KAUNO TECHNOLOGIJOS UNIVERSITETAS
INFORMATIKOS FAKULTETAS

Duomenų struktūros (P175B014)

Projektas

Atliko:

IF-8/1 gr. studentas

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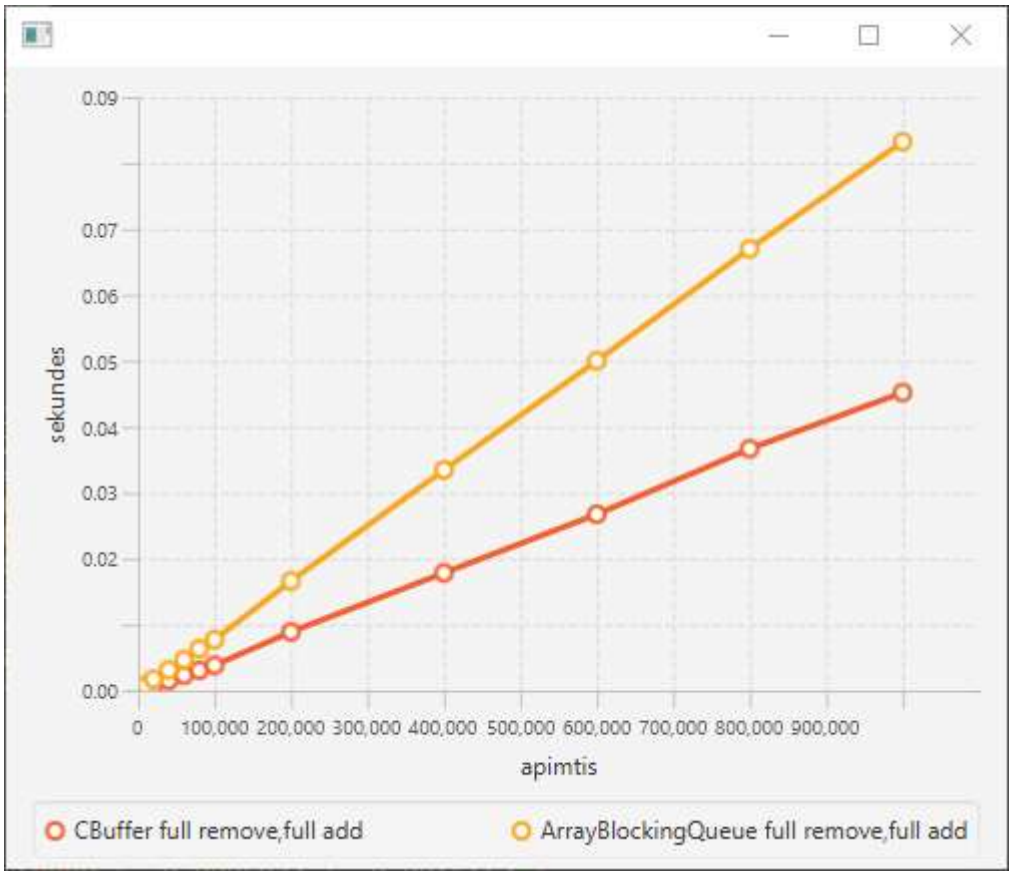
Priėmė:

Doc. Eimutis Karčiauskas

KAUNAS 2019

1. Metodų greitaveika

1.1. CircularBuffer ir ArrayBlockingQueue greitaveikos palyginimas (pilnas ištrynimas ir pilnas užpildymas)



2. Programinis kodas

2.1. CircularBuffer sąsaja

```java
package odinas;

/**
 * FIFO data structure
 * @param <T> Type param
 */
public interface CircularBuffer<T> {
    /**
     * @return true if buffer is full.
     */
    boolean isFull();

    /**
     * @return true if buffer is empty
     */
    boolean isEmpty();

    /**
     * adds element to the end
     * @param element element to add
     */
    void add(T element);
```

```
    /**
     * Removes element at head position (FIFO)
     * @return removed element or null if buffer is empty.
     */
    T remove();

    /**
     * Doesn't remove element, just returns it
     * @return element at head position or null if buffer is empty.
     */
    T peek();

    /**
     * Clears buffer to empty
     */
    void clear();
}
```

