
Recitation 5

Enums and
The Java Collections classes/interfaces

How do we represent . . .

- Suits - Clubs, Spades, Diamonds, Hearts
- Directions - North, South, East, West
- Days of week - Monday, Tuesday . . .
- Planets - Mercury, Venus, Earth . . .

Other small sets of values that do not change

Using constants

```
public class Suit {  
    public static final int CLUBS = 0;  
    public static final int SPADES = 1;  
    public static final int DIAMONDS = 2;  
    public static final int HEARTS = 3;  
}
```

Problems:

- no type checking
- readability

```
void setSuit(int suit) {...}
```

```
int getSuit() {...}
```

Objects as constants

```
public class Suit {  
    public static final Suit CLUBS = new Suit();  
    public static final Suit SPADES = new Suit();  
    public static final Suit DIAMONDS = new Suit();  
    public static final Suit HEARTS = new Suit();  
  
    private Suit() {}  
}
```

no new Suits can be created

cannot modify Suit objects

```
Suit v; ... if (v == Suit.CLUBS) { ...}      use ==
```

Enum declaration

could be any access modifier

```
public enum Suit {CLUBS, SPADES, DIAMONDS,  
HEARTS};
```

new keyword

name of enum

static final variables
of enum Suit

About enums

1. Can contain methods, fields, constructors
 - a. `Suit.HEARTS.getColor()` ;
1. Suit's constructor is private!
 - a. Cannot instantiate except for initial constants
1. `Suit.values()` returns a `Suit[]` of constants in enum

Demo: Enums in action


Create a class `PlayingCard` and class `Deck`.
What would be the fields for a `PlayingCard` object?

Enum odds and ends

1. Suit is a subclass of `java.lang.Enum`
2. `ordinal()` returns position in list (i.e. the order it was declared)
 - a. `Suit.CLUBS.ordinal() == 0`
3. enums automatically implement `Comparable`
 - a. `Suit.CLUBS.compareTo(Suit.HEARTS)` uses the ordinals for Clubs and Hearts
4. `toString()` of `Suit.CLUBS` is `"CLUBS"`
 - a. you can override this!

Enum odds and ends

5. `switch` statement

```
Suit s = Suit.CLUBS;  
switch(s) {  
    case CLUBS:    
    case SPADES:   
        color= "black"; break;  
    case DIAMONDS:   
    case HEARTS:   
        color= "red"; break;  
}
```

`s == Suit.CLUBS` is true

`switch` statements are fall through! `break` keyword is necessary.

