Compiler Construction
Winter 2020

Recitation 6:
Object-Oriented Code Generation*

* Low-level IR

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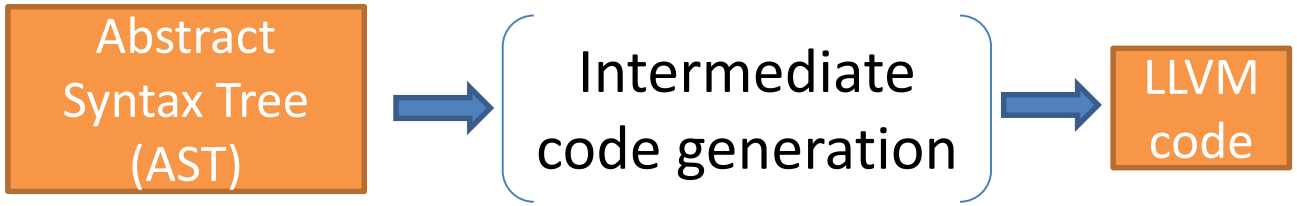
Based on materials by Yannis Smaragdakis
and slides by Guy Golan-Gueta

Code Generation



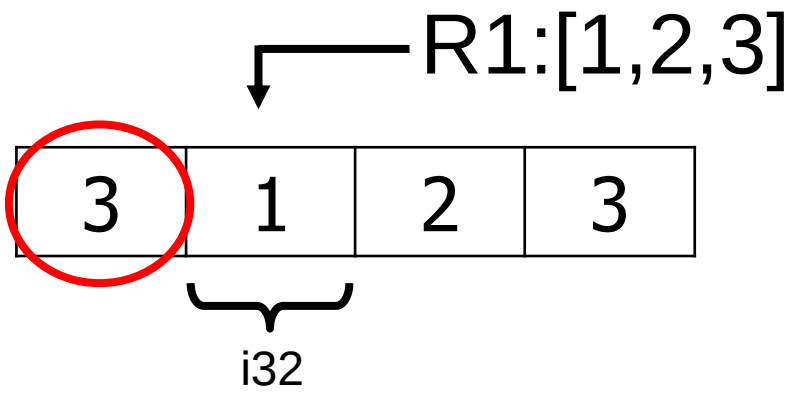
- Valid programs (ASTs) compile to an LLVM program that's
  - valid,
  - executes,
  - has the same input-output and external behavior (console output)
- Rules for valid MiniJava ASTs: https://www.cs.tau.ac.il/research/yotam.feldman/courses/wcc20/semantic.html

Arrays

- Allocation
- Access
- Assignment
- Dynamic checks
  - “ArrayIndexOutOfBoundsException”

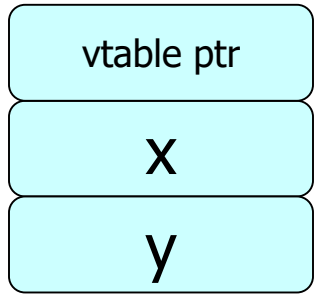
- Also: array length (exercise ☺)

