CS445 / CS645 / ECE451
Fall 2019 — Final Exam

6 December 2019, 9:00am–11:30am

Instructor: Daniel M. Berry

Time allowed: 2.5 hours = 150 minutes

No aids allowed (*i.e.,* closed book).

Answer all of the questions on this exam paper.

There are 8 questions for a total of 150 marks.

Plan your time wisely: 1 minute per mark

Your Name and Student Number

In the immortal words of the yet to be born Jean-Luc Picard of Earth,

$\boxed{\textit{Make it so!}}$

Q1		scaled to	20
Q2		scaled to	20
Q3		scaled to	20
Q4		scaled to	15
Q5		scaled to	20
Q6		scaled to	20
Q7		scaled to	30
Q8		scaled to	5
TOTAL		scaled to	150

In this exam, in a sentence with missing words, a short underscore of 1 inch (= 2.54 cm) should be filled with one word. A long underscore of 2 inches (= 5.08 cm) should be filled with a phrase consisting of one to several words. In either case, if you cannot think of exactly the right number of words, then give the best answer that you can and we'll give it as many marks as we can, possibly even full credit! If you cannot even think of just words to fill in, then write an answer as a sentence, and we'll give it as many marks as we can.

"(Complete the sentence.)" means that in the space following the current line, you are to complete the sentence that was started and interrupted with the "(Complete the sentence.)"

If you are asked a question, which ends with a "?", you are to answer that question in the space following the current line.

In this exam, if you are asked for a simple answer, you need not justify it, unless you are also asked explicitly "Why?". However, you may always write down assumptions that can help us give you partial credit.

If an exam question directs you to list, describe, write, explain, draw, mark, put, change, modify, or anything like that, just do so.

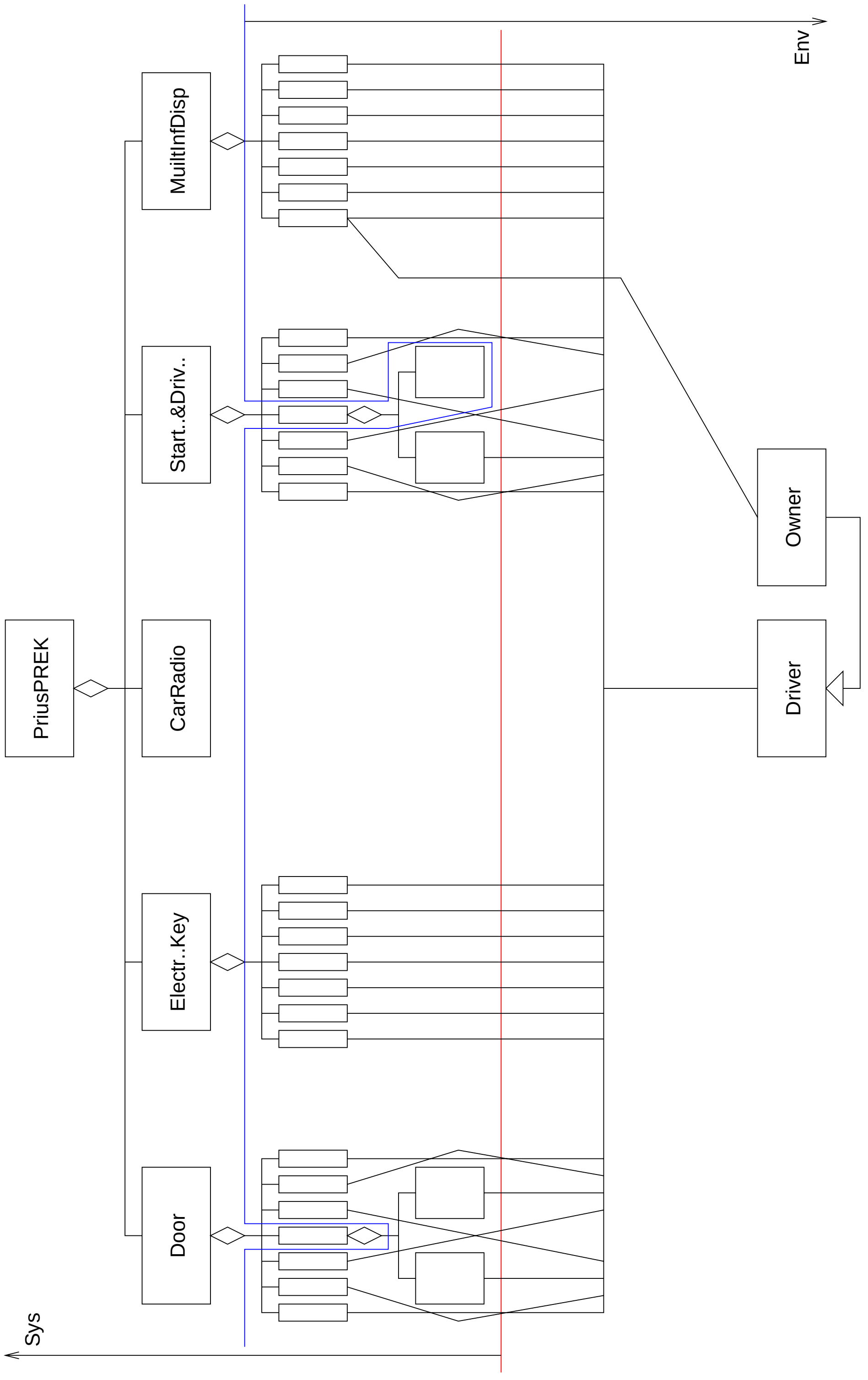
In the exam questions,
"CBS" means "computer-based system".
"SW" means "software".
"NFR" means "non-functional requirement", a.k.a. "quality attribute".
"RE" means "requirements engineering".
"SRS" means "software requirements specification, written according to some standard, e.g., IEEE".
"UM" means "user's manual".

