תוכנה 1

סמסטר א' תשס"ט

תרגול מס' 5

הבנק – חלק שני

ליאור שפירא ומתי שמרת

דיון – העברה בנקאית

מספר חלופות למימוש העברת סכום מחשבון לחשבון:

- אפשרות א: מתודה סטטית שתקבל שני חשבונות בנק ותבצע ביניהם העברה:

```
/**
 * Makes a transfer of amount from one account to the other
 * @pre 0 < amount <= from.getBalance()
 * @post to.getBalance() == $prev(to.getBalance()) + amount
 * @post from.getBalance() == $prev(from.getBalance()) – amount
 */
public static void transfer(double amount,
                            BankAccount from,
                            BankAccount to) {
    from.withdraw(amount);
    to.deposit(amount);
}
```

דיון – העברה בנקאית

- אפשרות ב:

```
/**
 * Makes a transfer of amount from the current account to
 * the other one
 */
public void transferTo(double amount,
                       BankAccount other) {
    other.deposit(amount);
    balance -= amount;
}
```

דיון – העברה בנקאית

- אפשרות ג: העמסת withdraw ו/או deposit שיקבלו שני ארגומנטים (סכום והפנייה לחשבון נוסף):

```
/**
 * Makes a transfer of amount from other to the current account
 * @pre 0 < amount <= other.getBalance()
 * @post getBalance() == $prev(getBalance()) + amount
 * @post other.getBalance() == $prev(other.getBalance()) – amount
 */
public void deposit(double amount, BankAccount other) {
    other.withdraw(amount);
    balance += amount;
}
```

שמורת המחלקה (Class Invariant)

- צריכה להתקיים "תמיד"
  - לפני ואחרי ביצוע כל מתודה ציבורית
  - אחרי הבנאי
- במחלקה חשבון בנק:
  - חשבון חייב להיות עם יתרה אי שלילית
  - לכל חשבון קיים מספר מזהה במערכת
  - לכל חשבון יש בעלים

שמורת BankAccount

```
/**
 * @inv getBalance() >= 0
 *  @inv getAccountNumber() > 0
 *@inv getOwner() != null
 */
public class BankAccount {
   ...
}
```

בנאי

- תפקיד: ליצור עצם חדש המקיים את שמורת המחלקה
- בנאי לא אמור לכלול לוגיקה נוספת פרט לכך
- במחלקה **`BankAccount`**:
  - בנאי ברירת המחדל יוצר עצם שאינו מקיים את השמורה!
- יש דברים שאינם באחריות המחלקה. למשל:
  - מי דואג לתקינות מספרי חשבון? (למשל שיהיו שונים)
  - מי מנהל את מאגר הלקוחות?

BankAccount בנאי

```
/**
 * Constructs a new account and sets its owner and identifier
 * @pre  ????????
 * @pre  ????????
 * @post ????????
 * @post ????????
 * @post ????????
 */
public BankAccount(Customer customer, long id) {
   accountNumber = id;
   owner = customer;
}
```

BankAccount בנאי

```
/**
 * Constructs a new account and sets its owner and identifier
 * @pre id > 0
 * @pre customer != null
 * @post ????????
 * @post ????????
 * @post ????????
 */
public BankAccount(Customer customer, long id) {
   accountNumber = id;
   owner = customer;
}
```

BankAccount בנא'

```
/**
 * Constructs a new account and sets its owner and identifier
 * @pre id > 0
 * @pre customer != null
 * @post getOwner() == customer
 * @post getAccountNumber() == id
 * @post getBalance() == 0
 */
public BankAccount(Customer customer, long id) {
   accountNumber = id;
   owner = customer;
}
```

final

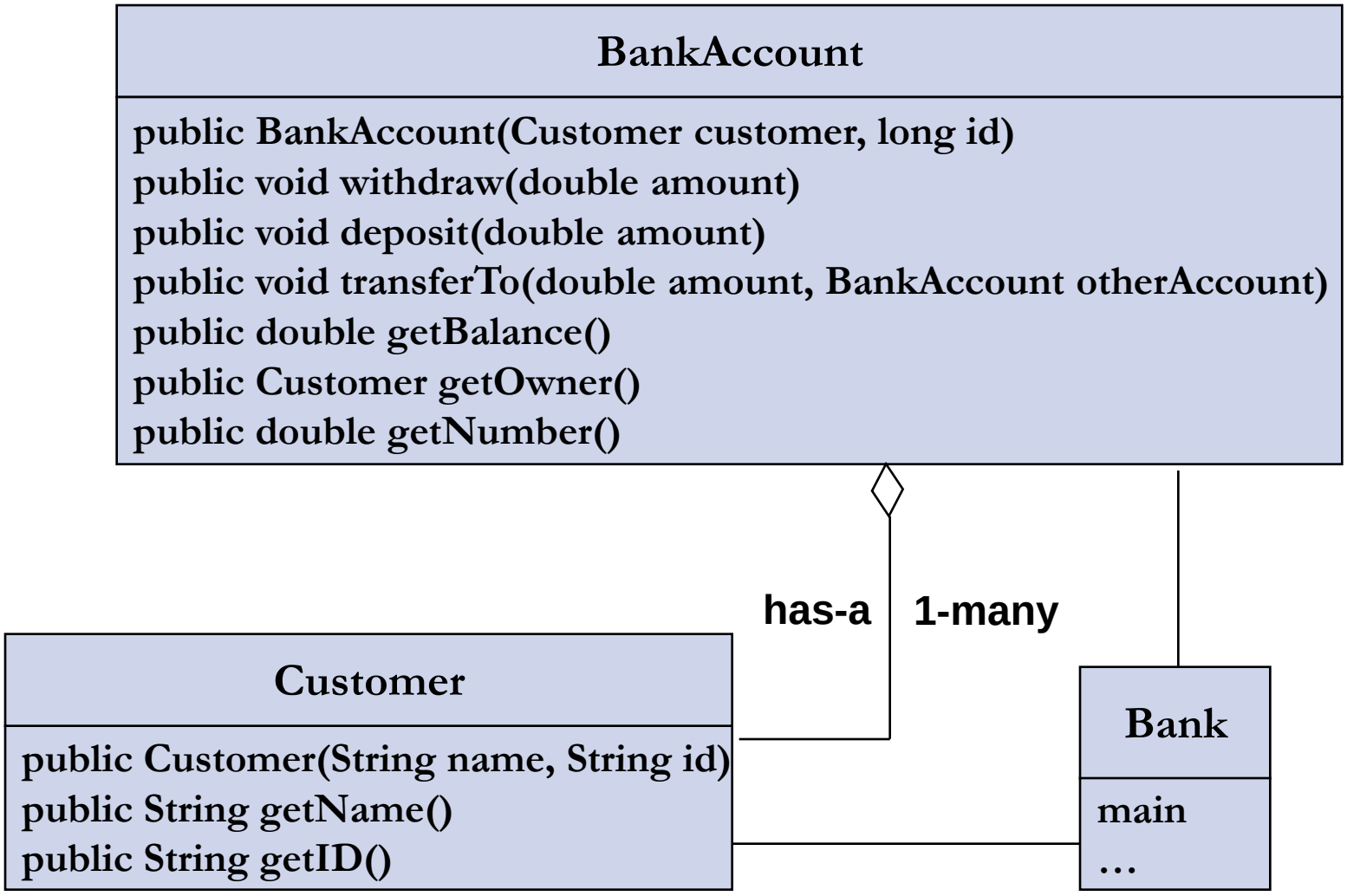
- חשבון בנק מזוהה חד-חד ערכית עם עצם לא משתנה של accountNumber. לכן, נהפוך שדה זה ל-**final**:

```
final private long accountNumber;
```

