

Analysis of Compression Ratio of Various Randomly Generated Images of Same Size

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Abstract

Various randomly generated images of size $m \times n$ are created and compressed using the standard TIF compression and their compression ratio are analyzed. TIF compression is used to preserve the original file size. This method is applied for various values of m and n . The study of randomized picture in the literature is very rare and this current paper is aimed to fill up that gap.

Keyword: randomly generated picture; compression ratio; JPEG; random image

1. Introduction

In mathematics, we have studied random path, randomly generated graphs, random matrix etc. But the study of randomly generated images is very rare. The purpose of this paper is to fill this big gap in the literature. We have created random pictures of various sizes of up to 10,000 pixels. Each fixed size is analyzed in two different ways. So for a given image of size, $m \times n$, we consider two sizes $a \times b$ and $c \times d$ so that, $ab = cd = mn$. In each case, 100 random pictures are generated and saved as “.tif” format to preserve original size. We gradually increase mn from 12 to all the way to 10,000 and analyze the file size. We use “Mathematica” software to generate the random image. To learn more about Mathematica, readers are encouraged to see (Purdue University, n.d.) and (Wolfram Mathematica, 2013). All the code is provided in this paper so that the reader can recreate the experiment using a computer.

2. Various Other Use of Image Compression

Image compression is an everyday application. When you post an image in the Facebook, or download/upload an image from/to the internet, it automatically goes through an image compression mechanism, most likely, JPEG compression (Group, n.d.), as this being the most standard means of compression. To learn the mathematics behind the JPEG compression see (Image Compression, 2011). Image compression is used in NASA (Center). To learn some specific examples of image compression in NASA, see (Prince, Franco, Salva, & Windolf, 2014). To learn some modeling with image pixel see (Oyvind, 2007). To learn some other types of image compression, like wavelets image compression, see (Center) and for SVD image compression see (Cooper & Lorenc, 2006).

3. Mathematica Code

We use the following code to create 100 random images of size $m \times n$.

```
T = Table[Image[RandomReal[{0,1}, {m, n, 3}]], {i, 1, 100}];
```

In the above code, you need to replace the m and n by the appropriate number. Then use the following code to export all the images to a folder:

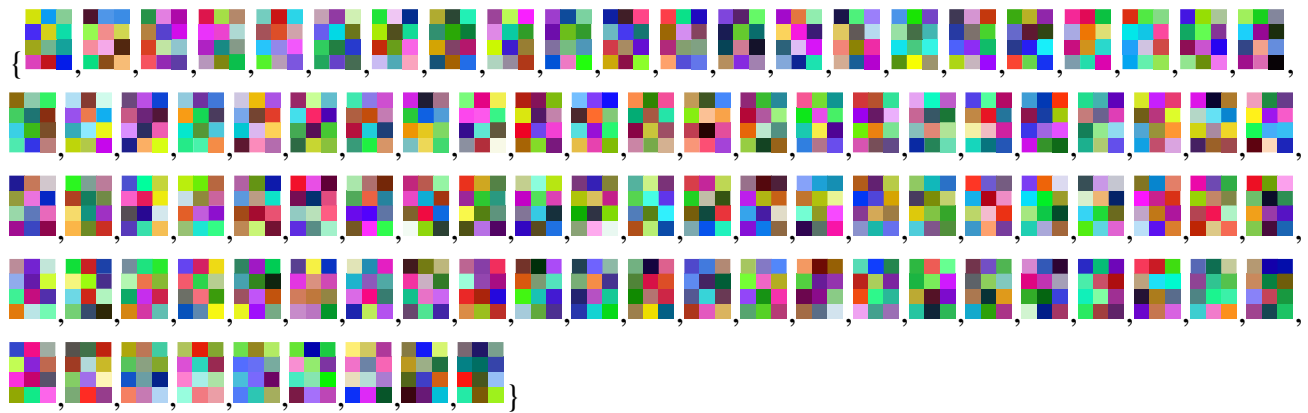
```
P = Export["C:\\Users\\prince\\Google Drive\\Portfolio_after_promotion\\publication_after_promotion\\  
\\Analyse Compression Ratio of Various Randomly Generated Images of Same Size\\  
\\compare_area_of_12\\4_by_3\\image001.tif", T, "VideoFrames"];
```

Here everything in red is the “folder path” where you want your images to be saved. The green part tells “Mathematica” to export the images one after the other. Note the .tif extension at the end which means that we are using “TIF” compression. If you want use “PNG” or “JPEG” instead, then use .png and .jpg respectively.

