Tournament bracket generation for martial arts events: digital draw algorithm

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Abstract

Objective of the study was to develop an efficient digital draw algorithm to generate tournament brackets for the martial arts events.

Methods and structure of the study. We developed the digital draw algorithm at the Physical Education Theory and Practice, Gymnastics and Life Safety Department of the Physical Education Institute of Udmurt State University. The digital draw algorithm was developed to complement the computer software toolkit for competitive event design, management and reporting by a Martial Arts Draw section. Generally, the modern martial arts communities set the following requirements for a draw algorithm and resultant tournament brackets: (1) Teammates (of the same regional team and/ or trained by the same coach) should compete at the latest stages; (2) Top-ranking athletes should compete in the finals; and (3) The draw system should be reasonably random, with the brackets expected to never repeat.

Every of the above requirements can be met quite simply. Thus, the teammates' matches may be prevented at the early stages by the tournament brackets with a rational numbering system that secures the teammates of the same region/ coach listed in a sequential manner. Individual competitive accomplishments will be fixed in a database of core events with respect to the ratings. Such rating systems need to be formed separately as provided, for example, in study. On the whole, a competitive draw system will offer a multi-criteria optimization method.

Results and conclusion. The digital draw algorithm of our design has been tested beneficial in the Udmurt-Republic-hosted martial arts events, with the digital-draw-algorithm-generated tournament bracket recognized efficient in sorting athletes by their professional skills, competitive ratings, regional teams and coaches. The digital draw algorithm is recommended for application in different sports events that imply draws to group the qualifiers using specific sets of grouping criteria dominated by their professional ranks.

Keywords: *martial arts, draw, algorithm, rating, tournament bracket, digital draw algorithm.*

Background. Presently the martial arts communities give a high priority to new digital draw algorithms with the relevant software toolkits geared to generate high-quality tournament brackets for the competitive events.

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Such rating systems need to be formed separately as provided, for example, in study [1]. On the whole, a competitive draw system will offer a multi-criteria optimization method. When the lists of competitors are short and there are no time limitations, a good tournament bracket may be made by experienced service personnel. However, modern major martial arts events that require a draw every competitive day still need modern digital draw systems for efficiency.

The digital draw algorithm needs at least the following input data: lists of qualifiers for the events with their full names, ratings, regions and coaches. An Olympic-system-based tournament bracket will be generated as a binary tree with the winner, runner-ups and so on ranked from bottom (root) to top, respectively (Figure 1, a), with every leaf representing a competitor. When the number of competitors in N class equals to a degree of two, we obtain a full binary tree with the filled-in tournament bracket, otherwise a pre-qualification is needed. We may use $2^{n-1}<N\leq 2^n$ precondition to find the number of qualifier rounds. When $N<2^n$, we should add fictitious athletes to the *N* class with zero ratings and non-existent regions to make a full binary tree.

Having a full binary tree in the database, we now may do without a complex data processing procedure and use only a two-dimensional data array of $n=1$ lines and 2^n columns; with each element (tree node) in the array giving the relevant list of competitors (Figure 1, b). Each i line corresponds to 2^{i-1} columns. Actual competitive practices show that the numbers of competitors in every class never exceed 64, although even a higher limit is acceptable for the memory claimed by the data storage capacity, with the data accessibility highly simplified.

Our digital draw algorithm includes the following sequential steps:

1. Make a full list of class N competitors for the relevant tree level ($i=1$ line, $j=1$ column).

2. Consider, in a cyclic manner, elements of the array for i line ($i=1...n$) and j column ($j=1...2^{i-1}$). Group the competitors into two groups stored in the next line ($i+1$) in the columns numbered ($2\cdot j-1$) and ($2\cdot j$) . The grouping will be made as follows:

(a) Put in the N class the individual ratings in a descending order;

(b) Select 50% of the leaders – at most two from every region/ coach;

(c) Add leaders to the groups using the "serpent" pattern [3], with the top rated athlete listed with the first group; second and third with the second group; fourth and fifth again with the first group, etc. When an athlete is grouped with his teammate, substitute him by a peer from another group of the same serpent lev-

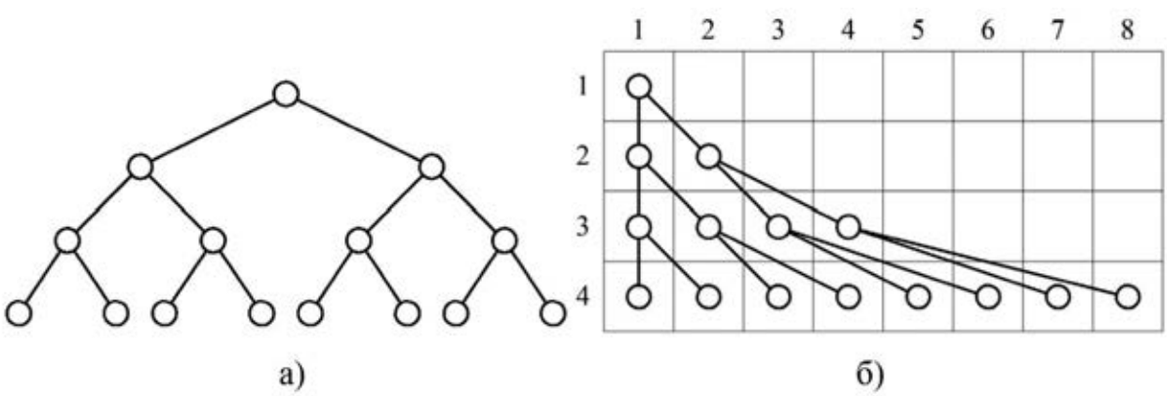

Figure 1. *Binary-tree-shaped tournament bracket (a) and the relevant data array (b)*

The tournament bracket is generated as follows: (1) Form a binary tree in parallel with the DD; and (2) Develop a digital draw algorithm for the binary tree.

