

マストークとは

和からの講師 岡本 による、数学のトークショー。

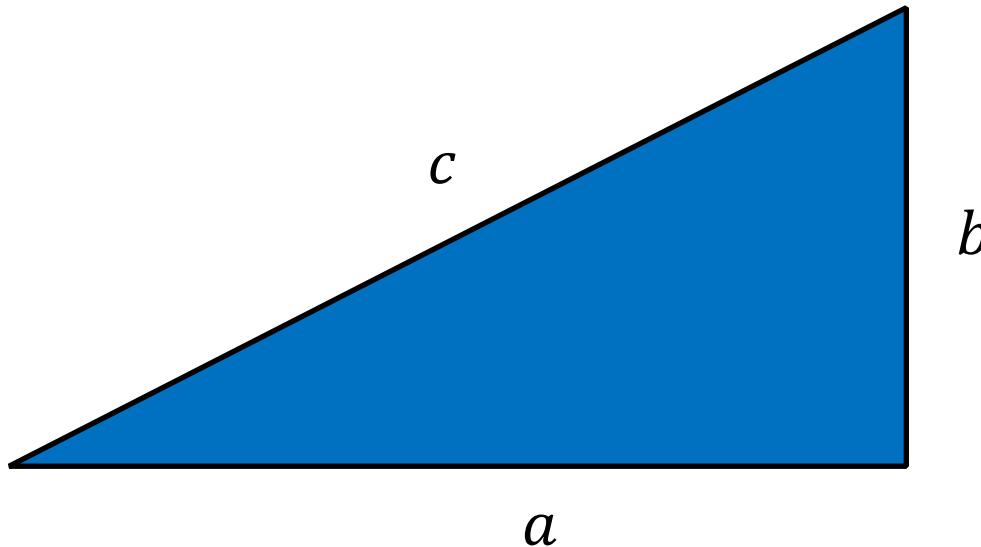
身近な話題から、深淵な数学の世界まで、皆様をご案内いたします。

第7回マストーク

ピタゴラスの定理の証明の展覧会

今回のマストーク

直角三角形



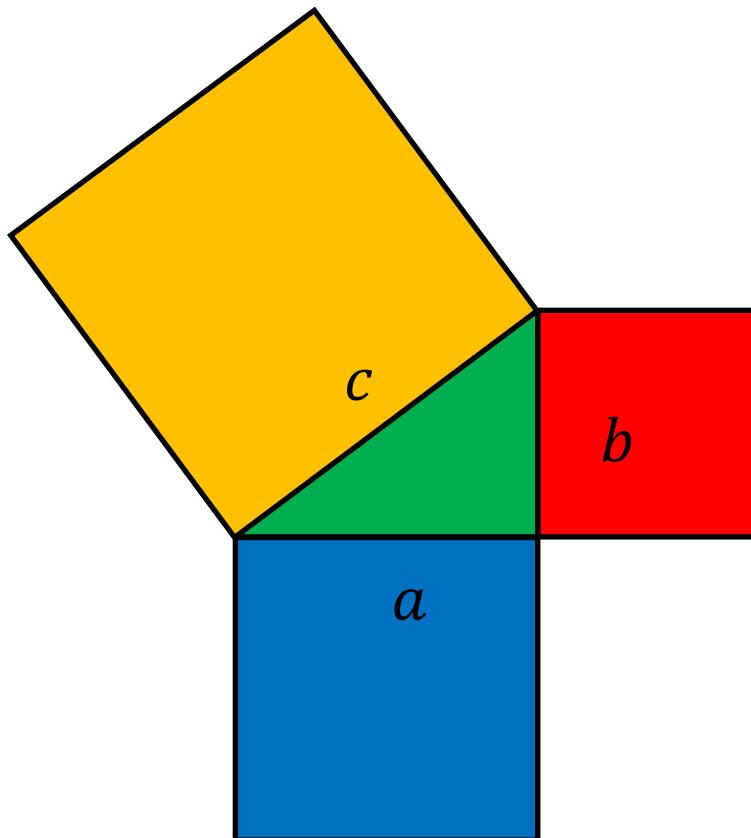
ピタゴラスの定理(三平方の定理)

$$a^2 + b^2 = c^2$$

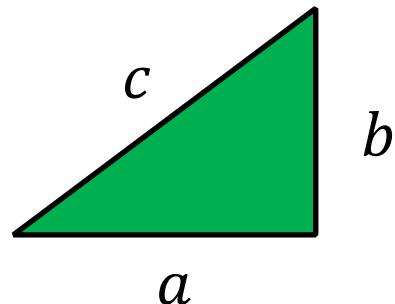
今日はひたすらこの証明(うつくしさ)を堪能していこうと思います。

ピタゴラスの定理の証明

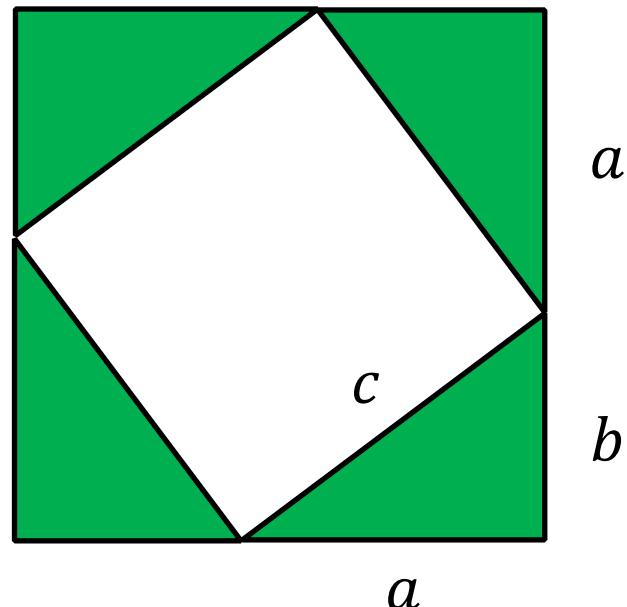
ピタゴラスの定理の証明その 1



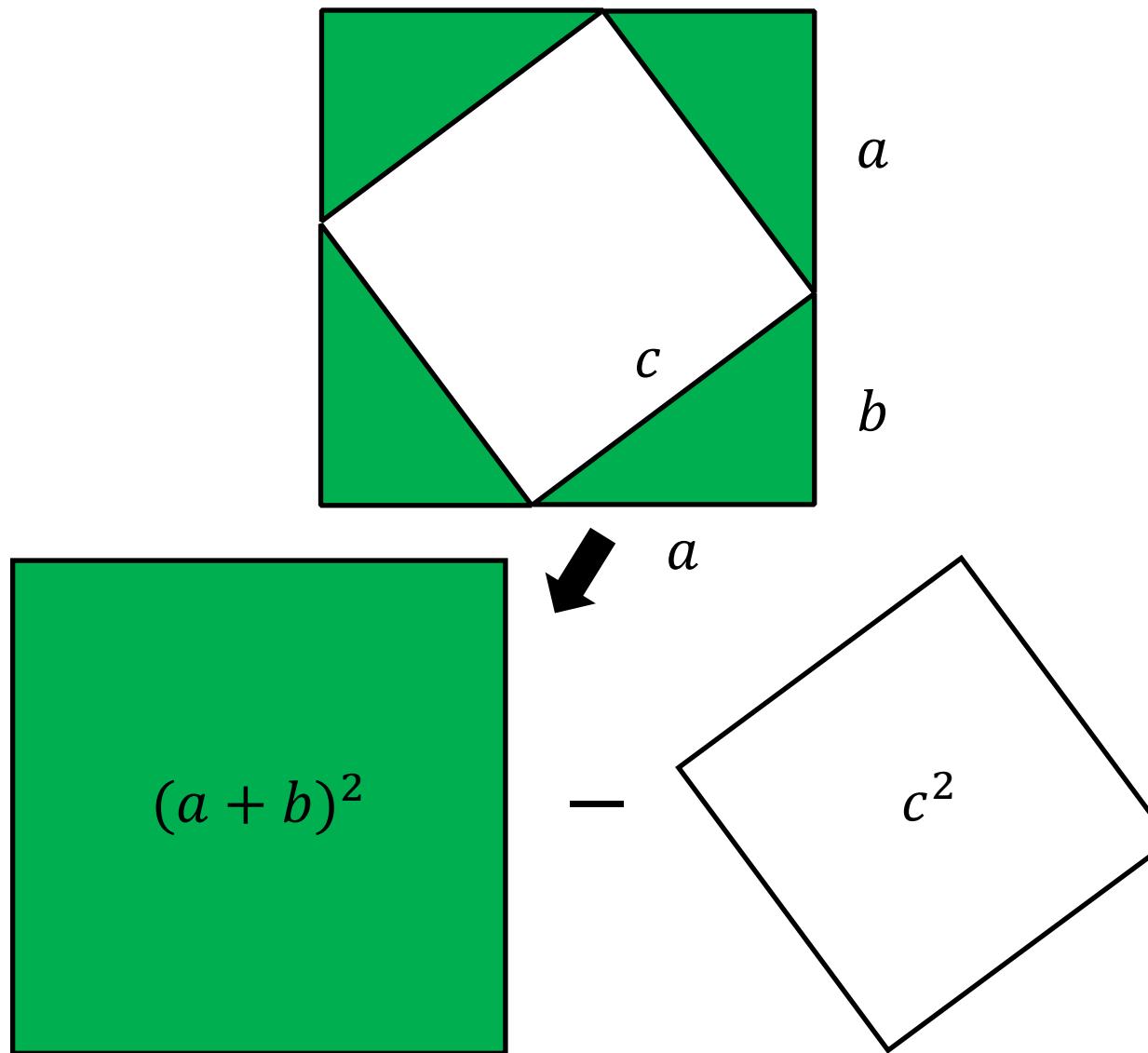
ピタゴラスの定理の証明その1



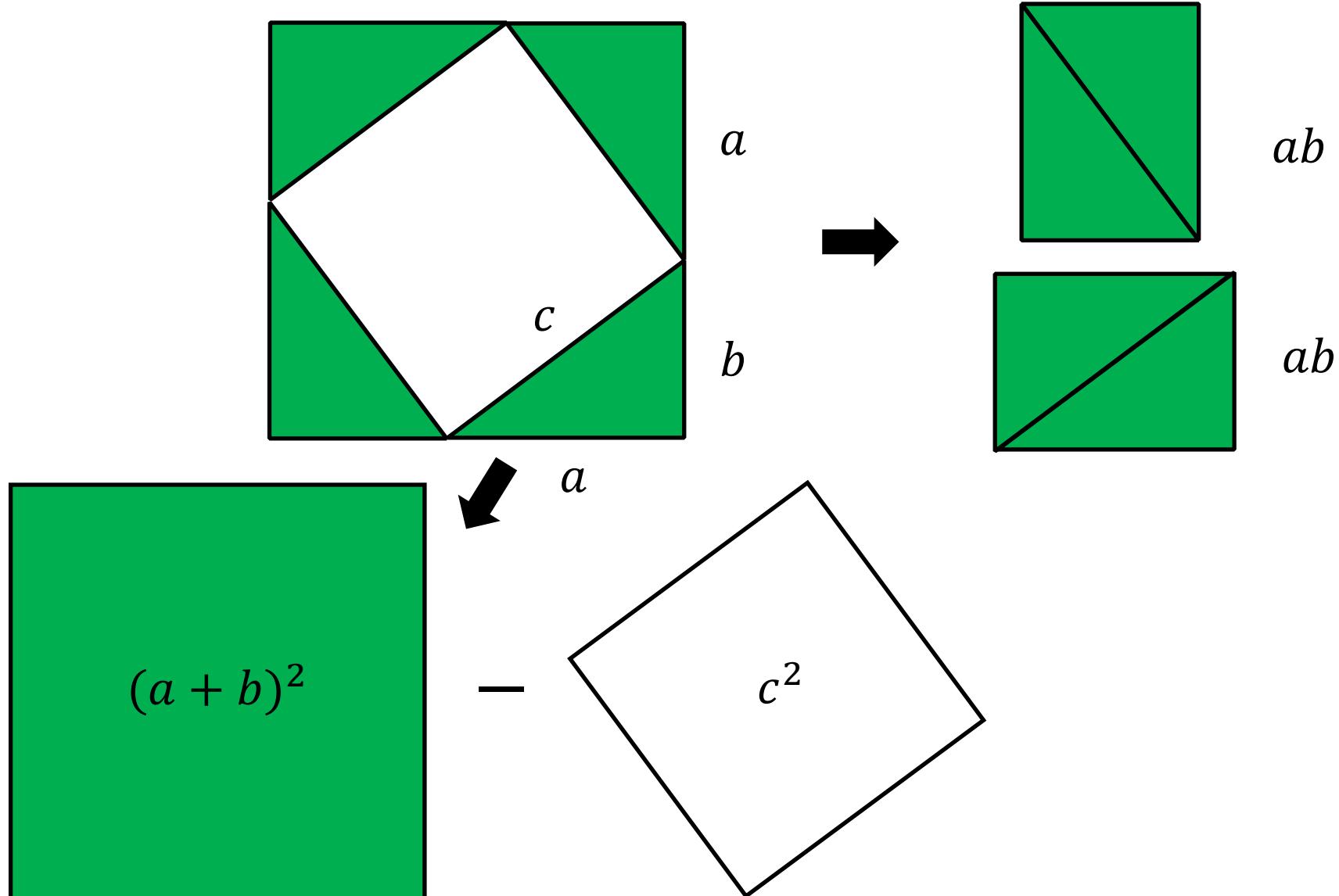
ピタゴラスの定理の証明その1



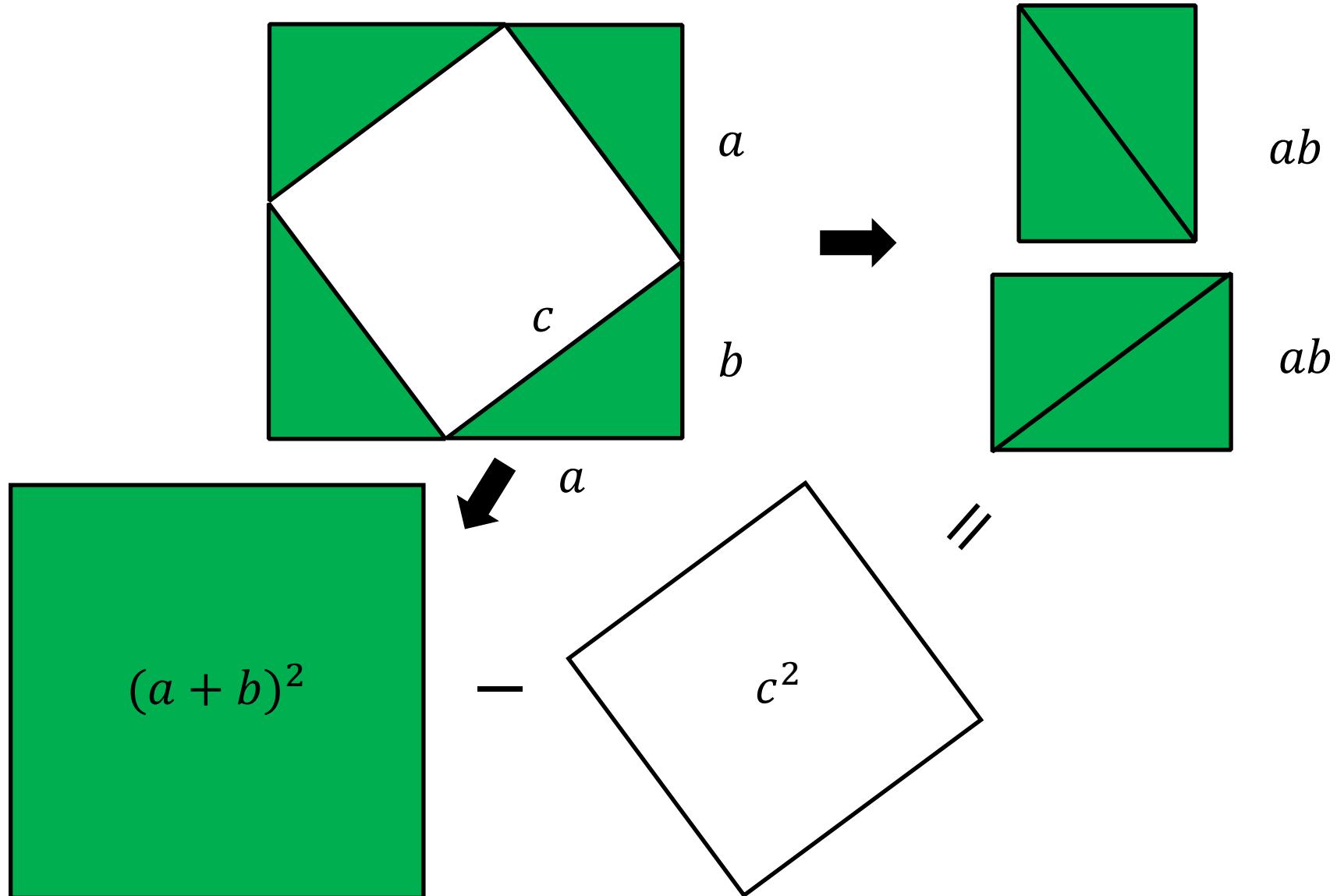
ピタゴラスの定理の証明その1



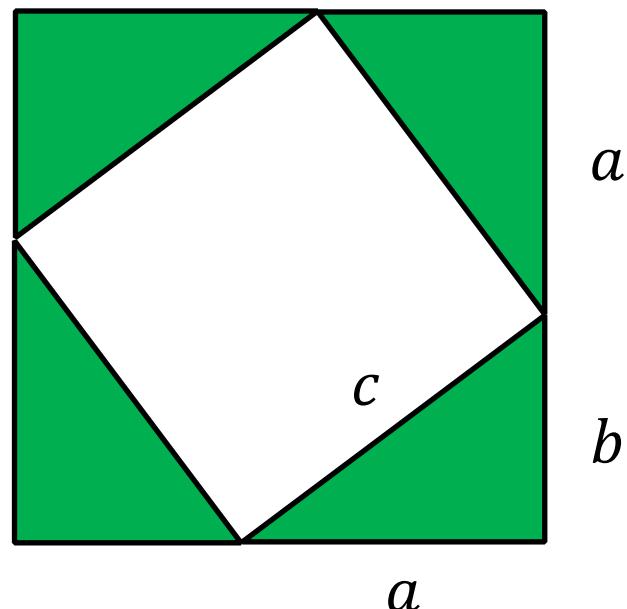
ピタゴラスの定理の証明その1



ピタゴラスの定理の証明その1

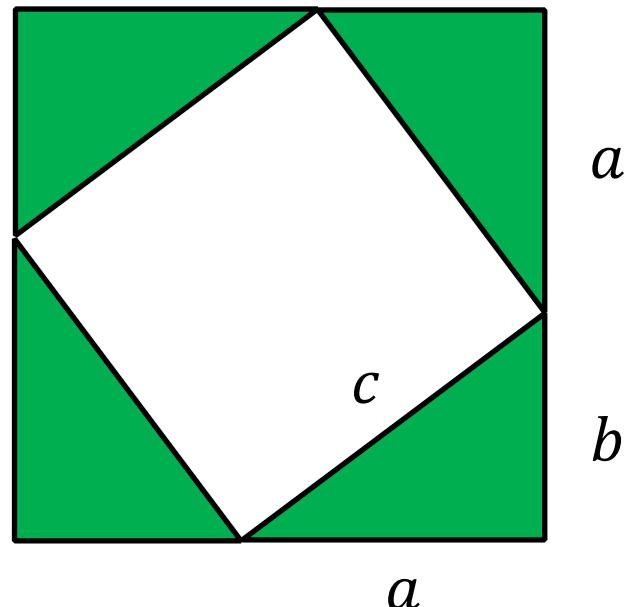


ピタゴラスの定理の証明その1



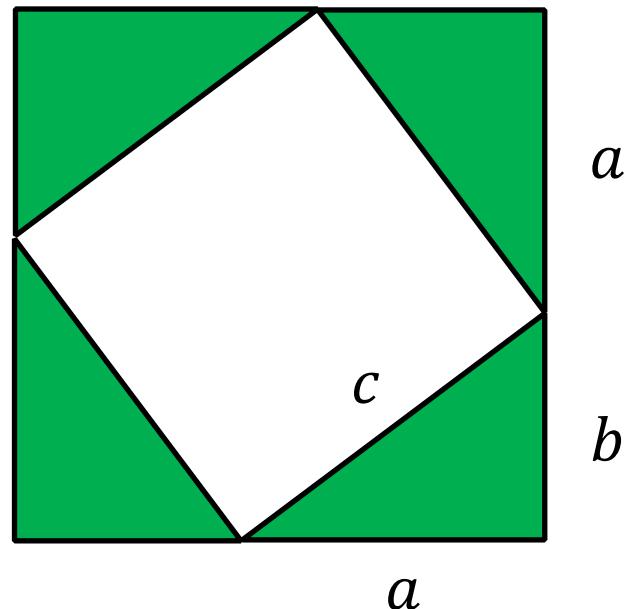
$$(a + b)^2 - c^2 = 2ab$$

ピタゴラスの定理の証明その1



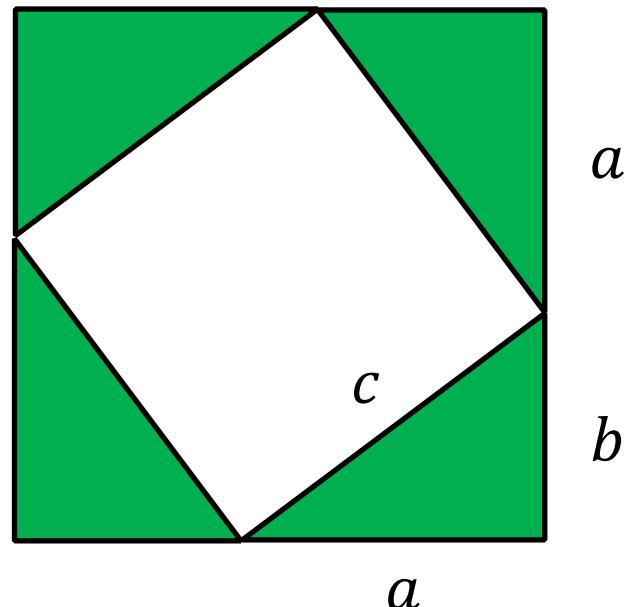
$$a^2 + 2ab + b^2 - c^2 = 2ab$$

ピタゴラスの定理の証明その1



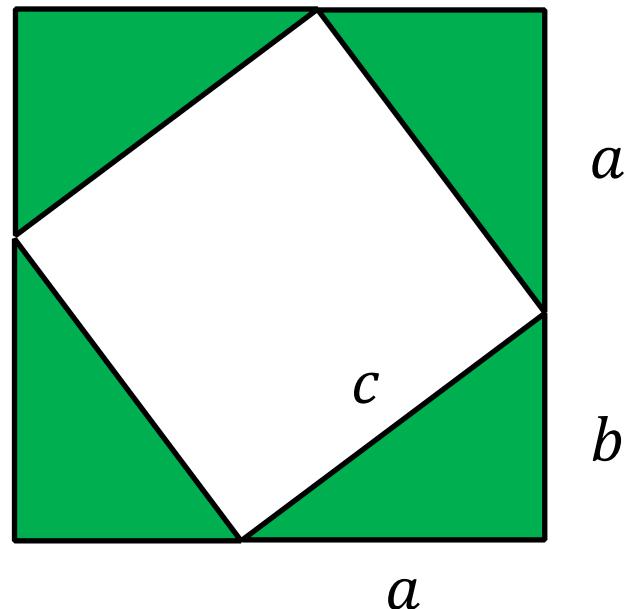
$$a^2 + 2ab + b^2 - c^2 = 2ab$$

ピタゴラスの定理の証明その1



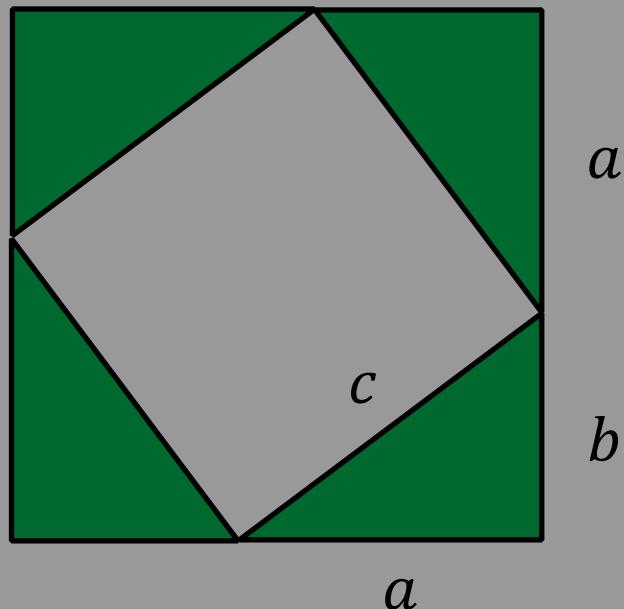
$$a^2 + b^2 - c^2 = 0$$

ピタゴラスの定理の証明その1



$$a^2 + b^2 = c^2$$

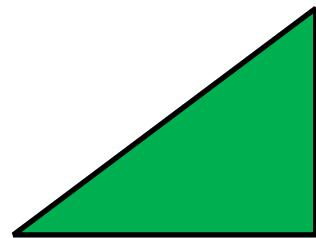
ピタゴラスの定理の証明その 1



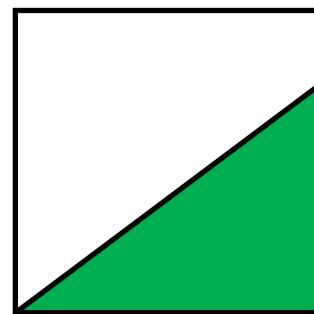
$$a^2 + b^2 = c^2$$

QED

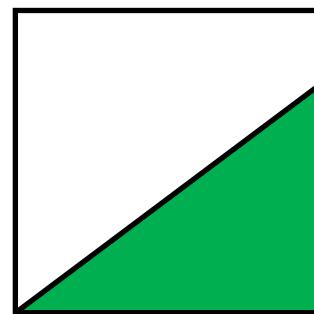
ピタゴラスの定理の証明その2



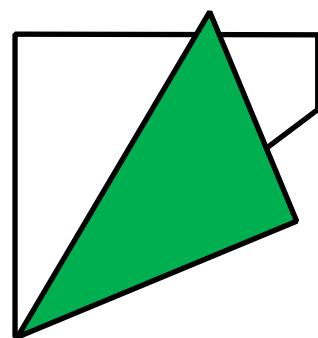
ピタゴラスの定理の証明その2



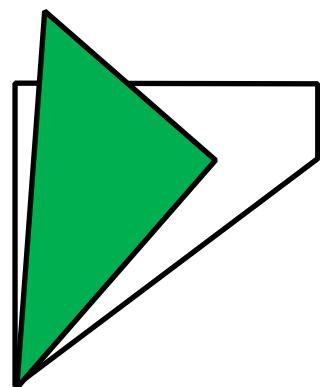
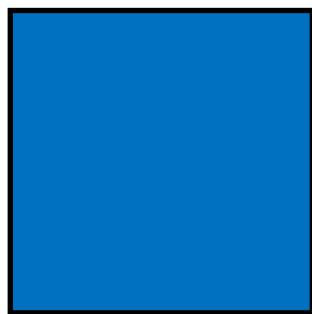
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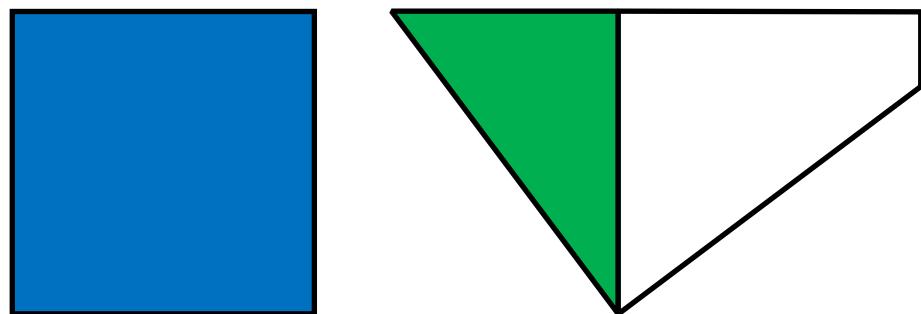
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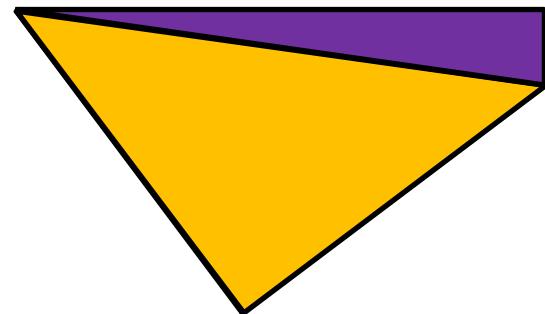
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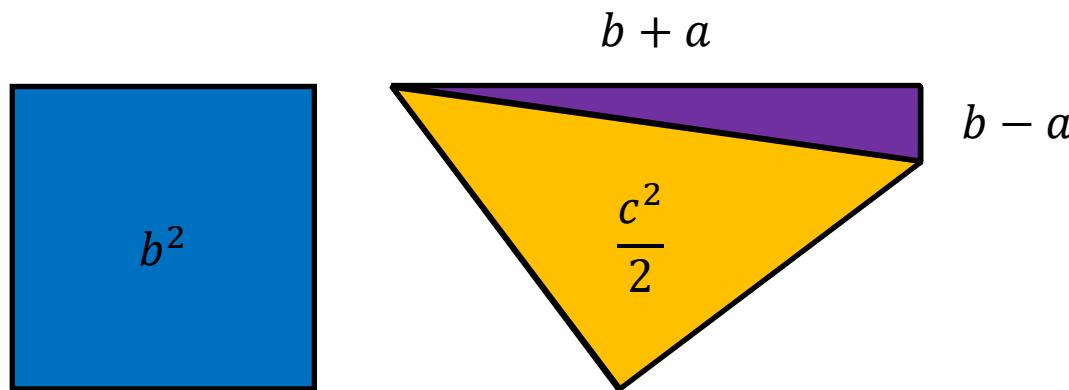
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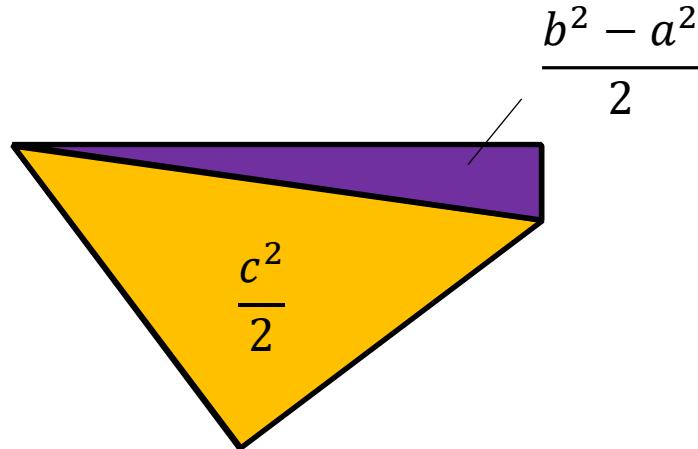
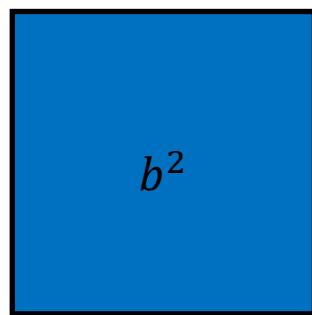
ピタゴラスの定理の証明その2



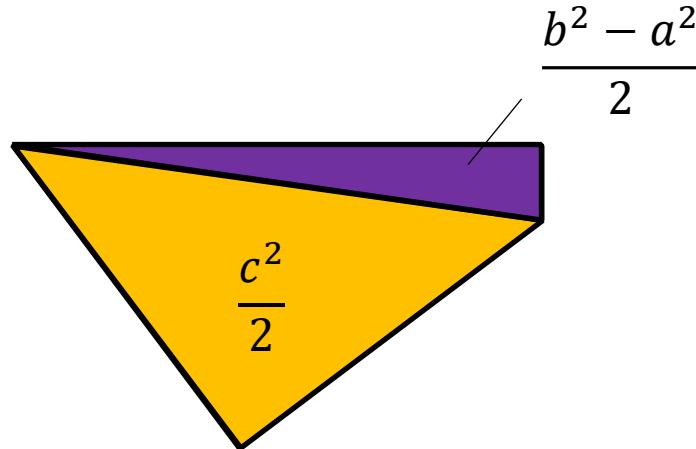
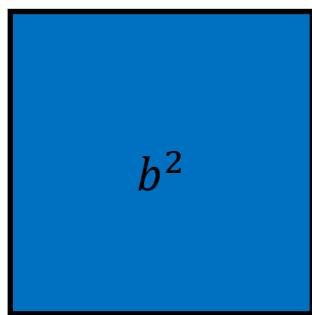
ピタゴラスの定理の証明その2



ピタゴラスの定理の証明その2

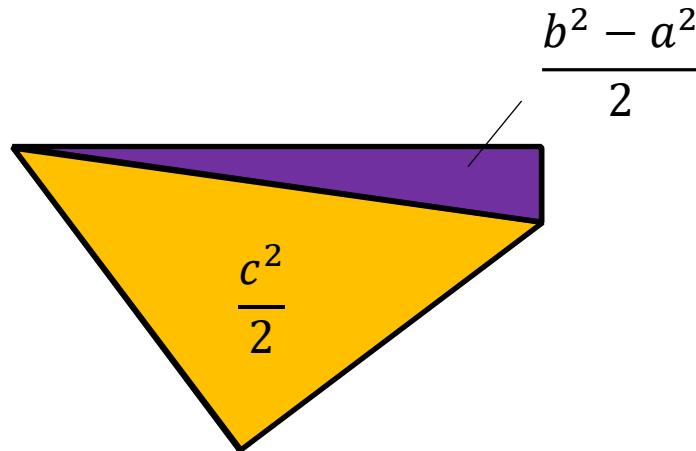
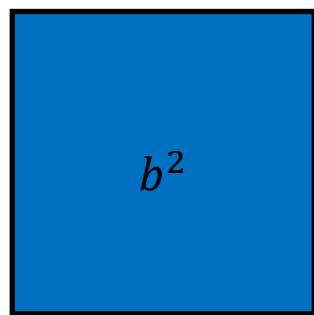


ピタゴラスの定理の証明その2



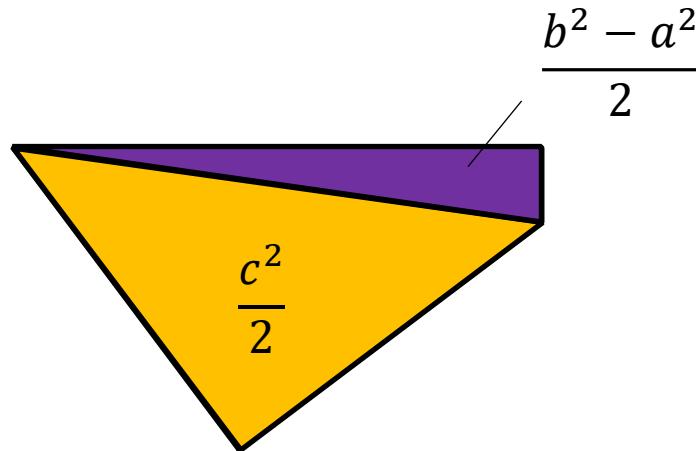
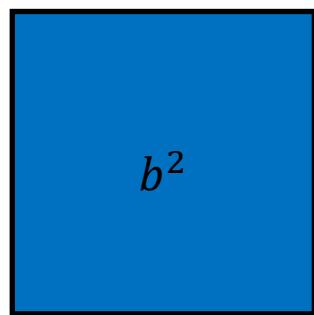
$$\frac{b^2 - a^2}{2} + \frac{c^2}{2} = b^2$$

ピタゴラスの定理の証明その2



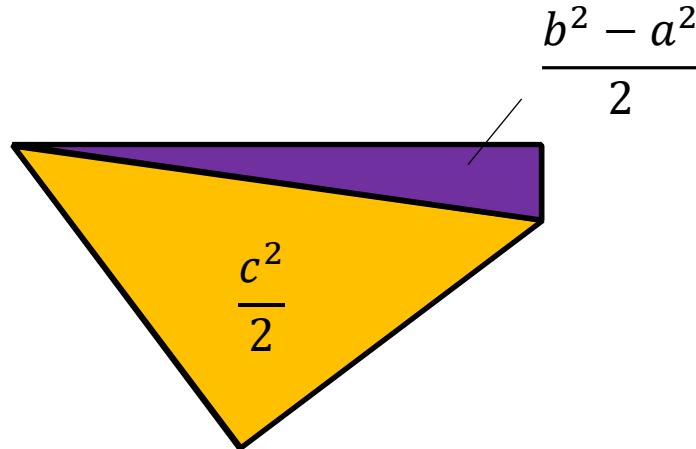
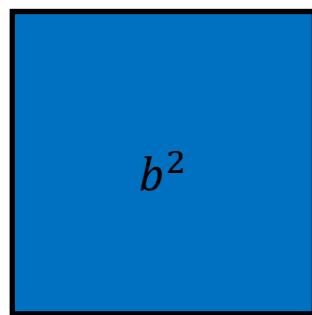
$$\frac{b^2 - a^2}{2} + \frac{c^2}{2} = b^2$$

ピタゴラスの定理の証明その2



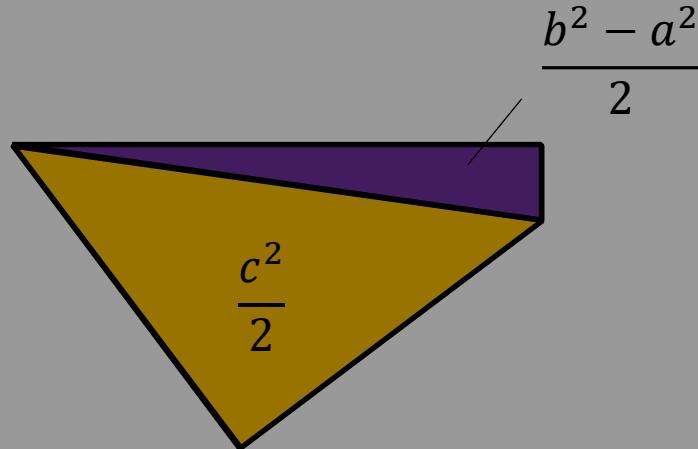
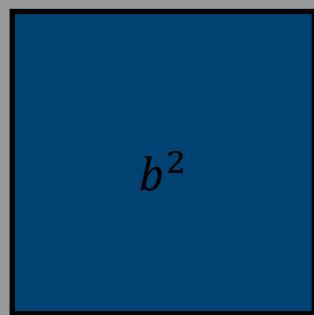
$$b^2 - a^2 + c^2 = \mathbf{2}b^2$$

ピタゴラスの定理の証明その2



$$c^2 = a^2 + b^2$$

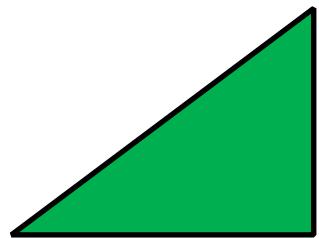
ピタゴラスの定理の証明その2



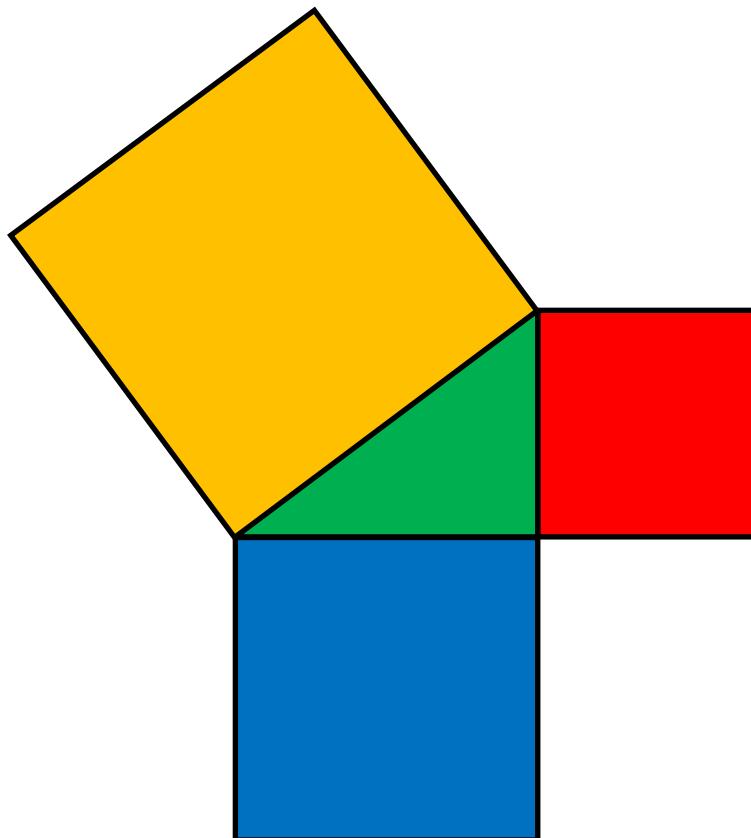
$$c^2 = a^2 + b^2$$

QED

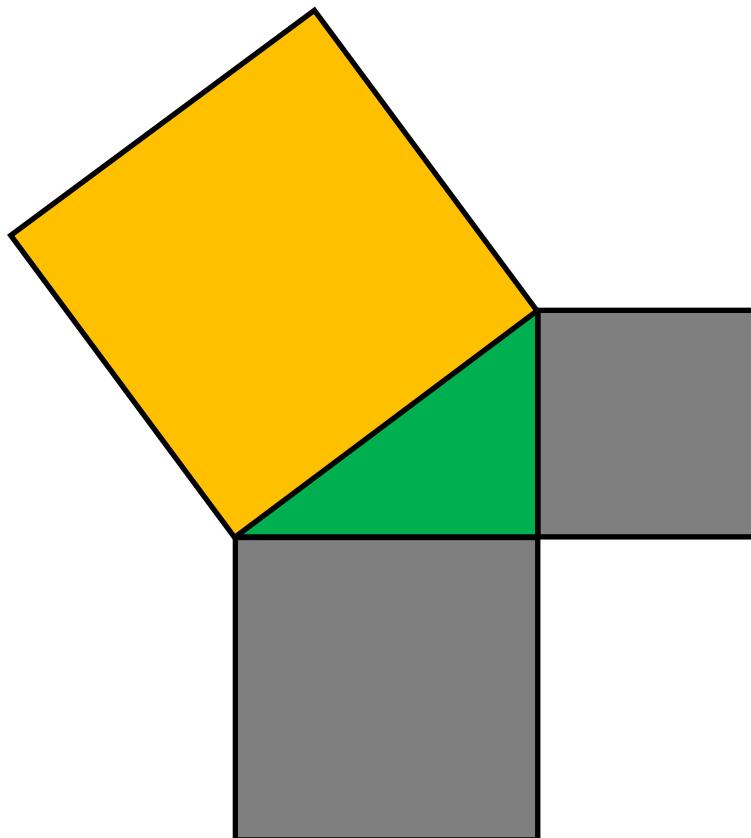
ピタゴラスの定理の証明その3



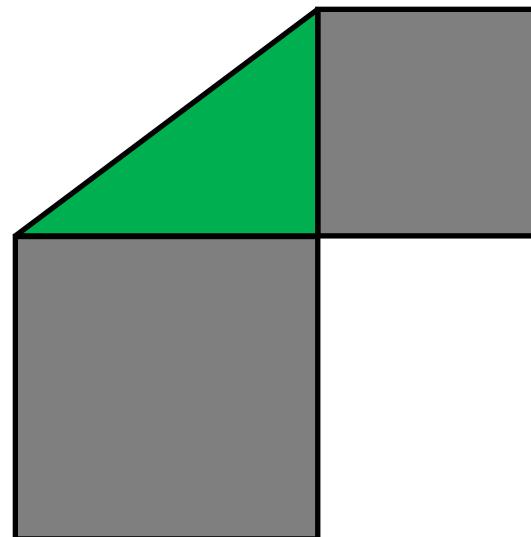
ピタゴラスの定理の証明その3



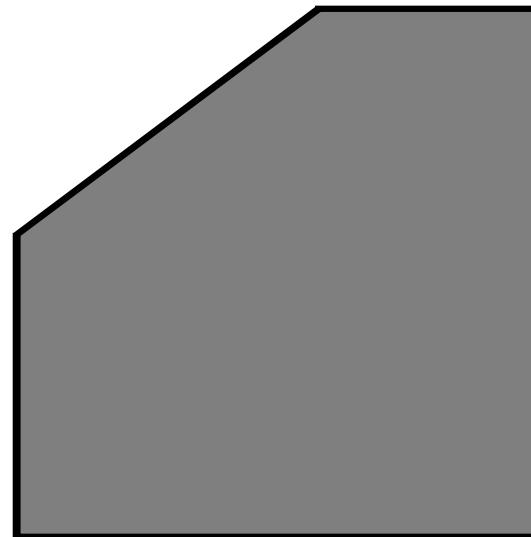
ピタゴラスの定理の証明その3



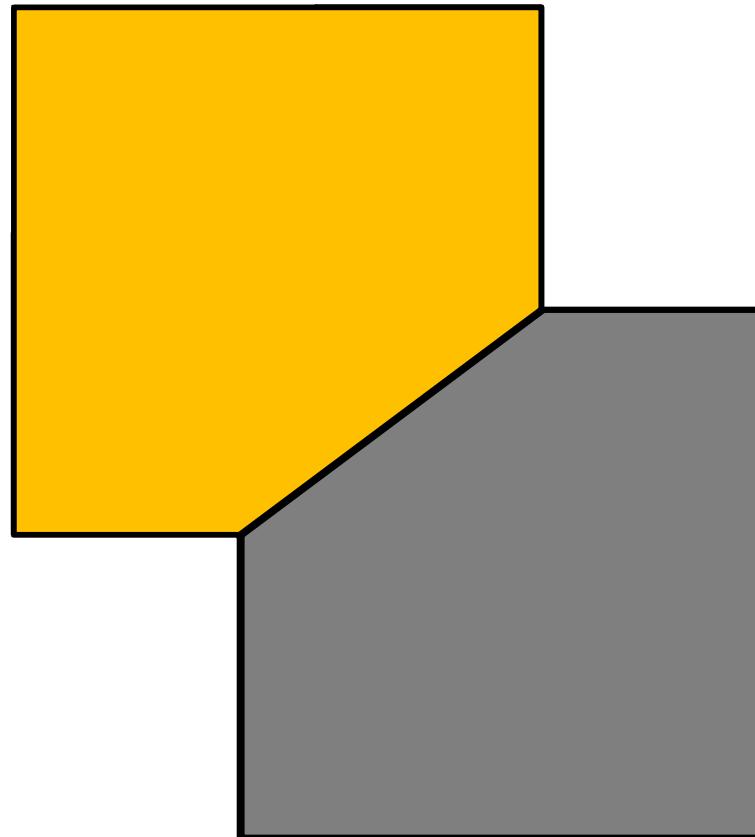
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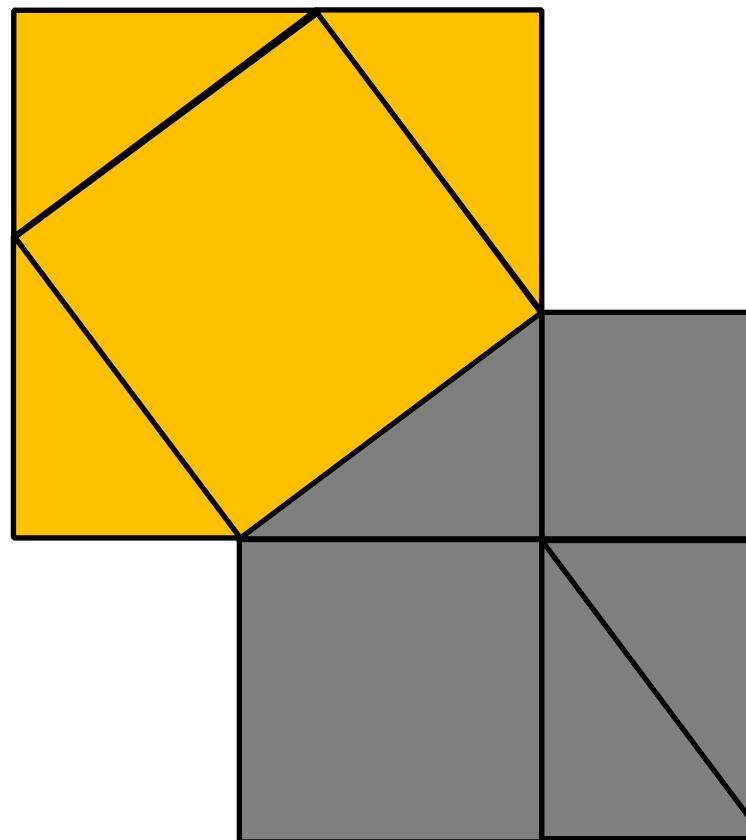
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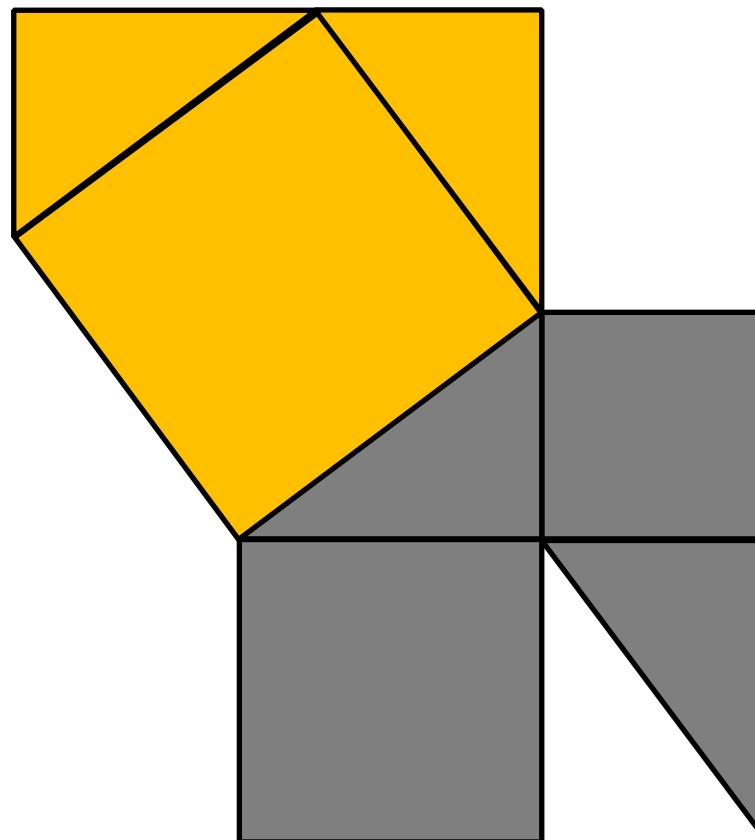
ピタゴラスの定理の証明その3



