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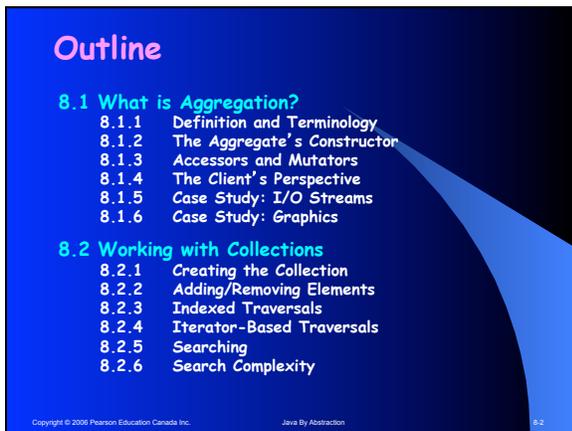
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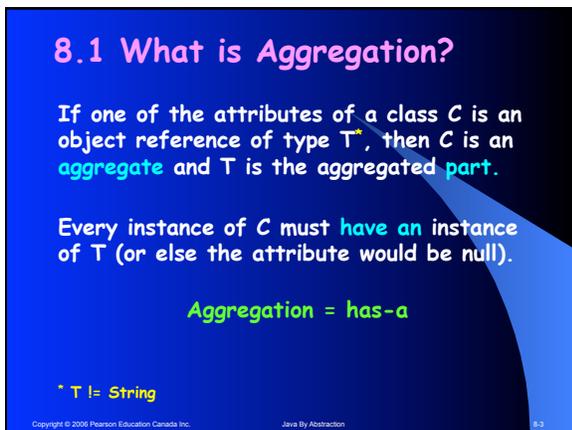
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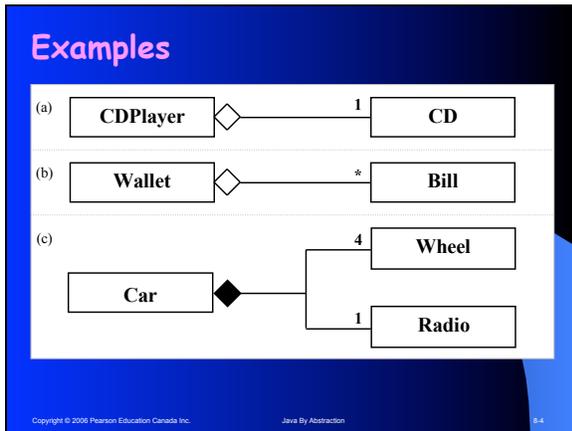
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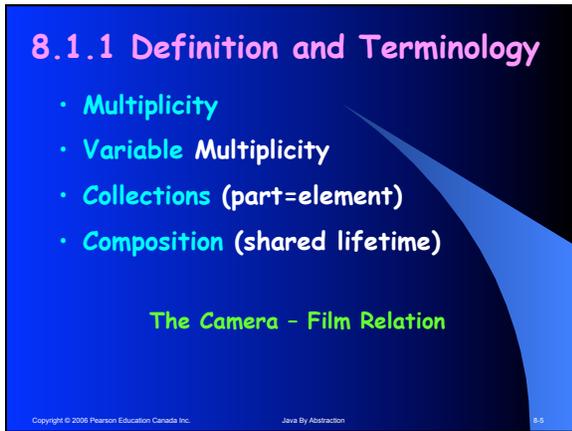
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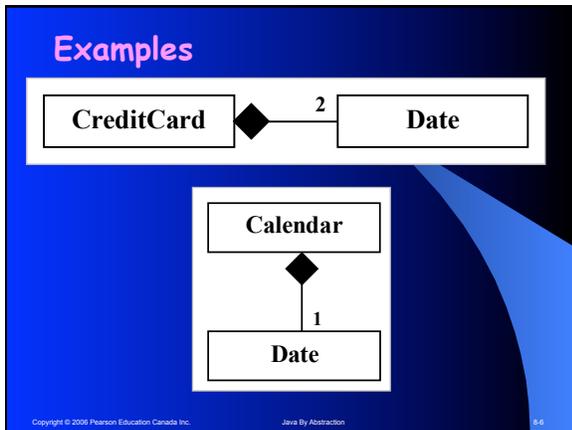
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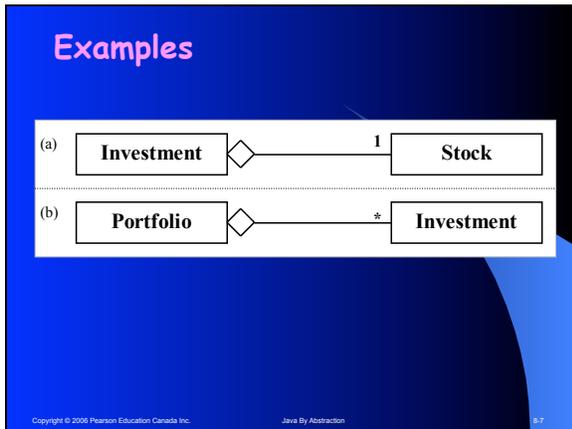
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### 8.1.2 The Aggregate's Constructor