Blank final field: a final field that hasn't been initialized at creation

- שדה *blank final* יש לאתחל פעם אחת בדיוק, בתוך הבנאי של המחלקה.
- אכיפה ע"י הקומפיילר: במקרה של השמות נוספות למשתנה final תהיה שגיאת קומפילציה

Class Diagram



The Customer Class

```
public class Customer {
    public Customer(String name, String id) {
        this.name = name;
        this.id = id;
    }

    public String getName() {
        return name;
    }

    public String getID() {
        return id;
    }

    private String name;
    private String id;
}
```

Toy Bank Program

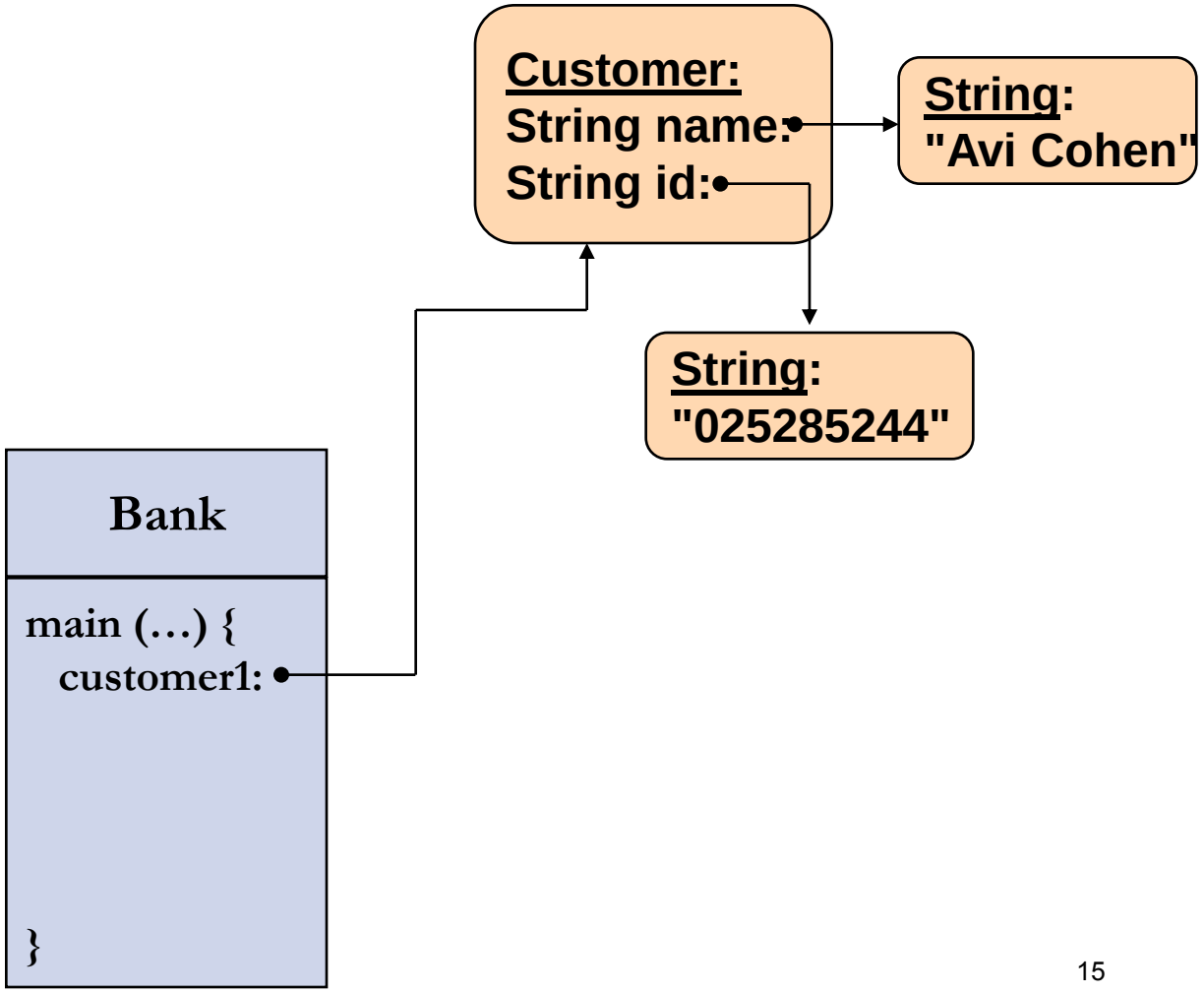
```
public class Bank {
    public static void main(String[] args) {
        Customer customer1 = new Customer("Avi Cohen", "025285244");
        Customer customer2 = new Customer("Rita Stein", "024847638");

        BankAccount account1 = new BankAccount(customer1, 1234);
        BankAccount account2 = new BankAccount(customer2, 5678);
        BankAccount account3 = new BankAccount(customer2, 2984);

        account1.deposit(1000);
        account2.deposit(500);
        account1.transferTo(100, account3);
        account2.withdraw(300);

        System.out.println("account1 has " + account1.getBalance());
        System.out.println("account2 has " + account2.getBalance());
    }
}
```

