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(1) Quiz – Find pattern

```java
public class FindPattern {
    /**
     * In this task you must find the first occurrence of a pattern in a
     * sequence.
     * This occurrence might also be **in a different order** than in
     * the pattern.
     *
     * For example, let:
     *      pattern = [1, 1, 3, 5]
     *      sequence = [3, 1, 2, 5, 1, 3, 1, 5, 1]
     *
     * Starting at index 3, we have the sub-sequence [5, 1, 3, 1] which
     * is the pattern reordered. Thus your method must return 3.
     * Note that the pattern also appears at index 4, but you must
     * return the first occurrence.
     * If the pattern is not in the sequence, you must return -1.
     */
}
```

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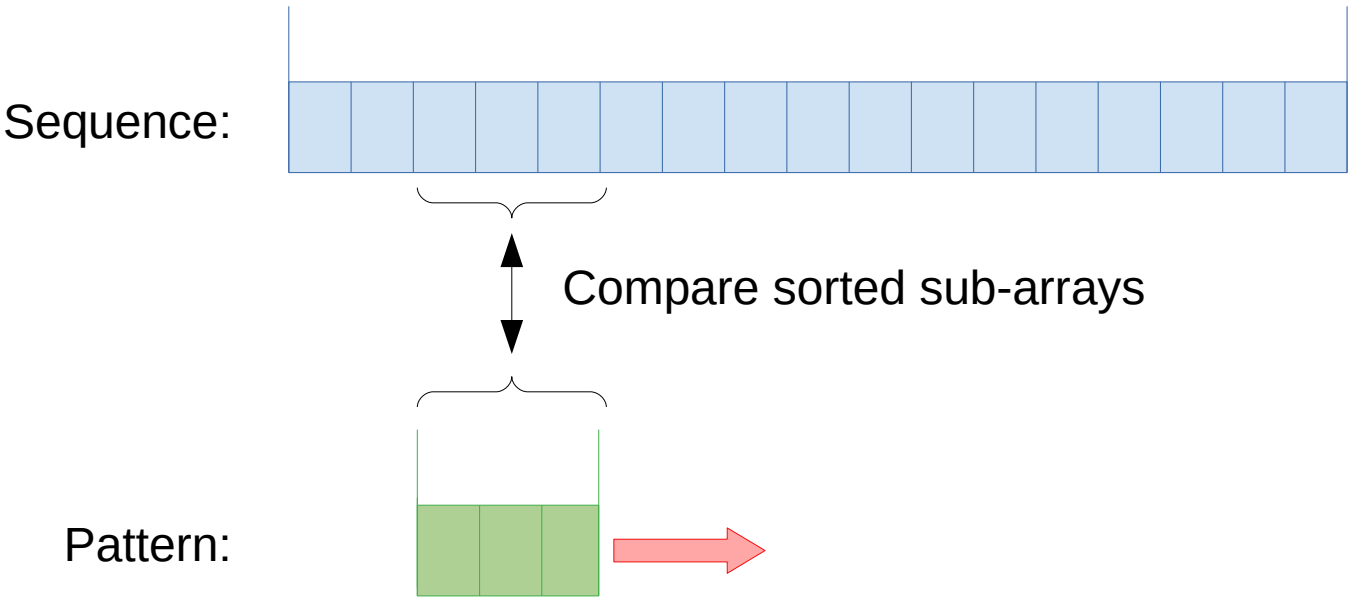
Version 1



