

Iron Trainers

Relatório

4º ano do Mestrado Integrado de Engenharia Informática e Computação

Métodos Formais de Engenharia de Software

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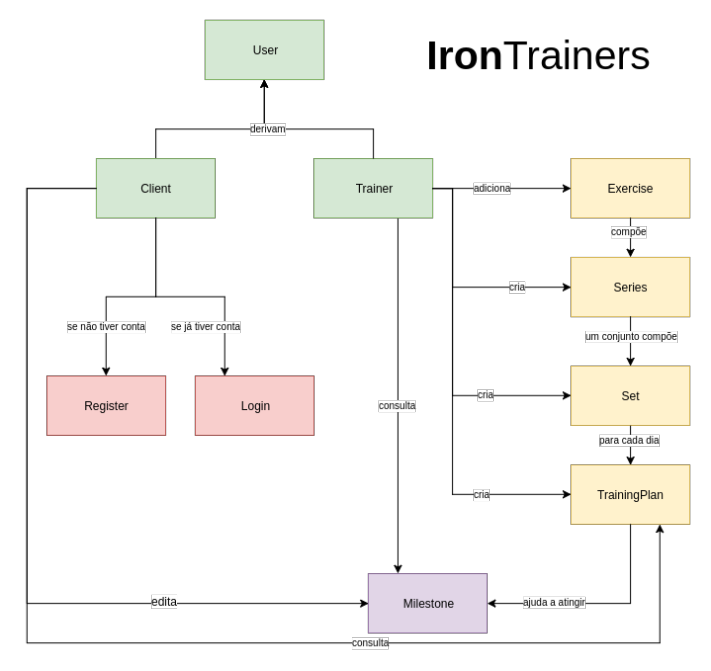
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# Descrição informal do sistema e lista de requisitos

## Descrição informal do sistema

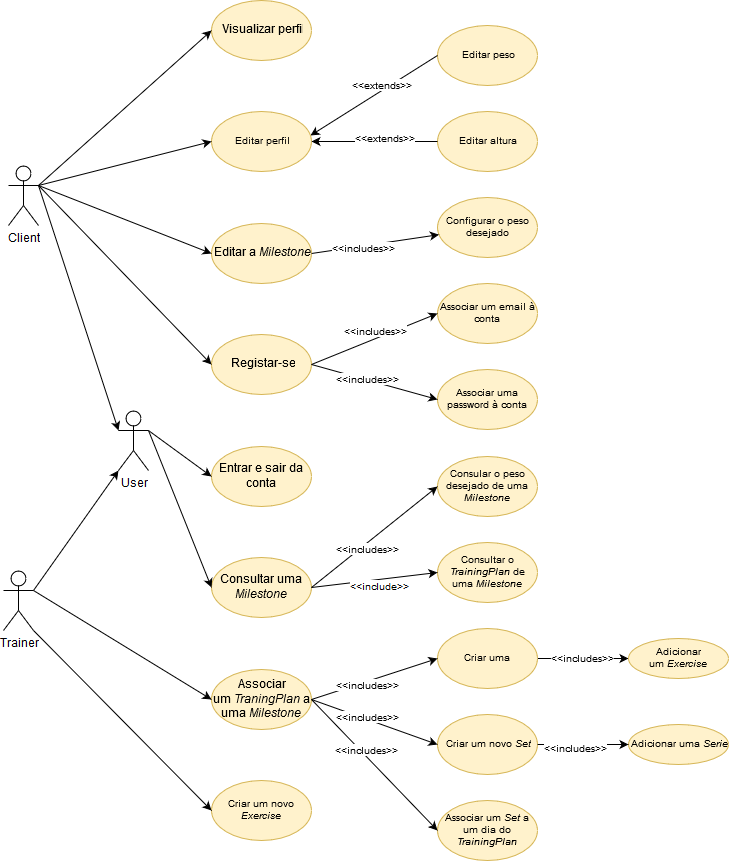


## Lista de requisitos

|  |  |  |
| --- | --- | --- |
| **ID** | **Prioridade** | **Descrição** |
| R1 | Obrigatório | Permitir que uma pessoa se possa registar na plataforma como *Client*, utilizando um email e uma password. Um utilizador não consegue criar uma conta se o email já estiver registado no sistema. |
| R2 | Obrigatório | Permitir que um utilizador registado (*Client* ou *Trainer*) possa fazer login e logout. |
| R3 | Obrigatório | Permitir que um *Client* possa visualizar o seu próprio perfil. |
| R4 | Obrigatório | Permitir que um *Client*possa editar as informações do seu perfil (peso e altura). |
| R5 | Obrigatório | Permitir a um *Client*ver e/ou definir a sua *Milestone.* |
| R6 | Obrigatório | Permitir a um *Client* consultar o *TrainingPlan* associado à sua *Milestone*. |
| R7 | Obrigatório | Permitir a um Trainer visualizar todos os exercícios existentes no sistema. |
| R8 | Obrigatório | Permitir a um *Trainer* adicionar um *Exercise*. |
| R9 | Obrigatório | Permitir a um *Trainer* criar uma *Series*. |
| R10 | Obrigatório | Permitir a um *Trainer* criar um *Set*. |
| R11 | Obrigatório | Permitir a um *Trainer* criar um *TrainingPlan*. |
| R12 | Obrigatório | Permitir a um *Trainer* procurar por um *Client.* |
| R13 | Obrigatório | Permitir que um *Trainer* possa observar a *Milestone* e o *TrainingPlan* de um *Client.* |
| R14 | Obrigatório | Permitir a um *Trainer* associar um *TrainingPlan* a uma *Milestone* de um *Client*. |
| R15 | Opcional | Permitir ao utilizador converter unidades de massa de quilograma (kg) para libras (lbs). |

# Modelos UML

## Modelo de casos de uso



Os casos de uso mais importantes são descritos em baixo.

|  |  |
| --- | --- |
| **Cenário** | **Registo de um utilizador** |
| **Descrição** | Um utilizador não registado pode registar-se como *Client* para usufruir de todas as funcionalidades do sistema. |
| **Pré-condições** | 1. O email inserido para registo não pode encontrar-se entre os utilizadores registados (*Client* e *Trainer*). 2. O email inserido tem entre 1 e 255 caracteres. 3. A password inserida tem entre 1 e 29 caracteres. 4. O nome tem entre 1 e 49 caracteres. 5. O peso e altura inseridos têm valores positivos. 6. A data de nascimento é menor que a data atual. 7. O género inserido só pode ser <F> (female) ou <M> (male). |
| **Pós-condições** | 1. O email inserido passa a encontrar-se nos utilizadores registados. 2. O utilizador registado é um *Client.* |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

|  |  |
| --- | --- |
| **Cenário** | **Iniciar sessão** |
| **Descrição** | Um utilizador registado pode iniciar sessão para usufruir das funcionalidades do sistema. O login é diferente para utilizadores do tipo *Client* e *Trainer*. |
| **Pré-condições** | 1. O email inserido para iniciar sessão encontra-se entre os utilizadores registados. 2. Não existe nenhum utilizador com sessão iniciada. 3. O email inserido tem entre 1 e 49 caracteres.   Para iniciar sessão como *Client:*   1. O email inserido pertence à conta de um *Client*.   Para iniciar sessão como *Trainer:*   1. O email inserido pertence à conta de um *Trainer*. |
| **Pós-condições** | (unspecified) |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

|  |  |
| --- | --- |
| **Cenário** | **Terminar sessão** |
| **Descrição** | Um utilizador com sessão iniciada pode terminar sessão. |
| **Pré-condições** | 1. Existe um utilizador com sessão iniciada. |
| **Pós-condições** | (unspecified) |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

|  |  |
| --- | --- |
| **Cenário** | **Visualizar perfil** |
| **Descrição** | Um *Client* pode visualizar o seu próprio perfil com a sua informação pessoal. |
| **Pré-condições** | 1. O utilizador deve ter sessão iniciada. 2. O utilizador deve ser um *Client.* |
| **Pós-condições** | (unspecified) |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

|  |  |
| --- | --- |
| **Cenário** | **Editar perfil** |
| **Descrição** | Um *Client* pode editar o seu próprio perfil (peso e/ou altura) |
| **Pré-condições** | 1. O utilizador deve ter sessão iniciada. 2. O utilizador deve ser um *Client.* 3. A altura (ou peso) inserida deve ter valores positivos. |
| **Pós-condições** | (unspecified) |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

|  |  |
| --- | --- |
| **Cenário** | **Editar a *Milestone*** |
| **Descrição** | Um *Client* pode editar a sua *Milestone* (peso que deseja atingir). |
| **Pré-condições** | 1. O utilizador deve ter sessão iniciada. 2. O utilizador com sessão iniciada deve ser um *Client*. 3. O “peso que se deseja atingir “ inserido deve ser positivo. |
| **Pós-condições** | (unspecified) |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

