Algorithmes und Datenstrukturen

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Todo list

1 Lösungen

1.1 Abstrakte Datenstruktur Arraylist

1.1.1 contains on ArrayList based LinkedList

```
{
    for (ArrayListElement<T> el = getFirst();
            el != null; el = el.getNext()) {
        for (Listobject<T> obj : el.getData()) {
            if (obj != null && data.equals(obj.getData())) {
                return true;
            }
        }
    }
    return false;
}
```

1.1.2 insert at position ArrayList based on SinglyLinkedList

1.1.3 remove on ArrayList on LinkedList

```
{
    if (i < 0 || getFirst() == null) {
        return false;
    }

    int index = 0;
    for (ArrayListElement<T> el = getFirst();
            el != null; el = el.getNext()) {
        final Listobject<T>[] data = el.getData();
        boolean found = false;
        for (int j = 0; j < el.getN(); j++) {
            if (index > i) {
                data[j - 1] = data[j];
            } else if (index == i) {
                found = true;
            }

            index++;
        }
        if (found) {
            el.decN();
            return true;
        }
    }
    return false;
}
```

Abstrakte Datenstruktur Arraylist: insert at position ArrayList based on SinglyLinkedList

1.2 Abstrakte Datenstrunktur PriorityQueue

1.2.1 Prio-Q auf LinkedList - peek

```
{
    return getHead() == null ? null : getHead().getKey();
}
```

1.2.2 Prio-Q auf LinkedList - push

```
{
    if (key == null) {
        return false;
    }

    final MListElement<T> elem = new MListElement<T>(key);
    final MListElement<T> head = getHead();
    if (head == null) {
        setHead(elem);

        return true;
    }
    if (getComp().compare(key, head.getKey()) <= 0) {
        elem.setNext(head);
        setHead(elem);

        return true;
    }

    for (MListElement<T> el = getHead(); el != null; el = el.getNext()) {
        if (getComp().compare(key, el.getKey()) > 0
                && (el.getNext() == null
                    || getComp().compare(key, el.getNext().getKey()) <= 0)) {
            elem.setNext(el.getNext());
            el.setNext(elem);

            return true;
        }
    }
    return false;
}
```

1.2.3 Prio-Q auf Linkedlist - pop

```
{
    final MListElement<T> head = getHead();
    if (head == null) {
```

```
            return null;
        }
        setHead(head.getNext());
        return head.getKey();
    }
```

1.3 Array

1.3.1 Array is sorted

```
{
    if (a == null) {
        return false;
    }

    for (int i = 0; i < a.length - 1; i++) {
        Integer x = a[i];
        Integer y = a[i + 1];
        if (x == null || y == null || comp.compare(x, y) > 0) {
            return false;
        }
    }
    return true;
}
```

1.3.2 Binary Search Iterative

1.3.3 Binary Search recursive

Array: Binary Search Iterative

1.3.4 duplicate every second element

```
{
    final Listobject<T>[] result =
            new Listobject[array.length + array.length / 2];
    for (int i = 0, j = 0; i < array.length; i++) {
        result[j++] = array[i];
        if (i % 2 != 0) {
            result[j++] = array[i];
        }
    }
    return result;
}
```

Array: Binary Search recursive

1.3.5 Insert Element In Array At

```
{
    final Listobject<T>[] oldArray = this.getArray();
    final Listobject<T>[] newArray;
```

```
    if (pos < oldArray.length && oldArray[pos] == null) {
        newArray = new Listobject[oldArray.length];
        for (int i = 0; i < oldArray.length; i++) {
            newArray[i] = oldArray[i];
        }
        newArray[pos] = element;
    } else {
        newArray = new Listobject[pos < oldArray.length
                ? oldArray.length + 1
                : pos + 1];
        for (int i = 0; i < newArray.length; i++) {
            if (i < pos && i < oldArray.length) {
                newArray[i] = oldArray[i];
            } else if (i > pos && i <= oldArray.length) {
                newArray[i] = oldArray[i - 1];
            } else if (i == pos) {
                newArray[i] = element;
            }
        }
    }
    setArray(newArray);
    return newArray;
}
```

