

Module Interface Specification for Software Engineering

Team #2, Campus Connections

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1 Revision History

Date	Version	Notes
Jan 15	1.0	Add introduction and module decomposition
Jan 17	1.0	Revision 0

2 Symbols, Abbreviations and Acronyms

See SRS Documentation at [SRS](#)

2.1 Abbreviations and Acronyms

symbol	description
MIS	Module Interface Specification
MG	Module Guide
SRS	Software Requirement Specification
AR	Augmented Reality

Contents

1	Revision History	i
2	Symbols, Abbreviations and Acronyms	ii
2.1	Abbreviations and Acronyms	ii
3	Introduction	1
4	Notation	1
5	Module Decomposition	2
6	MIS of User Module	3
6.1	Module	3
6.2	Uses	3
6.3	Syntax	3
6.3.1	Exported Constants	3
6.3.2	Exported Access Programs	4
6.4	Semantics	4
6.4.1	State Variables	4
6.4.2	Environment Variables	5
6.4.3	Assumptions	5
6.4.4	Access Routine Semantics	5
6.4.5	Local Functions	7
7	MIS of Lecture Module	8
7.1	Module	8
7.2	Uses	8
7.3	Syntax	8
7.3.1	Exported Constants	8
7.3.2	Exported Access Programs	8
7.4	Semantics	8
7.4.1	State Variables	8
7.4.2	Environment Variables	9
7.4.3	Assumptions	9
7.4.4	Access Routine Semantics	9
7.4.5	Local Functions	9
8	MIS of Event Module	10
8.1	Module	10
8.2	Uses	10
8.3	Syntax	10
8.3.1	Exported Constants	10

8.3.2	Exported Access Programs	10
8.4	Semantics	10
8.4.1	State Variables	10
8.4.2	Environment Variables	11
8.4.3	Assumptions	11
8.4.4	Access Routine Semantics	11
8.4.5	Local Functions	12
9	MIS of Account Module	13
9.1	Module	13
9.2	Uses	13
9.3	Syntax	13
9.3.1	Exported Constants	13
9.3.2	Exported Access Programs	13
9.4	Semantics	13
9.4.1	State Variables	13
9.4.2	Environment Variables	14
9.4.3	Assumptions	14
9.4.4	Access Routine Semantics	14
9.4.5	Local Functions	15
10	MIS of Friend Manager Module	16
10.1	Module	16
10.2	Uses	16
10.3	Syntax	16
10.3.1	Exported Constants	16
10.3.2	Exported Access Programs	16
10.4	Semantics	16
10.4.1	State Variables	16
10.4.2	Environment Variables	16
10.4.3	Assumptions	16
10.4.4	Access Routine Semantics	17
10.4.5	Local Functions	17
10.4.6	Local Constants	17
11	MIS of Friend Request Module	18
11.1	Module	18
11.2	Uses	18
11.3	Syntax	18
11.3.1	Exported Constants	18
11.3.2	Exported Access Programs	18
11.4	Semantics	18
11.4.1	State Variables	18

11.4.2	Environment Variables	18
11.4.3	Assumptions	18
11.4.4	Access Routine Semantics	18
11.4.5	Local Functions	19
11.4.6	Local Constants	19
12	MIS of Activity Detail View Module	20
12.1	Module	20
12.2	Uses	20
12.3	Syntax	20
12.3.1	Exported Constants	20
12.3.2	Exported Access Programs	20
12.4	Semantics	20
12.4.1	State Variables	20
12.4.2	Environment Variables	20
12.4.3	Assumptions	21
12.4.4	Access Routine Semantics	21
12.4.5	Local Functions	22
12.4.6	Local Constants	22
13	MIS of Lecture Detail View Module	23
13.1	Module	23
13.2	Uses	23
13.3	Syntax	23
13.3.1	Exported Constants	23
13.3.2	Exported Access Programs	23
13.4	Semantics	23
13.4.1	State Variables	23
13.4.2	Environment Variables	23
13.4.3	Assumptions	24
13.4.4	Access Routine Semantics	24
13.4.5	Local Functions	25
13.4.6	Local Constants	25
14	MIS of Event Detail View Module	26
14.1	Module	26
14.2	Uses	26
14.3	Syntax	26
14.3.1	Exported Constants	26
14.3.2	Exported Access Programs	26
14.4	Semantics	26
14.4.1	State Variables	26
14.4.2	Environment Variables	26

14.4.3	Assumptions	27
14.4.4	Access Routine Semantics	27
14.4.5	Local Functions	28
14.4.6	Local Constants	28
15	MIS of Lecture List Manager Module	29
15.1	Module	29
15.2	Uses	29
15.3	Syntax	29
15.3.1	Exported Constants	29
15.3.2	Exported Access Programs	29
15.4	Semantics	29
15.4.1	State Variables	29
15.4.2	Environment Variables	30
15.4.3	Assumptions	30
15.4.4	Access Routine Semantics	30
15.4.5	Local Functions	31
15.4.6	Local Constants	31
16	MIS of Event List Manager Module	32
16.1	Module	32
16.2	Uses	32
16.3	Syntax	32
16.3.1	Exported Constants	32
16.3.2	Exported Access Programs	32
16.4	Semantics	32
16.4.1	State Variables	32
16.4.2	Environment Variables	32
16.4.3	Assumptions	33
16.4.4	Access Routine Semantics	33
16.4.5	Local Functions	34
16.4.6	Local Constants	34
17	MIS of Pagination and Filter Module	35
17.1	Module	35
17.2	Uses	35
17.3	Syntax	35
17.3.1	Exported Constants	35
17.3.2	Exported Access Programs	35
17.4	Semantics	35
17.4.1	State Variables	35
17.4.2	Environment Variables	35
17.4.3	Assumptions	36