Object Diagram



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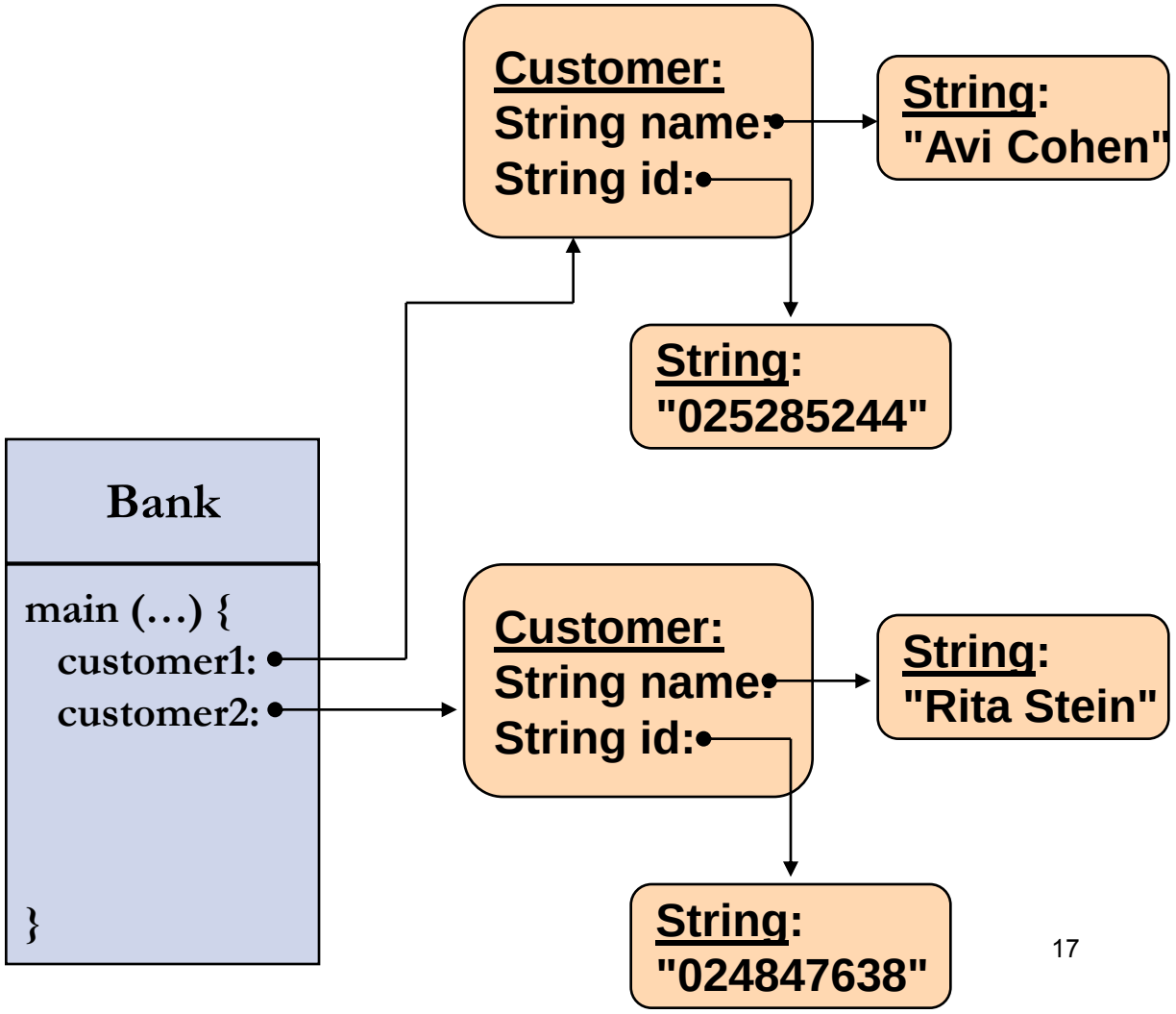

