Finding patterns in differences

The mathematics behind the game SET

What is SET?

What is SET?

Is there a card that doesn't belong?

What is SET?

Is there a card that doesn't belong?

Yes

What is SET?

Is there a card that doesn’t belong?

Yes

Not a SET!

What is SET?

Is there a card that doesn't belong?

Yes → **Not a SET!**

No → **A SET!**

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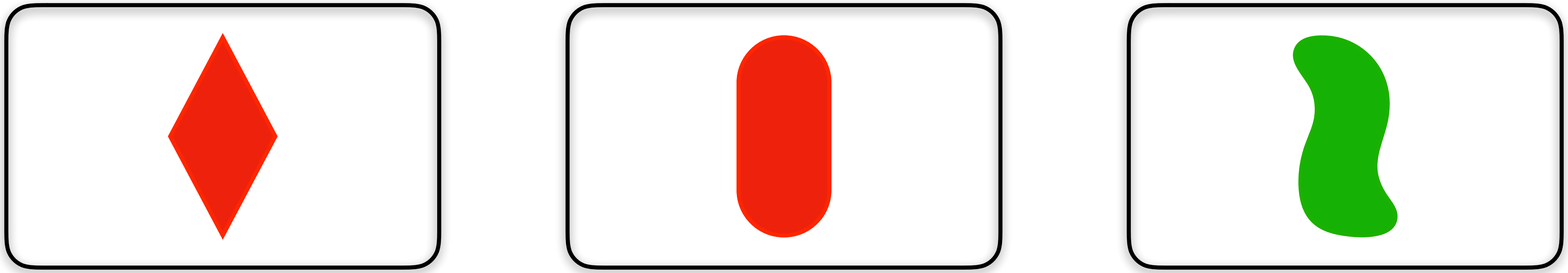

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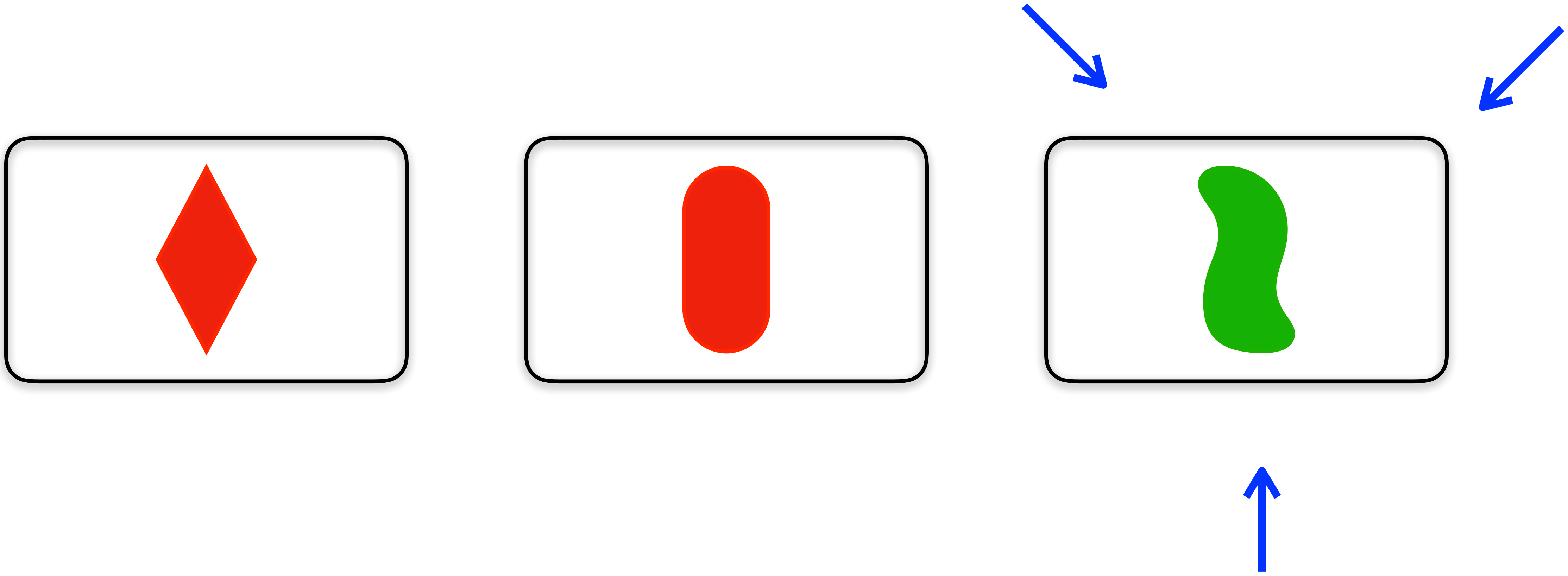

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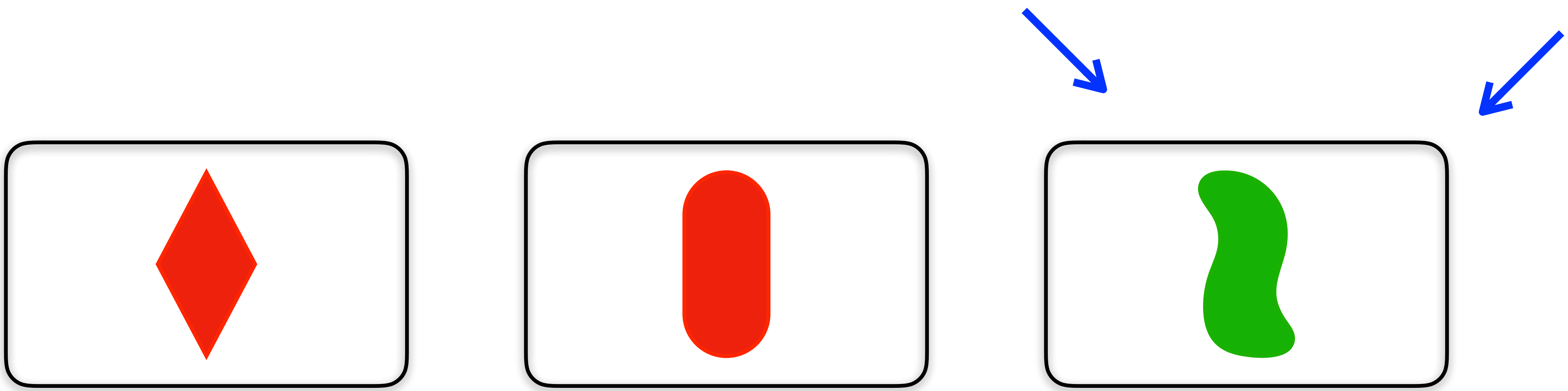

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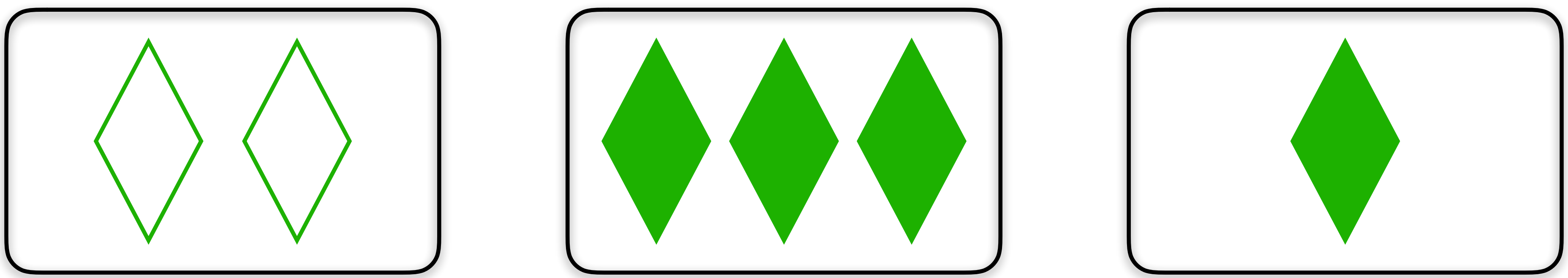

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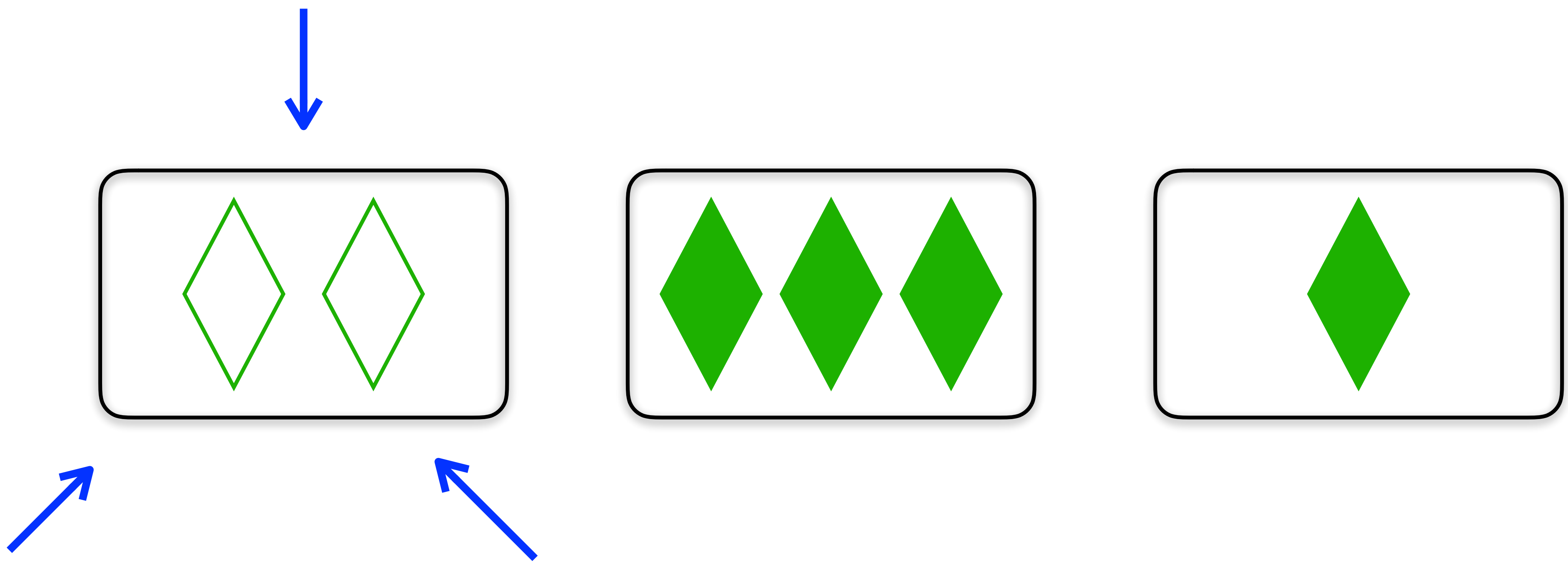

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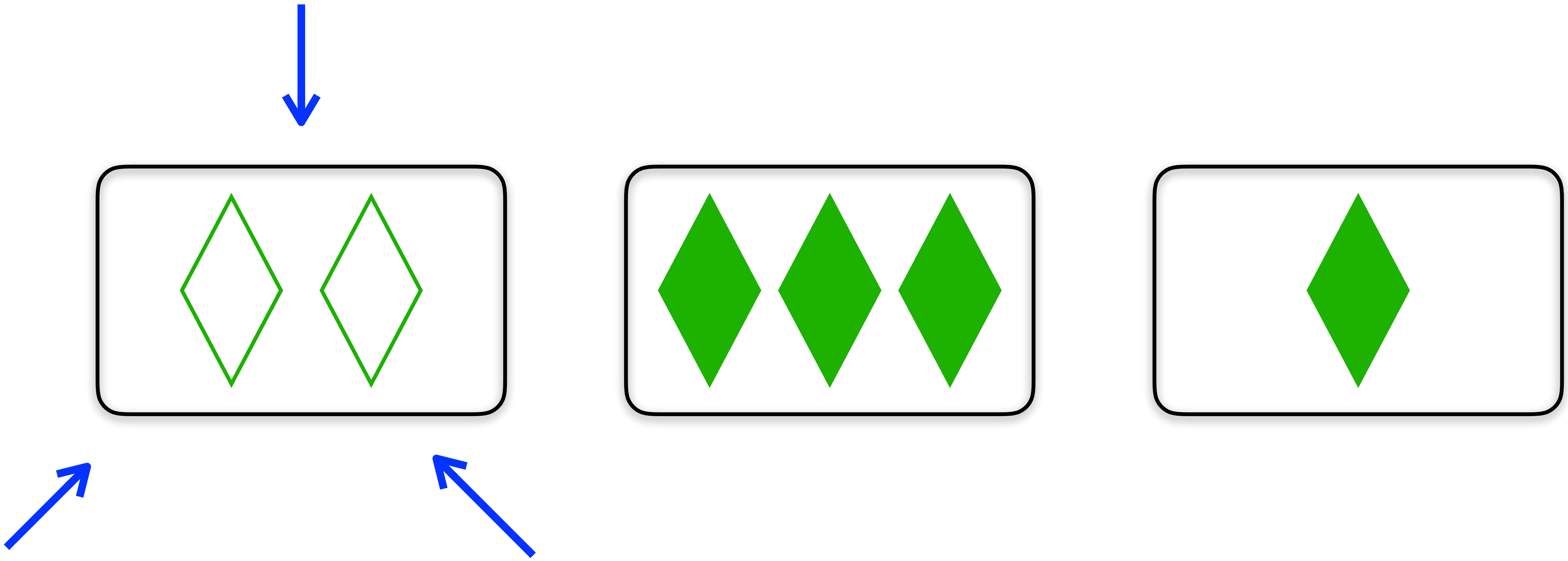

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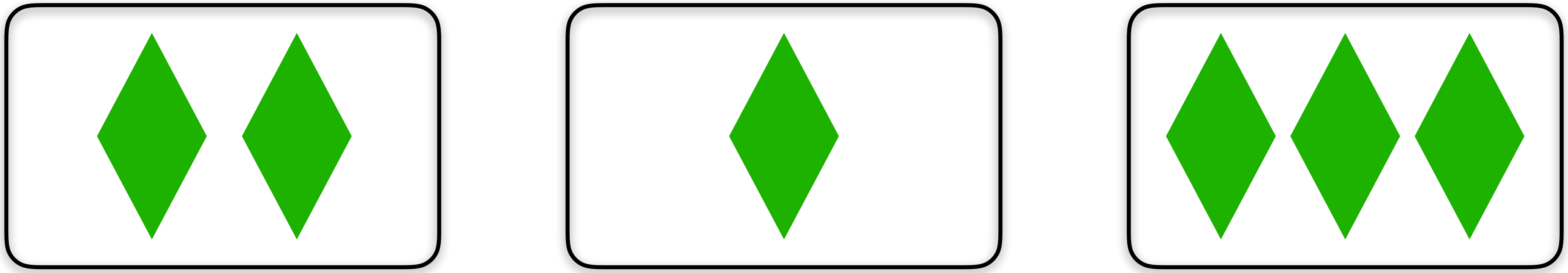

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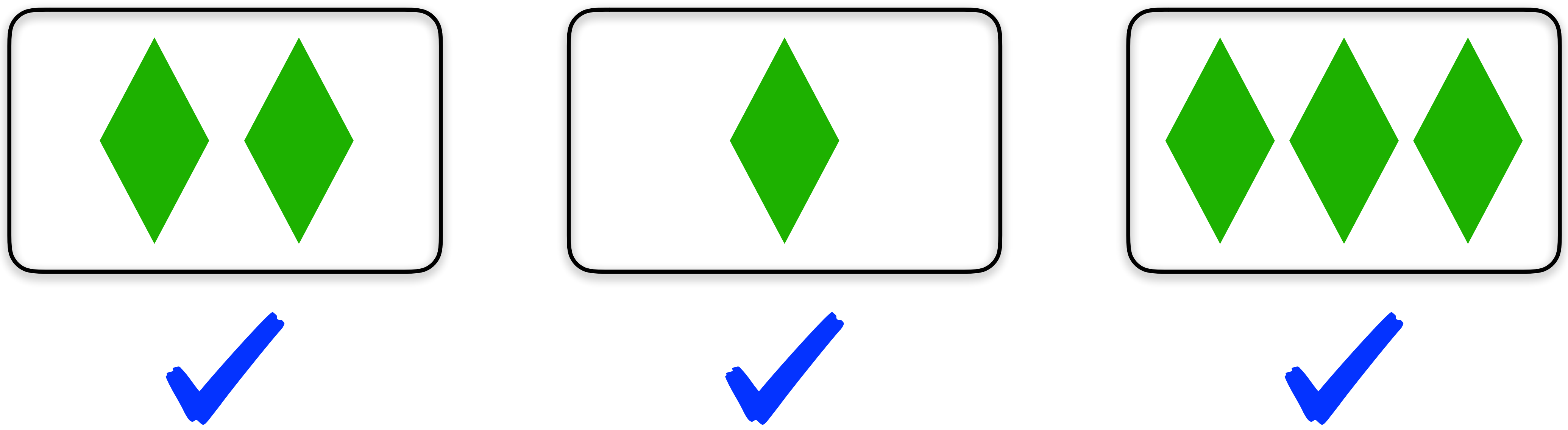

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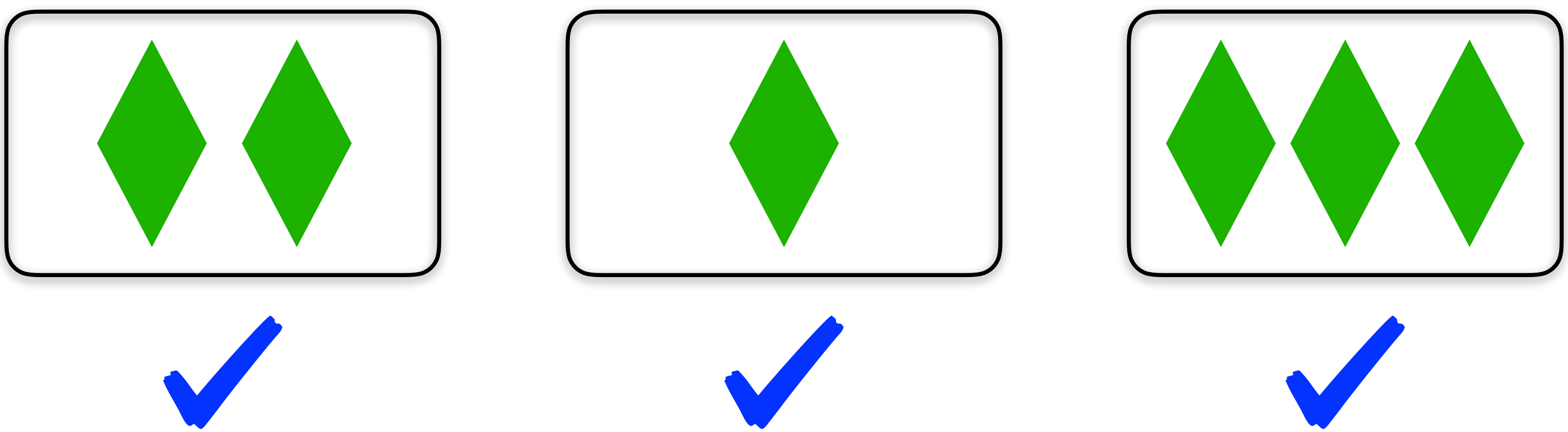

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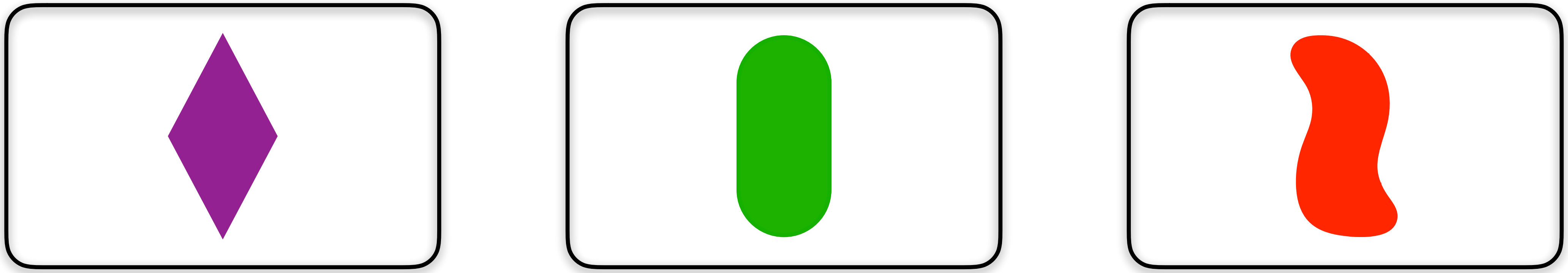

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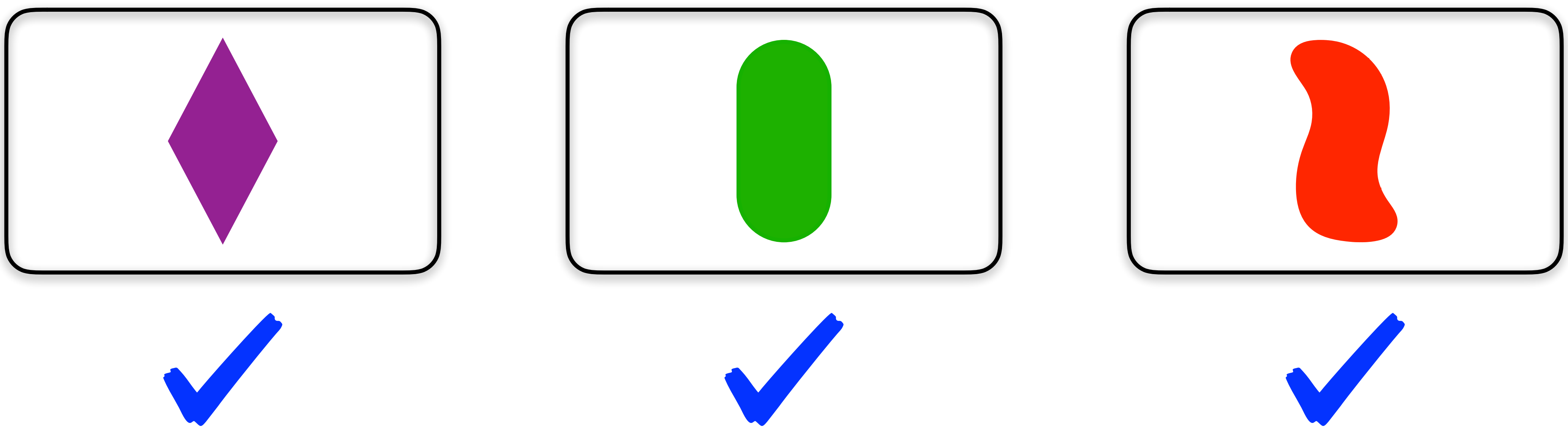

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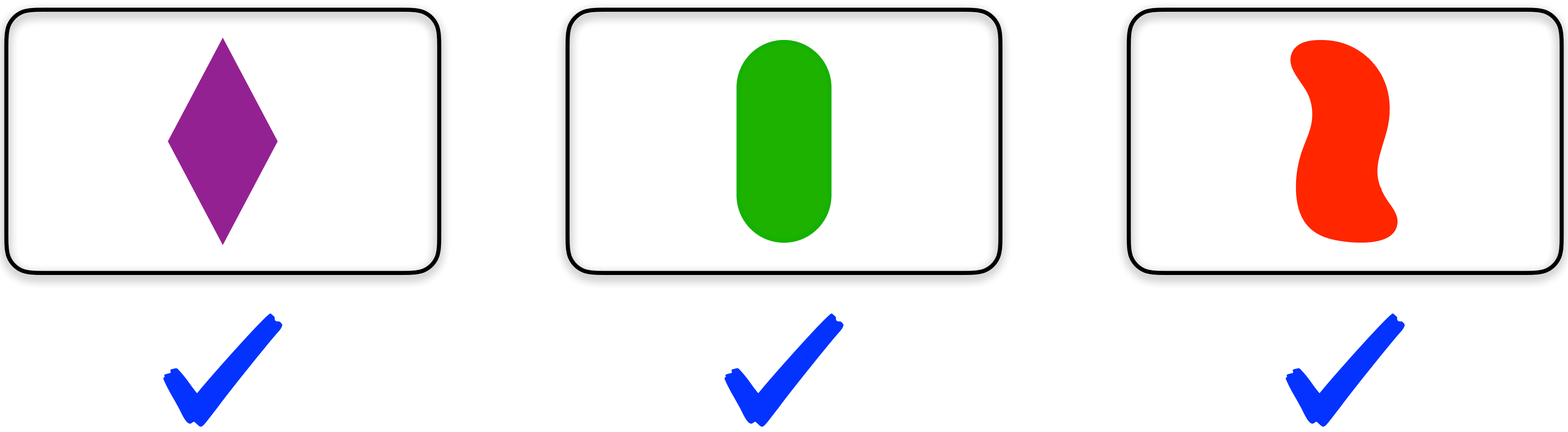

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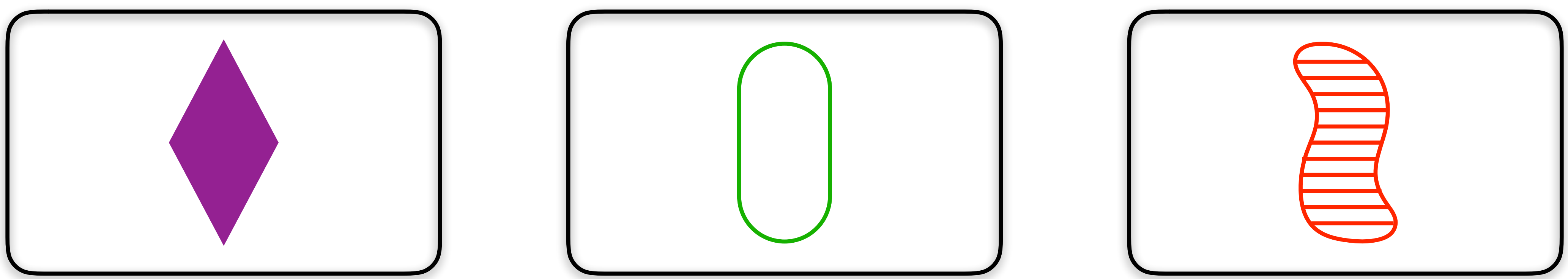

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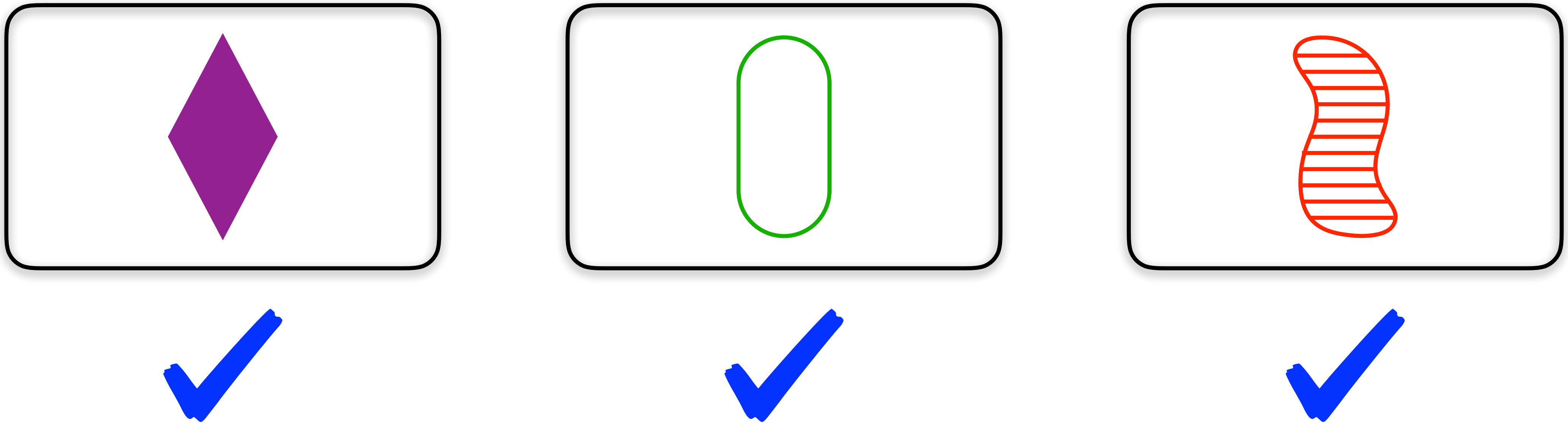

