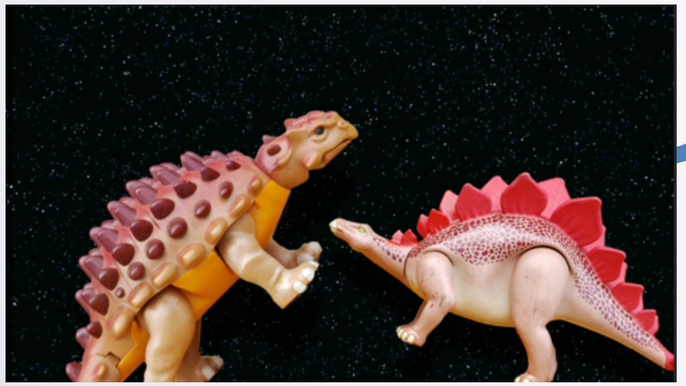
Computational Thinking

Green Screen Algorithm

Duke
UNIVERSITY

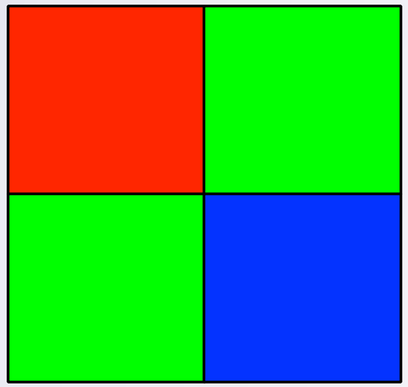
Green Screen



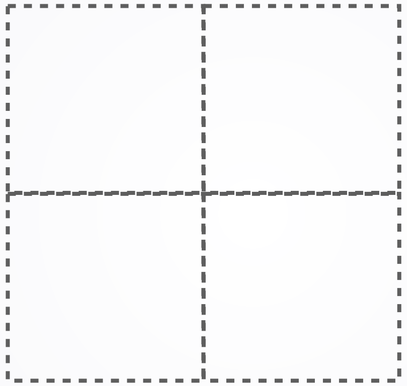
Need to figure out exactly how to do before we can program it…

This problem is too large to do by hand (2,073,600 pixels)

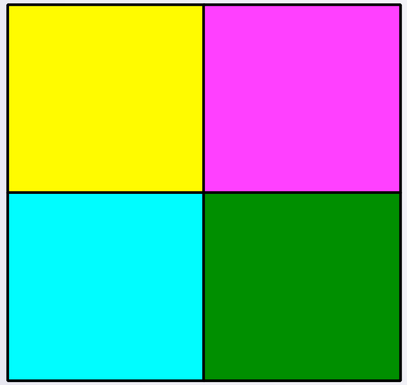
Work Smaller Example: 2x2 Image



Foreground Image

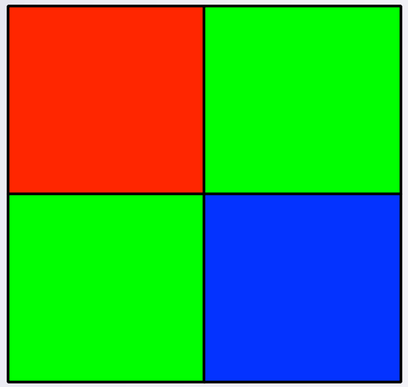


Output Image

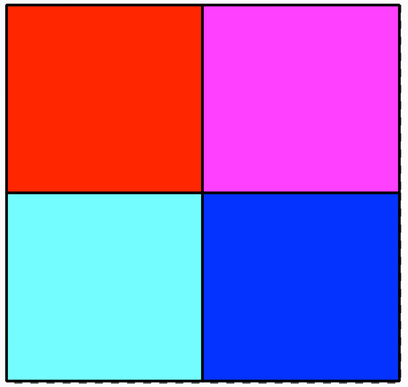


Background Image

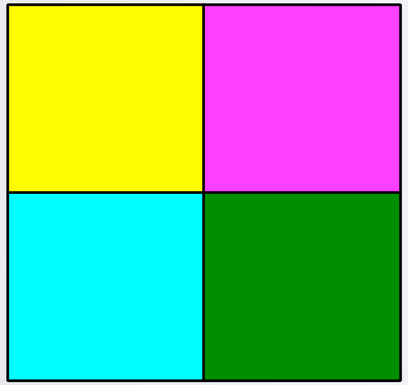
Work Smaller Example: 2x2 Image



Foreground Image

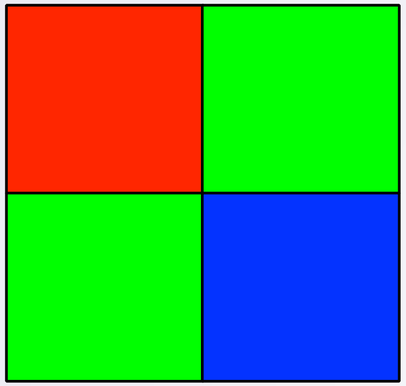


Output Image



Background Image

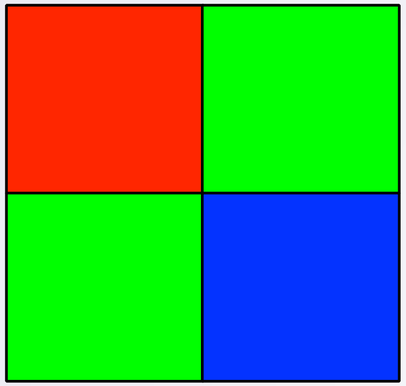
Write Down What We Just Did: Step-By-Step



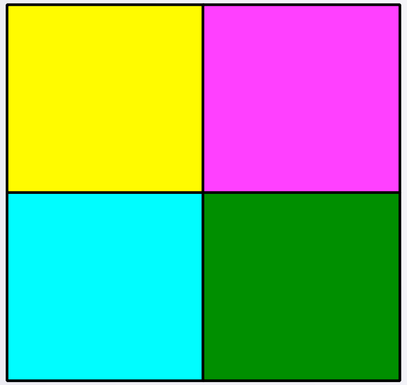
fgImage

1. I started with the foreground image I wanted (fgImage)

Write Down What We Just Did: Step-By-Step



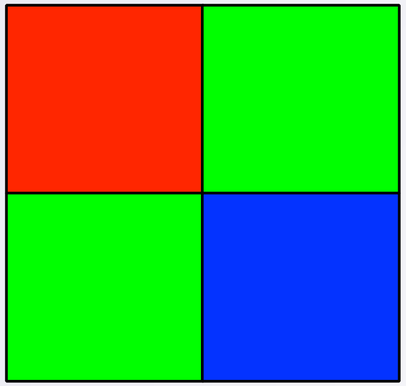
fgImage



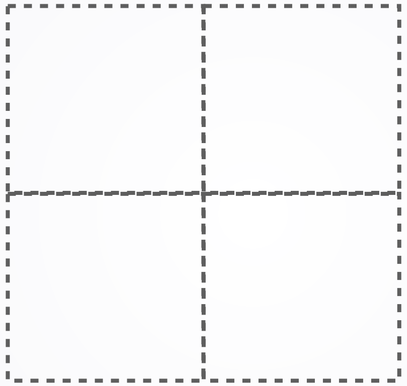
bgImage

2. and with the background image I wanted (bgImage)

