SE 4367, Homework #6, Equivalence Classes and Boundary Value Analysis

Given a program to calculate income tax based on the following marginal tax rates.

Income	Tax
Income < $10K	no tax
$10K ≤ Income < $20K	10%
$20K ≤ Income < $30K	12%
$30K ≤ Income < $40K	15%
Income ≥ $40K	20%

An example of using marginal tax rates: on an income of $25K, you pay $0 on the first $10K, 10% for income from $10-20K, and 12% for income from $20-25K, i.e., 0 + 1K + 0.6K = $1.6K.

a) **What are the equivalence classes for *Income* in this problem?**

b) **Create a test set generated from your equivalence classes.**

c) **What are the boundaries for *Income* in this problem?**

d) **Create a test set generated from (3-point) boundary value analysis.**

Note: enter Income in dollar amounts (integer, no cents).

Homework #6a

Income < $10K	no tax
$10K ≤ Income < $20K	10%
$20K ≤ Income < $30K	12%
$30K ≤ Income < $40K	15%
Income ≥ $40K	20%

What are the equivalence classes for this problem?

E_1: Income < 0	(-∞, 0)	IMPLICIT
E_2: 0 ≤ Income < 10,000	[0, 10,000)	
E_3: 10,000 ≤ Income < 20,000	[10,000, 20,000)	
E_4: 20,000 ≤ Income < 30,000	[20,000, 30,000)	
E_5: 30,000 ≤ Income < 40,000	[30,000, 40,000)	
E_6: 40,000 ≤ Income	[40,000, +∞)	

Either notation is acceptable. Note that (,) are the same as <,> and [,] are the same as ≤,≥ in standard mathematical notation.

Homework #6b

Create a test set generated from your equivalence classes.

Note that this test set is simply an example of the very large number of possible test sets that could be generated.

T_e = { -10,000,
5,000,
15,000,
25,000,
35,000,
100,000
}

E_1: Income < 0
E_2: 0 ≤ Income < 10,000
E_3: 10,000 ≤ Income < 20,000
E_4: 20,000 ≤ Income < 30,000
E_5: 30,000 ≤ Income < 40,000
E_6: 40,000 ≤ Income

Optional Equivalence Classes

The equivalence class (and associated BVA) for income < 0 is optional. It would be a good idea to include it, but it is derived based on knowledge of the application domain.

Homework #6c

What are the boundaries for this problem?

0
10,000
20,000
30,000
40,000

- **Questions: Would it make sense to have an upper bound for income?**
- **If so, what might that bound be?**
- **How would you discover it?**
- **Should it be driven by the problem (tax on income) or technology (how big can a number be on the computer)?**

Homework #6d

What is your test set based on boundary value analysis?

T_b = { -1, 0, 1,
9,999, 10,000, 10,001,
19,999, 20,000, 20,001,
29,999, 30,000, 30,001,
39,999, 40,000, 40,001
}

Question: Does boundary value analysis "subsume" equivalence class partitioning?

Question: Is it worthwhile to generate test cases based on both criteria? That is, $T = T_e + T_b$

Optional Boundaries

You could add a large positive income to test what happens when an input exceeds the "practical" maximum income that we might expect.

- **You should always talk to the customer about this kind of boundary.**

You could add an income greater than the max value that will fit into a variable.

- **This boundary is set by the technology, not the customer or the problem.**

Grading Rubric

Each of the four parts is worth 25 points

- **with a proportional number of points allocated to each component of the answer**

Formatting Submissions

In the file name, include:

- **class**
- **assignment identifier**
- **your name (or team's name)**
  - **e.g., se4367a01jdoe**

In the file (or hardcopy) submitted, include the class, assignment, and name information at the top.

Minus 5 points per violation. Potentially 30 points off for formatting mistakes!