17.4.4	Access Routine Semantics	36
17.4.5	Local Functions	37
17.4.6	Local Constants	37
18	MIS of Database Module	38
18.1	Module	38
18.2	Uses	38
18.3	Syntax	38
18.3.1	Exported Constants	38
18.3.2	Exported Access Programs	38
18.4	Semantics	39
18.4.1	State Variables	39
18.4.2	Environment Variables	39
18.4.3	Assumptions	40
18.4.4	Access Routine Semantics	40
18.4.5	Local Functions	41
19	MIS of Server Module	42
19.1	Module	42
19.2	Uses	42
19.3	Syntax	42
19.3.1	Exported Constants	42
19.3.2	Exported Access Programs	42
19.4	Semantics	42
19.4.1	State Variables	42
19.4.2	Environment Variables	42
19.4.3	Assumptions	42
19.4.4	Access Routine Semantics	42
19.4.5	Local Functions	42
20	MIS of AR Camera	43
20.1	Module	43
20.2	Uses	43
20.3	Syntax	43
20.3.1	Exported Constants	43
20.3.2	Exported Access Programs	43
20.4	Semantics	43
20.4.1	State Variables	43
20.4.2	Environment Variables	43
20.4.3	Assumptions	43
20.4.4	Access Routine Semantics	43
20.4.5	Local Functions	43

21 MIS of AR Interface	44
21.1 Module	44
21.2 Uses	44
21.3 Syntax	44
21.3.1 Exported Constants	44
21.3.2 Exported Access Programs	44
21.4 Semantics	44
21.4.1 State Variables	44
21.4.2 Environment Variables	44
21.4.3 Assumptions	44
21.4.4 Access Routine Semantics	44
21.4.5 Local Functions	45
22 MIS of MapBox	46
22.1 Module	46
22.2 Uses	46
22.3 Syntax	46
22.3.1 Exported Constants	46
22.3.2 Exported Access Programs	46
22.4 Semantics	46
22.4.1 State Variables	46
22.4.2 Environment Variables	46
22.4.3 Assumptions	46
22.4.4 Access Routine Semantics	46
22.4.5 Local Functions	47
22.4.6 Local Constants	47
23 MIS of Map Interface	48
23.1 Module	48
23.2 Uses	48
23.3 Syntax	48
23.3.1 Exported Constants	48
23.3.2 Exported Access Programs	48
23.4 Semantics	48
23.4.1 State Variables	48
23.4.2 Environment Variables	48
23.4.3 Assumptions	48
23.4.4 Access Routine Semantics	48
23.4.5 Local Functions	49

24 MIS of Friend Chat	50
24.1 Module	50
24.2 Uses	50
24.3 Syntax	50
24.3.1 Exported Constants	50
24.3.2 Exported Access Programs	50
24.4 Semantics	50
24.4.1 State Variables	50
24.4.2 Environment Variables	50
24.4.3 Assumptions	50
24.4.4 Access Routine Semantics	50
24.4.5 Local Functions	51
25 Appendix	52
25.1 Database Tables	52

3 Introduction

The following document details the Module Interface Specifications for CampusConnections. CampusConnections is a social media application with impressive AR camera and real time location map features that allows McMaster University students and visitors have an immersive user experience and expand their social networking. This application allows users to make new friends online and also encourage users to strengthen the friendship by in-person meet-ups with a on-campus location-sharing feature. It also provides heat maps of events and users, which allows students to join the most popular activities on campus. Besides, the application maintainers will share up-to-date events and lectures information for the community. The MIS will detail specifications for the project described above.

Complementary documents include the System Requirement Specifications (SRS) and Module Guide. (MG) The full documentation and implementation can be found at <https://github.com/beatlepie/4G06CapstoneProjectTeam2/blob/main/docs/SRS-Volere/SRS.pdf> and <https://github.com/beatlepie/4G06CapstoneProjectTeam2/blob/main/docs/Design/SoftArchitecture/MG.pdf>

4 Notation

The structure of the MIS for modules comes from Hoffman and Strooper (1995), with the addition that template modules have been adapted from Ghezzi et al. (2003). The mathematical notation comes from Chapter 3 of Hoffman and Strooper (1995). For instance, the symbol $:=$ is used for a multiple assignment statement and conditional rules follow the form $(c_1 \Rightarrow r_1 | c_2 \Rightarrow r_2 | \dots | c_n \Rightarrow r_n)$.

The following table summarizes the primitive data types used by Software Engineering.

Data Type	Notation	Description
character	char	a single symbol or digit
integer	\mathbb{Z}	a number without a fractional component in $(-\infty, \infty)$
natural number	\mathbb{N}	a number without a fractional component in $[1, \infty)$
real	\mathbb{R}	any number in $(-\infty, \infty)$
boolean	\mathbb{B}	True or False
sequence of T	$\langle T \rangle$	a list of object with type T
asynchronous step T	Task $\langle T \rangle$	an asynchronous result of T

The specification of Software Engineering uses some derived data types: sequences, strings, and tuples. Sequences are lists filled with elements of the same data type. Strings are sequences of characters. Tuples contain a list of values, potentially of different types. In

addition, Software Engineering uses functions, which are defined by the data types of their inputs and outputs. Local functions are described by giving their type signature followed by their specification.

5 Module Decomposition

The following table is taken directly from the Module Guide document for this project.

Level 1	Level 2
Hardware-Hiding	
	AR Interface Module
	Map Interface Module
	User Module
Behaviour-Hiding	Lecture Module
	Event Module
	Account Module
	Permission Module
	User Profile Module
	User Login Module
	Friend Manager Module
	Friend Request Module
	Friend Chat Module
	Lecture Detail View Module
	Event Detail View Module
	Lecture List Manager Module
	Event List Manager Module
Software Decision	Database Module
	Server Module
	Authentication Module
	AR Camera Module
	Mapbox Module
	Activity Detail View Module
	Pagination and Filter Module

Table 1: Module Hierarchy

6 MIS of User Module

6.1 Module

User

6.2 Uses

Lecture Module, Event Module

6.3 Syntax

6.3.1 Exported Constants

None

6.3.2 Exported Access Programs

Name	In	Out	Exceptions
User	String, String, Uri, String, \mathbb{R} , <User>, <User>, <Lecture>, <Event>	User	-
SetNickName	String	-	-
SetPhotoUri	Uri	-	-
SetProgram	String	-	-
SetLevel	\mathbb{R}	-	-
AddFriend	User	-	-
RemoveFriend	User	-	IndexOutOfBounds Ex- ception
AddRequester	User	-	-
RemoveRequester	User	-	IndexOutOfBounds Ex- ception
AddLecture	Lecture	-	-
RemoveLecture	Lecture	-	IndexOutOfBounds Ex- ception
AddEvent	Event	-	-
RemoveEvent	Event	-	IndexOutOfBounds Ex- ception

6.4 Semantics

6.4.1 State Variables

- email: String, User email
- nickName: String, User nickName
- photoUri: Uri, User avatar
- program: String, User program
- level: \mathbb{R} , User program level
- friends: <User>, List of friends

- requesters: <User>, List of friend requester
- lectures: <Lecture>, Pinned lecture
- events: <Event>, Pinned event

6.4.2 Environment Variables

None

6.4.3 Assumptions

Strings passed as input are of valid format, all the state variables of the object are directly accessible so getter is not needed.

