Homework #1
is posted

Decision Table based testing.

specification

↓

Input conditions

+

Actions/outcomes

↓

decision table

↓

test cases.

Tabular representation of complex logical decisions

a set of rules

	R1	R2
C1	T	T
C2	T	F
C3	F	F
A1		X
A2	X	
A3		X

completness

N conditions

2^N rules

don't care cond

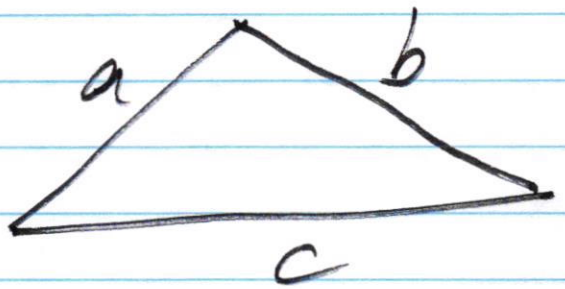
	R1	R2		R12
C1	T	T		T
C2	F	T		—
C3	T	T		T
A1				
A2	X	X		X
A3				

don't care.

Triangle program

3 inputs: a, b, c

a, b, c represent sides of a triangle.



precondition: a, b, c > 0

Outputs:

(1) not a triangle msg.
(2) scalene -"- -"-
(3) isosceles -"- -"-
(4) equilateral -"- -"-
(5) incorrect input -"-

input conditions:

$a > 0$, $b > 0$, $c > 0$

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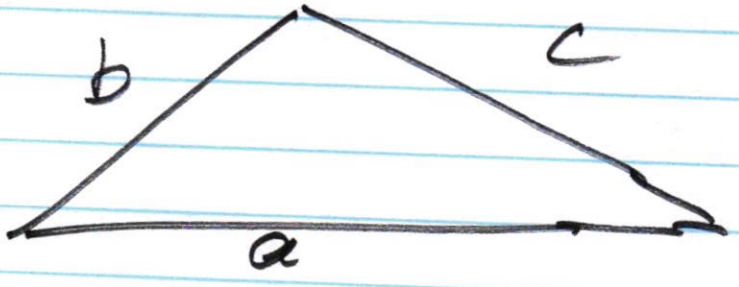
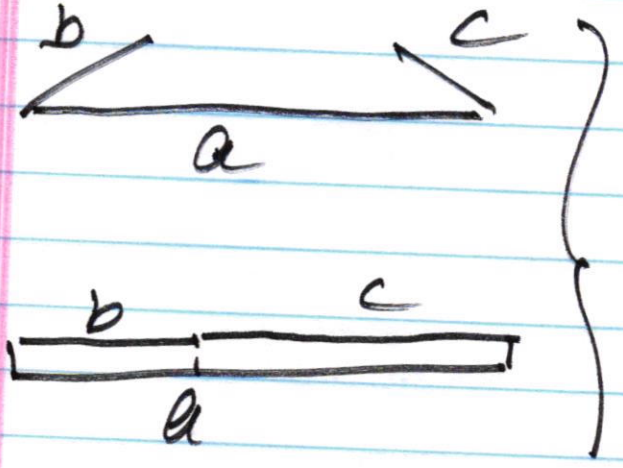
a, b, c



cond: $a < b + c$ → true → triangle

→ false → not a triangle

$a \geq b + c$



not a triangle.

	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14
c1: a>0	F	–	–	T	T	T	T	T	T	T	T	T	T	T
c2: b≥0	–	F	–	T	T	T	T	T	T	T	T	T	T	T
c3: c>0	–	–	F	T	T	T	T	T	T	T	T	T	T	T
c4: a<b+c	–	–	–	F	–	–	T	T	T	T	T	T	T	T
c5: b<a+c	–	–	–	–	F	–	T	T	T	T	T	T	T	T
c6: c<b+a	–	–	–	–	–	F	T	T	T	T	T	T	T	T
c7: a=b	–	–	–	–	–	–	T	T	T	F	F	F	F	T
c8: a=c	–	–	–	–	–	–	T	T	F	T	T	F	F	F
c9: b=c	–	–	–	–	–	–	T	F	T	T	F	T	F	F
a1: not triangle				X	X	X							X	
a2: scalene											X	X		X
a3: isosceles							X							
an equilateral														
a5: incorrect input	X	X	X											
impossible								X	X	X				