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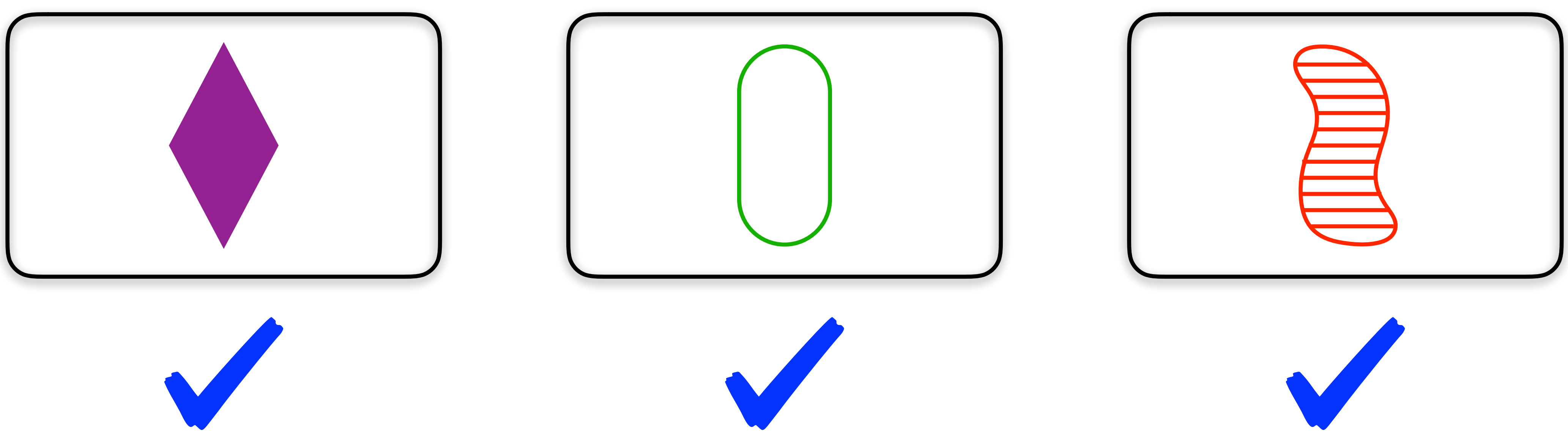
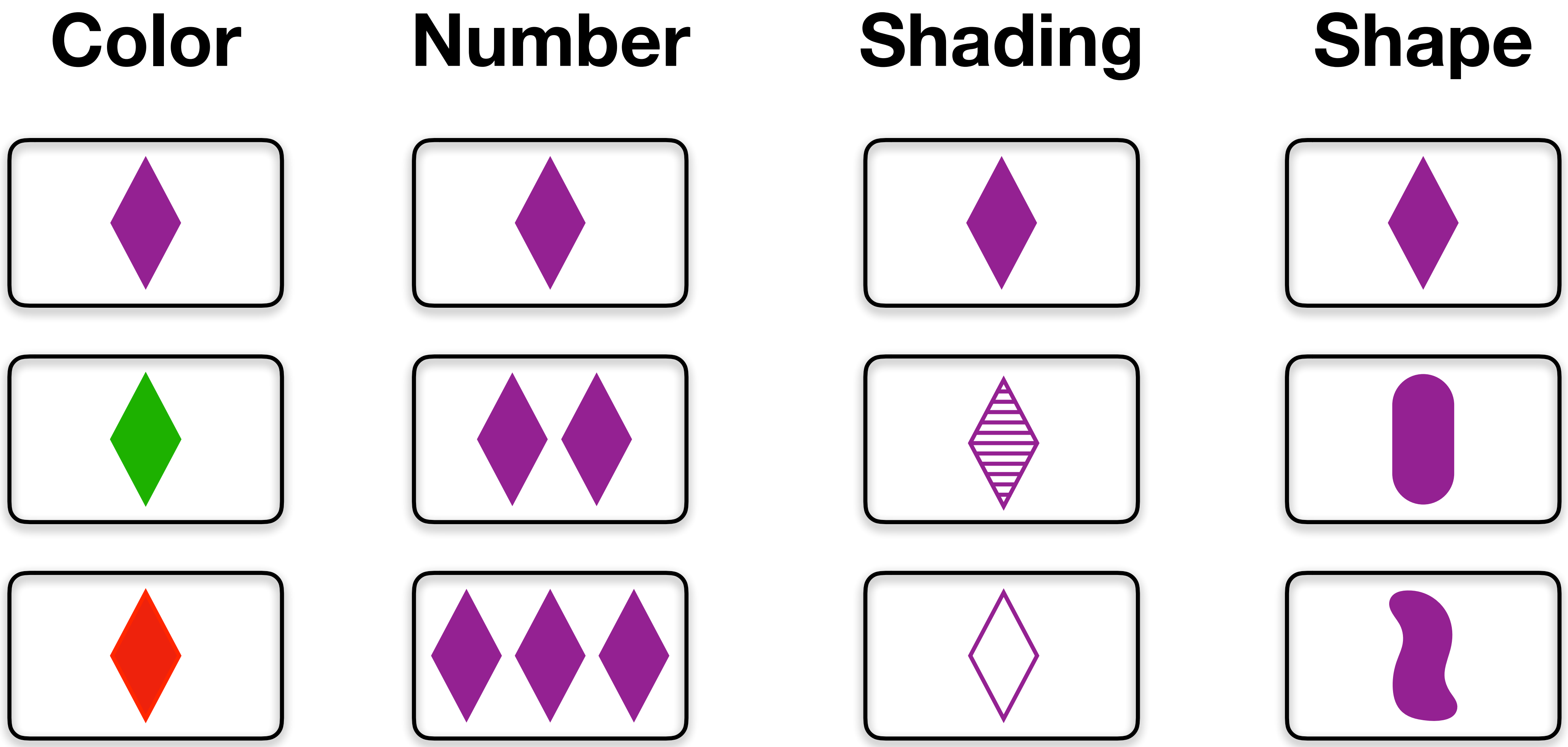


A SET!!

Each card in SET has 4 properties



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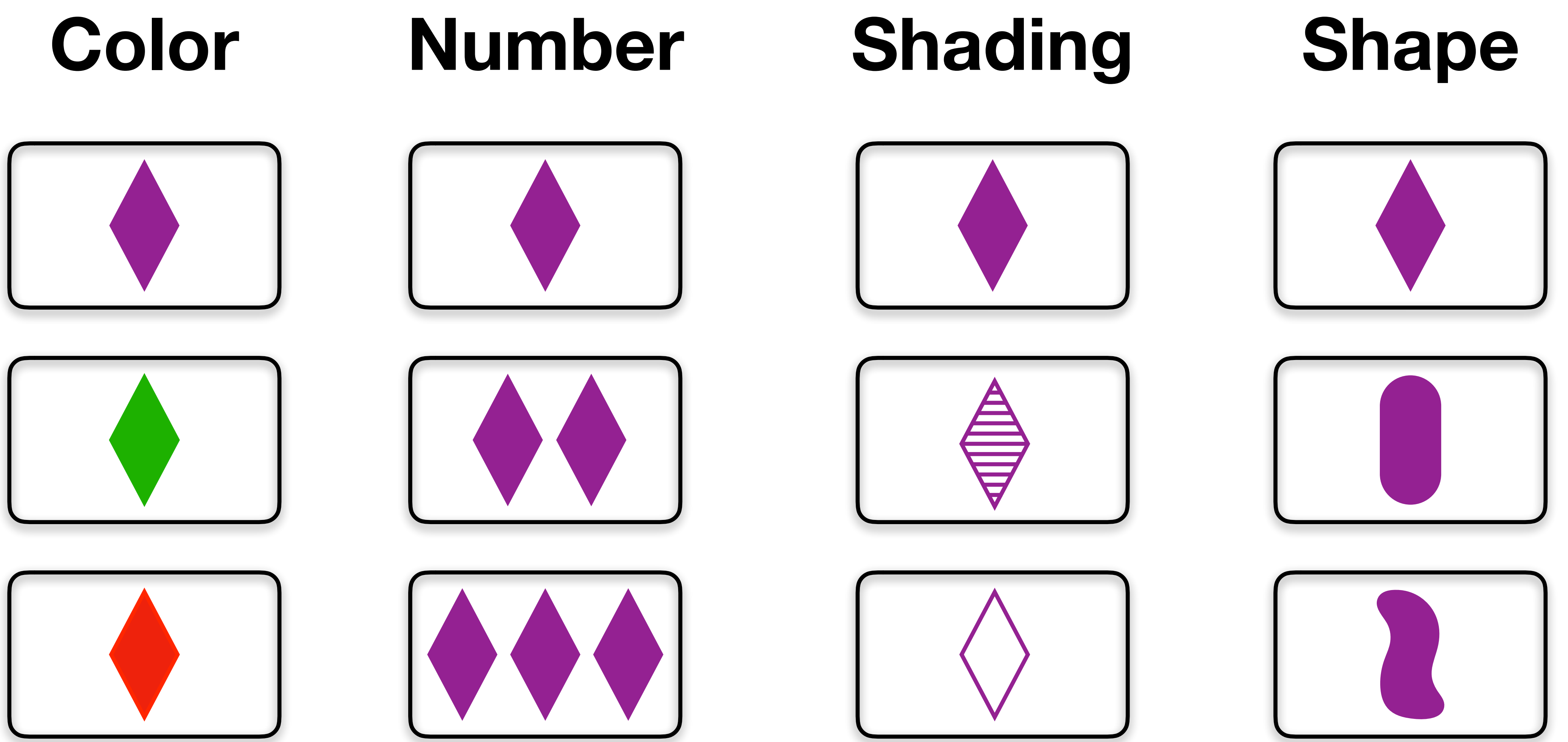


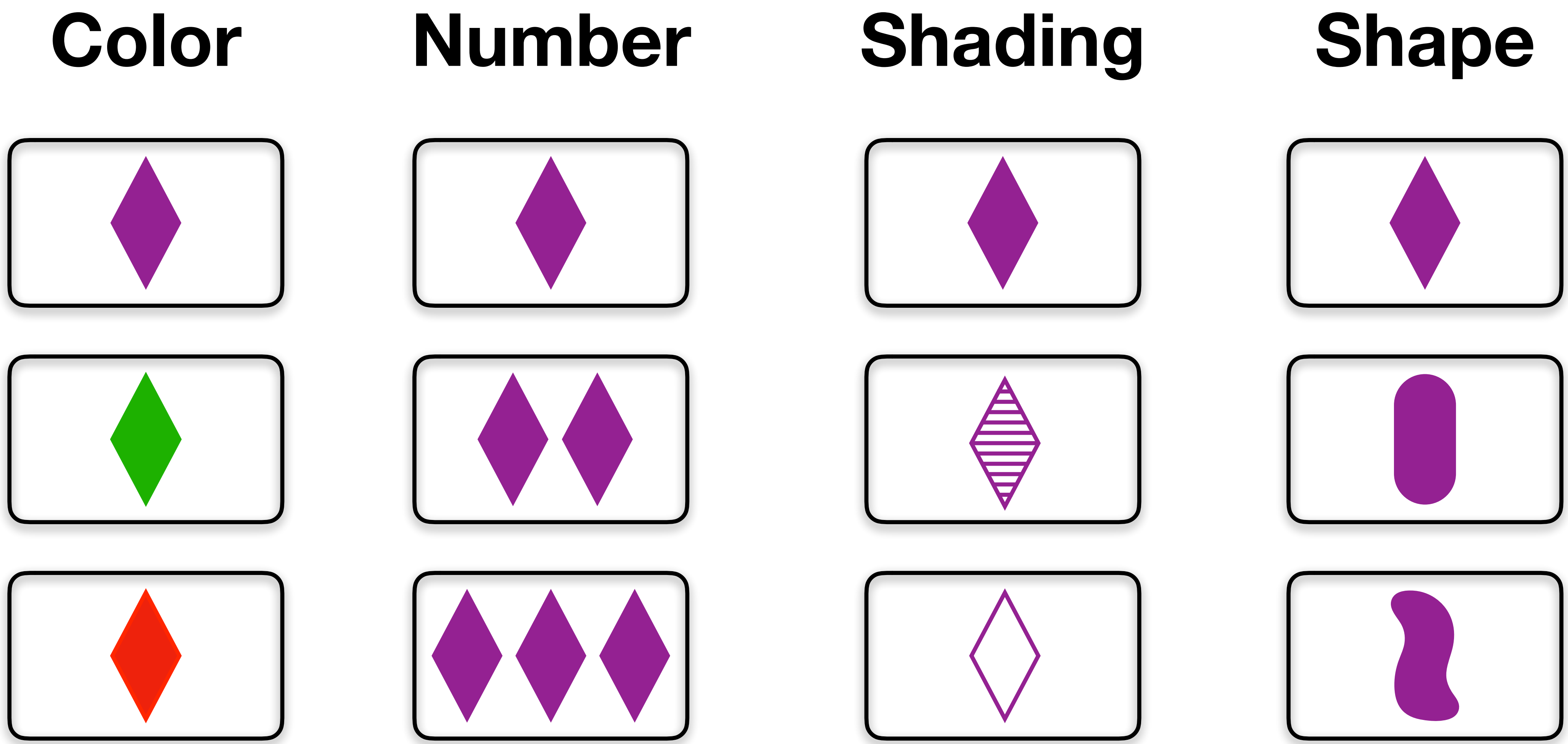
Have $3x3x3x3 = 3^4=81$ cards

No repeats!

"No card that doesn't belong"

↕

"For every property, all are the same or all are different"



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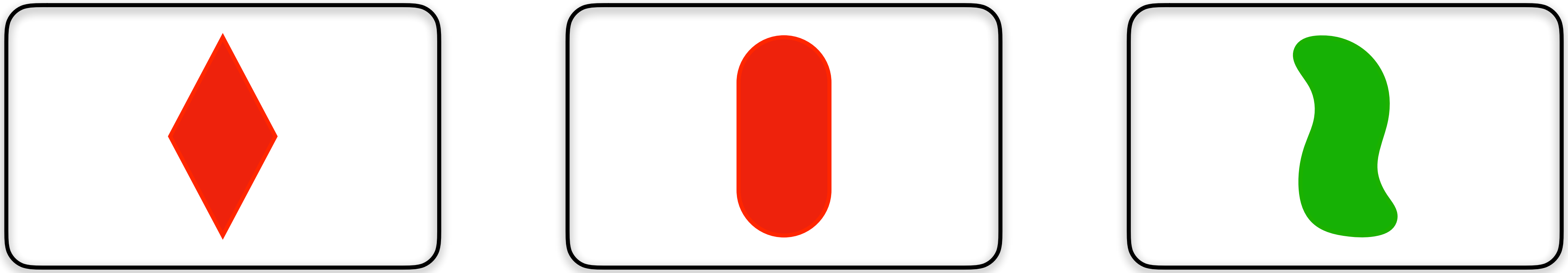
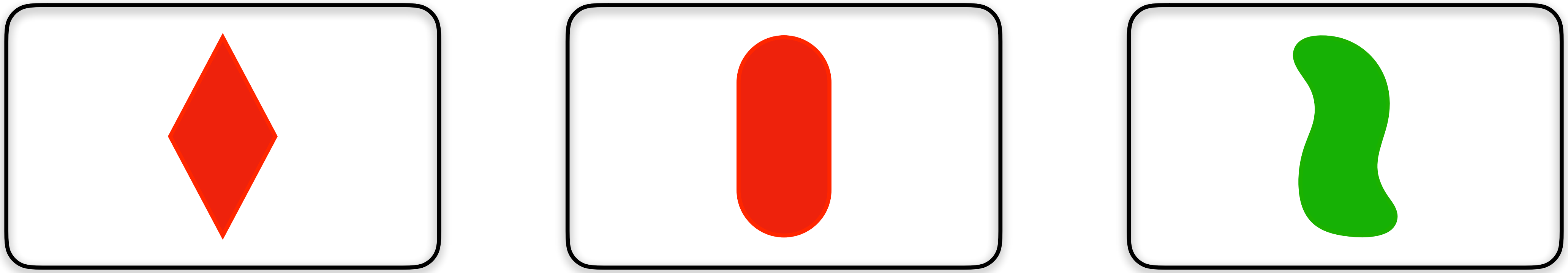


For every property, all are the same or all are different

Two are red, one is green



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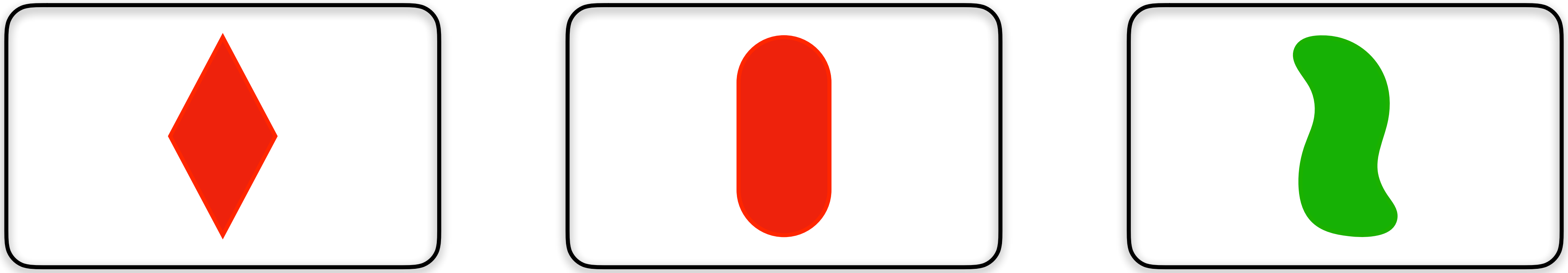

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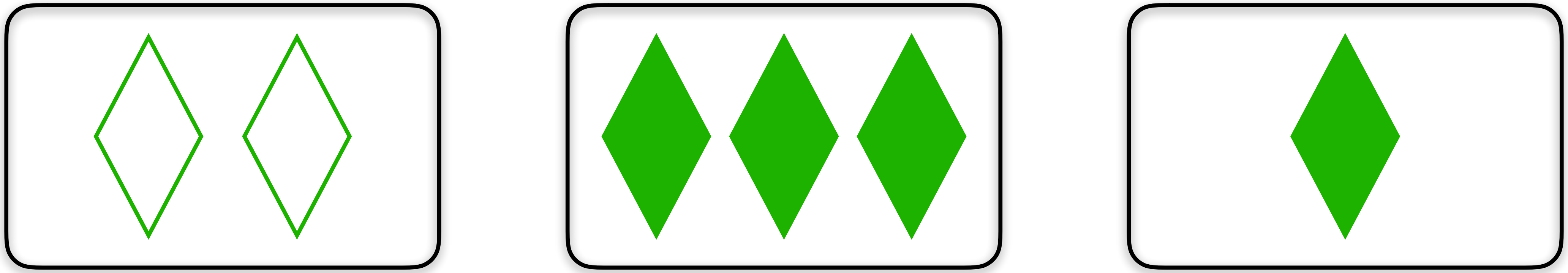
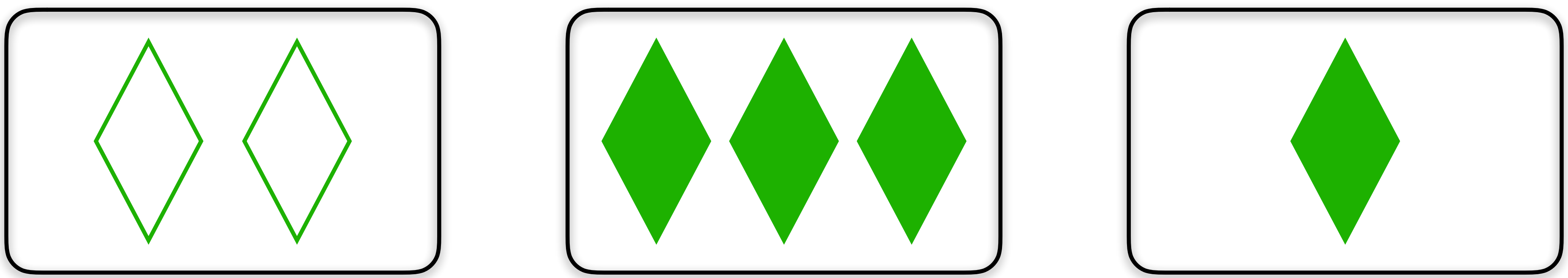


For every property, all are the same or all are different

Two are solid, one is empty



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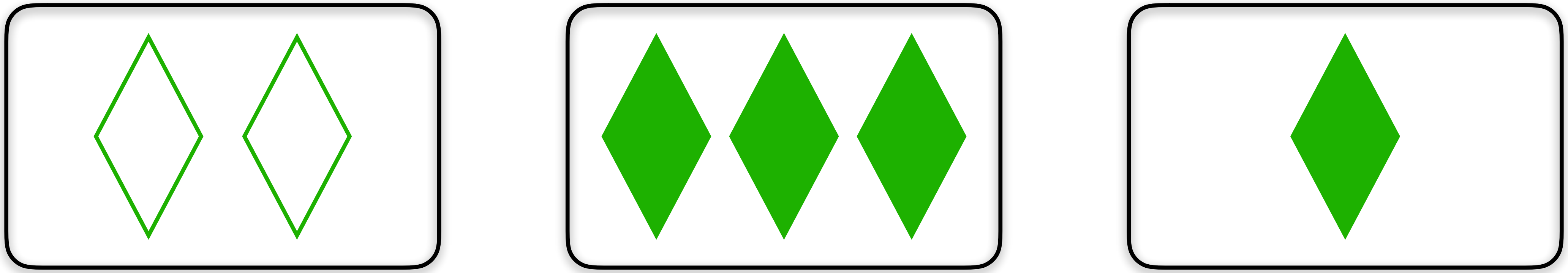

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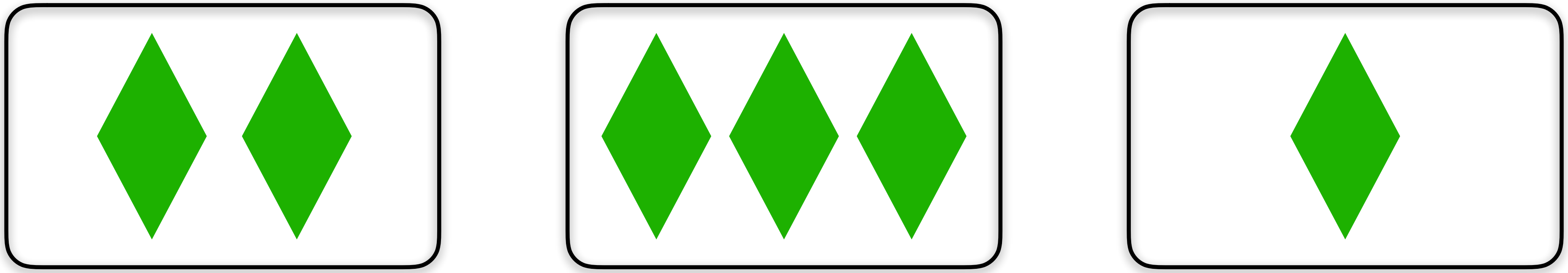
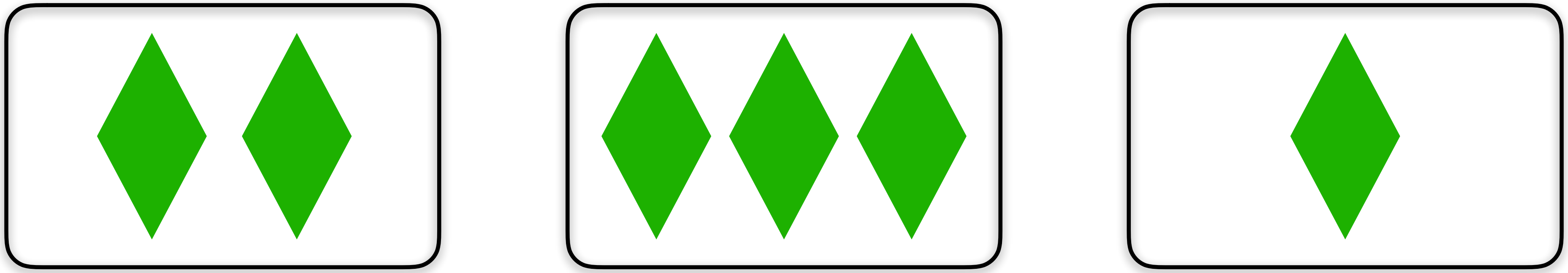


For every property, all are the same or all are different

All solid, all green, all diamonds, all *different* numbers



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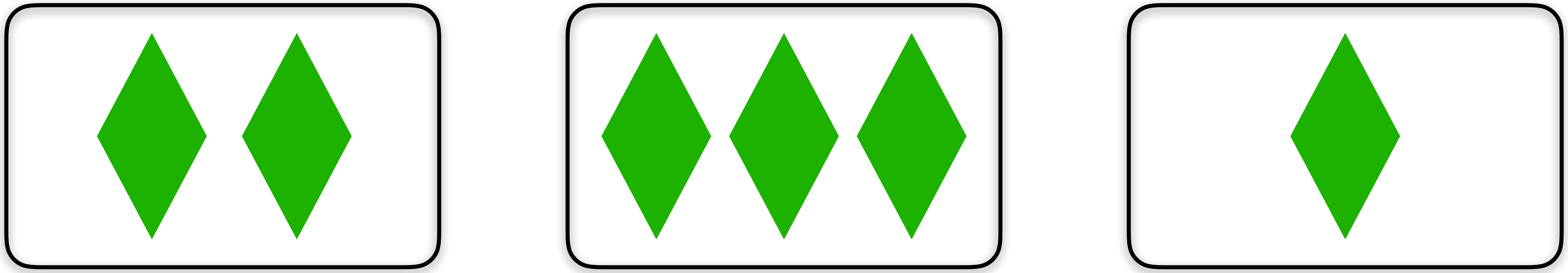

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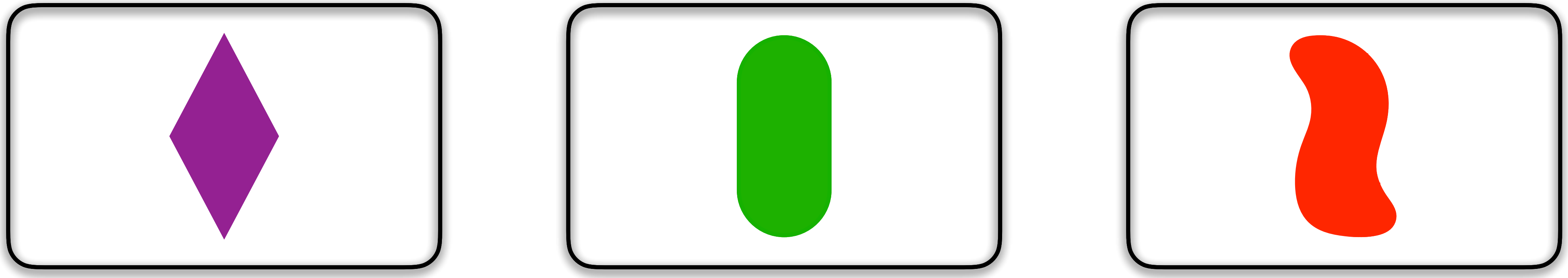
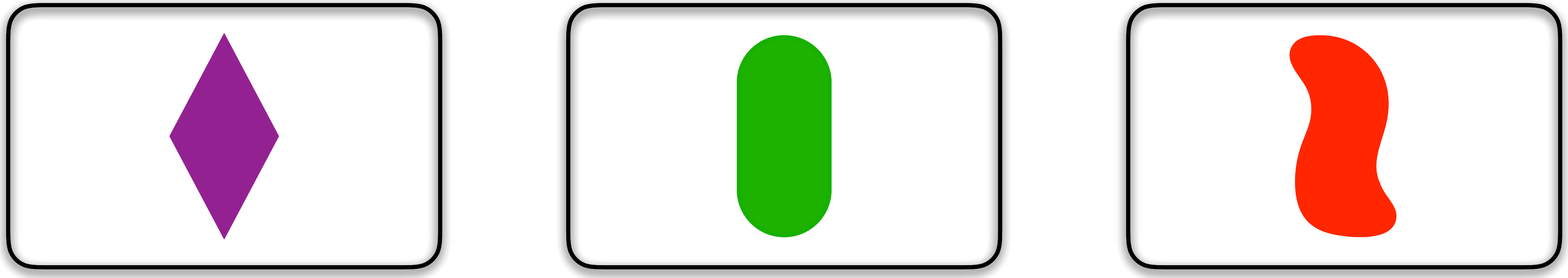


For every property, all are the same or all are different

**All the same number, all solid,
all different shapes, all different colors**



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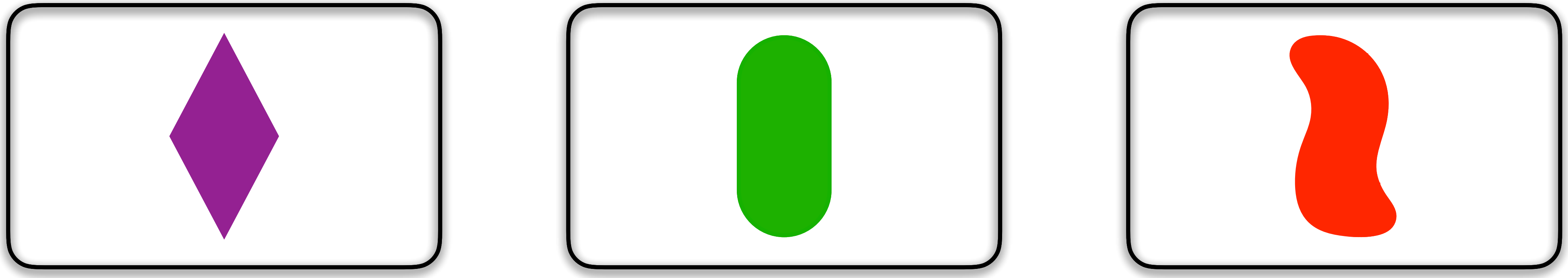