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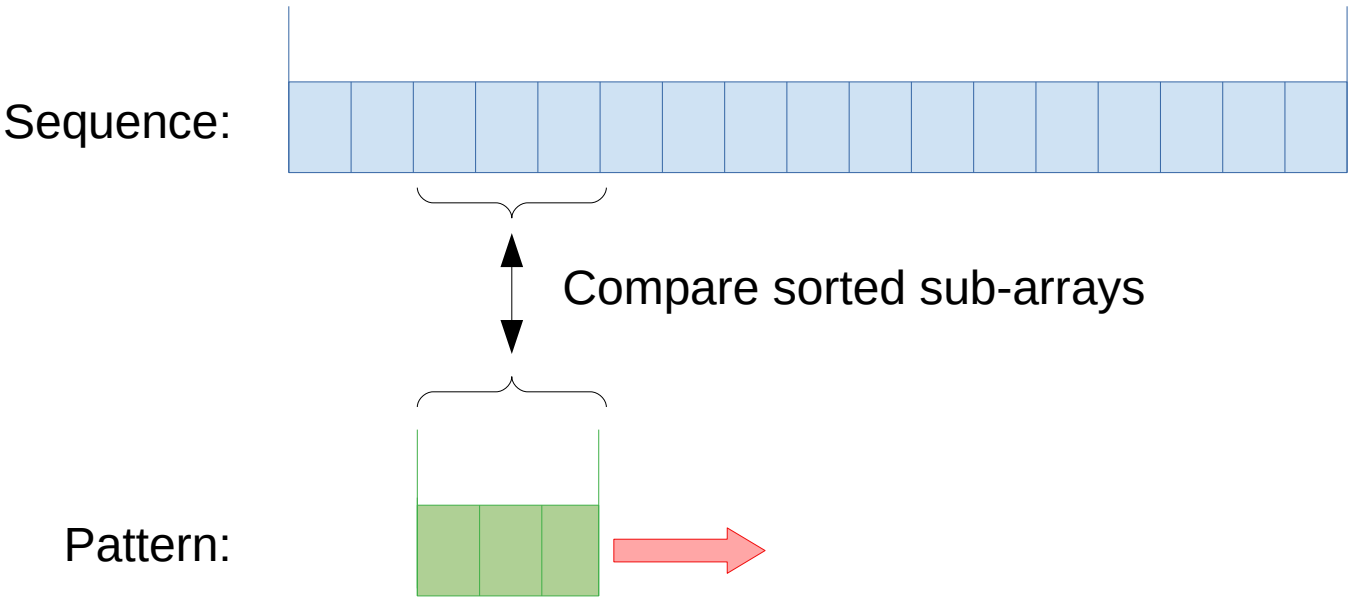
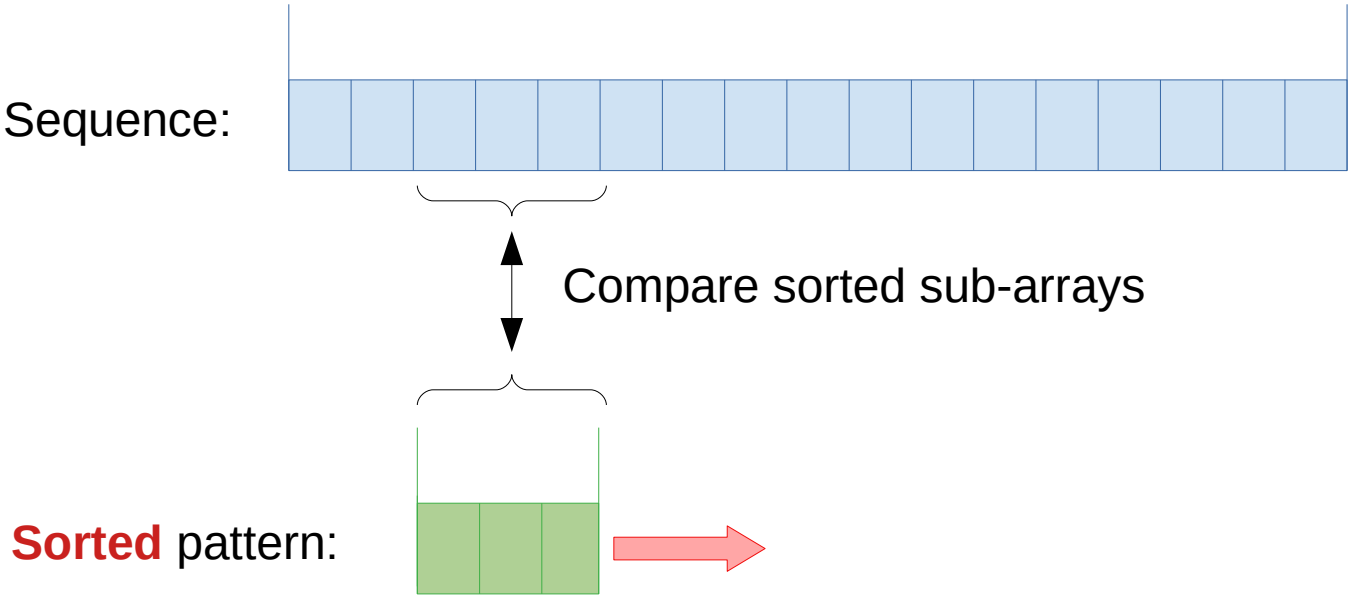
Version 1



We must:

1) Sort sub-arrays: `int[] sort(int[] sequence, int start, int length)`
2) Compare sub-arrays: `boolean compare(int[] a, int[] b)`

Version 2 – Minor optimization



The pattern can be sorted only once!

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Version 3 – Without sorting

The complexity of the internal loop depends on the length of the pattern!

Could this be avoided?

```
public class FindPattern {
    /**
     * ...
     * @param pattern The pattern to look for
     * @param sequence The sequence to look in. Each element of the sequence is
     *        in the interval [0, 15]
     * @return The index of the first occurrence of the pattern in the
     *         sequence or -1 if the pattern is not in the sequence
     */
}
```

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}
```

Let's take advantage of this [0, 15] range!

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Remember the “Anagram” exercise (module 1)?

S A N T A

S A T A N

Remember the “Anagram” exercise (module 1)?

S A N T A

S A T A N

Signature

```
A : 2
B : 0
C : 0
D : 0
E : 0
...
N : 1
...
S : 1
T : 1
...
```

We can compare signatures of length 16!

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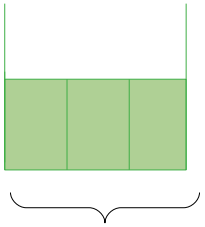
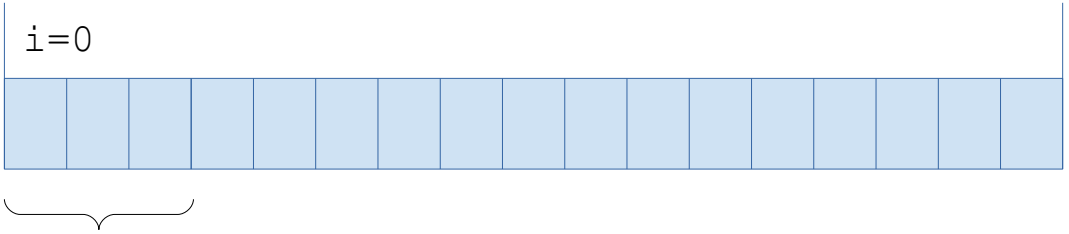
Efficient update of the signature of the sub-sequence

(1) Pattern signature:
(size = 16)



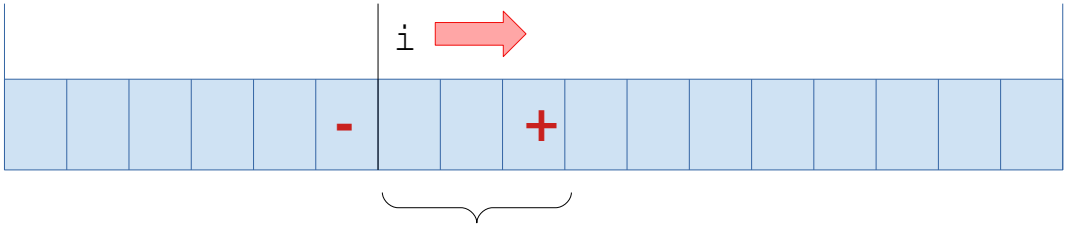
`int[] patternSignature`

(2) Initial sequence signature:



`int[] sequenceSignature`

(3) Update:



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(2) Quiz – Merge sorted lists, no duplicates

