More AnyLogic & Java Events
Java Types, and Enums

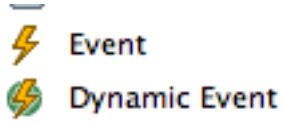
Nathaniel Osgood

CMPT 858

March 15, 2011

Reminder: Rates & Events

- *Rates* and *Timeouts* are associated with types of events in AnyLogic
- Events can also be declared explicitly from the pallette

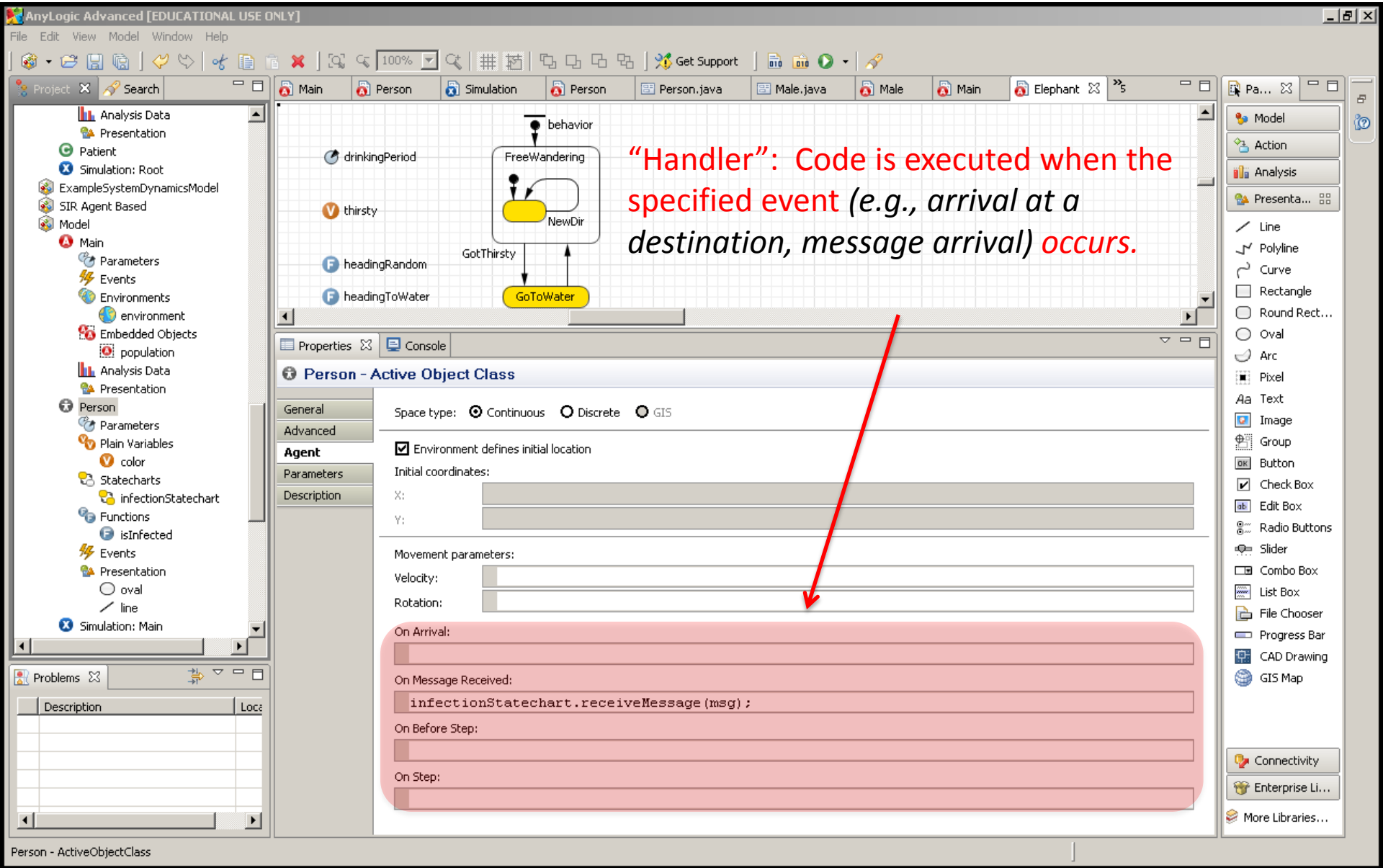


  - Dynamic events can have multiple instances
    - Each instance can be scheduled at the same time
    - The instances disappear after event firing
  - Regular (static) events can be rescheduled, enabled/disabled, but can only have one scheduled firing at a time
- There are some subtleties with events

