



MaPP Challenge '18

Mathematical Puzzle Programs



MaPP Challenge '18

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Part I

Game Overview



MaPP Challenge '18

Credits

Thanks for downloading the puzzle booklet for **MaPP Challenge '18** by Mathematical Puzzle Programs. These puzzle materials are provided as-is for use in the classroom (or anywhere else!) to help showcase the fun of mathematical problem-solving.

When the MaPP Challenge '18 is over, we'd love your feedback on how to improve this booklet. You can contact us by email at info@mappmath.org. Or better yet, submit an issue or pull request at our GitHub page at <https://github.com/MaPPmath> directly.

More information on Mathematical Puzzle Programs may be found at our website <http://mappmath.org> and on our Twitter @MaPPmath. Happy mathematical puzzling!

- MaPP Directors and Volunteers

Mathematical Puzzle Programs Leadership

- Steven Clontz — Director
- Braxton Carrigan — Associate Director
- PJ Couch — Associate Director
- Zachary Sarver — Assistant Director and Challenge18 Game Designer

Attribution

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Part II

Main Puzzles



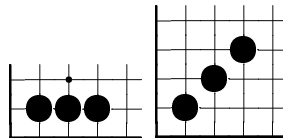
MaPP Challenge '18

Go Get 'Em!

Main Puzzle 1

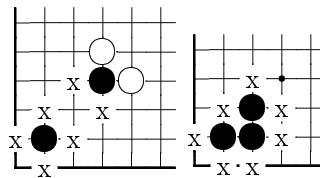
While traveling down Road 4.139π , you cross paths with a wise old Mobímon Trainer. After finally completing his **non-skippable seven-hour tutorial** on how to catch Mobímon, you try to slip away without him noticing. Alas, before you can make your excuses, he begins to tell you how Mobímon battles were fought **back in his day**.

Before Mobímon battles were limited to one-on-one matches, two trainers would send all their Mobímon into battle at once. Trainers would often practice battling by placing **black and white stones** on the **intersections of lines on a grid**, representing the positions of each trainer's Mobímon. The old man, not bothering to hide his frustration that you aren't showing any interest in this bit of history, insists on showing you the following examples.

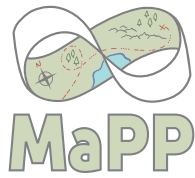


The senile old coot explains that the left figure is an example of a single **group** because the stones are directly adjacent horizontally or vertically on the board, but the right figure represents three separate groups of stones.

To defeat a group of stones, it seems that you are required to **completely surround the group with your own stones**, as illustrated in the old man's next examples.