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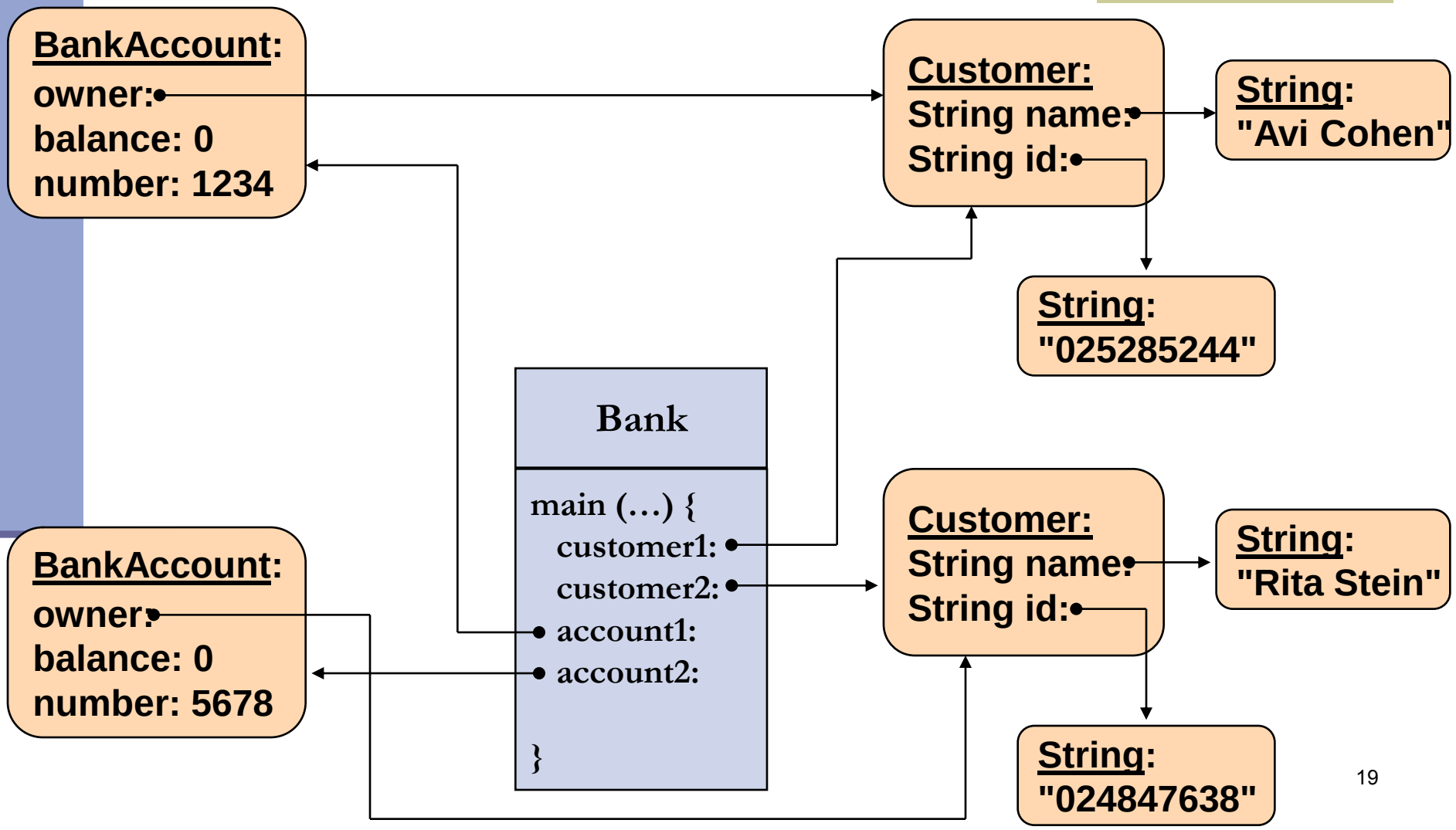

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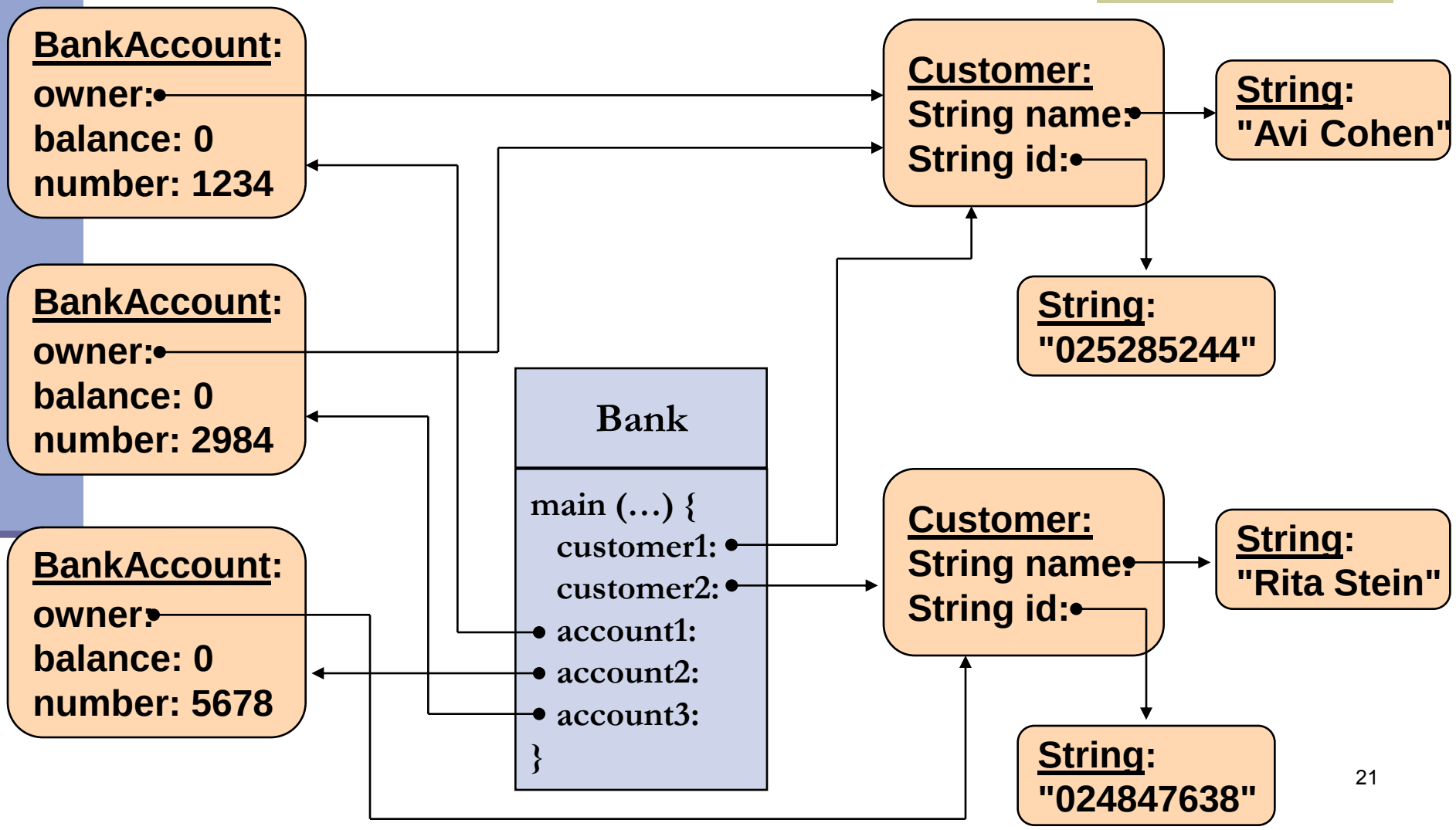