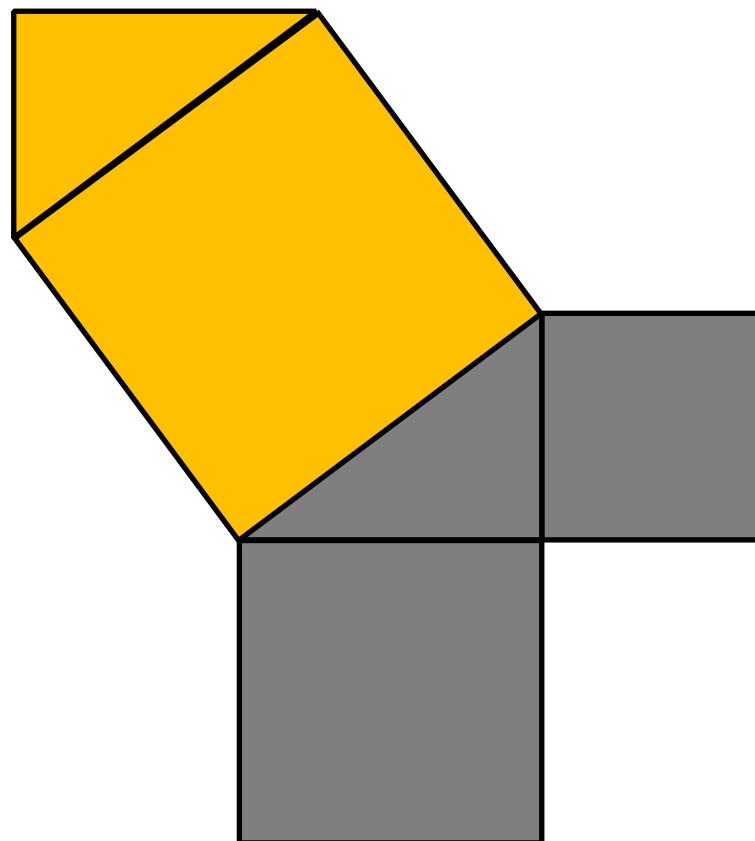
ピタゴラスの定理の証明その3



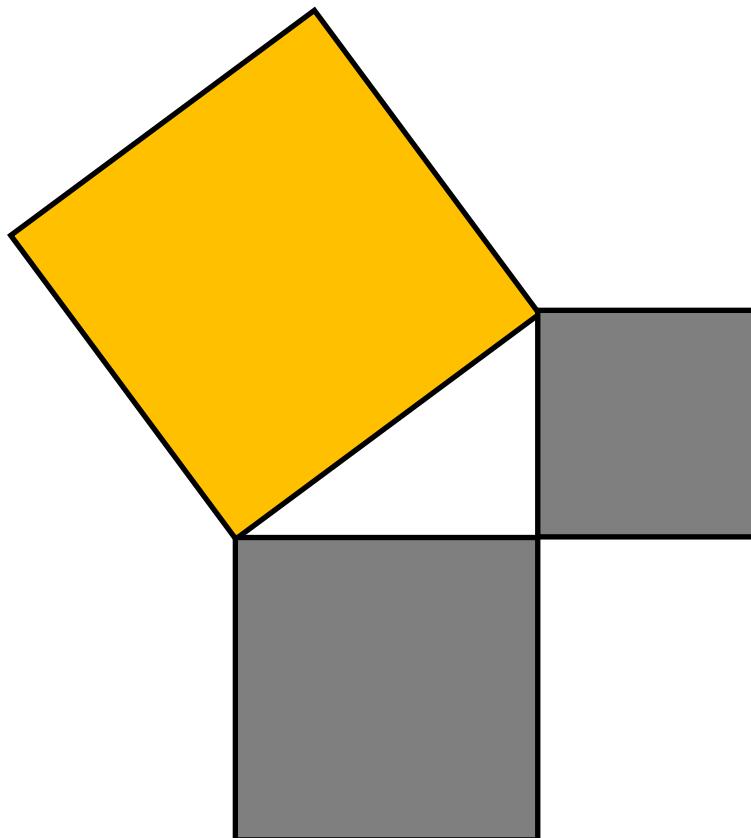
ピタゴラスの定理の証明その3



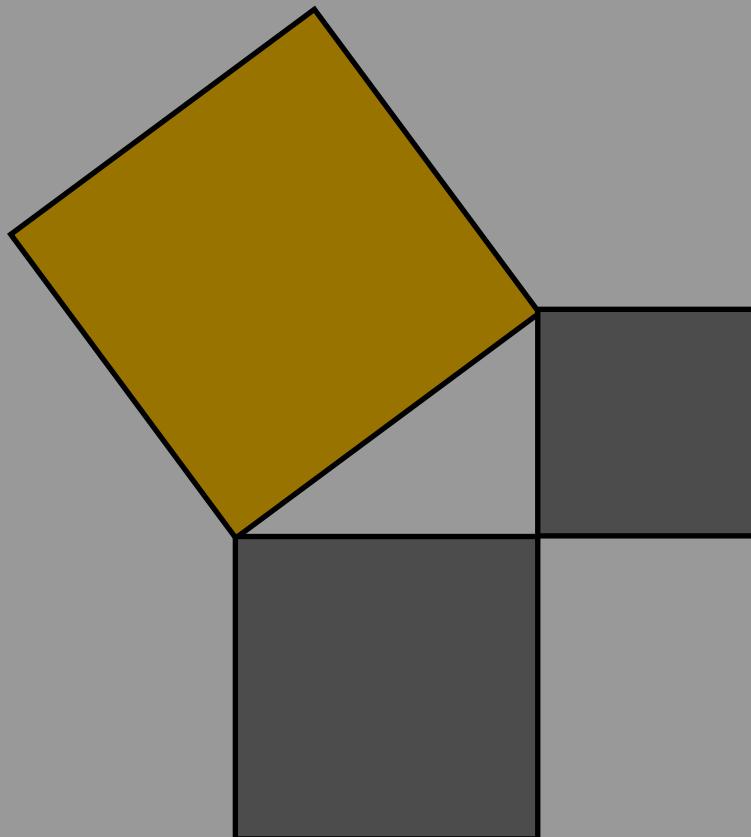
ピタゴラスの定理の証明その3



ピタゴラスの定理の証明その3

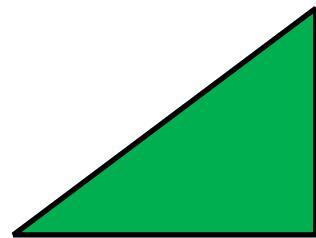


ピタゴラスの定理の証明その3

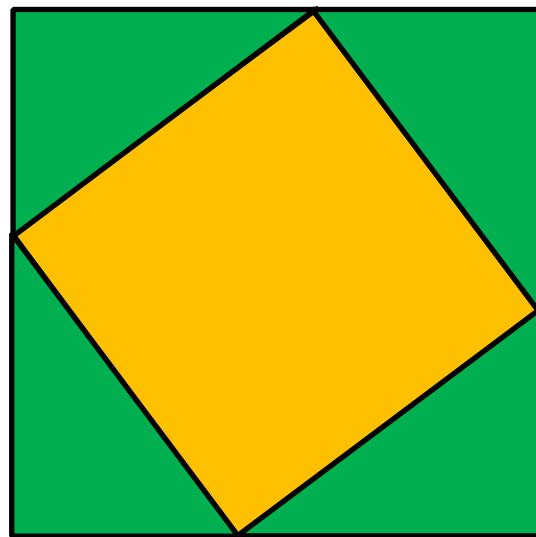


QED

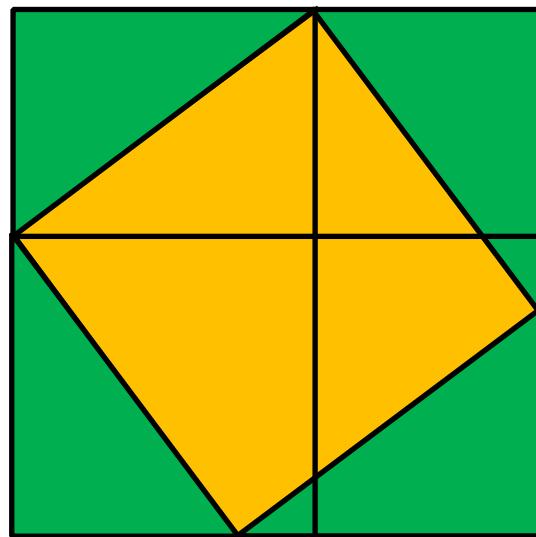
ピタゴラスの定理の証明その4



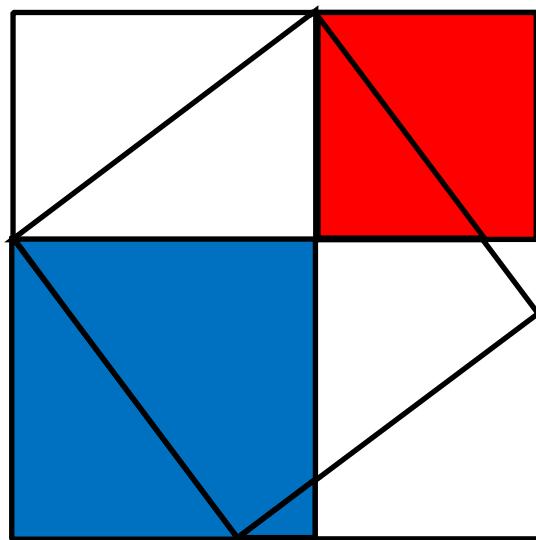
ピタゴラスの定理の証明その4



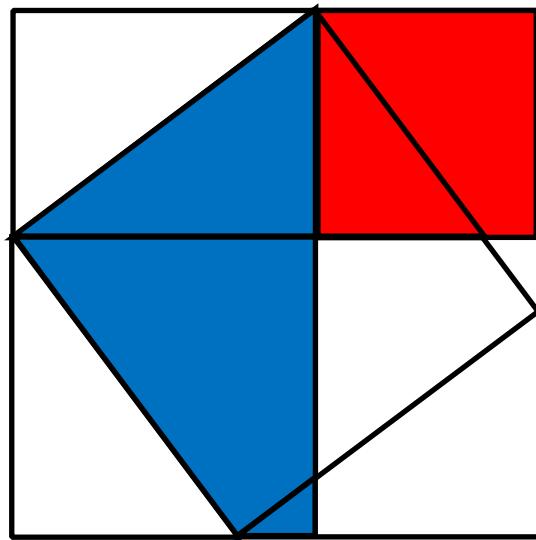
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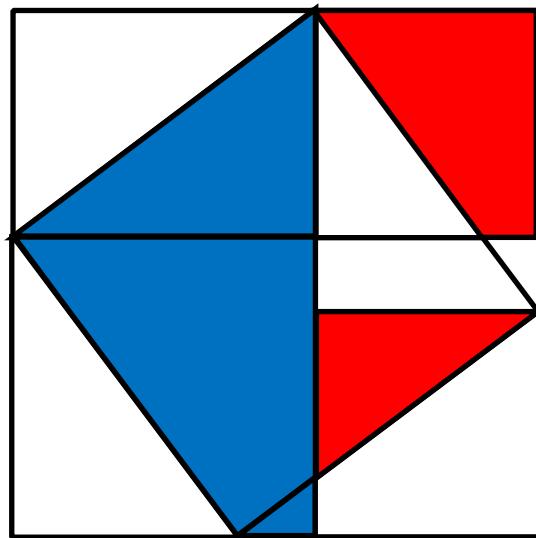
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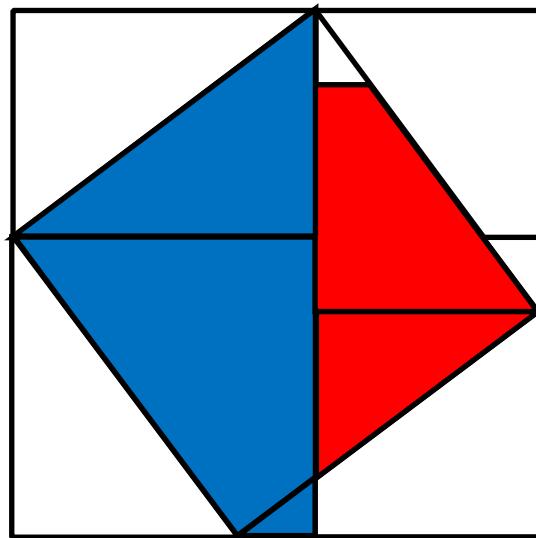
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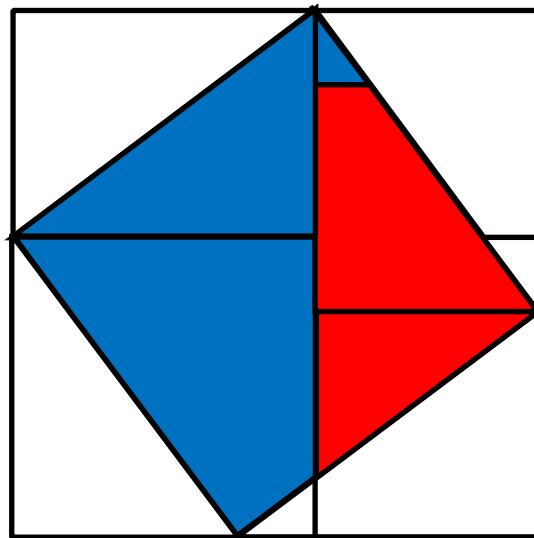
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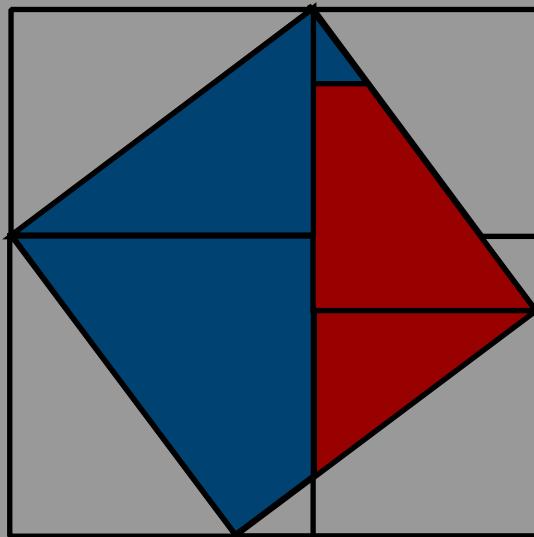
ピタゴラスの定理の証明その4



