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 asynchronious 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 arbitarily.

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 (wether 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.