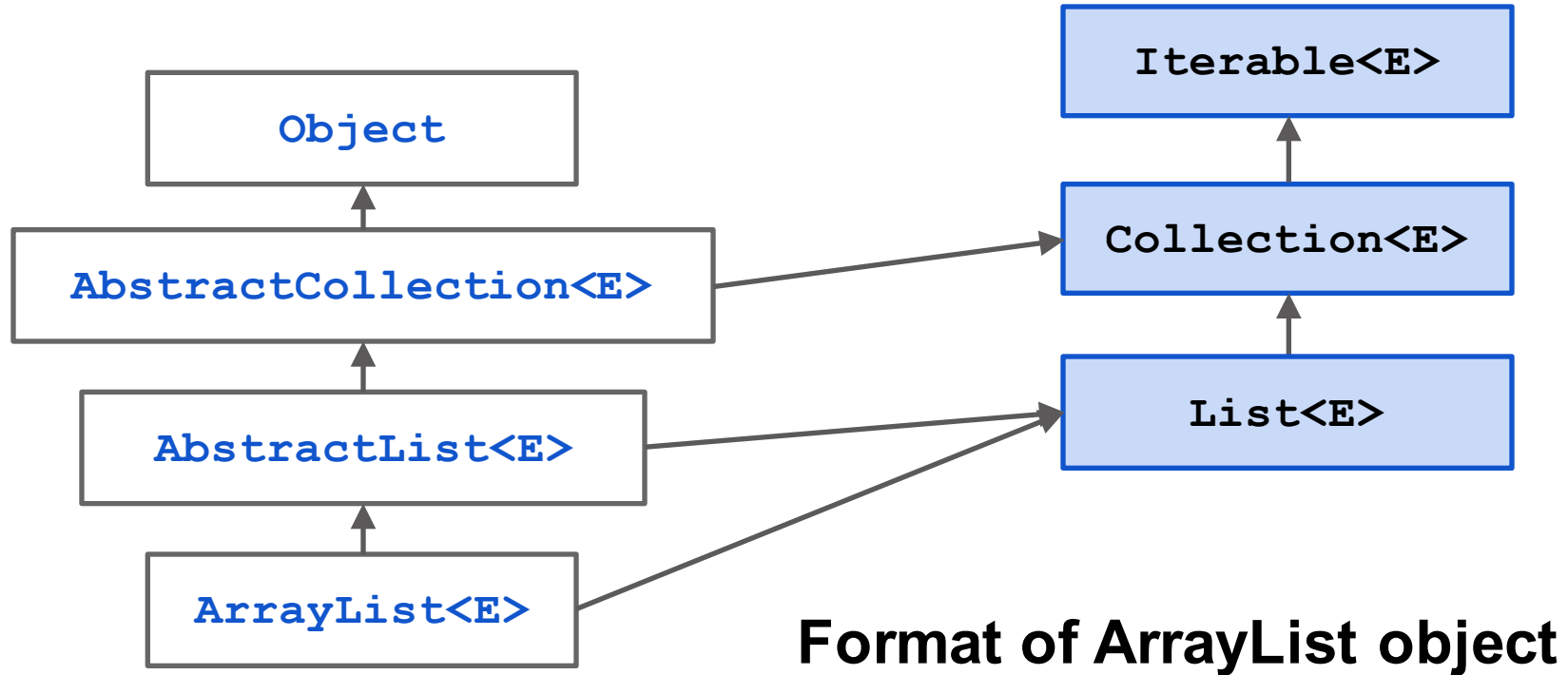
Collections and Map

The Collections classes and interfaces are designed to provide implementations of

- bags (like a bag of objects with duplicates allowed)
- sets
- lists
- Stacks
- queues

You will see in later assignments how easy it is to use these

Power of inheritance and interfaces



Important interfaces

```
Collection<E>  
add (E) ;  
contains (Object) ;  
isEmpty () ;  
remove (Object) ;  
size () ;  
...
```

```
Map<K,V>  
put (K,V) ;  
get (Object) ;
```

