DIT047 Requirements Engineering
Final Exam

March 18, 2025

Examiner/Contact Person

Jennifer Horkoff
Jennifer will come to the room to check for questions roughly every hour starting at 9:30.
Alternatively Phone: 0733 050517 (call again if no answer, I am in another exam room)

Authorized Aids

Writing instruments (pens, pencils), English Dictionary. No textbook or notes.

Grading Scale for Exams

% Grade	Final Grade
0-49	Fail (U)
50-64	3
65-79	4
80-100	5

PLEASE OBSERVE THE FOLLOWING:

- All answers must be in English. Answers must be legible and readable.

- Sort the questions in order before handing them in.

- Put the number of the question on every page.

- This exam has 14 pages.

Part 1: Multiple item and Short-Answer Questions

Question 1: Multiple Choice Questions (14 points)

On your paper, write the name of the question, then the letter(s) of your chosen answer(s), e.g., 1.1: c., 1.3: a, d, e. For each question, there may be more than one correct answer. For full marks, list all the correct answers. Each correct answer listed is +1 point, each incorrect answer is -1 point.

1. Which of these requirements captures design information and is therefore not well-formed? Note that these are intended to be requirements from users, not constraints on the design. The requirements are about an application for playing and managing music. In this question there may be more than one correct answer, list them all.

   (a) The system shall permit the user to create playlists of songs.

   (b) Different instances of the application accessing the file database will use a model-view-controller pattern.

   (c) Song playlists must be stored in M3U format.

   (d) If the user selects a song and the associated song file is not found, they system shall display the warning "File no longer available" in a pop-up window with options "Find new file" and "Cancel".

   (e) The system shall allow users to update cover art for songs and albums.

   (f) The system shall allow users to delete data they have entered.

   Answer: b, c, d

2. Which of the following statements about the models/diagrams we have covered in the course are true? There may be more than one correct answer.

   (a) Goal models are used to understand actors and dependencies

   (b) Use case models are used to understand entities and inputs and outputs

   (c) Use case models are used to explore scenarios

   (d) Context diagrams are used to understand entities and inputs and outputs

   (e) Context diagrams are used to understand actors and their involvement in high-level uses of the system

   (f) Customer journey maps are used to explore scenarios

   Answer: a, d, f

3. Which of the following statements about different requirements representations is correct? One or more may be correct.

   (a) Rupp's template is a template that contains items like priority, dependencies, conflicts and history

   (b) The Volere template contains items like priority, dependencies, conflicts and history

   (c) The EARS approach contains structured text that allows one to write requirements using patterns like ubiquitous, event-driven, and state-driven

   (d) Rupp's template is structured text that allows one to write requirements using patterns like ubiquitous, event-driven, and state-driven

   (e) Planguage allows you to capture requirements information using many structured keywords like Gist, plan, meter, wish, past, trend, and stakeholder

(f) Rupp's template contains patterns for writing requirements covering independent system activities, user interactions, and interface requirements

(g) The EARS approach contains patterns for writing requirements covering independent system activities, user interactions, and interface requirements

(h) The Volere template allows you to capture requirements information using many structured keywords like Gist, plan, meter, wish, past, trend, and stakeholder

