

**PROGRAMMING ASSIGNMENT #3**  
**CS 2223 D-TERM 2022**  
**PALINDROMES, INVERSIONS, AND**  
**BINARY REFLECTED GRAY CODE**

SEVENTY-FIVE POINTS  
DUE: THURSDAY, APRIL 7, 2022    11PM

1. (20 Points) A ***palindrome*** is a word, phrase, or sequence that reads the same backward as forward. Write a recursive Java program/procedure which determines whether an input sequence (string) from the keyboard is a palindrome or not. (You can assume the input will be shorter than 256 characters.) Call your program/project ‘palindromecheck’.

(3 Bonus Points) Make your program case insensitive, and have your program ignore white space and punctuation so that it recognizes the classics:

“never odd or even”

“Able was I ere I saw Elba.”

“A man, a plan, a canal: Panama!”

2. (25 Points) Let  $A[0..n-1]$  be an array of real numbers (or any ordered set). A pair  $(A[i], A[j])$  is said to be an ***inversion*** if these numbers (elements) are out of order, i.e.,  $i < j$  but  $A[i] > A[j]$ . Note that this pair need not be adjacent. The array/sequence (3, 2, 1) contains *three* inversions: (3,2), (2,1), and (3,1).

(10 Points) Write a program with a naïve  $O(n^2)$  [sorting] algorithm that counts the number of inversions in such an array  $A$ .

Call your program/project ‘easyinversioncount’.

(15 Points) Write a program with a  $O(n \log n)$  [sorting] algorithm that counts the number of inversions in such an array  $A$ .

Call your program/project ‘fastinversioncount’.

(Hints to follow...)

### 3. (30 Points) Binary Reflected Gray Code

The Klutzomaniacs are a troupe of five clowns—Axel, Boxo, Crunchy, Doofus, and Enzo—performing with the Silly Siblings & Risley & Turing Touring Circus. They often take to the center ring as roustabouts transition apparatus between aerial acts and daredevil stunts.

Their signature bit is an original twist on the traditional “group bike” act. When audience applause dies for the Lovelace Ladies—the circus’ trapeze triplets—a spotlight comes up on a giant tricycle. The Klutzomaniacs emerge from every section of the seats and begin to argue over who gets to ride the contraption. Ultimately, Axel leaps on and pedals around the center ring on it. As it passes its starting point, Boxo leaps aboard and begins pedaling as Axel climbs up on Boxo’s shoulders. The trike does lap after lap with one Klutzomaniac climbing on or tumbling off each time so that every possible subset of Klutzomaniacs rides around together until Enzo crashes out of the center ring alone as the Babbage Brothers swoop down from the rafters to do their Rollo Bollo (of Death!) balancing act.

Index	Gray Code	Klutzomaniacs Riding	Action
0	00000	EMPTY TRICYCLE	Spotlight
1	00001	Axel	Axel Pedals
2	00011	Boxo & Axel	Boxo Joins
3	00010	Boxo	Alex Leaves
4	00110	Crunchy & Boxo	Crunchy Joins
5	00111	Crunchy & Boxo & Axel	Axel Joins
6	00101	Crunchy & Axel	Boxo Leaves
⋮	⋮	⋮	⋮
31	10000	Enzo	Axel Leaves Enzo Crashes

- (5 Points) Using Java, implement algorithm BRGC( $n$ ) on page 148 of Levitin to produce the Binary Reflected Gray Code of order 5. (2<sup>nd</sup> Column)
- (10 Points) Add to your routine (or write a separate one using the idea in Problem 9b on page 149 of Levitin) to create a sequence of names representing which Klutzomaniac joins or leaves on each lap. The partial sequence up to six is: Axel, Boxo, Axel, Crunchy, Axel, Boxo, ... (4<sup>th</sup> Column)
- (15 Points) Put it all together to complete the table above for all 32 subsets of the Klutzomaniacs riding the tricycle around the center ring.

(3 Bonus Points) Extend your code so the Klutzomaniacs can welcome their fellow giant tricycle aficionados Fitz and Giggles to the troupe:

