

CSE 4321/5321 Homework 1
Previous Semester

Question 1-3 worth 30 percent each. Question 4 is worth 10 percent. 100 points total

The following are customer descriptions of software systems. For each problem state any assumptions made - but **do not change** the function being described.

1) Arlington Auto pays sales commission as follows. If the sales volume is between \$50,000 and \$200,000 the commission paid is 2.5%. If sales volume is less than \$50,000 the commission paid is 2.1%. If less than \$0 Arlington Auto charges its sales staff a \$300 fee to cover utilities, PC usage, etc. If the sales volume is greater than or equal to \$200,000 it pays 3.05% commission. If the sales volume is greater than \$300,000 it pays 3.75% interest. If the sales volume is greater than \$500,000 it pays 5% commission and he/she will receive an "top seller award" status which means that at Christmas he/she will receive a \$250 Amazon gift card. The software calculates the sales commission to be paid, charges, and awards. Sales status is used to print award plaques.

Develop the minimum set of test cases needed to test all actions and boundary values. List all inputs and expected outputs. Develop the test needed for the valid partitions only. Remember that currency is always truncated - never rounded up.

Answer:

The problem is framed as follows (this is not graded):

Sales Volume	Commission rate	Fee	Status	Gift Card
<\$0	0	-\$300.00	No sales	No
\$0.00	2.10%	\$0.00	Ordinary sales	No
\$49,999.99	2.10%	\$0.00	Ordinary sales	No
\$50,000.00	2.50%	\$0.00	Ordinary sales	No
\$199,999.99	2.50%	\$0.00	Ordinary sales	No
\$200,000.00	3.05%	\$0.00	Ordinary sales	No
\$300,000.00	3.05%	\$0.00	Ordinary sales	No
\$300,000.01	3.75%	\$0.00	Ordinary sales	No
\$500,000.00	3.75%	\$0.00	Ordinary sales	No
>\$500000.00	5%	\$0.00	Top Seller	Yes

The Equivalence Class Partitions with Boundary Values look like the following (Note: \$ and trailing zeroes are omitted to save space):

$-\infty$	-0.01	0	49,999.99	50,000	199,999.99	200,000	300,000	300,000.01	500,000	500,000.01	∞
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The 6 ECPs (and 12 BVs) mean that we need 12 test cases using the BVs.

The required test cases are as follows (this portion is graded).

Test Case	Inputs	Expected outputs		
	Sales Volume	Amount paid	Gift Card	Status
Test Case 1	-\$500.00	-\$300.00	No	No sales
Test Case 2	-\$0.01	-\$300.00	No	No sales
Test Case 3	\$0.00	\$0.00	No	Ordinary sales
Test Case 4	\$49,999.99	\$1,049.99	No	Ordinary sales
Test Case 5	\$50,000.00	\$1,250.00	No	Ordinary sales
Test Case 6	\$199,999.99	\$4,999.99	No	Ordinary sales
Test Case 7	\$200,000.00	\$6,100.00	No	Ordinary sales
Test Case 8	\$300,000.00	\$9,150.00	No	Ordinary sales
Test Case 9	\$300,000.01	\$11,250.00	No	Ordinary sales
Test Case 10	\$500,000.00	\$18,750.00	No	Ordinary sales
Test Case 11	\$500,000.01	\$25,000.00	Yes	Top Seller
Test Case 12	\$1,000,000.00	\$50,000.00	Yes	Top Seller
Grading note: Status for items in yellow above may be any number but must be distinct from "Top Seller". The two extreme values of Sales Volume can be any number in that respective partition.				

Notes/assumptions

- 1) Assuming the commission rate for sales volume of less than zero is zero.
- 2) Status must "Top Seller" and something other to successfully test Status.

2) Arlington transportation measures traveler frequency on its shuttle busses and the software has been designed to count this volume. The tester is assigned the task of developing test cases needed to test all actions and boundary values. The software counts the volume of passengers - these requirements are specified elsewhere - the customer desires that the tester develops acceptance tests based on the analysis of the volume which is the following.

Holiday travel volume is 20 percent lower than weekend volume. Weekend volume reduces by 50% over business day (M-F) travel. The average weekday rate of passengers is 300 passengers/hour. Volume increases for travel that departs between 6am and 9am by 200 percent over average daily volume (heavy volume traffic). Low volume traffic occurs for local departures starting 9am until 4pm. Heavy volume traffic also applies to busses leaving on or after 4pm until 7pm. Busses after 7pm revert back to Low volume traffic until 6am.