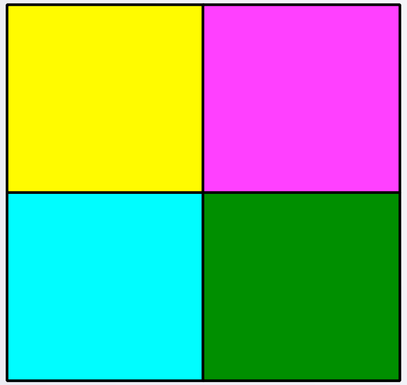
Write Down What We Just Did: Step-By-Step



fgImage



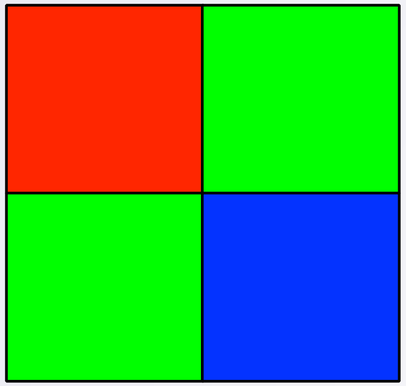
Output Image



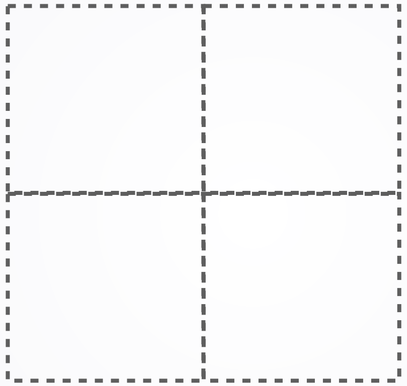
bgImage

3 I made a blank image of the same size (output)

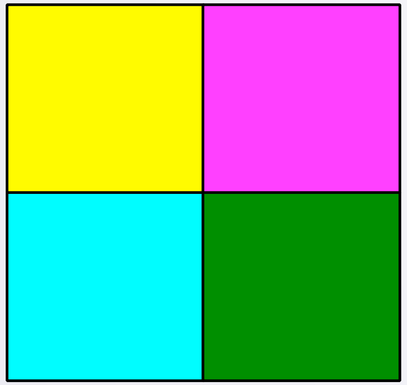
Write Down What We Just Did: Step-By-Step



fgImage



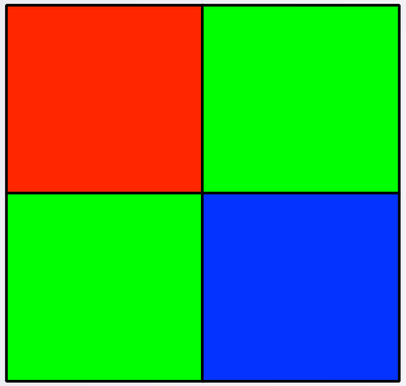
Output Image



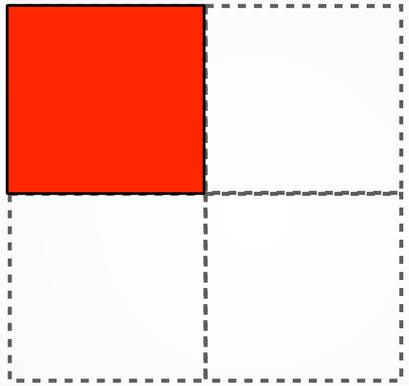
bgImage

4 I looked at the first pixel in fgImage

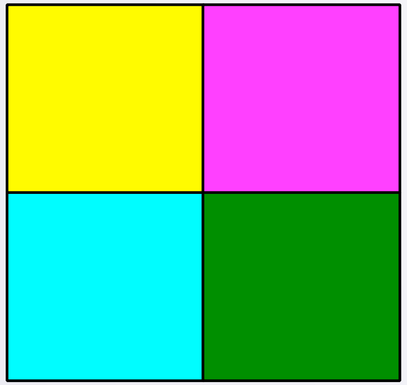
Write Down What We Just Did: Step-By-Step



fgImage



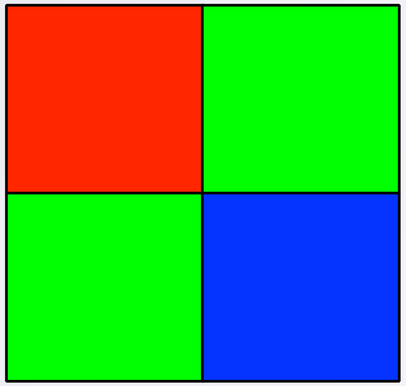
Output Image



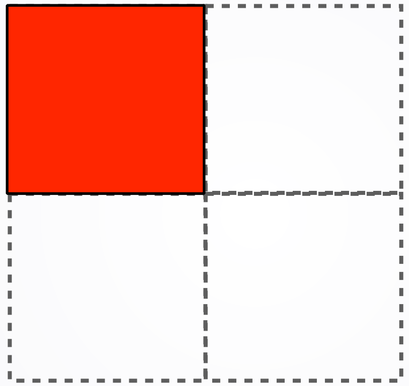
bgImage

5 It was red, so I set output's corresponding pixel to red

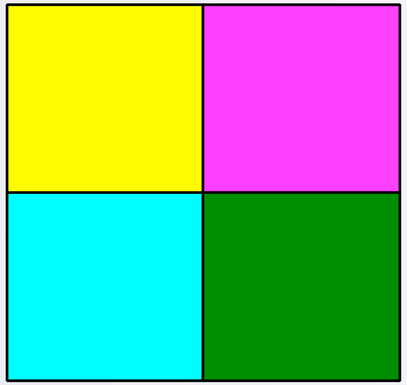
Write Down What We Just Did: Step-By-Step



