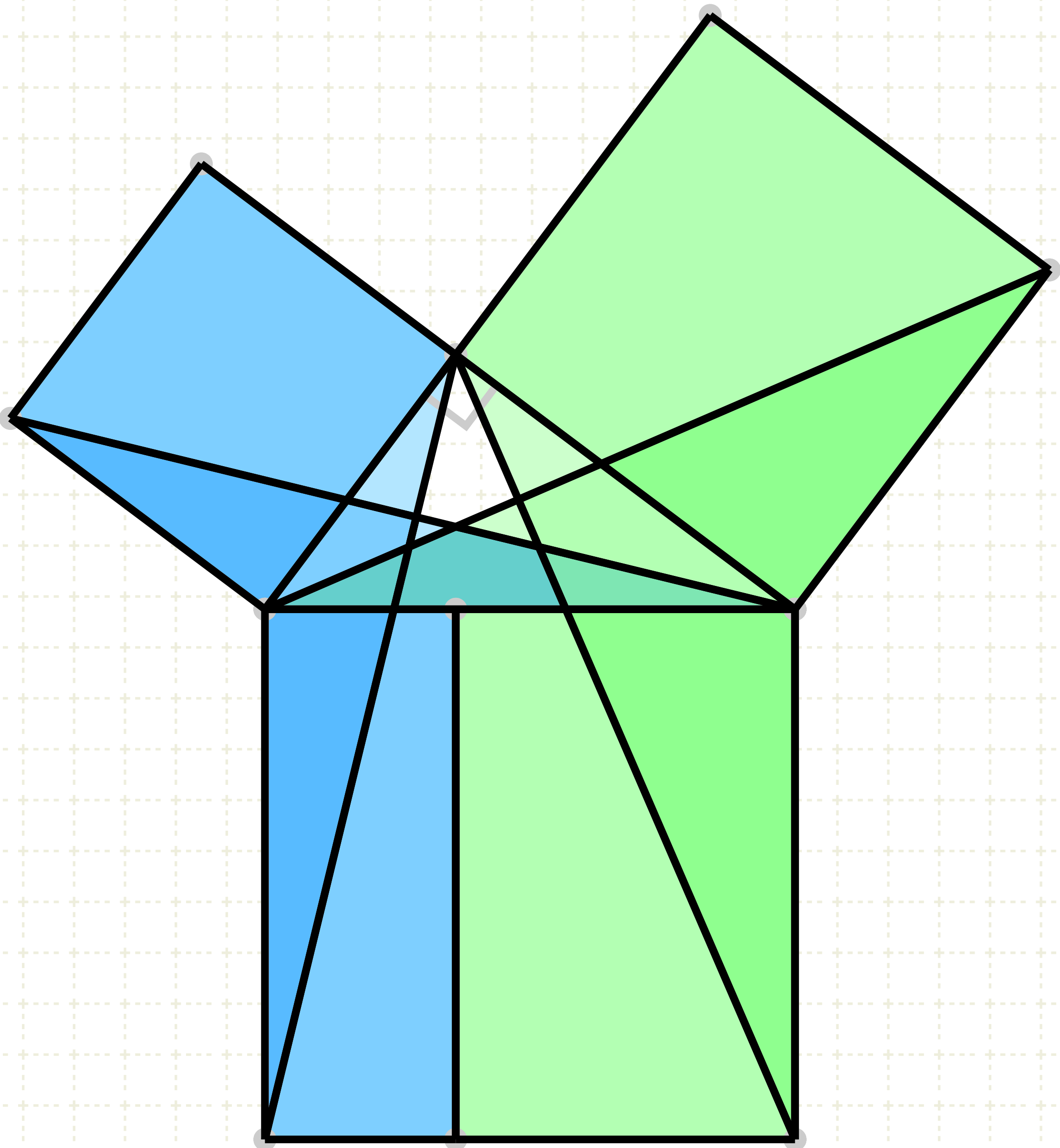
Euclid's Elements

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 47 of Book I

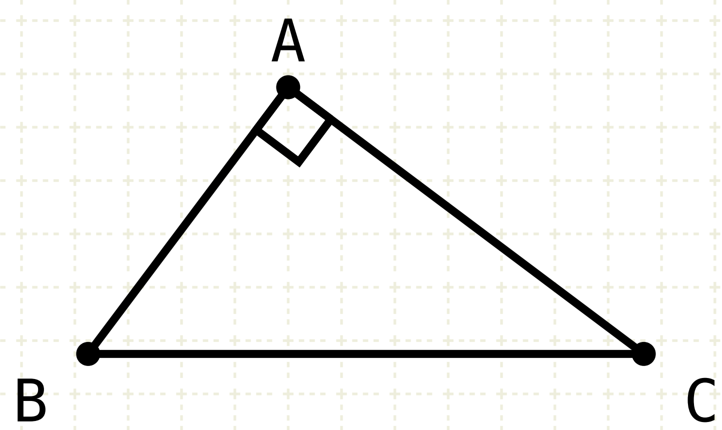
In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.

In other words...

Given a right angle triangle ABC



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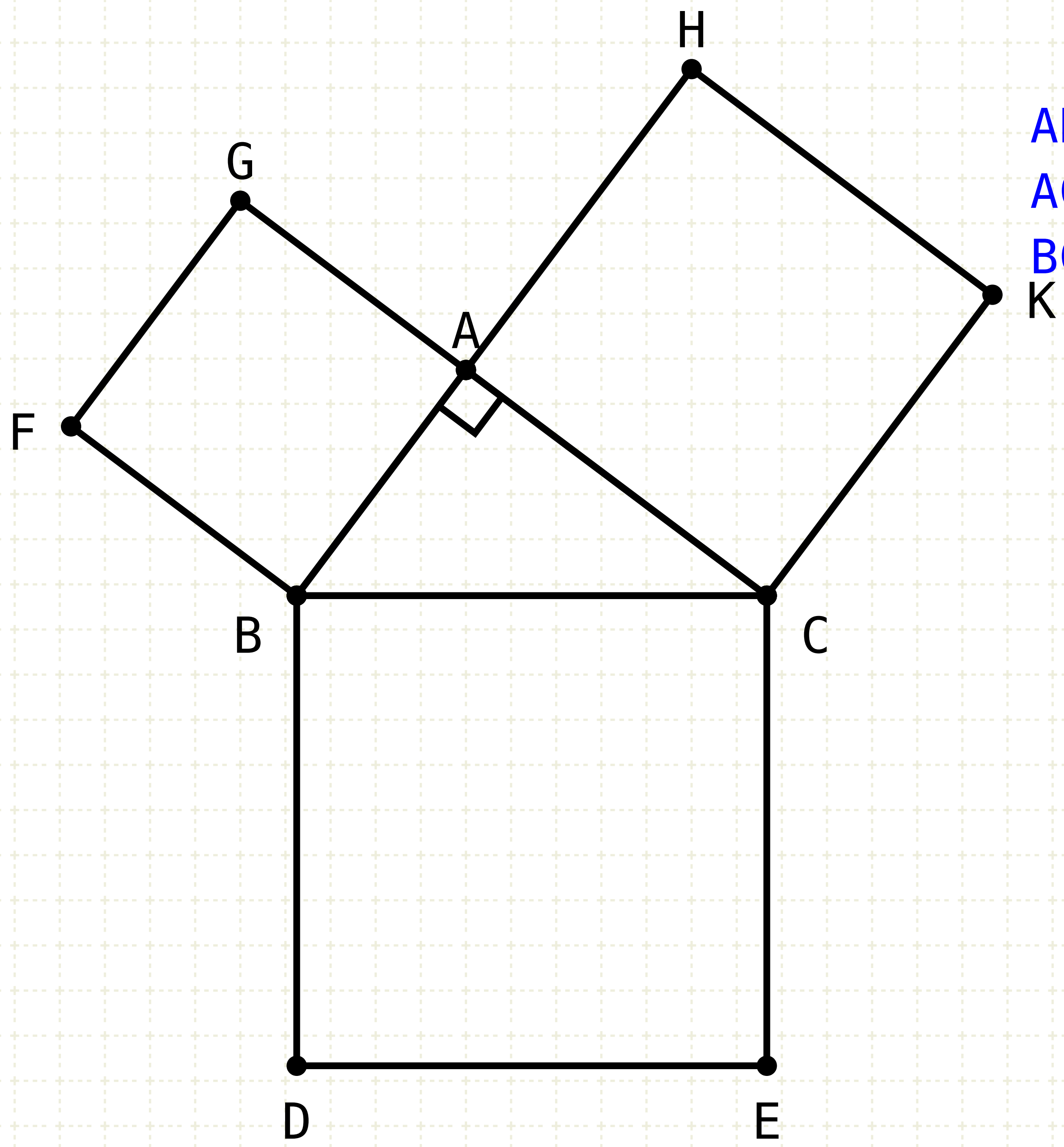
In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