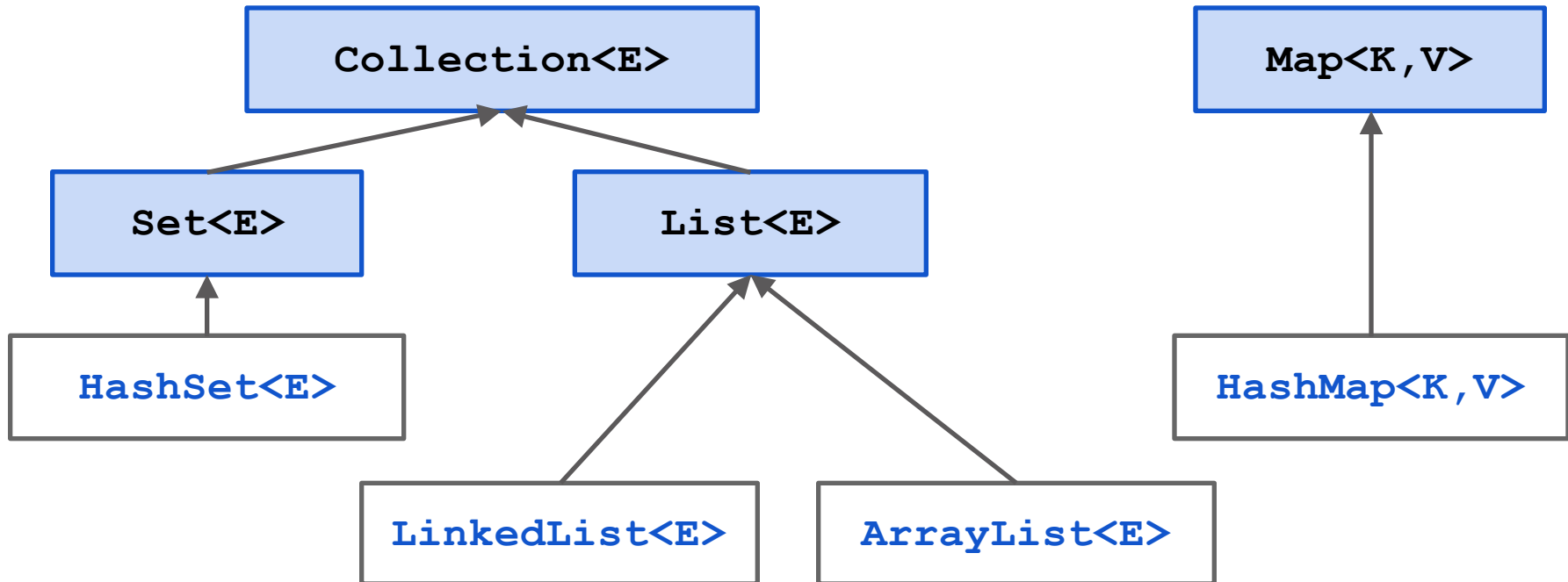
No new methods in Set<E>, just changes specifications

```
List<E>  
get (int) ;  
indexOf (int) ;  
add (int,E) ;  
...
```

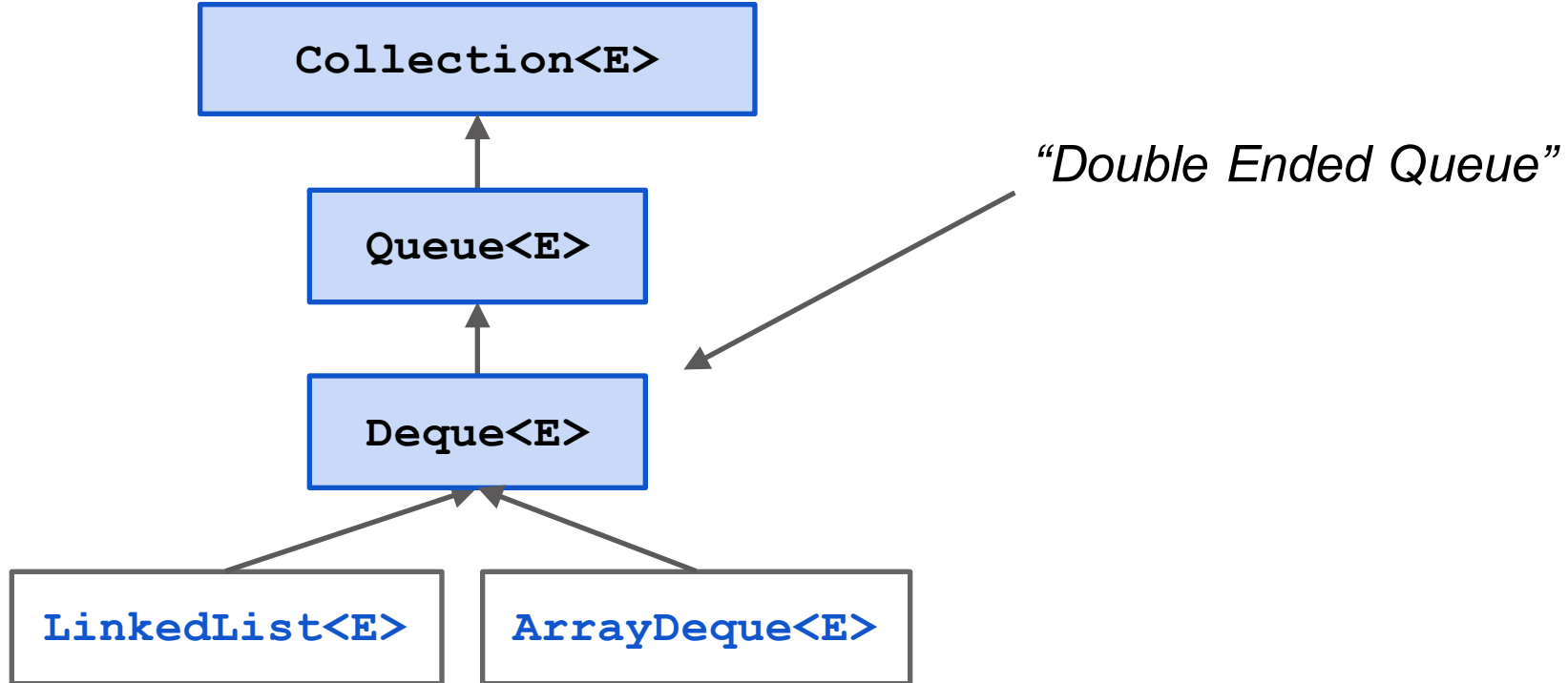
```
Set<E>
```

```
graph TD; List["List<E>"] --> Collection["Collection<E>"]; Set["Set<E>"] --> Collection;
```

