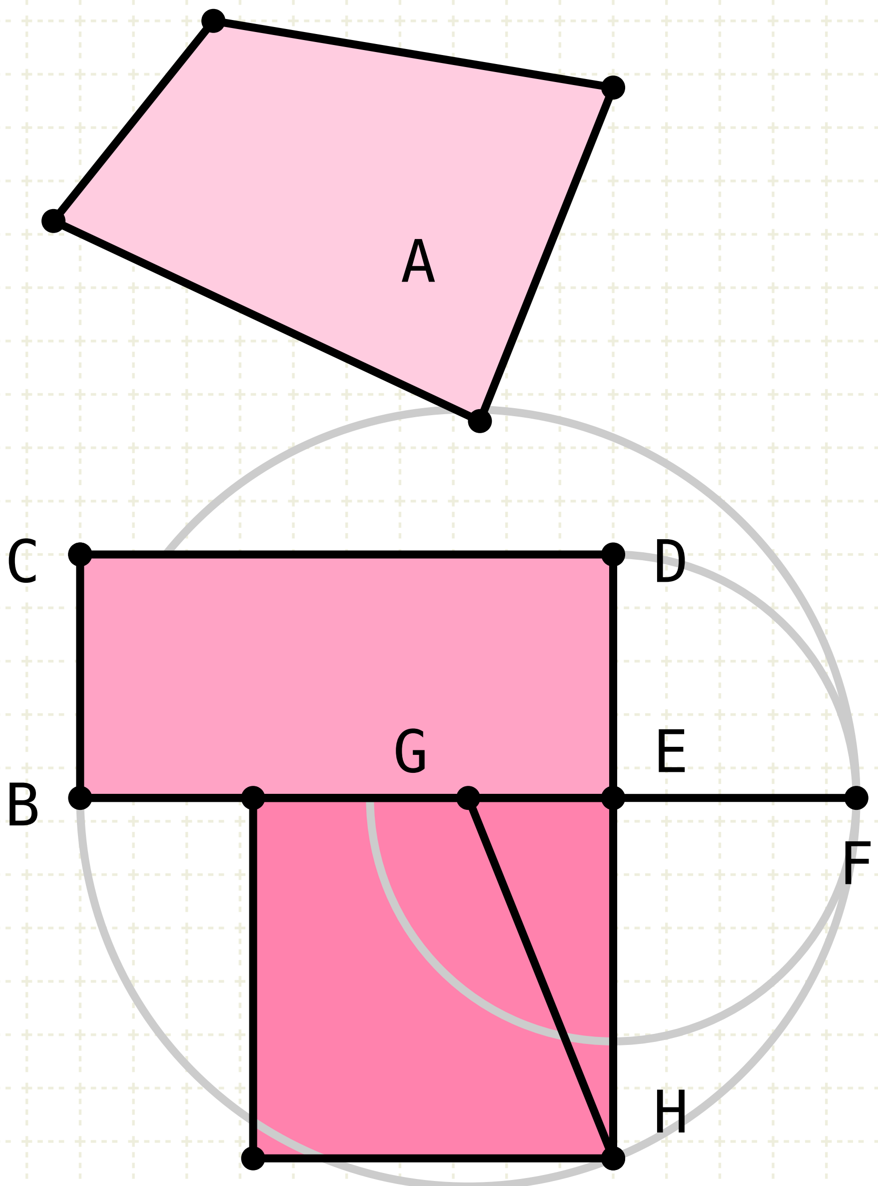
Euclid's Elements

Book II



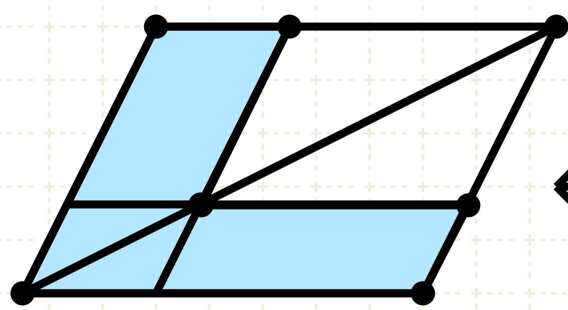
It is a remarkable fact in the history of geometry, that the Elements of Euclid, written two thousand years ago, are still regarded by many as the best introduction to the mathematical sciences.