ピタゴラスの定理の証明その4

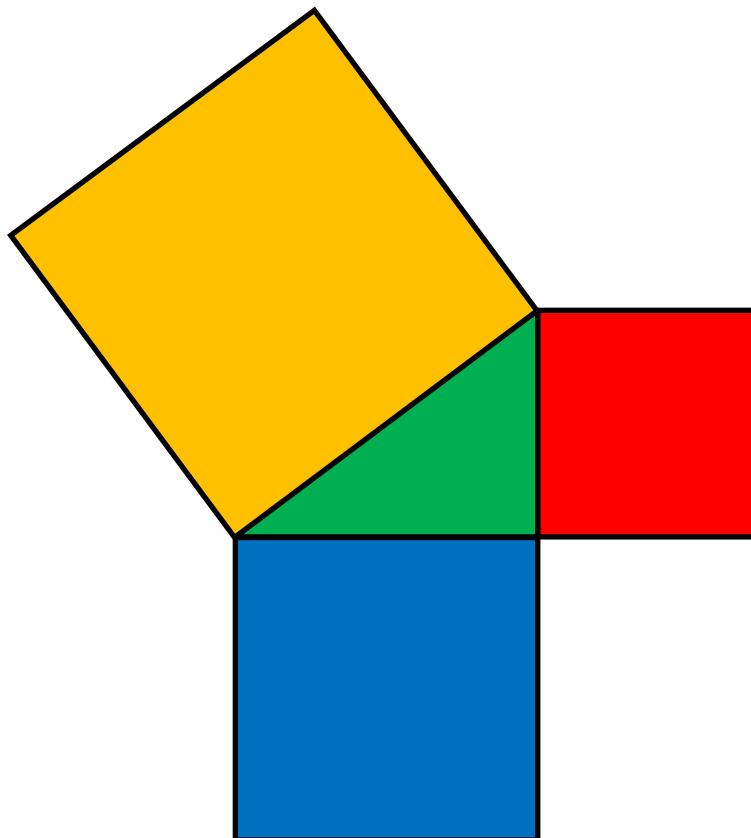


ピタゴラスの定理の証明その4

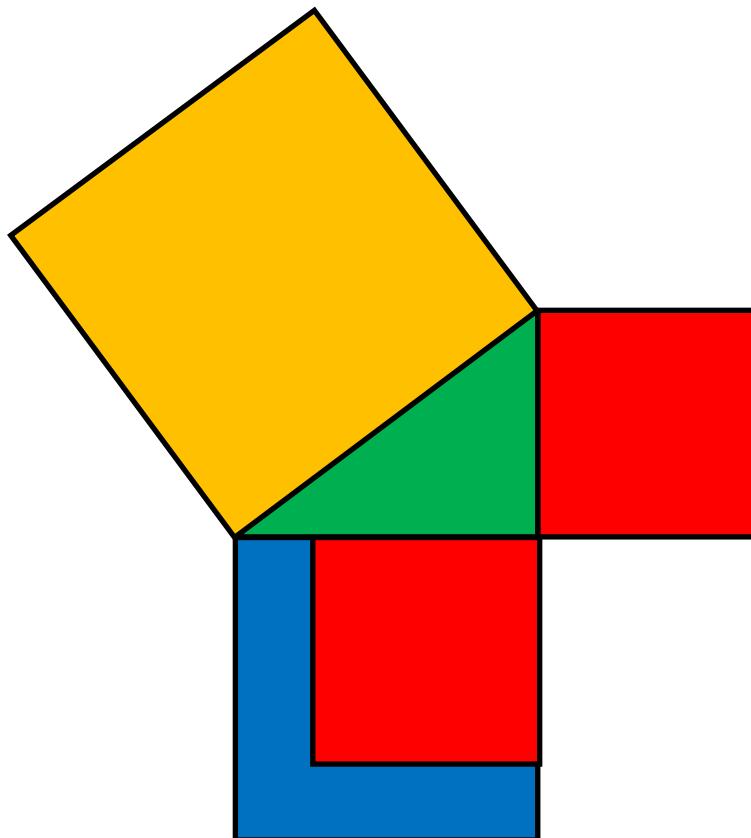


QED

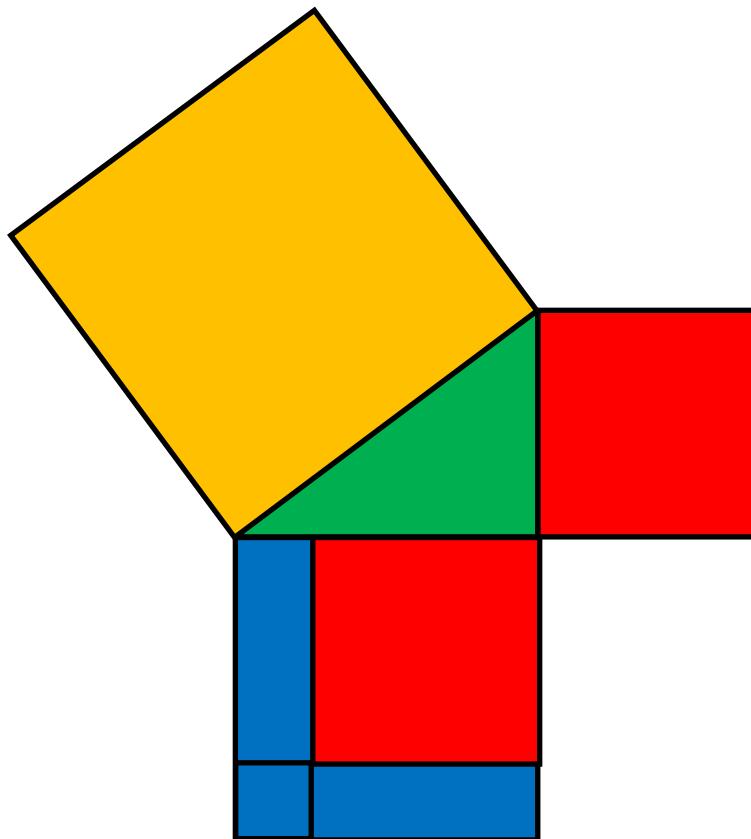
ピタゴラスの定理の証明その5



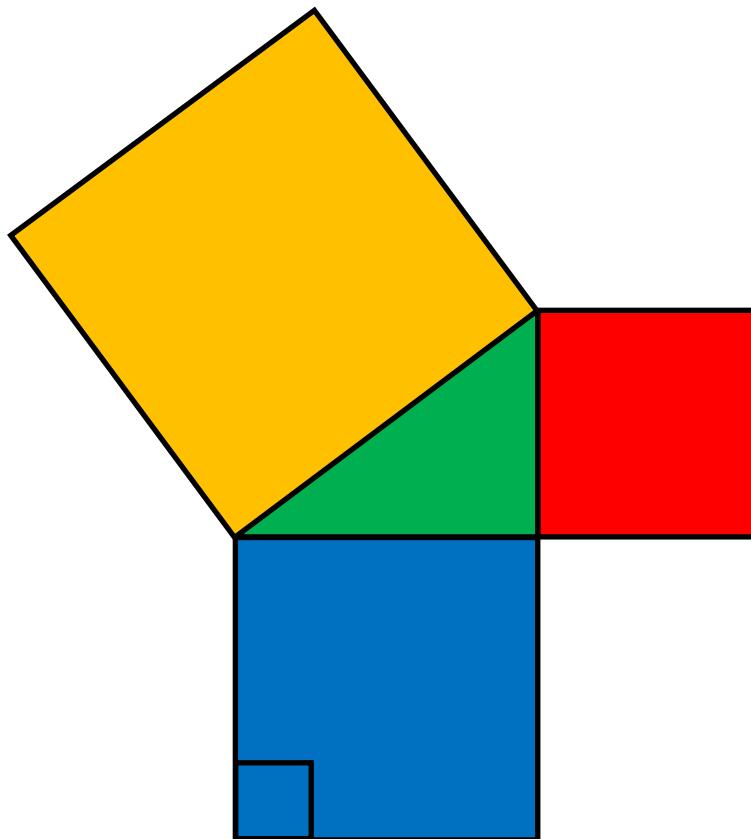
ピタゴラスの定理の証明その5



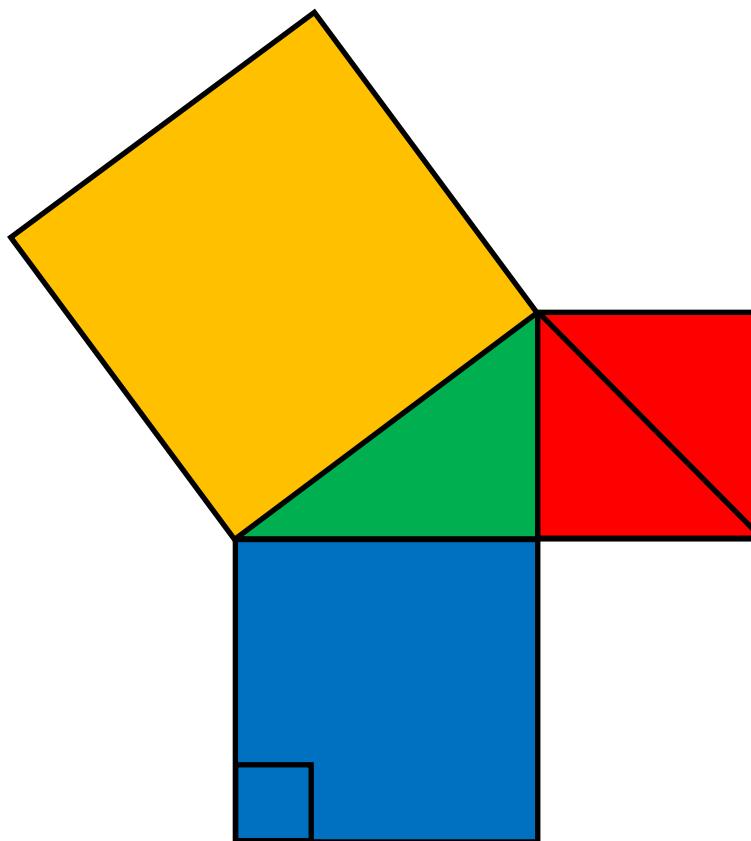
ピタゴラスの定理の証明その5



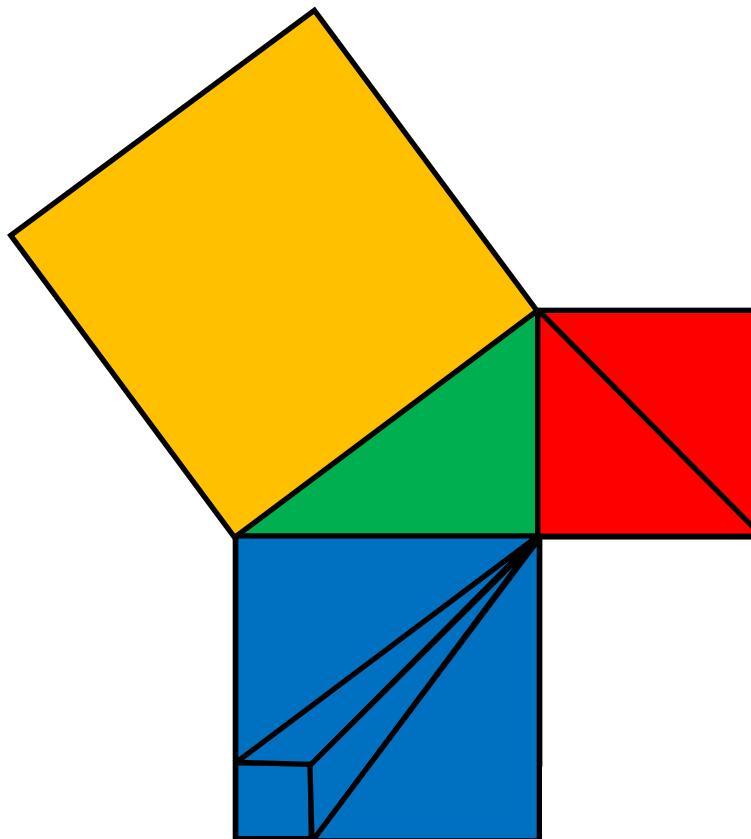
ピタゴラスの定理の証明その5



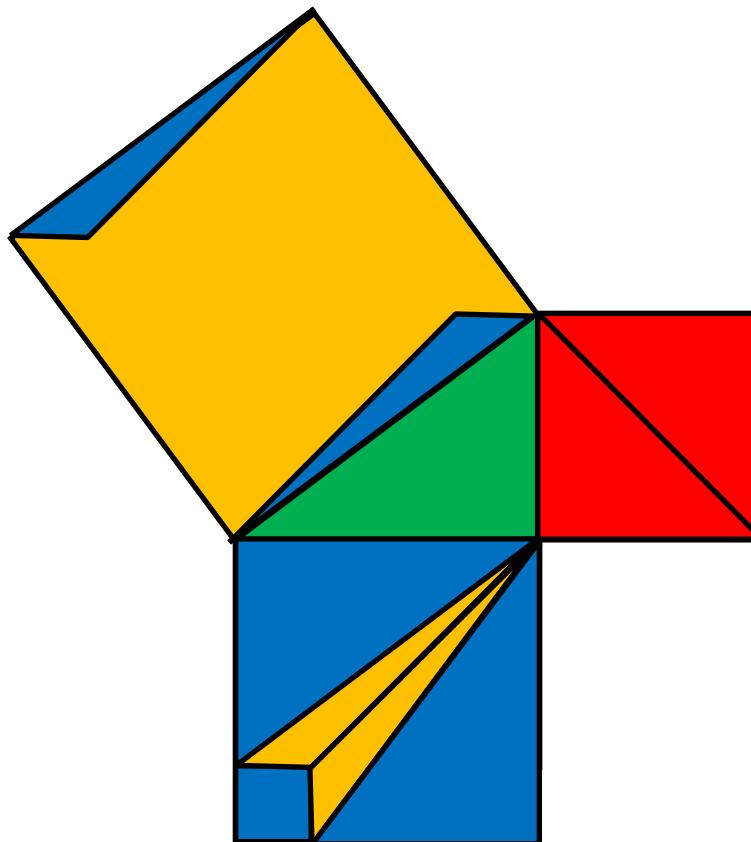
ピタゴラスの定理の証明その5



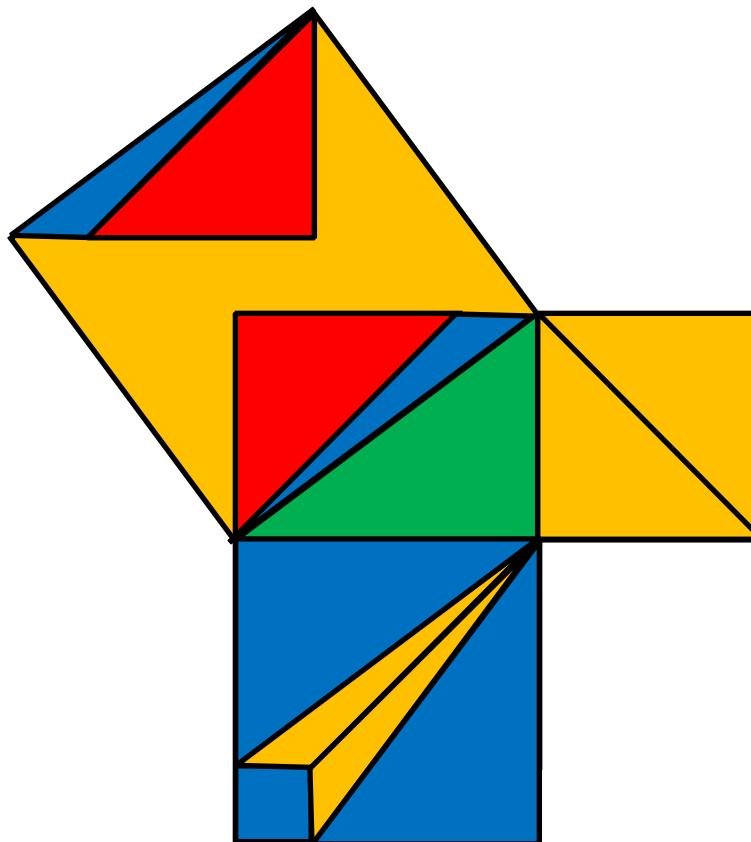
ピタゴラスの定理の証明その5



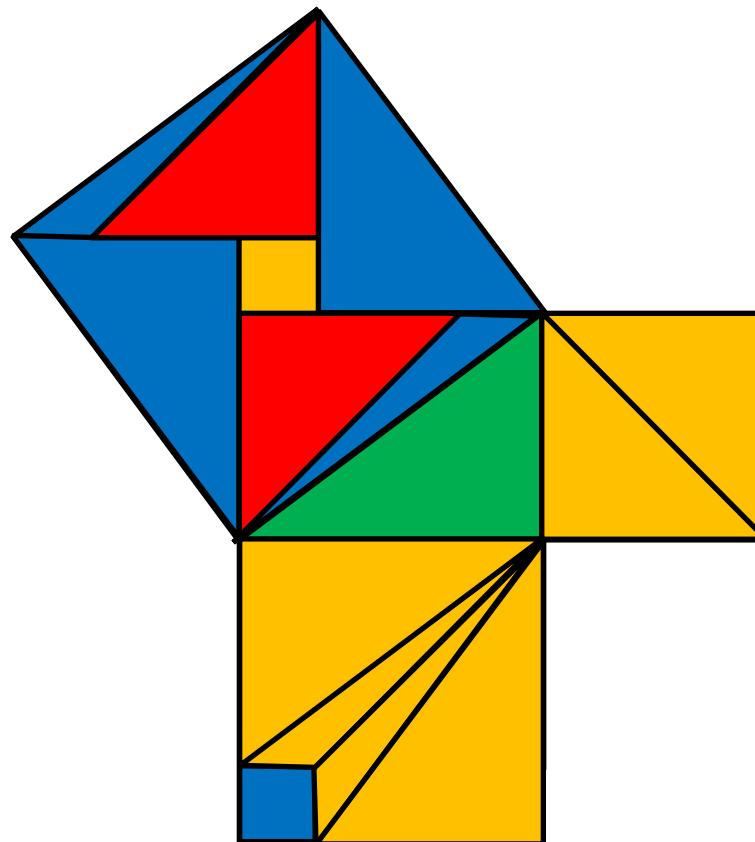
ピタゴラスの定理の証明その5



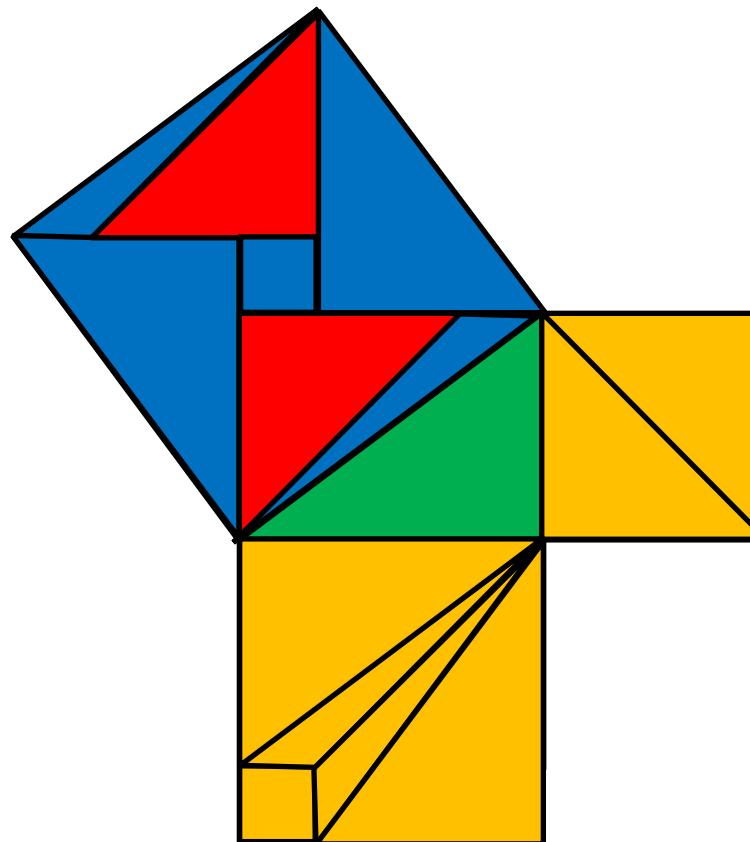
ピタゴラスの定理の証明その5



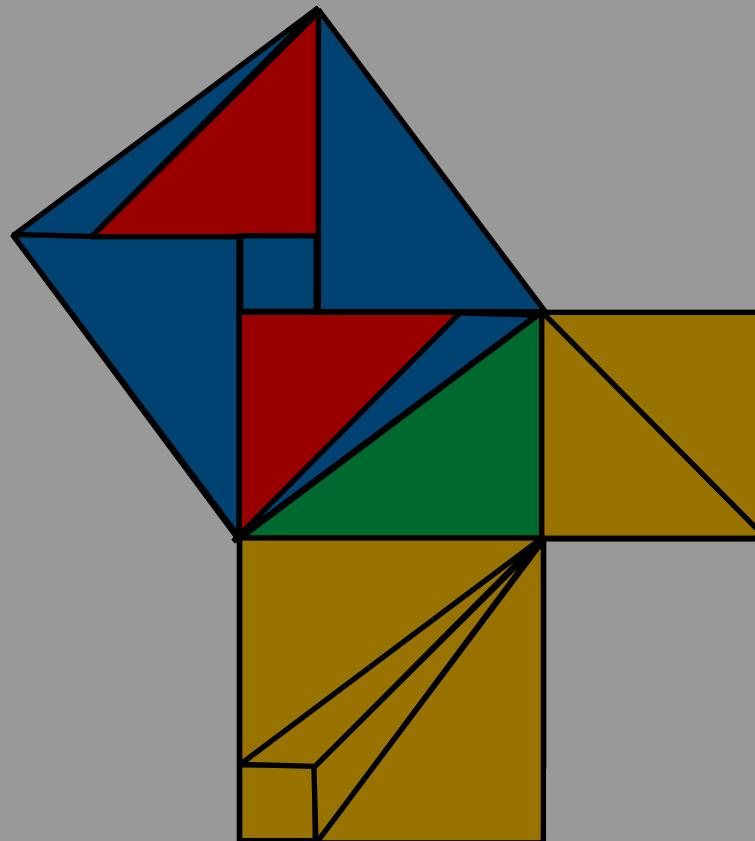
ピタゴラスの定理の証明その5



ピタゴラスの定理の証明その5

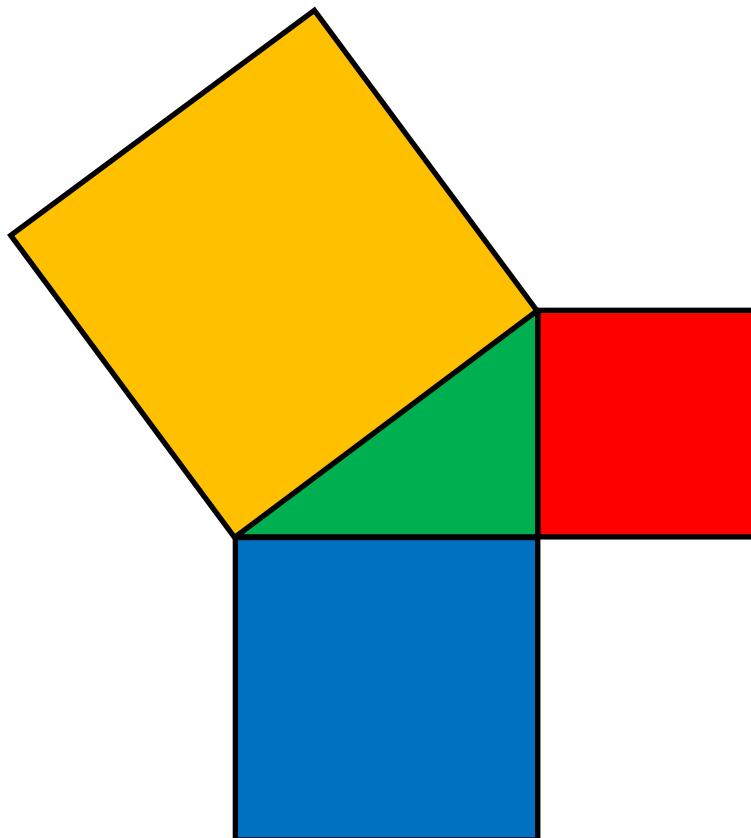


ピタゴラスの定理の証明その5

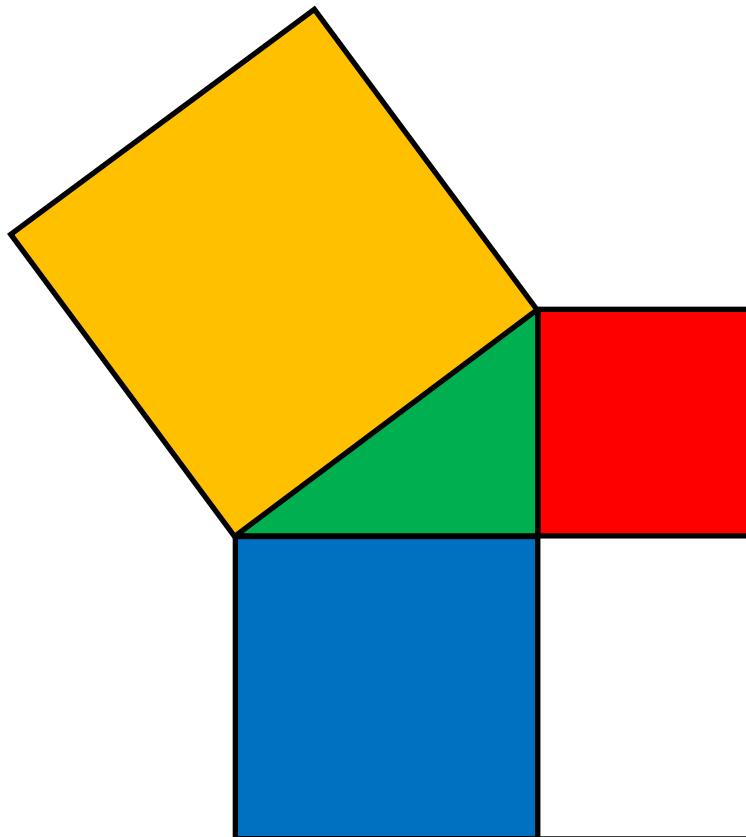


QED

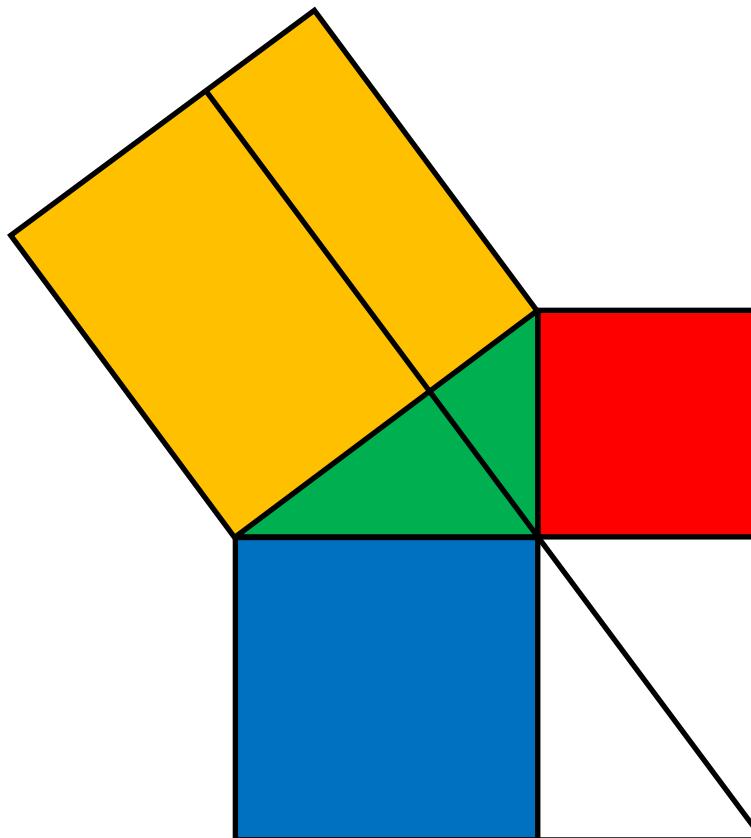
ピタゴラスの定理の証明その 6



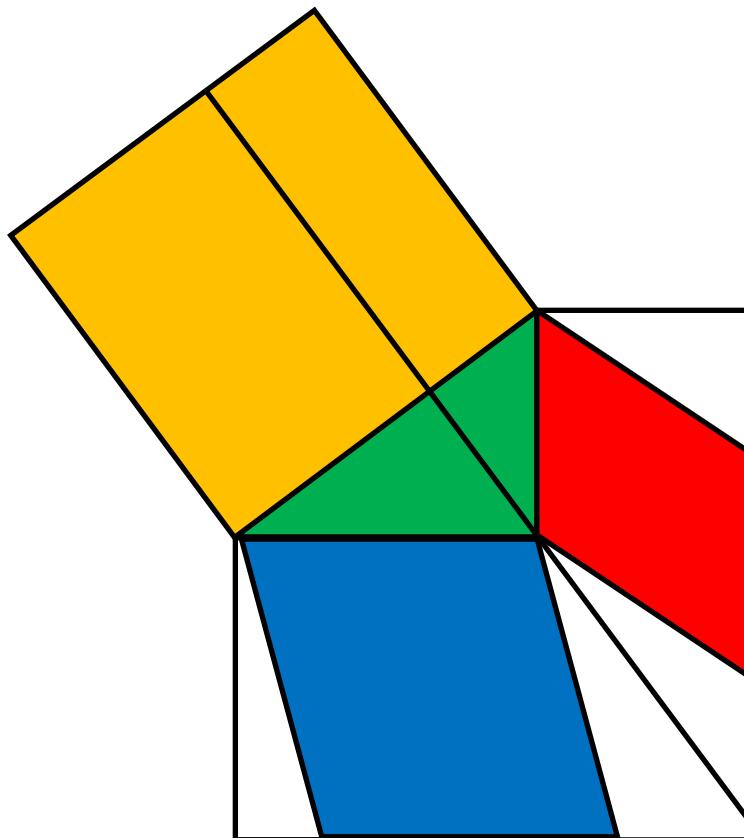
ピタゴラスの定理の証明その 6



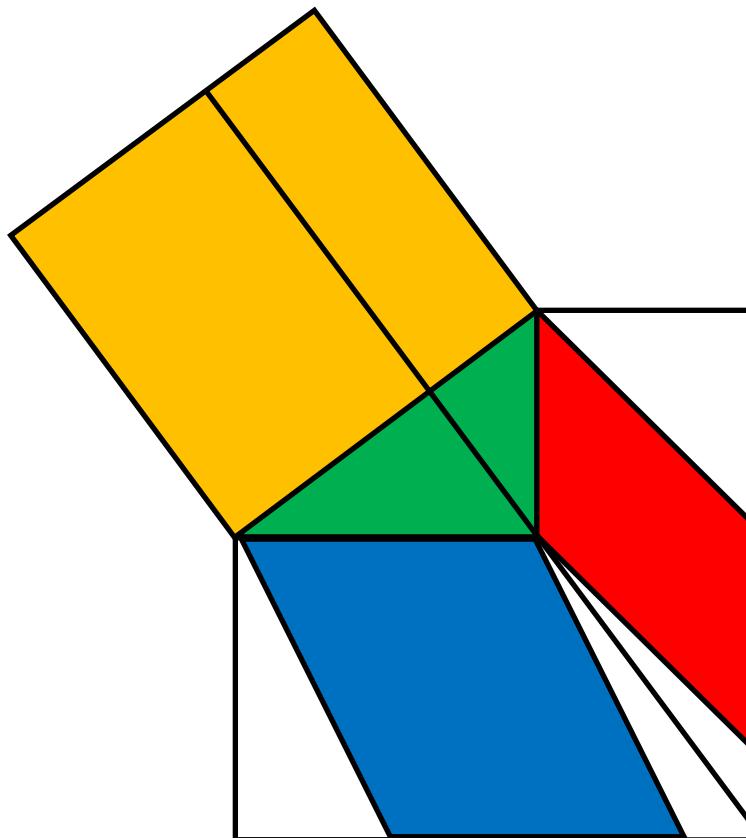
ピタゴラスの定理の証明その 6



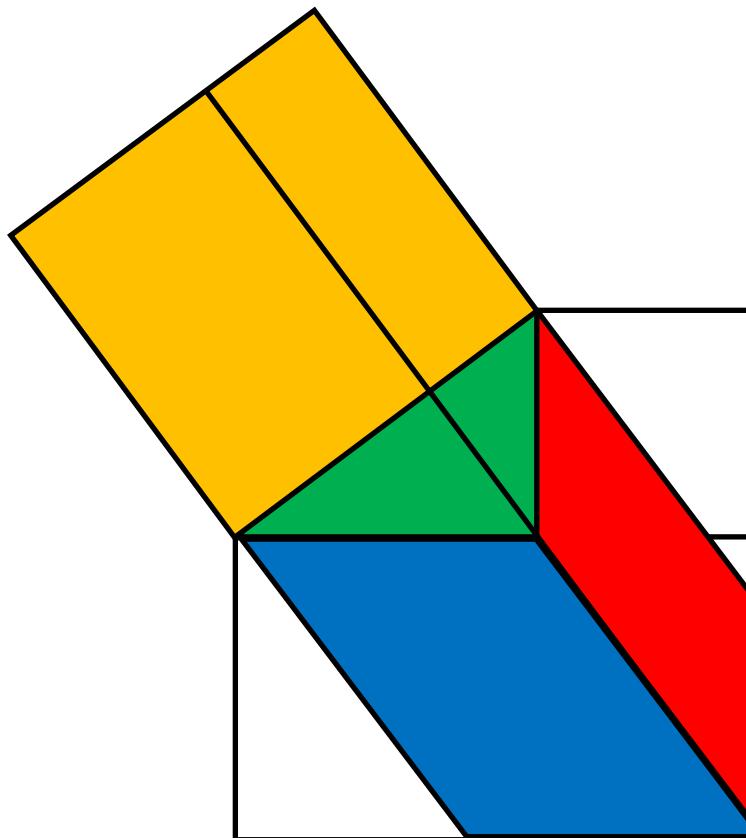
ピタゴラスの定理の証明その 6



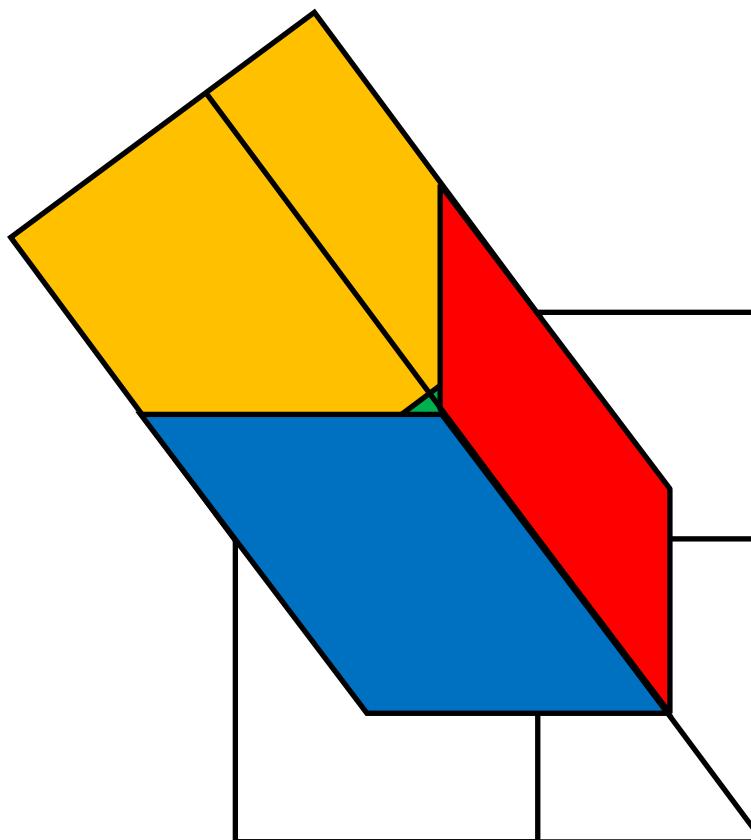
ピタゴラスの定理の証明その 6



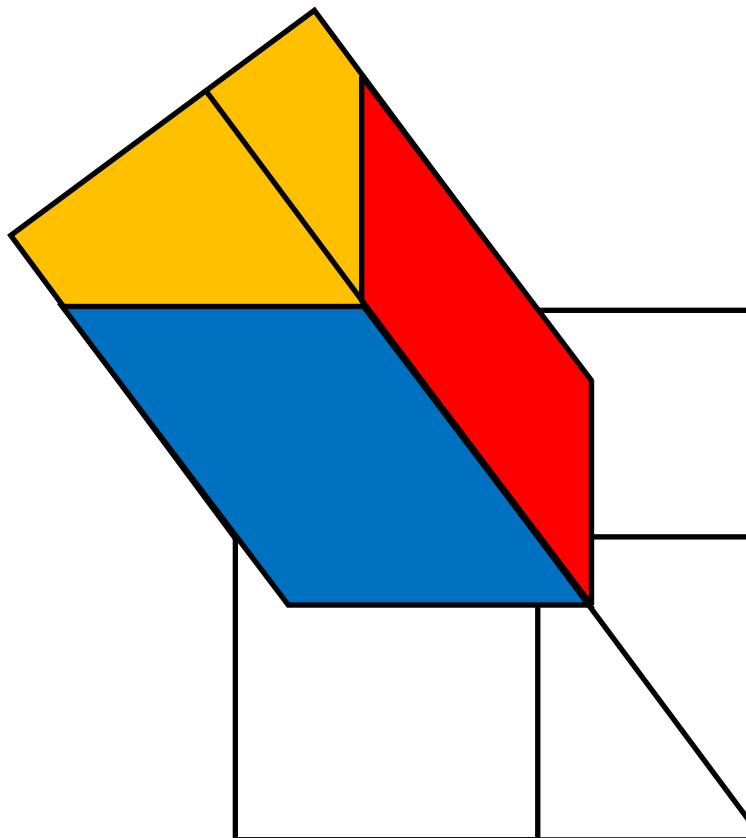
ピタゴラスの定理の証明その 6



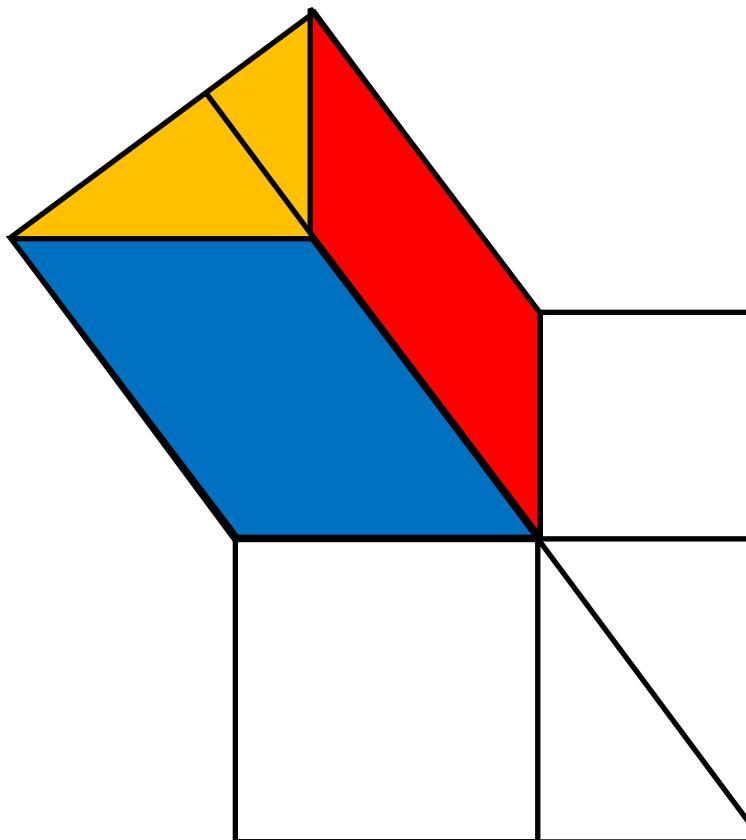
ピタゴラスの定理の証明その 6



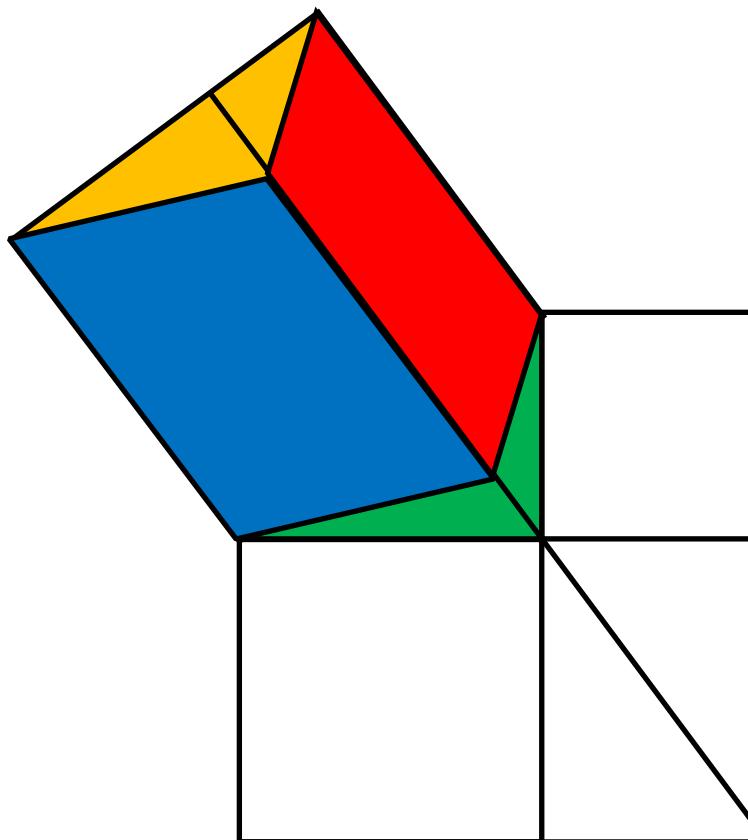
ピタゴラスの定理の証明その 6



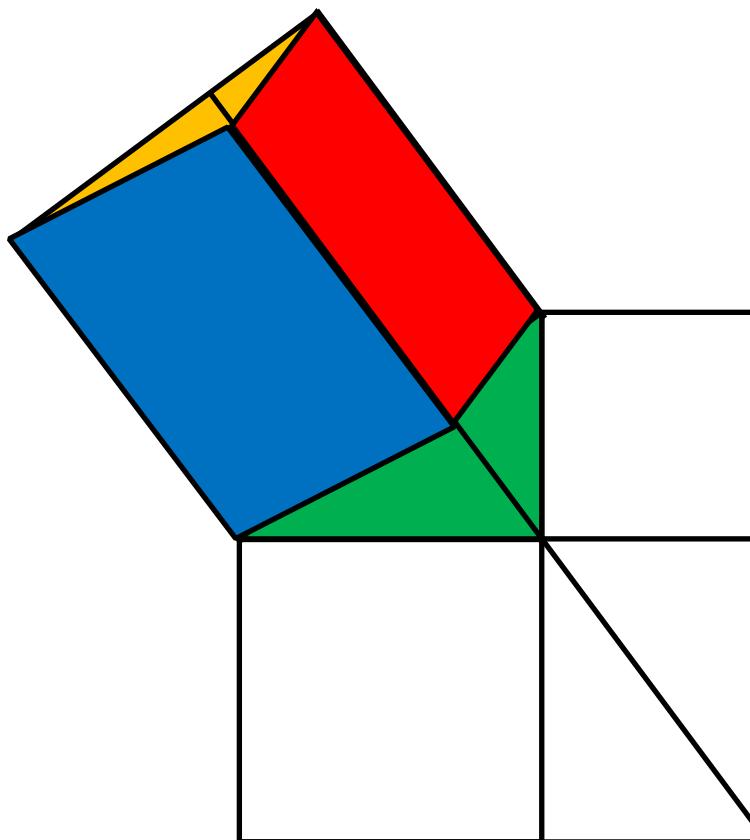
ピタゴラスの定理の証明その 6



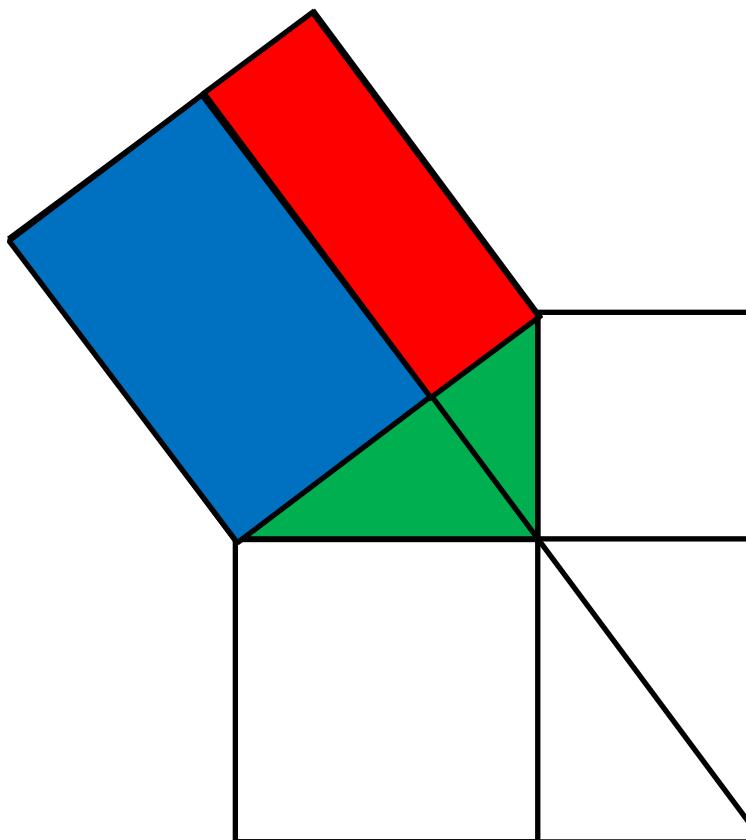
ピタゴラスの定理の証明その 6



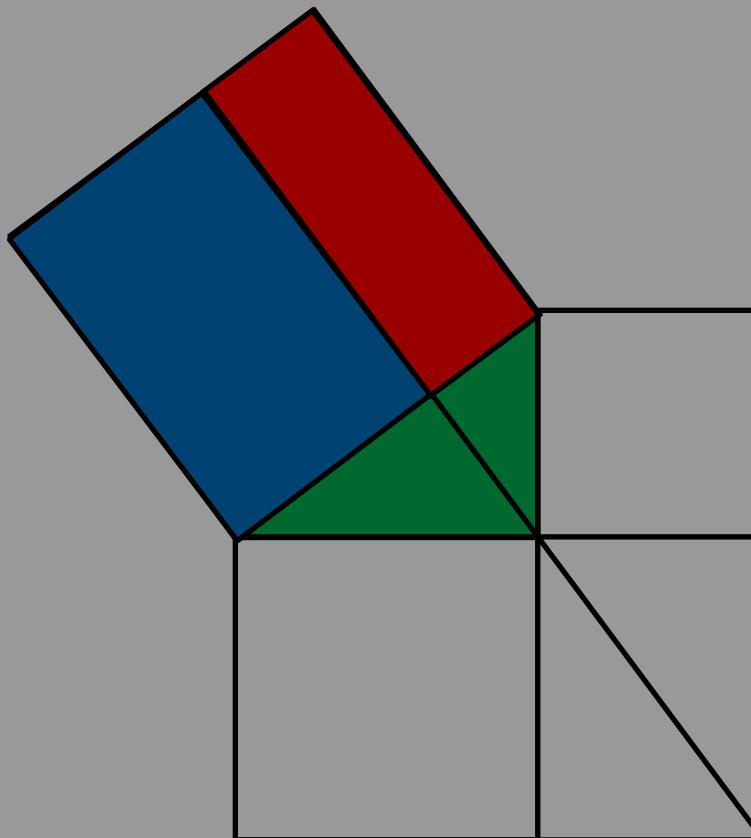
ピタゴラスの定理の証明その 6



ピタゴラスの定理の証明その 6

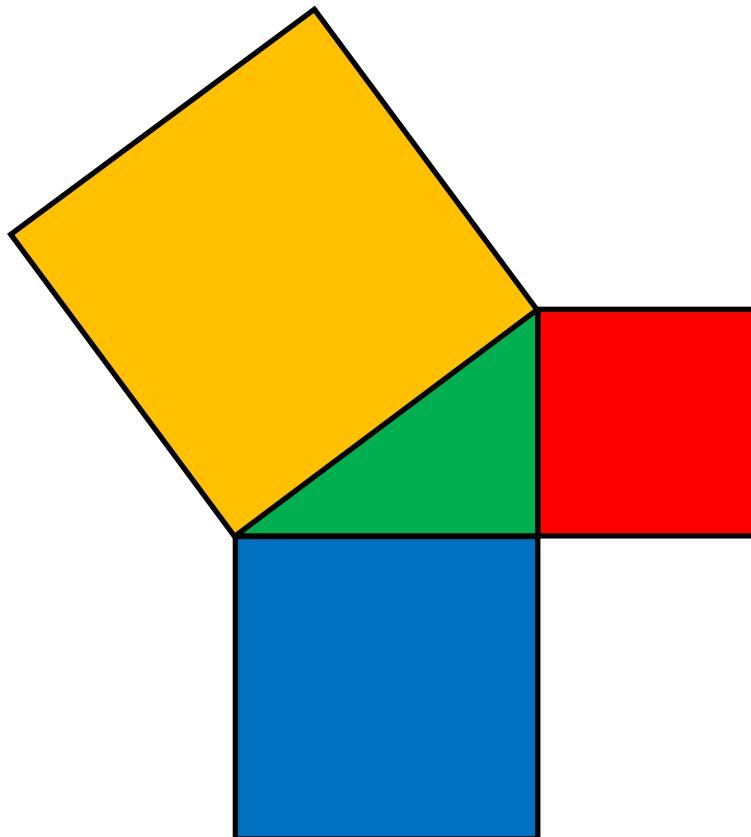


ピタゴラスの定理の証明その 6

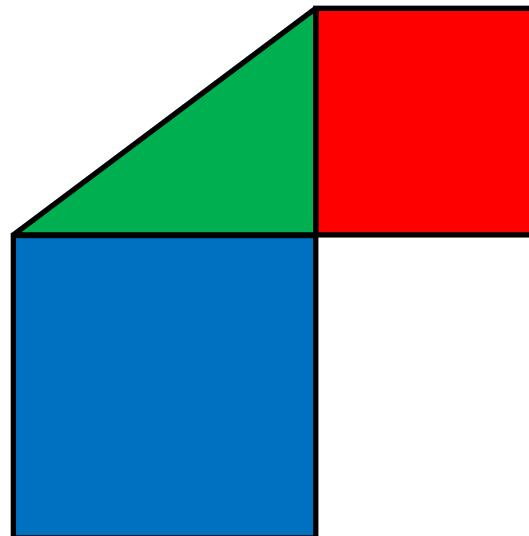


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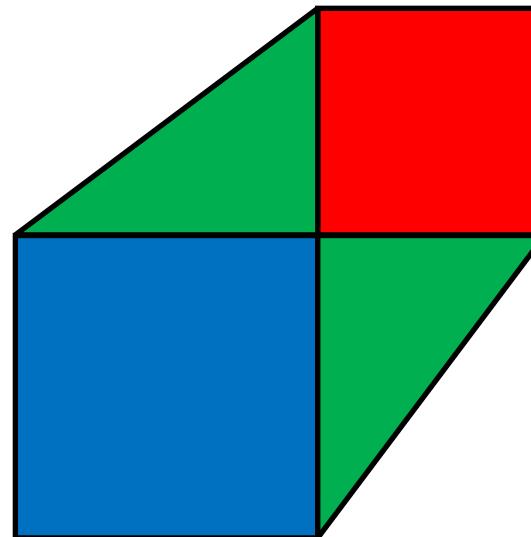
ピタゴラスの定理の証明その7



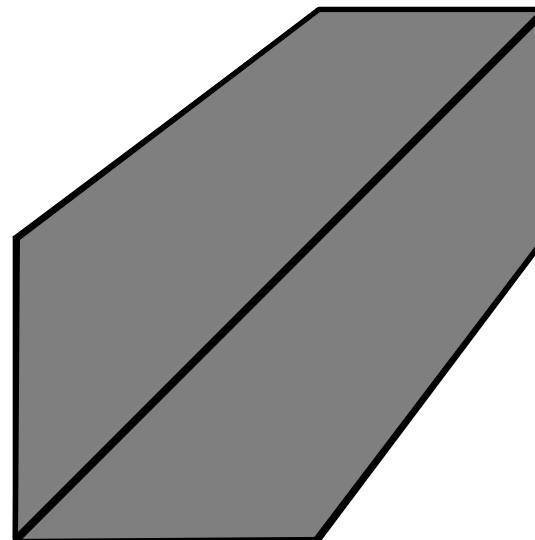
ピタゴラスの定理の証明その7



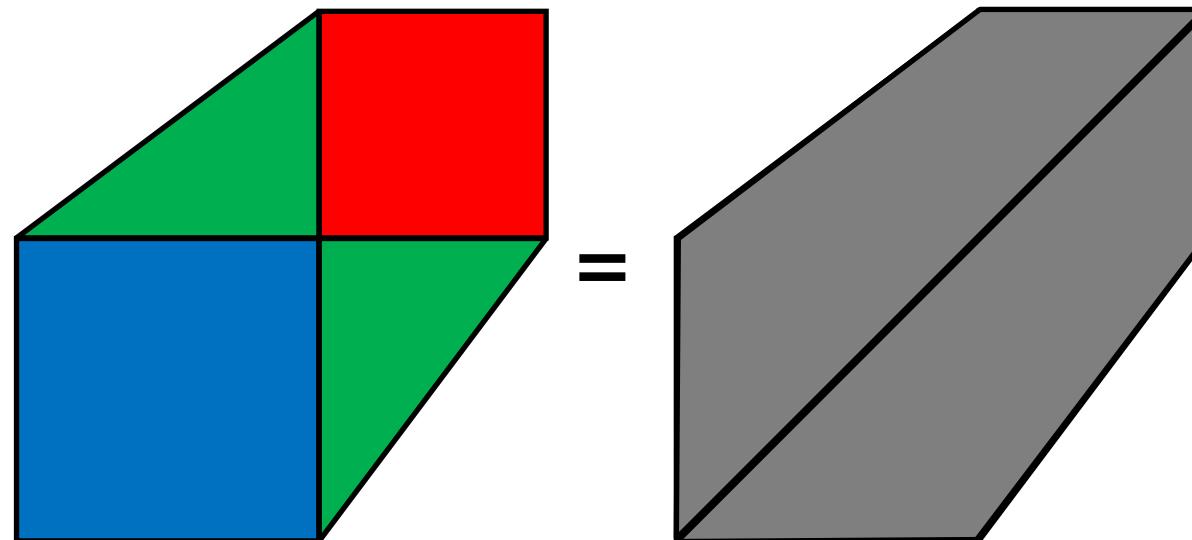
ピタゴラスの定理の証明その7



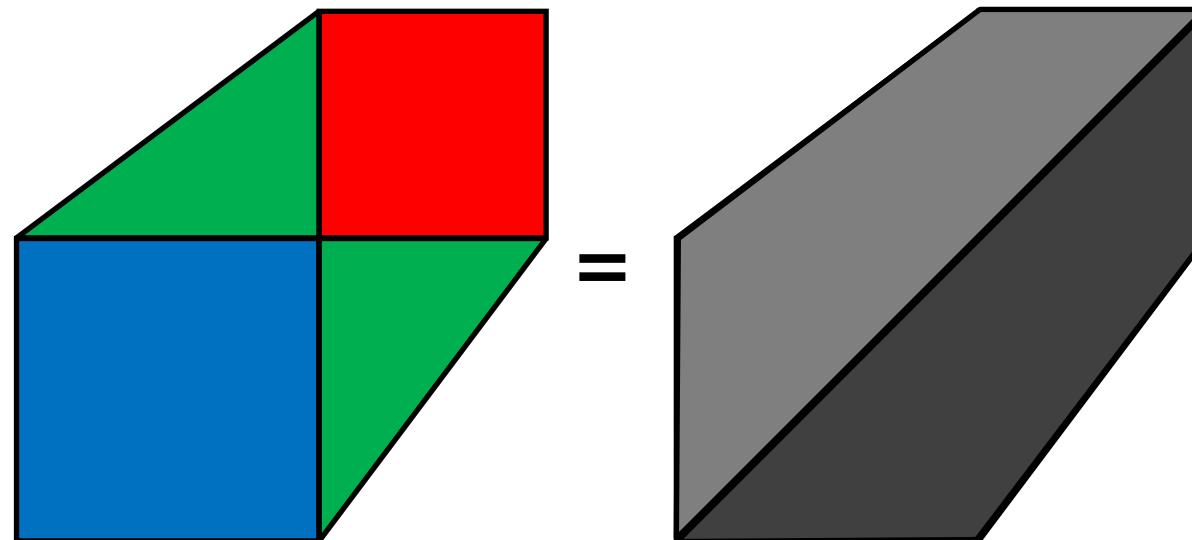
ピタゴラスの定理の証明その7



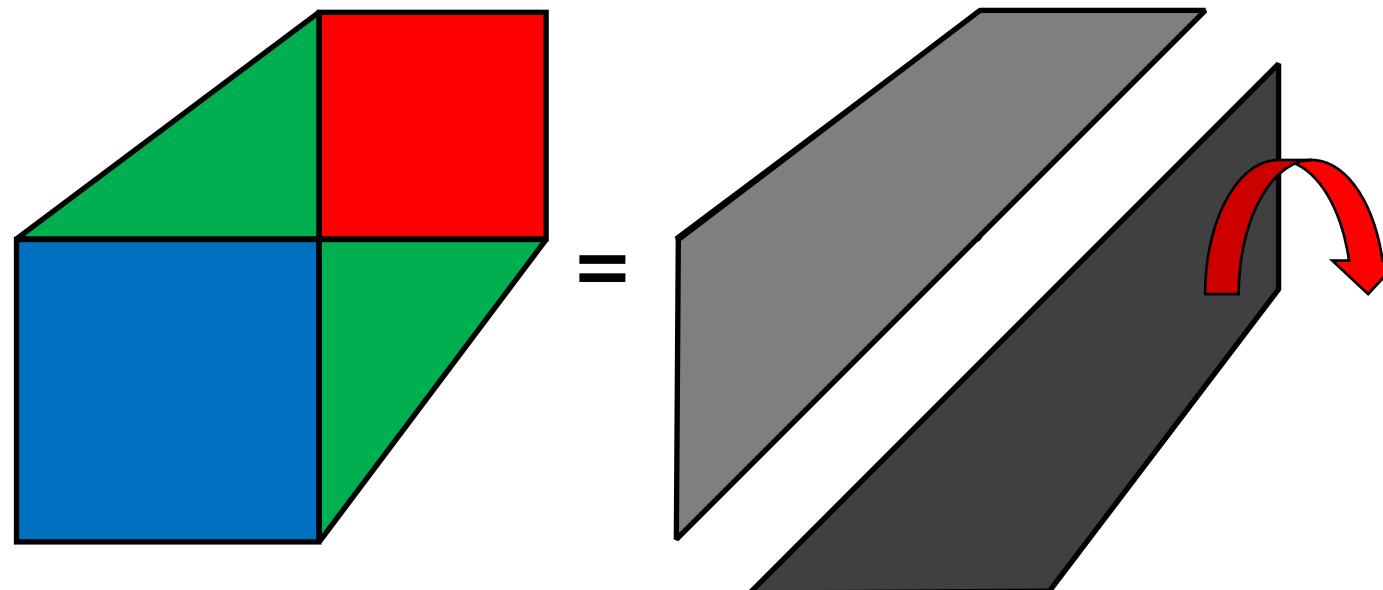
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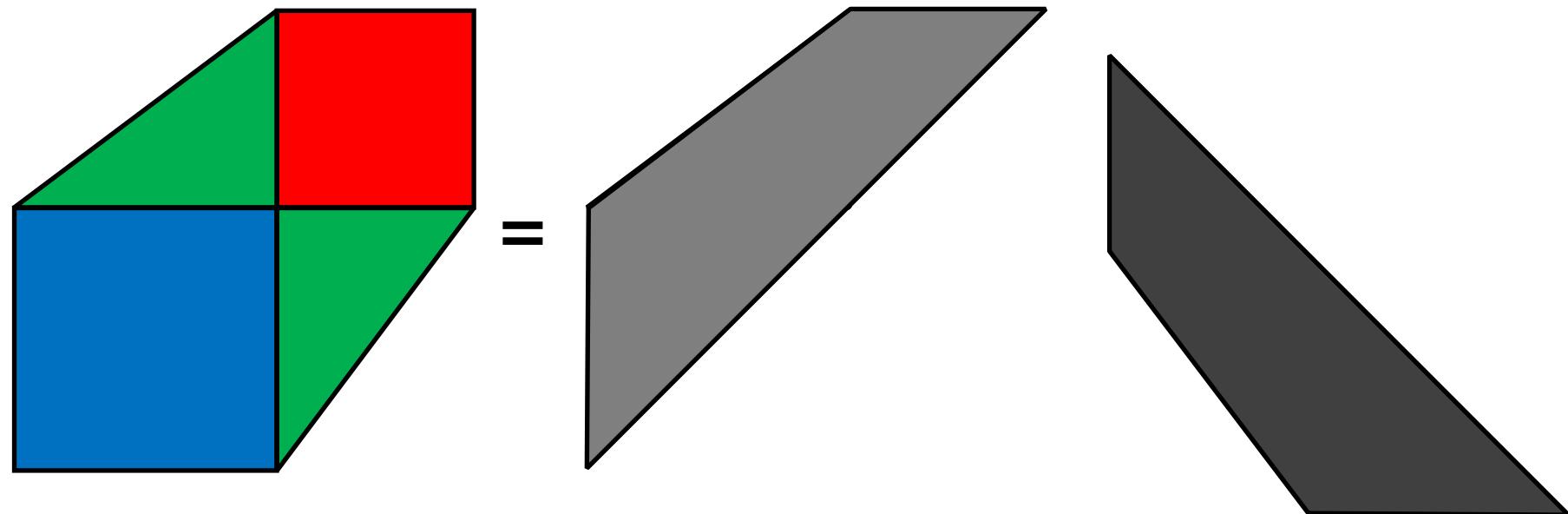
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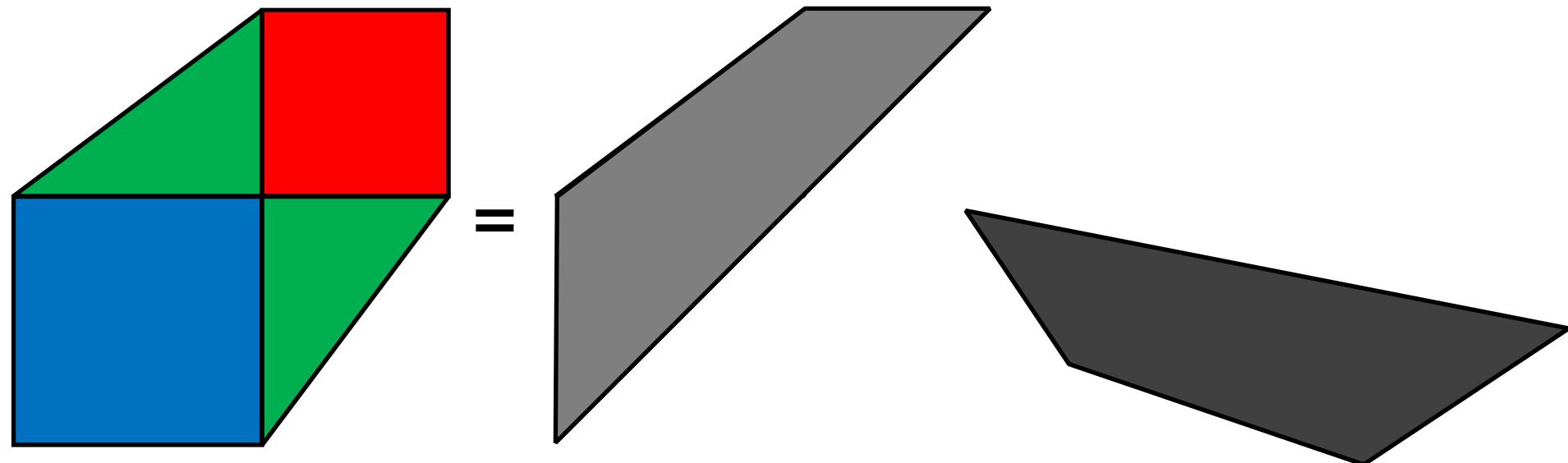
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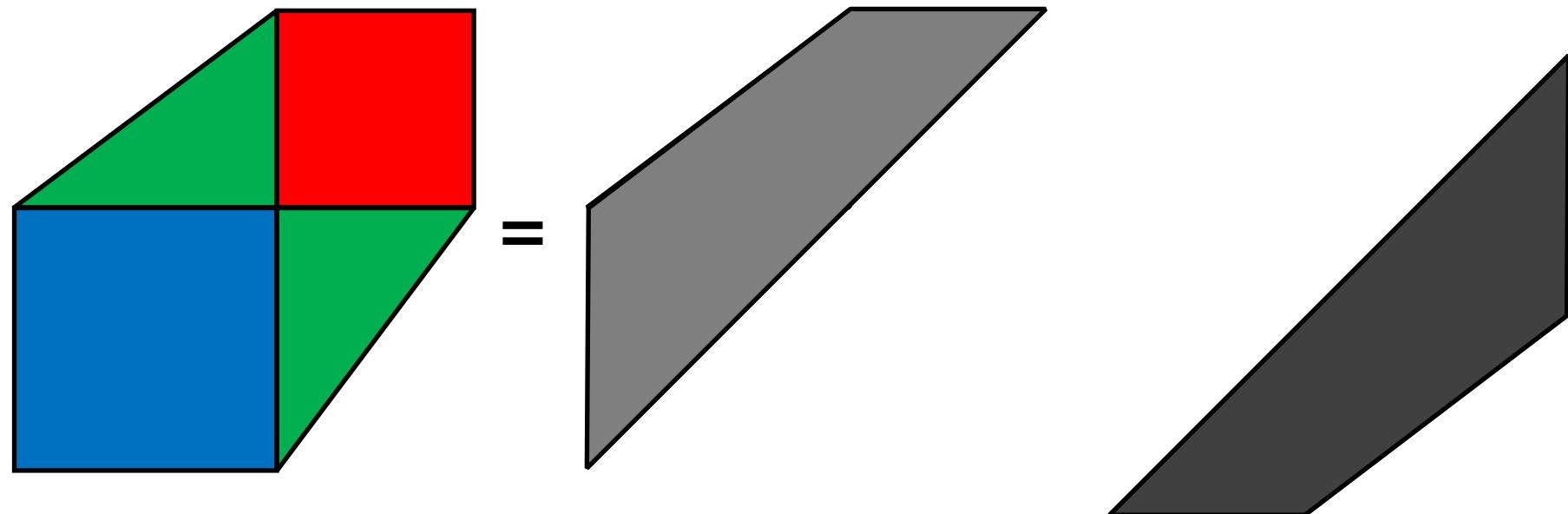
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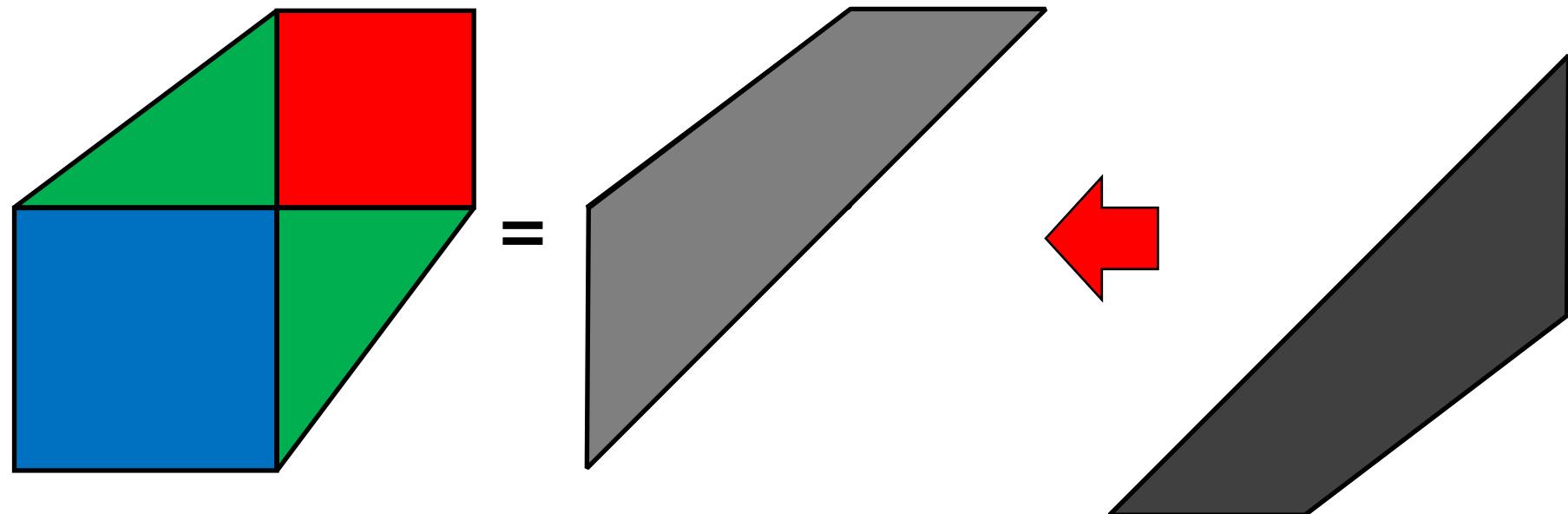
ピタゴラスの定理の証明その7



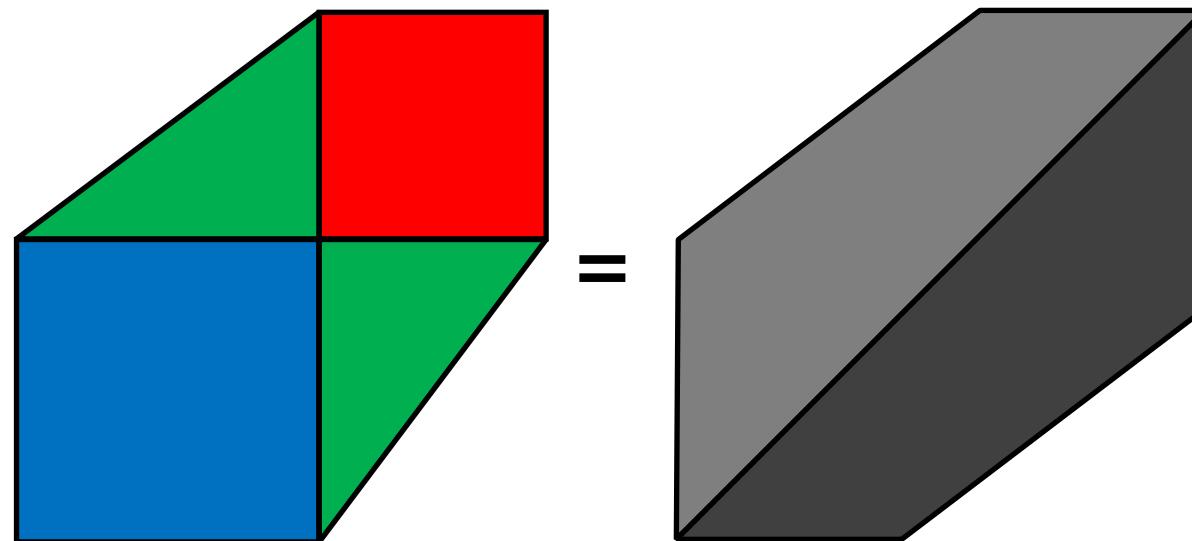
ピタゴラスの定理の証明その7



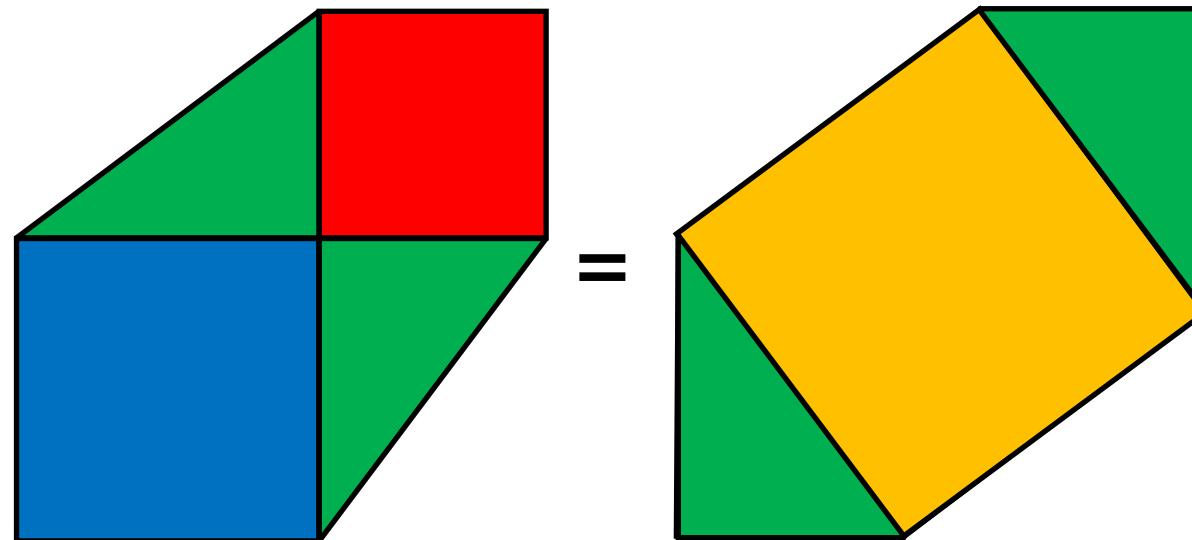
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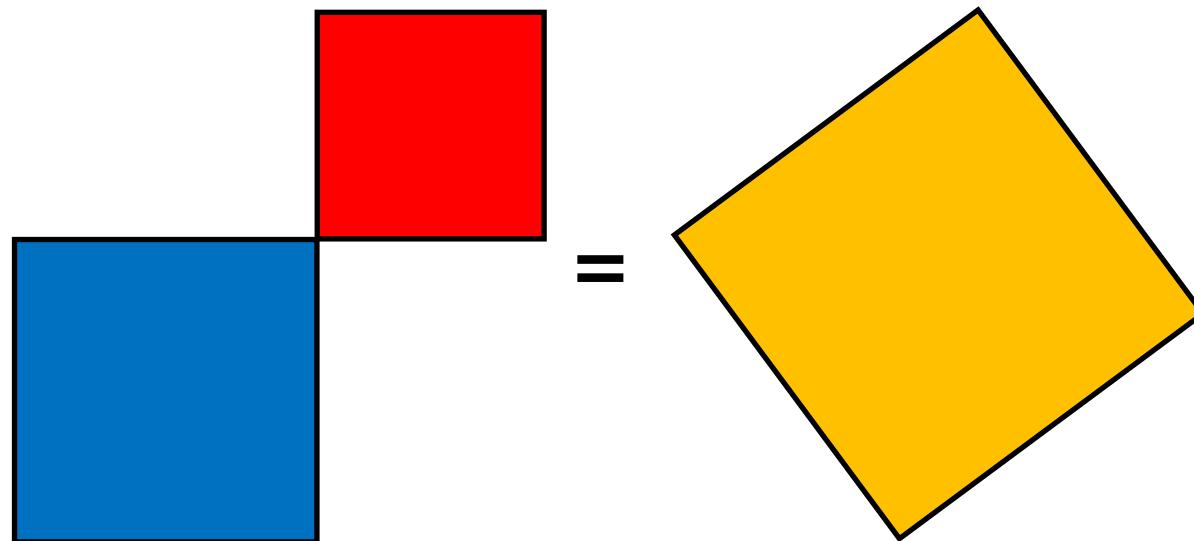
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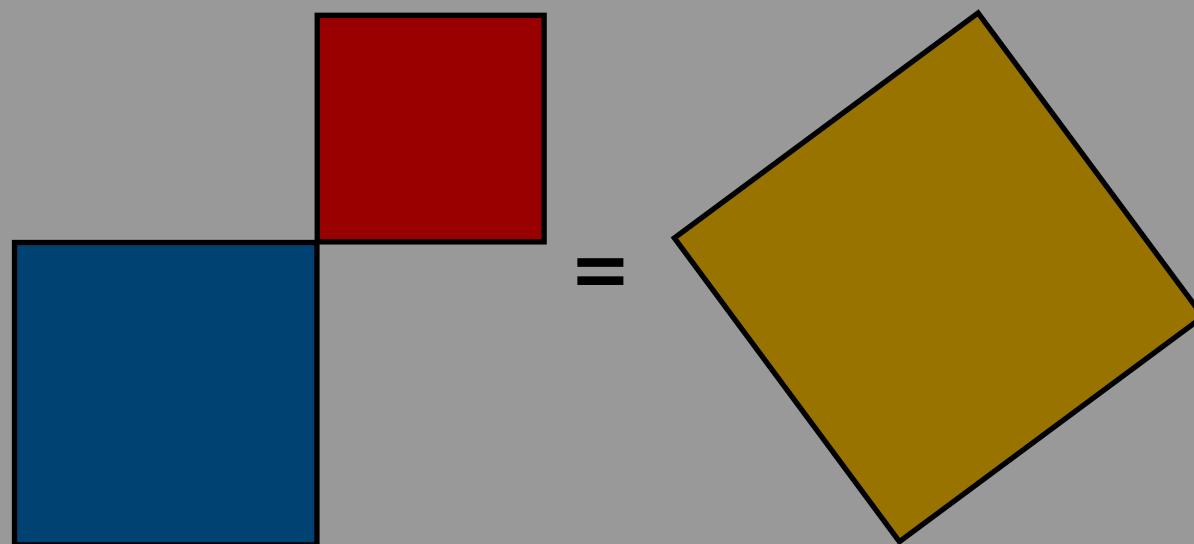
ピタゴラスの定理の証明その7



ピタゴラスの定理の証明その7

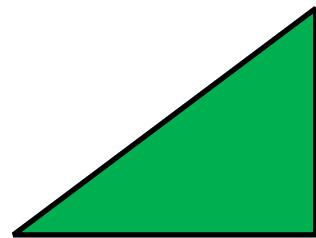


ピタゴラスの定理の証明その7

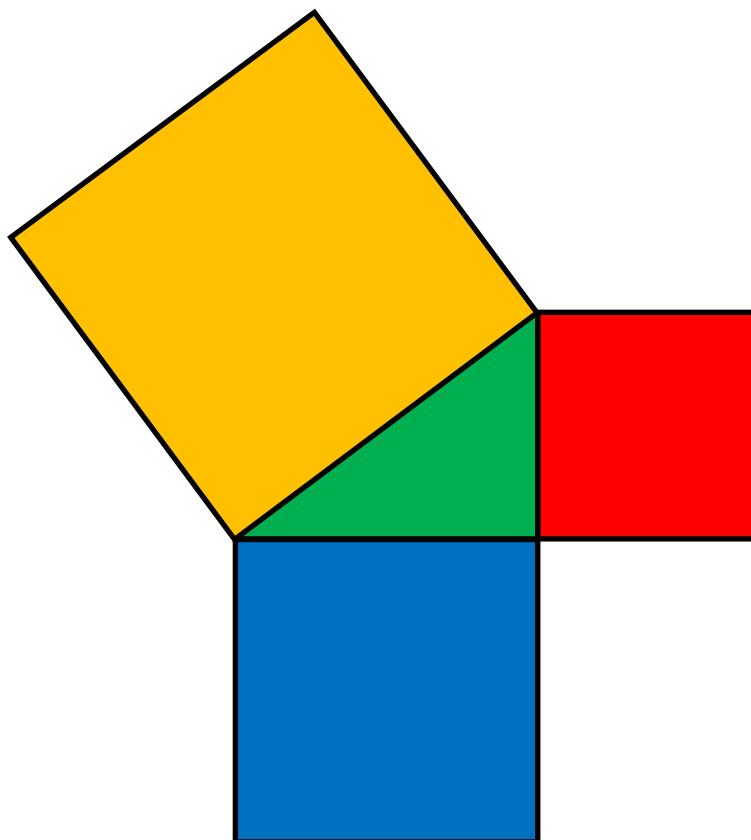


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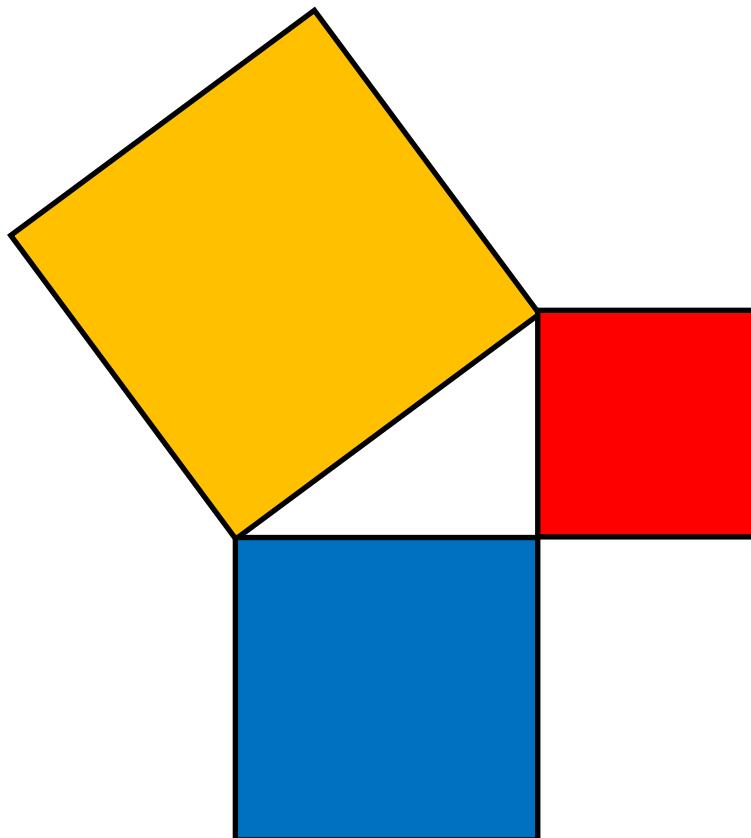
ピタゴラスの定理の証明その 8