9 input conditions

# of rules = $2^9 = 512$

⇓

# of rules reduced to 14 rules

⇓

3 impossible

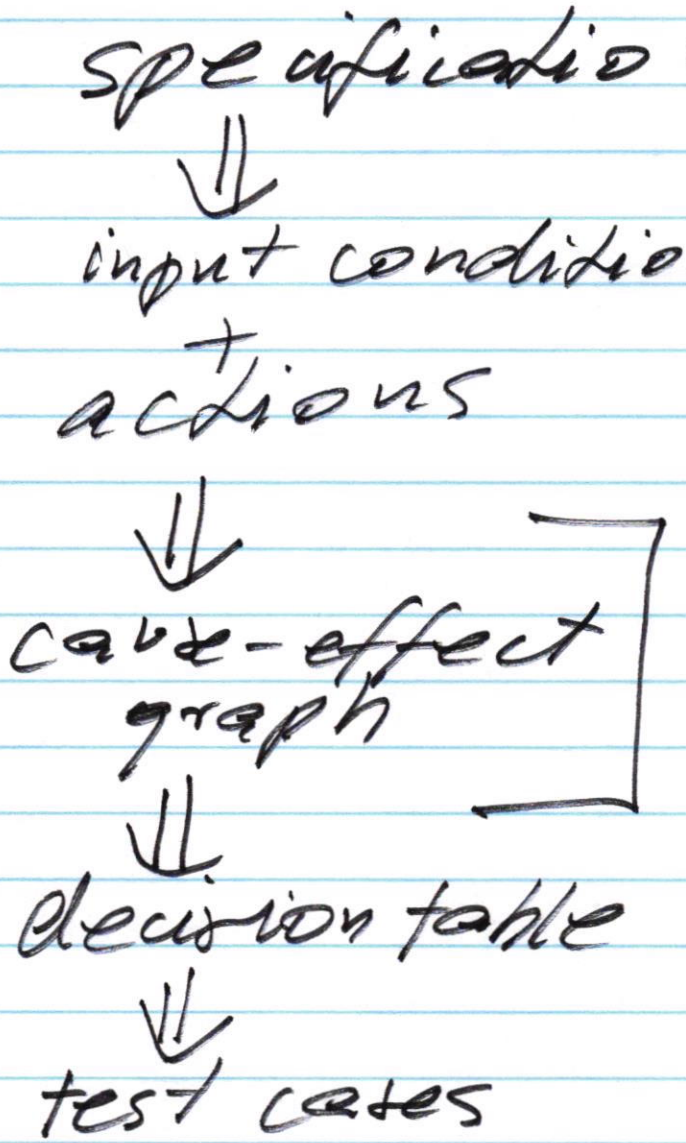
⇓

11 test cases

R1: T1: a=-5, b=5, c=7
R2: T2: a=5, b=0, c=7
R3: T3: a=5, b=7, c=-5
R4: T4: a=25, b=5, c=7
R5: T5: a=2, b=10, c=4
R6: T6: a=5, b=7, c=20
R7: T7: a=7, b=7, c=7
R8, R9, R10 - impossible ⇒ no tests
R11: T8: a=7, b=5, c=7
R12: T9: a=5 b=7, c=7
R13: T10: a=5, b=7, c=4
R14: T11: a=7, b=7, c=5

cause-effect graphing.

related to decision table



cause-effect graph

identify logical relationships between (causes) input condition and actions (effects)

cause-effect graph

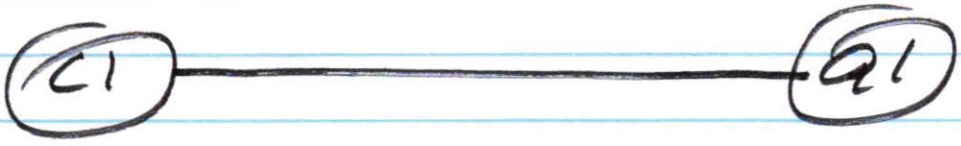
"input condition-action graph".

