**Exercise 2: E-commerce Platform Search Function**

**Scenario:**

You are working on the search functionality of an e-commerce platform. The search needs to be optimized for fast performance.

public class ProductSearch {

public static class Product {

private String productId;

private String productName;

private String category;

private double price;

public Product(String productId, String productName, String category, double price) {

this.productId = productId;

this.productName = productName;

this.category = category;

this.price = price;

}

public String getProductId() { return productId; }

public String getProductName() { return productName; }

public String getCategory() { return category; }

public double getPrice() { return price; }

@Override

public String toString() {

return String.format("%s - %s (%s) $%.2f", productId, productName, category, price);

}

}

private Product[] productsArray;

private Product[] sortedProductsArray;

public ProductSearch(Product[] products) {

this.productsArray = products.clone();

this.sortedProductsArray = products.clone();

java.util.Arrays.sort(sortedProductsArray, (a, b) -> a.getProductId().compareTo(b.getProductId()));

}

public Product linearSearchById(String productId) {

for (Product product : productsArray) {

if (product.getProductId().equals(productId)) {

return product;

}

}

return null;

}

public Product binarySearchById(String productId) {

int left = 0;

int right = sortedProductsArray.length - 1;

while (left <= right) {

int mid = left + (right - left) / 2;

int comparison = sortedProductsArray[mid].getProductId().compareTo(productId);

if (comparison == 0) {

return sortedProductsArray[mid];

} else if (comparison < 0) {

left = mid + 1;

} else {

right = mid - 1;

}

}

return null;

}

public static void main(String[] args) {

Product[] products = {

new Product("P100", "Wireless Mouse", "Electronics", 29.99),

new Product("P205", "Bluetooth Headphones", "Electronics", 89.99),

new Product("P302", "Mechanical Keyboard", "Electronics", 119.99),

new Product("P410", "Smart Watch", "Wearables", 199.99),

new Product("P505", "USB-C Cable", "Accessories", 12.99)

};

ProductSearch search = new ProductSearch(products);

System.out.println("Linear Search Results:");

System.out.println(search.linearSearchById("P302"));

System.out.println(search.linearSearchById("P999"));

System.out.println("\nBinary Search Results:");

System.out.println(search.binarySearchById("P410"));

System.out.println(search.binarySearchById("P001"));

}

}