



COLLECTING STREAMS

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THE COLLECTOR FUNCTIONS

- ❑ A Collector is specified by four functions that work together to accumulate entries into a mutable result container, and optionally perform a final transform on the result. They are:
 - ❑ creation of a new result container ([supplier\(\)](#))
 - ❑ incorporating a new data element into a result container ([accumulator\(\)](#))
 - ❑ combining two result containers into one ([combiner\(\)](#))
 - ❑ performing an optional final transform on the container ([finisher\(\)](#))
- ❑ Collectors also have a set of characteristics, such as [Collector.Characteristics.CONCURRENT](#), that provide hints that can be used by a reduction implementation to provide better performance.

THE COLLECTOR FUNCTIONS

- ❑ A sequential implementation of a reduction using a collector would
 - ❑ create a single result container using the supplier function
 - ❑ and invoke the accumulator function once for each input element.
- ❑ A parallel implementation would
 - ❑ partition the input
 - ❑ create a result container for each partition,
 - ❑ accumulate the contents of each partition into a subresult for that partition
 - ❑ use the combiner function to merge the subresults into a combined result
 - ❑ The combiner may fold state-returns a BinaryOperator

COLLECTING STREAMS

- ☐ Reducing and summarizing stream elements to a single value
- ☐ Grouping elements
- ☐ Partitioning elements

