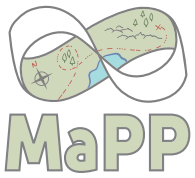

# MaPP Challenge '18

*Mathematical Puzzle Programs*

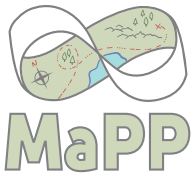
Version 2017/09/12




# MaPP Challenge '18

# 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

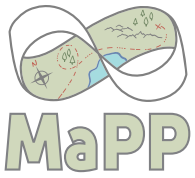
## Mathematical Puzzle Programs Leadership

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

## Attribution

# Part II

# Main Puzzles




## MaPP Challenge '18

# When Push Comes to Shove

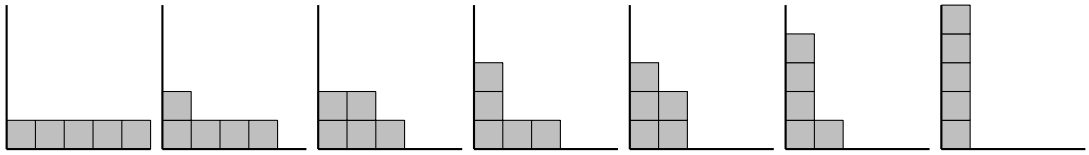
## Main Puzzle 1

While training your Mobímon on Interstate *i*, 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.


## MaPP Challenge '18

# An Unending Enigma

## Main Puzzle 2

As you make your way down Interstate *e*, 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 $\omega$ ("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 $\omega$-length chain of Doppl, but they look a little more like this.

- $\omega =$ 

Your Mobídex points out that while $\omega$ 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.

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

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 $\infty$ 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.

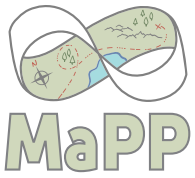
- $3 + 4 = \{\}\{\} = = 7$
- $7 + \omega = \{\}\{\} = = = \omega$
- $(\omega \cdot 4 + 3) + (\omega \cdot 2 + 5) = \{\}\{\}$
  $= \{\}\{\}\{\}\{\}\{\}\{\}$
  $= \omega \cdot 6 + 5$

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.

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

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!

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




MaPP Challenge '18

# The Name Rater

## Main Puzzle 3

(based on https://en.wikipedia.org/wiki/MU_puzzle)

## MaPP Challenge '18

# Go Get 'Em!

## Main Puzzle 4

While catching Mobímon on Interstate $\sqrt{1.73205...}$, you run across a wise old Mobímon trainer who challenges you to a Mobímon battle. But not just any Mobímon battle! This is a **puzzle battle.** The reward? The location where all the Mobímon gather.

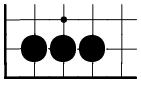
The old man tells you about a game he enjoyed in his youth called **Go.**

Go is a game of strategy played with black and white pieces on a grid. It's a bit like chess, except instead of lots of kinds of pieces, each player only has **one kind of piece, the stone.** And instead of playing on the squares, players play on the **intersections of the grid lines,** and you can play on board going from 9 by 9 up to 19 by 19. And **black goes first.** Maybe it's not all that much like chess.

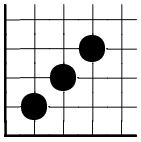
Much like chess, though, part of the strategy relies on **capturing your opponent's stones.** To capture you have to know about stones, groups of stones, and their **liberties.**

Stones typically don't stay isolated for very long from other stones of the same color. Stones form a **group** if they are **directly next to each other on the grid,** but **not diagonally.**

These stones form a group.

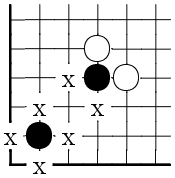


These stones **do not.** These are just three individual stones.



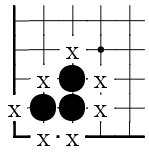
An individual stone has **liberties.** Liberties are the **empty spaces directly next to the stone on the grid,** but **not diagonally.** So a stone may have **as many as 4** liberties. If an individual stone has no liberties, **it is captured.**

The liberties of the black stones are marked with x's:



So the black stone on the lower left has **4 liberties,** and the black stone on the upper right **only has two liberties** because the other two spaces around it are occupied by white stones.

