Bank Account

Event-B model

Rigorous Software Development

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Introduction

- Develop an Event-B model

- Bank account
  - Different actions :
    - open
    - withdraw
    - deposit
    - transfer

How did we manage ?

Context definition

```
CONTEXT
    bankaccount_C0  ›
SETS
    CLIENTS  ›
    ACCOUNTS  ›
CONSTANTS
    k  ›
AXIOMS
    axm1:  finite(CLIENTS) not theorem ›
    axm2:  finite(ACCOUNTS) not theorem ›
    axm3:  k > 0 not theorem ›
END
```

Invariants

```
MACHINE
    bankaccount_M0 ›
SEES
    bankaccount_C0
VARIABLES
    client ›
    account ›
    balance ›
    ctransf ›
INVARIANTS
    invAcc: account ⊆ ACCOUNTS not theorem ›
    invBal: balance ∈ account ⟶ ℕ not theorem ›
    invCli: client ∈ account ⟶ CLIENTS not theorem ›
    invTra: ctransf ∈ account ⟶ ℕ not theorem ›
```

Initialisation

```
EVENTS
    INITIALISATION:     extended ordinary ›
    THEN
        iniCli: client = ø ›
        iniAcc: account = ø ›
        iniBal: balance = ø ›
        iniTra: ctransf = ø ›
    END
```

Open event

```
open:    not extended ordinary ›
ANY
    cli   ›
    acc   ›
WHERE
    isClient:   cli ∈ CLIENTS not theorem ›
    noRepeat:   acc ∈ account not theorem ›
THEN
    setBal: balance(acc) ≔ 0 ›
    setCli: client(acc) ≔ cli ›
    setTra: ctransf(acc) ≔ 0 ›
END
```

Deposit event

```
deposit:    not extended ordinary ›
ANY
    acc   ›
    amount    ›
    cli   ›
WHERE
    isCli:  cli ∈ CLIENTS not theorem ›
    isAcc:  acc ∈ account not theorem ›
    isPos:  amount ≥ 0 not theorem ›
THEN
    incBal: balance(acc) ≔ balance(acc) + amount ›
END
```

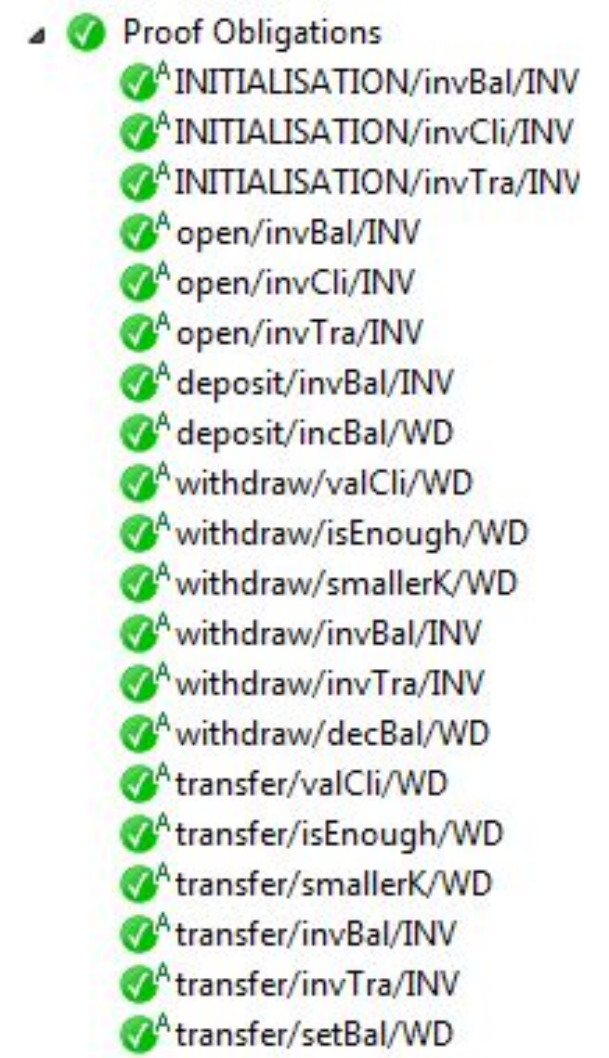
Withdraw event

```
withdraw:   not extended ordinary ›
ANY
    acc   ›
    amount   ›
    cli   ›
WHERE
    isAcc:  acc ∈ account not theorem ›
    isCli:  cli ∈ CLIENTS not theorem ›
    valCli: client(acc) = cli not theorem ›
    isPos:  amount ≥ 0 not theorem ›
    isEnough:   balance(acc) ≥ amount not theorem ›
    smallerK:   (ctransf(acc) + amount) ≤ k not theorem ›
THEN
    decBal: balance(acc) ≔ balance(acc) − amount ›
    setTra: ctransf(acc) ≔ amount ›
END
```

Transfer event

```
transfer:   not extended ordinary ›
ANY
    fromAcc   ›
    toAcc     ›
    amount    ›
    cli   ›
WHERE
    isAcc1: fromAcc ∈ account not theorem ›
    isAcc2: toAcc ∈ account not theorem ›
    isPos:  amount ≥ 0 not theorem ›
    isCli:  cli ∈ CLIENTS not theorem ›
    valCli: client(fromAcc) = cli not theorem ›
    isEnough:   balance(fromAcc) ≥ amount not theorem ›
    smallerK:   (ctransf(fromAcc) + amount) ≤ k not theorem ›
    notSame:    fromAcc ≠ toAcc not theorem ›
THEN
    setBal: balance ≔ balance ⩤ {fromAcc ↦ balance(fromAcc) − amount,toAcc ↦ balance(toAcc) + amount} ›
    setTra: ctransf(fromAcc) ≔ amount ›
END
```

Proof obligations



Conclusions

- Faultless software
- Satisfy requirements
- Sensitive software