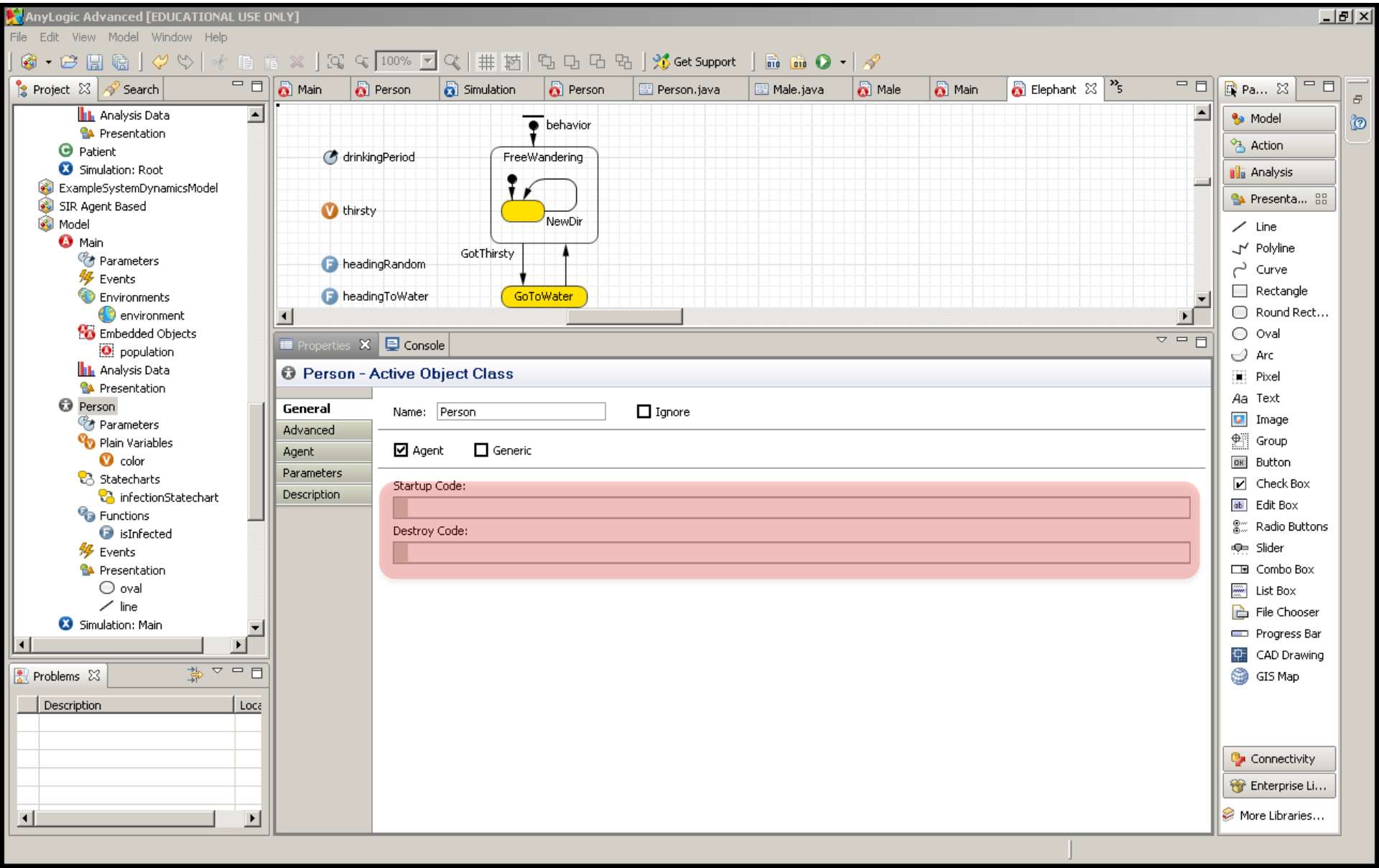
Built-In Events

- In addition to handling occurrence of explicit events, models automatically support “catching” certain “built-in” types of events
- To handle these events, code is inserted into certain handler areas for each of different sorts of classes