```java
public class MergeSortedLinkedListDuplicate {
    /**
     * You receive two linked lists containing elements in increasing order.
     * You are asked to return a new linked list that contains the
     * elements of both linked lists in increasing order but without duplicates.
     * The input linked lists must remain unchanged.
     * Moreover, the final linkedList must not contain duplicate values
     * That is, instead of 1-1-2-5, you must return 1-2-5.
     *
     * The complexity of your method must be in O(n+m)
     */
    public static Node merge(Node list1, Node list2) {
        // TODO
    }
}
```

We must stick to the data structure defined by class “Node”

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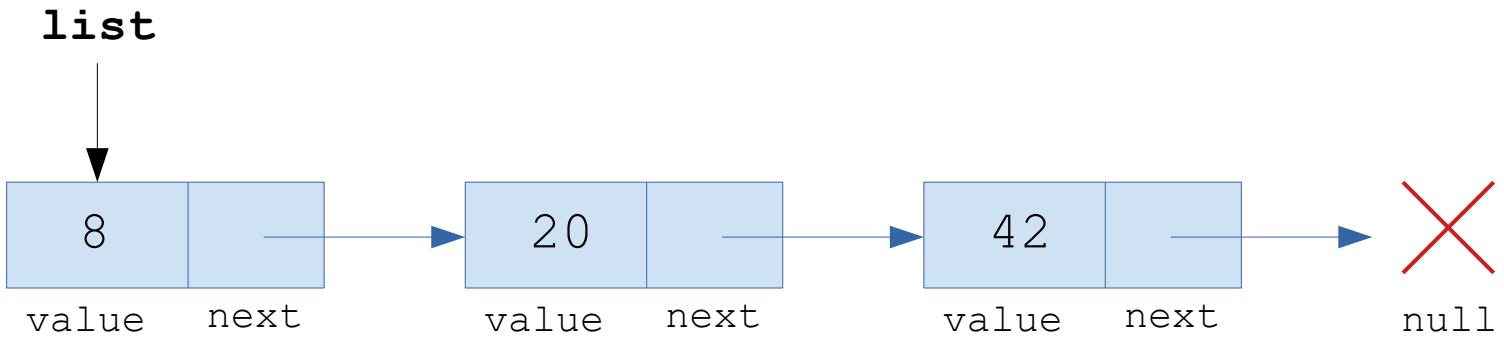
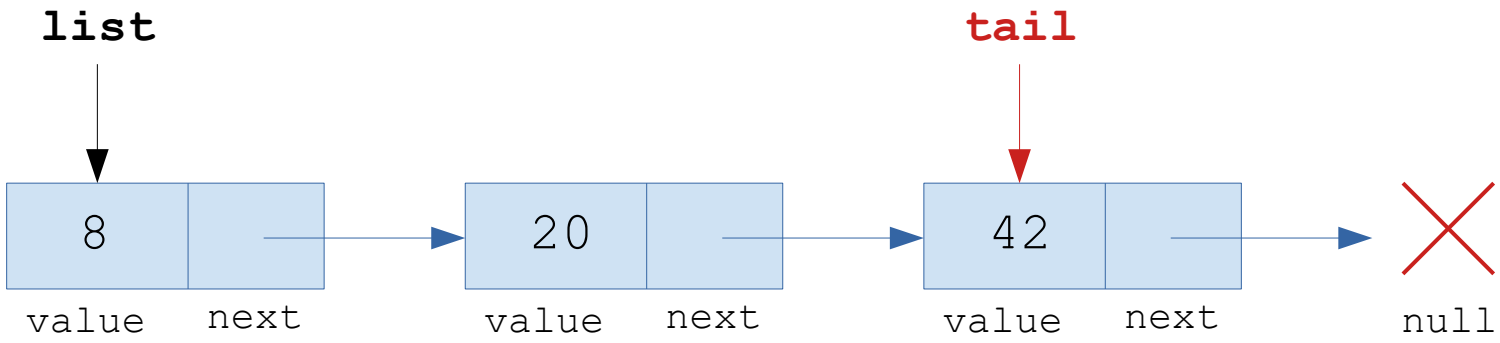
```
static class Node {
    int value;
    Node next;