Answer: b, c, e, f

4. Which of the following statements about the goal model excerpt shown below are true? There may be more than one correct answer.
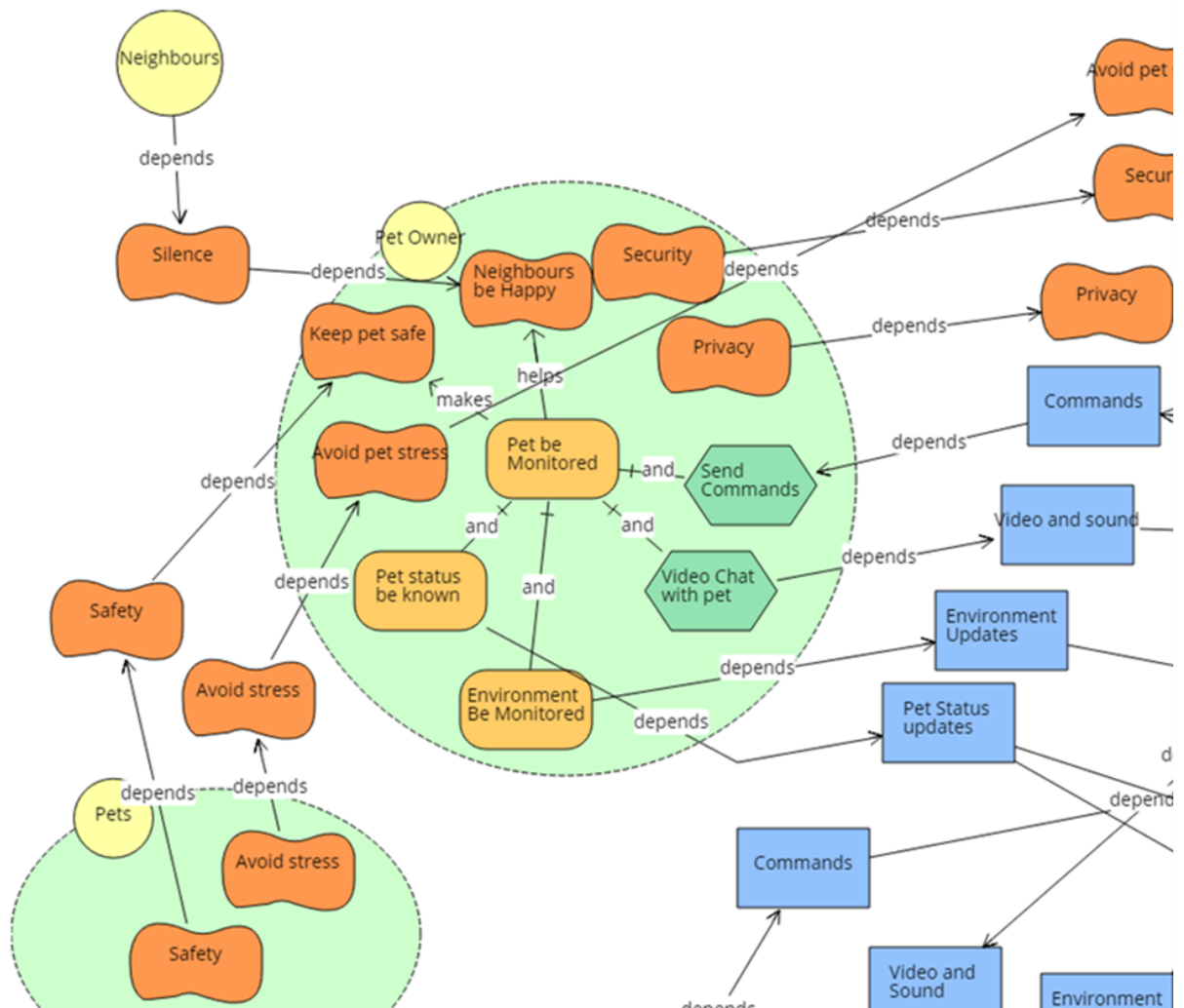
(a) The Pet Owner depends on Pets for Silence.

(b) The Pet depends on the Pet Owner to Avoid stress.

(c) Pets want to achieve two qualities.

(d) Pets want Privacy.

(e) If pets are monitored, then they are safe.

(f) The Pet Owner can monitor the pet without being able to Video Chat with the Pet

(g) The Pet Owner cannot monitor the pet without being able to Video Chat with the Pet

(h) The Pet Owner depends on another actor to Send Commands.

Answer: b, c, e, g

Question 2: Short-Answer Questions (16 points)

1. List two requirements elicitation techniques. List one advantage and disadvantage of each. (4 marks)

   Answer: See the lecture on elicitation, there are many listed, and each has advantages and disadvantages.