ABFG is a square
ACKH is a square
BCED is a square

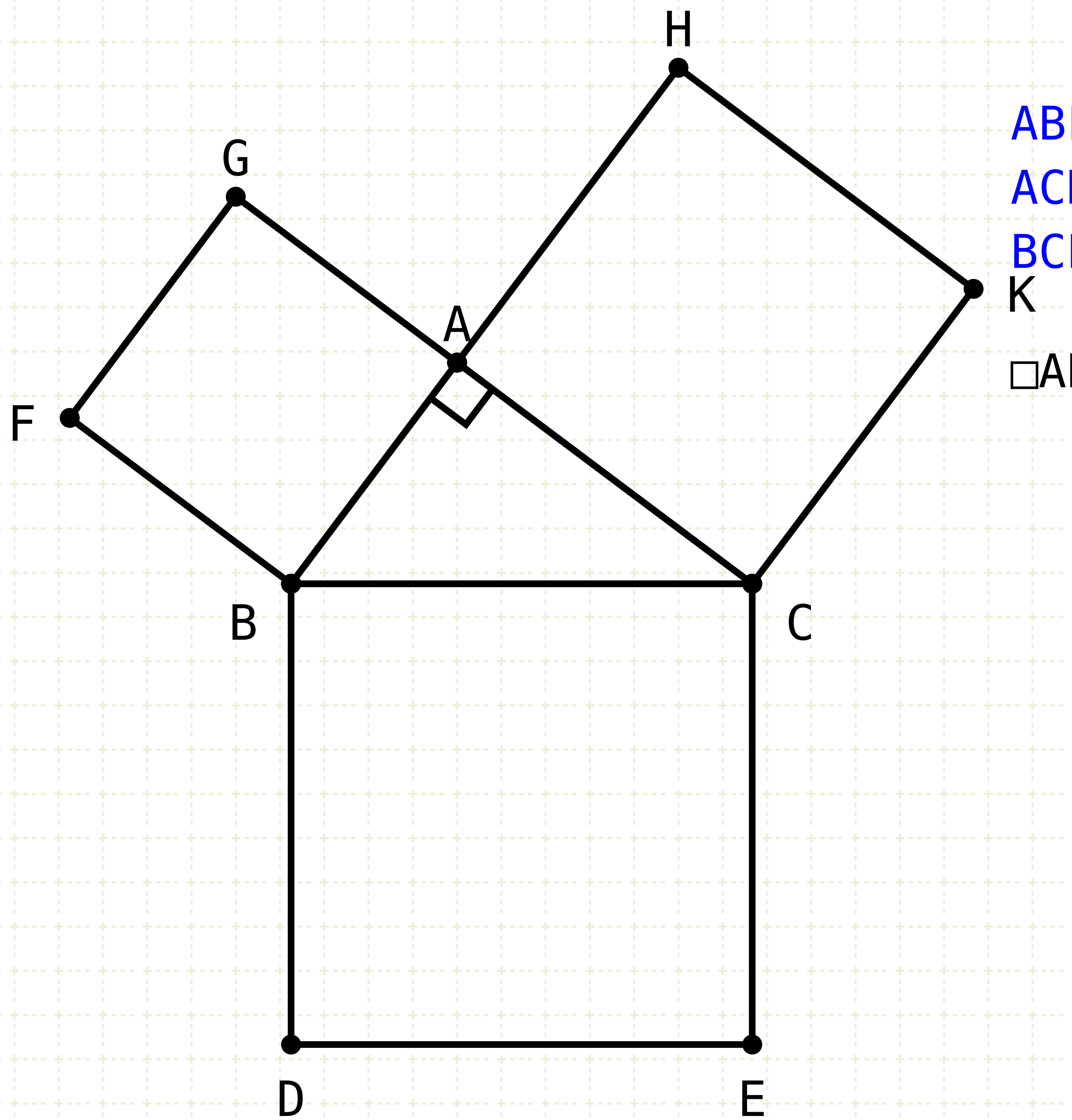
In other words...

Given a right angle triangle ABC

where squares have been construct squares on all sides (I·46)

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



ABFG is a square
ACKH is a square
BCED is a square

□AB + □AC = □BC

In other words...

Given a right angle triangle ABC

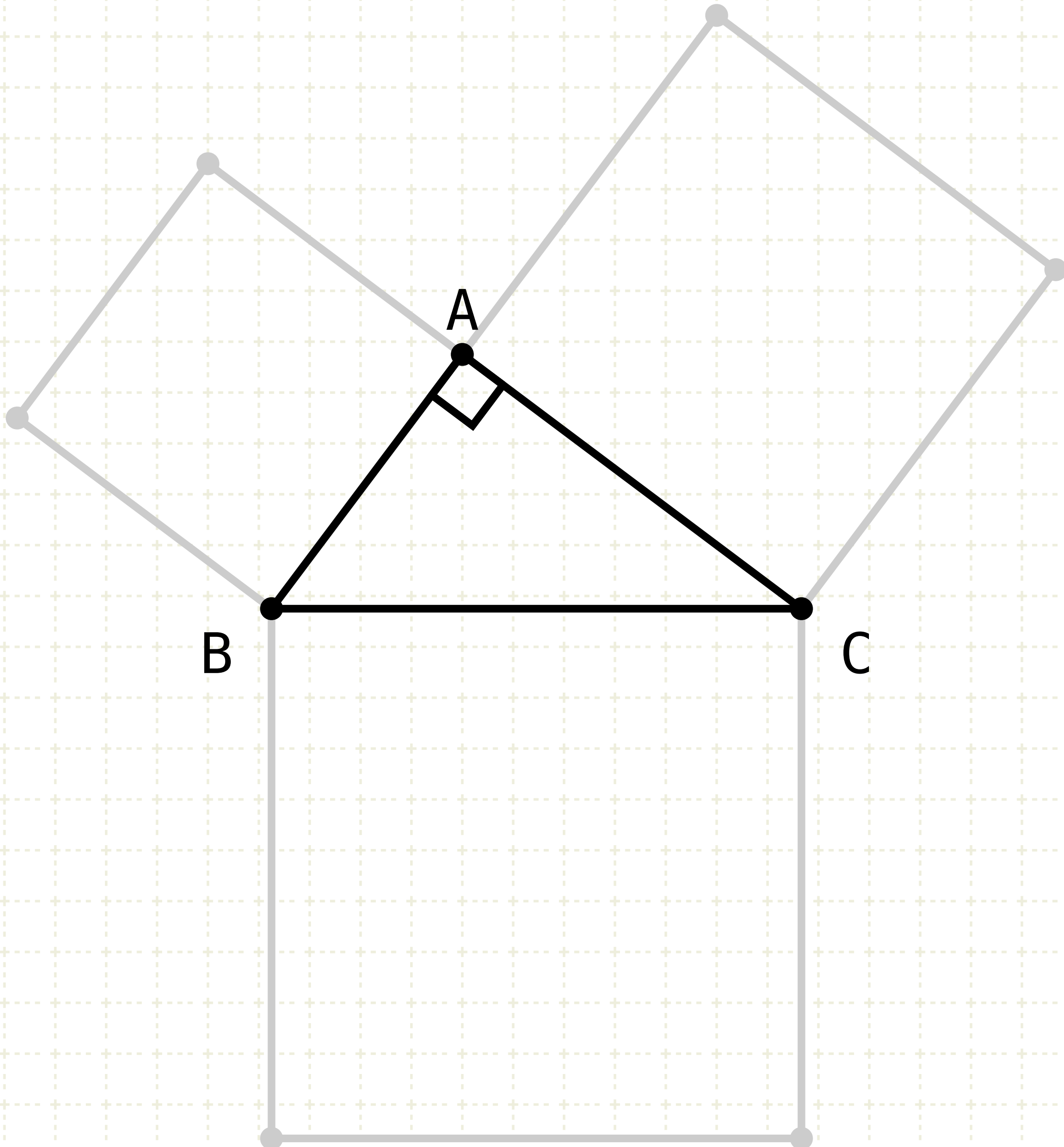
where squares have been construct squares on all sides (I·46)

Then the sum of the squares of lines AB and AC equals the square of BC

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.

Proof:



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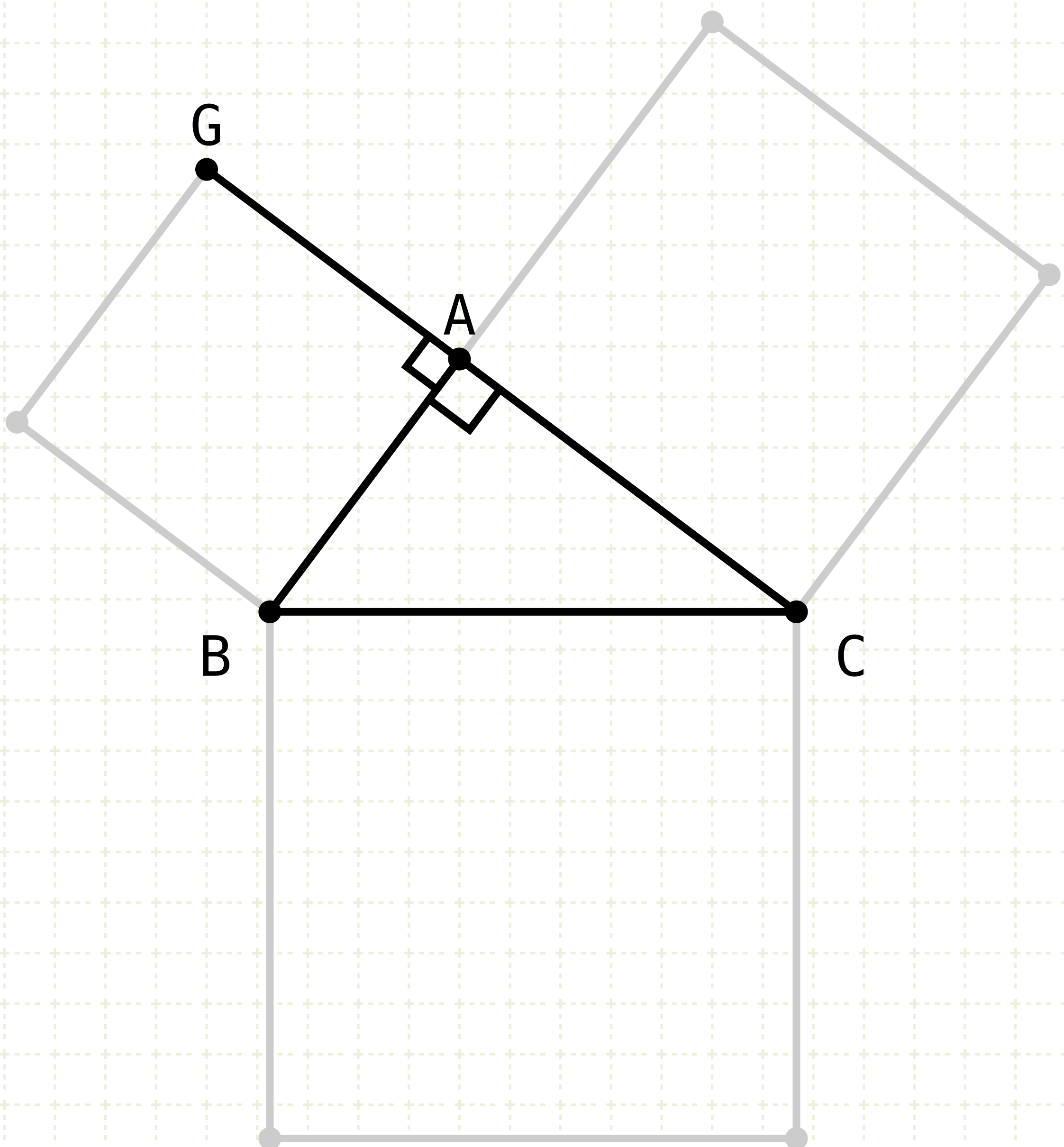

