# On NAPs, Doves, Hawks, and Retaliators

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In this short text, I would like to present main features of my Halite bot. The first part will be very brief and will cover expansion and fighting tactics, etc., basically everything not related to bot-to-bot-to-bot interplay. I used the word “bot” three times, because I do not find anything particularly interesting in one-on-one game strategies. In my opinion, either for one or another bot it is profitable to attack the opponent; thus, the war is imminent. I would love to read about efficient one-to-one strategies if you have one, but notice that I do mean strategies, not tactics.

The reasons I am not writing much about my expansion and fighting tactics are simple. Firstly, mine are quite cumbersome and definitely not neat. Secondly, @erdman can say much more on that than me. I won only 4 of our 20 one-on-one games.

Briefly speaking:

I first divide the map into regions (regions are squares near each other with a similar production to strength ratio). Then I create an order in which I want to visit these regions, this way I also obtain a square visiting order. I visit these squares using shortest paths trying to minimize utilized and wasted strength. After a number of turns, I switch to other expansion tactics (the previous tactic would not move tiles in the center of my region, and I was not able to get rid of this unwanted and irritating behavior). The other tactic is to move tiles in the direction of high production to strength ratio areas assuming that a tile is moved only if its strength is greater than a given threshold. There are obviously many more details in this approach but I do not want to waste my and your time on that. During the Initialization phase, I simulate the approach for a number of different parameters and select the best one. As for fighting tactics, I use simulate annealing to determine the best set of moves. I randomly create ten plausible set of enemies’ moves and determine my moves in a way maximizing the expected difference between inflicted and suffered damages.

That is all on tactics. Let’s move to the way I handle multiplayer games. As I wrote, I do not see any particular reason for fighting/not fighting in one-on-one games. You can spend a lot of time implementing a brilliant strategy allowing you to start a war at the perfect moment. Assume that you did. If your opponent also decided to invest in mastering this part of his/her strategy, then the one that did it better wins. However, if you opponent choses to attack you whenever there is a chance for that, your strategy will not change anything. If it was not the best time for him/her to attack you, then either you would attack him or you would wait to have even greater odds of winning. In both cases, his/her decision to attack you was a good choice. My decision was not to spend time on something that can so easily be made useless.

We are now ready to proceed to real multiplayer games. I believe that you all have already heard about NAPs. When I read about it for the first time, it reminded me of The Selfish Gene, an excellent book by Richard Dawkins. Shortly speaking, in the book, three strategies are presented: doves, hawks, and retaliators. A dove does not fight back. I believe that you can find a number of doves among lower ranked bots. They almost extinct when hawks appeared. Hawks are bots that expand, attack, and fight efficiently. Finally, we have retaliators. They expand, tend not to attack, but if

attacked, they fight back. Being a retaliator in the world of hawks makes you a hawk. However, when you meet another retaliator, you both gain an advantage over other players. This way all top bots evolved into retaliators with @erdman being the last hawk and paying the price. As far as I remember, one week before the deadline @erdman managed to stay 7$^{th}$ being the only hawk surrounded by retaliators – respect. In the book, the retaliator is the evolutionary stable strategy, i.e., there is no strategy that can make you perform better in the world of retaliators. In Halite, it was similar. Being at war with another player constrained you from expanding your area. Therefore, my bot only attacks opponents that are at least three times weaker than it. There are two reasons for that: you can profit from attacking really weak bots more than from attacking unoccupied tiles but only if you can overwhelm the victim; you prevent the weak bot from surviving longer than you when things unexpectedly get worse for you. Here it is worth mentioning that there is more to avoiding wars than just not attacking a tile which is next to an opponent. You have to also restrain from attacking tiles which are next to zero-strength tiles and those that are adjacent to tiles that can be occupied in this turn by an opponent.

The things described so far have been implemented by the majority of top bots – those that have not evolved, perished. Those that have evolved, are siting now guarding their areas and are waiting for an end of a game. The problem is that a winner has to be claimed. Moreover, the last place has to be also occupied by somebody. The first attempts to change status quo and expand their territories that I noticed were made by @shummie and @DexGroves. Their bots attacked on all fronts in the last turn. This way they were usually not able to expand their territories literally, but at least they deprived others of some squares. The strategy was later improved by @timfoden. If two bots simultaneously attack in the last turn, they both deprive themselves of some squares. But if one bot attacks both in the last turn and in one turn before the last turn, then the second bot can only defend. If you have enough resources, you can use the trick even earlier, three, four, or five turns before the end. On deadline Sunday, @timfoden proved the strategy to be extremely efficient against pure retaliators.

But is the pure retaliator really evolutionary stable in Halite? I believe yes but it has to be enhanced with some rules for a map with no free tiles left. Let's go back to a game between a bunch of retaliators hoarding forces and waiting for the end of the game. The one with the smallest territory will be last in the final ranking; thus, it should do something that can change its position. My bot, if it occupies the smallest territory (and there is no other war taking place; more about it later), attacks the weakest opponent. If it loses, it will not change my position but if it wins, it will occupy undisputedly the largest territory putting it from the last to the first place. That lead me to another conclusion: the war is imminent; if your bot is not the weakest, just wait and see. This is exactly the strategy my bot follows: when there is a war going on, it waits until one of the fighting bots is at least three times weaker than my bot. Then it joins the war attacking the weakest fighting bot aiming at the area which is the most distant from his other opponents. This way my bot not only participates in annexing the weakest bot territory but, when the weakest bot is defeated, it also automatically enters a war with other annexing bot(s) which is (are) much weaker at that time, as is was (they were) fighting the weakest bot from the beginning and I was hoarding forces at that time.

Finally, the last strategic trick that I implemented is managing the number of open fronts. Until now, I described my claiming war rules. However, there are different kind of wars in Halite. You can see "phoney" wars when two mighty bots are fighting against each other constantly attacking only a

single neutral zero-strength tile than separates them. On the other hand, you can see total wars, when bots are using all their forces to overwhelm their enemies. My bot opens a new front (against the same enemy; I never start a new war when I am already at war) only if it has at least 5000 unused strength hoarded somewhere in its territory. The new front is opened as far as possible from other open fronts. This way I usually I am able to gain some advantage from opening a new front, as most of the bots tend to move all their forces to already open fronts leaving their flanks unguarded.

These are the strategic rules my bot follows. I would love to read about your thoughts on that topic. Maybe you have other strategies that are worth considering? For instance I wanted to implement quite nasty strategy of putting opponents at war. When you are the weakest bot, instead of attacking the second weakest bot, you can attack area which is exactly between two players. I believe that most of bots would not even notice which bot is responsible for the fact that they are at war now (there are only zero-strength tiles between them and other bots). Why to do that? Because wars change situations, destroy some bots, make other bots stronger. Whatever they do, it cannot deteriorate the expected final position of the weakest bot.