Message Sequence Chart

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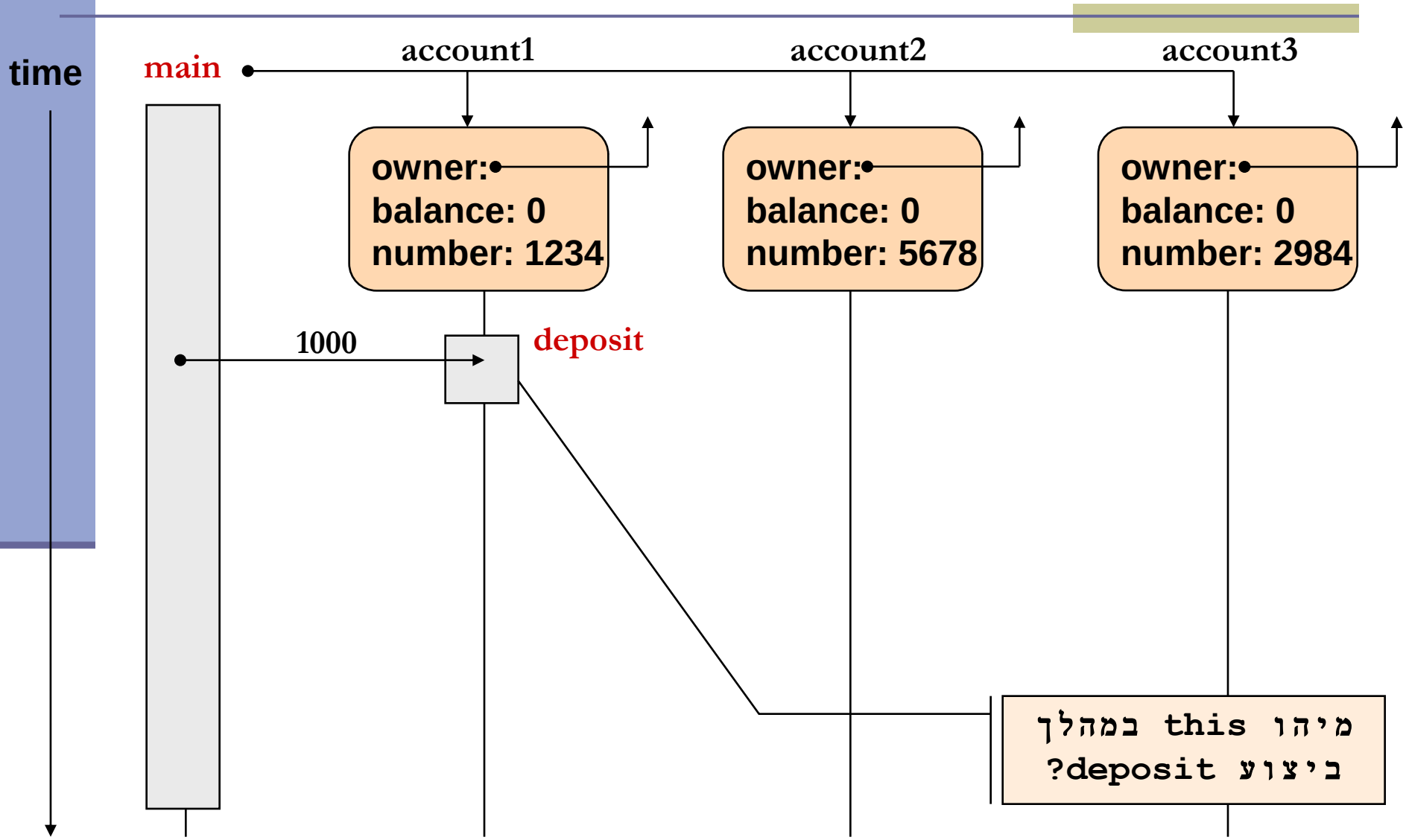
Message Sequence Chart