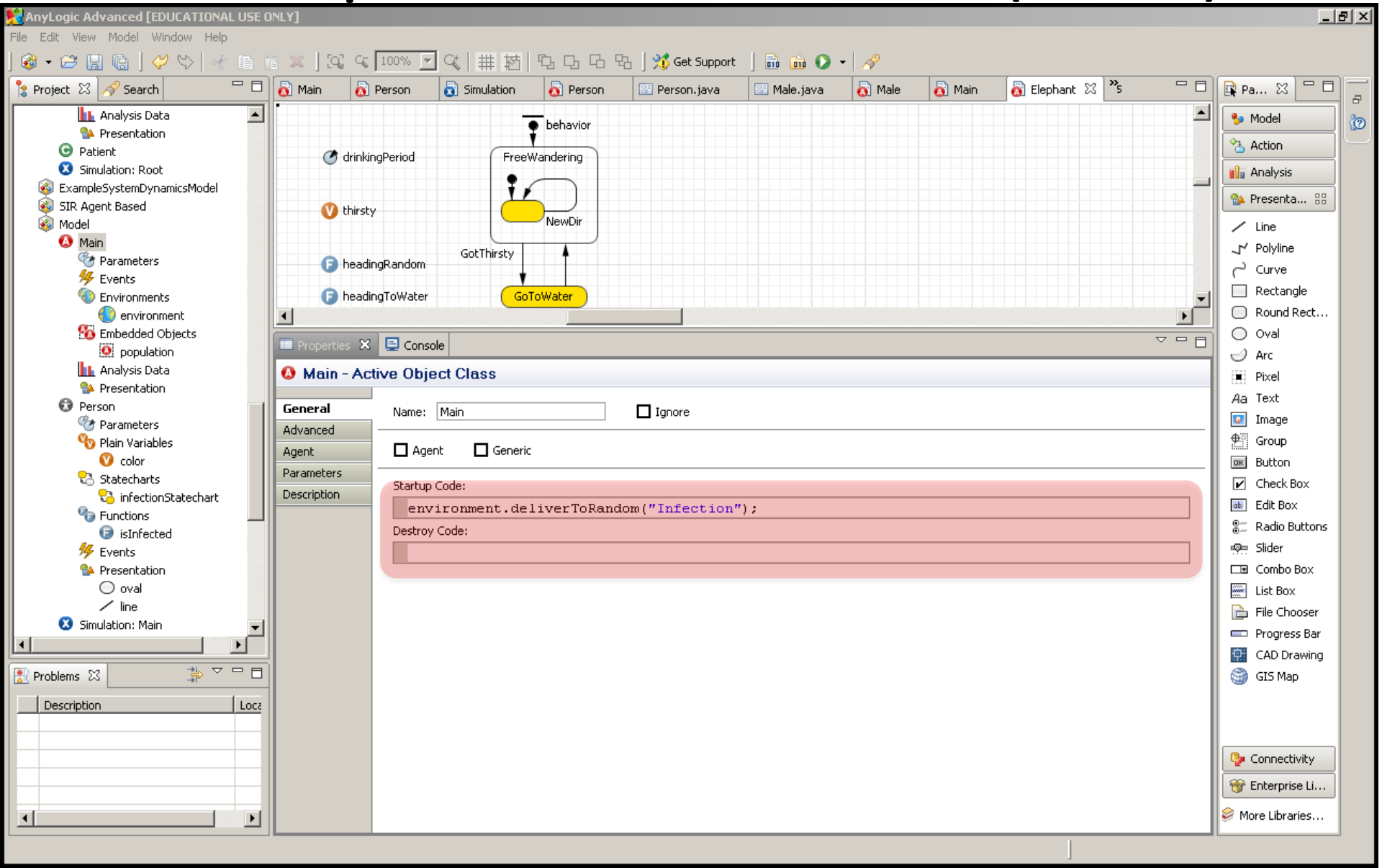
Example: Built-In Events (Agent 1)