Note the difference between a serif front like that used for *this* clause
and a sans serif font like that used for *this* clause.
A serif font is used for ordinary text in a question, and a sans serif font is used for text in a software or requirements specification artifact.

1. **[20 total marks]** Domain and Use Case Model of IEKS and Unknown Domains

   (a) Another possible backup for when the Prius's electronic key's battery is dead is that the hybrid system will start after it has heard the voice of an owner-registered driver saying "Prius, drive!"

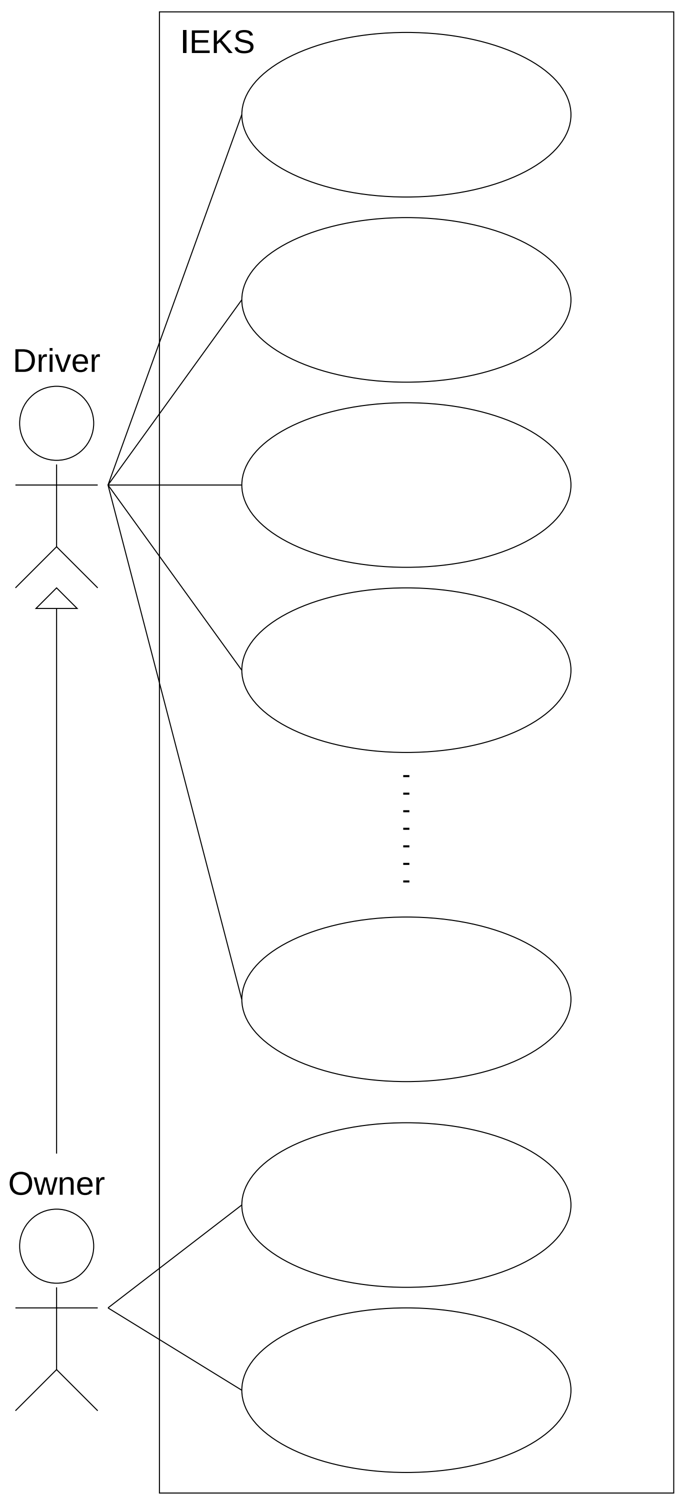
   Consider the two-part domain model (DM) posted as a solution to Deliverable 4:



```
E:Driver(∗)
E:Owner(1)
S:PriusPlusRemoteElectronicKey
        S:Door(5)
                SE:OutsideHandle(1)
                SE:LockSensorOnDriver'sDoorHandle(0,1)
                SE:OutsideMechanicalKeySlot(0,1)
                SE:InsideHandle(0,1)
                SE:InsideLock(0,1)
                S:InsideDoorLockSwitchPanel(0,1)
                        SE:WindowSwitch(4)
                        SE:Unlock/LockSwitch(1)
                SE:Buzzer(0,1)
        S:ElectronicKey(2)
                SE:KeyNumberPlate(0,1)
                SE:BatteryHolder(1)
                SE:MechanicalKey(1)
                SE:UnlockButton(1)
                SE:LockButton(1)
                SE:PanicButton(1)
                S:KeyRadio(1)
                S:NFCreceiver(1)
        S:CarRadio(1)
        S:StarterAndDriving(1)
                SE:BrakePedal(1)
                SE:AcceleratorPedal(1)
                SE:ParkingBrakePedal(1)
                SE:Transmission(1)
                SE:ParkButton(1)
                S:PowerSwitch(1)
                        S:NFCsender(1)
                        SE:Button(1)
        S:MultiInformationDisplay(1)
                SE:CombinationMeter(1)
                SE:AudioSystemScreenAndTouchSensor(1)
                SE:Camera(1)
                SE:Mic(1)
                SE:Speaker(1)
```

