CS 337 **Makeup Quiz 3** **12/15/03**

Open book and notes.

Max points = 50 Time = 50 min Do all questions.

1. (String Matching; 32 points)

   (a) (Rabin-Karp algorithm; 8 points) Suppose you are looking for the pattern 26 in the text 3141582653599793, where $val(n) = n \bmod 11$. How many string matches do you have to attempt which ultimately fail?

   (b) (KMP algorithm; 10 points) Show that you can determine if pattern p is in text t simply from the cores of the prefixes of pt.

   (c) (4 points) The algorithm for core computation includes the following code fragment; see notes on "String Matching", Page 10.

   if $p[\overline{u}] = p[\overline{v}]$
   then $c(v') := u'$
   else $c(v') := \epsilon$
   endif ;

   Is it possible that $u = \epsilon$ and $c(v') \neq \epsilon$ after execution of this portion of the program? Show a small example to support your claim.

   (d) (KMP Algorithm; 10 points) Apply the KMP algorithm on the following pattern and text. Show only the different values of l (see page 6 of the notes on "String Matching").

index	0	1	2	3	4	5	6	7	8	9	10	11	12
text	b	a	c	b	a	b	a	b	a	a	b	c	b
pattern	a	b	a	b	a	c	a						

2. (Data Parallel Programming; 18 points)

   (a) (Batcher Merge; 8 points) Suppose u is a sorted list. Show that

   $$u\ bm\ u \ = \ u \bowtie u$$

   where bm is the Batcher Merge function (see Page 13 of your notes on Powerlist).

   Hint: Use the following fact: if p and q partition a sorted list L, then $p\ bm\ q \ = \ L$.

   (b) (Prefix sum; 10 points) Let $ps\ L$ be the prefix sum of L. Suppose the corresponding operator $\oplus$ is commutative as well as associative. Argue that $ps(p \oplus q) \ = \ (ps\ p) \ \oplus \ (ps\ q)$. If $\oplus$ is not commutative, show that $ps(p \oplus q) \ = \ (ps\ p) \ \oplus \ (ps\ q)$ may not hold.

   Hint: I don't need a formal proof for the commutative result; let $p \ = \ \langle p_0 \ \cdots \ p_n \rangle$ and $q \ = \ \langle q_0 \ \cdots \ q_n \rangle$.