Distribution of players into teams.

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Optimization problem

Community/ online tournaments:

- Players don´t know each other
- Assigned role and known ranking of each player
- 8/16/32/64/128 teams of 3/5/11 players

Goal: try to make the teams „balanced“.

Brute–forcing

When each player has unique role in a team:

Total $(t!)^{\kappa-1}$ combinations of distributions, where t is number of teams and κ number of roles

for 16 teams, and 5 roles $\approx 2 \cdot 10^{53}$ combinations.

Variables

- I set of players
- T set of teams
- *Roles* set of roles κ
- x_{it} - binary variable, player i is in team t
- κ_i - role of i-th player
- n_κ number of players in team with role κ
- $rank_i$ rank of i-th player

Formulation of problem

$$\min_{x_i t} \sum_t s_t^+ + s_t^-$$

$$s.t. \qquad \sum_t x_{it} = 1 \quad \forall i \in I$$

$$\sum_i x_{it} = team\,size \quad \forall t \in T$$

$$\sum_i \mathbb{I}_{[\kappa_i = \kappa]} x_{it} = n_\kappa \quad \forall \kappa \in Roles, t \in T$$

$$\sum_i rank_i x_{it} + s_t^- - s_t^+ = 5\,\overline{rank} \quad \forall t \in T$$

$$x_{it} \in \{0, 1\} \quad \forall i \in I, t \in T$$

Rank of player can range from 100 to 3000

Number of variables : $(|I| + 2) * |T|$

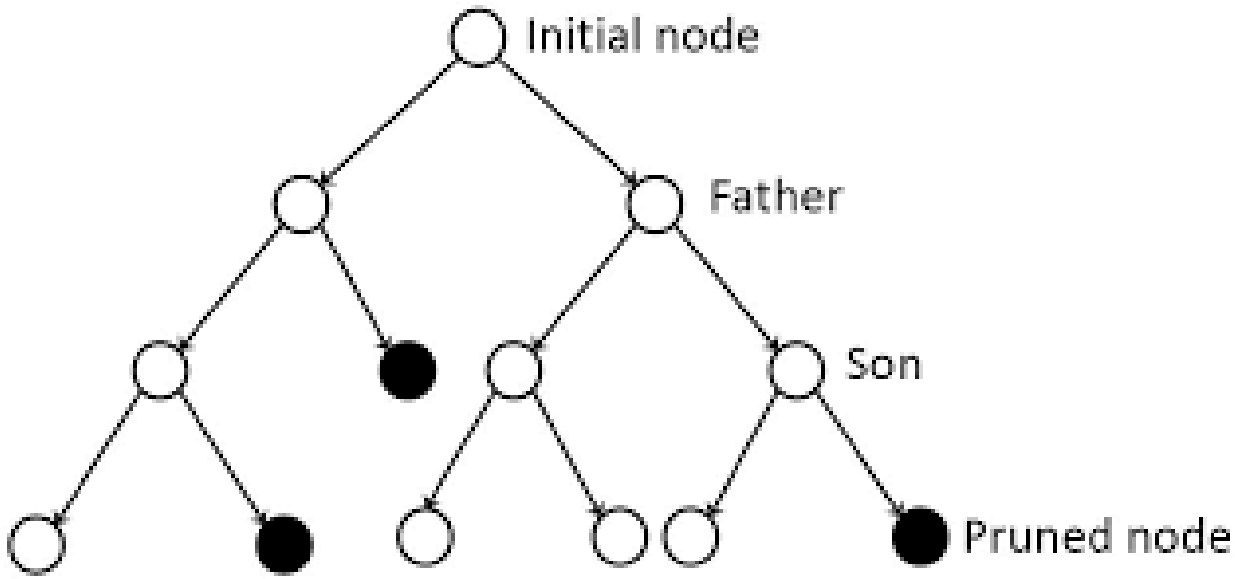
Doubling number of players:

- quadruples number of variables
- doubles number of constraints

1000 players in teams of 5 $\implies$ 200 400 variables

Branch and Bound

Variables aren´t treated as binary but as continuous.
In each layer fixes value of one variable.
Problem is quickly solved by simplex.
If it leads to at best unfeasible or "bad"solution, node is pruned.



Obrázek: First layers of solving the problem.

Paralel computing

By using 64 nodes we can

- speed up matrix operations inside simplex.
- or go to 8th layer and in parraler solve 64 „subproblems“ which can be cross-checked with left-over nodes redistributed.

Speed & memory

With 80 players in 16 teams „good“ solution is reached in 15 second on notebook.

With hundrets of players memory could be ok, but speed???