Dynamic Programming

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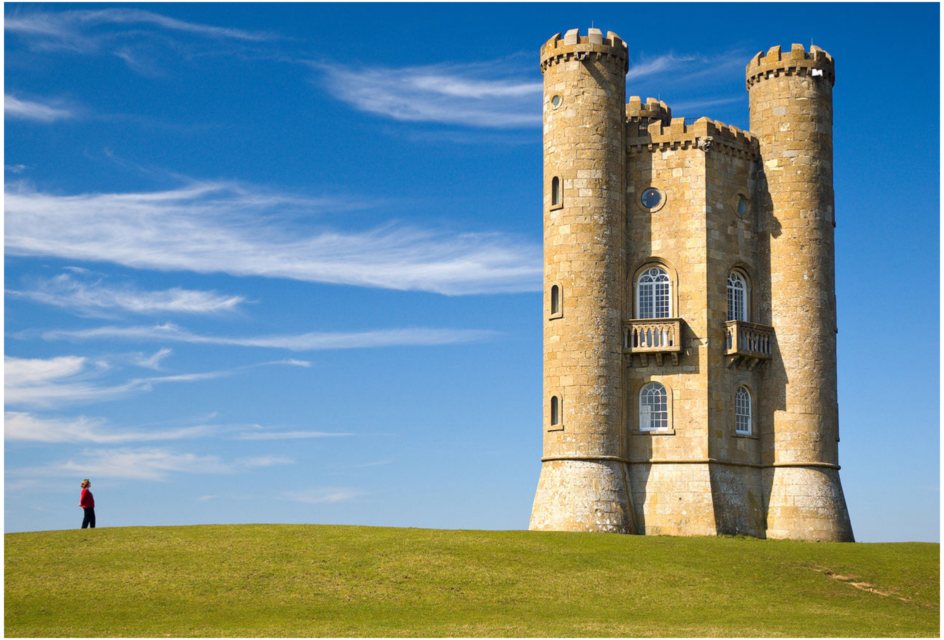
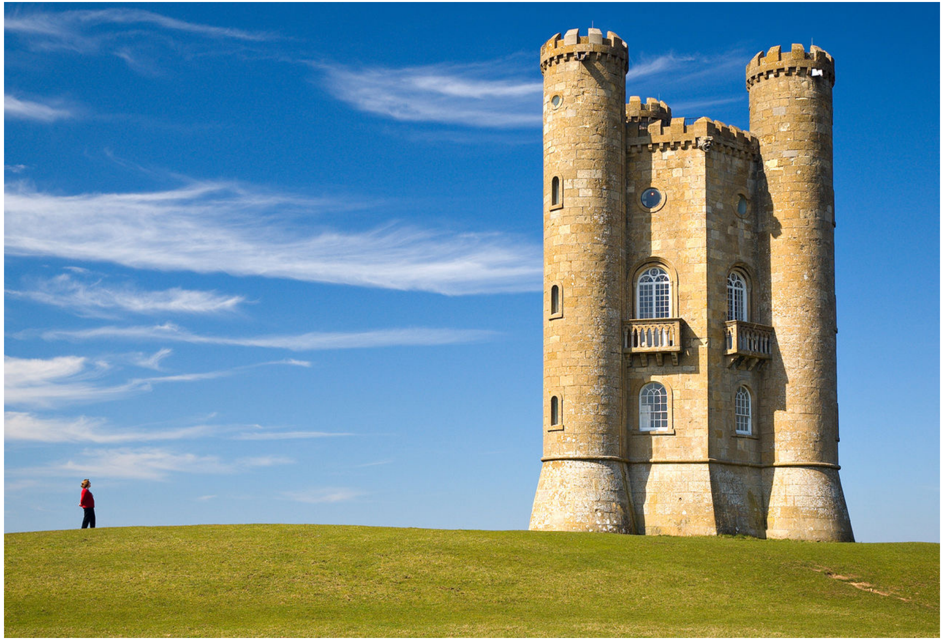
Image resizing



We want to perform 1/3rd reduction in width

Image source: wikipedia

Image resizing: Cropping



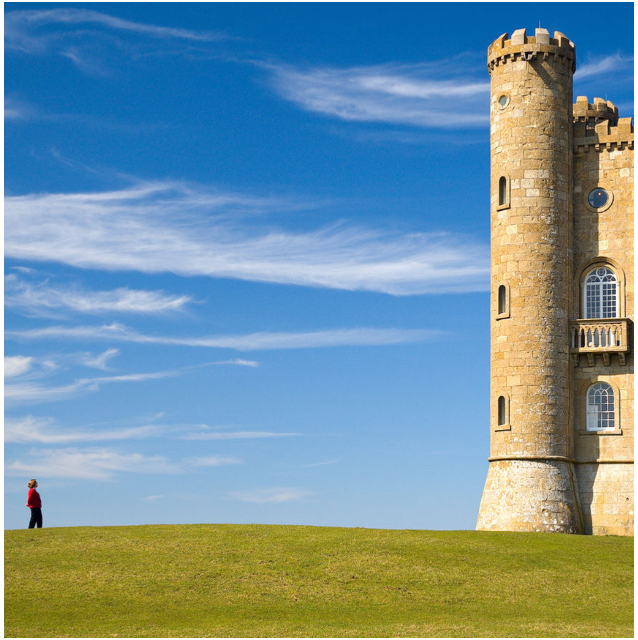
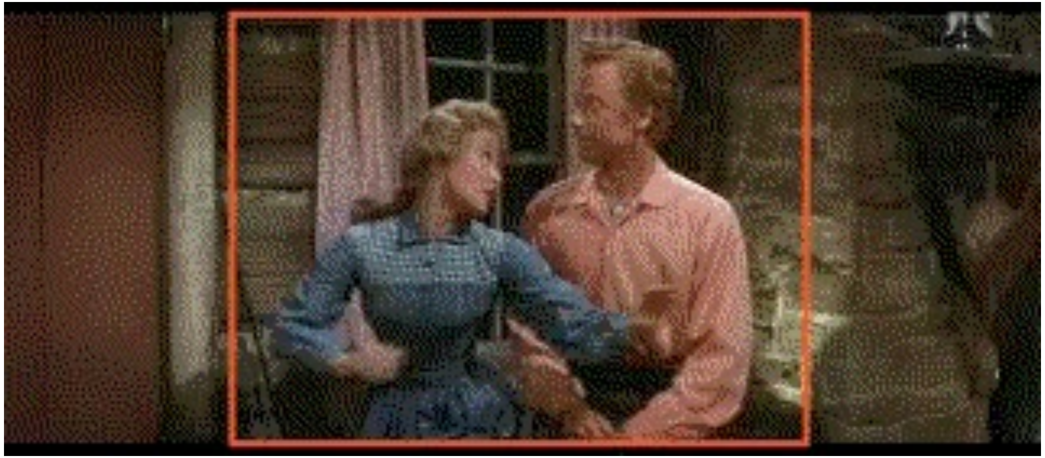
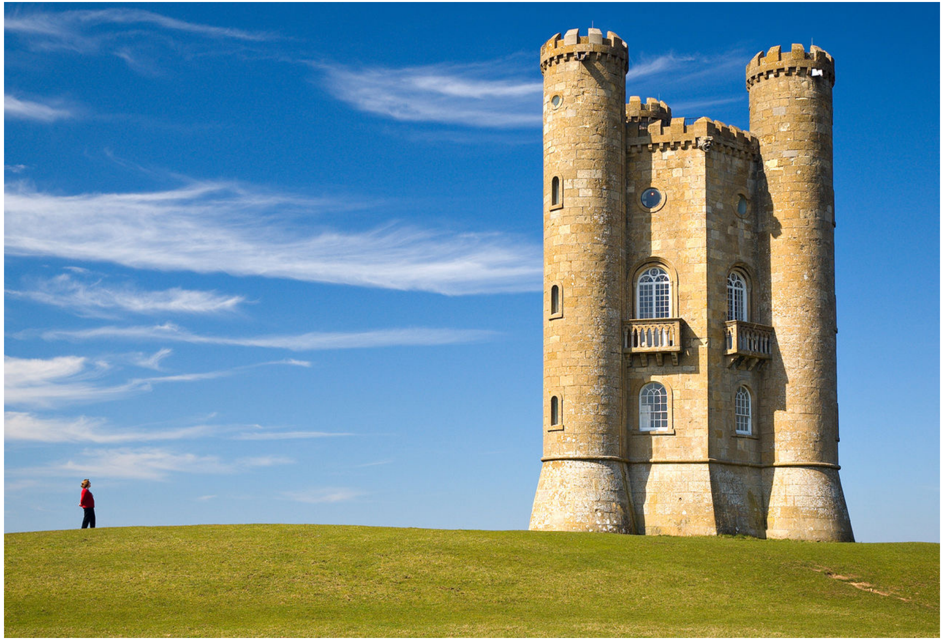


Image resizing (cropping in videos): Pan and scan



source: http://forum.videohelp.com/threads/300336-What-is-Pan-and-Scan

Image resizing: Scaling



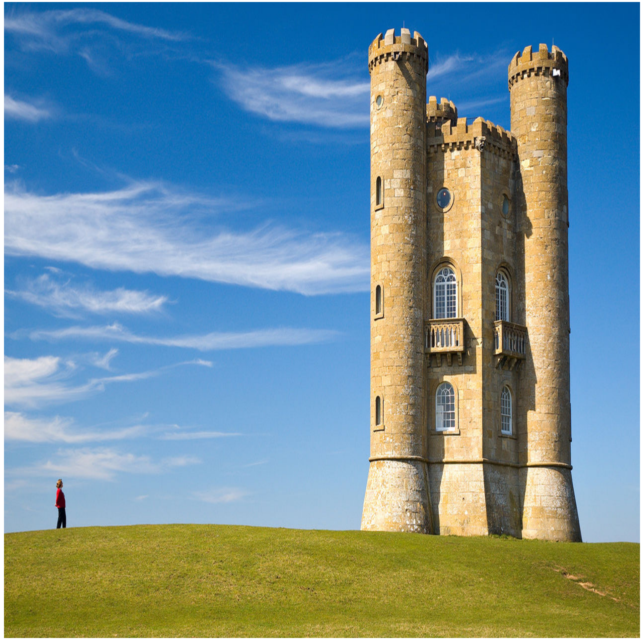


Image resizing: Letterboxing

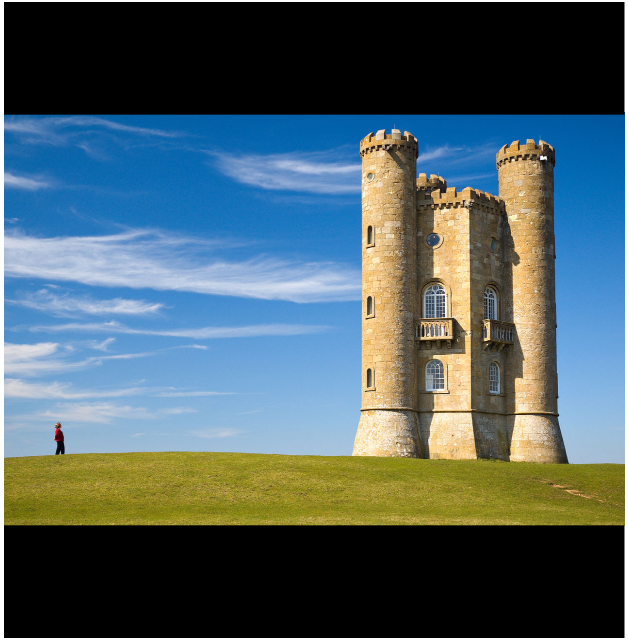
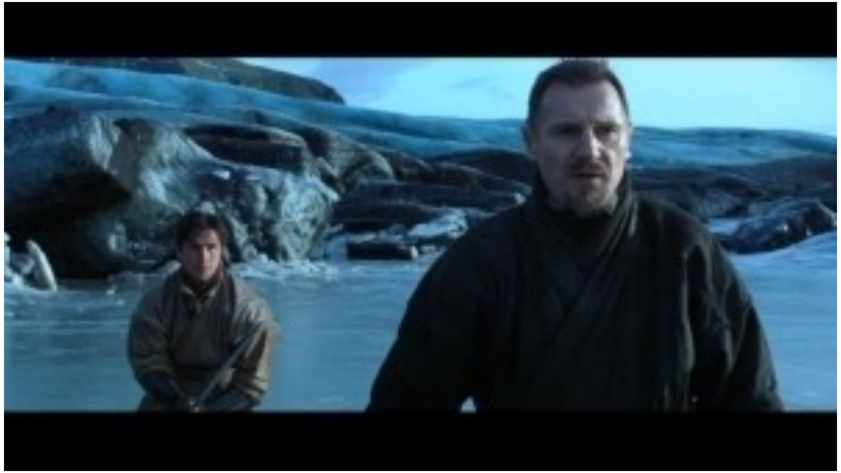