Florian Cajori,

A History of Mathematics (1893)

Definitions:

Any rectangular parallelogram is said to be contained by the two straight lines containing the right angle.



And in any parallelogrammic area let any one whatever of the parallelograms about its diameter with the two complements be called a gnomon.

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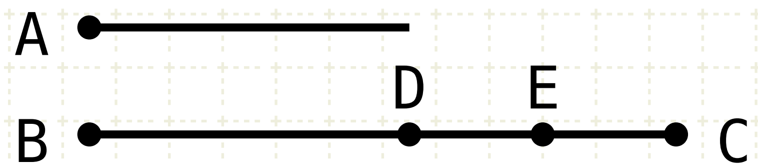
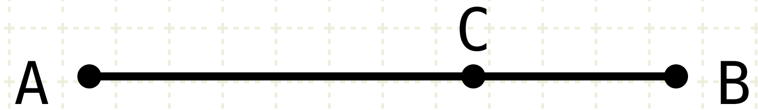


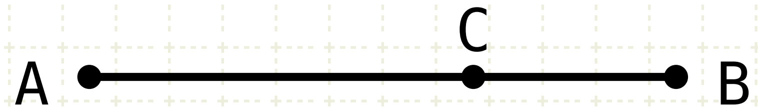
$A \cdot BC = A \cdot BD + A \cdot DE + A \cdot EC$

2



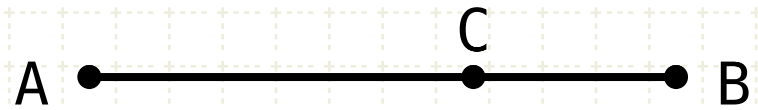
$\mathbf{AB^2 = AB \cdot AC + AB \cdot BC}$

3



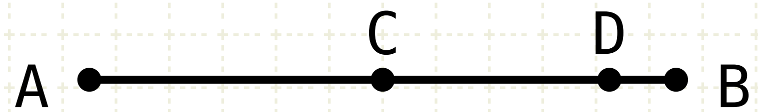
$AB \cdot CB = AC \cdot CB + CB^2$

4



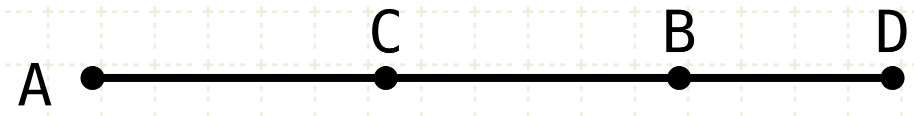
$AB^2 = AC^2 + CB^2 + 2 \cdot AC \cdot CB$

5



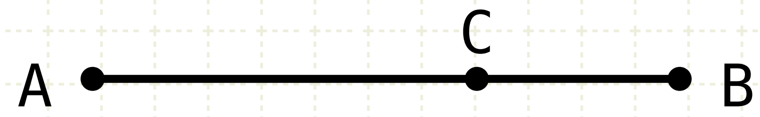
$AD \cdot DB + CD^2 = CB^2$

6



$AD \cdot DB + CB^2 = CD^2$

7

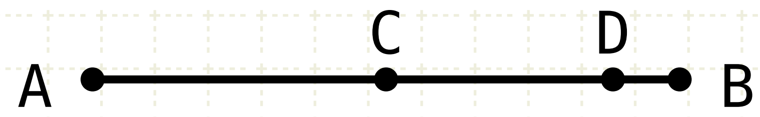


$AB^2 + BC^2 = AC^2 + 2 \cdot AB \cdot BC$

8

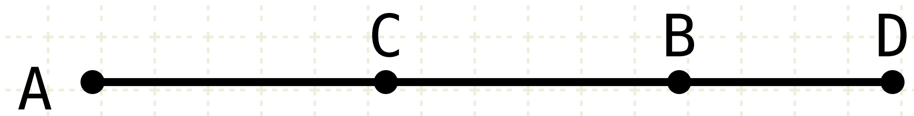
$4 \cdot AB \cdot BC + AC^2 = (AB+BC)^2$