Important classes



Queues? Stacks?



Iterating over a HashSet or ArrayList

```
HashSet s = new HashSet();  
  
... store values in the set ...  
  
for (Object e : s) {  
    System.out.println(c);  
}
```

Body of loop is executed once with **e** being each element of the set.
Don't know order in which set elements are processed

HashSet@y2

Object

HashSet

Fields contain
a set of objects

HashSet() add(Object)
contains(Object) size()
remove(Object) ...

s HashSet@y2

HashSet

Collections problems

1. Remove duplicates from an array
2. Find all negative numbers in array
3. Create ransom note
4. Implement a Stack with a max API
5. Braces parsing

Collections problems

Complete

```
Integer[] removeDuplicates(int[])
```

Remove all duplicates from an array of integers.

Very useful HashSet method:

```
hs.toArray(new Integer[hs.size()]);
```

Collections problems

Find Negative Numbers

Find all negative numbers in array and return an array with those integers

Very useful ArrayList method:

```
lst.toArray(new Integer[lst.size()]);
```

Collections problems

Create Ransom Note

Given a note (String) that you would like to create and a magazine (String), return whether you can create your note from the magazine letters.



Collections problems

Implement a `Stack<E>` with a `max()` function in $O(1)$ time

No matter how full the stack is, the `max` function should be in constant time. (ie you should not iterate through the Linked List to find the maximum element)

Collections problems

Braces parsing in $O(n)$ time

Return whether a String has the right format of square brackets and parenthesis.

e.g.

```
"array[4] = ((( new Integer(3) ))) ;" <- is true
```

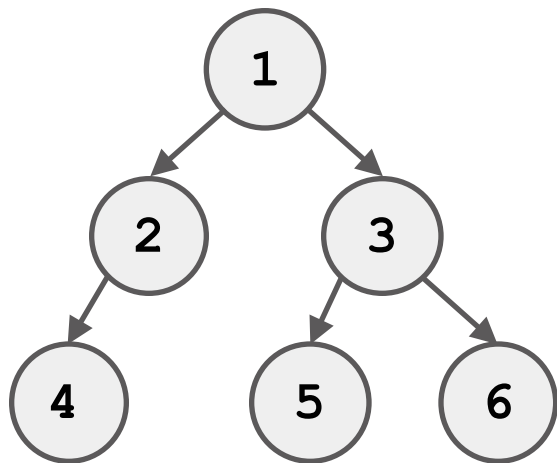
```
"( ) [ ]" <- is false
```

```
") (" <- is false
```

```
" ( [ ) ] " <- is false
```

Collections problems

Print a binary tree in level-order



Output: 1 2 3 4 5 6

Challenge Problem

Output:

1

2 3

4 5 6