Image resizing: Letterboxing



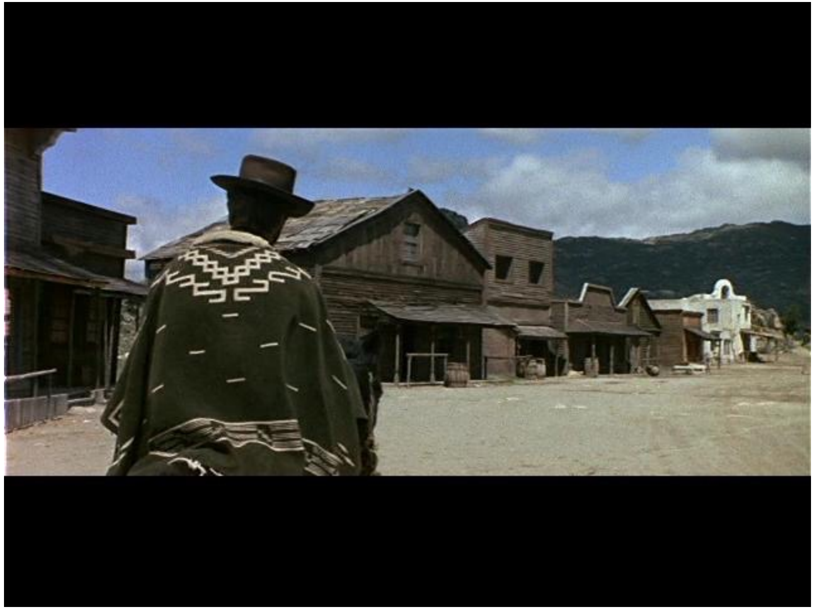
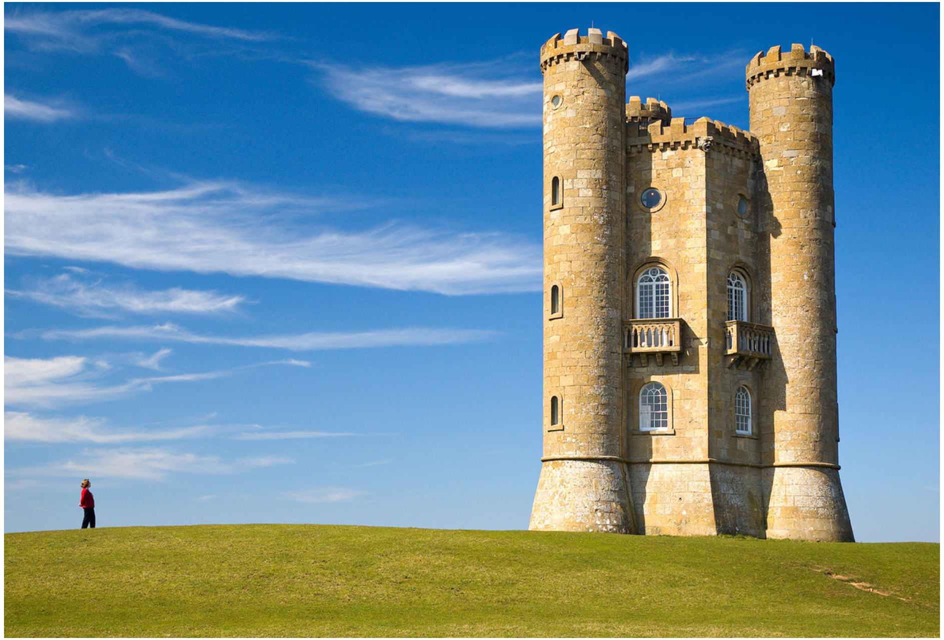
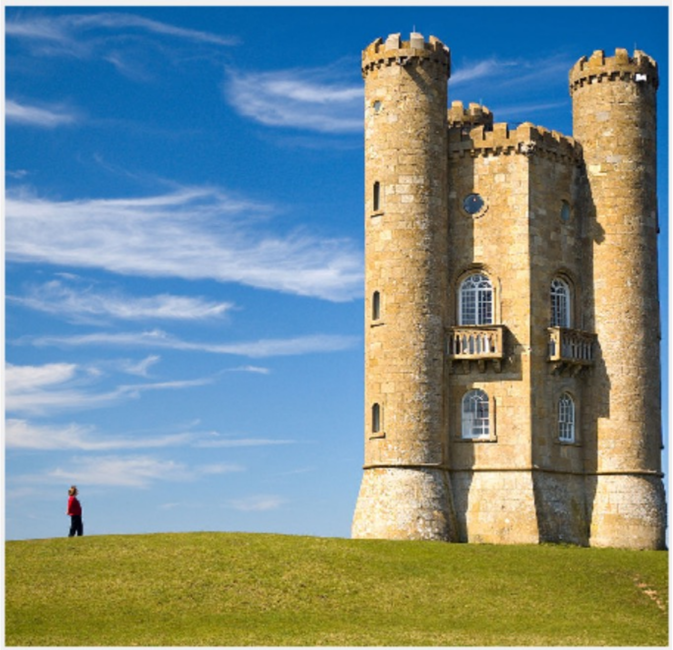


Image resizing: content aware





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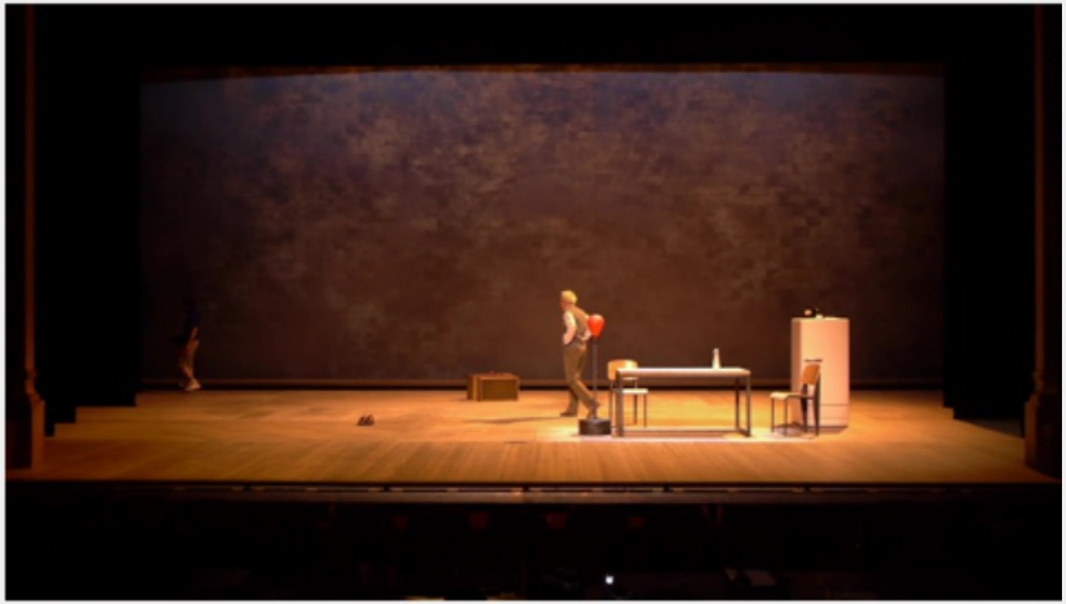

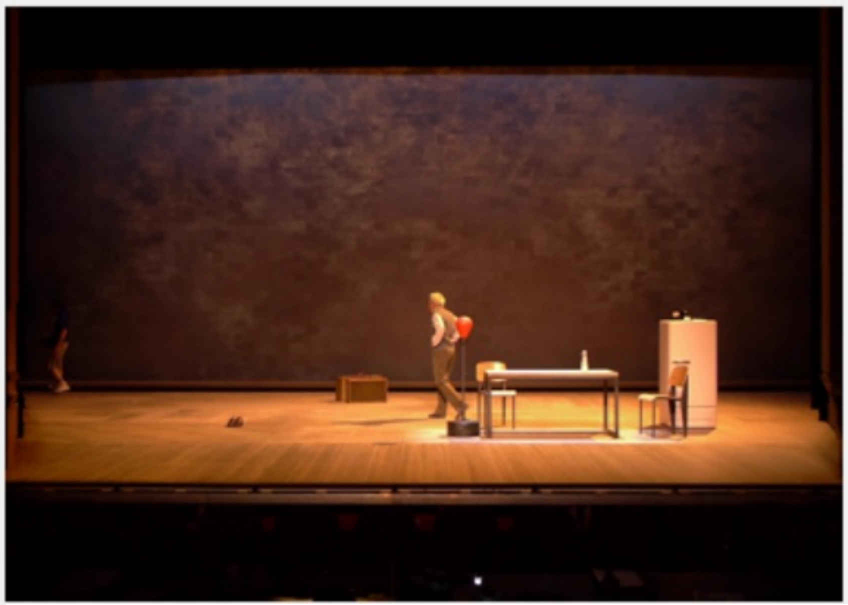

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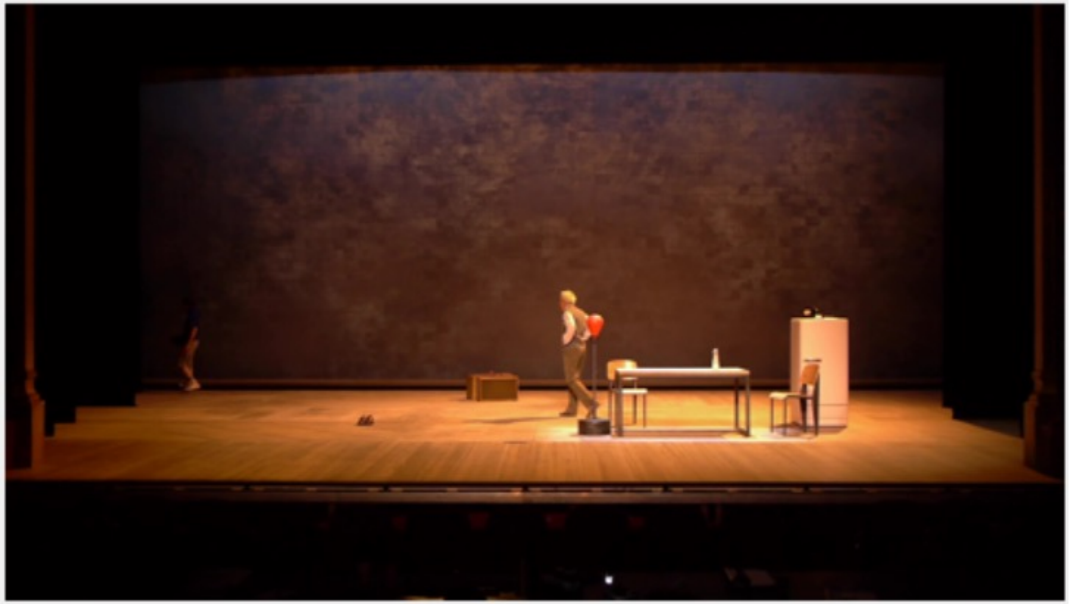