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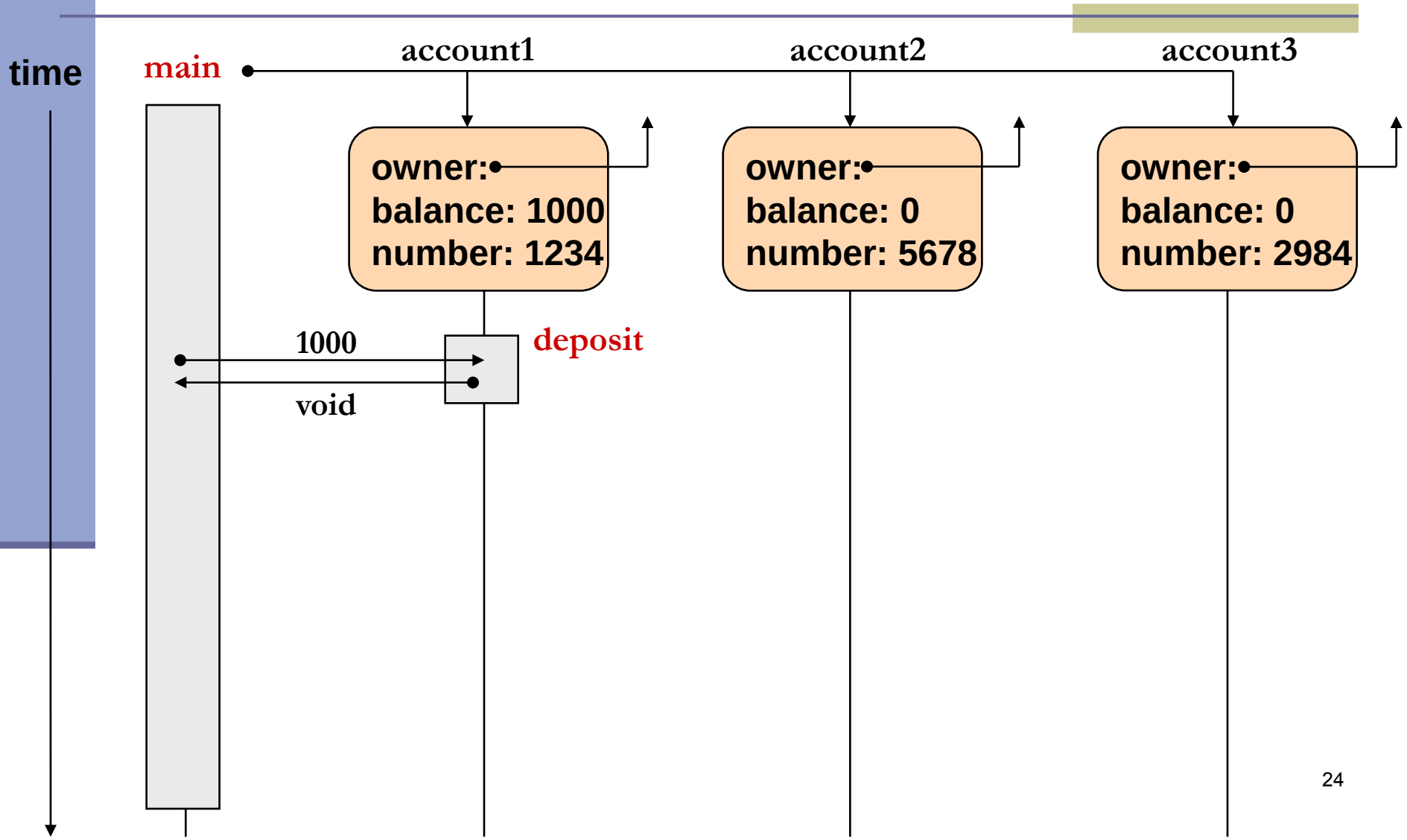

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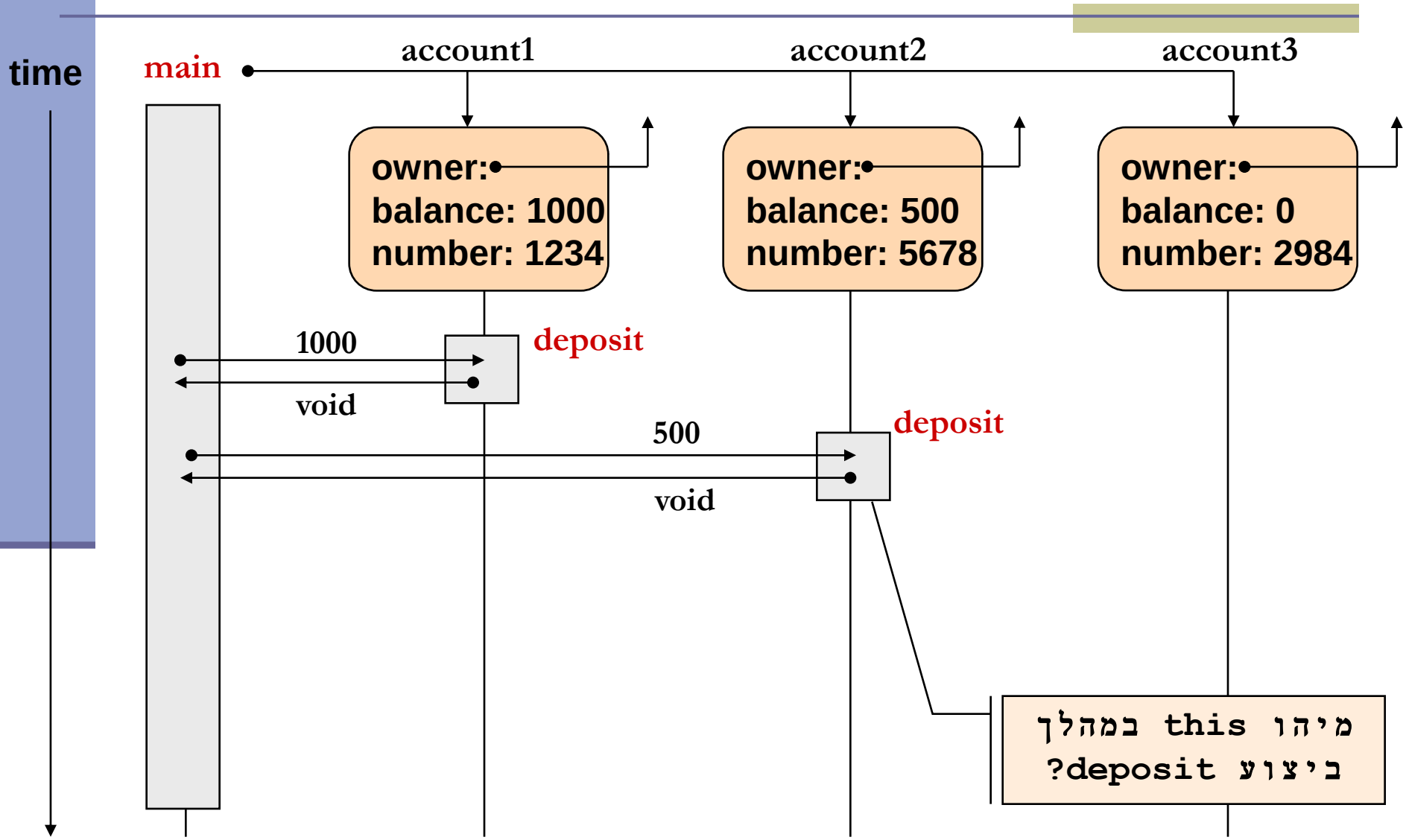