ABFG is a square
ACKH is a square
BCED is a square

GA,AC = GC

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

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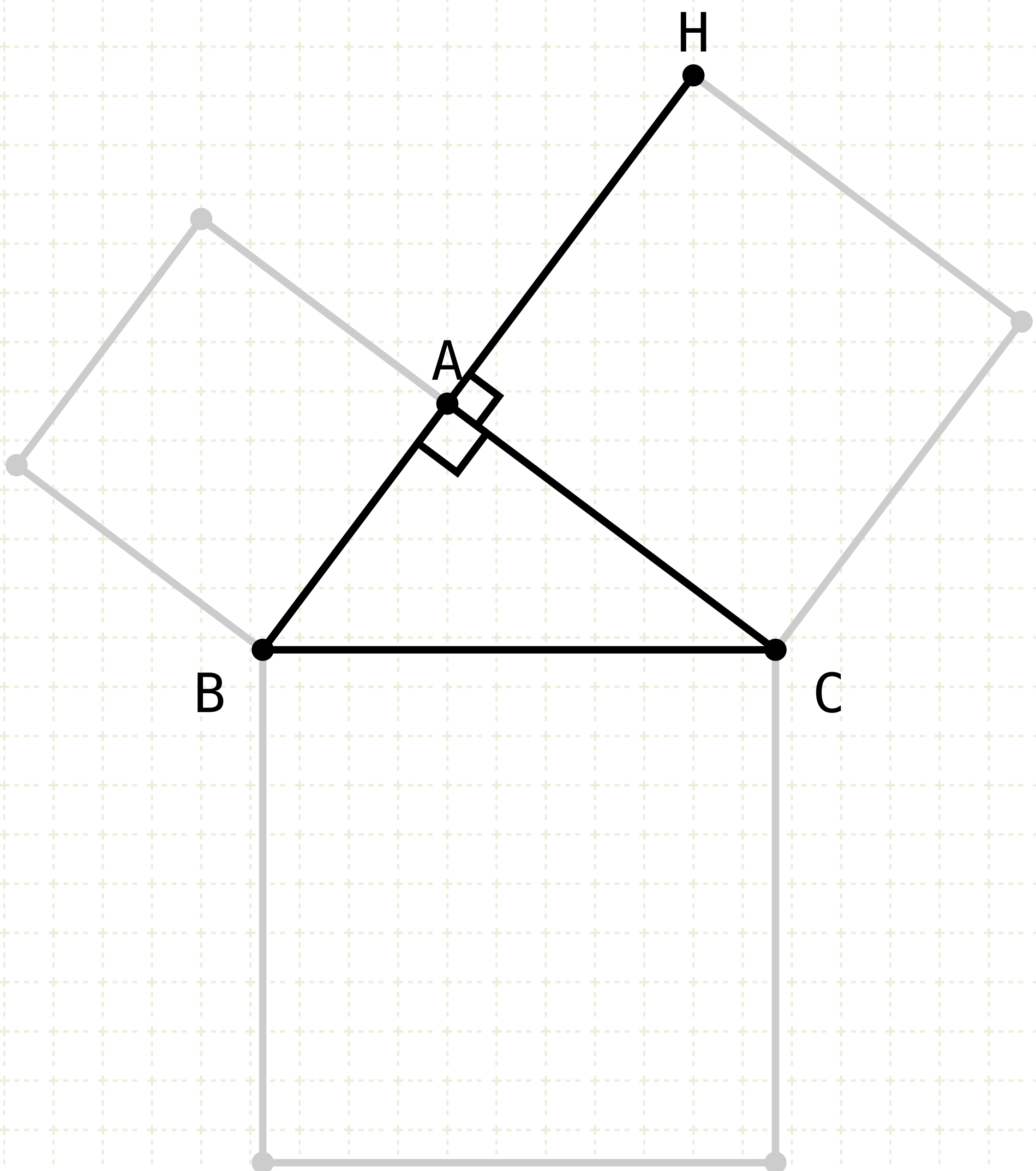


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ABFG is a square
ACKH is a square
BCED is a square

GA,AC = GC
BA,AH = BH
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Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

Similarly for line BH (I·14)

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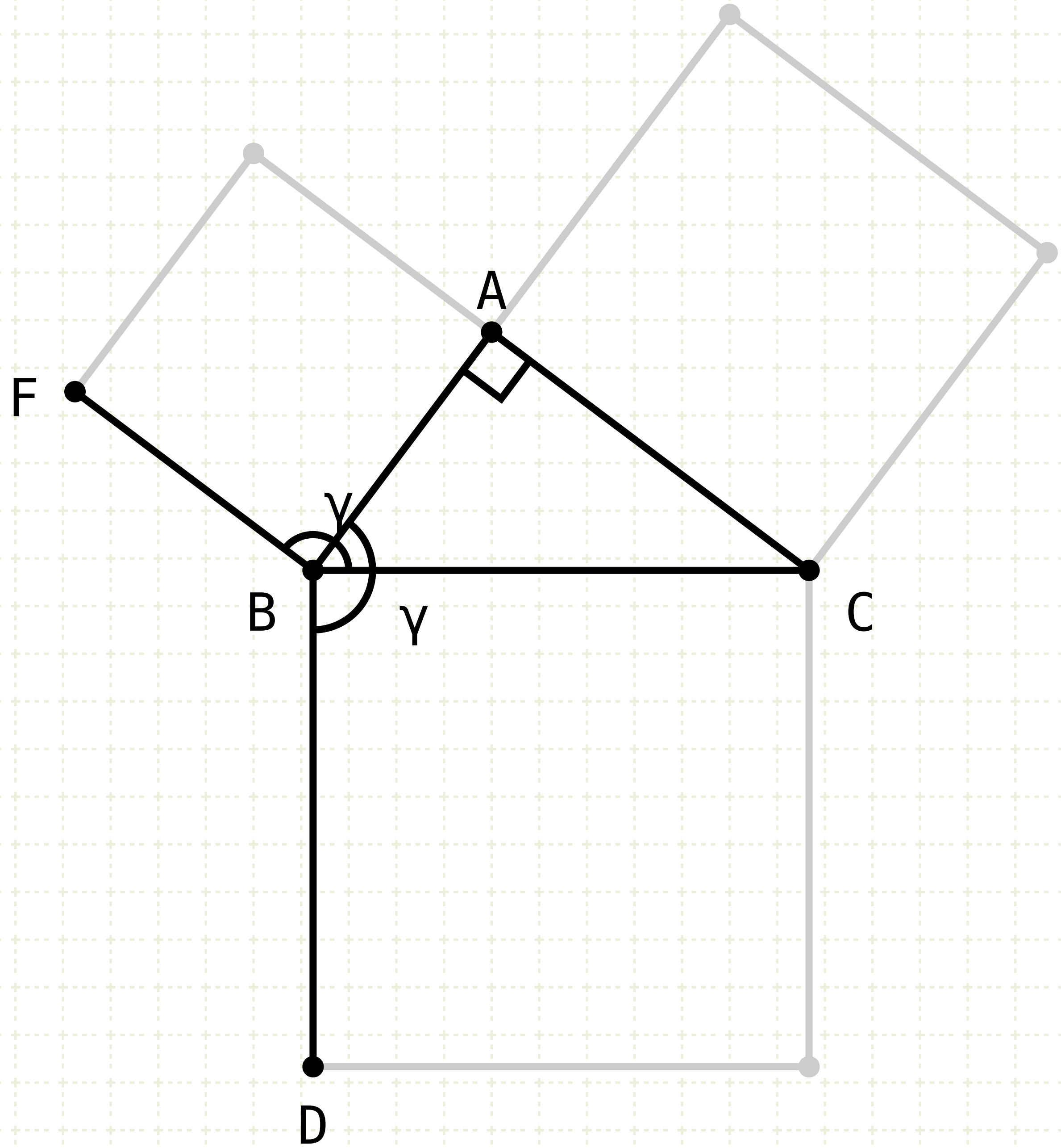
In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.