input condition

action

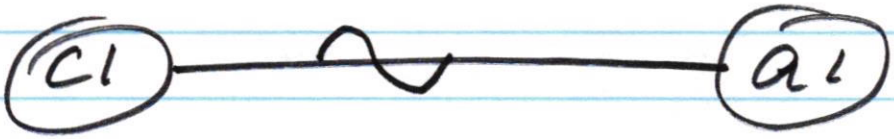
cause-effect relationships

(1) identity relationship



if c1 then a1

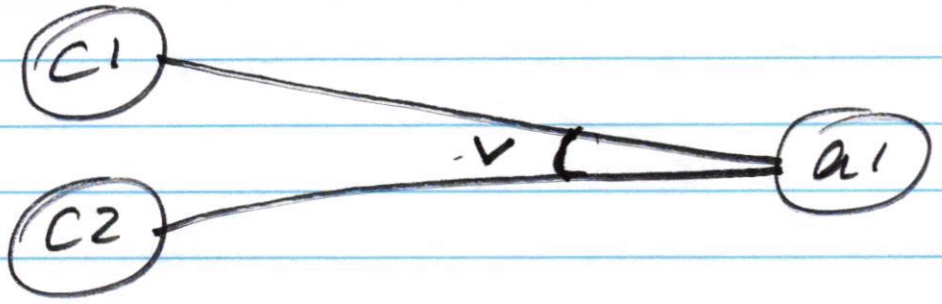
(2) "not" relation ship



if not c1 then a1

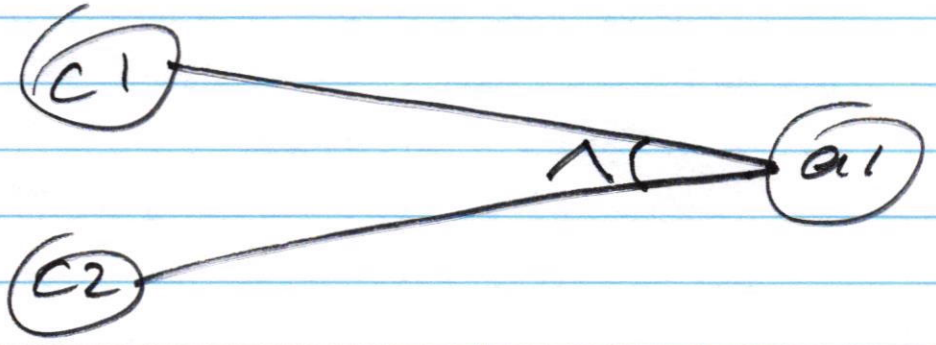
(3) no relationship

(4) "or" relationship



if C1 or C2 then a1

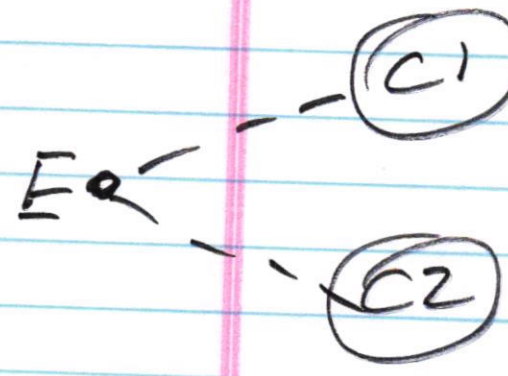
(5) "and" relationship.



if C1 and C2 then a1

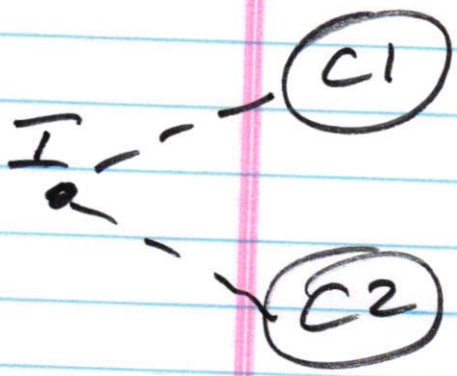
constraints

Exclusive



at most one of C1 or C2 can be true

Inclusive



at least one of C1, C2 must be true.

