Reduction Guide

General

Reduction in Minesweeper is used to simplify the logic of situations.
Specifically, this is done by taking known mines (or a set of cells containing a known number of mines) surrounding an empty cell, and subtracting this from the count shown in the empty cell.

Reduction is very briefly mentioned in the patterns section of **Minesweeper Online**, but I feel it's something that many players will understand, but skip over.

Reduction is never a *requirement* when solving, you can always just keep track of every mine relevant to the logic you are working on.
For this reason, it is possible to become very proficient at Minesweeper without ever giving this a second thought.

It it worth looking further into though, especially for higher density boards and more complicated logic.
With enough practice at this, you will no longer be intimidated and forced to slow down when you encounter a dense maze of **3**s and **4**s.
I strongly urge you to have a look over these examples, then using this concept

In this example, it's fairly trivial to complete without any thoughtful reduction, but it illustrates the basic idea.

The logic we will apply reduction to.

Identify any known mines, or acknowledge any that were found previously.

Finally:
"subtract" or "**reduce**" all the mines from the surrounding clear cells showing numbers.
Notice how this effects both the **3** and **1** cells, reducing them into **2** and **0** respectively.

The end goal is to be able to visualise this.
Truthfully try to **see** the **3** as a **2** or more usefully, that the yellow cells contain 2 mines between them.
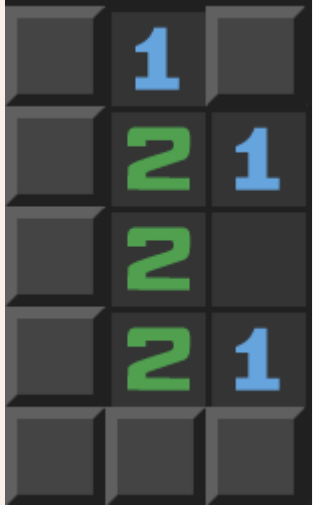You want this process to become second nature.

As stated, this situation is trivial, but I encourage you to study this, or even play a low density board now and try to see basic situations like this, even if you naturally wouldn't look for them.

Practical Uses

I believe there are 2 types of logic in which it is profitable to use reduction:
-Memorized patterns – *See the reduction section **here**, this is already explained so I will not cover it yet.*
-When you are reducing a set of cells that contains a number of mines, not just individual mines.

By this, I mean: If you can **guarantee** a cell is a mine (*I.e it can be correctly flagged*) then the effort of performing reduction outweighs the cost of simply keeping track of the mines.
  Look at the previous example, understand why it is inefficient to reduce there.

The real beauty / benefit of reduction comes from when we **don't** know precisely what cells are mines.

Perform the reduction*
Any number cell that is adjacent to all the cells in a set. You may "**reduce**" by subtracting the minecount of that set from the cell.

all cells in a set will be **unopened**.

Initial logic
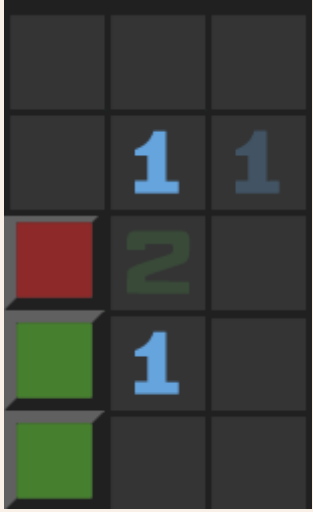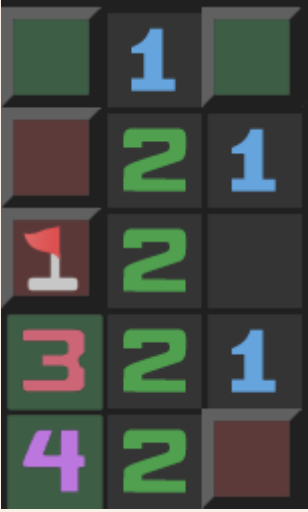
Define set of cells containing mines.
In this case each has exactly 1 mine in.

Perform the reduction.
Look how much easier this is!
If you learn to do this in your head, you improve greatly.

A very important note: Notice how the faded out **1** and **2** have **not** been reduced. This is because not every cell in the set (the top 3 red cells) are adjacent to those cells, so there is no guarantee we can abstract the mines away from these. It is also important to "fade" or "ignore" these mentally, since they do not reflect the number of mines in the uncovered cells remaining (after reducing).
We only want to focus on the numbers we **have** reduced.

Apply our derivations to the original board. From which we can proceed as usual.

*Note there are cells out-of-shot here, which is why the only closed cell adjacent to the right **1** is marked as safe.*

This example uses 2 sets for illustration, using the top set alone is sufficient to find a mine, but the 2 safe cells can be found neatly with another one.

Most practical cases will require only 1 set.

Solve the new, simple logic

New examples potentially included later.
If you find boards that illustrate reduction nicely, please contact me on **Minesweeper Online here**