6.4.4 Access Routine Semantics

User(email, nickName, photoUri, program, level, friends, requesters, lectures,events):

- transition: $email, nickName, photoUri, program, level, friends, requesters, lectures, events := email, nickName, photoUri, program, level, friends, requesters, lectures, events$
- output: $out := self$
- exception: none

SetNickName(newName):

- transition: $nickName := newName$
- output: none
- exception: none

SetPhotot(newUri):

- transition: $photoUri := newUri$
- output: none
- exception: none

SetProgram(newProgram):

- transition: $program := newProgram$
- output: none

- exception: none

SetLevel(newLevel):

- transition: $level := newLevel$
- output: none
- exception: none

AddFriend(newFriend):

- transition: $friends := friends + \{newFriend\}$
- output: none
- exception: none

RemoveFriend(targetFriend):

- transition: $friends := friends - \{targetFriend\}$
- output: none
- exception: $exc := targetFriend \notin friends \Rightarrow IndexOutOfBoundException$

AddRequester(newRequester):

- transition: $requesters := requesters + \{newRequester\}$
- output: none
- exception: none

RemoveRequester(targetRequester):

- transition: $requesters := requesters - \{targetRequester\}$
- output: none
- exception: $exc := targetRequester \notin requesters \Rightarrow IndexOutOfBoundException$

AddLecture(newLec):

- transition: $lectures := lectures + \{newLec\}$
- output: none
- exception: none

RemoveLecture(targetLecture):

- transition: $lectures := lectures - \{targetLecture\}$
- output: none
- exception: $exc := targetLecture \notin lectures \Rightarrow IndexOutOfBoundException$

AddEvent(newEvent):

- transition: $events := events + \{newEvent\}$
- output: none
- exception: none

RemoveEvent(targetEvent):

- transition: $events := events - \{targetEvent\}$
- output: none
- exception: $exc := targetEvent \notin events \Rightarrow IndexOutOfBoundException$

6.4.5 Local Functions

None

7 MIS of Lecture Module

7.1 Module

Lecture

7.2 Uses

None

7.3 Syntax

7.3.1 Exported Constants

None

7.3.2 Exported Access Programs

Name	In	Out	Exceptions
Lecture	String, String, String, String, String	Lecture	-
SetName	String	-	-
SetInstructor	String	-	-
SetTime	String	-	-
SetLocation	String	-	-

7.4 Semantics

7.4.1 State Variables

- code: String, Lecture code
- name: String, Lecture name
- instructor: String, Lecture instructor
- time: String, Lecture time
- location: String, Lecture location

7.4.2 Environment Variables

None

7.4.3 Assumptions

Strings passed as input are of valid format, all the state variables of the object are directly accessible so getter is not needed.

7.4.4 Access Routine Semantics

Lecture(lecCode, lecName, lecInstructor, lecTime, lecLocation):

- transition: *code, name, instructor, time, location := lecCode, lecName, lecInstructor, lecTime, lecLocation*
- output: *out := self*
- exception: none

SetName(newName):

- transition: *name := newName*
- output: none
- exception: none

SetInstructor(newInstructor):

- transition: *instructor := newInstructor*
- output: none
- exception: none

SetTime(newTime):

- transition: *time := newTime*
- output: none
- exception: none

SetLocation(newLocation):

- transition: *location := newLocation*
- output: none
- exception: none

7.4.5 Local Functions

None

8 MIS of Event Module

8.1 Module

Event

8.2 Uses

None

8.3 Syntax

8.3.1 Exported Constants

None

8.3.2 Exported Access Programs

Name	In	Out	Exceptions
Event	String, String, String,DateTime, \mathbb{R} , String, \mathbb{B}	Event	-
setDescription	String	-	-
setOrganizer	String	-	-
setStartTime	DateTime	-	-
setDuration	\mathbb{R}	-	-
setLocation	String	-	-
setPublic	\mathbb{B}	-	-

8.4 Semantics

8.4.1 State Variables

- name: String, Event name
- description: String, Event description
- organizer: String, Event hosted by
- startTime: DateTime, Event start date and time
- duration: \mathbb{R} , Event duration (in minutes)

- location: String, Event location (room and building)
- public : \mathbb{B} , is event public

8.4.2 Environment Variables

None

8.4.3 Assumptions

Strings passed as input are of valid format, all the state variables of the object are directly accessible so getter is not needed.

