Useful Java Collections

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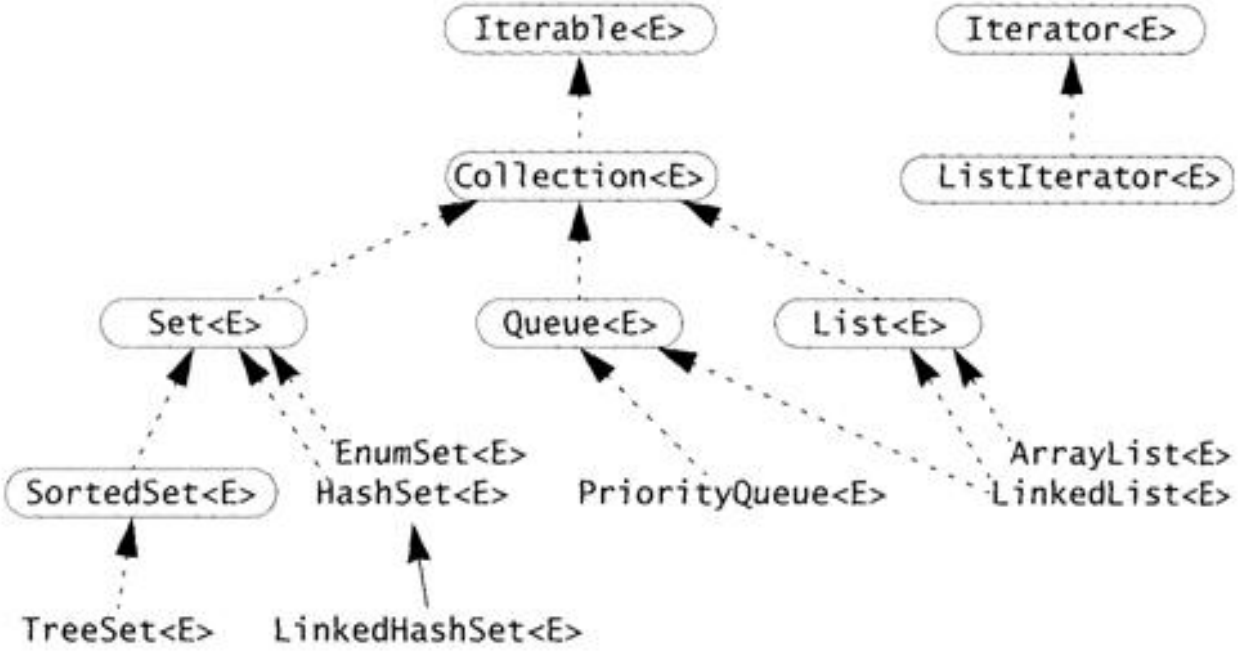
