Fundamental Algorithms 5

K-Exercise 1

Write a parallel program that computes the scalar product of two vectors (stored in two arrays). Discuss the runtime complexity on the EREW PRAM model. How many processors can be used?

K-Exercise 2

Extend the program of Exercise 1 to compute a matrix-vector or matrix-matrix product. Again, discuss the runtime complexity on the EREW PRAM and state the number of processors that are used.

K-Exercise 3

Given is the following parallel algorithm for prefix multiplication (for an EREW-PRAM).

```
PrefixPRAM(A: Array [1..n]) {
  // n assumed to be 2^k
  // Model: EREW PRAM (n-1 processors)

  for l from 0 to k-1 do
     for j from 2^l+1 to n do in parallel {
        tmp[j] := A[j-2^l];
        A[j] := tmp[j]*A[j];
     }
}
```

Assume that the j-loop of the above program is changed to

```
     for j from 2^l+1 to n do { ... }
```

(i.e., changed to a sequential loop). State why the resulting algorithm is no longer correct, and suggest how to change the j-loop to obtain a correct sequential implementation. Also, state why the parallel loop works correctly.