REDUCING AND SUMMARIZING

- ❑ Count the no of menu items

- ❑ `Collectors.counting()`

- ❑ `long countingDish=menu.stream().collect(Collectors.counting());`

- ❑ `maxBy()` and `minBy()`



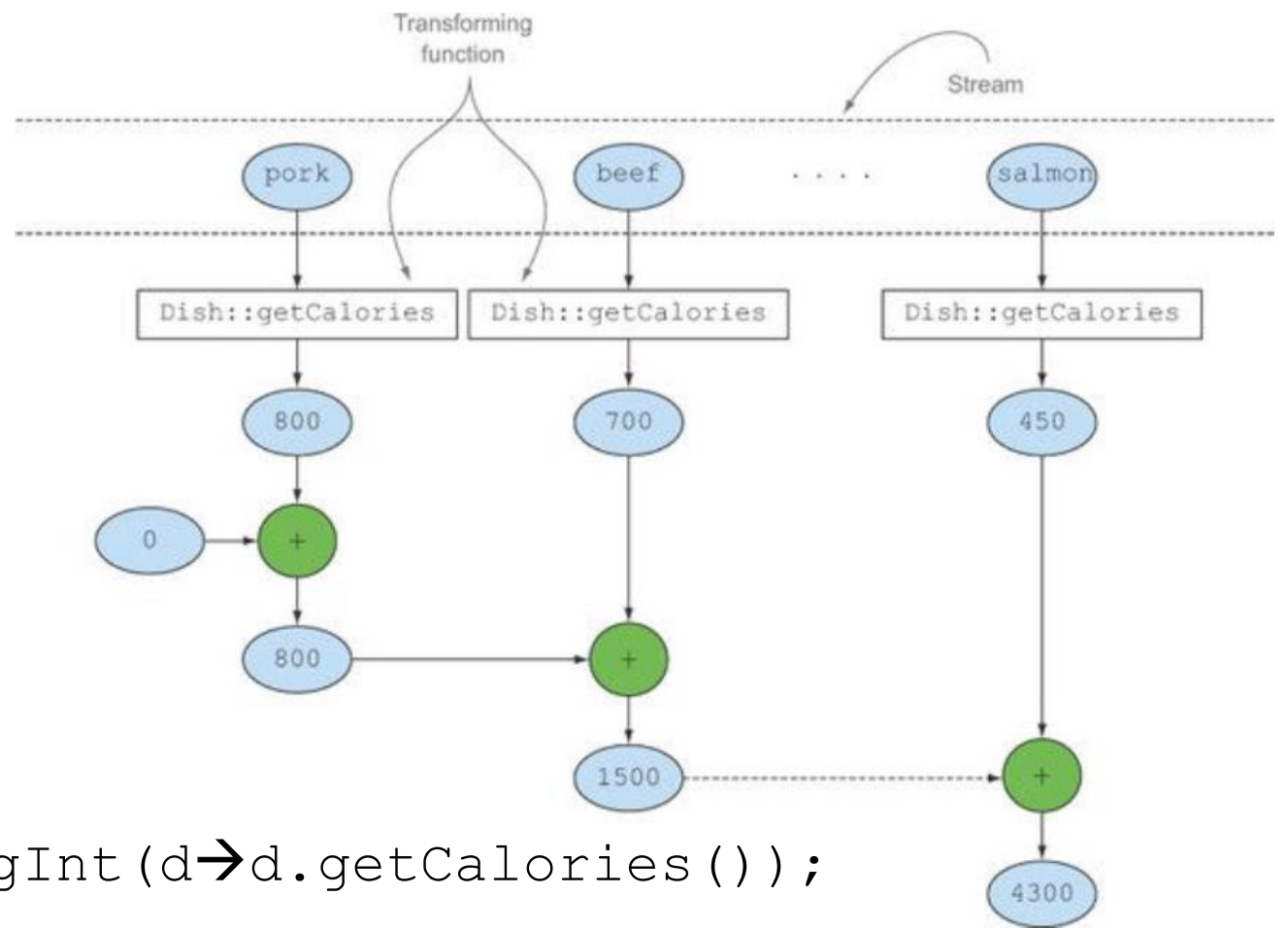
- ❑ `Comparator<Dish>`

- `dishCaloriesComp=Comparator.comparing(x→x.getCalories());`

- ❑ `Optional<Dish>`

- `TastyDish=menu.stream().collect(maxBy(dishCaloriesComp));`

SUMMARIZING



❑ `Collectors.summingInt()`

❑ `menu.stream().collect(summingInt(d -> d.getCalories()));`

❑ `averagingInt()`

❑ `summarizingInt()`

❑ `IntSummaryStatistics`

JOINING STRINGS

```
String results=menu.stream().filter(d→d.isVegetarian())  
                    .map(d→d.getName())  
  
                    .collect(Collectors.joining(",","["","]"));  
results=menu.stream().collect(reducing("",Dish::getName, (i,j)→i+j));
```

Initial Value

Identity
function/transformation

Binary operator

`Joining()` internally makes use of a `StringBuilder` to append the generated strings into one

REDUCING

```
results=menu.stream().
```

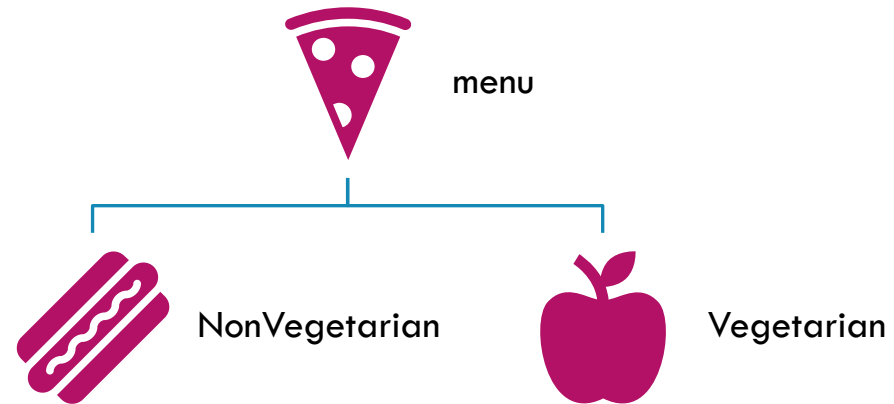
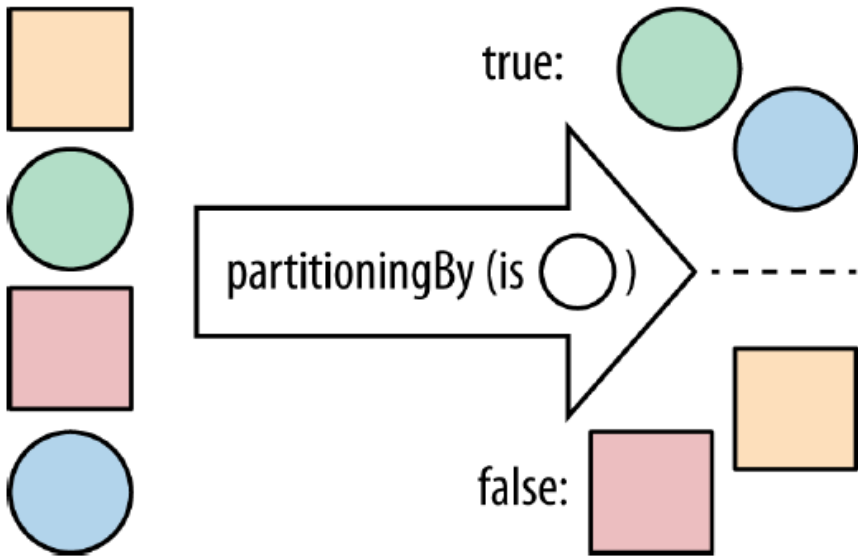
```
    collect(reducing("",Dish::getName, (i,j) → i+j));
```

```
Optional<Dish> mostCalorieDish = menu.stream().
```