fgImage



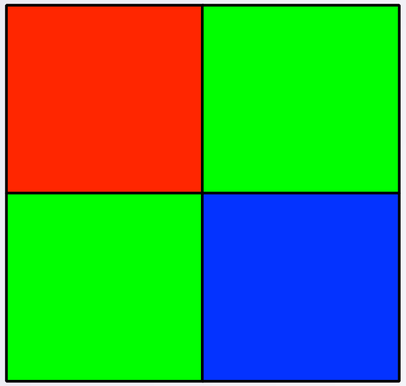
Output Image



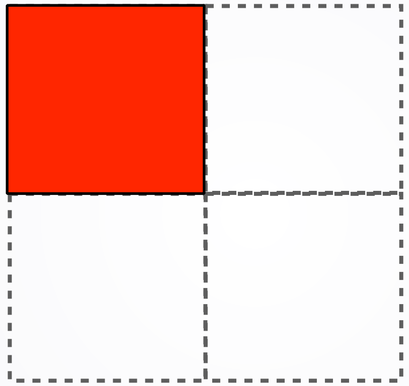
bgImage

6 I looked at the second pixel in fgImage

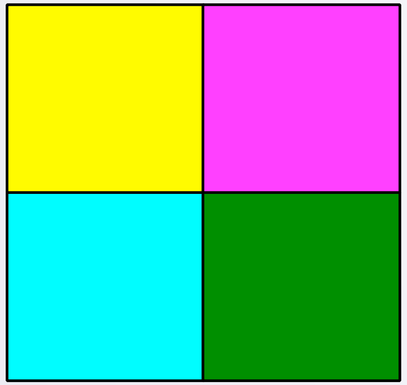
Write Down What We Just Did: Step-By-Step



fgImage



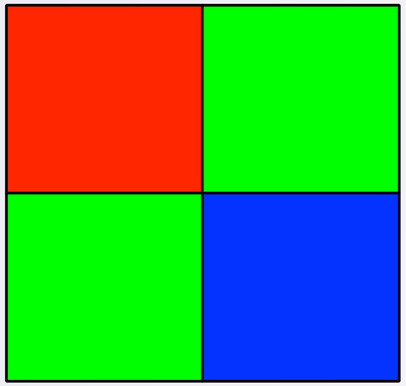
Output Image



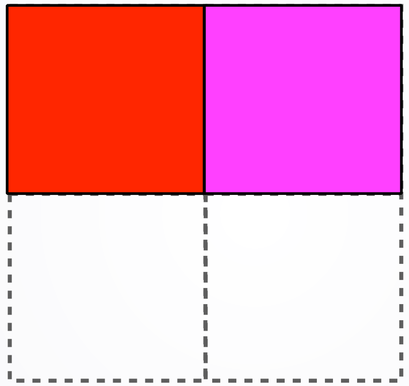
bgImage

7 It was green, so I looked at same position in bgImage

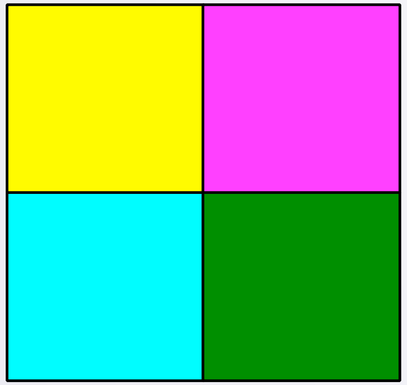
Write Down What We Just Did: Step-By-Step



fgImage



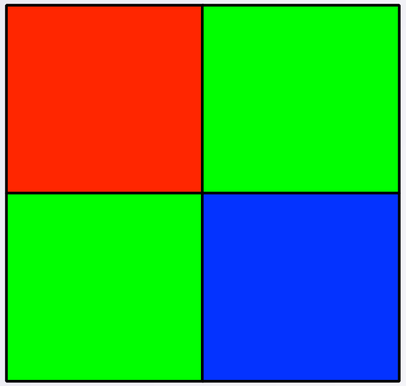
Output Image



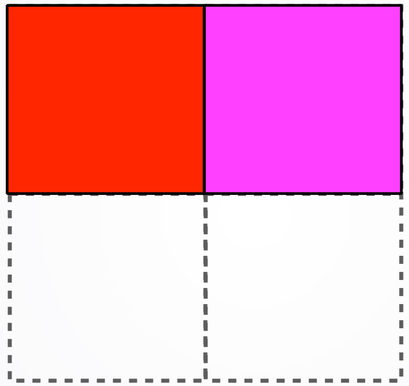
bgImage

8 and set output's corresponding pixel to bgImage's pixel

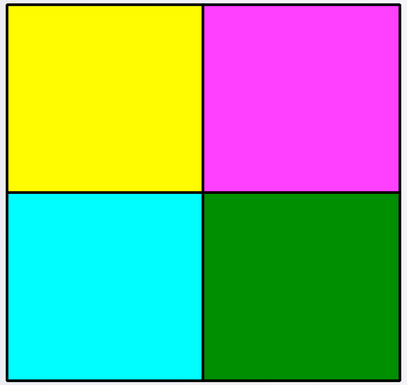
Write Down What We Just Did: Step-By-Step



fgImage



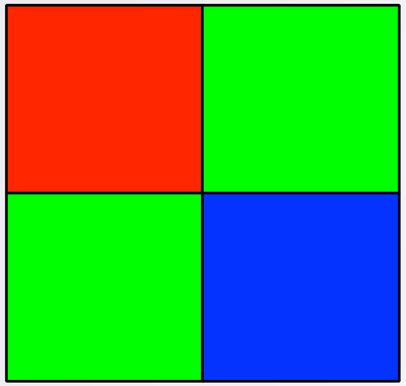
Output Image



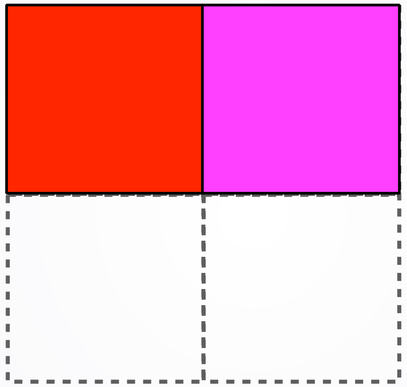
bgImage

9 I looked at the third pixel in fgImage

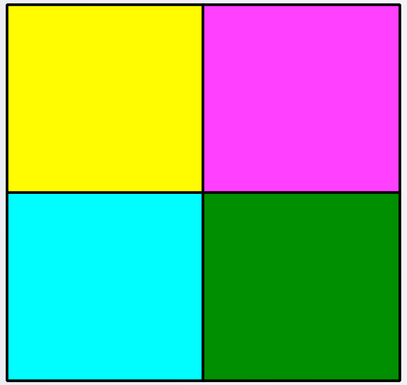
Write Down What We Just Did: Step-By-Step



