

MIOT Course Syllabus – Mental Math Skill Development Course 2024-2025 FY

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Course Goal

The goal of this course is to introduce fast mental calculation techniques and training directions to students who want to be efficient in solving math calculation problems.

Does the student having a hard time in Math Calculation?

If the student is experiencing any of the scenarios below, this course could be very helpful:

- (1) The student is having a hard time to focus.
- (2) The student is having a hard time to transition from other activities to study events.
- (3) The student spends a lot of time each time when doing math calculation.
- (4) The student is having errors when doing math calculation; the more complex the calculation, the more error the student will have.
- (5) The student may not know the ways to simplify calculation. For instance, 25×99 , the students will directly calculate using vertical multiplication, rather than simplifying into

$$25 \times (100 - 1) = 2500 - 25 = 2475$$

Why do we need to foster Mental Math Competency?

In many widely known Math Competitions, from AMC/AIME series, to university-based competitions, such as Princeton University Mathematics Competition (PUMaC), they are of limited time and students need to allocate their time properly and wisely in order to be able to solve all the questions. However, without Mental Math training, students will usually face two adversities: (1) spending too much time on just solving math calculation and having not enough time to go over the others; (2) even though the solution thinking method is correct, however the calculation generates wrong results. Those will negative impact student's competition performance related to Math.

In the recent competition questions, we observed an increasing trend of mental calculation of large numbers (multiplication, factorial, higher power etc.) within every level of math competition. We will show some examples:

(1) 2017 AMC 8 Problems/Problem 5

What is the value of the expression $\frac{1 \cdot 2 \cdot 3 \cdot 4 \cdot 5 \cdot 6 \cdot 7 \cdot 8}{1 + 2 + 3 + 4 + 5 + 6 + 7 + 8}$?

- (A) 1020 (B) 1120 (C) 1220 (D) 2240 (E) 3360

(2) 2017 AMC 12 Problems/Problem 12

What is the value of $2^3 - 1^3 + 4^3 - 3^3 + 6^3 - 5^3 + \dots + 18^3 - 17^3$?

- (A) 2023 (B) 2679 (C) 2941 (D) 3159 (E) 3235

(3) Omega Learn Math Contest

How many ways are there to arrange the letters of the word MISSISSIPPI?

The answer is $\frac{11!}{1! \cdot 4! \cdot 4! \cdot 2!} = ?$ ($11! = 11 \times 10 \times 9 \times \dots \times 2 \times 1$)

(4) [PuMAC 2023](#)

Find the integer x for which $135^3 + 138^3 = x^3 - 1$

We just need to use basically inequality and number theory (digit cycle) to solve this easily, however, we need to approximate $\sqrt[3]{2}$.

By just trying the above 4 questions we should be able to understand how fast mental calculation can bring time-saving and simplification to a lot of difficult calculation questions.

Prerequisite

This course is not based on grade, any students needing to enhance mental calculation competency are welcomed, as long as the student has knowledge on:

- (1) Addition / Subtraction
- (2) Multiplication from 1×1 to 9×9
- (3) Division and the Fraction representation
- (4) Basic knowledge about Prime numbers and Composite numbers

Course Settings

In-class 45 Minutes session, with Google Classroom as resource repositories.

Also, I encourage students to have frequent timed calculation exercises (preferably daily) with cooperations from parents.

Tentative Schedules

Week	Topic
1	Introduction to Mental Math
2	Find Friends - Addition / Subtraction
3	Little Union Practice - NiuNiu
4	Find Friends - Multiplication
5	Multiplication Techniques I
6	Multiplication Techniques II – Factorial Derivations
7	Division Techniques and Remainders
8	Butterfly Multiplications I
9	Butterfly Multiplications II
10	Lattice Multiplications
11	Be the One Benign
12	Give me Five
13	Almost Perfect Friends
14	Identical Units
15	Sandwich Multiplications
16	Forest Multiplications
17	Squares
18	Binary Search and Power Computing
19	Base Systems, Arabic Numerals
20	Case Study I – Colors in Computer
21	Case Study II – Colors in Computer
22	All Techniques Combo: the power of 64-bit
23	Fractions (Representations, Comparisons and Operations)
24	Repeating Decimals
25	Scientific Notations and Estimations
26	Radical Evaluations
27	Algebraic Evaluations
28	<u>Mental Math Championship</u>
29	Big Numbers in our Daily Lives
30	Record Level Big Numbers, Class Level Ceremonies, Photo Booths

Google Classroom Usages

The materials and exercises will be available via Google Classroom.

For Road-show Materials, please register to Google Classroom – Class code:

<https://classroom.google.com/c/NjUwNTc5MDE3Mjgw?cjc=a6qpxlv>