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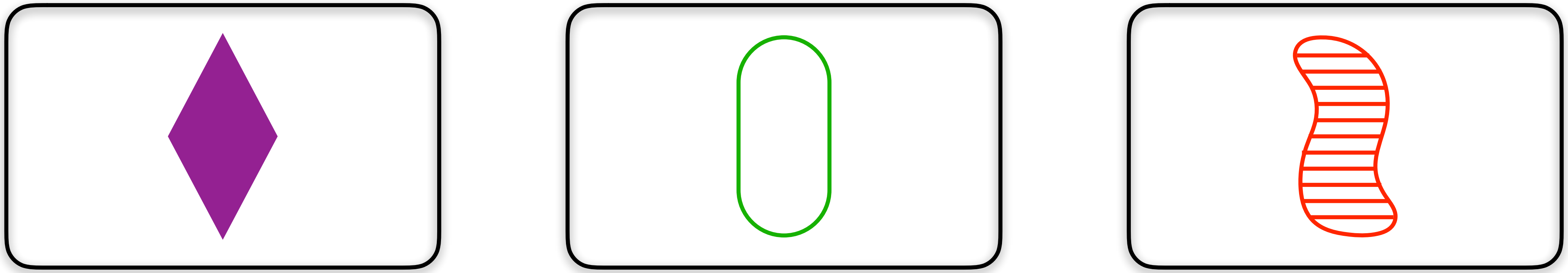
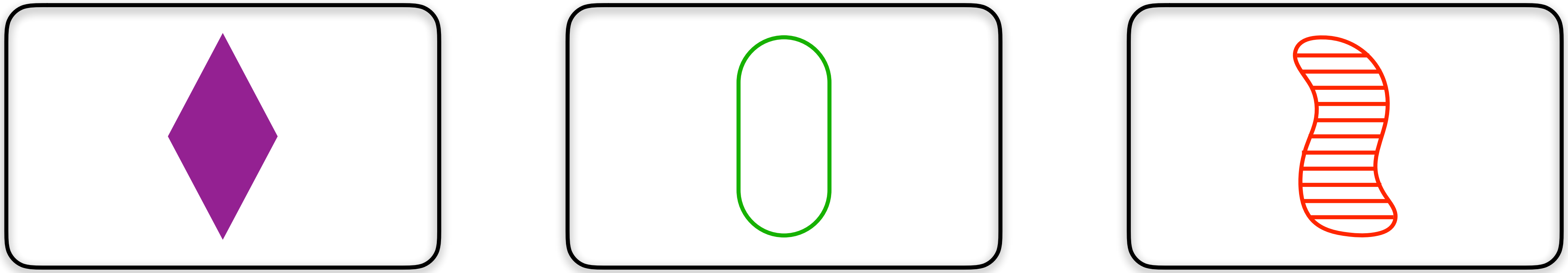


For every property, all are the same or all are different

Same number, all different shading, all different shapes, all different colors



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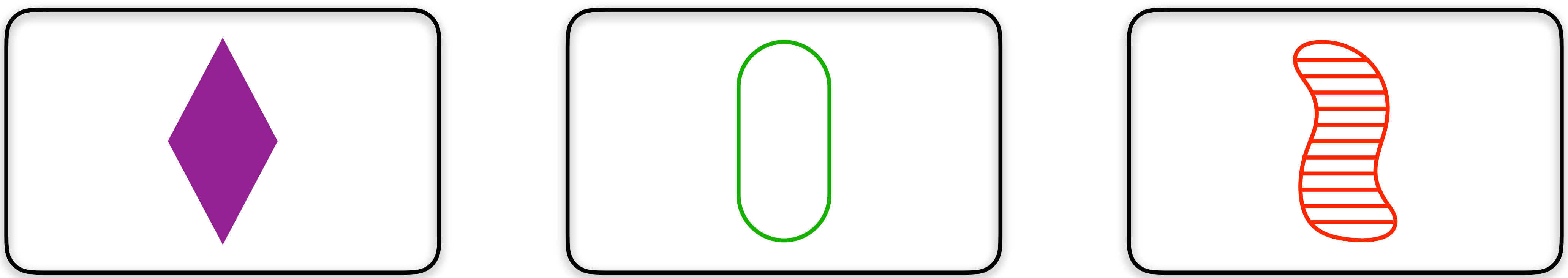

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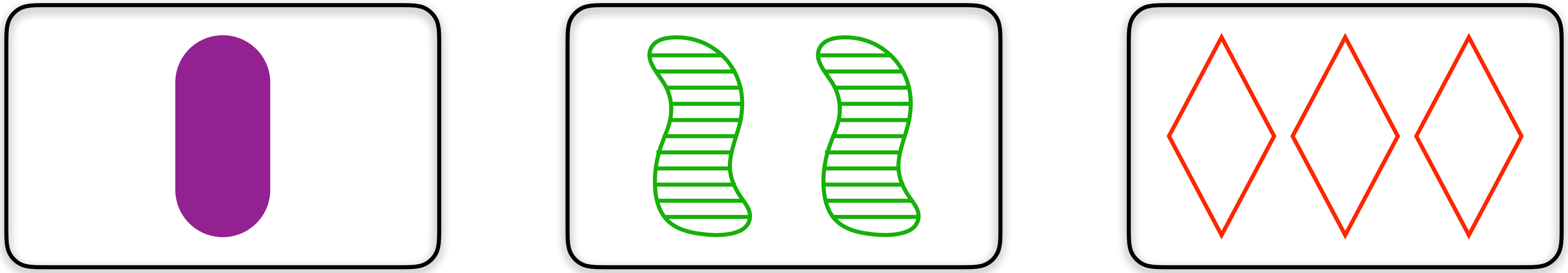

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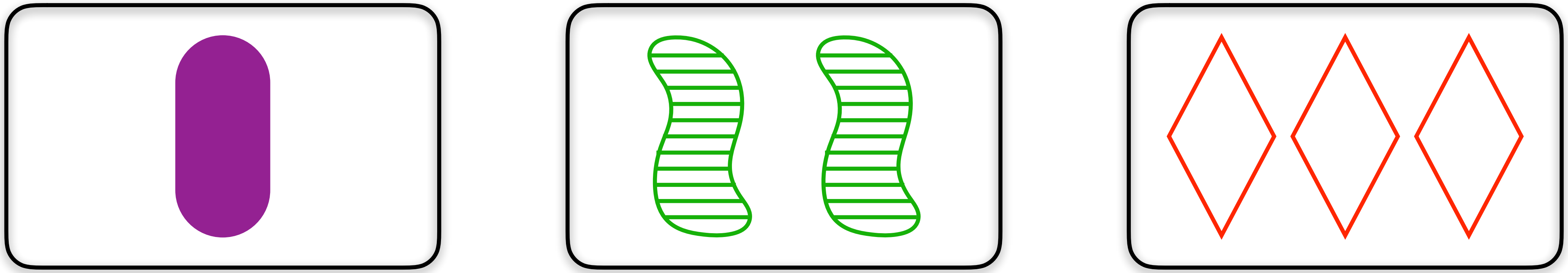
All different numbers, all different colors, all different shapes, all different shading



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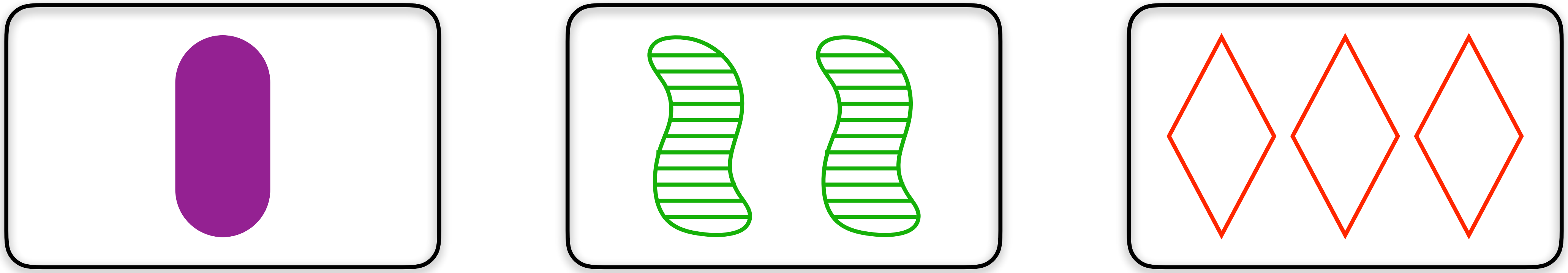
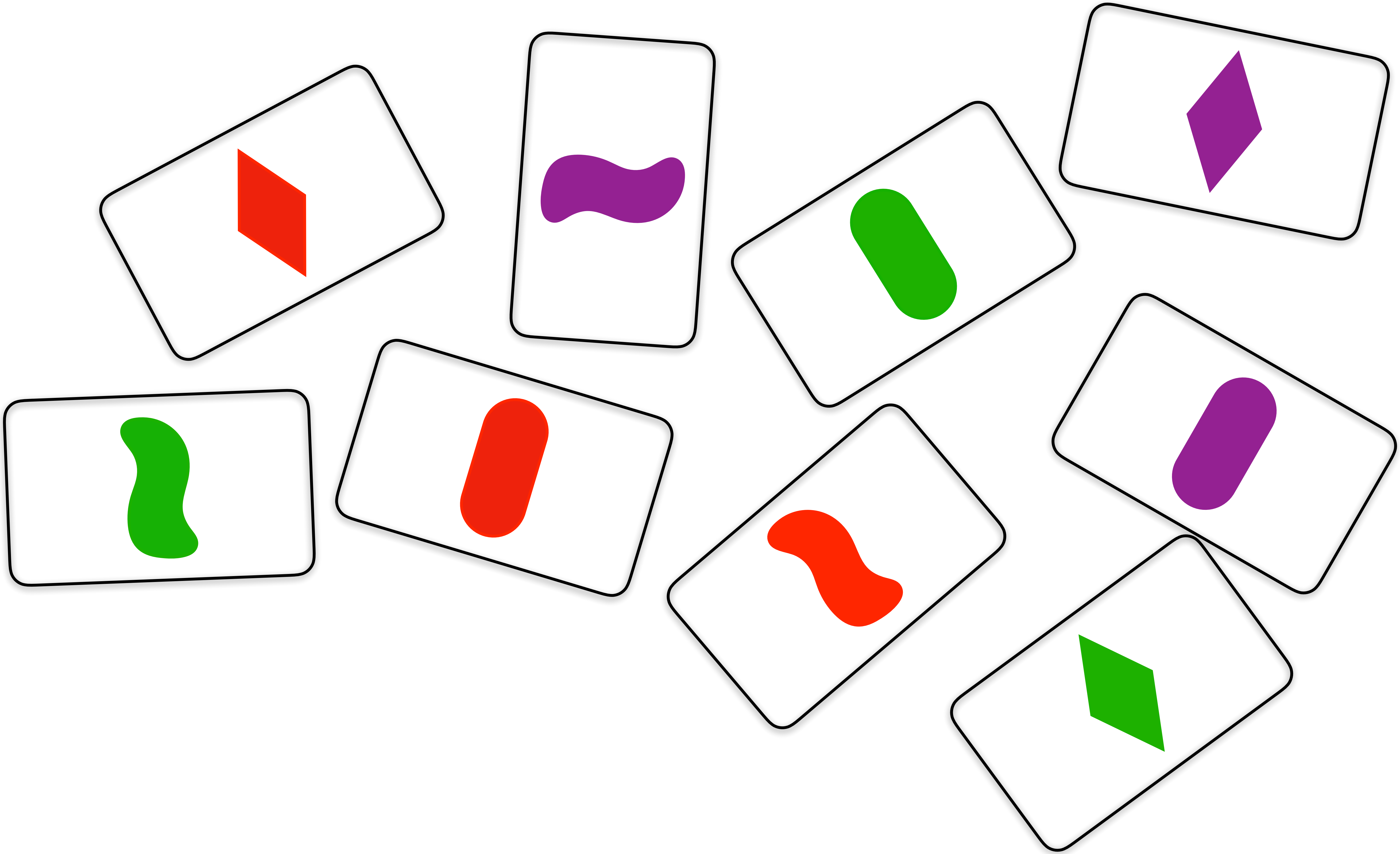
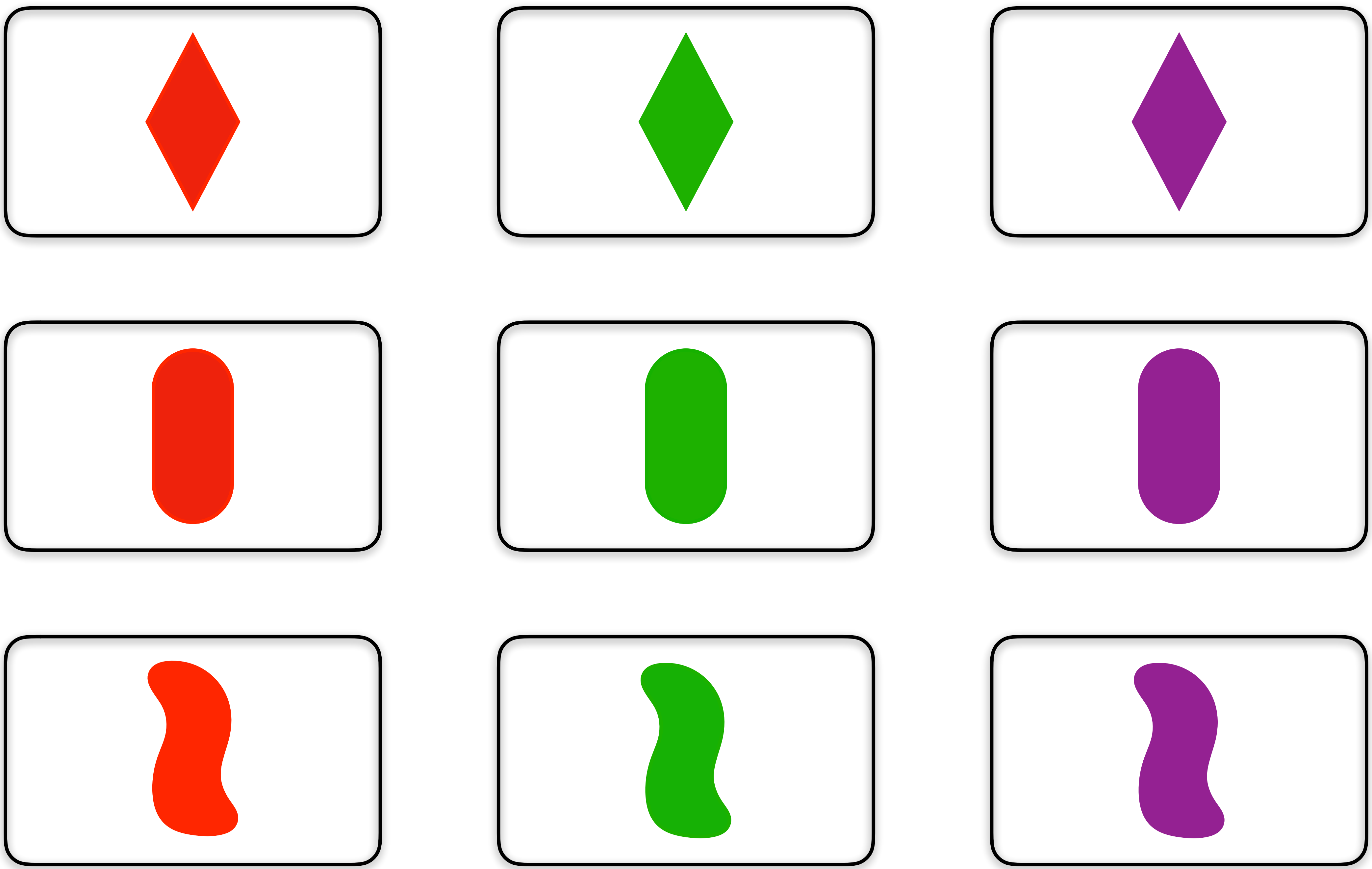


A SET!!

How many SETs are there?



What are the possible SETs?



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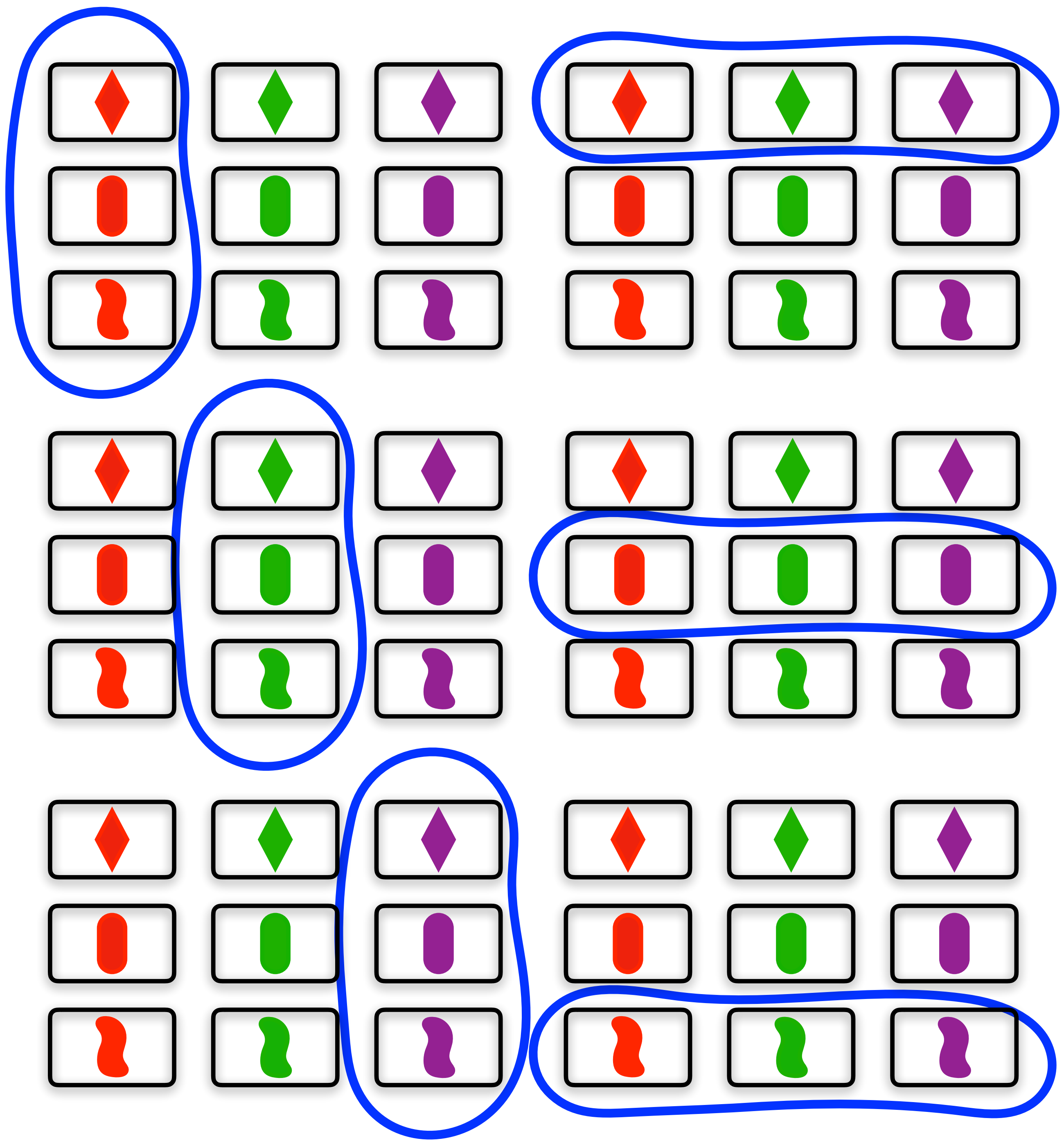
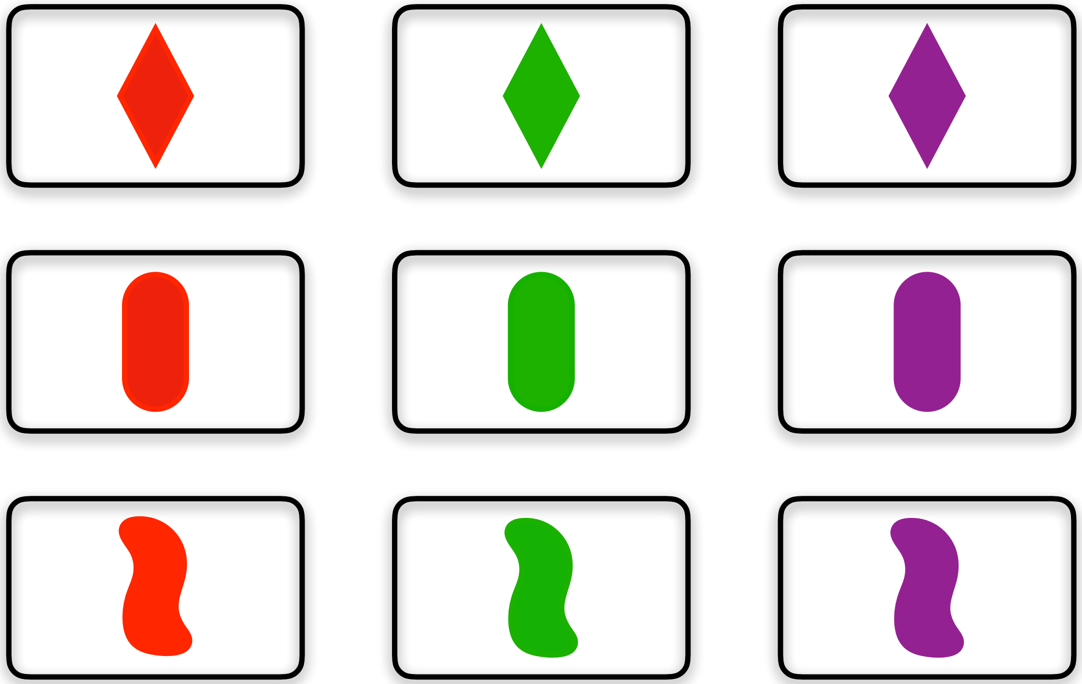
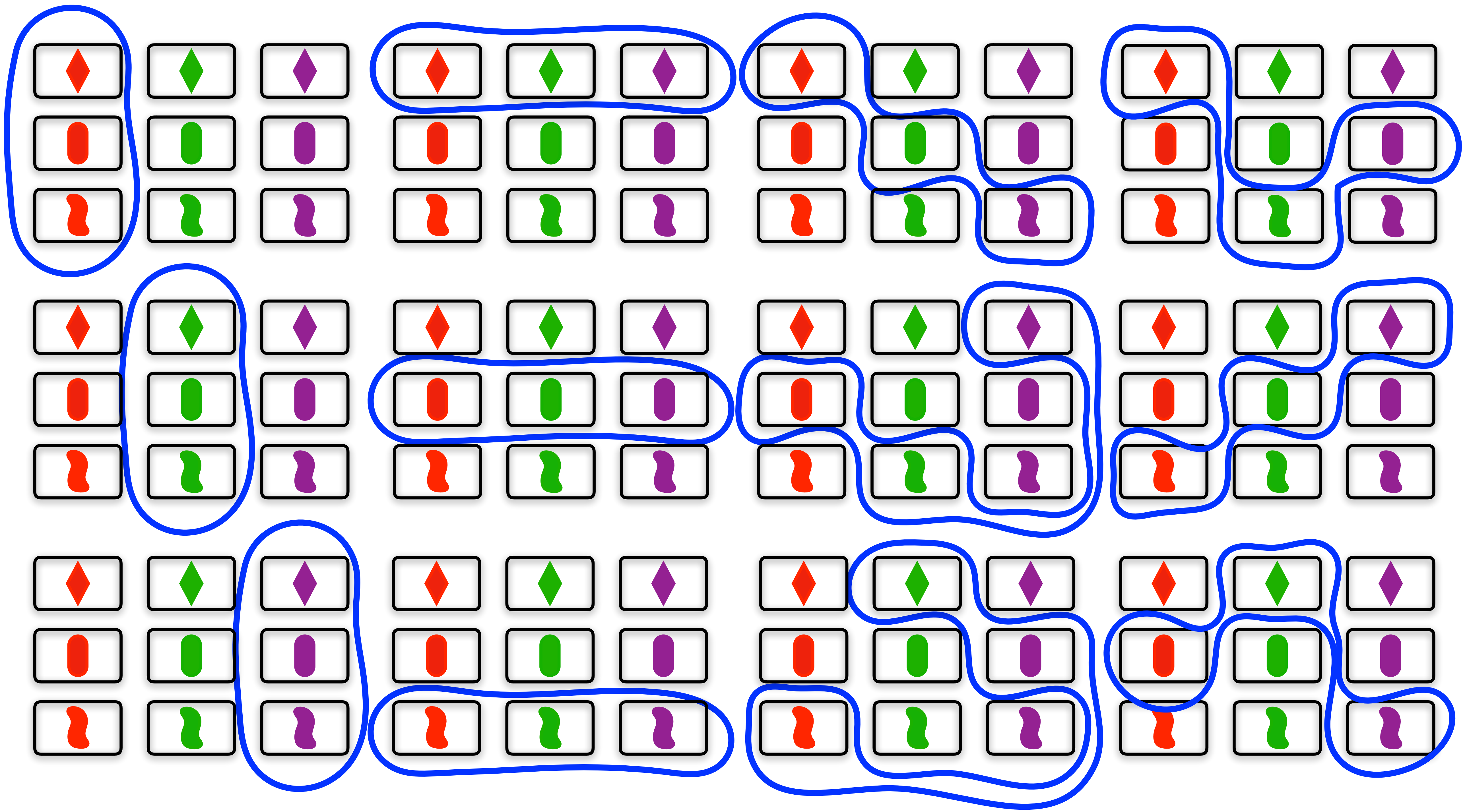
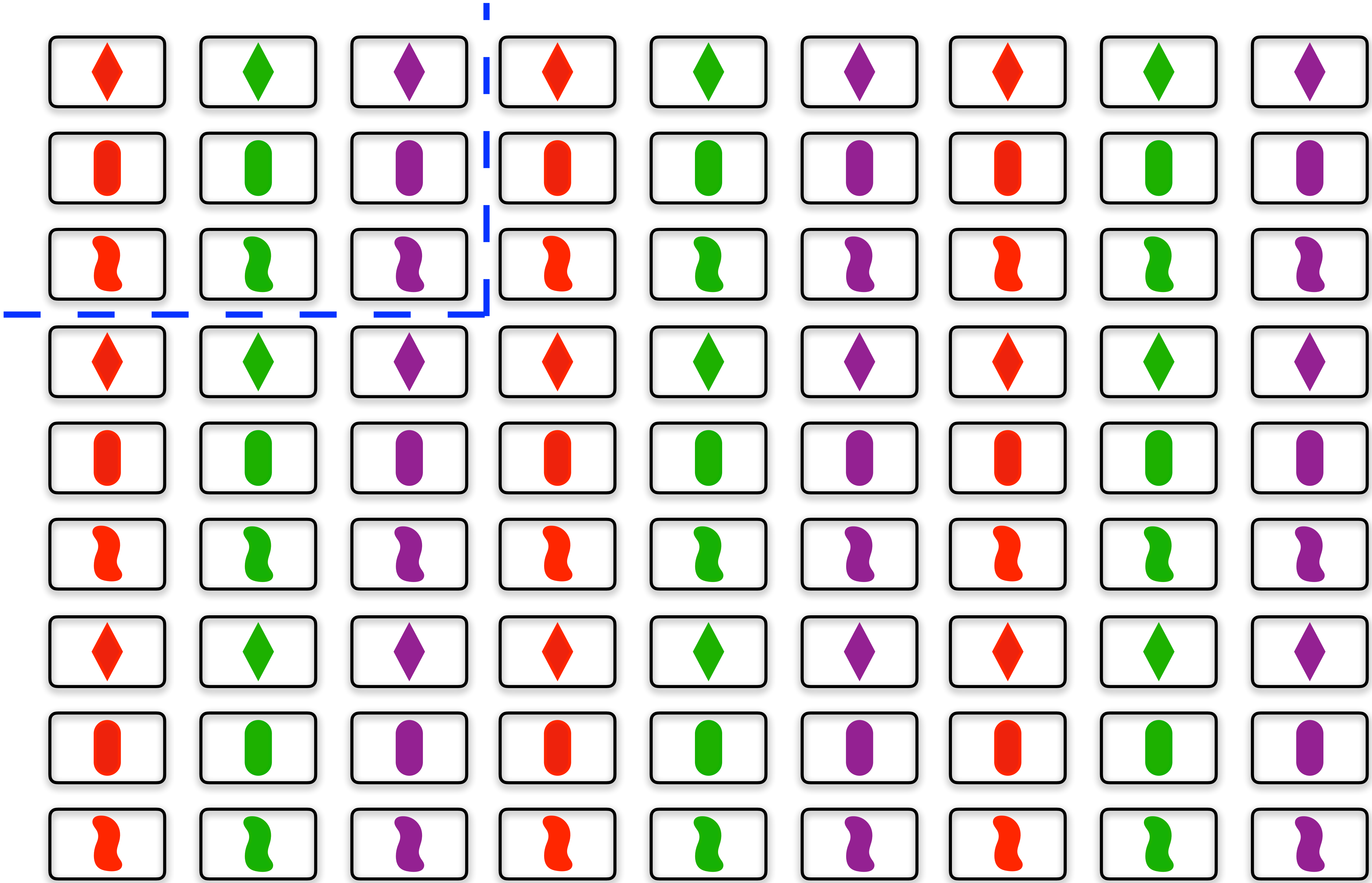