- When a client instantiates *C*, who instantiates *T*?
- Create an Investment
- Create a CreditCard
- What signature (for the Investment constructor) makes Investment a composition?

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### 8.1.3 Accessors and Mutators

- Aggregates must provide an accessor thru which the part can be accessed
- In a composition, the accessor returns a clone of the part
- An aggregate may provide a mutator so the client can mutate the part
- In a non-composition, such a mutator is not needed (why?)

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**8.1.4 The Client's Perspective**

- Aggregation = Layered Abstraction
- Sounds like an implementer's concern
- Why don't implementers hide it?  
If they did:
  - ❑ Investment would have to handle symbol, name, and price
  - ❑ CreditCard would have to accept day, month, and year.

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**Example-1: Copying an Aggregate**

Given a reference *x* to an aggregate, make a copy of it and call it *y*.

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**Example-1: Copying an Aggregate**

Given a reference *x* to an aggregate, make a copy of it and call it *y*.

Three different copies:

- An **Alias**
- A **Shallow Copy**
- A **Deep Copy**

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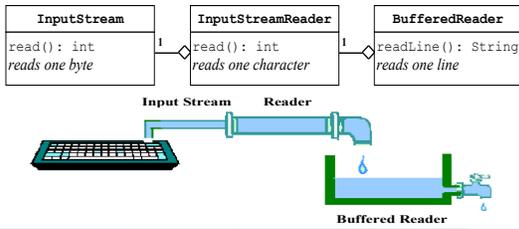
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### 8.1.5 Case Study: I/O Streams



```
BufferedReader buffer =
    new BufferedReader(
        new InputStreamReader(System.in) );
```

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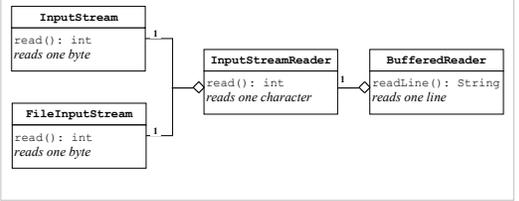
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### File Input:



```
BufferedReader filer =
    new BufferedReader(
        new InputStreamReader(
            new FileInputStream(filename) );
```

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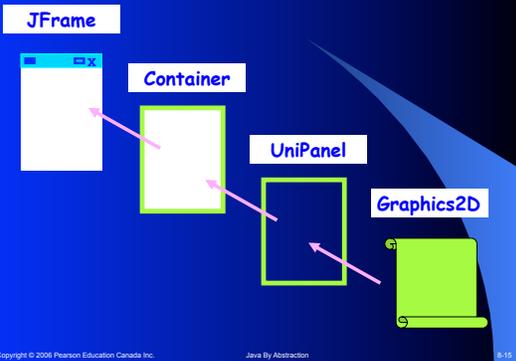
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### 8.1.6 Case Study: Graphics