In (1) the diagram above, (2) the text above, or (3) both,
show the entities necessary to achieve the proposed backup
by (1) highlighting existing parts, (2) adding new parts, or (3) both.

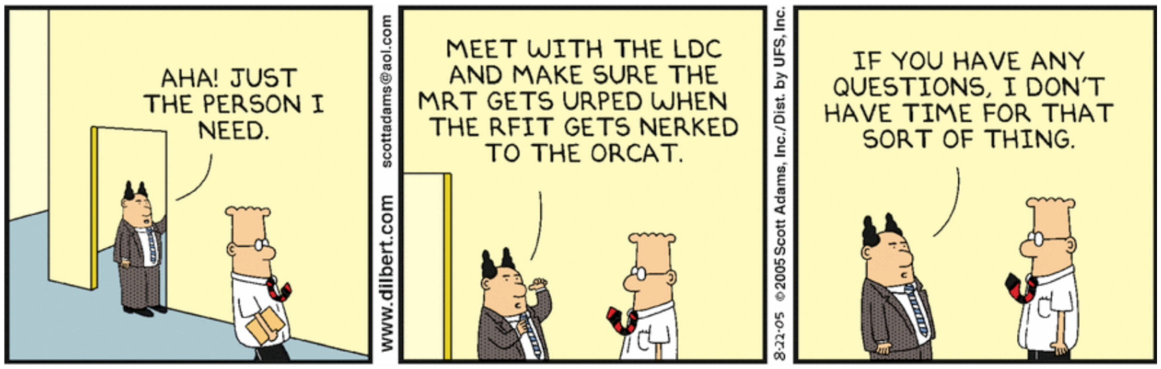
Consider the two-part use-case model (UCM) posted as a solution to Deliverable 4:



```
Use Cases

Actors: D=Driver, O=Owner
Process: p=Prius

Door.OutsideHandle.AttemptToOpen [D,p]
Door.OutsideHandle.Close [D,p]
Door.LockSensorOnDriver'sDoorHandle.TouchToLock [D,p]
Door.OutsideMechanicalKeySlot.InsertKey [D,p]
Door.OutsideMechanicalKeySlot.TurnKeyToUnlock [D,p]
Door.OutsideMechanicalKeySlot.TurnKeyToLock [D,p]
Door.OutsideMechanicalKeySlot.RemoveKey [D,p]
Door.InsideHandle.Open [D,p]
Door.InsideHandle.Close [D,p]
Door.InsideLock.Lock [D,p]
Door.InsideLock.Unlock [D,p]
Door.InsideDoorLockSwitchPanel.Unlock/LockSwitch.Lock [D,p]
Door.InsideDoorLockSwitchPanel.Unlock/LockSwitch.Unlock [D,p]

ElectronicKey.BatteryHolder.Open [D,p]
ElectronicKey.BatteryHolder.Remove [D,p]
ElectronicKey.BatteryHolder.Insert [D,p]
ElectronicKey.BatteryHolder.Close [D,p]
ElectronicKey.MechanicalKey.Withdraw [D,p]
ElectronicKey.MechanicalKey.Replace [D,p]
ElectronicKey.UnlockButton.PushToClick [D,p]
ElectronicKey.LockButton.PushToClick [D,p]

StarterAndDriving.BrakePedal.Push [D,p]
StarterAndDriving.BrakePedal.Unpush [D,p]
StarterAndDriving.AcceleratorPedal.Push [D,p]
StarterAndDriving.AcceleratorPedal.Unpush [D,p]
StarterAndDriving.ParkingBrakePedal.Push [D,p]
StarterAndDriving.ParkingBrakePedal.Unpush [D,p]
StarterAndDriving.Transmission.ShiftToD [D,p]
StarterAndDriving.Transmission.ShiftToR [D,p]
StarterAndDriving.Transmission.ShiftToN [D,p]
StarterAndDriving.Transmission.ShiftToB [D,p]
StarterAndDriving.PowerSwitch.Button.PushToClick [D,p]

MultiInformationDisplay.Mic.SpeakToCar [D,p]

MultiInformationDisplay.Camera.PutFaceInFrontOfCamera [D,p]
MultiInformationDisplay.Camera.PutOpenHandInFrontOfCamera [D,p]

MultiInformationDisplay.AudioSystemScreenAndTouchSensor.
         TypeCharacterOnVirtualKeyboardOnTouchScreen [D,p]
MultiInformationDisplay.AudioSystemScreenAndTouchSensor.
         SweepPatternAcrossTouchScreen [D,p]
MultiInformationDisplay.AudioSystemScreenAndTouchSensor.
         PutHandFlatOnTouchScreen [D,p]

MultiInformationDisplay.AudioSystemScreenAndTouchSensor.
         AuthorizeNewDriver(D) [O,p]
MultiInformationDisplay.AudioSystemScreenAndTouchSensor.
         DeauthorizeDriver(D) [O,p]
```

In (1) the diagram above, (2) the text above, or (3) both,
show the use cases necessary to achieve the proposed backup
by (1) highlighting existing parts, (2) adding new parts, or (3) both.

