

| $gates, obama, clinton : ACCNUM$

$CheckBalance ==$
 $CheckBalanceOk \vee AccountNotExists$
 $\vee IncorrectAmount \vee NotAnOwner$

$Bank$ $clients : UID \mapsto NAME$ $balances : ACCNUM \mapsto BALANCE$ $owners : UID \leftrightarrow ACCNUM$
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$NewClientOk$ $\Delta Bank$ $u? : UID; name? : NAME; n? : ACCNUM$
$u? \notin \text{dom } clients$ $n? \notin \text{dom } balances$ $clients' = clients \cup \{u? \mapsto name?\}$ $balances' = balances \cup \{n? \mapsto 0\}$ $owners' = owners \cup \{u? \mapsto n?\}$

$ClientAlreadyExists ==$
 $[\exists Bank; u? : UID \mid u? \in \text{dom } clients]$
 $AccountAlreadyExists ==$
 $[\exists Bank; n? : ACCNUM \mid n? \in \text{dom } balances]$
 $NewClient ==$
 $NewClientOk \vee$
 $ClientAlreadyExists \vee AccountAlreadyExists$

$ClientNotExists == [\exists Bank; u? : UID \mid u? \notin \text{dom } clients]$
 $NewAccount ==$
 $NewAccountOk \vee$
 $ClientNotExists \vee AccountAlreadyExists$

$DepositOk$ $\Delta Bank$ $n? : ACCNUM; m? : MONEY$
$n? \in \text{dom } balances$ $m? > 0$ $balances' = balances \oplus \{n? \mapsto balances\ n? + m?\}$ $clients' = clients$ $owners' = owners$

$IncorrectAmount == [\exists Bank; m? : MONEY \mid m? \leq 0]$

$Deposit ==$

$DepositOk \vee AccountNotExists \vee IncorrectAmount$

$AccountNotExists ==$

$[\exists Bank; n? : ACCNUM \mid n? \notin \text{dom } balances]$

$NewAccountOk$

$\Delta Bank$

$u? : UID; n? : ACCNUM$

$u? \in \text{dom } clients$

$n? \notin \text{dom } balances$

$balances' = balances \cup \{n? \mapsto 0\}$

$owners' = owners \cup \{u? \mapsto n?\}$

$clients' = clients$

$WithdrawOk$

$\Delta Bank$

$u? : UID; n? : ACCNUM; m? : \mathbb{N}$

$u? \mapsto n? \in owners$

$n? \in \text{dom } balances$

$m? > 0$

$m? \leq balances \ n?$

$balances' = balances \oplus \{n? \mapsto balances \ n? - m?\}$

$clients' = clients$

$owners' = owners$

$NotAnOwner ==$

$[\exists Bank; u? : UID; n? : ACCNUM \mid$

$u? \mapsto n? \notin owners]$

$InsufficientFunds ==$

$[\exists Bank; u? : UID; n? : ACCNUM; m? : \mathbb{N} \mid$

$m? > balances \ n?]$

$Withdraw ==$

$WithdrawOk$

$\vee AccountNotExists$

$\vee IncorrectAmount$

$\vee NotAnOwner \vee InsufficientFunds$

<i>CheckBalanceOk</i>	
$\Xi Bank$	
$u? : UID; n? : ACCNUM$	
$balance! : MONEY$	
$u? \mapsto n? \in owners$	
$n? \in \text{dom } balances$	
$balance! = balances\ n?$	

AddOwner ==
AddOwnerOk \vee
NotAnOwner \vee *OwnerAlreadyExists*
OwnerAlreadyExists ==
 $[\Xi Bank; t? : UID; n? : ACCNUM \mid$
 $t? \mapsto n? \in owners]$

<i>AddOwnerOk</i>	
$\Delta Bank$	
$u?, t? : UID; n? : ACCNUM$	
$u? \mapsto n? \in owners$	
$t? \mapsto n? \notin owners$	
$owners' = owners \cup \{t? \mapsto n?\}$	
$clients' = clients$	
$balances' = balances$	

$[ACCNUM, UID, NAME]$
 $MONEY == \mathbb{N}$
 $BALANCE == \mathbb{N}$