8.4.4 Access Routine Semantics

Event(name, description, organizer, startTime, duration, location, public):

- transition: *name, description, organizer, startTime, duration, location, public := name, description, organizer, startTime, duration, location, public*
- output: *out := self*
- exception: none

SetDescription(newDescription):

- transition: *description := newDescription*
- output: none
- exception: none

SetOrganizer(newOrganizer):

- transition: *organizer := newOrganizer*
- output: none
- exception: none

SetStartTime(newTime):

- transition: *startTime := newTime*
- output: none
- exception: none

SetDuration(newDuration):

- transition: *duration := newDuration*
- output: none
- exception: none

SetLocation(newLocation):

- transition: *location := newLocation*
- output: none
- exception: none

SetPublic(newPublicity):

- transition: *public := newPublicity*
- output: none
- exception: none

8.4.5 Local Functions

None

9 MIS of Account Module

9.1 Module

Account

9.2 Uses

Database Module, User Module, Authentication Module

9.3 Syntax

9.3.1 Exported Constants

None

9.3.2 Exported Access Programs

Name	In	Out	Exceptions
UpdateNickName	String	-	
UpdateProgram	String	-	
UpdateLevel	N	-	
AddFriend	User	-	
DeleteFriend	User	IndexOutOfBounds Ex- ception	
AddRequest	User	-	
DeleteRequest	User	IndexOutOfBounds Ex- ception	
PinLecture	Lecture	-	
UnPinLecture	Lecture	IndexOutOfBounds Ex- ception	
PinEvent	Event	-	
UnPinEvent	Event	IndexOutOfBounds Ex- ception	

9.4 Semantics

9.4.1 State Variables

- User: User User of the account

9.4.2 Environment Variables

None

9.4.3 Assumptions

All the state variables of User is accessible directly so there is no getters in the module.

9.4.4 Access Routine Semantics

UpdateNickName(newName):

- transition: $User.SetNickName(newName)$
- output: none
- exception: none

UpdateProgram(newProgram):

- transition: $User.SetProgram(newProgram)$
- output: none
- exception: none

UpdateLevel(newLevel):

- transition: $User.SetLevel(newLevel)$
- output: none
- exception: none

AddFriend(newFriend):

- transition: $User.AddFriend(newFriend)$
- output: none
- exception: none

DeleteFriend(targetFriend):

- transition: $User.RemoveFriend(targetFriend)$
- output: none
- exception: $exc := targetFriend \notin User.friends \Rightarrow IndexOutOfBoundException$

AddRequest(newFriend):

- transition: $User.AddRequester(newFriend)$
- output: none
- exception: none

DeleteRequest(targetFriend):

- transition: $User.RemoveRequester(targetFriend)$
- output: none
- exception: $exc := targetFriend \notin User.friendRequests \Rightarrow IndexOutOfBoundException$

PinLecture(newLec):

- transition: $User.AddLecture(newLec)$
- output: none
- exception: none

UnpinLecture(targetLec):

- transition: $User.RemoveLecture(targetLec)$
- output: none
- exception: $exc := targetLec \notin User.lectures \Rightarrow IndexOutOfBoundException$

PinEvent(newEvent):

- transition: $User.AddEvent(newEvent)$
- output: none
- exception: none

UnpinLecture(targetEvent):

- transition: $User.RemoveEvent(targetEvent)$
- output: none
- exception: $exc := targetEvent \notin User.events \Rightarrow IndexOutOfBoundException$

9.4.5 Local Functions

None

10 MIS of Friend Manager Module

10.1 Module

FriendManager

10.2 Uses

Account Module, Chat Module, Unity Transform Type

10.3 Syntax

10.3.1 Exported Constants

None

10.3.2 Exported Access Programs

Name	In	Out	Exceptions
DisplayFriendList	-	<Tranform>	-
onClickDeleteFriend	User	-	IndexOutOfBounds Ex- ception
onClickViewFriend	User	-	IndexOutOfBounds Ex- ception
onClickMessageFriend	User	2D seq of pixels	IndexOutOfBounds Ex- ception
onClickSendRequest	User	\mathbb{B}	-

10.4 Semantics

10.4.1 State Variables

None

10.4.2 Environment Variables

None

10.4.3 Assumptions

Assume the singleton Account is accessible from this module.

10.4.4 Access Routine Semantics

DisplayFriendList():

- transition: none
- output: $out := friendContainer$ where $(\forall x : \mathbb{Z} | 0 \leq x \leq Account.friends.length : friendsContainer[x].position, friendsContainer[x].content = (0, i * HEIGHT), Account.friends[i]),$
- exception: none

onClickDeleteFriend(targetUser):

- transition: $Account.DeleteFriend(targetUser)$
- output: none
- exception: $exc := targetUser.email \notin Account.User.friends \Rightarrow IndexOutOfBoundException$

onClickViewFriend(targetUser):

- transition: Switch scene to user profile where $User = targetUser$
- output: none
- exception: $exc := targetUser.email \notin Account.User.friends \Rightarrow IndexOutOfBoundException$

onClickMessageFriend(targetUser):

- transition: Call Chat Module to establish a connection
- output: UI of friend chat between $Account.User$ and $targetUser$
- exception: $exc := targetUser.email \notin Account.User.friends \Rightarrow IndexOutOfBoundException$

onClickSendRequest(targetUser):

- transition: $targetUser.AddRequest(Account1.User.email)$ if the current user has not send a request yet
- output: $Account1.User.email \notin targetUser.friendRequest$
- exception: none

10.4.5 Local Functions

None

10.4.6 Local Constants

$HEIGHT = 300$ px

11 MIS of Friend Request Module

11.1 Module

FriendRequest

11.2 Uses

Account Module, Unity Transform Type

11.3 Syntax

11.3.1 Exported Constants

None

11.3.2 Exported Access Programs

Name	In	Out	Exceptions
DisplayRequestList	-	<Transform>	-
onClickAcceptRequest	User	-	IllegalArgument Ex-ception
onClickIgnoreRequest	User	-	IllegalArgument Ex-ception

11.4 Semantics

11.4.1 State Variables

None

11.4.2 Environment Variables

None

11.4.3 Assumptions

Assume the singleton Account is accessible from this module.