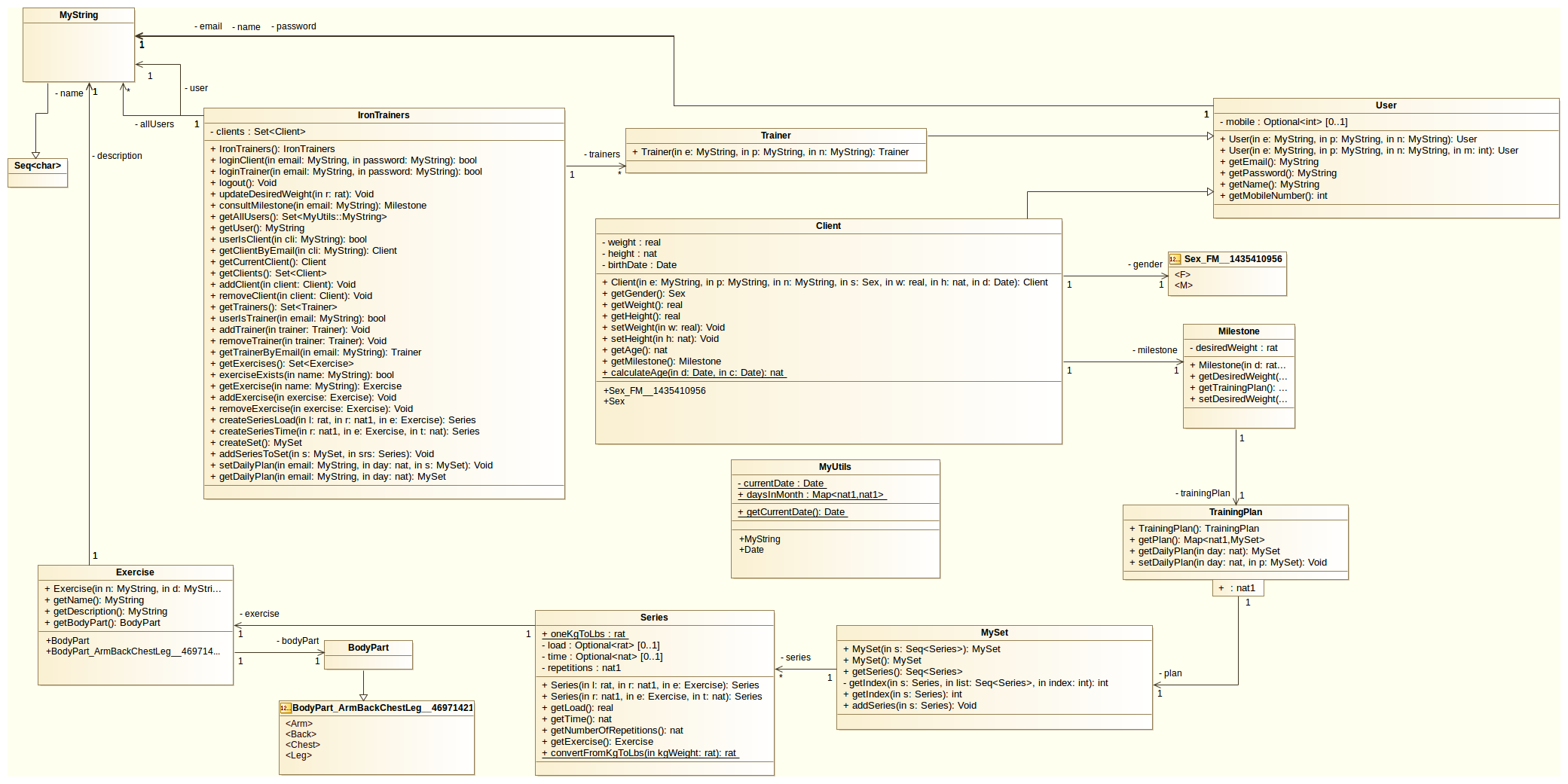
|  |  |
| --- | --- |
| **Cenário** | **Consultar uma *Milestone*** |
| **Descrição** | Um utilizador registado pode consultar uma *Milestone*. |
| **Pré-condições** | 1. O utilizador deve ter sessão iniciada.   Caso o utilizador seja um *Client*:   1. O utilizador com sessão iniciada deve ser um *Client*.   Caso o utilizador seja um *Trainer*:   1. O utilizador com sessão iniciada deve ser um *Trainer*. |
| **Pós-condições** | (unspecified) |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

|  |  |
| --- | --- |
| **Cenário** | **Associar um *TrainingPlan* a uma *Milestone*** |
| **Descrição** | Um treinador, com base no peso e peso que um *Client* pretende atingir, associa um plano de treino a esse mesmo cliente. |
| **Pré-condições** | 1. O utilizador tem sessão iniciada. 2. O utilizador com sessão iniciada é um *Trainer*. 3. O utilizador cujo treino é suposto ser alterado deve ser um *Client*. |
| **Pós-condições** | (unspecified) |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

|  |  |
| --- | --- |
| **Cenário** | **Adicionar um novo exercício** |
| **Descrição** | Um treinador adiciona um exercício ao sistema. |
| **Pré-condições** | 1. O utilizador deve ter sessão iniciada. 2. O utilizador com sessão iniciada deve ser um *Trainer*. 3. O exercício que se pretende inserir não deve encontrar-se no sistema. |
| **Pós-condições** | 1. O exercício inserido encontra-se na lista de exercícios existentes. |
| **Passos** | (unspecified) |
| **Exceções** | (unspecified) |

## Modelo de classes

### Classes



### Classes de teste

# 

# Modelo formal

## User

**class** User

**instance variables**

email : MyUtils`MyString;

password : MyUtils`MyString;

name : MyUtils`MyString;

mobile : [**int**];

**operations**

-- Constructor of user without mobile phone

**public** User : MyUtils`MyString \* MyUtils`MyString \* MyUtils`MyString ==> User

User(e, p, n) == (

email := e;

password := p;

name := n;

mobile := nil;

)

**pre** len e > 0 and len e < 256

and len p > 0 and len p < 30

and len n > 0 and len n < 50;

-- Constructor of user with mobile phone

**public** User : MyUtils`MyString \* MyUtils`MyString \* MyUtils`MyString \* **int** ==> User

User(e, p, n, m) == (

email := e;

password := p;

name := n;

mobile := m;

)

**pre** len e > 0 and len e < 256

and len p > 0 and len p < 30

and len n > 0 and len n < 50

and (m div 10\*\*8) = 9; -- begins with 9 and has 9 numbers

-- Get email of user

**pure** **public** getEmail : () ==> MyUtils`MyString

getEmail() == return email;

-- Get password of user

**public** getPassword : () ==> MyUtils`MyString

getPassword() == return password;

-- Get name of user

**public** getName : () ==> MyUtils`MyString

getName() == return name;

