Algorithmic Thinking and Structured Programming (in Greenfoot)

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Computational thinking

- **Working in a structured manner:**
  - Breaking problems down into subproblems
  - Design, solve and test solutions to subproblems
  - Combing these (sub)solutions to solve problem
- **Analyzing** the quality of a solution
- **Reflecting** about the solution chosen and proces
- **Generalizing** and re-use of existing solutions

Today’s Lesson plan (2)

- 15 min Pre-test: what DID you already know?
- Blocks of theory and exercises
  - Finish assignment 1
  - Begin assignment 2
- 10 min Wrapping up
  - Saving work
  - Handing-in
  - Plenary reflection

Last weeks homework:

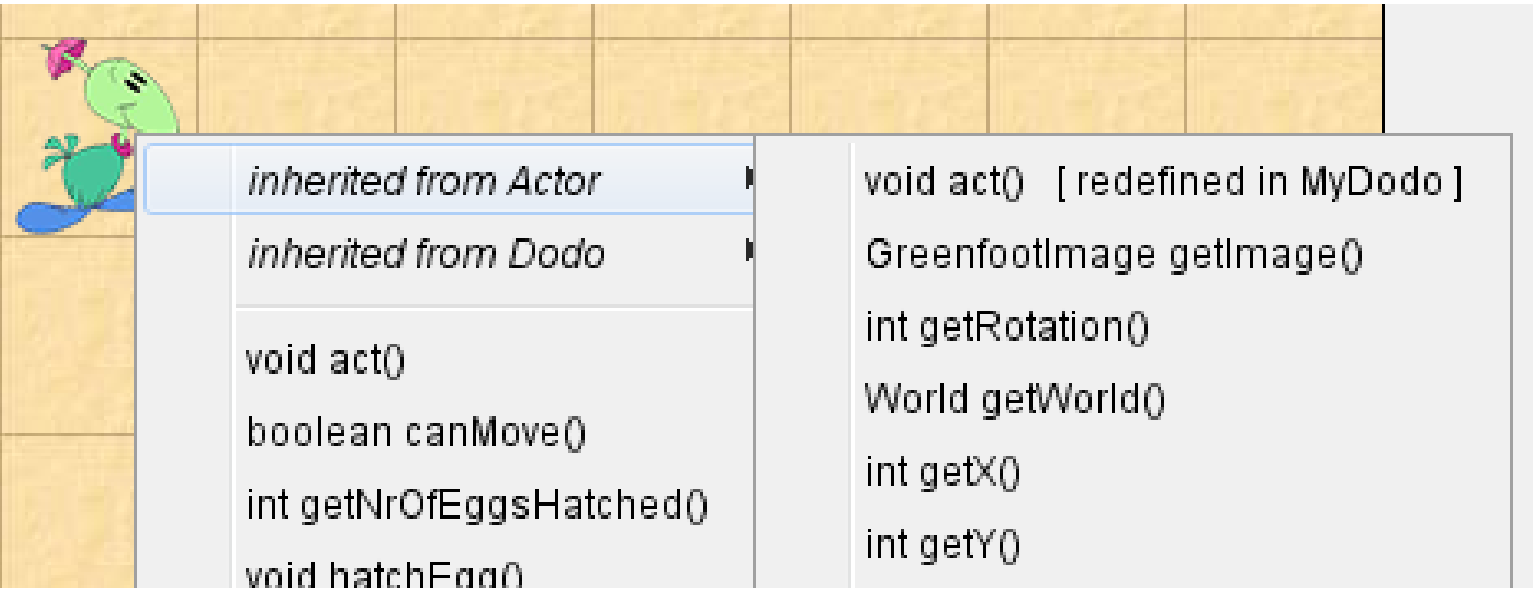
- Methods:
  - Mutator methods such as void move()
  - Accessor methods such as boolean canMove()
- Result types such as int, boolean, void

