GUIDELINES FOR OLYMPIC TRAINING

In this note, we elaborates on a few training principles that should be of benefit to high school students whose aim is to progress towards math competitions. The ideas discussed here are inspired by training programs designed for athletes at the highest level of competition in Olympic sports.

An adequate preparation for the International Mathematical Olympiad presents two daunting issues: First, one has to learn a plethora of conceptual ideas and techniques that are commonplace in Olympiad-type problems. Second, one has to go through the process of solving problem after problem in order to learn additional tricks and strategies of attack for the various problems one may face.

In addressing these issues, the principle of *specificity* states that in order to excel at any competitive endeavor, a competitor must spent the majority of their time training activities that are closest to what they face in competition. For an Olympiad competitor, it translates to dedicating most of their time solving problems from various mathematical Olympiad. The more they solve, the better they become. While such a highly specific form of training is effective for the seasoned competitor, it is not warranted for the novice. Indeed, a novice should spend more time building a solid foundation in all four Olympiad tested subjects: geometry, algebra, number theory, and combinatorics. This basic form of training is of greater benefit to the novice. It is therefore imperative for them to program a time for learning new ideas and skills (task 1), and a different time for problem solving (task 2). In its most optimal form, such programming must take into account the various national training camps qualifying to the IMO, and any other international competition that the competitor wishes to attend. This presents us with a serious dilemma.

On one hand, effectively learning a new technique (such as projective geometry, quadratic reciprocity, graph theory,...etc.) can be time consuming: After learning the underlying concepts, which usually doesn't take much time, the competitor builds comfort with the newly learned ideas by practicing on a few sample problems. The difficult part lies in making the new technique an integral part of their skill-set; a natural strategy; an automated reflex. This *adaptation* of motor-skills and thinking patterns takes time. For instance, reading an article on graph theory a couple of days before a national math Olympiad will be of little benefit, as the allocated learning time is not nearly sufficient to cause an adaptation of thinking patterns or motor-skills.

On the other hand, the principle of specificity requires competitors to focus on more specific activities in order sharpen their skills, perform best during competition, and keep their Olympic experience alive.

This dilemma leads to the principle of *periodization* of training by *seasons*. This simply states that most of a competitor's learning should be done as far back from competition as possible. As they approach a competition date, their training should shift more and more towards problem solving, and, in the last few weeks prior to the competition, they should be doing nothing but problem solving. This later phase is called *peaking*, and at the end of it, the competitor should theoretically be in their best possible shape for competition. The period of time between two competitions is called a *season*. Periodization ensures that contestants spend enough time solidifying their learnings and have them fully accessible on the day of the competition.

As an example, let's say that Samir's last math camp took place in July, and that the next one is scheduled for November, and that Samir has a weakness in combinatorics and number theory, but he feels comfortable with geometry and algebra. A sample program for Samir would be to focus on learning combinatorics and number theory during August and most of September. For the month of October, their focus will shift towards geometry and algebra until the last few week prior to the competition, where Samir will have to focus entirely on problem solving. It goes without saying that even when the focus is on combinatorics and number theory for example, the competitor should still allocate some of their time for some (light) problem-solving in the topics of geometry and algebra. After competing, it is recommended for Samir to take sometime for rest, re-evaluate his needs, and program accordingly for the next season.

In the sample program above, the whole season (July-November) was dedicated to one *cycle*: Samir only peaked once prior to the competition. It is possible to program multiple cycles with shorter peaking periods within a single season, provided it is long enough. In this case, it is advised that a competitor rests at the end of each cycle.

It also helps to have a long-term program underlining the important concepts a competitor wishes to learn prior to the IMO. This long-term program should be divided according to competition seasons, and should be updated after every peaking period.

When programming for a season, do not attempt to learn more concepts and techniques than you can handle. Aim for a manageable collection of ideas spanning the four Olympiad tested topics and prioritize improving on your weaknesses. Do not rush your training, if you get bored change topics, if you get tired get some rest. Finally, keep in mind that the success of a good training program is largely due to your commitment to it. So program wisely, commit, work hard, and glory will be yours.