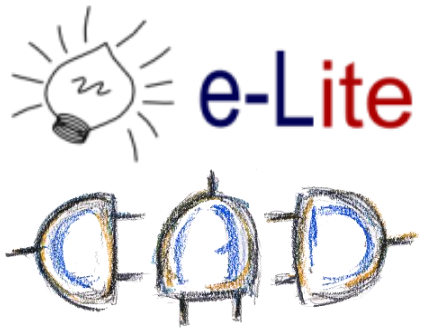


Priority Queue

Queuing, the smart way

Queue

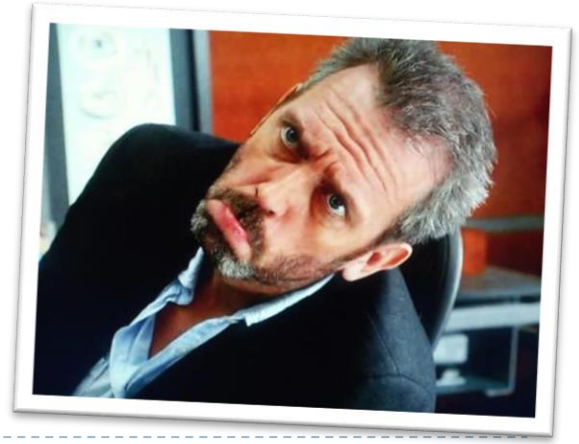
- First in, first out (FIFO)
- Easily implemented with a List
  - Also LIFO!

