**Homework T2 Submission Document**

You can work individually or in groups of 2.

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**Test Derivation for *addEmp(e:Employee)***

We will use the category-partition method to derive a set of test cases for this method.

1. **Identify what criteria must hold true for each test case to pass**

The side-effects of this method are:

* numEmps becomes incremented by 1 if the operation succeeds in adding an employee to the store
* the getNumEmps method will return a different value if the operation succeeds in adding the employee
* the getTotalHours method could return a different value depending on the state of the Employee which might be added
* the getTotalPay method could return a different value depending on the state of the Employee which might be added
* the removeEmployee method could behave differently if the Employee is added successfully

1. **Identify inputs/parameters for each feature under test.**

The input parameters are:

* primitive data type numEmps: integer
  + the number of employees that a currently in the store
* reference data type emps: Employee[]
  + the container in which the emps are collected
* reference data type e: Employee
  + the employee that is trying to be added
* primitive data type added: Boolean
  + the indication of success or failure upon add attempt

1. **Identify the categories/characteristics for each input/parameter.**

Categories of numEmps:

* value

Categories of emps:

* length
* content

Categories of e:

* state

Categories of added:

* value

1. **Partition categories into choices**

The choices for the numEmps parameter are *positions remaining = PR*  and *no positions remaining = P*.

* PR – numEmps ∈ [0,19]
* P – numEmps = 20

The choices for the emps parameter are *full = F* and *not full = NF*.

* NF – emps array has indices [0,19] available for use
* F – emps array has no indices available for use

The choices for the e parameter are *null = N* and *non-null = NN*.

* NN – e is a reference to an Employee object
* N – e is the null data type
* The choices for the added parameter are *success = S* and *fail = FA*.

1. **Number of tests before constraints added**

|  |  |  |  |
| --- | --- | --- | --- |
| Input | Category | Choices | Coded Choices |
| numEmps | Value | Positions Remaining, No Positions Remaining | PR,P |
| emps | Length | Full, Not Full | F,NF |
| e | State | Null, Not Null | N,NN |
| added | Value | Success, Fail | T,FA |

By the counting principle, there are 2\*2\*2\*2 = 16 possible combinations before constraints are added.

PRFNT, PRFNFA, PRFNNT, PRFNNFA,

PRNFNT, PRNFNFA, PRNFNNT, PRNFNNFA,

PFNT, PFNFA, PFNNT, PFNNFA,

PNFNT, PNFNFA, PNFNNT, PNFNNFA

The following combinations are removed because they are invalid:

PRFNT – This means that there are no positions remaining but the employee was added successfully.

PFNT– This means that there are no positions remaining but the employee was added successfully.

PNFNT – This means that there are no positions remaining but the employee was added successfully.

PFNNT– This means that there are no positions remaining but the employee was added successfully.

PRFNT – This means that the array is full but there are positions remaining and the employee was added successfully.

PRFNNT – This means that the array is full but there are positions remaining and the employee was added successfully.

PRNFNT – This means that the array is full but there are positions remaining and the employee was added successfully.

This leaves 9 combinations.

1. **TSL Input**

The *TSL* input file is shown below.

NumEmps:

PositionsRemaining.

NoPositionsRemaining. [property max]

Emps:

Full. [property full]

NotFull.

E:

Null. [property null]

NotNull.

Added:

Success. [if !full && !max && !null]

Fail.

Justification for the constraints:

|  |  |
| --- | --- |
| **Constraint** | **Justification** |
| Employees can only be added if there is room in the emps array and if the number of current employees is less than 20. | Employees can only be added if the emps array has indices available for use and numEmps is suggests that positions are remaining. |
| Only references to Employee objects can be added, no null data can be added. | Null objects are not handled, can cause null pointer exceptions, and cause failures. |

1. **TSL Output – Test Frames**

The 9 test frames are show below:

Test Case 1 (Key = 1.1.1.2.)

NumEmps : PositionsRemaining

Emps : Full

E : Null

Added : Fail

Test Case 2 (Key = 1.1.2.2.)

NumEmps : PositionsRemaining

Emps : Full

E : NotNull

Added : Fail

Test Case 3 (Key = 1.2.1.2.)

NumEmps : PositionsRemaining

Emps : NotFull

E : Null

Added : Fail

Test Case 4 (Key = 1.2.2.1.)

NumEmps : PositionsRemaining

Emps : NotFull

E : NotNull

Added : Success

Test Case 5 (Key = 1.2.2.2.)

NumEmps : PositionsRemaining

Emps : NotFull

E : NotNull

Added : Fail

Test Case 6 (Key = 2.1.1.2.)

