

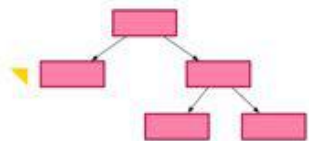
Functional Data Structures

Michael Wiedeking – MATHEMA Software GmbH

DevDays Vilnius 2016

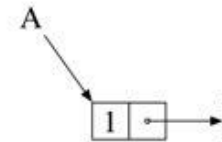
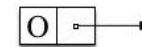
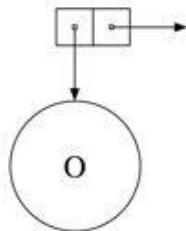
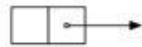
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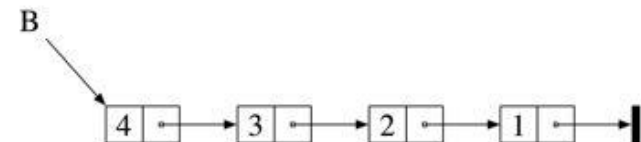
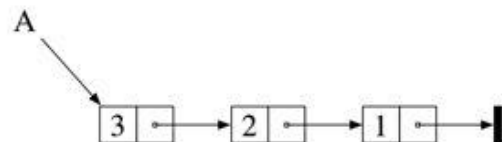
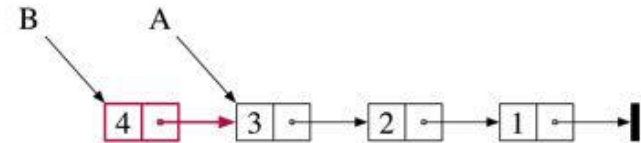
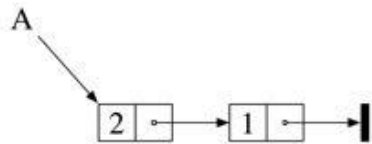
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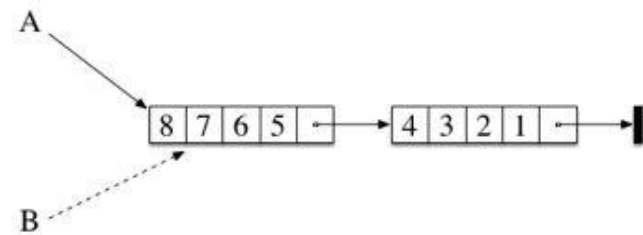
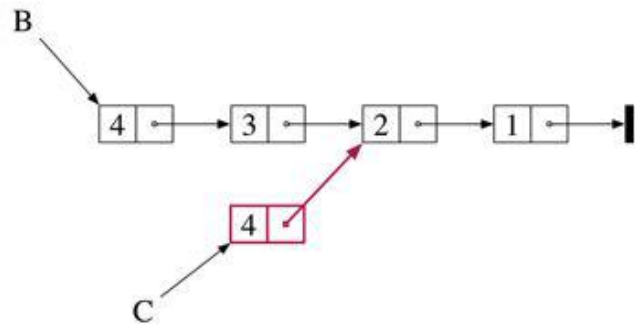
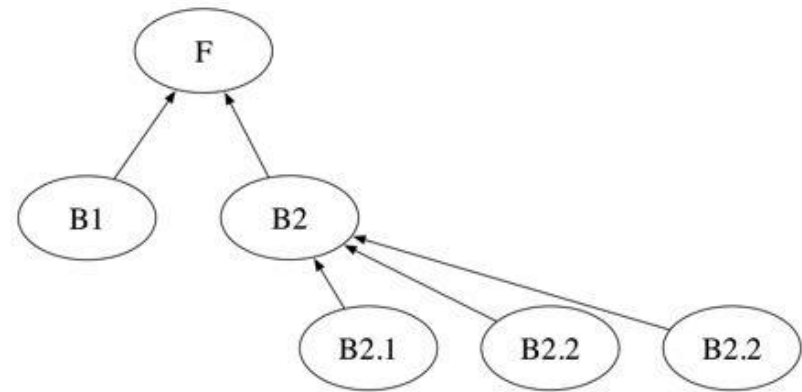
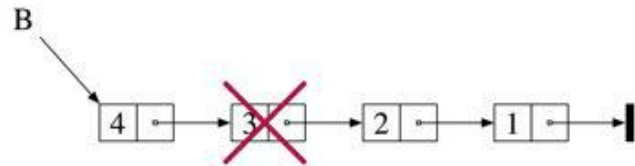