(b) Consider one of the strangest Dilbert cartoons:


AHA! JUST THE PERSON I NEED.
MEET WITH THE LDC AND MAKE SURE THE MRT GETS URPED WHEN THE RFIT GETS NERKED TO THE ORCAT.
IF YOU HAVE ANY QUESTIONS, I DON'T HAVE TIME FOR THAT SORT OF THING.
scottadams@aol.com
www.dilbert.com
8-22-05 © 2005 Scott Adams, Inc./Dist. by UFS, Inc.

We will assume that the LDC is the actor that does the NERKing and that the sole requirement is that

Whenever the RFIT gets NERKED to the ORCAT, the MRT gets URPED.

Fill in the details in the skeletal domain model (DM) on the next page to make a DM for the Dilbert cartoon. Your DM will have a class for each of

LDC,
MRT,
ORCAT, and
RFIT.

Give to each class its correct multiplicity, put the stereotype, <<actor>> in the correct class, and draw all needed links between the classes. Put the attributes

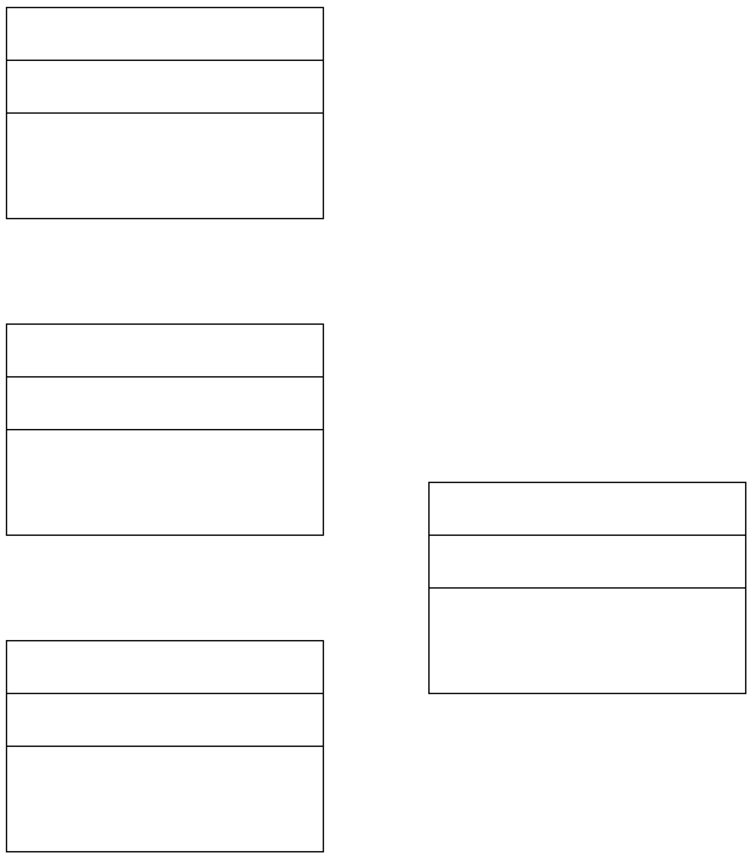
NERKED and
URPED

into the correct classes, and put the methods

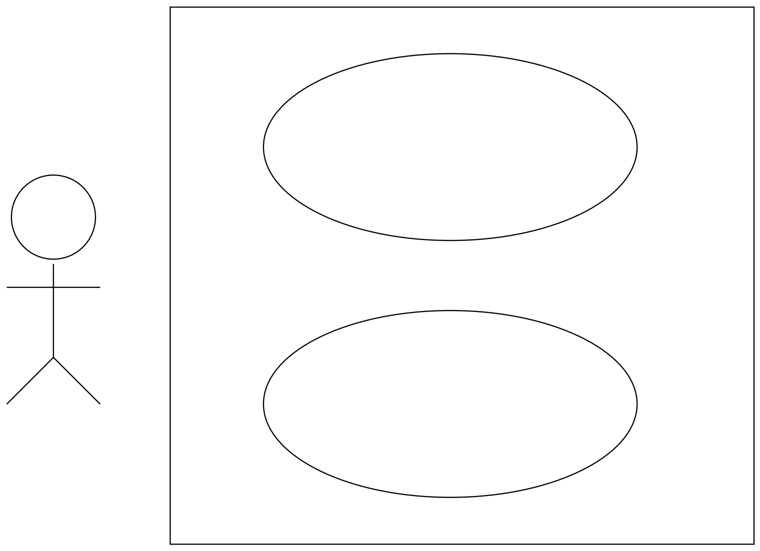
NERK and
URP

into the correct classes.

One of these methods needs to have a parameter, (P). Put this parameter with the correct method. A value of class ________________ is the argument for this parameter in the LDC's invocation of the NERK method. Your DM should make it clear how a value of this class can be an argument for this parameter, (P).