fgImage



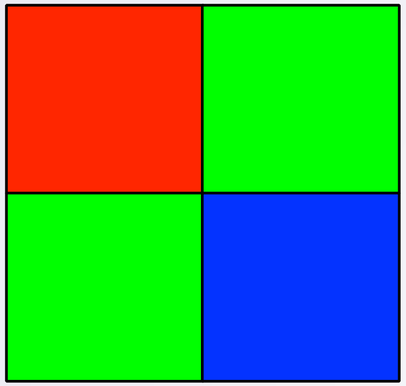
Output Image



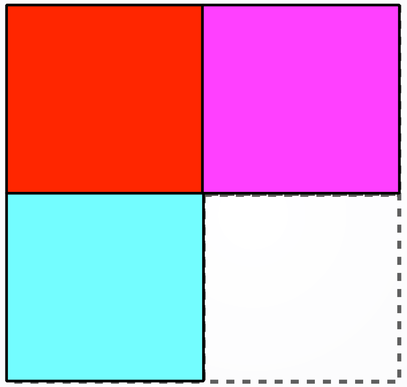
bgImage

10 It was green, so I looked at same position in bgImage

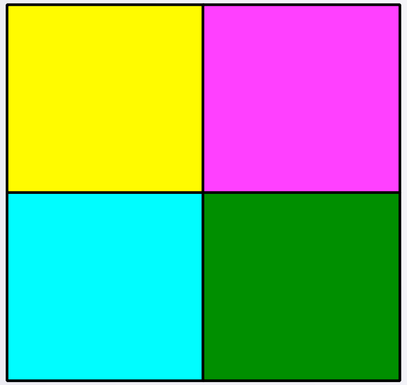
Write Down What We Just Did: Step-By-Step



fgImage



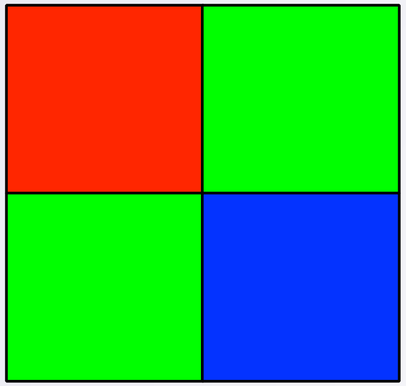
Output Image



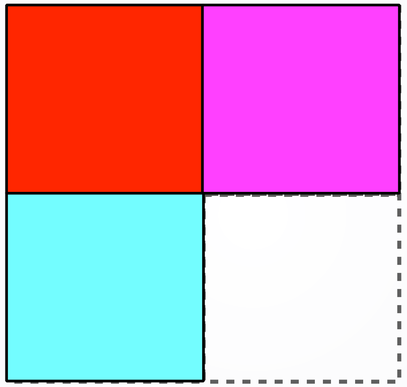
bgImage

11 and set output's corresponding pixel to bgImage's pixel

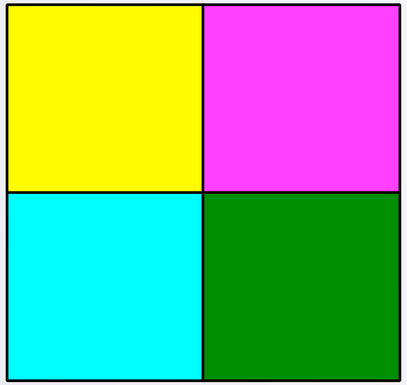
Write Down What We Just Did: Step-By-Step



fgImage



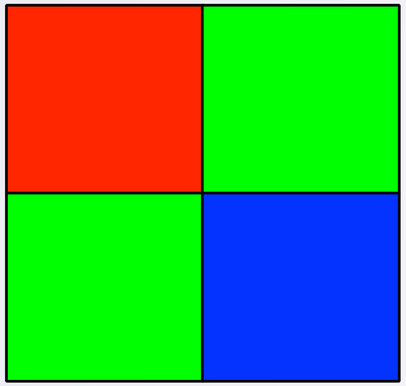
Output Image



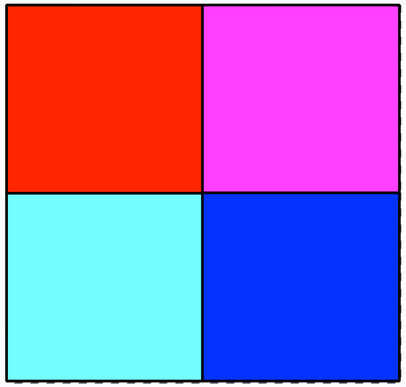
bgImage

12 I looked at the fourth pixel in fgImage

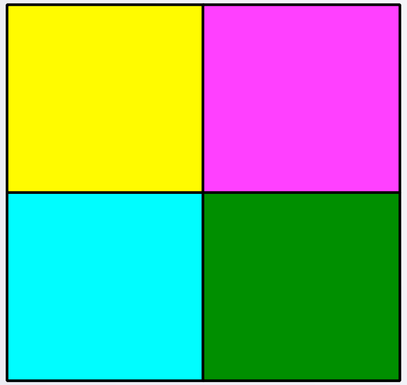
Write Down What We Just Did: Step-By-Step



fgImage



Output Image



bgImage

13 It was blue, so I set output's corresponding pixel to blue

Step-By-Step Instructions for This 2x2 Image

1. I started with the foreground image I wanted (fgImage)
2. and with the background image I wanted (bgImage)
3. I made a blank image of the same size (output)
4. I looked at the first pixel in fgImage
5. It was red, so I set output's corresponding pixel to red
6. I looked at the second pixel in fgImage
7. It was green, so I looked at the same position in bgImage
8. and set output's corresponding pixel to beImage's pixel
9. I looked at the third pixel in fgImage
10. It was green, so I looked at the same position in bgImage
11. and set output's corresponding pixel to beImage's pixel
12. I looked at the fourth pixel in fgImage
13. It was blue, so I set output's corresponding pixel to blue

Step-By-Step Instructions for This 2x2 Image

…but we want **any** image of **any** size…

1. I started with the foreground image I wanted (fgImage)
2. and with the background image I wanted (bgImage)
3. I made a blank image of the same size (output)
4. I looked at the first pixel in fgImage
5. It was red, so I set output's corresponding pixel to red
6. I looked at the second pixel in fgImage
7. It was green, so I looked at the same position in bgImage
8. and set output's corresponding pixel to beImage's pixel
9. I looked at the third pixel in fgImage
10. It was green, so I looked at the same position in bgImage
11. and set output's corresponding pixel to beImage's pixel
12. I looked at the fourth pixel in fgImage
13. It was blue, so I set output's corresponding pixel to blue