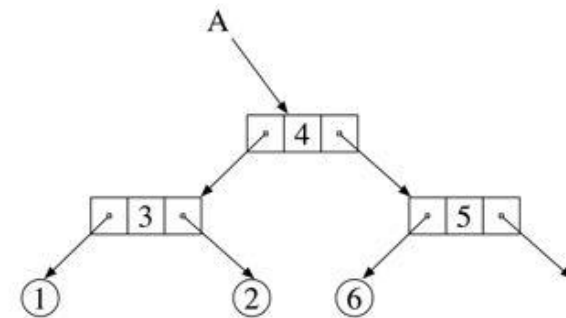
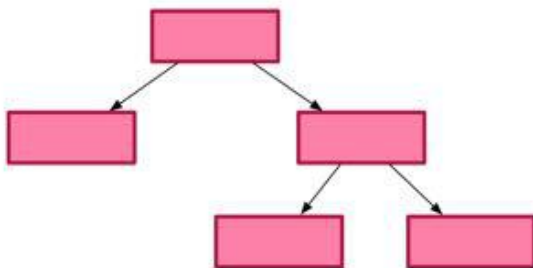
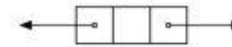
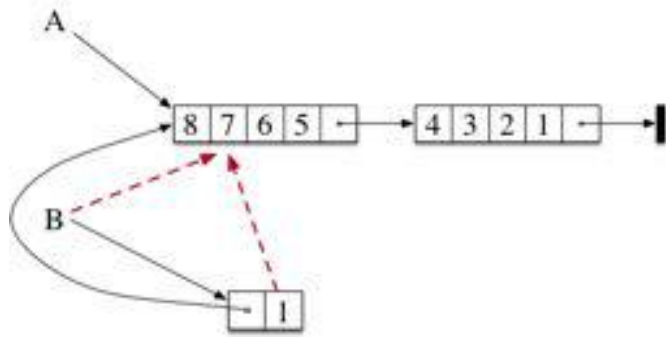
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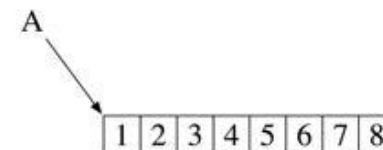
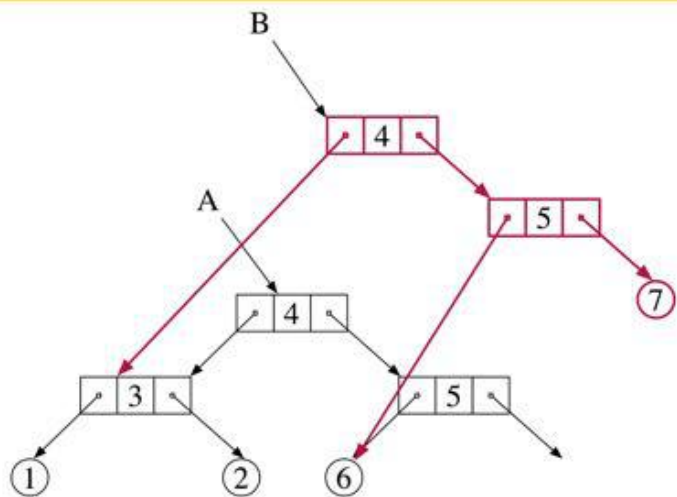
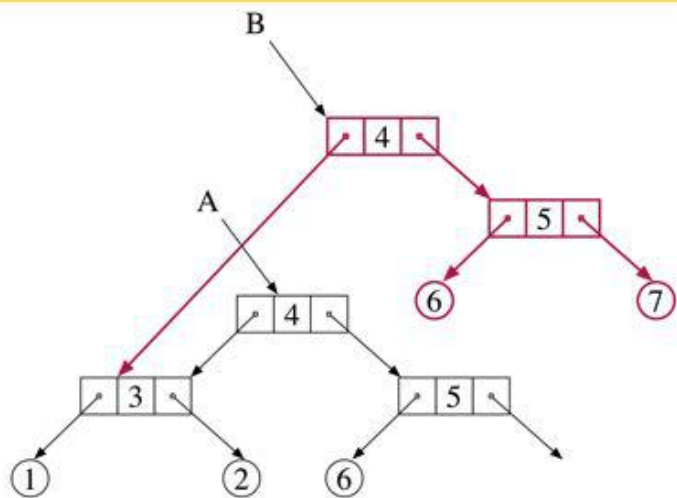