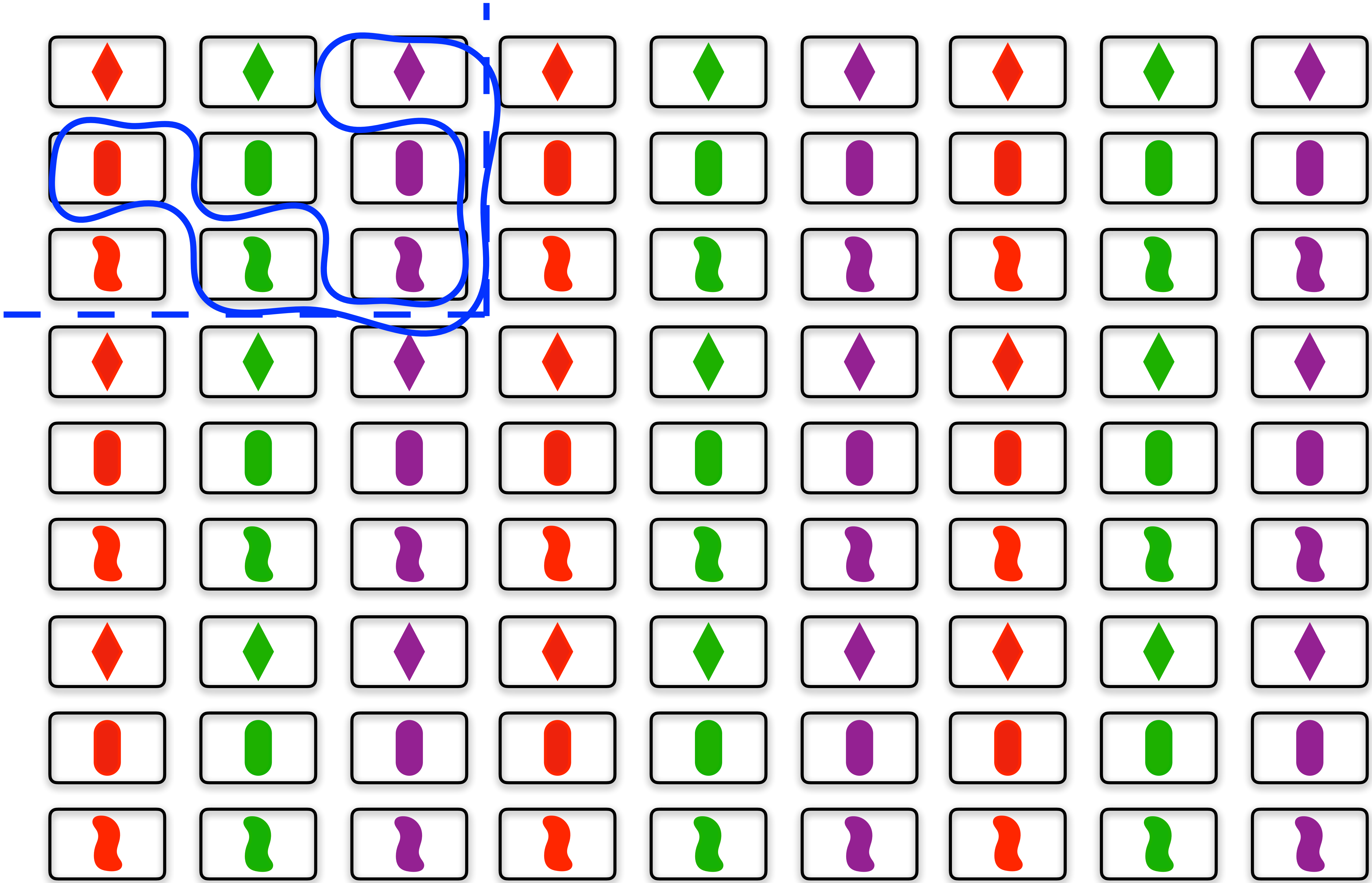


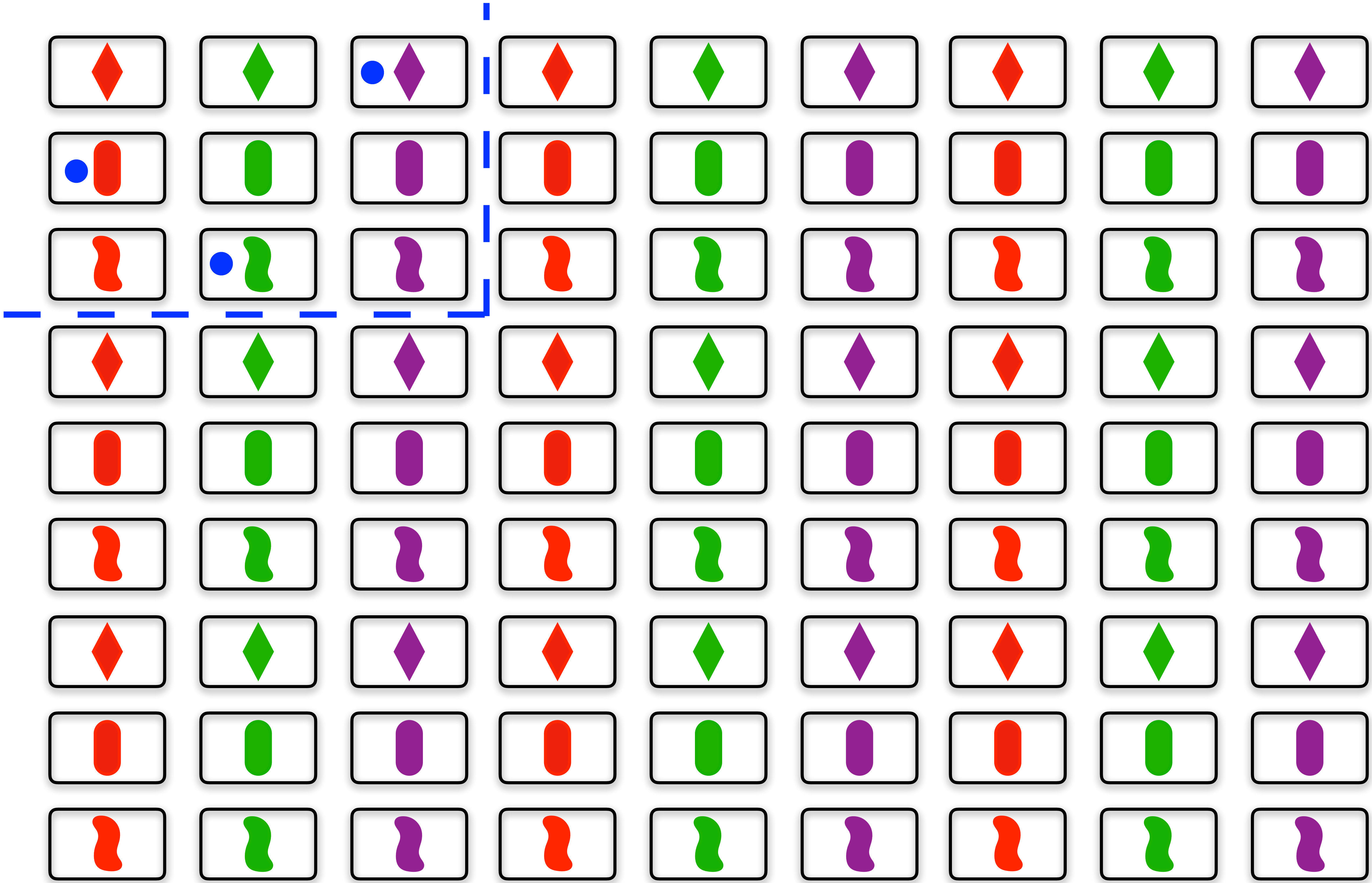
Are there more?

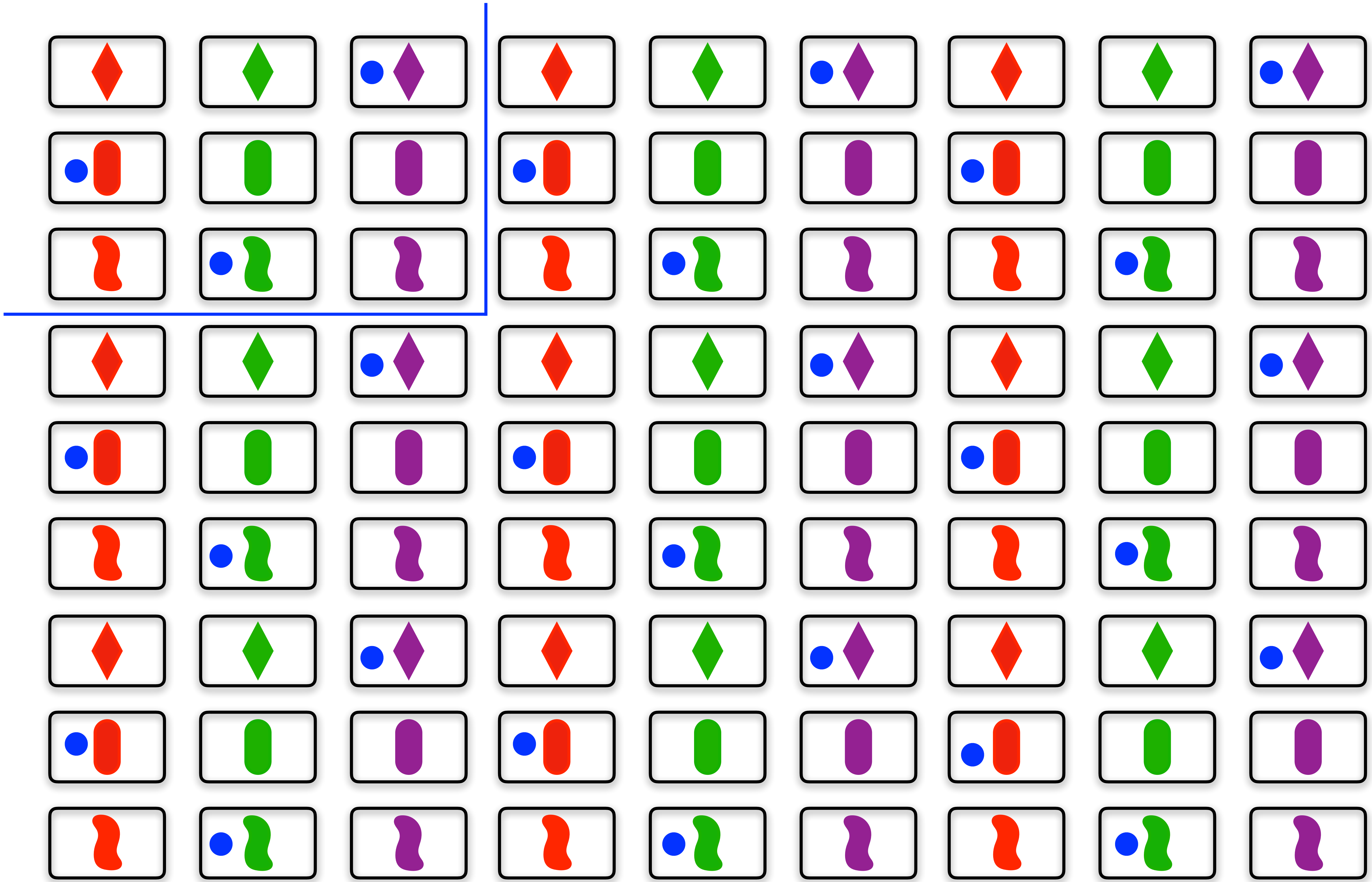
What are the possible SETs?

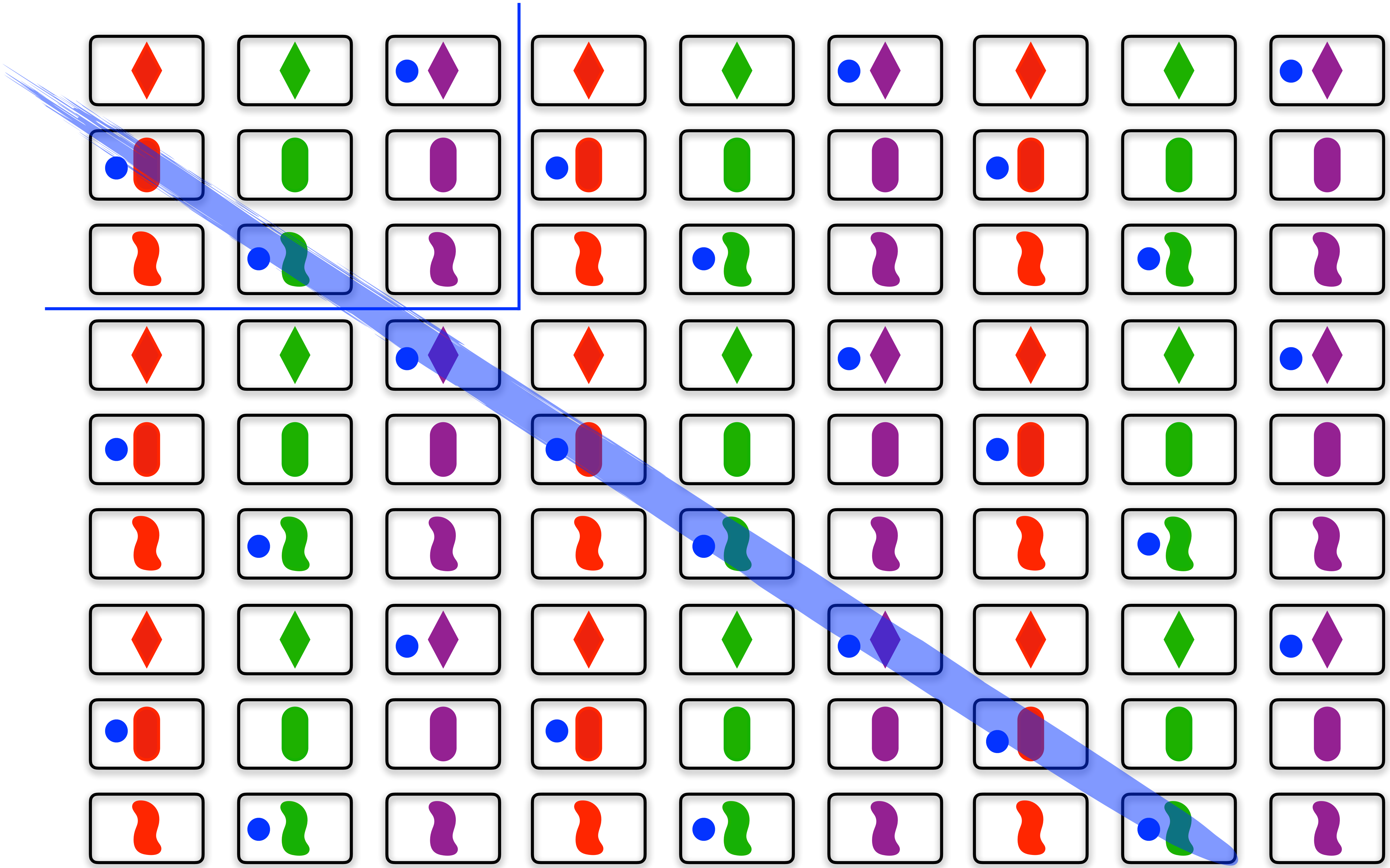












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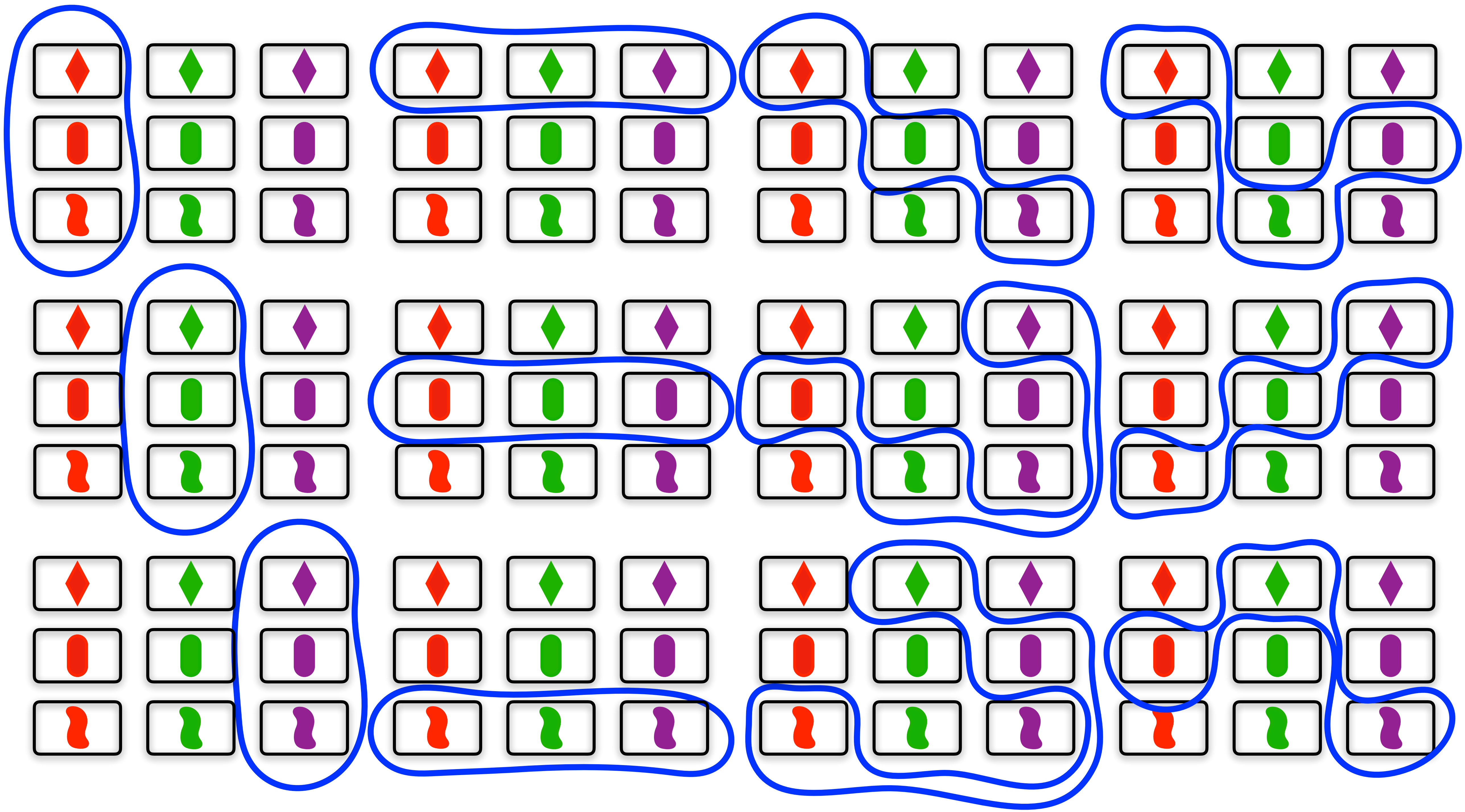

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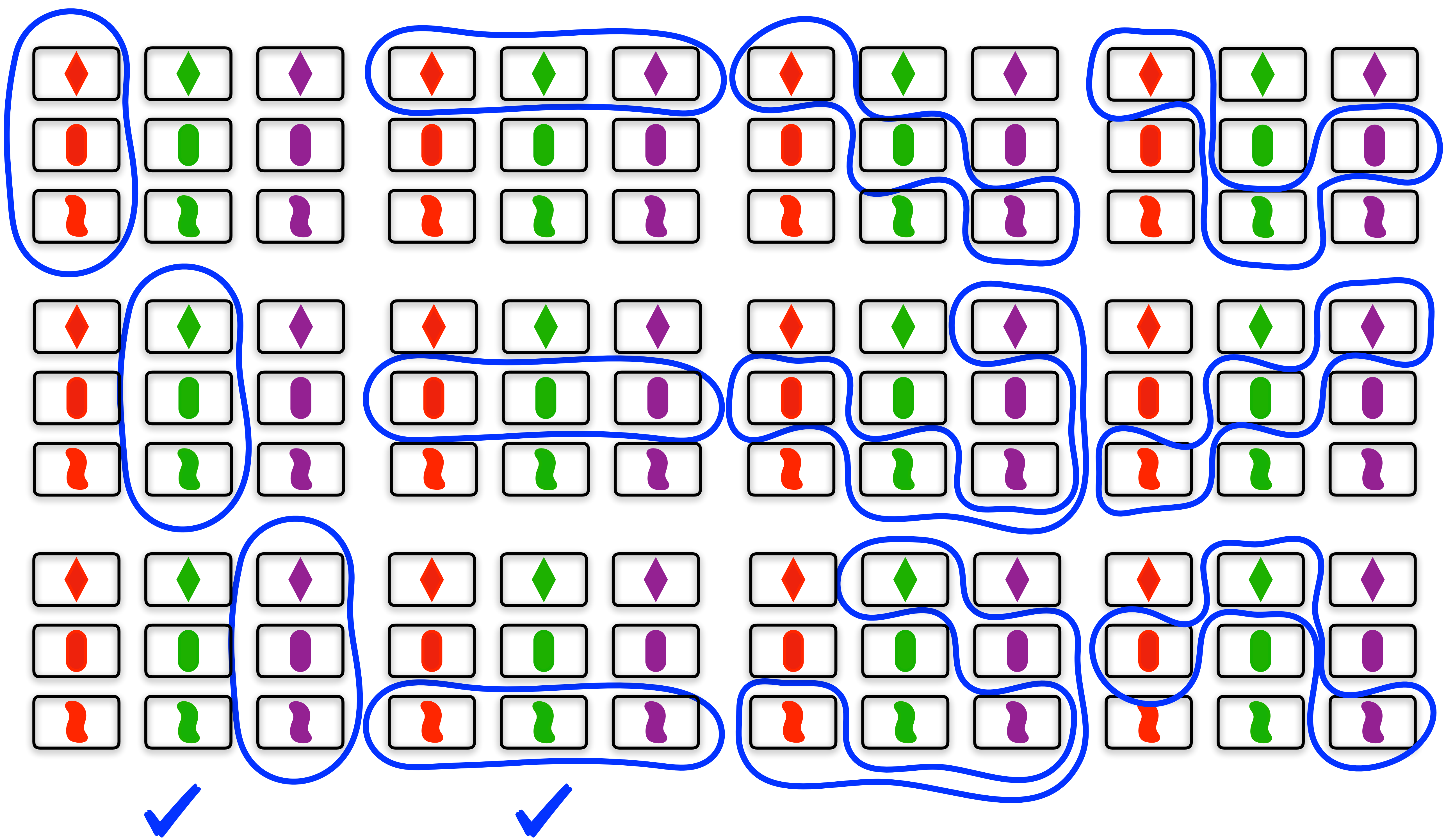

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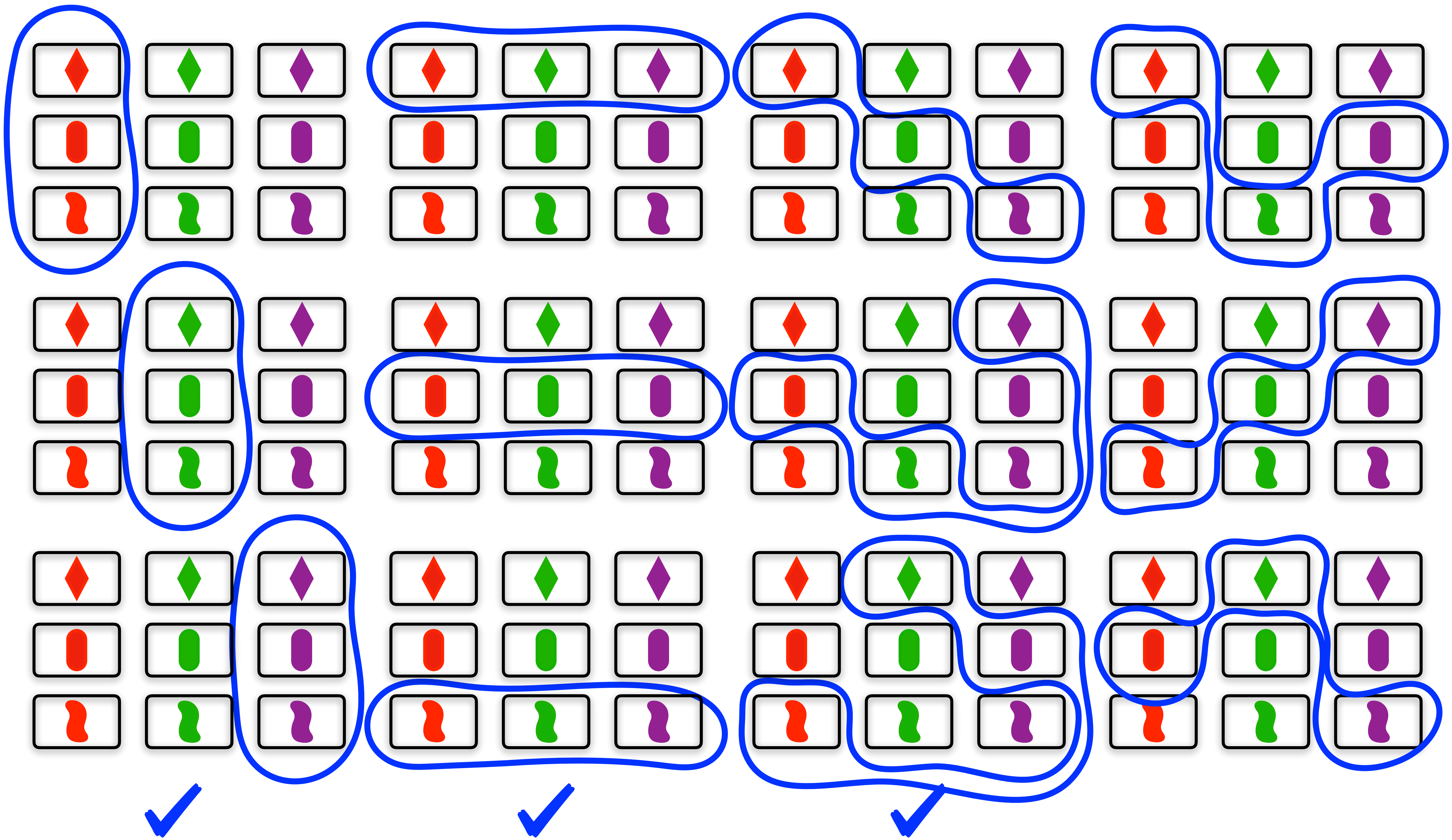

