

Module Interface Specification for Software Engineering

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1 Revision History

Date	Version	Notes
Date 1	1.0	Notes
Date 2	1.1	Notes

2 Symbols, Abbreviations and Acronyms

See SRS Documentation at [\[give url —SS\]](#)

[\[Also add any additional symbols, abbreviations or acronyms —SS\]](#)

Contents

1	Revision History	i
2	Symbols, Abbreviations and Acronyms	ii
3	Introduction	1
4	Notation	1
5	Module Decomposition	1
6	MIS of the User data 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	3
6.4	Semantics	3
6.4.1	State Variables	3
6.4.2	Environment Variables	3
6.4.3	Assumptions	4
6.4.4	Access Routine Semantics	4
6.4.5	Local Functions	6
7	MIS of Info Profile data module	6
7.1	Module	6
7.2	Uses	6
7.3	Syntax	6
7.3.1	Exported Constants	6
7.3.2	Exported Access Programs	6
7.4	Semantics	7
7.4.1	State Variables	7
7.4.2	Environment Variables	7
7.4.3	Assumptions	7
7.4.4	Access Routine Semantics	7
7.4.5	Local Functions	8
8	MIS of the Fetch Trials Modules	9
8.1	Module	9
8.2	Uses	9
8.3	Syntax	9
8.3.1	Exported Constants	9
8.3.2	Exported Access Programs	9

8.4	Semantics	9
8.4.1	State Variables	9
8.4.2	Environment Variables	9
8.4.3	Assumptions	9
8.4.4	Access Routine Semantics	10
8.4.5	Local Functions	10
9	MIS of the Trial Filtering Module	10
9.1	Module	10
9.2	Uses	10
9.3	Syntax	10
9.3.1	Exported Constants	10
9.3.2	Exported Access Programs	11
9.4	Semantics	11
9.4.1	State Variables	11
9.4.2	Environment Variables	11
9.4.3	Assumptions	11
9.4.4	Access Routine Semantics	11
9.4.5	Local Functions	12
10	MIS of the Email Notification Module	13
10.1	Module	13
10.2	Uses	13
10.3	Syntax	13
10.3.1	Exported Constants	13
10.3.2	Exported Access Programs	13
10.4	Semantics	13
10.4.1	State Variables	13
10.4.2	Environment Variables	13
10.4.3	Assumptions	13
10.4.4	Access Routine Semantics	13
10.4.5	Local Functions	14
11	Appendix	16

3 Introduction

The following document details the Module Interface Specifications for REACH, a web application used to improve patients' access to clinical trials and practitioners' access to potential participants. More specifically, it will provide the list of modules that have been decomposed from the Module Guide, each with their interface specification, detailing important characteristics such as the module's methods and state variables.

Complementary documents, such as the System Requirement Specifications and Module Guide can be found at <https://github.com/davimang/REACH>.

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 $(-\infty, \infty)$

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	
Behaviour-Hiding	Input Parameters Output Format Output Verification Temperature ODEs Energy Equations Control Module Specification Parameters Module
Software Decision	Sequence Data Structure ODE Solver Plotting

Table 1: Module Hierarchy

6 MIS of the User data module

6.1 Module

User

6.2 Uses

PatientInfo, Trial

6.3 Syntax

6.3.1 Exported Constants

None

6.3.2 Exported Access Programs

Name	In	Out	Exceptions
getName	-	seq of char	-
setName	seq of char	-	EmptyName
getEmail	-	seq of char	-
setEmail	seq of char	-	InvalidEmail
getInfoProfiles	-	list of InfoProfile	-
getInfoProfile	integer	InfoProfile	InvalidInfoProfileId
addInfoProfile	InfoProfile	-	-
removeInfoProfile	integer	-	-
addTrial	Trial	-	-
removeTrial	integer	-	-
getTrials	-	list of Trial	-
getTrial	integer	Trial	InvalidTrialId

6.4 Semantics

6.4.1 State Variables

name: seq of char

email: seq of char

infoProfiles: list of PatientInfo

trials: list of Trial

6.4.2 Environment Variables

None

6.4.3 Assumptions

- Each InfoProfile has a unique id.
- Each Trial has a unique id.

6.4.4 Access Routine Semantics

getName():

- transition: N/A
- output: $\text{out} := \text{self.name}$
- exception: N/A

setName(newName: seq of char):

- transition: $\text{self.name} := \text{newName}$
- output: N/A
- exception: $\text{exc} := \text{length}(\text{newName}) == 0 \Rightarrow \text{EmptyName}$

getEmail():

- transition: N/A
- output: $\text{out} := \text{self.email}$
- exception: N/A

setEmail(newEmail: seq of char):

- transition: $\text{self.email} := \text{newEmail}$
- output: N/A
- exception: $\text{exc} := \text{isInvalidEmail}(\text{newEmail}) \Rightarrow \text{InvalidEmail}$

getInfoProfiles():