2. Describe two different requirements quality trade-offs and explain or give an example of why these qualities can sometimes involve a trade-off. Each trade-off should involve two qualities. One of the qualities in your two described trade-offs can overlap. (4 points)

   Answer:

   I list four example trade-offs with examples, you only need two. The list is not complete.

   Security vs. Usability One can have a security requirement like secure password which creates usability issues when users have to pick a very long or complicated password.

   Security vs. Performance The means to make a system secure, like encryption, or multi-factor authentication, may cause the system run slower or take more time to do tasks.

   Privacy vs. Safety Storing personal information may help to keep users safe in case of an emergency, but it can also violate privacy if this information is stored or shared without permission to the wrong parties.

   Privacy vs. Usability Questions about storing data, e.g., cookies or licenses are necessary for proper privacy policies, but negatively impact the usability of apps or websites.

   Safety vs. Usability Various checks and stops to ensure safe actions are taken with a system (e.g., air traffic control, medical devices) could make the system harder to use.

3. Name two types of requirements traceability and explain what they are. (4 points)

   Answer:

   The lecture had 6 types, any two describe correctly is fine

   Pre-RS traceability, which is concerned with those aspects of a requirement's life prior to its inclusion in the RS (requirement production).

   Post-RS traceability, which is concerned with those aspects of a requirement's life that result from its inclusion in the RS (requirement deployment).

   Backward traceability or Backward-from traceability: Links requirements to their sources which are in e.g. other documents.

   Forward or Forward-from traceability: Links requirements to the design and implementation components.

   Backward-to traceability: Links design and implementation components back to the requirements.

   Forward-to traceability: Links other documents to relevant requirements, e.g., operation manuals describing the system functionality.

4. In the guest lectures you saw various examples of how different types of AI could be used to improves activities in requirements engineering. Give two examples of how AI can be used to help requirements engineering activities. Be as specific as possible. Describe one benefit and one drawback or either or both of these examples. (4 points)

   Answer: From Farnaz's lecture:

   AI can help in requirements elicitation by analyzing stakeholder documentation to extract requirements or helpful information, or analyzing interview or survey text.

   AI can help in requirements analysis by detecting ambiguous or inconsistent requirements.

AI can help with requirements priortization by using data from past projects to estimate priorities of requirements.

AI can help with requirements traceability by automatically finding trace links from or to or between requirements.

AI help help in change management by predicting evolving or changing requirements, or finding what requirements or code or tests are affected by changing requirements.

AI can help in regulatory compliance by seeing which requirements must be added, removed or changed when a regulation changes.

Benefits:

usually faster, reduces human effort

sometimes the AI will find interesting outputs that humans will miss

output could be more complete

make requirements engineers more competitive in industry, easier to get jobs

makes good people even better

Drawbacks:

AI can hallucinate

Some parts of the output will not be good, will have to be rejected or changed

AI is expensive, has environmental costs

A lot of AI, e.g., chatGPT, breaks privacy laws by sharing data with model owners

AI can be hard to set up, depending on the type

Gen AI requires careful prompt design, the output changes a lot depending on the prompts

If we use AI too much, human skill can be lost

Part 2: Domain Example and Long-Answer Questions

The remaining questions on the exam will relate to a problem in a domain, as described below. The scenario describes the situation today and the expectations for the new system. Focus your analysis and modeling on the envisioned (to be) system, but keep in mind the problems and requests with the as is situation, trying to avoid problems and satisfy user needs.

Campus Safety

The Current Situation: A large university campus has many thousands of students, buildings, and open spaces. Often students are on campus late at night or early in the morning, either for late or early classes, or to study or use other facilities. There are safety concerns with students walking, possibly alone, late at night or early in the morning.