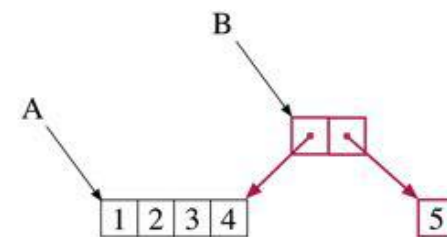
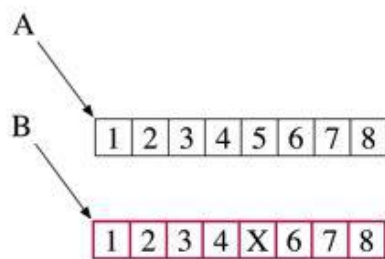
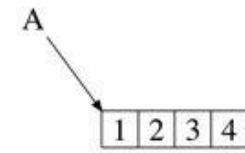
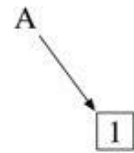


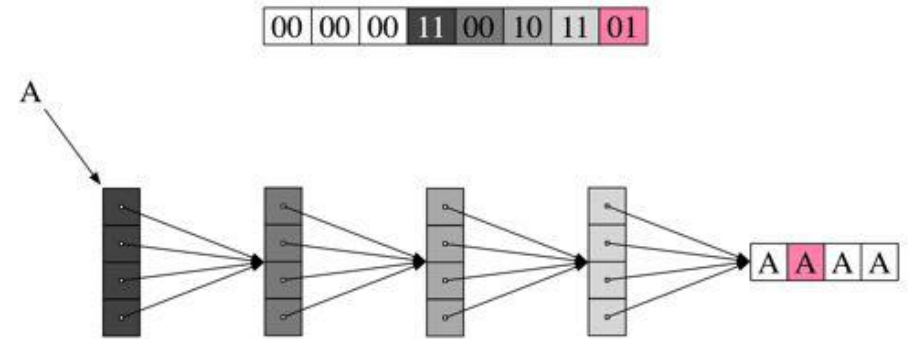
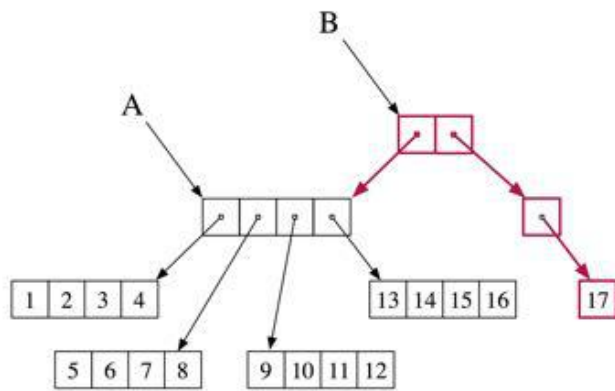
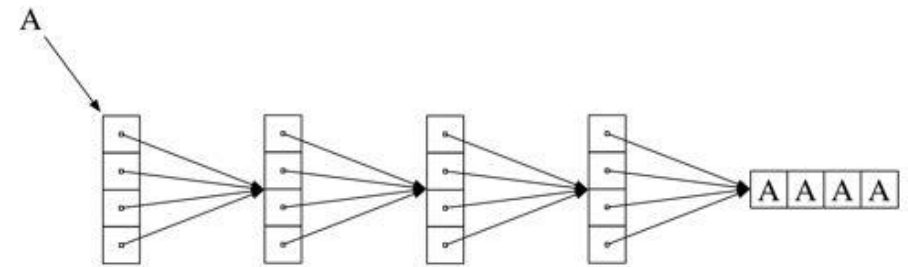
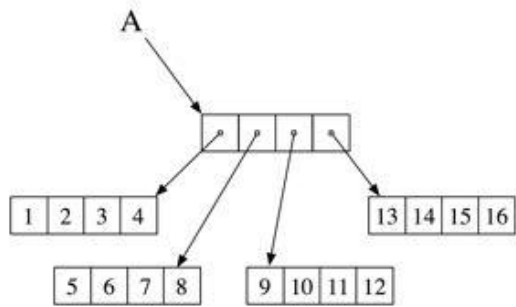