1.3.6 Insert Element In Array

```
{
    final Listobject<T>[] oldArray = getArray();
    final Listobject<T>[] newArray = new Listobject[oldArray.length + 1];
    boolean inserted = false;
    for (int i = 0; i < newArray.length; i++) {
        if (inserted) {
            newArray[i] = oldArray[i - 1];
        } else if (i == oldArray.length) {
            newArray[i] = element;
        } else {
            final Listobject<T> el = oldArray[i];
            if (el.compareTo(element) < 0) {
                newArray[i] = el;
            } else if (el.compareTo(element) > 0) {
                newArray[i] = element;
                inserted = true;
            } else {
                newArray[i] = element;
                inserted = true;
            }
        }
    }
    setArray(newArray);
    return newArray;
```

```
}
```

1.3.7 linear search

```
{
    if (getElem() == null) {
        return -1;
    }

    for (int i = 0; i < getArrayLength(); i++) {
        if (getArrayElem(i) == null) {
            continue;
        }

        if (getComp().compare(getElem(), getArrayElem(i)) == 0) {
            return i;
        }
    }
    return -1;
}
```

1.3.8 merge Arrays iterativly

```
{
    final Listobject<T>[] result =
            new Listobject[left.length + right.length];
    int i = 0;
    int a = 0;
    int b = 0;
    for (; a < left.length && b < right.length; i++) {
        final Listobject<T> aElem = left[a];
        final Listobject<T> bElem = right[b];
        if (aElem.compareTo(bElem) < 0) {
            result[i] = aElem;
            a++;
        } else {
            result[i] = bElem;
            b++;
        }
    }
    for (; a < left.length; i++, a++) {
        result[i] = left[a];
    }
    for (; b < right.length; i++, b++) {
        result[i] = right[b];
    }
    return result;
}
```

1.3.9 Quicksort recursive

1.3.10 Remove Element From Array

Array: Quicksort recursive

```
{
    final Listobject<T>[] newArray = new Listobject[array.length - 1];
    for (int i = 0; i < array.length; i++) {
        if (i < index) {
            newArray[i] = array[i];
        } else if (i > index) {
            newArray[i - 1] = array[i];
        }
    }
    return newArray;
}
```

1.3.11 rotate Pairs

```
{
    if (list == null) {
        throw new NullPointerException();
    }

    for (int i = 1; i < list.length; i += 2) {
        final Listobject<T> tmp = list[i - 1];
        list[i - 1] = list[i];
        list[i] = tmp;
    }

    return list;
}
```

1.3.12 rotate successive triples in array

```
{
    if (a < 0 || b < 0 || c < 0) {
        throw new IndexOutOfBoundsException();
    }
    if (a >= array.length || b >= array.length || c >= array.length) {
        return false;
    }

    final Listobject<T> aElem = array[a];
    final Listobject<T> bElem = array[b];
    final Listobject<T> cElem = array[c];
    array[a] = cElem;
```

```
    array[b] = aElem;
    array[c] = bElem;

    return true;
}
```

1.3.13 rotate triples

```
{
    if (a < 0 || b < 0 || c < 0) {
        throw new IndexOutOfBoundsException();
    }
    if (a >= array.length || b >= array.length || c >= array.length) {
        return false;
    }

    final Listobject<T> aElem = array[a];
    final Listobject<T> bElem = array[b];
    final Listobject<T> cElem = array[c];
    array[a] = cElem;
    array[b] = aElem;
    array[c] = bElem;

    return true;
}
```