- transition: N/A
- output: $\text{out} := \text{self.infoProfiles}$
- exception: N/A

getInfoProfile(id: integer):

- transition: N/A

- output: $\text{out} := \{\exists i \in \text{self.infoProfiles} | i.id = id\} \Rightarrow i$
- exception: $\text{exc} := \neg\{\exists i \in \text{self.infoProfiles} | i.id = id\} \Rightarrow \text{InvalidInfoProfileId}$

addInfoProfile(newInfoProfile: InfoProfile):

- transition: $\text{self.infoProfiles} = \text{self.infoProfiles} + \text{newInfoProfile}$ (add the new infoprofile to the list of info profiles connected to the current user)
- output: N/A
- exception: N/A

removeInfoProfile(oldInfoProfile: InfoProfile):

- transition: $\text{self.infoProfiles} = \text{self.infoProfiles} - \text{oldInfoProfile}$ (remove the info profile passed to the method from the list of info profiles connected to the current user)
- output: N/A
- exception: N/A

getTrials():

- transition: N/A
- output: $\text{out} := \text{self.trials}$
- exception: N/A

getTrial(id: integer):

- transition: N/A
- output: $\text{out} := \{\exists i \in \text{self.trials} | i.id = id\} \Rightarrow i$
- exception: $\text{exc} := \neg\{\exists i \in \text{self.trials} | i.id = id\} \Rightarrow \text{InvalidTrialId}$

addTrial(newTrial: Trial):

- transition: $\text{self.trials} = \text{self.trials} + \text{newTrial}$ (same idea as add info profiles)
- output: N/A
- exception: N/A

removeTrial(oldTrial: Trial):

- transition: $\text{self.trials} = \text{self.trials} - \text{oldTrial}$ (same idea as remove info profiles)
- output: N/A
- exception: N/A

6.4.5 Local Functions

saveUser(user: User):

- transition: Saves the user to the database.
- output: N/A
- exception: N/A

loadUser(user: User):

- transition: Loads the user from the database.
- output: N/A
- exception: N/A

7 MIS of Info Profile data module

7.1 Module

InfoProfile

7.2 Uses

None

7.3 Syntax

7.3.1 Exported Constants

None

7.3.2 Exported Access Programs

Name	In	Out	Exceptions
getDOB	-	datetime	-
setDOB	datetime	-	-
getAddress	-	seq of char	-
setAddress	seq of char	-	-
getGender	-	seq of char	-
setGender	seq of char	-	-
getHealthDetails	-	map<seq of char: Any>	-
setHealthDetails	map<seq of char: Any>	-	-

7.4 Semantics

7.4.1 State Variables

dateOfBirth: datetime
address: seq of char
gender: seq of char
healthDetails: map<seq of char: Any>

7.4.2 Environment Variables

None

7.4.3 Assumptions

None

7.4.4 Access Routine Semantics

getDOB():

- transition: N/A
- output: out := self.dateOfBirth
- exception: N/A

setDOB(newDOB: datetime):

- transition: self.dateOfBirth = newDOB
- output: N/A
- exception: N/A

getAddress():

- transition: N/A
- output: out := self.address
- exception: N/A

setAddress(newAddress: seqOfChar):

- transition: self.address = newAddress
- output: N/A
- exception: N/A

getGender():

- transition: N/A
- output: out := self.gender
- exception: N/A

setGender(gender: seq of char):

- transition: self.gender = gender
- output: N/A
- exception: N/A

getHealthDetails():

- transition: N/A
- output: out := self.healthDetails
- exception: N/A

setHealthDetails(newHealthDetails: map<seq of char: Any>):

- transition: self.healthDetails = newHealthDetails
- output: N/A
- exception: N/A

7.4.5 Local Functions

saveInfoProfile(infoProfile: InfoProfile):

- transition: Saves the info profile to the database.
- output: N/A
- exception: N/A

loadInfoProfile(infoProfile: InfoProfile):

- transition: Loads the info profile from the database.
- output: N/A
- exception: N/A

8 MIS of the Fetch Trials Modules

8.1 Module

TrialFetcher

8.2 Uses

Trial

8.3 Syntax

8.3.1 Exported Constants

None

8.3.2 Exported Access Programs

Name	In	Out	Exceptions
getTrials	seq. of String, integer, String	DataFrame	MissingParameter, InvalidAge, InvalidAddress
getLocator	-	geocoder	-
setLocator	geocoder	-	-

8.4 Semantics

8.4.1 State Variables

locator: geocoder

8.4.2 Environment Variables

None

8.4.3 Assumptions

- Each Trial has a unique id.
- The trial API will always be accessible.