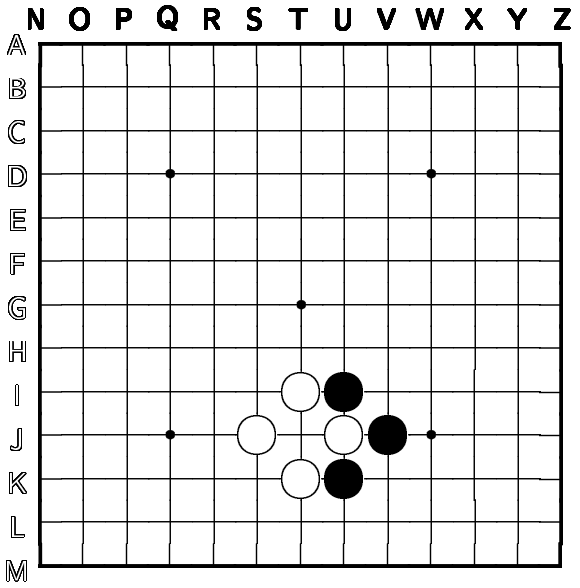
**Groups of stones share liberties.** A whole group of stones can be captured at the same time if the whole group has no liberties. The group of black stones below has **7 liberties.**

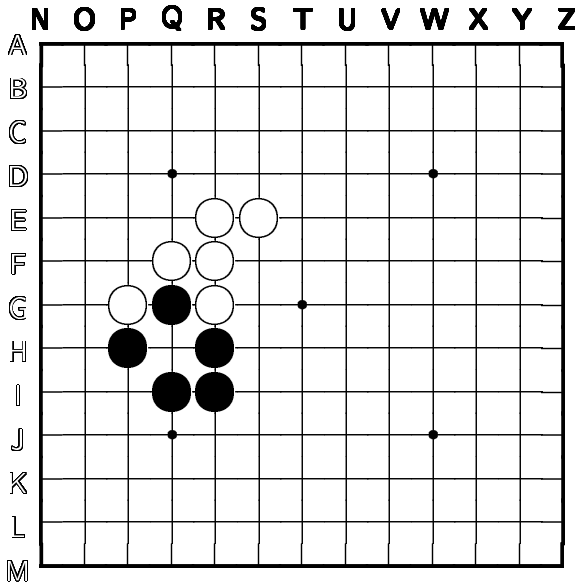


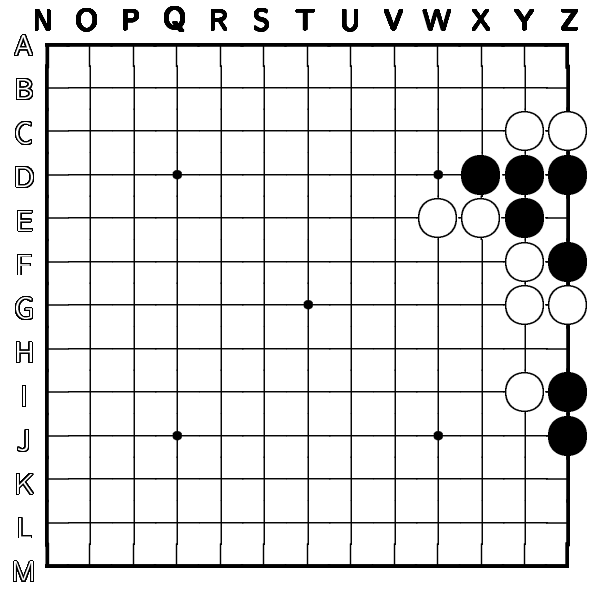
A stone can normally **not** be played in a space where it has no liberties, with **one important exception.** A stone can be placed into a space where it would have no liberties only if doing so **captures one or more enemy stones.**