Find Patterns (Generalize Step-By-Step Approach)

Doing **almost** the same thing **for each pixel**

1. I started with the foreground image I wanted (fgImage)
2. and with the background image I wanted (bgImage)
3. I made a blank image of the same size (output)
4. I looked at the first pixel in fgImage
5. It was red, so I set output's corresponding pixel to red
6. I looked at the second pixel in fgImage
7. It was green, so I looked at the same position in bgImage
8. and set output's corresponding pixel to beImage's pixel
9. I looked at the third pixel in fgImage
10. It was green, so I looked at the same position in bgImage
11. and set output's corresponding pixel to beImage's pixel
12. I looked at the fourth pixel in fgImage
13. It was blue, so I set output's corresponding pixel to blue

Find Patterns (Generalize Step-By-Step Approach)

When fgImage's pixel is **green**, we use **bgImage's** pixel

6. I looked at the second pixel in fgImage
7. It was green, so I looked at the same position in bgImage
8. and set output's corresponding pixel to beImage's pixel
9. I looked at the third pixel in fgImage
10. It was green, so I looked at the same position in bgImage
11. and set output's corresponding pixel to beImage's pixel

Find Patterns (Generalize Step-By-Step Approach)

When fgImage's pixel is **not green**, we use **fgImage's** pixel

4. I looked at the first pixel in fgImage
5. It was red, so I set output's corresponding pixel to red

12. I looked at the fourth pixel in fgImage
13. It was blue, so I set output's corresponding pixel to blue

Find Patterns (Generalize Step-By-Step Approach)

1. I started with the foreground image I wanted (fgImage)
2. and with the background image I wanted (bgImage)
3. I made a blank image of the same size (output)
4. **Look at the first pixel in fgImage and if it is green,**
   - **Look at same position in bgImage**
   - **set output's corresponding pixel to bgImage's pixel**

   Otherwise: set output's corresponding pixel to that pixel
5. I looked at the second pixel in fgImage
   - It was green, so I looked at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel
6. I looked at the third pixel in fgImage
   - It was green, so I looked at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel
7. Look at the fourth pixel in fgImage and if it is green,
   - Look at the same position in bgImage

Find Patterns (Generalize Step-By-Step Approach)

1. I started with the foreground image I wanted (fgImage)
2. and with the background image I wanted (bgImage)
3. I made a blank image of the same size (output)
4. Look at the first pixel in fgImage and if it is green,
   - Look at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel

   Otherwise: set output's corresponding pixel to that pixel
5. **I looked at the second pixel in fgImage**
   - **It was green, so I looked at same position in bgImage**
   - **set output's corresponding pixel to bgImage's pixel**

   Otherwise: set output's corresponding pixel to that pixel
6. I looked at the third pixel in fgImage
   - It was green, so I looked at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel
7. Look at the fourth pixel in fgImage and if it is green,
   - Look at the same position in bgImage

Find Patterns (Generalize Step-By-Step Approach)

1. I started with the foreground image I wanted (fgImage)
2. and with the background image I wanted (bgImage)
3. I made a blank image of the same size (output)
4. Look at the first pixel in fgImage and if it is green,
   - Look at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel

   Otherwise: set output's corresponding pixel to that pixel
5. I looked at the second pixel in fgImage
   - It was green, so I looked at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel

   Otherwise: set output's corresponding pixel to that pixel
6. **I looked at the third pixel in fgImage**
   - **It was green, so I looked at same position in bgImage**
   - **set output's corresponding pixel to bgImage's pixel**

   Otherwise: set output's corresponding pixel to that pixel
7. Look at the fourth pixel in fgImage and if it is green,
   - Look at the same position in bgImage

Find Patterns (Generalize Step-By-Step Approach)

1. I started with the foreground image I wanted (fgImage)
2. and with the background image I wanted (bgImage)
3. I made a blank image of the same size (output)
4. Look at the first pixel in fgImage and if it is green,
   - Look at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel

   Otherwise: set output's corresponding pixel to that pixel
5. I looked at the second pixel in fgImage
   - It was green, so I looked at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel

   Otherwise: set output's corresponding pixel to that pixel
6. I looked at the third pixel in fgImage
   - It was green, so I looked at same position in bgImage
   - set output's corresponding pixel to bgImage's pixel

   Otherwise: set output's corresponding pixel to that pixel
7. **Look at the fourth pixel in fgImage and if it is green,**
   - **Look at the same position in bgImage**

Observe:
repetition for each pixel

Find Patterns (Generalize Step-By-Step Approach)

1. I started with the foreground image I wanted (fgImage)
2. and with the background image I wanted (bgImage)
3. I made a blank image of the same size (output)
4. For each pixel (currentPixel) fgImage
   1. Look at currentPixel and if it is green,
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      - and set output's corresponding pixel to bgImage's pixel
   2. Otherwise: set output's corresponding pixel

Find Patterns (Generalize Step-By-Step Approach)

Step-by-step directions for any images:
An **algorithm**

1. Start with the foreground image I want (fgImage)
2. and with the background image you want (bgImage)
3. Make a blank image of the same size (output)
4. For each pixel (currentPixel) fgImage
   1. Look at currentPixel and if it is green,
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      - and set output's corresponding pixel to bgImage's pixel
   2. Otherwise: set output's corresponding pixel

Try on Different Inputs

What if we made a mistake?