Example

1) The first character must be "A" or "B"
2) The second character must be a digit.
3) if the first character is "A" or "B" and the second character is a digit, then the file is updated.
4) if the first character is incorrect, message X12 is issued
5) if the second character is not a digit, message X13 is issued.

cause-effect graph

C1: 1st char is "A"

C2: 1st char is "B"

C3: 2nd char is a digit

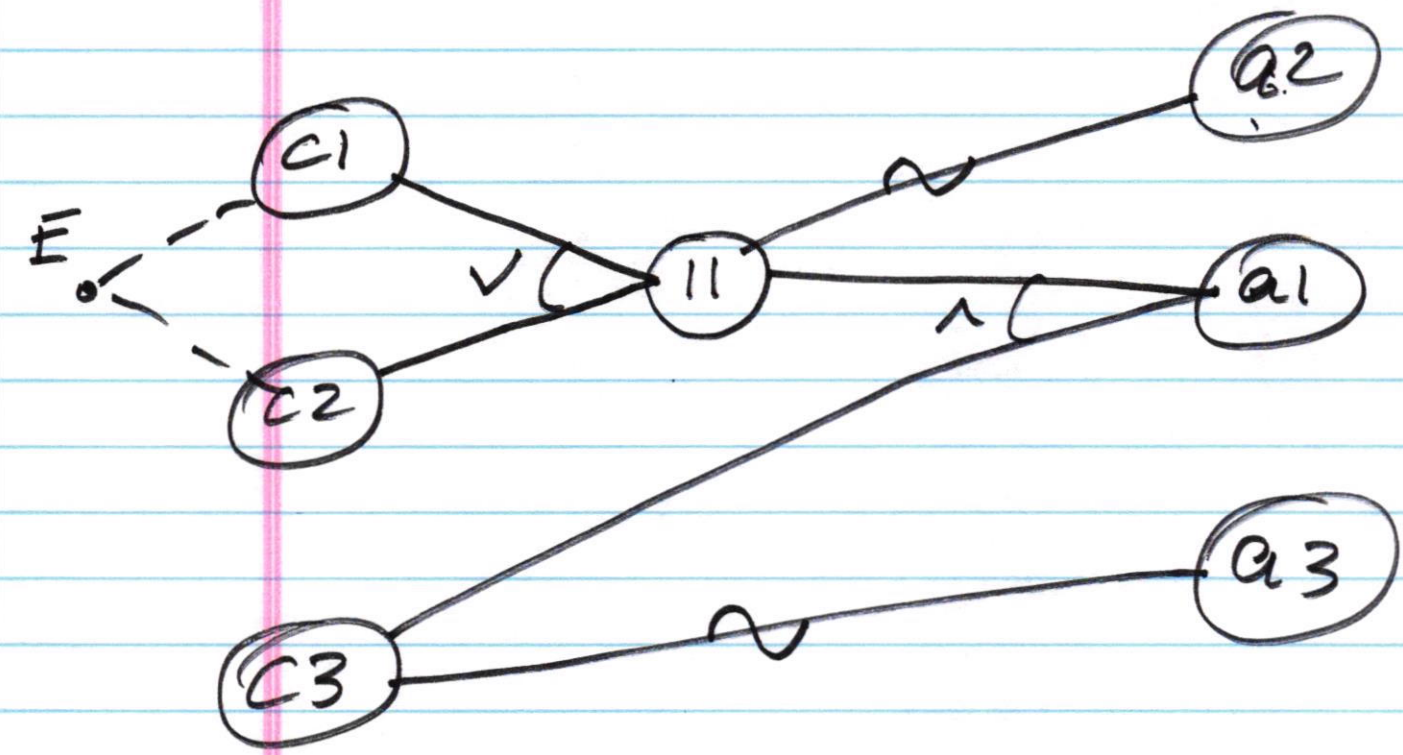
actions

a1: update file

a2: X12 msg

a3: X13 msg.

cause-effect graph



(11) first character is "A" or "B"

create a decision table

for every action
identify all combinations
of causes (input conditions)
that "influence" the action.