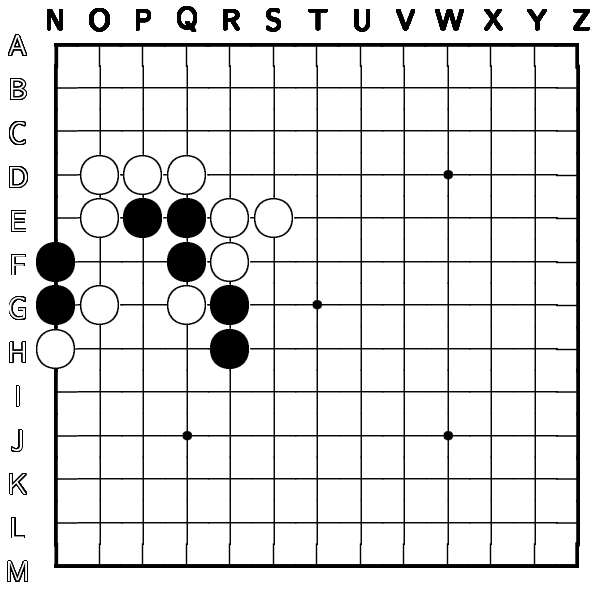
The old man lays out several boards in an intermediate size, then says, "In each of the Go boards below, there is exactly one stone you can play, white or black, that will allow you to make a capture. You need to figure out **what color stone** to play and **where to play it** in order to make a capture. Do that, and you will already know where all the Mobímon gather."

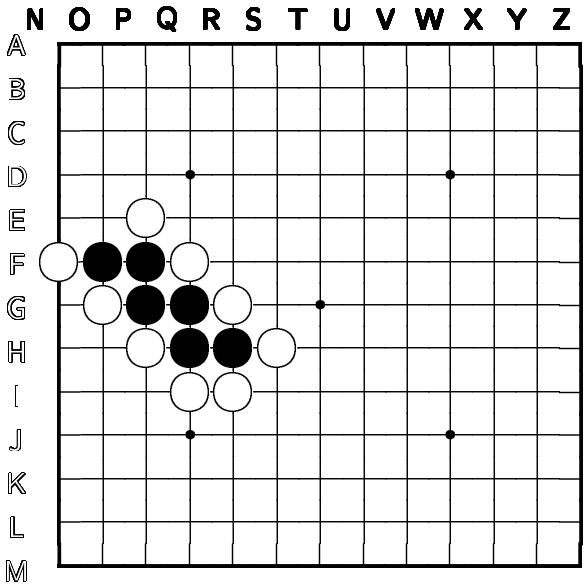
You notice that each of the boards the old man shows you is **13 by 13.** There are also **26 letters in the alphabet.** Hmmm...