9



$AD^2 + DB^2 = 2 \cdot (AC^2 + CD^2)$

10

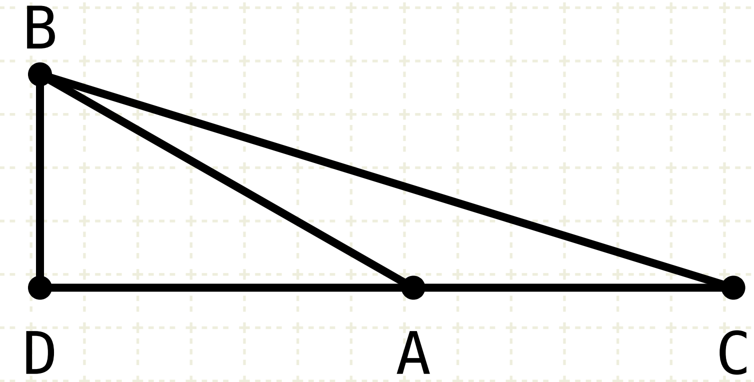


$AD^2 + DB^2 = 2 \cdot (AC^2 + CD^2)$

11

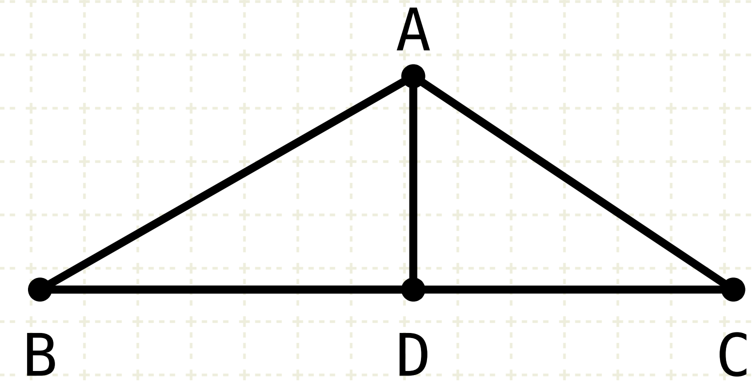
Find H. $AB \cdot BH = AH^2$

12



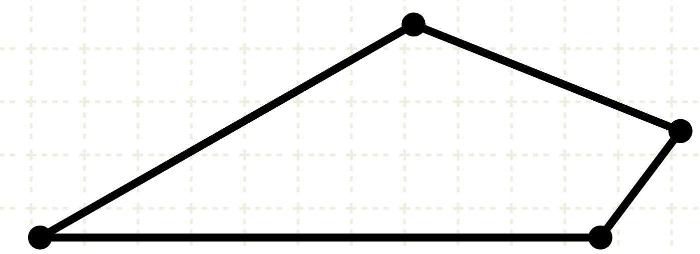
Cosine Law. $BC^2 = AB^2+AC^2+2 \cdot AD \cdot AC$

13



Cosine Law. $AC^2 = AB^2+BC^2-2 \cdot BD \cdot BC$

14



Find square of polygon

Proposition 2 of Book II

If a straight line be cut at random, the rectangles contained by the whole and both of the segments are equal to the square on the whole

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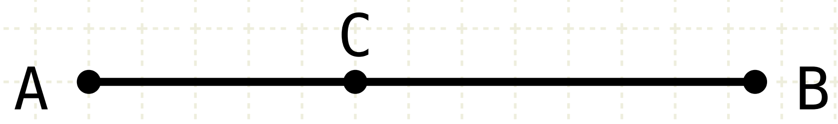