    public Node(int value, Node next) {
        this.value = value;
        this.next = next;
    }
}
```



Appending without duplicate, in constant time



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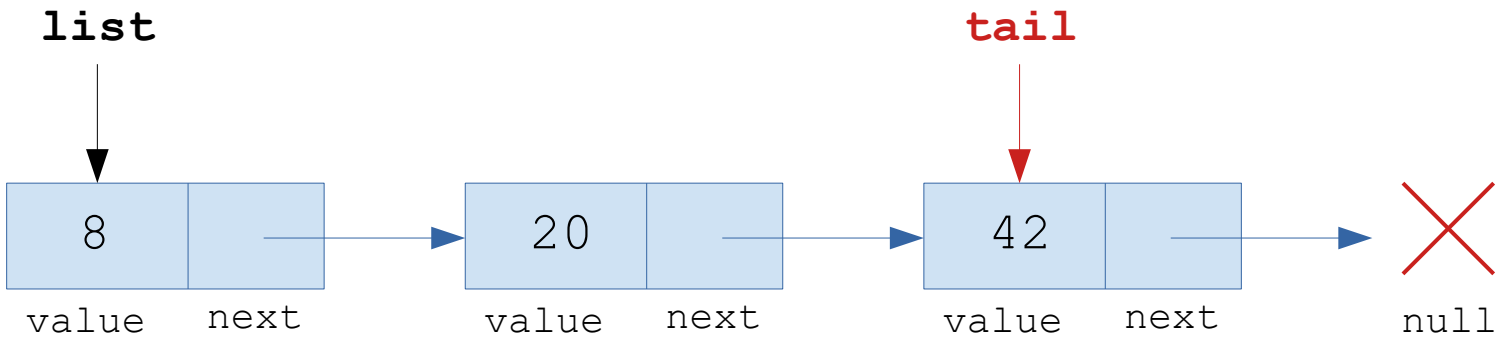
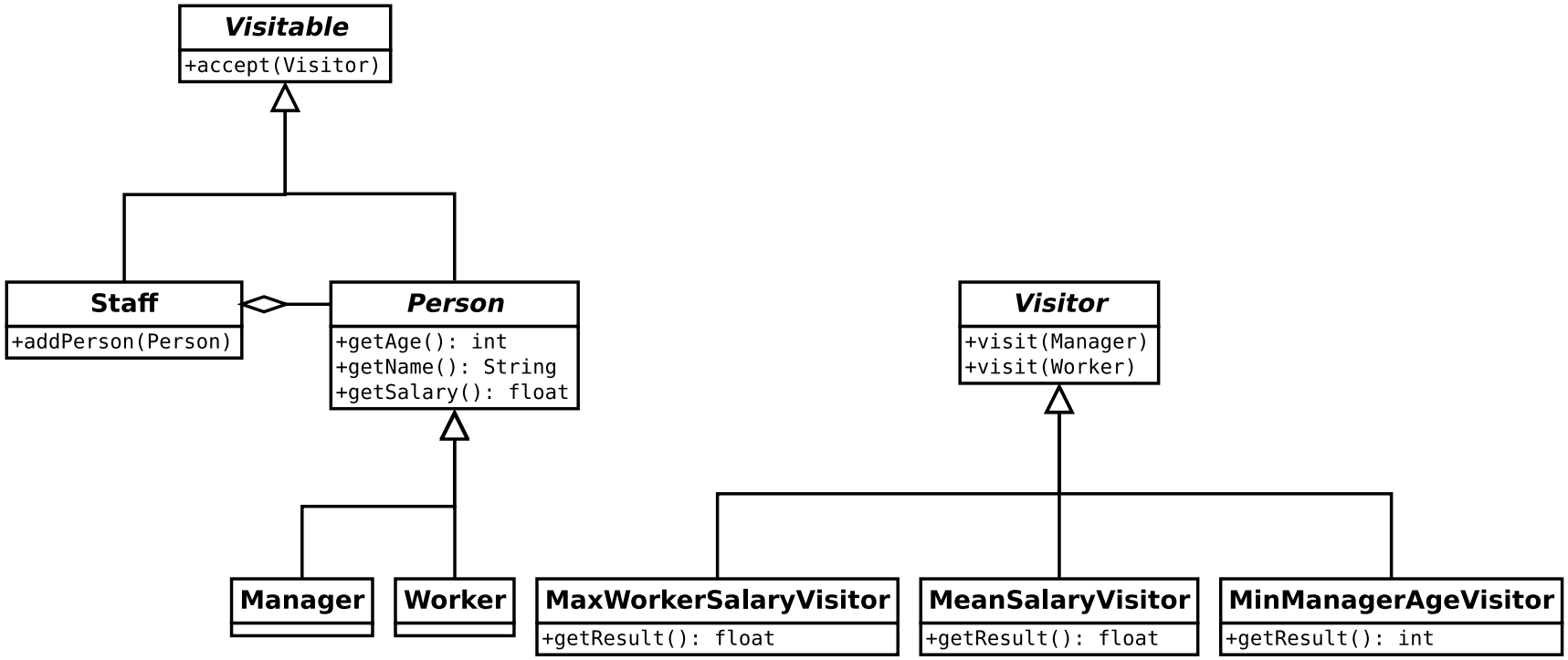
Appending without duplicate, in constant time

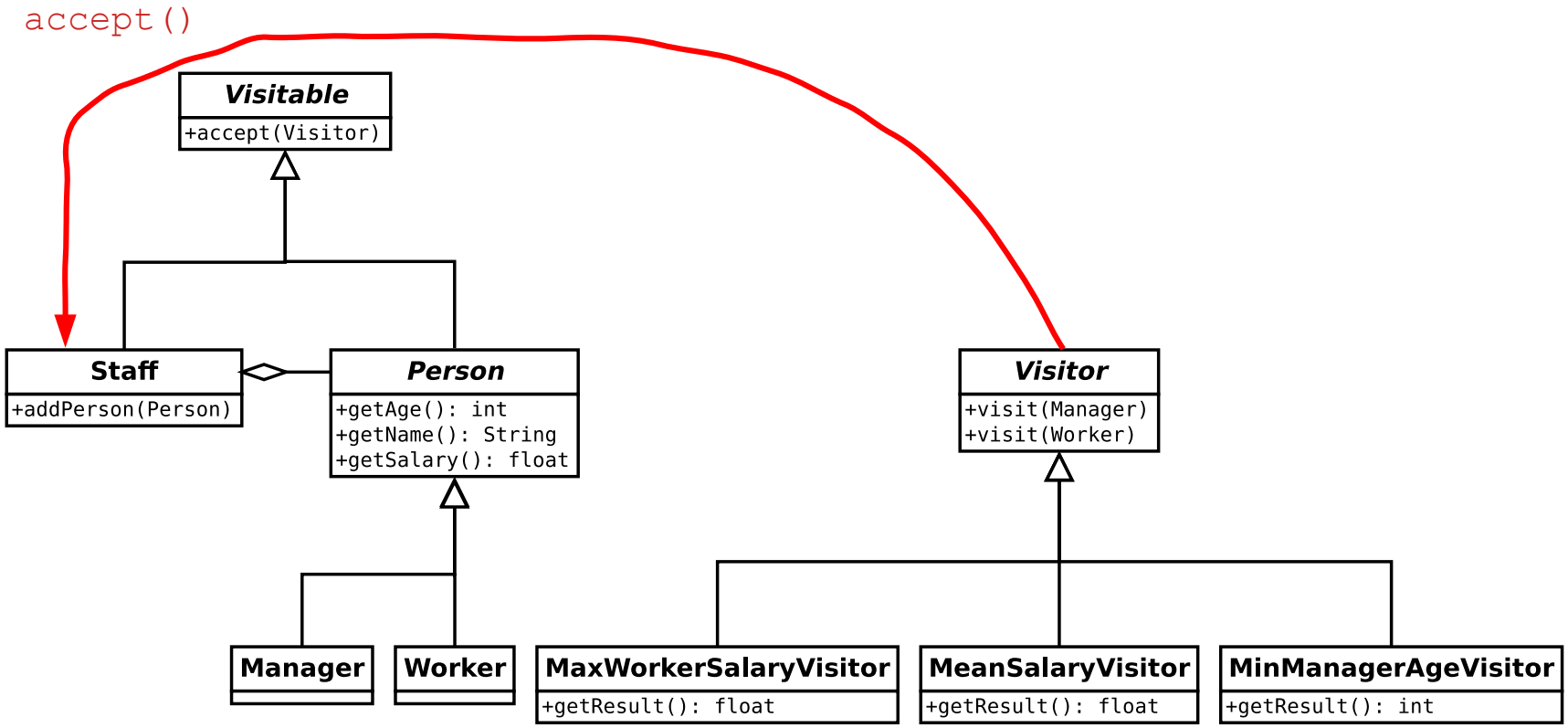



