

ENTELECT CHALLENGE

UNIVERSITY CUP

**ENTELECT
CHALLENGE
2019**

THE WORMS NEED YOUR HELP!

With all the battles going on, the home base has to be kept running somehow. Unfortunately, the worms have no idea how to schedule work!

The worms are working on helping their space station thrive, but they ran into some problems. They are highly skilled, but not very organized. We need your help to schedule their specialized workers to complete tasks in a timely fashion, without being a slave driver and causing the worms to suffer from burnout.

Various problems will befall your worms in the coming days, but because you have some near supernatural detection skills, you will be able to predict these issues well in advance and schedule a roster for your worms to attend to these issues. Any worm can do any task, but each one is particularly skilled in doing one specific task, meaning that when your worm is working on a task that is not their specialty they will find that task twice as hard!

This problem is based on the Nurse Scheduling problem, which requires you to schedule worms to cover tasks in an efficient manner, while both completing tasks on time, as well as keeping worms motivated to continue working!

TASKS

A task is defined as a unit of work that takes a certain amount of shifts to complete. A worm will take 1 shift to complete a task that falls in their specialty and 2 shifts for any other tasks. Worms have feelings too, so if you overwork them, they will resign! That is why you can make a worm take a break by giving them a free shift.

If a task takes 2 shifts to complete, you can tell the worm to take a break in between starting and finishing the task, but they will resign if they start a new type of task before they finish the initial task.

If every worm in the workforce is on a free shift at the same time, you will get 1 penalty point that will count against your score, but the worms will still receive their motivation regeneration.

TIMELINE

All decent timetables split their days into sections, and in these scenarios the days are split into 3 shifts: Morning, afternoon and night.

Each shift is denoted by the number of tasks that will require attention during that shift, and every three shifts in a row counts as one day. The first shift given will always be a morning shift.

ex. D, 0, 3, 0

This day is split up into the following:

- Morning has 0 tasks that will require attention
- Afternoon has 3 tasks that will require attention
- Night has 0 tasks that will require attention

Keep in mind that any tasks left over from one shift moves over to the next shift until it gets completed.

WORMS

A worm is defined by a couple of attributes. Each worm has the following:

- Worm type
- Motivation level
- Need for a weekend
- Employment status

WORM TYPES:

There are **four types** of worms working for you. Each worm type has their own specialty, which determines the task they are best at. They can complete their specialty tasks in only **one shift**, but take **two shifts** to complete a task that is not their specialty.

Worm Type	Speciality
['B'] BioChemist	['D'] Dome repair
['M'] Mech-Engineer	['R'] Rover repair
['S'] Space-plumber	['P'] Plumbing
['X'] Xenobiologist	['A'] Alien classification

MOTIVATION LEVEL:

Each worm has an initial motivation level of 15, which can then be used to complete tasks. Worms can both spend and gain motivation throughout their career.

Spending motivation:

Actions	Cost
Completing a shift	1 motivation
Completing 3 shifts in a row	4 motivation (3 shifts, plus 1 for exhaustion)
Completing 5 consecutive night shifts	6 motivation (5 shifts, plus 1 for exhaustion)

Gaining motivation:

Action	Reward
1 shift with no activity	1 motivation
Completing a specialised task within 3 days (9 shifts)	1 motivation
3 consecutive shifts of no activity (this satisfies the need for a weekend)	2 motivation

NEED FOR A WEEKEND:

A weekend in the worms world is defined as 1 day (3 shifts) of doing nothing. A worm will resign if it doesn't get a weekend after 5 consecutive days of work. A day is counted as "worked" if any shift in that day has been worked.

EMPLOYMENT STATUS:

Worms have one of two employment statuses, either employed or resigned. If a worm is resigned, they will no longer complete any tasks for you.

A worm will resign if it does not complete a task that it has started. This means if it is scheduled to work a shift of a non-specialty type, it's next working shift must be the same type. The worm can take as many breaks as you allow them between the start and end of the non-specialty task.

Just as worms will resign if they are overworked, they can get too lazy and resign because you don't give them enough work. If a worm doesn't work at least one shift every 5 days or if their motivation level goes above 42, they will resign out of boredom.

GOAL

The goal of this challenge is to build a scheduler that makes a schedule for the worms to complete the given tasks in the input file.

Points are awarded for the following major things:

- Each worm's remaining motivation at the end of the schedule
- Completing all tasks as close to on time as possible

For a schedule to be valid you must:

- Complete all tasks given by the input
- Have at least one worm that is still employed at the end of the schedule

INPUT FILE

EXAMPLE INPUT FILE:

```
2,2,0,0
D,2,0,1,3,0,0
R,1,0,1,2,1,1
P,0,0,0,0,0,0
A,0,0,0,0,0,0
```

WORKER COUNTS:

The first line of the input file is a comma separated list of the worker counts. They will always be given in the following order:

[BioChemist, Mech-Engineer, Space-plumber, Xenobiologist]

In this example you have 2 BioChemist and 2 Mech-Engineer worms.

TASKS:

There are four lines after that, with the first character representing the type of task:

Row	Speciality task	First character
1	Dome repair	D
2	Rover repair	R
3	Plumbing	P
4	Xenobiological classification	A

After the character specifying the type, a comma separated list of task numbers are given. These represent the shifts and how many tasks require attention in that shift.

The shifts will always start with a morning shift and continue synchronously with afternoon, night, morning, etc.

SUBMISSIONS

Submissions must be in the following format:

- Each line is a unique worm
- The first character of the line defines the worker's specialty:
 - [**B,M,S,X**]
- Each character after the first should be a task type that that worker is performing:
 - [**D,R,P,A**] or **F** if the worker is on a free shift

The submission is only valid if there are as many lines, defining workers with their schedule, as there were workers given in the input file.

EXAMPLE OUTPUT FILE:

```
B,D,D,F,D,D,F
B,D,F,F,D,F,F
M,R,F,F,R,R,F
M,R,F,F,R,R,F
```

This results in a score of 60.