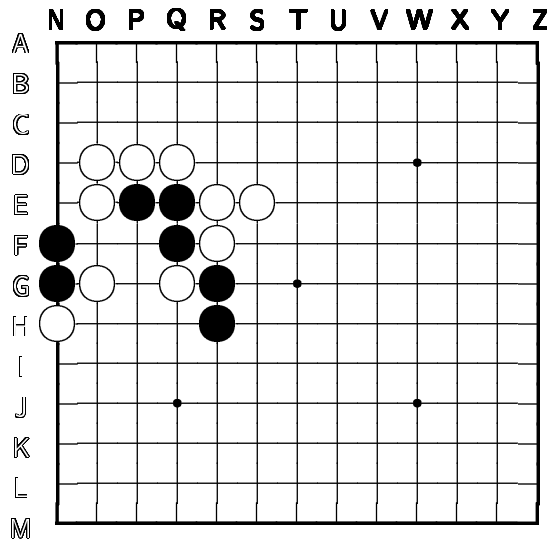
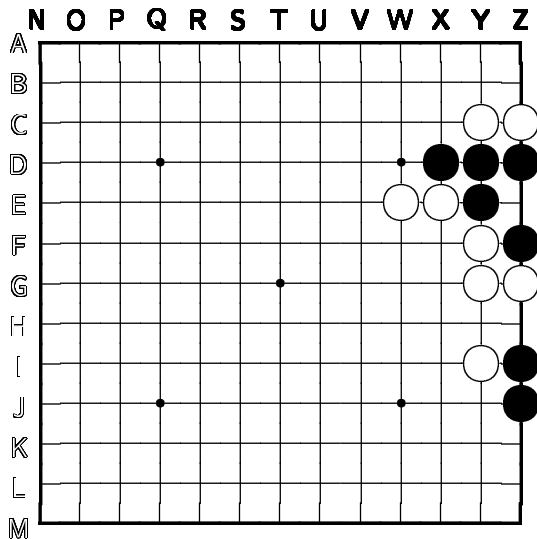
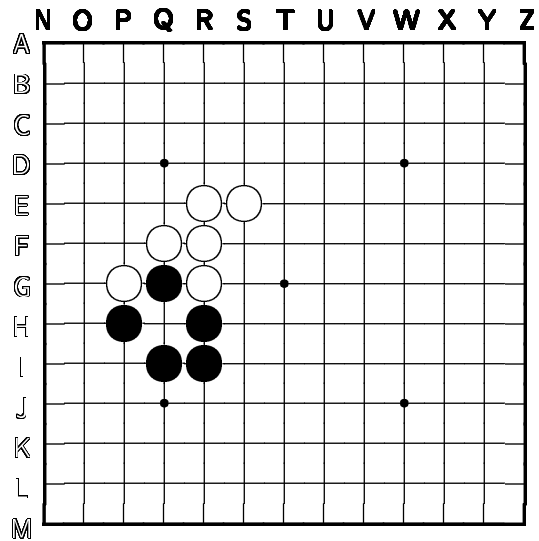
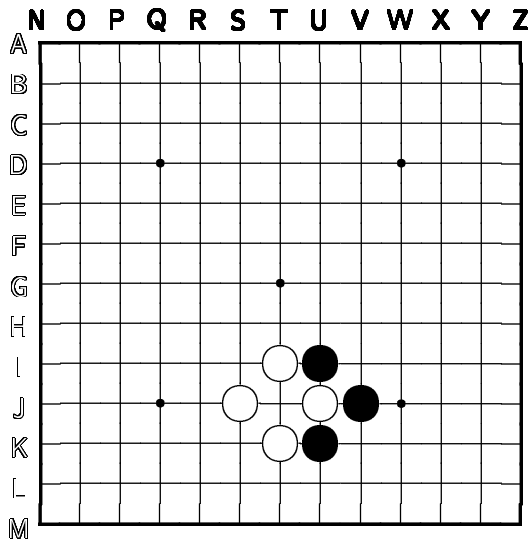
You haven't really been listening, but then the old man mentions that he might be able to tell you where to **find some interesting Plant-type Mobímon** if you can solve a related **puzzle**. In each of the provided **Old-School Mobímon Battle Grids**, there is exactly one position where a stone could be played (white or black) to defeat a group of opposite-colored stones. Solve his puzzle by taking the boundary letters that match the color and position of the correct stone for each grid (and then get out of there before the old man can start another long-winded conversation!).