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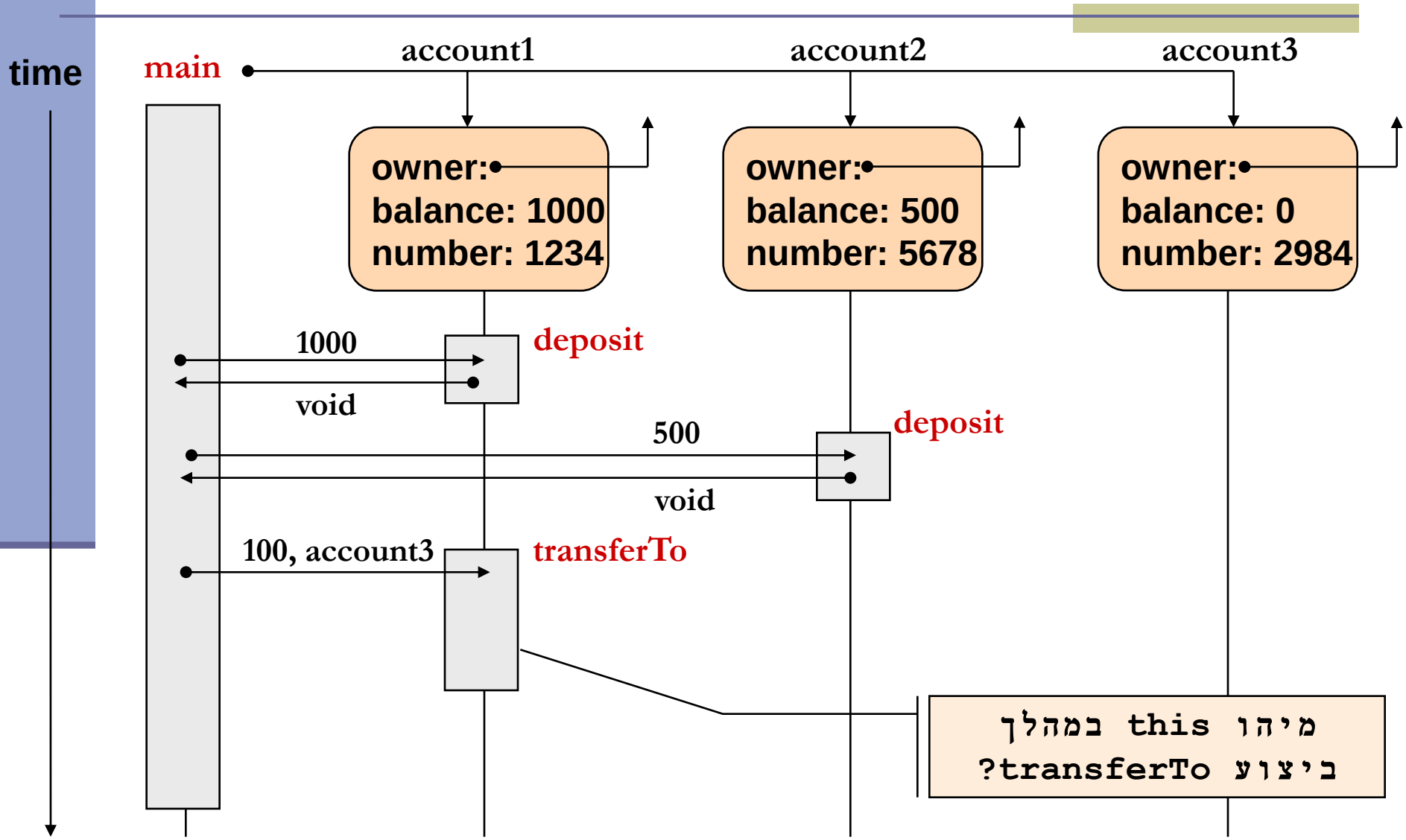

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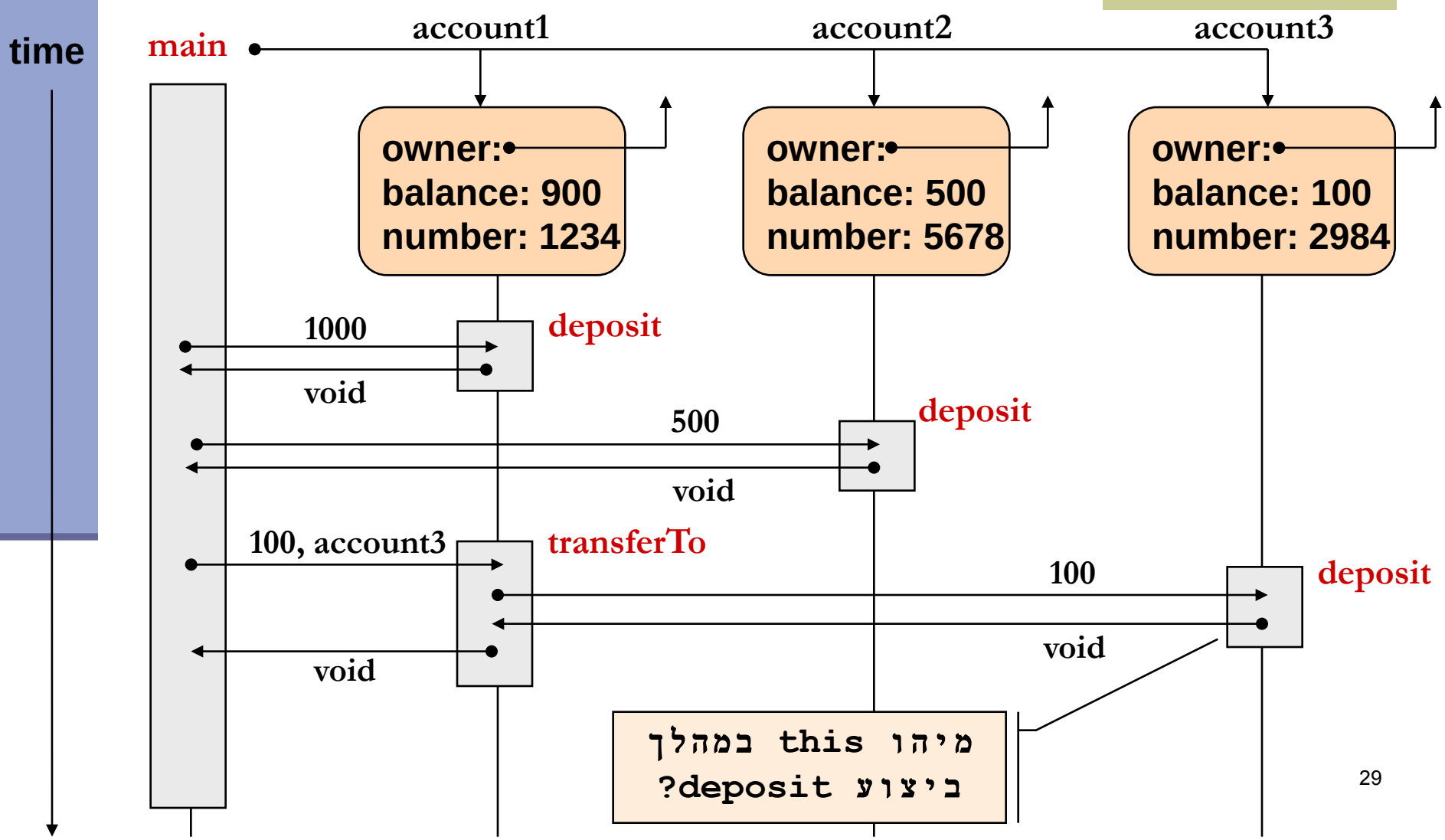