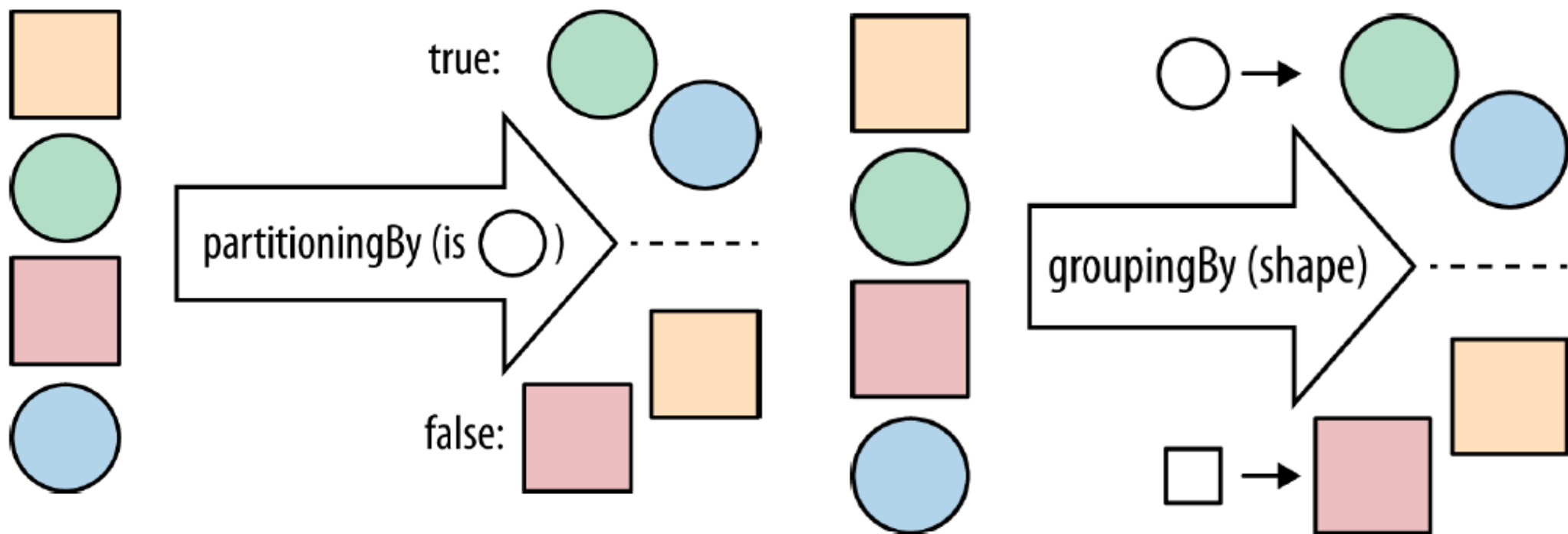
```
collect(reducing((d1, d2) -> d1.getCalories() > d2.getCalories() ? d1 : d2));
```


PARTITIONING

```
Map<Boolean, List<Dish>> mapResults=  
menu.stream().collect(partitioningBy(d -> d.isVegetarian()));
```



