CS345H: Programming Languages

Lecture 17: Introduction to Object-Oriented Languages

Thomas Dillig

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- We will also explore how to formalize some aspects of it

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- Why? Because the fields of Y are a superset of the fields of X

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- Observe that subtyping is really another kind of polymorphism as it allows us to write code that works with more than one type

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- This is also known as "duck typing"

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- We create an instance of a class to use it
- Every instance has its own data

Classes Example

- Consider the following program:

```
struct point {
  int x;
  int y;
};
void inc_x(point* p) {
  p->x++;
}

point *p = new point;
inc_x(p);
```

Classes Example Cont.

- Here is the same program rewritten with classes:

```
class point {
  int x;
  int y;
  void inc_x() {
    this->x++;
  }
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- Object = instantiated class

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- Important: Every instance of a class has its own set of instance variables!
- Constructor: A special method that is run on instance creation

Classes Example Extended

- Here is a slightly extended version of the program

```
class point {
  int x;
  int y;
  point() { this->x = 0; this->y = 0; }
  void inc_x() {
    this->x++;
  }
};

point *p = new point();
point *q = new point();
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- What is the value of `y->x`? 0

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- But subtyping now also needs to take methods into account!
- Specifically, any subtype must also have (at least) the same methods as the original type
- This way, we can use the subtype in any context that expects the original type

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- Allowing redefinition of methods is known as virtual methods
- This is another key OO feature

Virtual Method Example

- Consider the following code:

```
class point {
  int x;
  int y;
  point() { this->x = 0; this->y = 0; }
  virtual void inc_x() {
    this->x++;
  }
};
class bigpoint:public point {
  int x;
  int y;
  virtual void inc_x() {
    this->x+=2;
  }
};
point *p = new bigpoint();
p->inc_x();
```

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- The dynamic type decides which virtual method is called!
- This is sometimes called the essence of OO

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- In OOP, we also use types at run-time to decide which method to invoke!
- You can think of this operationally as an implicit run-time check on a type tag that decides which version of a method is called

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- Fortunately, this only rejects some programs at compile time but does not change semantics

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- Actually, old idea: This is also known as abstract data types (ADT) and predates OOP

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- If the problem you are solving fits into the OO model!

Uses of OOP

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  - ....
- In fact, OOP fits so many problems reasonably well that it has become the default paradigm used in most software
- In fact, many modern languages, such as Java, force an OOP style
- However, not every problem maps well into objects!

History of OOP

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- Over the years, various features that we would call object-oriented today made their way into various LISP dialects

Object Orientation: History Cont.

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  - Simula was designed as an special-purpose language for discrete event simulations
  - But it as certainly not designed as a general-purpose programming language

Features Combined in Simula

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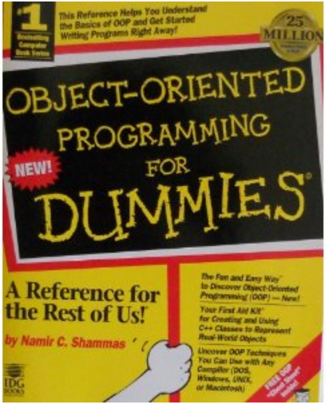
- And lead to a huge wave of OO languages
- This was an huge fad in the late 90’s

OO in the Real World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This Reference Helps You Understand the Basics of OOP and Get Started Writing Programs Right Away!
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FREE OOP "Cheat Sheet" Inside!
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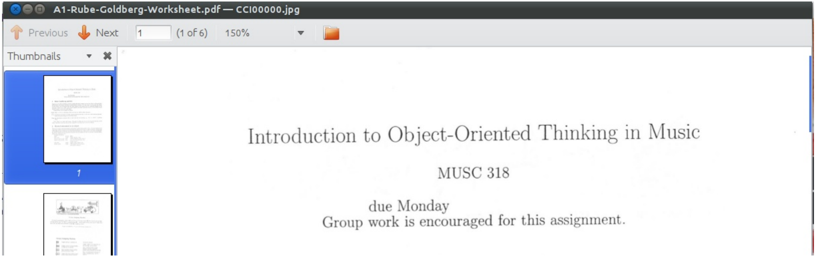
OO in the Real World



Introduction to Object-Oriented Thinking in Music

MUSC 318

due Monday
Group work is encouraged for this assignment.

Other OO languages

- C++

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- C++
- Java

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- C++
- Java
- C#

Other OO languages

- C++
- Java
- C#
- Pretty much any newer imperative language (and plenty functional ones as well)

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The OO paradigm in the wild

- Object oriented programming is one of the very few techniques that actually seems to make it easer for humans to build software
- But it does not work well for every problem
- However, since it is so pervasive, this tends to be forgotten

Summay

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- Next time: Some issues with semantics and typing in OO languages