Example: Built-In Events (Agent 2)



Example: Built-In Events (Main)



Types in Java

- Types tell you the class of values from which a variable is drawn
- In Java we specify types for
  - Parameters
  - Variables
  - Return values
  - Class Fields
- Typically, we encode information described by elements of one or more different types

Types & Legal Operations

- For a given type, only certain “operators” can be used e.g.
  - e.g. a double precision value can be divided, multiplied, turned into a String etc.
  - A boolean can be tested for truthhood, turned into a String, etc.
  - A (reference to a) string can be used to
    - Extract prefixes or suffixes, find the length, concatenated, etc.
  - An enum’s values can be turned turned into a String, converted to integer, etc.

Java Primitive Types

- These are built-in to the Java language
- Primitive types in Java are the following
  - boolean
  - double
  - short (small integer)
  - int
  - char
  - byte
  - long
  - float

Non-Primitive Types

- Most types we used are not primitive types
- These are defined either
  - In our code
  - In the standard Java libraries

Why Types?

- Like specifying dimensions for an object (e.g. L, L^3/T), specifying types lets us
  - Know what we're dealing with (so we know what to do with it)
  - Avoid making a silly mistake
    - e.g. attempting to divide a number by a (reference to) a Person
    - Absent types, it is likely that these mistakes wouldn't be identified until runtime
      - If we don't happen to test that portion of the program, we won't be aware of the error
    - With types, we can discover these errors when we are building the program -- during our "Build"

Type Coercion ("Casting"): Why

- Sometimes we have something that is a member of one type, but that can be logically converted to another type
- Examples:
  - We have a double-precision value and we wish to convert it instead to an integer (by dropping fractional component)
  - We have an integer (or a double, char, boolean, etc.) and wish to convert it to a string
  - (Subtyping) We have an ActiveObject that we know is a Person and wish to treat it as a Person

Type Coercion (“Casting”): How

- To “cast” a value *v* in one type to another type, the following syntax is used

  (TargetType) v

- Examples:

  traceln((String) age)

  ((Female) item).stateChart.isStateActive(Pregnant)