Develop the minimum set of test cases needed to test all unique rates and boundary values. List all inputs and expected outputs. Develop the test needed for the valid partitions only. Volume calculations are always truncated - never rounded up. Assume significance of 1 second on time and make a reasonable assumption on units not specified. For the test cases start the day at 12 midnight (12:00:00 am).

Answer:

First, note that the significance for volume of people is going to be 1 (we only count whole people) and accordingly it is an integer. Using a double/float is acceptable but the significance is still going to be 1.

Second, only the average daily volume is given and peak volume. Low volume must be calculated. There are 6 hours of heavy volume traffic per day and 18 of low volume traffic. An increase of 200 percent means 3x, so the heavy volume traffic is $3 \times 300 = 900$ people/hour. The low volume traffic is calculated as, $(24 \times 300 - 6 \times 900) / 18 = 100$ people/hour.

Third, the significance on time is 1 second, so time will be represented as hh:mm:ss am/pm. Further, the clock starts at midnight 12:00:00 am and goes up to and including 11:59:59 pm the same day (when the day ends according to the significance).

The problem is framed as follows (this part is not graded).

Time	Daily Traffic Volume Type	Estimated Volume/hr		
		Weekday	Weekend	Holiday
12:00:00 AM	Low Volume	100	50	40
6:00:00 AM	Low Volume	100	50	40
6:00:01 AM	Heavy Volume	900	450	360
8:59:59 AM	Heavy Volume	900	450	360
9:00:00 AM	Low Volume	100	50	40
3:59:59 PM	Low Volume	100	50	40
4:00:00 PM	Heavy Volume	900	450	360
7:00:00 PM	Heavy Volume	900	450	360
7:00:01 PM	Low Volume	100	50	40
11:59:59 PM	Low Volume	100	50	40

Test cases then are as follows (this part is graded).

Test Case	Inputs		Expected Outputs
	Time	Type Day	Volume/hr
Test Case 1	12:00:00 AM	Weekday	100
Test Case 2	6:00:00 AM	Weekday	100
Test Case 3	6:00:01 AM	Weekday	900
Test Case 4	8:59:59 AM	Weekday	900
Test Case 5	9:00:00 AM	Weekday	100
Test Case 6	3:59:59 PM	Weekday	100
Test Case 7	4:00:00 PM	Weekday	900
Test Case 8	7:00:00 PM	Weekday	900
Test Case 9	7:00:01 PM	Weekday	100
Test Case 10	11:59:59 PM	Weekday	100
Test Case 11	12:00:00 AM	Weekend	50
Test Case 12	6:00:00 AM	Weekend	50
Test Case 13	6:00:01 AM	Weekend	450
Test Case 14	8:59:59 AM	Weekend	450
Test Case 15	9:00:00 AM	Weekend	50
Test Case 16	3:59:59 PM	Weekend	50
Test Case 17	4:00:00 PM	Weekend	450
Test Case 18	7:00:00 PM	Weekend	450
Test Case 19	7:00:01 PM	Weekend	50
Test Case 20	11:59:59 PM	Weekend	50
Test Case 21	12:00:00 AM	Holiday	40
Test Case 22	6:00:00 AM	Holiday	40
Test Case 23	6:00:01 AM	Holiday	360
Test Case 24	8:59:59 AM	Holiday	360
Test Case 25	9:00:00 AM	Holiday	40
Test Case 26	3:59:59 PM	Holiday	40
Test Case 27	4:00:00 PM	Holiday	360
Test Case 28	7:00:00 PM	Holiday	360
Test Case 29	7:00:01 PM	Holiday	40
Test Case 30	11:59:59 PM	Holiday	40

Grading note: The colors above are not required and added for readability.

3) A homeowner has invested in a wind-turbine system that creates energy based on wind currents. The homeowner wants to know if she has made a good investment and develops some monitoring software that sounds certain alarms when the stored energy reaches certain levels. She is contracting out the test of the software to you since you are a testing expert - you are required to develop the acceptance tests needed to ensure the software works correctly. Interface requirements are specified elsewhere and are not part of this problem.