	R1	R2	R3	R4
C1	T	F	F	—
C2	F	T	F	—
C3	T	T	—	F
a1	X	X		
a2			X	
a3				X

R1: T1: A2
R2: T2: B7
R3: ~~T3: C7~~ T3: C7
R4: T4: AC

} 4 tests

Homework #1

Problem #1

Input conditions for each input variable

↓

valid/invalid subdomains

(1) last name

(a) $1 \leq \text{length} \leq 15$

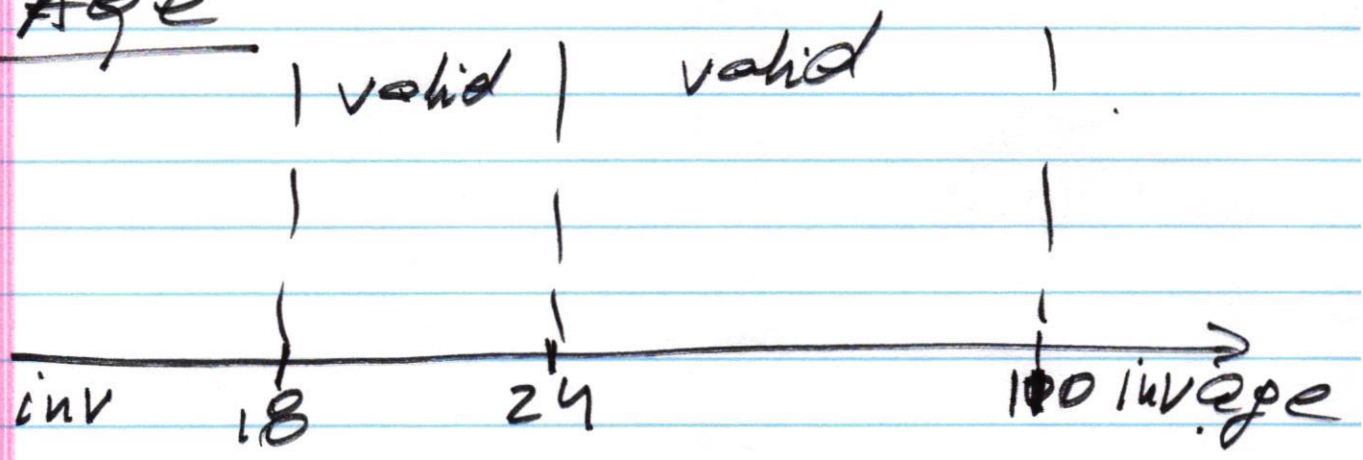
1 valid, 2 invalid

(b) contains only letter characters

yes – valid

no – invalid

Age



Car type

{ valid
| invalid.

VIN

length = 17 < yes valid
no invalid

format:

BLLLLDDLLLLDDDDDD

V1 V2 V3 V4 V5

(a) strong normal eq. testing.

age ≠ 2

car type ✓

VIN ✓

# of claims ✓ assume.

# of tests: 2·5·5·✓ = 250 tests.

weak robust eq. testing.

1 claim invalid subdomains

Problem #3

conditions:

C1

C: $\bar{U}$

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grade A

grade B

invalid input

HOMEWORK ASSIGNMENT #1

CS589; Fall 2021
Due Date: **September 22, 2021**
Late homework 50% off
After **September 26,** the homework assignment will not be accepted.

This is an **individual** assignment. **Identical or similar** solutions will be penalized.

Submission: All homework assignments must be submitted on the Blackboard. The hardcopy submissions will not be accepted.