  ((int) age) + 1

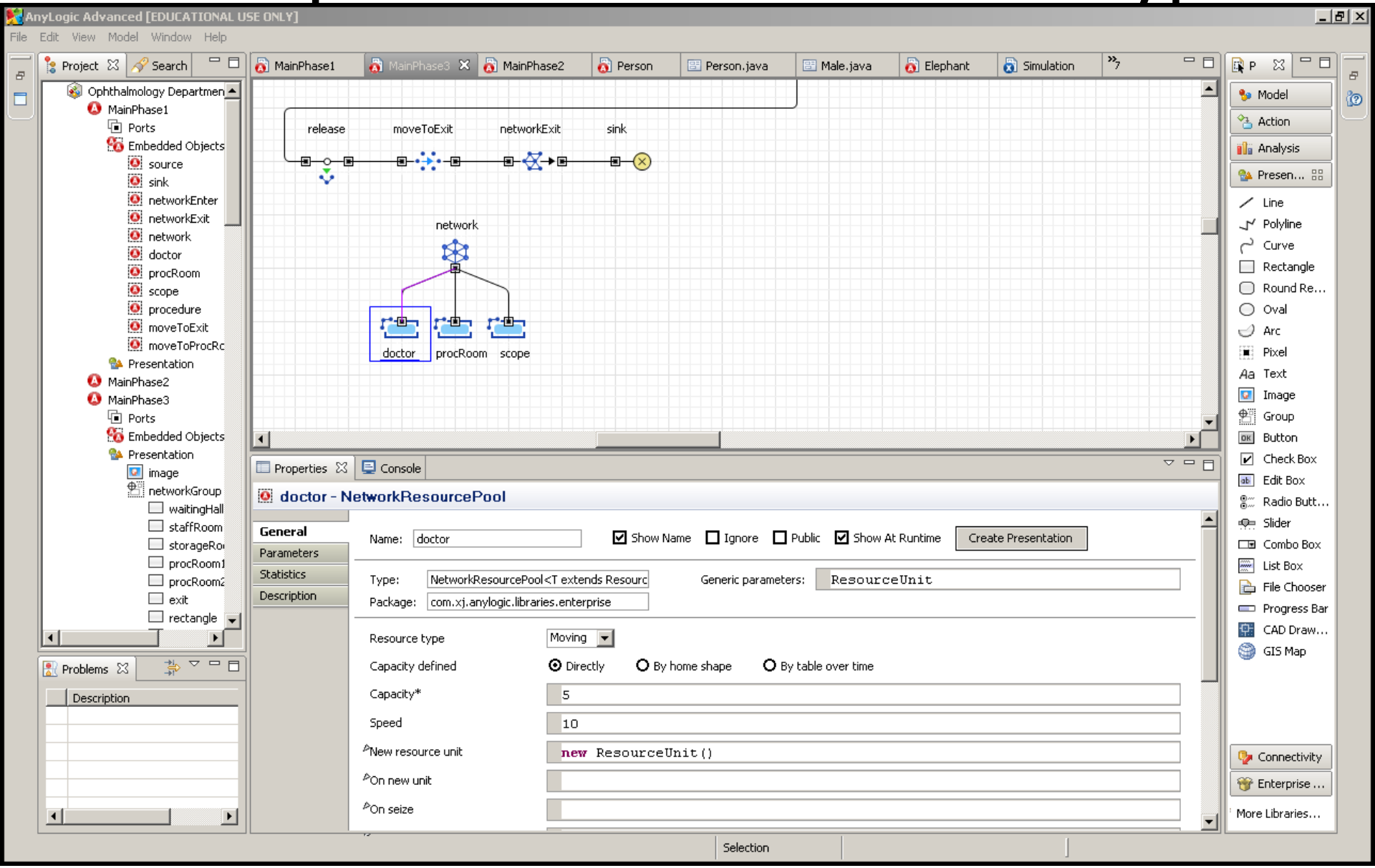
Parameterized Types

- Sometimes a type (A) is defined in terms of another type “(B)
  - This allows the definition of A to take & give back information specific to type B
    - e.g. methods take an A as a “parameter”, or return a B, etc.
- Common example: Collections depending on the type of their content
- We say that the type A is “parameterized by” type B
- We can describe such “Parameterized Types” using Java “Generics”
  - Syntax used: A<B>

Examples of Parameterized Type (Generics)

- A resource pool depending on what resources are included (ResourcePool<MyResourceUnit>)
- An “array list” (like an extensible vector) depending on the type of the elements (ArrayList<Person>)
- Hypothetical: A Pair defined in terms of the first and second element
  - Pair< String, Double>

Example of a Parameterized Type



Enums: Why

- Often we desire in our models to encode categorical information
- We can certainly encode such information using integers (or shorts, etc.)
  - e.g.
    - Male=0, Female=1
    - Province: NL=0,NB=1,PEI=2,QC=3,etc.

- Example using variables

```
int    sex
int province
```

Problem: This is fragile

- We could easily mistake a value “0” as encoding either Males or Newfoundland/Labrador
- e.g.
  - Reversing order of parameters given to a method, or entered into a file
  - Assigning value for one to another, due to a poorly named values

- e.g.

sex=province

Enums in Java

- Enums let us
  - Give names to such information
  - Refer to the names in our code
  - Convert the names (where necessary) into their associated values
  - Compare names
  - Define operations on names

Simplest Examples

- enum Sex { Male, Female };
- enum Province { NL, NB, PEI, QC, ON, MB, SK, AB, BC};
- Variables using enum:

  Sex sex

  Province province
- Causes error: sex=province