

A Social Media Combinatorial Problem

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Abstract

This article discusses an algorithmic approach and a computer program based on it to solve an elementary combinatorial problem popular on social media.

1 Introduction

Consider the following puzzle¹:

1 *Can you make 24 using the numbers 1, 3, 4, and 6 exactly once each, and the four arithmetic operations (+, −, ×, ÷) any number of times^a?*

^aUsing a number formed by concatenating two or more numbers (e.g. 13) is disallowed

A ready-made answer is probably just an Internet search away. Just for fun, however, one should find such an arithmetic expression. It took the author quite some time to find it.

1.1 Initial Impressions

This puzzle is surprisingly challenging, especially if one is not well-versed with solving such puzzles. We take arithmetic for granted, but the four basic operations combine with four small numbers to render this puzzle tantalizingly difficult. This is so even if you are able to solve it.

We start with some heuristics: If we can make 4 using 1, 3, and 4, we can definitely make 24 by additionally using 6.

¹I first heard it from [Sunil Singh](#), a mathematics educator

$$\begin{aligned}\lambda_{1,2} &= \frac{\text{tr}(\bar{\mathbf{M}})}{2} \pm \sqrt{\left(\frac{\text{tr}(\bar{\mathbf{M}})}{2}\right)^2 - \det(\bar{\mathbf{M}})} \\ &= \frac{1}{2} \cdot \left(\bar{A} + \bar{B} \pm \sqrt{\bar{A}^2 - 2 \cdot \bar{A} \cdot \bar{B} + \bar{B}^2 + 4 \cdot \bar{C}^2} \right),\end{aligned}\tag{2}$$

2 An Algorithmic Approach to Searching

2.1 The Algorithm

2.2 An Implementation

3 Summary and Conclusion

4 Answer to the Puzzle

$$((7 \div 8) - 1) \div 9 \text{ I}$$

$$\bar{\mathbf{M}} = \begin{pmatrix} A * H_{\sigma}^G & C * H_{\sigma}^G \\ C * H_{\sigma}^G & B * H_{\sigma}^G \end{pmatrix} = \begin{pmatrix} \bar{A} & \bar{C} \\ \bar{C} & \bar{B} \end{pmatrix}\tag{1}$$

may fit without any modification, larger structures like the one shown in Equation 2 need special treatment. In this case, the equation was wrapped into a `\begin{figure*} ... \end{figure*}` environment, which produces an unnumbered float object that extends across the full page width. Additional details can be found in the source text.

4.1 Graphics and Images

Similarly, the horizontal space available for graphical elements is the width of a single column. Thus elements inserted with `\includegraphics{..}` should use the length `\columnwidth` for scaling. An example is shown in Fig. 1 (see the source text for details).

And by the way, the `lipsum` package was used to create the following dummy texts.

4.2 Bibliography

The use of citations and the compilation of the bibliography work much the same as in the thesis template. The only difference is that `\printbibliography` is used directly at the end of the document.

5 Existing Techniques

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Figure 1: Coca-Cola advertisement photographed in 1940 [0].

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6 Our Radically New Approach

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References

- [0] Herbert Voß. *Math mode*. Version 2.47. Jan. 30, 2014. URL: <http://mirrors.ctan.org/obsolete/info/math/voss/mathmode/Mathmode.pdf>.
- [0] Marion Post Wolcott. *Natchez, Miss.* Library of Congress Prints and Photographs Division Washington, Farm Security Administration/Office of War Information Color Photographs. Aug. 1940. URL: <https://www.loc.gov/pictures/item/2017877479/> (cit. on p. 3).