SPECIFICATION-BASED TESTING

Suppose a software component (called a Car Insurance System) has been implemented to handle processing the annual renewal of a hypothetical auto insurance policy. The following are requirements for the component:

> If the insured made one claim in the last year and is age 25 or older, the increase is $60 and no letter is sent. If the insured had no claims in the last year and is age 24 or younger, the increase is $60 and no letter is sent. If the insured had no claims in the last year and is age 25 or older, the increase is $35 and no letter is sent. If the insured made two, three, or four claims in the last year and is age 24 or younger, the increase is $310 and a warning letter is sent. If the insured made one claim in the last year and is age 24 or younger, the increase is $110 and a warning letter is sent. If the insured made two, three, or four claims in the last year and is age 25 or older, the increase is $210 and a warning letter is sent. If the insured made five or more claims in the last year, the policy is canceled.

The component accepts the input in the following format (6 input variables):

1. last name
2. first name
3. Age
4. car type
5. VIN
6. # of claims

The maximum size of the "*first name*" is 10 characters and "*last name*" is 15 characters.
The *car type* can be: *sedan, mini-van, truck, SUV, Taxi*

Assumptions:

- *last name* and *first name* contain only letter characters.
- *age* is an integer. The minimum *age* is 18 and the maximum *age* is 110.
- The maximum *# of claims* is 10.
- VIN (a vehicle identification number) contains 17 characters (letters and digits) and has the following format: DLLLLDDLLLLDDDDDD, where D is a digit and L is a letter.

A sample component test:
Test #1:

last name	Smith
first name	John
Age	27
car type	Truck
VIN	1HGBH41JXMN109186
# of claims	3

PROBLEM #1 (35 points): Equivalence partition testing
For the Car Insurance System identify input conditions related to:

1. last name
2. first name
3. Age
4. Car type
5. VIN
6. # of claims

From the identified input conditions list valid and invalid sub-domains (equivalence classes). Based on identified sub-domains design test cases using:

a. Strong normal equivalence testing.
b. Weak robust equivalence testing.

Hint: Before designing test cases, identify related/unrelated input conditions.

PROBLEM #2 (30 points): Boundary-value testing
Based on identified sub-domains in Problem #1 design:

1. Normal Boundary-Value Analysis test cases.
2. Robust Boundary test cases.

- 1 dim.

PROBLEM #3 (35 points): Decision-Table based testing

Suppose a software component (called a Grader component) has been implemented to automatically compute a grade in a course. A course taught at a university has two components: (1) two exams and (2) a project. To pass the course with grade C a student must score at least 50 points in Exam-1, 60 points in Exam-2, and 50 points in the Project. Students pass the course with grade B if they score at least 60 points in Exam-1, 65 points in Exam-2, and 60 points in the Project. If, in addition to this, the average of the exams and the Project is at least 75 points then students are awarded a grade A. Final grades for the course are: A, B, C, and E. The Grader component accepts four inputs:

Student #
Exam-1
Exam-2
Project

Assumptions:

- Assume *Exam-1, Exam-2,* and *Project* are integers and represent the scores of the exams and the project.
- The ranges for the exam scores and the project score are:
  - $0 \leq Exam\text{-}1 \leq 100$
  - $0 \leq Exam\text{-}2 \leq 100$
  - $0 \leq Project \leq 100$
- *Student #* is a number represented as a 9-character string in the following format: AXXXXXXXX, where X is a digit.

Sample test cases for the Grader component:

Test #1: *Student #*=A11112222, *Exam-1*=57, *Exam-2* = 64, *Project*=55
Test #2: *Student #*=A42312242, *Exam-1*=75, *Exam-2* = 24, *Project*=85

Use **decision-table** based testing to design test cases to test the GRADER program. Provide a decision table and test cases derived from the decision table.

Note: In your solution conditions cannot be complex logical expressions. For example:

(Exam-1<50) and (Exam-2 ≥ 60)

is **not acceptable** as a condition in the decision table. However, "*Exam-1 <50*" is a condition; "*Exam-2 ≥ 60*" is a condition.