To help with safety, students have created a Safe Walk program, where students can ask for someone to walk them from building to building, to their car in a university or nearby parking lot, or to public transit. The service is offered from 19:00 to 7:00 by a group of students (helpers). Right now, a student who wants someone to walk with them calls a number and tells the person on the phone where they are leaving from, when they are leaving, and where they are going. Currently, there can be a wait, so the helper answering the phone will tell the student roughly when someone will be there. Wait times can sometimes be up to 30 minutes. Sometimes the student who needs help waits, but other times they give up and go alone. Sometimes the student will call back to say they are leaving alone, and other times they leave without calling.

To make the service work, there are 2-6 helpers working every night. Each night, one helper is given the role of communicator, and uses a university mobile phone to answer calls. The helpers coordinate with each other via a group chat, e.g., who is available, where are you, how soon can you be in this location? This is used by the communicator to estimate the arrival time when someone calls. This means that helpers, in addition to walking people, need to spend a lot of time on their phones in to group chats, which could increase danger when walking at night. For their own safety, helpers only ever go out in groups of two.

As the university provides space, permission, and some compensation to the helpers, they want statistics how much much the service is used, waiting times, and other relevant measures. Right now, notes are made at the end of the night about activities, and one of the helpers takes on the role of reporter to summarize the notes into reports twice year.

Vision (system to be): You will write requirements for a new app to help students wanting help and helpers. The system should allow students to sign up to use the app. The app should be able to confirm if the students are registered students or not, but full student information should not be available to the helpers, only the first name and details about their request. Students should be able to ask for someone to walk with them, give a location, desired time, and destination, and get a response with an estimated arrival time within one minute. The assignments of helpers to students are made automatically by the system. The student can then indicate that they will wait or cancel the request. Groups of two helpers are assigned walking requests and given the request information. There should be a way for helpers to contact the student through the app with short messages, e.g., to say they are running late or are not able to find the student. There should also be a way for the student wanting help to call a helper (communicator) to ask questions if something is not working.

For safety and planning, the helpers should have their current location tracked, but viewable only by other helpers. Information on the students requesting help, including their location and usage patterns should be confidential, and only provided to the university in an anonymous, summarized form. It should not be possible to track the habits of individual students who are not helpers through the app. The app should help the helper who is acting as a reporter produce reports on relevant statistics for the university. All privacy laws, like GDPR should be followed. We can assume that all students have a mobile phone newer than 5 years old and have access to the internet. The system should be ready to use by 2026.

Question 3: Context Diagram (10 points)

For the given case, draw a context diagram. Add the system actor, identify the relevant stake-holder/actor entities, and the relationships between the system and these entities, labelled with high-level inputs and outputs. Try to capture four actors (the system actor counts), and appropriate relationships. Supplement the diagram with text to explain any ambiguous or unclear parts of the model.
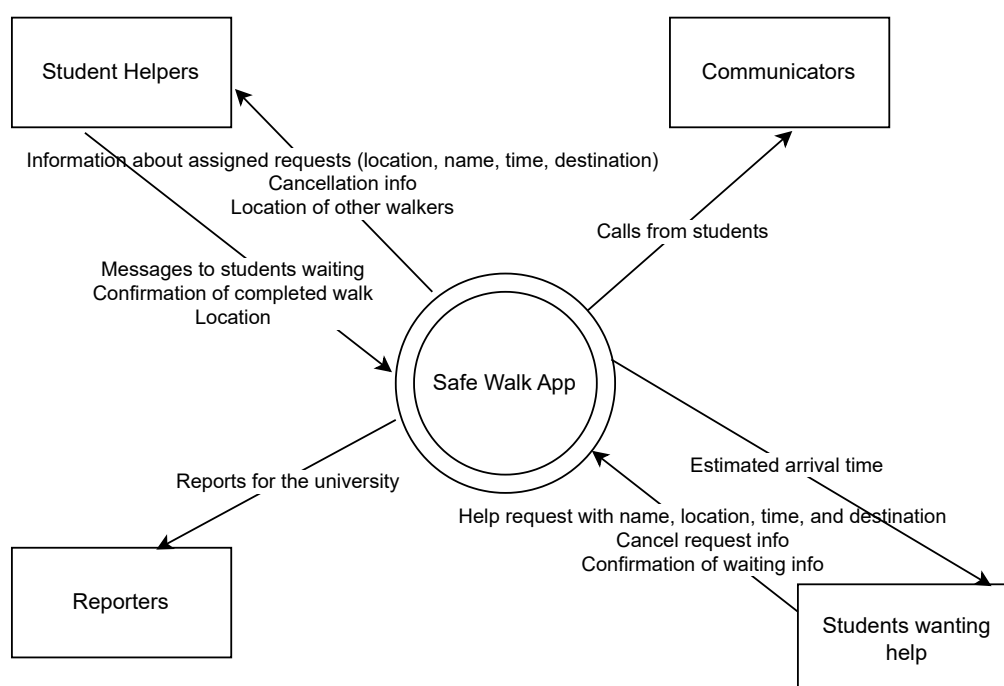
Sample Answer:

Grading

4 marks for actors

6 marks for at least 6 correct relationships

A sample answer, many are possible:

Question 4: Use Case Diagram (10 points)

For the given case case, draw a use case diagram. Capture the system and other relevant stakeholders. Identify the major use cases and relationships, both between the stakeholders and the use cases, and between use cases. Try to capture three actors, and appropriate use cases. Try to use at least one example each of extends and includes in the model.
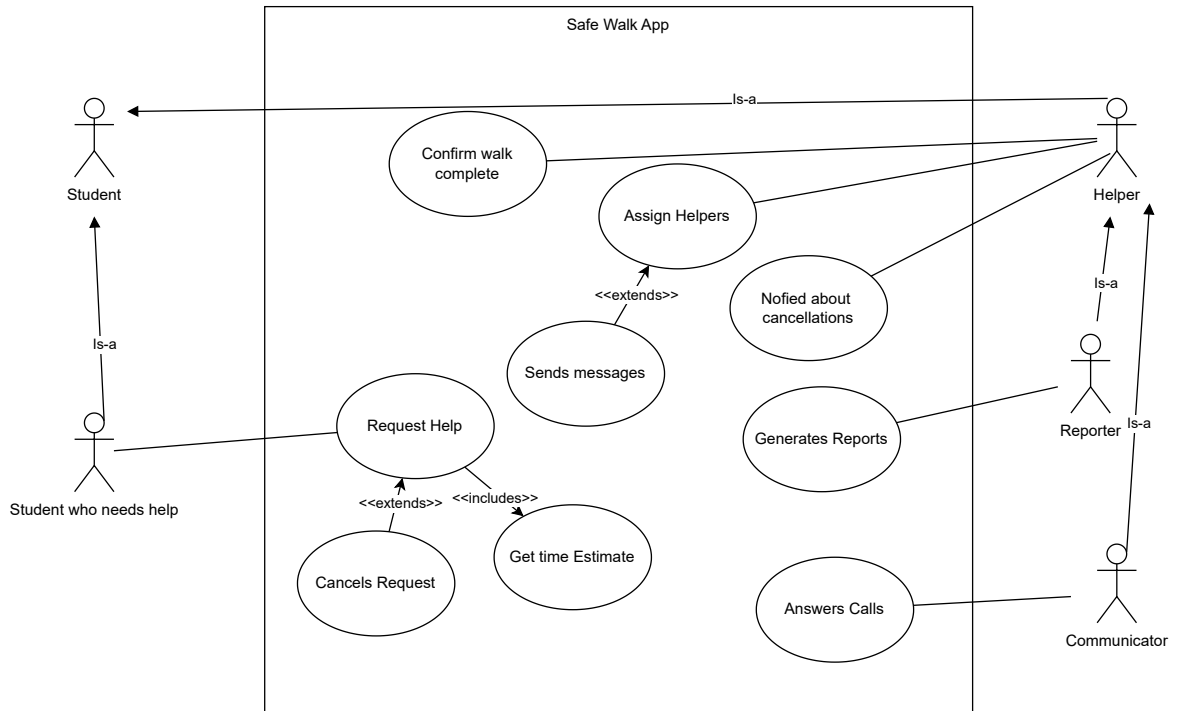
Answer:

System boundary and name: 1 point

Actors: 3 points

Use cases: at least 5 with correct associations

Extends/includes: 1 point

Question 5: Scenario (10 points)

Pick one use case (if you have not created a use case, create one now). For this use case, fill out Cockburn's Use Case template (obligatory template elements listed below). Flesh out the details of the process, including exception cases and error cases. Pick a use case with at least one extension and sub-variation.