11.4.4 Access Routine Semantics

DisplayRequestList():

- transition: none

- output: $out := requestContainer$ where $(\forall x : \mathbb{Z} | 0 \leq x \leq Account.friendRequests.length :$

$requestContainer[i].position, requestContainer[i].content =$
 $(0, i * HEIGHT), Account.friendRequests[i]),$

- exception: none

onClickAcceptRequest(targetUser):

- transition: $targetUser.friends := targetUser.friends + Account.User.email$
 $Account.User.AddFriend(targetUser)$
 $Account.User.DeleteRequest(targetUser)$
- output: none
- exception: $exc := targetUser \notin Account.User.friendRequests \Rightarrow$
 $IllegalArgumentException$

onClickIgnoreRequest(targetUser):

- transition: $Account.User.DeleteRequest(targetUser)$
- output: none
- exception: $exc := targetUser \notin Account.User.friendRequests \Rightarrow$
 $IllegalArgumentException$

11.4.5 Local Functions

UpdateBadge(): String

It returns the content of friend request badge given the request number

- transition: none
- output: $out := requestNum = 0 \Rightarrow emptystring$
 $0 < requestNum < 100 \Rightarrow requestNum$
 $100 \leq requestNum \Rightarrow 99+$
- exception: none

11.4.6 Local Constants

HEIGHT = 150 px

12 MIS of Activity Detail View Module

12.1 Module

ActivityDetailView

12.2 Uses

Database Module, Permission Module

12.3 Syntax

12.3.1 Exported Constants

None

12.3.2 Exported Access Programs

Name	In	Out	Exceptions
ViewActivities	-	-	-
AddActivity	Activity	-	InvalidPermission Exception
EditActivity	Activity, Activity	-	IndexOutOfBounds Exception, Invalid- Permission Exception
DeleteActivity	Activity	-	IndexOutOfBounds Exception, Invalid- Permission Exception
PinActivity	Activity	-	-
UnpinActivity	Activity	-	IndexOutOfBounds Ex- ception

12.4 Semantics

12.4.1 State Variables

- activities: set of Activity
- pinnedActivities: set of Activity

12.4.2 Environment Variables

None

12.4.3 Assumptions

Activity is a generic class with $\langle T \rangle$ and it can be instantiated with type Lecture and Event. The singleton module Permission is accessible from this module.

12.4.4 Access Routine Semantics

ViewActivities():

- transition: Display activities
- output: none
- exception: none

AddActivity(newActivity):

- transition: $activities := activities + \{newActivity\}$
- output: none
- exception: $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

EditActivity(targetActivity, editedActivity):

- transition: $activities := activities - \{targetActivity\} + \{editedActivity\}$
- output: none
- exception: $exc := targetActivity \notin activities \Rightarrow IndexOutOfBoundException$,
 $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

DeleteActivity(targetActivity):

- transition: $activities := activities - \{targetActivity\}$
- output: none
- exception: $exc := targetActivity \notin activities \Rightarrow IndexOutOfBoundException$,
 $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

PinActivity(newActivity):

- transition: $pinnedActivities := pinnedActivities + \{newActivity\}$
- output: none
- exception: none

UnpinActivity(targetActivity):

- transition: $pinnedActivities := pinnedActivities - \{targetActivity\}$
- output: none
- exception: $exc := targetActivity \notin pinnedActivities \Rightarrow IndexOutOfBoundException$

12.4.5 Local Functions

None

12.4.6 Local Constants

None

13 MIS of Lecture Detail View Module

13.1 Module

LectureDetailView

Inherit Activity Detail View Module (Activity Detail View <Lecture>)

13.2 Uses

Activity Detail View Module, Lecture Module

13.3 Syntax

13.3.1 Exported Constants

None

13.3.2 Exported Access Programs

Name	In	Out	Exceptions
ViewActivities	-	-	-
AddActivity	Lecture	-	InvalidPermission Exception
EditActivity	Lecture, Lecture	-	IndexOutOfBounds Exception, Invalid- Permission Exception
DeleteActivity	Lecture	-	IndexOutOfBounds Exception, Invalid- Permission Exception
PinActivity	Lecture	-	-
UnpinActivity	Lecture	-	IndexOutOfBounds Ex- ception

13.4 Semantics

13.4.1 State Variables

- activities: set of Lecture
- pinnedActivities: set of Lecture

13.4.2 Environment Variables

None

13.4.3 Assumptions

The singleton module `Permission` is accessible from this module.

13.4.4 Access Routine Semantics

`ViewActivities()`:

- transition: `Display lectures`
- output: `none`
- exception: `none`

`AddActivity(newActivity)`:

- transition: $activities := activities + \{newActivity\}$
- output: `none`
- exception: $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

`EditActivity(targetActivity, editedActivity)`:

- transition: $activities := activities - \{targetActivity\} + \{editedActivity\}$
- output: `none`
- exception: $exc := targetActivity \notin activities \Rightarrow IndexOutOfBounds Exception,$
 $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

`DeleteActivity(targetActivity)`:

- transition: $activities := activities - \{targetActivity\}$
- output: `none`
- exception: $exc := targetActivity \notin activities \Rightarrow IndexOutOfBounds Exception,$
 $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

`PinActivity(newActivity)`:

- transition: $pinnedActivities := pinnedActivities + \{newActivity\}$
- output: `none`
- exception: `none`

`UnpinActivity(targetActivity)`:

- transition: $pinnedActivities := pinnedActivities - \{targetActivity\}$
- output: `none`
- exception: $exc := targetActivity \notin pinnedActivities \Rightarrow IndexOutOfBounds Exception$

13.4.5 Local Functions

None

13.4.6 Local Constants

None

14 MIS of Event Detail View Module

14.1 Module

EventDetailView

Inherit Activity Detail View Module (Activity Detail View <Event>)

14.2 Uses

Activity Detail View Module, Event Module

14.3 Syntax

14.3.1 Exported Constants

None

14.3.2 Exported Access Programs

Name	In	Out	Exceptions
ViewActivities	-	-	-
AddActivity	Event	-	InvalidPermission Exception
EditActivity	Event, Event	-	IndexOutOfBounds Exception, Invalid- Permission Exception
DeleteActivity	Event	-	IndexOutOfBounds Exception, Invalid- Permission Exception
PinActivity	Event	-	-
UnpinActivity	Event	-	IndexOutOfBounds Ex- ception

14.4 Semantics

14.4.1 State Variables

- activities: set of Event
- pinnedActivities: set of Event

14.4.2 Environment Variables

None

14.4.3 Assumptions

The singleton module `Permission` is accessible from this module.