1.3.14 Search second largest Element

```
{
    for (int i = 0; i < getLength(); i++) {
        if (getElem(i) == null) {
            continue;
        }

        if (getLargest() == -1) {
            setLargest(i);
        } else if (getComp().compare(
                getElem(i), getElem(getLargest())) >= 0) {
            if (getComp().compare(getElem(i), getElem(getLargest())) != 0) {
                setSecLargest(getLargest());
            }
            setLargest(i);
        } else if (getSecLargest() == -1
                || getComp().compare(getElem(i),
                        getElem(getSecLargest())) >= 0) {
            setSecLargest(i);
        }
    }
}
```

1.3.15 selectionsort iterative

```
{
    for (int i = array.length - 1; i > 0; i--) {
        int m = 0;
        for (int j = 0; j < i; j++) {
            if (array[m].compareTo(array[j]) < 0) {
                m = j;
            }
        }

        if (array[m].compareTo(array[i]) > 0) {
            Listobject<T> tmp = array[i];
            array[i] = array[m];
            array[m] = tmp;
        }
    }
    return array;
}
```

1.3.16 shift elements left with rotation

```
{
    if (list == null) {
        return null;
    }
    if (list.length == 0) {
        return list;
    }

    Listobject<T> first = list[0];
    for (int i = 0; i < list.length - 1; i++) {
        list[i] = list[i + 1];
    }
    list[list.length - 1] = first;

    return list;
}
```

1.3.17 shift elements right with rotation

```
{
    if (list == null) {
        return null;
    }

    Listobject<T>[] result = Listobject
            .factoryMethodListobjectTArray(list.length);
```

```
    result[0] = list[list.length - 1];
    for (int i = 0; i < list.length - 1; i++) {
        result[i + 1] = list[i];
    }
    return result;
}
```

1.3.18 Sort $O(n^2)$ iterative

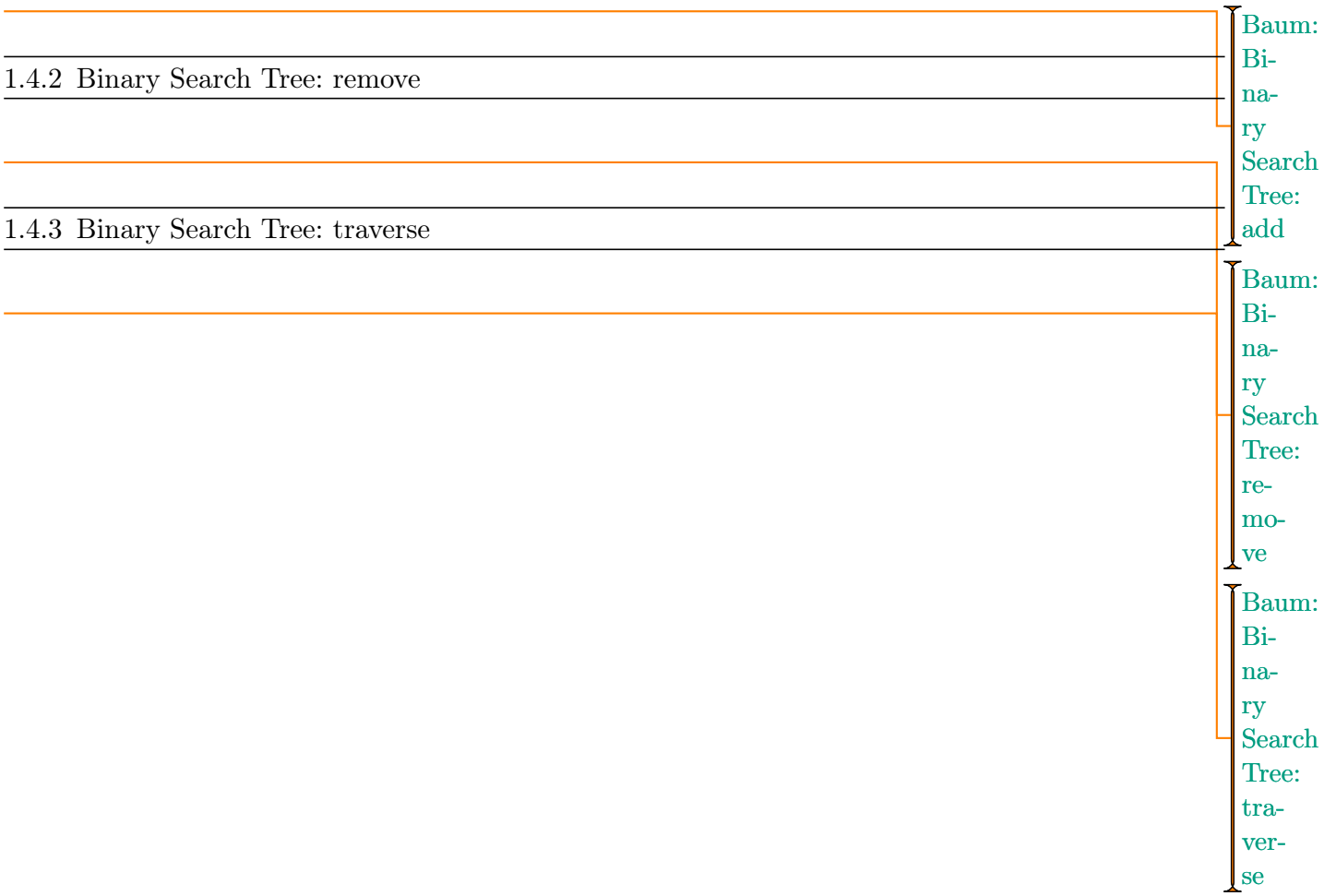
```
{
    for (int i = 0; i < inputdata.length; i++) {
        for (int j = 1; j < inputdata.length - i; j++) {
            if (comp.compare(inputdata[j - 1], inputdata[j]) > 0) {
                final Listobject<T> tmp = inputdata[j - 1];
                inputdata[j - 1] = inputdata[j];
                inputdata[j] = tmp;
            }
        }
    }

    return inputdata;
}
```