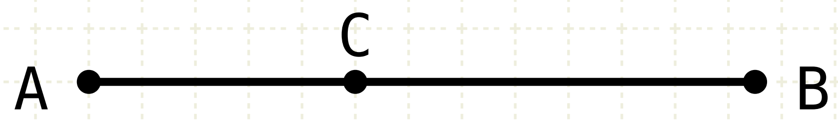
In other words

Let AB be a straight line, arbitrarily cut at point C

AB = AC + CB

Proposition 2 of Book II

If a straight line be cut at random, the rectangles contained by the whole and both of the segments are equal to the square on the whole



In other words

Let AB be a straight line, arbitrarily cut at point C

Then the area of the square formed by line AB is equal in area to the sum of the rectangles formed by line AB and AC, and line AB and BC

$$AB = AC + CB$$

$$AB \cdot AB = AB \cdot AC + AB \cdot BC$$

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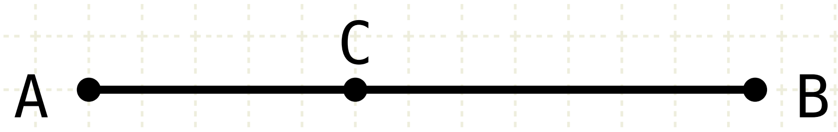

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Let AB be a straight line, arbitrarily cut at point C

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Proof:

$AB = AC + CB$

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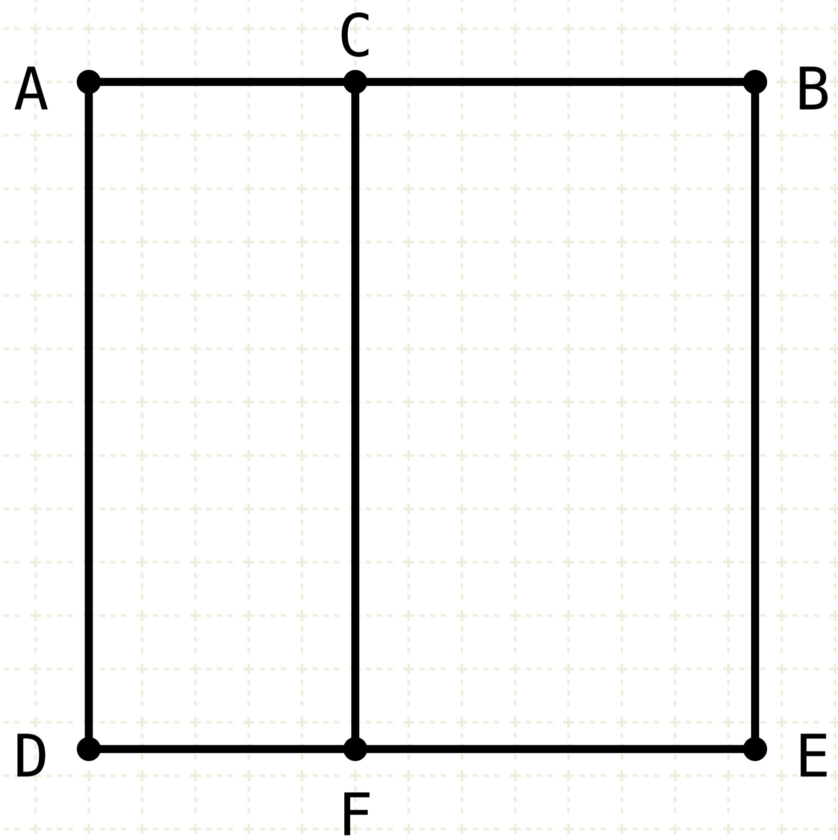

AB = AC + CB

AB = AD = CF

In other words

Let AB be a straight line, arbitrarily cut at point C

Then the area of the square formed by line AB is equal in area to the sum of the rectangles formed by line AB and AC, and line AB and BC

Proof:

Draw a square ABED on the line AB (I·46) and draw a line CF parallel to either AD or BE (I·31)