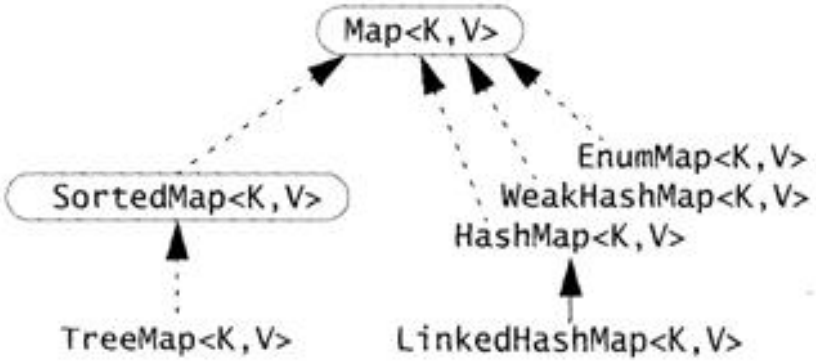
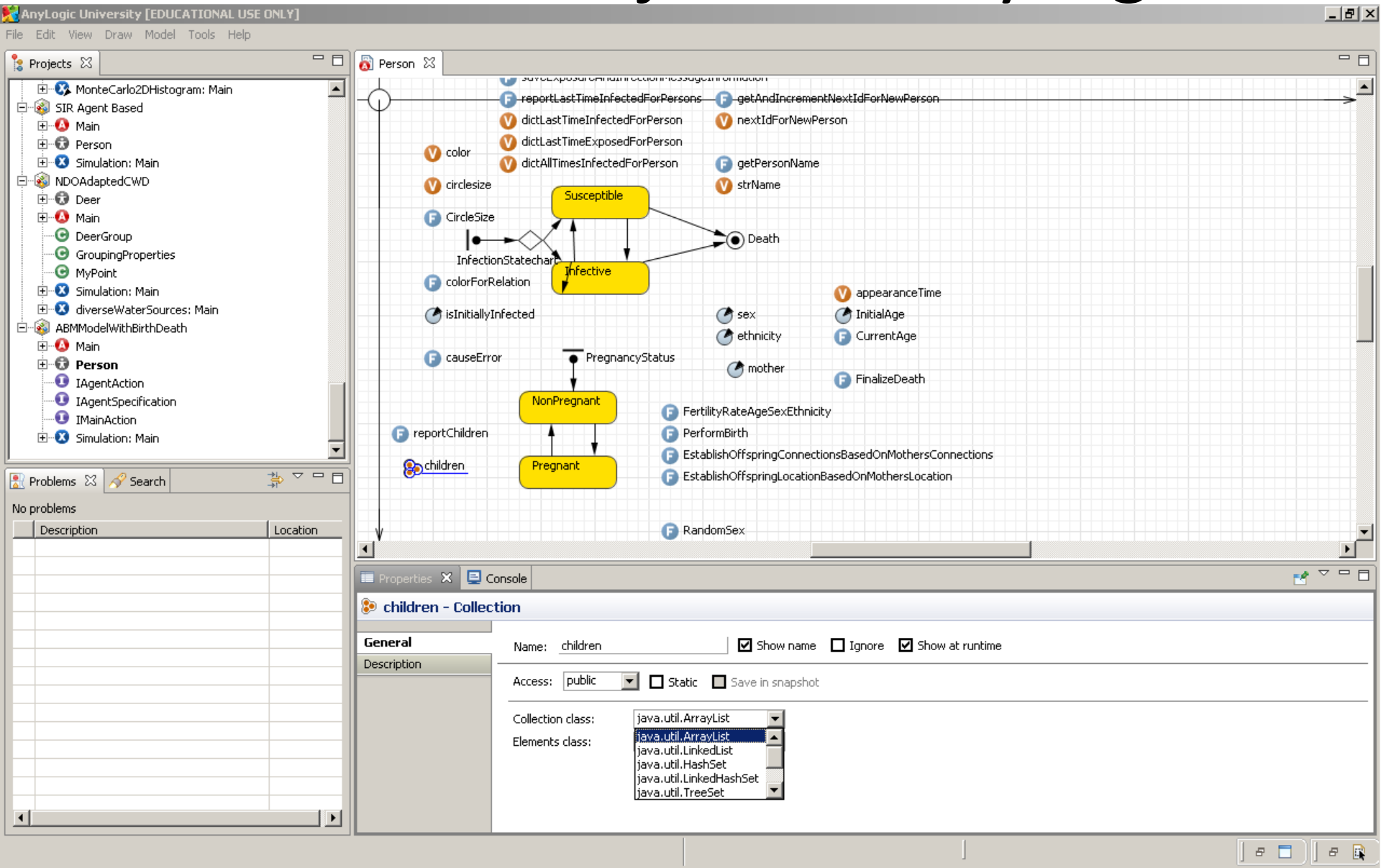
May 9, 2012