8.4.4 Access Routine Semantics

getTrials(conditions: sequence of String, age: int, address: String):

- transition: None
- output: $\text{out} := \text{DataFrame}$ populated with trials from the ClinicalTrials.gov API
- exception: $\text{exc} := (\text{age} \notin (0, 120] \rightarrow \text{InvalidAge}) \vee (\neg \text{checkAddress}(\text{address}) \rightarrow \text{InvalidAddress}) \vee ((\exists x.x \in \text{parameters} : x = \varepsilon) \rightarrow \text{MissingParameter})$

8.4.5 Local Functions

convertTrialsToDataFrame(rawData: csv):

- transition: None
- output: $\text{out} := \text{rawData}$ formatted as a DataFrame
- exception: None

checkAddress(address: String):

- transition: None
- output: $\text{out} := \text{True}$
- exception: $\text{exc} := (\text{geopy.geolocator}(\text{address}) = \text{exception} \rightarrow \text{False})$

9 MIS of the Trial Filtering Module

9.1 Module

TrialFilterer

9.2 Uses

Trial

9.3 Syntax

9.3.1 Exported Constants

None

9.3.2 Exported Access Programs

Name	In	Out	Exceptions
exportTrials	-	json	-
fetchTrials	seq. of String, integer, String	-	-
getLocator	-	geocoder	-
setLocator	geocoder	-	-

9.4 Semantics

9.4.1 State Variables

locator: geocoder

trials: DataFrame

9.4.2 Environment Variables

None

9.4.3 Assumptions

- Each Trial has a unique id.
- Exceptions are caught downstream by the TrialFetcher module

9.4.4 Access Routine Semantics

fetchTrials(conditions: sequence of String, age: int, address: String):

- transition: self.trials populated with trials via TrialFilterer module
- output: None
- exception: None

exportTrials():

- transition: None
- output: out:= self.trials as json
- exception: None

getLocator():

- transition: None

- output: $\text{out} := \text{self.locator}$
- exception: None

setLocator(loc: geocoder):

- transition: $\text{self.locator} = \text{loc}$
- output: None
- exception: None

9.4.5 Local Functions

cleanAge(stringAge: String):

- transition: None
- output: $\text{out} := (\text{inMonths} \rightarrow \text{int}(\text{stringAge})/12) \rightarrow \text{int}(\text{stringAge})$
- exception: $\text{exc} := \text{stringAge} \notin \mathbb{R} \rightarrow \text{InvalidAge}$

geodesicDistance(address: geocode, trialLocation: geocode):

- transition: None
- output: $\text{out} := \arccos(\sin(\text{address.latitude}) \cdot \sin(\text{trialLocation.latitude}) + \cos(\text{address.latitude}) \cdot \cos(\text{trialLocation.latitude}) \cdot \cos(\text{trialLocation.longitude} - \text{address.longitude})) \cdot 6371000$
- exception: None

calculateDistance():

- transition: $\text{self.trials}[\text{distance}] \mapsto \text{geodesicDistance}(\text{address}, \text{self.trials}[\text{trialLocation}])$
- output: None
- exception: None

convertToJSON(df: DataFrame):

- transition: None
- output: $\text{df} \rightarrow \text{json}(\text{df})$
- exception: None

10 MIS of the Email Notification Module

10.1 Module

NotificationModule, User, PatientInfo, Trial

10.2 Uses

10.3 Syntax

10.3.1 Exported Constants

None

10.3.2 Exported Access Programs

Name	In	Out	Exceptions
sendEmail	String, String	-	DeliveryFailed
getAPIKey	-	String	-
setAPIKey	String	-	-

10.4 Semantics

10.4.1 State Variables

APIKey: String

10.4.2 Environment Variables

connection: API connection

10.4.3 Assumptions

- Emler API is operational and accessible
- ClinicalTrial.gov API is operational and accessible

10.4.4 Access Routine Semantics

sendEmail(emailAddress: String, subject: String, body: String):

- transition: None
- output: out := email request sent through the emailing API
- exception: exc := emailer returns error code \rightarrow *DeliveryFailed*

getAPIKey():

- transition: None
- output: $\text{out} := \text{self.APIKey}$
- exception: None

setAPIKey(key: String):

- transition: $\text{self.APIKey} := \text{key}$
- output: None
- exception: None

10.4.5 Local Functions

findNewTrials():

- transition: None
- output: $\text{out} := \{ \text{trials} : \text{trial.postedDate} > \text{lastCheckedDate} \}$
- exception: None

matchUsersToNewTrials():

- transition: None
- output: $\text{out} := \{ \text{user} \times \text{trial} : \text{user.conditions} \subseteq \text{trial.conditions} \}$
- exception: None

References

- Carlo Ghezzi, Mehdi Jazayeri, and Dino Mandrioli. *Fundamentals of Software Engineering*. Prentice Hall, Upper Saddle River, NJ, USA, 2nd edition, 2003.
- Daniel M. Hoffman and Paul A. Strooper. *Software Design, Automated Testing, and Maintenance: A Practical Approach*. International Thomson Computer Press, New York, NY, USA, 1995. URL <http://citeseer.ist.psu.edu/428727.html>.

11 Appendix

[Extra information if required —SS]