**public** getMobileNumber : () ==> **int**

getMobileNumber() == return mobile;

**end** User

## Client

**class** Client **is subclass of** User

**types**

**public** Sex = **<F>** | **<M>**

**inv** s == s = <F> or s = <M>;

**instance variables**

gender : Sex;

weight : **real**;

height : **nat**;

birthDate : MyUtils`Date;

milestone : Milestone;

-- Invariants

**inv** weight > 0 and height > 0;

**operations**

-- Constructor

**public** Client : MyUtils`MyString \* MyUtils`MyString \* MyUtils`MyString \* Sex \* **real** \* **nat** \* MyUtils`Date ==> Client

Client(e, p, n, s, w, h, d) == (

gender := s;

weight := w;

height := h;

birthDate := d;

milestone := new Milestone(0.0);

User(e, p, n);

)

**pre** w > 0 and h > 0

and d.day <= MyUtils`daysInMonth(d.month);

-- Get gender

**public** getGender : () ==> Sex

getGender() == return gender

**pre** not gender = nil;

-- Get weight

**public** getWeight : () ==> **real**

getWeight() == return weight;

-- Get height

**public** getHeight : () ==> **real**

getHeight() == return height;

-- Set weight

**public** setWeight : **real** ==> ()

setWeight(w) == weight := w

**pre** not w <= 0;

-- Set height

**public** setHeight : **nat** ==> ()

setHeight(h) == height := h

**pre** not h <= 0;

-- Get age

**public** getAge : () ==> **nat**

getAge() == return calculateAge(birthDate, MyUtils`getCurrentDate());

-- Get milestone

**public** getMilestone : () ==> Milestone

getMilestone() == return milestone;

**functions**

**public** calculateAge : MyUtils`Date \* MyUtils`Date -> **nat**

calculateAge(d, c) ==

c.year - d.year

**pre** c.year > d.year and d.year > 0

and c.month > 0 and c.month <= 12

and d.month > 0 and d.month <= 12

and c.day > 0 and c.day <= 31

and d.day > 0 and d.day <= 31;

**end** Client

## Trainer

**class** Trainer **is subclass of** User

**operations**

**public** Trainer : MyUtils`MyString \* MyUtils`MyString \* MyUtils`MyString ==> Trainer

Trainer(e, p, n) == (

User(e, p, n);

);

**end** Trainer

## Exercise

**class** Exercise

**types**

**public** BodyPart = **<Leg>** | **<Arm>** | **<Chest>** | **<Back>**

**inv** b == b = <Leg> or b = <Arm> or b = <Chest> or b = <Back>;

**instance variables**

name : MyUtils`MyString;

description : MyUtils`MyString;

bodyPart : BodyPart;

**inv** len name > 0 and len name < 50

and len description > 0 and len description < 250;

**operations**

**public** Exercise : MyUtils`MyString \* MyUtils`MyString \* BodyPart ==> Exercise

Exercise(n, d, b) == (

name := n;

description := d;

bodyPart := b;

)

**pre** len n > 0 and len n < 50

and len d > 0 and len d < 250;

**public** **pure** getName : () ==> MyUtils`MyString

getName() == return name;

**public** getDescription : () ==> MyUtils`MyString

getDescription() == return description;

**public** getBodyPart : () ==> BodyPart

getBodyPart() == return bodyPart;

**end** Exercise

## Series

**class** Series

**values**

**public** oneKgToLbs = 2.20462262;

**instance variables**

load : [**rat**];

time : [**nat**];

repetitions: **nat1**;

exercise : Exercise;

**inv** repetitions > 0;

**operations**

**public** Series : **rat** \* **nat1** \* Exercise ==> Series

Series(l, r, e) == (

load := l;

repetitions:= r;

exercise := e;

time := nil;

)

**pre** l > 0 and r > 0

**post** load > 0;

**public** Series : **nat1** \* Exercise \* **nat** ==> Series

Series(r, e, t) == (

repetitions:= r;

exercise := e;

time := t;

load := nil;

)

**pre** t > 0 and r > 0

**post** time > 0;

**public** getLoad : () ==> **real**

getLoad() == return load

**pre** load <> nil;

**public** getTime : () ==> **nat**

getTime() == return time

**pre** time <> nil;

**public** getNumberOfRepetitions : () ==> **nat**

getNumberOfRepetitions() == return repetitions;

**public** getExercise : () ==> Exercise

getExercise() == return exercise;

**functions**

**public** convertFromKgToLbs: **rat** -> **rat**

convertFromKgToLbs(kgWeight) == kgWeight \* oneKgToLbs

**pre** kgWeight > 0;

**end** Series

## MySet

**class** MySet

**instance variables**

series : **seq** **of** Series;

**operations**

**public** MySet : **seq** **of** Series ==> MySet

MySet(s) == (

series := s;

);

**public** MySet : () ==> MySet

MySet() == (

series := [];

);

**public** getSeries : () ==> **seq** **of** Series

getSeries() == return series;

-- Verifies if an element s exists in seq. If so, returns its index, else returns -1.

**private** getIndex : Series \* **seq** **of** Series \* **int** ==> **int**

getIndex(s, list, index) ==

if len list = 0

**then** return -1

**else** if (s = hd list)

**then** return index

**else** getIndex(s, tl list, index + 1)

**pre** index >= 0 and len list >= 0;

-- Verifies if an element s exists in seq. If so, returns its index, else returns -1.

**public** getIndex : Series ==> **int**

getIndex(s) ==

return getIndex(s, series, 0);

-- Adds series to series

**public** addSeries : Series ==> ()

addSeries(s) ==

if getIndex(s) = -1

**then** series := series ^ [s];

**end** MySet

## TrainingPlan

**class** TrainingPlan

**instance variables**

plan : **map** **nat1** **to** MySet;

**operations**

**public** TrainingPlan : () ==> TrainingPlan

TrainingPlan() == (

plan := { |-> }; -- empty map

);

**public** getPlan : () ==> **map** **nat1** **to** MySet

getPlan() ==

return plan;

**public** getDailyPlan : **nat** ==> MySet

getDailyPlan(day) ==

return plan(day)

**pre** day > 0;

**public** setDailyPlan : **nat** \* MySet ==> ()

setDailyPlan(day, p) ==

plan(day) := p

**pre** day > 0;

**end** TrainingPlan

## Milestone

**class** Milestone

**instance variables**

desiredWeight : **rat**;

trainingPlan : TrainingPlan;

-- Invariants

**inv** desiredWeight >= 0;

**operations**

**public** Milestone : **rat** ==> Milestone

Milestone(d) == (

desiredWeight := d;

trainingPlan := new TrainingPlan();

)

**pre** d >= 0;

**public** getDesiredWeight : () ==> **rat**

getDesiredWeight() == return desiredWeight;

**public** getTrainingPlan : () ==> TrainingPlan

getTrainingPlan() == return trainingPlan;

**public** setDesiredWeight : **rat** ==> ()

setDesiredWeight(w) ==

desiredWeight := w

**pre** w >= 0;

**end** Milestone

## MyUtils

**class** MyUtils

**types**

**public** MyString = **seq1** **of** **char**;

**public** Date::

day : **nat1**

month: **nat1**

year : **nat**

**inv** d == d.month > 0 and d.month <= 12

and d.day > 0 and d.day <= 31

and d.year > 1900;

**values**

**private** currentDate = mk\_Date(3, 1, 2018);

**instance variables**

**public** **static** daysInMonth : **map** **nat1** **to** **nat1** := {

1 |-> 31,

2 |-> 29,

3 |-> 31,

4 |-> 30,

5 |-> 31,

6 |-> 30,

7 |-> 31,

8 |-> 31,

9 |-> 30,

10 |-> 31,

11 |-> 30,

12 |-> 31

};

**operations**

**public** **static** getCurrentDate: () ==> Date

getCurrentDate() ==

(

return currentDate;

);