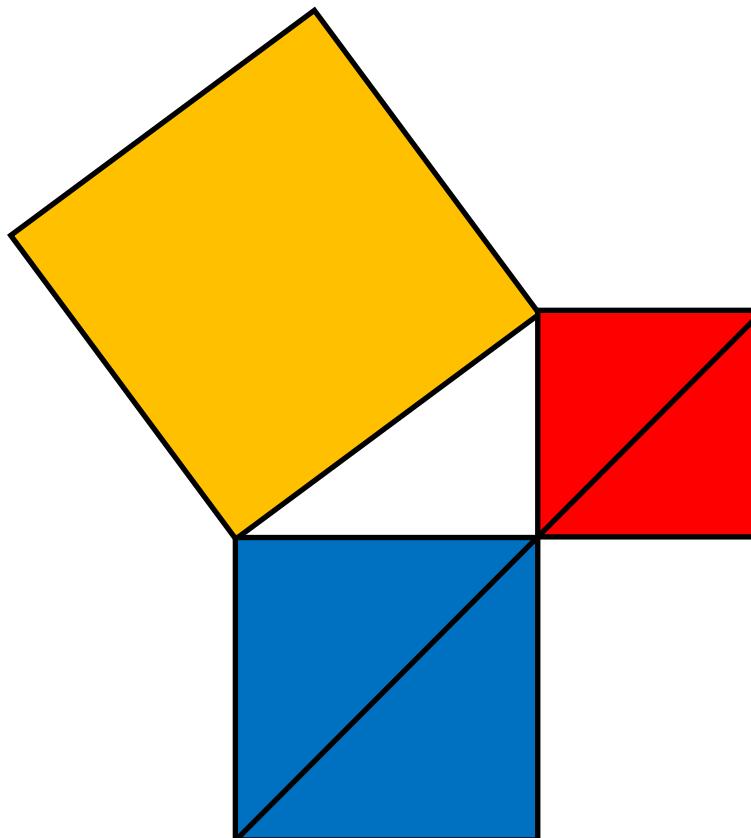
ピタゴラスの定理の証明その 8



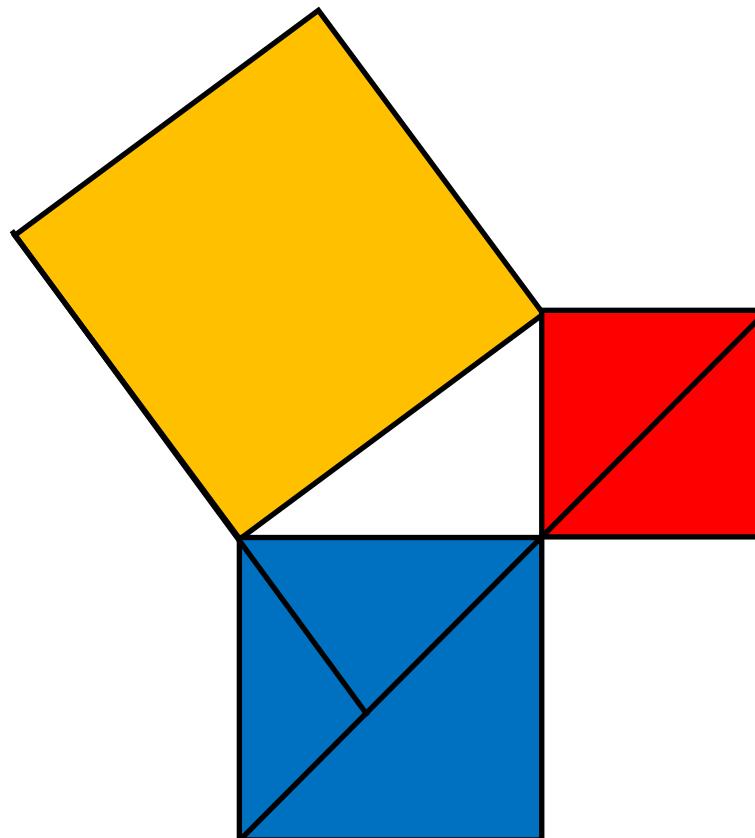
ピタゴラスの定理の証明その 8



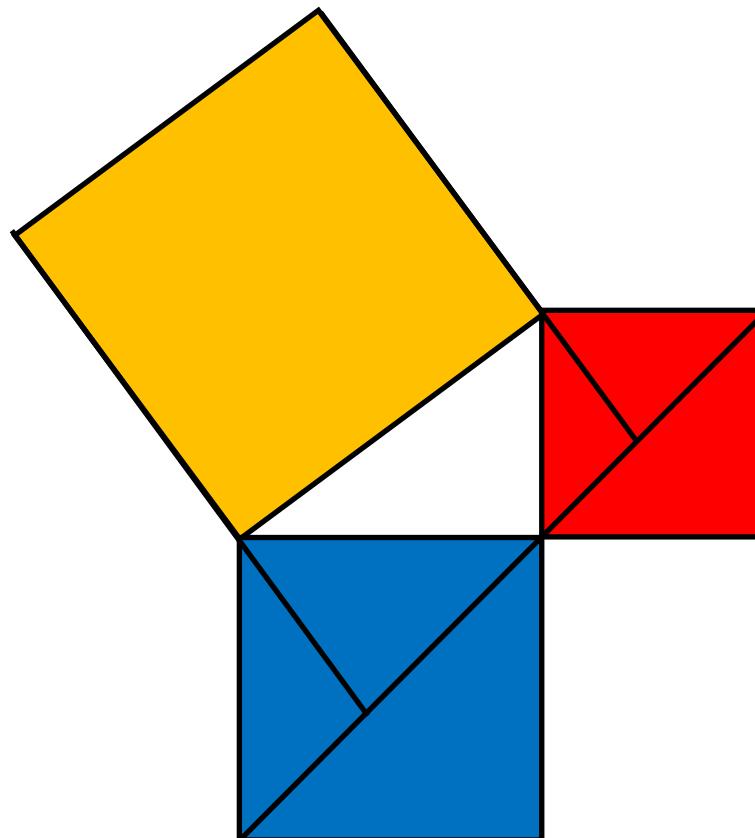
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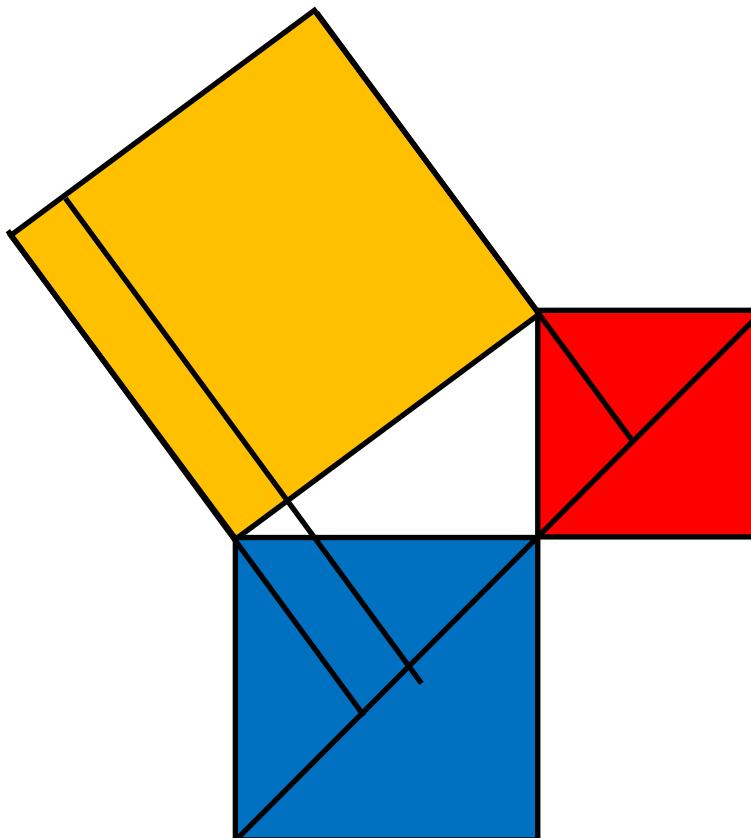
ピタゴラスの定理の証明その 8



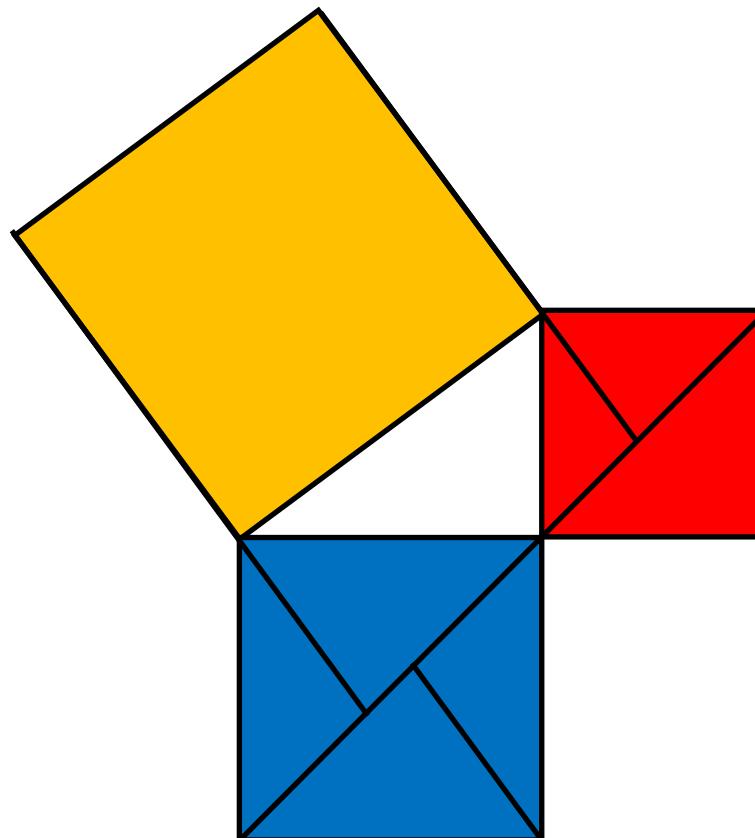
ピタゴラスの定理の証明その 8



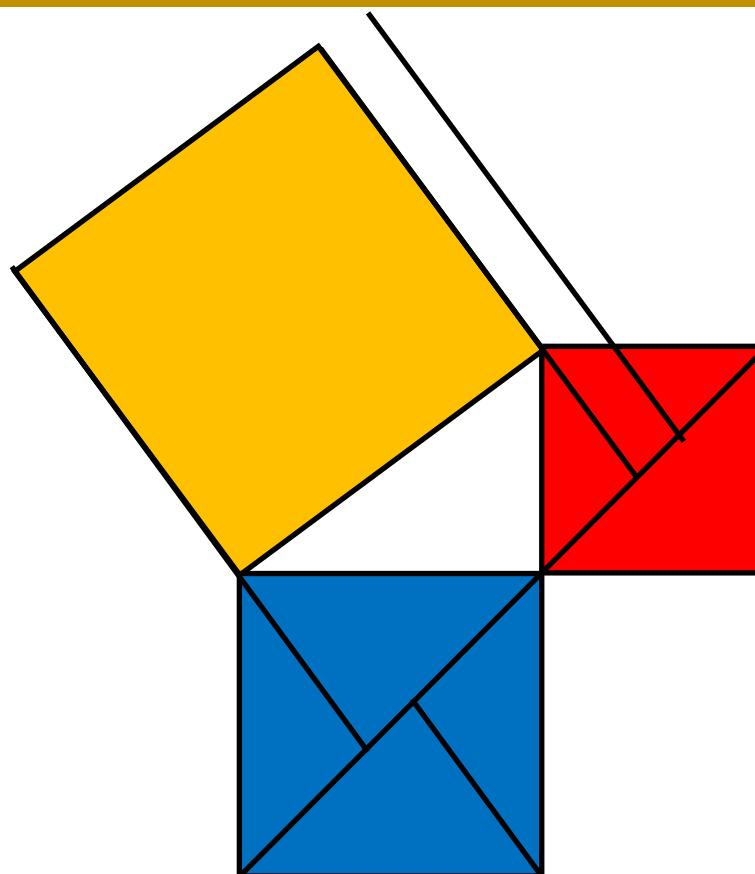
ピタゴラスの定理の証明その 8



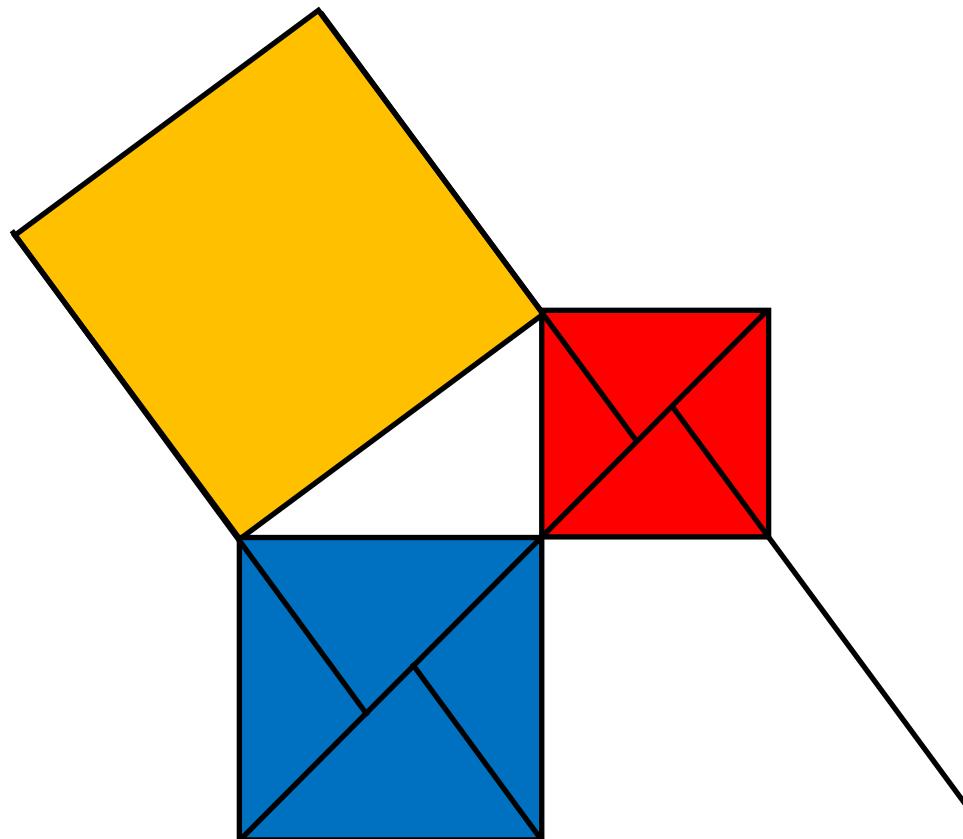
ピタゴラスの定理の証明その 8



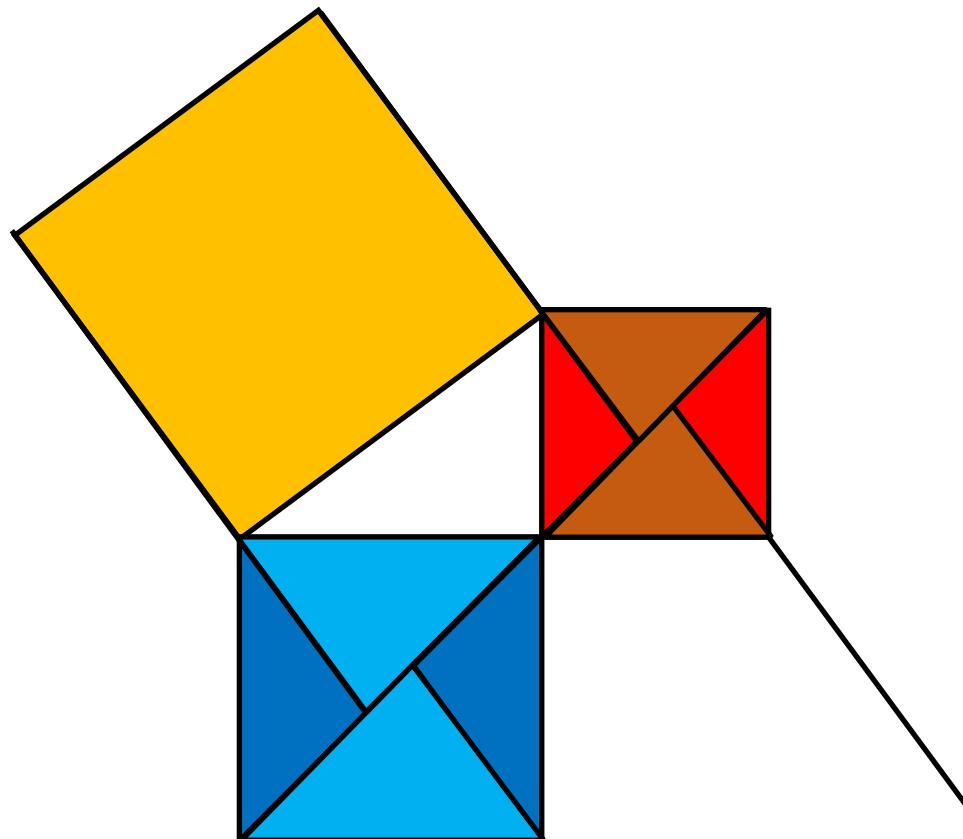
ピタゴラスの定理の証明その 8



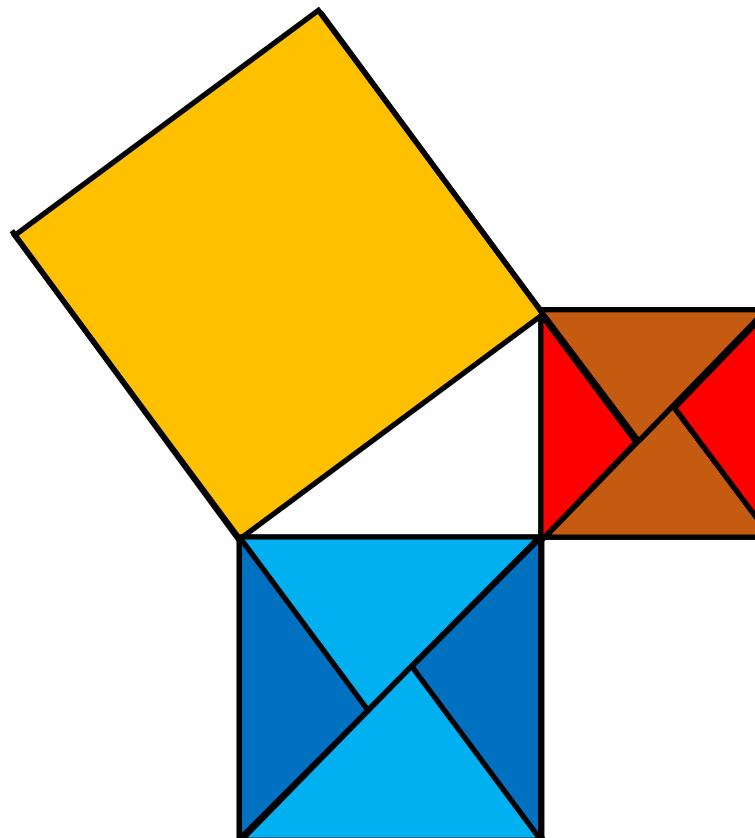
ピタゴラスの定理の証明その 8



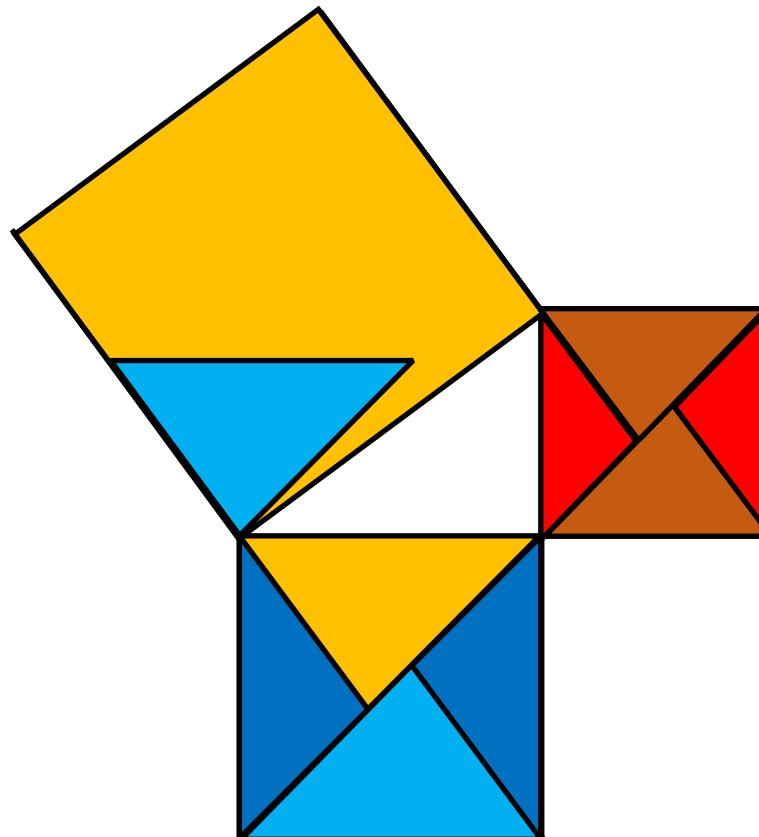
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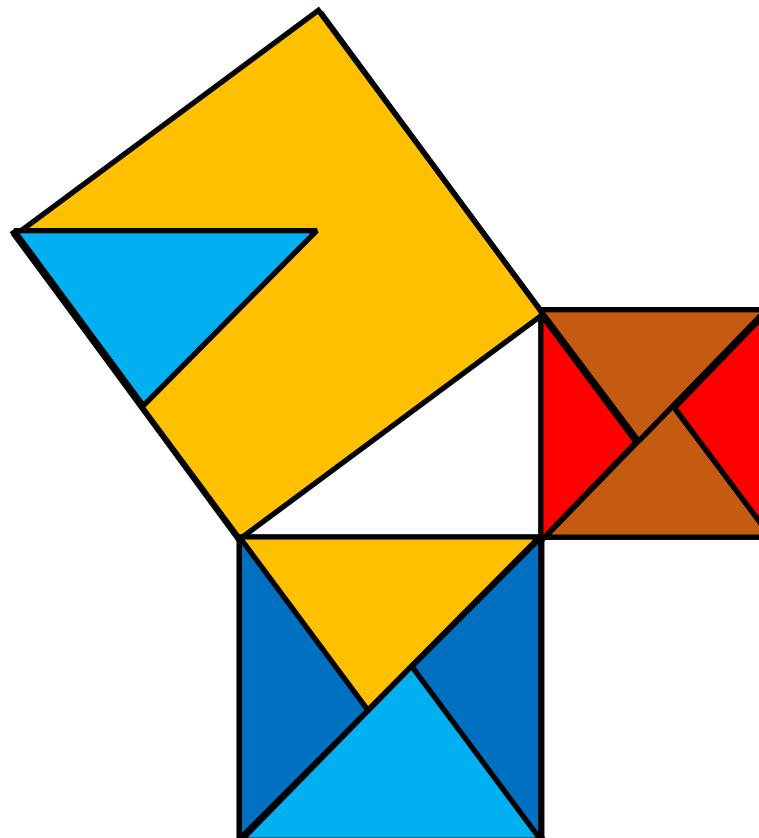
ピタゴラスの定理の証明その 8



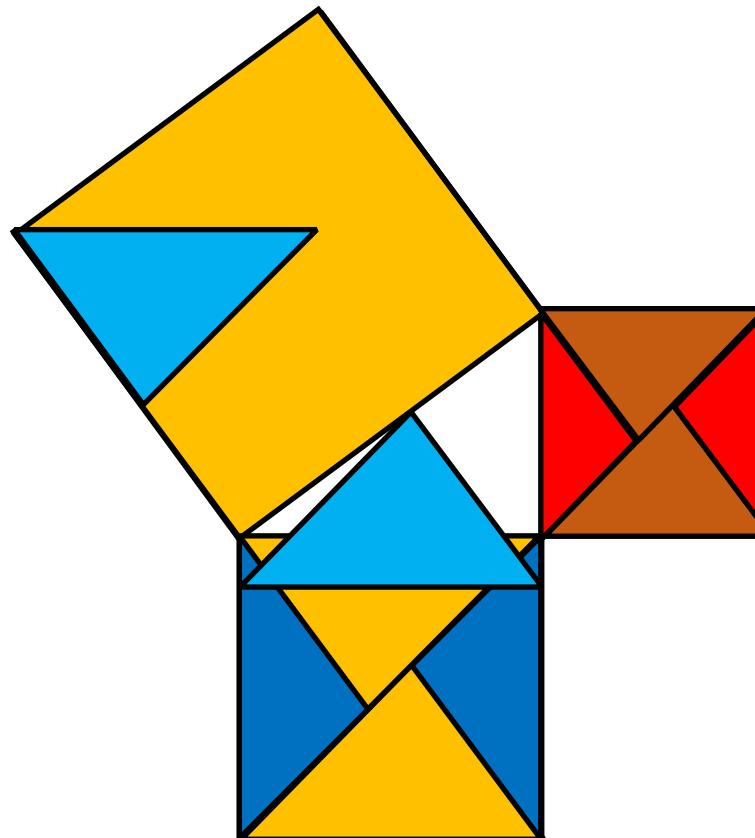
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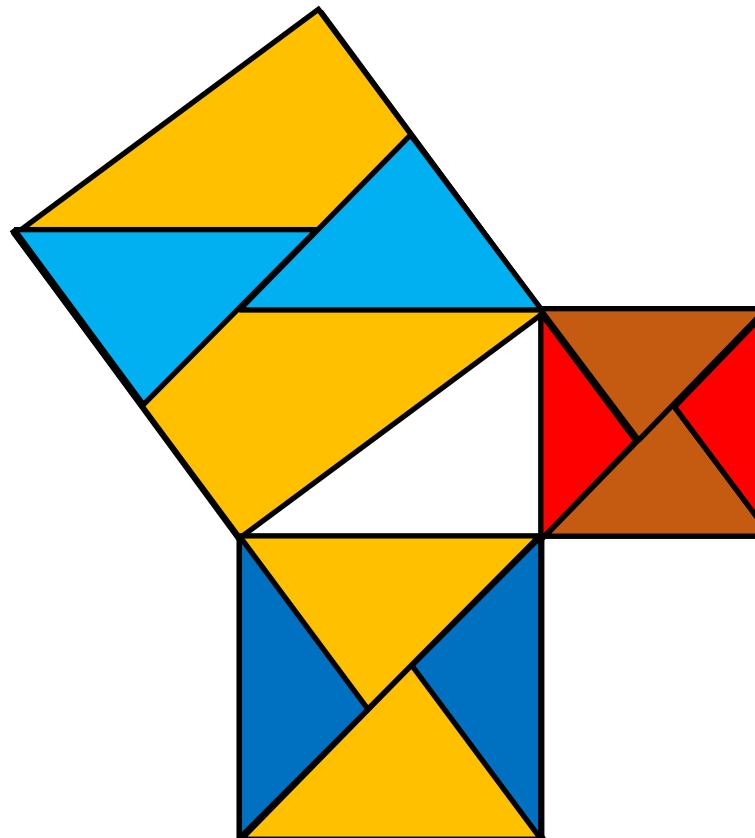
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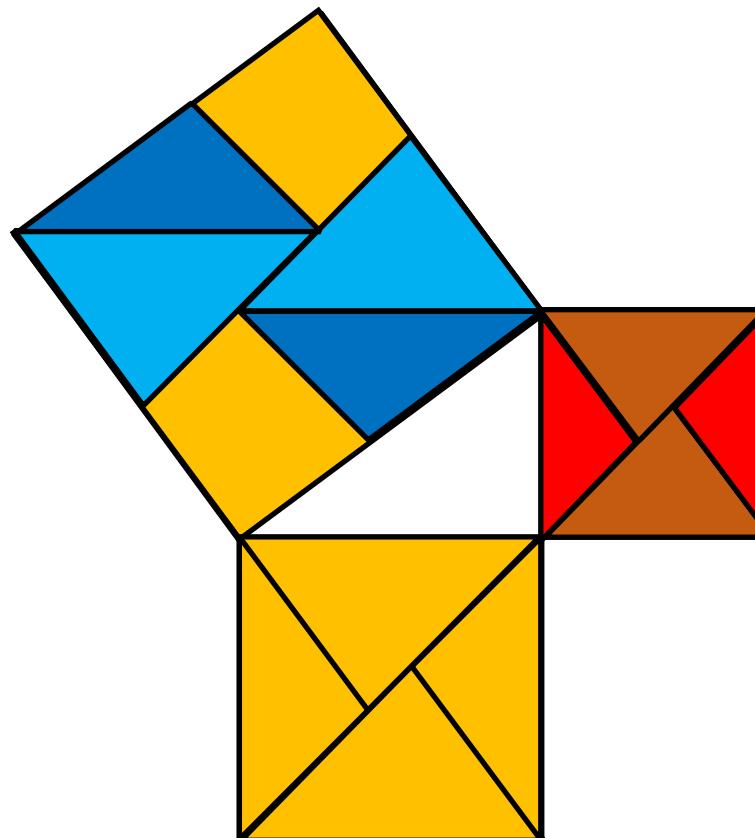
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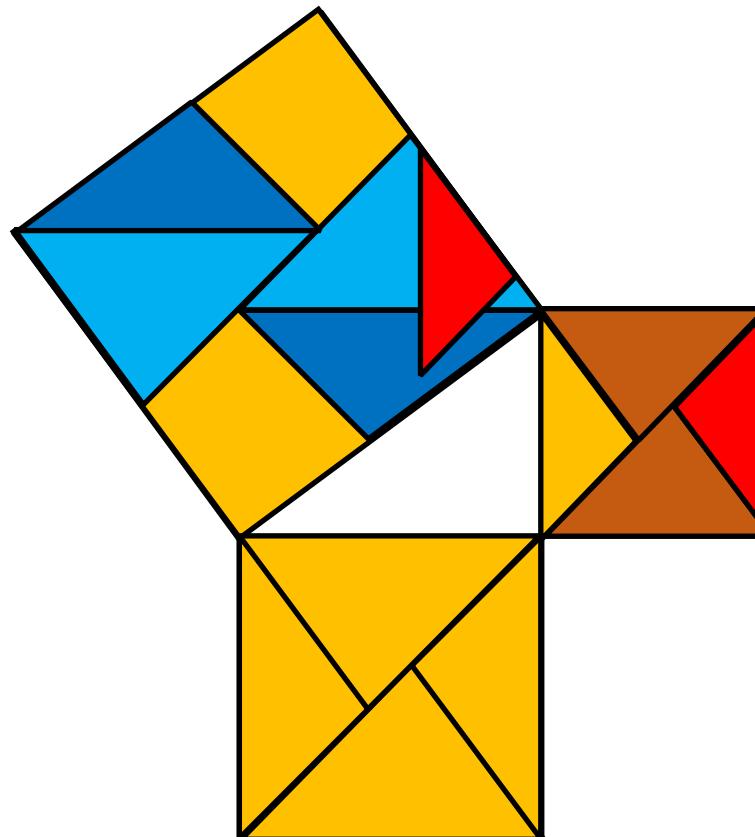
ピタゴラスの定理の証明その 8



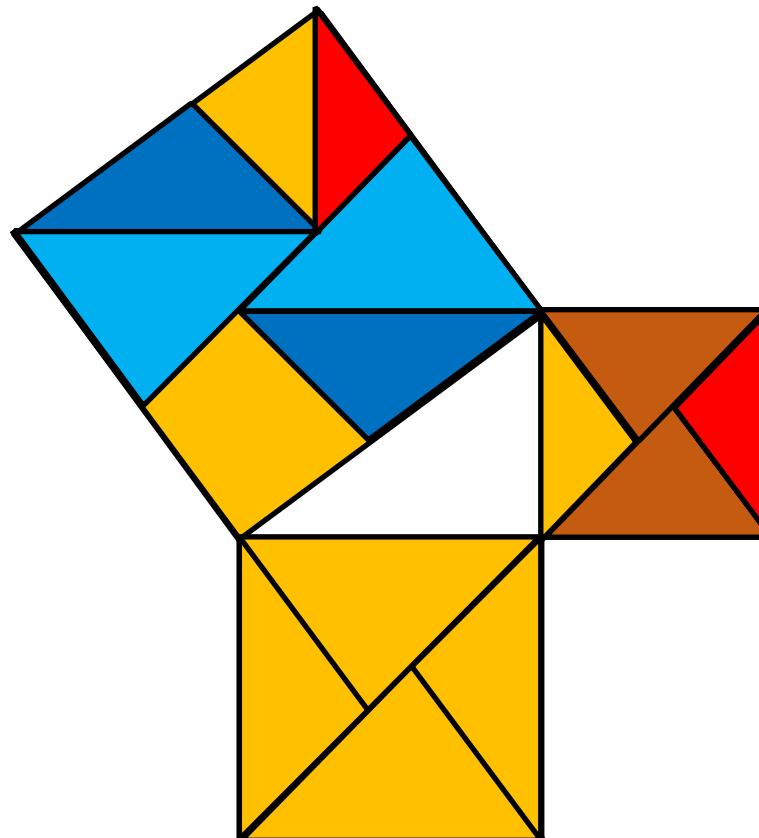
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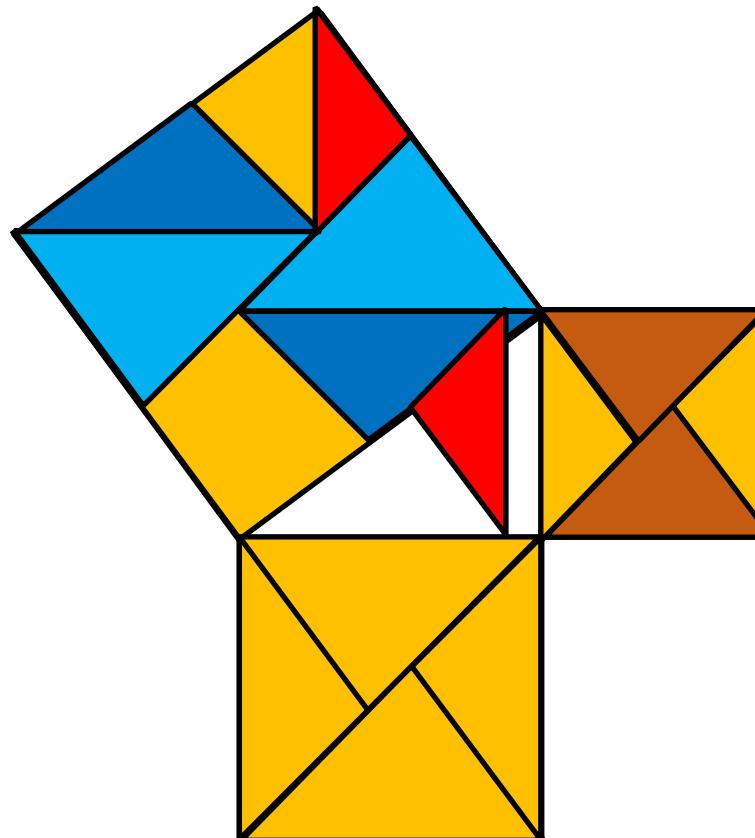
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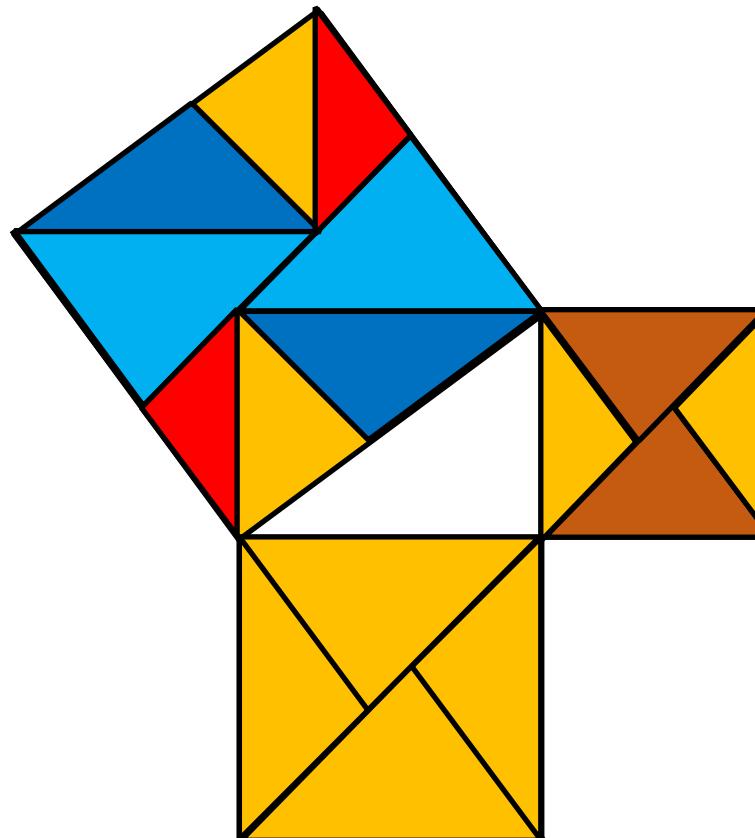
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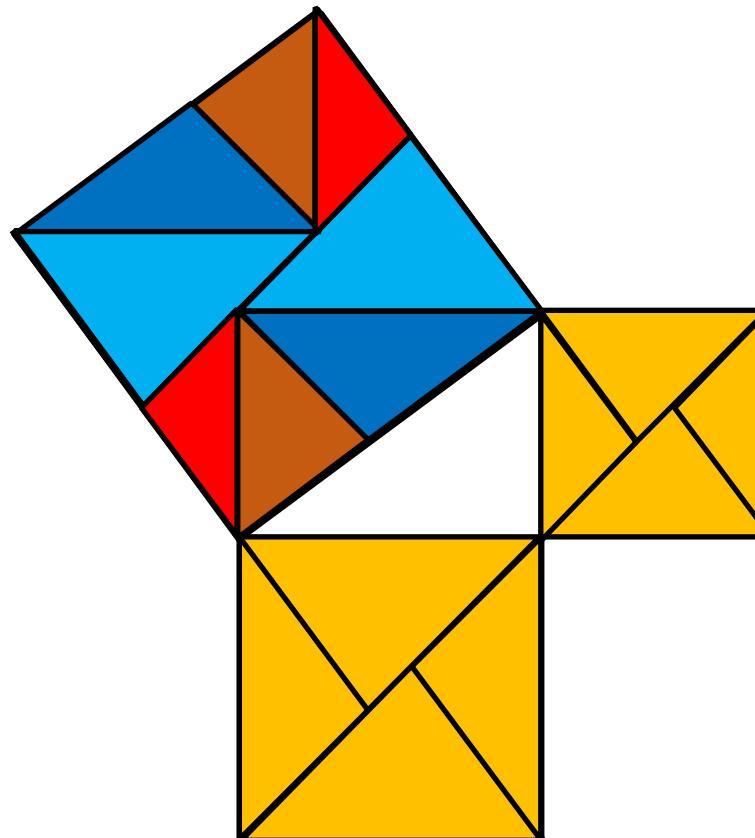
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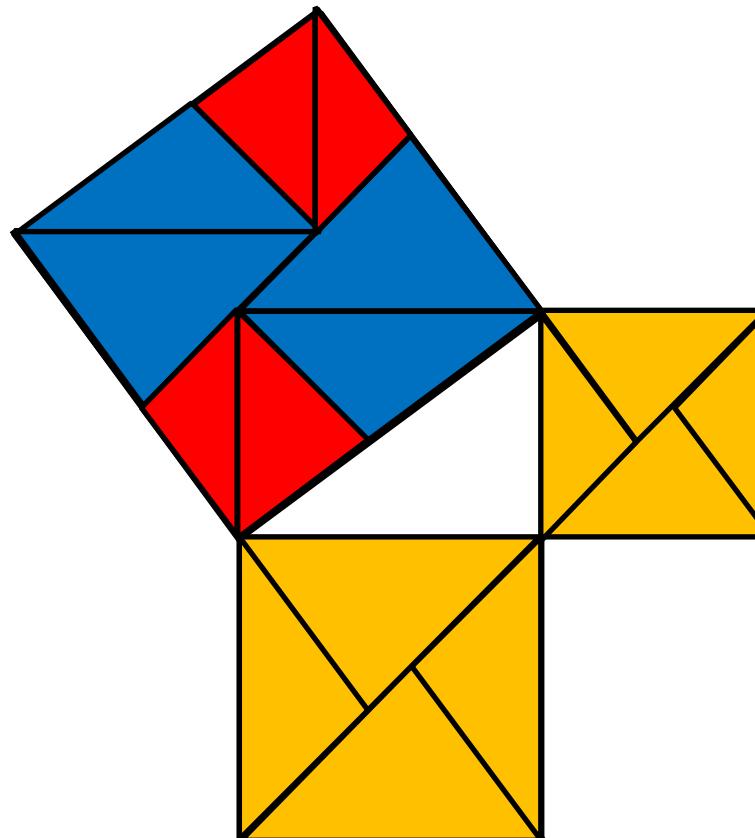
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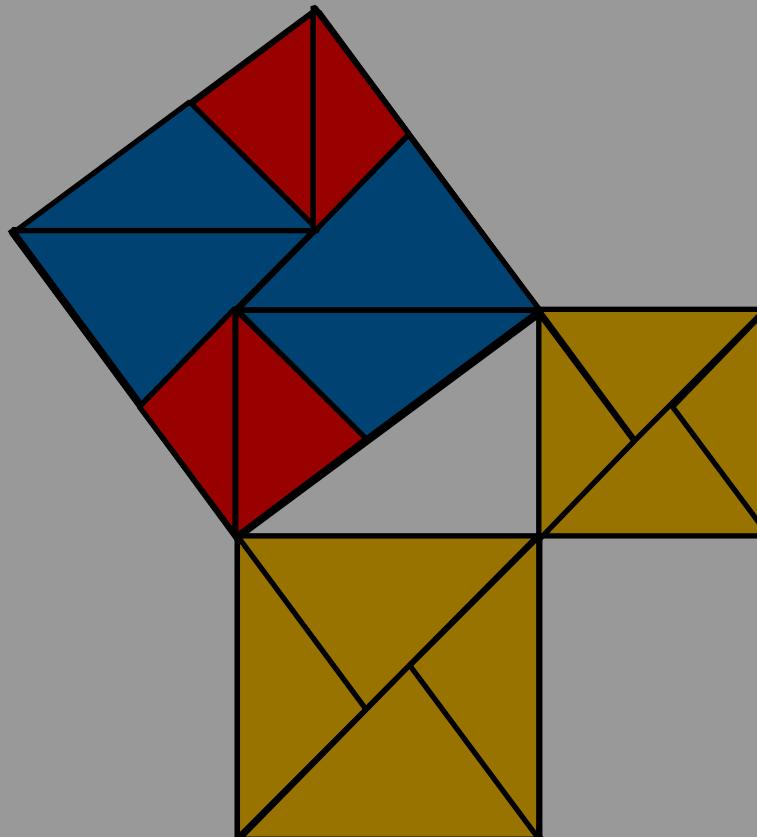
ピタゴラスの定理の証明その 8



ピタゴラスの定理の証明その 8

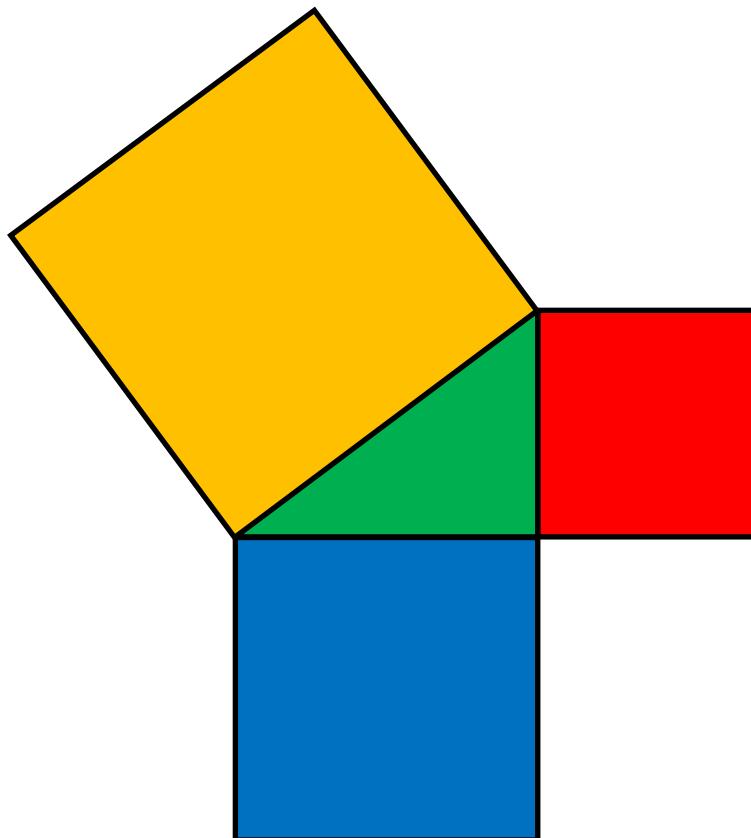


ピタゴラスの定理の証明その 8

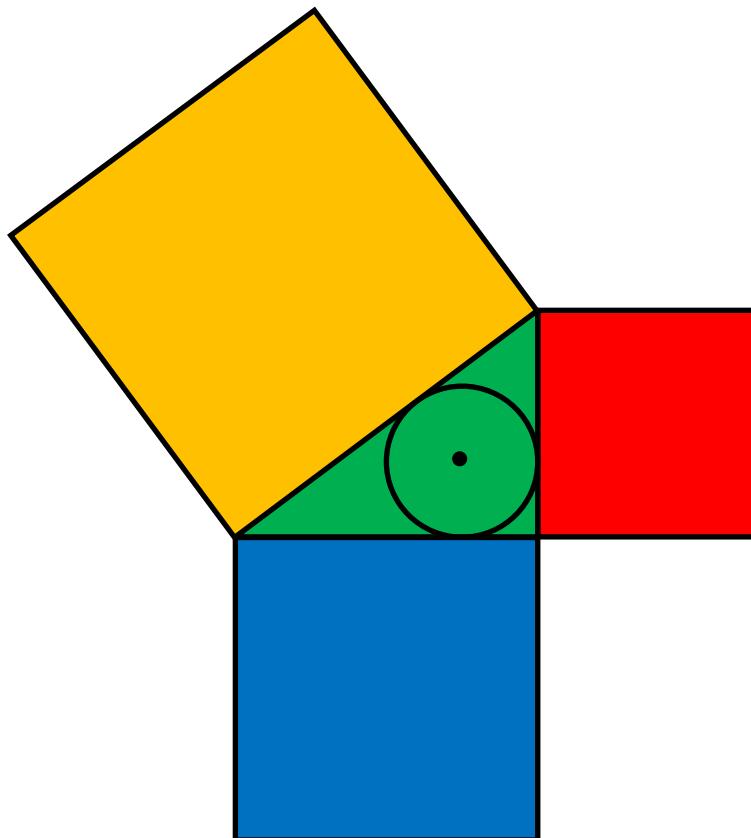


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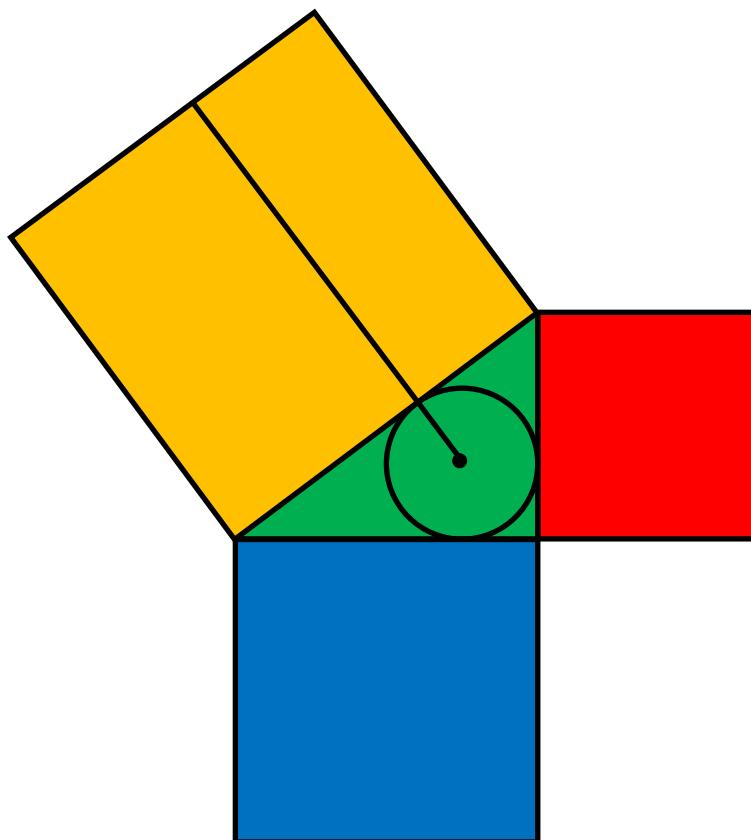
ピタゴラスの定理の証明その9