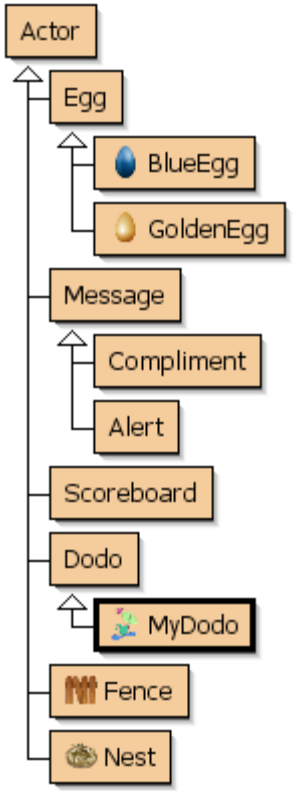
- Java is an Object Oriented Programming (OOP) language
- In OOP, objects (such as MyDodo) have:
  - Methods (*what it can do*)
  - States (*what it knows / is*)

Objects and classes

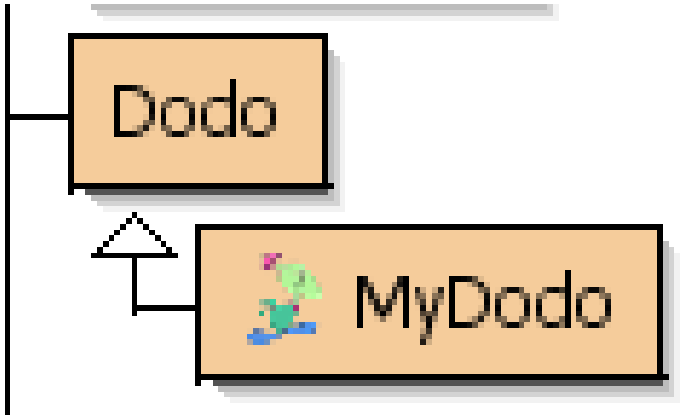
- Every objects belongs to a class.
  - a class provides the blueprint for objects
  - Mimi is an instance (or object) of the MyDodo class

Class diagram =>





Inheritance



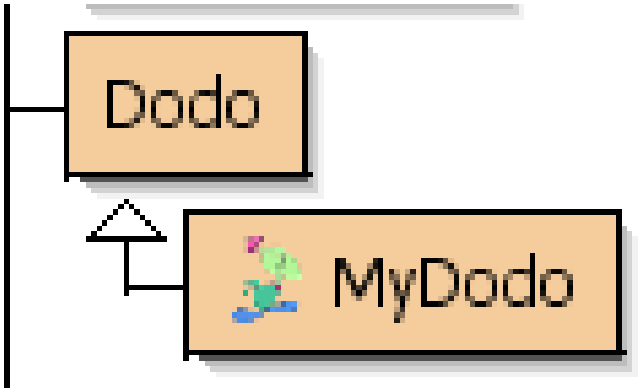
- Class diagram
- Mimi is a MyDodo, so:
  - Mimi can perform MyDodo methods, such as:
    - void move()
- But a MyDodo is a Dodo
  - Mimi can also perform all Dodo methods too!
    - void layEgg()

- MyDodo is a subclass of Dodo
- Dodo is a super class of MyDodo

Exercise: inheritance

Imagine a new Dodo species: IntelligentDodo

- Sketch the class diagram
- Which is subclass? Which is super class?



