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Missouri University of Science & Technology — Department of Computer Science
**Spring 2024** — **CS 2500: Algorithms (Sec: 102)**

**Homework 2a: Insertion and Merge Sort**

**Instructor:** *Sid Nadendla* — **Due:** *February 19, 2024*

# Problem 1 Stability *3 points*

Demonstrate both `InsertionSort` and `MergeSort` iterations on the following input array:
$A = \{1, 5, 2, 3, 0, 2, 2, 1, 4, 5\}$.

Using the above example, discuss if `InsertionSort` and `MergeSort` are stable, i.e. if the repeated elements are placed in the same order as given in the input array.

# Problem 2 3-way MergeSort *2 points*

Problem 2.4 (Ref. Page 43 in the textbook.)

**Statement:**
Consider the following modification to the `MergeSort` algorithm:

Divide the input array into thirds (rather than halves), recursively sort each third, and finally combine the results using a three-way `Merge` subroutine.

What is the asymptotic runtime of this algorithm as a function of the length $n$ of the input array?

(a) $O(n)$ (b) $O(n \log n)$ (c) $O\Big(n(\log n)^2\Big)$ (d) $O(n^2 \log n)$