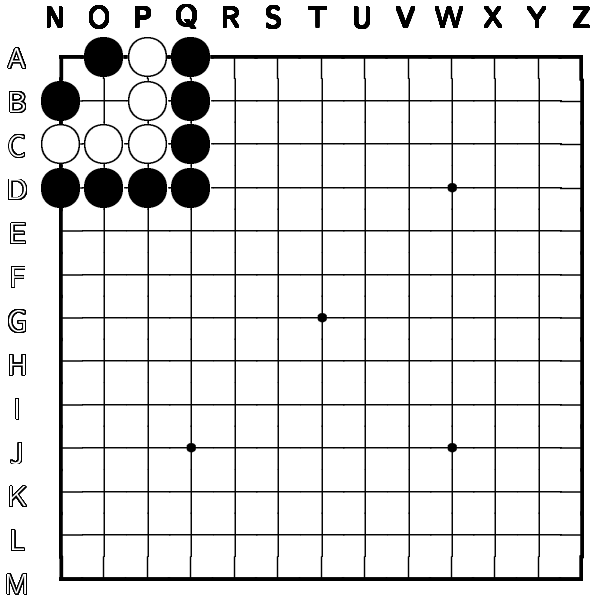


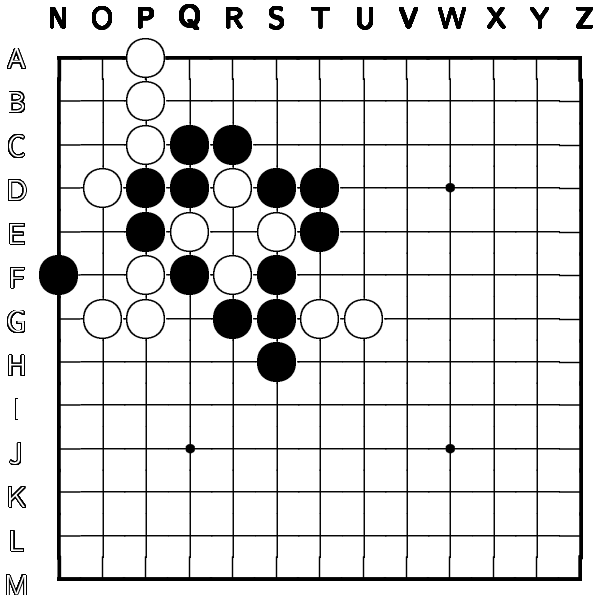



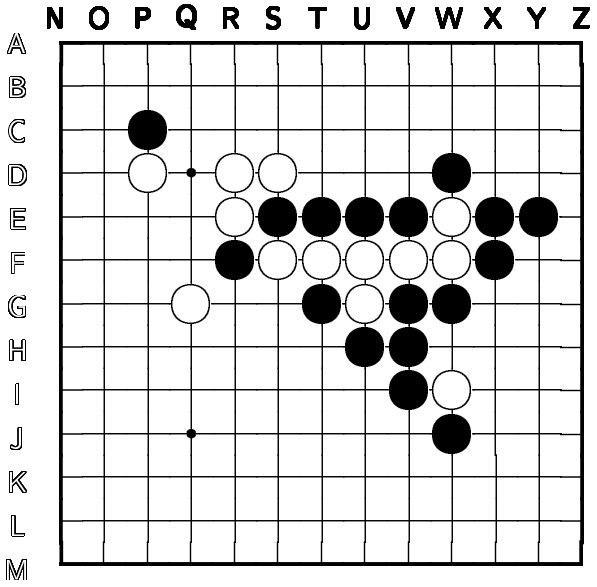

N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M

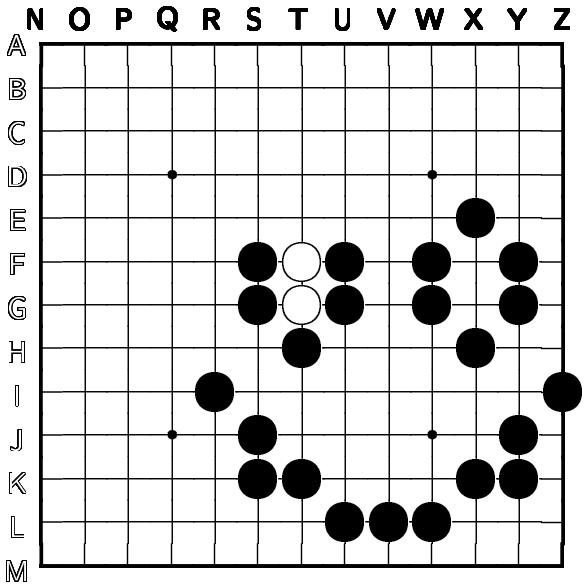

N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M


N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M


N O P Q R S T U V W X Y Z
A B C D E F G H I J K L M




Where should you find the Mobímon?

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |

# Part III

# Bonus Puzzle

## MaPP Challenge '18

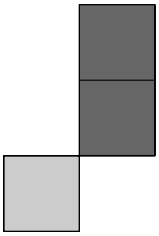
# The Expedition Zone

## Bonus Puzzle

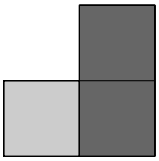
Take a trip through the **Expedition Zone** to catch as many Mobimon as you can! Theres a catch, though: your path through the Expedition Zone has to follow certain **expedition pieces.** Here are the rules:

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!