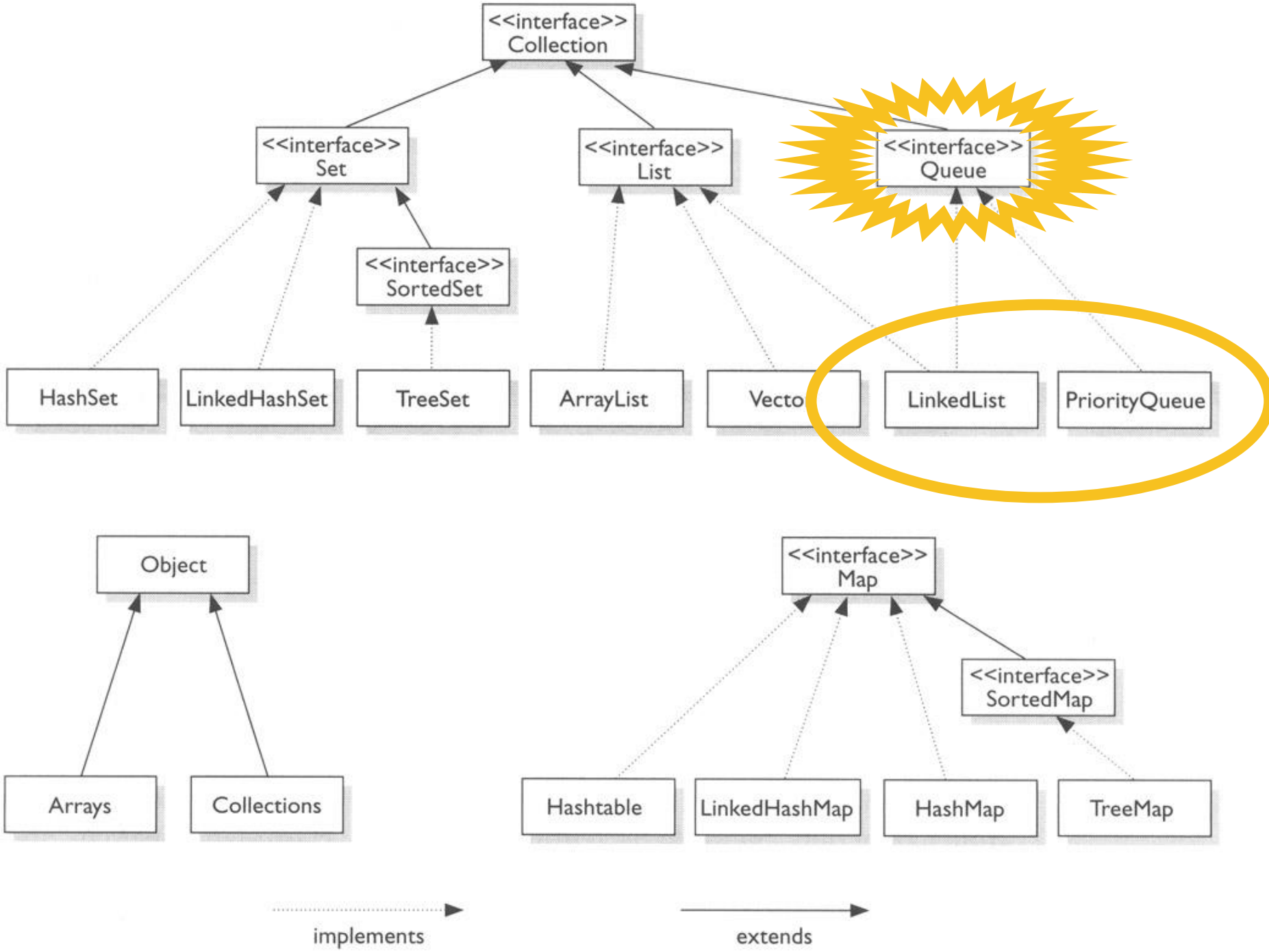
Priority Queue

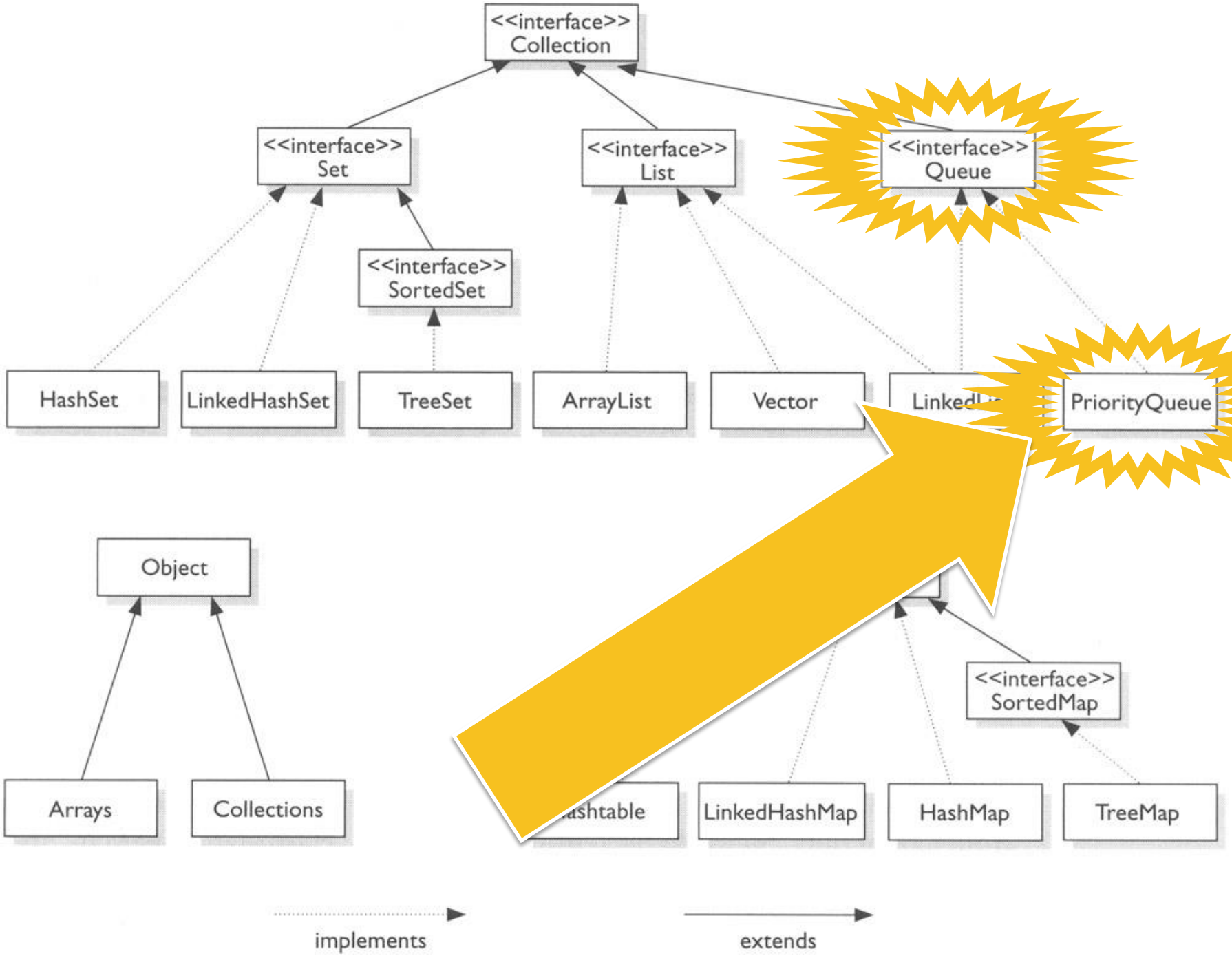
- Prioritization problems
- Canonical example: ER scheduling
  - A gunshot victim should probably get treatment sooner than that one guy with a sore neck, regardless of arrival time. How do we always choose the most urgent case when new patients continue to arrive?