COLLECTING STREAM ELEMENTS



GROUPING

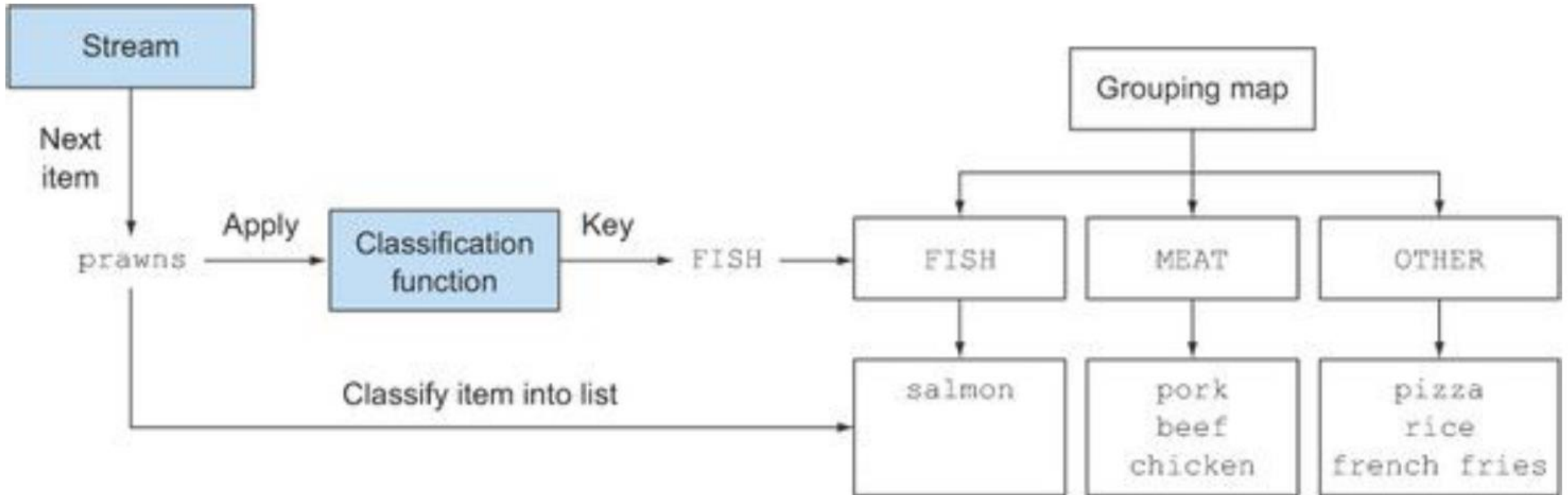
```
menu.stream().collect(groupingBy(d → d.getType()))
```

We call this Function a *classification* function because it's used to classify the elements of the stream into different groups.

Dish

```
private final String name;  
private final boolean vegetarian;  
private final int calories;  
private final Type type;  
  
public Dish(String name, boolean vegetarian, int calories, Type type);  
public String getName();  
public boolean isVegetarian();  
public int getCalories();  
public Type getType();  
public String toString();  
public enum Type { MEAT, FISH, OTHER }
```

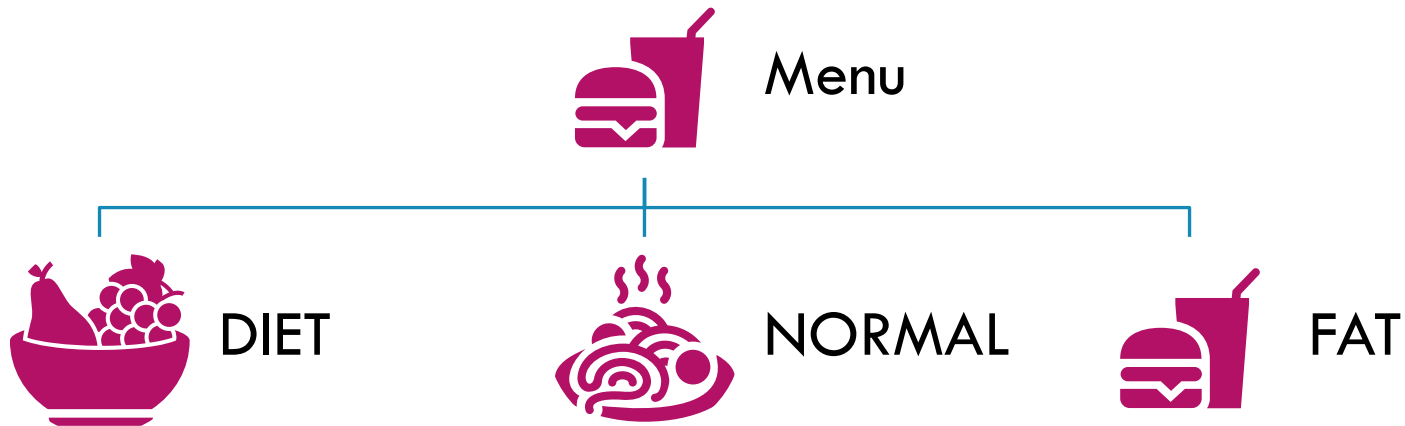
GROUPING



GROUPING

It isn't always possible to use a method reference as a classification function, because you may wish to classify using something more complex than a simple property accessor

```
public enum Category { DIET, NORMAL, FAT }
```