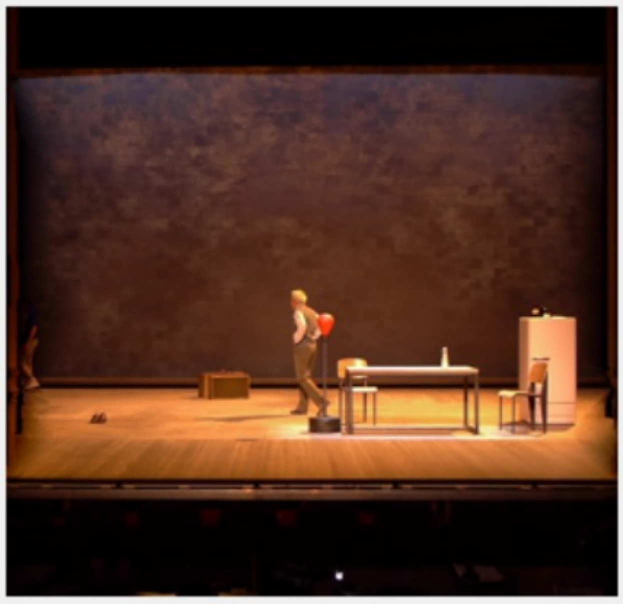
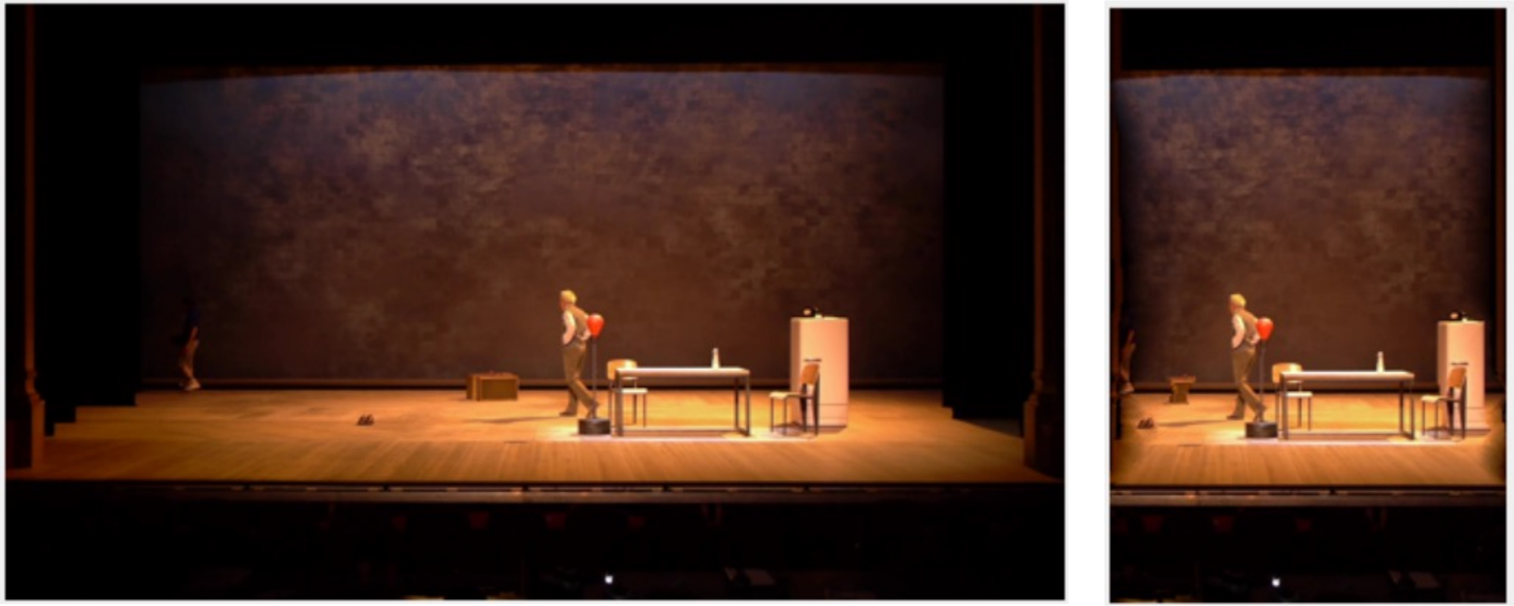


Image resizing: content aware

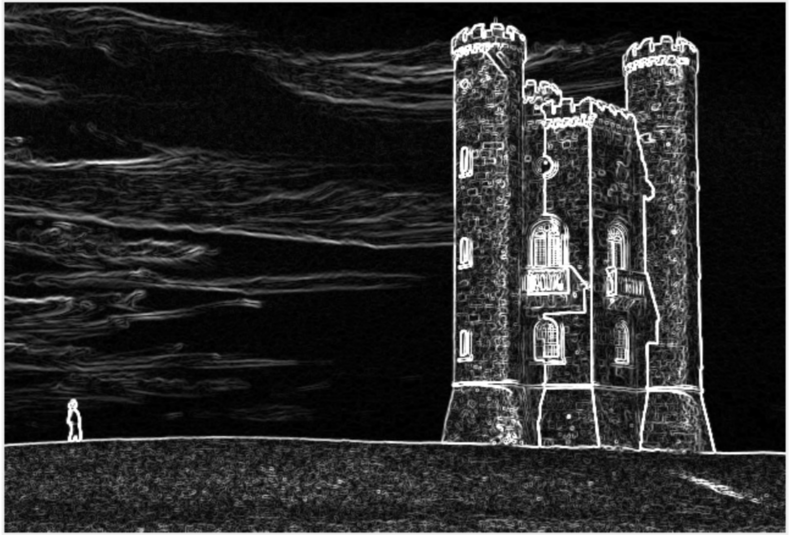


How do we do it?

Many algorithms…..

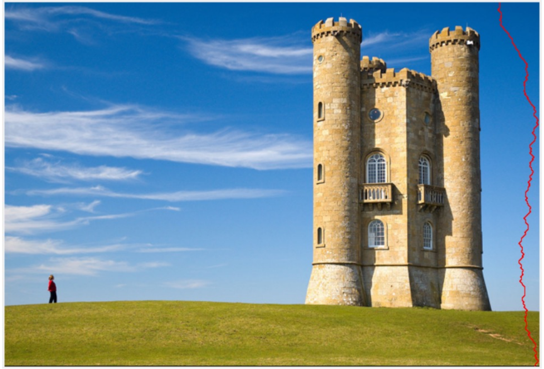
We will discuss a particular one today, called seam carving!

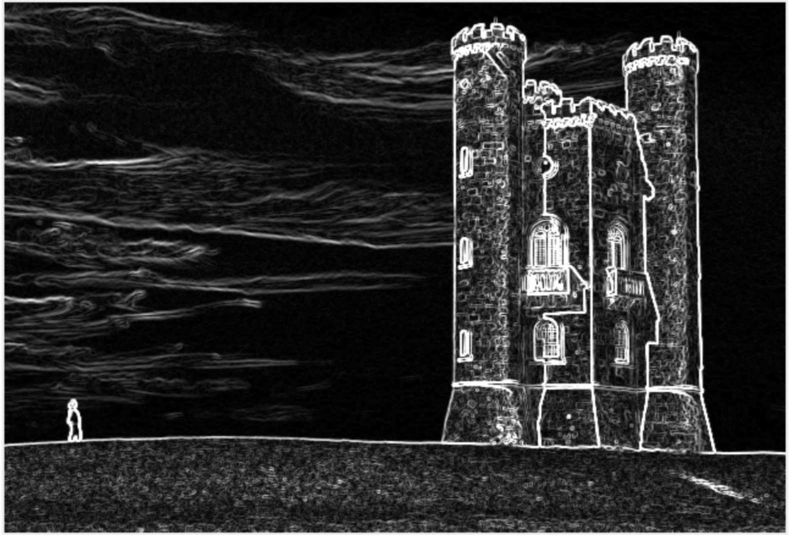
Overview: step 1

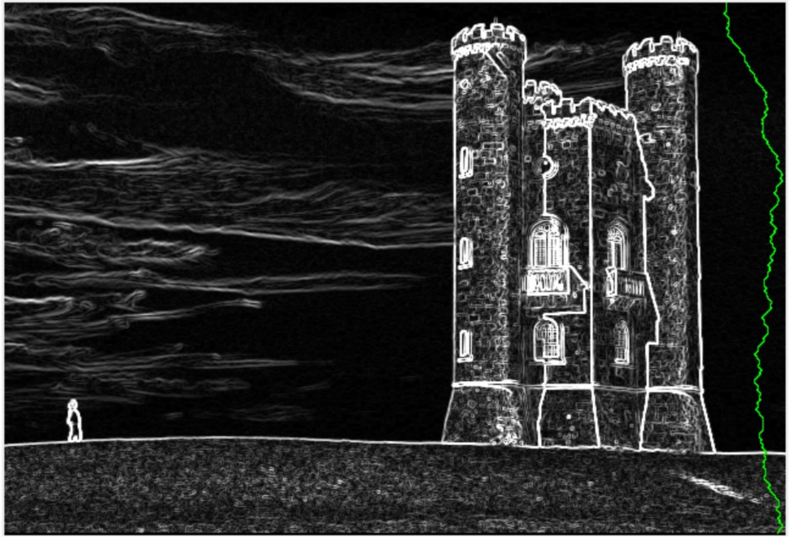


Compute some sort of importance characteristic: gradient magnitude, entropy, visual saliency, eye-gaze movement

Overview: step 2

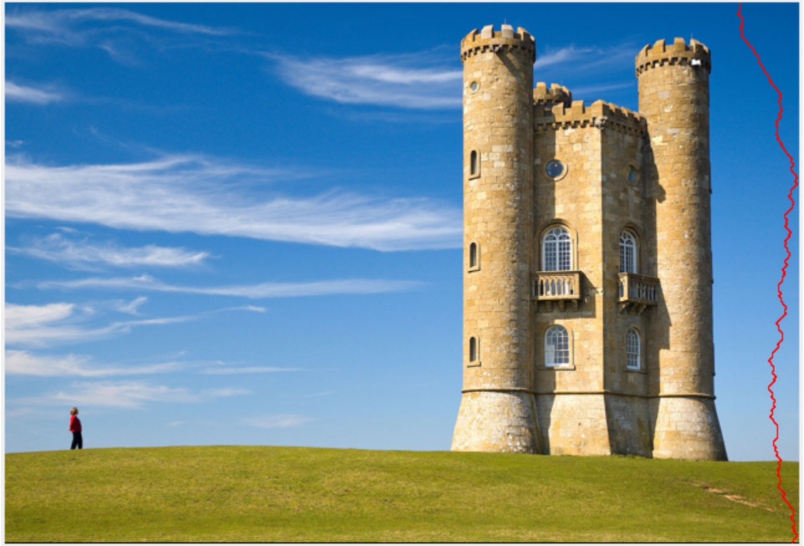






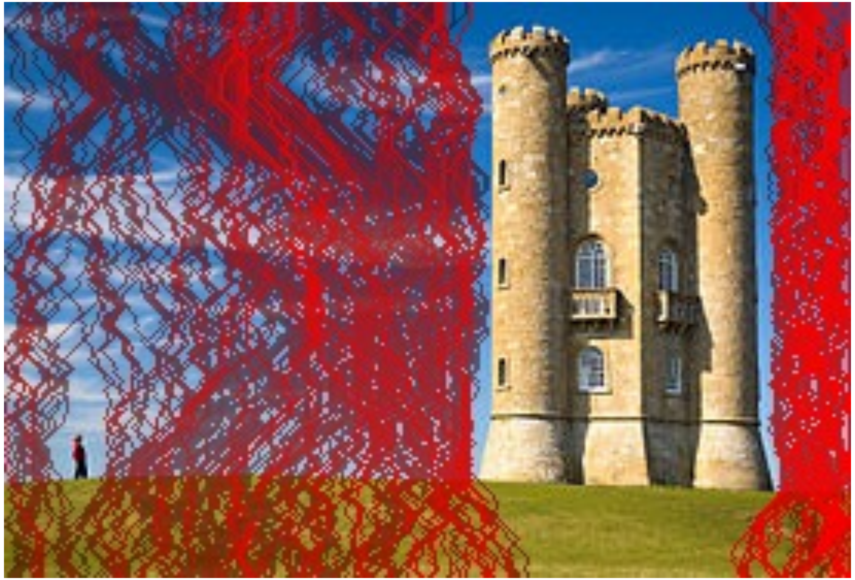
Find the path of minimum cost in the importance image

