Note Cards.
- Name - Nickname
- Hometown/HS
- [illegible]
- Hobbies

[illegible] [illegible] [illegible]

[illegible] Note Cards

Course Structure: math [illegible].edu/~dk/math 171

1. Textbook: Abstract Algebra,
   Theory & Applications,
   Thomas Judson

2. HW due Thursdays

3. TWO EXAMs → takehome
   Exam 1. Out 2/20 - In 2/27
   Exam 2 Out 4/26 - 5/8

4. Grades: A: HW 25%
   B: Exam 1 25% D = max {A, B, C} 25%
   C: Exam 2 25%

~~Office~~
5. Office Hours
   Tue/Wed/Thurs 3-4 p.m. + open door
   SHAN 3414

6. Tutoring 7-9 p.m. 4th B445, Sundays + Wednesdays

HW 1
(3.4)
2, 5, 10
33, 47, 54

— Thursday
the 25th?

— [illegible]
class Thursday

Read
CH 3.

Note Cards.
- Name-Nickname
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- pronouns
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ten years tenures

Magic Note Cards

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(3.4)
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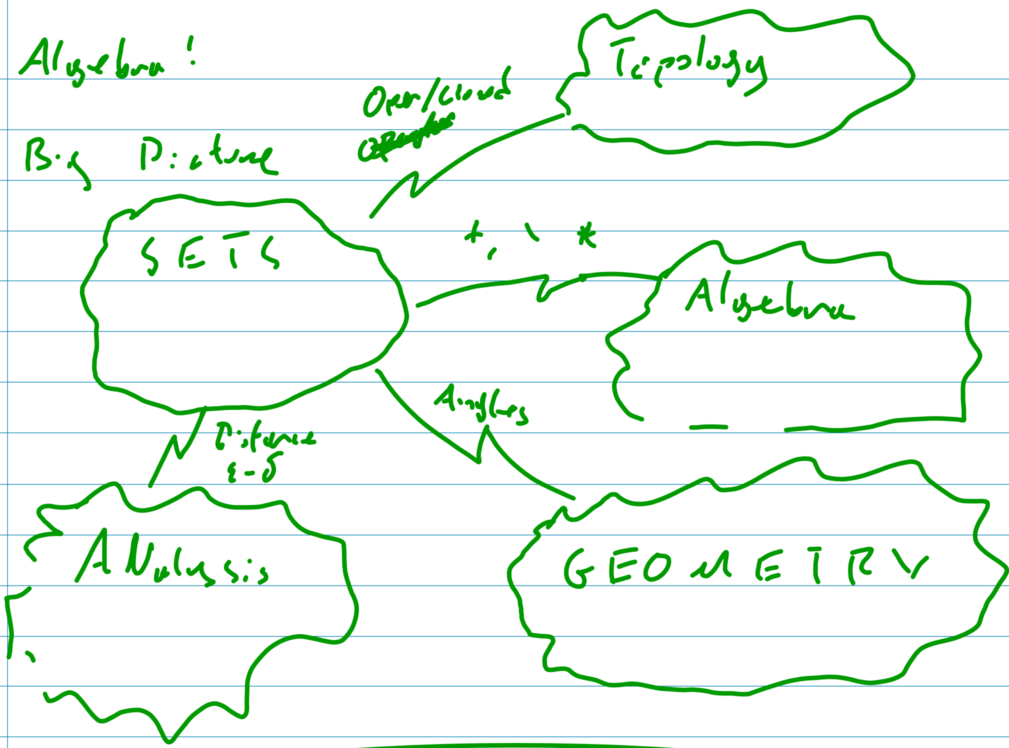
Algebra!

Big Picture



1st Game:

Q How many ways are there to rearrange the numbers 1, 2, and 3?

A: 6 ✓   1 2, 3   1 3 2,   3, 1, 2

PERMUTATIONS Array Notation:

$\sigma_0 = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{pmatrix}$ $\sigma = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix}$

$\sigma_2 = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{pmatrix}$ $\sigma_3 = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix}$

$\sigma_4 = \begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{pmatrix}$ $\sigma_5 = \begin{pmatrix} 1 & 2 & 3 \\ 1 & 3 & 2 \end{pmatrix}$

Permutation multiplication

$$\sigma_5 * \sigma_2 = \begin{pmatrix} 1 & 2 & 3 \\ & 3 & 2 \end{pmatrix} * \begin{pmatrix} & 2 & 3 \\ 3 & 1 & 2 \end{pmatrix}$$

$$\sigma_3 = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix}$$

GROUP work:

$$\begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix} * \begin{pmatrix} 1 & 2 & 3 \\ 1 & 3 & 2 \end{pmatrix}$$