14.4.4 Access Routine Semantics

`ViewActivities()`:

- transition: Display events
- output: none
- exception: none

`AddActivity(newActivity)`:

- transition: $activities := activities + \{newActivity\}$
- output: none
- exception: $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

`EditActivity(targetActivity, editedActivity)`:

- transition: $activities := activities - \{targetActivity\} + \{editedActivity\}$
- output: none
- exception: $exc := targetActivity \notin activities \Rightarrow IndexOutOfBounds Exception,$
 $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

`DeleteActivity(targetActivity)`:

- transition: $activities := activities - \{targetActivity\}$
- output: none
- exception: $exc := targetActivity \notin activities \Rightarrow IndexOutOfBounds Exception,$
 $exc := \neg Permission.isAdmin \Rightarrow InvalidPermissionException$

`PinActivity(newActivity)`:

- transition: $pinnedActivities := pinnedActivities + \{newActivity\}$
- output: none
- exception: none

`UnpinActivity(targetActivity)`:

- transition: $pinnedActivities := pinnedActivities - \{targetActivity\}$
- output: none
- exception: $exc := targetActivity \notin pinnedActivities \Rightarrow IndexOutOfBounds Exception$

14.4.5 Local Functions

None

14.4.6 Local Constants

None

15 MIS of Lecture List Manager Module

15.1 Module

Lecture List Manager

15.2 Uses

Lecture Module, Pagination and Filter Module

15.3 Syntax

15.3.1 Exported Constants

None

15.3.2 Exported Access Programs

Name	In	Out	Exceptions
LectureList	-	-	-
Display	-	-	-
OnClickLecture	Lecture	-	IllegalArgumentException Exception
nextPage	-	-	-
prevPage	-	-	-
firstPage	-	-	-
lastPage	-	-	-
filter	String	-	-
AddLecture	Lecture	-	-

15.4 Semantics

15.4.1 State Variables

- lecList: <Lecture>, displayed lectures
- pageNum: \mathbb{N} , current page
- keyword: String, filter keyword

15.4.2 Environment Variables

None

15.4.3 Assumptions

None

15.4.4 Access Routine Semantics

LectureList():

- transition: $lecList, pageNum, keyword :=$ all lectures in the database, 1, null
- output: none
- exception: none

Display():

- transition: Display a list of lecture displayedLecs, where $displayedLecs := lecList.filter(keyword)[(pageNum-1)*PAGECOUNT, pageNum*PAGECOUNT]$
- output: none
- exception: none

OnClickLecture(targetLec):

- transition: Switch to Lecture Detail view with targetLec
- output: none
- exception: $exc := targetLec \notin lecList \Rightarrow IllegalArgumentException$

nextPage():

- transition: $pageNum*PAGECOUNT < lecList.length \Rightarrow pageNum := pageNum + 1$
- output: none
- exception: none

prevPage():

- transition: $pageNum > 1 \Rightarrow pageNum := pageNum - 1$
- output: none

- exception: none

firstPage():

- transition: $pageNum := 1$
- output: none
- exception: none

lastPage():

- transition: $pageNum := \text{int}(lecList / PAGECOUNT) + 1$
- output: none
- exception: none

AddLecture(newLec):

- transition: $lecList := PagniationandFilter.Add(lecList, newLec)$
- output: none
- exception: none

15.4.5 Local Functions

None

15.4.6 Local Constants

PAGECOUNT = 10

16 MIS of Event List Manager Module

16.1 Module

Event List Manager

16.2 Uses

Event Module, Pagination and Filter Module

16.3 Syntax

16.3.1 Exported Constants

None

16.3.2 Exported Access Programs

Name	In	Out	Exceptions
EventList	-	-	-
Display	-	-	-
OnClickEvent	Lecture	-	IllegalArgumentException Ex- ception
nextPage	-	-	-
prevPage	-	-	-
firstPage	-	-	-
lastPage	-	-	-
filter	String	-	-
AddEvent	Event	-	-

16.4 Semantics

16.4.1 State Variables

- eventList: <Event>, displayed events
- pageNum: \mathbb{N} , current page
- keyword: String, filter keyword

16.4.2 Environment Variables

None

16.4.3 Assumptions

None

16.4.4 Access Routine Semantics

EventList():

- transition: $eventList, pageNum, keyword := \text{all events in the database, 1, null}$
- output: none
- exception: none

Display():

- transition: Display a list of event displayedEvents, where $displayedEvents := eventList.filter(keyword)[(pageNum-1)*PAGECOUNT, pageNum*PAGECOUNT]$
- output: none
- exception: none

OnClickEvent(targetEvent):

- transition: Switch to Event Detail view with targetEvent
- output: none
- exception: $exc := targetEvent \notin eventList \Rightarrow IllegalArgumentException$

nextPage():

- transition: $pageNum*PAGECOUNT < eventList.length \Rightarrow pageNum := pageNum + 1$
- output: none
- exception: none

prevPage():

- transition: $pageNum > 1 \Rightarrow pageNum := pageNum - 1$
- output: none
- exception: none

firstPage():

- transition: $pageNum := 1$

- output: none
- exception: none

lastPage():

- transition: $pageNum := \text{int}(\text{eventList} / \text{PAGECOUNT}) + 1$
- output: none
- exception: none

AddEvent(newEvent):

- transition: $\text{eventList} := \text{PagniationandFilter.Add}(\text{eventList}, \text{newEvent})$
- output: none
- exception: none

16.4.5 Local Functions

None

16.4.6 Local Constants

PAGECOUNT = 10

17 MIS of Pagination and Filter Module

17.1 Module

Pagination and Filter

17.2 Uses

Database Module, Permission Module

17.3 Syntax

17.3.1 Exported Constants

None

17.3.2 Exported Access Programs

Name	In	Out	Exceptions
Initialize	-	-	-
Display	-	-	-
nextPage	-	-	-
prevPage	-	-	-
firstPage	-	-	-
lastPage	-	-	-
filter	String	-	-
Add	<T>, Activity	-	-

17.4 Semantics

17.4.1 State Variables

- list: <T>, displayed entries
- pageNum: \mathbb{N} , current page
- keyword: String, filter keyword

17.4.2 Environment Variables

None

17.4.3 Assumptions

Activity is a generic type $\langle T \rangle$ and it can be instantiated with type Lecture and Event. The singleton module Permission is accessible from this module.