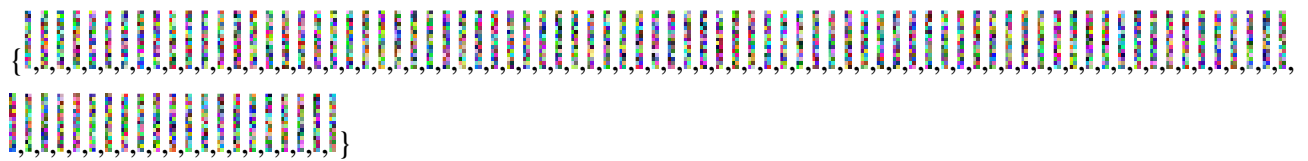
4. Sample Data

Following are some sample of random pictures of various sizes: (in each cases, we have 100 random images)

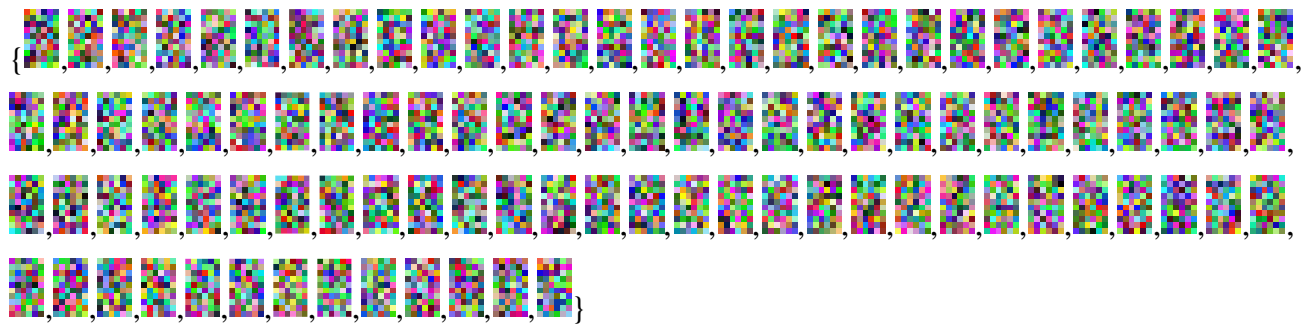
12×12



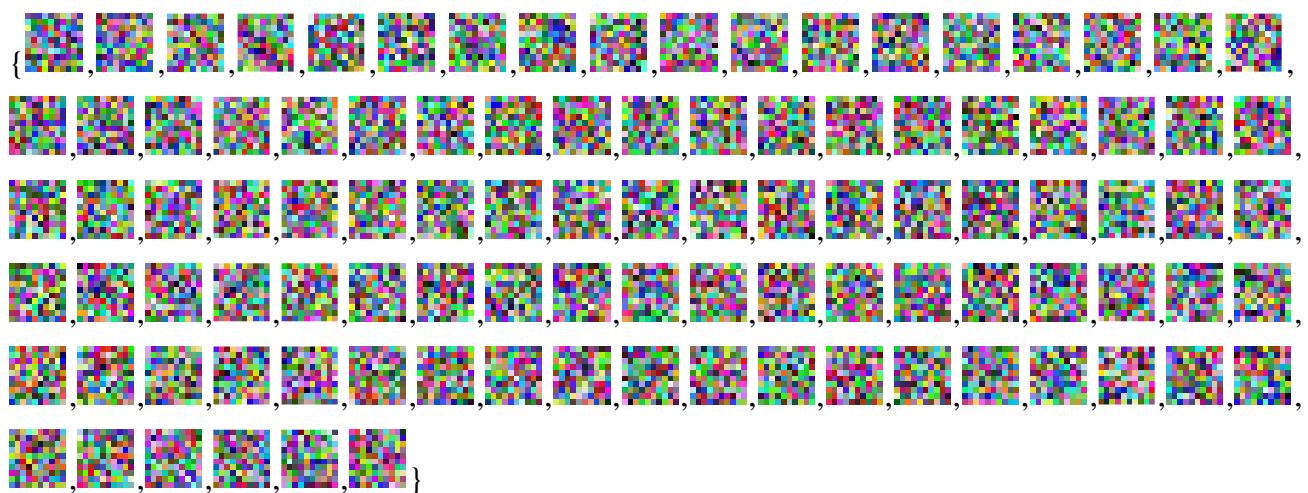
15×2



10×6



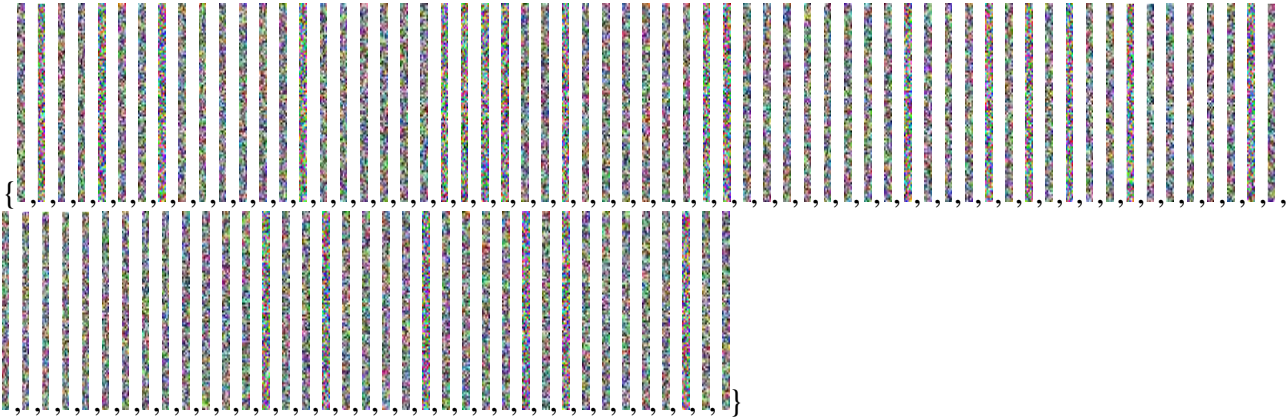
10×10



25 × 20



100 × 5





















25 × 40

























Sample of Exported File (only a first few are shown) and Their Analysis

4×3




















 43image001	6/20/2017 9:42 AM	TIF File	1 KB
 43image002	6/20/2017 9:42 AM	TIF File	1 KB
 43image003	6/20/2017 9:42 AM	TIF File	1 KB
 43image004	6/20/2017 9:42 AM	TIF File	1 KB
 43image005	6/20/2017 9:42 AM	TIF File	1 KB
 43image006	6/20/2017 9:42 AM	TIF File	1 KB
 43image007	6/20/2017 9:42 AM	TIF File	1 KB
 43image008	6/20/2017 9:42 AM	TIF File	1 KB
 43image009	6/20/2017 9:42 AM	TIF File	1 KB
 43image010	6/20/2017 9:42 AM	TIF File	1 KB
 43image011	6/20/2017 9:42 AM	TIF File	1 KB
 43image012	6/20/2017 9:42 AM	TIF File	1 KB
 43image013	6/20/2017 9:42 AM	TIF File	1 KB
 43image014	6/20/2017 9:42 AM	TIF File	1 KB
 43image015	6/20/2017 9:42 AM	TIF File	1 KB