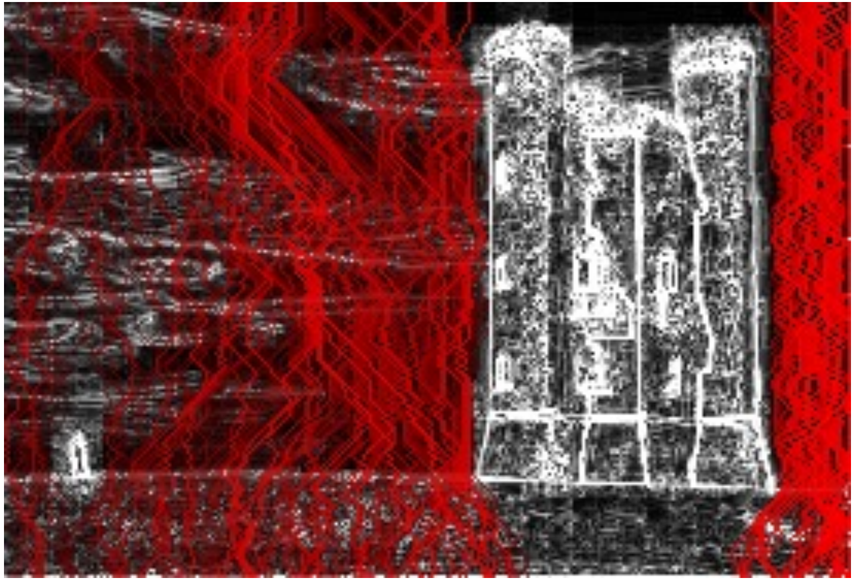
Overview: step 3



Delete the minimum cost seam

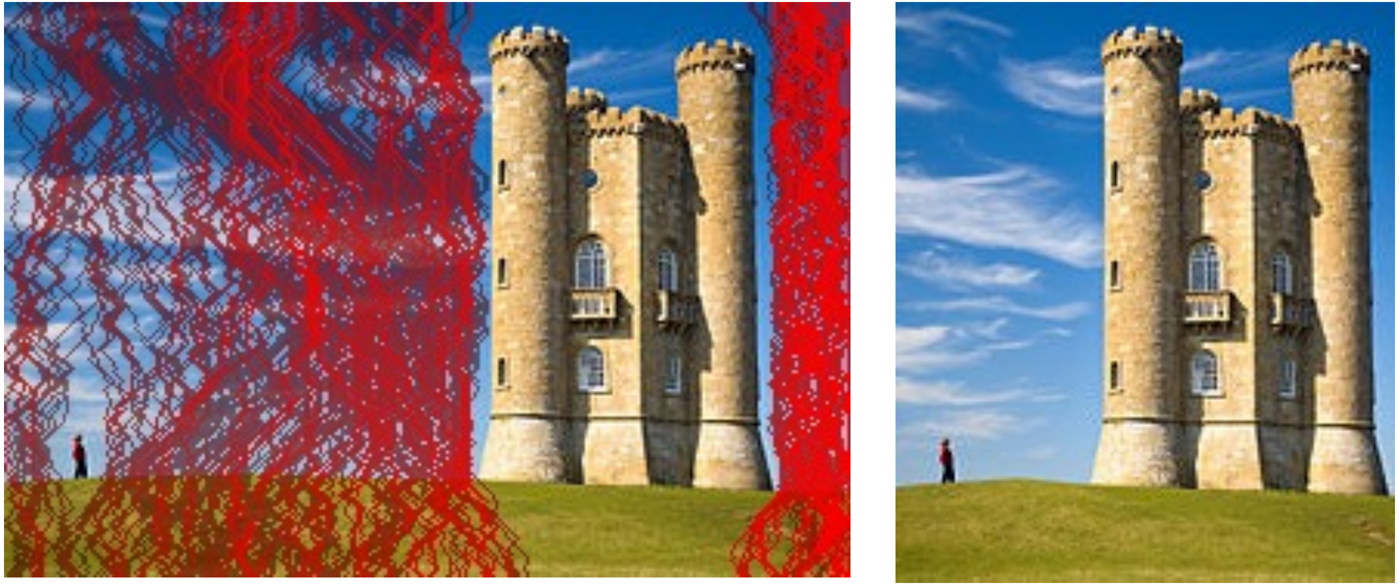
Overview: step 4





Repeat step 1, 2 and 3 until reaching the desired size

Overview: step 4

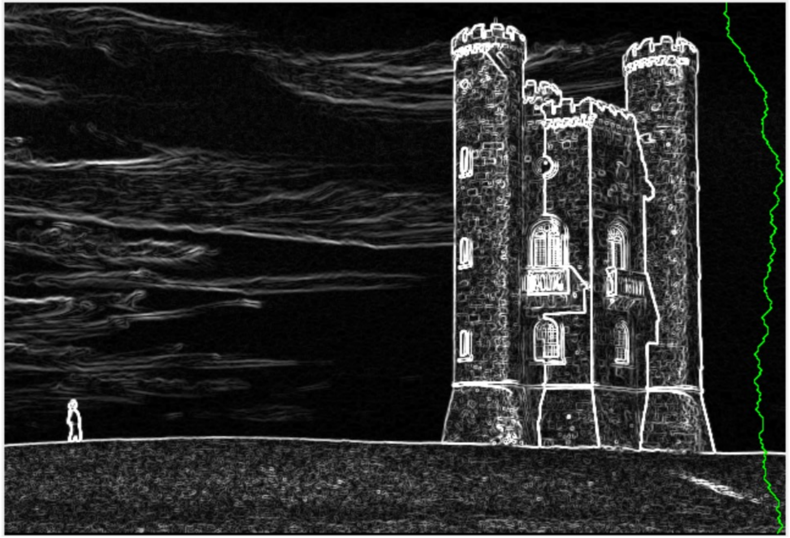


Repeat step 1, 2 and 3 until reaching the desired size

Video Illustration

Source: http://blogs.techsmith.com/

How to find the minimum cost seam?

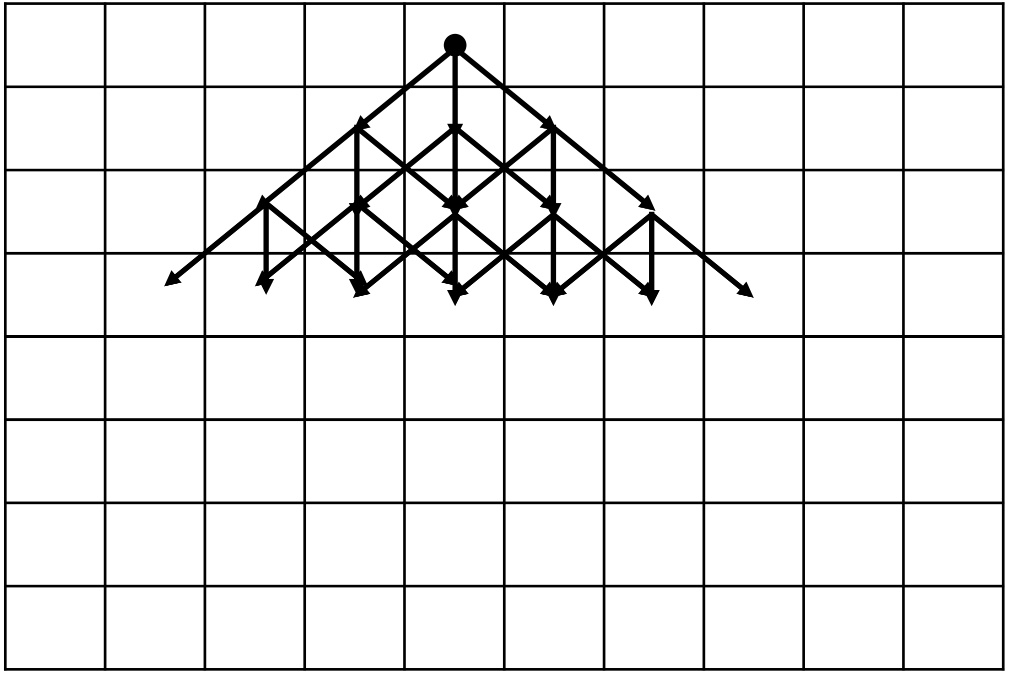


How to find the minimum cost seam?

- Find minimum cost **connected** path from top to bottom (width reduction)

Naïve algorithm

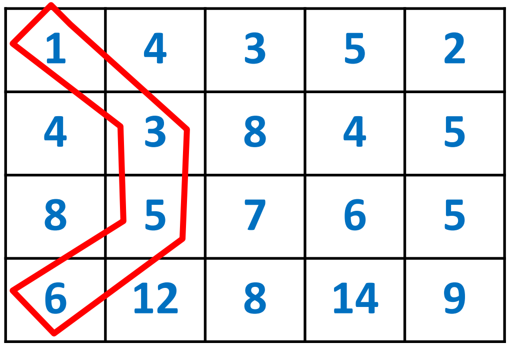
- Check all possible paths
  - foolish and infeasible



Dynamic programming

1	4	3	5	2
3	2	5	2	3
5	2	4	2	1
1	7	3	9	4

Importance image (M)

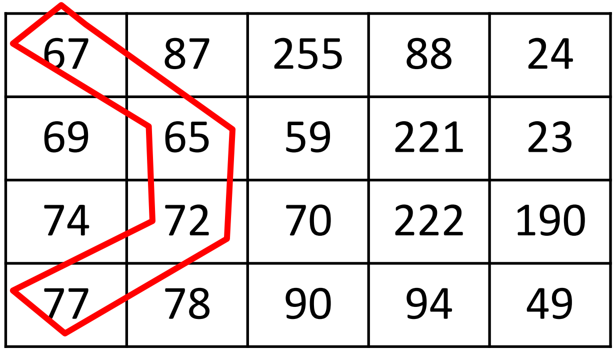


1	4	3	5	2
4	3	8	4	5
8	5	7	6	5
6	12	8	14	9

Cost matrix (C)

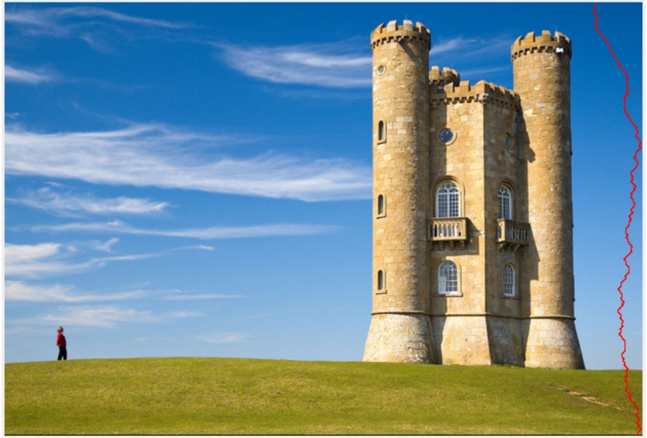
$$C(i,j) = M(i,j) + \min \begin{cases} C(i-1, j-1) \\ C(i-1, j) \\ C(i-1, j+1) \end{cases}$$