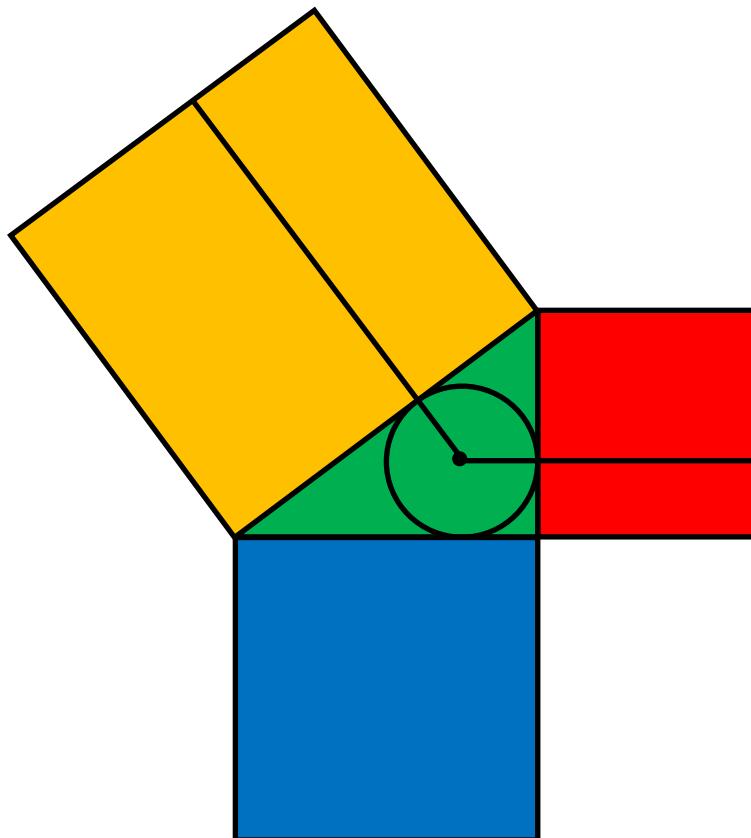
ピタゴラスの定理の証明その9



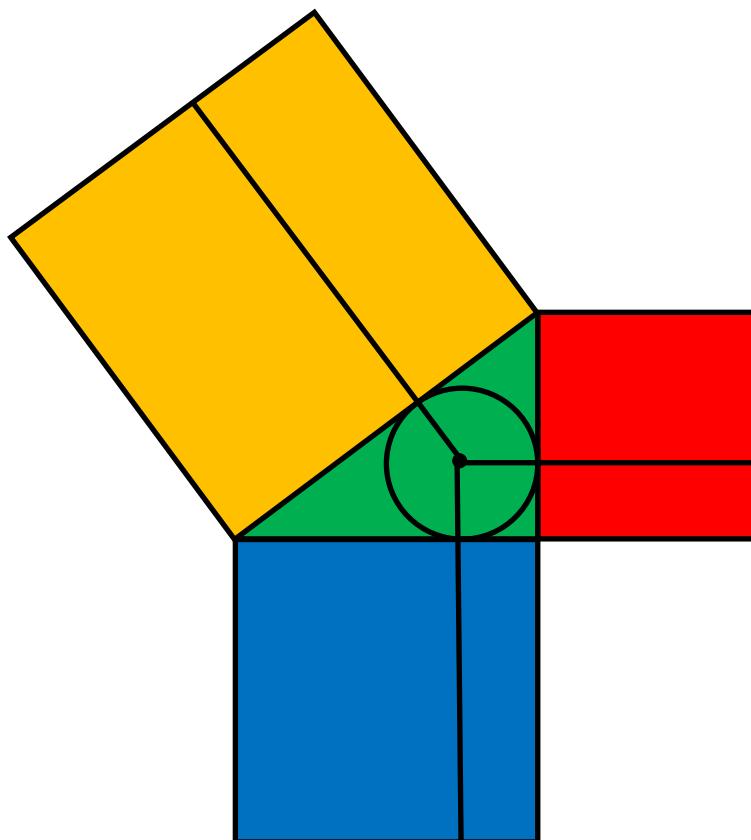
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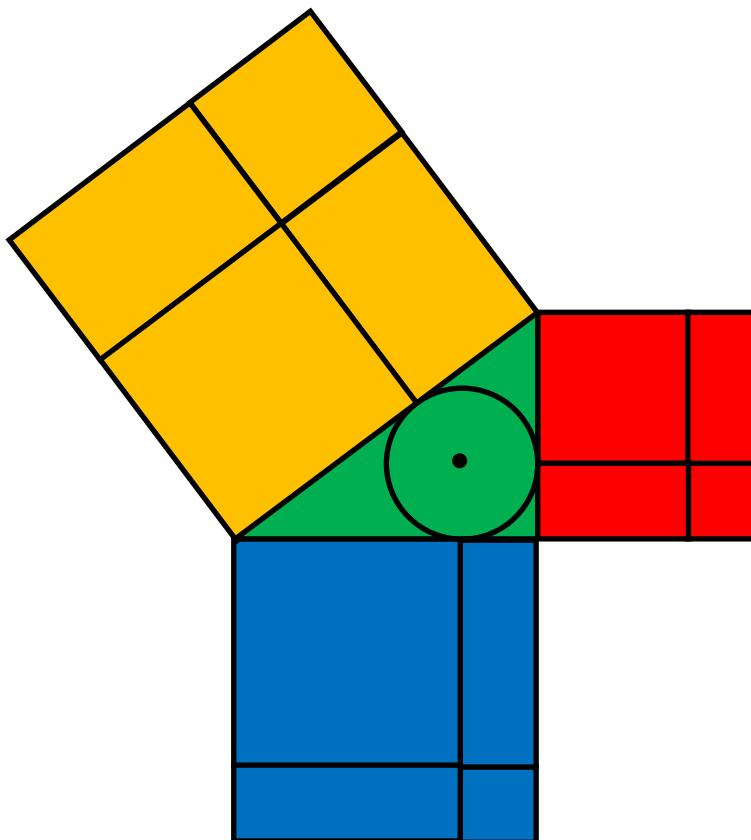
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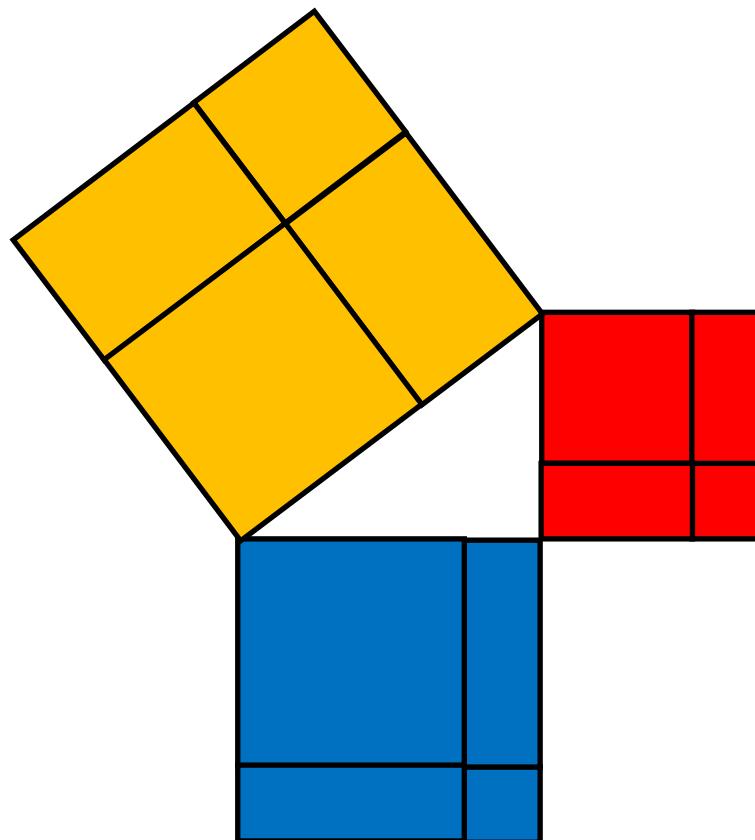
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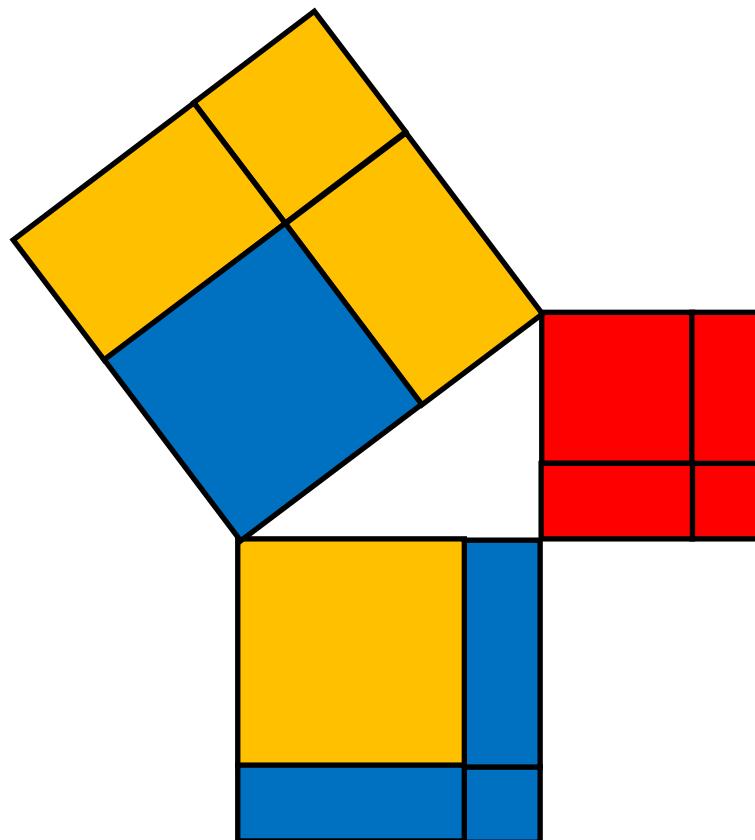
ピタゴラスの定理の証明その9



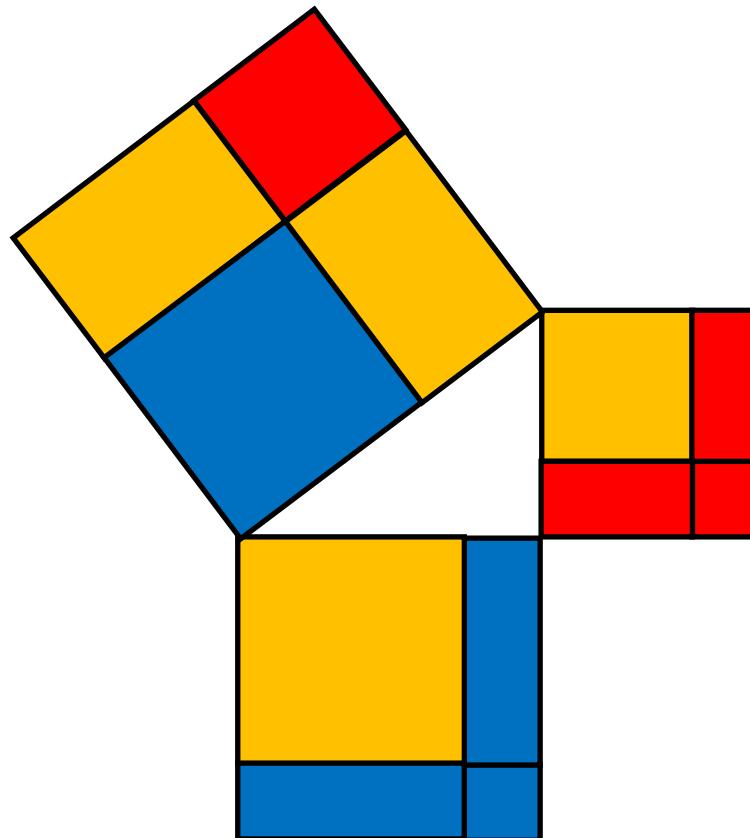
ピタゴラスの定理の証明その9



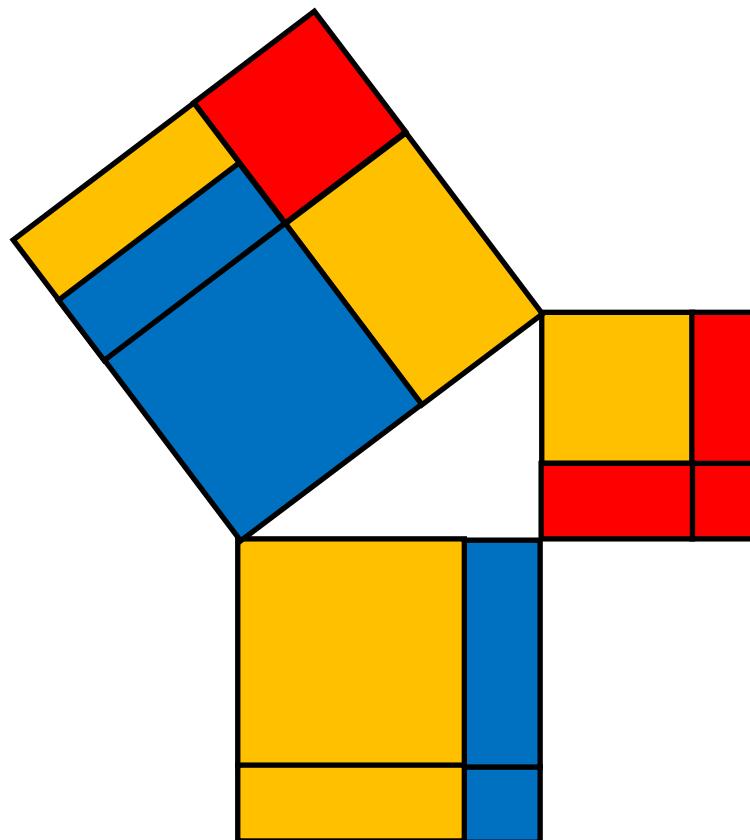
ピタゴラスの定理の証明その9



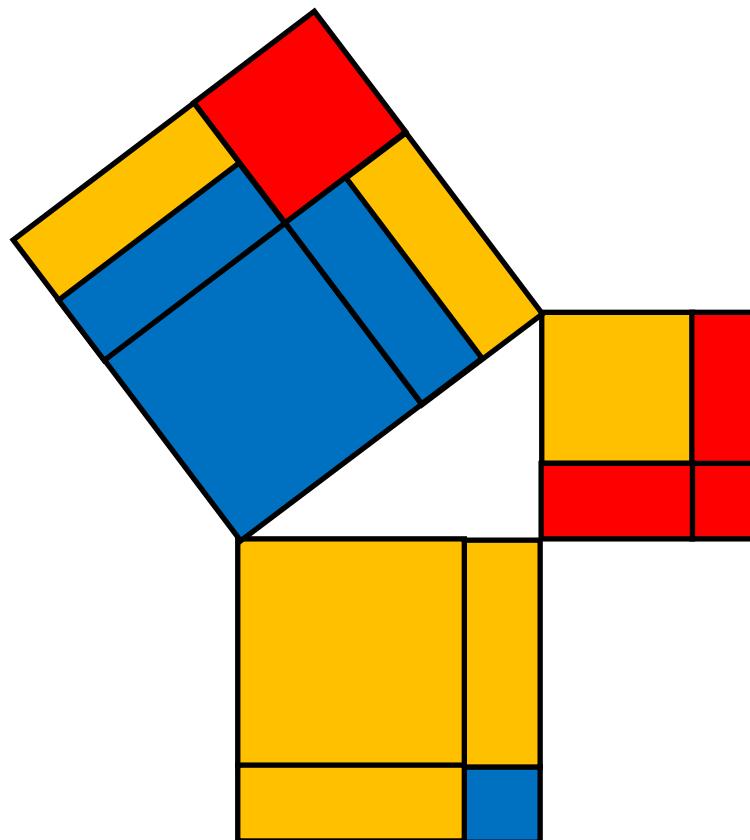
ピタゴラスの定理の証明その9



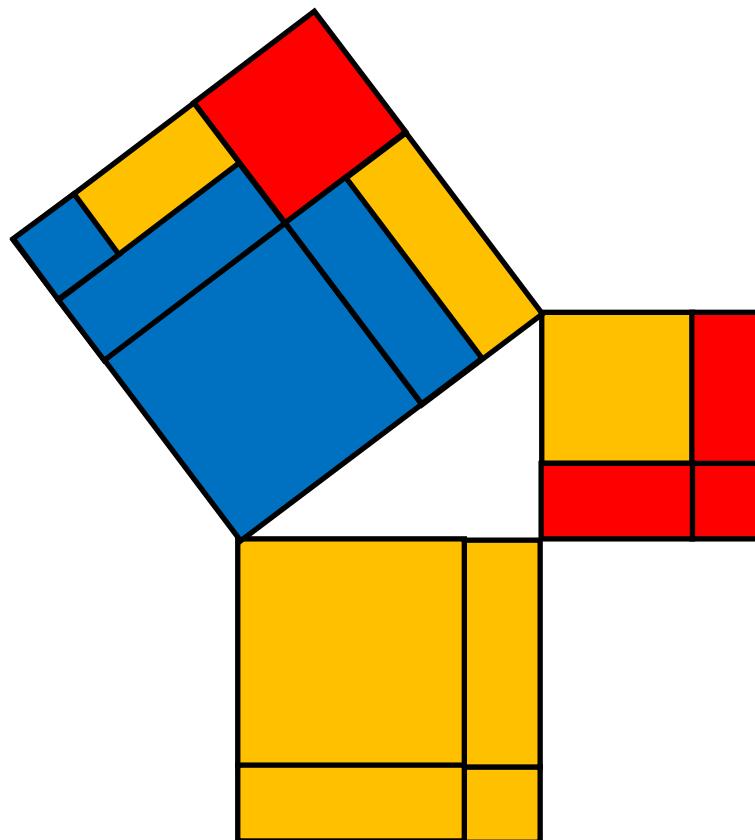
ピタゴラスの定理の証明その9



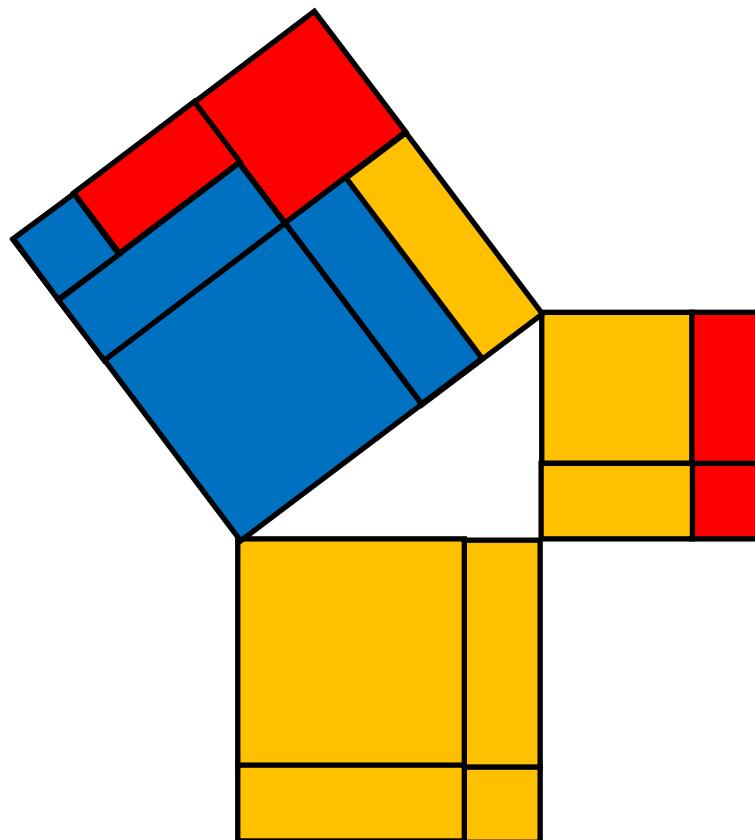
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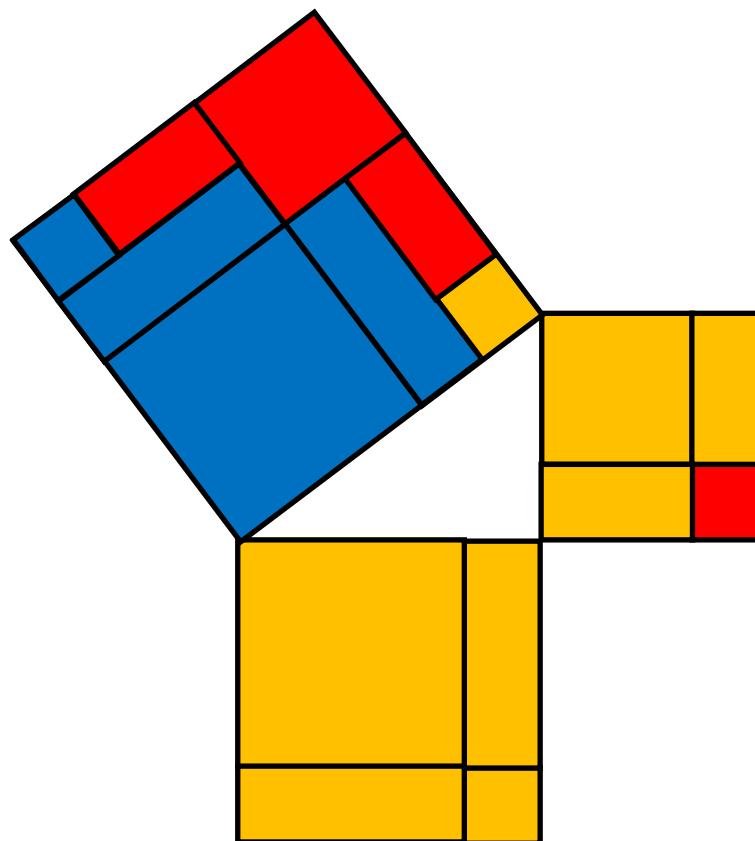
ピタゴラスの定理の証明その9



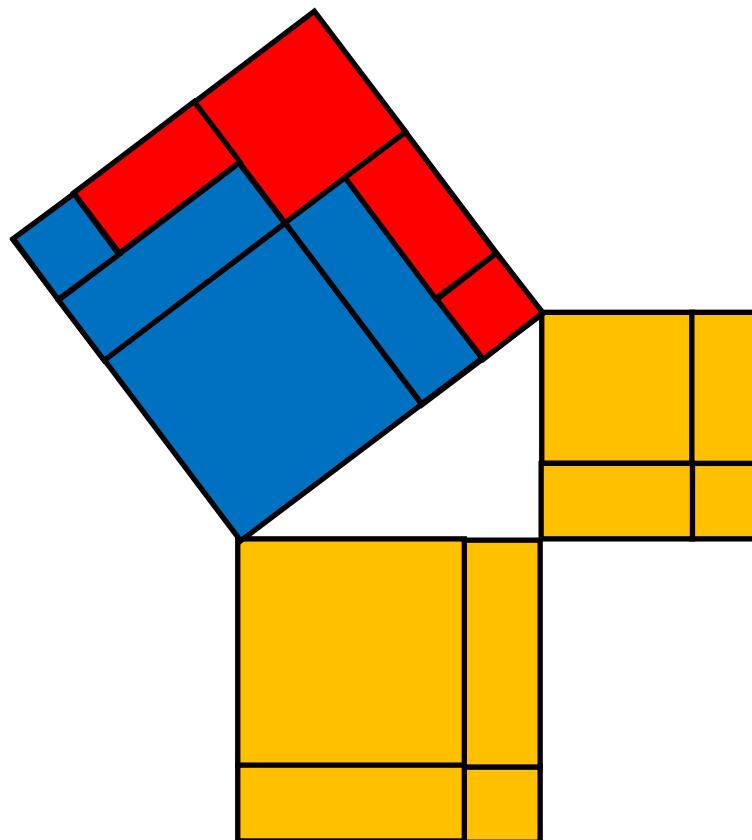
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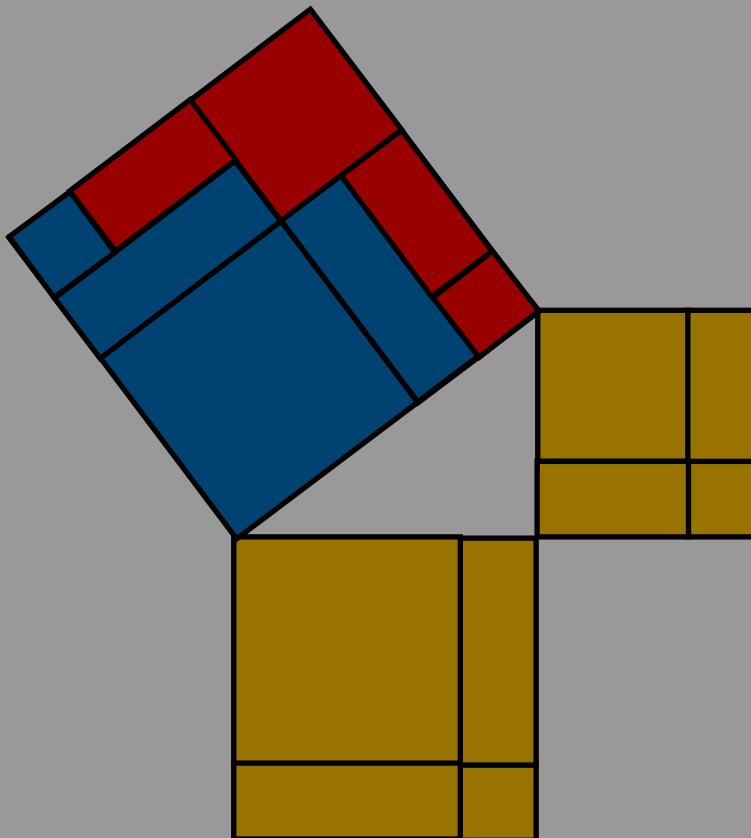
ピタゴラスの定理の証明その9



ピタゴラスの定理の証明その9

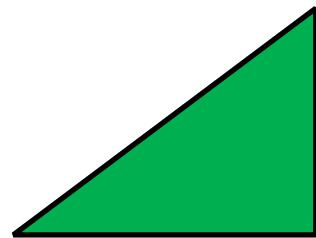


ピタゴラスの定理の証明その9

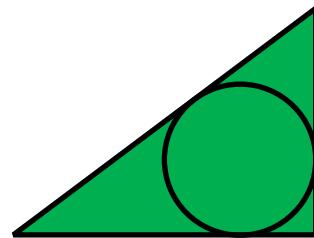


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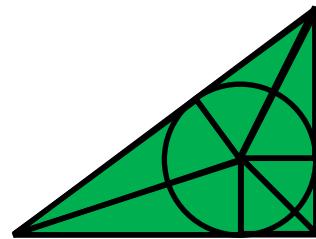
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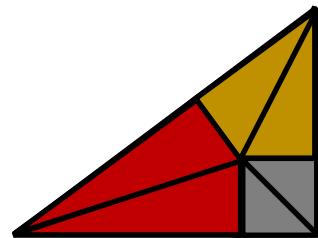
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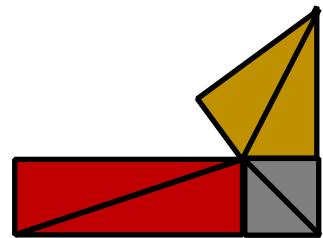
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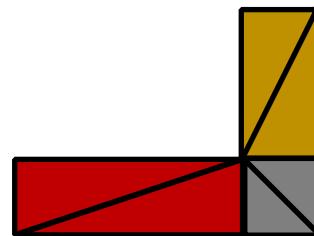
ピタゴラスの定理の証明その10



ピタゴラスの定理の証明その10



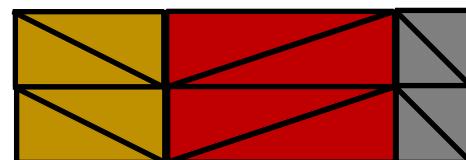
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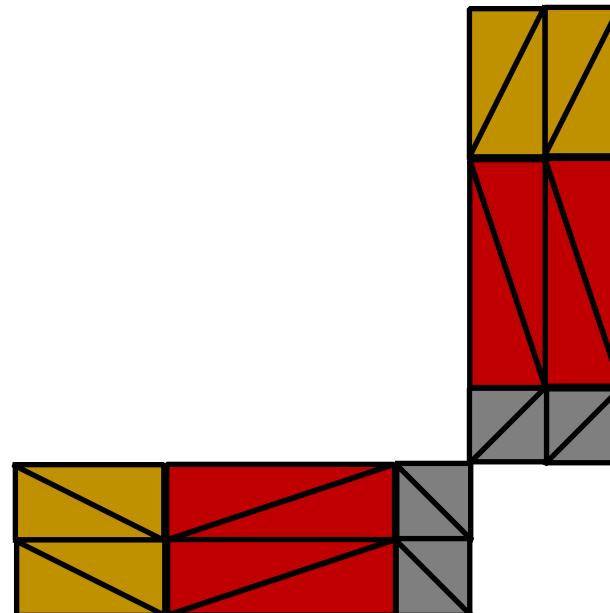
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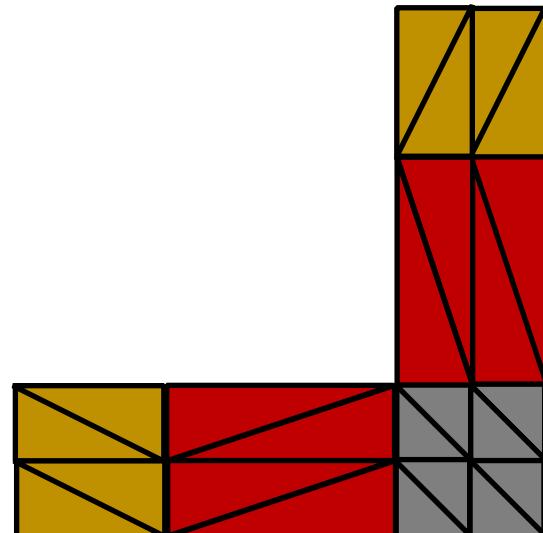
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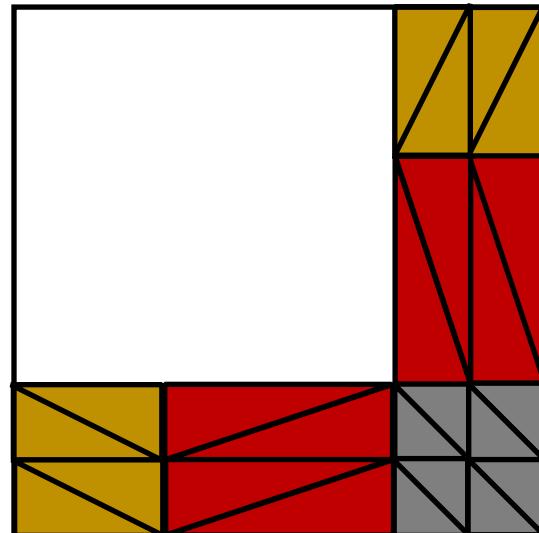
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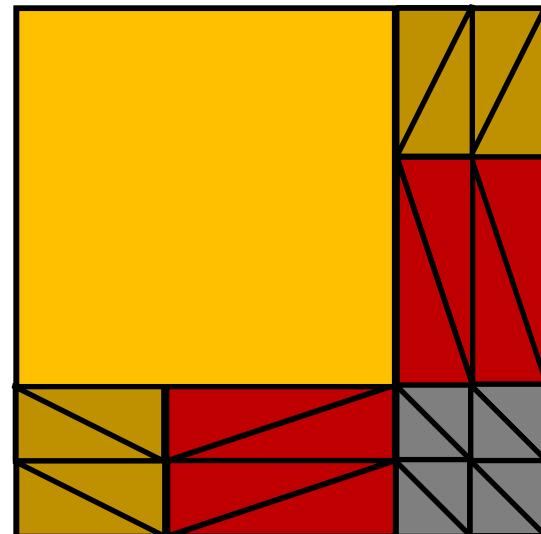
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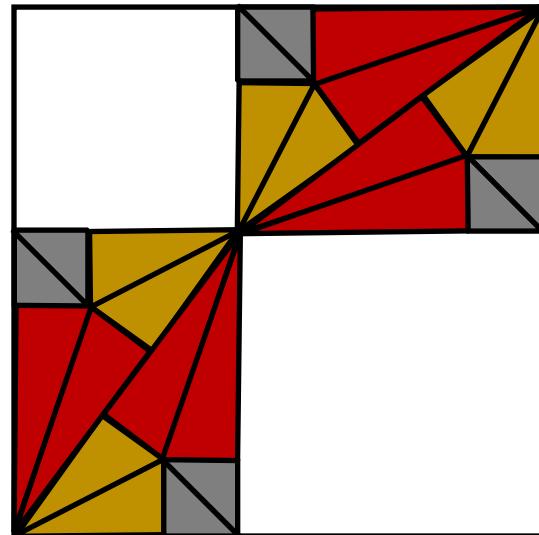
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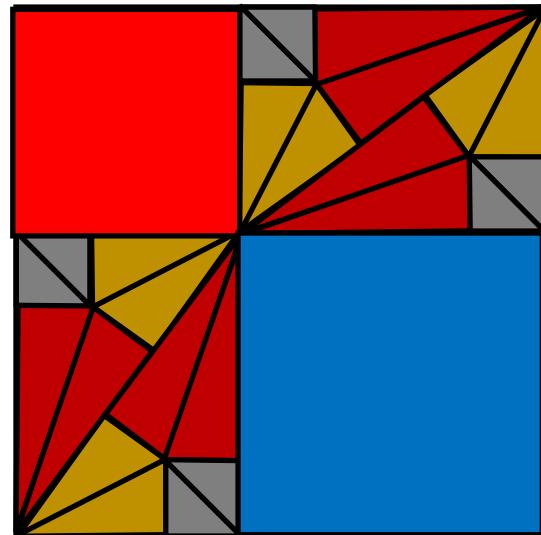
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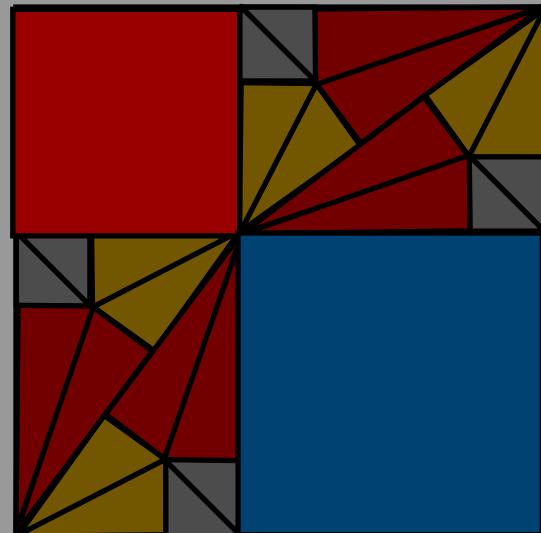
ピタゴラスの定理の証明その10



ピタゴラスの定理の証明その10

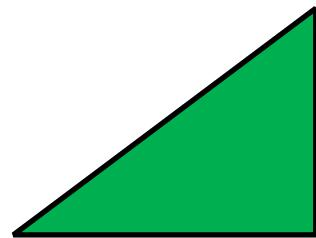


ピタゴラスの定理の証明その10

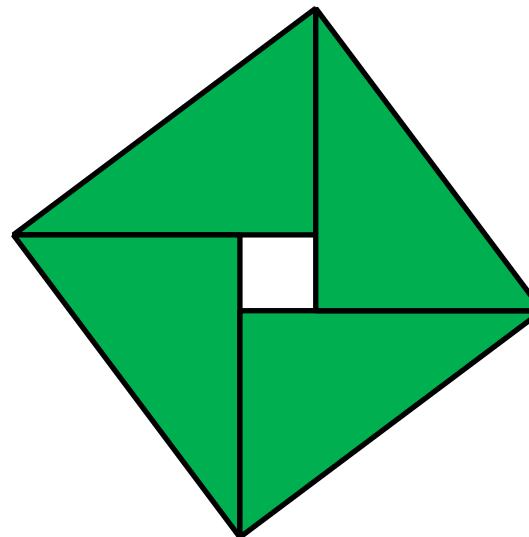


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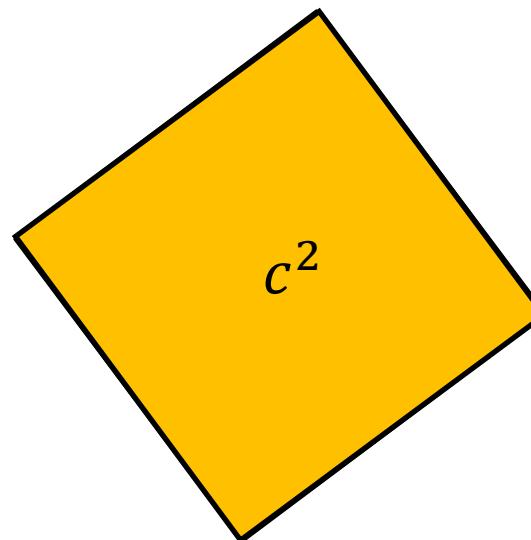
ピタゴラスの定理の証明その11



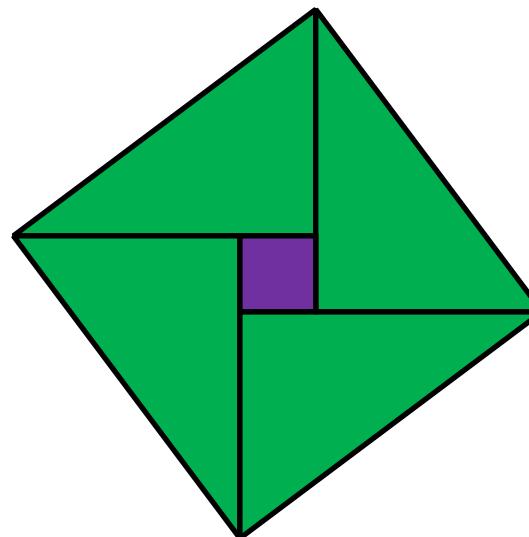
ピタゴラスの定理の証明その11



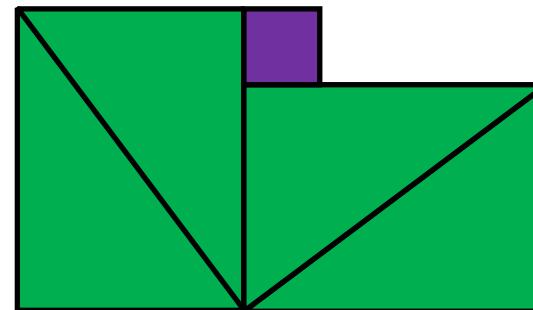
ピタゴラスの定理の証明その11



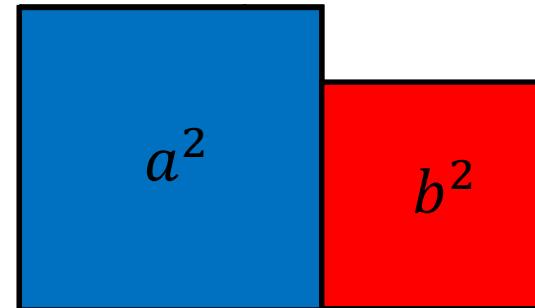
ピタゴラスの定理の証明その11



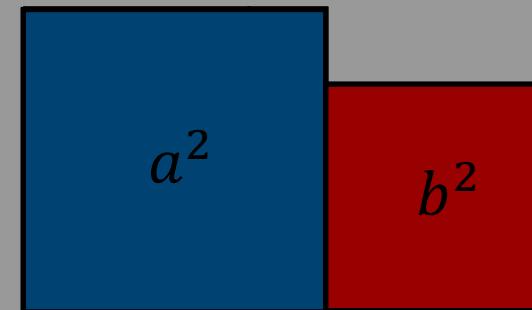
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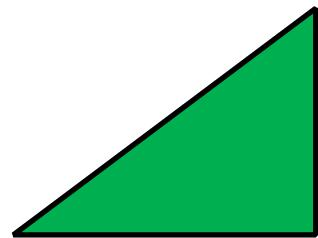


ピタゴラスの定理の証明その11

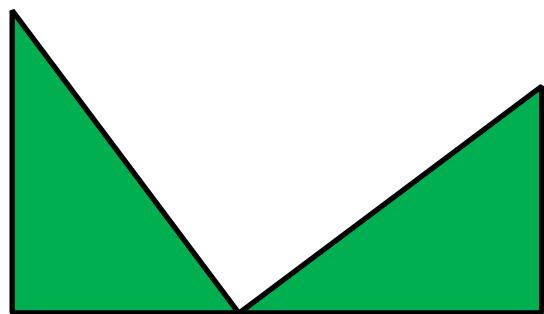


QED

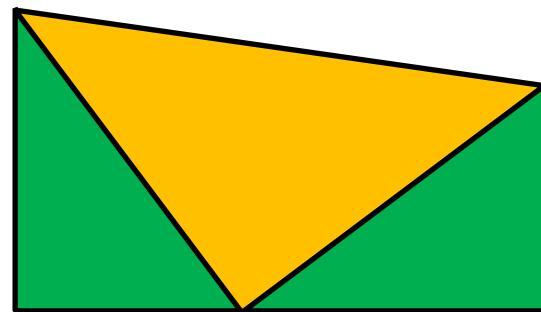
ピタゴラスの定理の証明その12



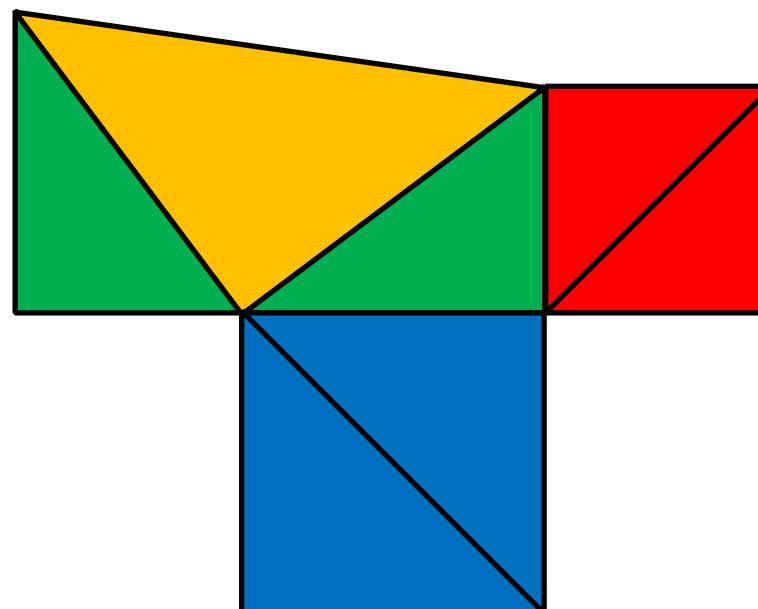
ピタゴラスの定理の証明その12



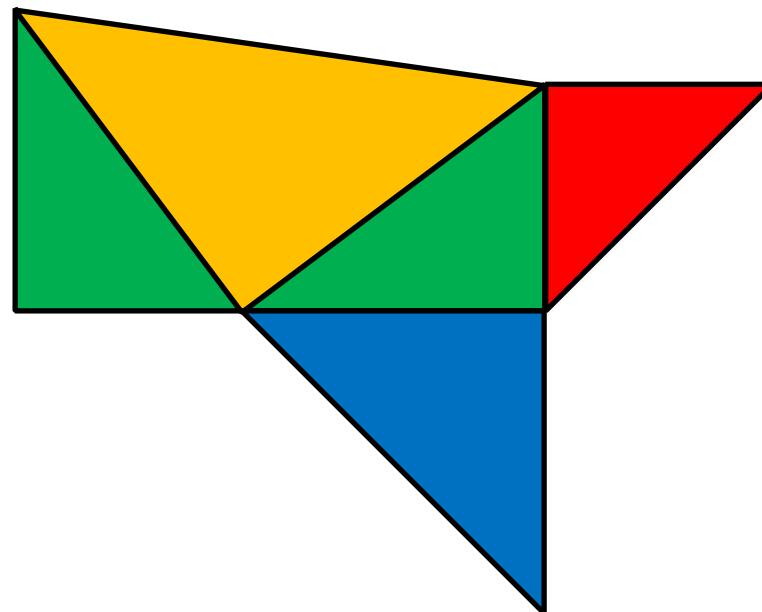
ピタゴラスの定理の証明その12



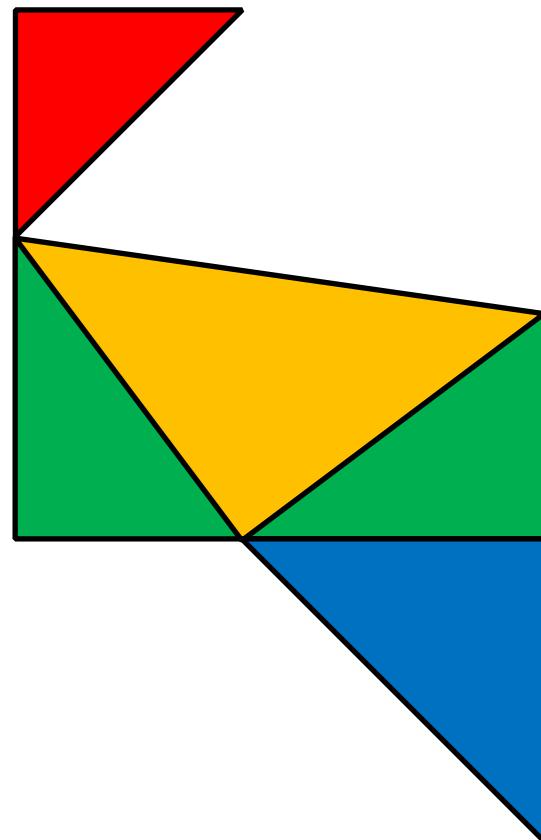
ピタゴラスの定理の証明その12



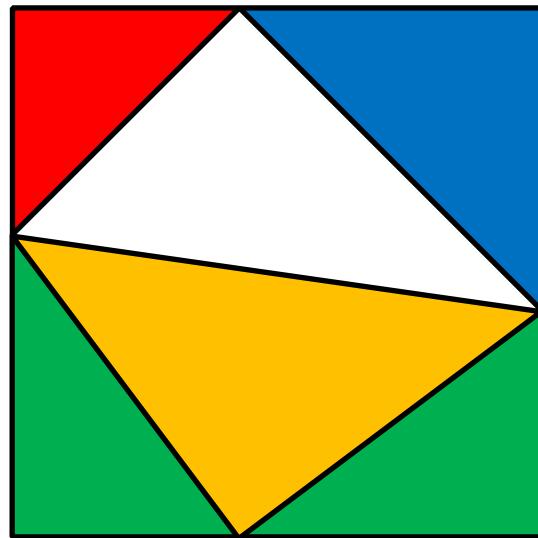
ピタゴラスの定理の証明その12



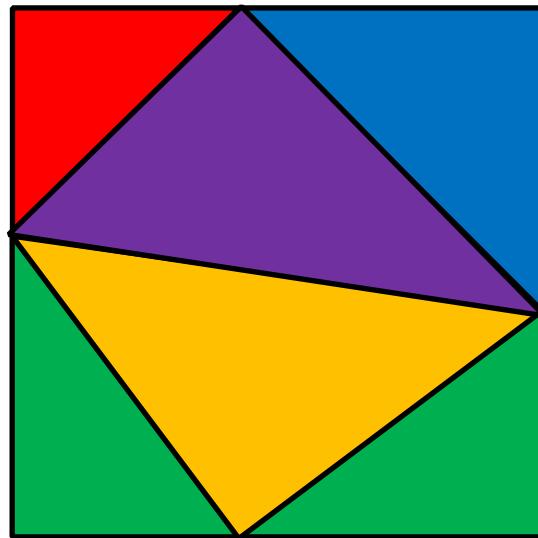
ピタゴラスの定理の証明その12



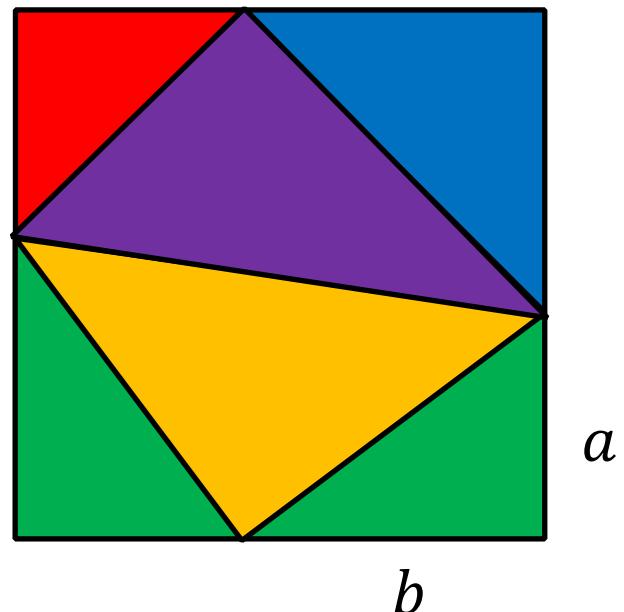
ピタゴラスの定理の証明その12



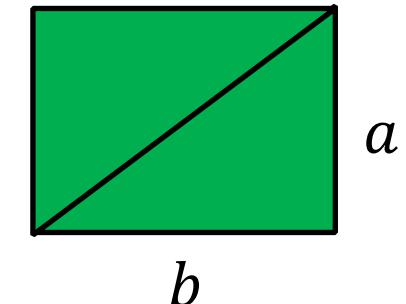
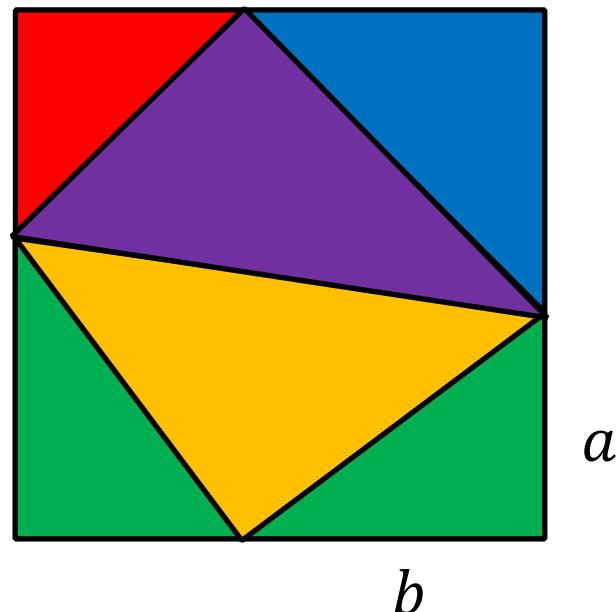
ピタゴラスの定理の証明その12



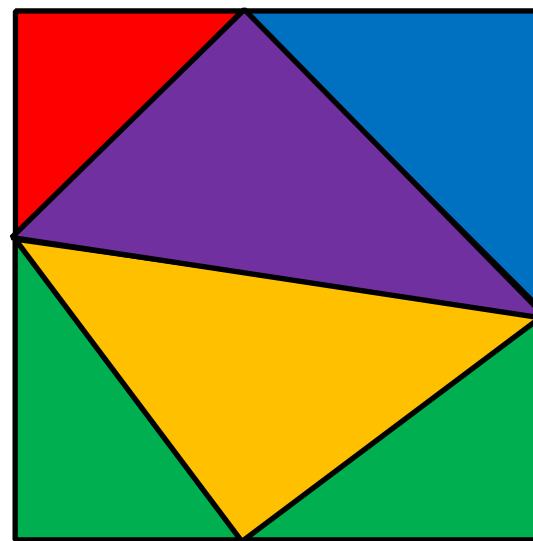
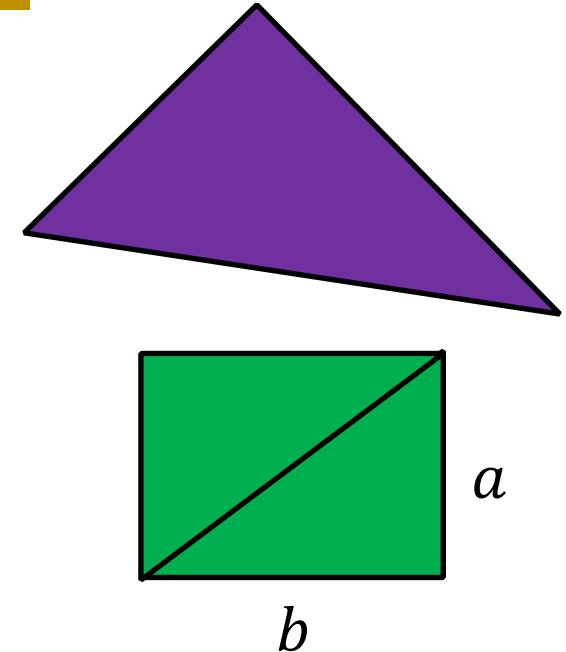
ピタゴラスの定理の証明その12



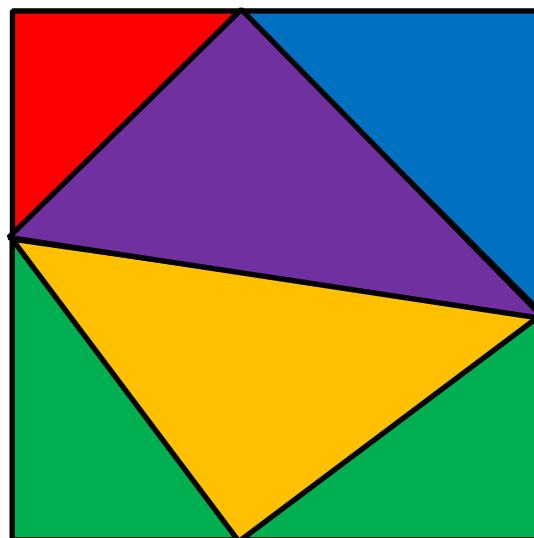
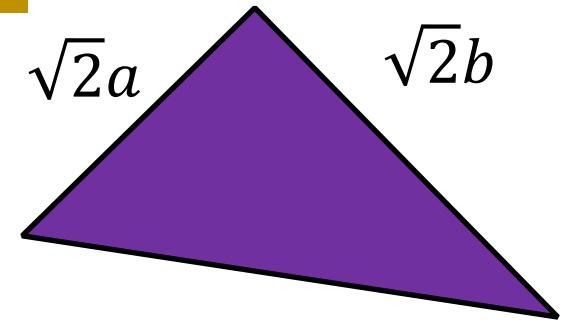
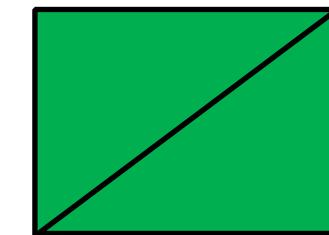
ピタゴラスの定理の証明その12