1.4 Baum

1.4.1 Binary Search Tree: add

1.4.2 Binary Search Tree: remove

1.4.3 Binary Search Tree: traverse



1.5.12 Floydwarshall: functionality

1.5.13 Floydwarshall - complete

1.5.14 Graph: addEdge

1.5.15 Graph: addNode

1.5.16 Graph: addSubgraph

1.5.17 Graph: countEdges

1.5.18 Graph: countNodes

1.5.19 Graph: findConnectedSubgraphs

1.5.20 Graph: findNode

1.5.21 Graph: removeEdge

1.5.22 Graph: removeNode

1.5.23 Kruskal: breakCondition/variant

Graph: Floydwarshall - complete

Graph: Graph: addEdge

Graph: Graph: addNode

Graph: Graph: countEdges

Graph: Graph: countNodes

Graph: Graph: findConnectedSubgraphs

Graph: Graph: find-

1.5.24 Kruskal: functionality

1.5.25 Kruskal: invariant

1.5.26 Kruskal: UnionFind

1.5.27 Kruskal - complete

1.5.28 Prim: breakCondition/variant

1.5.29 Prim: functionality

1.5.30 Prim: invariant

1.5.31 Prim - complete

Graph: Kruskal: functionality

Graph: Kruskal: invariant

Graph: Kruskal: UnionFind

Graph: Kruskal - complete

Graph: Prim: breakCondition/variant

Graph: Prim: functionality

Graph: Prim: invariant

1.6 Iterativ

1.6.1 check for palindrome in arrays of String

```
{
    if (a == null) {
        throw new NullPointerException();
    }
    if (a.length <= 0) {
        return null;
    }

    final boolean[] result = new boolean[a.length];
    for (int i = 0; i < a.length; i++) {
        final String s = a[i].toLowerCase();
        boolean palindrome = true;
        for (int j = 0; j < StringHelper.length(s) / 2; j++) {
            if (s.charAt(j) != s.charAt(s.length() - j - 1)) {
                palindrome = false;
                break;
            }
        }
        result[i] = palindrome;
    }
    return result;
}
```

