Five or More Group Analysis
Part Two

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November 30, 2010

Definitions

Queue:	List of marbles dropping on the board in the next turn.
Group:	A set of same-color marbles on the board that are in an unobstructed row of 5, but not necessarily touching.
Attach:	Moving a marble to a group's edge.
Completed:	When a group gets five marbles in a row and is taken off the board.
k-Connected:	There are k acyclical paths between a marble and an associated group.
Blocked:	There are no paths between this marble and an associated group.
Region:	Continous unoccupied area on the board.

Goals

To be clear, we are optimizing for average longevity and points per game. This contrasts with the approach of taking high risks and attempting to get an incredible amount of points while failing frequently; betting on the high risk and high reward route. We are taking the safe route, so to speak.

We recognize that you do get more points for removing lines of length greater than the minimum 5, however you shouldnt prioritize this technique. The problem is that it sets you up to lose access to that group when a new marble is spawned in a place that you had reserved for one of your final marbles. Now, not only can you not get the 6 or more marbles you were stacking up, but it is possible you cannot even get the original 5. This is too much of a risk, and will not pay out in the long term.

Group Selection

Ranked in order of highest priority. When multiple color groups match a rule, the use the list of tie breaking rules, or continue to the next rule if no rules break the tie, similar to the way which Bucket Sort operates.

1) Choose a group that has the possibility of being completed with one available move.

2) Group with the most marbles in it. Break ties by:

   a) Has the most same-colored connected marbles on the board.

   b) Has the most same-colored marbles in the queue.

3) If no groups have conected marbles, then we should start a new group, rules for which color and where to start it are discussed below.

Because we are not going out of our way to to get groups of 6 or more, the obvious choice is to complete a group as soon as possible. We should always try and complete one specific group so that we can clear its marbles and open the board up because that increases the longevity of our game, and thus the amount of points we can gain.

Actual Marble Selection

After deciding which group to move, these are the rules on how to pick which marble should be moved to the group if there are multiple options. These rules also discuss which side of the group the marble should be attached to.

1) Pick the marble that would open up the most paths on the board when moved.

2) Prioritize marbles that open up paths to other large groups.

3) Pick marbles that have small k-connections. They are more likely to be blocked by incoming marbles from the queue.

How to Move a Selected Marble

1) Attach marbles to a space in a group that has the least paths to it. That position is more likely to become blocked by the incoming marbles.

2) Don't attach a marble to the side of a group if that move would divide a region (unless that move will complete the group).

Our primary goals of marble selection are to aid in the completion of the largest groups and to keep the board open and clear. The reason for attaching marbles to the side that is more blocked off is that after your turn it will be harder to move marbles to that group, so you sould take advantage of the crowded areas before they are blocked off and inaccessible.
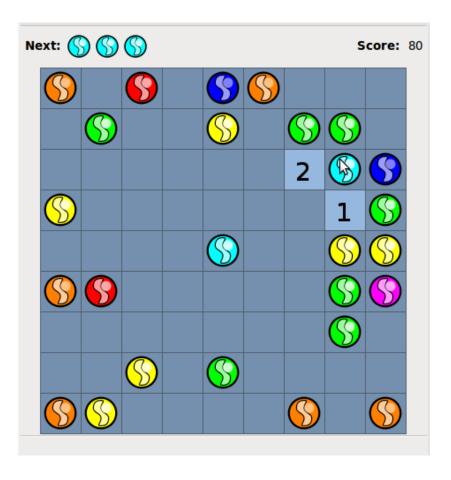
Starting a group

These are guidelines about when no groups are ideal or available, so we need to start a new one.

1) Pick the color that has the most same-color connected marbles on the board that has sufficient room to be completed.

2) Pick a base marble which has the most connected marbles of the same color and has sufficient room to complete the group. Then pick the marble with smallest k-connection to move to it. This marble is the most likely to be blocked after the incoming marbles are dropped.

3) Avoid starting diagonal groups. The rectangular area occupied by a diagonal group is completely unavailable to other horizontal and vertical groups. While a vertical or horizontal group occupies at most 5 squares, a diagonal group occupies 25.

This also ties in to our technique of completing groups as fast as possible. We are only picking groups that have a high potential of being completed in as few turns as possible. We are estimating potential by whether there are enough marbles on the board or in the queue, and if they are even currently connected.
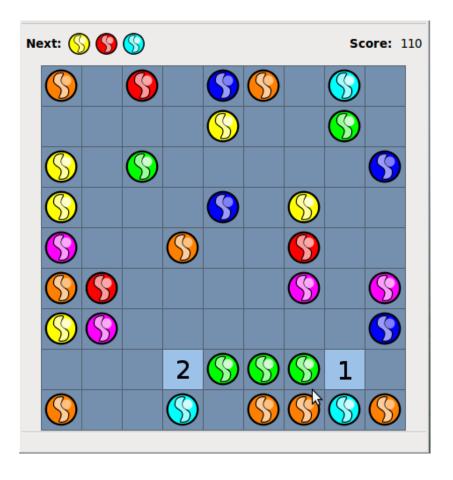
Special Cases

1) Our heuristic would notice that there's more greens on the board than any other color, and therefore pick that as the group to work with. The best place to move a green to would be the space labeled with a 1. Our choice would be to move the light blue marble to position 2. It accomplishes more than simply moving a green. There are three light blues in the queue that are very unlikely to be blocked from the group when they are dropped. It also frees up the already started yellow group which can now build in to the center.

2) According to our heuristic, we should move a green marble to the position marked with a 1. It has fewer paths to it, and is more likely to become blocked from a queue-drop. It would be more logical in the long run to move to position 2, which leaves more possibilities for the group to be completed.

If we were to move the marble to position 2, there are less combinations of queue drops that could block the reminaing green marbles from the group than if we moved to position 1. In the case of position 1, the group could be blocked with just one dropped marble, while position 2 depends on where two of the three queued drop.

3) The heuristic would not suggest moving the marble to the position marked 1, but that is the more logical place to move. It divides a region on the right side of the board, but there will be many more paths that will complete the red group on the next turn. If we were to move to position 2, we couldn't finish the group without moving other marbles.