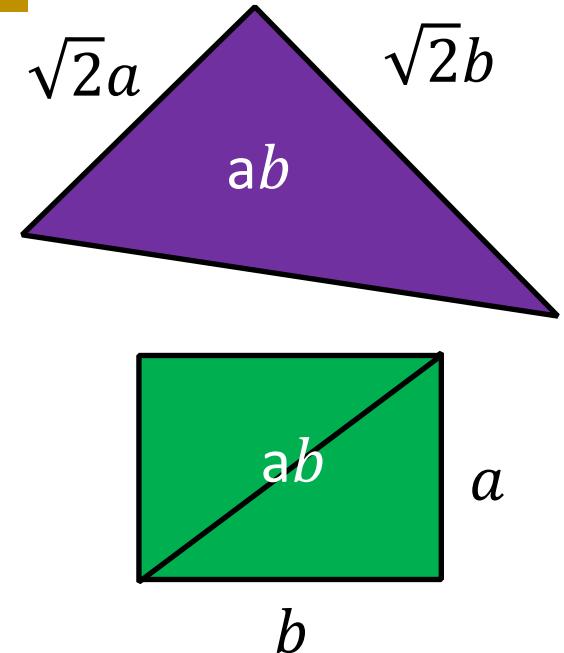
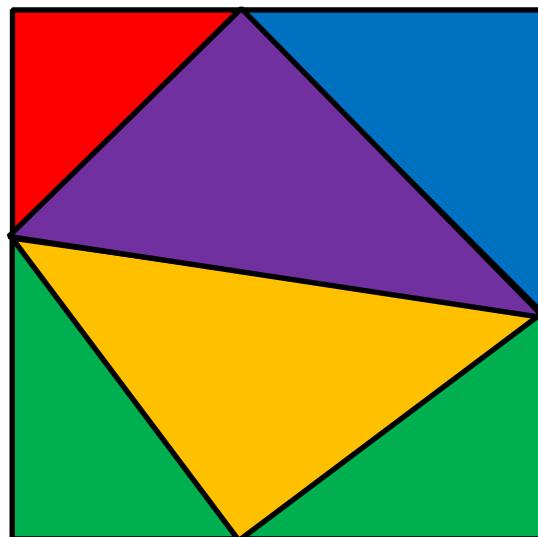
ピタゴラスの定理の証明その12

 b a  b a

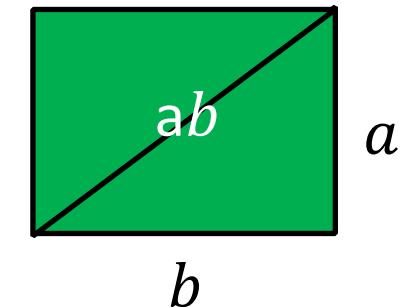
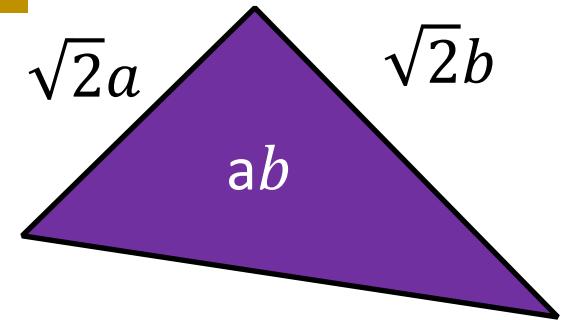
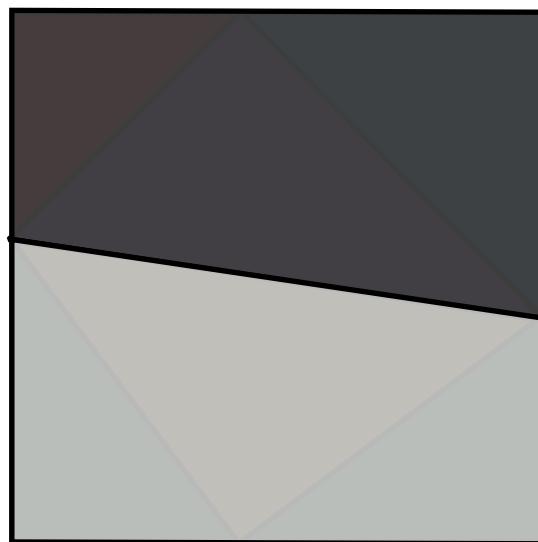
ピタゴラスの定理の証明その12

 b a  a  b

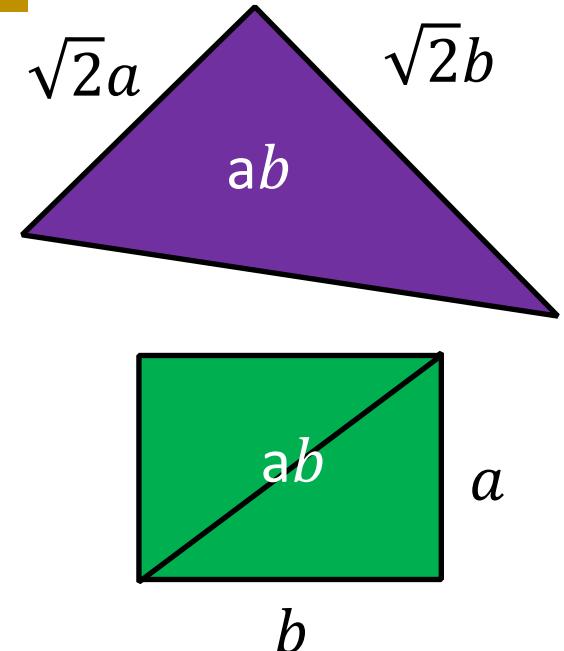
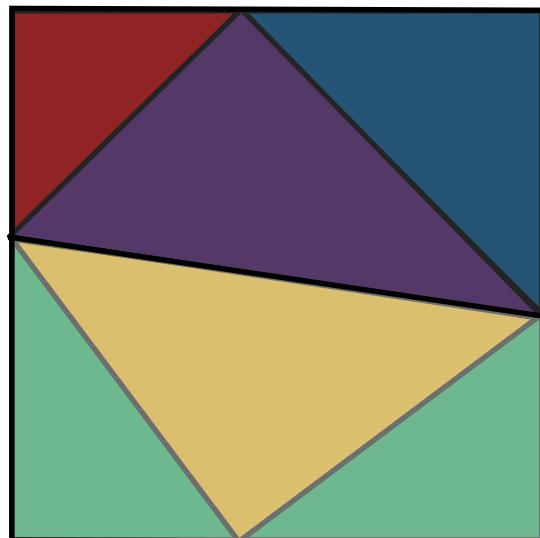
ピタゴラスの定理の証明その12



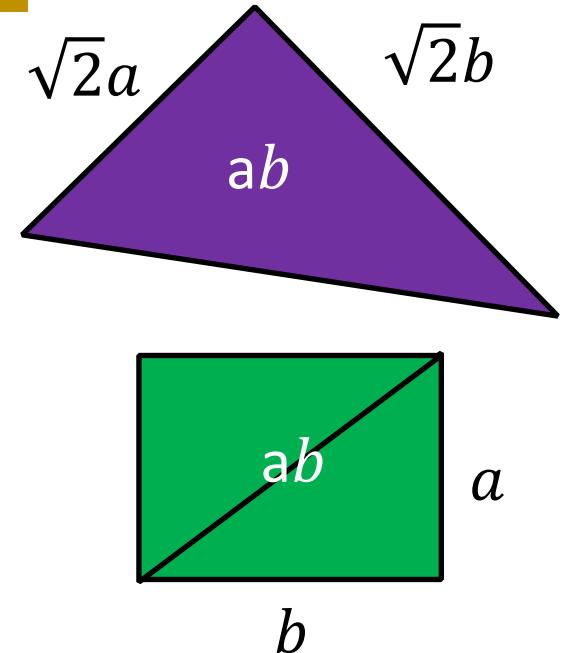
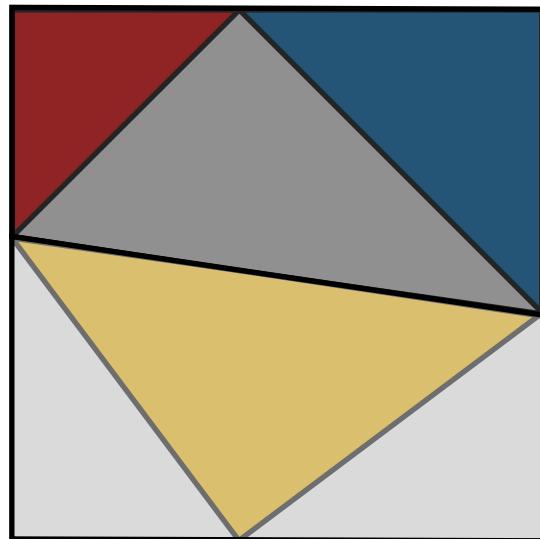
ピタゴラスの定理の証明その12



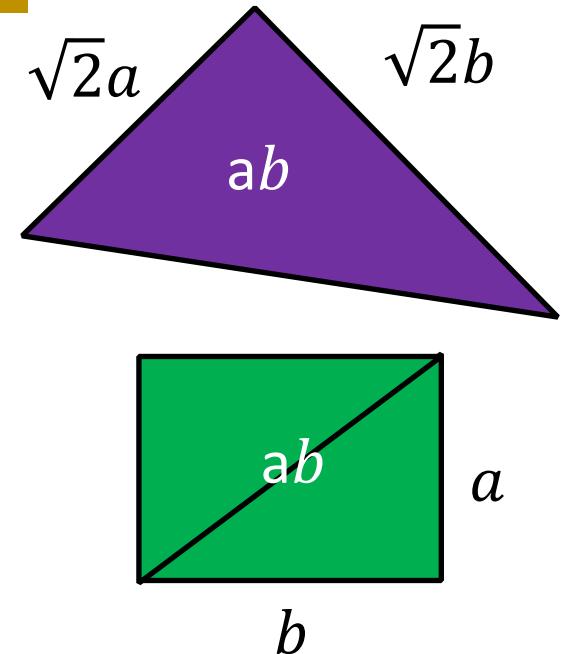
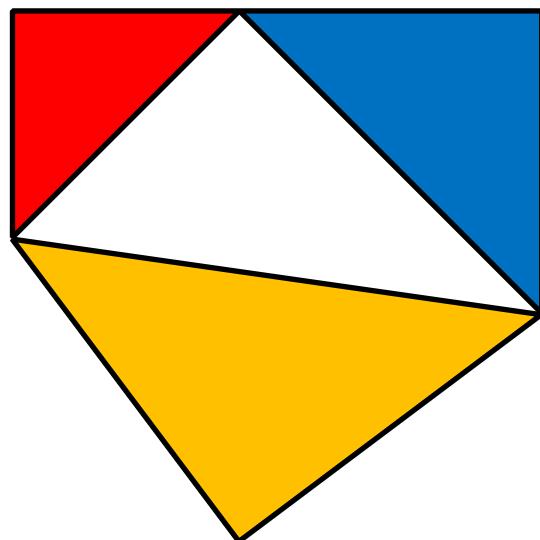
ピタゴラスの定理の証明その12



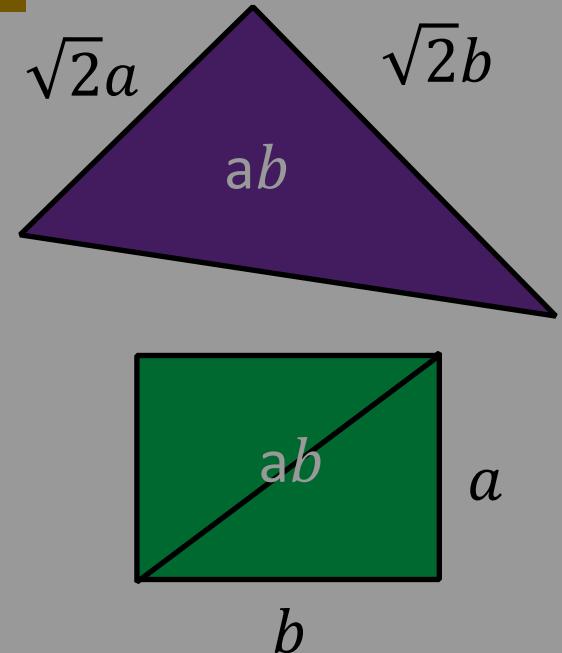
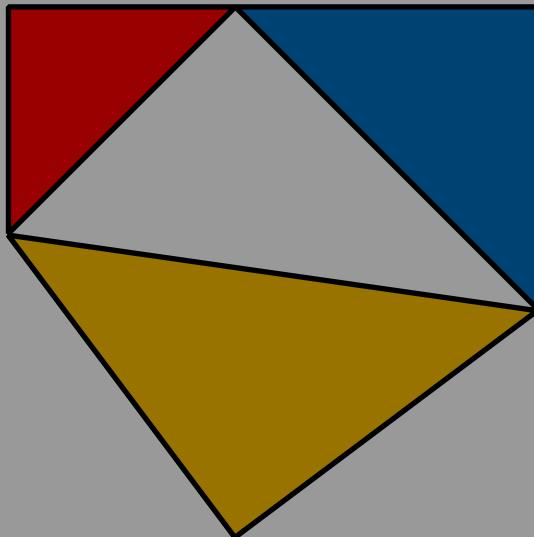
ピタゴラスの定理の証明その12



ピタゴラスの定理の証明その12

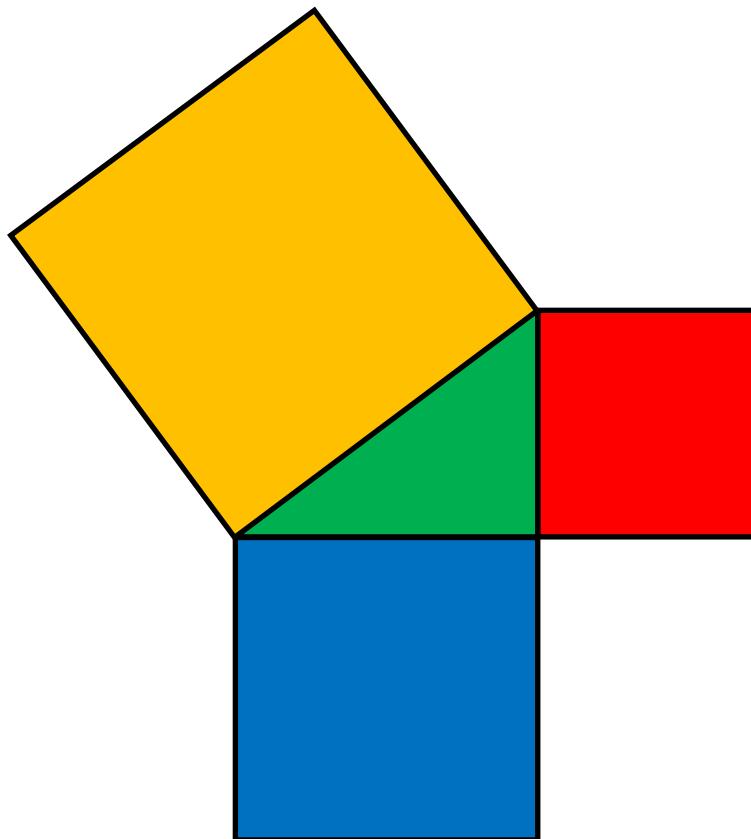


ピタゴラスの定理の証明その12

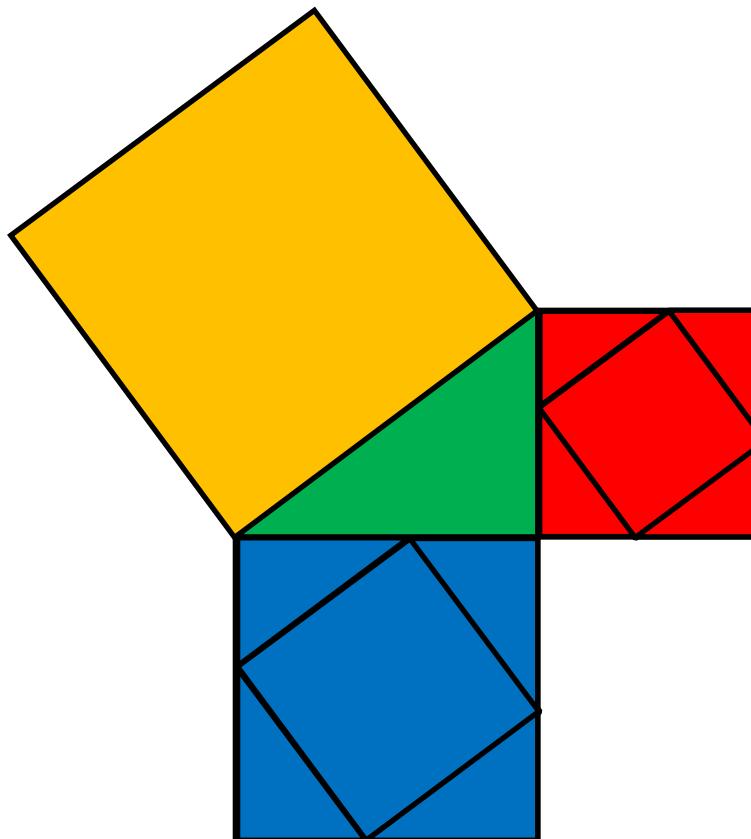


QED

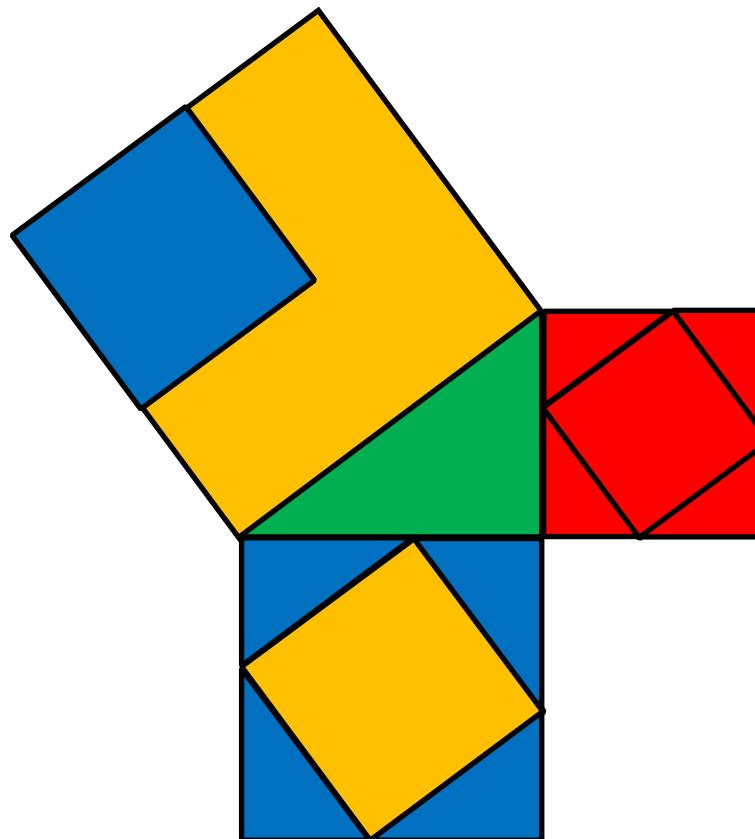
ピタゴラスの定理の証明その13



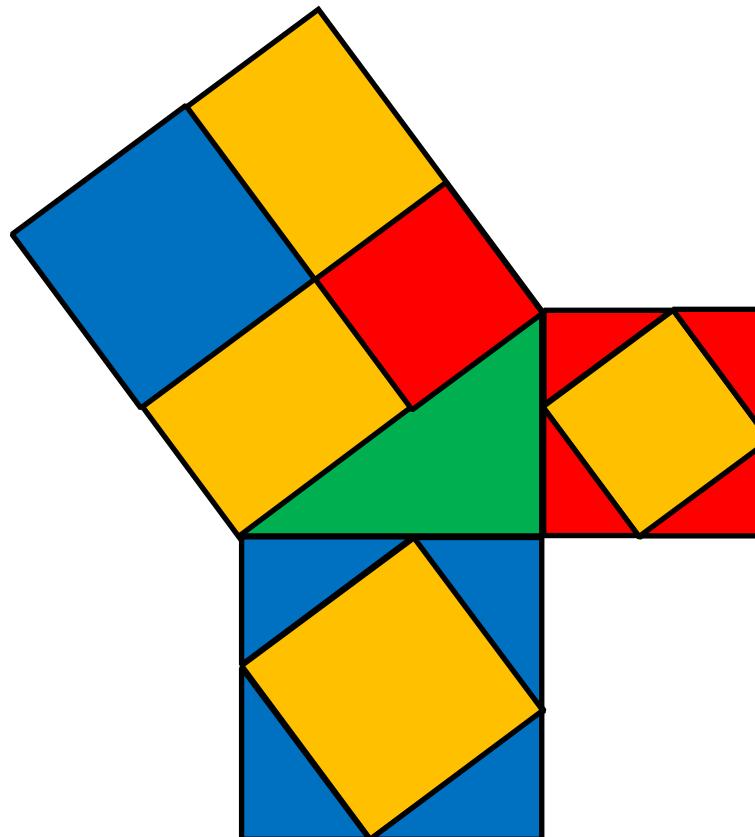
ピタゴラスの定理の証明その13



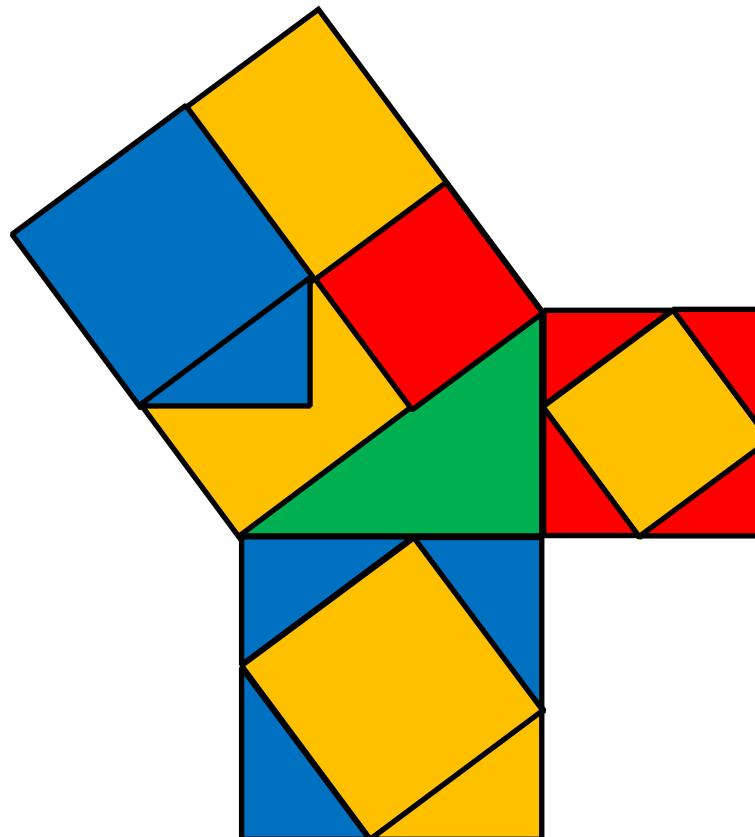
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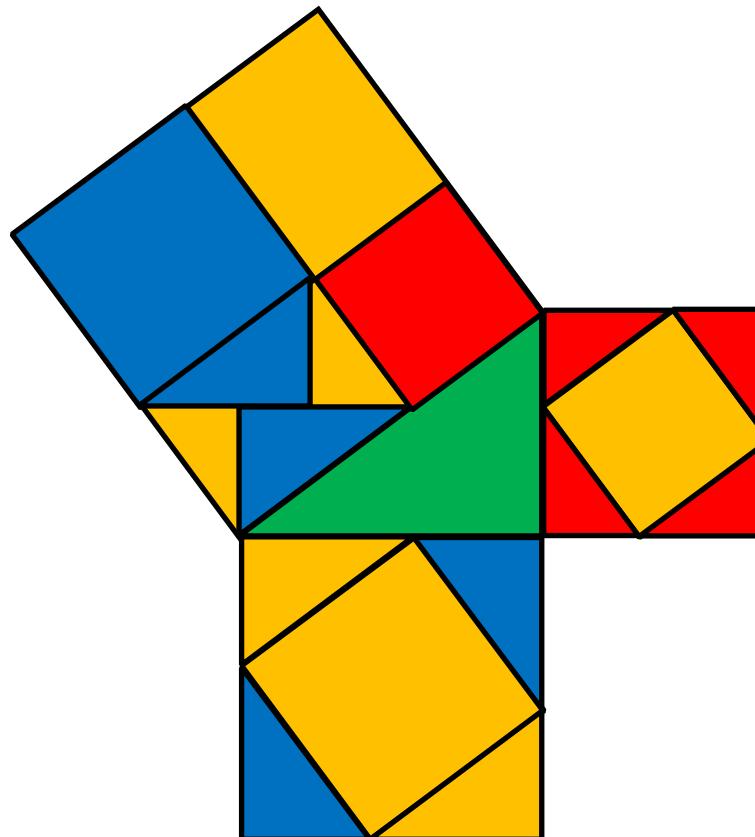
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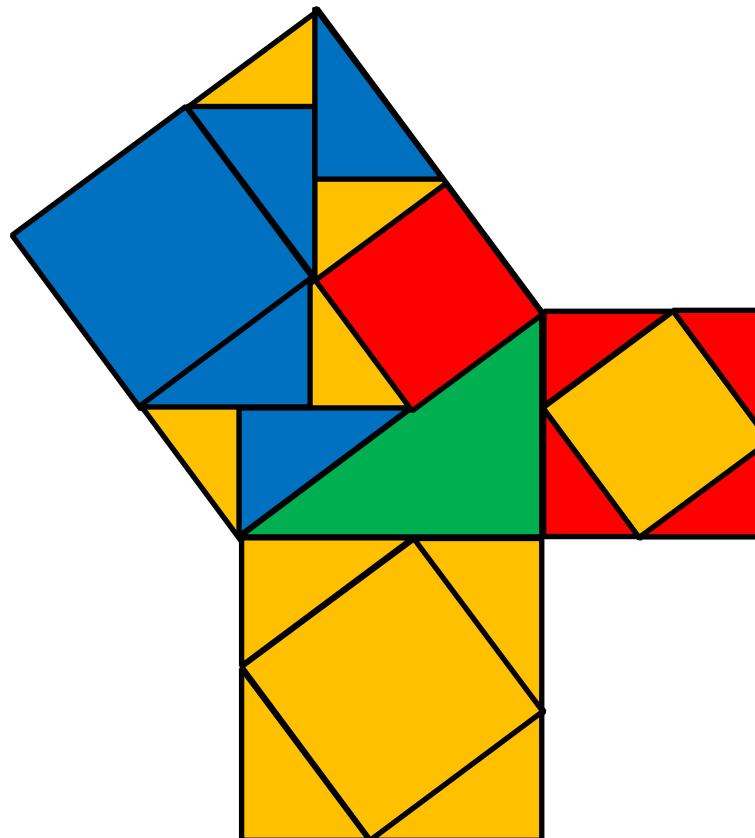
ピタゴラスの定理の証明その13



