

# Minor Paper on Researching and Introducing new Fine Art concepts in pure mathematics ("Colored Magic Square")

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"A Computer Game Development student (mainly on CS and Maths subjects), with about seem to be 5 years (2014-2019) of independent game-related experiences. Served as a **minor** TA in school for the past 4 years.

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## I. A) Before the story begins...and Background

After I temporarily left my service at school and suffered from scaled-8-over-10 pain and through sickness that lasted 2 more weeks, the doctor advised me to have a further investigation on my immunity system and scheduled several times of emergency follow-up plans on this day (17 Sept), and on 8 October. When I say slowly, I mean as slow as a snail, walking through the hospital corridor, there are some artworks related to MRI scanning and computer graphics. It is shocking, and nice because they apply technical things to fine art. I can not show them up because I can not take photos there.

So, rather than resting on the bed to relieve pain, fatigue, and chronic pain-induced depression, I tried to distract myself by **creating artwork**, technical artwork of course. Instead of filling Sudoku on the newspaper like playing with spreadsheet numbers at school, an infused coloured version of sudoku and the magic square was created, **accidentally**.

## I. B) Pure Mathematics and Fine Art crossover

Pure maths have a fun fact, is a sector of maths truly a wilderness realm, engages people to discover by curiosity and aesthetics, but is not really useful in a range of observables and we know, currently. Later, somehow and someone works on an ingenious problem maybe 50 or 100 years later, they discover these old realms may be exact things they needed to solve problems.

Fine art tells the difference between decorative and applied art (aka. design), one of the ways is created primarily for aesthetic and intellectual purposes, judged (tasted) for its beauty.

I created this concept for **no reason, kind of tasting something new**. I whether not know if this concept in "maths" can or can not be applied in my life or even observe someone use it, but why not try them out? Thus, I stepped into this wilderness.

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## II. Learning expectation(s)

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This essay will discuss (1) how we can introduce, and explain this concept in an easy way, which would not be tough.

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## III. Starting & Rules set

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### III-A. Starting sprite and grid

To create concepts from the ground up, we can follow these steps..... The magic square contains an  $n \times n$  grid, where  $n$  is  $\geq 3$ .

For those single boxes in the grid, each contains 2 (two) elements, The corners, and the center diamond shape. In tier 1 magic square, the corner and diamond shapes are fixed to fill one and only one colour. In the upper tier, there are different variants of changes that are extremely complicated.

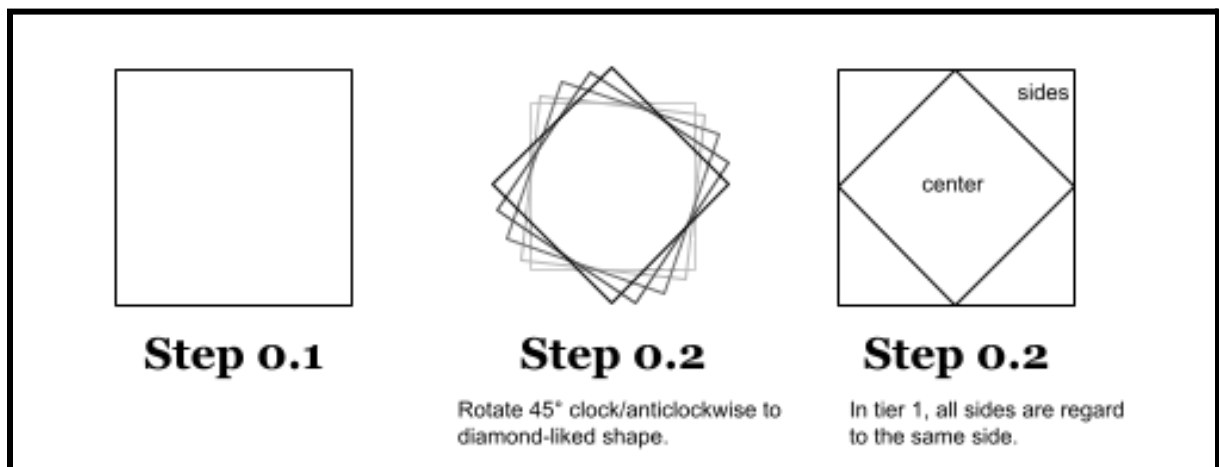
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### Procedure 0 Drawing the first sprite

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<u>STEP</u>	<u>DESCRIPTIONS</u>
0.1	Draw a square
0.2	Draw a diamond shape (a square-like shape rotated 45 degrees clockwise or anticlockwise) in the square which sticks to each side.