 43image016	6/20/2017 9:42 AM	TIF File	1 KB
 43image017	6/20/2017 9:42 AM	TIF File	1 KB
 43image018	6/20/2017 9:42 AM	TIF File	1 KB

6×2




















 62image001	6/20/2017 9:53 AM	TIF File	1 KB
 62image002	6/20/2017 9:53 AM	TIF File	1 KB
 62image003	6/20/2017 9:53 AM	TIF File	1 KB
 62image004	6/20/2017 9:53 AM	TIF File	1 KB
 62image005	6/20/2017 9:53 AM	TIF File	1 KB
 62image006	6/20/2017 9:53 AM	TIF File	1 KB
 62image007	6/20/2017 9:53 AM	TIF File	1 KB
 62image008	6/20/2017 9:53 AM	TIF File	1 KB
 62image009	6/20/2017 9:53 AM	TIF File	1 KB
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 62image012	6/20/2017 9:53 AM	TIF File	1 KB
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 62image015	6/20/2017 9:53 AM	TIF File	1 KB
 62image016	6/20/2017 9:53 AM	TIF File	1 KB
 62image017	6/20/2017 9:53 AM	TIF File	1 KB
 62image018	6/20/2017 9:53 AM	TIF File	1 KB
 62image019	6/20/2017 9:53 AM	TIF File	1 KB
 62image020	6/20/2017 9:53 AM	TIF File	1 KB
 62image021	6/20/2017 9:53 AM	TIF File	1 KB
 62image022	6/20/2017 9:53 AM	TIF File	1 KB

From the above we see that both 4×3 and 6×2 takes the same space, 1 KB.