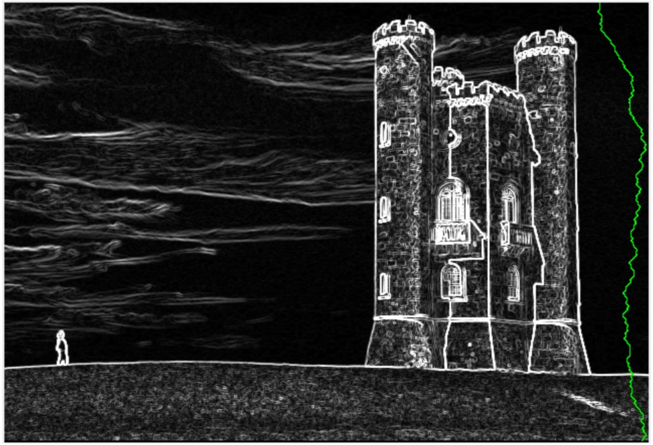
Deleting a column



67	87	255	88	24
69	65	59	221	23
74	72	70	222	190
77	78	90	94	49

Example cost matrix





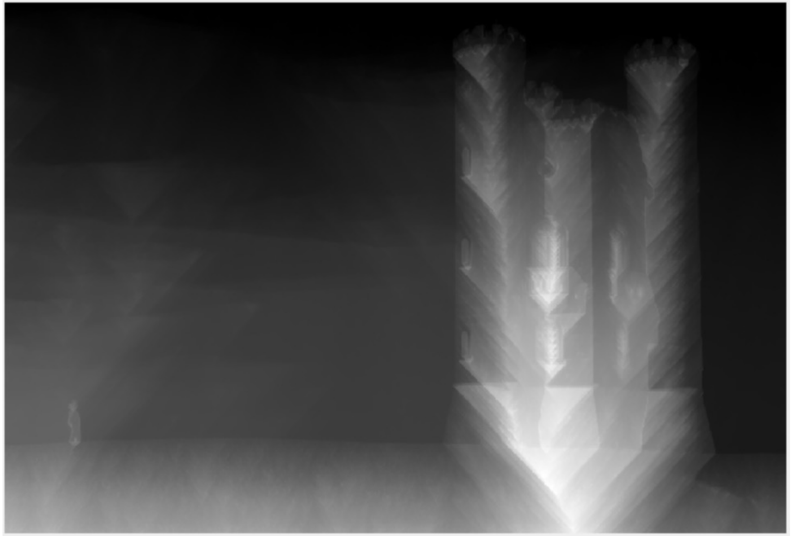
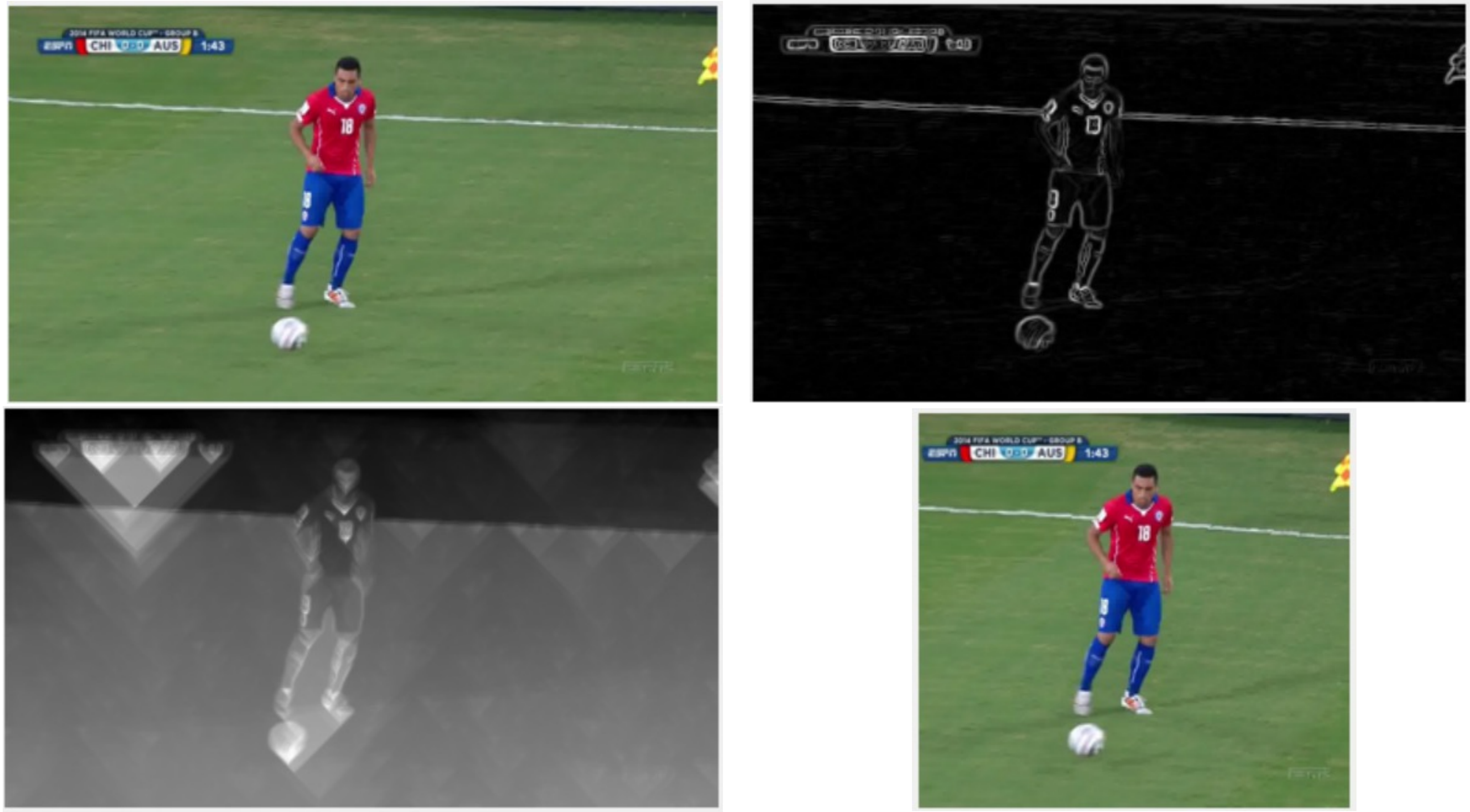
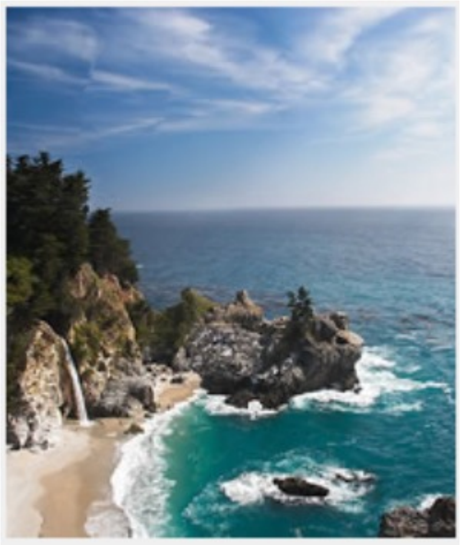
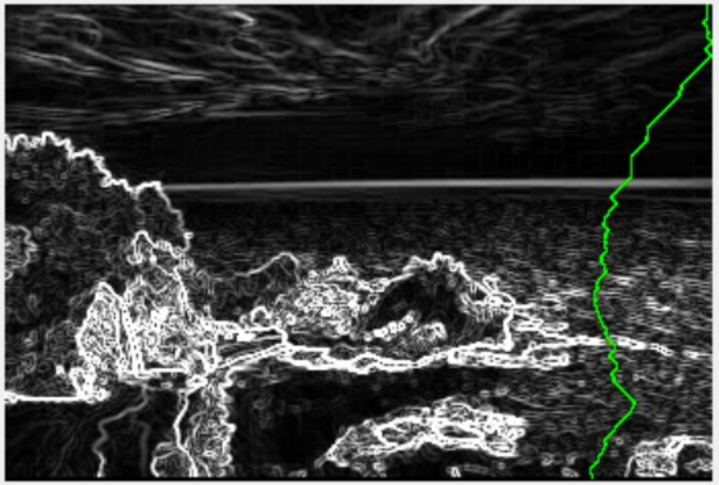


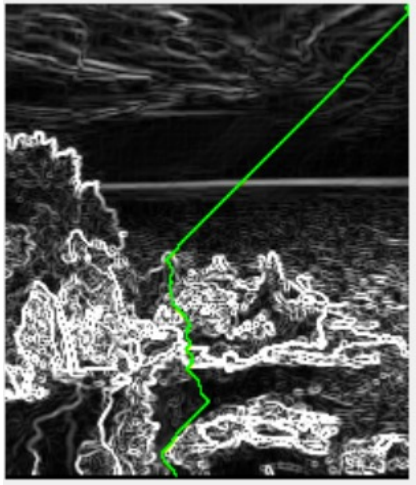
Image resizing: content aware





First
seam

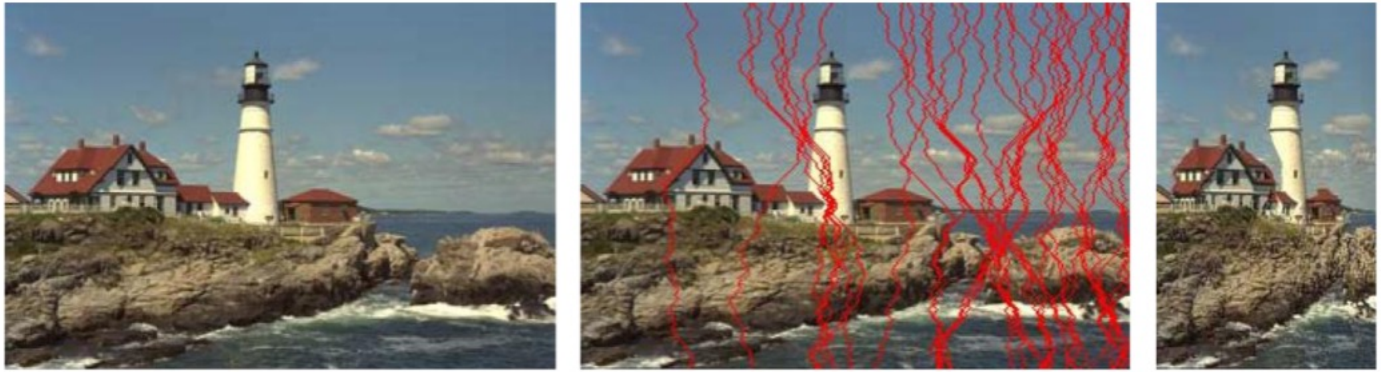




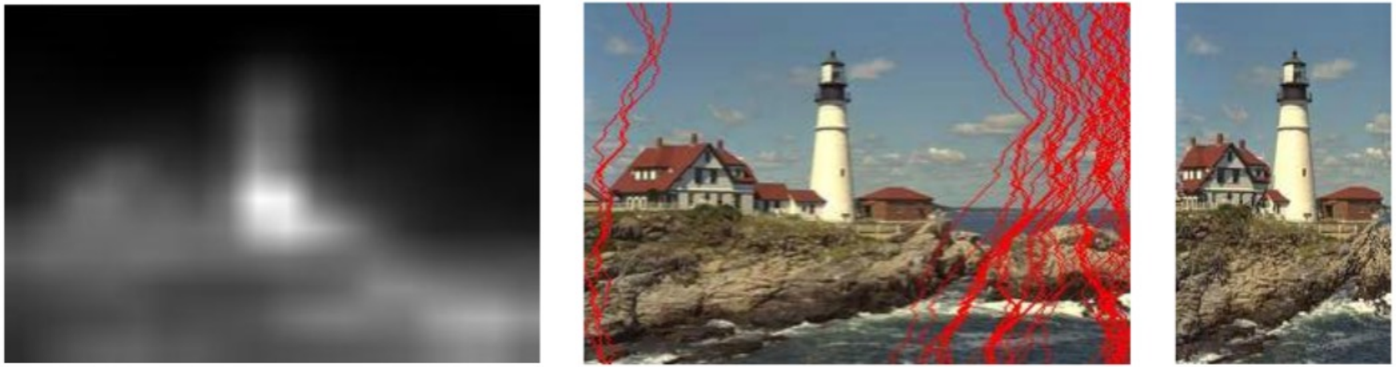
Last
seam

Changing the importance criteria

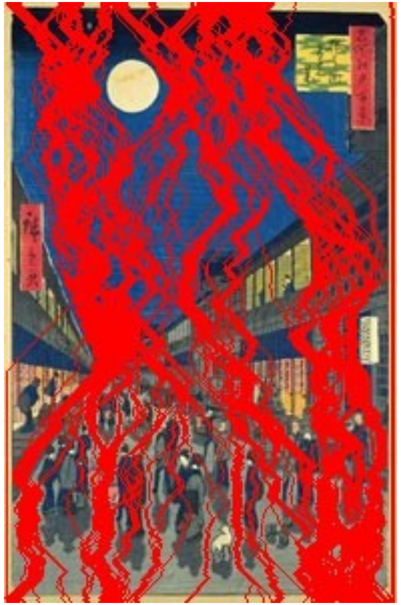
Gradient magnitude

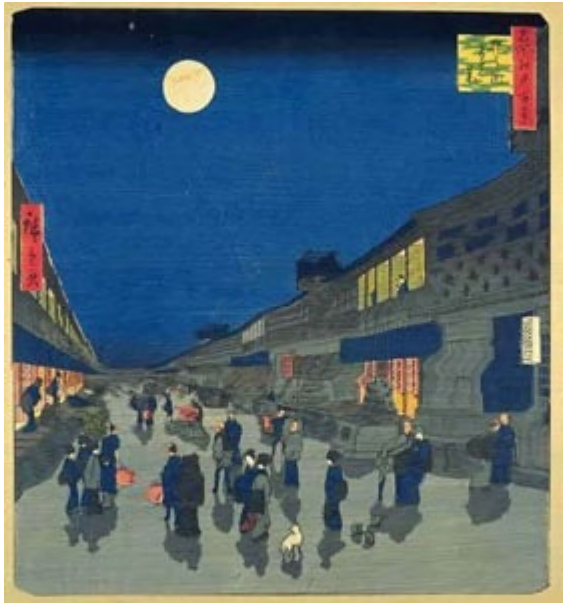


Saliency



Can we do more?