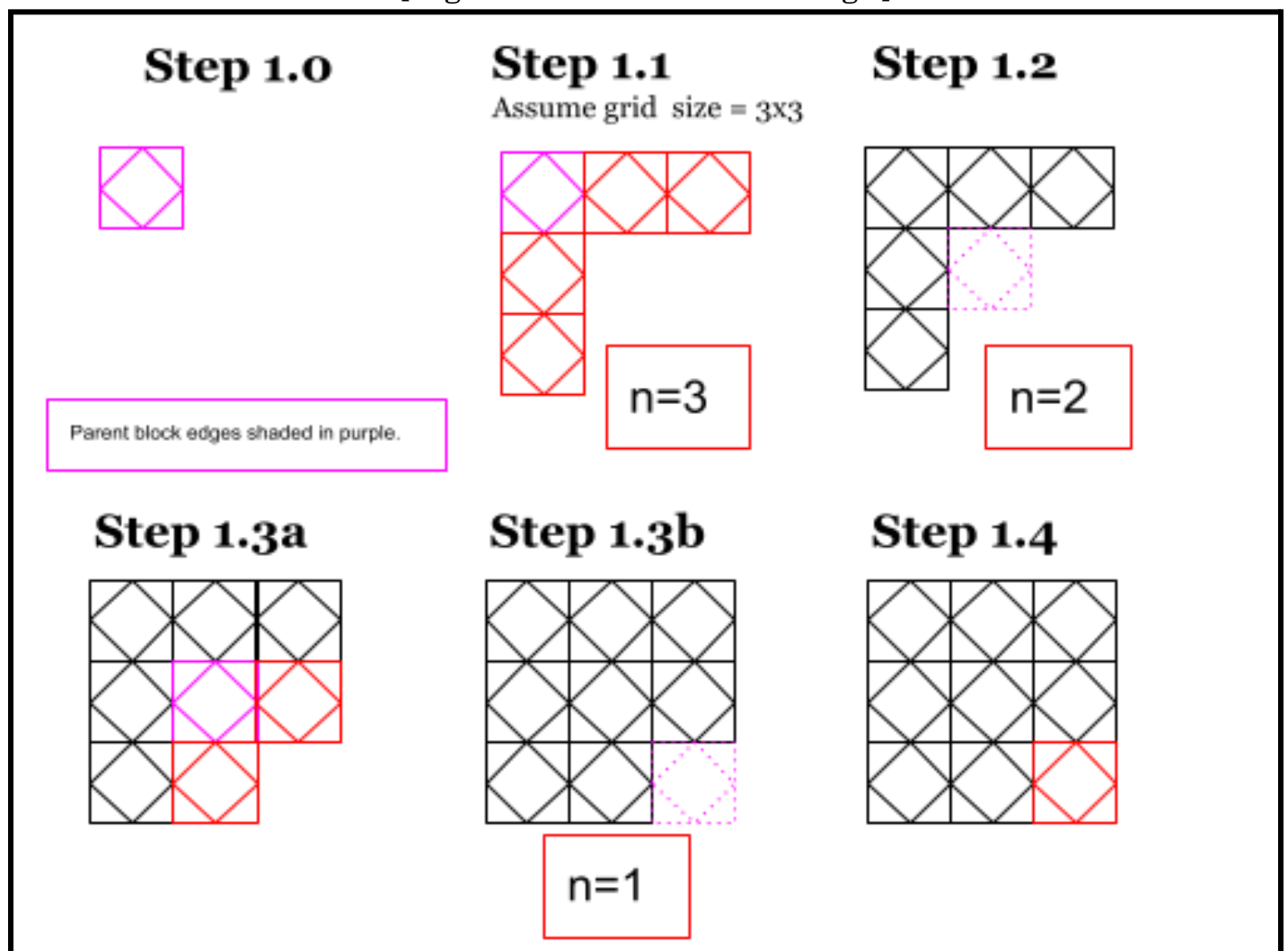
**[Fig 1 Procedure 0 Walkthrough]**



## Procedure 1 Creating coloring grid of magic square

STEP	DESCRIPTIONS
1.0	Copy drawn square from procedure 0, for one of the parent blocks.
1.1	Copy parent blocks for serval n times (n times for a $n \times n$ grid)horizontally and vertically, and place them tight, with no space allowed between each other. (Caution: N-counter also counts parent blocks in each iteration. )
1.2	Jump to the lower-right diagonal space. <b>But, here n-value was decreased by 1.</b> <b>And make it the next parent block.</b>
1.3	Repeat step 1, until each row and column contains the squares.
1.4	Completed