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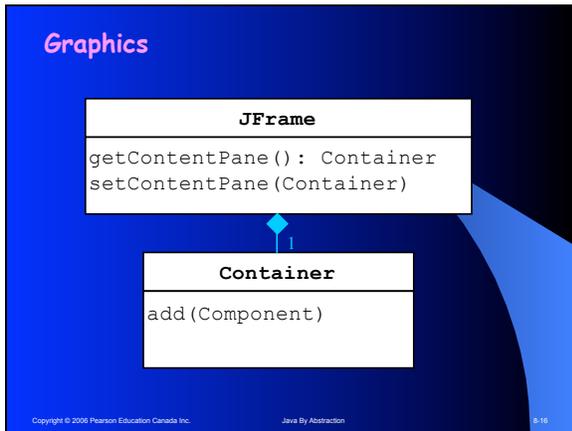
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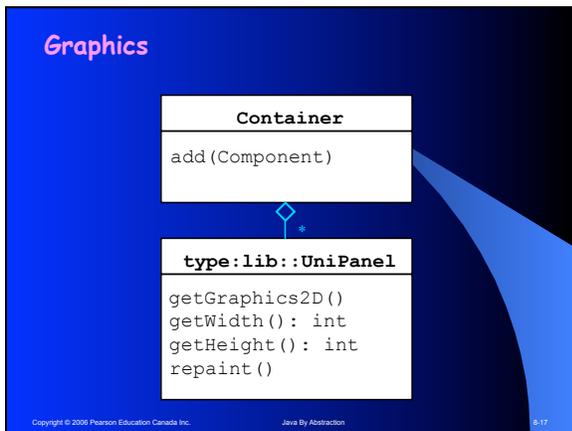
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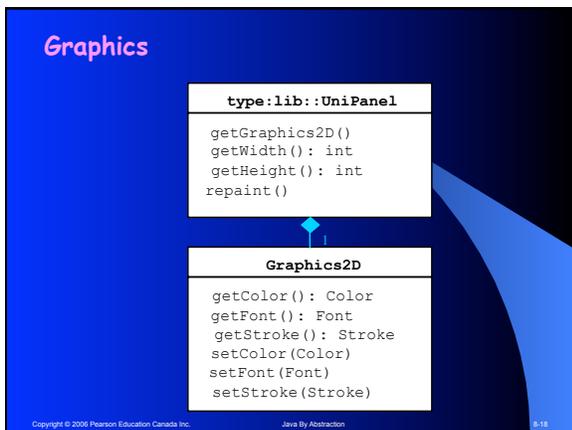
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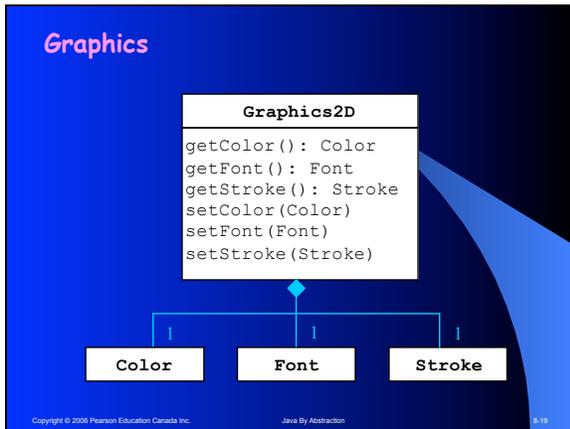
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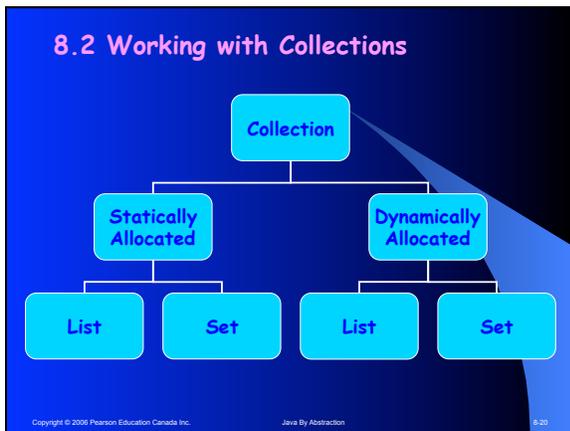
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### 8.2.1 Creating the Collection