Cockburn's Use Case Template (reduced)
  Use Case:⟨ the name should be the goal as a short active verb phrase ⟩

CHARACTERISTIC INFORMATION
  Goal in Context: ⟨a longer statement of the goal, if needed⟩
  Scope: ⟨what system is being considered black-box under design⟩
  Preconditions: ⟨what we expect is already the state of the world⟩
  Success End Condition: ⟨the state of the world upon successful completion⟩
  Failed End Condition: ⟨the state of the world if goal abandoned⟩
  Primary Actor: ⟨a role name for the primary actor, or description⟩
  Trigger: ⟨the action upon the system that starts the use case, may be time event⟩

MAIN SUCCESS SCENARIO
  ⟨put here the steps of the scenario from trigger to goal delivery, and any cleanup after⟩
  ⟨step #⟩ ⟨action description⟩

EXTENSIONS
  ⟨put here the extensions, one at a time, each referring to the step of the main scenario⟩
  ⟨step altered⟩ ⟨condition⟩ : ⟨action or sub.use case⟩
  ⟨step altered⟩ ⟨condition⟩ : ⟨action or sub.use case⟩

SUB-VARIATIONS
⟨put here the sub-variations that will cause eventual bifurcation in the scenario⟩
⟨step or variation # ⟩ ⟨list of sub-variations⟩
⟨step or variation # ⟩ ⟨list of sub-variations⟩

Answer:
Generally, 3 points total for characteristic information,
3 points for main scenario,
2 for extensions,
2 for sub-variations.
We can take off other marks for more general mistakes, with explanation.

Example 1:
Cockburn's Use Case Template (reduced)
Use Case: Request Help
CHARACTERISTIC INFORMATION
Goal in Context: a student wants someone to walk with them at night for safety
Scope: The safe walk system
Preconditions: student has an account in the system, student is logged in, student is confirmed to be a student
Success End Condition: Student gets to their destination with a helper walking with them
Failed End Condition: Student does not get to their destination, student goes to their destination alone
Primary Actor: student
Trigger: none

MAIN SUCCESS SCENARIO
1. Student opens the app
2. Student starts making a request
3. Student enters their location
4. Student enters their destination
5. Student enters their desired time to depart
6. Student gets back a confirmation with a waiting time
EXTENSIONS
3. Student does not know their location, has to open a map
5. Student does not have a specific time in mind, leaves this blank.
5. Student indicates as soon as possible
6. Student does not get a confirmation, calls through the app to make the request instead

SUB-VARIATIONS
1. The app does not open
6. No helpers are available
6. Student does not get a confirmation, gives up
6. The wait time is too long, the student cancels the request

Example 2: Cockburn's Use Case Template (reduced)
Use Case: Assign Helpers
CHARACTERISTIC INFORMATION
Goal in Context: a student wants someone to walk with them at night for safety and two helpers are assigned to task
Scope: The safe walk system
Preconditions: helper has an account in the system, is logged in, is confirmed to be a student
Success End Condition: Student gets to their destination with a helper walking with them

Failed End Condition: Student does not get to their destination, student goes to their destination alone