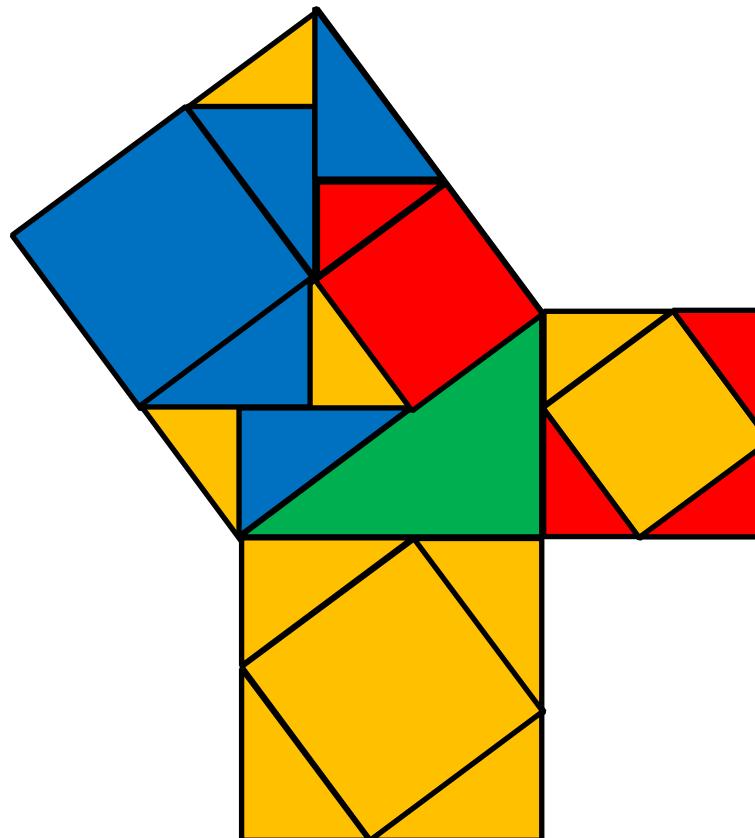
ピタゴラスの定理の証明その13



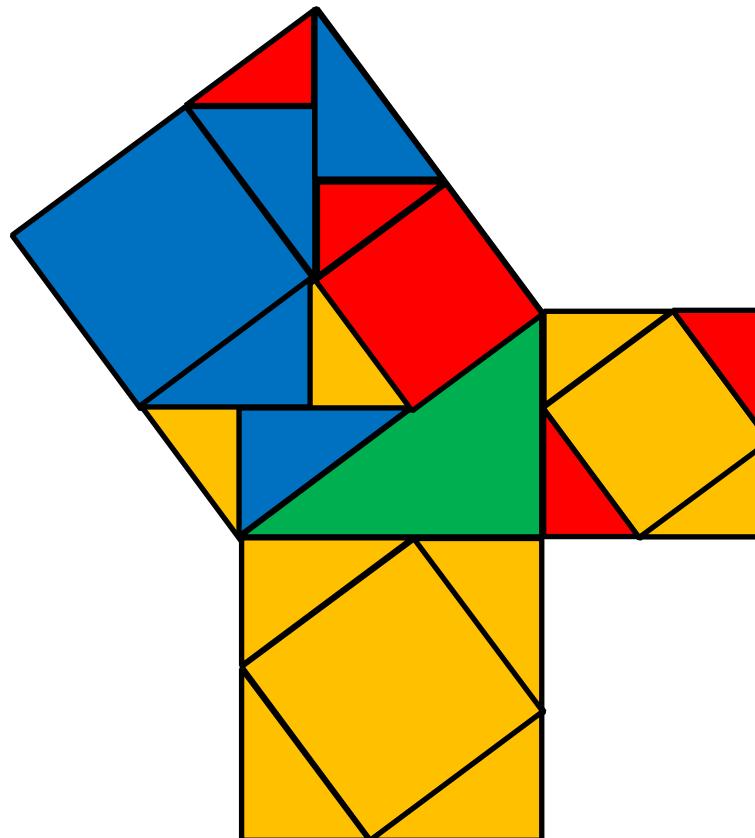
ピタゴラスの定理の証明その13



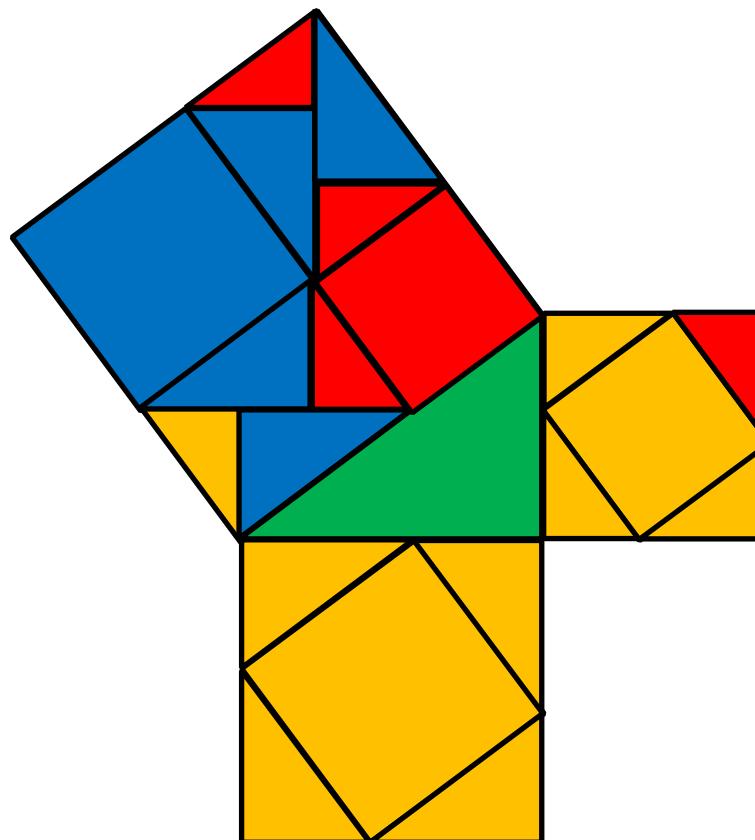
ピタゴラスの定理の証明その13



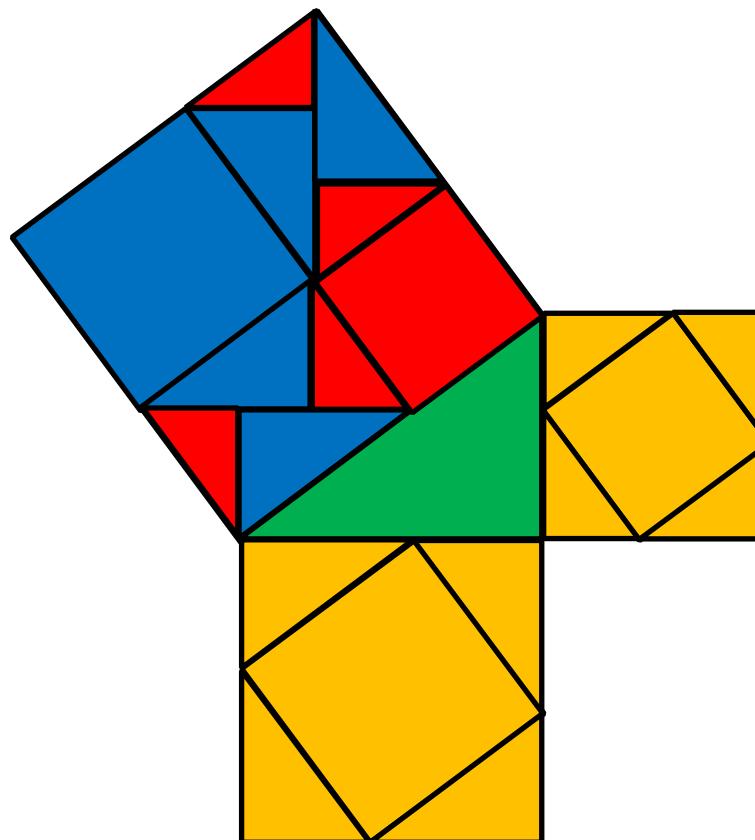
ピタゴラスの定理の証明その13



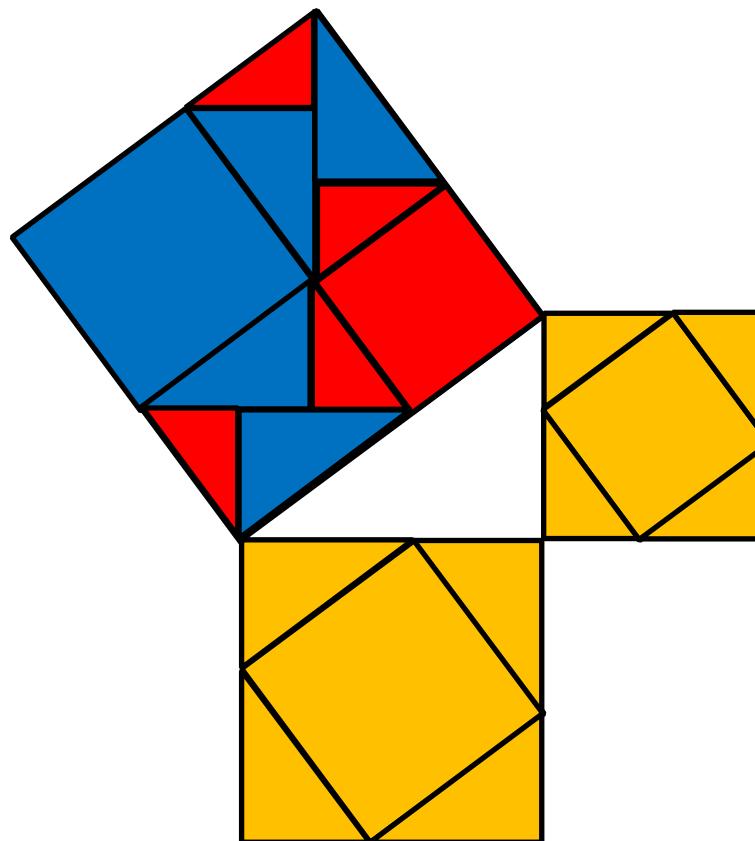
ピタゴラスの定理の証明その13



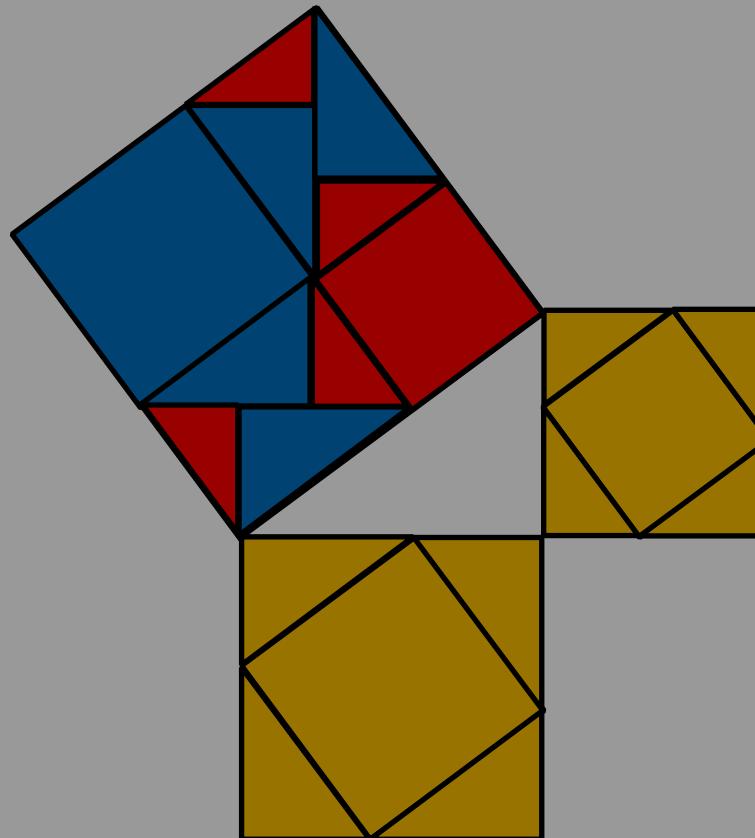
ピタゴラスの定理の証明その13



ピタゴラスの定理の証明その13

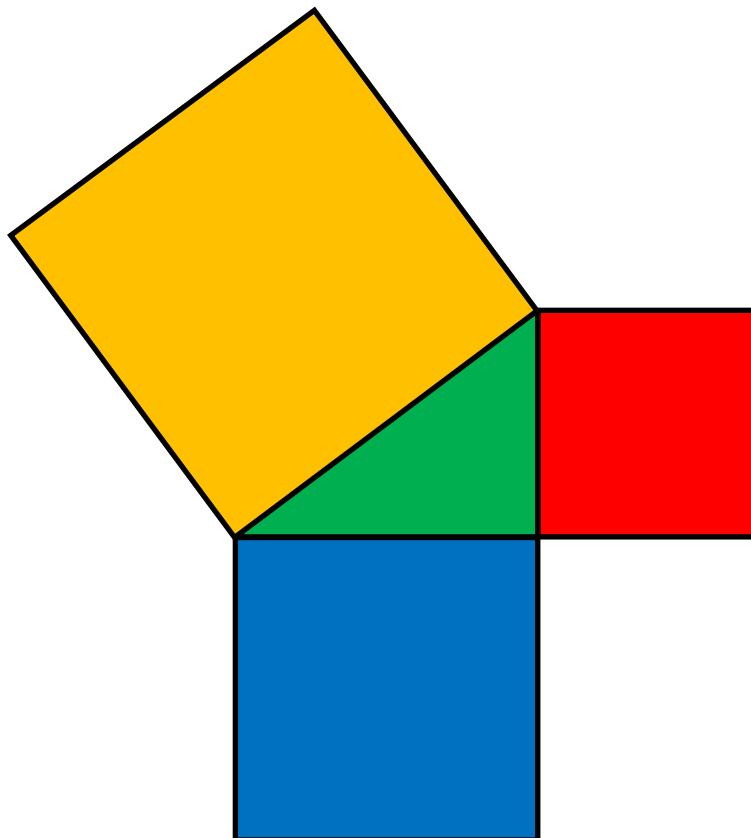


ピタゴラスの定理の証明その13

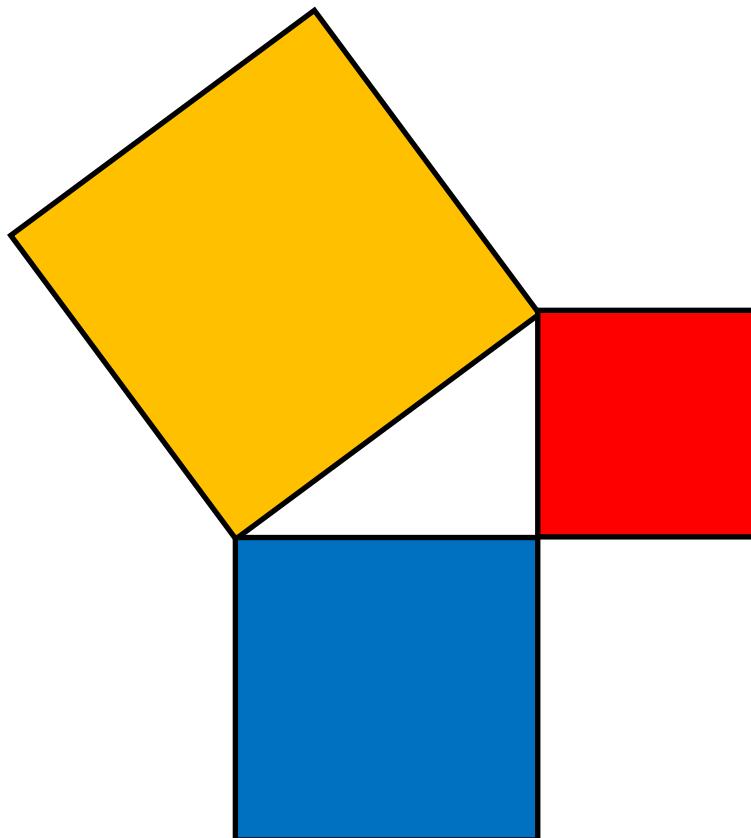


QED

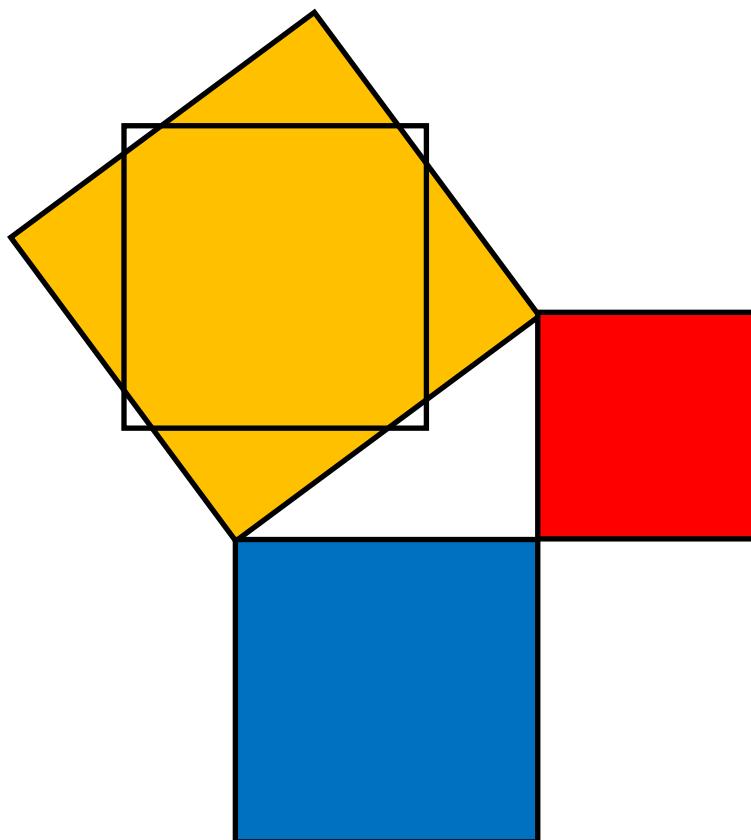
ピタゴラスの定理の証明その14



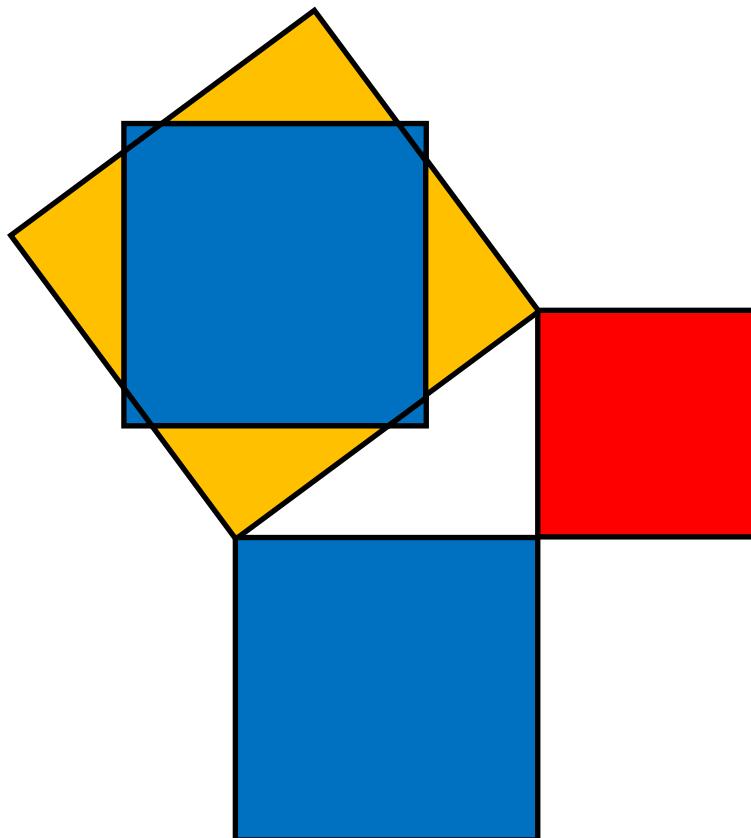
ピタゴラスの定理の証明その14



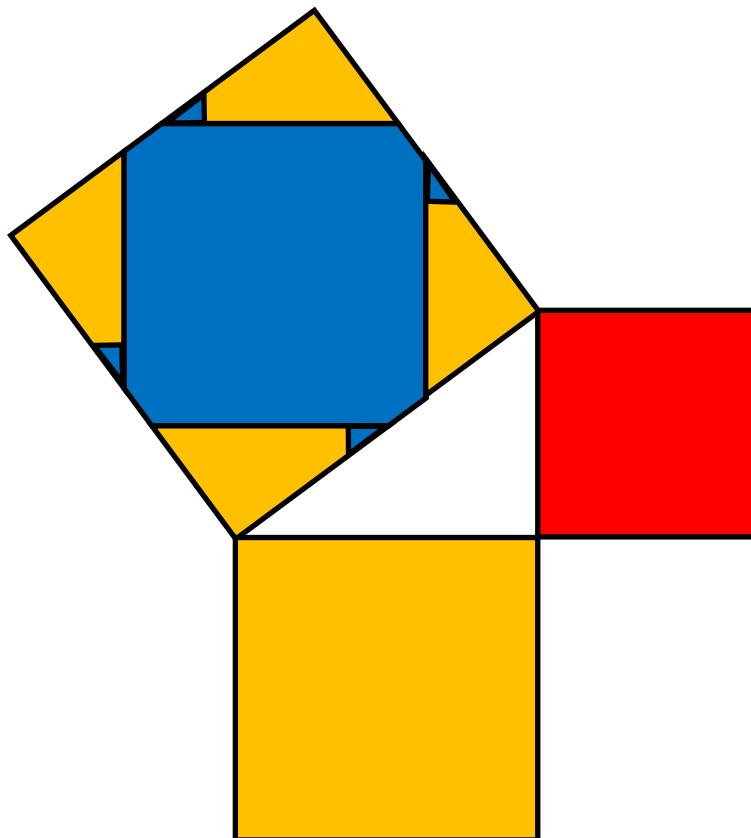
ピタゴラスの定理の証明その14



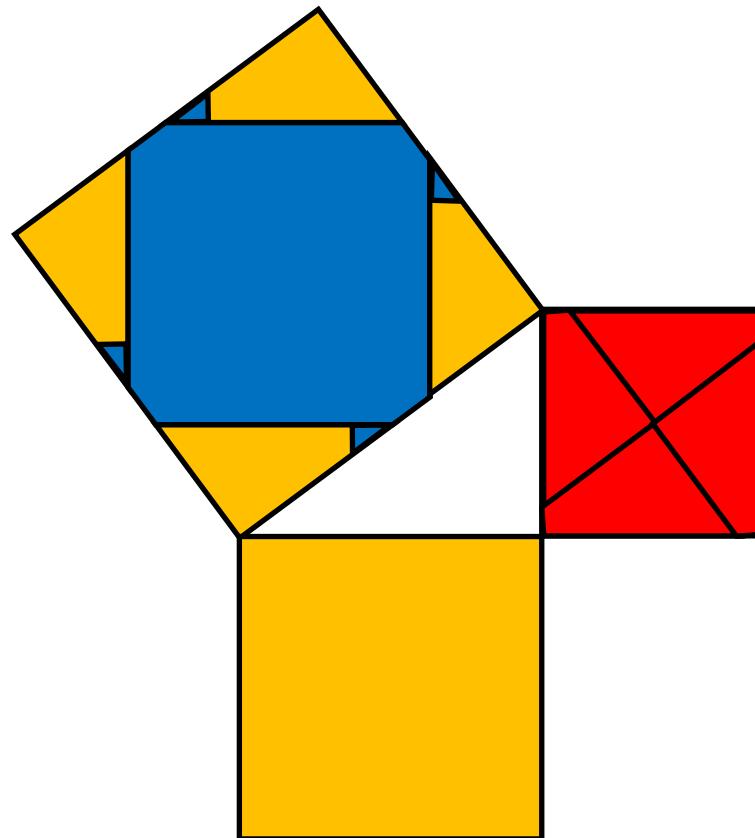
ピタゴラスの定理の証明その14



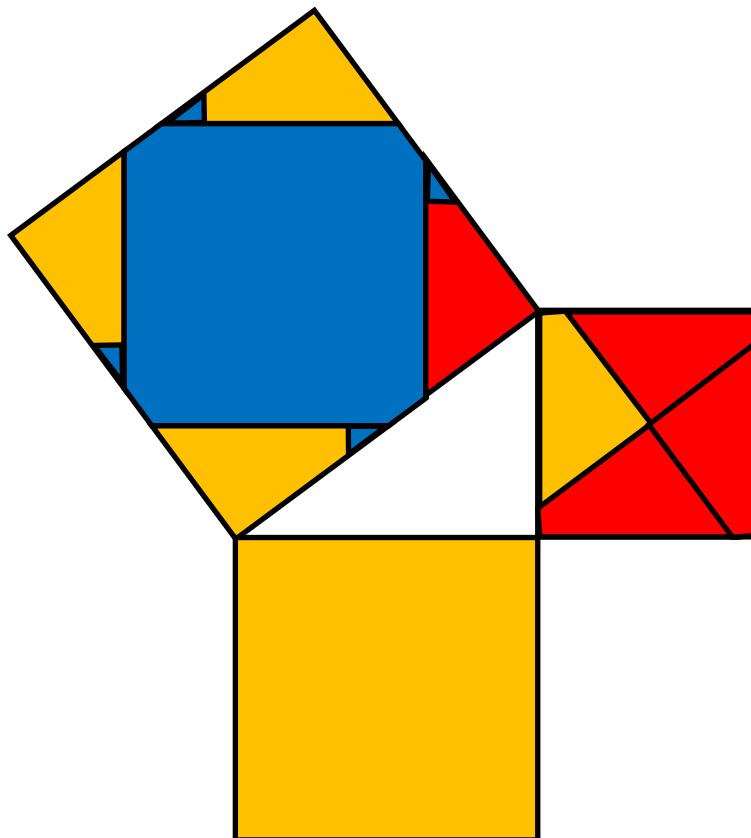
ピタゴラスの定理の証明その14



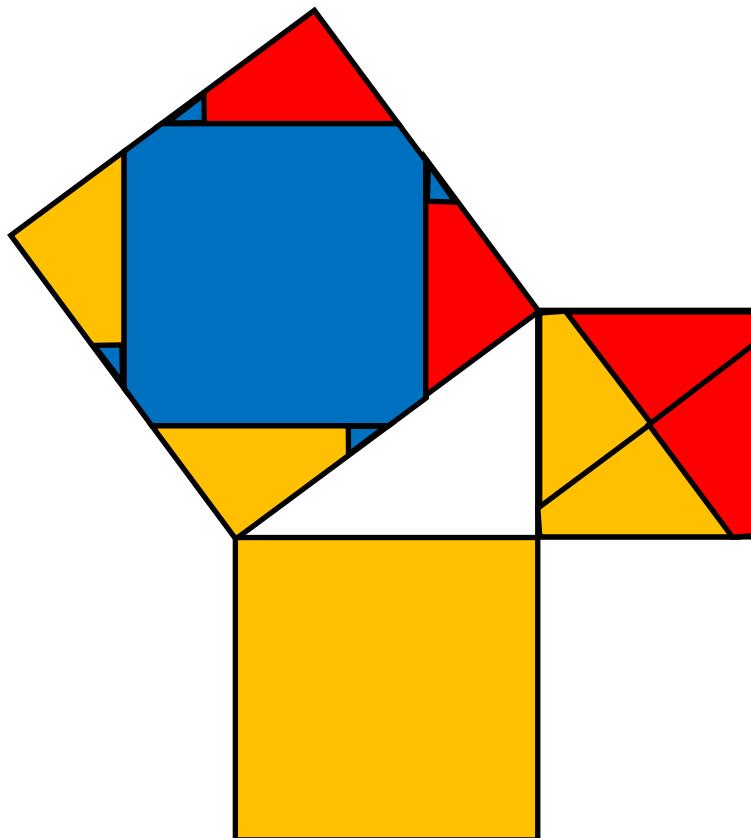
ピタゴラスの定理の証明その14



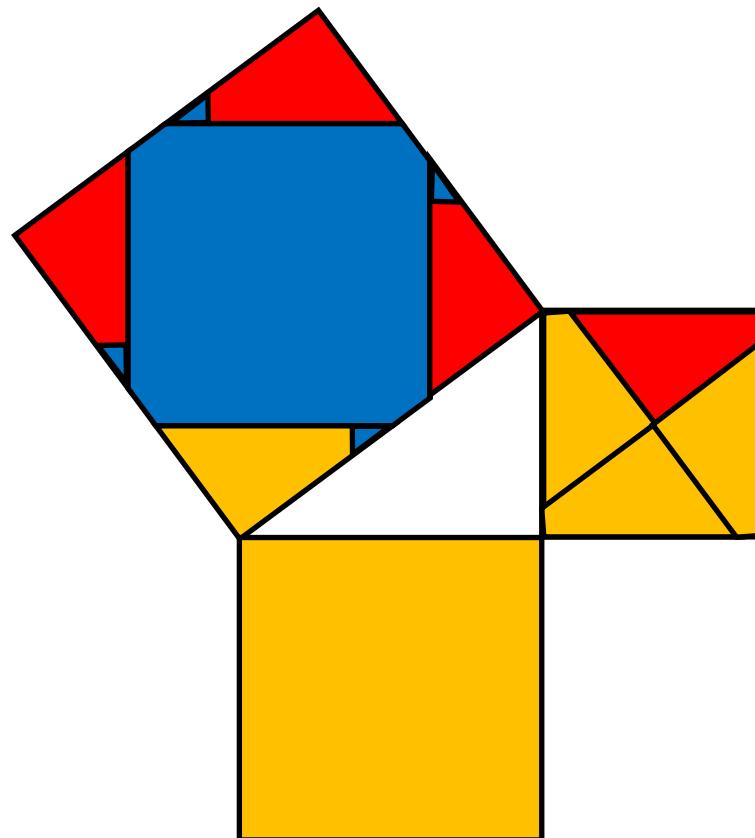
ピタゴラスの定理の証明その14



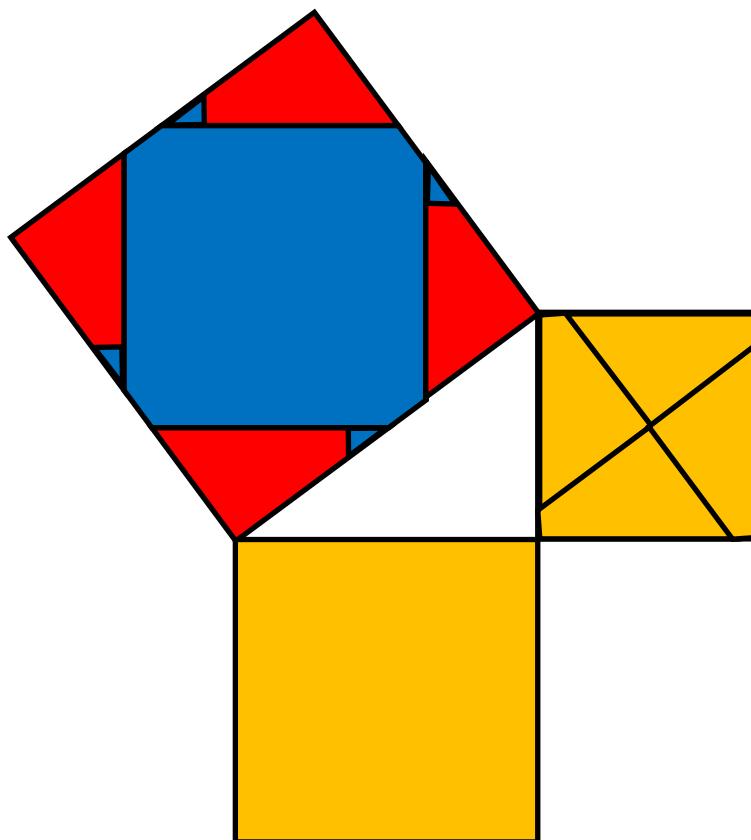
ピタゴラスの定理の証明その14



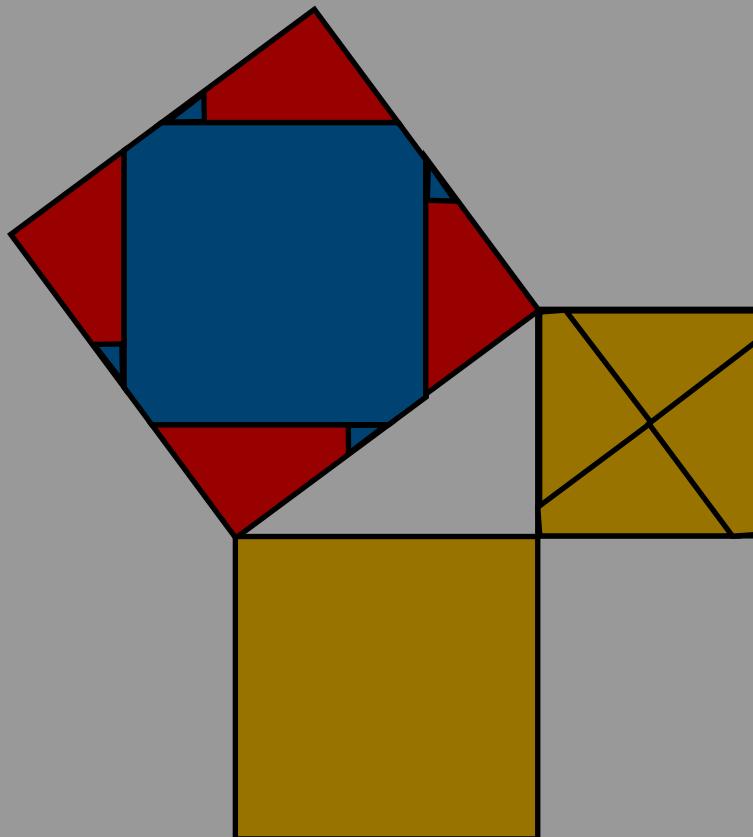
ピタゴラスの定理の証明その14



ピタゴラスの定理の証明その14



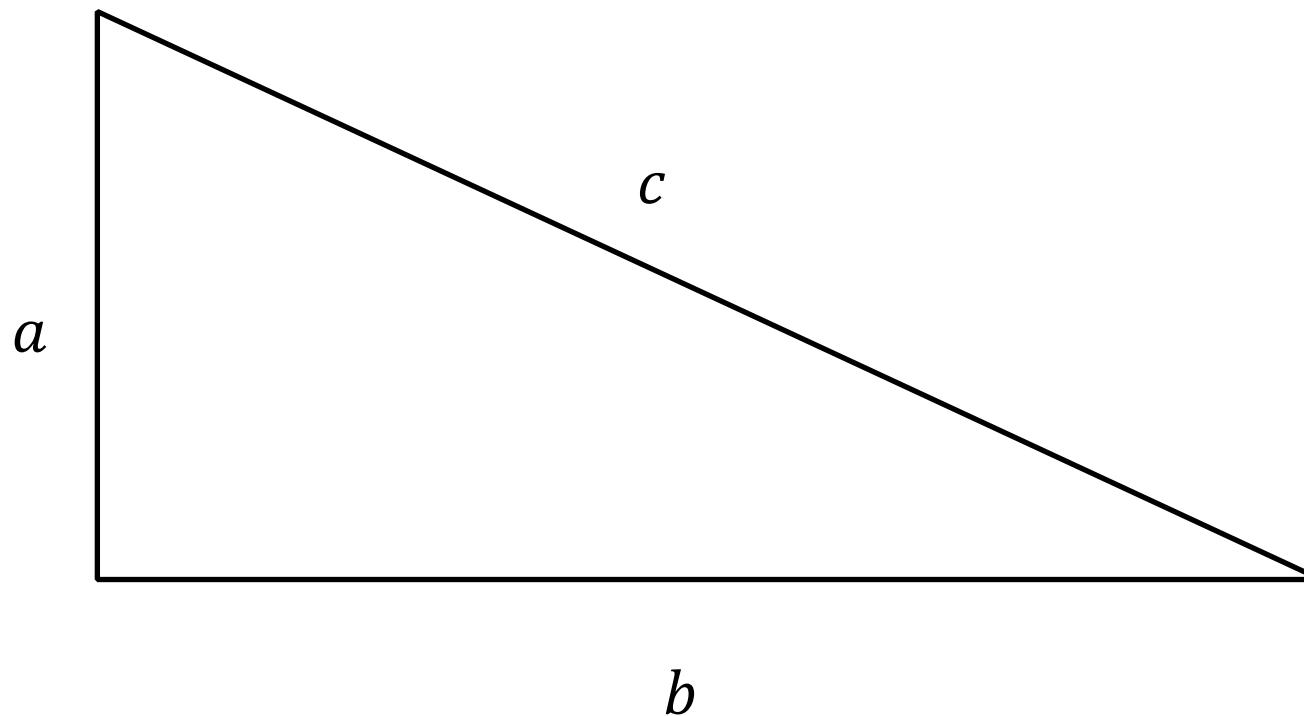
ピタゴラスの定理の証明その14



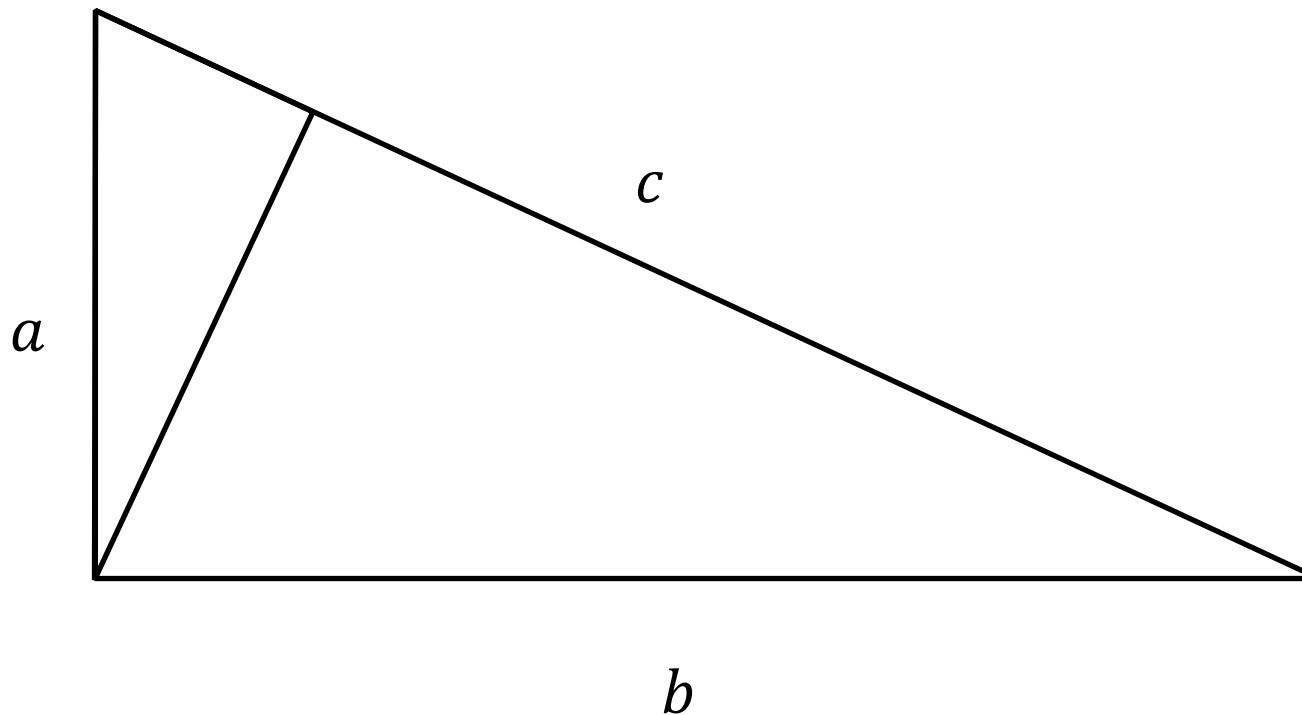
QED

ピタゴラスの定理の証明(上級編)

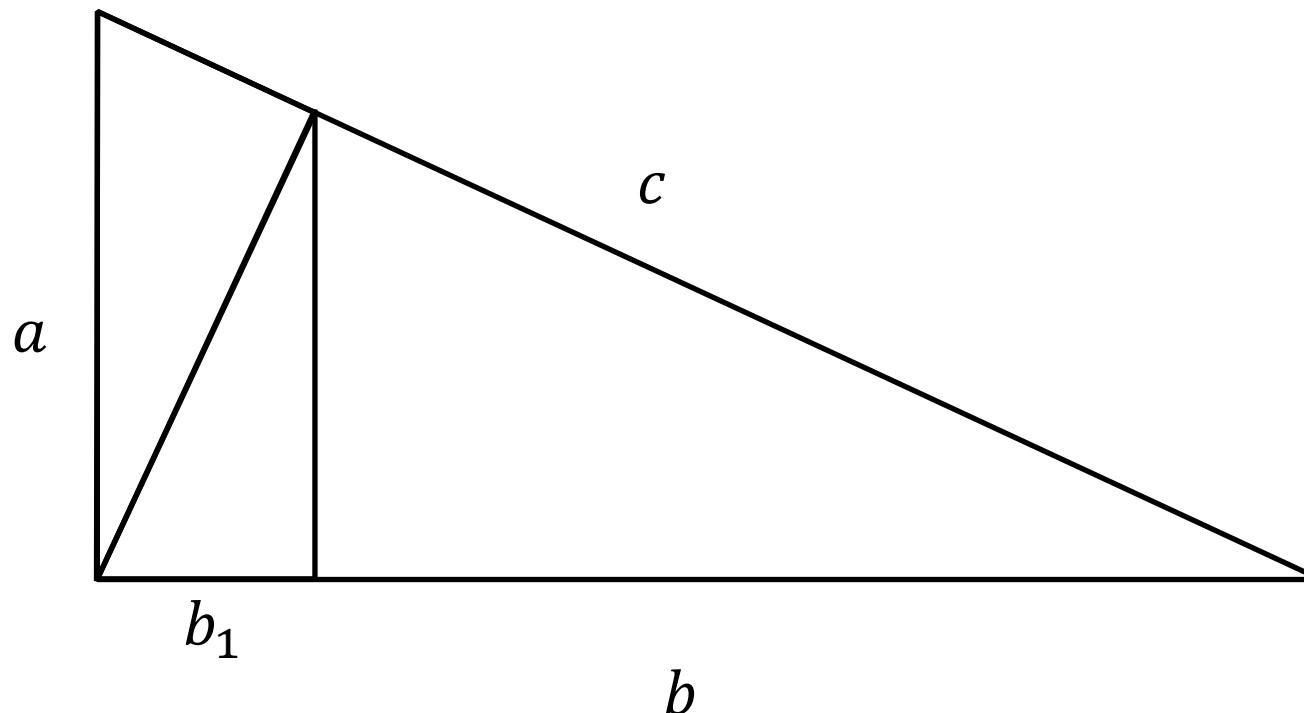
ピタゴラスの定理の証明その15



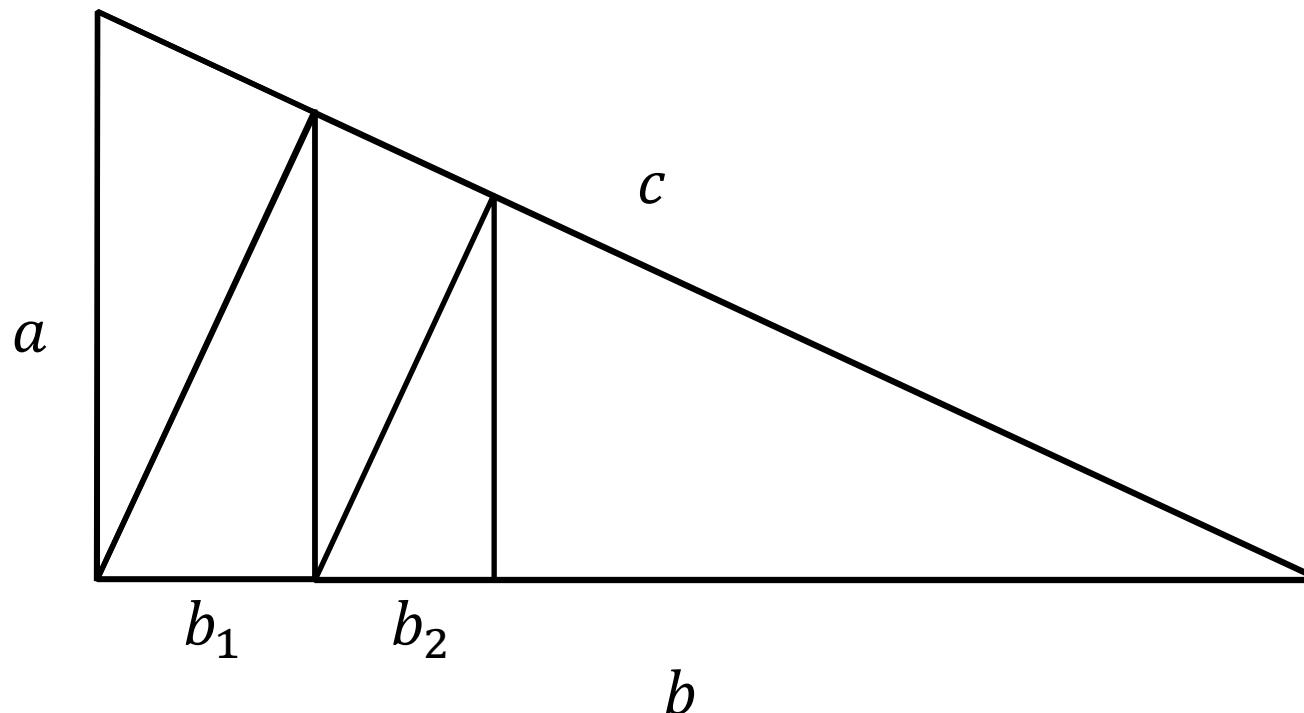
ピタゴラスの定理の証明その15



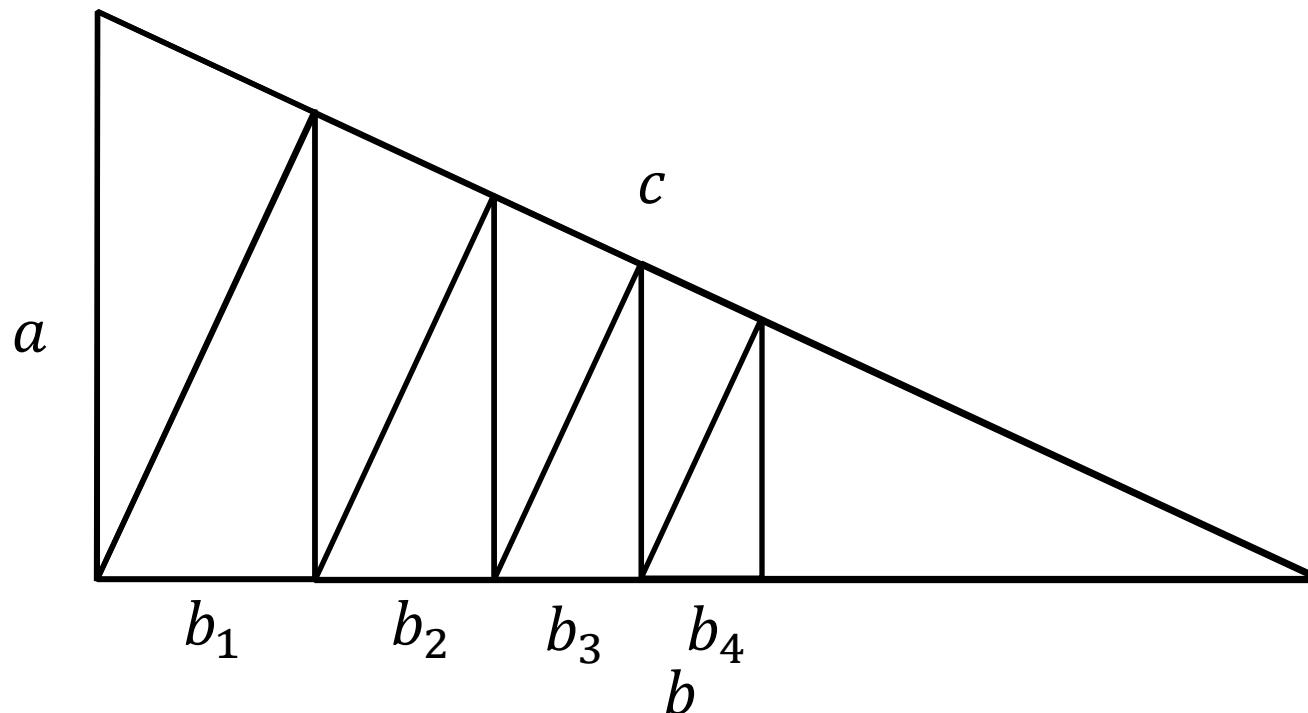
ピタゴラスの定理の証明その15



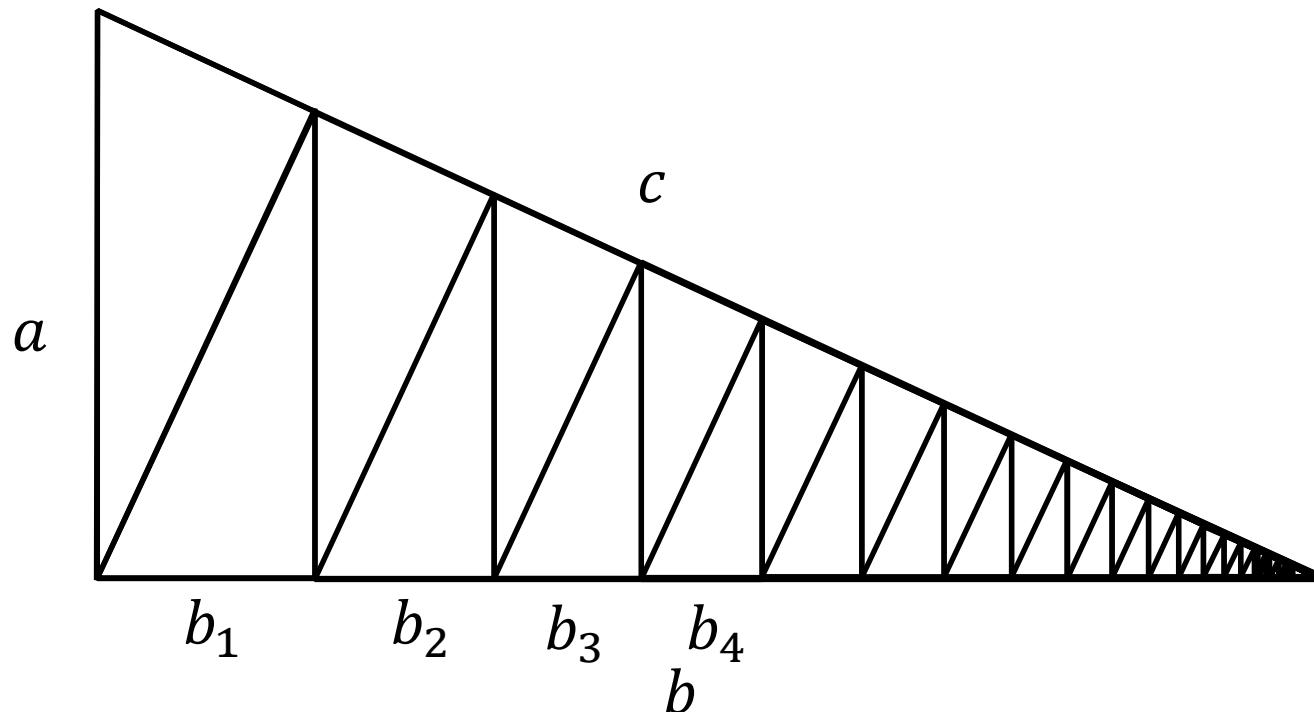
ピタゴラスの定理の証明その15



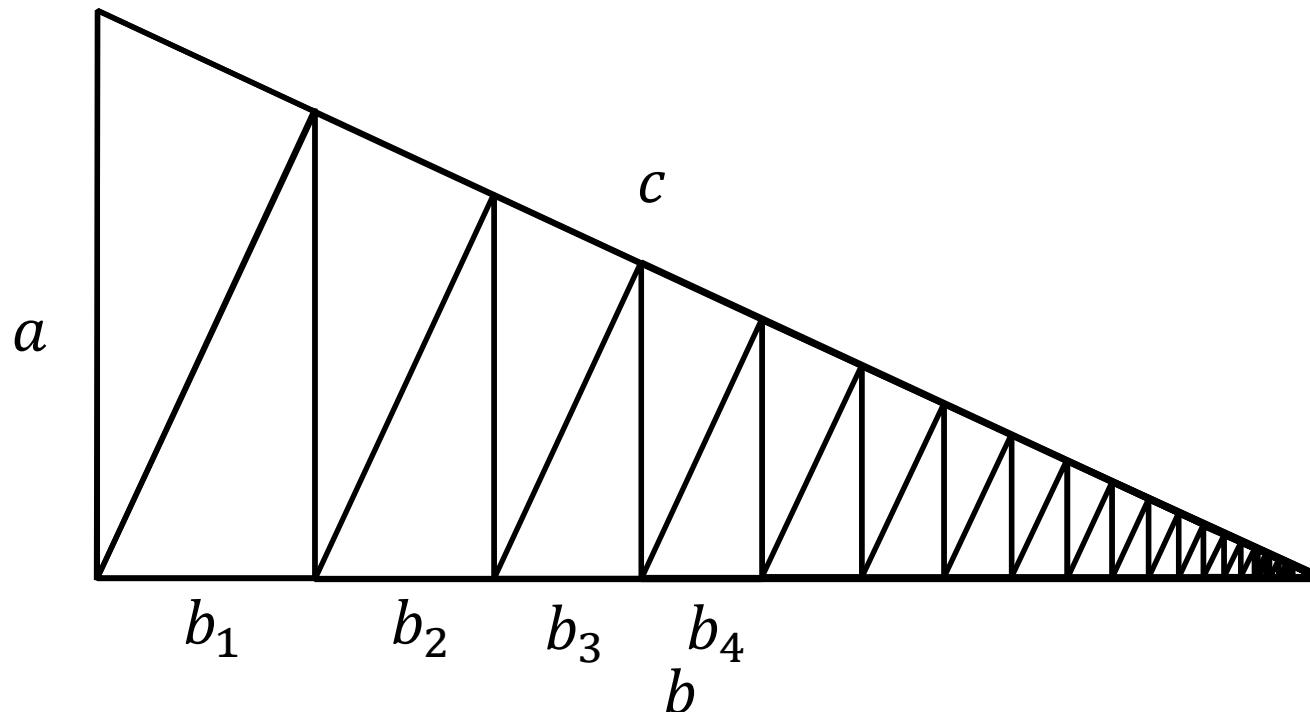
ピタゴラスの定理の証明その15



ピタゴラスの定理の証明その15

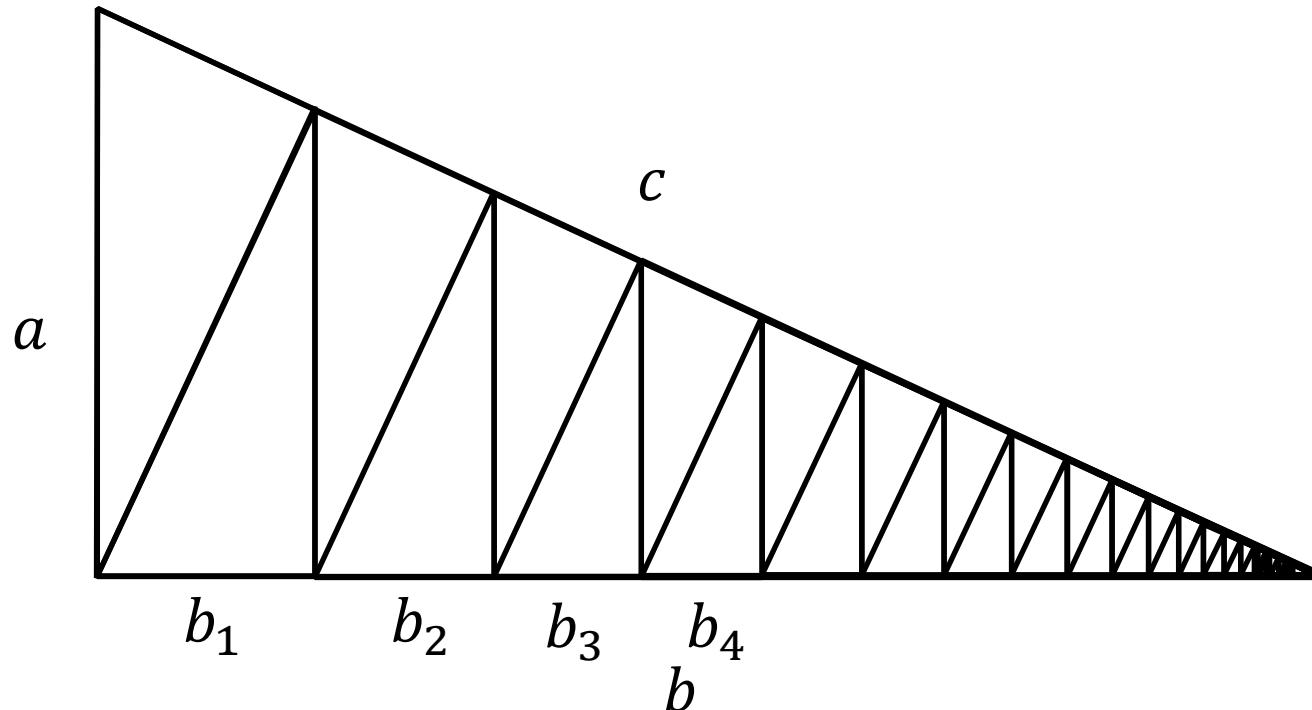


ピタゴラスの定理の証明その15



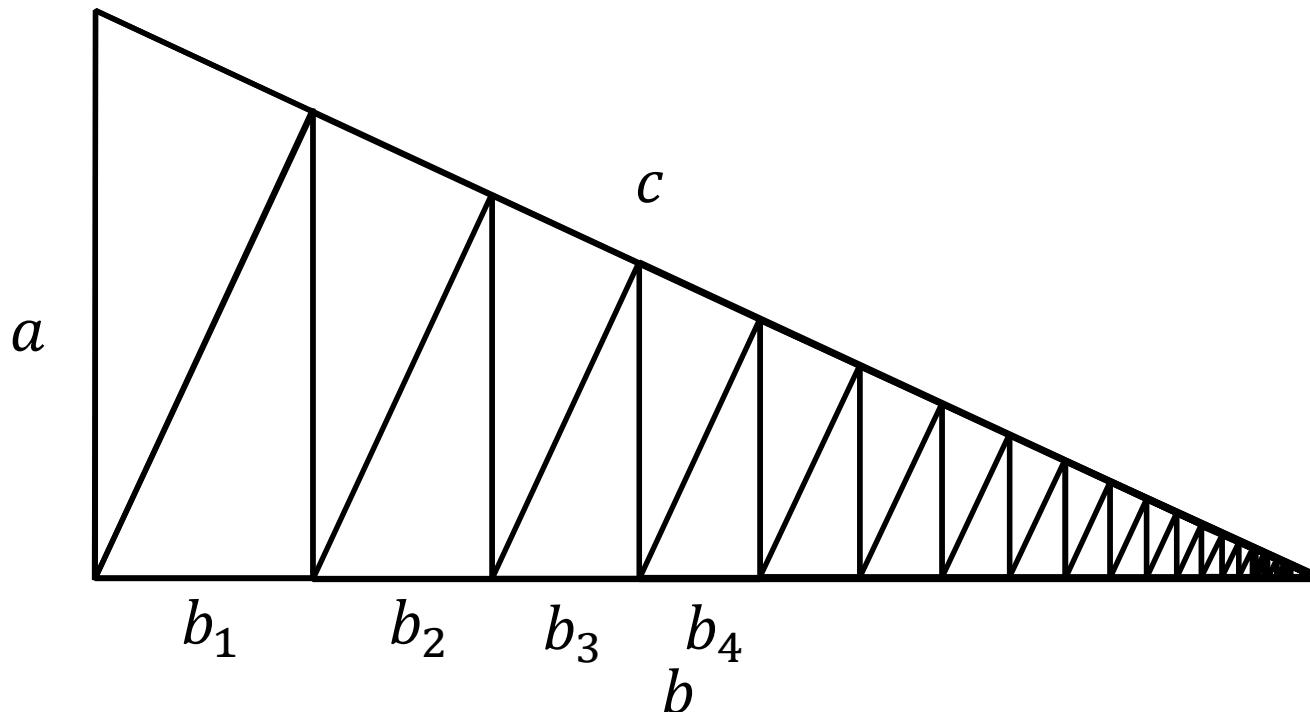
$$b = b_1 + b_2 + b_3 + b_4 + \dots$$

ピタゴラスの定理の証明その15



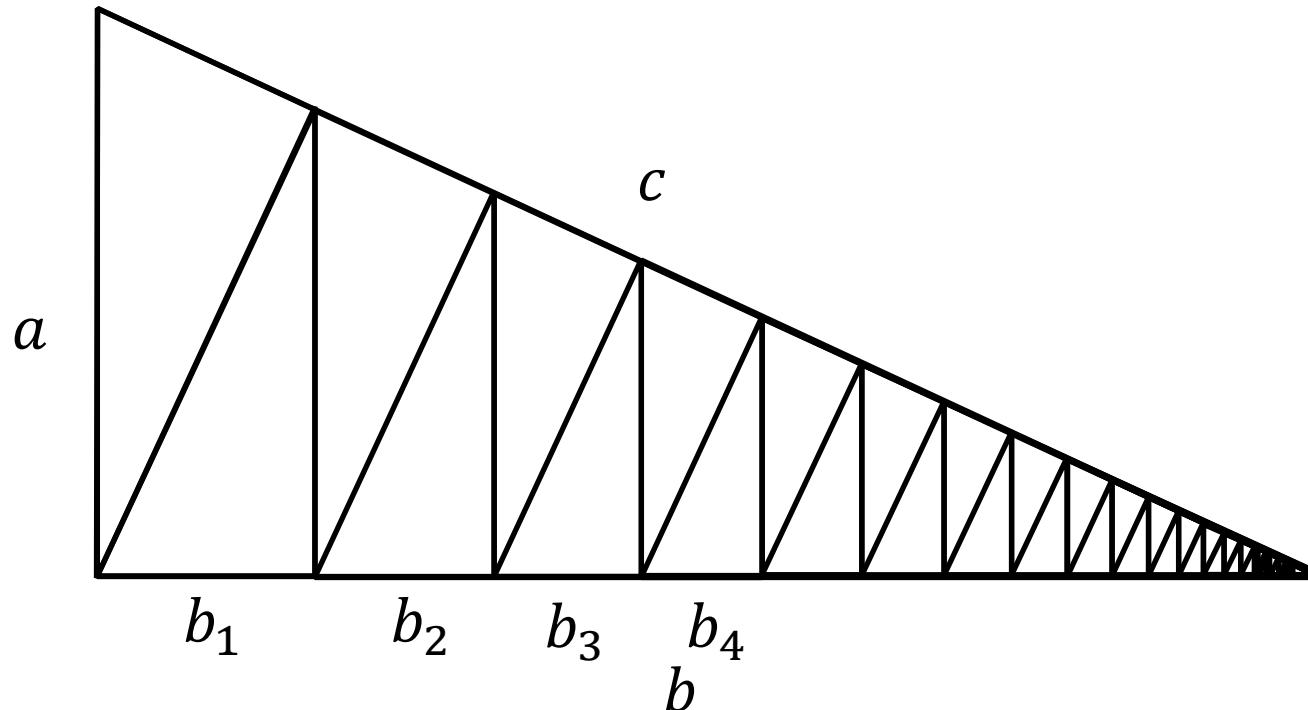
$$b = b_1 + b_1 \frac{b^2}{c^2} + b_1 \left(\frac{b^2}{c^2} \right)^2 + b_1 \left(\frac{b^2}{c^2} \right)^3 +$$

ピタゴラスの定理の証明その15



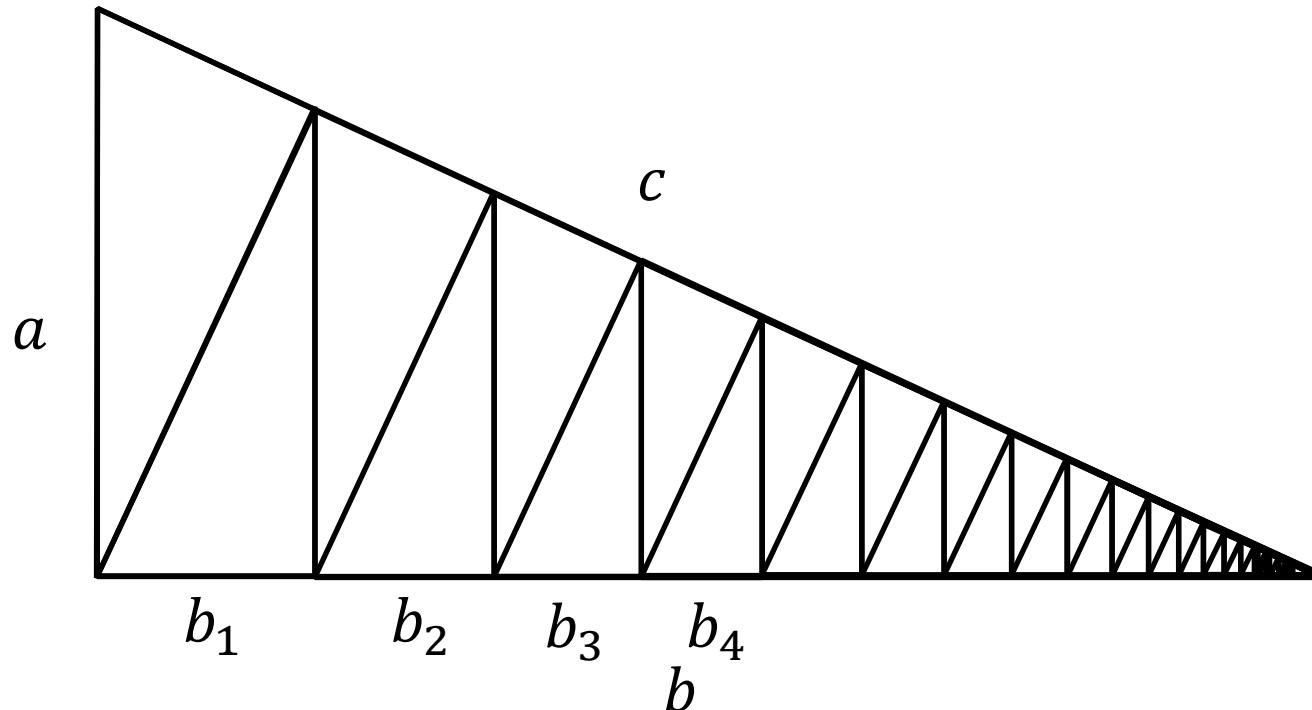
$$b = \textcolor{red}{b}_1 + \textcolor{red}{b}_1 \frac{b^2}{c^2} + \textcolor{red}{b}_1 \left(\frac{b^2}{c^2} \right)^2 + \textcolor{red}{b}_1 \left(\frac{b^2}{c^2} \right)^3 +$$

ピタゴラスの定理の証明その15



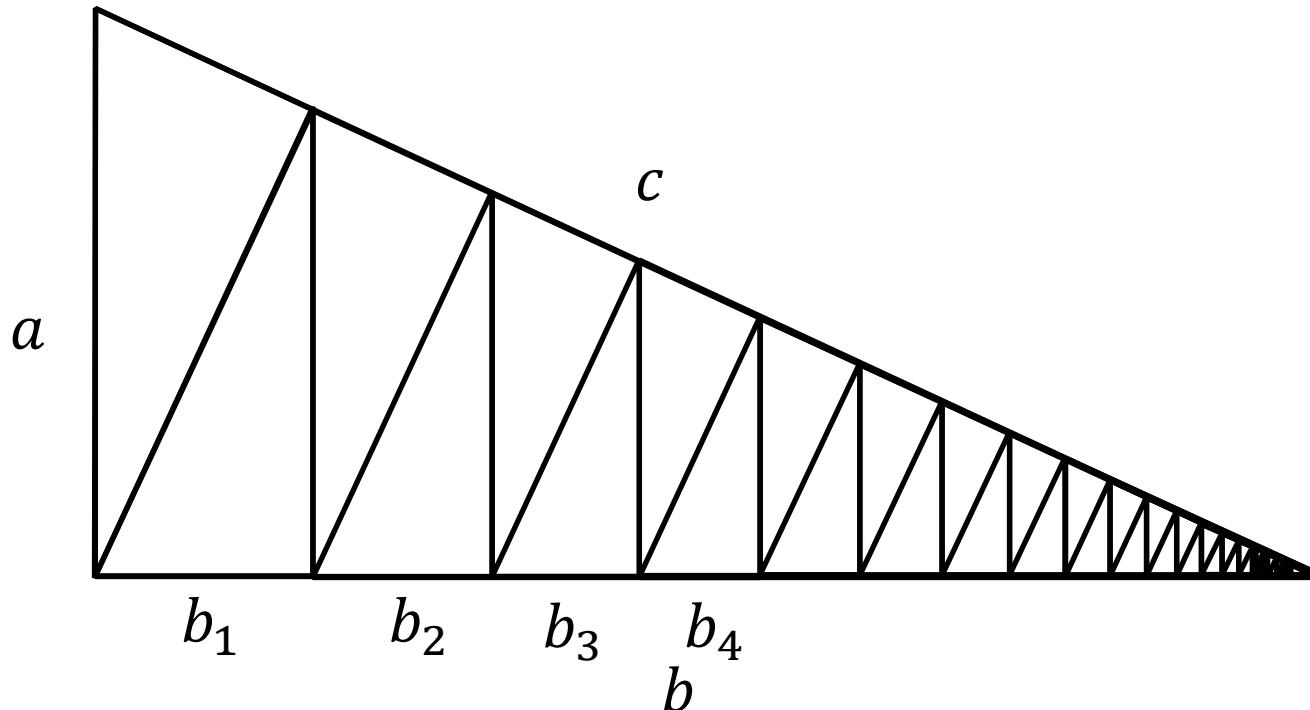
$$b = \textcolor{red}{b_1} \times \left(1 + \frac{b^2}{c^2} + \left(\frac{b^2}{c^2}\right)^2 + \left(\frac{b^2}{c^2}\right)^3 + \dots\right)$$

ピタゴラスの定理の証明その15



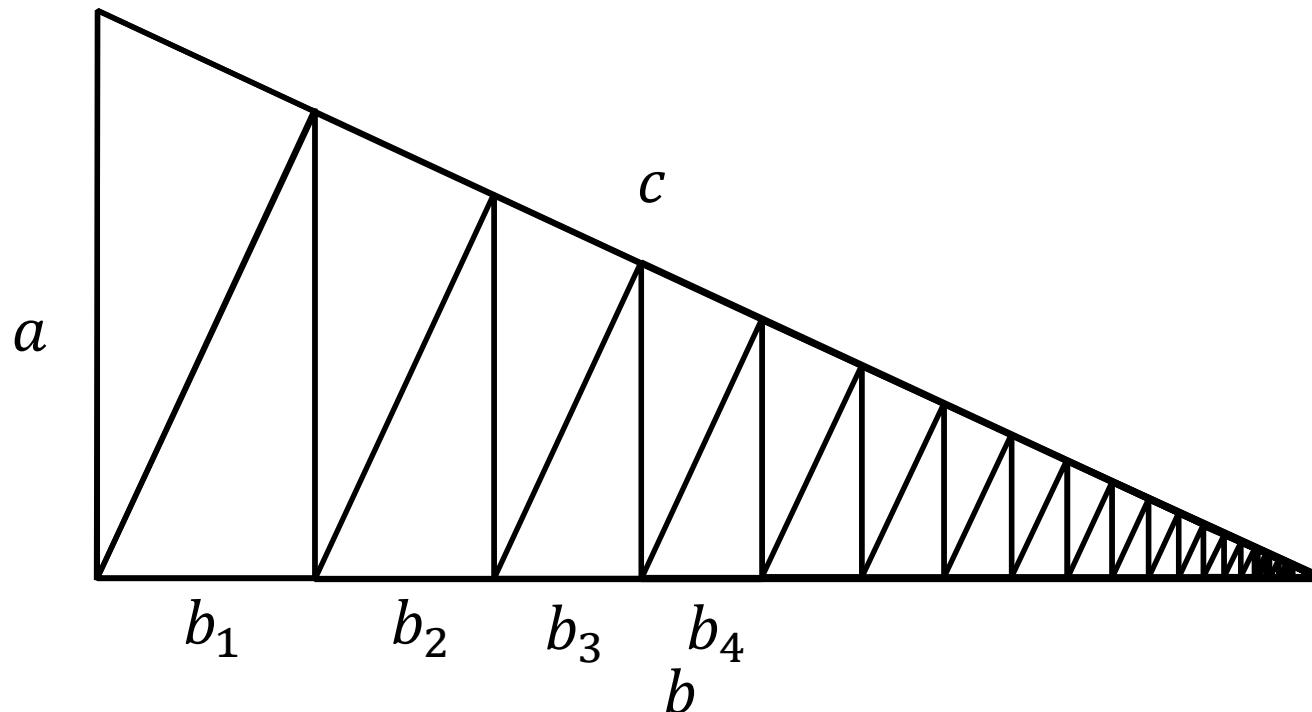
$$b = \color{red}{b_1} \times \frac{1}{1 - \frac{b^2}{c^2}}$$