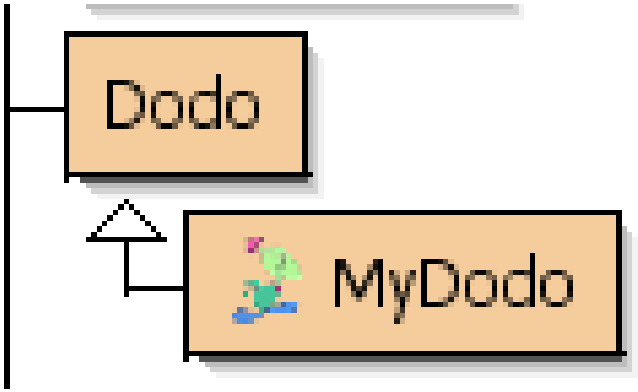
Exercise: inheritance

Imagine a new Dodo species: IntelligentDodo

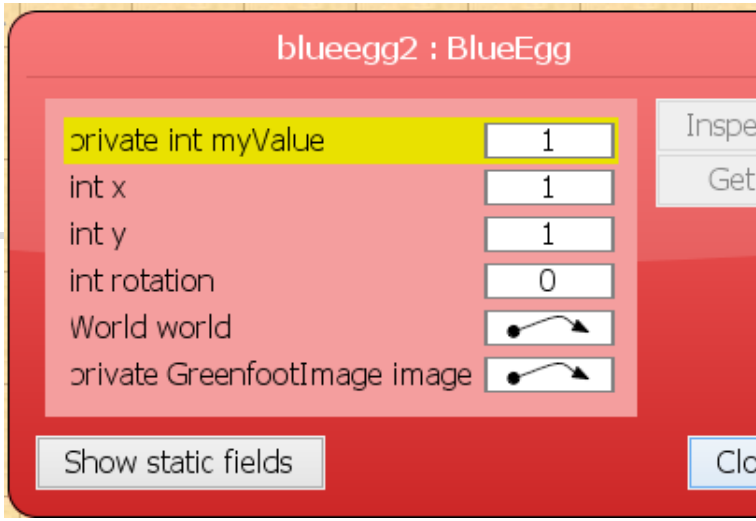
- What methods does IntelligentDodo get for free from her super class?
- If we write a new IntelligentDodo method: void readBook()

  Which classes can perform that method (more than one answer is possible):

  a) IntelligentDodo
  b) MyDodo
  c) Dodo
  d) Actor
  e) Mimi



State of an object



- Every object has a state: its data
- 3 Egg objects
  - have the **same methods** (can do the same things)
  - but are different objects (or instances)
- Each can have an **own** state
  - for example: different coordinates

Exercise: state of an object

- Drag an Egg object into the world
- Right-click on that egg and choose ‘Inspect’
  - What is the x-coordinate of the egg?
  - What is the y-coordinate of the egg?
- Move the egg to the bottom-left corner
  - What are the coordinates of the bottom-left corner?

0 or 1 Results

- A method can return **one** result:
  - Example: int getNrOfEggsHatched()
  - Returns an int (whole number) as a result

- A method can have **NO** results
  - void move()
  - Returns a void (nothing) as a result

- A method **cannot return more than one** result

0 or more Parameters

A method can have:

- zero parameters:
  - Example: move( )
  - Has **no** parameters
- one parameter:
  - Example: jump (int distance)
  - Has **one** parameter: distance
  - Type of the parameter: int
- more than one parameter:
  - Example: turn (int direction, int time)
  - Has **two** parameters: direction and time

Generic methods and parameters

- Method with parameters can be used for more things
  - jump(1): Mimi jumps 1 place forward
  - jump(2): Mimi jumps 2 places forward
  - jump(100): Mimi jumps 100 places forward

- Method without parameters can only be used for 1 thing:
  - move( ): Mimi moves 1 place forward