2.2. Sąsają realizuojanti klasė

```
package odinas;

import java.util.Arrays;
import java.util.Iterator;
import java.util.NoSuchElementException;

public class CBuffer<T> implements CircularBuffer<T>, Iterable<T> {
    private Object[] elements;
    private int head = -1;
    private int tail = -1;
    private int size = 0;

    public CBuffer(int maxSize) {
        elements = new Object[maxSize];
    }

    public CBuffer(T[] elements) {
        this.elements = elements;
        head = tail = 0;
        size = elements.length;
    }

    @Override
    public boolean isFull() {
        return size == elements.length;
    }

    @Override
    public boolean isEmpty() {
        return size == 0;
    }

    @Override
    public void add(T element) throws IndexOutOfBoundsException {
        if (isFull())
            throw new IndexOutOfBoundsException("Buffer is full");
        else if (tail == -1) {
            tail = head = 0;
            elements[0] = element;
            size++;
        } else {
            tail = (tail + 1) % elements.length;
            elements[tail] = element;
```

```
            size++;
        }
    }

    @Override
    public T remove() throws NoSuchElementException {
        if (isEmpty())
            throw new NoSuchElementException("Buffer is empty");
        else {
            var element = elements[head];
            head = (head + 1) % elements.length;
            size--;
            return (T) element;
        }
    }

    @Override
    public T peek() {
        if (!isEmpty())
            return (T) elements[head];

        return null;
    }

    @Override
    public void clear() {
        tail = head = size = 0;
    }

    @Override
    public String toString() {
        return Arrays.toString(elements);
    }

    @Override
    public Iterator<T> iterator() {
        return new InfiniteIterator();
    }

    /**
     * Infinite looping iterator (used for calculating timetables or shifts in fabrics,
etc.)
     */
    private class InfiniteIterator implements Iterator<T> {
        private int i = -1;

        @Override
        public boolean hasNext() {
            return true;
        }

        @Override
        public T next() {
            i = (i + 1) % elements.length;
            return (T) elements[i];
        }
    }
}
```

2.3. Panaudojimo pavyzdys

Slenkančio darbo grafiko, pamainų, budėjimų tvarkaraščių sudarymas.

```
Tvarkaraštis sudarytas

2019-11-26 budi Jonas
2019-11-27 budi Antanas
2019-11-28 budi Vacys
2019-11-29 budi Julius
2019-11-30 budi Jonas
2019-12-01 budi Antanas
2019-12-02 budi Vacys
2019-12-03 budi Julius
2019-12-04 budi Jonas
2019-12-05 budi Antanas
2019-12-06 budi Vacys
2019-12-07 budi Julius
2019-12-08 budi Jonas
2019-12-09 budi Antanas
2019-12-10 budi Vacys
2019-12-11 budi Julius
2019-12-12 budi Jonas
2019-12-13 budi Antanas
2019-12-14 budi Vacys
2019-12-15 budi Julius
2019-12-16 budi Jonas
2019-12-17 budi Antanas
2019-12-18 budi Vacys
2019-12-19 budi Julius
2019-12-20 budi Jonas
2019-12-21 budi Antanas
2019-12-22 budi Vacys
2019-12-23 budi Julius
2019-12-24 budi Jonas
2019-12-25 budi Antanas
2019-12-26 budi Vacys
```