1 3

*	σ_0	σ_1	σ_2	σ_3	σ_4	σ_5
σ_0	σ_0	σ_1	σ_2	σ_3	σ_4	σ_5
σ_1	σ	σ_2	σ_0	σ_4	σ_5	σ_3
σ_2	σ_2	σ_0	σ_1			
σ_3	σ_3	σ_4				
σ_4	σ_4	σ_5				
σ_5	σ_5	σ_3 σ_3				

2 3
3 1

$\sigma * \sigma_1$:

$$\begin{matrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{matrix} \qquad \begin{matrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 3 & \downarrow & \downarrow \\ & & 2 \end{matrix}$$

$\sigma * \sigma_2$

$$\begin{matrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ & 2 & 3 \end{matrix} \qquad \begin{matrix} & 2 & 3 \\ 3 & 1 & 2 \\ 1 & 2 & 3 \end{matrix}$$

$$\cancel{\begin{pmatrix} a & b & c \\ c & y_0 & z_0 \end{pmatrix} \begin{pmatrix} a & b & c \\ x & y_1 & z_1 \end{pmatrix}}$$

$\sigma_2 * \sigma_1$

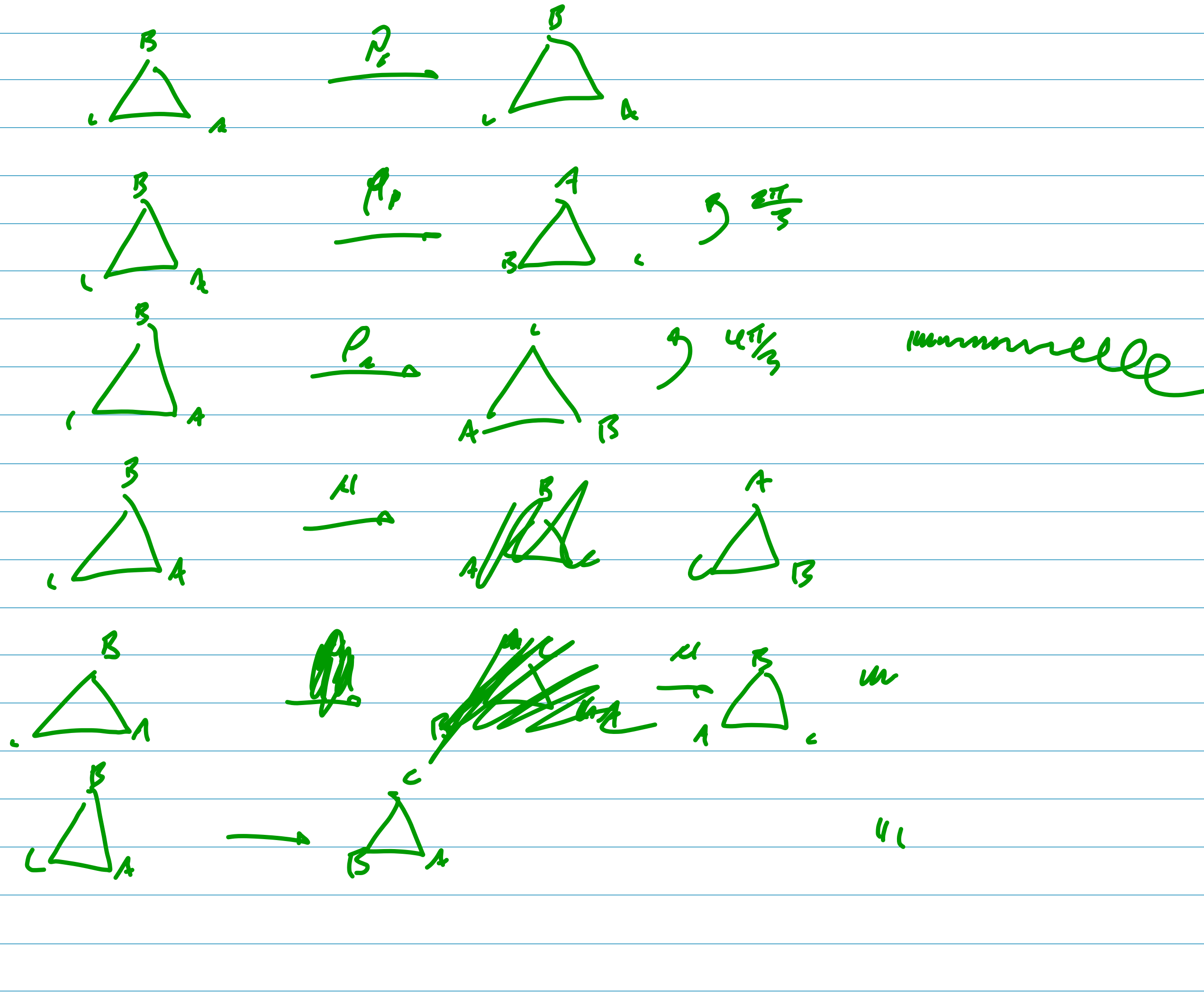
$$\sigma_1 * \sigma_3 = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix} \begin{pmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{pmatrix}$$
$$\begin{matrix} \downarrow & \downarrow & \downarrow \\ 3 & 2 & 1 \end{matrix}$$