1.6.2 Check for palindrome

```
{
    if (s == null) {
        throw new NullPointerException();
    }
    if (StringHelper.isEmpty(s)) {
        return false;
    }

    final String lower = s.toLowerCase();
    for (int i = 0; i < StringHelper.length(lower) / 2; i++) {
        if (lower.charAt(i) != lower.charAt(s.length() - i - 1)) {
            return false;
        }
    }
    return true;
}
```

1.6.3 Fibonacci Iterativ

```
{
    if (n < 0) {
        throw new IllegalArgumentException();
    }

    if (n == 0) {
        return 0;
    }

    int prev = 0;
    int result = 1;
    for (int i = 1; i < n; i++) {
        result = prev + (prev = result);
    }
    return result;
}
```

1.7 lambda Aufgaben

1.7.1 lambda-expressions + StrategyPattern

doArrayWork:

```
{
    final Integer[] result = new Integer[array.length];
    for (int i = 0; i < array.length; i++) {
        result[i] = array[i];
    }
    for (int i = 0; i < ops.length; i++) {
        getOperations()[ops[i]].doSomeThingOnArrays(result);
    }
    return result;
}
```

makeOperations:

```
{
    getOperations()[0] = arr -> {
        for (int i = 0; i < arr.length; i++) {
            arr[i] = arr[i] * arr[i];
        }
        return arr;
    };
    getOperations()[1] = arr -> {
        for (int i = 0; i < arr.length; i++) {
            arr[i] = arr[i] * 2;
        }
        return arr;
    };
    getOperations()[2] = arr -> {
        for (int i = 0; i < arr.length; i++) {
            arr[i] = arr[i] + 2;
        }
        return arr;
    };
}
```

1.8 MIPS

1.8.1 Array Sortieren

1.8.2 Euklidischer Algorithmus

1.8.3 Pascalsches Dreieck

MIPS: Array Sortieren

MIPS: Euklidischer Algorithmus

MIPS: Pascalsches Dreieck

1.9 Rekursiv

1.9.1 Aprox Square root (new)

```
{
    if (x < 0 || g < 0 || tolerance < 0) {
        throw new IllegalArgumentException();
    }

    if (Math.abs((x / g) - g) < tolerance) {
        return g;
    }

    return proxRootRec(x, ((x / g) + g) / 2, tolerance);
}
```

1.9.2 Fibonaccireihe Rekursiv

```
{
    if (i <= 0) {
        return 0;
    }
    if (i == 1) {
        return 1;
    }
    return fibRec(i - 1) + fibRec(i - 2);
}
```

1.10 Singly Linked List

1.10.1 clone linked elements

```
{
    if (el == null) {
        throw new NullPointerException();
    }

    final ListElement<T> head = new ListElement<T>(el.getData());
    ListElement<T> clone = head;
    for (ListElement<T> orig = el.next();
            orig != null; orig = orig.next()) {
        final ListElement<T> elem = new ListElement<T>(orig.getData());
        clone.setNext(elem);
        clone = elem;
    }
    return head;
}
```

1.10.2 clone singly linked list

```
{
    if (list == null) {
        throw new NullPointerException();
    }
    if (list.isEmpty()) {
        return new LinkedList<T>();
    }

    final ListElement<T> head = list.getFirst();
    final LinkedList<T> result = new LinkedList<T>();
    ListElement<T> clone = new ListElement<T>(head.getData());
    result.setFirst(clone);
    int count = 1;
    for (ListElement<T> el = head.next(); el != null; el = el.next()) {
        final ListElement<T> elem = new ListElement<T>(el.getData());
        clone.setNext(elem);
        clone = elem;
        count++;
    }
    result.setSize(count);
    result.setLast(clone);
    return result;
}
```