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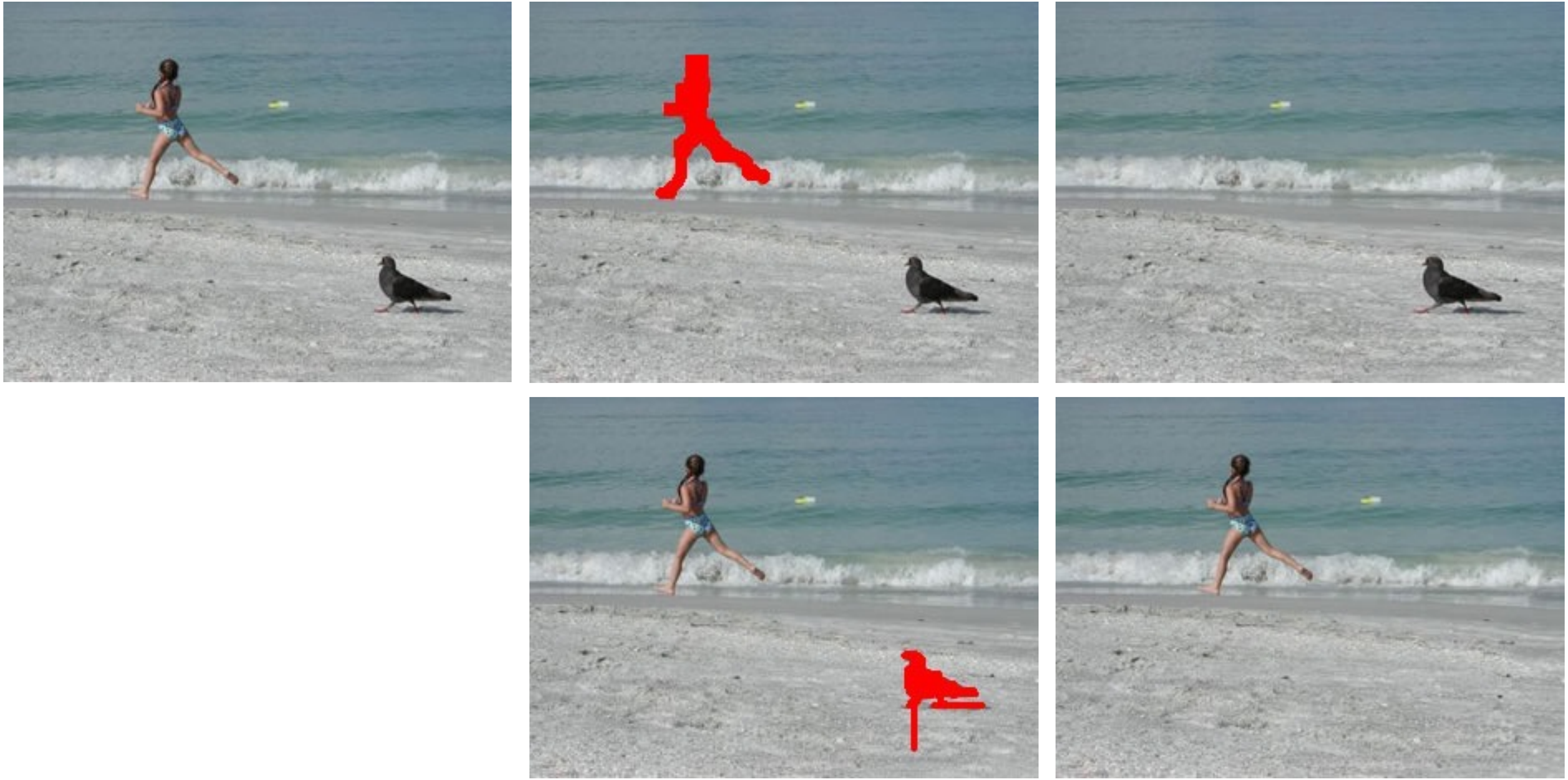
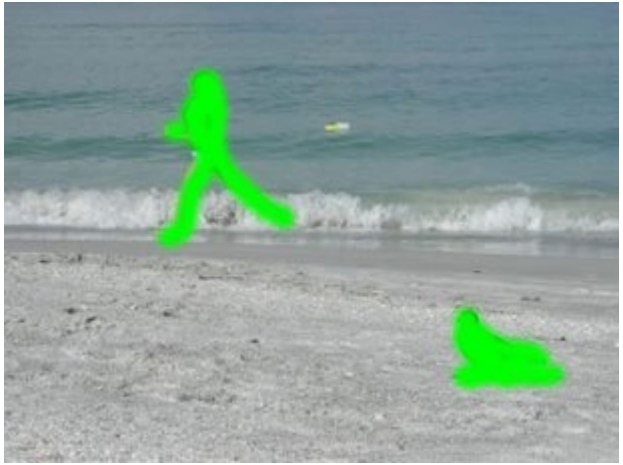


Can we do more?



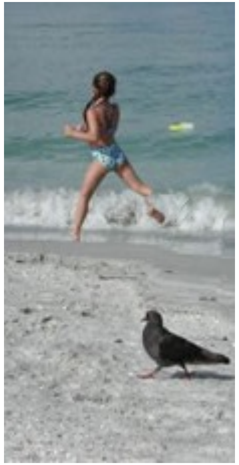
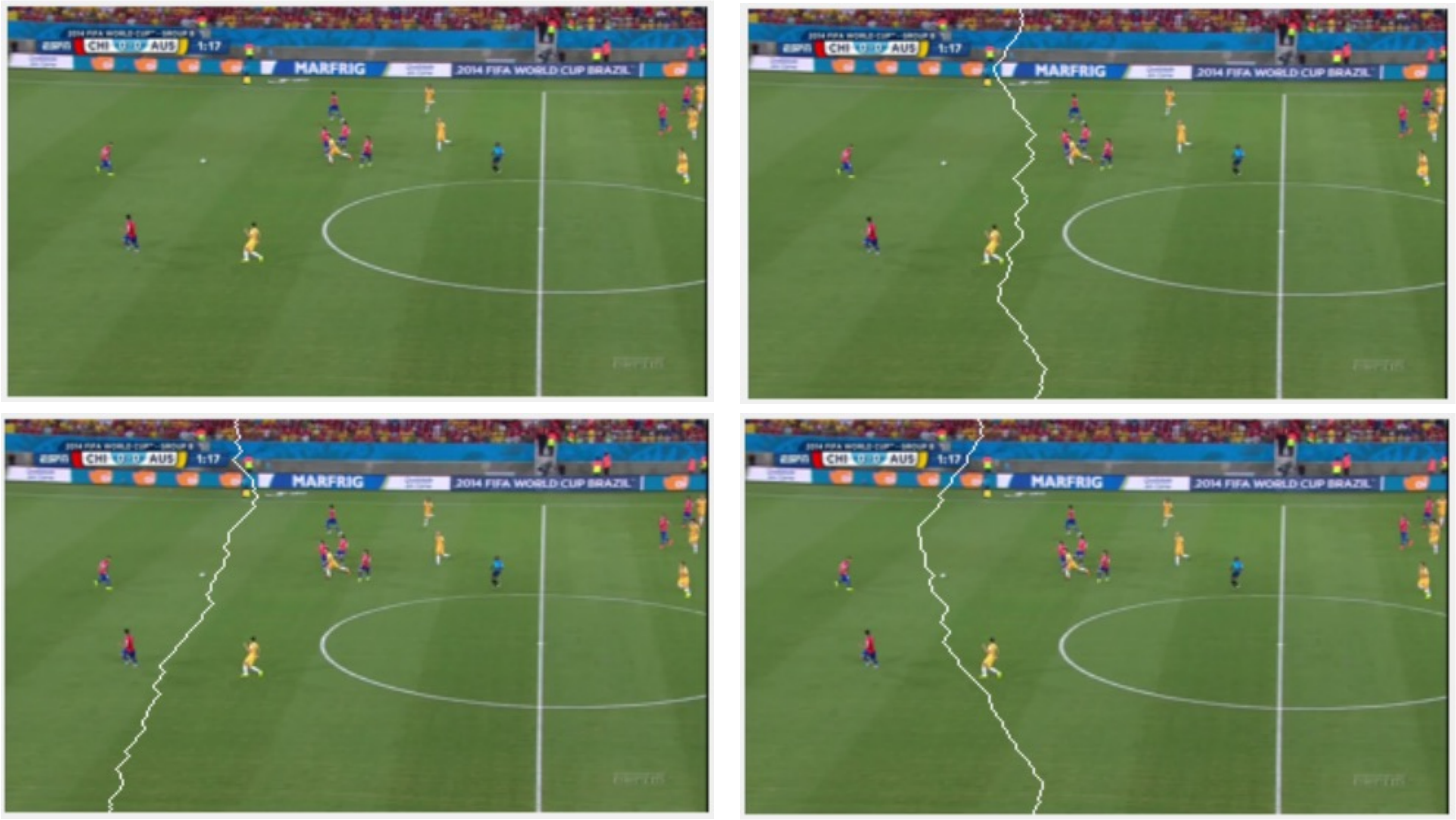
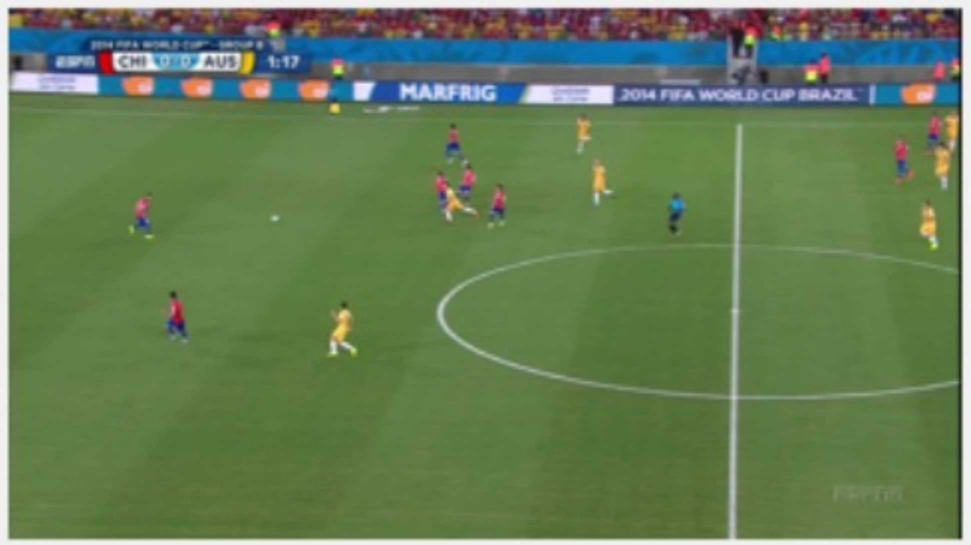
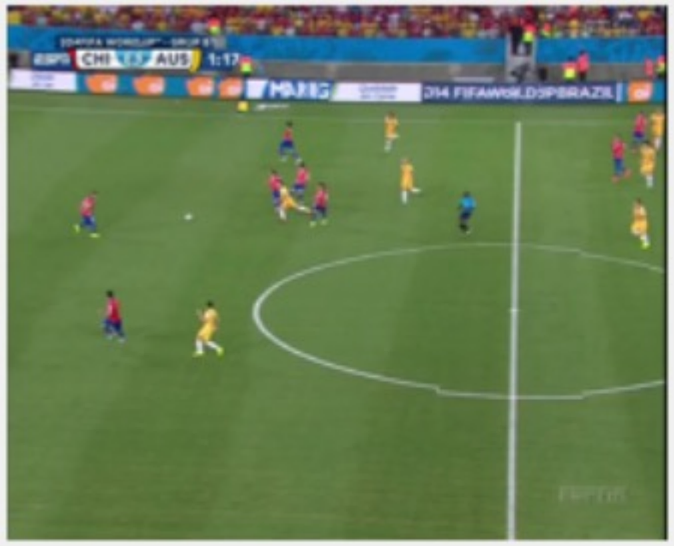