- Cannot specify elements as parameters
- Create an empty one then populate

<b>Constructor Summary - Portfolio</b>
<code>Portfolio(java.lang.String title, int capacity)</code> Construct an empty portfolio having the passed name and capable of holding the specified number of investments.

<b>Constructor Summary - GlobalCredit</b>
<code>GlobalCredit()</code> Construct a GC processing centre having the name "NoName".

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### 8.2.2 Adding / Removing Elements

- All collections provide a void or a boolean add to enable clients to populate.
- These methods are boolean for diff reasons:

#### Method Summary - Portfolio

```
boolean add(Investment inv)
Attempt to add the passed investment to this portfolio.
```

#### Method Summary - GlobalCredit

```
boolean add(CreditCard card)
Attempt to add the passed credit card to this GCC.
```

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### 8.2.3 Indexed Traversals

- Traversal in lieu of accessors
- Traverse = Visit each element once. Don't miss and don't over-visit.
- Indexed = Pretend the elements are numbered (0 offset).
- Two methods: **get(int)** and **size()**

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### Example of an indexed traversal

Given a reference x to a Portfolio, list all its investments in a tabular fashion:

<u>Inv.</u>	<u>Market</u>	<u>Book</u>	<u>Net</u>
001	3450.00	2870.00	580.00
002	450.00	500.00	-50.00
.	.	.	.
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<b>Total</b>			

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### 8.2.4 Iterator-Based Traversals

- More abstract than **indexed**
- Relies on the **enhanced for loop**
- Works if the collection implements **Iterable**

```
for (E e : bag)
{
    // visit element e
}
```

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### Example of a chained traversal

Given a reference *x* to a *GlobalCredit*, list all its credit cards in a tabular fashion:

Card No	Balance	Exp 36m?
907321-5	76.85	
671282-1	81.64	
464184-0	134.49	<
755917-2	232.43	
.....	.....	.....

The last column indicates if the card will expire within 36 months

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### 8.2.5 Searching

Searching can be done via a traversal:

- Set up a **traversal** loop
- In each iteration, **compare** the element we are searching for with an element of the collection. **Set** a boolean flag accordingly
- The result (found or not found) must be somehow **remembered** after the loop is exited.

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**A search example:**

Given a reference `gc` to a random `GlobalCredit`, determine whether a given card `c` is in it.

**Attempt #1 (incorrect):**

```
boolean found = false;
for (CreditCard card : gc)
{
    found = card.equals(c);
}
```

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**A search example, cont.**

Correct it by adding the **loop invariant**:

The value of `found` is the same as the sentence: `c` is equal to one of the elements seen so far

**Attempt #2 (correct):**

```
boolean found = false;
for (CreditCard card : gc)
{
    found = found || card.equals(c);
}
```

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**8.2.6 Search Complexity**

- Traversal-based search is **Exhaustive**
- $N$  comparisons in the worst case. It is thus a linear search

A bag contains  $N$  numbered balls and you can pick one ball one at a time. Can you determine if ball number 55 is in the bag by picking less than  $N$  times? In the worst case?

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**Search Complexity**

- Traversal-Based search:  $O(N)$ .
- Complexity of an algorithm can be:  $O(1)$ ,  $O(\lg N)$ ,  $O(N)$ ,  $O(N^2)$  ...  $O(2^N)$ ,  $O(N!)$
- Can break the  $O(N)$  barrier by pre-arranging the elements in some manner
- Sorting, Hashing, Tree structures can lead to sub-linear search complexity.
- GlobalCredit offers a non-exhaustive search. It is sub-linear

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