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ABFG is a square
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GA,AC = GC
BA,AH = BH
∠FBC = ∟ + ∠ABC = ∠ABD
```

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

Similarly for line BH (I·14)

Angles FBA and CBD are both right angles

Adding angle ABC to both demonstrates that angles FBC and ABD are also equal

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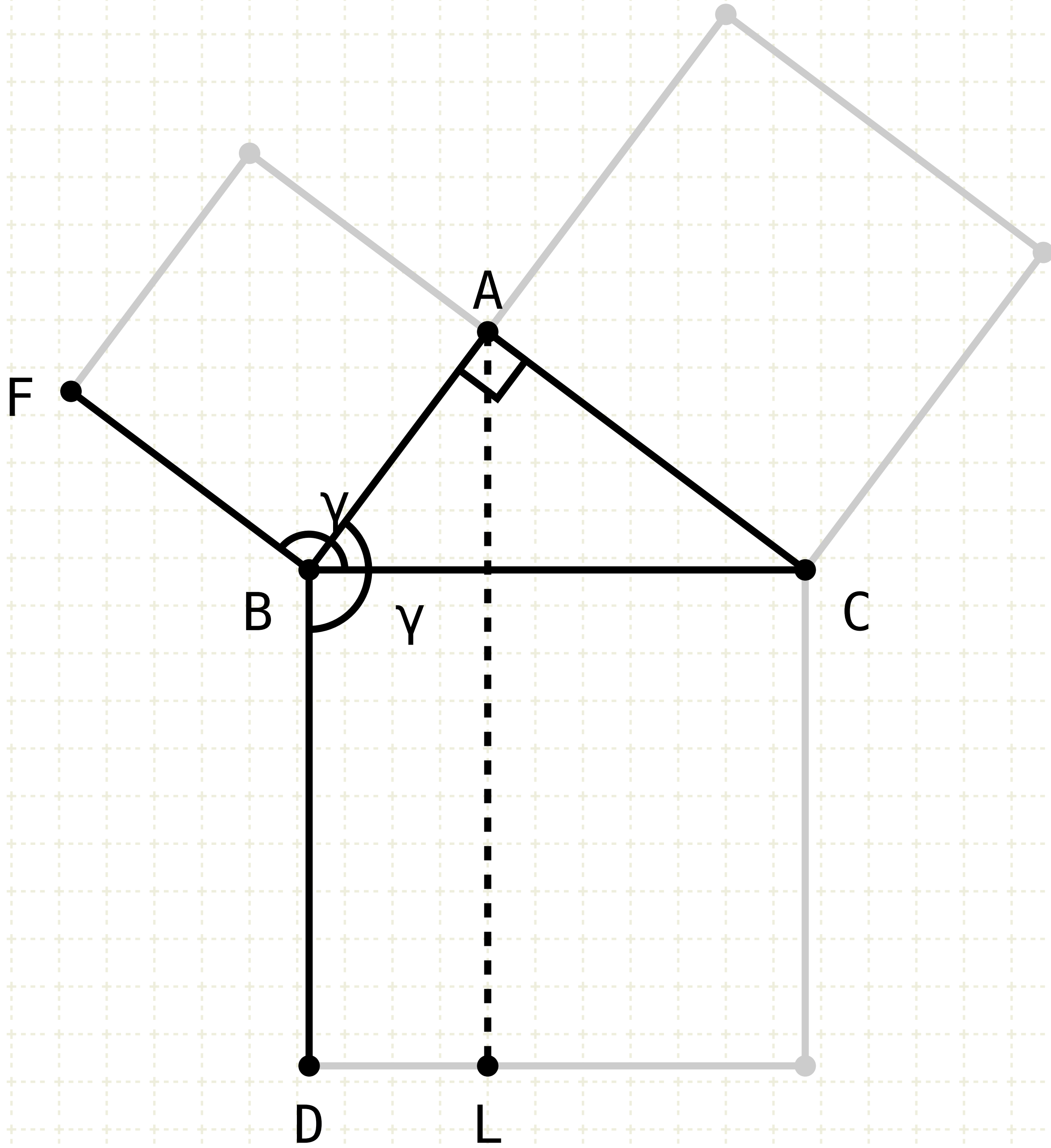

ABFG is a square
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GA,AC = GC
BA,AH = BH
$\angle FBC = ∟ + \angle ABC = \angle ABD$
AL || BD

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

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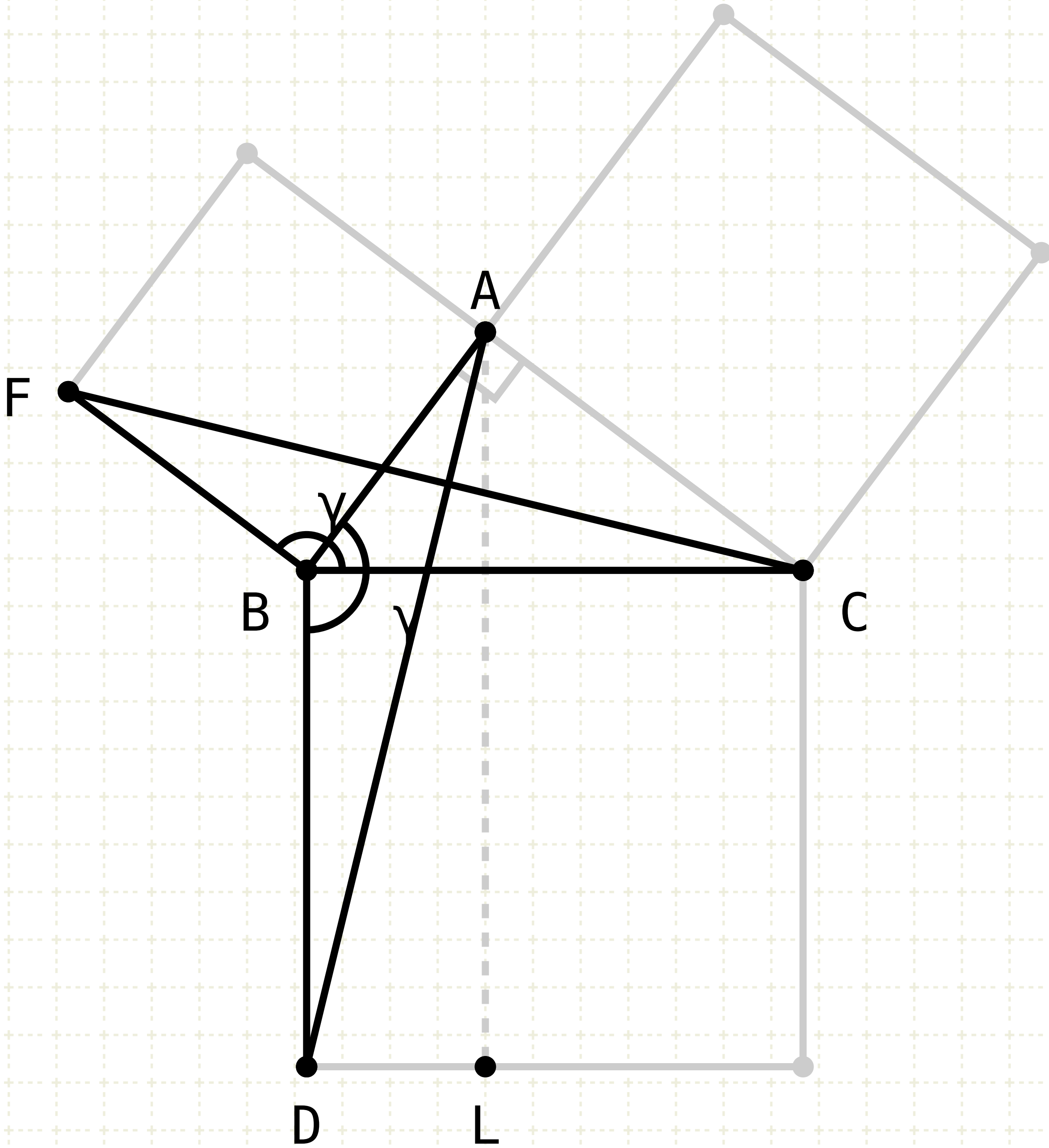

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BA,AH = BH
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Proof:

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Draw lines AD and FC, and consider triangles FBC and ABD

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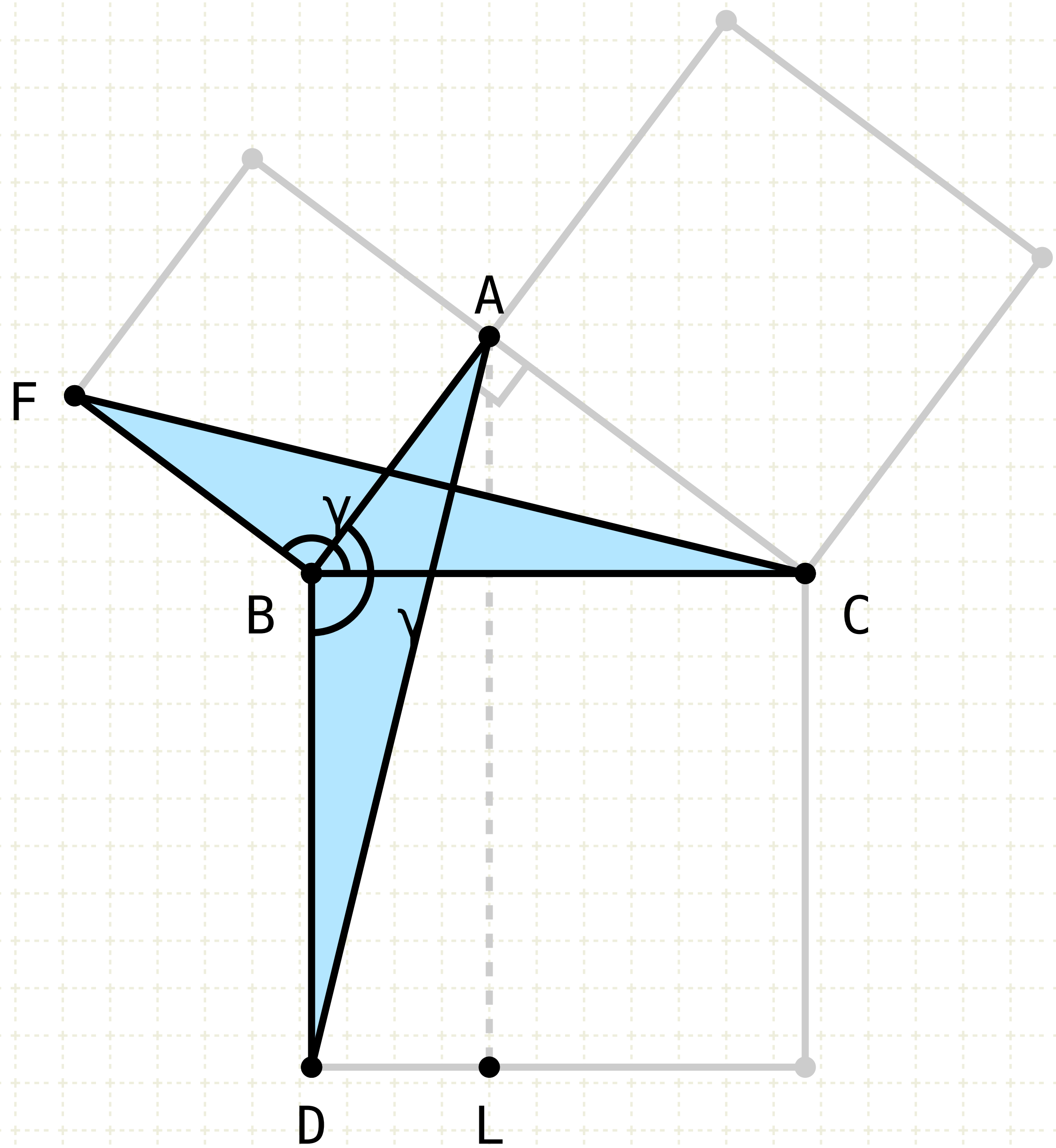

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ΔFBC = ΔABD

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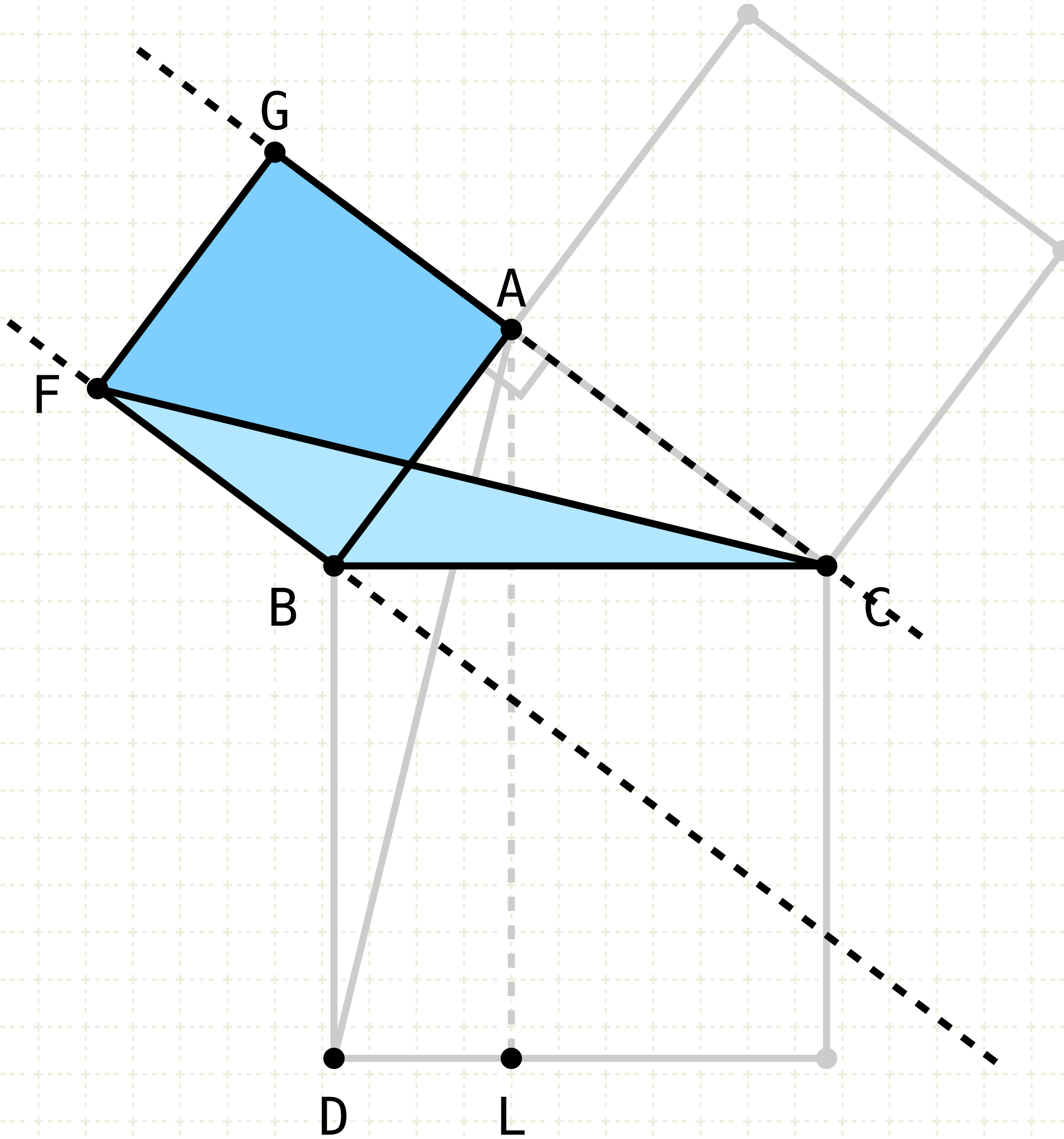

ABFG is a square
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GA,AC = GC
BA,AH = BH
∠FBC = ∟ + ∠ABC = ∠ABD
AL ∥ BD
ΔFBC = ΔABD
ΔFBC = ½ □AB

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

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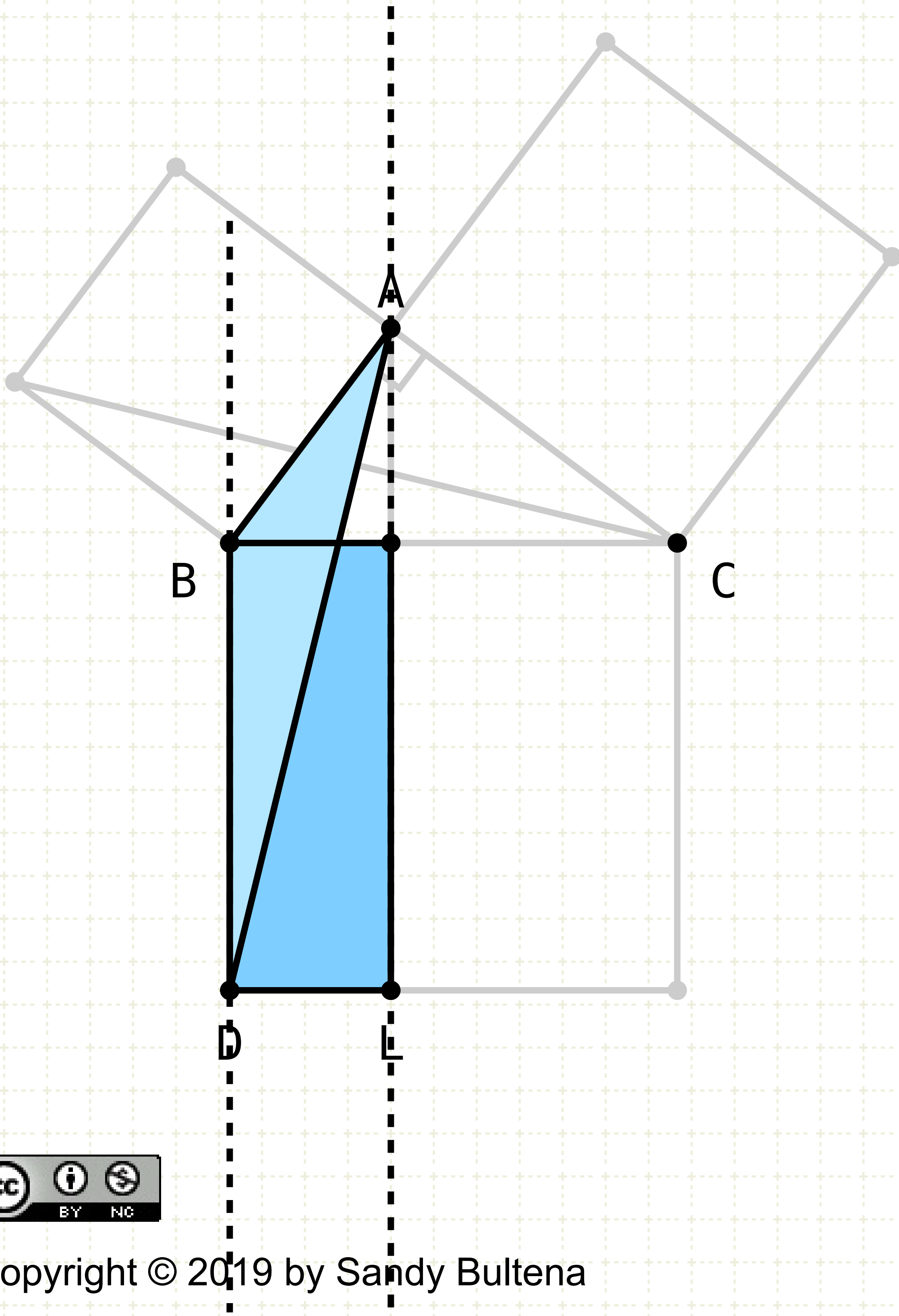
The square AB and the triangle FBC share the same base, and are enclosed by the same parallel lines GC,FB thus FBC is one half ABFG (I·41)

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



ABFG is a square
ACKH is a square
BCED is a square