3. Papildomai

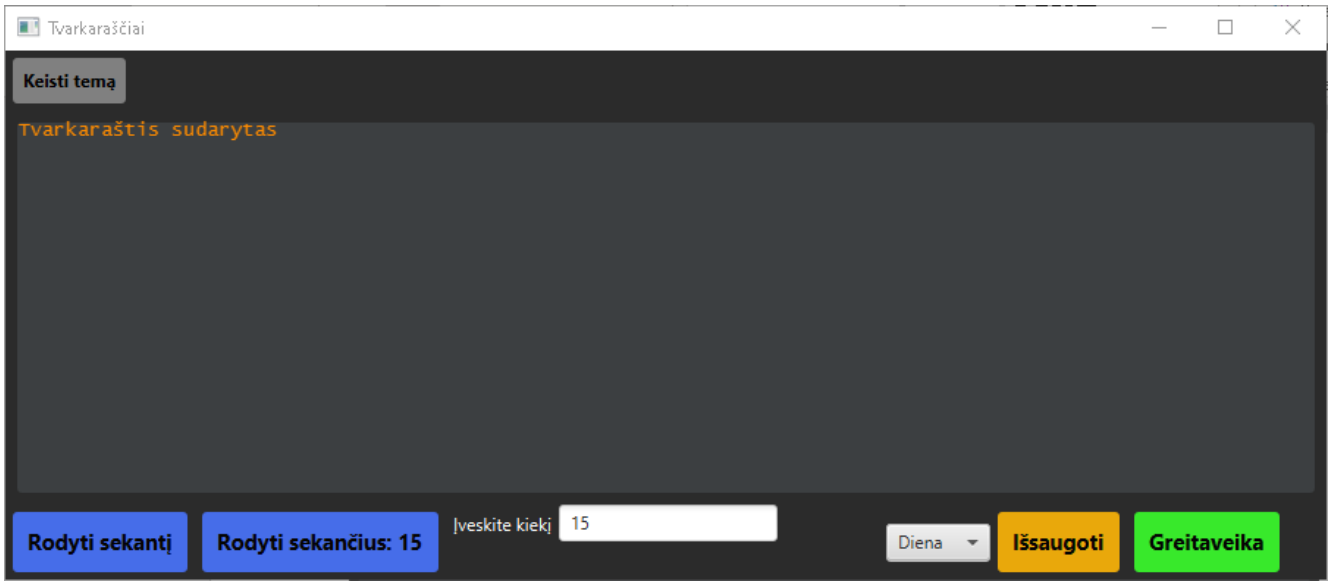
3.1. Testavimas su JUnit

```java
package tests;

import odinas.CBuffer;
import org.junit.jupiter.api.Test;

import java.lang.reflect.Field;

import static org.junit.jupiter.api.Assertions.*;

class CBufferTest {

    @org.junit.jupiter.api.Test
    void isFull() {
        var a = new CBuffer<Integer>(2);
        assertFalse(a.isFull());
        a.add(1);
        assertFalse(a.isFull());
        a.add(2);
        assertTrue(a.isFull());
```

```
        for (int i = 2; i < 30; i++) {
            a = new CBuffer<Integer>(i);
            for (int j = 0; j < i - 1; j++) {
                a.add(j);
                assertFalse(a.isFull());
            }
            a.add(5);
            assertTrue(a.isFull());
        }
    }

    @org.junit.jupiter.api.Test
    void isEmpty() {
        var a = new CBuffer<Integer>(3);
        assertTrue(a.isEmpty());
        a.add(1);
        assertFalse(a.isEmpty());
        a.remove();
        assertTrue(a.isEmpty());
    }

    @org.junit.jupiter.api.Test
    void add() throws NoSuchFieldException, IllegalAccessException {
        for (int i = 1; i < 100; i++) {
            var a = new CBuffer<Integer>(i);
            Field f = a.getClass().getDeclaredField("elements");
            Field f2 = a.getClass().getDeclaredField("tail");
            f.setAccessible(true);
            f2.setAccessible(true);

            for (int j = 1; j < i; j++) {
                Integer element = j;
                a.add(element);
                var elements = (Object[]) f.get(a);
                var tail = (int) f2.get(a);
                assertTrue(elements[tail].equals(element));
            }
        }
    }


    @Test
    void clear() {
        var a = new CBuffer<String>(3);
        assertTrue(a.isEmpty());
        a.add("asd");
        assertFalse(a.isEmpty());
        a.clear();
        assertTrue(a.isEmpty());
    }

    @Test
    void peek() throws NoSuchFieldException, IllegalAccessException {
        var a = new CBuffer<Integer>(3);
        assertNull(a.peek());
        a.add(5);
        a.add(6);
        var field = a.getClass().getDeclaredField("size");
        field.setAccessible(true);
        int size1 = (int) field.get(a);

        assertEquals(5, a.peek());
        var field2 = a.getClass().getDeclaredField("size");
        field2.setAccessible(true);
```

```
        int size2 = (int) field2.get(a);
        assertEquals(size1, size2);
    }
}
```

3.2. Grafinė sąsaja



4. Išvados

Atlikus nedidelę modifikaciją programą galima panaudoti slaptažodžių generavimui.

Viena naudingiausių „circular buffer“ duomenų struktūros ypatybių yra tai, jog nereikia perstumti elementų, kai prieinamas buferio galas. Todėl buferis tinka dažnoms įrašymo/trynimo operacijoms.

Visos operacijos buferyje atliekamos per laikotarpį O(1).

LZ77 duomenų suspaudimo algoritmų šeima naudoja „circular buffer“ duomenims saugoti.

Jeigu reikalinga fiksuoto dydžio eilė (FIFO), tai „circular buffer“ implementacija tam yra ideali.

Laboratorinio darbo kodas: https://github.com/d0ubletr0uble/Projektas_IF-8-1_Odinas_Tomas