Java.util Collection Hierarchies

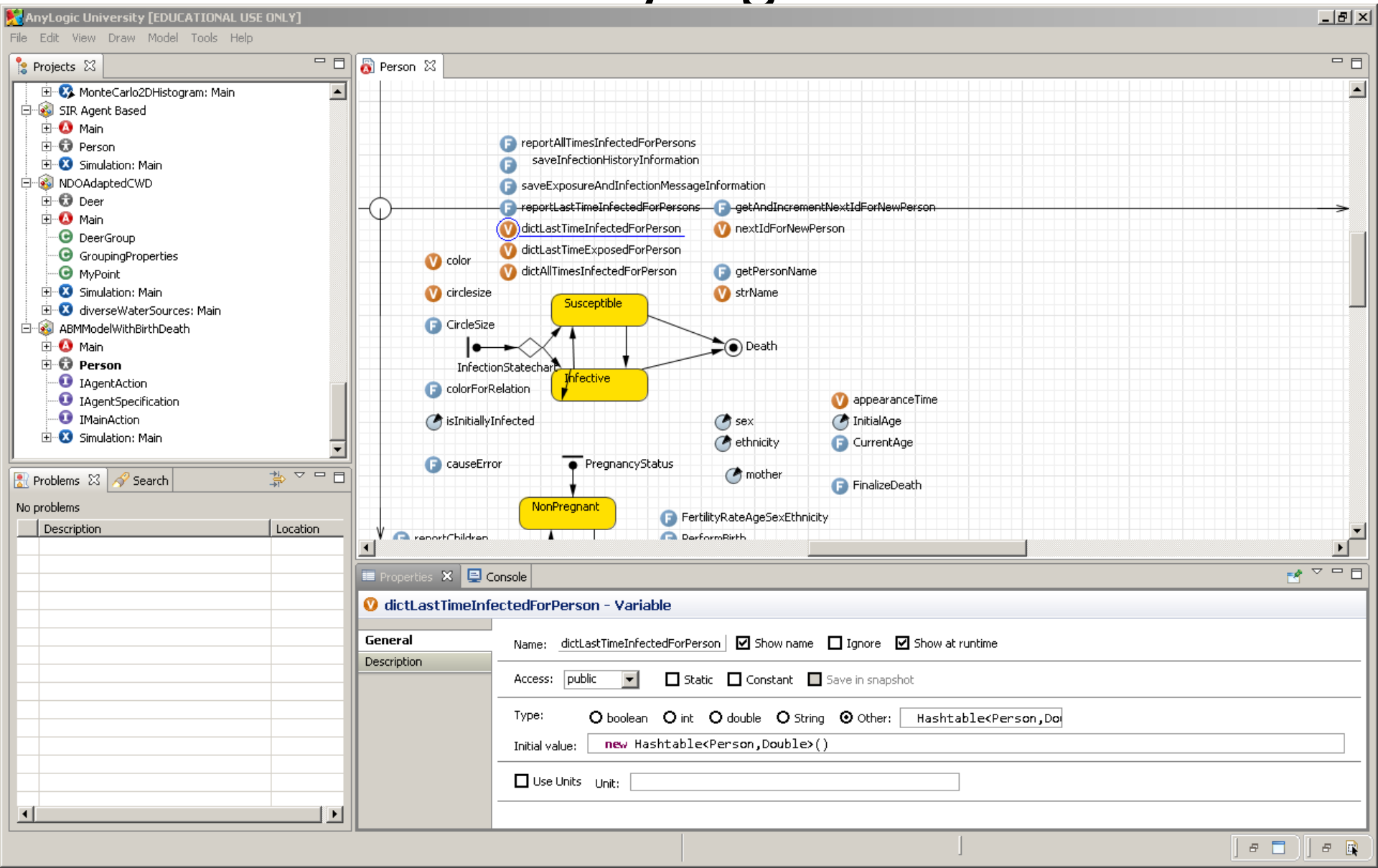




Collection Objects in AnyLogic



Informal Collection Variables in AnyLogic



Useful Collections

- Array
- ArrayList
- Linked list
- Dictionary (e.g. implementation: HashTable)
- Set
- Priority queue
- Binary Tree

Common Characteristics

- Capacity to store information
- Iteration thru elements (support for Iterable interface)
- Separation of *interface* from *implementation*
  - There are often several particular “implementations” that can atch a given interface (contract)
    - These differ in the details of “how” they accomplish the tasks prescribed in the implementation, but adhere to the contract
  - You can create your own implementation of an imterface
- Java supports built-in rich set of collections
  - Java.collections
- Many collections use *generics* syntax to allow for “customized versions” for particular contents
  - e.g. ArrayList<Person>, HashMap<String,Person>
  - Note that these “generics” parameters *must be classes*!