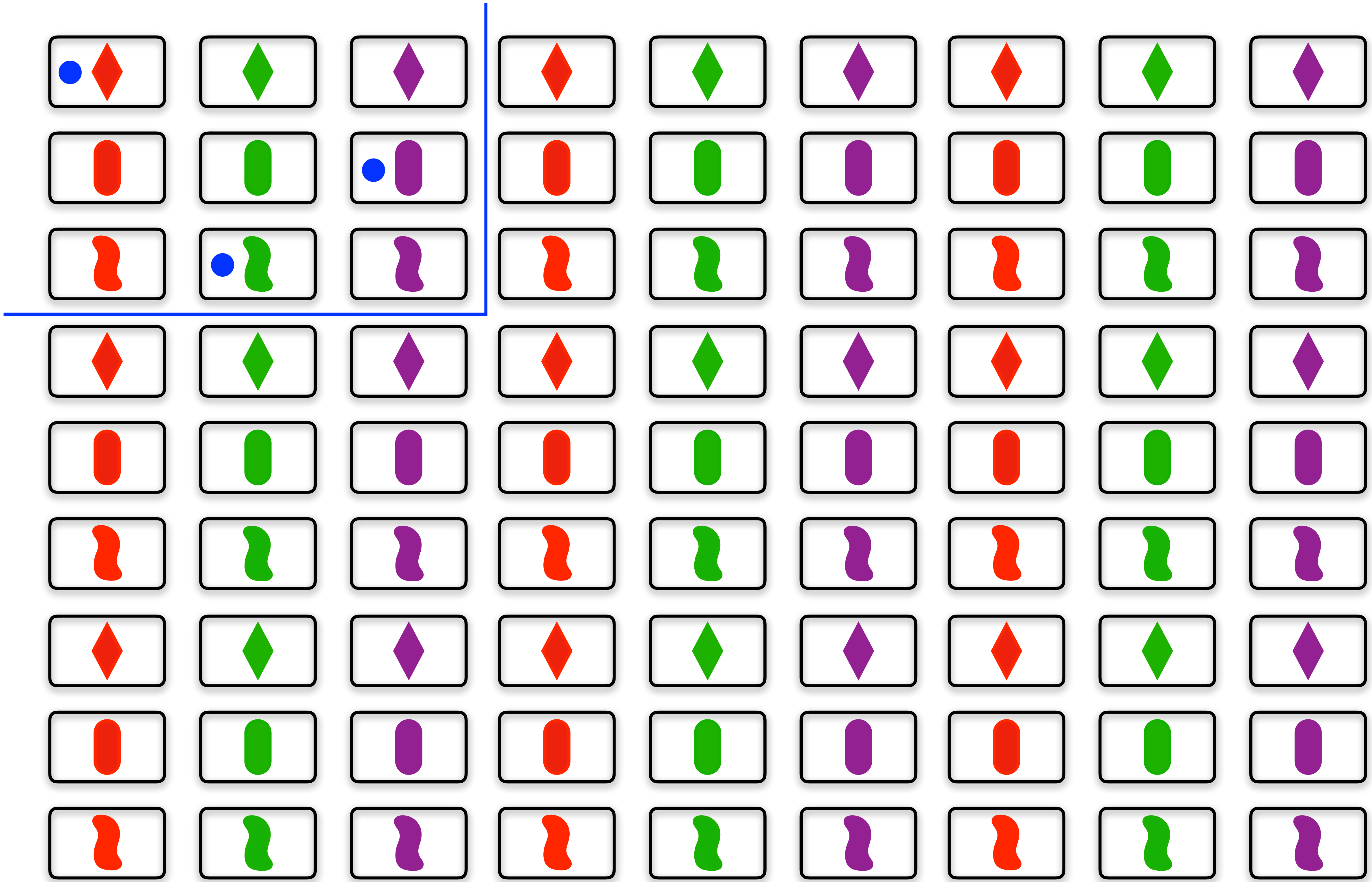

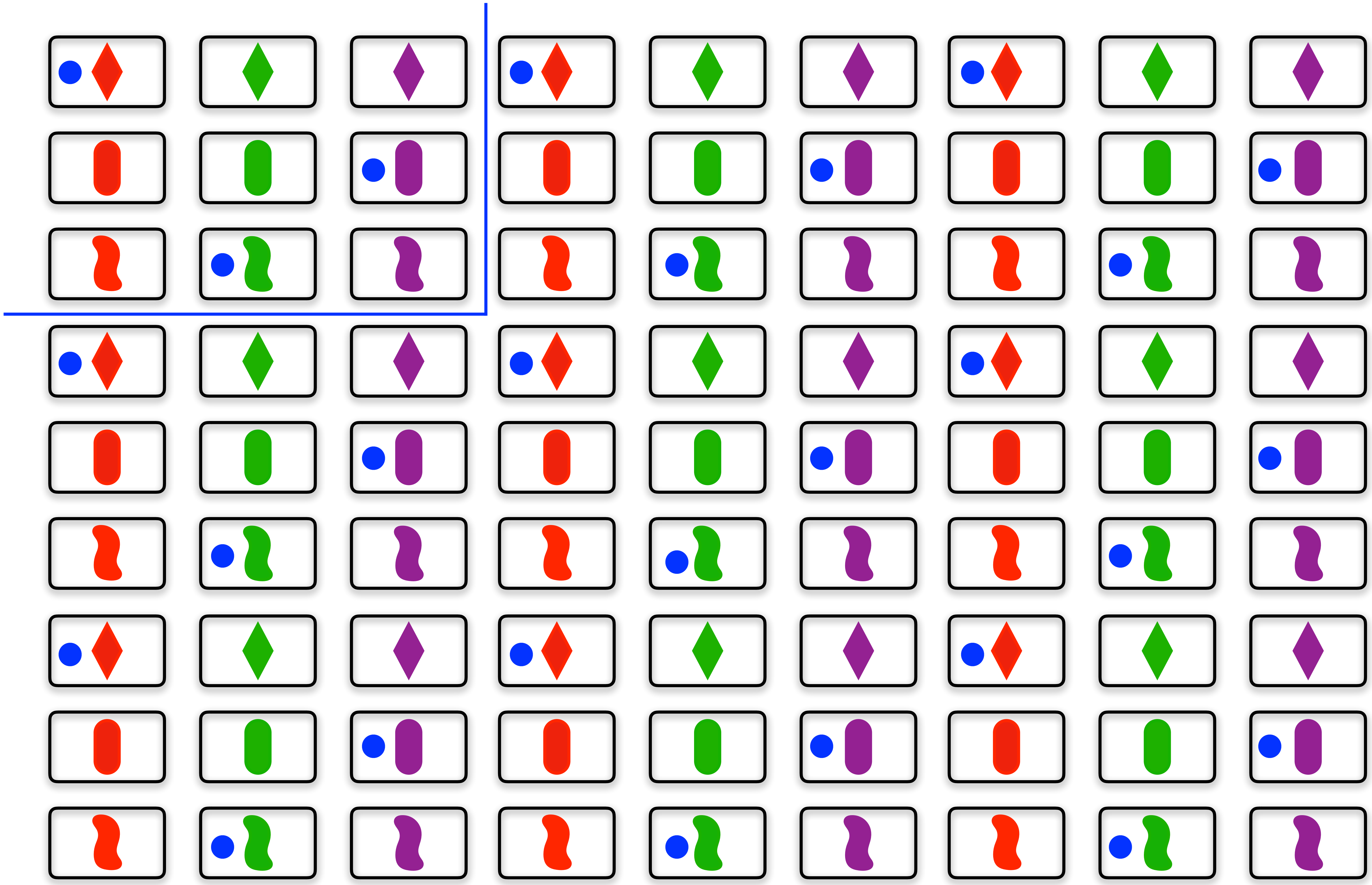

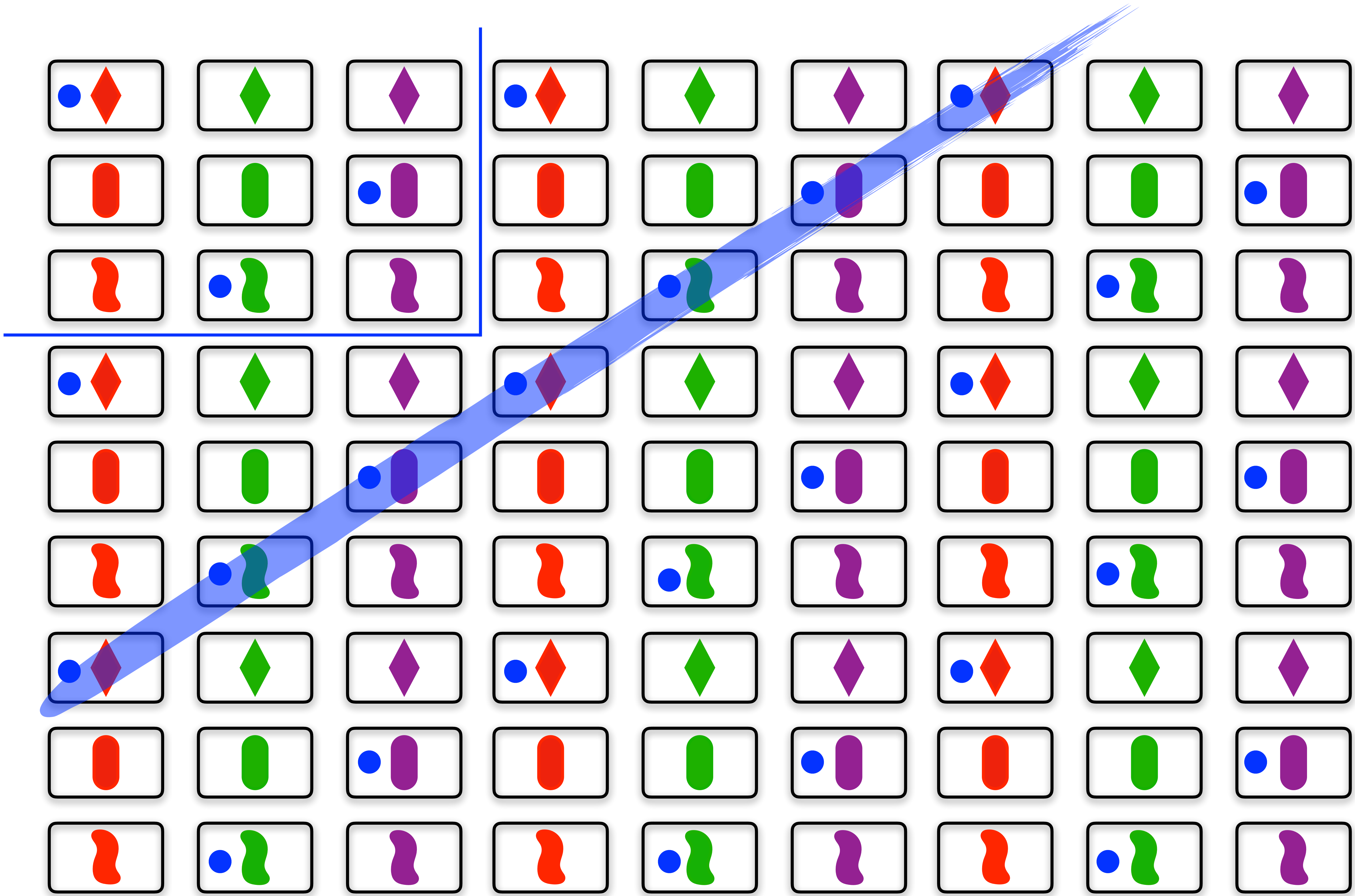

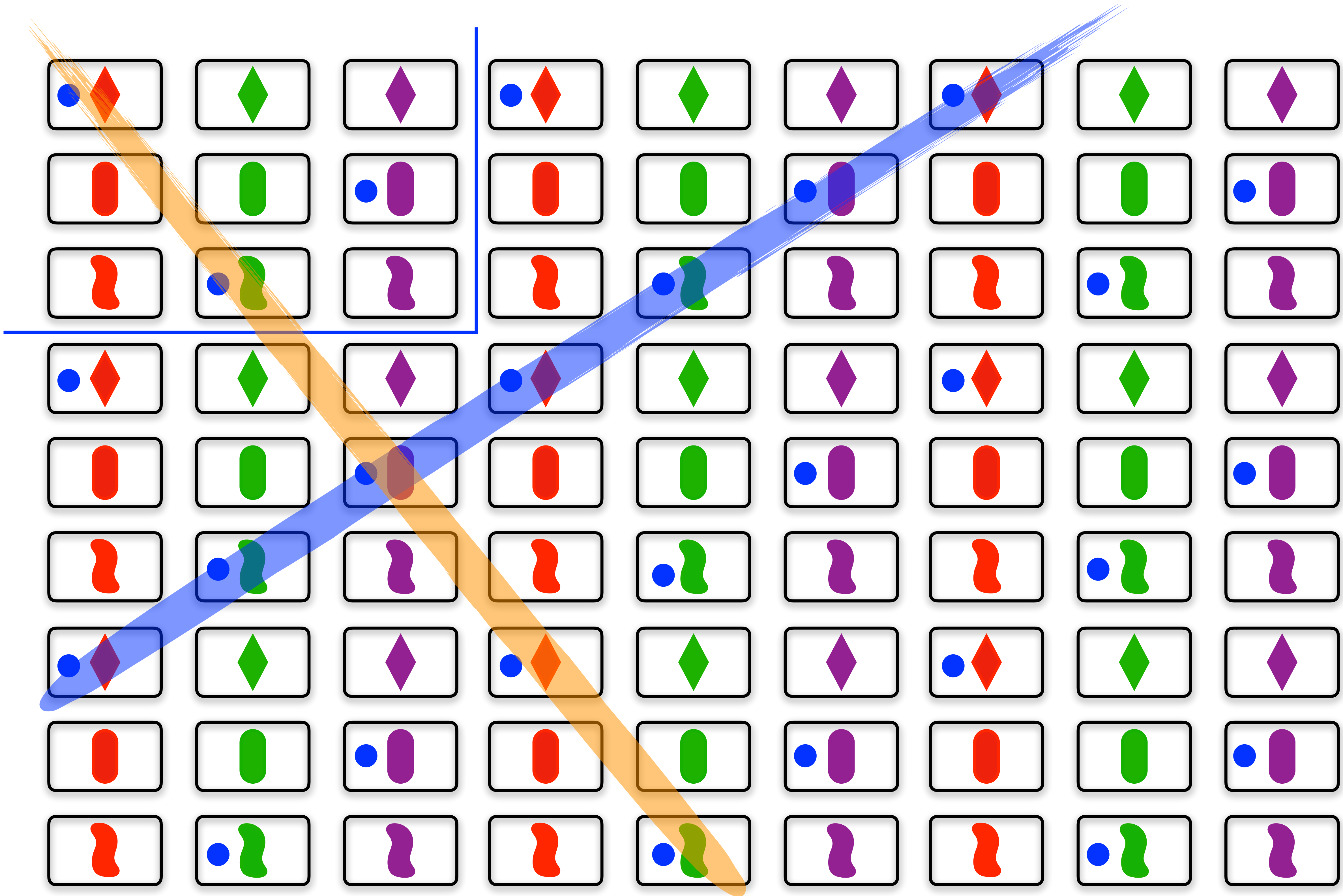

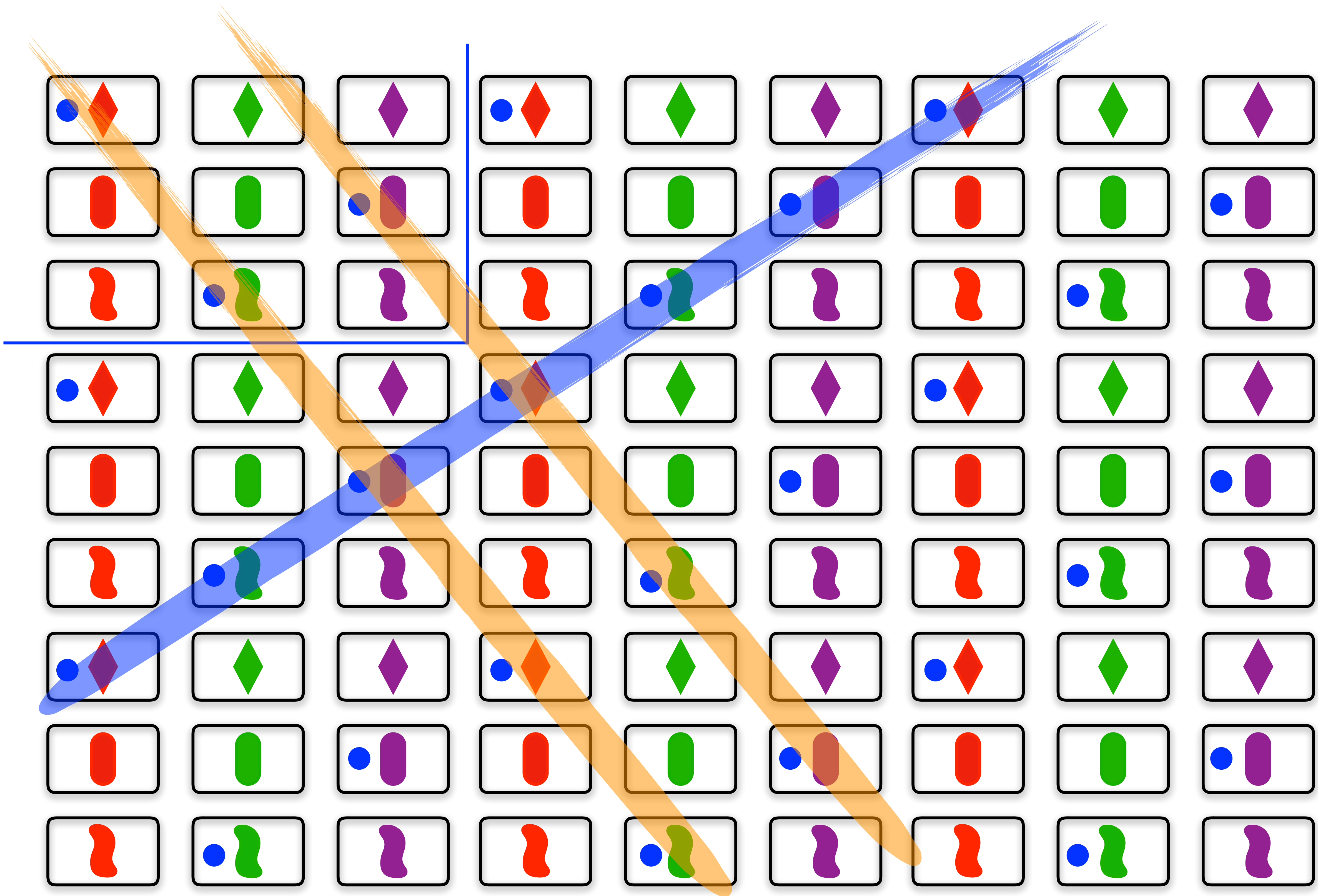

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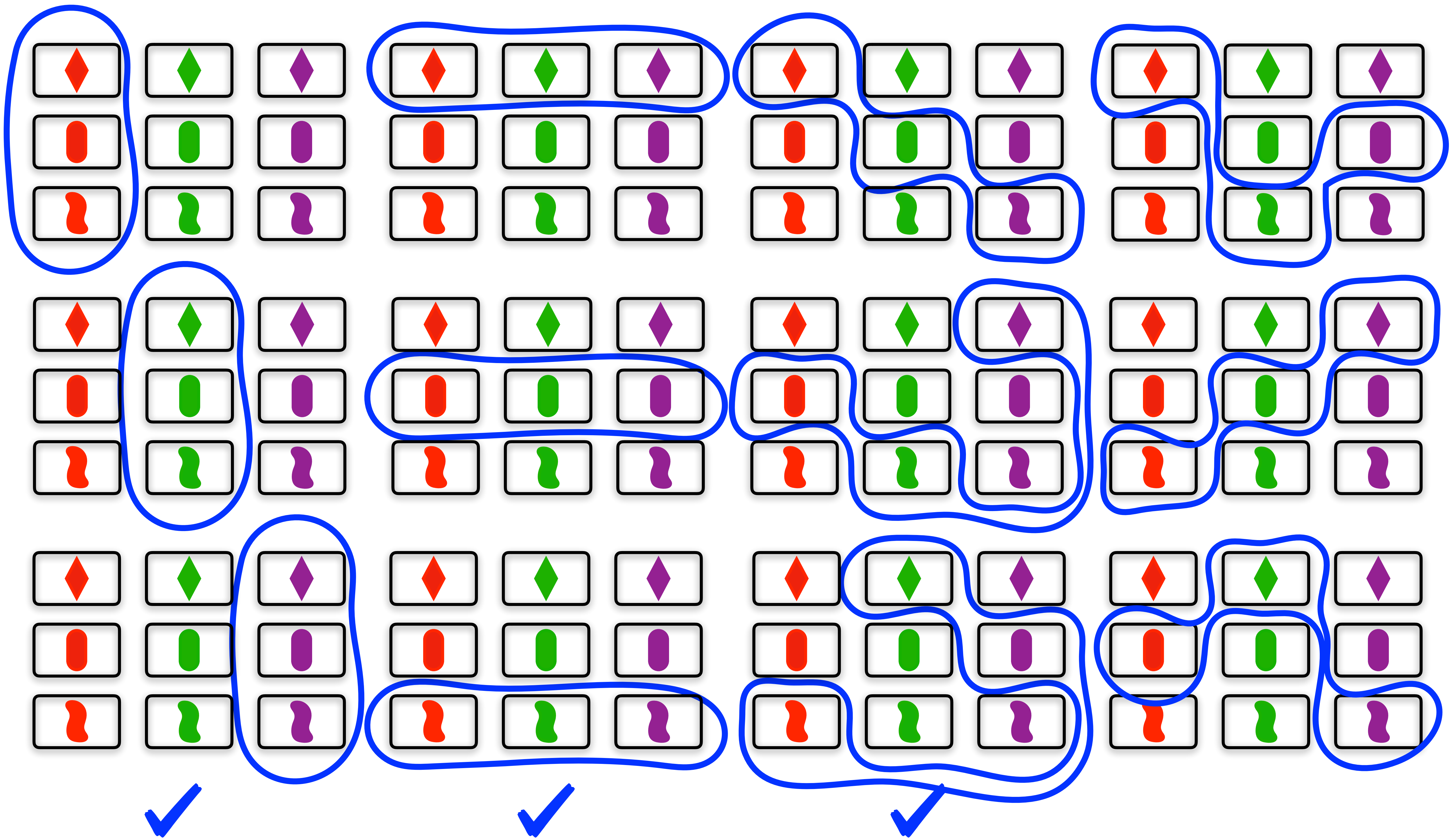

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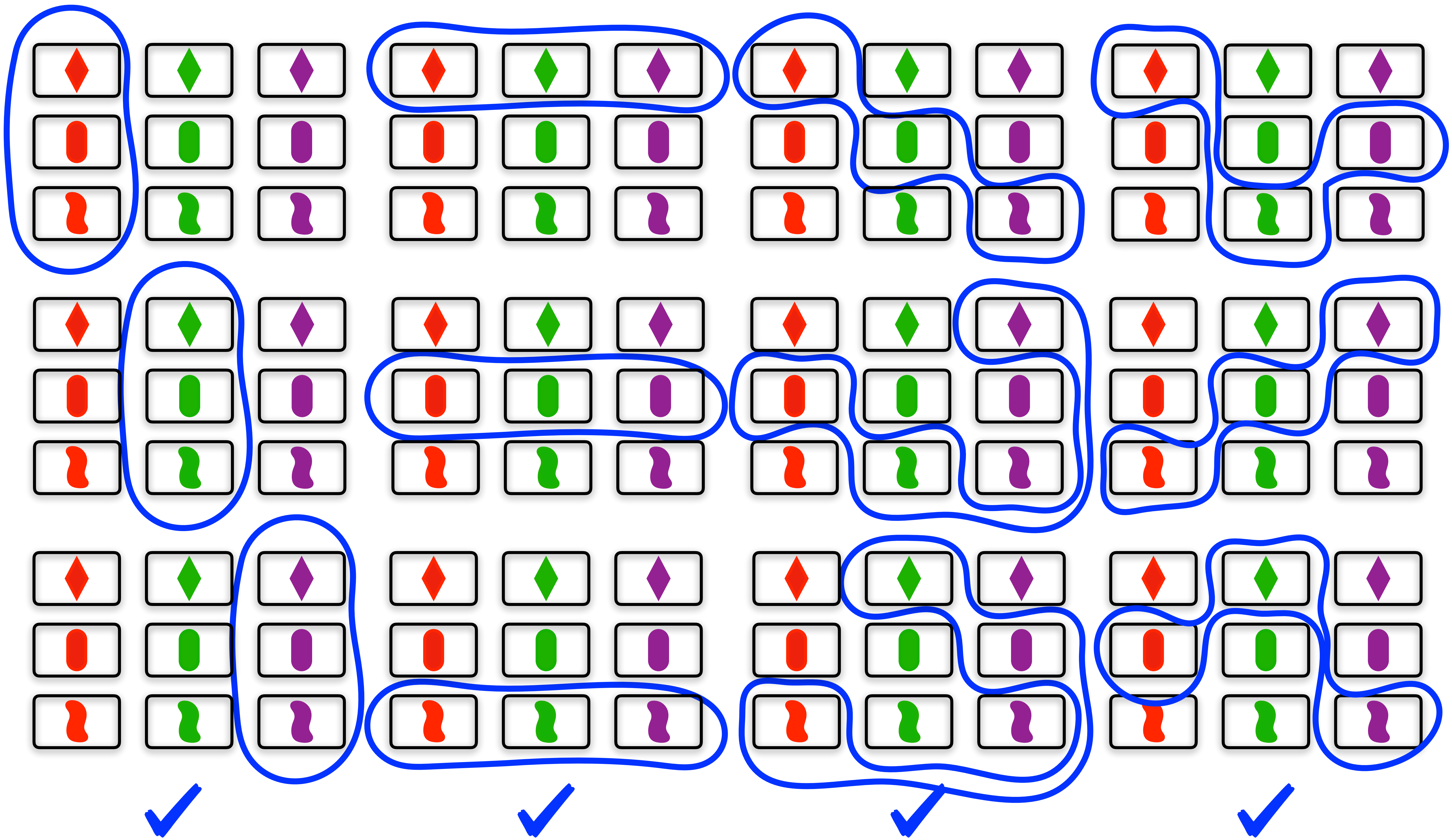
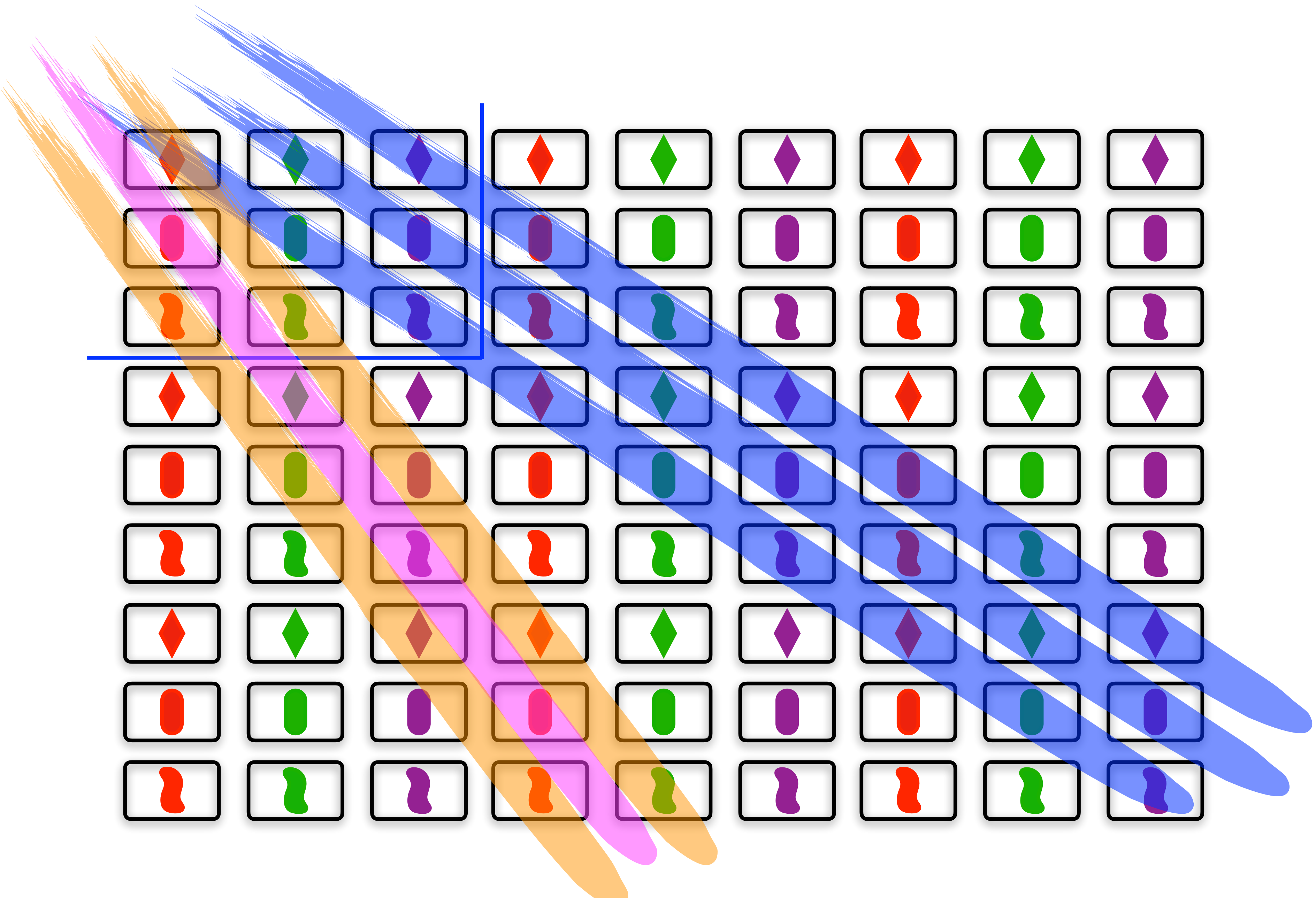


We observed that SETs lie on lines!



Is this a real thing?!?

Is this a real thing?!?

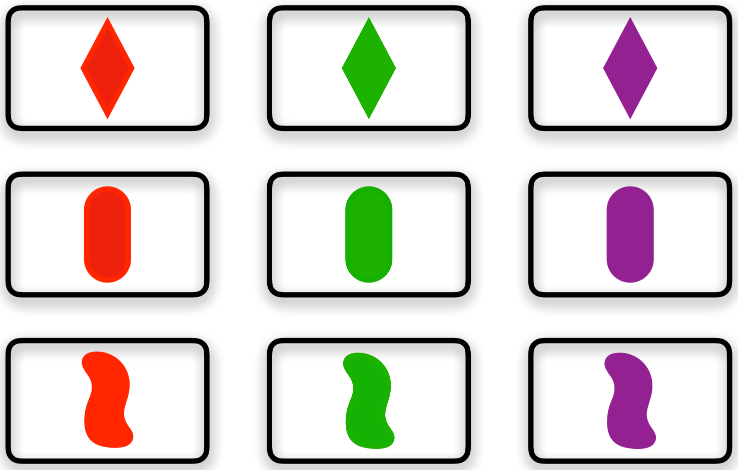
Why can we just repeat the grid like that?

Is this a real thing?!?

Why can we just repeat the grid like that?

Does every SET have to lie on a line? Or is it just the ones that we found?

Why can we just repeat the grid like that?