**end** MyUtils

## IronTrainers

**class** IronTrainers

**instance variables**

clients : **set** **of** Client;

trainers : **set** **of** Trainer;

allUsers : **set** **of** MyUtils`MyString;

exercises : **set** **of** Exercise;

user : MyUtils`MyString;

**operations**

**public** IronTrainers : () ==> IronTrainers

IronTrainers() == (

clients := {};

trainers := {};

allUsers := {};

exercises := {};

user := "undefined";

);

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* LOGIN & LOGOUT \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- Login in the application

**public** loginClient : MyUtils`MyString \* MyUtils`MyString ==> **bool**

loginClient(email, password) ==

if getClientByEmail(email).getPassword() = password

**then** (

user := email;

return true;

)

**else** return false

**pre** len email > 0 and len email < 50

and {email} inter allUsers <> {}

and userIsClient(email) and user = "undefined";

-- Login in the application

**public** loginTrainer : MyUtils`MyString \* MyUtils`MyString ==> **bool**

loginTrainer(email, password) ==

if getTrainerByEmail(email).getPassword() = password

**then** (

user := email;

return true;

)

**else** return false

**pre** len email > 0 and len email < 50

and {email} inter allUsers <> {}

and userIsTrainer(email) and user = "undefined";

-- Logout from the application

**public** logout : () ==> ()

logout() ==

user := "undefined"

**pre** not user = "undefined"

and {user} inter allUsers <> {};

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* MILESTONE \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- A client updates its own desired weight

**public** updateDesiredWeight : **rat** ==> ()

updateDesiredWeight(r) ==

let cli = getClientByEmail(user)

**in**

if isofclass(Client, cli)

**then** cli.getMilestone().setDesiredWeight(r)

**pre** userIsClient(user) = true and user <> "undefined";

-- An user consults its own milestone

**public** consultMilestone : MyUtils`MyString ==> Milestone

consultMilestone(email) ==

let cli = getClientByEmail(email)

**in**

if isofclass(Client, cli)

**then** return cli.getMilestone()

**else** return new Milestone()

**pre** (userIsClient(user) or userIsTrainer(user))

and user <> "undefined";

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* USER \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- Returns all users

**pure** **public** getAllUsers : () ==> **set** **of** MyUtils`MyString

getAllUsers() == return allUsers;

-- Returns user

**public** getUser : () ==> MyUtils`MyString

getUser() == return user;

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* CLIENT \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- Checks if user is a client

**public** **pure** userIsClient : MyUtils`MyString ==> **bool**

userIsClient(cli) == (

for **all** c **in set** clients **do** (

if cli = c.getEmail()

**then** return true

);

return false;

);

-- Gets client by email

**public** getClientByEmail : MyUtils`MyString ==> Client

getClientByEmail(cli) == (

for **all** c **in set** clients **do** (

if cli = c.getEmail()

**then** return c;

);

return new Client();

)

**pre** userIsClient(cli);

-- Gets current logged in user

**public** getCurrentClient : () ==> Client

getCurrentClient() == (

return getClientByEmail(user);

)

**pre** user <> "undefined" and userIsClient(user);

-- Returns all registered clients

**pure** **public** getClients : () ==> **set** **of** Client

getClients() == return clients;

-- Adds client to registered clients.

**public** addClient : Client ==> ()

addClient(client) == (

atomic(

clients := clients union {client};

allUsers := allUsers union {client.getEmail()}

);

)

**pre** ({client} inter clients = {}) and client.getEmail() not **in set** allUsers

**post** client in **set** clients and client.getEmail() in **set** allUsers;

-- Removes client from registered clients

**public** removeClient : Client ==> ()

removeClient(client) == (

atomic(

clients := clients \ {client};

allUsers := allUsers \ {client.getEmail()}

);

)

**pre** client in **set** clients and client.getEmail() in **set** allUsers

**post** client not **in set** clients and {client.getEmail()} inter allUsers = {};

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* TRAINERS \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- Returns all trainers

**pure** **public** getTrainers : () ==> **set** **of** Trainer

getTrainers() == return trainers;

-- Checks if user is a trainer

**public** **pure** userIsTrainer : MyUtils`MyString ==> **bool**

userIsTrainer(email) == (

for **all** t **in set** trainers **do** (

if email = t.getEmail()

**then** return true

);

return false;

);

-- Adds trainer to trainers. If can't add trainer, it returns false

**public** addTrainer : Trainer ==> ()

addTrainer(trainer) == (

atomic(

trainers := trainers union {trainer};

allUsers := allUsers union {trainer.getEmail()};

);

)

**pre** trainer not **in set** trainers and trainer.getEmail() not **in set** allUsers

**post** trainer in **set** trainers;

-- Removes trainer from trainers

**public** removeTrainer : Trainer ==> ()

removeTrainer(trainer) ==

(

atomic(

trainers := trainers \ {trainer};

allUsers := allUsers \ {trainer.getEmail()};

);

)

**pre** ({trainer} subset trainers) = true and trainer.getEmail() in **set** allUsers

**post** ({trainer} subset trainers) = false;

-- Gets trainer by email

**public** getTrainerByEmail : MyUtils`MyString ==> Trainer

getTrainerByEmail(email) == (

for **all** t **in set** trainers **do** (

if email = t.getEmail()

**then** return t;

);

return new Trainer();

)

**pre** userIsTrainer(email);

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* EXERCISES \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- Gets alls exercises in exercises set

**public** getExercises : () ==> **set** **of** Exercise

getExercises() == (

return exercises;

);

-- Checks if exercise exists

**public** **pure** exerciseExists : MyUtils`MyString ==> **bool**

exerciseExists(name) == (

for **all** ex **in set** exercises **do** (

if (name = ex.getName())

**then** return true;

);

return false;

);

-- Gets exercise in exercises set by name

**public** getExercise : MyUtils`MyString ==> Exercise

getExercise(name) == (

for **all** ex **in set** exercises **do** (

if (name = ex.getName())

**then** return ex;

);

return new Exercise();

)

**pre** exerciseExists(name);

-- Adds exercise to exercises set

**public** addExercise : Exercise ==> ()

addExercise(exercise) == (

exercises := exercises union {exercise}

)

**pre** not {exercise} subset exercises

**post** {exercise} subset exercises;

-- Removes exercise from exercises set

**public** removeExercise : Exercise ==> ()

removeExercise(exercise) == (

exercises := exercises \ {exercise}

)

**pre** {exercise} subset exercises

**post** not {exercise} subset exercises;

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* SERIES \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- Creates a series (load)

**public** createSeriesLoad : **rat** \* **nat1** \* Exercise ==> Series

createSeriesLoad(l, r, e) == (

return new Series(l, r, e);

);

-- Creates a series (time)

**public** createSeriesTime : **nat1** \* Exercise \* **nat** ==> Series

createSeriesTime(r, e, t) == (

return new Series(r, e, t);

);

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* SET \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- Creates a set

**public** createSet : () ==> MySet

createSet() == (

return new MySet();

);

-- Add series to set

**public** addSeriesToSet : MySet \* Series ==> ()

addSeriesToSet(s, srs) ==

s.addSeries(srs);

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* TRAINING PLAN \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

-- A trainer creates a daily plan to add to the training plan of a client

**public** setDailyPlan : MyUtils`MyString \* **nat** \* MySet==> ()

setDailyPlan(email, day, s) == (

let cli = getClientByEmail(email)

**in**

(

cli.getMilestone().getTrainingPlan().setDailyPlan(day, s);

)

)

**pre** userIsClient(email) and userIsTrainer(user);

-- A trainer consults a daily plan of the training plan of a client

**public** getDailyPlan : MyUtils`MyString \* **nat**==> MySet

getDailyPlan(email, day) == (

let cli = getClientByEmail(email)

**in**

(

return cli.getMilestone().getTrainingPlan().getDailyPlan(day);

)

)