Built-in Java Arrays

- Allocated via (explicit or implicit) new operator
- Can optionally list initial contents
- Can contain both “unboxed” (e.g. int) and “boxed” (e.g. Integer) contents
- Syntax Examples

  int arrayNeighborIndices[] = new int[n];

  String arrayCities[] = { “Bangor”, “Portland”, “Mooselookmeguntic” };
- Note that can have array of size 0

Java Arrays: Tradeoffs

- Pros
  - Can easily specify initial contents
  - Simple syntax
  - Boxed & unboxed elements
  - Fast lookup (by index)
- Cons
  - Painful to extend or delete elements(need to manually copy elements)
  - Only integer (int, short) indices

ArrayList

- Generic class
  - Syntax: ArrayList<Int>, ArrayList<String>
- Pros
  - Rapid insertion & deletion
  - Convenient integer-based indexing
- Note that can have empty ArrayList
- Combines good aspects of
  - Array
  - Linked list
- Suggestion: Use a built-in array if you know the size ahead of time

Linked List

- A sequential list of elements of arbitrary length
- Can iterate forward down list
- This is a Doubly Linked List
  - can iterate backwards in list (from end back to beginning)
- Be prepared for potential empty list!
- Application example: Linked List of History Information, *Persons* who have been infected, in order of infection occurence

Dictionary (Hashtable and HashMap as Implementation)

- If key is the same as value, can be used to implement "content-indexed memory" (and "associative arrays")
  - Cf:
    - Array: Look up content at integer
    - Dictionary: Can lookup many types of keys
      - e.g. look up information associated with String
- Example use of generics: HashMap<String,Person>, Hashtable<String,ArrayList<Person> >
- Two associated collections
  - Keys
  - Values
  - (each key can be used to look up an associated vale)

Hashtable and HashMap Implementation of Map

- Pros
  - Rapid insertions (flexible size)
  - Can readily inset items by associated information
- Cons
  - Low bucket count => Risk of clashes between keys => longer time for insertions
    - If too few “buckets”, performance can grow similar to linked list
  - Larger data structure (“wasted space” in the form of empty buckets if load factor is off)
- Application Example: Look up City Characteristics for Names

Hashtable vs. HashMap

- Tolerance for null
  - Hashtable prohibits null keys & values
  - HashMap allows
    - One null key
    - Many null values
- HashMap has a subclass with a predictable order of iteration
- HashMap and Hashtable also differ with respect to multithreading support (beyond scope of course)

Set

- Dichotomous inclusion/omission
  - .contains
- No ordering of elements
  - Cannot tell if A was inserted before B or vice-versa
- Set operations
  - Union (.addAll())
  - Intersection (.retainAll())
  - (Assymetric) Set difference (.removeAll())
- Example: Keeping track of *Person*s that have been infected thus far

Priority Queue

- For a given priority level, this is first-in-first-out
  - First inserted is first to reach “head” of queue
- Can prioritize according to arbitrary comparator
  - Like “first class” vs. “economy” lane, those with higher priority can “skip ahead” of those with lower priority
- A key use lies in representing a waiting list
- Getting element at head
  - Call to poll() (returns reference to element and removes from head of queue)
  - Call to peek() (returns reference to item at queue head)

Building Your Own Collections

- Java developers routinely create novel “data structures”, including some collections
- Often these data structures are composed of pieces using the above-described (“built-in”) collections
- If you build your own collections, be aware that care should be taken in several areas
  - Need to be careful about passing out references to values from the collection, in case they can be modified
  - Need to be careful about storing away references to external values, since this might allow external code to (typically, inadvertently) modify the data structure internals