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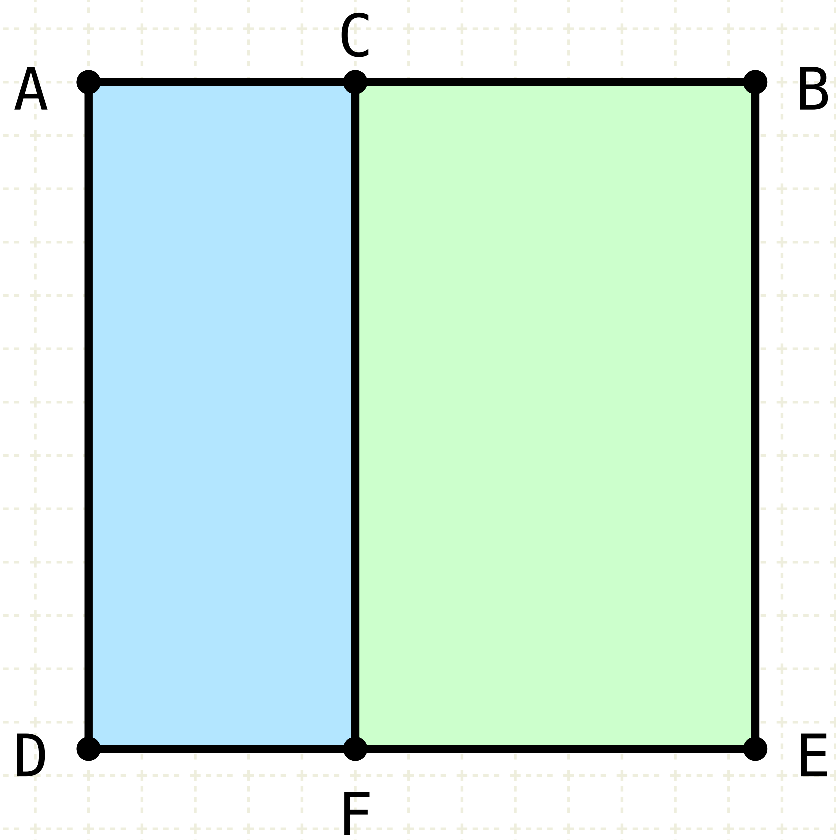

AB = AC + CB

AB = AD = CF

□AE = □AF + □CE

In other words

Let AB be a straight line, arbitrarily cut at point C

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The rectangle AE is the sum of the rectangles AF and CE

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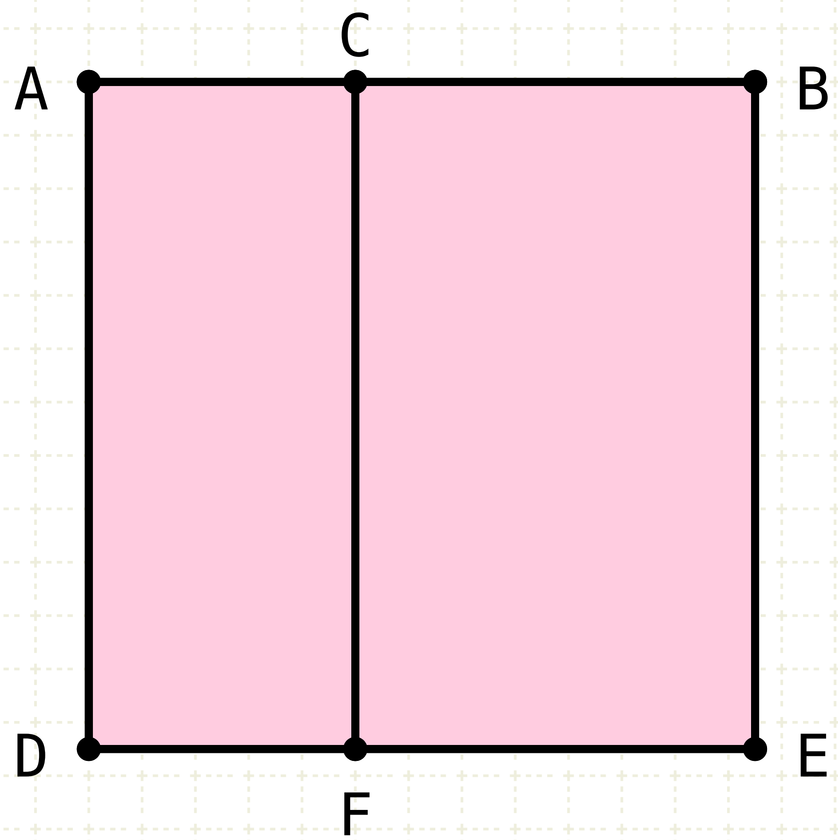