Fig. 2. *Excerpt from the Registration Form*

Draw	Sex	Last name	First name	Patronymic	Date of birth	Age	Title	Region	Coach
1	M	Athlete	R=80		15.10.2015		Oriental Combat	A	A
2	M	Athlete	R=55		19.08.2015		Oriental Combat	V	V
3	M	Athlete	R=60		07.07.2014		Oriental Combat	B	B
4	M	Athlete	R=30		18.12.2015		Oriental Combat	A	A
5	M	Athlete	R=70		09.10.2015		Oriental Combat	B	B
6	M	Athlete	R=40		20.09.2014		Oriental Combat	V	V
7	M	Athlete	R=65		25.11.2015		Oriental Combat	G	G
8	M	Athlete	R=50		12.10.2015		Oriental Combat	A	A

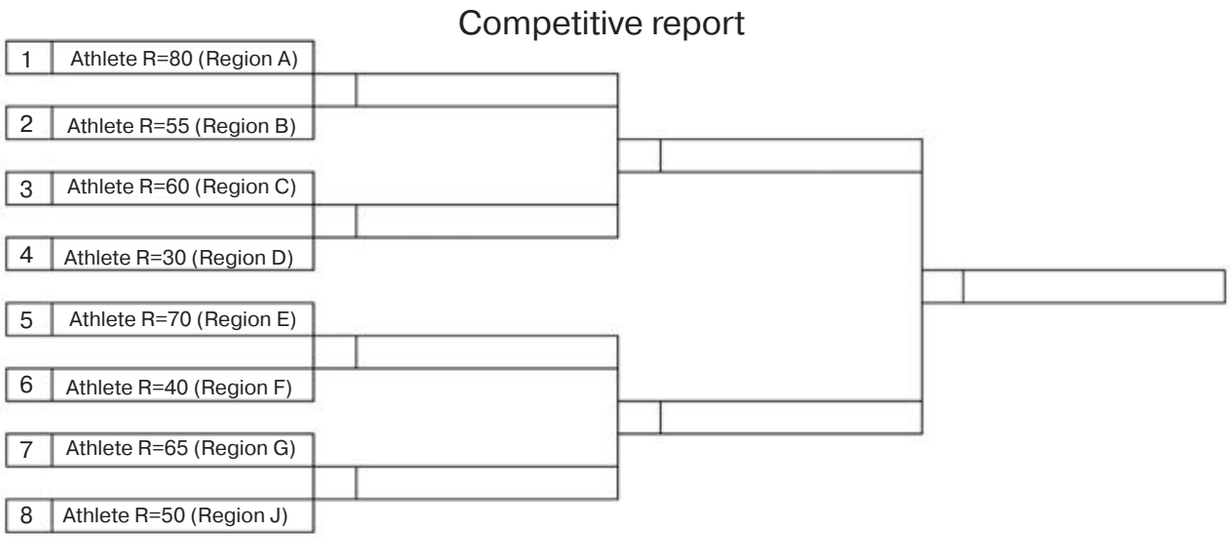

Figure 3. *Digital-draw-algorithm-generated tournament bracket*

el. This procedure generates virtually the same group rating structures and prevents the teammates' matches at the early stages;

(d) Form teams of the remaining competitors by the regions/ coaches and rearrange the team members randomly; and

e) Add athletes from the randomly selected teams to the groups using the serpent pattern, to ensure that every region/ coach is equally represented in both groups.

3. Form the class N protocol by moving the competitors' data from $i=n+1$ lines and $j=1...2^n$ columns into a Microsoft Excel spreadsheet, with the tournament bracket formed by automatic references, and with the fictitious athletes' entries left empty in the tournament bracket.

Results and discussion. Given in Figures 2 and 3 hereunder are the sample digital draw algorithm for a tournament bracket of eight competitors. The digital draw algorithm has been successfully tested in the computerized tournament bracket and reporting system during the municipal/ regional/ federal multidisciplinary karate and combat sports events hosted by the Udmurt Republic. Quality of the tournament brackets generated by the digital draw algorithm of our design was recognized by the event organizers and coaching teams.

Conclusion. The digital draw algorithm of our design has been tested beneficial in the Udmurt-Republic-hosted martial arts events, with the digital-draw-algorithm-generated tournament bracket recognized efficient in sorting athletes by their professional skills, competitive ratings, regional teams and coaches. The digital draw algorithm is recommended for application in different sports events that imply draws to group the qualifiers using specific sets of grouping criteria dominated by their professional ranks.

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