EXTRACTING GROUP-WISE FEATURES

- ❑ Using a collector created with a two-argument version of the `Collectors.groupingBy` factory method
- ❑ It accepts a second argument of type collector besides the usual classification function
- ❑ The regular one-argument `groupingBy(f)`, where `f` is the classification function, is in reality just shorthand for `groupingBy(f, toList())`.

MULTILEVEL COLLECTION

- ❑ Second level collector may not always subgroup
- ❑ Reducing and summarizing stream elements to a single value
- ❑ Grouping elements
- ❑ Partitioning elements

GROUPWISE FEATURES

- ❑ `{MEAT=3, FISH=2, OTHER=4}`
- ❑ `Map<Dish.Type, Long> typesCount=`
- ❑ `menu.stream().collect(groupingBy(Dish::getType, counting()));`
- ❑ highest-calorie Dish for a given type:
- ❑ `{FISH=Optional[salmon], OTHER=Optional[pizza], MEAT=Optional[Burger]}`
- ❑ `groupingBy` works in terms of “buckets.”
- ❑ The first `groupingBy` creates a bucket for each key. You then collect the elements in each bucket with the downstream collector
- ❑ Each bucket gets associated with the key provided by the classifier function
- ❑ The `groupingBy` operation then uses the downstream collector to collect each bucket and makes a map of the results

DO YOU REMEMBER?

- ❑ Count the no of menu items

- ❑ `Collectors.counting()`

- ❑ `long countingDish=menu.stream().collect(Collectors.counting());`

- ❑ `maxBy()` and `minBy()`



- ❑ `Comparator<Dish>`

- `dishCaloriesComp=Comparator.comparing(x→x.getCalories());`

- ❑ `Optional<Dish>`

- `TastyDish=menu.stream().collect(maxBy(dishCaloriesComp));`

COLLECTING

- ❑ `{FISH=Optional[salmon], OTHER=Optional[pizza], MEAT=Optional[Burger]}`
- ❑ `menu.stream().collect(groupingBy(d->d.getType(),
maxBy(Comparator.comparingInt(d->d.getCalories()))))`
- ❑ `Map<Dish.Type, Optional<Dish>>`
- ❑ The values in this Map are Optionals because this is the resulting type of the collector generated by the `maxBy` factory method
- ❑ if there's no Dish in the menu for a given type, that type won't have an `Optional.empty()` as value; it won't be present at all as a key in the Map
- ❑ The `groupingBy` collector lazily adds a new key in the grouping Map only the first time it finds an element in the stream

EXTRACTING GROUP FEATURES

❑ Mapping can also be done

```
albums.collect(groupingBy(Album::getMainMusician,
mapping(Album::getName, toList())));
```

❑ In the same way that a collector is a recipe for building a final value, a downstream collector is a recipe for building a part of that value, which is then used by the main collector

❑ This method takes two arguments: a function transforming the elements in a stream and a further collector accumulating the objects resulting from this transformation.

```
Map<Dish.Type, Set<CaloricLevel>>
caloricLevelsByType =
menu.stream().collect(
groupingBy(Dish::getType, mapping(
dish -> { if (dish.getCalories() <= 400)
return CaloricLevel.DIET;
else if (dish.getCalories() <= 700) return
CaloricLevel.NORMAL;
else return CaloricLevel.FAT; },
toSet() )));
```

