

Collections

- What is a collection?
- Collections and data structures
- Java implementation of collections -
`java.util.Collection`
- Iterators
- Comparing

Overview of arrays

- Disadvantages
 - Arrays have a fixed size/length
 - Arrays can store objects/primitives of one type only
 - “Static” structure – can't change their size
- Advantages
 - Accessibility to every member of the array
 - Can hold more than one object/primitive

- Dynamic data structure – can change its size
- Contains objects
 - Primitives can also be stored or retrieved
- Basic collection types:
 - List - `java.util.List`
 - Set - `java.util.Set`
 - Stack and Queue
 - Map – `java.util.Map`

Iterators

- Iterators are individual objects for each collection object
- Iterators provide the ability for traversing through the collection

*Iteration continues
while there are elements
available
to the iterator*

*Defining an iterator
to a collection*

```
Iterator it = list.iterator();  
while(it.hasNext()){  
    Car car = (Car)it.next();  
}
```

*hasNext() returns a boolean
It checks the availability
of next element*

*next() retrieves
the next element*

*next() return Object
therefore casting is needed*

- List features
 - Can add/remove new objects at any part of the list
 - Can hold equal object
 - Direct access to every object in the list
- `java.util.List`
- Most common implementations:
 - `LinkedList`
 - `ArrayList`
 - `Vector`

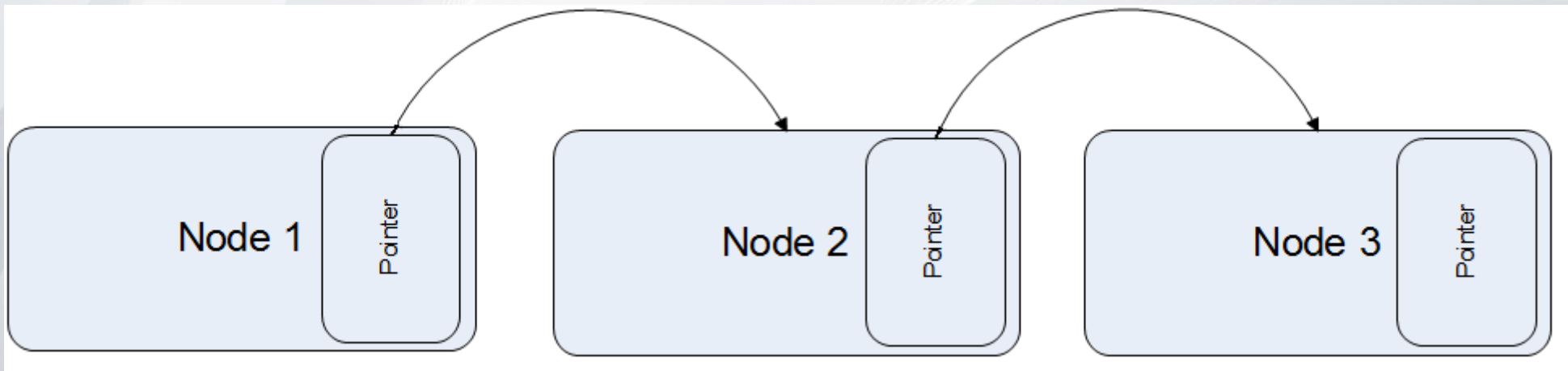
- Basic methods
 - add()
 - get()
 - clear()
 - remove()
 - contains()
 - toArray()

ArrayList

- Class which contains an array of objects
- Each time a new object is being added to the list a check for the array length is made. If there isn't sufficient space, a new larger array is created and the elements of the old one are copied into the new one.
- `ensureCapacity(int n)` – ensures capacity of n

LinkedList

- Each node of the structure contains a pointer which points to next node of the structure
- Not Synchronized



How to use Lists in Java

- Constructor
 - `List arrayList = new ArrayList();`
 - `List linkedList = new LinkedList();`
- Add object
 - `list.add(o1);` - Adds object at the end of the list
 - `list.addFirst(o1)` – adds an object at the beginning
- Remove object
 - `list.remove(o1)` – removes object
 - `list.remove(3)` – removes the 4th element

