CSE 4321/5321 Homework 1

Spring 2020

Question 1-5 worth 14 percent each. Question 6 is worth 30 percent. 100 points total

Guidance for all problems:

1. Develop the minimum set of test cases needed to adequately test all actions and boundary values.
2. List all inputs and expected outputs using the test case table depicted in the previous HW 1 solution.
3. Develop the test needed for all partitions with two test cases per partition.
4. Assume that currency is truncated to the Cent.
5. State any assumptions made, but do not change the function of the problem.

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

1) Arlington Bank credits/debits accounts as follows. If the account balance is between $2,000 and $7,500 the interest paid is 2.35%. If account balance is less than or equal to $2,000 the interest paid is 2.15%. If less than or equal to $0 it assess a $35 overdraft/disuse fee and no interest is paid. If the account balance is greater than $7,500 it pays 2.55% interest. If the account balance is greater than or equal to $15,000 it pays 2.95% interest, if greater than $25,000 it pays 3.15% interest and if the account balance is greater than or equal $30,000 it pays 3.25% interest and the account owner will receive an "honored" status which means that on the bank anniversary the account owner will receive a $75 Starbucks gift card. The software calculates the interest to be paid, fees, and awards. Account status is used to obtain gift cards. The bank always calculates only the highest applicable interest rate.

SOLUTION:

The Equivalence Class Partitions with Boundary Values look like the following (Note: $ and in some cases trailing zeroes are omitted to save space) **- this is NOT required or graded:**

The 7 ECPs (and 14 BVs) mean that we need 14 test cases using the BVs. Note that students MUST use units ($) for balance as both an input and expected output. **The following is graded.**



Notes/assumptions

1. Status must "honored" and something other to successfully test Status.
2. Truncation in excel is used as follows: =TRUNC(A5+TRUNC(H5\*B5,2),2) - truncation needs to be performed on every calculation step.

2) Arlington Airlines measures traveler frequency on its aircraft 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 350 percent higher than weekend volume. Weekend volume reduces by 20% over business day (M-F) travel. The average weekday rate of passengers is 12,000 passengers/day. Volume increases for travel that departs between 5am and 9am (high volume traffic) by a factor of 2.33 over average hourly volume. ﻿﻿All high volume traffic uses this same factor. Low volume traffic occurs for local departures from 9am until 3pm. High volume traffic also applies to flights leaving on or after 3pm until 6pm. Flights later than and including 6pm revert back to Low volume traffic until 5am.

Additional guidance:

1. Volume calculations are always truncated to the nearest whole - never rounded up.
2. Assume significance of 1 second on time.
3. For the test cases start the day at 12 midnight (12:00:00 "am"). You must show time significance to the nearest second.

SOLUTION:



To calculate the low and high volumes we have to give attention to the phrases "increased by" - increase by a factor of 2.33 is the same as multiplying by 3.33 = x+2.33\*x = 3.33\*x, note that "2.33 times higher" would require the same factor because both the these terms use relative descriptors, not absolute. Conversely, multiplied by a factor of 2.33 would simply be 2.33\*x

To calculate the Low and High Volumes we note that the average hourly volume is 12,000/24=500 passengers/hour. The High Volume is 3.33\*500 = 1,665 passengers/hour.

Low Volume is then (12,000 - 1,665\*7)/17 = 20 passengers/hour (truncated).

This gives us 1,665\*7 + 20\*17 = 11,995 passengers/day (we lose 5 due to truncation) and an hourly rate of 499 with truncation.

Weekend volume reduces by 20% over weekday travel. To calculate this, we first calculate 20 percent of 1,665 which is 333, so High Volume weekend travel is 1,665 - 333 = 1,332 passengers/hour. Low volume weekend is 20 - 4 = 16 passengers/hour.

Holiday volume is 350 percent **higher** than weekend - this means that Holiday volume = 4.5\*weekend. So we get 5,994 and 72 passengers/hour.

There are three day types: Weekday, weekend, and Holiday. Each has 5 ECPs (as identified in the table above) and therefore each day type has 10 test cases, so we end up with 30 test cases as follows.



Grading notes:

1. Only two inputs are required and only one expected output is required. Time must show seconds. Day type must show use the labels given. Volume must indicate units (passengers/hour). Volume must truncate to the passenger (integer).
2. Digits separators should be used to increase readability (no deduction this homework only, if not used).

3) A car uses gas at a rate of 25 miles/gallon. The owner drives his car 62.5 miles/day and has a gas tank of 25 gallons. He drives at an average speed of 50 miles/hour with a maximum of 70 mph. He likes to listen to music and is sometimes a little distracted so he forgets to pay attention to stop lights and stop signs (stop indicators) getting several tickets and now runs the risk of having his license taken away. He got an upgrade to his car made by a local dealer so that it now has a red light, yellow light, green light, and buzzer that are triggered at 100 feet, 75 feet, 50 feet and 25 feet from a stop indicator respectively. He is hoping this will solve his problem.

Additional guidance:

1. Assume all values are Java doubles with a significance of 0.1.
2. Also assume that when the car passes the stop indicator or when it first starts, all alerts reset.

SOLUTION:

The ECPs look like the following (distance is in feet):

Since we have 5 ECPs there will be 10 test cases as follows:



Grading notes:

1. Only one input is required and four expected outputs are required. Distance must show 0.1 feet and indicate units (feet).
2. Bold not required - added to increase readability.