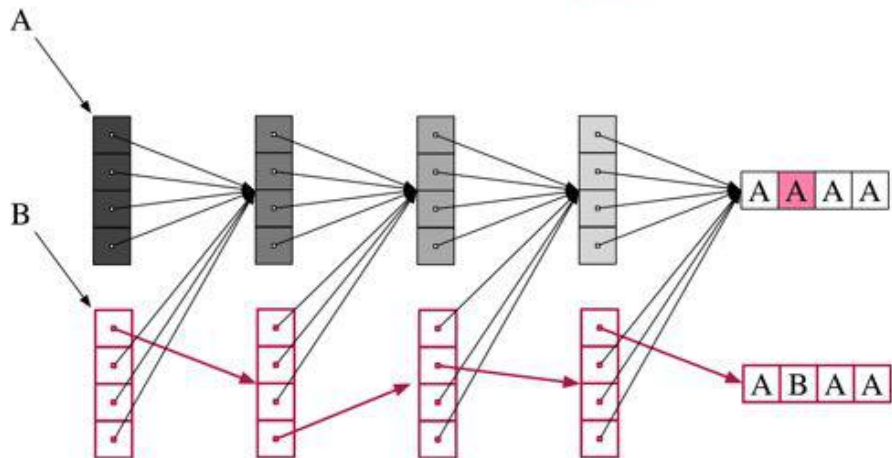






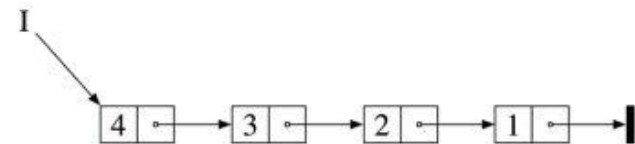


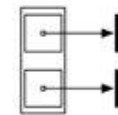
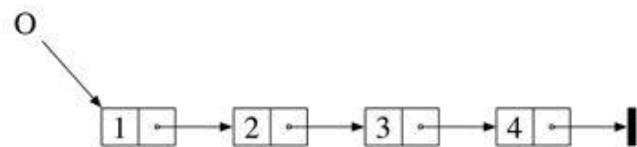
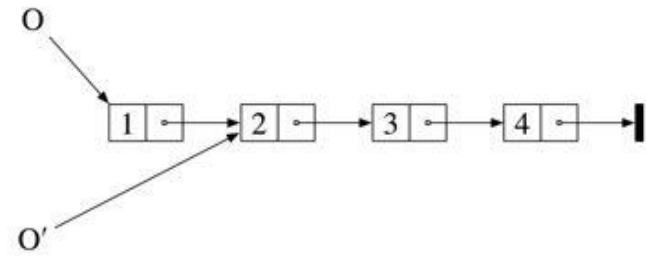
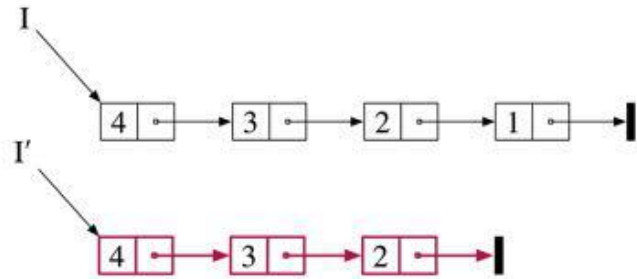
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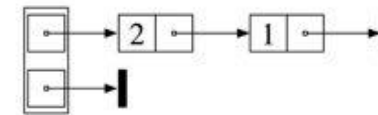
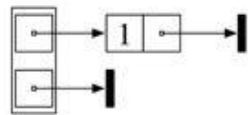
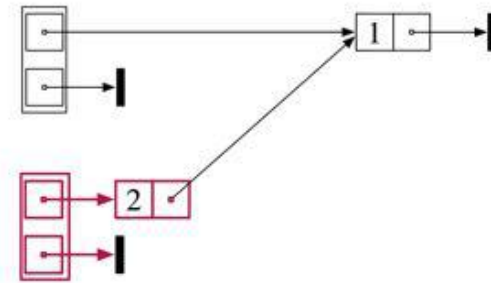
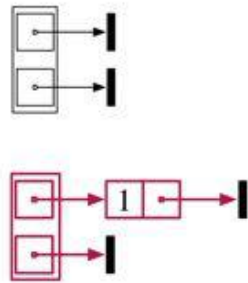