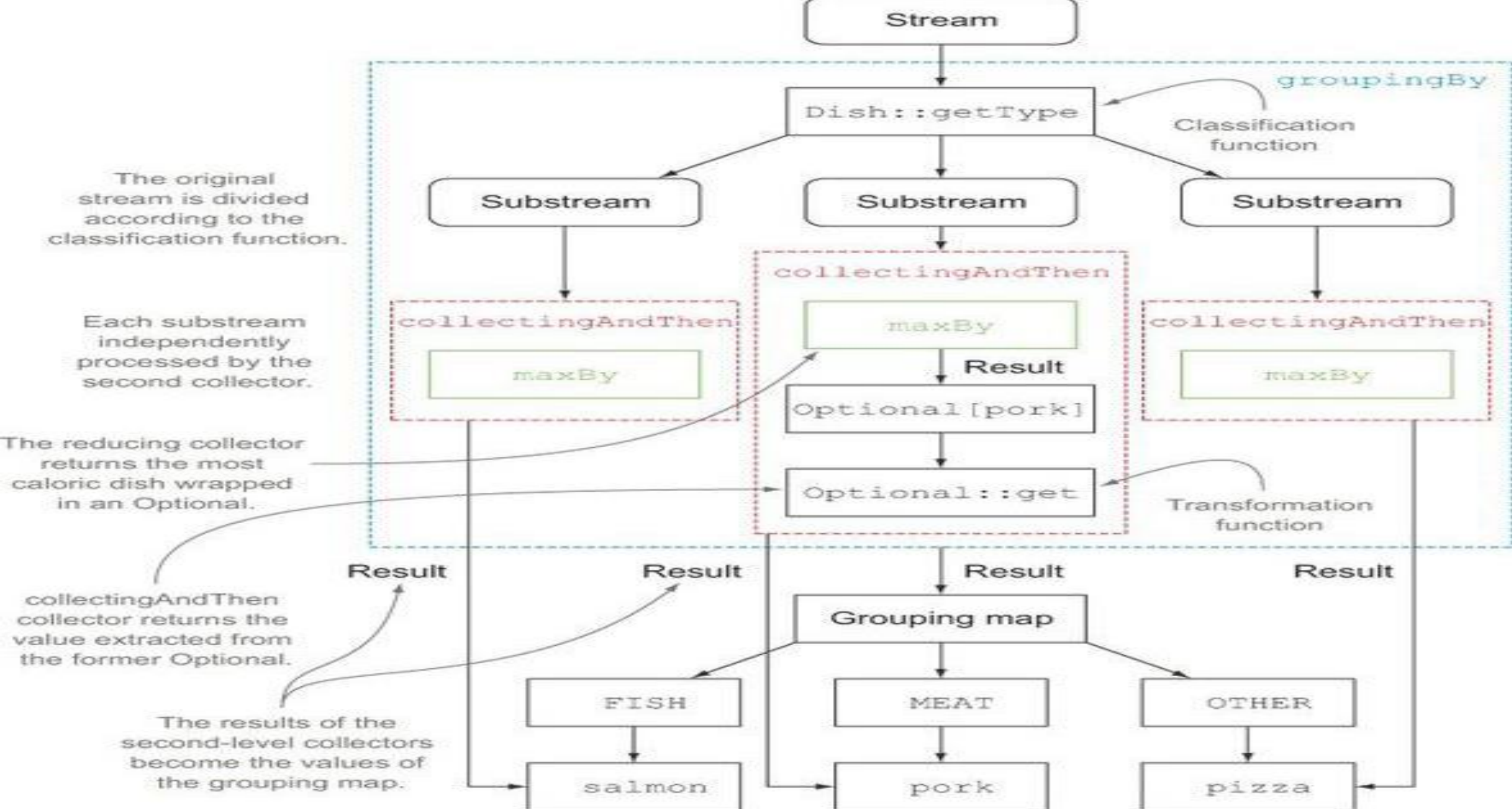
COLLECTING AND THEN WRAPPING

```
Map<Dish.Type, Dish> result4=menu.stream().collect(groupingBy(d->d.getType(), collectingAndThen(maxBy(Comparator.comparingInt(d->d.getCalories()))), s->s.get()))
```

This factory method takes two arguments, the collector to be adapted and a transformation function, and returns another collector

This additional collector acts as a wrapper for the old one and maps the value it returns using the transformation function as the last step of the collect operation

```
collectingAndThen (Collector<T,A,R> downstream, Function<R,RR> finisher)
```