Demo



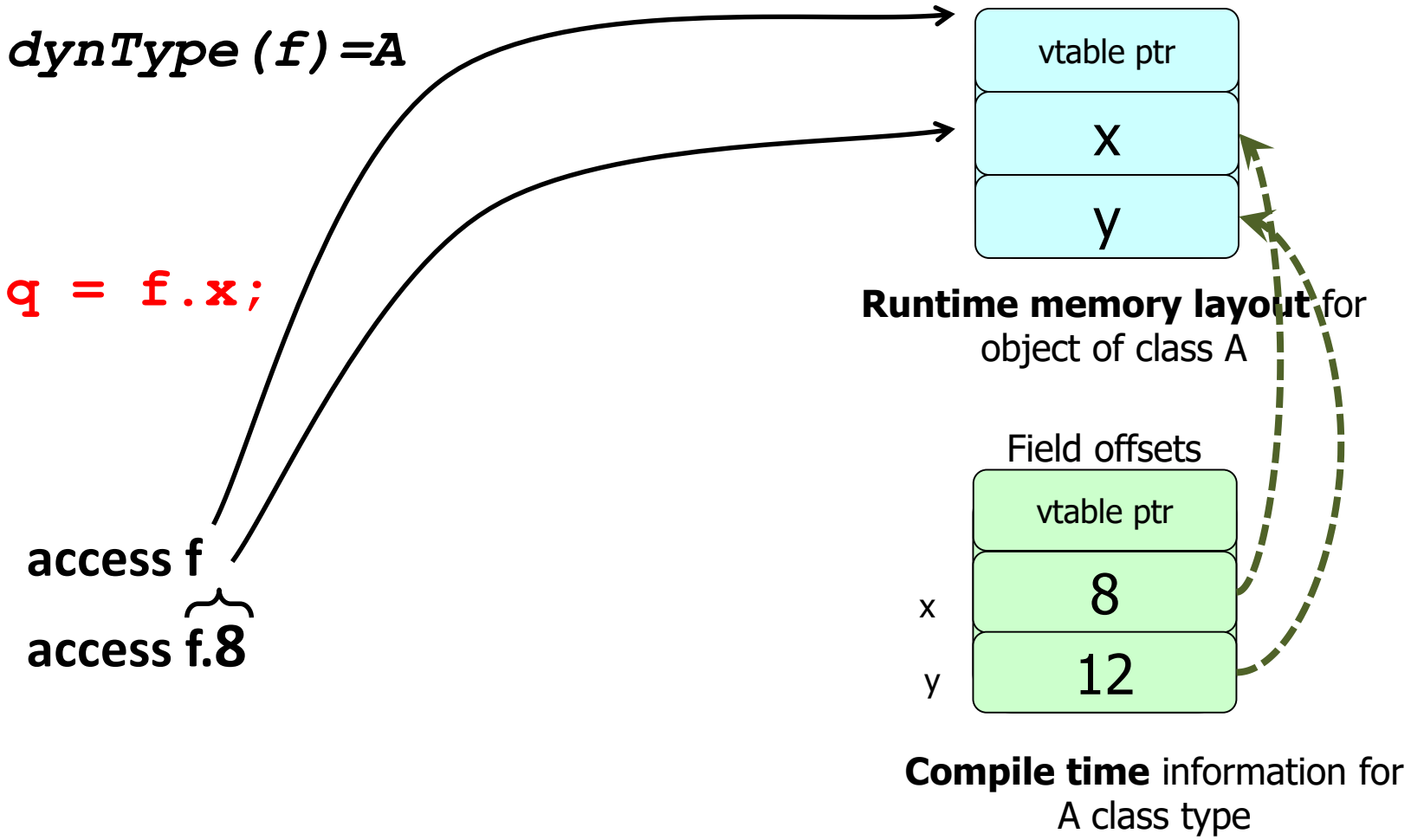
Objects

```
class A{
   int x;
   int y;
   …
}
```



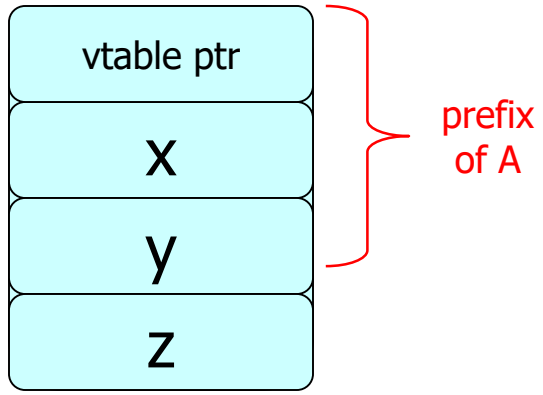
Runtime memory layout for object of class A