How to use Lists in Java

- Contain object
 - `list.contains(o1);`
- Iterator
 - `list.iterator();`
- Get an Object
 - `list.get(3)` – gets the 4th element. Returns an object and casting is needed
 - `iterator.next()` - Returns an object and casting is needed

- Java objects can be compared
 - equals() or „==“ return the equality of a reference but not the logical equality meant by the programmer
- Two types of comparing in java
- Comparable = java.lang.Comparable
 - Requires overriding of **compareTo(Object o1)**
 - CompareTo returns (by Convention)
 - -1 if o1>this
 - 0 if o1==this
 - 1 if o1<this

Comparing

- Comparator = `java.util.Comparator`
 - Requires overriding of **`compare(Object o1, Object o2)`**
 - Compare returns (by Convention)
 - 1 if $o1 > o2$
 - 0 if $o1 == o2$
 - -1 if $o1 < o2$

How to compare

*Comparable should be implemented and
the class that should be compared against is specified in <>*

```
public class CarCompare implements Comparable<CarCompare>{  
    //some code here  
    public int compareTo(CarCompare car){  
        if(this.getMaxSpeed() > car.getMaxSpeed()){  
            return 1;  
        }  
        else{  
            if(this.getMaxSpeed() < car.getMaxSpeed()){  
                return -1;  
            }  
        }  
        return 0;  
    }  
}
```

*compareTo() is used
for comparing*

*Returning 1 if this is greater
-1 if this is less
and 0 if equals*

How to compare

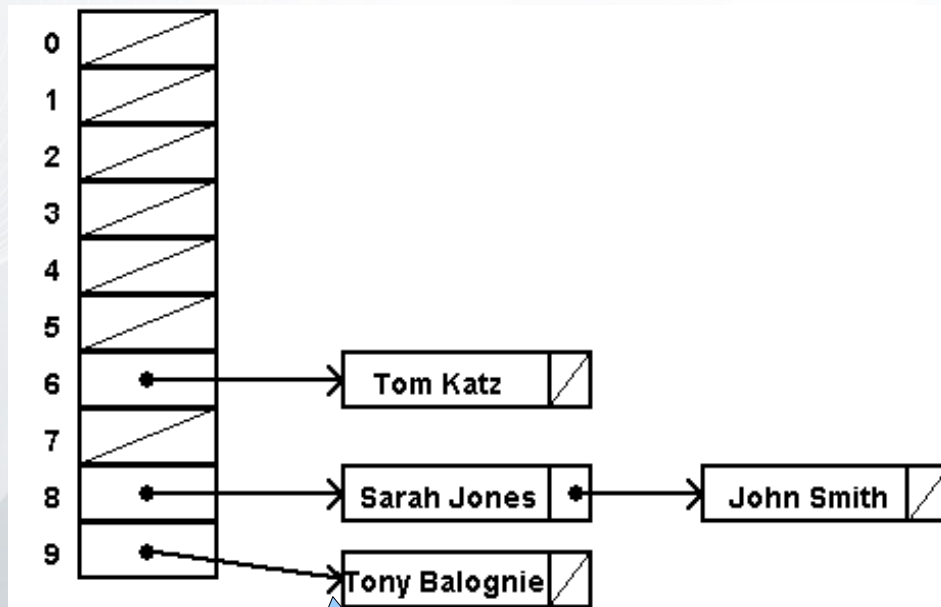
*Comparator should be implemented and
the class that should be compared against is specified in <>*

```
public class CarComparator implements Comparator<Car>{  
    @Override  
    public int compare(Car car1, Car car2) {  
        if(car1.getMaxSpeed() > car2.getMaxSpeed()){  
            return 1;  
        }  
        else{  
            if(car1.getMaxSpeed() < car2.getMaxSpeed()){  
                return -1;  
            }  
        }  
        return 0;  
    }  
}
```