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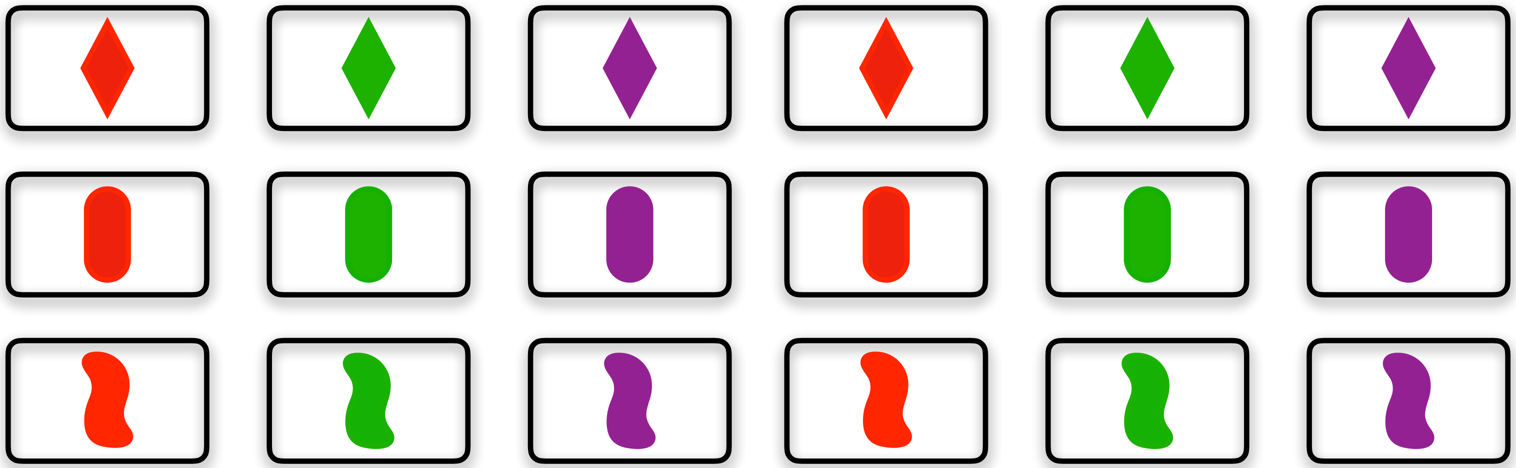

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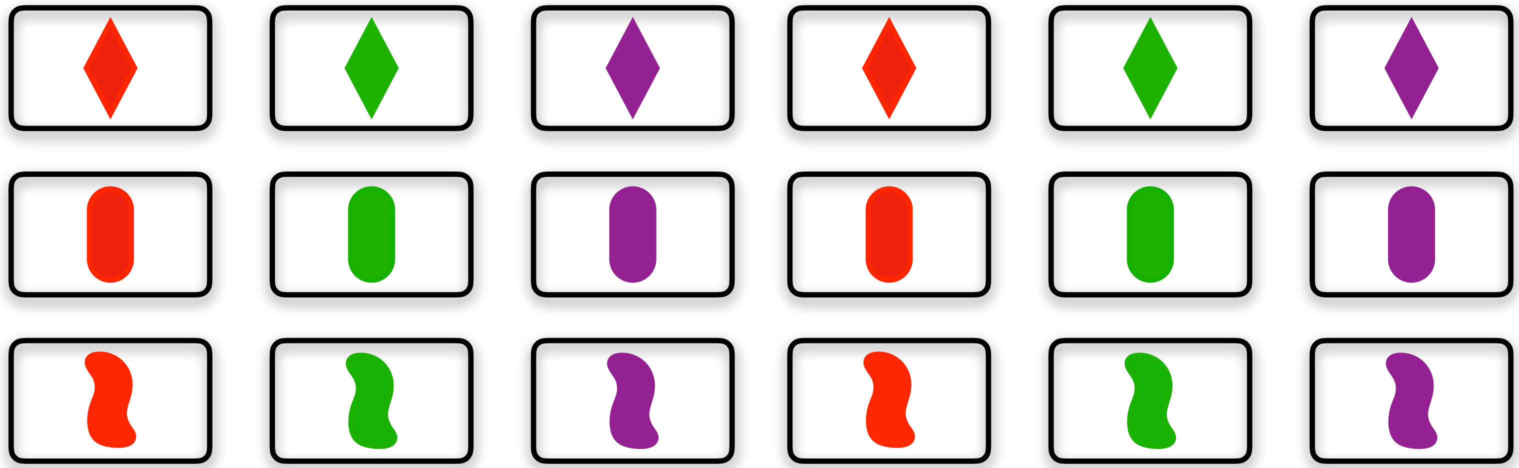

Why can we just repeat the grid like that?

14 is the same as 2

26 is the same as 2

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This is called working ***mod 12***.

We do usual arithmetic, but treat 12 as 0.

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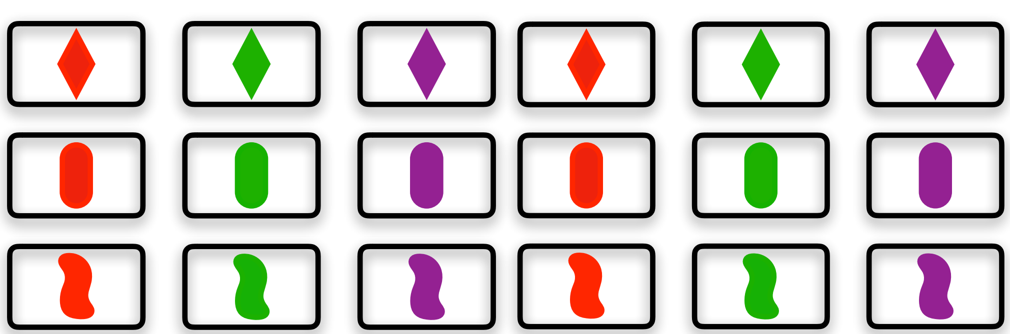

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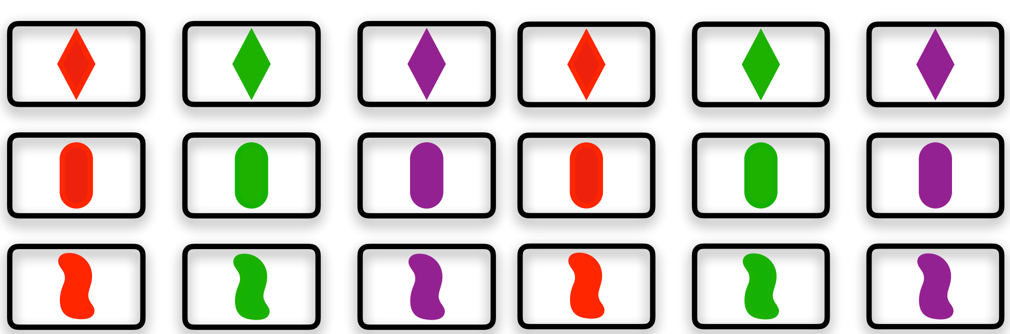

It makes sense to repeat
when we work ***mod 3***!

Is this a real thing?!?

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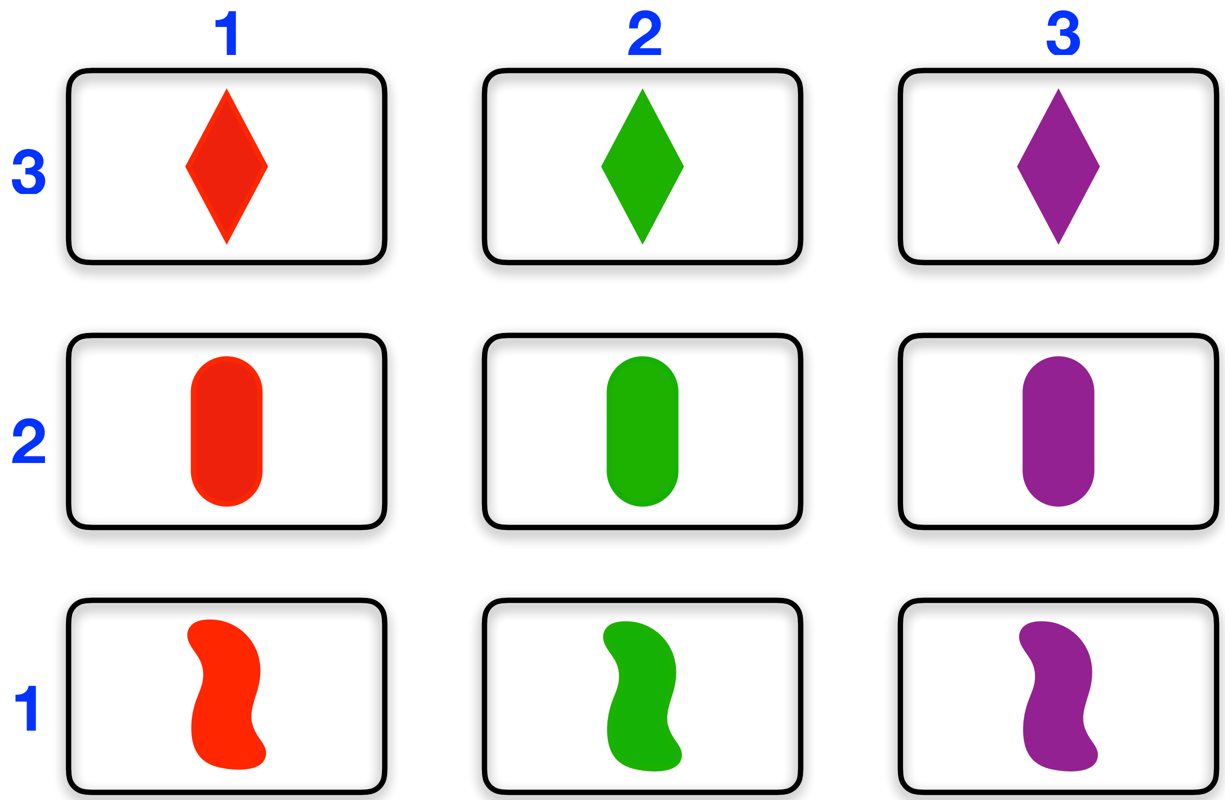

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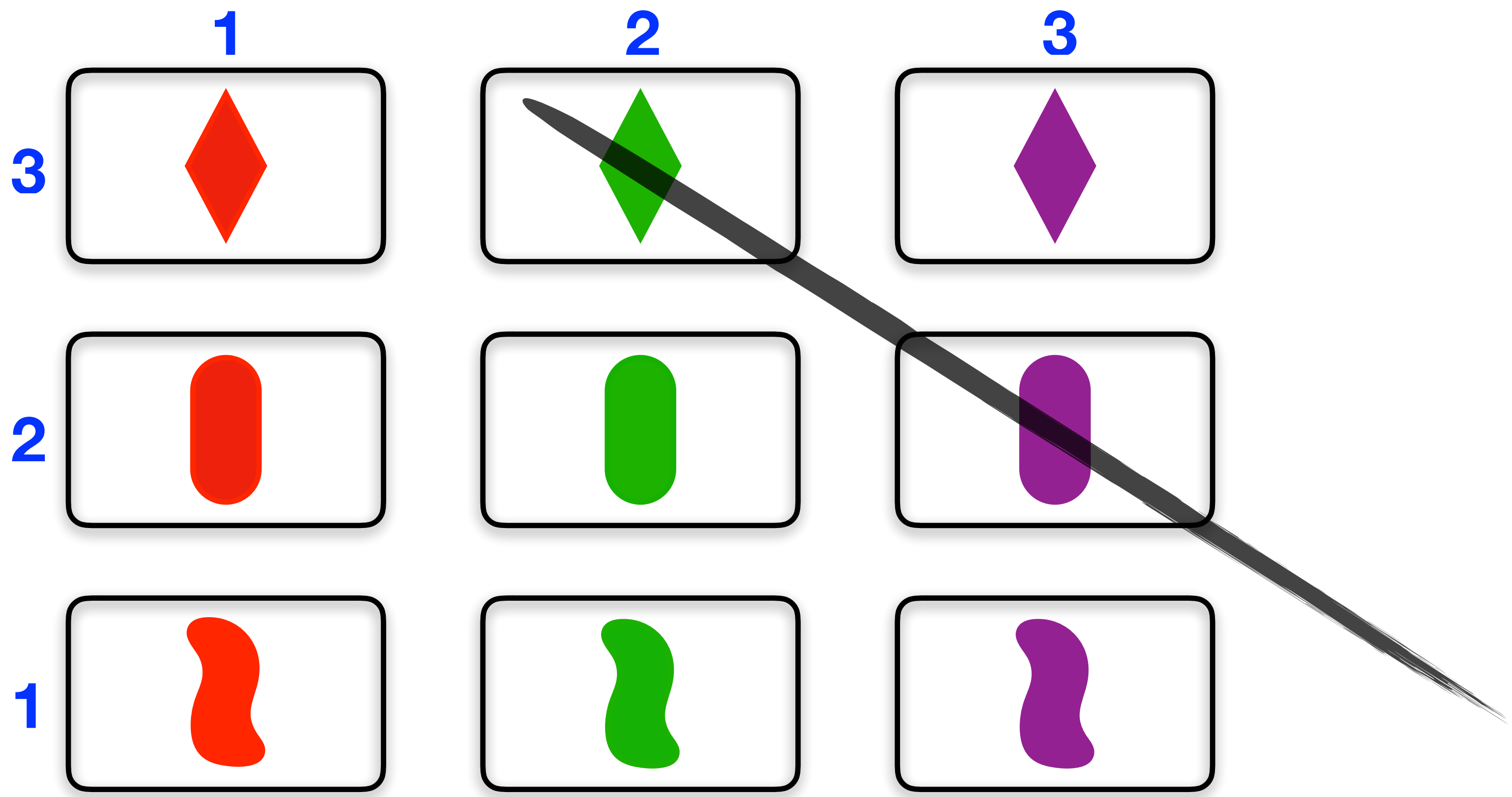

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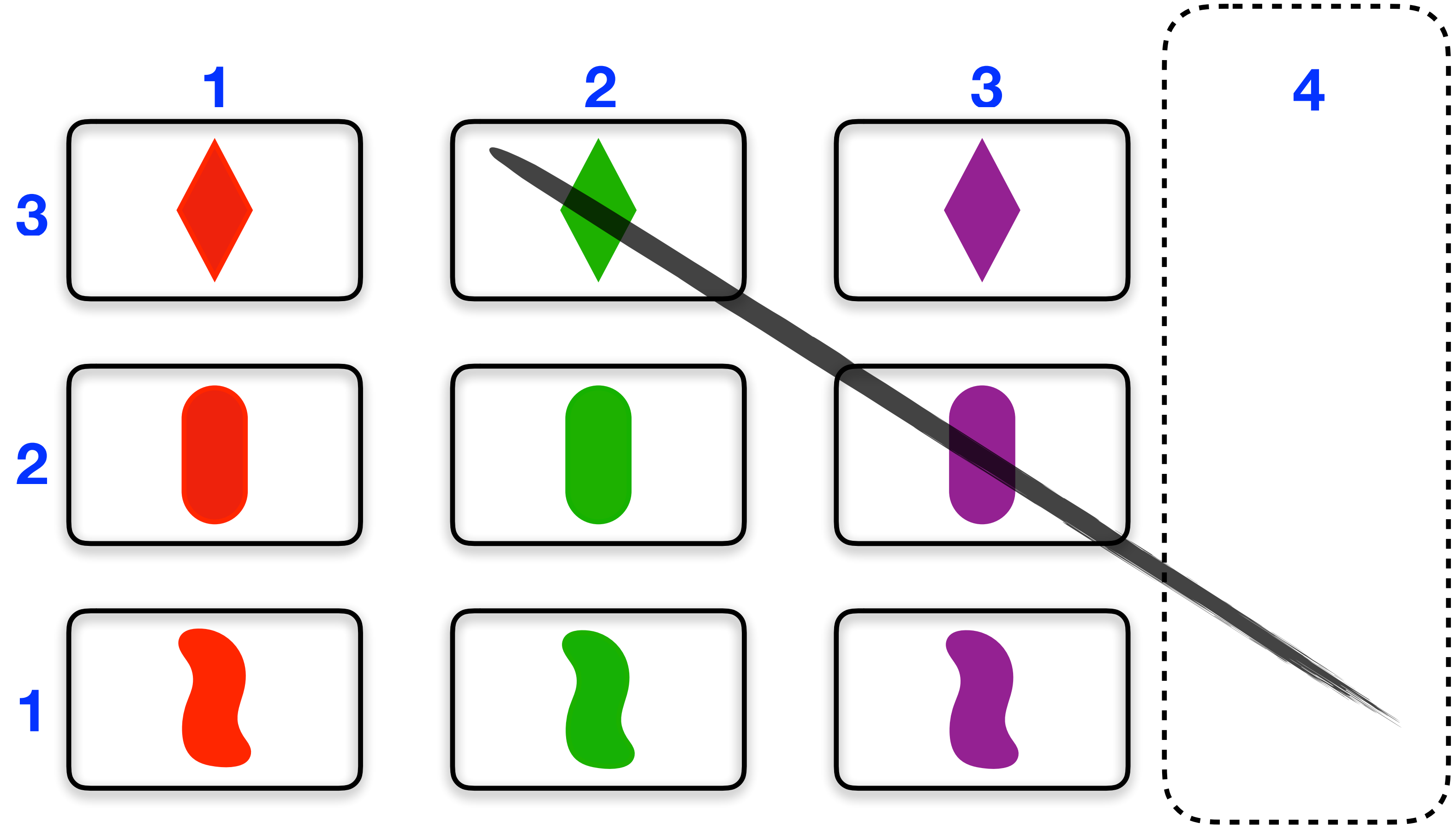

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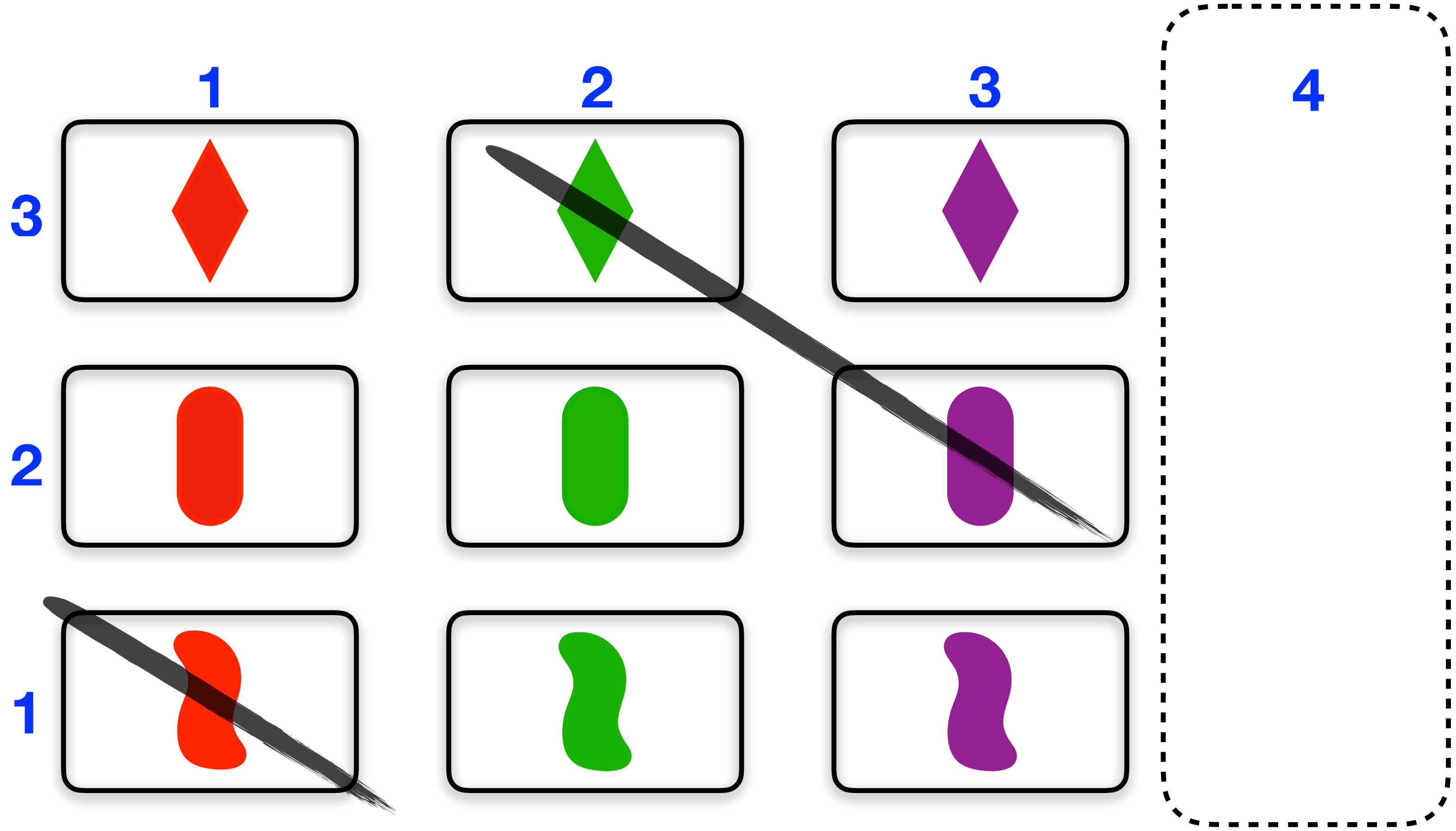

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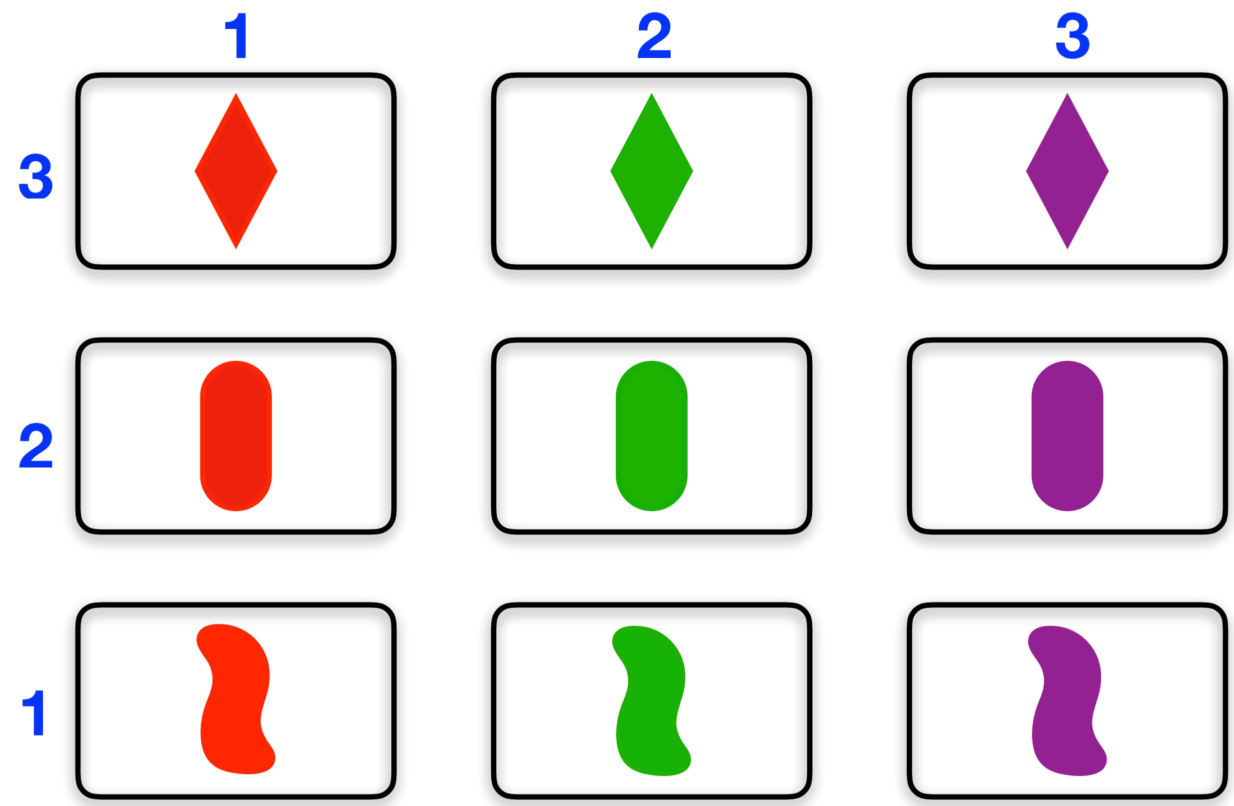

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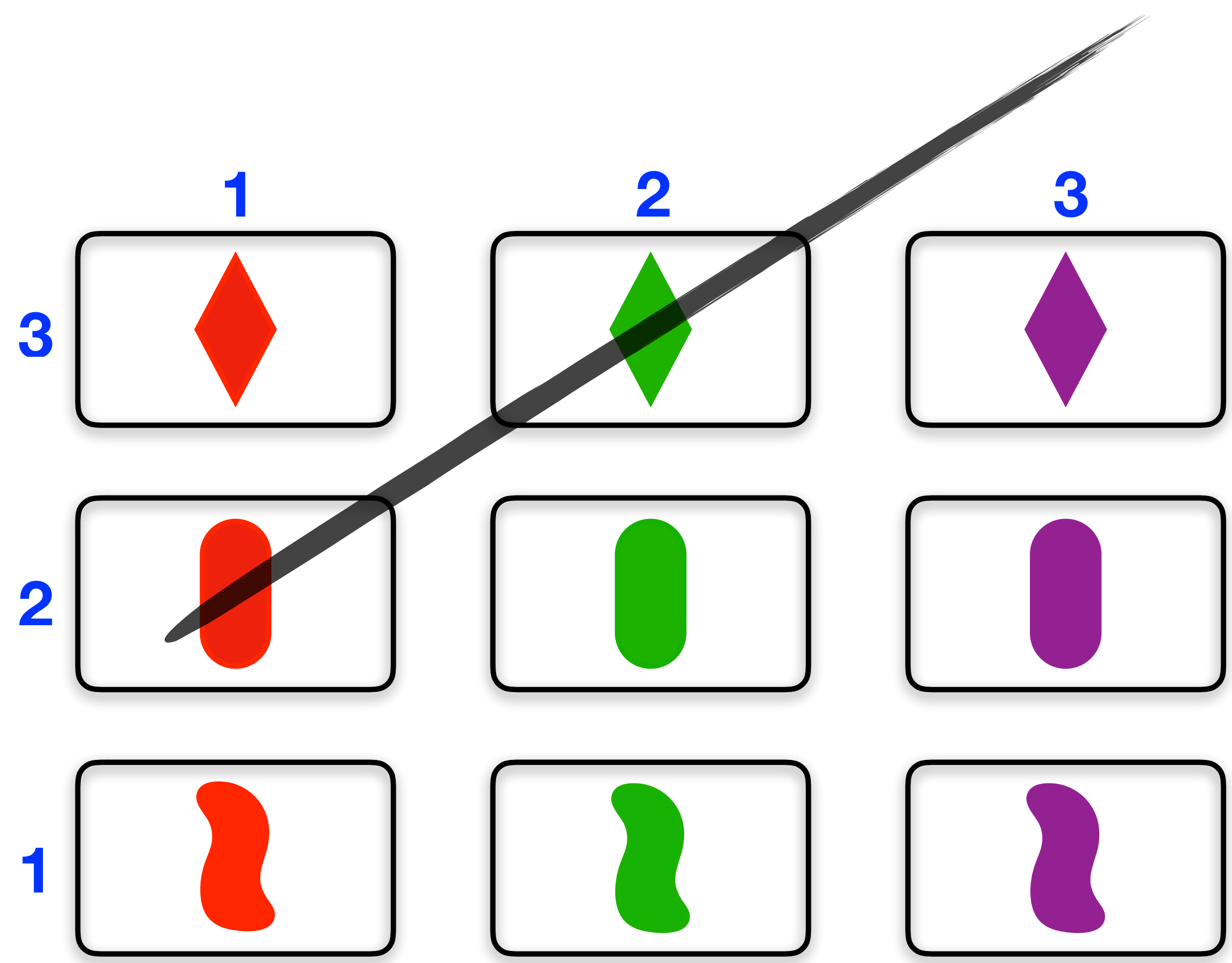

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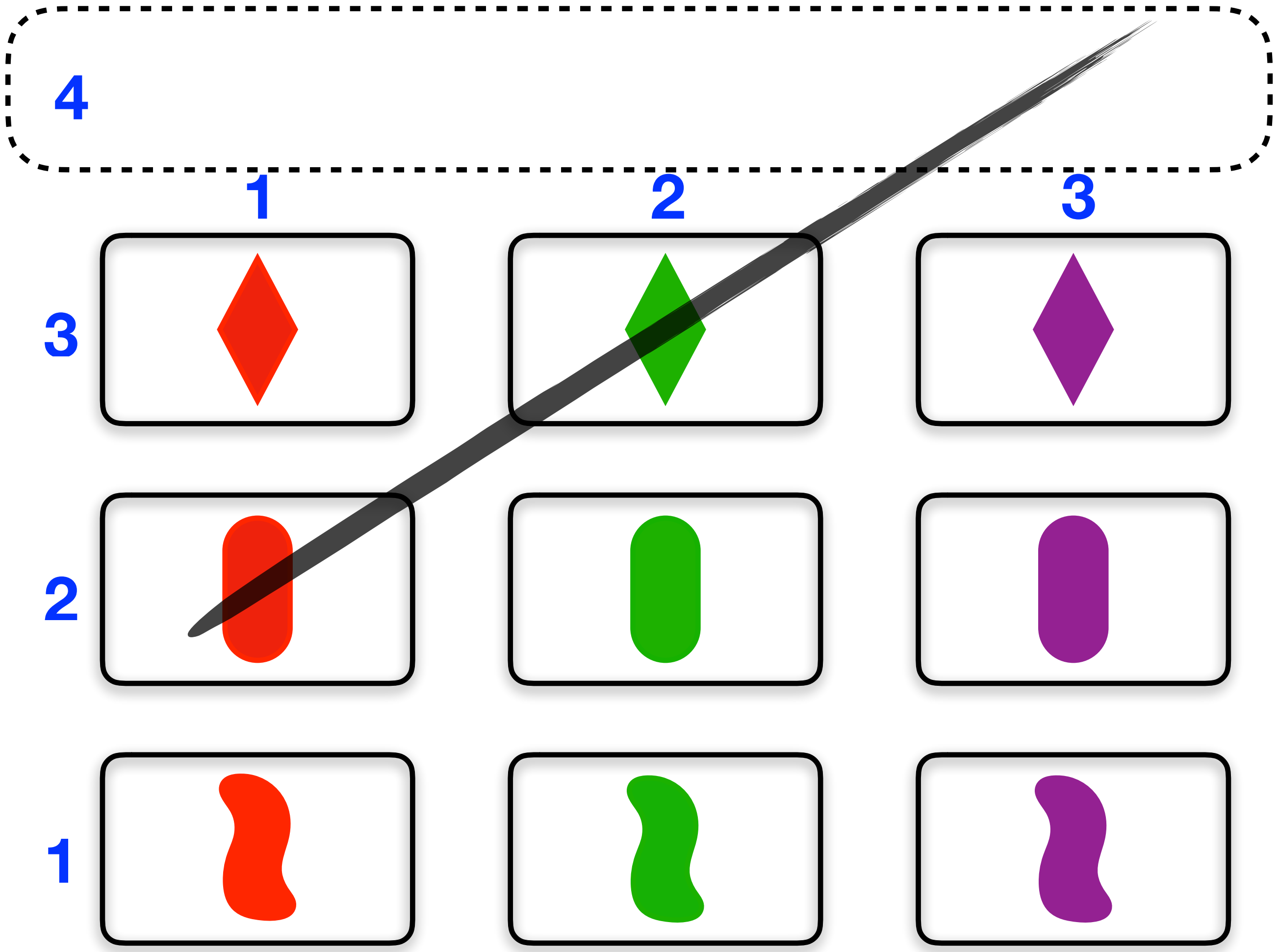