17.4.4 Access Routine Semantics

Initialize():

- transition: $list, pageNum, keyword := \text{all type } T \text{ entries in the database, } 1, \text{ null}$
- output: none
- exception: none

Display():

- transition: Display a list of event T , where $T := list.filter(keyword)[(pageNum - 1) * PAGECOUNT, pageNum * PAGECOUNT]$
- output: none
- exception: none

nextPage():

- transition: $pageNum * PAGECOUNT < list.length \Rightarrow pageNum := pageNum + 1$
- output: none
- exception: none

prevPage():

- transition: $pageNum > 1 \Rightarrow pageNum := pageNum - 1$
- output: none
- exception: none

firstPage():

- transition: $pageNum := 1$
- output: none
- exception: none

lastPage():

- transition: $pageNum := \text{int}(list / PAGECOUNT) + 1$

- output: none
- exception: none

Add(list, T):

- transition: none
- output: $out := Permission.isAdmin \Rightarrow list := list + \{T\}$ and update database
- exception: none

17.4.5 Local Functions

None

17.4.6 Local Constants

PAGECOUNT: number of entries shown in one page

18 MIS of Database Module

18.1 Module

FirestoreDatabase

This module uses Firebase Realtime Database library. For details of all syntax and semantics of exported constants and access programs, see [Firestore database documentation](#).

18.2 Uses

18.3 Syntax

18.3.1 Exported Constants

See [Firestore database documentation](#).

18.3.2 Exported Access Programs

The following table will show some functions the application uses most frequently, for more details, see [Firestore database documentation](#).

Name	In	Out	Exceptions
Child	String	DatabaseReference	PermissionDenied, NetworkError, ExpiredToken
HasChild	String	\mathbb{B}	PermissionDenied, NetworkError, ExpiredToken
RemoveValueAsync	String	Task< \mathbb{B} >	PermissionDenied, NetworkError, ExpiredToken
SetValueAsync	String, String	Task< \mathbb{B} >	PermissionDenied, NetworkError, ExpiredToken
GetValueAsync	String	Task<DataSnapshot>	PermissionDenied, NetworkError, ExpiredToken
GoOffline	-	-	PermissionDenied, NetworkError, ExpiredToken
GoOnline	-	-	PermissionDenied, NetworkError, ExpiredToken

18.4 Semantics

18.4.1 State Variables

None

18.4.2 Environment Variables

- DBreference: `Firebase.Database.DatabaseReference`
A reference to the root location of this database
- User: `Firebase.Auth.FirebaseUser`
The current user that operates this database
- PermittedUsers: set of String
The list of user emails that are allowed to read the database content
- Admins: set of String
The list of user emails that are allowed to edit the database content

18.4.3 Assumptions

Assume the database connection is stable and it will not disconnect unless the user disconnect it manually.

18.4.4 Access Routine Semantics

Child(pathString):

- transition: none
- output: $out := \text{DatabaseReference to pathString relative to the root}$
- exception: $exc := NoInternet \Rightarrow NetworkError \mid TokenExpired \Rightarrow ExpiredToken \mid User.email \notin PermittedUsers \Rightarrow PermissionDenied$

HasChild(pathString):

- transition: none
- output: $out := DBreference.Child(pathString) = \text{null}$
- exception: $exc := NoInternet \Rightarrow NetworkError \mid TokenExpired \Rightarrow ExpiredToken \mid User.email \notin PermittedUsers \Rightarrow PermissionDenied$

RemoveValueAsync(pathString):

- transition: $DBreference.Child(pathString) := \text{null}$
- output: $out := DBreference.HasChild(pathString)$
- exception: $exc := NoInternet \Rightarrow NetworkError \mid TokenExpired \Rightarrow ExpiredToken \mid User.email \notin Admins \Rightarrow PermissionDenied$

SetValueAsync(pathString, value):

- transition: $DBreference.Child(pathString) := value$
- output: $out := DBreference.Child(pathString) = value$
- exception: $exc := NoInternet \Rightarrow NetworkError \mid TokenExpired \Rightarrow ExpiredToken \mid User.email \notin Admins \Rightarrow PermissionDenied$

GetValueAsync(pathString):

- transition: none
- output: $out := \text{Snapshot of } DBreference.Child(pathString)$

- exception: $exc := NoInternet \Rightarrow NetworkError \mid TokenExpired \Rightarrow ExpiredToken \mid User.email \notin PermittedUsers \Rightarrow PermissionDenied$

GoOffline():

- transition: Manually disconnect the FirebaseDatabase client from the server and disable automatic reconnection.
- output: none
- exception: $exc := NoInternet \Rightarrow NetworkError \mid TokenExpired \Rightarrow ExpiredToken \mid User.email \notin Admins \Rightarrow PermissionDenied$

GoOnline():

- transition: Manually reestablish a connection to the FirebaseDatabase server and enable automatic reconnection.
- output: none
- exception: $exc := NoInternet \Rightarrow NetworkError \mid TokenExpired \Rightarrow ExpiredToken \mid User.email \notin Admins \Rightarrow PermissionDenied$

18.4.5 Local Functions

None

19 MIS of Server Module

19.1 Module

RTCServer

19.2 Uses

19.3 Syntax

19.3.1 Exported Constants

19.3.2 Exported Access Programs

Name	In	Out	Exceptions
SendMessage	User, String	Task	-
SendLocationGroup	Double, Double, Double	Task	-

19.4 Semantics

19.4.1 State Variables

19.4.2 Environment Variables

19.4.3 Assumptions

User identifiers are unique.