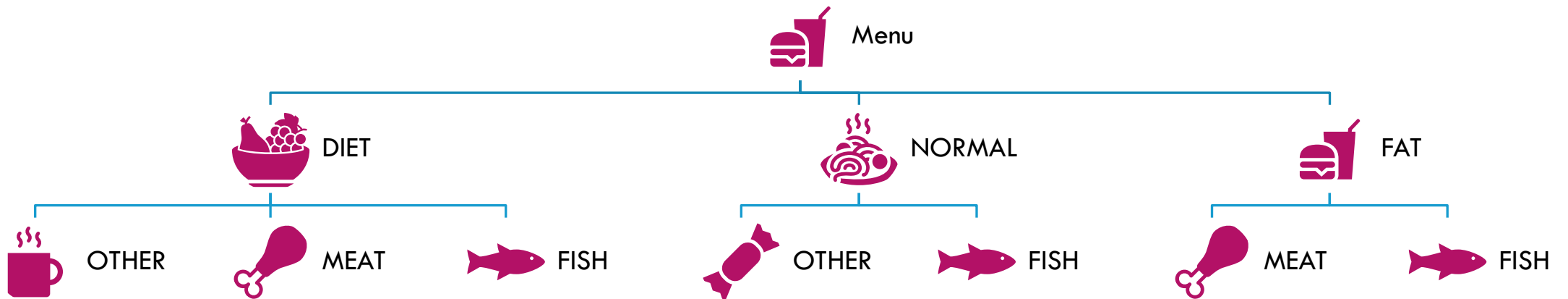


ANY TYPE OF COLLECTION

```
Map<Dish.Type, Set<CaloricLevel>> caloricLevelsByType =  
menu.stream().collect(  
    groupingBy(Dish::getType, mapping(  
        dish -> { if (dish.getCalories() <= 400) return CaloricLevel.DIET;  
        else if (dish.getCalories() <= 700) return CaloricLevel.NORMAL;  
        else return CaloricLevel.FAT; },  
        toCollection(HashSet::new) )))
```

EXTRACTING GROUP-WISE FEATURES

- ❑ The regular one-argument `groupBy(f)`, where `f` is the classification function, is in reality just shorthand for `groupBy(f, toList())`.
- ❑ To perform a two-level grouping, you can pass an inner `groupBy` to the outer `groupBy`



MULTILEVEL GROUPING

```
Map<Category, Map<Dish.Type, List<Dish>>> dishesByCalorie
menu.stream().collect(groupingBy(dish->{if(dish.getCalories()<=400)
    return Category.DIET;
else if(dish.getCalories()<=700)
    return Category.NORMAL;
else
    return Category.FAT;}},
groupingBy(d2->d2.getType())));
```


MORE GROUPINGS

```
groupBy(Function<T, K> classifier, Collector<T,A,D> downstream)
```

How to achieve *n*-level groupings

NUMERIC STREAMS

Creating numeric streams

- `IntStream oneToHundred`
`=IntStream.rangeClosed(1,100).filter(i%2==0)`
- `IntStream oneToNinetyNine =`
`IntStream.range(1,100).filter(i%2==0)`

BUILDING STREAMS

Static methods

- `Stream.of(" ", "'", " ", " ");`
- `Stream.empty()`
- `Arrays.stream(1,2,3,4)`
- `Str.chars()`
- From files

STREAMS FROM FILES

```
long NoOfUniqueWords =0;
try{
    Stream<String> lines1=
        Files.lines(Paths.get("dataFile.txt"),
            Charset.defaultCharset());
```

word

word

word

word

word

word

word

word

word

word

word

word

word

word

word

word

word

word

word

word

word

```
NoOfUniqueWords =lines1.flatMap(lines2->
    Arrays.stream(lines2.split(" "))
    .distinct().count());
System.out.println("1. Unique words are "
    + NoOfUniqueWords);
}catch(Exception e){}
```

EXAMPLES

- ❑ Identify and list the distinct letters;
- ❑ Group it's words into three categories depending on word length-2-letter words, 3-letter words and more than 3 letter words.

INFINITE STREAMS

Iterate

- ***Stream.iterate(0, n -> n + 2)***.limit(10).forEach(System.out::println);
- Stream.of(1,2,3,4,5,6,7,8,9,10).?

Fibonacci number

Stream.iterate(new int[]{0, 1}, ???).limit(20)

.forEach(t -> System.out.println("(" + t[0] + "," + t[1]
+"))");

INFINITE STREAMS

It takes a lambda of type `Supplier<T>` to provide new values

Stream.generate(Math::random)

`.limit(5)`

`.forEach(System.out::println);`

a supplier that's stateful isn't safe to use in parallel code