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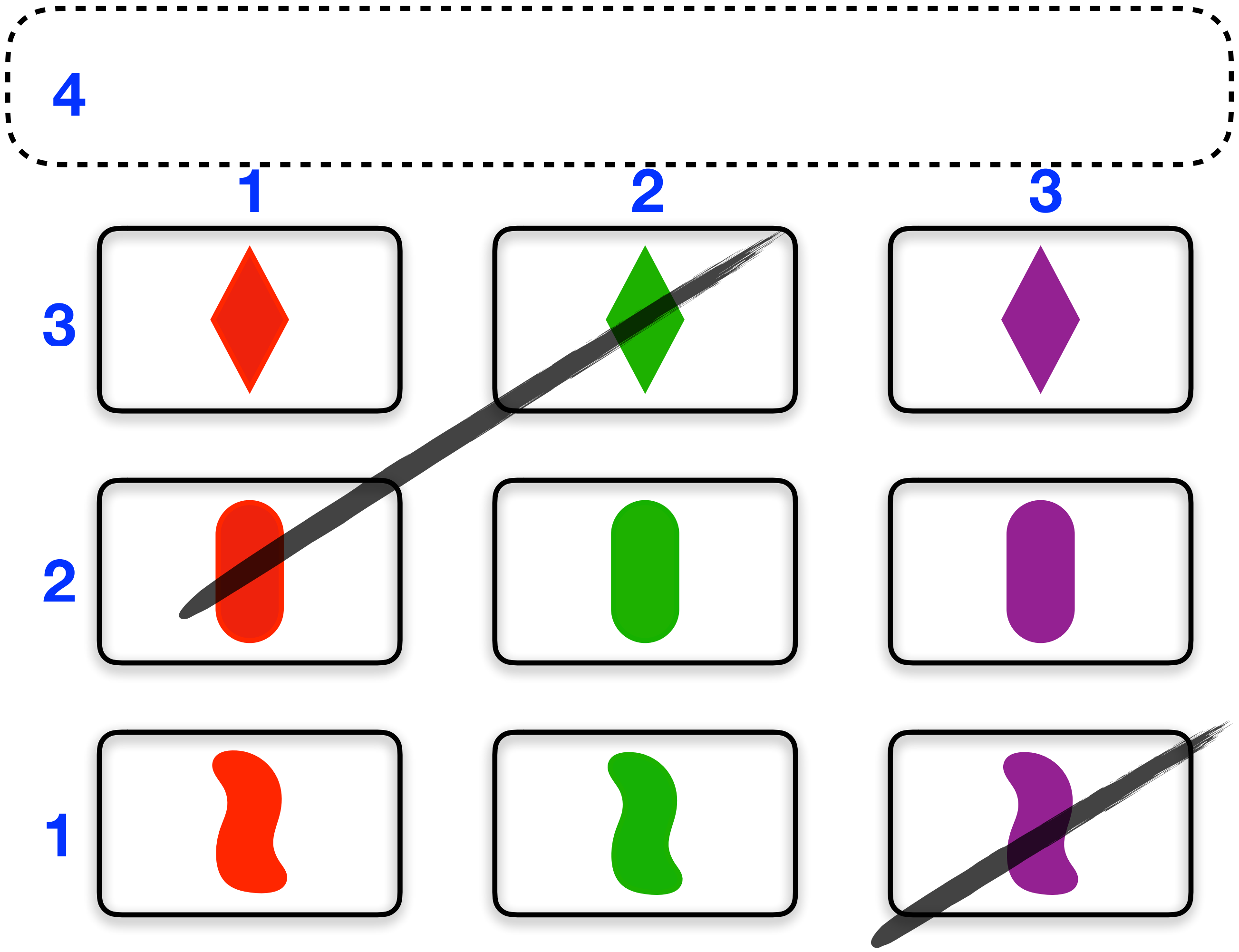

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The only possible slopes are 1, 0, -1, or ∞

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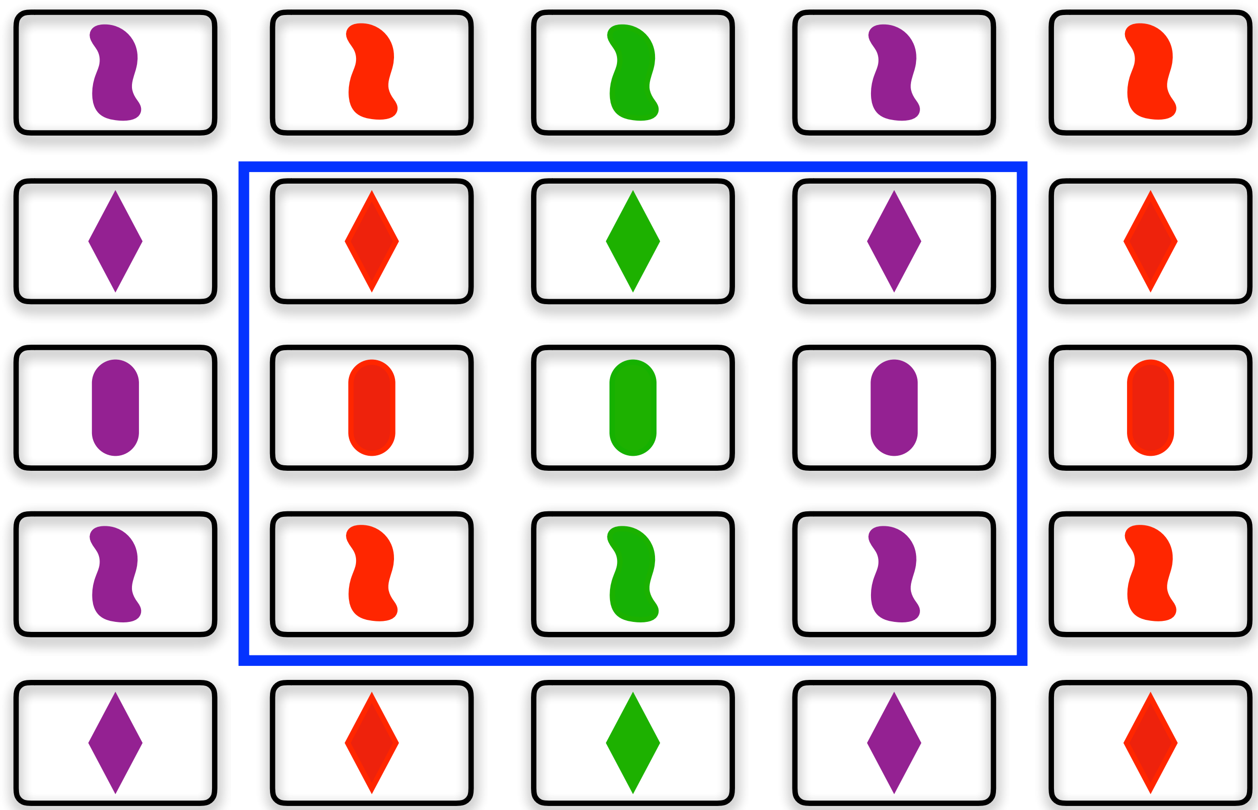

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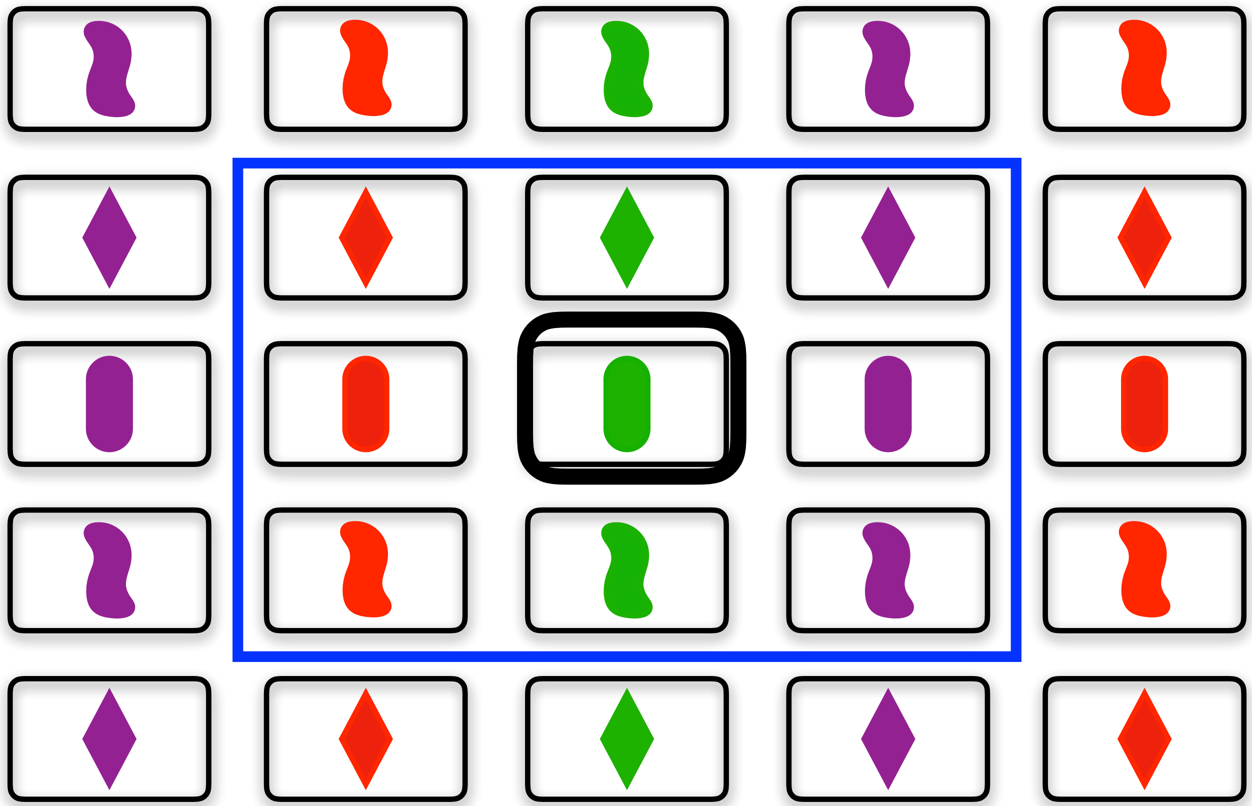

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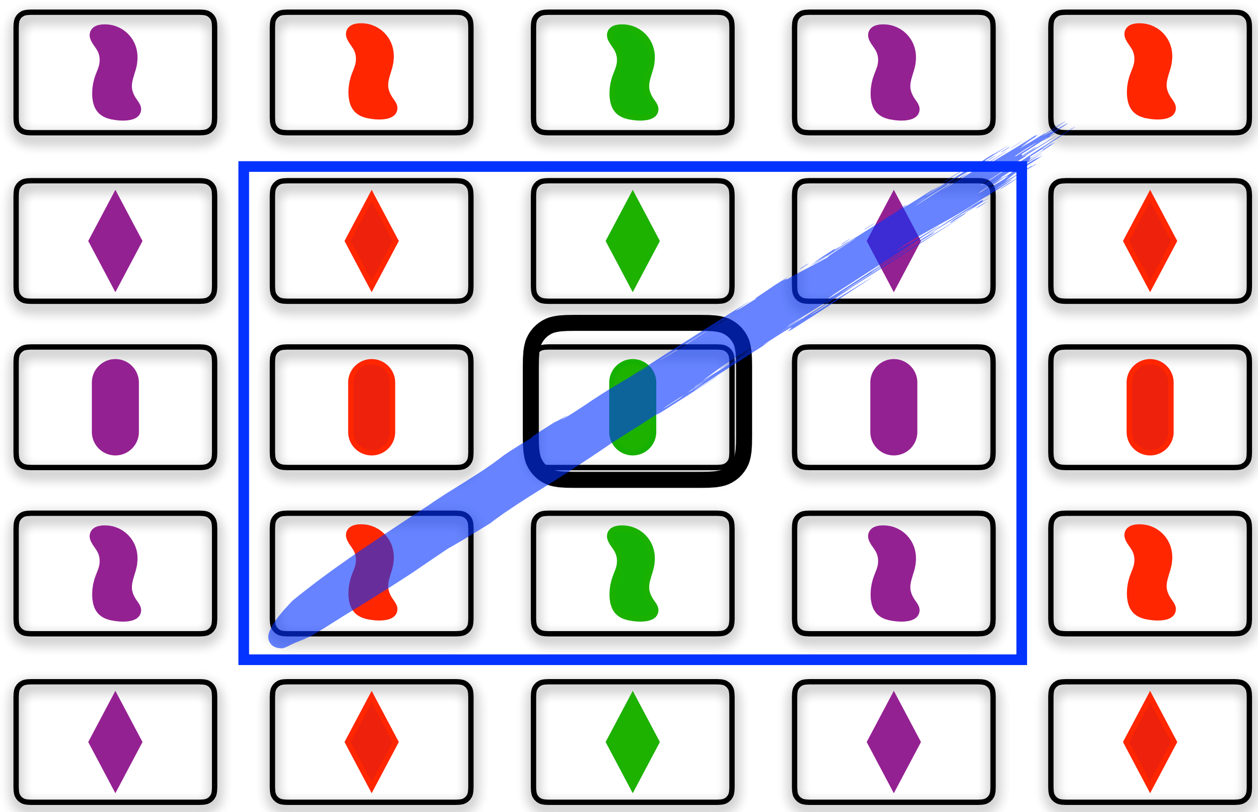

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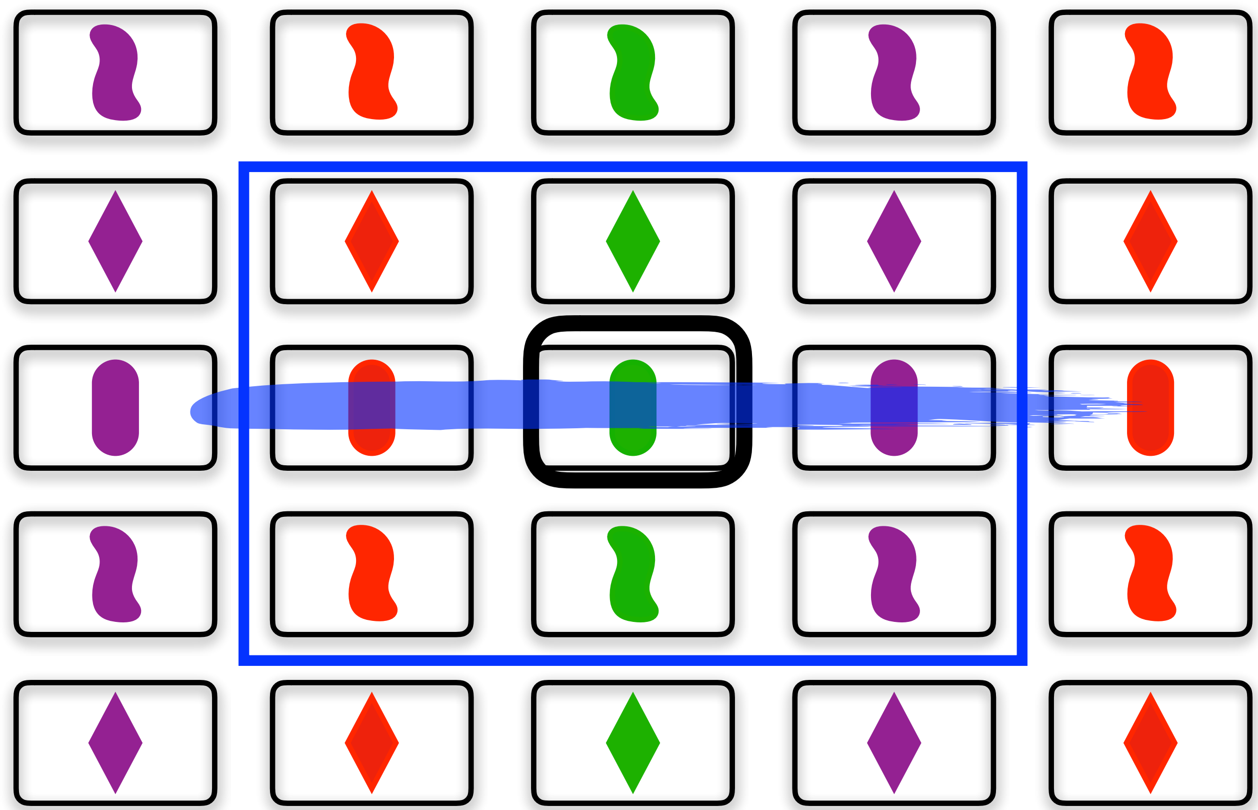

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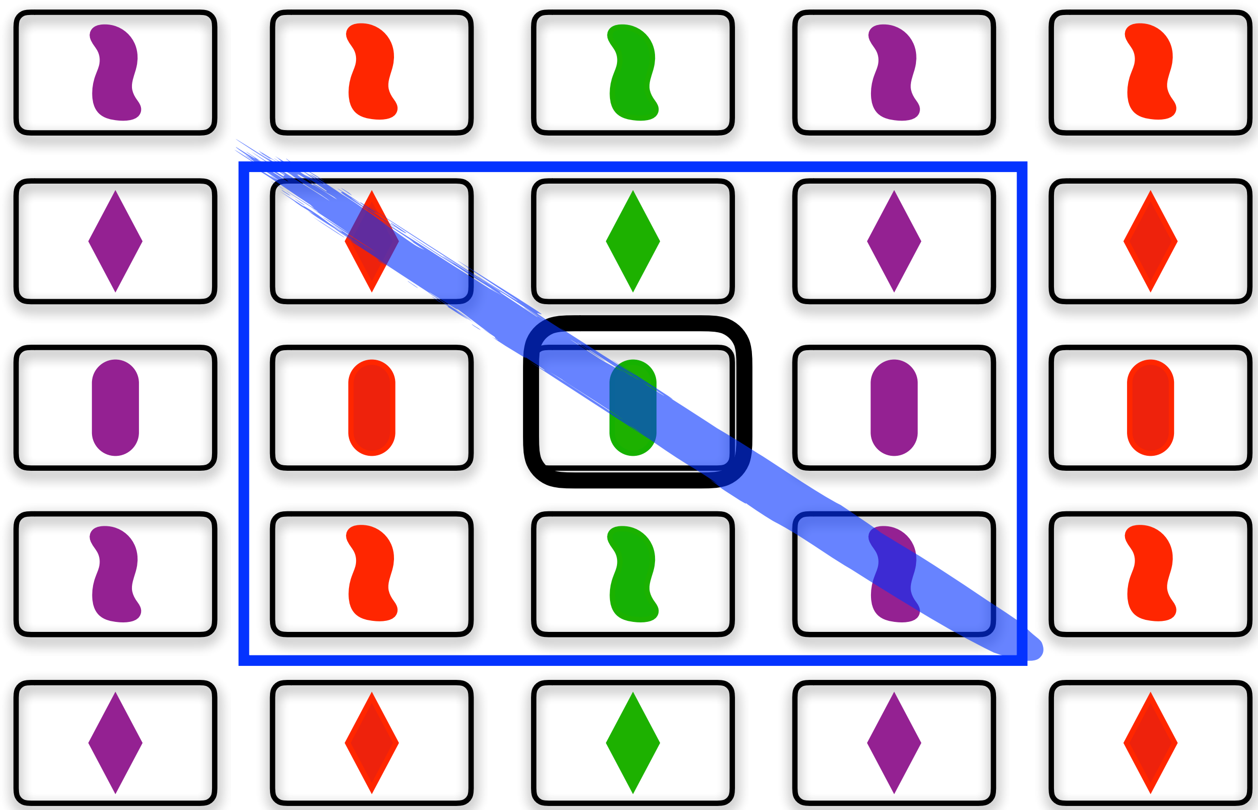

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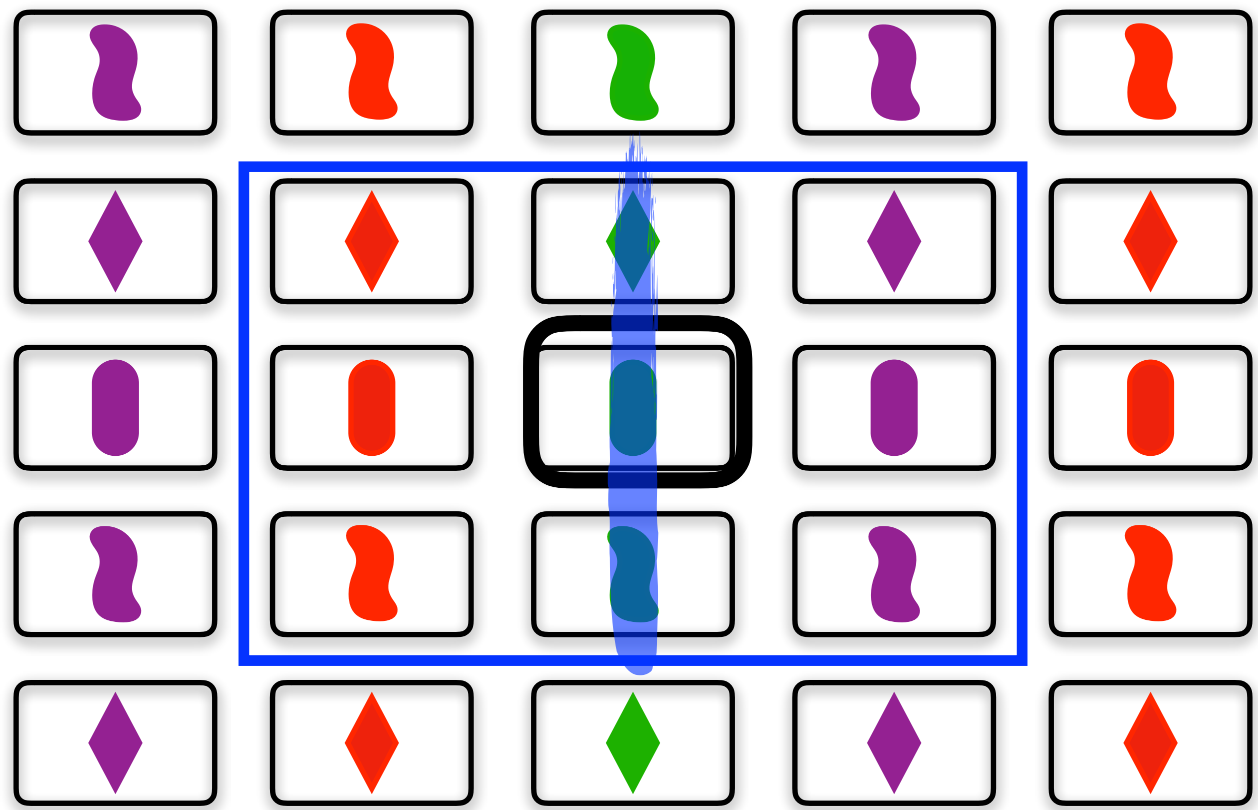

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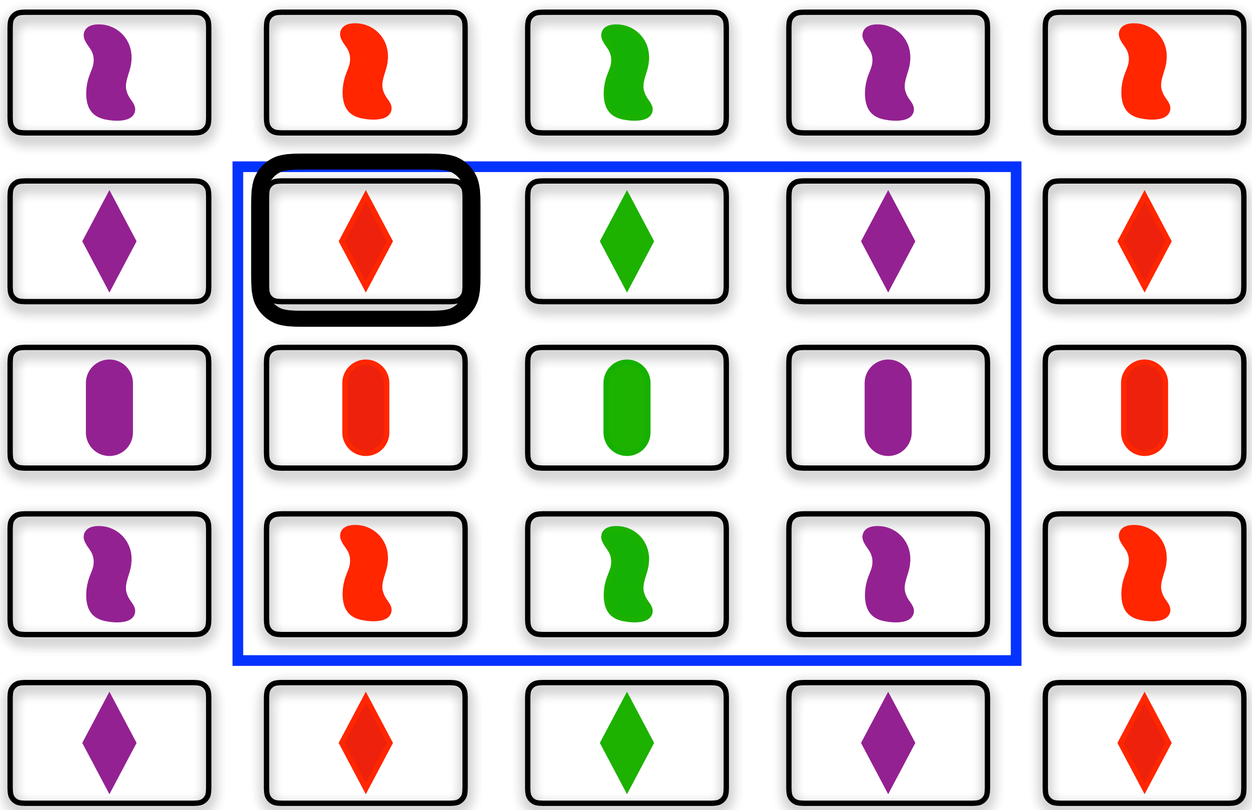

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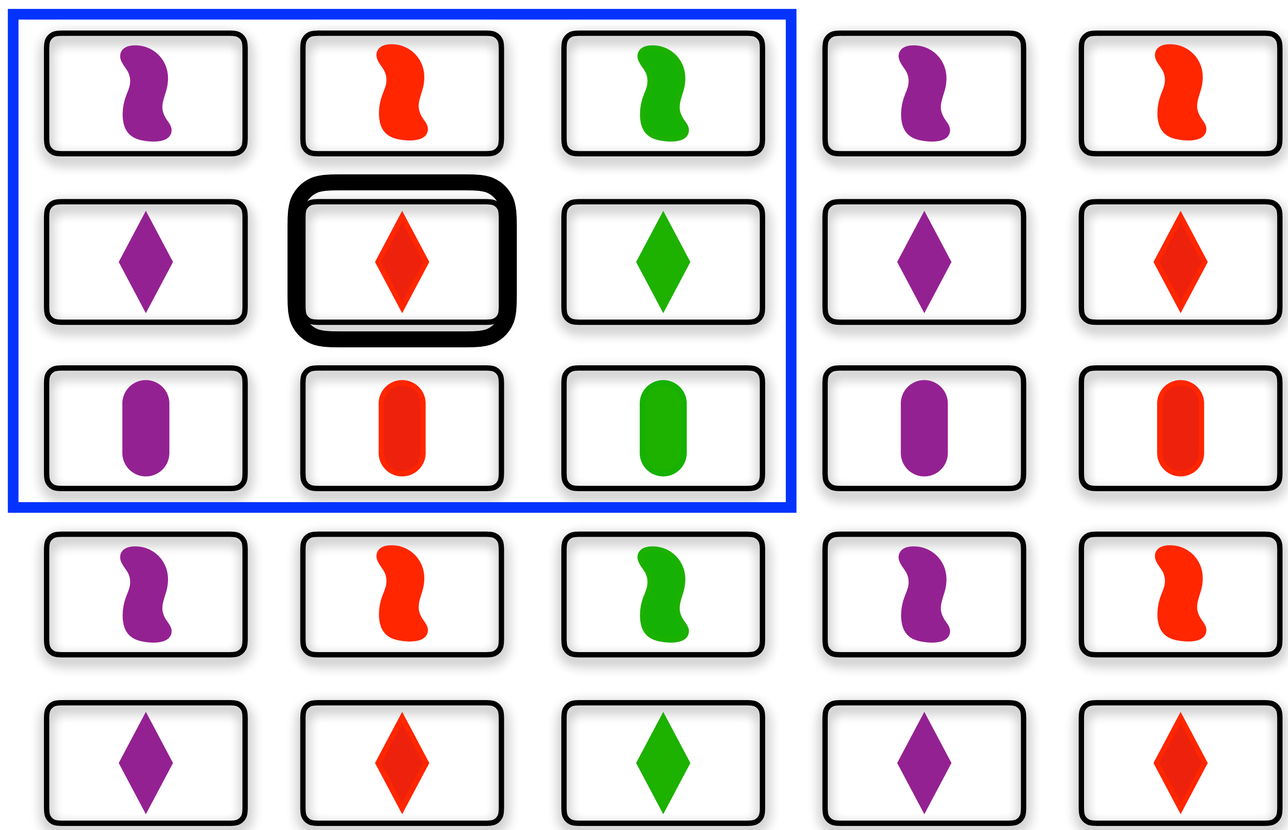