4) Arlington Bank (problem 1) was sued by a disgruntled former sales person who wanted a larger reward for the "honored" account owner. The settlement wasn't exactly what she wanted but the top status account is now based on two new levels of recognition: "Honored status" if the total balance including interest is over $45,000 and "Top-status" if the total balance including interest is $55,000 or higher. Honored status means that at the Bank Anniversary date he/she will receive a $100 Amazon gift card and Top-status $135 account credit.

Additional guidance:

1. Provide only the test cases that must be added to test these new award rules and levels.
2. Use balance with interest and compute the new tests cases as in Problem 1.
3. The input to the test cases is the pre-interest account balance.
4. The outputs include the total balance (balance with interest and other credits).

SOLUTION:

The problem is framed as follows - **this is NOT required or graded:**



Note that the problem only required the four test cases above (two per new award threshold), but to be complete we should go back and correct the test cases for Problem 1 since the Honored status level has changed - this is not required, but should be done normally to be complete. **The following is graded.**



Balance must show units of $, with thousand separators, and be truncated to the Cent.

5) Convert the first three problems above into decision tables. Divide this problem into parts a) b) and c) for problem 1, 2 and 3 respectively. For each, provide

1. the decision table
2. the number of test cases required (do not supply the specific test cases)
3. does this number agree with the number of tests developed above? Yes or No. If no, why not?

SOLUTION

a.

1. The decision table follows



1. It has the same number of test cases as above
2. Yes they agree

Notes:

1. The solution MUST mention "first-of" rule.
2. Currency values must have $
3. Thousands separators must be used.
4. Status - the status value of Regular is not specified in the problem. This value can be anything but Prime.
5. Significance must be shown correctly

b.

1. The decision table follows



1. It has the same number of test cases as above
2. Yes they agree

c.

1. The decision table follows



1. It has the same number of test cases as above
2. Yes they agree

6) Arlington Enterprises is developing a fuel pump - it doesn't have all of the full features of some fuel pumps, but we are hoping that the basic features will ensure high volume and keep our cost competitive.



The fuel pump system consists of a Gas Pump System, Gas Pump Panel, and two sensors: Gas Pump Nozzle Head (in holder), and Gas Pump Nozzle Flow (squeezable handle). The Gas Pump Panel has a Display (text message) and two buttons Start and Stop. Inside the station the cashier presses a Paid button indicating the fuel has been paid for.

**Nozzle Sensors (2)**



The customer purchases gas as follows (must follow this sequence)

1. "Welcome"
   1. When the display (D) shows the "Welcome" message, the customer presses the Start button (S=true) and the software displays a "Ready" message.
   2. All other inputs but S are ignored.
2. "Ready"
   1. the customer removes the Gas Pump Nozzle Head from its holster (this causes the Gas Pump Nozzle Head sensor N=T). The software displays the message "Dispensing".
   2. All other inputs but N are ignored.
3. "Dispensing"
   1. The customer squeezes the Gas Pump Nozzle Flow handle (H=T). When H=T the software sets G=T to pump the gas.
   2. If N=F (the Nozzle is put back in the holster) then the software returns to "Ready"
   3. The inputs S and C are ignored
   4. When the customer presses the Stop button (X=T) the software stops the fuel flow and displays "Please pay cashier". Otherwise, the fuel continues to be dispensed when the customer squeezes the handle.
4. "Please pay cashier "
   1. When the customer has paid the cashier, the cashier presses the Paid button which provides a C=T input to the software. This causes the display to show the "Welcome" message and the software awaits the next customer.
   2. At this point the inputs H, N, S, and X are ignored until the C input is received.

The software MUST not allow fuel to flow except when "Dispensing" and when the handle is squeezed. This is a safety feature.

C is ignored until the Stop button is pressed.

D (the Gas Pump Display message) is an output of the software. It is a String in Java. When the system powers-up it displays the "Welcome" message and awaits further inputs.

During pumping, G is an output of the software used to turn on the pump motor which dispenses gas.

Develop

1. State diagram.

Draw the simplest state diagram (Mealy)

1. make sure all inputs and outputs are depicted where required.
2. Each state is labeled S0, S1, ... SN
3. Inputs to the state diagram are single letters (e.g.S). When the input is true S=T this is shown on the diagram as S. When S=F then !S.
4. Outputs are shown as single letters as the inputs are shown. D="Message" is used to display the text *Message* on the display.
5. Only true values as shown for inputs except when used as a logic interlock. For example, when in the idle state !C would not be an input.

SOLUTION



Notice that for S2 we have 32 possible enumerations of the 5 inputs (C, H, N, S, X). Of those 32 the description says that "when N is T at most one other input can be T at the same time". Of these 32 the following evaluations apply

1. When N is F (!N) the system returns to S1 - this is 16 of the 32 possible enumerations
2. It is not possible that more than 1 input is T when N is T - this is 11 of the 32 possible enumerations
3. The system goes to state S3 when N and X are true - this is 1 of the 32 enumerations
4. The system stays in S2 when N=T & H=T or when N=T & S=T or when N=T & C=T as the diagram shows - this is 3 of the 32 enumerations
5. The remaining enumeration is when N=T and all other inputs are F as the diagram shows.

The following table shows the mapping of the 32 possible enumerations for state S2 "Dispensing"as described above.