1.10.3 duplicate every second element

```
{
    boolean duplicate = true;
    for (MListElement<T> el = head; el != null; el = el.getNext()) {
        if (duplicate) {
            final MListElement<T> dupl = new MListElement<T>(el.getKey());
            dupl.setNext(el.getNext());
            el.setNext(dupl);
            el = dupl;
        }

        duplicate = !duplicate;
    }

    return head;
}
```

1.10.4 get

```
{
    int i = 0;
    for (ListElement<T> el = getFirst(); el != null; el = el.next(), i++) {
        if (i == idx) {
            return el;
        }
    }
    return null;
}
```

1.10.5 insert

1.10.6 insertFirst

Singly Linked List: insert

```
{
    if (el == null) {
        return false;
    }
    // Loop detection using Floyd's circle-finding algorithm.
    boolean run = true;
    for (ListElement<T> i = el, j = el; run;) {
        if (i.hasNext()) {
            i = i.next();
        } else {
            run = false;
            break;
        }
        if (j.hasNext() && j.next().hasNext()) {
```

```
            j = j.next().next();
        } else {
            run = false;
            break;
        }

        if (i == j) {
            return false;
        }
    }

    ListElement<T> last = null;
    int count = 0;
    for (ListElement<T> elem = el; elem != null;
            elem = elem.next(), count++) {
        if (contains(elem)) {
            return false;
        }
        if (!elem.hasNext()) {
            last = elem;
        }
    }
    setSize(size() + count);
    last.setNext(getFirst());
    setFirst(el);
    if (getLast() == null) {
        setLast(last);
    }

    return true;
}
```

1.10.7 insertLast

```
{
    if (el == null) {
        return false;
    }
    // Loop detection using Floyd's circle-finding algorithm.
    boolean run = true;
    for (ListElement<T> i = el, j = el; run;) {
        if (i.hasNext()) {
            i = i.next();
        } else {
            run = false;
            break;
        }
        if (j.hasNext() && j.next().hasNext()) {
            j = j.next().next();
        } else {
```

```
                run = false;
                break;
            }

            if (i == j) {
                return false;
            }
        }

        ListElement<T> last = null;
        int count = 0;
        for (ListElement<T> elem = el;
                elem != null; elem = elem.next(), count++) {
            if (contains(elem)) {
                return false;
            }
            if (!elem.hasNext()) {
                last = elem;
            }
        }
        setSize(size() + count);
        if (getLast() == null) {
            setFirst(el);
        } else {
            getLast().setNext(el);
        }
        setLast(last);

        return true;
    }
```

1.10.8 insertSingle

```
{
    if (el == null || idx < 0 || idx > size() || contains(el)) {
        return false;
    }

    el.setNext(null);

    if (idx == 0) {
        el.setNext(getFirst());
        setFirst(el);
        if (getLast() == null) {
            setLast(el);
        }
    } else if (idx == size()) {
        if (getLast() == null) {
            setFirst(el);
            setLast(el);
```

```
        } else {
            getLast().setNext(el);
            setLast(el);
        }
    } else {
        int i = 1;
        for (ListElement<T> elem = getFirst();
                elem != null; elem = elem.next(), i++) {
            if (i == idx) {
                el.setNext(elem.next());
                elem.setNext(el);
                break;
            }
        }
    }
    setSize(size() + 1);
    return true;
}
```

1.10.9 InsertSingleFirst

```
{
    if (el == null || getFirst() == el) {
        return false;
    }

    if (getFirst() == null) {
        setLast(el);
    }
    el.setNext(getFirst());
    setFirst(el);
    setSize(size() + 1);

    return true;
}
```