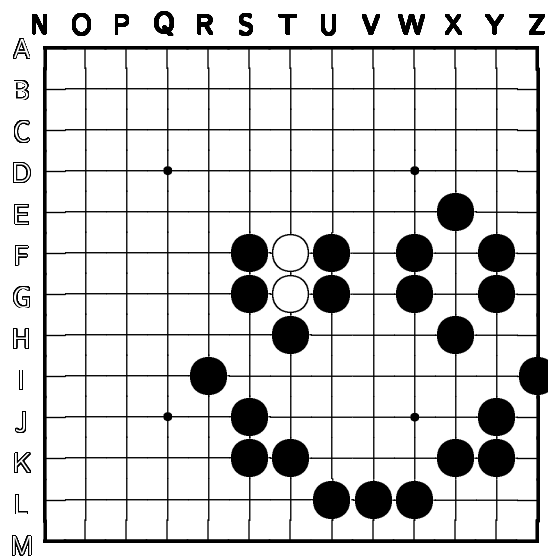
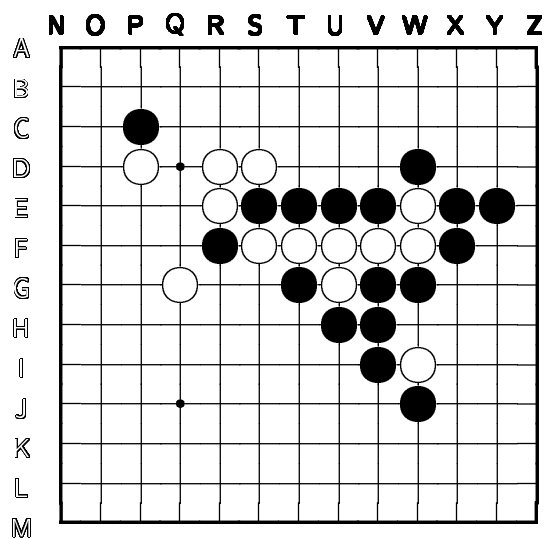
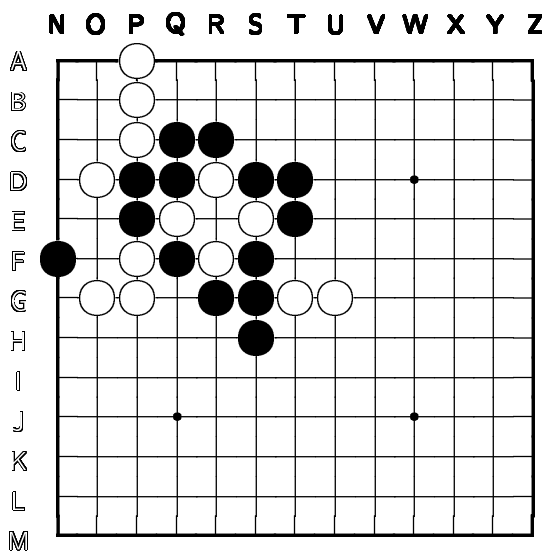
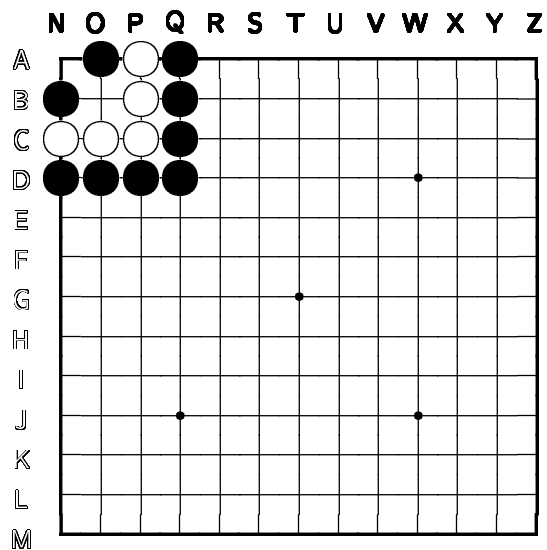
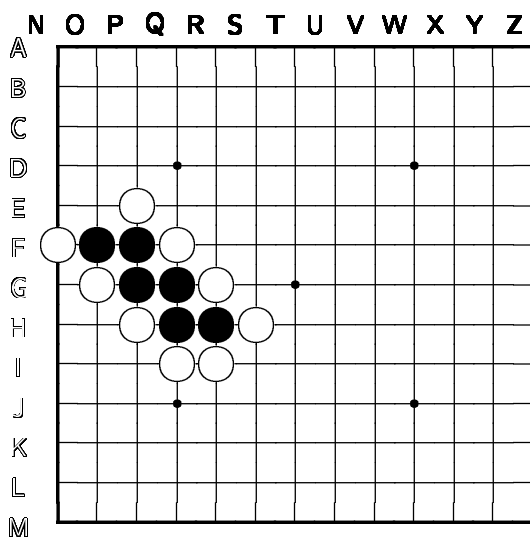


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Go Get 'Em!