NumEmps : NoPositionsRemaining

Emps : Full

E : Null

Added : Fail

Test Case 7 (Key = 2.1.2.2.)

NumEmps : NoPositionsRemaining

Emps : Full

E : NotNull

Added : Fail

Test Case 8 (Key = 2.2.1.2.)

NumEmps : NoPositionsRemaining

Emps : NotFull

E : Null

Added : Fail

Test Case 9 (Key = 2.2.2.2.)

NumEmps : NoPositionsRemaining

Emps : NotFull

E : NotNull

Added : Fail

1. **Test Cases**

The test cases we derived are shown below.

PRFNFA, PRFNNFA, PRNFNFA, PRNFNNT, PRNFNNFA, PFNFA, PFNNFA, PNFNFA, PNFNNFA

Notice that the highlighted cases are not valid for logical reasons.

PRFNFA – It is impossible for there to be positions remaining with the emps array being full.

PRFNNFA – It is impossible for there to be positions remaining with the emps array being full.

PRNFNNFA – If there are positions remaining and the emp is not null, then it should be successfully added.

PNFNFA – It is impossible for there to be no positions remaining while the emps array is not full.

PNFNNFA – It is impossible for there to be no positions remaining while the emps array is not full.

We are left with 4 test cases.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test** | **Value [PR / P]** | **Length [F / NF]** | **State [N / NN]** | **Value [T / FA]** |
| 1 | PR | NF | N | FA |
| 2 | PR | NF | NN | T |
| 3 | P | F | N | FA |
| 4 | P | F | NN | FA |

**Test Derivation for *removeEmployee(pos:int):Employee***

We will use the category-partition method to derive a set of test cases for this method.

1. **Identify what criteria must hold true for each test case to pass**

The side-effects of this method are:

* OutOfBoundsException. If a user removes an employee at the end of the array, it’ll try and shift out of bounds.
* If we run the method and the array is empty.

1. **Identify inputs/parameters for each feature under test.**

The index being passed through is needed.

Variable to return the moved employee will be needed.

Will need the employees array and variable for number of employees

1. **Identify the categories/characteristics for each input/parameter.**

The index that gets passed is an integer.

Variable that holds the removed employee should be of type Employee.

Employee array is type employee with values.

Number of employees is a positive integer.

1. **Partition categories into choices**

Exceed Boundaries: index = Is the index < 0 or > 20

Valid Data: Null, Non-Null, Zero, Non-Zero

1. **Number of tests before constraints added**

|  |  |  |  |
| --- | --- | --- | --- |
| Input | Category | Choices | Coded Choices |
| index | Value | Negative, Positive, Exceed | N, P, X |
| emps | Value | Null, NN | N, NN |
| numEmp | Value | Zero, Non-Zero | Z, NZ |

I have 12 combinations (3\*2\*2).

NNZ, NNNZ, NNNZ, NNNNZ, PNZ, PNNZ, PNNZ, PNNNZ, XNZ, XNNZ,

XNNZ, XNNNZ

1. **TSL Input**

The *TSL* input file is shown below.

Justification for the constraints:

|  |  |
| --- | --- |
| **Constraint** | **Justification** |
| NNNZ | There’s no way you can have a null array of employees and numEmp is >= 1 |
| PNNZ | There’s no way you can have a null array of employees and numEmp is >= 1 |
| XNNZ | There’s no way you can have a null array of employees and numEmp is >= 1 |
| PNNZ | numEmps can’t be zero if there’s non-null values in emps |
| XNNZ | numEmps can’t be zero if there’s non-null values in emps |
| NNNZ | numEmps can’t be zero if there’s non-null values in emps |

1. **TSL Output – Test Frames**

The \_6\_ test frames are show below:

1. **Test Cases**

The test cases we derived are shown below.

[Remove unused columns]

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test** | **[Value]** | **[Value]** | **[Value]** |  |  |  |  |  |
| 1 | N | N | Z |  |  |  |  |  |
| 2 | N | N | NZ |  |  |  |  |  |
| 3 | N | NN | Z |  |  |  |  |  |
| 4 | N | NN | NZ |  |  |  |  |  |
| 5 | P | N | Z |  |  |  |  |  |
| 6 | P | N | NZ |  |  |  |  |  |
| 7 | P | NN | Z |  |  |  |  |  |
| 8 | P | NN | NZ |  |  |  |  |  |
| 9 | X | N | Z |  |  |  |  |  |
| 10 | X | N | NZ |  |  |  |  |  |
| 11 | X | NN | Z |  |  |  |  |  |
| 12 | X | NN | NZ |  |  |  |  |  |