

## Trabalho 2

### Métodos Formais

Alterações no arquivo 'test.cpp':

- Adicionar todas ações faltantes no 'switch'
- Utilizar funções correspondentes para cada ação
- Comparações entre 'expectde\_bank\_state' e 'bank\_state'
- 'Assert' para parar verificação no primeiro erro ou diferença encontrados

Testes e Correções:

**Erro** - Saldo insuficiente para transferência

```
Transferring 37 from Bob to Alice

— Bank State —
Balances:
  Account: Alice, Balance: 37
  Account: Bob, Balance: -37
  Account: Charlie, Balance: 0
Investments:
  No investments found.

— Expected Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: 0
Investments:
  No investments found.
Actual error:
Expected error: Balance is too low

a.out: test.cpp:194: int main(): Assertion `error == expected_error' failed.
[1] 88680 IOT instruction (core dumped) ./a.out
```

**Correção** - Adição Linhas 39-41:

```
37  string transfer(BankState &bank_state, string sender, string receiver,
38  |              | int amount) {
39  |      if (bank_state.balances[sender] < amount) {
40  |          return "Balance is too low";
41  |      };
42  |
43  |      bank_state.balances[sender] -= amount;
44  |      bank_state.balances[receiver] += amount;
45  |      return "";
46  |  }
```

**Erro** - Venda de investimento inexistente:

```
Selling investment with ID 10 from Alice

— Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: 0
Investments:
  No investments found.

— Expected Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: 0
Investments:
  No investments found.
Actual error: No investment with this id
Expected error: No investment with this id
```

**Correção:** Adição das linhas 63-66:

```
61  string sell_investment(BankState &bank_state, string seller,
62                          int investment_id) {
63      if (bank_state.investments.find(investment_id) ==
64          bank_state.investments.end()) {
65          return "No investment with this id";
66      }
67      bank_state.balances[seller] += bank_state.investments[investment_id].amount;
68      return "";
69  }
```

**Erro** - Comprando quantidade negativa de investimento:

```
Buying investment for -22 from Charlie

— Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: 22
Investments:
  Investment ID: 0
  Owner: Charlie, Amount: -22

— Expected Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: 0
Investments:
  No investments found.
Actual error:
Expected error: Amount should be greater than zero
```

**Correção** - Adição de verificação 'If (amount <= 0)'

```
string buy_investment(BankState &bank_state, string buyer, int amount) {
    if (amount <= 0) {
        return "Amount must be greater than zero";
    }
    bank_state.balances[buyer] -= amount;
    bank_state.investments[bank_state.next_id] = {buyer, amount};
    bank_state.next_id++;
    return "";
}
```

**Erro** - Saque de quantidade negativa:

```
Withdrawing -19 from Charlie

— Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: 19
Investments:
  No investments found.

— Expected Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: 0
Investments:
  No investments found.
Actual error:
Expected error: Amount should be greater than zero
```

**Correção** - Adição de Linhas 33-35

```
32  string withdraw(BankState &bank_state, string withdrawer, int amount) {
33      if (amount ≤ 0) {
34          return "Amount should be greater than zero";
35      }
36      bank_state.balances[withdrawer] -= amount;
37      return "";
38  }
```

**Erro** - Depósito de quantidade negativa:

```
Depositing -16 from Bob

— Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 49
  Account: Charlie, Balance: 0
Investments:
  No investments found.

— Expected Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 65
  Account: Charlie, Balance: 0
Investments:
  No investments found.
Actual error:
Expected error: Amount should be greater than zero
```

**Correção** - Adição das linhas 28-30:

```
27  string deposit(BankState &bank_state, string depositor, int amount) {
28      if (amount ≤ 0) {
29          return "Amount should be greater than zero";
30      }
31      bank_state.balances[depositor] += amount;
32      return "";
33  }
```

**Erro** - Transferência de quantidade negativa:

```
Transferring -35 from Charlie to Alice

— Bank State —
Balances:
  Account: Alice, Balance: -35
  Account: Bob, Balance: 65
  Account: Charlie, Balance: 95
Investments:
  No investments found.

— Expected Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 65
  Account: Charlie, Balance: 60
Investments:
  No investments found.
Actual error:
Expected error: Amount should be greater than zero
```