**pre** userIsClient(email) and ( userIsTrainer(user) or userIsClient(user));

**end** IronTrainers

# Validação do modelo

## Test

**class** Test

**operations**

-- fails if expected is not equal to actual

**protected** **static** assertEquals: ? \* ? ==> ()

assertEquals(expected, actual) ==

if expected <> actual **then**

(

IO`print("Actual value(");

IO`print(actual);

IO`print(") different from expected (");

IO`print(expected);

IO`print(")\n");

)

**post** expected = actual;

**protected** **static** assertNotEquals: ? \* ? ==> ()

assertNotEquals(expected, actual) ==

if expected = actual **then**

(

IO`print("Actual value(");

IO`print(actual);

IO`print(") equal is equal to expected (");

IO`print(expected);

IO`print(") when it SHOULDN'T be.\n");

)

**post** expected <> actual;

**public** **static** run: () ==> ()

run() ==

(

UserTest`run();

TrainerTest`run();

ClientTest`run();

MilestoneTest`run();

ExerciseTest`run();

SeriesTest`run();

SetTest`run();

TrainingPlanTest`run();

IronTrainersTest`run();

TestCases`run();

);

**end** Test

## UserTest

**class** UserTest **is subclass of** Test

**instance variables**

testEmail: **seq** **of** **char** := "testEmail";

testPassword: **seq** **of** **char** := "testPassword";

testName: **seq** **of** **char** := "testName";

testMobileNumber : **int** := 911911911;

emptyEmail: **seq** **of** **char** := "";

emptyPassword: **seq** **of** **char** := "";

emptyName: **seq** **of** **char** := "";

invalidMobileNumber1: **int** := 911;

invalidMobileNumber2: **int** := 199119119;

u1 : User := new User(testEmail, testPassword, testName);

u2 : User := new User(testEmail, testPassword, testName, testMobileNumber);

**operations**

**private** testConstructor: () ==> ()

testConstructor() ==

(

assertEquals(u1.getEmail(), testEmail);

assertEquals(u1.getPassword(), testPassword);

assertEquals(u1.getName(), testName);

assertEquals(u2.getEmail(), testEmail);

assertEquals(u2.getPassword(), testPassword);

assertEquals(u2.getName(), testName);

assertEquals(u2.getMobileNumber(), testMobileNumber);

);

**private** testWithEmptyInputs: () ==> ()

testWithEmptyInputs() ==

(

assertEquals(new User(emptyEmail, emptyPassword, emptyName), nil);

);

**private** testWithInvalidMobileNumber: () ==> ()

testWithInvalidMobileNumber() ==

(

--assertEquals(new User(testEmail, testPassword, testName, invalidMobileNumber1),nil);

assertEquals(new User(testEmail, testPassword, testName, invalidMobileNumber2),nil);

);

**public** **static** run: () ==> ()

run() ==

(

**new** UserTest().testConstructor();

/\*\*\*\*\* TEST CASES WITH INVALID INPUTS (EXECUTE ONE AT A TIME) \*\*\*\*\*\*/

--new UserTest().testWithInvalidMobileNumber(); -- does not respect mobile number pre-condition

--new UserTest().testWithEmptyInputs();

);

**traces**

-- test cases will be generated in all possible combinations

-- must use the 'Combinatory Testing' (CT) perspective

-- calls u.getName() 1 to 5 times when selecting Full Evaluation

-- if we use 'Filtered Evaluation' we can random the number of times it is called

-- these tests do not account for coverage

GetNameSeveralTimes:

u1.getName(){1, 5};

**end** UserTest

## ClientTest

**class** ClientTest **is subclass of** Test

**instance variables**

-- To import a type from another classe, use Class`Type (with the '`' character).

testEmail: **seq** **of** **char** := "testEmail";

testPassword: **seq** **of** **char** := "testPassword";

testName: **seq** **of** **char** := "testName";

testMobileNumber : **int** := 911911911;

testGender : Client`Sex := <F>;

testGender2 : Client`Sex := <M>;

testWeight: **real** := 65.0;

testHeight: **int** := 180;

testBirthDate: MyUtils`Date := mk\_MyUtils`Date(2, 3, 1980);

c1 : Client := new Client(testEmail, testPassword, testName, testGender, testWeight, testHeight, testBirthDate);

c2 : Client := new Client(testEmail, testPassword, testName, testGender2, testWeight, testHeight, testBirthDate);

**operations**

**private** testConstructor: () ==> ()

testConstructor() ==

(

assertEquals(c1.getEmail(), testEmail);

assertEquals(c1.getPassword(), testPassword);

assertEquals(c1.getName(), testName);

assertEquals(c1.getGender(), testGender);

assertEquals(c1.getWeight(), testWeight);

assertEquals(c1.getHeight(), testHeight);

assertEquals(c1.getAge(), MyUtils`getCurrentDate().year - testBirthDate.year);

);

/\*\*\* USE CASE SCENARIO R4 AND R5: Edit Profile and Change Milestone \*\*\*/

-- A user may change its information.

-- A user may change its milestone.

**private** testSetters: () ==> ()

testSetters() ==

(

**dcl** newHeight : **nat** := 2;

**dcl** newWeight : **real** := 1.2;

**dcl** newDesiredWeight : **rat** := 60.0;

c1.setWeight(newWeight);

assertEquals(c1.getWeight(), newWeight);

c1.setHeight(newHeight);

assertEquals(c1.getHeight(), newHeight);

c1.getMilestone().setDesiredWeight(newDesiredWeight);

assertEquals(c1.getMilestone().getDesiredWeight(), newDesiredWeight);

);

**public** **static** run: () ==> ()

run() ==

(

**new** ClientTest().testConstructor();

**new** ClientTest().testSetters();

);

**end** ClientTest

## TrainerTest

**class** Trainer **is subclass of** User

**operations**

**public** Trainer : MyUtils`MyString \* MyUtils`MyString \* MyUtils`MyString ==> Trainer

Trainer(e, p, n) == (

User(e, p, n);

);

**end** Trainer

## ExerciseTest

**class** ExerciseTest **is subclass of** Test

**instance variables**

testName : **seq** **of** **char** := "testName";

testDescription: **seq** **of** **char** := "testDescription";

testBodyPart1: Exercise`BodyPart := <Arm>;

testBodyPart2: Exercise`BodyPart := <Leg>;

testBodyPart3: Exercise`BodyPart := <Chest>;

testBodyPart4: Exercise`BodyPart := <Back>;

e1 : Exercise := new Exercise(testName, testDescription, testBodyPart1);

e2 : Exercise := new Exercise(testName, testDescription, testBodyPart2);

e3 : Exercise := new Exercise(testName, testDescription, testBodyPart3);

e4 : Exercise := new Exercise(testName, testDescription, testBodyPart4);

**operations**

**private** testConstructor: () ==> ()

testConstructor() ==

(

assertEquals(e1.getName(), testName);

assertEquals(e1.getDescription(), testDescription);

assertEquals(e1.getBodyPart(), testBodyPart1);

assertEquals(e2.getBodyPart(), testBodyPart2);

assertEquals(e3.getBodyPart(), testBodyPart3);

assertEquals(e4.getBodyPart(), testBodyPart4);

);

**public** **static** run: () ==> ()

run() ==

(

**new** ExerciseTest().testConstructor();

);

**end** ExerciseTest

## SeriesTest

**class** SeriesTest **is subclass of** Test

**instance variables**

kgToLbs : **rat** := 2.20462262;

testLoad: **rat** := 120.0;

testTime: **nat** := 60;

testRepetitions: **nat1** := 5;

testExerciseName : **seq** **of** **char** := "testExerciseName";

testExerciseDescription : **seq** **of** **char** := "testExerciseDescription";

testExerciseBodyPart : Exercise`BodyPart := <Arm>;

testExercise : Exercise := new Exercise(testExerciseName, testExerciseDescription, testExerciseBodyPart);

s1 : Series := new Series(testLoad, testRepetitions, testExercise);

s2 : Series := new Series(testRepetitions, testExercise, testTime);

