B Assignment 1

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Name of assignment: **ass1**
Due date: **March 4 2012**
Assessment: 5 marks
Submission: `give cs2111 ass1 CoffeeClub.zip`

1 Overview

Important: please read

This assignment is intended to help you become familiar with:

- Event-B symbols,
- using Rodin,
- creating projects and machines,
- entering information into the bodies of machines

. This should help you become familiar with a number of functions of the Rodin toolkit. The marked up machines are appended to this specification. They are presented in the ISO characters used in the toolkit; some of those characters must be entered using ASCII representations.

Please see bonus requirement.

2 Requirement

A specification of machine **CoffeeClub**, context **Members**, and machine **MemberShip**, as discussed in the lectures, is required. You must carry out the actions described in the following section.

3 What you have to do

Please read and follow the instructions carefully.

1. **Create a new development directory** You can call it what you want, but for the purposes of this specification, it will be called **CoffeeClub**.
2. Run Rodin toolkit and create or load a workshpace.
3. Use the Event-B explorer to create a project called *CoffeeClub*.

4. Within the *CoffeeClub* project create the machine *CoffeeClub*.
5. Fix any errors and check the proof obligations in Event-B explorer.
6. Create the context *Members* and the machine *MemberShip*.
7. Please note that, where appropriate, the listing of refined events is shown with status extended.
8. Export (File menu) a zip archive of the CoffeeClub project.
9. **Submit assignment** as above.

3.1 Requirements

The following is an abbreviated set of requirements.

REQ1	money bank for storing finite, non-negative funds
REQ2	an operation for adding money to the money bank
REQ3	an operation for removing money from the money bank.
REQ4	a facility for members to join the coffee club; each member has a distinct membership id
REQ5	members have an account that cannot go into debt;
REQ6	an operation that enables a member to add money to their account;
REQ7	money added to a members account is also added to the club money bank;
REQ8	an operation that sets the price for a cup of coffee;
REQ9	an operation that enables a member to buy a cup of coffee; the member's account is reduced by the cost of a cup of coffee.

4 CoffeeClub Machine

MACHINE **CoffeeClub**

VARIABLES
piggybank REQ1

INVARIANTS
inv1: $piggybank \in \mathbb{N}$ REQ1: piggybank must be non-negative

EVENTS

Initialisation $\widehat{=}$

THEN
act1: $piggybank := 0$ initialise piggybank to satisfy inv1
END

FeedBank $\widehat{=}$ REQ2

ANY
amount
WHERE
grd1: $amount \in \mathbb{N}1$
THEN
act1: $piggybank := piggybank + amount$
END

RobBank $\widehat{=}$

ANY
amount
WHERE
grd1: $amount \in \mathbb{N}1$
grd2: $amount \leq piggybank$ There must be enough in the piggybank
THEN
act1: $piggybank := piggybank - amount$
END

END

4.1 Context Members

CONTEXT **Members**
SETS
MEMBER
AXIOMS
axm1: $finite(MEMBER)$ REQ3: a finite set of members

END

4.2 MemberShip Machine (Refinement)

MACHINE **MemberShip**
Requirements:
REQ4, REQ5, REQ6, REQ7, REQ8, REQ9

REFINES
CoffeeClub
SEES
Members

VARIABLES
piggybank
members REQ4: the set of current members
accounts REQ5: the member accounts
coffeeprice REQ8: the price of a cup of coffee

INVARIANTS

inv1:	$piggybank \in \mathbb{N}$	
inv2:	$members \subseteq MEMBER$	REQ4: each member has unique id
inv3:	$accounts \in members \rightarrow \mathbb{N}$	REQ5: each member has an account
inv4:	$coffeeprice \in \mathbb{N}1$	REQ8: any price other than free!

EVENTS

Initialisation : ***extended*** $\widehat{=}$

THEN

act2:	$members := \varnothing$	empty set of members
act3:	$accounts := \varnothing$	empty set of accounts
act4:	$coffeeprice :\in \mathbb{N}1$	initial coffee price set to arbitrary non-zero value

END

SetPrice $\widehat{=}$ REQ8

ANY
amount
WHERE

grd1: $amount \in \mathbb{N}1$

THEN

act1: $coffeeprice := amount$

END

NewMember $\widehat{=}$ REQ4, REQ5

ANY

member

WHERE

grd1: $member \in MEMBER \setminus members$ choose a unique member id

THEN

act1: $members := members \cup \{member\}$

act2: $accounts(member) := 0$

END

Contribute $\widehat{=}$

REFINES

FeedBank

ANY

amount

member

WHERE

grd1: $amount \in \mathbb{N}$

grd2: $member \in members$

THEN

act1: $piggybank := piggybank + amount$

act2: $accounts(member) := accounts(member) + amount$

END

BuyCoffee $\widehat{=}$ REQ9

ANY

member

WHERE

grd1: $member \in members$

grd2: $accounts(member) \geq coffeeprice$

THEN

act1: $accounts(member) := accounts(member) - coffeeprice$

END

FeedBank : *extended* $\widehat{=}$

REFINES

FeedBank

ANY

WHERE

THEN
END

RobBank : *extended* $\widehat{=}$

REFINES
RobBank
ANY

WHERE
THEN
END

END