GA,AC = GC
BA,AH = BH
$\angle FBC = \llcorner + \angle ABC = \angle ABD$
$AL \parallel BD$
$\Delta FBC = \Delta ABD$
$\Delta FBC = \frac{1}{2} \square AB$
$\Delta ABD = \frac{1}{2} \square BDL$

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

Similarly for line BH (I·14)

Angles FBA and CBD are both right angles

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The triangle ABD equals half the parallelogram BDL (I·41)

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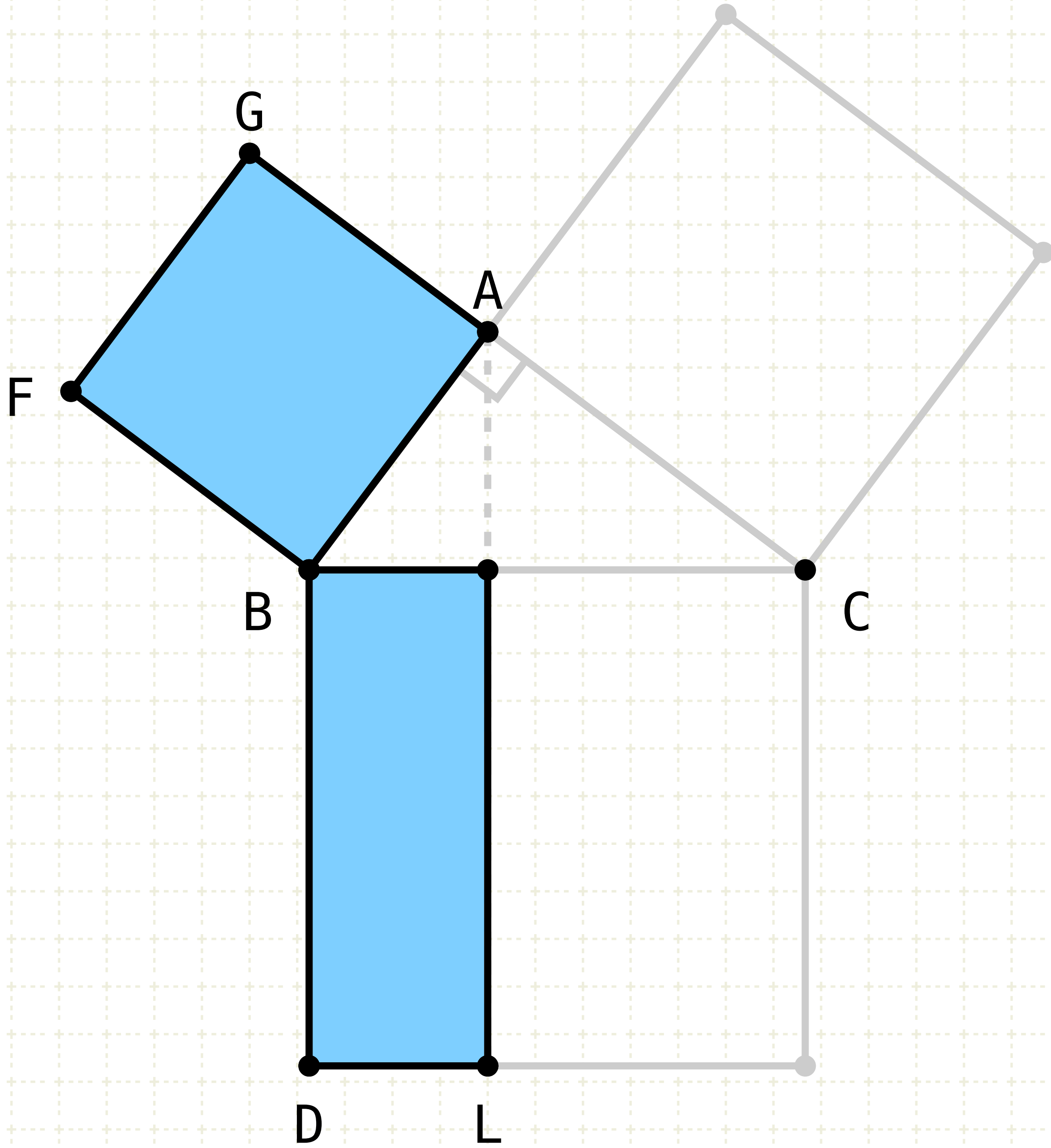

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∠FBC = ∟ + ∠ABC = ∠ABD
AL ∥ BD
ΔFBC = ΔABD
ΔFBC = ½ □AB
ΔABD = ½ □BDL
□AB = □BDL

Proof:

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The triangle ABD equals half the parallelogram BDL (I·41)

Therefore, the square of AB equals the polygon BDL

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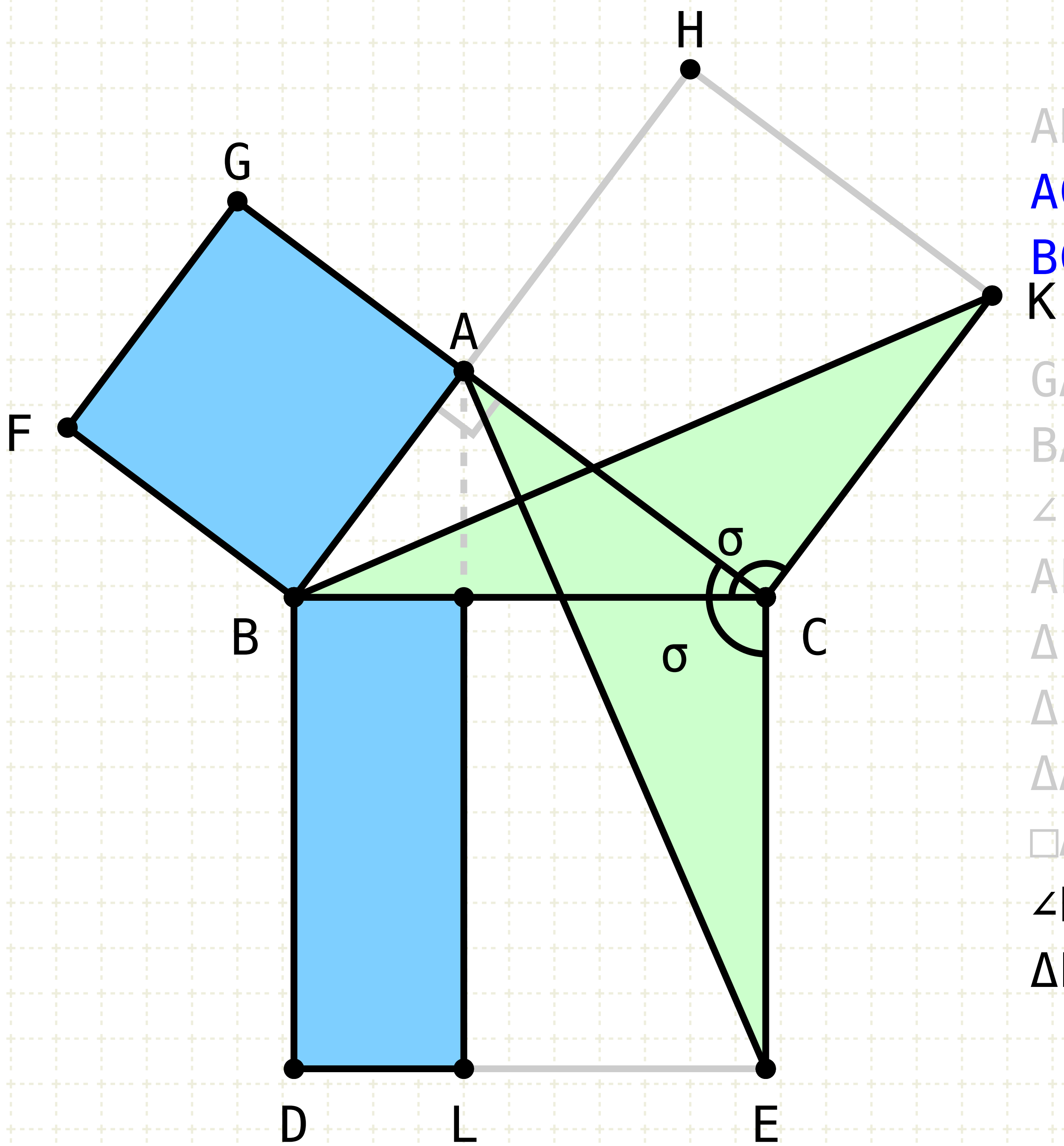
In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



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GA,AC = GC

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AL ∥ BD

ΔFBC = ΔABD

ΔFBC = ½ □AB

ΔABD = ½ □BDL

□AB = □BDL

∠BCK = ∠ACE

ΔECA = ΔBCK

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

Similarly for line BH (I·14)

Angles FBA and CBD are both right angles

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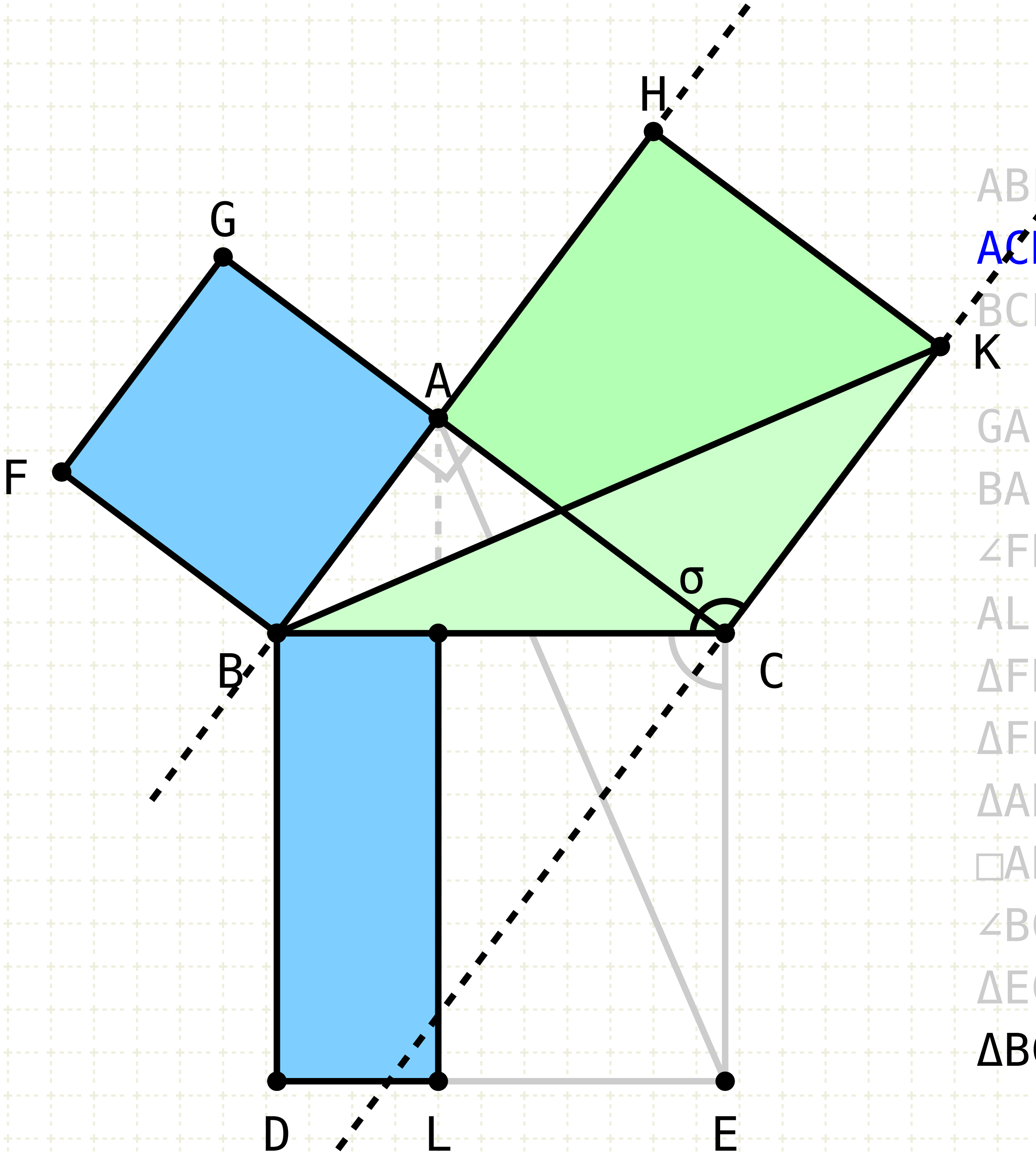
The triangle ABD equals half the parallelogram BDL (I·41)

Therefore, the square of AB equals the polygon BDL

Applying the same logic as before, triangles BCK and AEC are equal (I·4)

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



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AL ∥ BD
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ΔFBC = ½ □AB
