

## Understanding Loops

```
/**
 * Determine if the collection generated by the given Traversal
 * contains an element that satisfies the given predicate.
 */
public <T> boolean contains(Traversal<T> tr, ISelect<T> choice){
    try{
        if (tr.isEmpty())
            return false;
        else
            if (choice.select(tr.getFirst()))
                return true;
            else
                return contains(tr.getRest(), choice);
    }
    catch(IllegalUseOfTraversalException e){
        System.out.println("Illegal traversal: " + e.getMessage());
        return false;
    }
}

/**
 * Count how many elements in the collection generated by the
 * given Traversal satisfy the given predicate.
 */
public <T> int countSuch(Traversal<T> tr, ISelect<T> choice){
    try{
        if (tr.isEmpty())
            return 0;
        else
            if (choice.select(tr.getFirst()))
                return 1 + countSuch(tr.getRest(), choice);
            else
                return countSuch(tr.getRest(), choice);
    }
    catch(IllegalUseOfTraversalException e){
        System.out.println("Illegal traversal: " + e.getMessage());
        return 0;
    }
}
```

```

/*-----
TEMPLATE - ANALYSIS:
-----
ReturnType method-name(Traversal<T> tr){
    +-----+
// invoke the methodAcc: | acc <-- BASE-VALUE |
    +-----+
    method-name-acc(Traversal<T> tr, BASE-VALUE);
}

ReturnType method-name-acc(Traversal<T> tr, ReturnType acc)
... tr.isEmpty() ...           -- boolean      ::PREDICATE
if true:
... acc                         -- ReturnType   ::BASE-VALUE
if false:
+-----+
... | tr.getFirst() | ...      -- T           ::CURRENT
+-----+

... update(T, ReturnType)      -- ReturnType   ::UPDATE
+-----+
i.e.: ... | update(tr.getFirst(), acc) | ...
+-----+

... | tr.getRest() |           -- Traversal<T>  ::ADVANCE
+-----+

... method-name(tr.getRest(), ReturnType) -- ReturnType
i.e.: ... method-name-acc(tr.getRest(), update(tr.getFirst(), acc))
-----

COMPLETE METHOD TEMPLATE:
-----
<T> ReturnType method-name(Traversal<T> tr){
    +-----base-value-----+
// invoke the methodAcc: | acc <-- BASE-VALUE |
    +-----+
    method-name-acc(Traversal tr, BASE-VALUE);
}

<T> ReturnType method-name(Traversal<T> tr, ReturnType acc){
    +---predicate---+
    if (| tr.isEmpty() |)
    +-----+
    return acc;
    else
    +---advance---+ +---update-using-current---+
    return method-name-acc(| tr.getRest() |, | update(tr.getFirst(), acc) |);
    +-----+ +-----+
}

<T> return-type update(T t, return-type acc){
...
}

```

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/-----
orMap:
boolean orMap(Traversal tr, ISelect choice){
    return orMapAcc(tr, false, ISelect choice);
}

Method Header: boolean orMapAcc(Traversal tr, boolean acc, ISelect choice)
BASE-VALUE:    false
UPDATE:        boolean update(T t, boolean acc, ISelect choice){
                return (choice.select(t) || acc);
            }
-----*/

/** RECURSIVE VERSION
 * Determine if any data item generated by the given traversal
 * satisfies the given ISelect predicate.
 */
public <T> boolean orMap(Traversal<T> tr,
                        ISelect<T> choice){

    return orMapAcc(tr, false, choice);
}

/** RECURSIVE VERSION --- accumulator based helper.
 * Determine if any data item generated by the given traversal
 * satisfies the given ISelect predicate.
 */
public <T> boolean orMapAcc(Traversal<T> tr,
                            boolean acc,
                            ISelect<T> choice){

    if (tr.isEmpty())
        return acc;
    else
        return orMapAcc(tr.getRest(),
                        updateOrMap(tr.getFirst(), acc, choice),
                        choice);
}

/** A helper to produce the updated value of the accumulator
 * @param <T> the type of data in this data set
 * @param t the instance of the data to be used in the update
 * @param acc the current value of the accumulator
 * @param choice the given ISelect predicate.
 * @return the updated value of the accumulator.
 */
protected <T> boolean updateOrMap(T t,
                                  boolean acc,
                                  ISelect<T> choice){

    return (choice.select(t) || acc);
}

```

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/*-----
countSuch:
int countSuch2(Traversal<T> tr, ISelect<T> choice){
    return countSuchAcc(tr, 0, choice);
}

Method Header: int countSuchAcc(Traversal tr, int acc, ISelect choice)
BASE-VALUE:    0
UPDATE:        int update(T t, int acc, ISelect choice){
                if (choice.select(t))
                    return acc + 1;
                else
                    return acc;
            }
-----*/

/** RECURSIVE VERSION
 * Count how many data elements generated by the given traversal
 * satisfy the given ISelect predicate.
 */
public <T> int countSuch2(Traversal<T> tr, ISelect<T> choice){
    return countSuchAcc(tr, 0, choice);
}

/** RECURSIVE VERSION --- accumulator based helper.
 * Count how many data elements generated by the given traversal
 * satisfy the given ISelect predicate.
 */
public <T> int countSuchAcc(Traversal<T> tr,
                           int acc,
                           ISelect<T> choice){
    if (tr.isEmpty())
        return acc;
    else
        return countSuchAcc(tr.getRest(),
                             updateCountSuch(tr.getFirst(), acc, choice),
                             choice);
}

/** A helper to produce the updated value of the accumulator
 * @param <T> the type of data in this data set
 * @param t the instance of the data set to be used in the update
 * @param acc the current value of the accumulator
 * @param choice the given ISelect predicate.
 * @return the updated value of the accumulator.
 */
protected <T> int updateCountSuch(T t,
                                   int acc,
                                   ISelect<T> choice){
    if (choice.select(t))
        return acc + 1;
    else
        return acc;
}