$AB = AC + CB$

$AB = AD = CF$

$\square AE = \square AF + \square CE$

$\square AE = AB \cdot AD, \quad \therefore \square AE = AB \cdot AB$

In other words

Let AB be a straight line, arbitrarily cut at point C

Then the area of the square formed by line AB is equal in area to the sum of the rectangles formed by line AB and AC, and line AB and BC

Proof:

Draw a square ABED on the line AB (I·46) and draw a line CF parallel to either AD or BE (I·31)

The rectangle AE is the sum of the rectangles AF and CE

Since AD is equal in length to AB, the rectangle AE is equal to the square contained by line AB

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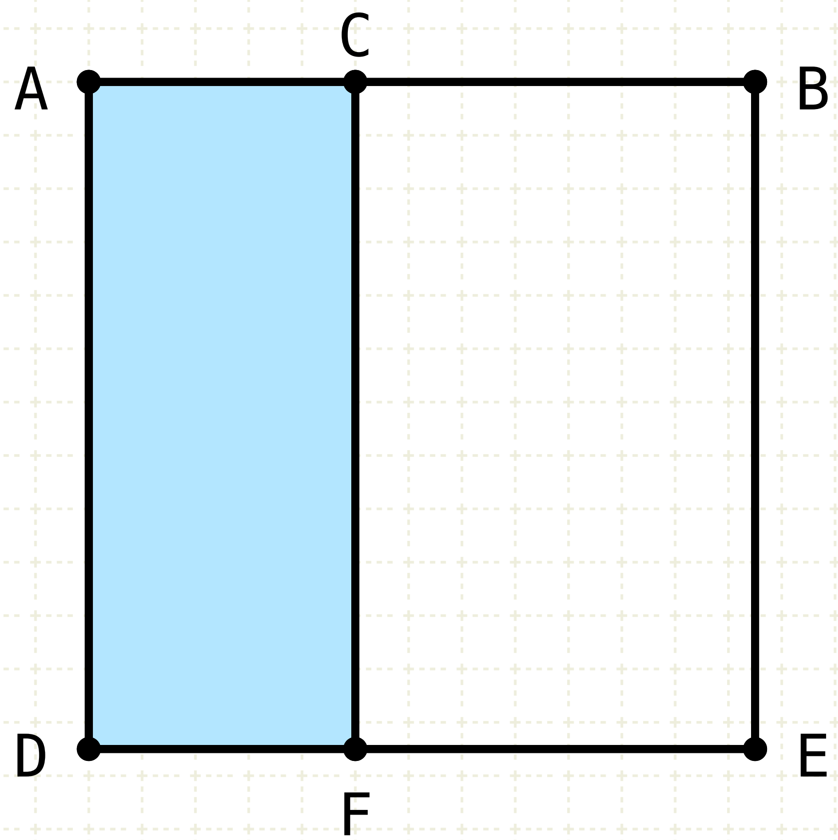

$$AB = AC + CB$$

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$$\square AE = AB \cdot AD, \quad \therefore \square AE = AB \cdot AB$$

$$\square AF = AD \cdot AC, \quad \therefore \square AF = AB \cdot AC$$

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Let AB be a straight line, arbitrarily cut at point C

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Proof:

Draw a square ABED on the line AB (I·46) and draw a line CF parallel to either AD or BE (I·31)

The rectangle AE is the sum of the rectangles AF and CE

Since AD is equal in length to AB, the rectangle AE is equal to the square contained by line AB

Similarly, the rectangle AF is equal to the rectangle contained by lines AB and AC