Field Selection

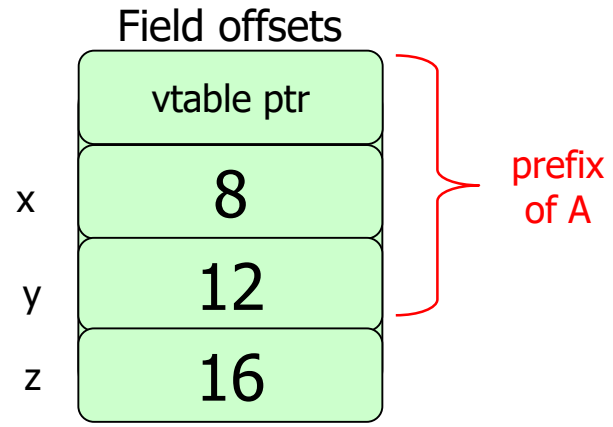


Fields and Inheritance

```
class A{
   int x;
   int y;
   …
}
class B extends A {
   int z;
   …
}
```

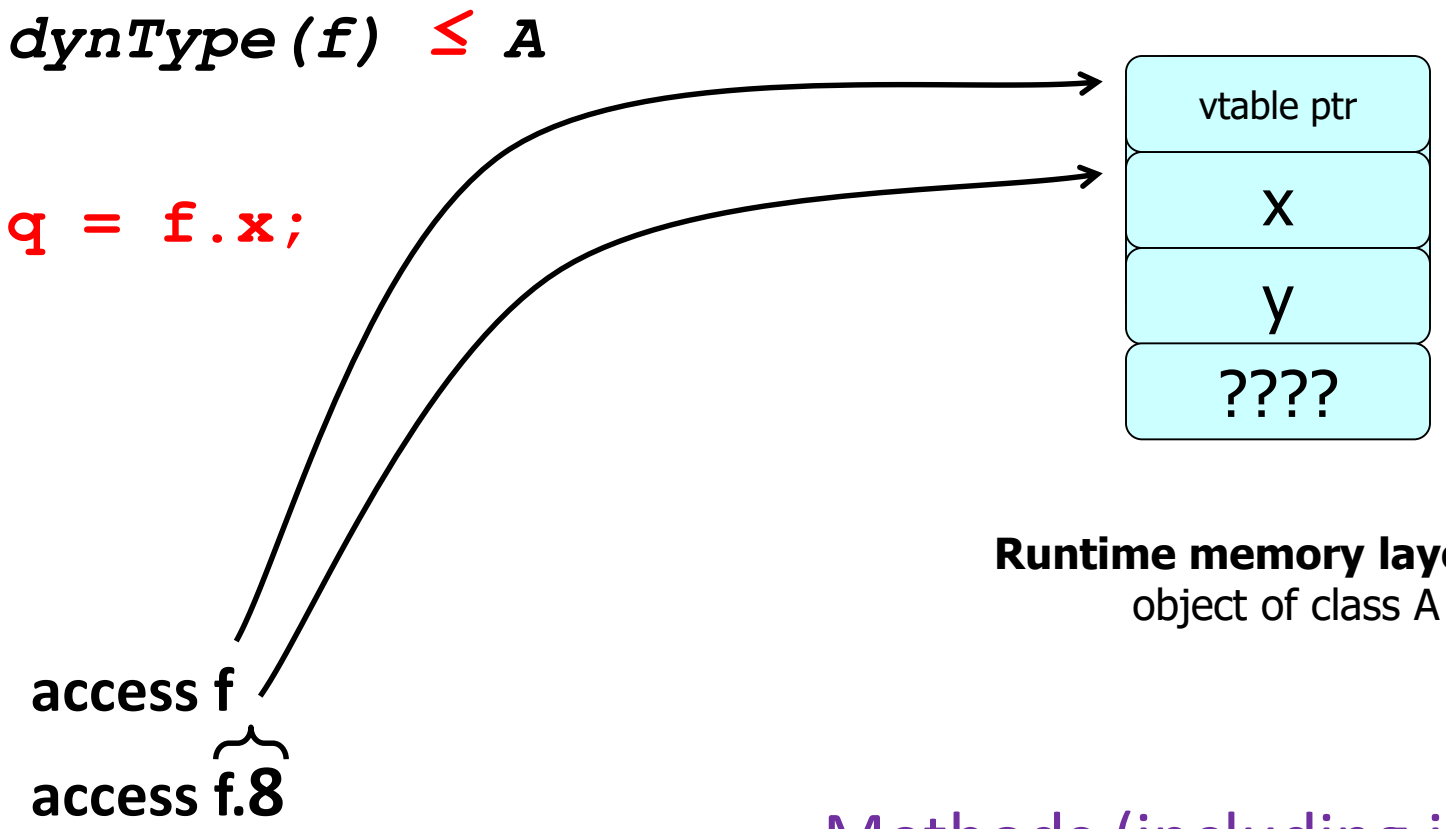


Runtime memory layout for object of class B