Old-School Mobímon Battle Grids







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When Push Comes to Shove

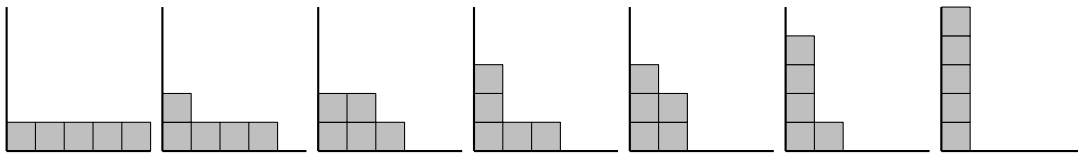
Main Puzzle 2

While training your Mobímon on Road $\sqrt{9^2 + 12^2}$, you are approached by **Dockworker Dave**, who challenges you to a Mobímon battle! Of course you accepted... turning him down would be **rude**, don't you think?

It was a close match, but you win! As Dave gives you your victory money, he tells you about a group of **Tattarat** Mobímon that infest the warehouse he works in. These obnoxious critters like to **rearrange the boxes** in his warehouse, so Dave cuts you a deal. He'll let you catch a Tattarat for your team, but only if you help him reorganize his boxes.

The boxes in the warehouse must be **stacked** so that each row of boxes is always pressed up against the **left wall** of the warehouse, and each row of boxes must have the **same or less boxes** than every lower row.

Other than that, it's up to you. For example, there are **seven** different ways to stack **five** boxes.



The dockworker notices your good work. "Hey, didya say you were aiming to become one of them Mobímon Champions? Maybe you're smart enough to solve this **puzzle** for me then." It seems that if you can count the following different combinations of stacked boxes, you'll be able to reveal a **hidden message** by converting the numbers to appropriate letters (A=1, B=2, and so on).

- The number of ways you can stack either 2 or 6 boxes.
- The number of ways you can stack 12 boxes, if every row must contain an odd number.
- The number of ways you can stack 8 boxes, if every row must contain less than eight.
- The number of ways you can stack up to 5 boxes. (An empty room counts as one way...)
- The number of ways you can stack 4 boxes.
- The number of ways you can stack 8 boxes, if every row must contain less than seven.
- The number of ways you can stack 13 boxes, if every row must have less boxes than the row below it.
- The number of ways you can stack 42 boxes, if you can only use one row.
- The number of ways you can stack 1 or 12 boxes, if every row must have a unique number of boxes.



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The Nickname Rater

Main Puzzle 3

As your adventure continues, you find yourself in **Achromatopsia City**, located at the end of Road 20.7183—*e* and home of the famous **Nickname Rater**. She explains that while Trainers often like to give their Mobimon cute nicknames, she's very particular about the rules for an **excellent** nickname. For clarity, you can assume that a **vowel** is any of the letters A/E/I/O/U, and a **consonant** is any other English letter.

- Nicknames that contain **exactly one vowel** are always excellent.
 - Examples: A, I, and O are excellent nicknames.
- **Adding a consonant to the end** of an excellent nickname that **previously ended with a vowel** creates a new excellent nickname.
 - Examples: If GOLE is excellent, then GOLEN and GOLEK are excellent also.
- **Doubling** an excellent nickname creates a new excellent nickname.
 - Example: If PIKA is excellent, then PIKAPIKA is excellent also.
- **Replacing three consecutive vowels** in an excellent nickname **with a consonant** creates a new excellent nickname.
 - Example: If QUEUEBONE is excellent, then QTEBONE and QURBONE are excellent also.
- **Removing any double consonant** from an excellent nickname creates a new excellent nickname.
 - Example: If DOUGTRIO is excellent, then DOUGIO and DOURIO are excellent also.

The Nickname Rater, not one to shy away from a good **puzzle**, offers you the chance to rate the following nicknames yourself. You'll know when you've done it correctly, because if you **use the first letters of the excellent nicknames below**, you will spell **another good word for a nickname** (even if it's not particularly **excellent** itself).

- | | | |
|--------------|--------------|-------------|
| • MANKAY | • EEVOL | • AERODYCTL |
| • ULTRAMON | • NOHTYP | • PARACENT |
| • OMASTARE | • BLASTMOIST | • EARSEA |
| • VOLTEON | • ICHU | • DRAGONAT |
| • GENGASKHAN | • KADABERA | • RAGMAR |







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An Unending Enigma

Main Puzzle 4


As you make your way down Road $\frac{6.4984}{\sin(20^\circ)}$, you find a group of **Doppl** Mobímon in a patch of tall grass. At first the size of the group is **finite**, so you can count them in the usual way.