Try on different inputs to catch/fix mistakes early

1. Start with the foreground image I want (fgImage)
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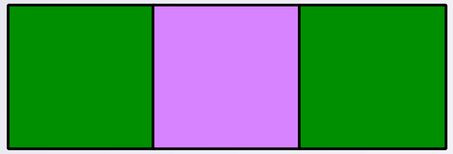
Try on Different Inputs



fgImage

1. Start with the foreground image I want (fgImage)
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   1. Look at currentPixel and if it is green,
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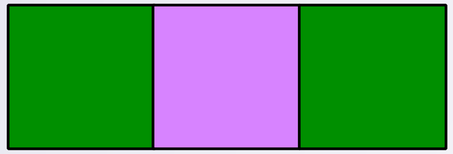
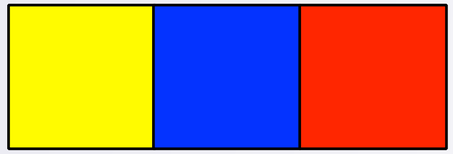
Try on Different Inputs



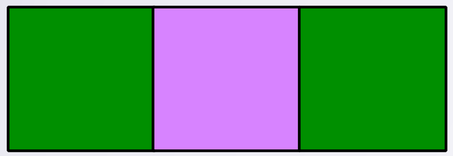
fgImage



bgImage

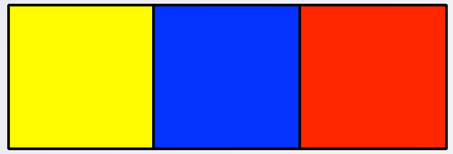
1. Start with the foreground image I want (fgImage)
2. and with the background image you want (bgImage)
3. Make a blank image of the same size (output)
4. For each pixel (currentPixel) fgImage
   1. Look at currentPixel and if it is green,
      - Look at same position in bgImage
      - and set output's corresponding pixel to bgImage's pixel
   2. Otherwise: set output's corresponding pixel

Try on Different Inputs



fgImage

output



bgImage

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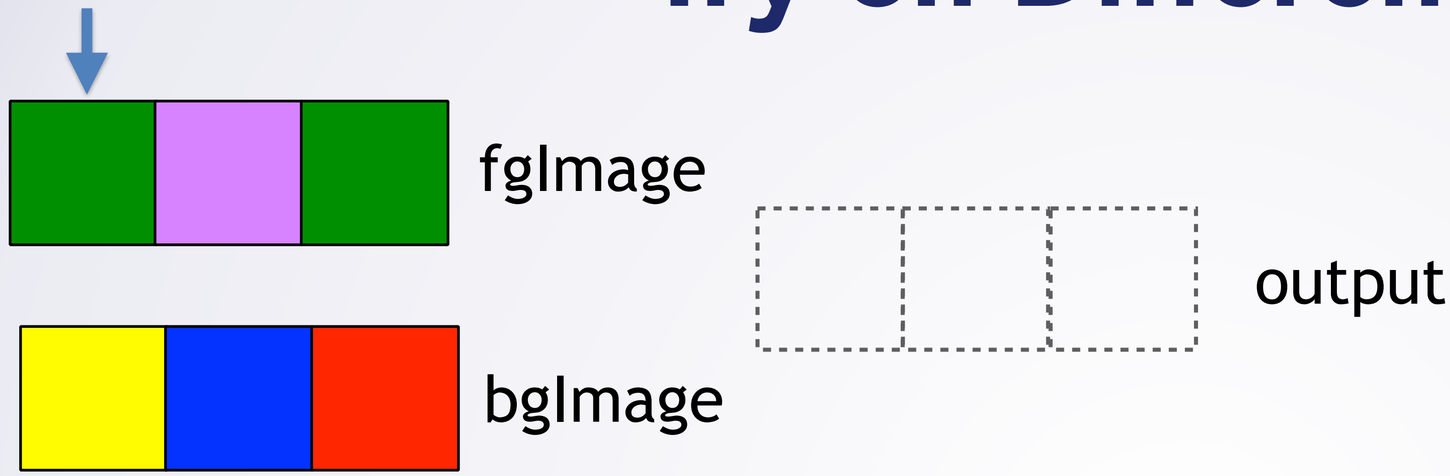
Try on Different Inputs



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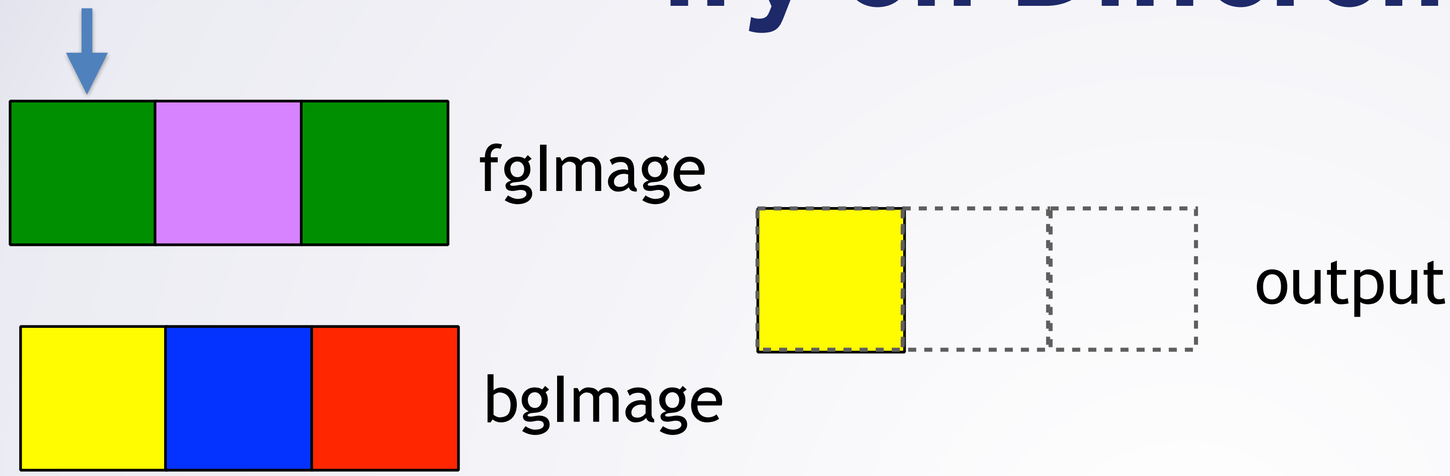