MaPP Challenge '18

# The Expedition Zone

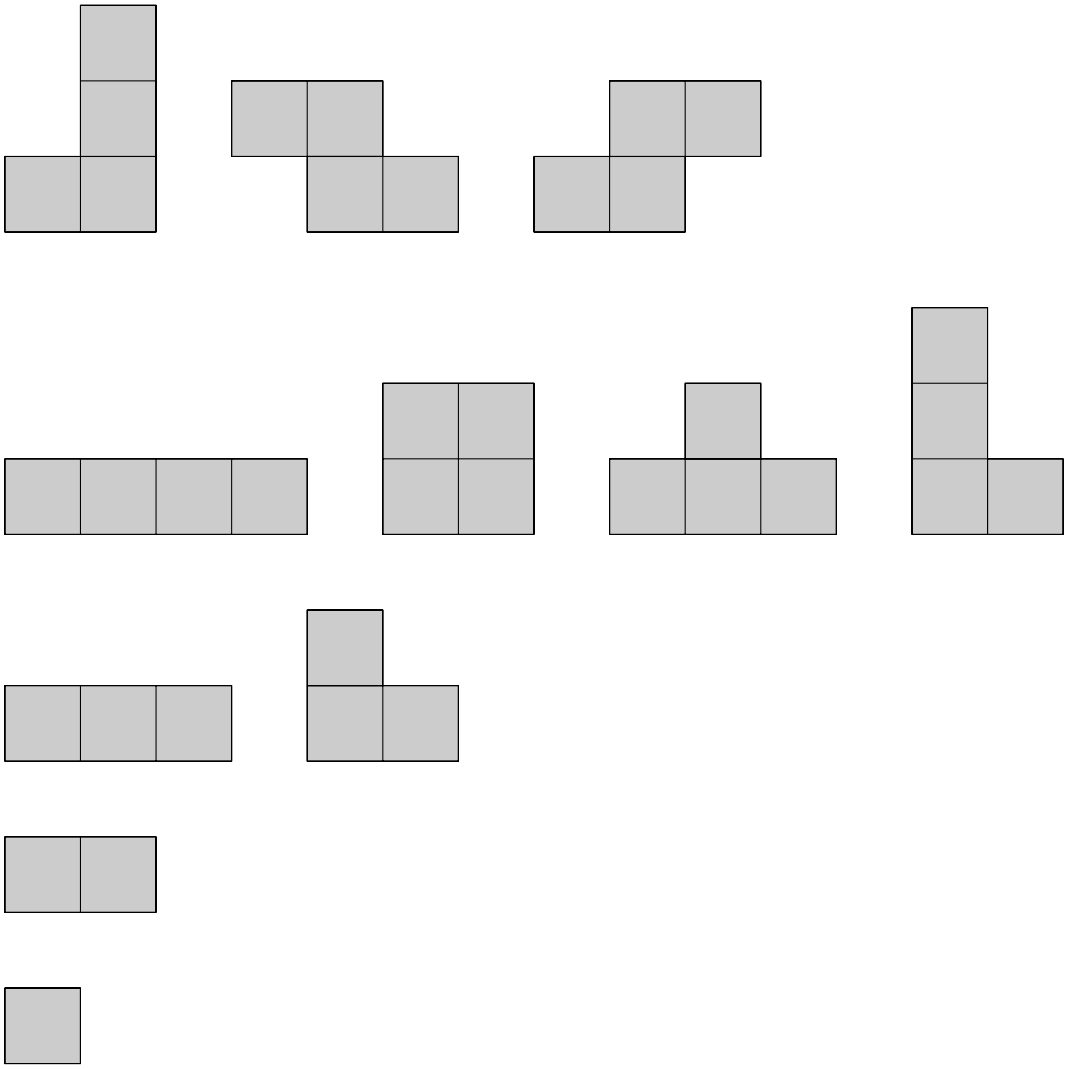
## Expedition Zone Map

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 |

MaPP Challenge '18

# The Expedition Zone

## Path Pieces



# Part IV

# Cryptic Puzzles


## MaPP Challenge '18

# Civic Duty

## Cryptic Puzzle 1

The Mobimon in **Wenge** are running wild! 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.

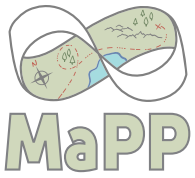
- Forluxi needs the fewest tamers.
- Tiktok needs the most tamers.
- Ayepey and Sonitus need the same number of tamers. No other two Mobimon need the same number of tamers.
- The number of tamers needed by Burnie and Forluxi differ by one.
- Burnie and Ayepey need 9 trainers between the two of them.

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.
- Eletrumble 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!

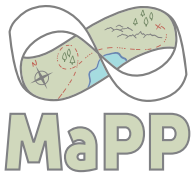



## MaPP Challenge '18

# Cross Products

## Cryptic Puzzle 2

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

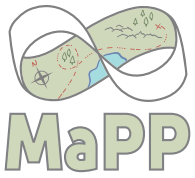



## MaPP Challenge '18

# Blind Luck

## Cryptic Puzzle 3

(a Braille criss-cross like Puzzle D in VBPuzzlehunt)




## MaPP Challenge '18

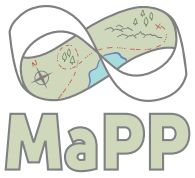
# Pin it Down

## Cryptic Puzzle 4

(sketches of Mobimon that include pigpen symbols)

# Part V

# Metapuzzle




MaPP Challenge '18

# Faceoff with the Ultimiate Quartet

## Metapuzzle

(use the Mobimon names uncovered in the Cryptics to compute winners of tournaments)