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Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

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The triangle ABD equals half the parallelogram BDL (I·41)

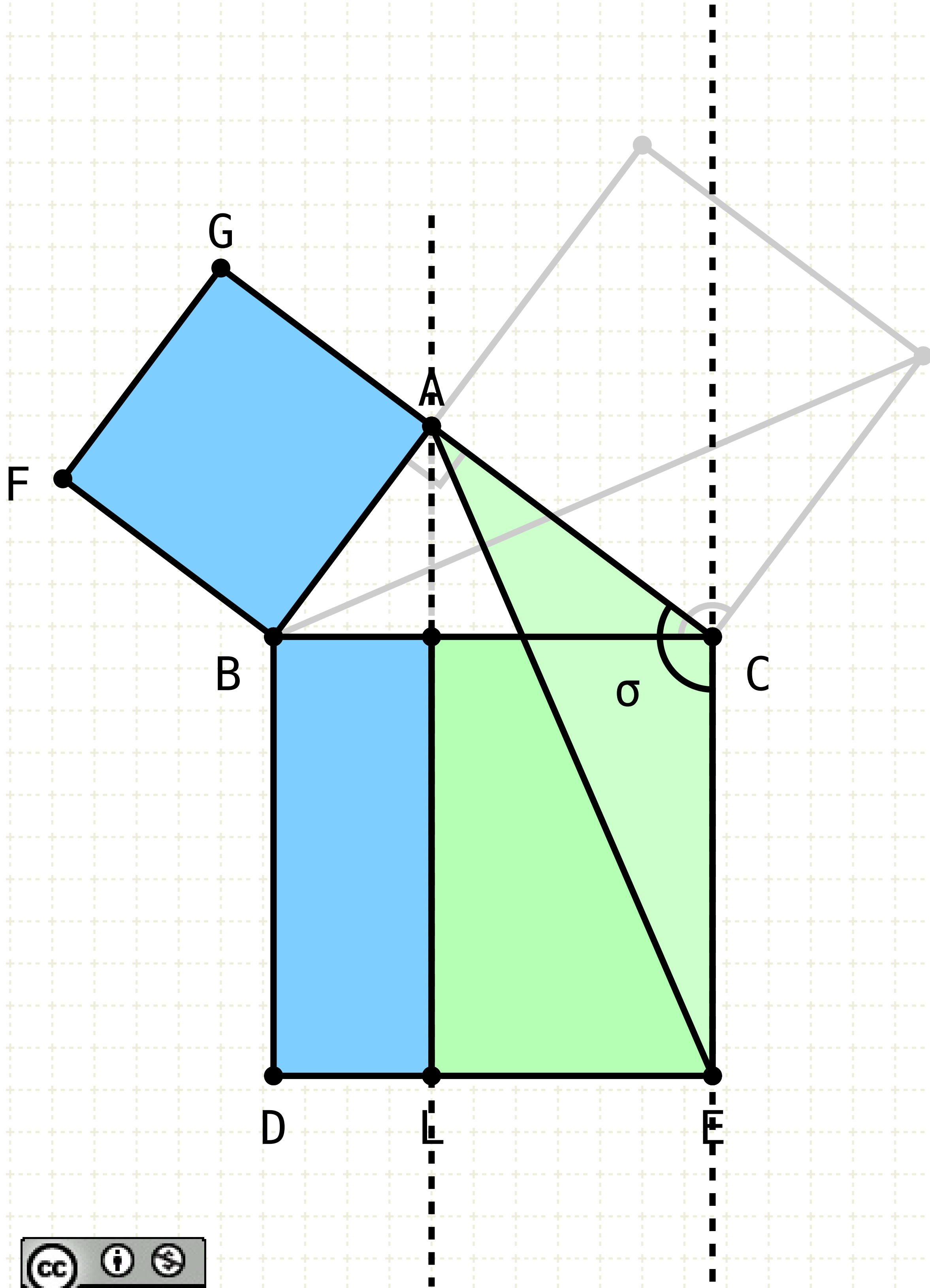
Therefore, the square of AB equals the polygon BDL

Applying the same logic as before, triangles BCK and AEC are equal (I·4)

Triangle BCK is half the square AC

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



ABFG is a square

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GA, AC = GC

BA, AH = BH

$\angle FBC = \llcorner + \angle ABC = \angle ABD$

$AL \parallel BD$

$\Delta FBC = \Delta ABD$

$\Delta FBC = \frac{1}{2}\ \square AB$

$\Delta ABD = \frac{1}{2}\ \square BDL$

$\square AB = \square BDL$

$\angle BCK = \angle ACE$

$\Delta ECA = \Delta BCK$

$\Delta BCK = \frac{1}{2}\ \square AC$

$\Delta ECA = \frac{1}{2}\ \square CEL$

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

Similarly for line BH (I·14)

Angles FBA and CBD are both right angles

Adding angle ABC to both demonstrates that angles FBC and ABD are also equal

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The triangle ABD equals half the parallelogram BDL (I·41)

Therefore, the square of AB equals the polygon BDL

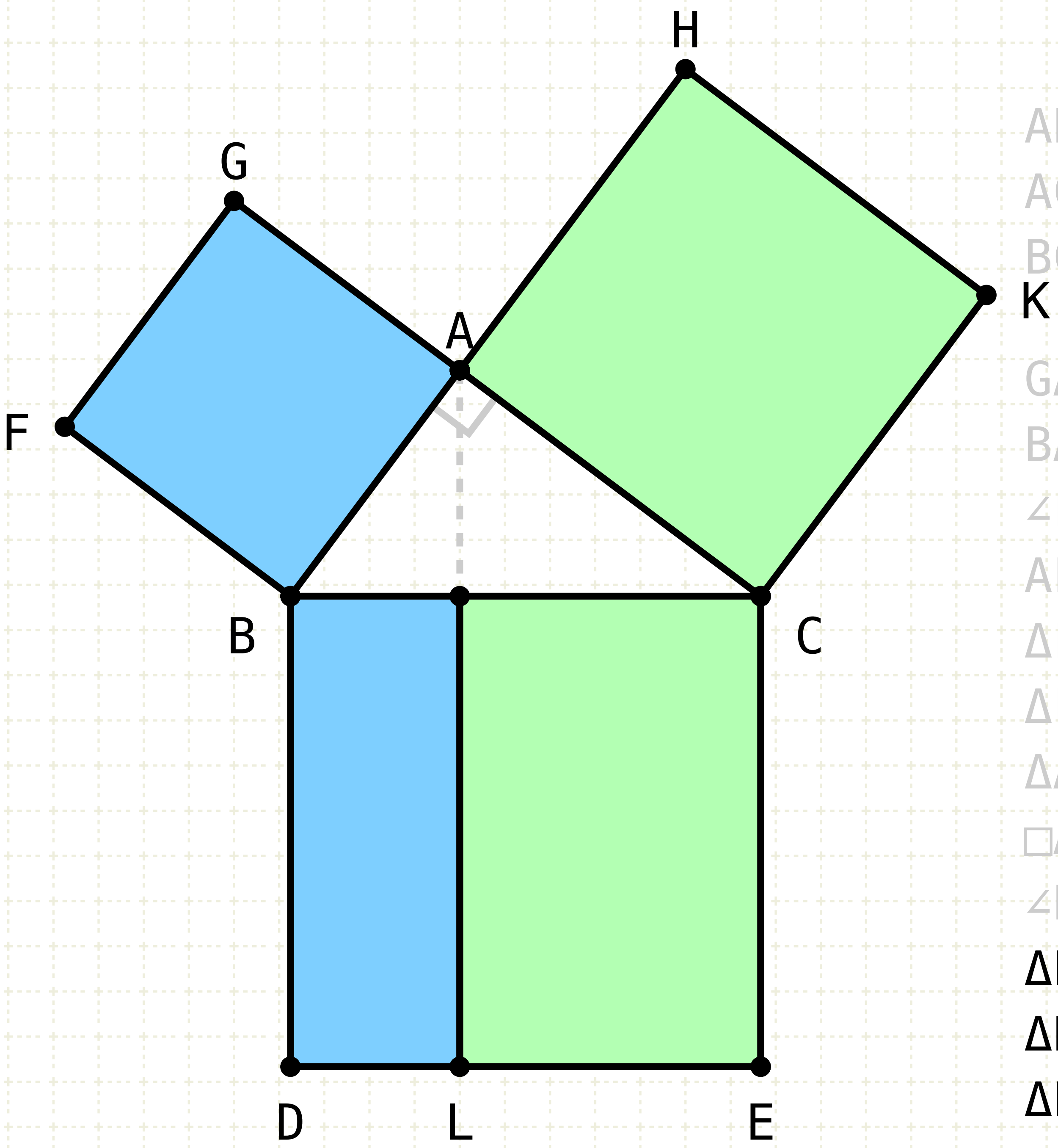
Applying the same logic as before, triangles BCK and AEC are equal (I·4)

Triangle BCK is half the square AC

Triangle ECA is half the parallelogram CEL (I·41)

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



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$\square AB = \square BDL$
$\angle BCK = \angle ACE$
$\Delta ECA = \Delta BCK$
$\Delta BCK = \frac{1}{2} \square AC$
$\Delta ECA = \frac{1}{2} \square CEL$
$\square AC = \square CEL$

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