10×10



















 1010image001	6/20/2017 10:11 AM	TIF File	2 KB
 1010image002	6/20/2017 10:11 AM	TIF File	2 KB
 1010image003	6/20/2017 10:11 AM	TIF File	2 KB
 1010image004	6/20/2017 10:11 AM	TIF File	2 KB
 1010image005	6/20/2017 10:11 AM	TIF File	2 KB
 1010image006	6/20/2017 10:11 AM	TIF File	2 KB
 1010image007	6/20/2017 10:11 AM	TIF File	2 KB
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 1010image010	6/20/2017 10:11 AM	TIF File	2 KB
 1010image011	6/20/2017 10:11 AM	TIF File	2 KB
 1010image012	6/20/2017 10:11 AM	TIF File	2 KB
 1010image013	6/20/2017 10:11 AM	TIF File	2 KB
 1010image014	6/20/2017 10:11 AM	TIF File	2 KB
 1010image015	6/20/2017 10:11 AM	TIF File	2 KB
 1010image016	6/20/2017 10:11 AM	TIF File	2 KB
 1010image017	6/20/2017 10:11 AM	TIF File	2 KB
 1010image018	6/20/2017 10:11 AM	TIF File	2 KB
 1010image019	6/20/2017 10:11 AM	TIF File	2 KB

 25×4



















 254image001	6/20/2017 10:13 AM	TIF File	2 KB
 254image002	6/20/2017 10:13 AM	TIF File	2 KB
 254image003	6/20/2017 10:13 AM	TIF File	2 KB
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 254image005	6/20/2017 10:13 AM	TIF File	2 KB
 254image006	6/20/2017 10:13 AM	TIF File	2 KB
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 254image015	6/20/2017 10:13 AM	TIF File	2 KB
 254image016	6/20/2017 10:13 AM	TIF File	2 KB
 254image017	6/20/2017 10:13 AM	TIF File	2 KB
 254image018	6/20/2017 10:13 AM	TIF File	2 KB
 254image019	6/20/2017 10:13 AM	TIF File	2 KB

From the above we see that both 10×10 and 25×4 takes the same space, 2 KB

 25×20



















 2520image001	6/20/2017 10:15 AM	TIF File	4 KB
 2520image002	6/20/2017 10:15 AM	TIF File	4 KB
 2520image003	6/20/2017 10:15 AM	TIF File	4 KB
 2520image004	6/20/2017 10:15 AM	TIF File	4 KB
 2520image005	6/20/2017 10:15 AM	TIF File	4 KB
 2520image006	6/20/2017 10:15 AM	TIF File	4 KB
 2520image007	6/20/2017 10:15 AM	TIF File	4 KB
 2520image008	6/20/2017 10:15 AM	TIF File	4 KB
 2520image009	6/20/2017 10:15 AM	TIF File	4 KB
 2520image010	6/20/2017 10:15 AM	TIF File	4 KB
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100 × 5


















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 1005image003	6/20/2017 10:18 AM	TIF File	4 KB
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From the above we see that both 25×20 and 100×5 takes the same space, 4 KB

25×40



















 2540image001	6/20/2017 10:19 AM	TIF File	7 KB
 2540image002	6/20/2017 10:19 AM	TIF File	7 KB
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 2540image018	6/20/2017 10:19 AM	TIF File	7 KB

 100×10




















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From the above we see that both 25×40 and 100×10 takes the same space, 7 KB

100×100

 100100image001	6/20/2017 10:24 AM	TIF File	60 KB
 100100image002	6/20/2017 10:24 AM	TIF File	60 KB
 100100image003	6/20/2017 10:24 AM	TIF File	60 KB
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 100100image018	6/20/2017 10:24 AM	TIF File	60 KB

 200×50

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 20050image003	6/20/2017 10:26 AM	TIF File	60 KB
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 20050image005	6/20/2017 10:26 AM	TIF File	60 KB
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From the above we see that both 100×100 and 200×50 takes the same space, 60 KB

5. Conclusion

So we conclude that the space of the images of size $a \times b$ and $c \times d$ is same as long as $ab = cd$. But as the product, mn , increase for the image of size $m \times n$, the space will also increase. We also notice that as we increase the product mn , 10 times, the space does not increase 10 times – it actually increases less. For example, when mn increase from 1,000 to 10,000, the space increase from 7 KB to 60 KB (a little less than 10 times). In this experiment, we only save the output

image as “TIF” format. The readers are encouraged to redo the experiment and use different types of output format, for example, “PNG” and “JPEG” etc. and see how the result changes, if any.

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