Problem Set 4
CSE 373 Fall 2015
Due November 30 2015

Notes on Grading

• You can write “I don’t know” for any question and receive 25% credit. You can
take this option for any numbered problem, but not for part of a problem. For
example, you can answer 3.1 and write “I don’t know” for 3.2, but you can’t write
part of the solution for 3.2 and then write “I don’t know” for the rest.

• You get a 10% bonus for typing your homework. You are encouraged to use LATEX.
You must type your entire homework to receive the bonus. The 10% bonus does
not apply to problems answered with “I don’t know.”

External-memory algorithms

• (5 points) In class, we analyzed the amortized I/O complexity of inserting items
into a $B'$-tree. What is the worst-case I/O complexity of inserting an item into a
$B'$-tree?

• (5 points) How long would it take to sort $N$ items by inserting them into a $B'$-tree
and then iterating over them in order?

• (5 points) What about if you use an LSM-tree?

• (5 points) How do these compare with the I/O cost of sorting using $M/B$-way
merge sort?

• (10 points) Analyze the I/O complexity of the following matrix multiplication al-
gorithm:
Algorithm 1 Recursive matrix multiply algorithm. TL, TR, BL, and BR indicate the top-left, top-right, bottom-left, and bottom-right quadrants of a matrix.

function MM-Scan(A,B)
    if |A| = 1 × 1 then
        return A[0,0] × B[0,0]
    else
        X_{TL} ← MM-Scan(A_{TL}, B_{TL})
        X_{TR} ← MM-Scan(A_{TL}, B_{TR})
        X_{BL} ← MM-Scan(A_{BL}, B_{TL})
        X_{BR} ← MM-Scan(A_{BL}, B_{TR})
        Y_{TL} ← MM-Scan(A_{TR}, B_{BL})
        Y_{TR} ← MM-Scan(A_{TR}, B_{BR})
        Y_{BL} ← MM-Scan(A_{BR}, B_{BL})
        Y_{BR} ← MM-Scan(A_{BR}, B_{BR})

        C ← X + Y
        return C
    end if
end function