```
public void append(int value) {
    if (list == null) {
        list = new Node(value, null);
        tail = list;
    } else if (value != tail.value) {
        Node node = new Node(value, null);
        tail.next = node;
        tail = node;
    }
}
```

(3) Staff visitor



(3) Staff visitor



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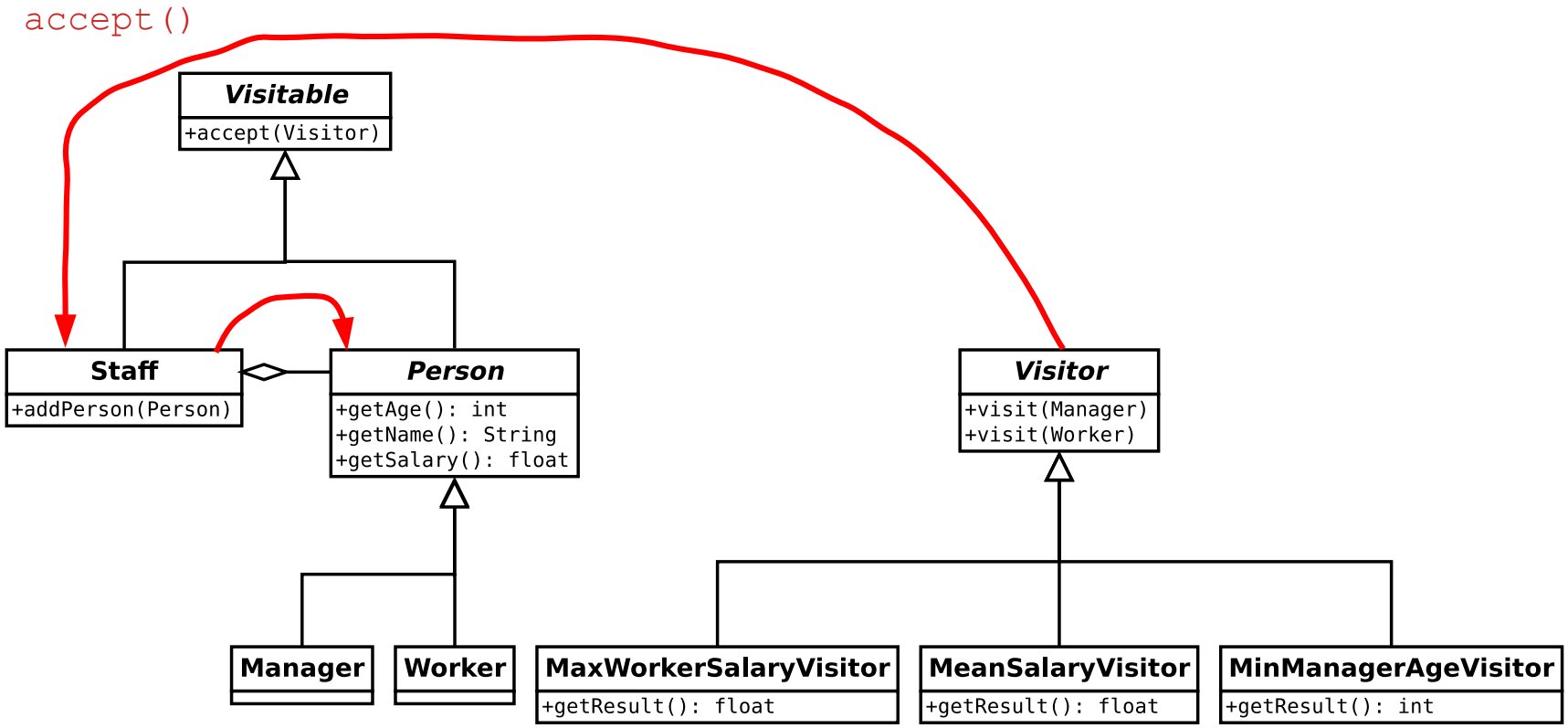

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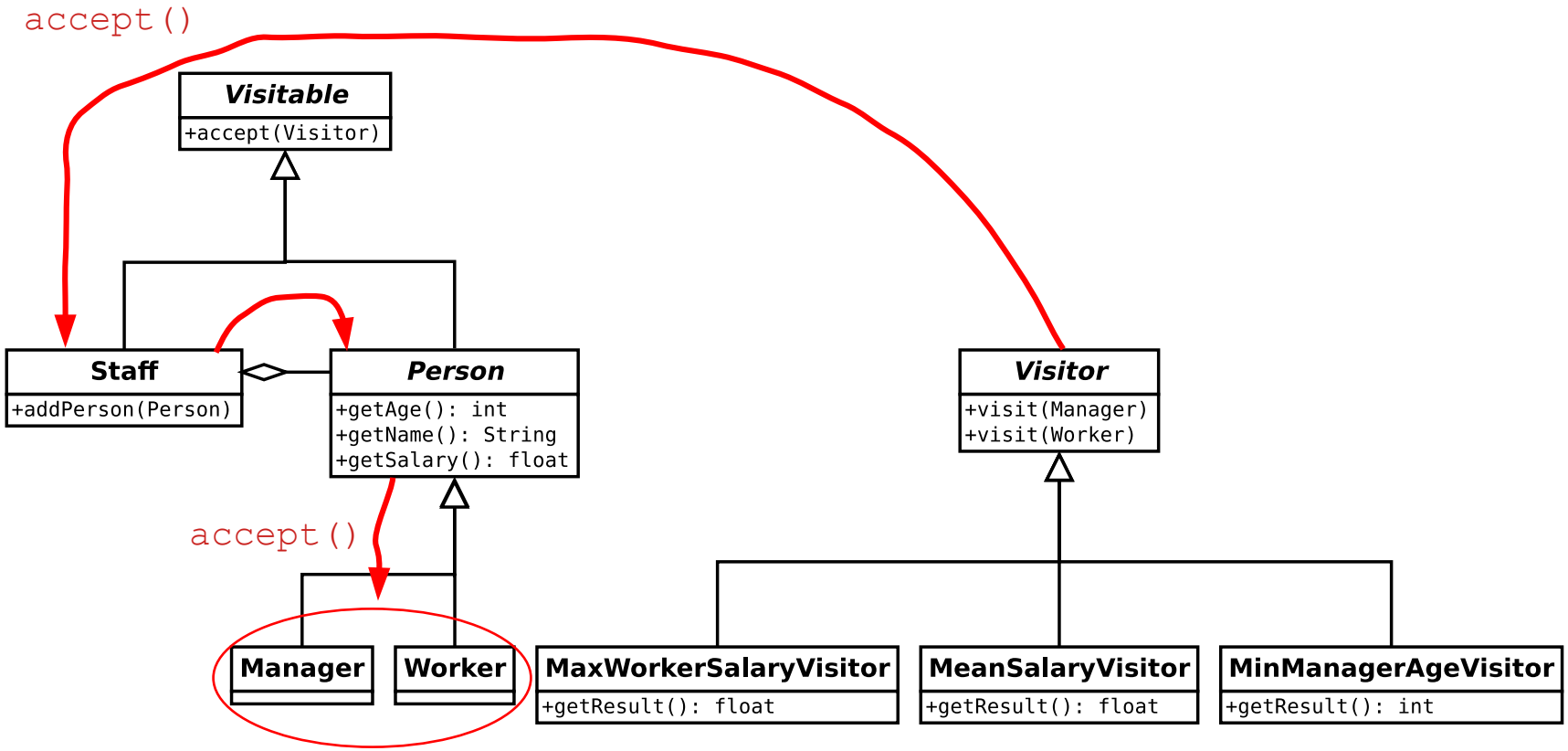
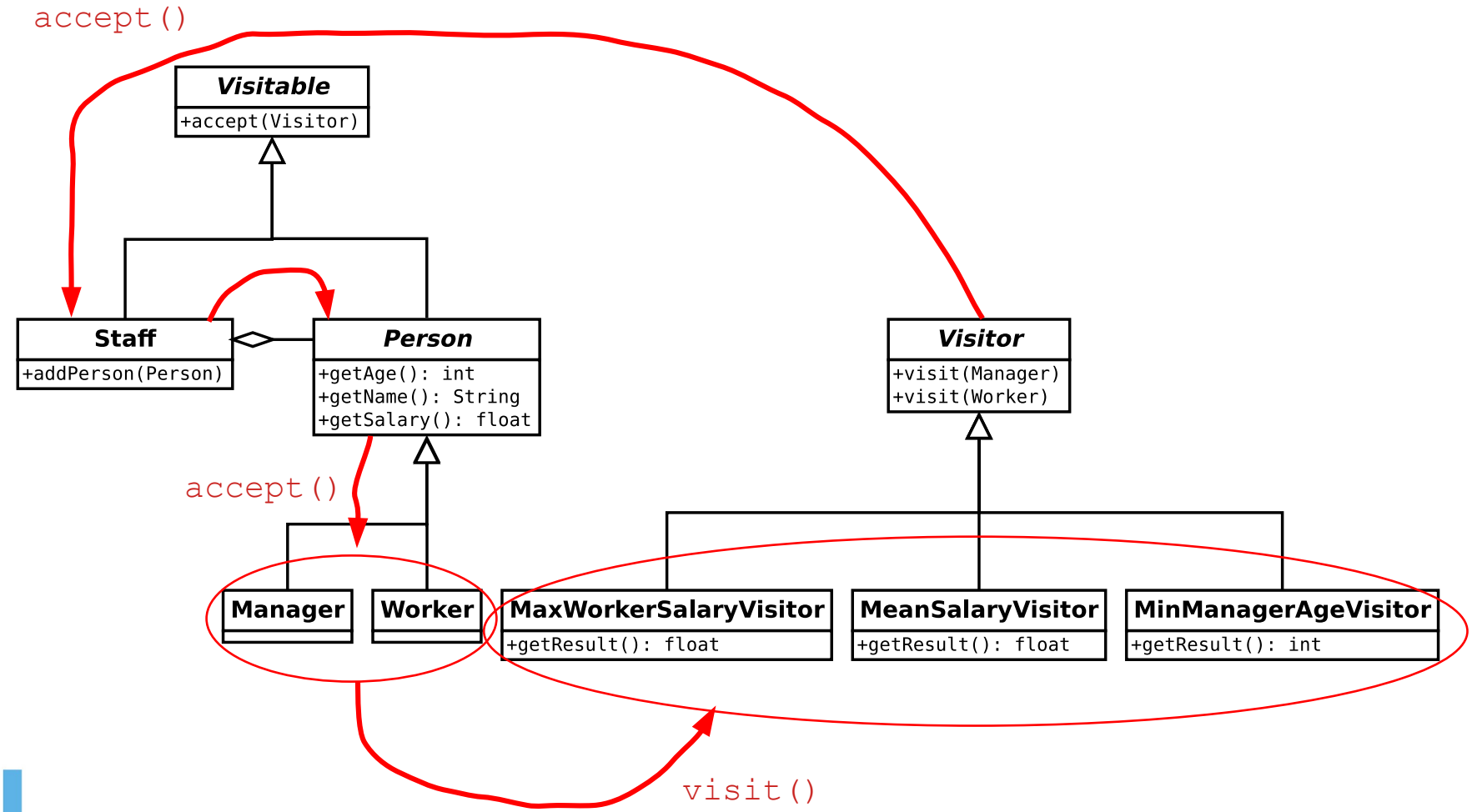
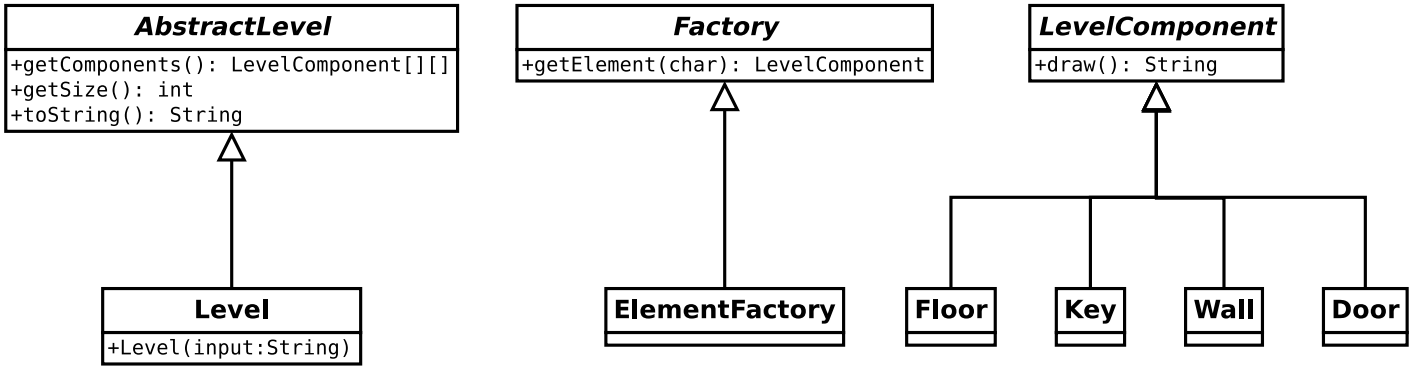


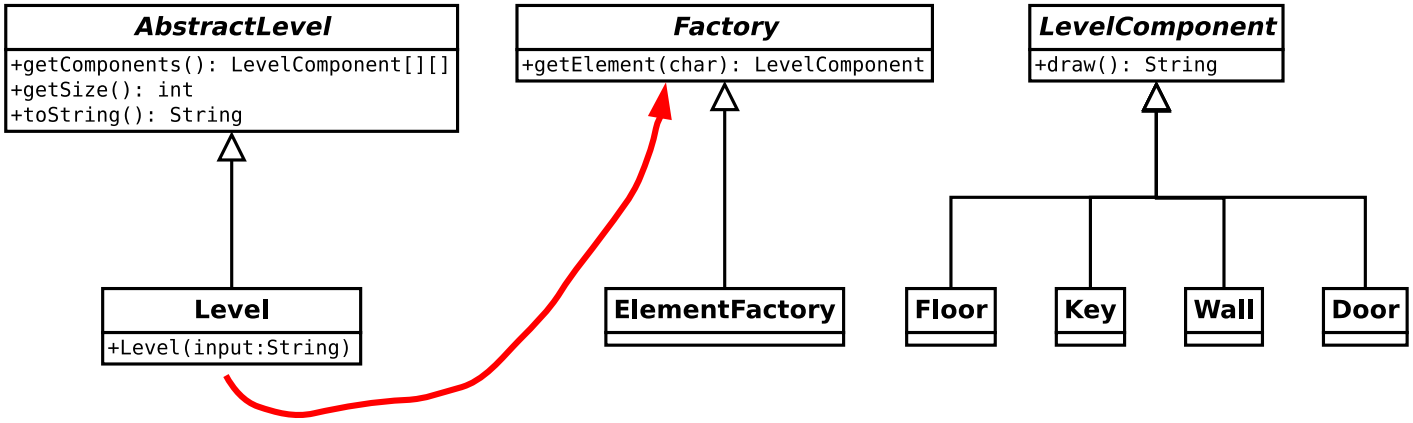
(3) Staff visitor