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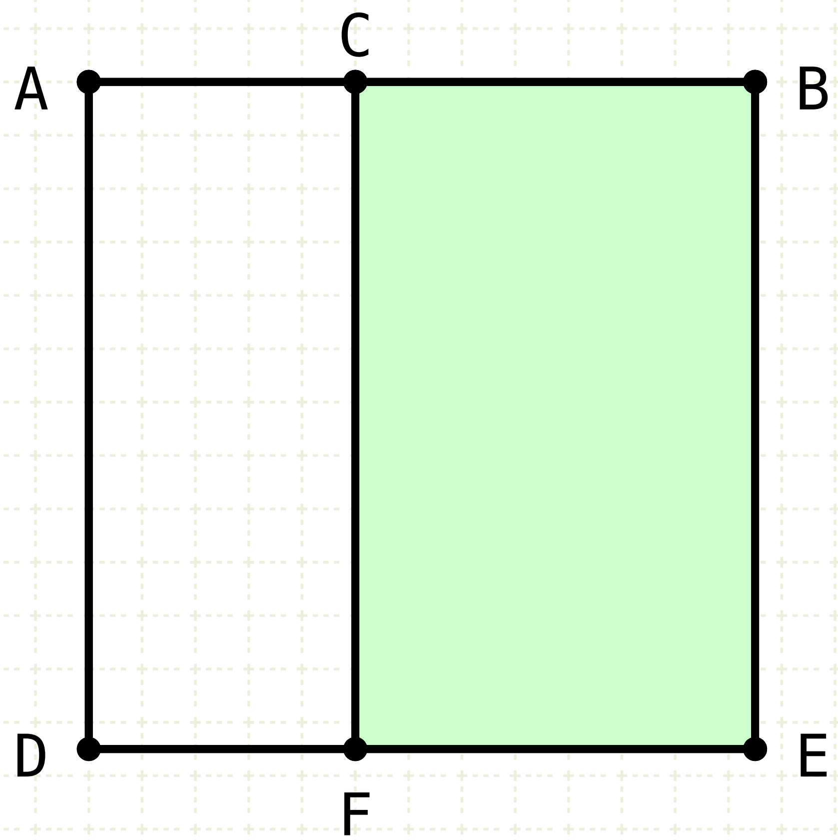

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$\square AE = \square AF + \square CE$

$\square AE = AB \cdot AD, \quad \therefore \square AE = AB \cdot AB$

$\square AF = AD \cdot AC, \quad \therefore \square AF = AB \cdot AC$

$\square CE = CF \cdot CB, \quad \therefore \square CE = AB \cdot CB$

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Proof:

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The rectangle AE is the sum of the rectangles AF and CE

Since AD is equal in length to AB, the rectangle AE is equal to the square contained by line AB

Similarly, the rectangle AF is equal to the rectangle contained by lines AB and AC

Since AB equals CF (I·34), CE is equal to the rectangle contained by lines AB and CB