$$\sigma_1 * \sigma_4 = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{pmatrix} * \begin{pmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{pmatrix}$$
$$\begin{matrix} \downarrow & \downarrow & \downarrow \\ & 3 & 2 \end{matrix}$$

1	3	-
2	1	3
3	2	1

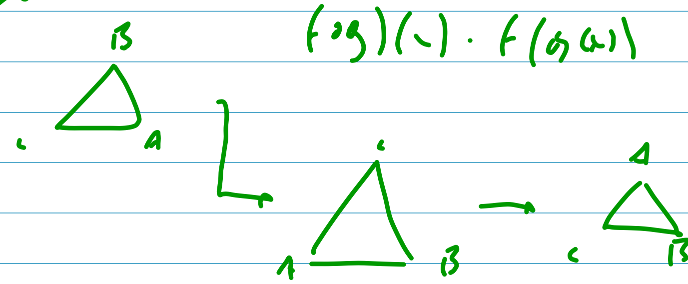
$\circ$	σ_0	σ_1	σ_2	σ_3	σ_4	σ_5
σ_0	σ_0	σ	σ_2	σ_3	σ_4	σ_5
σ_1	σ_1	σ_2	σ_0	σ_4	σ_5	σ_3
σ_2	σ_2	σ_0	σ_1	σ_5	σ_3	σ_4
σ_3	σ_3	σ_5	σ_4	σ_0	σ_2	σ_1
σ_4	σ_4	σ_3	σ_5	σ_1	σ_0	σ_2
σ_5	σ_5	σ_4	σ_3	σ_2	σ_1	σ_0

Another Game: Symmetries of the triangle (Rigid Motion)



Multiplication: $\circ$

$\mu_3 \circ \rho_2 =$



$(f \circ g)(x) = f(g(x))$

$\circ$	ρ_0	ρ_1	ρ_2	μ_1	μ_2	μ_3
ρ_0	ρ_0	ρ_1	ρ_2	μ_1	μ_2	μ_3
ρ_1	ρ_1	ρ_2	ρ_0	μ_2	μ_3	μ_1
ρ_2	ρ_2	ρ_0	ρ_1	μ_3	μ_1	μ_2
μ_1	μ_1	μ_3	μ_2	ρ_0	ρ_2	ρ_1
μ_2	μ_2	μ_1	μ_3	ρ_1	ρ_0	ρ_2
μ_3	μ_3	μ_2	μ_1	ρ_2	ρ_1	ρ_0

Note: These are the same groups.

Let ~~$(S, \circ)$~~ S_3 be the set of permutations of $\{1,2,3\}$ (called the symmetric group on 3 elements)

Let D_3 be the set of symmetries of the triangle (dihedral group)

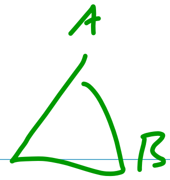
Define a map of sets $\phi : S_3 \to D_3$

isomorphism

$\phi(\sigma_0) = \rho_0$ $\quad \phi(\sigma_1) = \rho_1$ $\quad \phi(\sigma_2) = \rho_2$

$\phi(\sigma_3) = \mu_1$ $\quad \phi(\sigma_4) = \mu_2$ $\quad \phi(\sigma_5) = \mu_3$

ϕ is a bijection



Notice φ respects multiplication

$$\varphi^{-1}(\mu_3 * \rho_2) = \varphi^{-1}(\mu_1) = \sigma_3$$

$$\varphi^{-1}(\mu_3) * \varphi^{-1}(\rho_2) = \sigma_3 * \tau_2 = \tau_3$$

$$\varphi(x * y) = \varphi(x) * \varphi(y)$$