Poor choices

- list
  - remove max by searching is O(N)
- sorted list
  - remove max is O(1); add (remove) is O(N)
- binary search tree
  - remove max, add and remove are O(log N)
  - … but tree may becomes unbalanced




<<interface>>
Collection
<<interface>>
Set
<<interface>>
List
<<interface>>
Queue
<<interface>>
SortedSet
HashSet
LinkedHashSet
TreeSet
ArrayList
Vecto
LinkedList
PriorityQueue
Object
Arrays
Collections
<<interface>>
Map
<<interface>>
SortedMap
Hashtable
LinkedHashMap
HashMap
TreeMap
implements
extends


<<interface>>
Collection
<<interface>>
Set
<<interface>>
List
<<interface>>
Queue
<<interface>>
SortedSet
HashSet
LinkedHashSet
TreeSet
ArrayList
Vector
PriorityQueue
Object
Arrays
Collections
<<interface>>
SortedMap
LinkedHashMap
HashMap
TreeMap
implements
extends

Queue interface

- Add elements
  - boolean **add**(element)
  - boolean **offer**(element)
- Remove elements
  - element **remove**()
  - element **poll**()
- Examine
  - element **element**()
  - element **peek**()

Queue Interface Structure

Type of Operation	Throws exception	Returns special value
Insert	`add(e)`	`offer(e)`
Remove	`remove()`	`poll()`
Examine	`element()`	`peek()`

Queues

- Known implementing classes:
  - ArrayBlockingQueue
  - ArrayDeque
  - ConcurrentLinkedQueue
  - DelayQueue
  - LinkedBlockingDeque
  - LinkedBlockingQueue
  - LinkedList
  - PriorityBlockingQueue
  - **PriorityQueue** 
  - SynchronousQueue

Queues

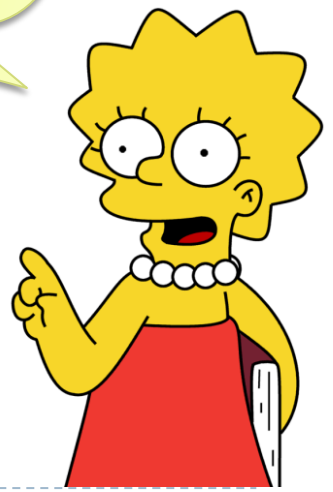
- Known implementing classes:
  - **ArrayBlockingQueue**
  - ArrayDeque
  - ConcurrentLinkedQueue
  - **DelayQueue**
  - **LinkedBlockingDeque**
  - **LinkedBlockingQueue**
  - LinkedList
  - **PriorityBlockingQueue**
  - PriorityQueue
  - **SynchronousQueue**

Supports operations that wait for the queue to become non-empty when retrieving an element, and wait for space to become available in the queue when storing an element. Useful only in concurrent (multithreaded) applications.

Queues

- Known implementing classes:
  - ArrayBlockingQueue
  - **ArrayDeque**
  - ConcurrentLinkedQueue
  - DelayQueue
  - **LinkedBlockingDeque**
  - LinkedBlockingQueue
  - LinkedList
  - PriorityBlockingQueue
  - PriorityQueue
  - SynchronousQueue

Double ended queues support insertion and removal at both ends. The name *deque* is short for "double ended queue" and is usually pronounced "deck"



Queues

- Known implementing classes:
  - ArrayBlockingQueue
  - ArrayDeque
  - **ConcurrentLinkedQueue**
  - DelayQueue
  - LinkedBlockingDeque
  - LinkedBlockingQueue
  - LinkedList
  - PriorityBlockingQueue
  - PriorityQueue
  - SynchronousQueue