Image resizing: content aware

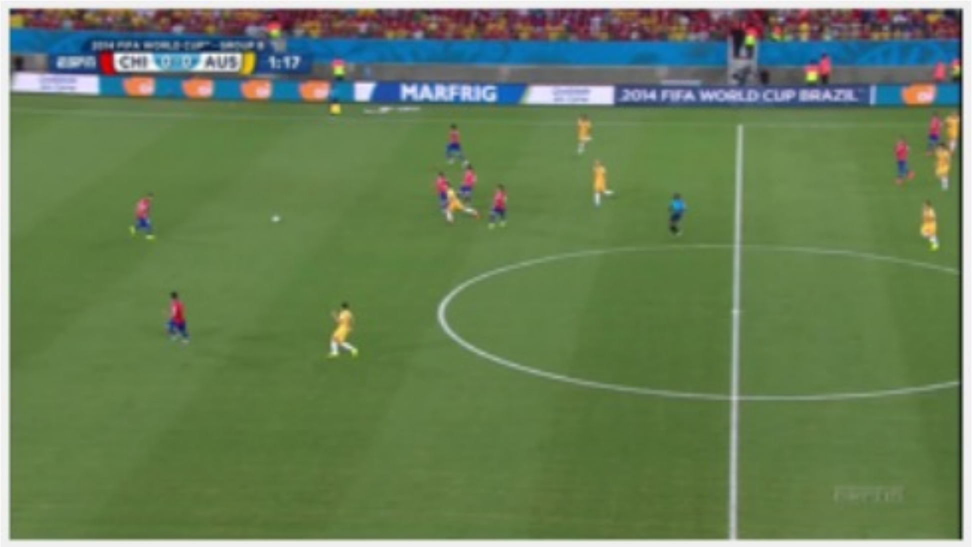


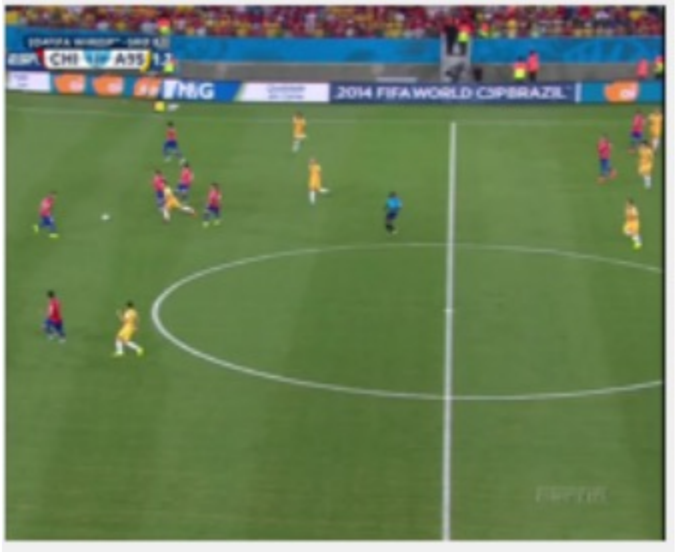
Failure: regular structures



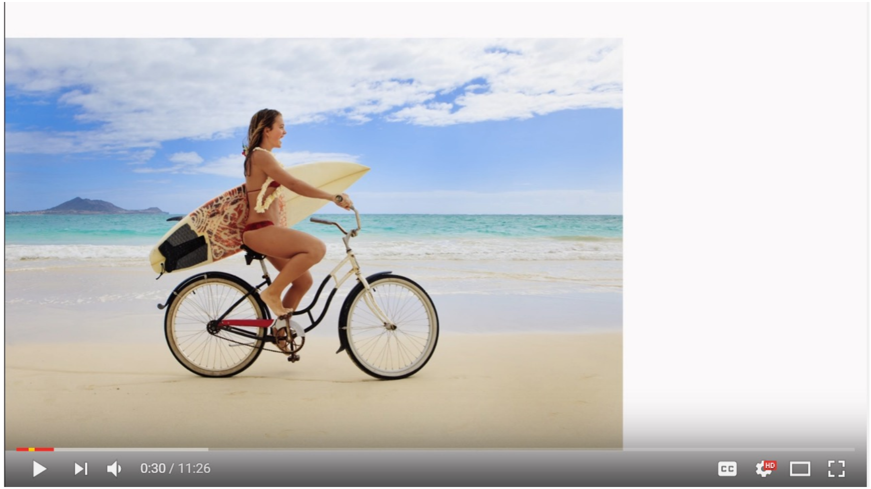


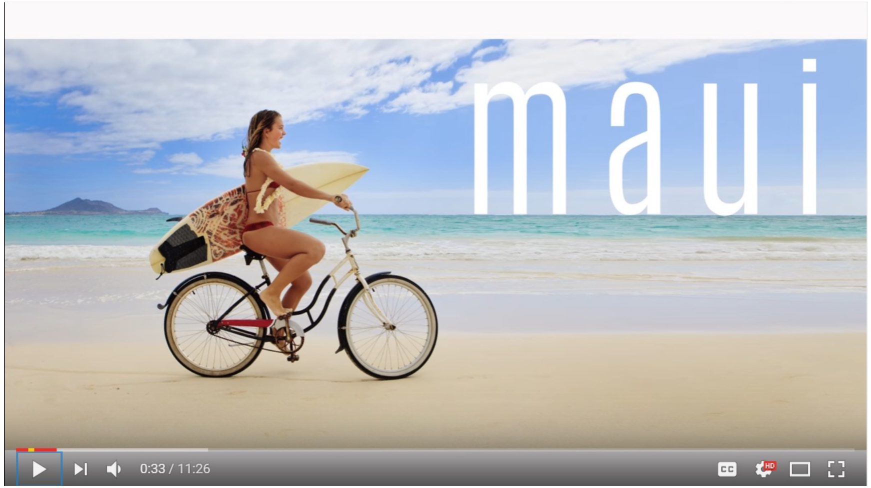
Failure: regular structures





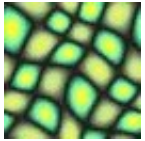
More





https://www.youtube.com/watch?v=ixCroJfzM6U

Application to texture synthesis



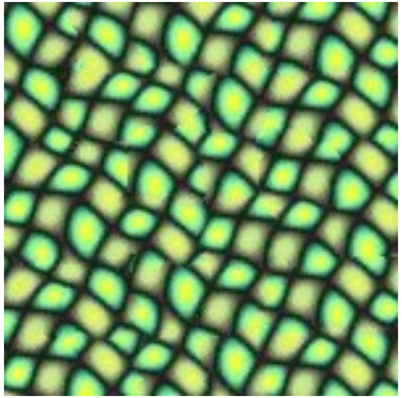
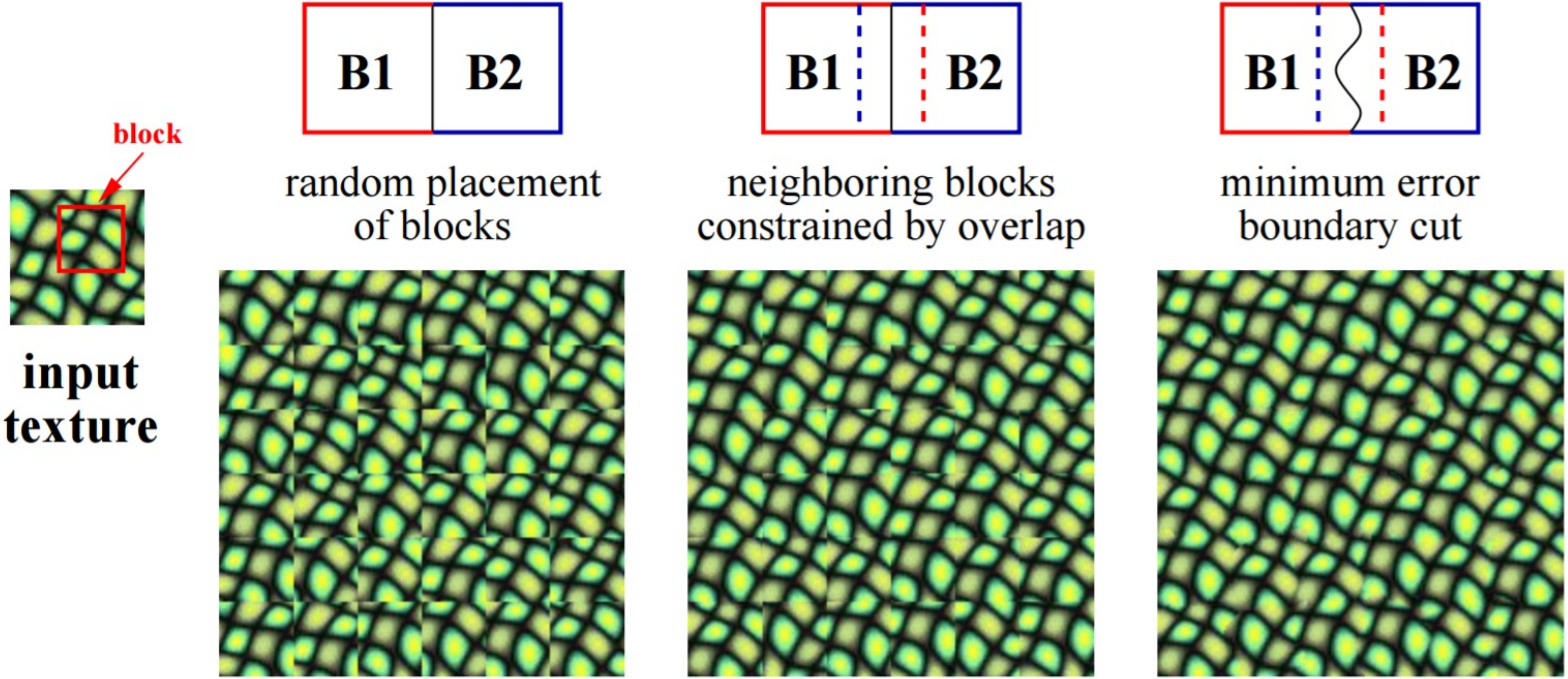


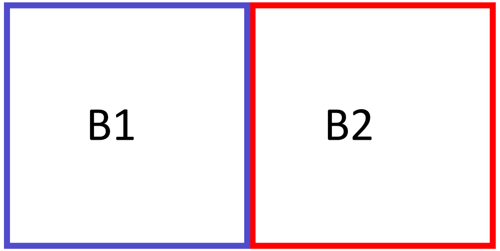
Image Quilting for Texture Synthesis & Transfer, SIGGRAPH 2001

Slides from A. Efros

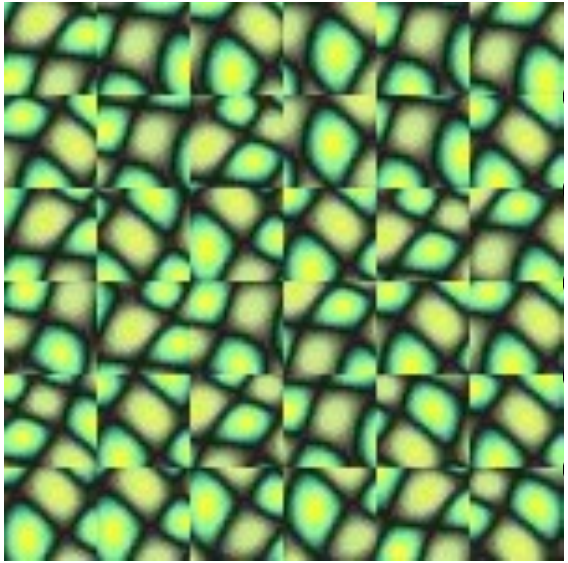
Application to texture synthesis


block
input texture
B1
B2
random placement of blocks
B1
B2
neighboring blocks constrained by overlap
B1
B2
minimum error boundary cut

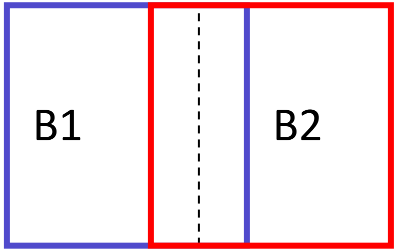
Application to texture synthesis



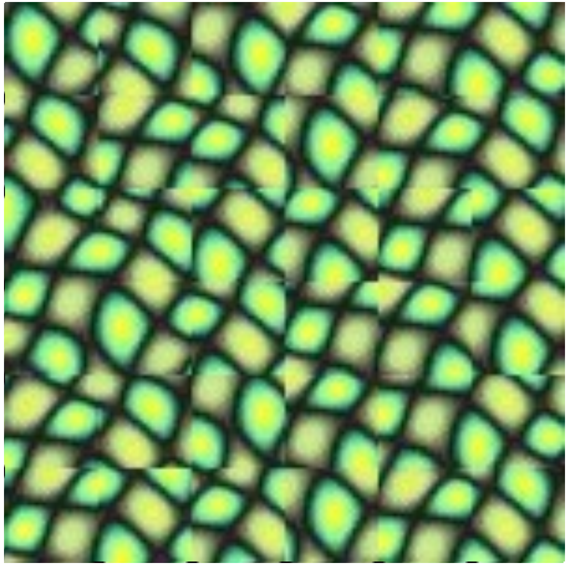
Random placement of blocks



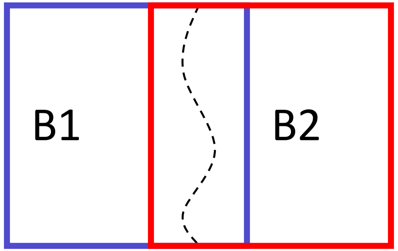
Application to texture synthesis



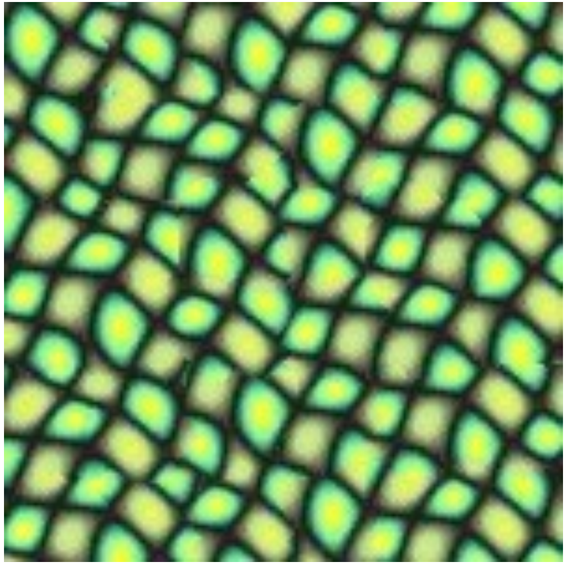
Neighboring blocks constrained by overlap