**operations**

**private** testConstructor: () ==> ()

testConstructor() ==

(

assertEquals(s1.getLoad(), testLoad);

assertEquals(s1.getNumberOfRepetitions(), testRepetitions);

assertEquals(s1.getExercise(), testExercise);

assertEquals(s2.getTime(), testTime);

assertEquals(s2.getNumberOfRepetitions(), testRepetitions);

assertEquals(s2.getExercise(), testExercise);

);

-- USE CASE R15

-- It converts kg to lbs

**private** testFunctions: () ==> ()

testFunctions () ==

(

assertEquals(s1.convertFromKgToLbs(s1.getLoad()), testLoad \* kgToLbs);

);

**public** **static** run: () ==> ()

run() ==

(

**new** SeriesTest().testConstructor();

**new** SeriesTest().testFunctions();

);

**end** SeriesTest

## SetTest

**class** SetTest **is subclass of** Test

**instance variables**

testLoad: **rat** := 120.0;

testTime: **nat** := 60;

testRepetitions: **nat1** := 5;

testExerciseName : **seq** **of** **char** := "testExerciseName";

testExerciseDescription : **seq** **of** **char** := "testExerciseDescription";

testExerciseBodyPart : Exercise`BodyPart := <Arm>;

testExercise : Exercise := new Exercise(testExerciseName, testExerciseDescription, testExerciseBodyPart);

testSeries1 : Series := new Series(testLoad, testRepetitions, testExercise);

testSeries2 : Series := new Series(testRepetitions, testExercise, testTime);

testSeries3 : Series := new Series(testLoad + 10.0, testRepetitions + 5, testExercise);

testSeries4 : Series := new Series(testRepetitions + 10, testExercise, testTime + 20);

testSeriesSequence : **seq** **of** Series := [testSeries1, testSeries2, testSeries3];

s1 : MySet := new MySet(testSeriesSequence);

s2 : MySet := new MySet();

**operations**

**private** testConstructor: () ==> ()

testConstructor() ==

(

assertNotEquals(s1.getIndex(testSeries1), -1);

assertNotEquals(s1.getIndex(testSeries2), -1);

assertNotEquals(s1.getIndex(testSeries3), -1);

assertEquals(s1.getSeries(), testSeriesSequence);

assertEquals(s1.getIndex(testSeries4), -1);

assertEquals(len s2.getSeries(), 0);

);

**private** testAddSeries: () ==> ()

testAddSeries () ==

(

s1.addSeries(testSeries4);

assertNotEquals(s1.getIndex(testSeries4), -1);

);

**public** **static** run: () ==> ()

run() ==

(

**new** SetTest().testConstructor();

**new** SetTest().testAddSeries();

);

**public** getTestSet: () ==> MySet

getTestSet() ==

(

return s1;

);

**end** SetTest

## TrainingPlanTest

**class** TrainingPlanTest **is subclass of** Test

**instance variables**

exampleSet: MySet := new SetTest().getTestSet();

tp1 : TrainingPlan := new TrainingPlan();

**operations**

**private** testConstructor: () ==> ()

testConstructor() ==

(

assertEquals(tp1.getPlan(), {|->});

);

**private** testGetters: () ==> ()

testGetters() ==

(

tp1.setDailyPlan(1, exampleSet);

assertEquals(tp1.getDailyPlan(1), exampleSet);

);

**private** testSetters: () ==> ()

testSetters() ==

(

tp1.setDailyPlan(1, exampleSet);

assertEquals(tp1.getDailyPlan(1), exampleSet);

);

**public** **static** run: () ==> ()

run() ==

(

**new** TrainingPlanTest().testConstructor();

**new** TrainingPlanTest().testGetters();

**new** TrainingPlanTest().testSetters();

);

**end** TrainingPlanTest

## MilestoneTest

**class** MilestoneTest **is subclass of** Test

**instance variables**

testDesiredWeight : **rat** := 60.0;

m1 : Milestone := new Milestone(testDesiredWeight);

**operations**

**private** testConstructor: () ==> ()

testConstructor() ==

(

assertEquals(m1.getDesiredWeight(), testDesiredWeight);

);

**private** testSetters: () ==> ()

testSetters() ==

(

**dcl** testNewDesiredWeight : **rat** := 65.0;

m1.setDesiredWeight(testNewDesiredWeight);

assertEquals(m1.getDesiredWeight(), testNewDesiredWeight);

);

**public** **static** run: () ==> ()

run() ==

(

**new** MilestoneTest().testConstructor();

**new** MilestoneTest().testSetters();

);

**end** MilestoneTest

## TestCases

**class** TestCases **is subclass of** Test

/\*

\* Class which includes all test cases for the mandatory requirements of the app.

\*/

**operations**

/\*\*\* USE CASE SCENARIO R0: Initial configuration \*\*\*/

-- The app initially has no clients and only one registered trainer account.

**private** initialConfigScn : Trainer ==> IronTrainers

initialConfigScn(trainer) ==

(

**dcl** it : IronTrainers := new IronTrainers();

it.addTrainer(trainer);

return it;

)

**post** (RESULT.getTrainers() = {trainer} and -- only the trainer is registered as trainer

RESULT.getClients() = {} and -- no clients are registered

card RESULT.getAllUsers() = 1 and -- there is only one user (the trainer)

RESULT.getAllUsers() = {trainer.getEmail()}); -- confirm that the sole user's email is the trainer email

/\*\*\* USE CASE SCENARIO R1: Register \*\*\*/

-- A user may register as a Client using an email and a password, and providing the profile information.

**public** **static** run: () ==> ()

run() ==

(

**dcl** it0 : IronTrainers := new TestCases().initialConfigScn(new Trainer("diogo@gmail.com", "pass123", "Diogo"));

/\* These asserts are only for suppressing warnings about the variables not being used.\*/

assertEquals(it0, it0);

);

**end** TestCases

## IronTrainersTest

**class** IronTrainersTest **is subclass of** Test

**instance variables**

e1 : IronTrainers := new IronTrainers();

**operations**

**private** testConstructor: () ==> ()

testConstructor() ==

(

assertEquals(e1.getClients(), {});

assertEquals(e1.getTrainers(), {});

);

/\*\*\* USE CASE SCENARIO R1: Register \*\*\*/

-- A user may register as a Client using an email and a password, and providing the profile information.

**private** testCreateClient : () ==> Client

testCreateClient() ==

(

**dcl** testEmail: **seq** **of** **char** := "testEmail";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

**dcl** testName: **seq** **of** **char** := "testName";

**dcl** testGender : Client`Sex := <F>;

**dcl** testWeight: **real** := 65.0;

**dcl** testHeight: **int** := 180;

**dcl** testBirthDate: MyUtils`Date := mk\_MyUtils`Date(2, 3, 1980);

**dcl** c1 : Client := new Client(testEmail, testPassword, testName, testGender, testWeight, testHeight, testBirthDate);

return c1;

);

**private** testCreateTrainer : () ==> Trainer

testCreateTrainer() ==

(

**dcl** testEmail: **seq** **of** **char** := "testEmailTrainer";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

**dcl** testName: **seq** **of** **char** := "testNameTrainer";

**dcl** t1 : Trainer := new Trainer(testEmail, testPassword, testName);

return t1;

);