Fill in the details of the skeletal use-case model (UCM) below to make a UCM for the Dilbert cartoon. This diagram must show the actor, LDC, the two use cases that were exposed in the DM, and the correct links pointing to each use case.



2. **[20 total marks]** RE Reference Model, Verification & Validation, and Inspection

(a) Questions (a) and (b) are about $D, S \vdash R$:

For a universal statement such as

> $CRSIN$: Every resident, of some official kind, of Canada has his or her own unique Social Insurance Number (SIN).

to be part of S is considered dangerous because (complete the sentence with something that includes "$CRSIN$", "D", "S", and "R")

Therefore, S must not deal with only what happens when $CRSIN$ is true. S must deal with also (Complete the sentence.)

Thus, the programmer must consider as two separate cases (Complete the sentence, while indicating which case probably occurs more often at run time *and* which case probably requires more code.)

(b) A CBS C written in a programming language such as C is considered to be *formal*, because whether C satisfies S, i.e., whether $C \Rightarrow S$, is a question of mathematical logic, i.e., "Can it be proved as a theorem?"

On the other hand, an artifact, such as D, is considered to be *informal*, because whether D is true depends on understanding the real world, and such understandings are scientific questions, i.e., empirical.

Is R formal?

Why or why not?

A machine-learning-based artificial intelligence CBS M learns its behavior by being trained with data d describing the real-world situation about which it is supposed to be intelligent. Is M formal?

Why or why not?

A molecular program B consists of proteins whose shape and contents are designed so that when the proteins of the right shapes are fitted next to each other in the only way their shapes allow, the chemicals that trigger the desired chemical reaction are adjacent to each other. Is B formal?

Why or why not?

(c) Inspection of any document can be described as __________ for __________ in the inspected document. In this __________ process, the first part, the ____________________ step is done by the document __________ while the second part, the ____________________ step is done by the document's __________ as they try to __________ the __________ found in the inspected document.

(d) What data from various sources, reported also in the Iceberg slides, prove that validation is significantly harder to do than verification is, possibly even at least twice as hard?

(e) If a program gets the correct output in each of its 1,000,000 test cases that are designed to cover examples of every kind of input to the program, are we certain that the program is completely correct?

Why or why not?

Al Davis suggested a test for ambiguity that serves as the definition of ambiguity for many people:

> Imagine a sentence that is extracted from an SRS, given to ten people who are asked for an interpretation. If there is more than one interpretation, then that sentence is probably ambiguous.

If a sentence in an SRS *is* given to 10 people who agree on one interpretation, are we certain that the sentence is completely not ambiguous?

Why or why not?

Nevertheless, this definition is considered very good and is relied upon, especially for a sentence in an SRS

in a project with no more than ______________________________ in it.

(f) An active review to validate a set of scenarios is an inspection meeting attended by the scenarios' authors and the customers and users, in which the participants together exercise the scenarios with relevant sample data to see if the scenarios do with the data what the customers and users expect. An active review both

- suffers the main drawback of normal testing with a running program: (Explain the drawback.)

- and has an advantage over normal testing with a running program: (Explain the advantage.)

3. **[20 total marks]** Elicitation, User Interfaces, and User's Manuals

   (a) For Microsoft 365 (what used to be called "MS Office") for corporate buyers,
      i. who is the owner/client?

      ii. who is the customer?

      iii. who is the user?

   (b) For Microsoft 365 (what used to be called "MS Office") for individual buyers like you and me,
      i. who is the owner/client?

      ii. who is the customer?

      iii. who is the user?

   (c) For a program developed by you for only your own use,
      i. who is the owner/client?

      ii. who is the customer?

      iii. who is the user?

   (d) For a program developed by Boeing's software developers to help Boeing's engineers to build aircraft,
      i. who is the owner/client?

      ii. who is the customer?

      iii. who is the user?

   (e) Is there any source of information about a CBS that you intend to build that you should not use in requirements elicitation?

      Why or why not? (Explain the answer that you gave.)

(f) Assume that we are building a CBS C with heavy user interaction. That is,
Repeatedly, ad infinitum,

> the user inputs a command for C to execute a function,
> C does the function, and
> C reports the function's output back to the user.

i. What is the main reason, driven by the realities of the architecture of the implementation code that (1) the user interface of C must be specified in a requirements specification along with the functions and that (2) the user interface cannot be added to the implementation after the functions have been implemented?

ii. A failure to have this architecture from the beginning in an agile development of C leads to the necessity of major ______________ .

(g) In writing a user's manual or any SRS, it is often necessary to distinguish four different uses of a word, (1) for its meaning, (2) as the word itself, (3) as the name of a key on the keyboard, and (4) as a part of input or output. Consider the sentences containing 4 occurrences of the word "enter", typeset in one font, Times Roman, which is used for normal text that is read for its meaning:

> Here are four uses of the word enter:
> Please enter the enter key in order to see the text enter on the screen.

In the spread out copy of the same below, implement one way to distinguish these four uses of "enter". To indicate a font change for some word, please underline the word and write the name of the font above it. You may insert other characters and punctuation. You may even draw some shapes.

> Here are four uses of the word enter :
>
> Please enter the enter key in order to see the text enter on the screen .

(h) While code in a programming language is a very precise way to specify the behavior of software, it is very ______________ to ______________ when it is found to be wrong for any reason.