Primary Actor: helper

Trigger: none

MAIN SUCCESS SCENARIO

1. Helper opens the app

2. Helper gets assignment to go with other helper to find student with location, time, name and destination

3. Helpers find the student at their location

4. Helpers take the student to their destination

5. Helpers indicate in the app that the help has been given

EXTENSIONS

2. The assignment is in the future, the helper waits.

3. Helpers cannot find student, sends message through the app to get their location

SUB-VARIATIONS

1. The app does not open

2. Helpers get notification that request is cancelled

3. Helpers cannot find student, they do not answer message, give up

4. Helpers and student cannot find their destination, e.g., the car or bus, helpers give up.

5. Helpers forget to indicate that the help has been given

Question 6: Textual Requirements (20 points)

Write SRS requirements and user stories for the case provided. List four functional requirements in SRS form, two non-functional requirements in SRS form, two domain assumptions, and two constraints. In addition, list five user stories, each with acceptance criteria. The user stories should be unique, i.e. not a repeat of one of the SRS requirements. Remember the desired characteristics of user stories and SRS requirements when writing your requirements.

Sample Answers:

Functional Requirements 1. The system shall allow students to request walking help in the app.

1.1. Walking help request should contain the location, destination, and time.

1.2 When requesting help walking, students should get an estimation of the arrival time of the helpers.

1.3 Students should be able to cancel their requests for help.

2. The system shall notify helpers when they have been assigned to a walking help request.

2.1 The notification shall include the location, student name, destination, and time.

Non-functional Requirements

3. The system shall provide students with an estimation of the helpers arrival to their request within one minute.

4. The system should keep student information anonymous when providing reports, no names or other identifying student information should be included.

Domain Assumptions

5. We assume that students have access to a mobile phone that is no older than 5 years.

6. We assume students have access to the internet on their mobile phone.

7. We assume that students all have a common language and can communicate with each other.

8. We assume students and helpers have sufficient phone battery to use the app.

Constraints

9. The system shall follow all GDPR rules.

10. The system shall be available in 2026.

User Stories

11. As a helper, I want to be able to contact students requesting help through the app, so that I can give them updates on my location.

Acceptance criteria:

All current requests assigned to a helper have the option to send the student a message

The message can be up to 200 characters long

The message should be sent to the student within 3 seconds

Incoming messages should be shown to the students in the app in some way

12. As a student, I want to be able to call a helper, so that I can get help if I'm not getting a response from the app, or can't figure out how to use the app.

Acceptance criteria:

There should be an option to call a helper available through a help option

This help option should be visible on every page of the app

The help option should make it clear that the student is calling a real person helper

Students should be able to call again if the call is not answered or dropped.

13. As a reporter, I want to generate reports with the app of past usage, for the university to justify the service.

Acceptance criteria:

Reports should contain the date range

Reports should contain the number of help requests made and satisfied

reports should contain the average, min, and max waiting times

Reports should show service usage per time of night, peak periods

Reports should show how many helpers work during what periods

14. As a student, I want to be able to sign up for the app, so that I can get help when I need it.

Acceptance criteria:

Sign in should ask for the students' student ID

Sign in should ask for a password

The password should be more than 6 characters long

If the students' ID shows they have not been a registered user in the last six months, the registration shall be denied with messages explaining why.

15. As a helper, I only want to help current students, not non-students or former students, for safety.

Acceptance criteria:

Once every 6 months, the app finds all registered students who have not been an active student for more than a year. These students will have their account canceled with a notification.

Only registered students, or those students who have been registered in the six months can sign up for the app.

Question 7: Security, Sustainability, Safety, and Usability Requirements (5 points)

Write five SRS requirements or user stories for the case provided. These requirements should cover security, sustainability, safety, or usability. Tell us which requirement covers which topic. You can write all requirements for one topic, or a mix of topics, as long as the topic is clear. These requirements should not be the same as those provided for previous questions, they should be new. For this question, if you provide user stories, you do not need to provide acceptance criteria.

Sample Answers:

Security

16. No app users can see the full details of any student non-helper user, including name, location, or past usage.

17. It should not be possible to track the habits of individual student user within the app, i.e., frequency of use, common locations, or destinations.

Sustainability

18. The app should not assign the same helpers more than three walks per hour.

Safety

19. If two helpers are not available to handle a request, the request is not accepted. 18.1 Students are notified if a request is not accepted, with an explanation as to why.