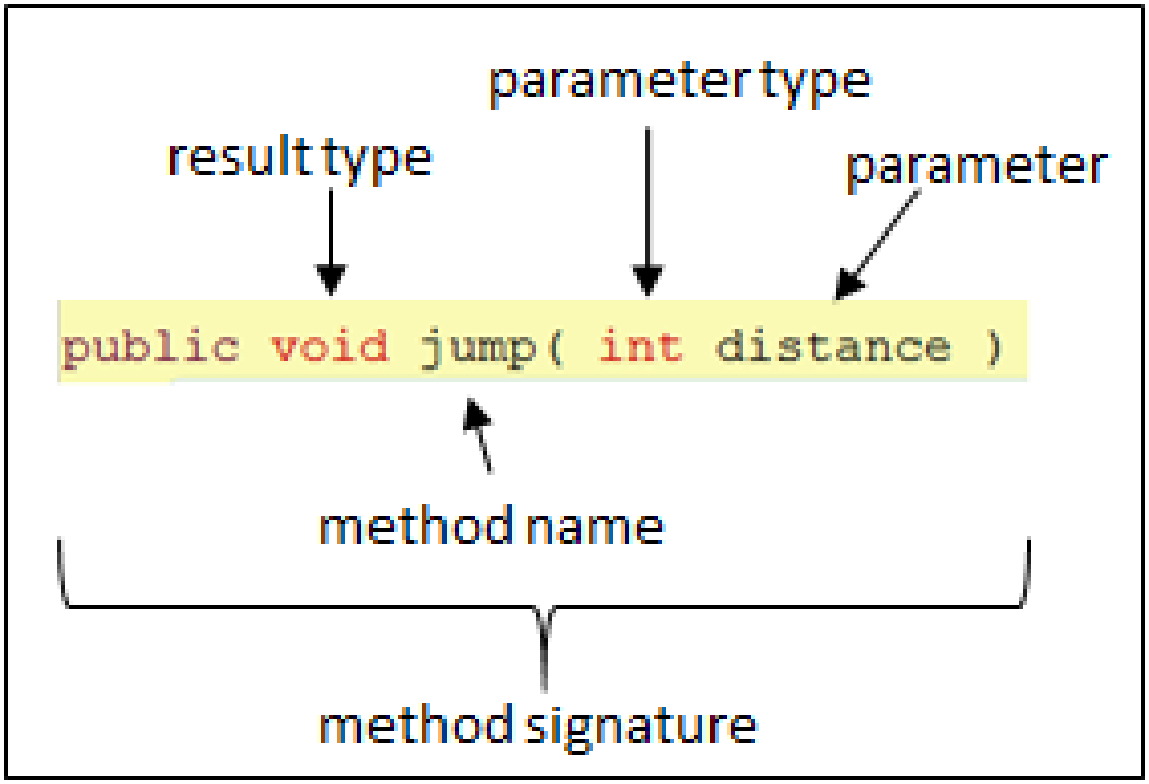
- Generic: method with parameters is more generic, because it can be used in more situations.
- We **LIKE** generic methods! They're **SMART**.

Types

- Results and parameters have **types**
- Examples:

Type	Meaning	Example
`int`	whole number	2
`boolean`	'true' or 'false'	**`true`**
`String`	text	"I lost my pen."
`List`	list	[1,2,3]

Signature


parameter type
result type
parameter
public void jump(int distance)
method name
method signature

Intermezzo: Assignment

- Download and unzip the scenario 2 at http://www.cs.ru.nl/~S.Smetsers/Greenfoot/Kandinsky/

- Class will continue in 15 minutes

Algorithm

- Algorithm: precise set of instructions
  - For a certain problem (initial situation)
  - Always leads to exact same outcome (final situation)
  - Like a recipe, but more precise
- Program code: algorithm written specifically for a computer

Language ambiguous

“Time flies like an arrow”

What could this mean?