On the other hand, ideas in someone's mind about the behavior of software are very ______________ to ______________ when they are found to be wrong for any reason. However, it is ______________ for anyone to know for sure what the ideas ______________ .

The nice thing about an SRS or UM is that it both (1) is ______________ to ______________ than is program code when it is found to be wrong for any reason and (2) is ______________ than are ideas for anyone to know for sure what the SRS or UM ______________ .

4. **[15 total marks]** NFRs and Cost Estimation

   (a) When one implements a CBS C with requirements specification S, it is necessary to decide whether C satisfies S.

   Is this decision verification or validation?

   For the specification of a so-called functional requirement, e.g., (give an example)

   this decision is straight forward: you see if given the inputs in the CBS's domain, C delivers the output specified by S.

   (b) A major difficulty with any NFR N is deciding whether C with N as a specified requirement satisfies N. What are two problems with an NFR such as The CBS shall be user friendly.?

   -
   -

   (c) What are two problems with an NFR such as The CBS shall have a fast response time.?

   -
   -

   (d) Linguists consider a word like fast to be ______________, because, in any situation, it has no clear, natural, obvious ______________.

   (e) Mathematicians consider whether a CBS has a fast response time to be (1) not Boolean, with answers true or false and nothing in between, but to be (2) ______________, with answers having all values ranging from ______________ to ______________.

(f) List three different sources of error in predicting the eventual cost of building a CBS.

•

•

•

(g) What are the three biggest influences on the cost of developing a CBS?

•

•

•

(h) Function Point Analysis shows how to estimate the number of ______________ for a CBS from essentially the CBS's use cases, and then to estimate the CBS's code ________ from these same ______________ .

(i) COCOMO shows how to estimate for a CBS, both its

1. project ________ in person months, and

2. project ________ in months

from the CBS's estimated code ________ obtained from a Function Point Analysis of the CBS.

(j) **If** each person added to a CBS development project team adds 8 hours of productive work to the total work that the team can do, and
if each person added to the same team costs 1 hour of communication overhead with each other person in the group, and
each hour of communication overhead reduces the total productive work that the team can do by one hour,

then at what team size, *before* the addition, does adding one more person to the team reduce the total productive work of the team to less than it was before the addition? (**answer here**)

Hence, Fred Brooks said, "Adding more people to a late project makes it even ________".

5. **[20 total marks]** Ambiguity

In the text examples that are in the sans serif typeface (font), please ignore changes from upper to lower and from lower to upper case, as you move, remove, or insert text.

(a) Suppose

> [A:] Suppose I have only one e-key, this e-key is *the* e-key for my Prius, no one else has an e-key for my Prius, I have only one Prius, and everything that is specified in the original Prius user's manual about a Prius e-key is true.

No additional method to operate the Prius in the event of a dead e-key battery exists yet.

In the sentence S,

> My e-key operates my Prius.,

X operates Y means having, showing, or entering X inside Y allows the driver to start the hybrid system of Y. Consider the 5 variations of S obtained by distributing only to different places in S. Put a checkmark in the underscore next to each variant of S that is true given A.

_______ 1. Only my e-key operates my Prius.

_______ 2. My only e-key operates my Prius.

_______ 3. My e-key only operates my Prius.

_______ 4. My e-key operates only my Prius.

_______ 5. My e-key operates my only Prius.

Make a single sentence that is true given A, with as many onlys as possible, by crossing off in this not true sentence as few onlys as possible:

> Only my only e-key only operates only my only Prius.

(b) I want to say that

> [B:] Each of three *additional* methods,
> i. my finger prints,
> ii. my PIN, and
> iii. a cellphone loaded with an app that imitates my e-key,
> operates my Prius.

in the following three sentences that have a number of positions marked with underscores. Put also only in each underscore that is required so that Sentences 6, 7, and 8 convey what I say with A and B.

6. _______ My _______ finger prints _______ operate _______ my _______ Prius.

7. _______ My _______ PIN _______ operates _______ my _______ Prius.

8. _______ A cellphone loaded with an app that imitates _______ my _______ e-key _______ operates _______ my _______ Prius.

(c) Given A *and* B, which of sentences 1 through 5 are still true?

(d) I have arranged in *addition* to A and B that

[C:] The finger prints of one friend, Joe, operates my Prius.

Sentence 9 has a number of positions marked with underscores. Put also only in each underscore that is required so that Sentence 9 conveys what I say with C.

9. _______ Joe's _______ finger prints _______ operate _______ my _______ Prius.

(e) Assuming A, B, and C, put a checkmark in the underscore next to each sentence that can be true.

_______ 10. Only my e-key operates my Prius.

_______ 11. Only an e-key operates my Prius.

(f) Correct each of the following incorrect sentences to what it should mean by showing with a checkmark the position to which the sentence's only only must be moved. Do not consider moving it to any position not marked by an underline. If the only must not be moved, then underline *it*. If it helps you to understand what you are doing, you may, but are not required to, cross out any only that you move.

12. Only pay for _______ what _______ you _______ need. (Pay for no more insurance coverage than you need.)

13. _______ A paper's _______ abstract only summarizes _______ the _______ paper.

14. _______ I only smoke _______ Winstons.

15. _______ Of the two versions, _______ please _______ read only the _______ second in full detail.