The turbine generates 2,000 watts per hour. The monitoring software runs on a PC that uses 100 watts/hour. The battery is capable of storing 10,000 watts. The software controls 3 lights (red, yellow and green) and a siren. When the stored energy is over 10 percent battery capacity the software turns on a red light, when over 20 percent is turns on the yellow light, when over 30 percent the green light, and when below 5 percent turns on the siren. Develop the test cases needed to qualify the software.

Assume all values are Java doubles with a significance of 0.1. Develop the minimum set of test cases needed to test all actions and boundary values. List all inputs and expected outputs. Develop the tests needed for the valid partitions only. Pay attention to the significance. Assume the battery cannot have less than 0 watts.

Answer:

The hardest part of this problem is the following:

- 1) Ignore the colors and indicators and what they mean. This problem tests how well you follow the specified requirements despite the natural inclination to believe that red should not be lit as described.
- 2) That these indicators overlap - the tendency is to want them to be distinct, but that is not what the problem says. This is where treating the requirement as a contractual statement is so important.

The problem is framed as follows (this part is not graded).

Battery Capacity (watts)	Red Light	Yellow Light	Green Light	Siren
10,000.0	On	On	On	Off
3,000.1	On	On	On	Off
3,000.0	On	On	Off	Off
2,000.1	On	On	Off	Off
2,000.0	On	Off	Off	Off
1,000.1	On	Off	Off	Off
1,000.0	Off	Off	Off	Off
500.0	Off	Off	Off	Off
499.9	Off	Off	Off	On
0.0	Off	Off	Off	On

The 5 ECPs (and 10 BVs) mean that we need 10 test cases using the BVs.

0	499.99	500	1,000	1,000.1	2000	2,000.1	3,000	3,000.1	10,000
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Note that the two extreme values are within the described battery range.

The test cases follow (this part is graded). Note that there are 5 ECPs and therefore 10 test cases.

Test Case	Input	Expected Outputs			
	Battery Capacity (watts)	Red Light	Yellow Light	Green Light	Siren
Test Case 1	10,000.0	On	On	On	Off
Test Case 2	3,000.1	On	On	On	Off
Test Case 3	3,000.0	On	On	Off	Off
Test Case 4	2,000.1	On	On	Off	Off
Test Case 5	2,000.0	On	Off	Off	Off
Test Case 6	1,000.1	On	Off	Off	Off
Test Case 7	1,000.0	Off	Off	Off	Off
Test Case 8	500.0	Off	Off	Off	Off
Test Case 9	499.9	Off	Off	Off	On
Test Case 10	0.0	Off	Off	Off	On

4) Arlington Auto (problem 1) was sued by a disgruntled former sales person who was never a top-seller. The settlement wasn't exactly what she wanted but the top-sales award is now based on two new levels of recognition: Ruby if the commission is over \$30,000 and Diamond if the commission is \$40,000 or higher. Ruby means that at Christmas he/she will receive a \$250 Amazon gift card and Diamond \$300.

Provide only the test cases that must be added to test these new award rules and levels. Use sales volume and compute the new tests cases as in Problem 1. State any assumptions made. Remember that currency is always truncated - never rounded up.

Answer:

Note that the problem specifies that the new levels are based on the sales commission, not the volume. But the problem asks us to use the sales volume just like the rest of the test cases in Problem 1. So it must be converted back from commission into sales volume and these values used to test the new requirements. Since the first threshold is $\geq \$30,000.01$ this converts back into a sales volume of \$600,000.20 when the 5% factor and truncation is used.

The following are the test cases required.

Test Case	Inputs	Expected outputs		
	Volume	Amount paid	Gift Card	Status
Test Case 1	\$600,000.19	\$30,000.00	None	Ordinary Sales
Test Case 2	\$600,000.20	\$30,000.01	\$250	Ruby
Test Case 3	\$799,999.99	\$39,999.99	\$250	Ruby
Test Case 4	\$800,000.00	\$40,000.00	\$300	Diamond

The question only required us to test the new levels - it did not ask us to go back and change the previous tests, so only these are required. It would not be incorrect to change the previous tests for the Top Seller test cases if done correctly.

Grading note: "Ordinary Sales" name is not required but that level is no longer a Top Seller and the newly added test cases must reflect that change.