- $0 =$ no Doppl
- $1 =$ 
- $2 =$ 
- $3 =$ 
- $4 =$ 




However, before you know it, the size of the group grows to be literally **infinite**! Your Mobídex (an electronic guide used by most trainers) informs you that the lowercase Greek letter ω ("omega") is used to represent the shortest possible chain of infinitely-many Doppl.

- $\omega =$ 





As soon as they appeared, most of the Doppl **shrink** down to fill the available space. Now, there's still an ω -length chain of Doppl, but they look a little more like this.

- $\omega =$ 

Your Mobídex points out that while ω is the first **infinite number**, but it's not the only one! You see, bizzare as it sounds, there's always room for another Doppl to join the party.

- $\omega + 1 =$ 
- $\omega + 2 =$ 
- $\omega + 3 =$ 

Suddenly, it gets really weird as you notice more infinite-length families of Doppl in the surrounding area. Your Mobídex is able to count a few of these groups.

- $\omega + \omega = \omega \cdot 2 =$ 
- $\omega + \omega + \omega + 5 = \omega \cdot 3 + 5 =$ 
- $\omega + \omega + \omega + \dots = \omega \cdot \omega = \omega^2 =$ 
 $=$ 

Your Mobídex points out that the rules of **arithmetic** behave differently when the numbers involved aren't all finite. (You suddenly remember your math teacher pleading with you to not use ∞ like it's a real number, and now realize why!)

When chains of Doppl are added together, a finite chain of Doppl will be absorbed into an infinite chain on its right, but not its left.

- $3 + 4 = \{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\} = \text{Doppl}\text{Doppl}\text{Doppl}\text{Doppl}\text{Doppl} = 7$
- $7 + \omega = \{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\} = \text{Doppl}\text{Doppl}\text{Doppl}\text{Doppl}\text{Doppl}\text{Doppl} = \text{Doppl} = \omega$
- $(\omega \cdot 4 + 3) + (\omega \cdot 2 + 5) = \{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\} = \{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\} = \omega \cdot 6 + 5$

The Mobídex informs you that Doppl chains can also be multiplied. When this occurs, each Doppl in the second factor splits into a copy of the Doppl chain given by the first factor.

- $3 \cdot 4 = \{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\} = 12$
- $(\omega + 1) \cdot 2 = \{\text{Doppl}\}\{\text{Doppl}\} = \{\text{Doppl}\}\{\text{Doppl}\} = \omega \cdot 2 + 1$
- $2 \cdot (\omega + 1) = \{\text{Doppl}\}\{\text{Doppl}\} = \{\text{Doppl}\}\{\text{Doppl}\} = \omega + 2$
- $(\omega + 1) \cdot \omega = \{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\} = \{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\}\{\text{Doppl}\} = \omega^2$

Somehow you're not too shocked when your Mobídex tells you that there's a **puzzle** associated with counting Doppl. It's said that a Doppl's favorite Mobímon attack is "24007042951", but you'll need to solve the following Doppl arithmetic problems to figure out what that means in English!

$$\begin{aligned}
 (\omega + 3) \cdot (\omega + 5) &= \omega^2 \cdot E + \omega \cdot G + S \\
 \omega + 1 + \omega + 3 + \omega + 5 + \omega + 7 &= \omega \cdot I + O \\
 3 \cdot \omega + \omega^2 \cdot 5 + 4 \cdot (\omega^2 + 2) &= \omega^2 \cdot L + \omega \cdot R + N \\
 2 \cdot (2 + \omega \cdot 3) + (\omega \cdot 3 + 2) \cdot 2 &= \omega \cdot A + M
 \end{aligned}$$

Part III

Bonus Puzzle



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The Expedition Zone

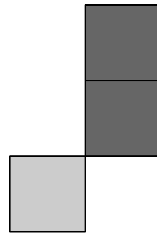
Bonus Puzzle

The **Expedition Zone**, found off the side of Road $6 + i^2$, is a great place to catch some rare Mobímon!

