Klára Schovánková

schovkla@fit.cvut.cz

presented:

Bamboo Garden Trimming Problem

Leszek Gasieniec, Ralf Klasing, Christos Levcopoulos, Andrzej Lingas, Jie Min a Tomasz Radzik

http://lup.lub.lu.se/record/7fc24267-259c-45e5-83d7-3b316e462262

Definitions

- Garden: n bamboos, daily growth rates $h_1 \geq h_2 \geq \ldots \geq h_n$
- $H = \sum h_i$
- $\mathcal{A}(I)$ is perpetual trimming schedule for instance I
- $MH(\mathcal{S})$ is the supremum of heights over all times for schedule $\mathcal{S}$
- $MST(V)$ is the minimum weight of a Steiner tree on points V
- $D(V)$ is the diameter of the set V
- An instance of BGT is α-*balanced*, if $h_1 \leq \alpha \cdot H$, for some constant $\alpha < 1$

Problems

Given bamboo garden, design perpetual trimming schedule to make $MH(\mathcal{S})$ as low as possible. The main goal is a low approximation ratio.

DISCRETE BGT
Trim one bamboo at the end of each day. Online and offline scheduling.

CONTINUOUS BGT
Trim bamboo anytime, the time needed to move between bamboos.

Theorems

Theorem 1. REDUCE-FASTEST(2) is *4-approximation algorithm* for discrete BGT.

Lemma 1. A solution (if feasible) to the proper instance $I(\delta)$ of Pinwheel results in a $(1+\delta)$-approximation schedule for the original BGT problem.

Corollary 1. There is a 2-approximation algorithm for the BGT problem.

Theorem 2. For any $\delta > 0$, the Main Algorithm produces $(1+\delta)$-approximation discrete BGT schedules for α-balance instances, if $\alpha \leq \frac{\delta^2(1+\delta)}{(2+\delta)^2}$.

Lemma 2. $MH(\mathcal{A}) \geq Dh_{max}$, for any algorithm $\mathcal{A}$.

Lemma 3. $MH(\mathcal{A}) = \Omega(h_{min}(V') \cdot MST(V'))$, for any algorithm $\mathcal{A}$ and $V' \subseteq V$.

Theorem 3. *Algorithm 1* is an $O(h_{max}/h_{min})$-approximation algorithm for the continuous BGT problem.

Theorem 4. *Algorithm 2* is an $O(\log(h_{max}/h_{min}))$-approximation algorithm for the continuous BGT problem.

Theorem 5. *Algorithm 3* is an $O(\log(n))$-approximation algorithm for the continuous BGT problem.