Recitation 4

Enums and
The Java Collections classes

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() {...}
```


Better way: 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() {}
}
```

cannot modify Suit objects

no new Suits can be created

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

Enum (enumeration) declaration

can 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
   - `Suit.HEARTS.getColor();`
2. Suit's constructor is private!
   - Cannot instantiate except for initial constants
3. `Suit.values()` returns a `Suit[]` of constants in the `enum`

Demo: Enums in action

Look at `enum` Suit.

Create a class PlayingCard and a 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 Maps

The Collections classes and interfaces that come with Java provide implementations of

- bags (a.k.a. multiset – sets with repeated values)
- sets (and sorted sets)
- lists
- stacks
- queues
- maps (and sorted maps) [like dictionaries]

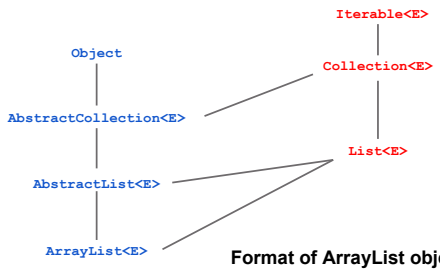
You will see in later assignments how easy it is to use these

ArrayList as example of structure

Class ArrayList implements a list in an array that can grow and shrink. Example of code:

```
ArrayList<Integer> t= new ArrayList<Integer>();
t.add(5);
t.add(7);
System.out.println(t.get(0));  // prints 5
t.add(0, 2);    // insert 2 at index 0, shifting other
                // values up. Can be costly.
System.out.println(t);   // prints [2, 5, 7]
```


Power of inheritance and interfaces



Format of ArrayList object

Important interfaces, some methods in them

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

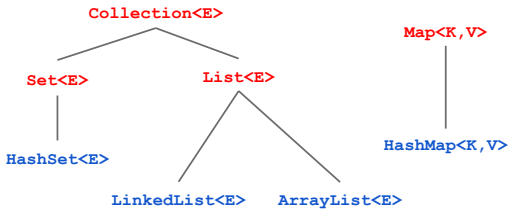
No new methods in Set<E>, just changes specifications

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

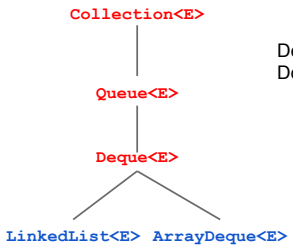
Map<K,V>
```
put(K,V);
get(Object);
```

Set<E>

Important classes and interfaces



Queues? Stacks?

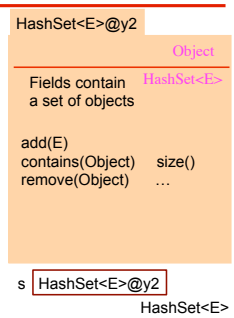


Deque:
Double-Ended Queue

Iterating over a HashSet or ArrayList

```
HashSet<E> s= new HashSet<E>();
… store values in the set …
for (E e : s) {
    System.out.println(e);
}
```

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



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
```