



Parallel and Distributed Algorithms

Winter 2009/2010

8

Issue: 7.12.2009

Due: 14.12.2009

Information

Solutions in english or german are fine.

8.1. Problem (8)

Mandelbrot Set

For a complex number c we define the following iteration

$$z_0(c) = 0, z_{k+1}(c) = z_k^2(c) + c.$$

The Mandelbrot Set \mathcal{M} consists of all numbers c such that the sequence $z_k(c)$ is bounded, i.e., the set $\{|z_k(c)| \mid k \in \mathbb{N}\}$ is contained in some ball with center zero. One can show $|c| \leq 2$ for all $c \in \mathcal{M}$.

Assume $|z_k(c)| = 2 + \epsilon$ for some $\epsilon > 0$. **Show** that $|z_{k+1}(c)| \geq (1 + \epsilon)|z_k(c)|$. (As a consequence c does not belong to \mathcal{M} whenever $|z_k(c)| > 2$ for some k .)

8.2. Problem (8)

Asynchronous Round Robin

We consider the asynchronous round robin method for work distribution among p processes. Each process p_i has a local target variable pointing to exactly one process. Initially target variables are set arbitrarily.

Whenever a process requests work, it accesses its local target variable, requests work from the specified process and increments its target variable by one modulo p (whether the request has been granted or not).

If a process with work $\leq \frac{W}{p}$ receives a request it will not share its work.

Show that $\Theta(p)$ rounds are required until at least p processes have received work, provided the target values are initialized in a worst-case fashion.

8.3. Problem (8)

Work Stealing for Backtracking

Consider Remark 6.1 on page 115 and **show** that any parallel algorithm that traverses a tree T by a depth-first traversal has to spend at least $\max\{\frac{N}{p}, h\}$ steps, where N is the total number of nodes of T , h is the depth of T and p is the number of processes used.