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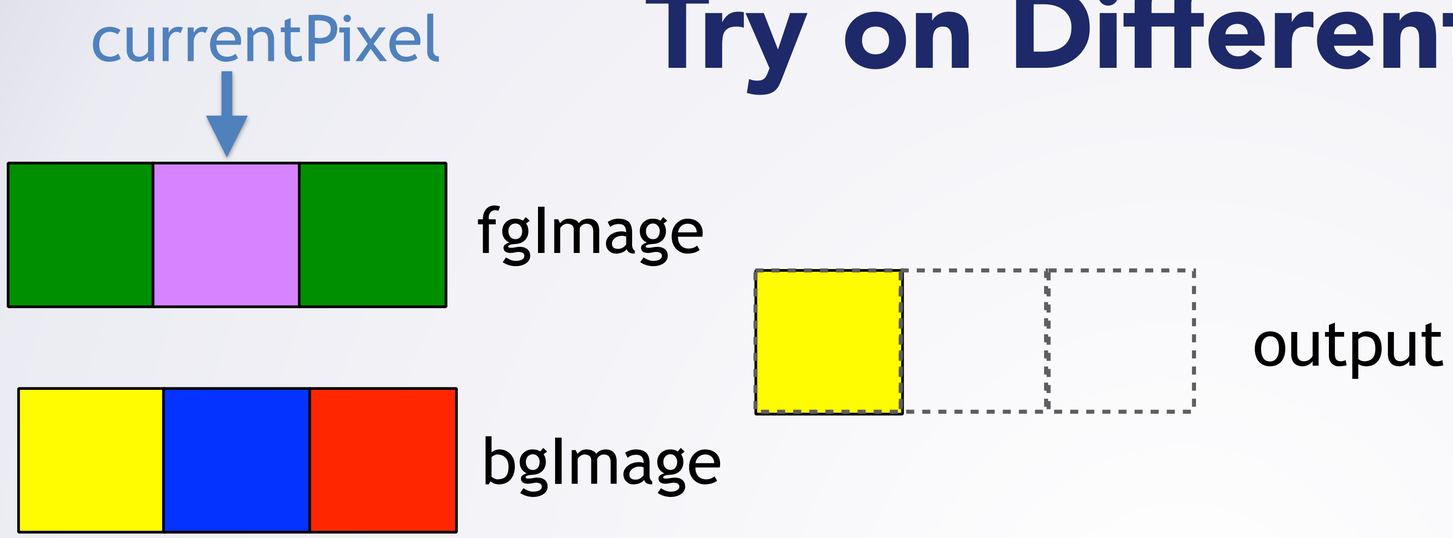

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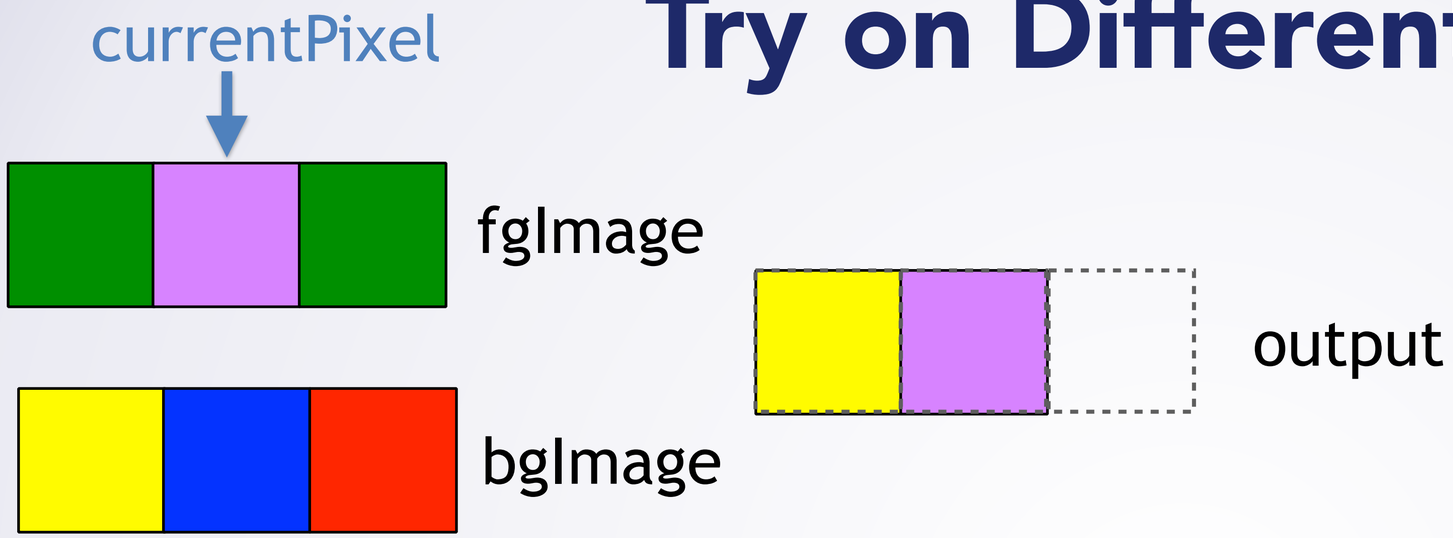
Try on Different Inputs



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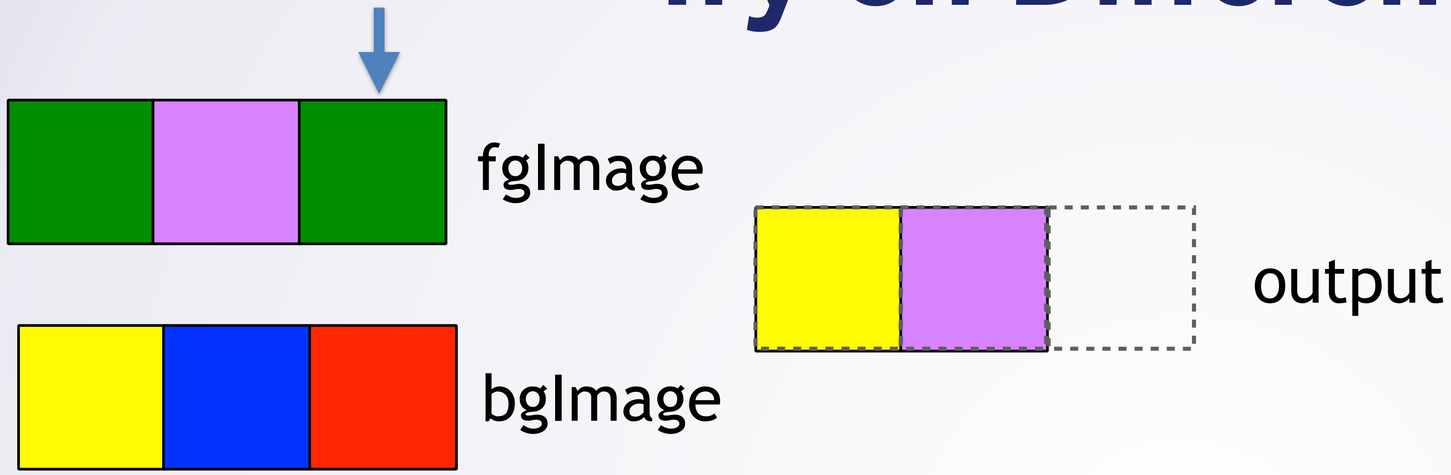

