

# Contents

- 1 Introduction 3**
  - 1.1 Sequential and Parallel Searching: A Brief Survey . . . . . 7
    - 1.1.1 Hashing . . . . . 7
    - 1.1.2 Binary searching . . . . . 9
  - 1.2 Overview . . . . . 13
  
- 2 Bulk Synchronous Parallel Computing 14**
  - 2.1 The BSP Model . . . . . 15
  - 2.2 The BSP\* Model . . . . . 18
  - 2.3 BSP vs BSP\* . . . . . 20
  - 2.4 The Bulk Synchronous Style of Parallel Programming . . . . . 21
  - 2.5 Discussion of the BSP/BSP\* Cost Model . . . . . 23
    - 2.5.1 Qualitative Arguments . . . . . 24
    - 2.5.2 Quantitative Arguments . . . . . 27
  - 2.6 Other Models of Parallel Computation . . . . . 31
    - 2.6.1 PRAM Models . . . . . 32
    - 2.6.2 Network Models . . . . . 34
    - 2.6.3 Intermediate Models . . . . . 34
  - 2.7 The BSP Model as a “Bridging Model” . . . . . 39
  
- 3 Basic algorithms on the BSP\* model 42**
  - 3.1 Broadcasting . . . . . 43
    - 3.1.1 Segmented broadcast . . . . . 44
  - 3.2 Computing Prefix Sums in Parallel . . . . . 45
    - 3.2.1 Segmented parallel prefix computation . . . . . 47
  - 3.3 Scanning . . . . . 47
  - 3.4 Integer Sorting . . . . . 49

3.4.1	Sequential algorithms for integer sorting . . . . .	50
3.4.2	A parallel sorting algorithm for small ranges of key values . . . . .	51
3.4.3	A parallel sorting algorithm for larger ranges of key values . . . . .	56
3.4.4	The segmented $s$ -sorting problem . . . . .	58
3.5	$s$ -Relations . . . . .	59
<b>4</b>	<b>Overview of the Multisearch Schemes</b>	<b>62</b>
<b>5</b>	<b>The General Searching Scheme</b>	<b>67</b>
5.1	The General Searching Scheme . . . . .	67
5.2	Solving the $(m, n)$ -Multisearch Problem for $m \leq n$ . . . . .	72
<b>6</b>	<b>Randomized Mapping</b>	<b>76</b>
6.1	The $z$ -Mapping . . . . .	77
6.2	The Searching Scheme . . . . .	83
<b>7</b>	<b>Deterministic Mapping</b>	<b>88</b>
7.1	The Redundant Mapping Scheme . . . . .	89
7.1.1	The Mapping of Tree Nodes to Processors . . . . .	89
7.1.2	Selection of Target Sets . . . . .	90
7.1.3	BSP* Implementation of Target Set Selection . . . . .	94
7.2	The Searching Scheme . . . . .	101
7.2.1	Computing the Locations of the Copies . . . . .	106
7.3	Improving the Runtime by Randomization . . . . .	107
7.3.1	Randomized Target Set Selection . . . . .	108
7.3.2	Randomized Multisearch . . . . .	119
7.4	Lower Bound . . . . .	120
	<b>Bibliography</b>	<b>122</b>