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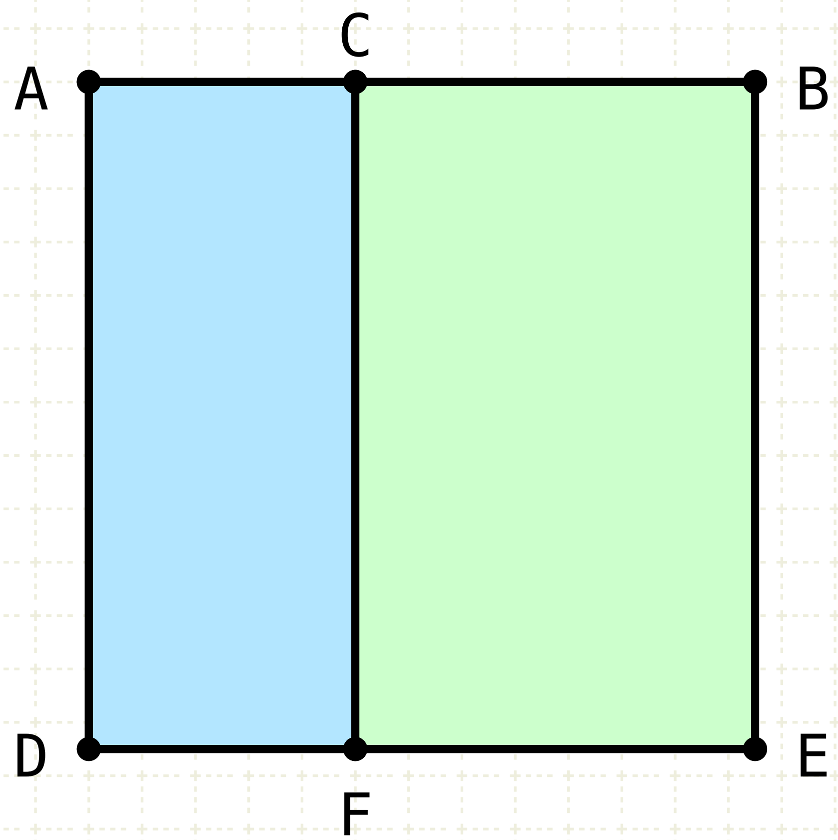
If a straight line be cut at random, the rectangles contained by the whole and both of the segments are equal to the square on the whole



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$\square AE = AB \cdot AD, \quad \therefore \square AE = AB \cdot AB$

$\square AF = AD \cdot AC, \quad \therefore \square AF = AB \cdot AC$

$\square CE = CF \cdot CB, \quad \therefore \square CE = AB \cdot CB$

$AB \cdot AB = AB \cdot AC + AB \cdot CB$

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Since AB equals CF (I·34), CE is equal to the rectangle contained by lines AB and CB

Thus the square of AB is equal to the rectangle formed by AB,AC and the rectangle formed by AB,CB

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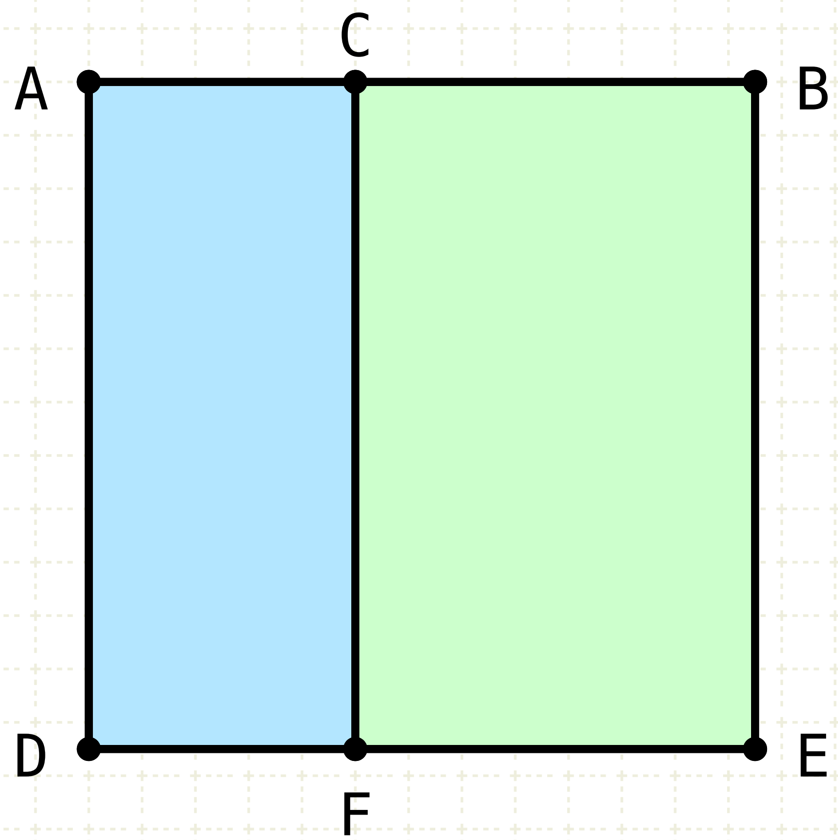

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