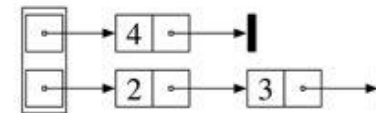
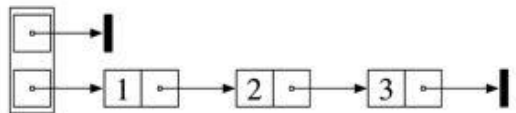
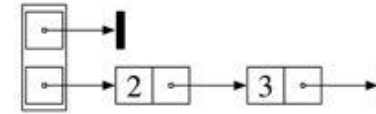
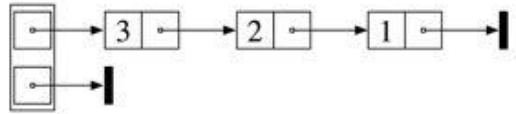
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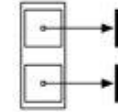
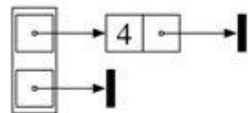
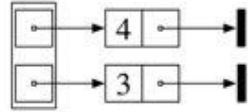
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Some Words

- ▼ $O(1)$ constant
- ▼ $O(\log n)$ logarithmic
- ▼ $O(n)$ linear
- ▼ $O(n \log n)$ quasilinear
- ▼ $O(n^2)$ quadratic
- ▼ $O(n^3)$ cubic
- ▼ $O(n^k)$ polynomial
- ▼ $O(2^n)$ exponential
- ▼ $O(n!)$ factorial

n	1	10	100	1000
▼ $O(1)$	1 ns	1 ns	1 ns	1 ns
▼ $O(\log n)$	1 ns	2 ns	3 ns	4 ns
▼ $O(n)$	1 ns	10 ns	100 ns	1 μ s
▼ $O(n \log n)$	1 ns	20 ns	300 ns	4 μ s
▼ $O(n^2)$	1 ns	100 ns	10 μ s	1 ms
▼ $O(n^3)$	1 ns	1 μ s	1 ms	1 s
▼ $O(2^n)$	1 ns	~1 μ s	~ 10^{13} a	

n	1	10	100	1000
▼ $O(1)$	1 s	1 s	1 s	1 s
▼ $O(\log n)$	1 s	2 s	3 s	4 s
▼ $O(n)$	1 s	10 s	100 s	1000 s
▼ $O(n \log n)$	1 s	20 s	300 s	4000 s
▼ $O(n^2)$	1 s	100 s	2,8 h	277,8 h
▼ $O(n^3)$	1 s	1000 s	277,8 h	31 a
▼ $O(2^n)$	1 s	1024 s	10^{22} a	

Complexity	1 ns	1 s
▼ $O(1)$	1	∞
▼ $O(\log n)$	1	$10^{1\,000\,000\,000}$
▼ $O(n)$	1	10^9
▼ $O(n^2)$	1	31 623
▼ $O(n^3)$	1	1000
▼ $O(2^n)$	1	30

Complexity	$2 \cdot C$	$10 \cdot C$
▼ $O(1)$	∞	∞
▼ $O(\log n)$	$10 \cdot n$	$10^9 \cdot n$
▼ $O(n)$	$2 \cdot n$	$10 \cdot n$
▼ $O(n^2)$	$1,41 \cdot n$	$3,16 \cdot n$
▼ $O(n^3)$	$1,26 \cdot n$	$2,15 \cdot n$
▼ $O(2^n)$	$n + 1$	$n + 3,3$

Questions?

Thank You!