[Fig 2 Procedure 1 Walkthrough]



### III-B. Rules

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#### Rules set     (With Boundaries, Parameters, and Arguments)

- In tier 1, all sides spaces are regarded to the same side. (Fig. 1)
  - For easy understanding, use **4\*4** as the sample.
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#### Rules

#### DESCRIPTIONS

- Starting]**  
1     You must choose **FOUR** different colours, for filling in a **4by4-sized** grid of magic square
  - Compulsory Object]**  
2
    - For all horizontal rows and vertical columns, each **4** of centre diamond shape and sides should only shade with types of colour **only one time, respectfully**.
    - So, you cannot shade the same colour on the same row (column) twice, in the centre diamond (side).
  - Optional Object (if acceptable)]**  
3     Diagonally rules on rule 2 are not enforced, since some of the size or tier of magic squares **perfect solution does not exist**.
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#### **Notes / Here is an example (with experimentation):**

- A **5by5-sized** grid, with **no** perfect solution to fulfill rule 3. (In **Fig 4** in attn 1)
  - A **4by4-sized** grid, with the **perfect solution to fulfill rule 3**. (In **Fig 3** in attn 1)
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## IV. Paper Researched Fields / Aspects of Learning

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### 1. Computer Science & Pure Mathematics

#### a. Computer Programming (Multidimensional Array) & Advanced Usage in Linear algebra

**[Matrix elements contain more than 1 thing (“Inception” -- Put boxes inside boxes)]**

- We all know matrices contain an array of numbers, each slot only used up by a single

element of value, here are some examples.

$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \text{ or even } \begin{pmatrix} \sqrt[3]{5} & 0 \\ 1 & \sum_{i=1}^{\pi} \prod_{j=3}^7 k \end{pmatrix}.$$

- For all magic squares, you can write in some mathematical notations in the newly introduced matrix below that contain **two or above** elements in a single slot, with a **tight relationship on each identifiable feature in each element**.

#### b. Information Technology usage

- Colourful QR code
  - Implementing colour in QR code was in 2013, but they were lack of equipment to identify the code via ordinary devices. With camera and scanner technology advancements, this hurdle should have been overcome.
  - Each colour can represent a unique set of information that the QR code needs to carry. A serval number of colours should expand and support enough “channels” of information in each QR code. So that you can get multiple results from a single colourful QR code.
- Storage of multiple data in the same element.
  - Storing multiple data in the same element is one of the main aims of this research. We usually program a line of code, which only supports one data type for one variable.

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## V. Implementation / Topic Research Product

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### Attach Documents List:

- Two scanned hand-drawn product **perfect (Fig.1) and imperfect (Fig.2) solutions.**

[Attn.1]

### [About me]

- Author: Nelson, LAN**
- HongKonger
- Graduated from School of Continuing and Professional Studies (CUSCS), The Chinese University of Hong Kong;
  - Year 2017, Computer Game Development HD Programme
- Currently work in the education industry in primary school as teaching assistant, handle for multimedia production.

### [Public Repository for project hosting]

(\*Links provide updates after Oct 2023 follow-up)

- The public repository of this project ("Coloured Magic Square")
  - [https://github.com/nelsonlan01/MathematicalArt\\_Magical\\_Square](https://github.com/nelsonlan01/MathematicalArt_Magical_Square)
- The public repository of OpenSea NFT Products
  - <https://opensea.io/collection/magical-square-1>



### [Social Media link related to this project]

- Links provide updates after Oct 2023 follow-up**

### For Internal Use

Knowledge Reg: \_\_\_\_\_

Code: ~~MATH-~~\_\_\_\_\_

Filing Date: \_\_\_\_\_

**[END of Paper]**