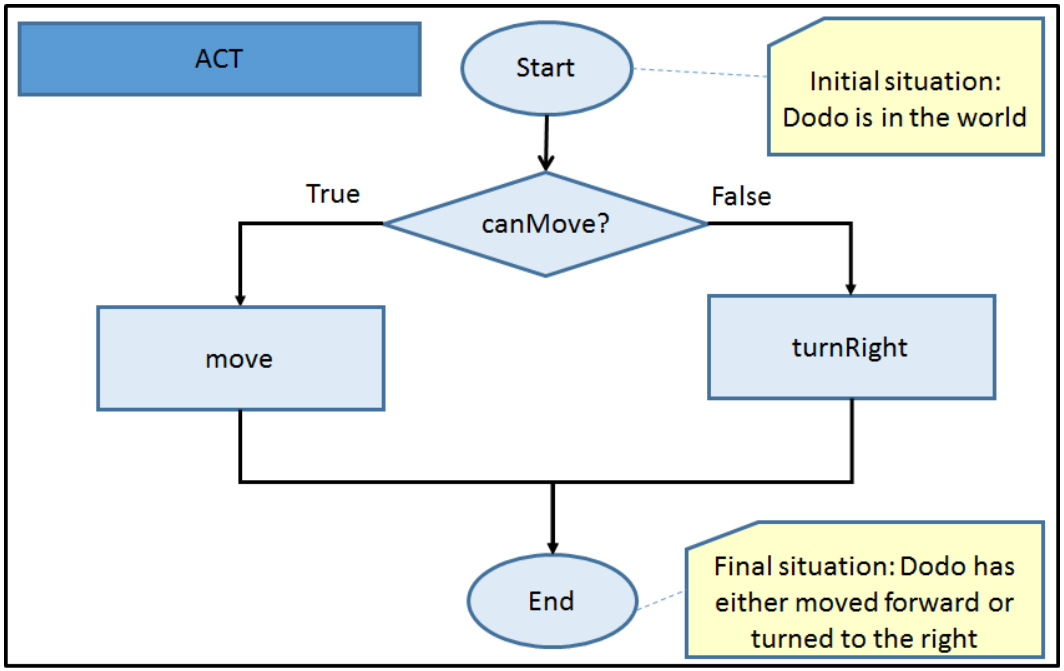
Language ambiguous

“Time flies like an arrow”

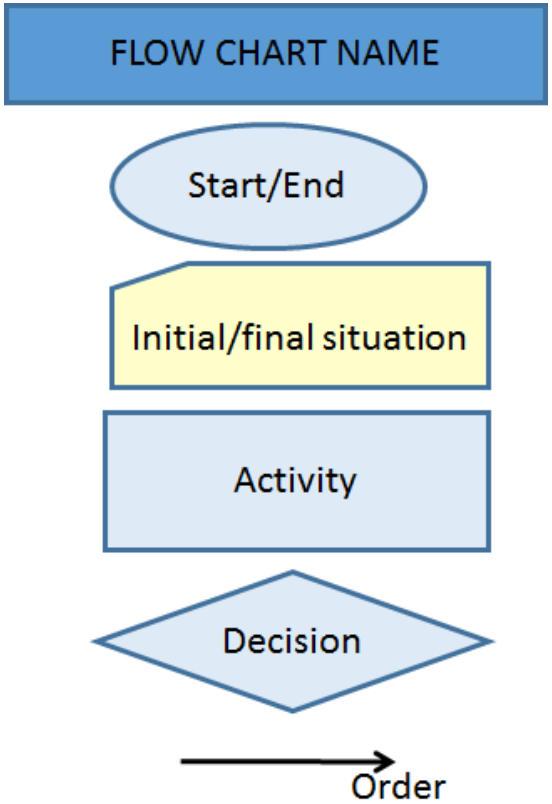
- Time moves fast, like an arrow moves fast
- Measure the speed of flies which resemble arrows
- Measure the speed of flies in the same way you would measure the speed of an arrow
- Insects of a type known as 'time flies' are fond of arrows
- "Flies like an arrow" is the name of an American Indian. Time him

Flowchart: visualize algorithm

Flowchart:

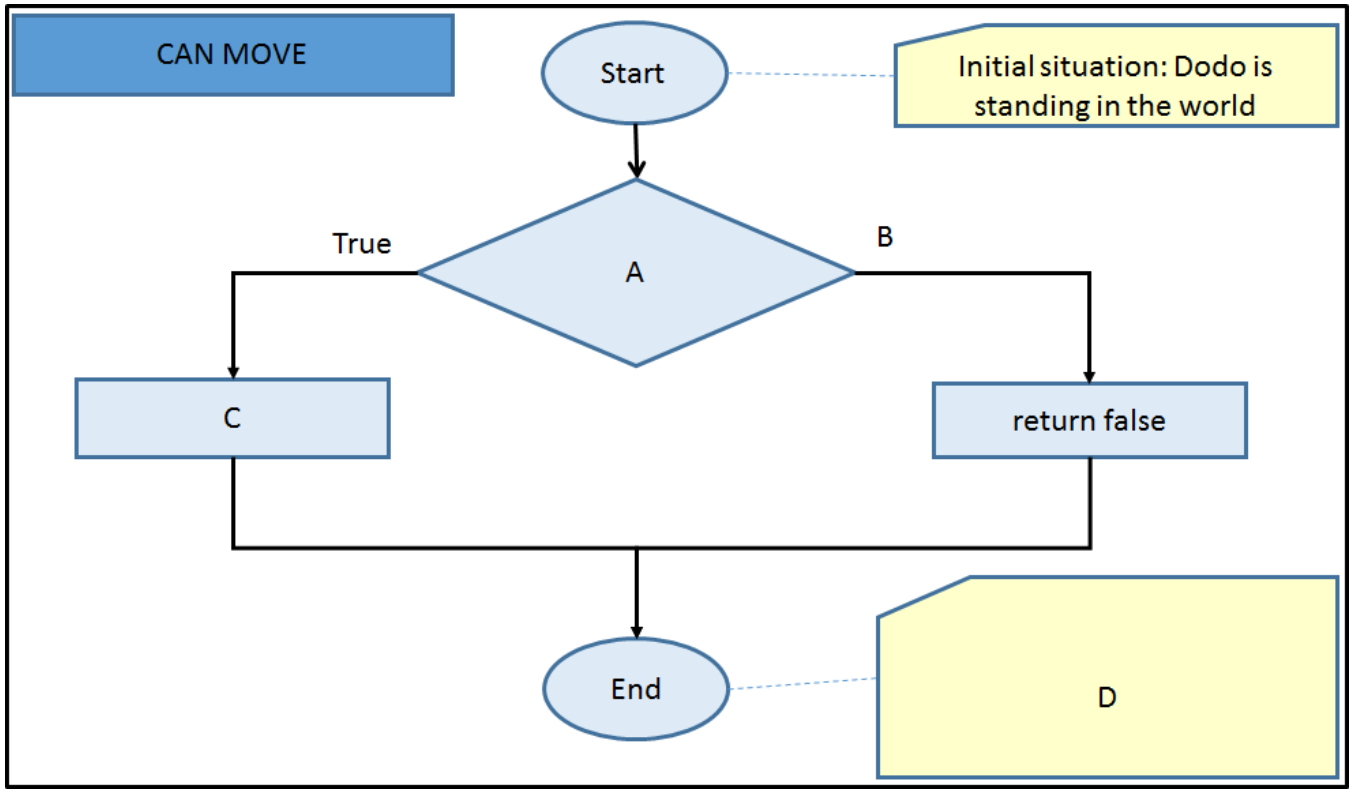


Key:



Exercise: Flowchart

- Flowchart visualizing the algorithm boolean canMove():



- What are A, B, C and D?

Compiling, running & testing code

- Need compiling:

- Compile:
  - Fix error messages
- Test:
  - Right-click on object & choose method to test
  - Check if works as expected
    - i.e. Compare initial and final situation with flowchart
  - Not OK? Check if code is same as flowchart
  - Still not OK? Check if flowchart same as algorithm

Naming conventions

- Use meaningful names
- Letters/numbers: No space, comma, strange character
- Methods:
  - As a command
  - lowerCaseCamel
  - Example: canMove
- Parameters:
  - One or more nouns
  - lowerCaseCamel
  - Example: nrOfEggs

Exercise: naming conventions

Come up with names for the following:

1. A method which makes Mimi lay an egg
2. A parameter indicating how many eggs Mimi must lay

What types would those have?

Error messages

- Syntax error:
  - Example: typo
  - Compiler doesn’t understand and complains
  - Shown at bottom of Greenfoot screen

- Logical error:
  - Example: Dodo turns left instead of right
  - Compiler doesn’t complain, but program doesn’t do what you expect
  - Much harder to find

Exercise: error message

1. Open MyDodo, find the act() method
2. Delete the semi-colon ‘;’
3. Compile
4. What error message do you get?
5. Replace semi-colon ‘;’ and recompile

- Repeat the above for:
  1. Remove a bracket ‘(’
  2. Remove a curly bracket ‘{’
  3. Change the spelling of a parameter

Wrapping up

Save your work! Discuss how/when to finish off and who will turn it in.

<u>Homework:</u>

- Download scenario 2 at http://www.cs.ru.nl/~S.Smetsers/Greenfoot/Kandinsky/
- Finish Assignment 1:
  - 5.5 until and incl 5.10
  - Diagnostic test 6.1 and check own answers 6.2
- Assignment 2: Until and incl 5.1 (lots of reading)
- **Hand in to Magister before Wednesday 8:30**
- **ALSO**: 5.1.2 ex 4 into pigeon hole (or photo)