Class design

- From last time: finish Names example:
  - implementing remove
- Preconditions
- Class invariants
    - representation invariants
    - testing repr. invariants

Announcements

- This week’s pre-lab: read PA2, see lab for details.
- Don’t wait until after MT to start PA2
- Midterm 1 is on Thur 2/16
  - sample problems have been published
  - Location: coming soon
  - Closed book, closed note, no electronic devices
  - Bring USC ID card

Method preconditions

- a restriction on how a method can be called
  - Ex (from book): in **`BankAccount`** class

    ```
    void deposit(double amount)
    ```

  Precondition:

- document any preconditions in the method comment
- why not

  "amount must be type double" ?

Method contract

- client must satisfy precondition
- a contract between client code and method:
  - if you call the function this way,
    we guarantee it will do what we say it does
  - otherwise, behavior is undefined
- avoid performing duplicate checks between client and method code

What should method do?

- a call that violates the precond is incorrect (remember: undefined results)
- Java **`assert`** statement is useful:

```
assert amount >= 0;
```

- checks a condition, and crashes if its false

Restrictions on implicit parameter

The **`x`** in **`x.foo();`**

- Another reason for a precond:
- restriction on when certain methods can be called
  - object can be in different states
- Illegal to call **`next()`** when **`Scanner`** has no more input (eof in lab4)
- **`PRE: hasNext() is true`**
- Try to minimize them

Your Precondition comments

- Two ways to document at the top of a method:
- Javadoc style (next to param in question):

```
@param amount
       the amount of money to deposit,
       must be >= 0
```

- Or state all preconditions on separate line:

```
PRE: amount >= 0
```

Class Invariants

- a statement about an object that's always true between method calls:
  - true after constructor
  - true after every mutator
  - (therefore, also true before every method call)
- interface invariant: true from client view
- representation invariant: true about object representation

Interface Invariants

- sometimes related to preconditions
- Example in book: **`BankAccount`**

```
Invariant: getBalance() >= 0
```

- would document in overall class comment
- For **`Names`** class

```
Invariant: names are in alphabetical order
                and are unique
```

Representation invariants

- a statement about the *internal object representation* that's always true between method calls:
  - true after constructor
  - true after every mutator
  - (therefore, also true before every method call)
- describes valid internal state of the object

Ex: Repr. invar. for **`Names`** class

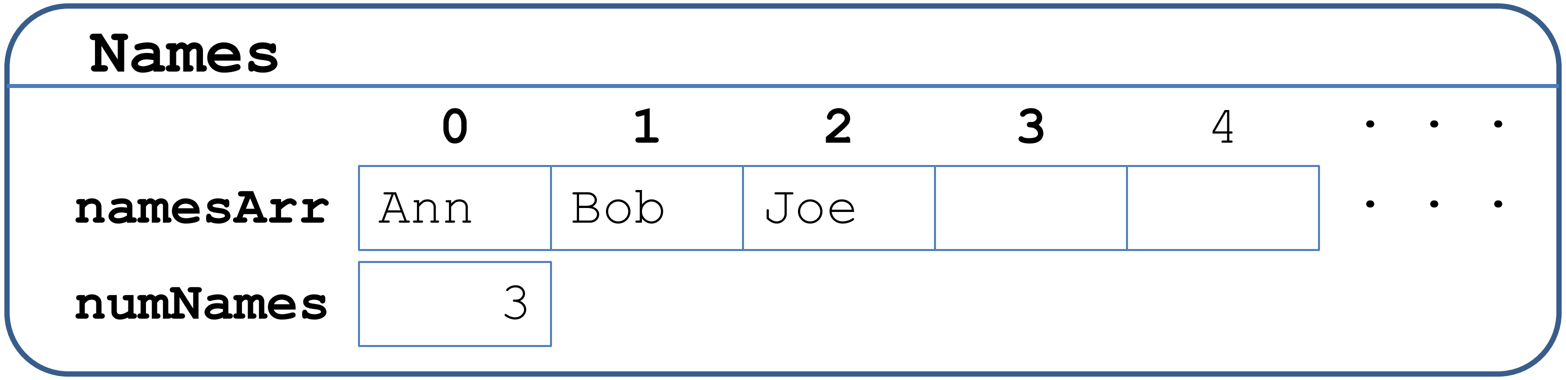
- … that uses *ArrayList* representation

```
class Names {
   . . .
   private ArrayList<String> namesArr;
   /* Representation invariant:
      -- names are unique
      -- names are in alphabetical order in namesArr
      -- number of names stored is namesArr.size()
   */
}
```

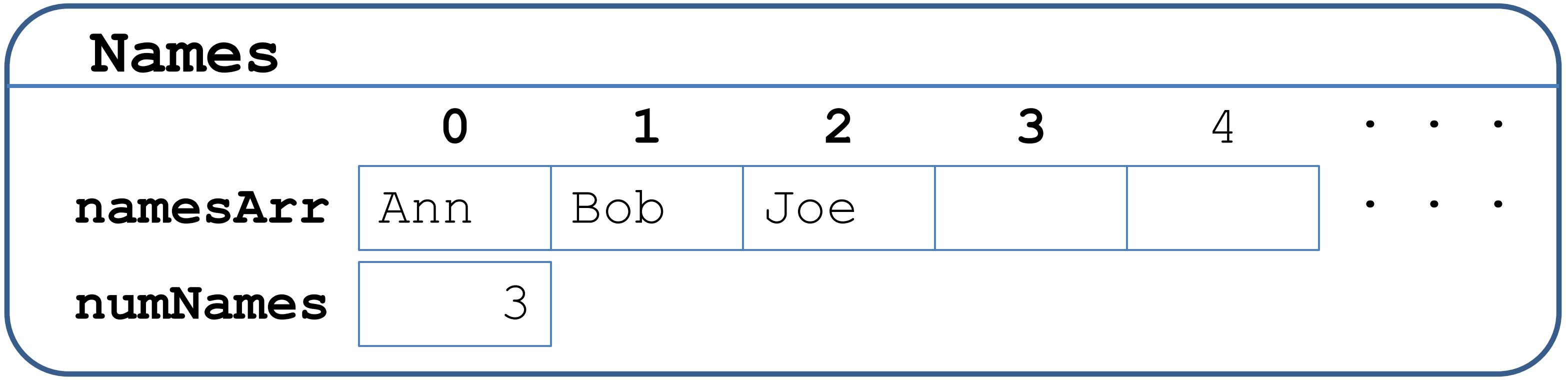
Ex 2: Repr. invariant for **`Names`** class

- … that uses *partially filled array* representation

```
class Names {
    . . .
    private String[] namesArr;
    private int numNames;
}
```



Ex 2 of repr. invariants (cont.)



Names

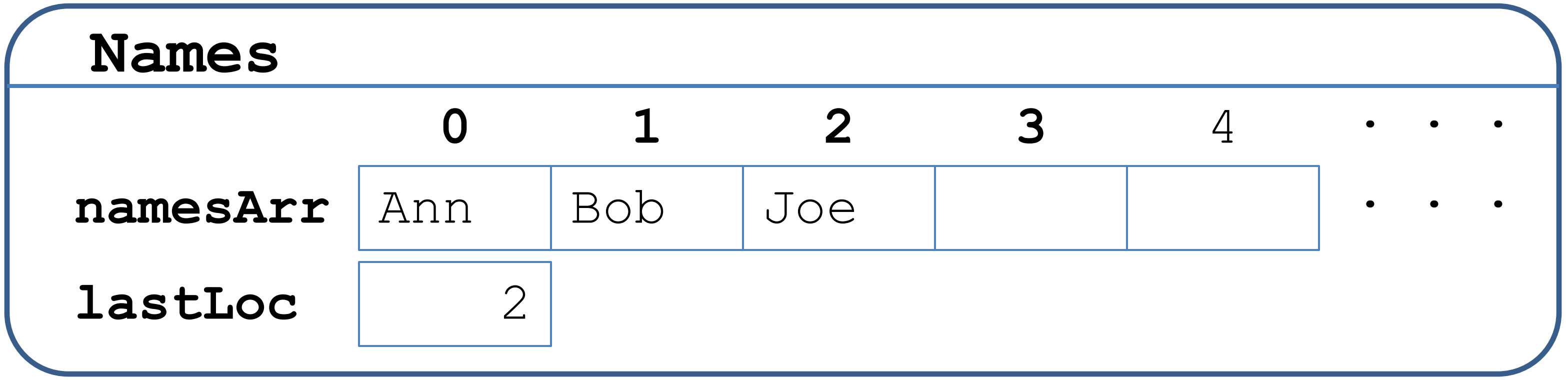
	0	1	2	3	4	. . .
namesArr	Ann	Bob	Joe			. . .
numNames	3					

repr. invariant:

- **numNames is the number of names**
- **0 <= numNames <= namesArr.length**
- **if numNames > 0, the names are in**
  namesArr[0] - namesArr[numNames - 1]
- **names are in alphabetical order**
- **names are unique**

Different invar. with same data types

```
class Names {
   . . .
   private String[] namesArr;
   private int lastLoc;
}
```



Names

	0	1	2	3	4	. . .
namesArr	Ann	Bob	Joe			. . .
lastLoc	2					

Different invariant (cont.)

Names

	0	**1**	**2**	**3**	4	. . .
namesArr	Ann	Bob	Joe			. . .
lastLoc	2					

- representation invariant:

Testing representation invariants

- Can use **`assert`** for sanity checks.
- One kind of sanity check:

  check representation invariant
- Write a *private* method:

  ```
  boolean isValidObject()
  ```
- at end of every method:

  ```
  assert isValidObject();
  ```
- You will be doing this in pa2.