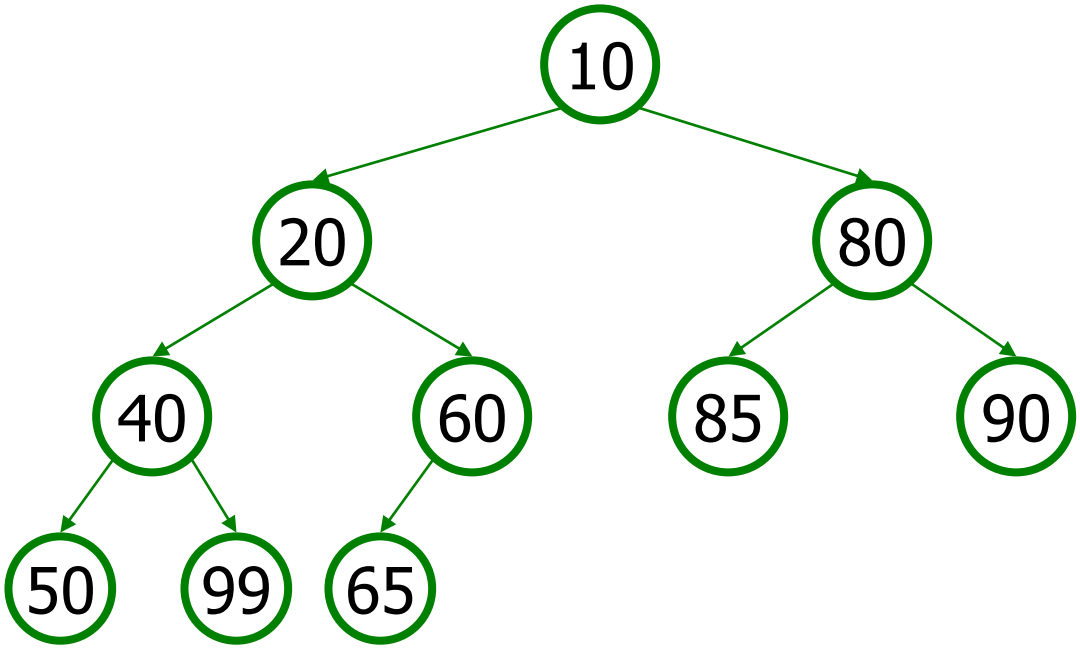
PriorityQueue

- An unbounded priority queue based on a priority heap.

Method/Constructor	Description	Runtime
`PriorityQueue<E>()`	constructs new empty queue	O(1)
`add(E value)`	adds value in sorted order	O(log *N*)
`clear()`	removes all elements	O(1)
`iterator()`	returns iterator over elements	O(1)
`peek()`	returns minimum element	O(1)
`remove()`	removes/returns min element	O(log *N*)
`size()`	number of elements in queue	O(1)

What is a Heap?

- Kind of binary tree
- "Partially" ordered



Note

- For a priority queue to work, elements must have an **ordering**.
  - Elements must implement the ***Comparable*** interface

```
public class Foo implements Comparable<Foo> {
    …
    public int compareTo(Foo other) {
        // Return positive, zero, or negative integer
    }
}
```

  - The comparator must be specified in the constructor

```
public PriorityQueue(int initialCapacity,
                     Comparator<? super E> comparator)
```

Licenza d'uso

- Queste diapositive sono distribuite con licenza Creative Commons "Attribuzione - Non commerciale - Condividi allo stesso modo (CC BY-NC-SA)"
- Sei libero:
  - di riprodurre, distribuire, comunicare al pubblico, esporre in pubblico, rappresentare, eseguire e recitare quest'opera
  - di modificare quest'opera

- Alle seguenti condizioni:
  - **Attribuzione** — Devi attribuire la paternità dell'opera agli autori originali e in modo tale da non suggerire che essi avallino te o il modo i cui tu usi l'opera.

  - **Non commerciale** — Non puoi usare quest'opera per fini commerciali.

  - **Condividi allo stesso modo** — Se alteri o trasformi quest'opera, o se la usi per crearne un'altra, puoi distribuire l'opera risultante solo con un licenza identica o equivalente a questa.

- http://creativecommons.org/licenses/by-nc-sa/3.0/