**private** testAddExercises : () ==> ()

testAddExercises() ==

(

**dcl** testName: MyUtils`MyString := "Running";

**dcl** testName2: MyUtils`MyString := "Squats";

**dcl** testName3: MyUtils`MyString := "Jumps";

**dcl** testName4: MyUtils`MyString := "Cycling";

**dcl** testDescription: MyUtils`MyString := "Running";

**dcl** testBodyPart1: Exercise`BodyPart := <Leg>;

**dcl** testBodyPart2: Exercise`BodyPart := <Arm>;

**dcl** testBodyPart3: Exercise`BodyPart := <Chest>;

**dcl** testBodyPart4: Exercise`BodyPart := <Back>;

**dcl** ex1 : Exercise := new Exercise(testName, testDescription, testBodyPart1);

**dcl** ex2 : Exercise := new Exercise(testName2, testDescription, testBodyPart2);

**dcl** ex3 : Exercise := new Exercise(testName3, testDescription, testBodyPart3);

**dcl** ex4 : Exercise := new Exercise(testName4, testDescription, testBodyPart4);

-- Add exercises

e1.addExercise(ex1);

assertEquals(e1.getExercises(), {ex1});

e1.addExercise(ex2);

assertEquals(e1.getExercises(), {ex1, ex2});

e1.addExercise(ex3);

assertEquals(e1.getExercises(), {ex1, ex2, ex3});

e1.addExercise(ex4);

assertEquals(e1.getExercises(), {ex1, ex2, ex3, ex4});

);

**private** testClient: () ==> ()

testClient() ==

(

**dcl** c1 : Client := testCreateClient();

e1.addClient(c1);

assertEquals(e1.getClients(), {c1});

assertEquals(e1.getAllUsers(), {c1.getEmail()});

e1.removeClient(c1);

assertEquals(e1.getClients(), {});

assertEquals(e1.getAllUsers(), {});

);

**private** testTrainer: () ==> ()

testTrainer() ==

(

**dcl** t1 : Trainer := testCreateTrainer();

e1.addTrainer(t1);

assertEquals(e1.getTrainers(), {t1});

assertEquals(e1.getAllUsers(), {t1.getEmail()});

e1.removeTrainer(t1);

assertEquals(e1.getTrainers(), {});

assertEquals(e1.getAllUsers(), {});

);

/\*\*\* USE CASE SCENARIO R2: Client Login \*\*\*/

-- A user may enter as a Client using an email and a password.

**private** testClientLoginLogout: () ==> ()

testClientLoginLogout() ==

(

**dcl** testEmail: **seq** **of** **char** := "testEmail";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

**dcl** c1 : Client := testCreateClient();

e1.addClient(c1);

-- Login

assertEquals(e1.loginClient(testEmail, testPassword), true);

assertEquals(e1.getUser(), testEmail);

assertEquals(e1.getCurrentClient(), c1);

-- Logout

e1.logout();

assertEquals(e1.getUser(), "undefined");

);

/\*\*\* USE CASE SCENARIO R2: Trainer Login \*\*\*/

-- A user may enter as a Trainer using an email and a password.

**private** testTrainerLoginLogout: () ==> ()

testTrainerLoginLogout() ==

(

**dcl** testEmail: **seq** **of** **char** := "testEmailTrainer";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

**dcl** t1 : Trainer := testCreateTrainer();

e1.addTrainer(t1);

-- Login

assertEquals(e1.loginTrainer(testEmail, testPassword), true);

assertEquals(e1.getUser(), testEmail);

-- Logout

e1.logout();

assertEquals(e1.getUser(), "undefined");

);

**private** testNotRegisterLoginLogout: () ==> ()

testNotRegisterLoginLogout() ==

(

**dcl** testEmail: **seq** **of** **char** := "testEmail";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

-- Login

assertEquals(e1.loginClient(testEmail, testPassword), false);

assertEquals(e1.getUser(), "undefined");

-- Logout

e1.logout();

assertEquals(e1.getUser(), "undefined");

);

**private** testDuplicateTrainerEmails: () ==> ()

testDuplicateTrainerEmails() ==

(

**dcl** testEmail: **seq** **of** **char** := "testEmail";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

**dcl** testName: **seq** **of** **char** := "testName";

**dcl** t1 : Trainer := new Trainer(testEmail, testPassword, testName);

**dcl** t2 : Trainer := new Trainer(testEmail, testPassword, testName);

e1.addTrainer(t1);

e1.addTrainer(t2);

);

**private** testDuplicateUserEmails: () ==> ()

testDuplicateUserEmails() ==

(

**dcl** testEmail: **seq** **of** **char** := "testEmail";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

**dcl** testName: **seq** **of** **char** := "testName";

**dcl** testGender : Client`Sex := <F>;

**dcl** testWeight: **real** := 65.0;

**dcl** testHeight: **int** := 180;

**dcl** testBirthDate: MyUtils`Date := mk\_MyUtils`Date(2, 3, 1980);

**dcl** c1 : Client := new Client(testEmail, testPassword, testName, testGender, testWeight, testHeight, testBirthDate);

**dcl** t1 : Trainer := new Trainer(testEmail, testPassword, testName);

e1.addTrainer(t1);

e1.addClient(c1);

);

**private** testCurrentYear: () ==> ()

testCurrentYear() ==

(

assertEquals(MyUtils`getCurrentDate(), mk\_MyUtils`Date(3, 1, 2018));

);

**private** testMilestone: () ==> ()

testMilestone() ==

(

**dcl** testEmail: **seq** **of** **char** := "testEmail";

**dcl** testEmail2: **seq** **of** **char** := "testEmailTrainer";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

**dcl** testDesiredWeight: **real** := 60.0;

**dcl** c1 : Client := testCreateClient();

**dcl** t1 : Trainer := testCreateTrainer();

e1.addClient(c1);

e1.addTrainer(t1);

-- Login with client account

assertEquals(e1.loginClient(testEmail, testPassword), true);

-- Update Milestone

e1.updateDesiredWeight(testDesiredWeight);

assertEquals(e1.getCurrentClient(), c1);

assertEquals(e1.consultMilestone(e1.getUser()).getDesiredWeight(), testDesiredWeight);

e1.logout();

-- Login with trainer account

assertEquals(e1.loginTrainer(testEmail2, testPassword), true);

-- Consult Training plan

assertEquals(e1.consultMilestone(testEmail).getTrainingPlan().getPlan(), { |-> });

-- Add training Plan

assertEquals(e1.consultMilestone(testEmail).getTrainingPlan().getPlan(), { |-> });

);

**private** testExercise: () ==> ()

testExercise() ==

(

**dcl** testName: MyUtils`MyString := "Running";

**dcl** testDescription: MyUtils`MyString := "Running";

**dcl** testBodyPart1: Exercise`BodyPart := <Leg>;

**dcl** testBodyPart2: Exercise`BodyPart := <Arm>;

**dcl** testBodyPart3: Exercise`BodyPart := <Chest>;

**dcl** testBodyPart4: Exercise`BodyPart := <Back>;

**dcl** ex1 : Exercise := new Exercise(testName, testDescription, testBodyPart1);

**dcl** ex2 : Exercise := new Exercise(testName, testDescription, testBodyPart2);

**dcl** ex3 : Exercise := new Exercise(testName, testDescription, testBodyPart3);

**dcl** ex4 : Exercise := new Exercise(testName, testDescription, testBodyPart4);

-- Add exercises

e1.addExercise(ex1);

assertEquals(e1.getExercises(), {ex1});

e1.addExercise(ex2);

assertEquals(e1.getExercises(), {ex1, ex2});

e1.addExercise(ex3);

assertEquals(e1.getExercises(), {ex1, ex2, ex3});

e1.addExercise(ex4);

assertEquals(e1.getExercises(), {ex1, ex2, ex3, ex4});

-- Remove exercises

e1.removeExercise(ex4);

assertEquals(e1.getExercises(), {ex1, ex2, ex3});

e1.removeExercise(ex3);

assertEquals(e1.getExercises(), {ex1, ex2});

e1.removeExercise(ex2);

assertEquals(e1.getExercises(), {ex1});

e1.removeExercise(ex1);

assertEquals(e1.getExercises(), {});

);