1.10.10 InsertSingleLast

```
{
    if (el == null || getLast() == el) {
        return false;
    }

    if (getFirst() == null) {
        setFirst(el);
    } else {
        getLast().setNext(el);
    }
    setLast(el);
```

```
    el.setNext(null);

    setSize(size() + 1);

    return true;
}
```

1.10.11 invert iterativly LinkedList

```
{
    if (head == null) {
        return null;
    }

    ListElement<T> next = null;
    ListElement<T> cur = head;
    for (ListElement<T> el = head.next(); el != null; el = next) {
        next = el.next();

        el.setNext(cur);
        cur = el;
    }
    head.setNext(null);
    return cur;
}
```

1.10.12 merge linked lists

```
{
    if (left == null || right == null || comp == null) {
        throw new IllegalArgumentException();
    }

    MListElement<T> result = null;
    for (MListElement<T> i = left, j = right, merged = null;
            i != null || j != null; ) {
        final MListElement<T> use;
        if (i == null) {
            use = j;
            j = j.getNext();
        } else if (j == null) {
            use = i;
            i = i.getNext();
        } else if (comp.compare(i.getKey(), j.getKey()) < 0) {
            use = i;
            i = i.getNext();
        } else {
            use = j;
            j = j.getNext();
```

```
            }

            if (merged != null) {
                merged.setNext(use);
            }
            merged = use;
            if (result == null) {
                result = merged;
            }
        }

        return result;
    }
```

1.10.13 remove

1.10.14 remove duplicated linked list elements

Singly Linked List: remove

```
{
    if (head == null) {
        return null;
    }

    ListElement<T> prev = head;
    for (ListElement<T> el = head.next(); el != null; el = el.next()) {
        if (comp.compare(prev.getData(), el.getData()) == 0) {
            prev.setNext(el.next());
        } else {
            prev = el;
        }
    }
    return head;
}
```

1.10.15 removeFirst

```
{
    final ListElement<T> first = getFirst();
    if (first != null) {
        setFirst(first.next());
        setSize(size() - 1);
        if (size() == 0) {
            setLast(null);
        }
    }
    return first;
}
```

1.10.16 removeLast

```
{
    if (getFirst() == null) {
        return null;
    }

    final ListElement<T> result = getLast();
    if (getFirst() == getLast()) {
        setFirst(null);
        setLast(null);
    } else {
        ListElement<T> secondLast = getFirst();
        while (secondLast.next() != getLast()) {
            secondLast = secondLast.next();
        }

        secondLast.setNext(null);
        setLast(secondLast);
    }
    setSize(size() - 1);
    return result;
}
```

1.11 String Operations

1.11.1 Prefix Check

```
{
    if (a == null || b == null) {
        return false;
    }

    final String lowerA = a.toLowerCase();
    final String lowerB = b.toLowerCase();
    for (int i = 0; i < lowerA.length(); i++) {
        if (i >= lowerB.length() || lowerA.charAt(i) != lowerB.charAt(i)) {
            return false;
        }
    }
    return true;
}
```

1.11.2 simple String Matcher

```
{
    if (S == null || T == null) {
        throw new IllegalArgumentException();
    }

    final String haystack = S.toLowerCase();
    final String needle = T.toLowerCase();

    final ArrayList<int[]> tupels = new ArrayList<int[]>();
    final ArrayList<Integer> result = new ArrayList<Integer>();
    for (int i = 0; i < haystack.length(); i++) {
        tupels.add(new int[] { i + 1, -1 } );

        final java.util.Iterator<int[]> it = tupels.iterator();
        while (it.hasNext()) {
            final int[] tupel = it.next();
            tupel[1] += 1;
            if (haystack.charAt(i) != needle.charAt(tupel[1])) {
                it.remove();
            } else if (tupel[1] == needle.length() - 1) {
                it.remove();
                result.add(tupel[0]);
            }
        }
    }
    return result;
}
```