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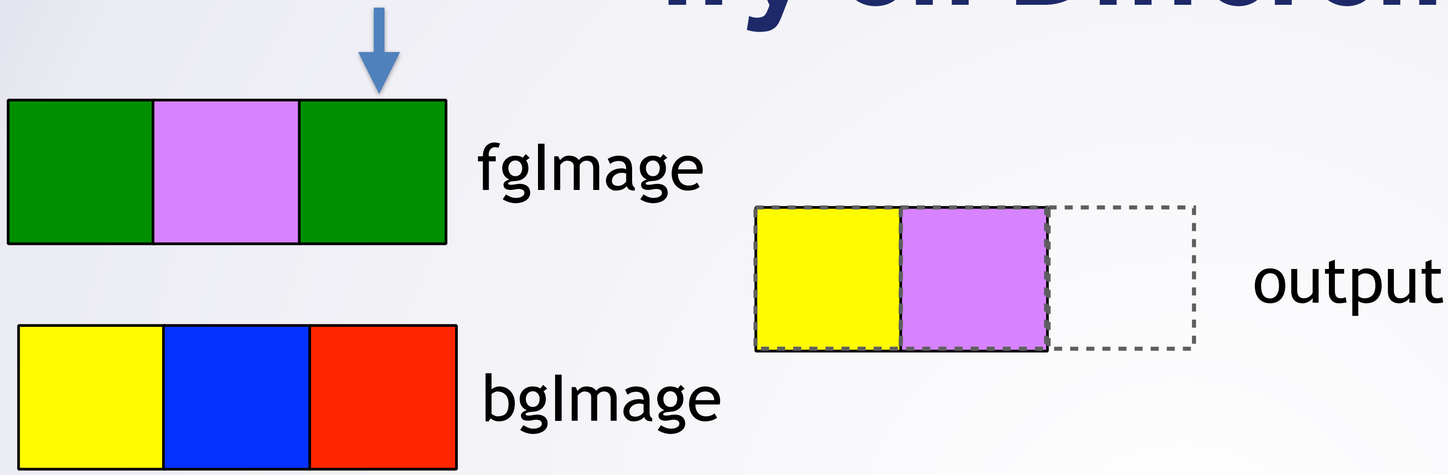

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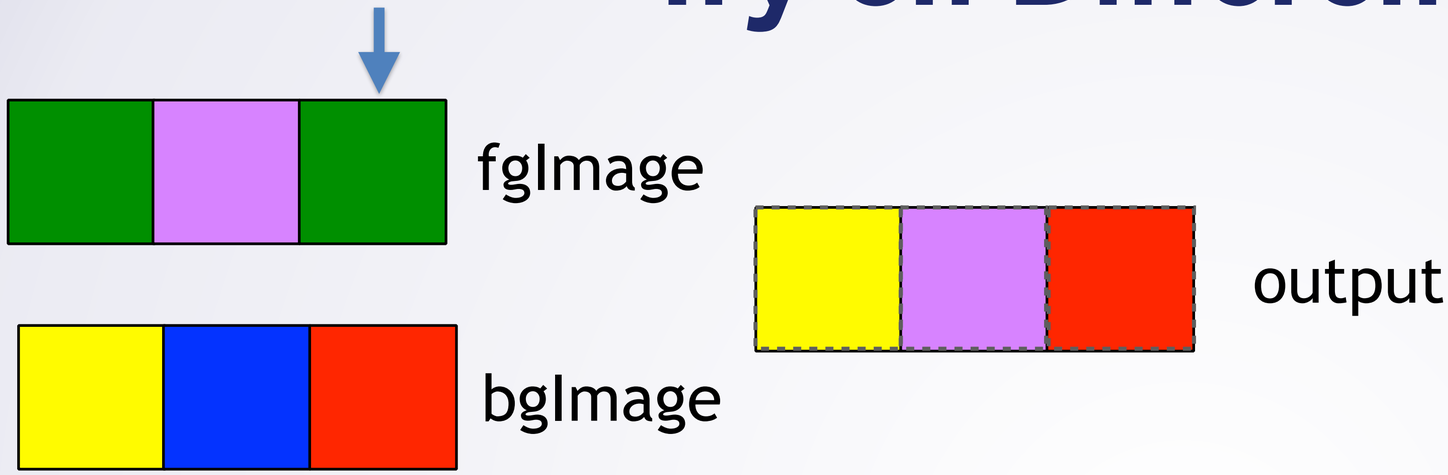

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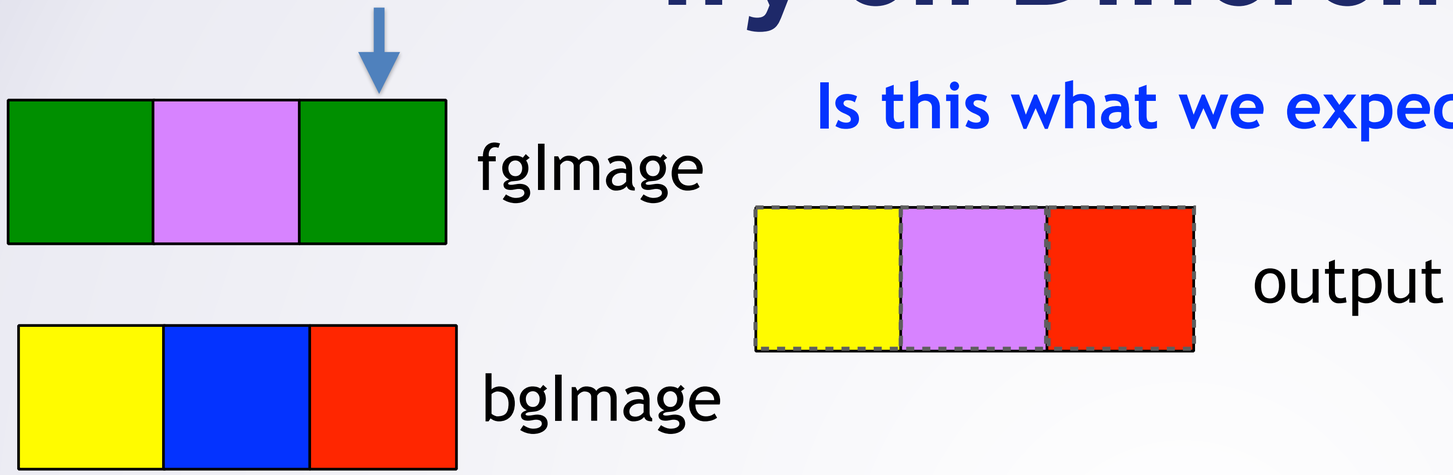

Is this what we expected?

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Ready to Code!

Algorithm appears to work!
Next: implement it in code…

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