ピタゴラスの定理の証明その15



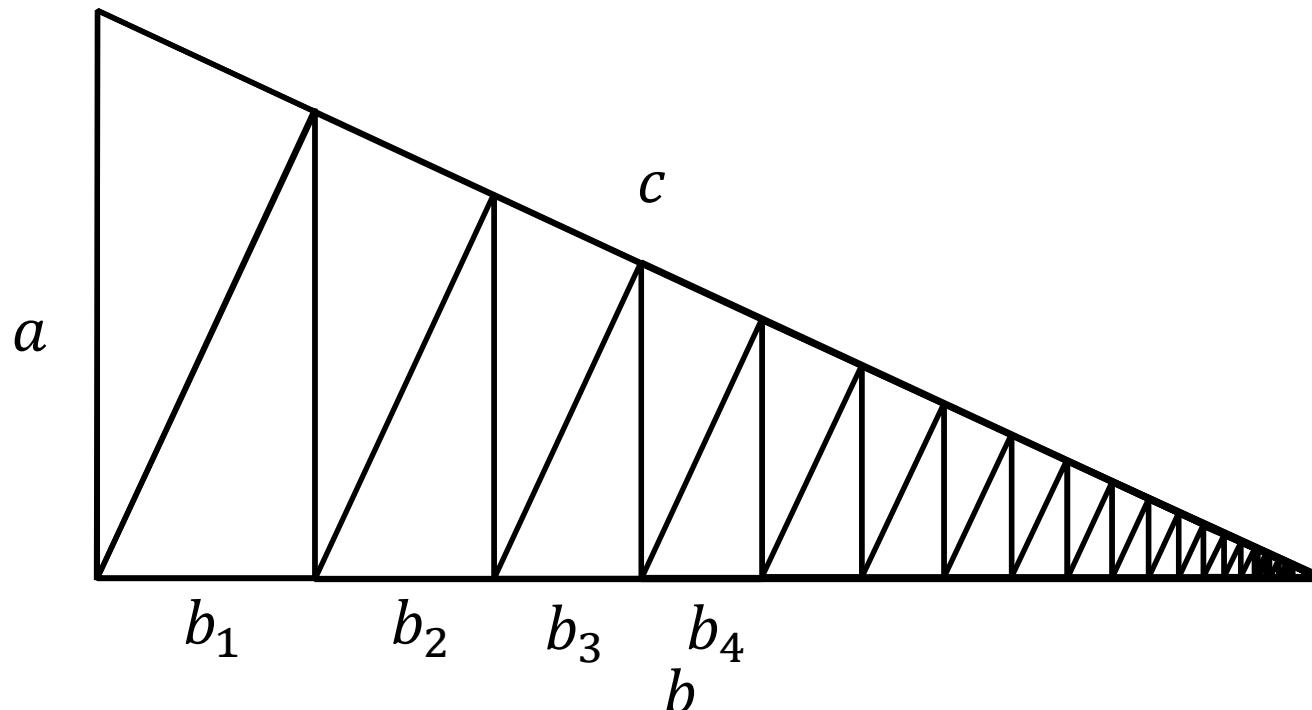
$$b = b \frac{a^2}{c^2} \times \frac{1}{1 - \frac{b^2}{c^2}}$$

ピタゴラスの定理の証明その15



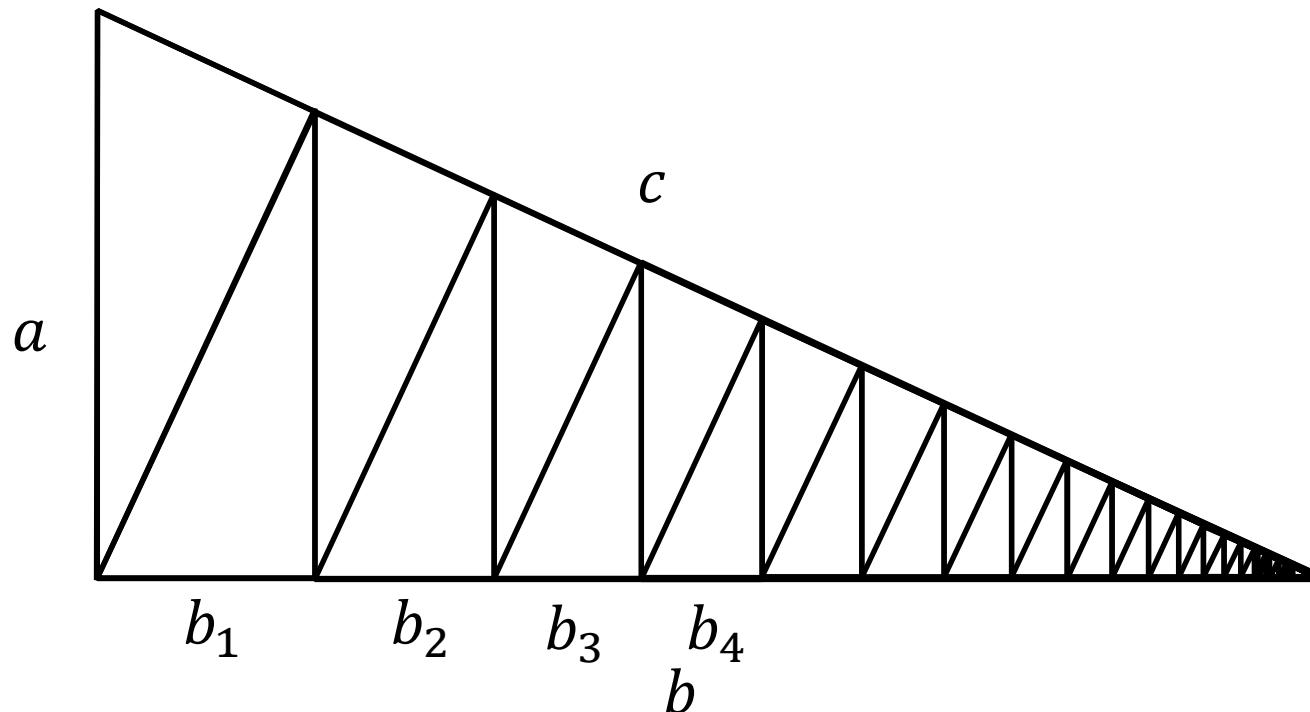
$$b = b \times \frac{a^2}{c^2 - b^2}$$

ピタゴラスの定理の証明その15



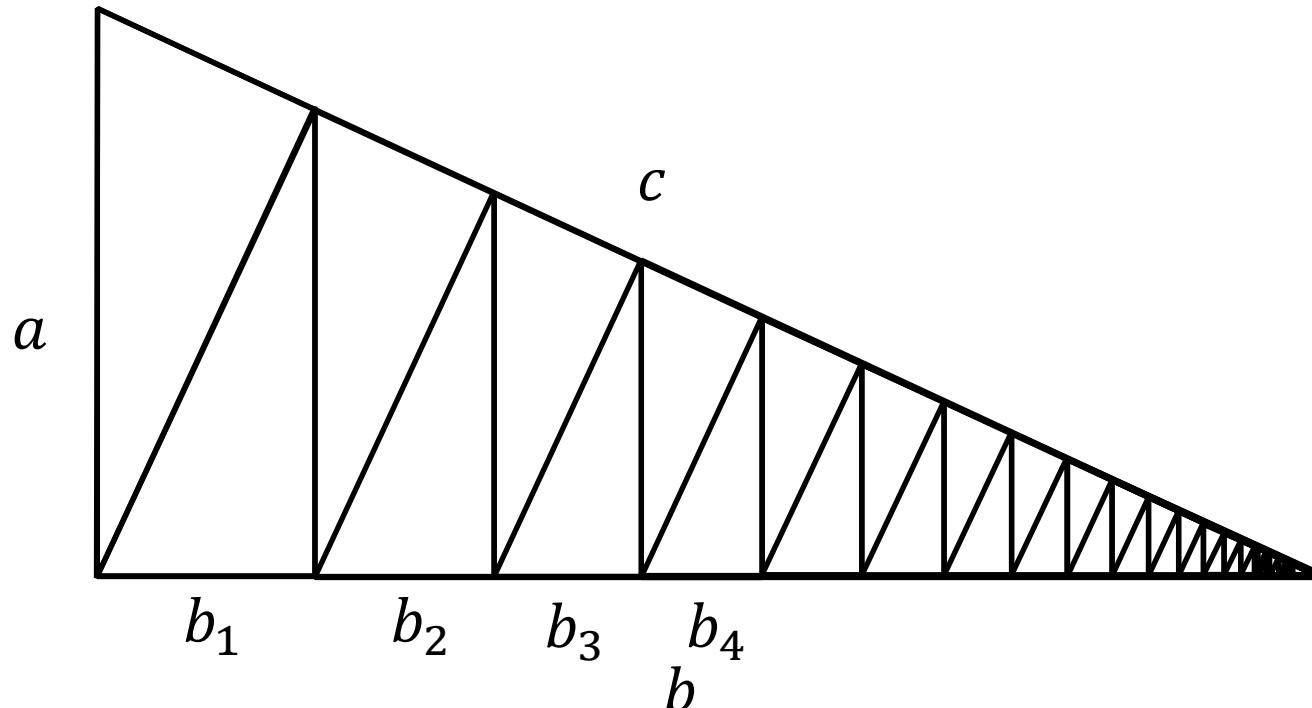
$$1 = \frac{a^2}{c^2 - b^2}$$

ピタゴラスの定理の証明その15



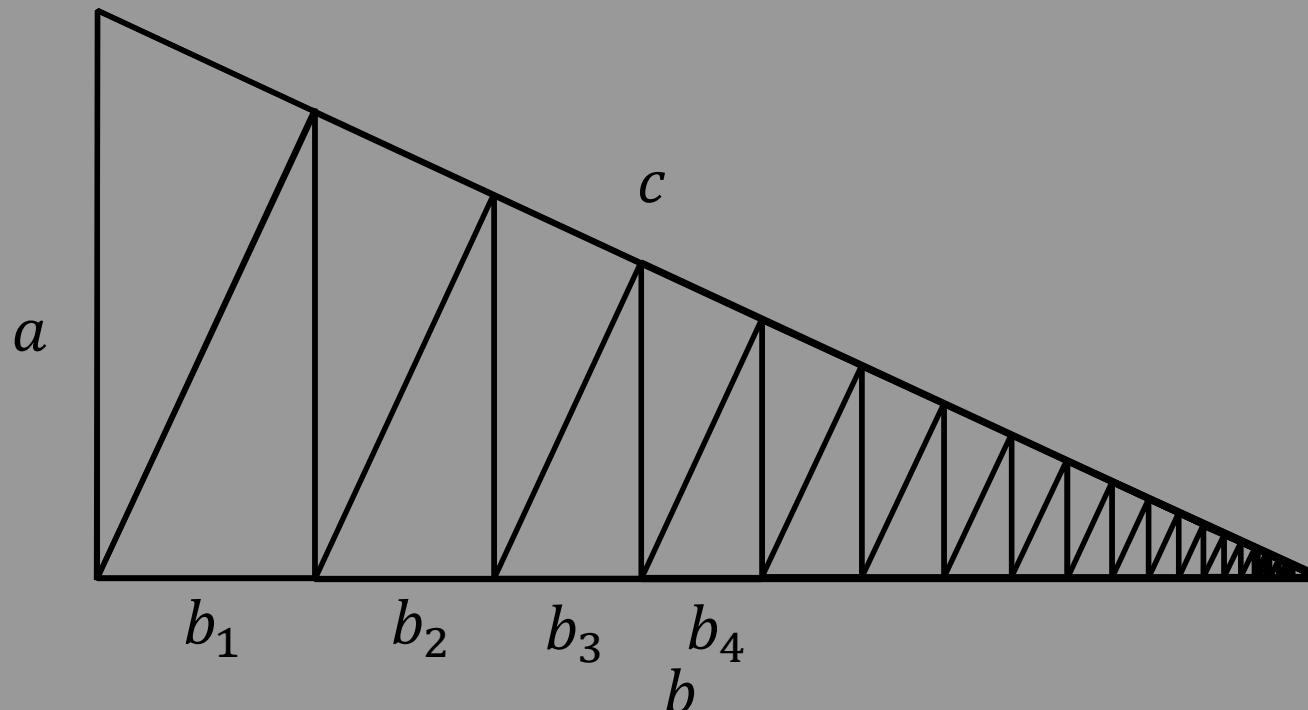
$$c^2 - b^2 = a^2$$

ピタゴラスの定理の証明その15



$$c^2 = a^2 + b^2$$

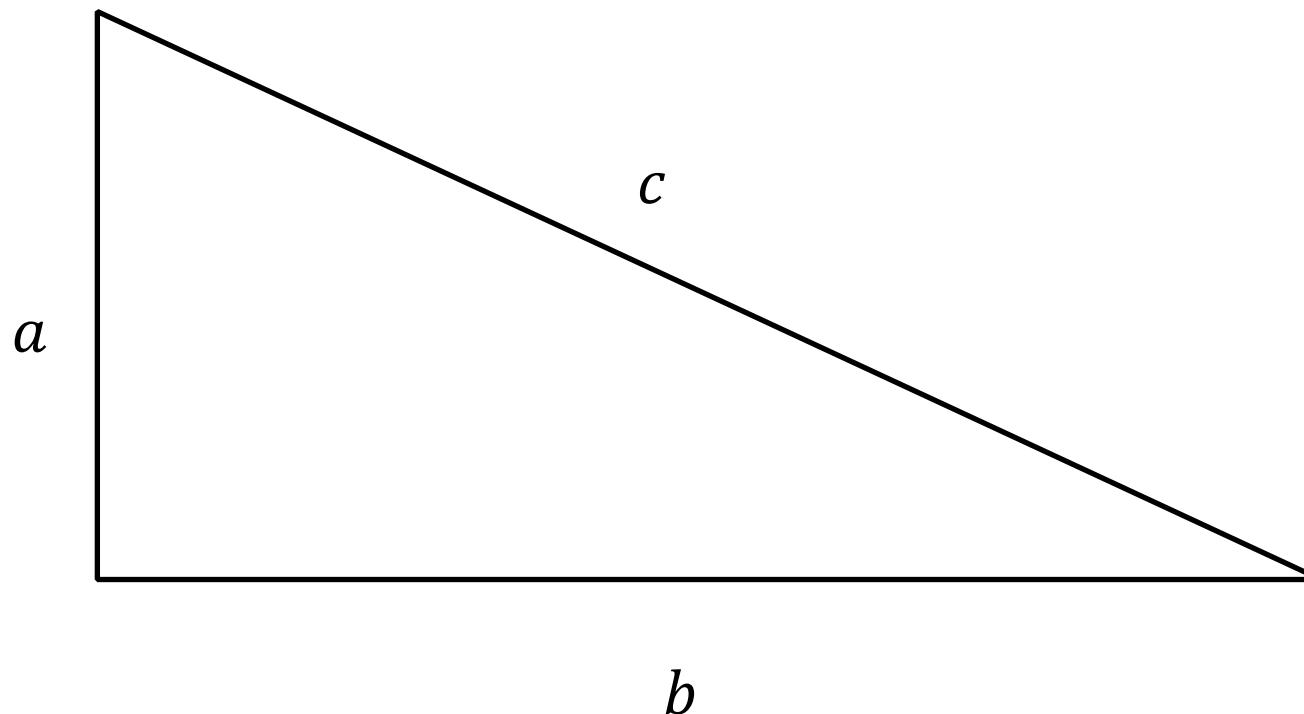
ピタゴラスの定理の証明その15



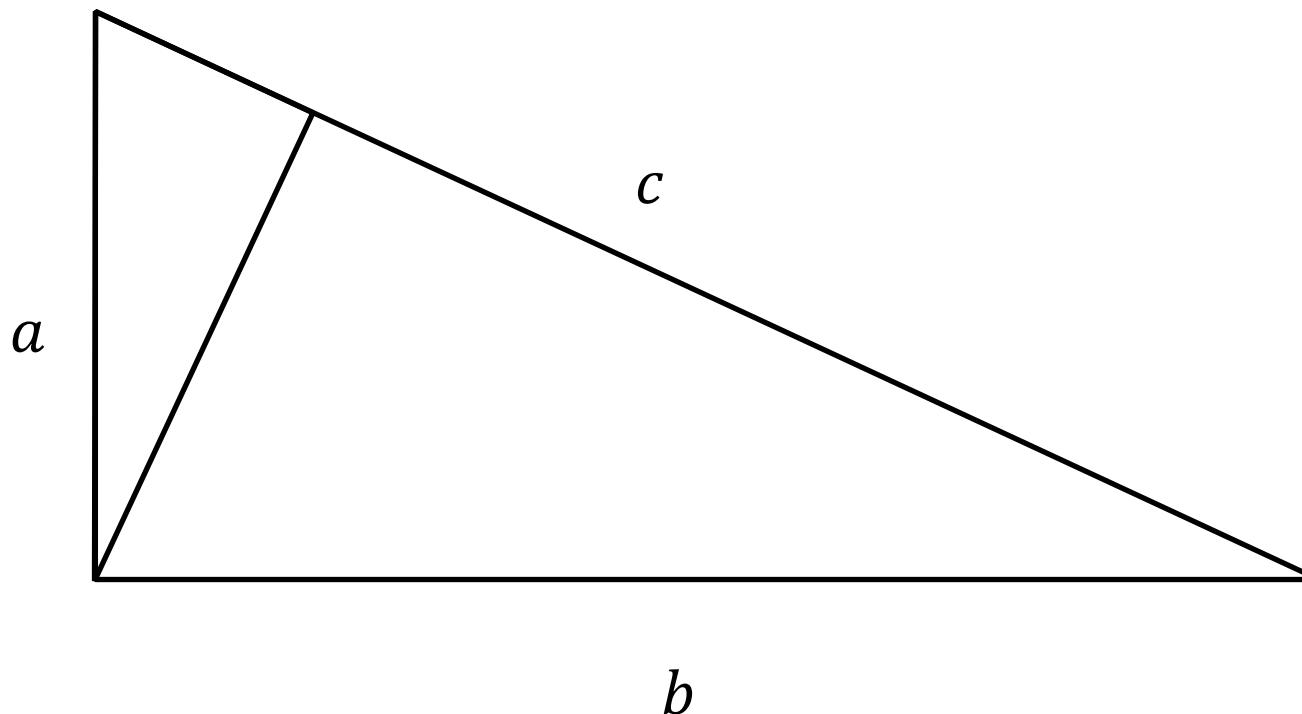
$$c^2 = a^2 + b^2$$

QED

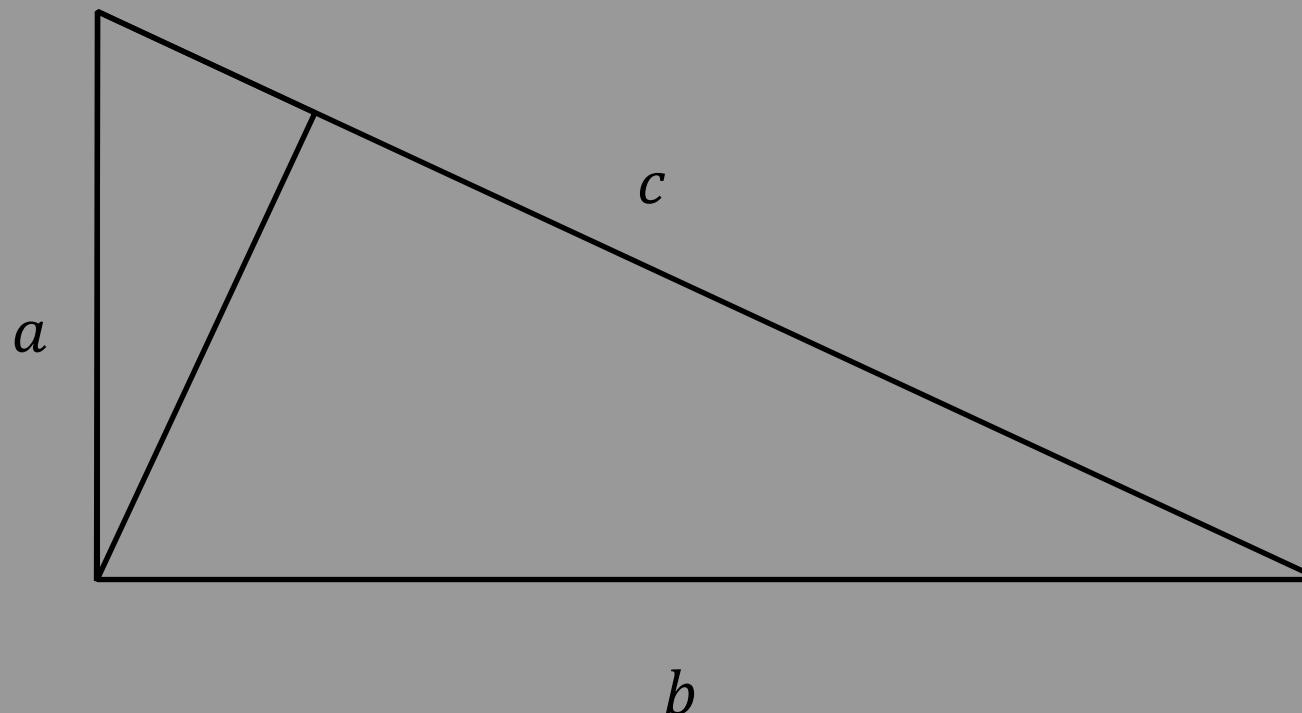
ピタゴラスの定理の証明その16



ピタゴラスの定理の証明その16

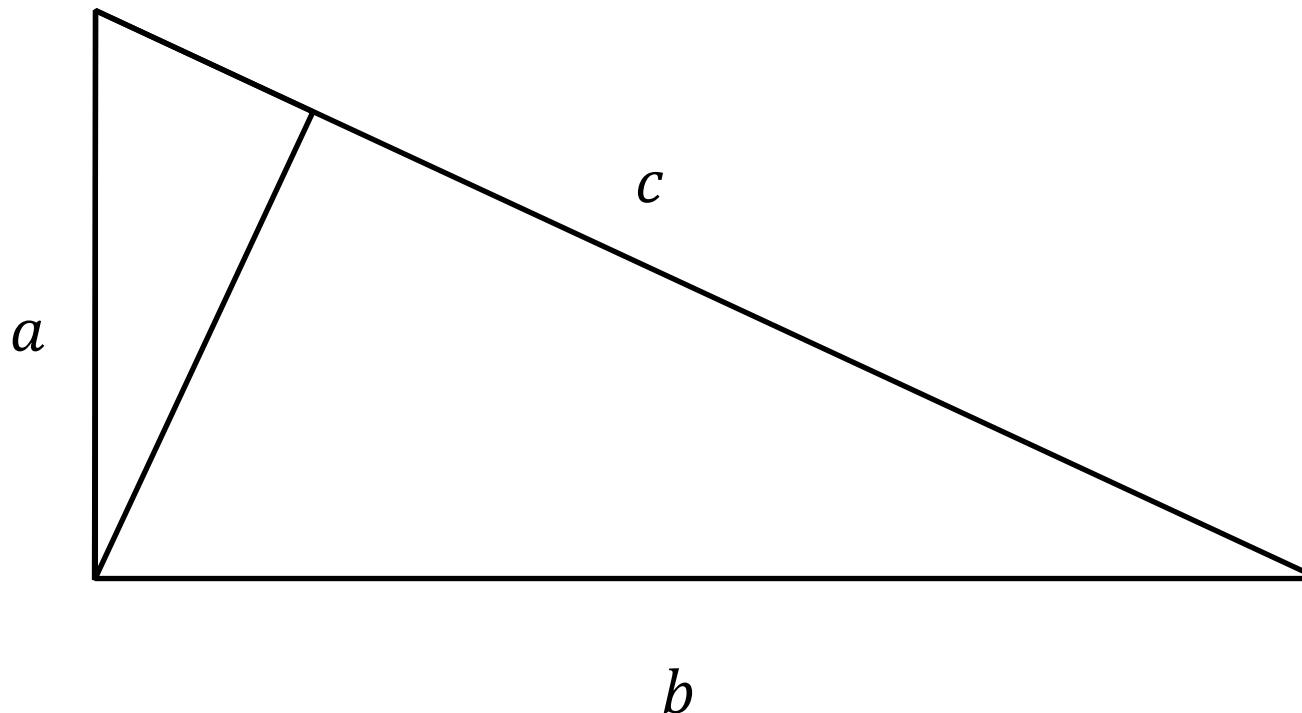


ピタゴラスの定理の証明その16

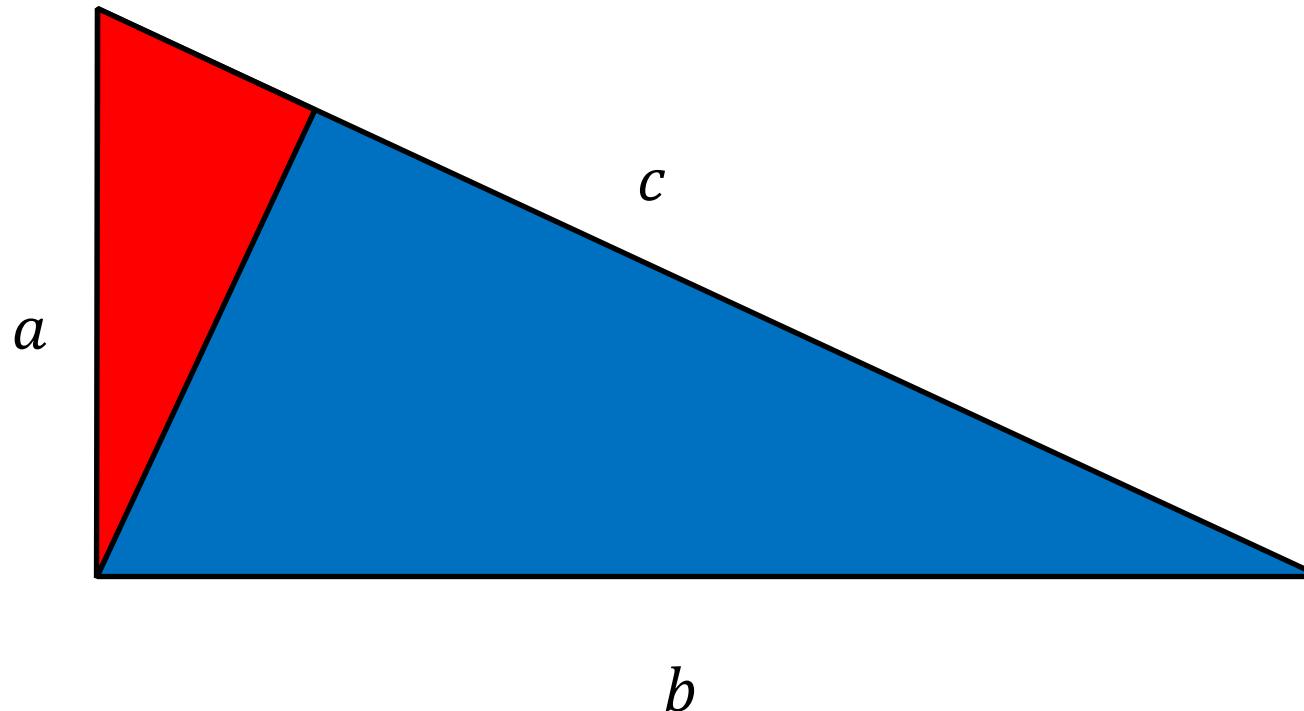


QED

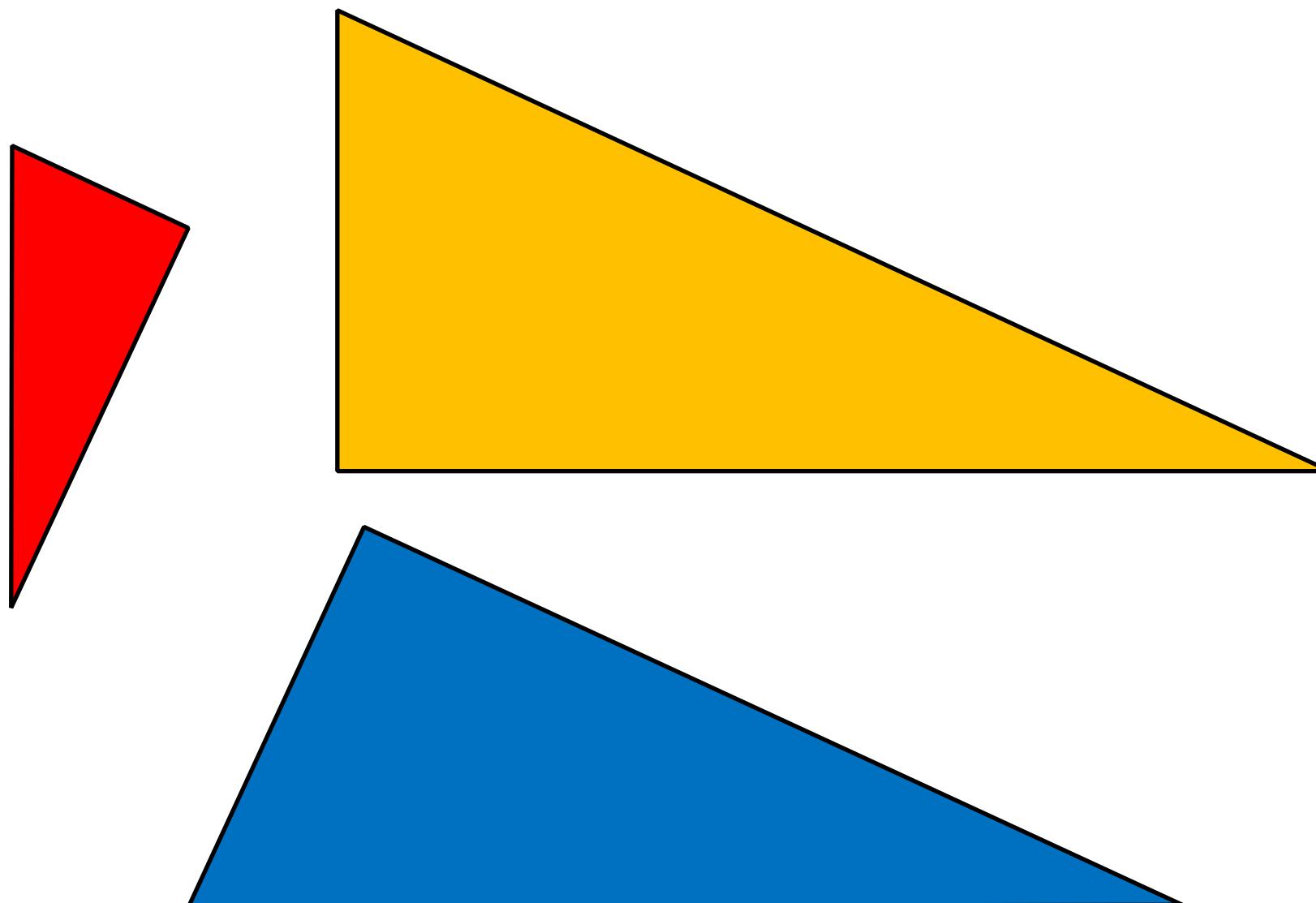
ピタゴラスの定理の証明その16



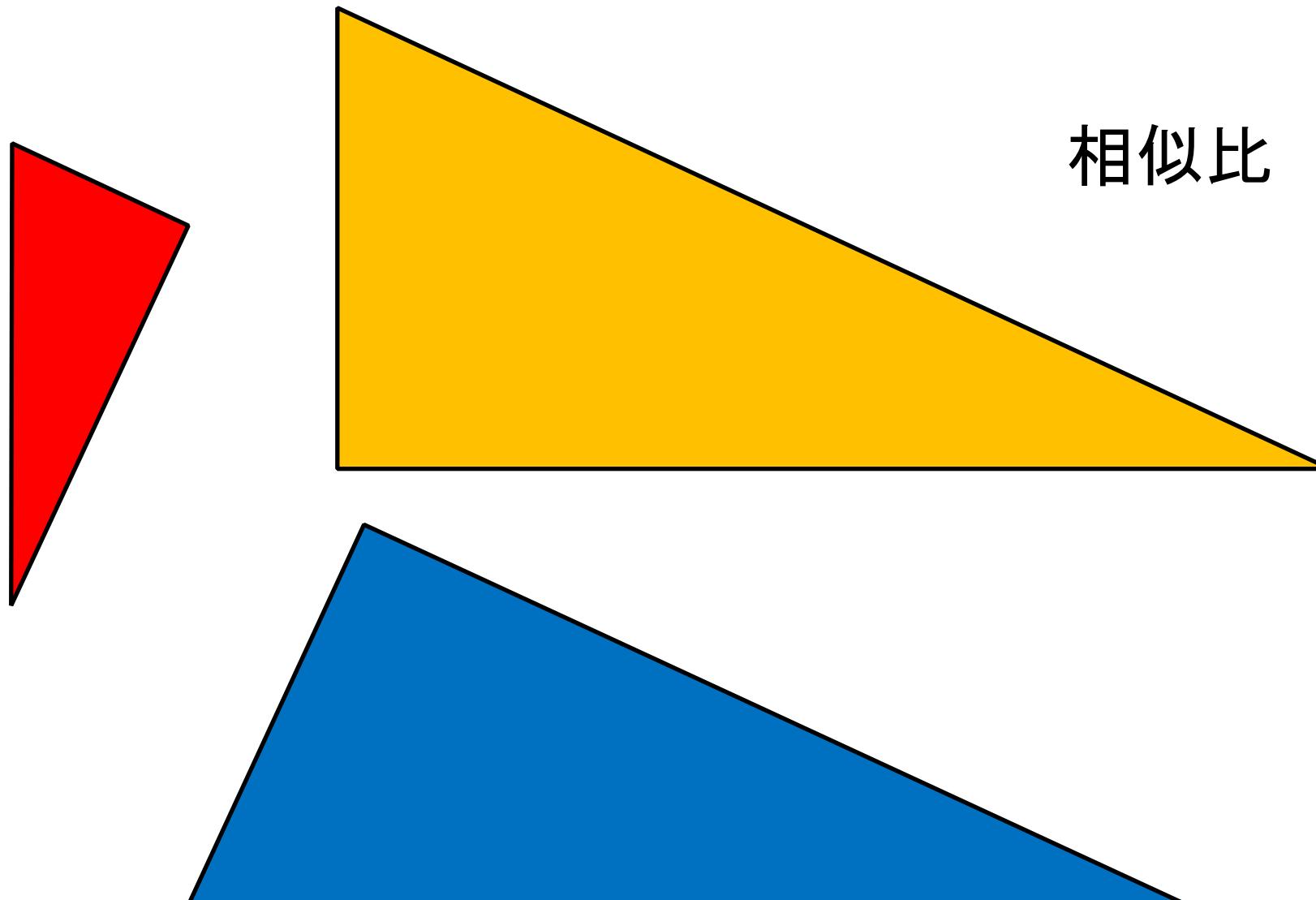
ピタゴラスの定理の証明その16



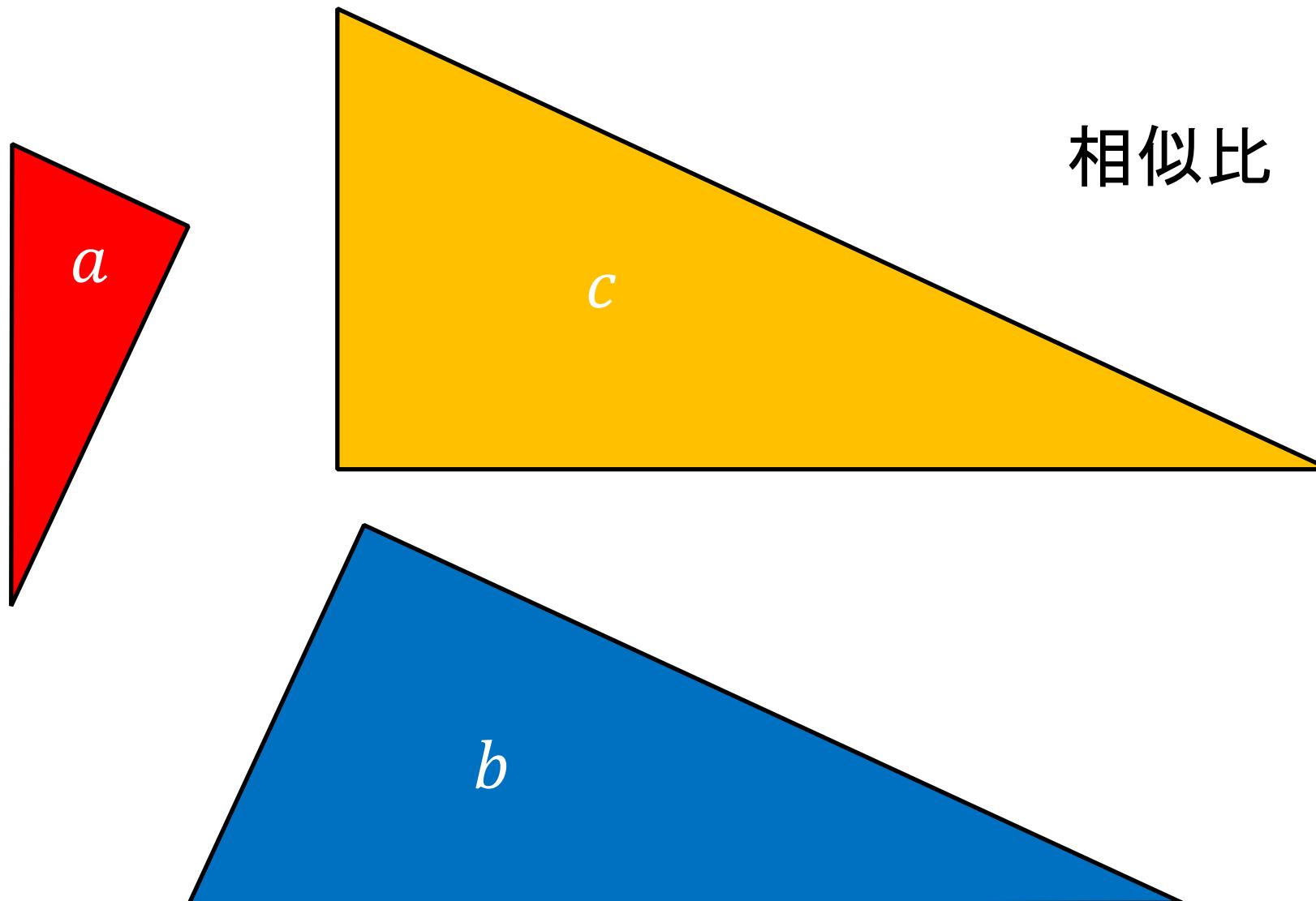
ピタゴラスの定理の証明その16



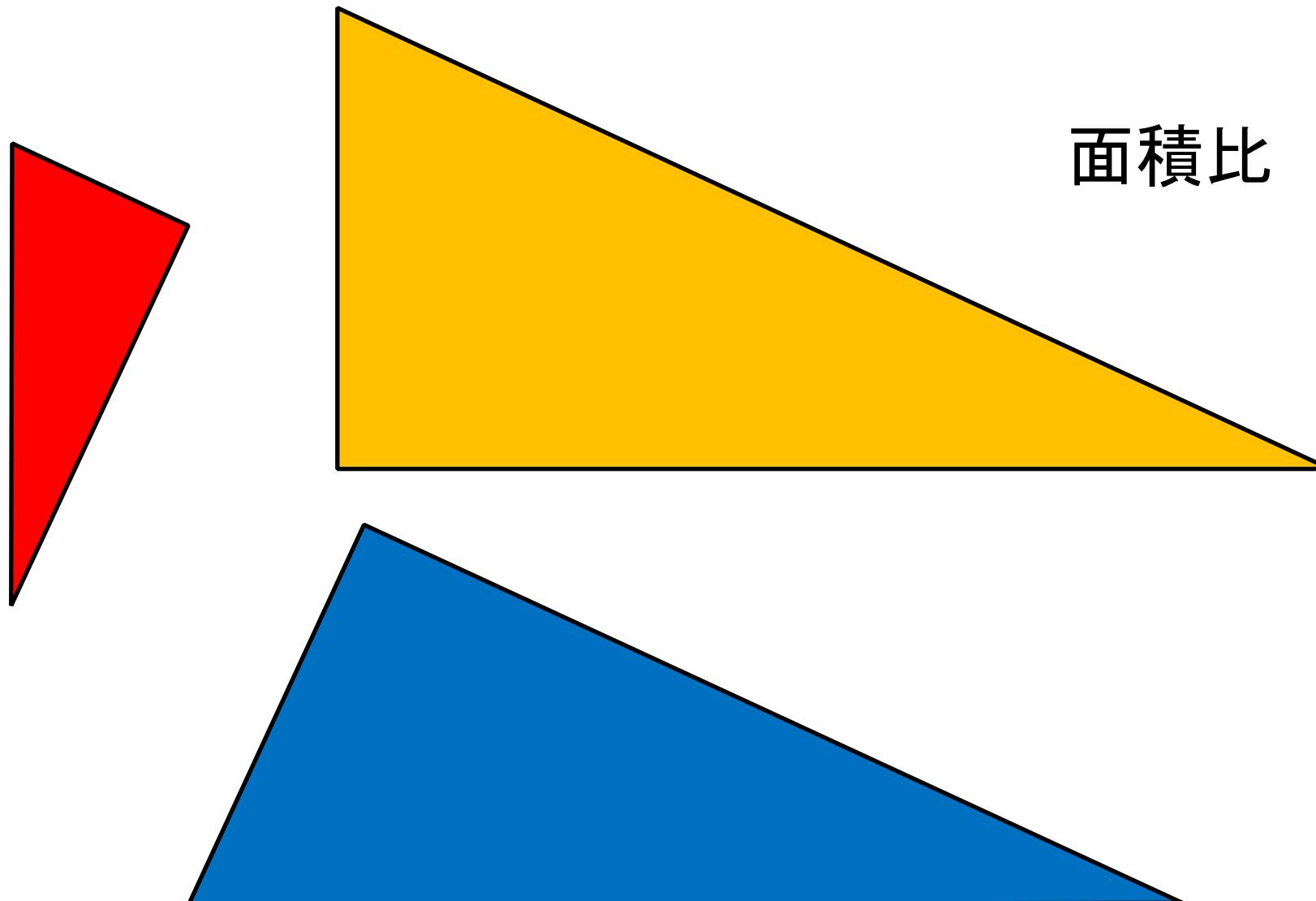
ピタゴラスの定理の証明その16



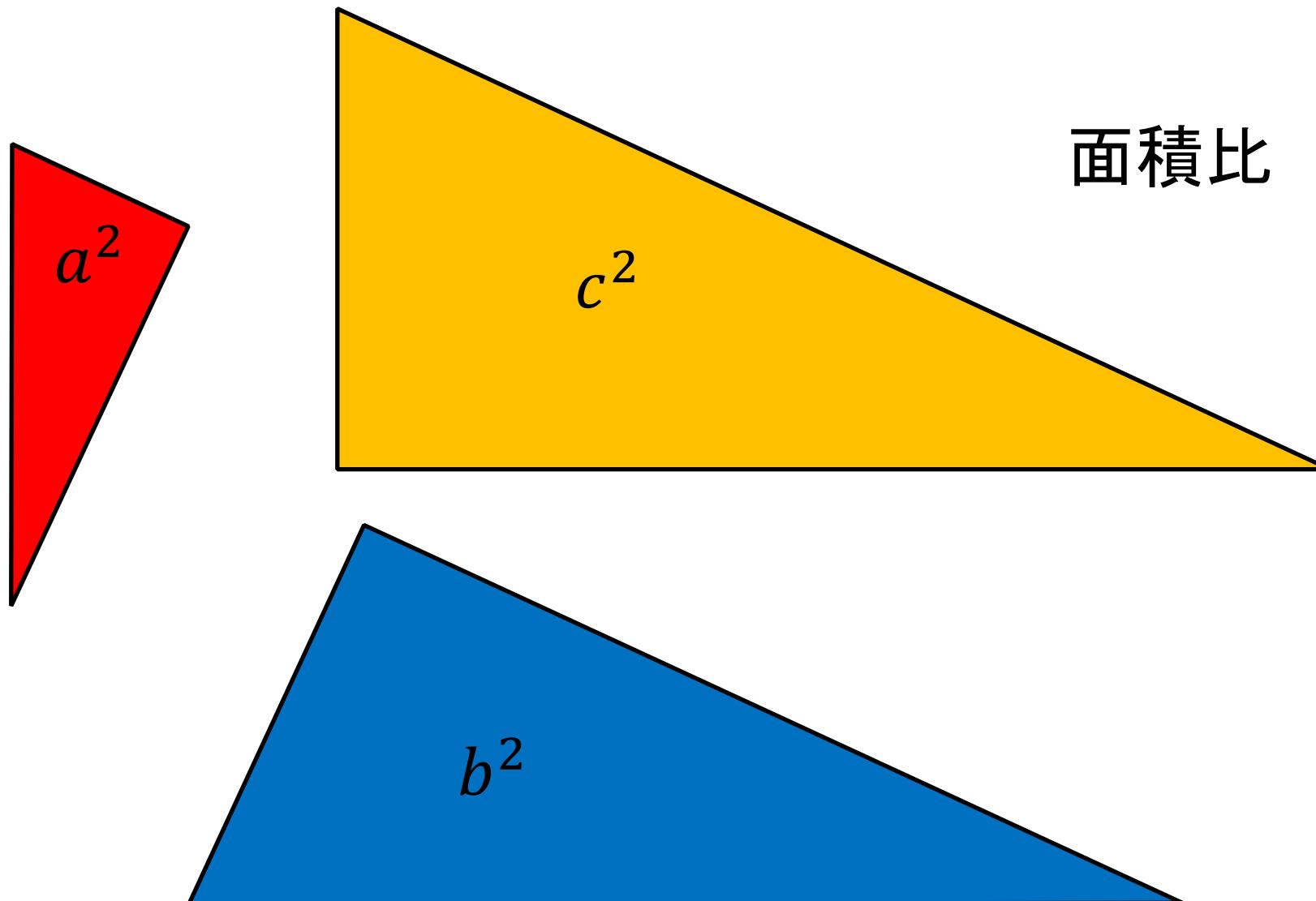
ピタゴラスの定理の証明その16



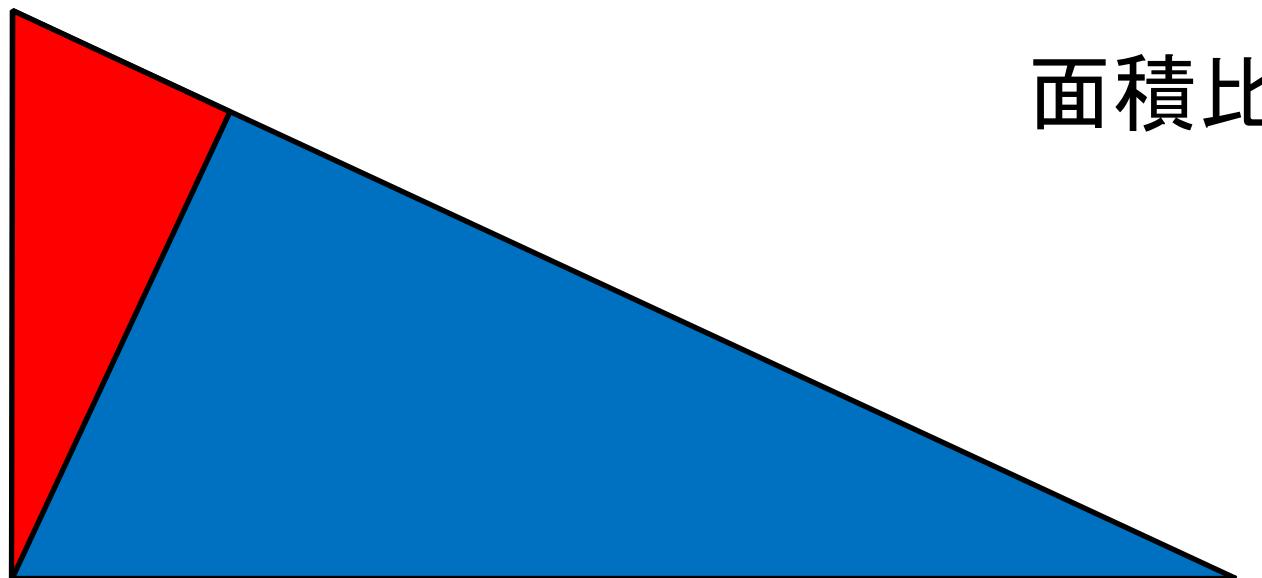
ピタゴラスの定理の証明その16



ピタゴラスの定理の証明その16

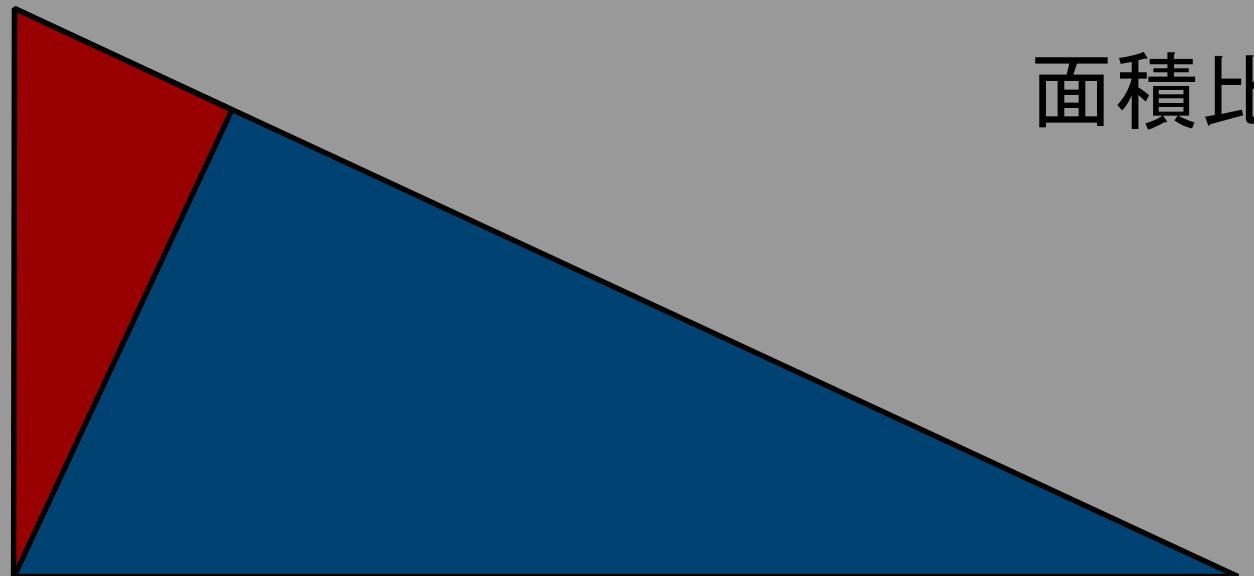


ピタゴラスの定理の証明その16



$$a^2 + b^2 = c^2$$

ピタゴラスの定理の証明その16



$$a^2 + b^2 = c^2$$

QED