(4) Level generator (Factory)



(4) Level generator (Factory)



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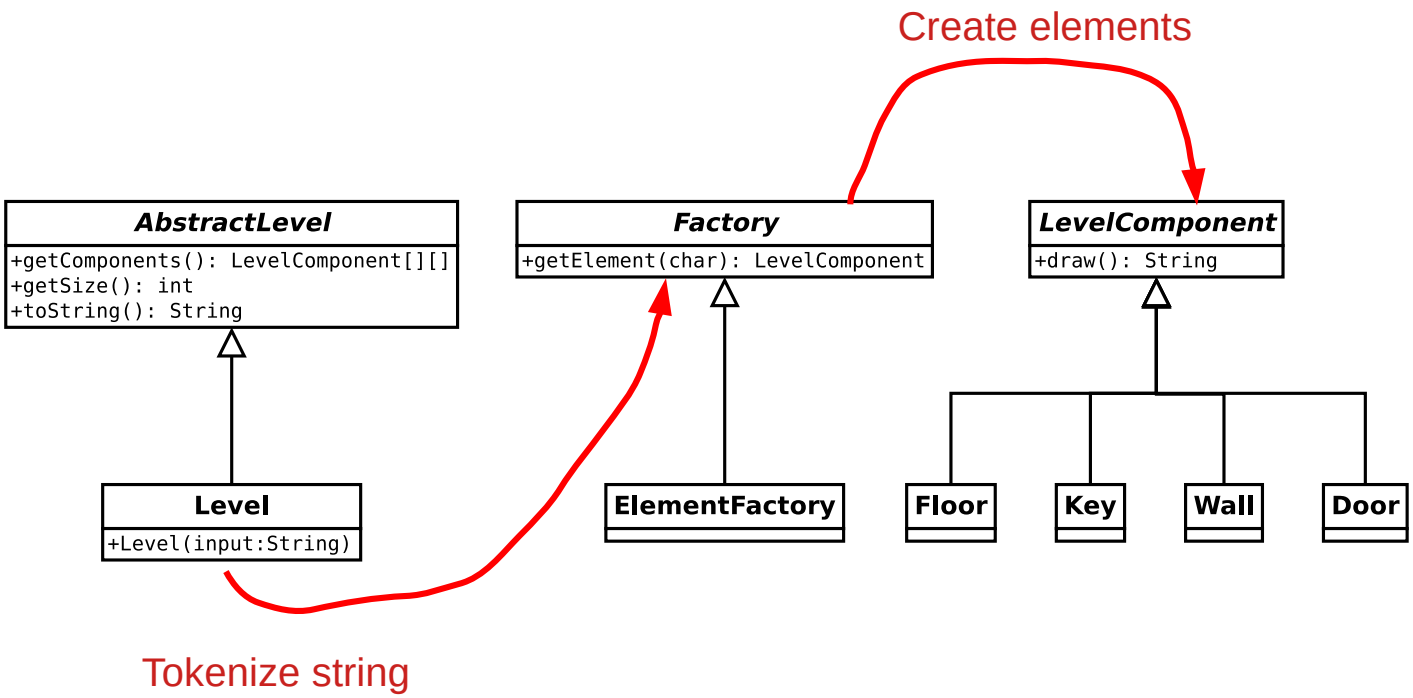

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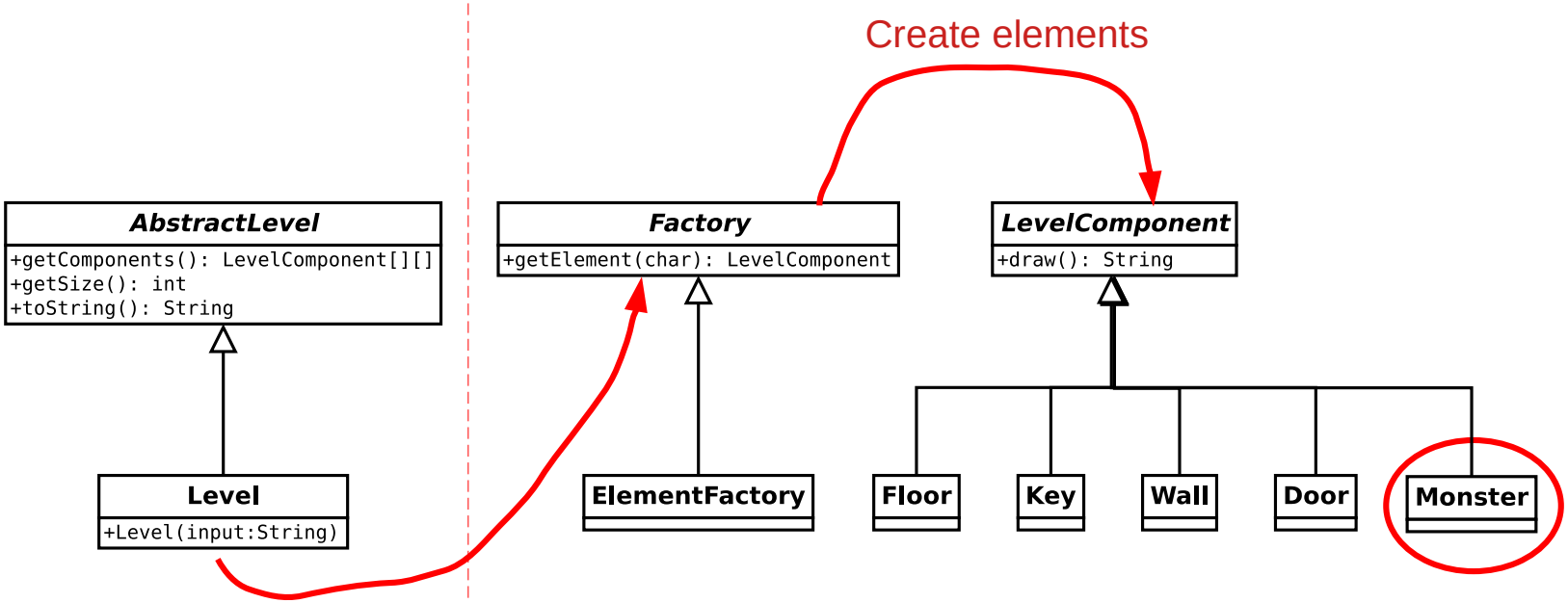

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Singleton

```
public class ElementFactory extends Factory {

    private static ElementFactory instance = null;

    public static ElementFactory getInstance() {

        if (instance == null) {
            instance = new ElementFactory();
        }

        return instance;
    }
}
```

Only create heavyweight objects once!