19.4.4 Access Routine Semantics

SendMessage(recipient, msg):

- transition: none
- output: $out := \text{Task}$; $out.IsCompleted := \text{True}$
- exception: none

SendLocation(friendGroup, lat, lon):

- transition: none
- output: $out := \text{Task}$; $out.IsCompleted := \text{True}$
- exception: none

19.4.5 Local Functions

None

20 MIS of AR Camera

20.1 Module

AR Camera

20.2 Uses

20.3 Syntax

20.3.1 Exported Constants

20.3.2 Exported Access Programs

Name	In	Out	Exceptions
DetectTarget-		-	-

20.4 Semantics

20.4.1 State Variables

20.4.2 Environment Variables

- cameraFeed: 2D array of pixels
- sceneCamera: Camera
- imageTargets: list of Target
- scanTargets: list of Target

20.4.3 Assumptions

20.4.4 Access Routine Semantics

DetectTarget():

- transition: Implicitly invokes the AR Interface when a valid target is detected.
- output: none
- exception: none

20.4.5 Local Functions

None

21 MIS of AR Interface

21.1 Module

AR Interface

21.2 Uses

AR Camera

21.3 Syntax

21.3.1 Exported Constants

21.3.2 Exported Access Programs

Name	In	Out	Exceptions
Initialize	(String, <3D Objects>)	<3D -	IllegalArgumentException Exception
Display	String	-	IllegalArgumentException Exception

21.4 Semantics

21.4.1 State Variables

- dictionary: Dictionary<String, <3D Objects>>, the dictionary of target name and corresponding AR objects

21.4.2 Environment Variables

21.4.3 Assumptions

21.4.4 Access Routine Semantics

Initialize(target, objects):

- transition: $dictionary[target] := objects$
- output: none
- exception: $target \notin dictionary.keys \Rightarrow IllegalArgumentException$

Display(target):

- transition: Displays $dictionary[target]$ objects in Unity scene
- output: none
- exception: $target \notin dictionary.keys \Rightarrow IllegalArgumentException$

21.4.5 Local Functions

None

22 MIS of MapBox

22.1 Module

MapBox

Third party library Mapbox

22.2 Uses

22.3 Syntax

22.3.1 Exported Constants

22.3.2 Exported Access Programs

Name	In	Out	Exceptions
Map	-	-	IllegalArgument Exception
Display	-	-	-
ChangeStyle	String	-	IllegalArgument Exception
Pan	(\mathbb{R}, \mathbb{R})	-	
Zoom	\mathbb{N}	-	

22.4 Semantics

22.4.1 State Variables

- MapStyle: String
- MapCenter: (\mathbb{R}, \mathbb{R})
- Zoom: \mathbb{N}

22.4.2 Environment Variables

- APIKey: String

22.4.3 Assumptions

22.4.4 Access Routine Semantics

Map():

- transition: Check APIKey and initialize the map

- output: none
- exception: $exc := APIKeyexpires \Rightarrow IllegalArgumentException$

Display():

- transition: Displays a map with default state variables
- output: none
- exception: none

ChangeStyle(style):

- transition: $MapStyle := style$
- output: none
- exception: $exc := style \notin MAPSTYLES \Rightarrow IllegalArgumentException$

Pan((long, lat)):

- transition: $MapCenter := (long, lat)$
- output: none
- exception: none

Zoom(scale):

- transition: $Zoom := scale$
- output: none
- exception: none

22.4.5 Local Functions

None

22.4.6 Local Constants

MAPSTYLES = a sequences of map styles with type String

23 MIS of Map Interface

23.1 Module

Map Interface

23.2 Uses

Map Module, Server Module, Database Module

23.3 Syntax

23.3.1 Exported Constants

23.3.2 Exported Access Programs

Name	In	Out	Exceptions
HandleInputBuilding	-	-	-
DisplayAvatar	Uri, (\mathbb{R} , \mathbb{R})	-	-
DisplayUserHeatMap	-	-	-
DisplayEventHeatMap	-	-	-

23.4 Semantics

23.4.1 State Variables

- building: list of BuildingLocation

23.4.2 Environment Variables

- camera: Camera

23.4.3 Assumptions

23.4.4 Access Routine Semantics

HandleInputBuilding():

- transition: Opens user interface when a building marker is tapped
- output: none
- exception: none

DisplayAvatar(photoUri, (long, lat)):

- transition: Displays the corresponding avatar on the map at (long, lat)

- output: none
- exception: none

DisplayUserHeatMap():

- transition: Retrieves collected user location data from the database and plot them on the map
- output: none
- exception: none

DisplayEventHeatMap():

- transition: Retrieves collected event location data from the database and plot them on the map
- output: none
- exception: none

23.4.5 Local Functions

None

24 MIS of Friend Chat

24.1 Module

Friend Chat

24.2 Uses

Server Module

24.3 Syntax

24.3.1 Exported Constants

24.3.2 Exported Access Programs

Name	In	Out	Exceptions
StartConnection	String, String	-	-
SendMessage	User, String	-	-
ReceiveMessage	User, String	-	-

24.4 Semantics

24.4.1 State Variables

- connection: HubConnection
- onMessageReceived: Action

24.4.2 Environment Variables

24.4.3 Assumptions

24.4.4 Access Routine Semantics

StartConnection(url, handler):

- transition: Creates a new HubConnection and stores it in connection. Connects the given handler to the server endpoint.
- output: none
- exception: none

SendMessage(recipient, message):

- transition: Sends a message to the recipient through the server hub connection.

- output: none
- exception: none

ReceiveMessage(sender, message):

- transition: Receives a message from the server hub connection. The sender's id is received as well.
- output: none
- exception: none

24.4.5 Local Functions

None

25 Appendix

25.1 Database Tables

User

Column Name	Type	Description
email	String	ID of a user
nickName	(Optional) String	Nickname/display name of a user
photoUri	(Optional) Uri	Visual Avatar
program	(Optional) String	Study field
level	(Optional) int	Level of program
friends	(Optional) <User>	List of friends
friendRequests	(Optional) <User>	List of requesters
lectures	(Optional) <Lecture>	List of pinned lecture
events	(Optional) <Event>	List of pinned event

Lecture

Column Name	Type	Description
code	String	ID of a course, course code
name	(Optional) String	formal name of a course
instructor	(Optional) String	name of the instructor
time	(Optional) String	Includes start and end time in a weekly schedule
location	(Optional) String	Building and room

Event

Column Name	Type	Description
name	String	ID of an event
description	(Optional) String	event description
organizer	(Optional) String	organizer of the event
startTime	(Optional) DateTime	when it starts
duration	(Optional) int	how long is the event (in minutes)
location	(Optional) String	Building and room
isPublic	\mathbb{B}	If it is a public event

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