TD MCP – session 1 – Streams

January 30, 2024

Learning objective: manipulate Java Streams (sequential data-processing operations and basic collectors).

We assume that a class `Dish` is defined with the methods: `getType`, `isVegetarian`, `getCalories` and `getName`. All dishes are stored into `menu`, which is a list.

**Exercise 1: external vs. internal iteration**
Which stream operation would you use to refactor the following code?

```java
List<Dish> vegetarianDishes = new ArrayList<>();
for (Dish d : menu) {
    if (d.isVegetarian())
        vegetarianDishes.add(d);
}
```

What would be the resulting code?

**Exercise 2: external vs. internal iteration**
Which stream operation would you use to refactor the following code?

```java
List<String> highCaloricDishes = new ArrayList<>();
Iterator<String> iterator = menu.iterator();
while (iterator.hasNext()) {
    Dish dish = iterator.next();
    if (dish.getCalories() > 300)
        highCaloricDishes.add(d.getName());
}
```

What would be the resulting code?

**Exercise 3: mapping**
Given a list of numbers, how would you return a list of the square of each number? For example, given `[1, 2, 3, 4, 5]` you should return `[1, 4, 9, 16, 25]`.

**Exercise 4: filtering/slicing**
Given a list of `Dish` with method `getType`, write the stream that puts in a list the first two meat dishes?

**Exercise 5: nested streams**
Write a stream that puts in a list only the integers from a first list that are contained in a second one (like `List::retainAll`) without using any feature of the Java collections. For example, given the lists `[1, 2, 3]` and `[1, 2, 4]`, the resulting list is `[1, 2]`. The solution must exhibit a nested stream (like a nested loop, but with streams).

**Exercise 6: flatMap**
Given a list of lists of numbers, how would you return a single flattened list of all nested numbers? For example, given a list `[[1, 2, 3], [2, 3, 4], [3, 4, 5]]`, you should return `[1, 2, 3, 2, 3, 4, 3, 4, 5]`. 
Exercise 7: flatMap
Given a list of strings, how would you return a list of all distinct sorted capitalized characters? For example, given two strings "dcb" and "abc", you should return ["A", "B", "C", "D"].

Exercise 8: flatMap
Given two lists of numbers, how would you return all pairs of numbers? For example, given a list [1, 2, 3] and a list [3, 4] you should return [[1, 3], [1, 4], [2, 3], [2, 4], [3, 3], [3, 4]]. For simplicity, you can represent a pair as an array with two elements.

How would you extend the previous example to return only pairs whose sum is divisible by 3?

Exercise 9: reducing
How would you count the number of dishes in a stream using the map and reduce methods (i.e. without count)?

Exercise 10: peek
list is a List<Integer> containing all integers from 2 to 4.

What is the output when executing this stream?

```java
list.stream()
    .peek(System.out::print)
    .filter(i -> i % 2 == 0)
    .peek(System.out::print)
    .map(i -> -i)
    .peek(System.out::print)
    .sorted()
    .peek(System.out::print)
    .toList();
```

Exercise 11: intermediate vs. terminal operations
In the stream pipeline that follows, identify the intermediate and terminal operations?

```java
long count = menu.stream()
    .filter(dish -> dish.getCalories() > 300)
    .distinct()
    .limit(3)
    .count();
```

Exercise 12: equivalence
Is it possible to rewrite any instruction that uses anyMatch with either noneMatch or allMatch? When possible, propose how to rewrite these instructions given a predicate pred().

Exercise 13: short-circuiting
Which of the following operations allows short-circuiting? skip - findFirst - dropWhile - filter

Exercise 14: intermediate vs. terminal operations
Which of the following operations is terminal? dropWhile - map - skip - toList