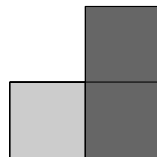
Theres a catch, though: your path through the Expedition Zone has to follow certain **expedition pieces**. Here are the rules:

1. Two expedition pieces are adjacent if any of their **corners** are touching, but **no other parts touch**.

These pieces are adjacent.



These pieces are not.

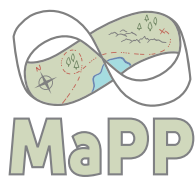


2. You must have a expedition piece in the **lower left corner**.
3. You may not have any breaks in your path. It must be an **unbroken collection** of adjacent pieces.

You may notice several Mobimon inhabiting the Expedition Zone! These Mobimon are represented by **numbers**, and each number is its **strength**. To catch a Mobimon, you must

1. make sure your path goes over that Mobimon, and
2. a piece on that Mobimon must have **more squares than that Mobimon's strength**.

Your score is the **sum of the strengths of the Mobimon you catch**. The teams with the two highest scores get **Victory Points**! Good luck!

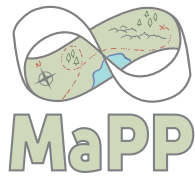


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The Expedition Zone

Expedition Zone Map

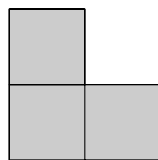
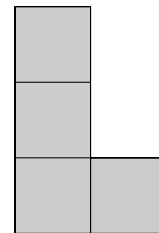
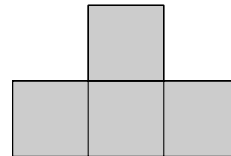
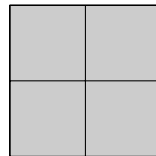
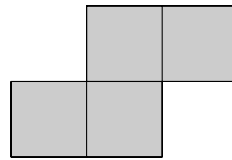
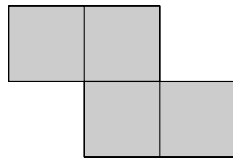
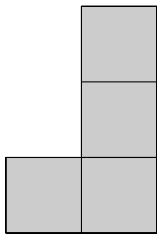
		3	9	9	9		1		6	1	
1	3		6	1	4	5	1	8	1		3
6	3	6	6	3	5	1		3	8	9	
	9		1	1	9	8	4	9	3		
5		5	8			4	8	7	6		7
	9		7	3		8	1		1	9	5
	4					1		6	5	5	
	5		6	9	2		9	8		5	4
	3			3	1	1	6	9	7		2
	6	8	7	3	5	2	1	3		8	5
2		5	1	9	9				9	2	6
7	6	5	4	4	3	8	1	9	2		1



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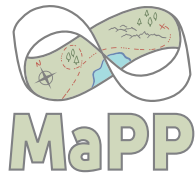
The Expedition Zone

Path Pieces



Part IV

Cryptic Puzzles



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Civic Duty

Cryptic Puzzle 1

The Mobímon in **Wenge** are running wild, blocking the path through Road In(148.45)!

All of the city utilities that are powered by Mobimon are offline. The citizens of Wenge don't have electricity, clean water, or even cell phone signal! **Eight utilities** have been disrupted in total.

1. Electricity, powered by the lightning Mobimon **Electrumble**,
2. water, powered by the moisture Mobimon **Floobles**,
3. traffic lights, controlled by the temporal Mobimon **Tiktok**,
4. garbage, incinerated by the flame Mobimon **Burnie**,
5. cell phone access, routed by the data Mobimon **Ayepey**,
6. sewage, treated by the filter Mobimon **Stankgunk**,
7. street lights, controlled by the photosensitive Mobimon **Forluxi**,
8. and ambulance sirens, controlled by the noisy Mobimon **Sonitus**.

Luckily Wenge has 86 Mobimon tamers on staff and they will need **all of them** to restore service. They've picked up a few tricks for **how many tamers** should work with each different utility Mobimon.