Similarly for line BH (I·14)

Angles FBA and CBD are both right angles

Adding angle ABC to both demonstrates that angles FBC and ABD are also equal

Draw a line from A, parallel to BD

Draw lines AD and FC, and consider triangles FBC and ABD

The two triangles are equal, FB equals AB, BC equals BD, with a common angle γ (I·4)

The square AB and the triangle FBC share the same base, and are enclosed by the same parallel lines GC,FB thus FBC is one half ABFG (I·41)

The triangle ABD equals half the parallelogram BDL (I·41)

Therefore, the square of AB equals the polygon BDL

Applying the same logic as before, triangles BCK and AEC are equal (I·4)

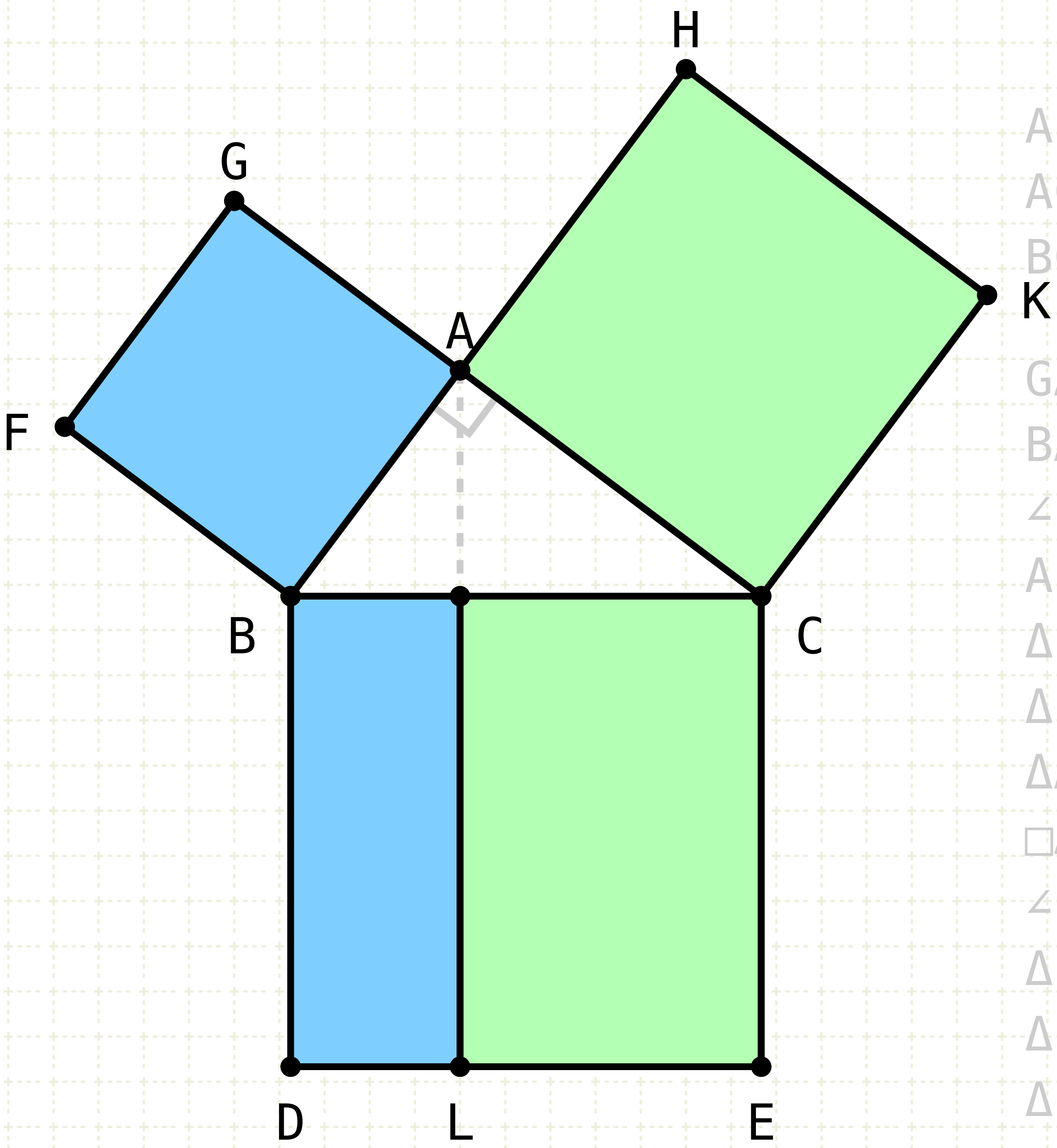
Triangle BCK is half the square AC

Triangle ECA is half the parallelogram CEL (I·41)

Therefore the square of AC equals the parallelogram CEL

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



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$\square AB = \square BDL$

$\angle BCK = \angle ACE$

$\Delta ECA = \Delta BCK$

$\Delta BCK = \frac{1}{2} \square AC$

$\Delta ECA = \frac{1}{2} \square CEL$

$\square AC = \square CEL$

$\square BC = \square BDL + \square CEL$

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

Similarly for line BH (I·14)

Angles FBA and CBD are both right angles

Adding angle ABC to both demonstrates that angles FBC and ABD are also equal

Draw a line from A, parallel to BD

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The square AB and the triangle FBC share the same base, and are enclosed by the same parallel lines GC,FB thus FBC is one half ABFG (I·41)

The triangle ABD equals half the parallelogram BDL (I·41)

Therefore, the square of AB equals the polygon BDL

Applying the same logic as before, triangles BCK and AEC are equal (I·4)