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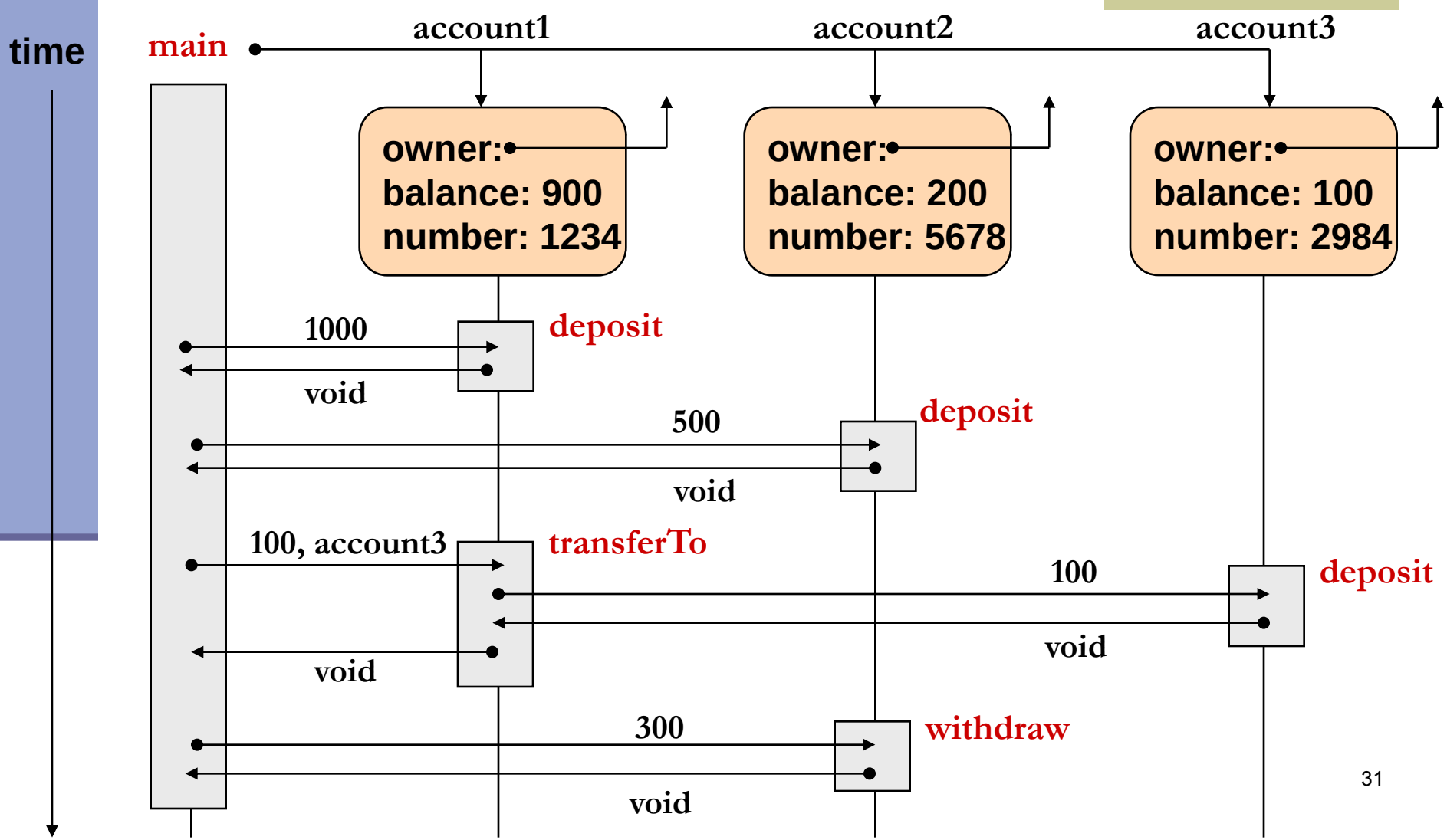

Output

```
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        System.out.println("account1 has " + account1.getBalance());
        System.out.println("account2 has " + account2.getBalance());
    }
}
```

output: account1 has 900.0
account2 has 200.0