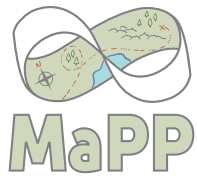
- Forluxi needs the fewest tamers.
- Tiktok needs the most tamers.
- Ayepey and Sonitus need the same number of tamers. No other two Mobimon need the same number of tamers.
- The number of tamers needed by Burnie and Forluxi differ by one.
- Burnie and Ayepey need 9 trainers between the two of them.

The four strongest of the utility Mobimon need some **extra tricks**!

- Each of Electrumble, Floobles, Tiktok, and Stankgunk need a two-digit number of tamers.
- Electrumble is particularly picky, and needs a perfect square number of tamers.
- Electrumble, Floobles, and Stankgunk each need an even number of tamers.
- The number of tamers needed by Electrumble and the number of tamers needed by Floobles has something in **common**.

- The number of tamers needed by Floobles and the number of tamers needed by Tiktok also has something in **common**.
- The number of tamers needed by Tiktok and the number of tamers needed by Stankgunk also has something in **common**!
- But the number of tamers needed by Tiktok and the number of tamers needed by Electrumble doesn't have much in common.

Every Mobimon adventure is about becoming the very best, and helping out the city of Wenge should tell you something about **what kind of trait a Mobimon champion should have**. Also, the mayor promised to give you his **strongest Mobimon** as a reward! Sweet!



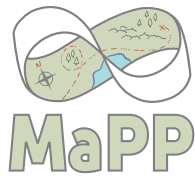
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Cross Products

Cryptic Puzzle 2

Something something Road $\tan(87.4094^\circ)$.

(angry Dojo Master has a mixed up word search like Puzzle A in VBPuzzlehunt)



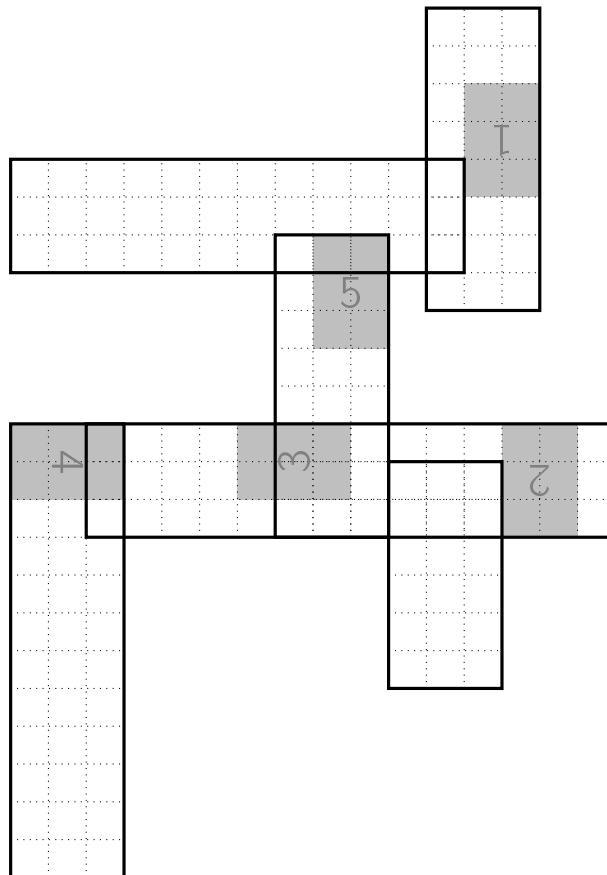
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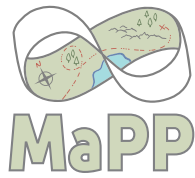
Blind Luck

Cryptic Puzzle 3

Something something Road 500%.