16. _______ I only eat _______ vegetables.

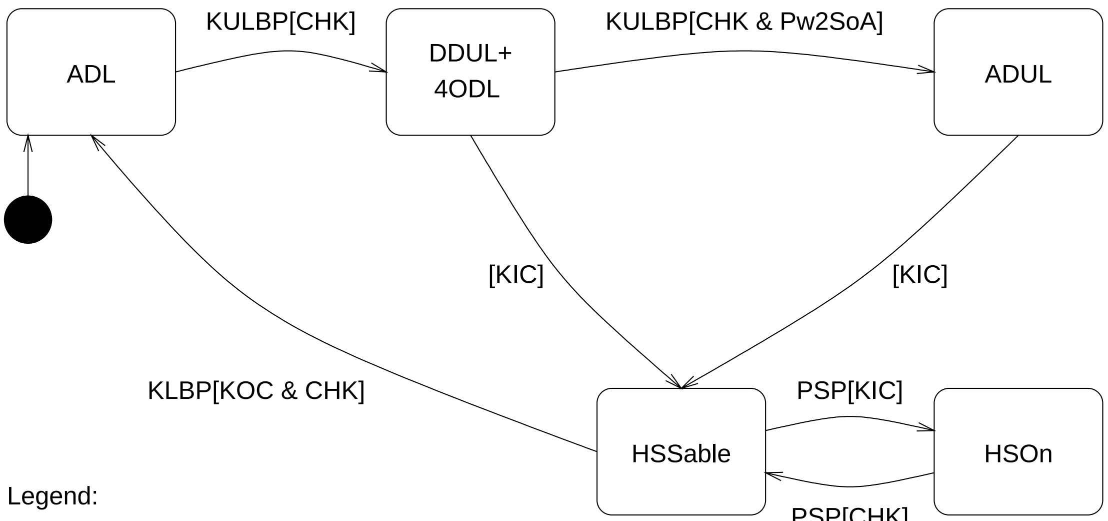
17. _______ A hamburger _______ should only be _______ eaten _______ after cooking _______ it.

(g) What was the empirical test that most English speakers routinely put an only incorrectly before the main verb of its sentence rather than correctly before the word limited by the only?

(h) What should a developer do if he or she finds an ambiguous statement in the specification that he or she is implementing?

6. **[20 total marks]** State Machines and Linear Temporal Logic

   (a) Please modify the state machine SM below, which was given as part of the IEKS vision document



Legend:
ADL: all doors locked
DDUL+4ODL: driver door unlocked and 4 other doors locked
ADUL: all doors unlocked
HSSable: hybrid system startable
HSOn: hybrid system on

KULBP: key's unlock button pushed
KLBP: key's lock button pushed
PSP: power switch pushed

CHK: car hears key
Pw2SoA: pushed within 2 seconds of another
KIC: key in cabin
KOC: key outside cabin

to reflect the following events:

i. the use of a manual key to unlock the driver door,
ii. the use of an interior unlock-doors button to unlock all doors, and
iii. the use of two backup methods for the e-key's battery being dead in order to to get into a state in which the hybrid system is startable.

You must correctly insert transitions whose events are
TMK (Turn Manual Key),
PIUDB (Push Interior Unlock-Doors Button),
BUP1 (Backup Method 1), and
BUP2 (Backup Method 2).
There may be more than one transition for any of these events.

   (b) In the above, each backup method is treated as a simple transition. To fully reflect the behavior of a backup method, each such simple transition should be replaced by (Complete the sentence.)

(c) Remember that
$\Box$ means “henceforth”,
$\Diamond$ means “eventually”,
$\bigcirc$ means “in the next state”,
$\mathcal{U}$ means “until”, and
$\mathcal{W}$ means “unless”.

Give a Linear Temporal Logic specification of the *original*, not the modified, state machine SM.

(d) For each of the linear temporal logic formulae below, in the underscore before the formula, write "T" if the formula is true and write "F" if the formula is false. Each incorrect answer is worth the negative of one half the marks that a correct answer is worth; i.e., it's not worth guessing. Nevertheless, you cannot get less than zero in total for the temporal logic formulae.

_______ 1. $(A) \Rightarrow (\Diamond A)$

_______ 2. $(\Diamond A) \Rightarrow (A)$

_______ 3. $(A) \Rightarrow (\Box A)$

_______ 4. $(\Box A) \Rightarrow (A)$

_______ 5. $(A) \Rightarrow (\bigcirc A)$

_______ 6. $(\bigcirc A) \Rightarrow (A)$

_______ 7. $(\Box A) \Rightarrow (\bigcirc A)$

_______ 8. $(\bigcirc A) \Rightarrow (\Box A)$

_______ 9. $(\Diamond A) \Rightarrow (\bigcirc A)$

_______ 10. $(\bigcirc A) \Rightarrow (\Diamond A)$

_______ 11. $(\Diamond A) \Rightarrow (\Box A)$

_______ 12. $(\Box A) \Rightarrow (\Diamond A)$

_______ 13. $(\Box \Diamond A) \Rightarrow (\Diamond \Box A)$

_______ 14. $(\Diamond \Box A) \Rightarrow (\Box \Diamond A)$

_______ 15. $(A \, \mathcal{U} \, B) \Rightarrow (\Diamond B)$

_______ 16. $(\Diamond B) \Rightarrow (A \, \mathcal{U} \, B)$

_______ 17. $(\Diamond A) \Rightarrow ((A) \vee (\bigcirc \Diamond A))$

_______ 18. $((A) \vee (\bigcirc \Diamond A)) \Rightarrow (\Diamond A)$

7. **[30 total marks]** Requirements Determination is Unstoppable and the Requirements Iceberg

   (a) In the lifecycle for the development of a CBS C, what are the most fundamental, simplest reasons that requirements determination continues through to the end of the writing of the code for C if the specification S for C is not complete?