Triangle BCK is half the square AC

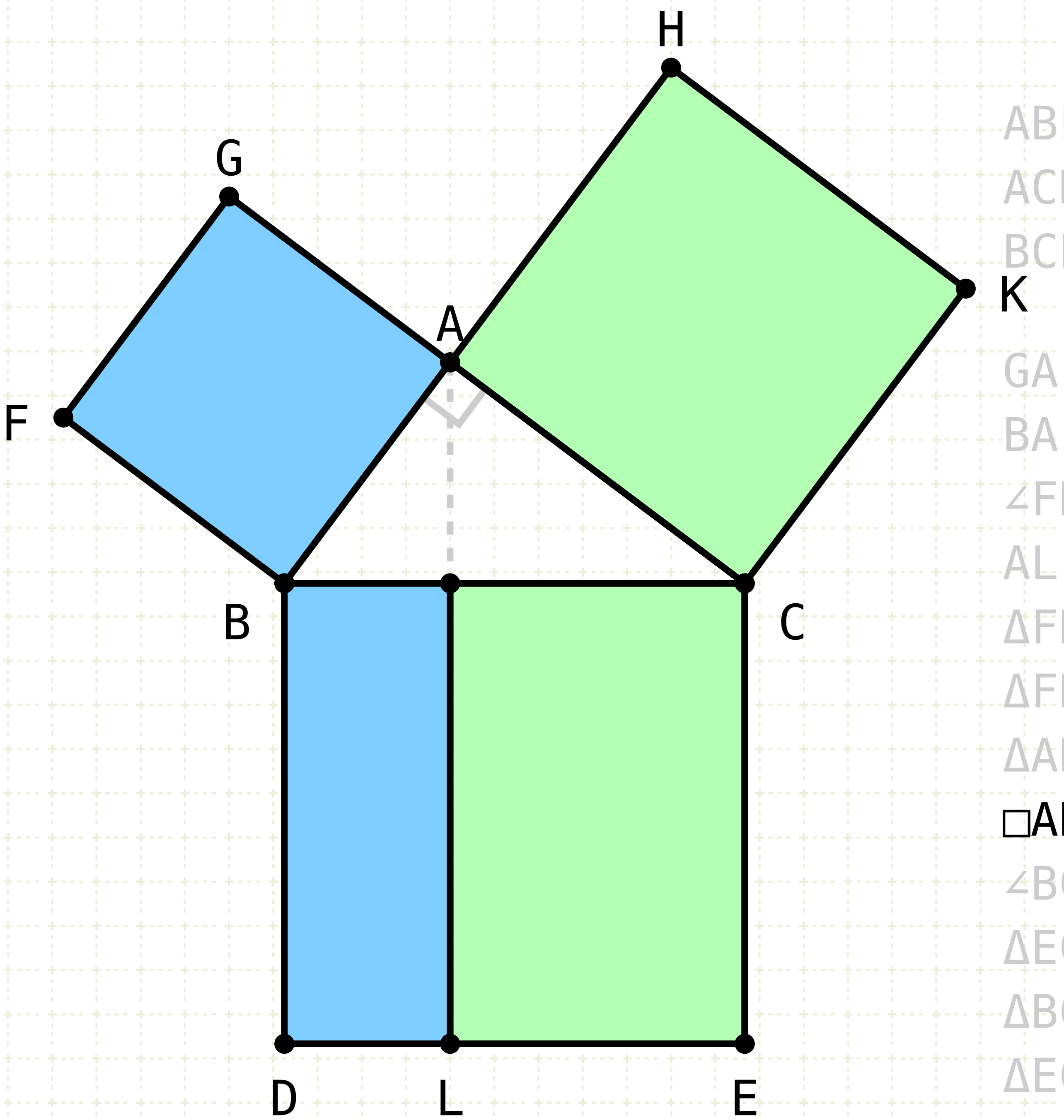
Triangle ECA is half the parallelogram CEL (I·41)

Therefore the square of AC equals the parallelogram CEL

The square of line BC equals the sum of BDL and CEL

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



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$\square BC = \square AB + \square AC$

Proof:

By construction, angle GAB is a right angle, as is BAC, therefore lines GA and AC form a single line GC (I·14)

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The triangle ABD equals half the parallelogram BDL (I·41)

Therefore, the square of AB equals the polygon BDL

Applying the same logic as before, triangles BCK and AEC are equal (I·4)

Triangle BCK is half the square AC

Triangle ECA is half the parallelogram CEL (I·41)

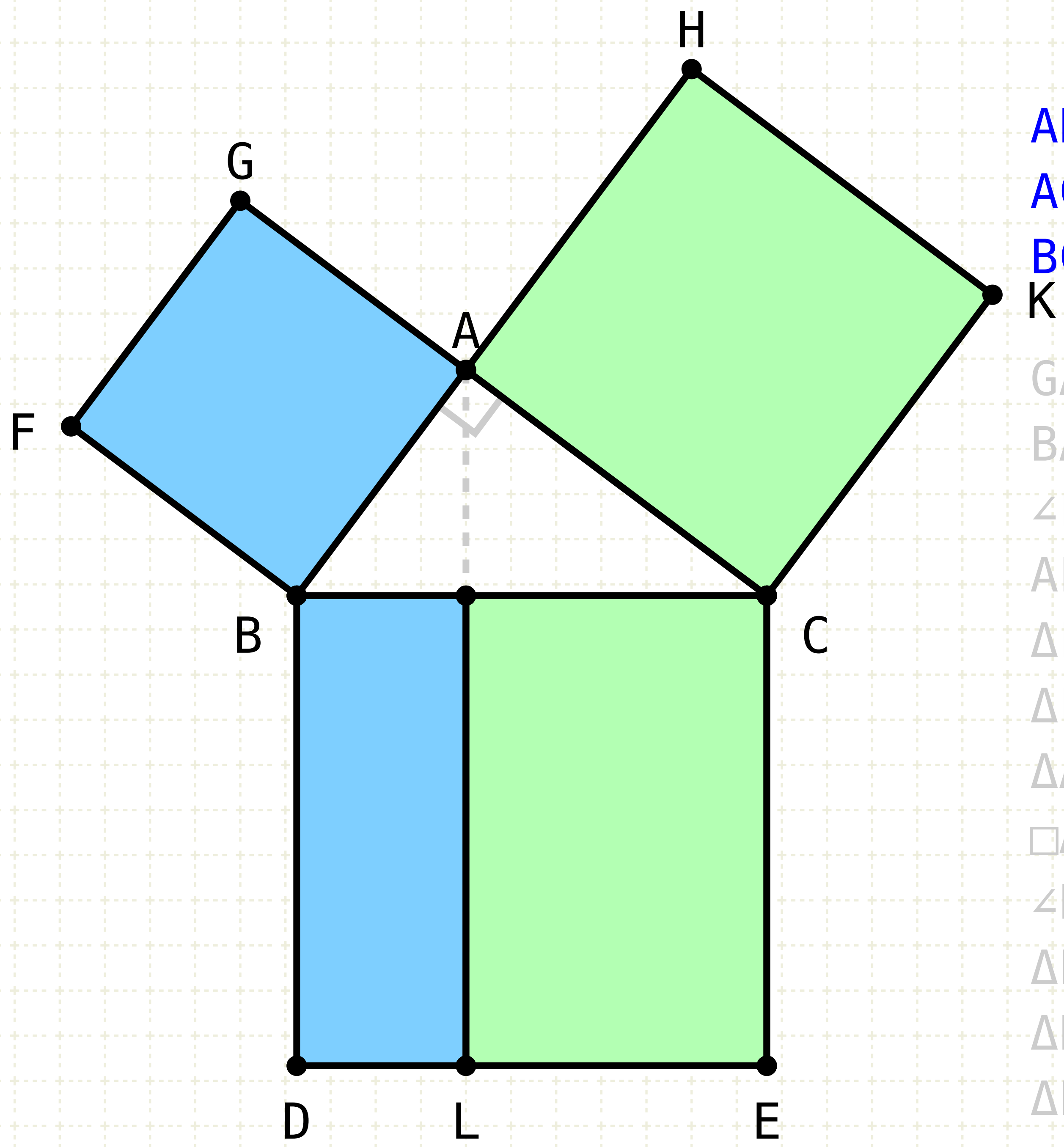
Therefore the square of AC equals the parallelogram CEL

The square of line BC equals the sum of BDL and CEL

The sum of the squares of lines AB and AC equals the square of BC

Proposition 47 of Book I

In right-angled triangles the square on the side opposite the right angle equals the sum of the squares on the sides containing the right angle.



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The triangle ABD equals half the parallelogram BDL (I·41)

Therefore, the square of AB equals the polygon BDL

Applying the same logic as before, triangles BCK and AEC are equal (I·4)

Triangle BCK is half the square AC

Triangle ECA is half the parallelogram CEL (I·41)

Therefore the square of AC equals the parallelogram CEL

The square of line BC equals the sum of BDL and CEL

The sum of the squares of lines AB and AC equals the square of BC

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