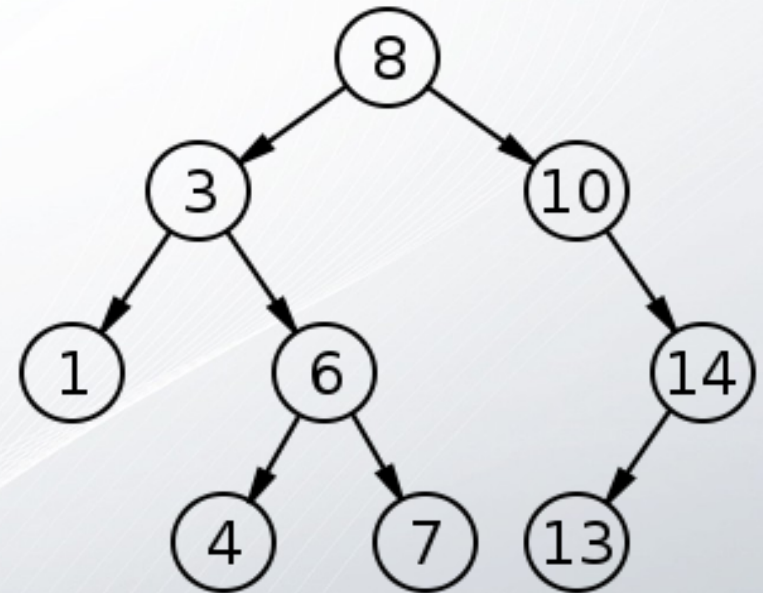
*compare is used
for comparing
Two objects are passed*

*Returning 1 if first object is greater
-1 if first objects is less
and 0 if equals*

Trees & Hash Tables



*HashSet – stores the values for particular key.
Values are retrieved by the key*



Tree- hierarchical structure

- Contains only unique values
 - What is uniqueness?
- Implementations – TreeSet, HashSet, LinkedHashSet
 - TreeSet
 - The elements in the set are sorted
 - Not synchronized
 - Objects in TreeSet MUST implement Comparable
 - Uniqueness is granted by Comparable

- HashSet
 - No guarantee the order of the elements will be kept
 - Not synchronized
 - hashCode() is used for keeping track of the uniqueness

How to use Set in Java

- Constructors

- `HashSet hashSet = new HashSet();`
- `TreeSet treeSet = new TreeSet();`

- Methods

- `set.add(o1);`
- `set.add(o1);`
- `set.remove(o1);`
- `set.size();`
- `set.iterator;`

- Stack is a LIFO structure
- All elements are added at the top
- All elements are extracted from the top
- In Java Stack extends Vector
- Methods
 - push() - adds an element
 - pop() - removes an element

Queue

- FIFO structure
 - All new elements are added at the beginning
 - All elements are got from the end
- `java.util.Queue`
- Methods
 - `offer(Object o1)` - adds a new element
 - `remove()` - retrieves and removes the head
 - `peek()` - retrieves but does not remove the head
 - `poll()` - same as peek, returns null if the queue is empty

Understanding Set, List, Queue and Stack

- Use List as a Set
- Use Set as a List?
- Use List as a Queue
- Use List as a Stack
- Use Queue and Stack as a List?

Map

- Contains key-value pairs
- Keys are unique
- Most common implementations
 - HashMap – HashSet of keys i.e. order of elements may change.
 - SortedMap – Elements are sorted by key
 - TreeMap – Red-black tree

How to use Map

- Constructor

- `Map map = new HashMap();`
- `Map map = new TreeMap();`

- Methods

- `map.put(key,value);`
- `map.remove(key);`
- `map.containsKey(key);`
- `map.containsValue(value);`
- `Set keySet = map.keySet();`
- `Collection values = map.values();`

Collections class

- `addAll()`
- `fill()`
- `max()`, `min()`
- `shuffle()`
- `sort`, `swap()`
- `unmodifiableList()`

Custom implementation of LinkedList

- Create a class Node
 - Create a field next of type Node
 - Create a field element for the values
- Create a class LinkedList
 - Implement List
 - Create a field head of type Node
 - Implement all methods from List
 - Create methods get
 - Rearrange pointers when adding/removing a node

Custom implementation of Stack and Queue

- Each node points to the next one – define a Node class as for LinkedList
- Create class Stack/Queue
- Create a field head/top of type Node
- Create methods push() and pop() for stack
- Create methods pop() and poll() for queue
- For queue – change the head when removing
- For stack – change the top when adding

Summary

- Collections are dynamic structures
- Basic data structures – linked list, binary tree, hash table
- Basic collection types – list, set, map, stack, queue
- Iterators
- Comparing