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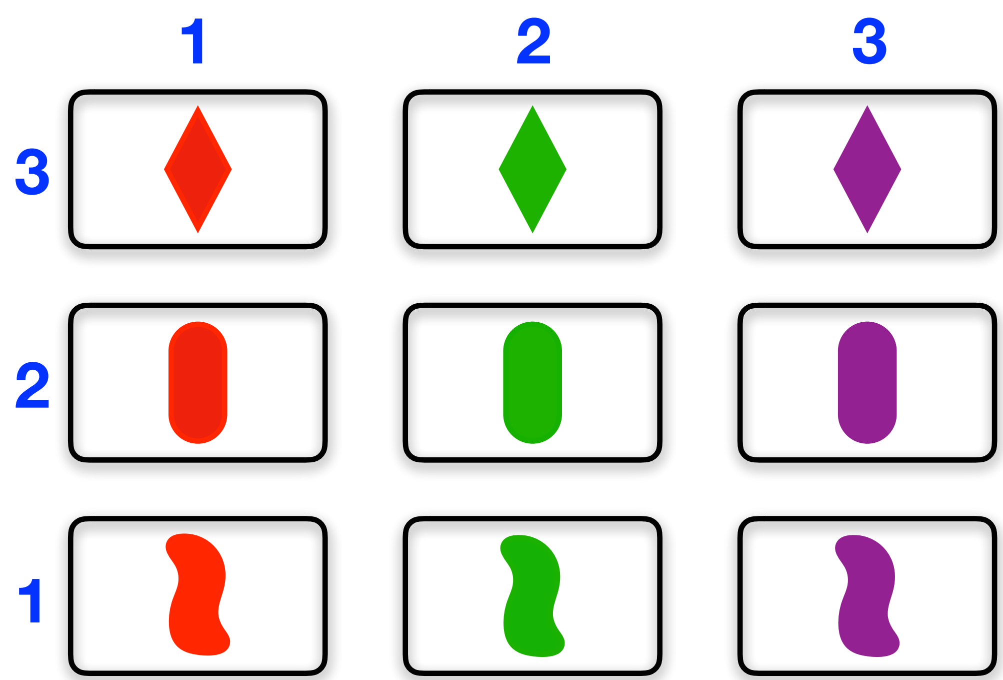

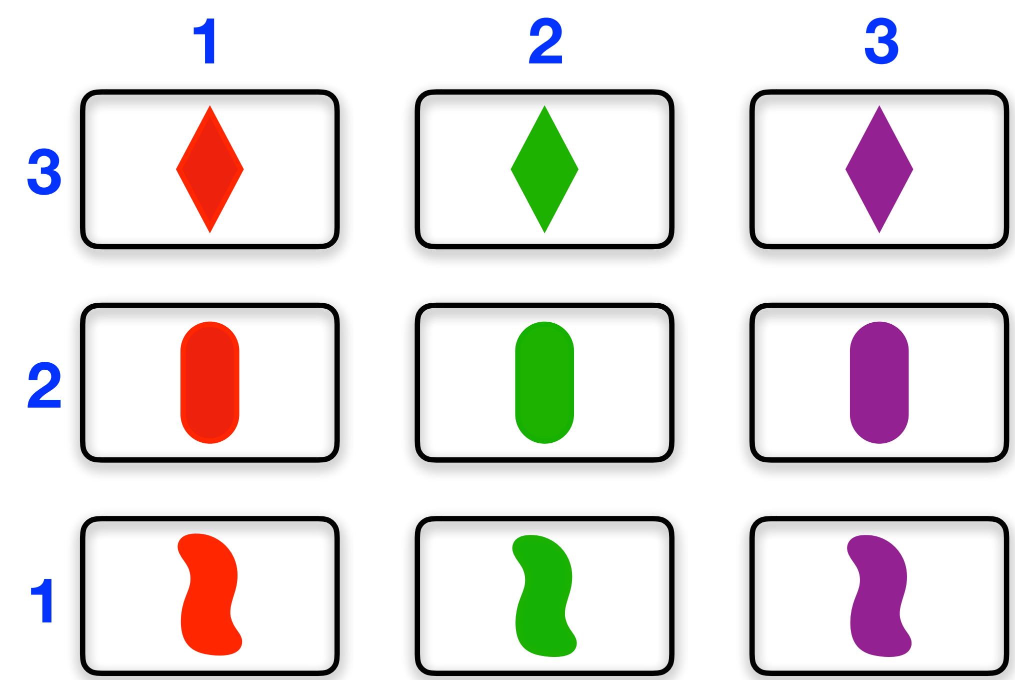

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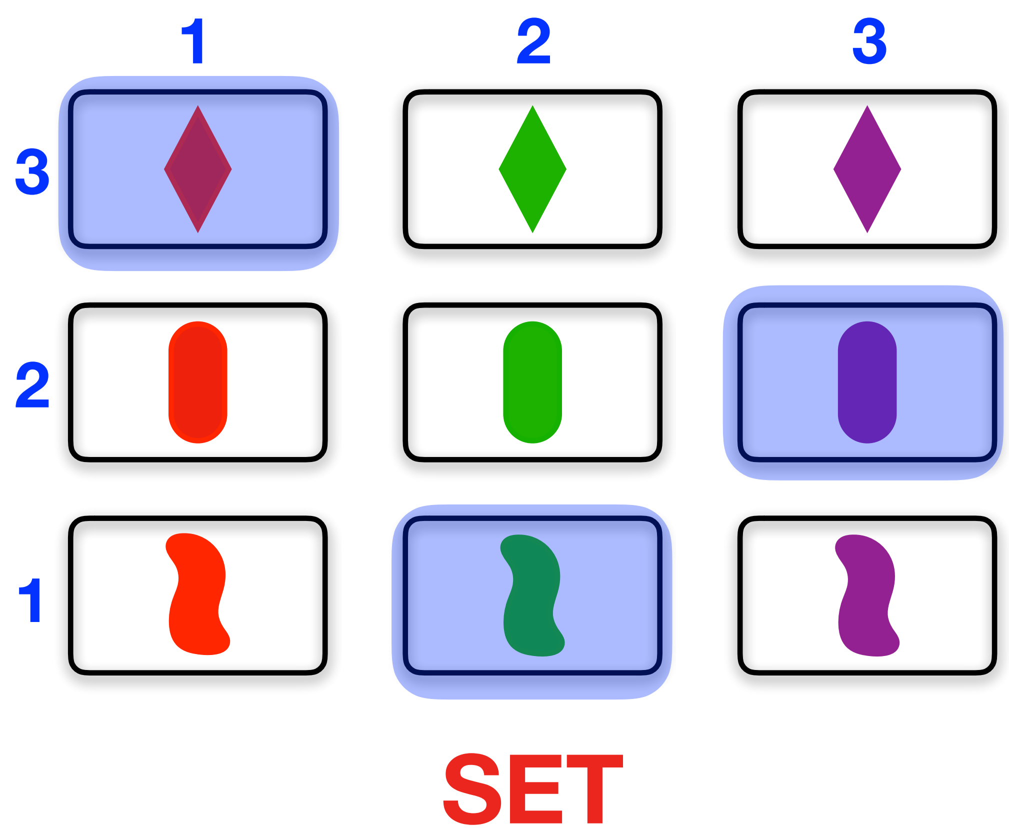

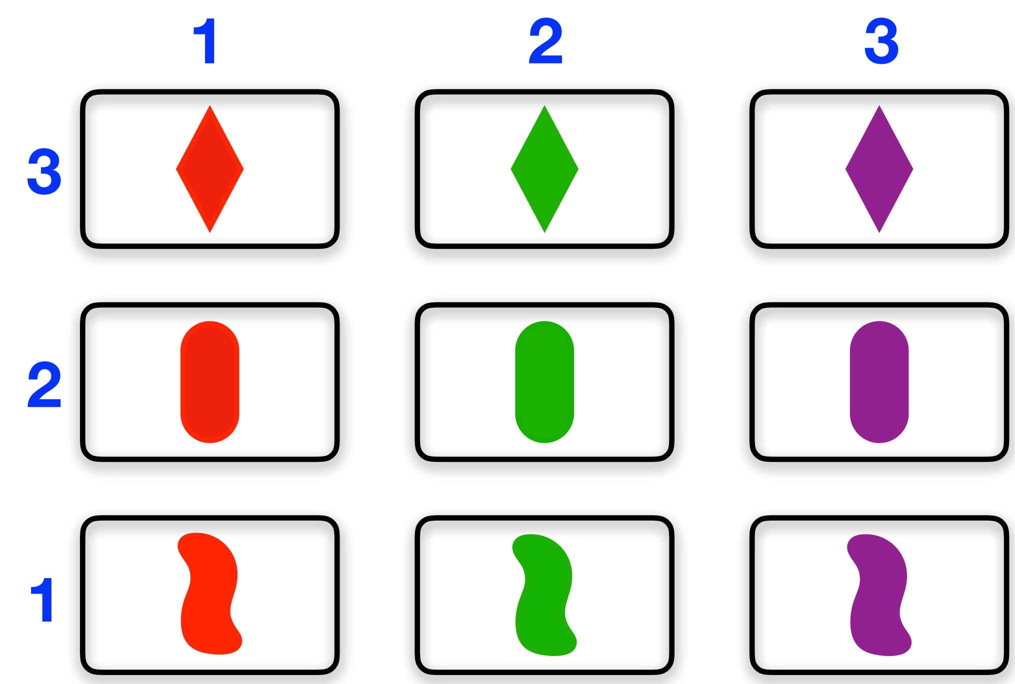

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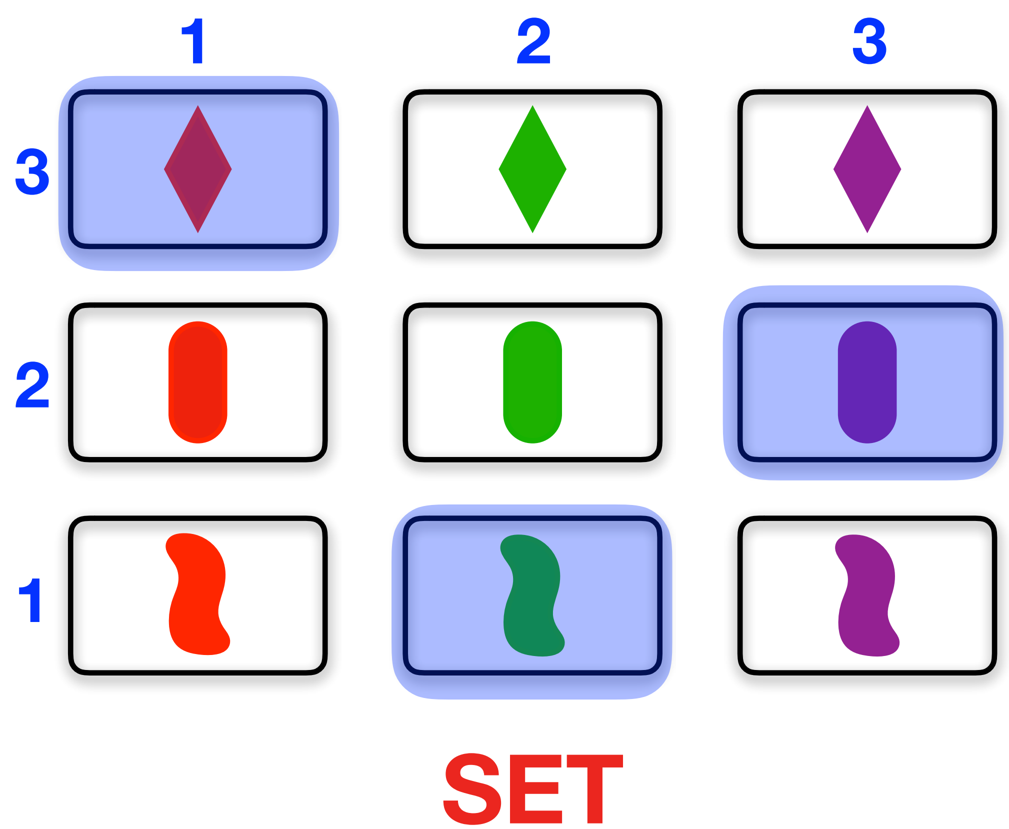

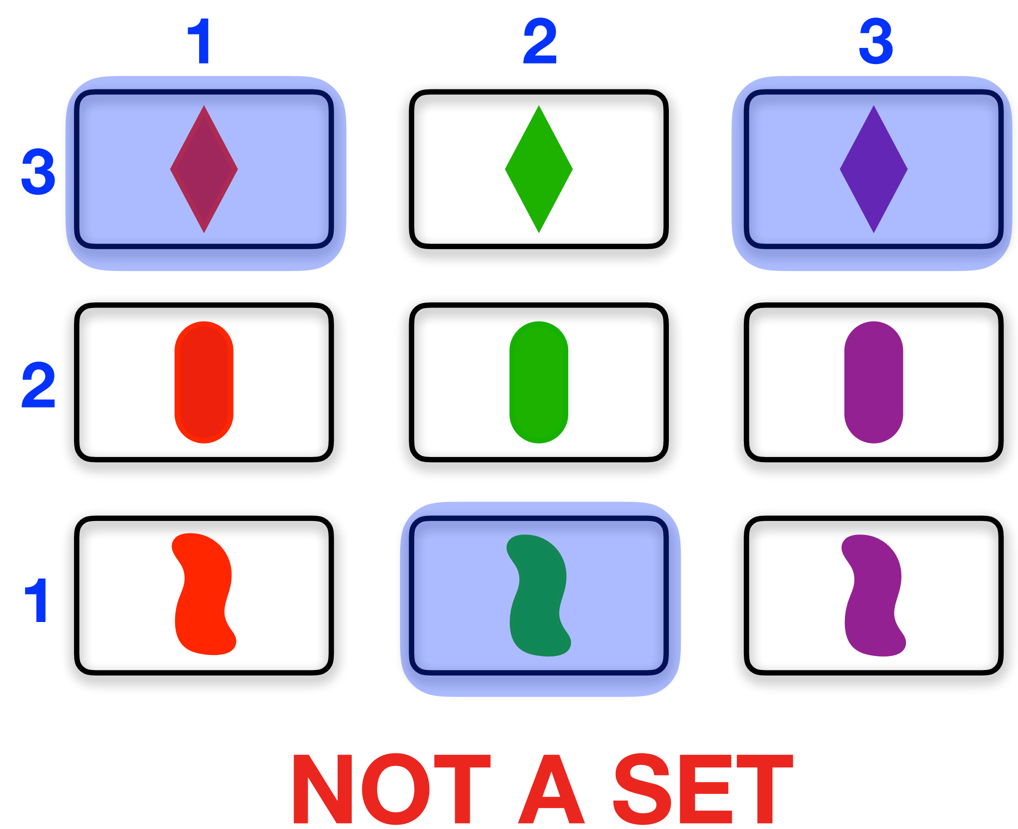

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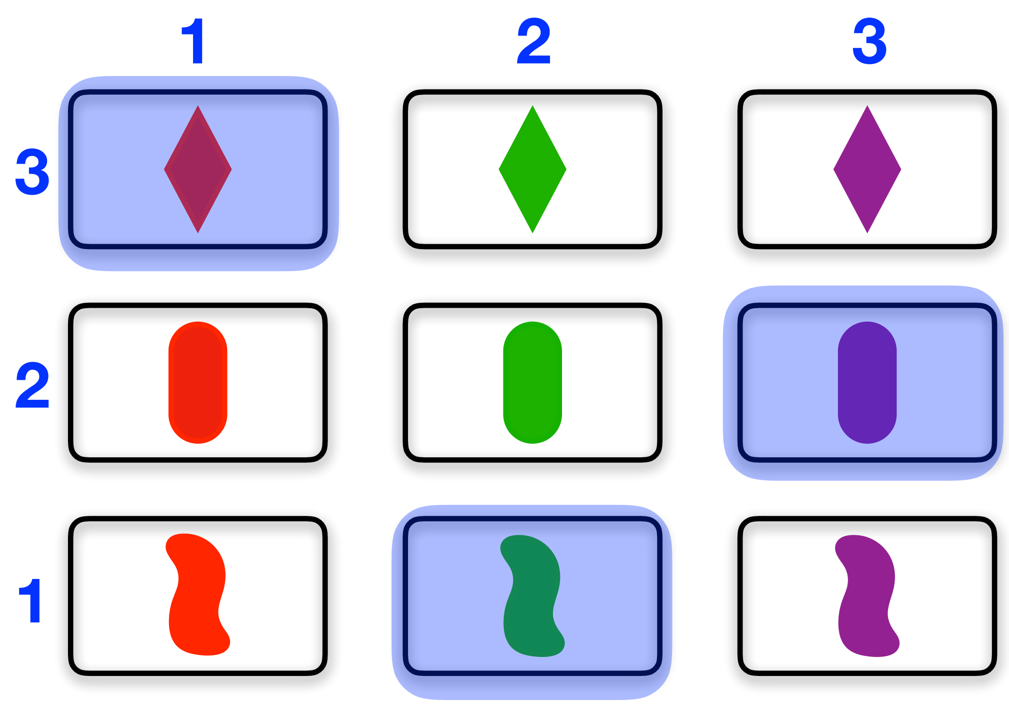
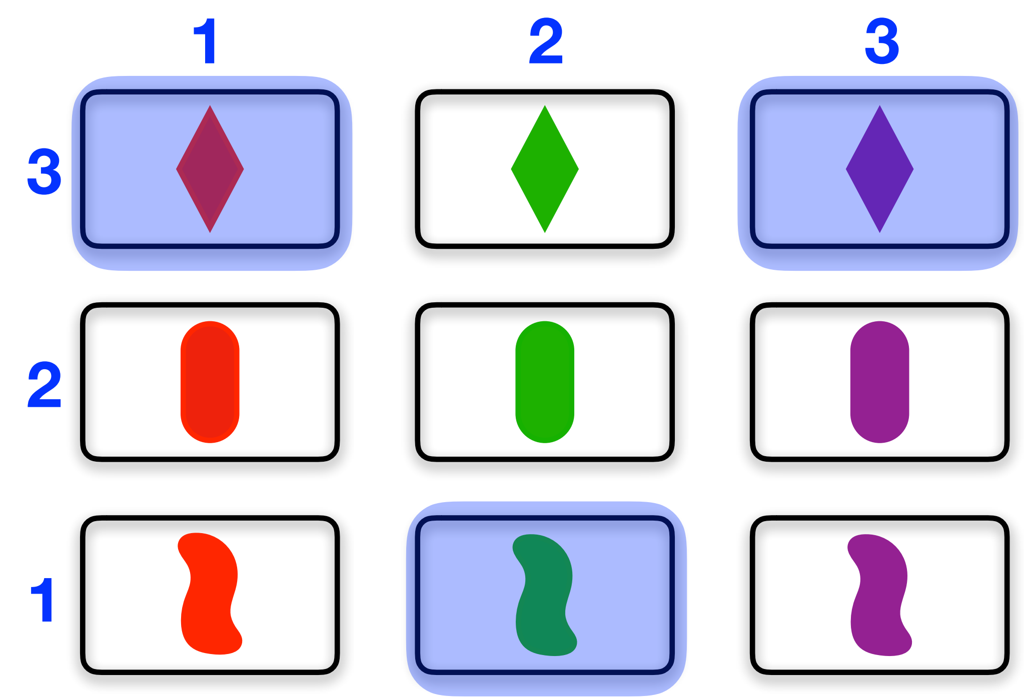


SET

slopes are 1, 1, 1



NOT A SET

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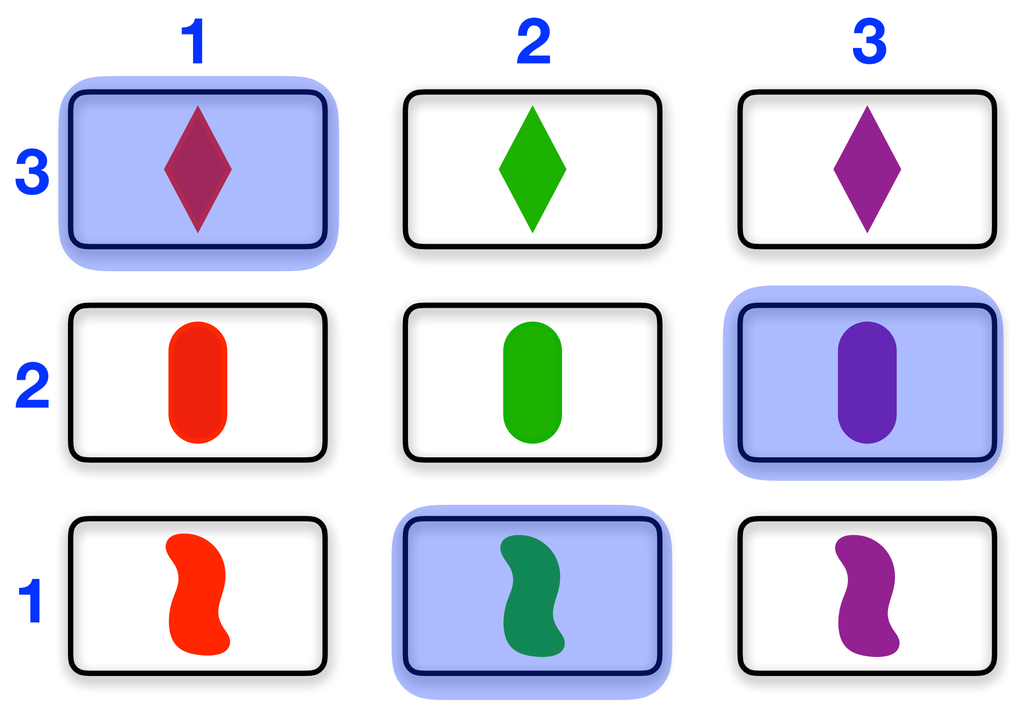

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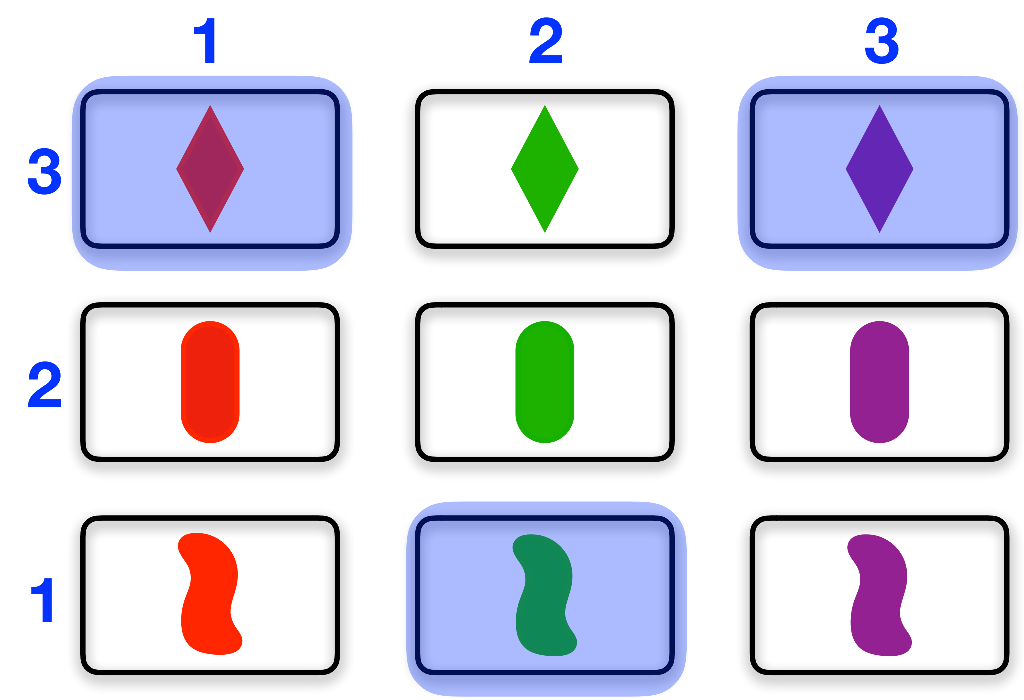

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slopes are 0, 1, -1

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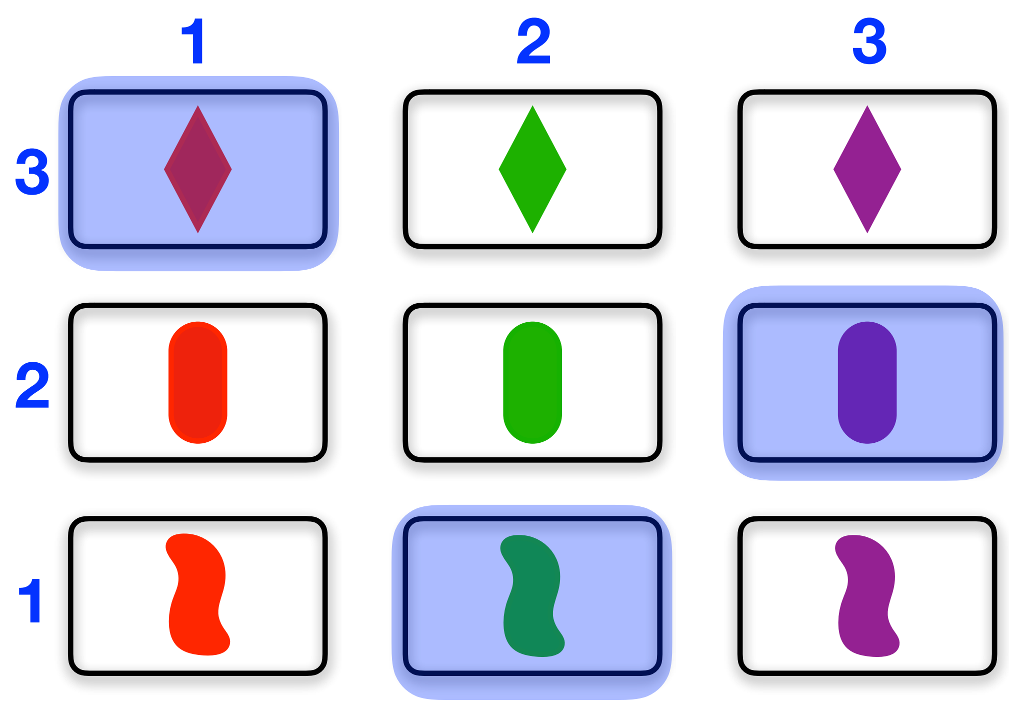
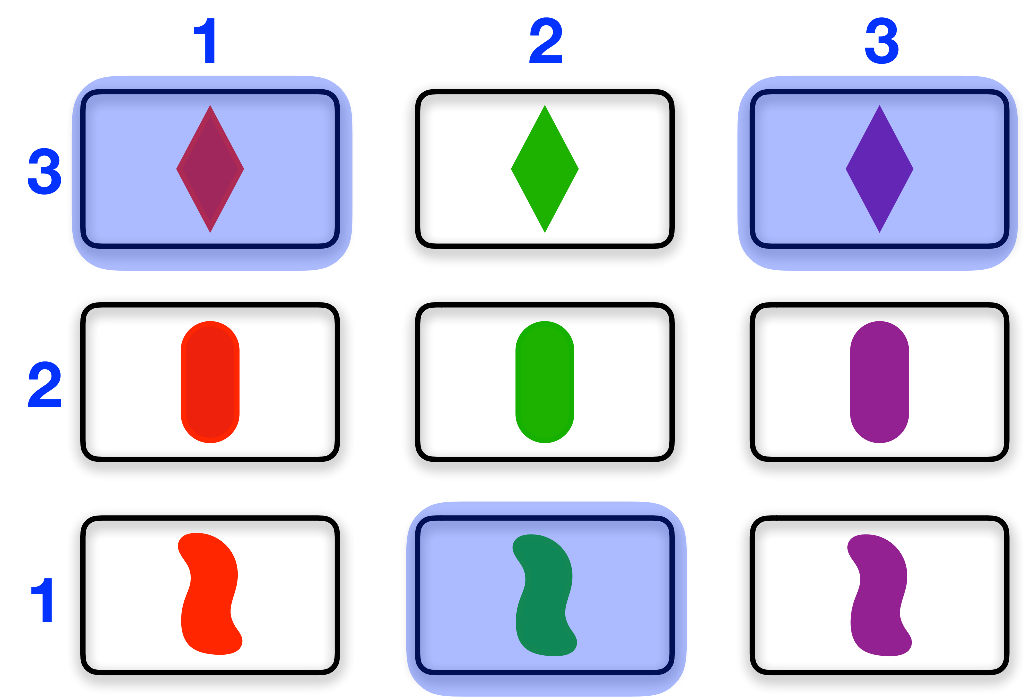


SET

slopes are 1, 1, 1



NOT A SET

slopes are 0, 1, -1

If 3 points lie on a line, then all pairs have the same slope

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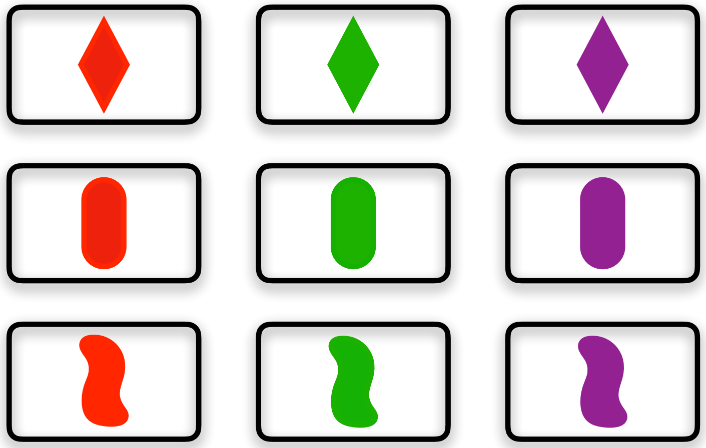

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