20. The app should track the current location of every helper.

21. Helpers should be able to see the current location of helpers on duty, but no other users.

Usability

22. Request should be easy to make, 9 out of 10 registered users should be able to fill out a request within two minutes.

Question 8:   Requirements Prioritization (5 points)

You now have many different requirements. Take five of the requirements (SRS FR, SRS NFR, constraint, or user story) and show how you can prioritize them using one of the methods taught in class. For this, you can refer to the requirements by number instead of re-writing them. Use the prioritization technique to provide a final prioritized list for the five requirements.

Sample Answers:

Priortize the 5 user stories

I show two ways, only need one.
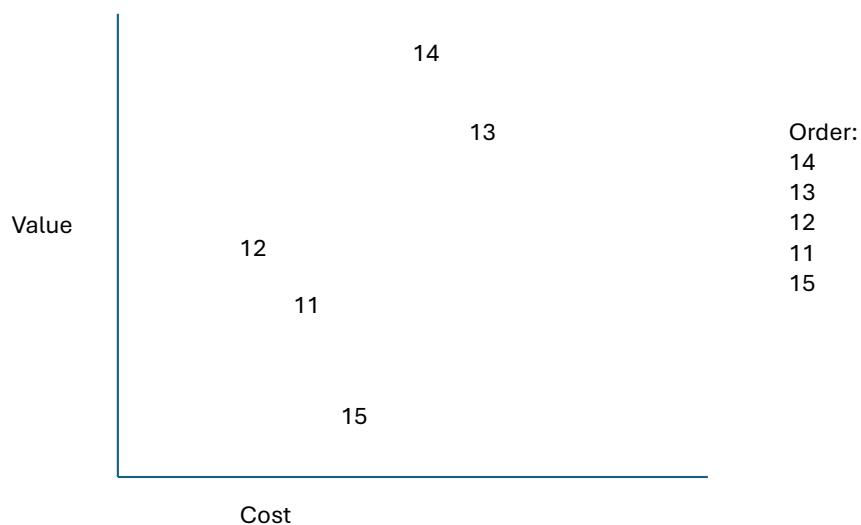
Requirement	Cost	Why?
11	12	Nice to have but not essential, will be used sometimes
12	5	Nice to have but not essential, will be used infrequently
13	30	Without this it is hard to justify the existence of the service
14	35	No one can use the app if they can't sign in, can't check student status without it
15	18	Important for safety, but the app works without it

Order: 14, 13, 15, 11, 12

Question 9: Prototype (10 points)

Draw one prototype screen for the given case implementation. The screen can include pop-up windows, just be clear how and why they appear. The purpose of each screen should be clear. The screen should implement at least three functional requirements (SRS or user stories). These requirements should be clearly implemented on this screen. The requirements do not have to be the requirements from previous questions. Write the full text of the two requirements implemented here, even if they are not new, so we do not have to flip back to find them. For the screen, write: the three requirements implemented, how the requirements are implemented.

Answer:
We give 6 points for the requirements,
and 4 points for the screen.

Safe Walk App

Do you want someone to
walk with you? Enter your
details:

Location:

Building 3c

Pick up time:

23:30

Destination:

East bus stop

Enter

Estimated arrival time: 10
minutes

Accept   Cancel

Call a Helper Now

Requirements Implemented:

1. The system shall allow students to request walking help in the app.

How: The whole screen implements this requirement, other than the bottom call icon

1.1. Walking help request should contain the location, destination, and time.

How: these fields are enterable on the screen

1.2 When requesting help walking, students should get an estimation of the arrival time of the helpers.

How: this is shown on the screen after the request details have been entered

1.3 Students should be able to cancel their requests for help.

How: either before after the time estimate is received, students can cancel their request

12. As a student, I want to be able to call a helper, so that I can get help if I'm not getting a response from the app, or can't figure out how to use the app.

How: the icon on the bottom is clickable, on every screen, and lets you call a helper.