/\*\*\* USE CASE SCENARIO R6: Client can consult its training plan \*\*\*/

-- A client can consult the training plan related to its milestone

/\*\*\* USE CASE SCENARIO R8, R9, R10, R11, R12, R13 and R14: Trainer associates a training plan to a milestone of a client \*\*\*/

-- Trainer adds Exercise

-- Trainer creates Series

-- Trainer creates Set

-- Trainer creates TrainingPlan

-- Trainer associates TrainingPlan to the Milestone of the Client

**private** testDailyPlan: () ==> ()

testDailyPlan() ==

(

**dcl** s1 : MySet := e1.createSet();

**dcl** s2 : MySet := e1.createSet();

**dcl** series1 : Series;

**dcl** series2 : Series;

**dcl** ex1 : Exercise;

**dcl** ex2 : Exercise;

**dcl** testEmail: **seq** **of** **char** := "testEmail";

**dcl** testEmailTrainer: **seq** **of** **char** := "testEmailTrainer";

**dcl** testPassword: **seq** **of** **char** := "testPassword";

**dcl** c1 : Client := testCreateClient();

**dcl** t1 : Trainer := testCreateTrainer();

e1.addClient(c1);

e1.addTrainer(t1);

testAddExercises();

-- Login

assertEquals(e1.loginTrainer(testEmailTrainer, testPassword), true);

-- Create MySet Load

ex1 := e1.getExercise("Running");

series1 := e1.createSeriesTime(1, ex1, 60);

e1.addSeriesToSet(s1, series1);

e1.setDailyPlan(testEmail, 1, s1);

assertEquals(e1.getDailyPlan(testEmail, 1), s1);

-- Create MySet Time

ex2 := e1.getExercise("Squats");

series2 := e1.createSeriesLoad(10.0, 10, ex2);

e1.addSeriesToSet(s2, series2);

e1.setDailyPlan(testEmail, 2, s2);

assertEquals(e1.getDailyPlan(testEmail, 2), s2);

e1.logout();

-- Login with client account

assertEquals(e1.loginClient(testEmail, testPassword), true);

assertEquals(e1.getDailyPlan(testEmail, 2), s2);

);

**public** **static** run: () ==> ()

run() ==

(

**new** IronTrainersTest().testConstructor();

**new** IronTrainersTest().testClient();

**new** IronTrainersTest().testTrainer();

**new** IronTrainersTest().testCurrentYear();

**new** IronTrainersTest().testClientLoginLogout();

**new** IronTrainersTest().testTrainerLoginLogout();

**new** IronTrainersTest().testMilestone();

**new** IronTrainersTest().testExercise();

**new** IronTrainersTest().testDailyPlan();

/\*\*\*\*\* TEST CASES WITH INVALID INPUTS (EXECUTE ONE AT A TIME) \*\*\*\*\*\*/

--new IronTrainersTest().testNotRegisterLoginLogout();

--new IronTrainersTest().testDuplicateTrainerEmails();

--new IronTrainersTest().testDuplicateUserEmails();

);

**end** IronTrainersTest

# Verificação do modelo

## Exemplo de verificação de domínio

Uma das *Proof Obligations* geradas pelo Overture é:

|  |  |  |
| --- | --- | --- |
| Número | Nome | Tipo |
| 10 | IronTrainers`addClient(Client) | Adição de um elemento a um *Set*. |

O código sob análise é o seguinte:

-- Adds client to registered clients.

**public** addClient : Client ==> ()

addClient(client) == (

**atomic**(

        clients := clients **union** {client};

        allUsers := allUsers **union** {client.getEmail()}

    );

)

**pre** ({client} **inter** clients = {}) **and** client.getEmail() **not in set** allUsers

**post** client **in set** clients **and** client.getEmail() **in set** allUsers;

Esta operação adiciona um *Client* ao *set* de *Clients* de um objeto *IronTrainers*. Para evitar duplicações de identificadores, que neste caso é o email de cada cliente, o domínio desta operação é restrito a:

* Objetos *Client* que não existam já no conjunto de clientes:
  + {client} inter clients = {}
* Objetos *Client* cujos emails não estejam atribuídos a nenhum utilizador, quer seja ele *Client* ou *Trainer*:
  + client.getEmail() not in set allUsers

    A segunda condição é uma versão mais forte da primeira. Por exemplo, existindo um cliente já registado com o email “[email@domain.com](mailto:email@domain.com)” e tentando um novo cliente registar-se com esse email, o programa não o permitiria. Admitindo que um cliente é caracterizado apenas pelo seu email, podemos elaborar a seguinte prova:

1. c1.email = “[email@domain.com](mailto:email@domain.com)”
2. clients = {c1}
3. newClient = “[email@domain.com](mailto:email@domain.com)”
4. clients inter newClient = {c1}
5. {c1} != {}

    Assim, a primeira condição já falharia e o cliente não seria registado, pois já existia um cliente com a sua informação toda duplicada. No entanto, esta condição deixava que clientes se pudessem registar com emails que já tinham sido atribuídos a treinadores, pelo que foi necessário acrescentar a segunda condição.

1. t1.email = [email@domain.com](mailto:email@domain.com)
2. trainers = {t1}
3. clients = {}
4. allUsers = {“[email@domain.com](mailto:email@domain.com)”}
5. newClient = “[email@domain.com](mailto:email@domain.com)”
6. clients inter newClient = {}, pelo que a primeira condição era verdadeira
7. “[email@domain.com](mailto:email@domain.com)” not in {“[email@domain.com](mailto:email@domain.com)”}

    A condição no último ponto é falsa, pelo que o utilizador não seria registado.

    A *proof obligation* gerada pelo Overture é a seguinte:

(forall client:Client &

(((({client} inter clients) = {}) and

((client.getEmail)() not in set allUsers)) =>

((client in set (clients union {client})) and

((client.getEmail)() in set (allUsers union{(client.getEmail)()})))))

## Exemplo de verificação de invariante

Outra das *Proof Obligations* geradas pelo Overture é:

|  |  |  |
| --- | --- | --- |
| Número | Nome | Tipo |
| 4 | Client`setWeight(real) | Estado da invariante é mantido. |

O código sob análise é o seguinte:

-- Set weight

**public** setWeight : **real** ==> ()

    setWeight(w) == weight := w

**pre** **not** w <= 0;

Esta operação altera o valor do peso de um cliente para um novo valor real. Na declaração da variável de instância “weight” é especificada a seguinte variância:

inv weight > 0 and height > 0;

    Esta variância impede que valores inválidos de altura e de massa sejam inseridos na aplicação, já que é impossível que a altura e a massa sejam valores negativos.

    Após a execução do bloco, o valor “weight” da instância de *Client* é alterado para um determinado número real que tenha sido dado como argumento. No entanto, a pré condição:

pre not w <= 0;

    Apenas permite que valores positivos sejam utilizados como argumento. Desta forma, a invariância mantém-se.

    A *proof obligation* gerada pelo Overture é a seguinte:

(forall w:real &

((not (w <= 0)) => (((weight > 0) and (height > 0)) =>

((w > 0) and (height > 0)))))

# Geração de Código

A partir do modelo elaborado no VDM++, foi gerado código Java. A partir desse mesmo código, foi criada uma interface, que se encontra no package ***gui***, para facilitar a demonstração do trabalho que foi desenvolvido. Esta interface recorre às classes do package ***model*** geradas pelo VDM++.

# Conclusões

O modelo desenvolvido cobre todos os requisitos.

    Este projeto demorou cerca de 25 horas por pessoa a concluir. Perto de um terço deste período foi dedicado à elaboração do modelo, recorrendo a diagramas e implementando utilizando a ferramenta Overture. A elaboração de testes ao modelo e respetiva correção ocupou perto de 10 horas, enquanto que a implementação da interface gráfica e elaboração deste relatório ocupou a restante porção de tempo.

# Referências

1. Site do Overture, <http://overturetool.org>
2. “Report Vending Machine”, J. P. Faria
3. “VDM++”, A. C. Paiva