```

```

/*-----*/
TEMPLATE-ANALYSIS:
return-type method-name(Traversal tr){
  return-type acc = BASE-VALUE;
  while (CONTINUATION-PREDICATE){
    acc = UPDATE (CURRENT, acc);
    tr = ADVANCE;
  }
  return acc;
}

COMPLETE METHOD TEMPLATE:
-----
<T> return-type method-name(Traversal<T> tr){
+-----+
| return-type acc = BASE-VALUE |;
+-----+
      +-----+
while (| !tr.isEmpty() |)
+-----+
{
      +-----+
  acc = | update(tr.getFirst(), acc) |;
+-----+
      +-----+
  tr = | tr.getRest() |;
+-----+
}
  return acc;
}

<T> return-type update(T t, return-type acc){
...
}
-----*/

```

```

/** VERSION THAT USES THE while LOOP.
 * Count how many data elements generated by the given traversal
 * satisfy the given ISelect predicate.
 */
// orMap with while loop and iterator
public <T> boolean orMapWhile(Traversal<T> tr,
                             ISelect<T> choice){

  // preamble: Define accumulator, initialize it to the BASE-VALUE
  boolean acc = false;

  // loop header: while(continuation-predicate)
  while(!tr.isEmpty()){

    // loop body: update
    acc = updateOrMap(tr.getFirst(), acc, choice);

    // loop advance:
    tr = tr.getRest();
  }

  // postmortem: produce the result
  return acc;
}

```

```

/*-----*/
TEMPLATE-ANALYSIS:
return-type method-name(Traversal tr){
  return-type acc = BASE-VALUE;
  for (return-type acc = BASE-VALUE; *** DO NOT INCLUDE - DONE ALREADY ***
      CONTINUATION-PREDICATE;
      tr = ADVANCE){
    acc = UPDATE (CURRENT, acc);
  }
  return acc;
}

COMPLETE METHOD TEMPLATE:
-----
<T> return-type method-name(Traversal<T> tr){
  +-----+
  | return-type acc = BASE-VALUE |;
  +-----+

  for (... no initialization is needed ...;
      +-----+
      | !tr.isEmpty() |;
      +-----+

      +-----+
      tr = | tr.getRest() |)
      +-----+

  {
    +-----+
    acc = | update(tr.getFirst(), acc) |;
    +-----+
  }
  return acc;
}

<T> return-type update(T t, return-type acc){
  ...
}
-----*/

/** IMPERATIVE VERSION THAT USES for LOOP WITH THE Traversal.
 * Count how many data elements generated by the given traversal
 * satisfy the given ISelect predicate.
 */
// orMap with for loop and iterator
public <T> boolean orMapFor(Traversal<T> tr, ISelect<T> choice){

  // Define the accumulator and initialize it to the BASE-VALUE;
  boolean acc = false;
  // loop header:
  // for(... accumulator is already defined and initialized ... ;
  //     continuation-predicate;
  //     update)
  for(;
      !tr.isEmpty();
      tr = tr.getRest()){

    // loop body: uses current element
    acc = updateOrMap(tr.getFirst(), acc, choice);
  }

  // postmortem: produce the result
  return acc;
}

```

```

/*-----*/
TEMPLATE-ANALYSIS:
return-type method-name(ArrayList<T> alist){
    int index; // to represent the traversal
    return-type acc = BASE-VALUE;
    for (index = 0; // start the traversal at the beginning
        CONTINUATION-PREDICATE;
        index = ADVANCE){
        acc = UPDATE (CURRENT, acc);
    }
    return acc;
}

COMPLETE METHOD TEMPLATE:
-----
<T> return-type method-name(ArrayList<T> alist){
+-----+
| return-type acc = BASE-VALUE |;
+-----+

    for (index = 0;
        +-----+
        | index < alist.size() |;
        +-----+
        index = | index + 1 |)
            +-----+
            {
                +-----+
                acc = | update(alist.get(index), acc) |;
                +-----+
            }
    return acc;
}

<T> return-type update(T t, return-type acc){
...
}

/** IMPERATIVE VERSION THAT USES for LOOP WITH index based traversal.■
 * Count how many data elements in thre given ArrayList
 * satisfy the given ISelect predicate.
 */
public <T> boolean orMapForCounted(ArrayList<T> alist,
                                   ISelect<T> choice){

    // Define the accumulator and initialize it to the BASE-VALUE;
    boolean acc = false;
    // loop header:
    // for(... accumulator is already defined and initialized ...
    //     ...BUT initalize the loop index: int index = 0;
    // continuation-predicate: index < alist.size()
    // update: index = index + 1
    for(int index = 0; index < alist.size(); index = index + 1){

        // loop body: uses current element
        acc = updateOrMap(alist.get(index), acc, choice);
    }

    // postmortem: produce the result
    return acc;
}

```