Application to texture synthesis

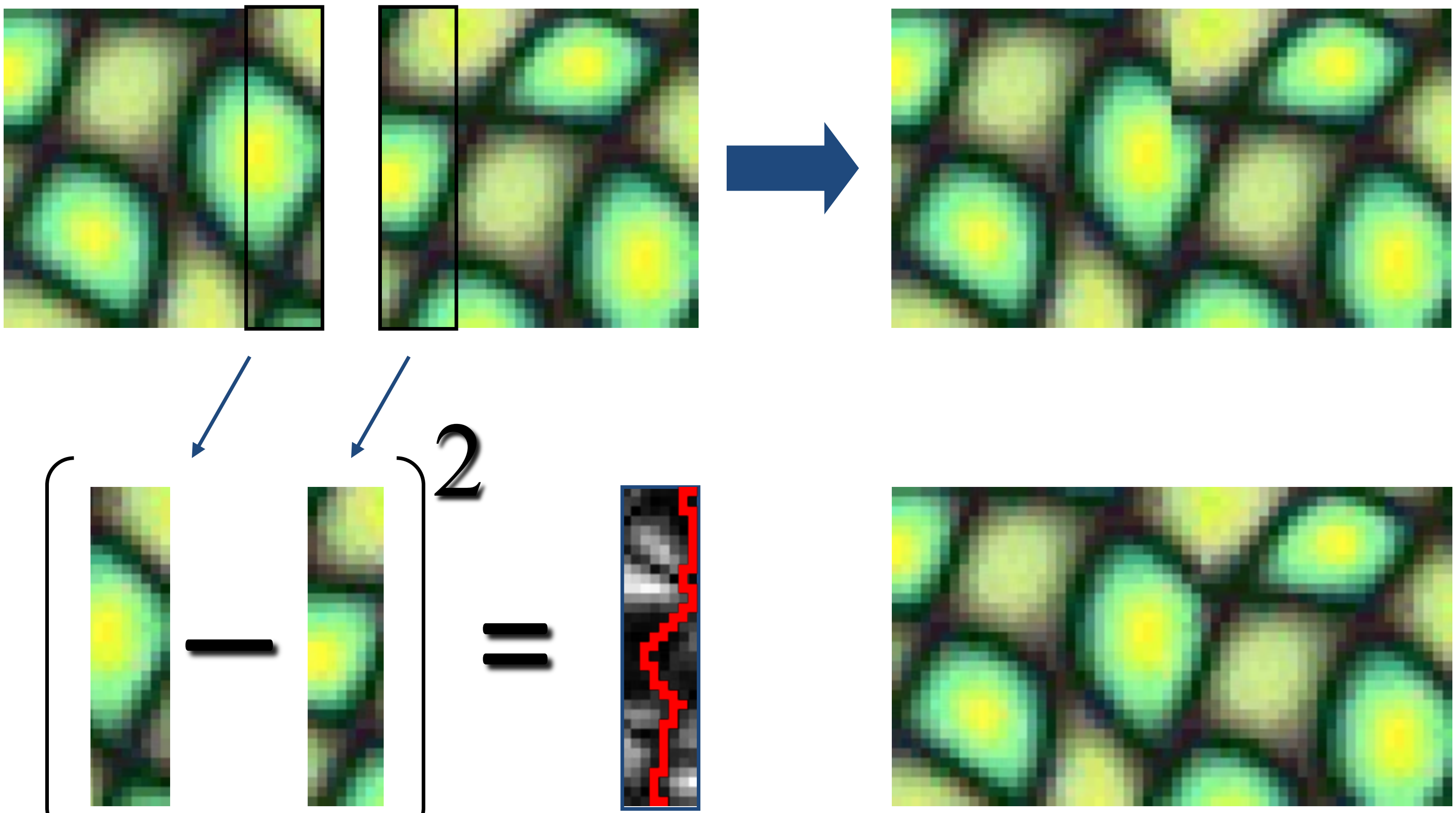


Minimal error boundary cut



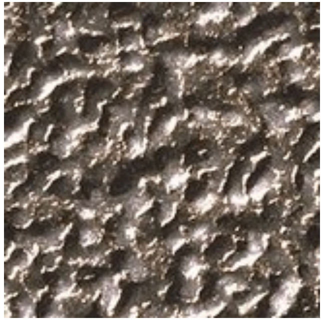
overlapping blocks

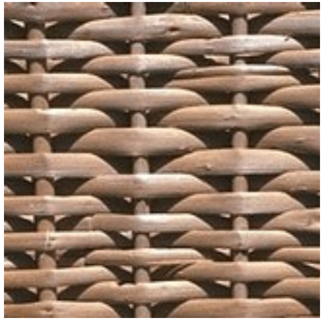
vertical boundary

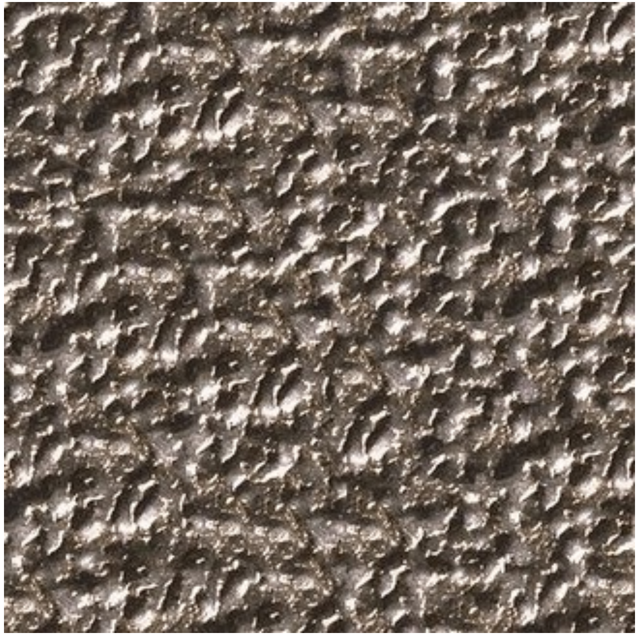


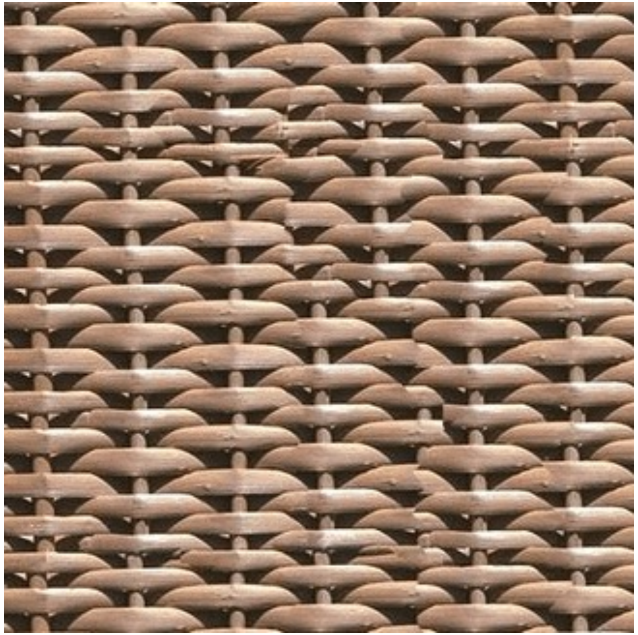
overlap error

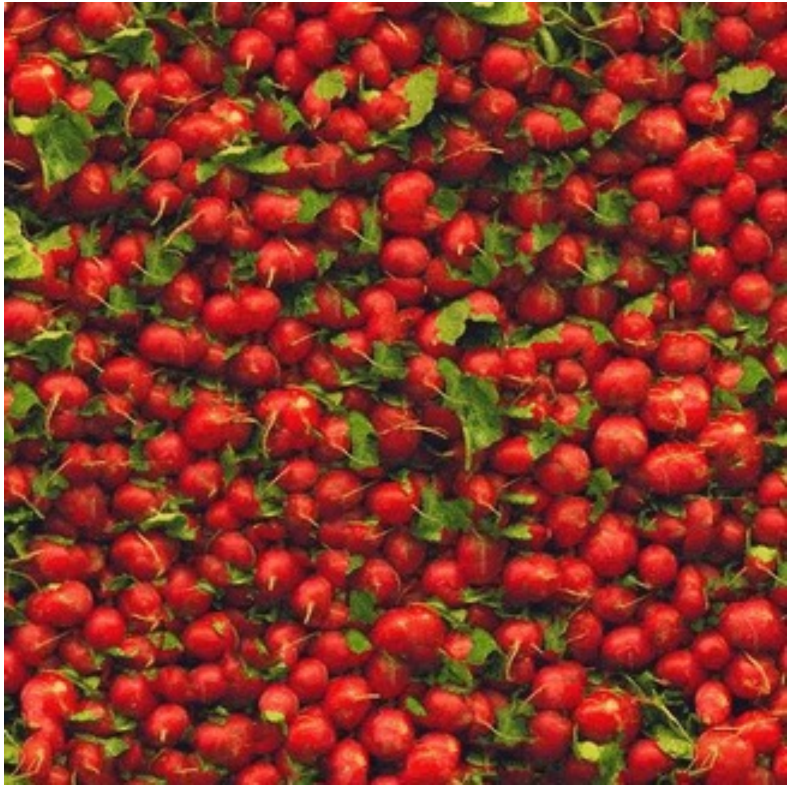
min. error boundary





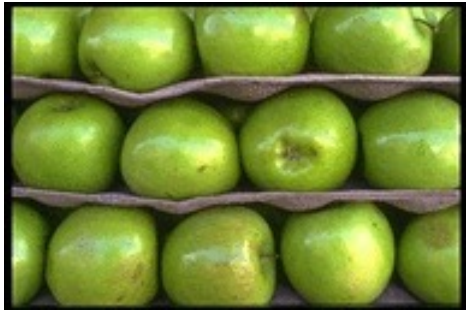


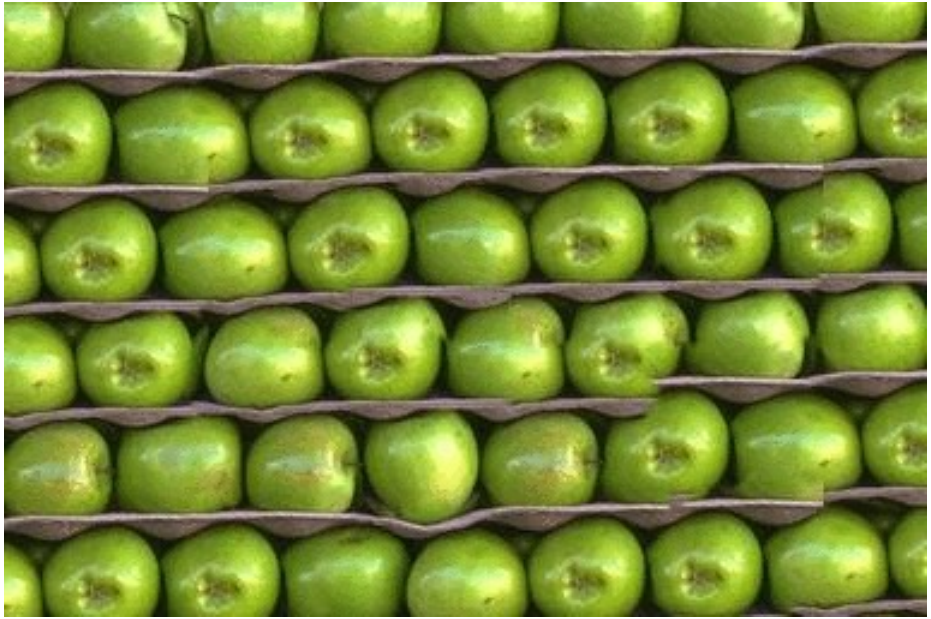


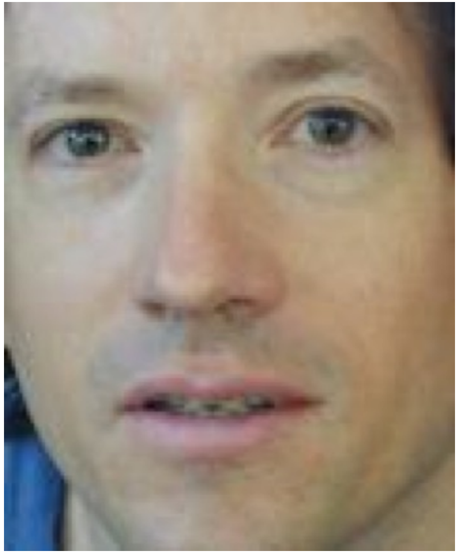


College Inn
Chicken Broth

College Inn
Chicken Broth







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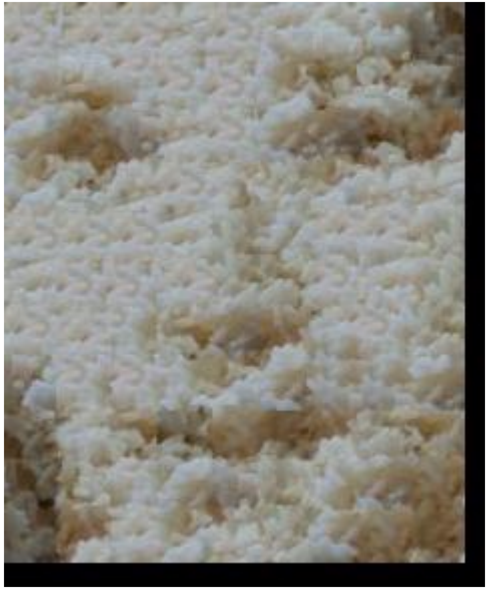

parmesan