Exercise 3

Hand-out: 19 April 2005
Due: 26 April 2005

Master Solution

1. Understanding Abstract Data Types (ADT)

An ADT specification is a formal, mathematical description that consists of four parts: TYPES, FUNCTIONS, AXIOMS, and PRECONDITIONS.

1.1 Review the concept of ADT

Review the example, the ADT of a stack, in the textbook (chapter 6), understand the four parts TYPES, FUNCTIONS, AXIOMS, and PRECONDITIONS clearly.

1.2 Finish an ADT specification as required

Write an ADT specification for a “bank account” type with operations such as “deposit”, “withdraw”, “current balance”, “holder”, “change holder” and a lower “balance limitation”. Think of how you would write a class BANK_ACCOUNT and how you would specify its features. Submit the ADT specification of the “bank account” type to your group assistant.

Solution:

TYPES:

BANK_ACCOUNT

FUNCTIONS:

new: BANK_ACCOUNT
is_empty: STRING -> BOOLEAN
deposit: BANK_ACCOUNT × INTEGER ⇒ BANK_ACCOUNT
withdraw: BANK_ACCOUNT × INTEGER ⇐ BANK_ACCOUNT
current_balance: BANK_ACCOUNT → INTEGER
minimum_balance: BANK_ACCOUNT → INTEGER
holder: BANK_ACCOUNT → STRING
$$\text{change\_holder: BANK\_ACCOUNT} \times \text{STRING} \rightarrow \text{BANK\_ACCOUNT}$$

**PRECONDITIONS:**
- deposit \((a: \text{BANK\_ACCOUNT}; i: \text{INTEGER})\) \textbf{require} \(i \geq 0\)
- withdraw \((a: \text{BANK\_ACCOUNT}; i: \text{INTEGER})\) \textbf{require} \(i \geq 0\)
  \textbf{and} \(\text{current\_balance}(a) - i \geq \text{minimum\_balance}(a)\)
- change\_holder \((a: \text{BANK\_ACCOUNT}; s: \text{STRING})\) \textbf{require} \((\text{not}(s = \text{holder}(a)) \textbf{and} \text{not}(\text{is\_empty}(s)))\)

**AXIOMS:**
- For all \(a: \text{BANK\_ACCOUNT}, i: \text{INTEGER}, s: \text{STRING}\)
  \(\text{current\_balance}(a) \geq \text{minimum\_balance}(a)\)
  \(\text{current\_balance}(\text{withdraw}(\text{deposit}(a, i), i)) = \text{current\_balance}(a)\)
  \(\text{current\_balance}(\text{deposit}(a, i)) = \text{current\_balance}(a) + i\)
  \(\text{holder}(\text{change\_holder}(a, s)) = s\)
  \(\text{current\_balance}(\text{new}) = \text{minimum\_balance}(\text{new})\)