**Correção** - Adição das linhas 49-51:

```
43 string transfer(BankState &bank_state, string sender, string receiver,
44                int amount) {
45     if (bank_state.balances[sender] < amount) {
46         return "Balance is too low";
47     };
48
49     if (amount ≤ 0) {
50         return "Amount should be greater than zero";
51     }
52
53     bank_state.balances[sender] -= amount;
54     bank_state.balances[receiver] += amount;
55     return "";
56 }
```

**Erro** - Saldo insuficiente para saque:

```
Withdrawing 92 from Charlie

— Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: -92
Investments:
  No investments found.

— Expected Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 0
  Account: Charlie, Balance: 0
Investments:
  No investments found.
Actual error:
Expected error: Balance is too low
```

Correção: Adição linhas 40-42:

```
35  string withdraw(BankState &bank_state, string withdrawer, int amount) {
36      if (amount ≤ 0) {
37          return "Amount should be greater than zero";
38      }
39
40      if (bank_state.balances[withdrawer] < amount) {
41          return "Balance is too low";
42      }
43
44      bank_state.balances[withdrawer] -= amount;
45      return "";
46  }
```

Erro - Saldo insuficiente para comprar investimento:

```
Buying 46 investment from Bob

— Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: -40
  Account: Charlie, Balance: 0
Investments:
  Investment ID: 0
  Owner: Bob, Amount: 46

— Expected Bank State —
Balances:
  Account: Alice, Balance: 0
  Account: Bob, Balance: 6
  Account: Charlie, Balance: 0
Investments:
  No investments found.
Actual error:
Expected error: Balance is too low
```

Correção - Adição linhas 68-70:

```
63  string buy_investment(BankState &bank_state, string buyer, int amount) {
64      if (amount ≤ 0) {
65          return "Amount should be greater than zero";
66      }
67
68      if (bank_state.balances[buyer] < amount) {
69          return "Balance is too low";
70      }
71
72      bank_state.balances[buyer] -= amount;
73      bank_state.investments[bank_state.next_id] = {buyer, amount};
74      bank_state.next_id++;
75      return "";
76  }
```



Erro - Venda de investimento com dono diferente:

---

Selling investment with ID 0 from Charlie

— Bank State —

Balances:

Account: Alice, Balance: 58

Account: Bob, Balance: 20

Account: Charlie, Balance: 51

Investments:

Investment ID: 0

Owner: Alice, Amount: 49

Investment ID: 1

Owner: Charlie, Amount: 3

Investment ID: 2

Owner: Alice, Amount: 5

Investment ID: 3

Owner: Charlie, Amount: 52

— Expected Bank State —

Balances:

Account: Alice, Balance: 58

Account: Bob, Balance: 20

Account: Charlie, Balance: 2

Investments:

Investment ID: 0

Owner: Alice, Amount: 49

Investment ID: 1

Owner: Charlie, Amount: 3

Investment ID: 2

Owner: Alice, Amount: 5

Investment ID: 3

Owner: Charlie, Amount: 52

Actual error:

Expected error: Seller can't sell an investment they don't own

---

Erro - Investimento permanecendo no mapa de investimentos após venda:

---

Selling investment with ID 0 from Bob

— Bank State —

Balances:

Account: Alice, Balance: 57

Account: Bob, Balance: 114

Account: Charlie, Balance: 0

Investments:

Investment ID: 0

Owner: Bob, Amount: 12

— Expected Bank State —

Balances:

Account: Alice, Balance: 57

Account: Bob, Balance: 114

Account: Charlie, Balance: 0

Investments:

No investments found.

Actual error:

Expected error:

---

Correção - Adição da linha 90:

```
78 string sell_investment(BankState &bank_state, string seller,
79                        int investment_id) {
80     if (bank_state.investments.find(investment_id) ==
81         bank_state.investments.end()) {
82         return "No investment with this id";
83     }
84
85     if (bank_state.investments[investment_id].owner != seller) {
86         return "Seller can't sell an investment they don't own";
87     }
88
89     bank_state.balances[seller] += bank_state.investments[investment_id].amount;
90     bank_state.investments.erase(investment_id);
91     return "";
92 }
```