RED BLUE YELLOW GOLD SILVER CRYSTAL

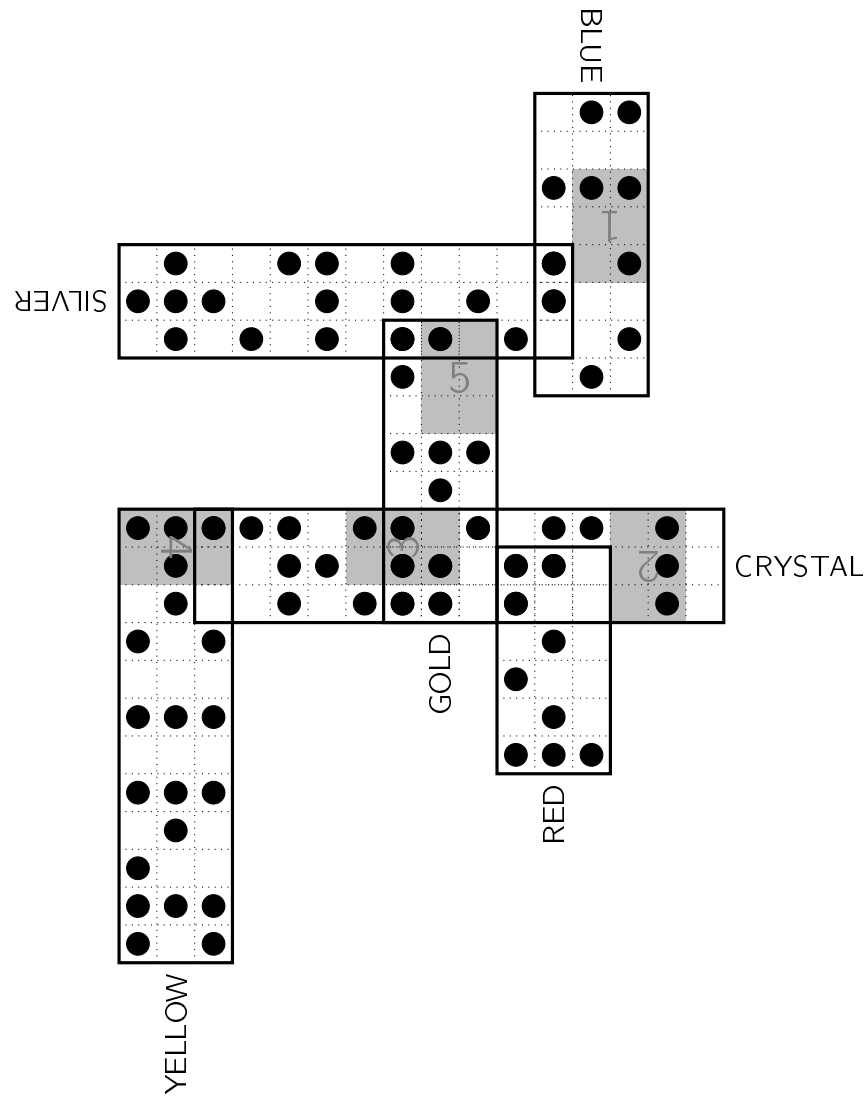




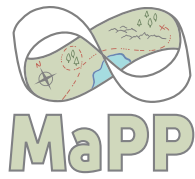
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Blind Luck

Solution



The numbered regions spell out ULTRA in Braille.



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Pin it Down

Cryptic Puzzle 4

After figuring out the mysteries of the Doppl Mobímon, you realize that they are **trying to tell you something**. Could it be the location of a Mobímon Dojo?! (Of course it is.)

Sure enough, at the end of Road $\frac{19!}{18!}$, you find the Dojo. The Dojo Master doesn't even hesitate, and as soon as you enter her lair, she sends out two of the most ferocious Mobímon you've faced yet!



You should be able to take them on with your own team, but only if you embody the **same trait** that this Dojo Master seems to value in her team...

Part V

Metapuzzle



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Faceoff with the Ultimate Quartet Metapuzzle

Before you head into the arena, your Mobímon mentor, Dr. Treetype, suggests that you review this chart of advantages each Mobímon type (Ordinary, Flame, Aqua, Plant, Magic, Undead, and Lightning) has against each other type.

	O	F	A	P	M	U	L
O					1/2	1/2	1/2
F		1/2	1/2	2		2	
A		2	1/2	1/2	2		
P		1/2	2	1/2			2
M	1/2	2					2
U	1/2			2	2		
L	1/2		2			2	