   (b) In the famous quotation by Michael Jackson,

   RE is where the informal meets the formal.,

   what are the informal?

   and what are the formal?

   (c) Recall the distinction between *scope determining* and *scope determined* requirements. Given two examples of each in the IEKS (your project).

   scope determining

   -
   -

   scope determined

   -
   -

(d) Consider a software development organization that is developing for an external customer, a CBS C in a domain in which the organization has worked before. Often, in such an organization, the manager of the development team that is assigned to build C tells the rest of the team, besides him, to begin programming, based on what they already understand of C's domain. In the meantime, the manager begins to talk with the customer to determine the requirements. The plan is that when the requirements specification is complete, the team will modify what they have written according to the just completed requirements specification. The idea, subscribed to by everyone on the team, is that by starting to write the code based on what they already know, they will get a head start with whatever percentage P of the code that does not have to be changed.

Why is this head start a poor bet? (Use P in your answer.)

What is a better use of the rest of the team that was put to work writing the code?

What evidence does the Martin & Tsai failed study using a SRS for a centralized railroad traffic controller offer that using the rest of the team this way is a benefit? (Your answer must describe the benefit.)

(e) One bit of advice is to

Discover and specify *all* requirements for a CBS *before* beginning to implement the CBS.

Why is doing so impossible?

Why is doing so necessary?

So, what is a solution? (stated in terms of scope determining and scope determined requirements)

(f) In what ways is each of the following software?

(1) a complete natural language (NL) requirements specification (RS), S, either a UM or an SRS, and

(2) a C program P that correctly implements S.

In what ways are the so-called computers that execute S and P different?

(g) The original requirements for the ARPAnet, which later became the Internet, according to Berry, Cerf, Leiner, or Kleinrock were that it be (Complete the sentence.)

Does the Internet satisfy these original requirements?

In the early 1990s, because of the wild success of the Internet in the non-profiting academic and research world, there was a lot of pressure on the Internet leadership to allow the Internet to be available for the profiting commercial world. The .com domain was created, and oy! The rest is history!
Explain how the Internet is a classic E-type system as described by Meir Lehman.

What happened to the Internet as it went commercial is a classic case of what often happens with a requirements-exploring prototype when the prototype developer is asked to make a production version of the prototyped CBS. Explain what often happens in this case.

Explain what *should* happen in this case.

What does Berry say needs to be done to fix the Internet so that it can be secure?

What does Kleinrock say needs to be done to save the Internet from the dark side that emerged with ferocity?

8. **[5 total marks]** Graduate Student Lectures

   (a) Henry Pabst described his experience at a 4-month internship at Really Big Retailer (RBR) in the summer of 2019.

   RBR's payment processor has about 80 API keys that rotate monthly, the rotation being a lengthy manual process.

   His job was to integrate a new API that reduces the number of keys to manage, which in turn would make the monthly rotation go faster.

   He had complete autonomy and was to do the entire project from requirements to deployment by himself.

   What was one particular major mistake that Henry said that he made during requirements elicitation?

   What was a particularly bad result of this mistake?

   What were three other mistakes in Henry's elicitation process?

   Henry planned to learn the existing system and gather requirements at the end of one month, then to deliver at the end of three months a running implementation, and finally to do a small follow-up project in the remaining month. In fact, he was still learning the existing system and gathering requirements by the end of the 4 months.

   In retrospect, was it realistic to expect that he would finish deployment by the end of the 4-month internship?

   What would have been a more reasonable deliverable for his 4-month internship?

(b) RongHao Yang described two different internships,

- one in the research division of an established, hierarchically organized, mutli-national corporation, I-company, whose flagship product is a database with lots of loyal customers around the world, and
- the other in the engineering group of a new, flatly organized, small startup, W-company.

RongHao's project in I-company was to help develop an AI-based SQL optimizing tool for its flagship database, hereinafter called IDB.

RongHao's project in W-company was to help develop tools for to allow merchants to work with product images, including to search for similar products offered by competitors.

What were the advantages for RongHao of working at I-company as a big corporation?

What were the advantages for RongHao of working at W-company as a startup?

1(to allow referring to this question below) Why did I-company want to build a tool to optimize its IDB?

RongHao observed correctly that the AI aspect of his project was technically unnecessary. Why?

2 Why did I-company want to make its SQL-optimizing tool based on AI?

What is a possible reason that I-company was keeping secret from the public that it was building this AI-based SQL-optimizing tool?

So the tool that RongHao worked on at I-company had two main requirements:

i. it optimizes SQL queries on IDB, and
ii. it uses deep AI to do this optimization.

Based on **1** and **2** above, what kind of requirement is each?

i.

ii.

As a refinement of this "kind" classification, Requirement (ii) is a ______________ability requirement.