Compile time information for B class type

Field selection



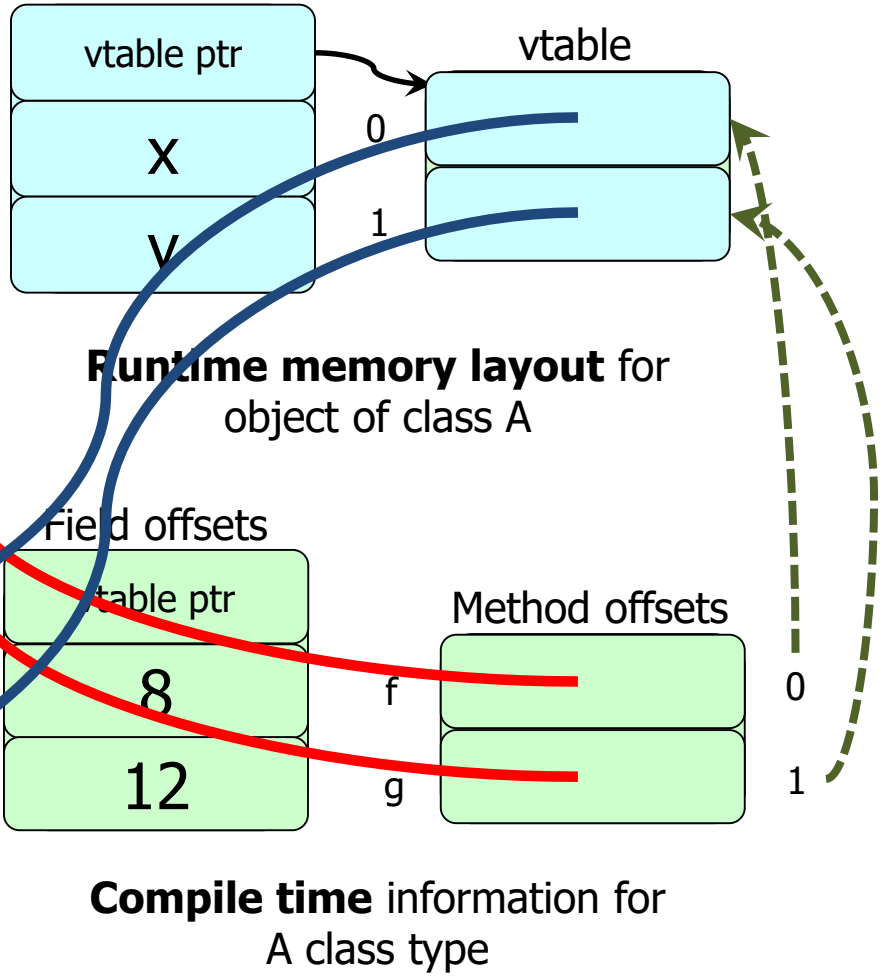
Runtime memory layout for object of class A

Methods (including inherited!) find x in the same place

Virtual Methods

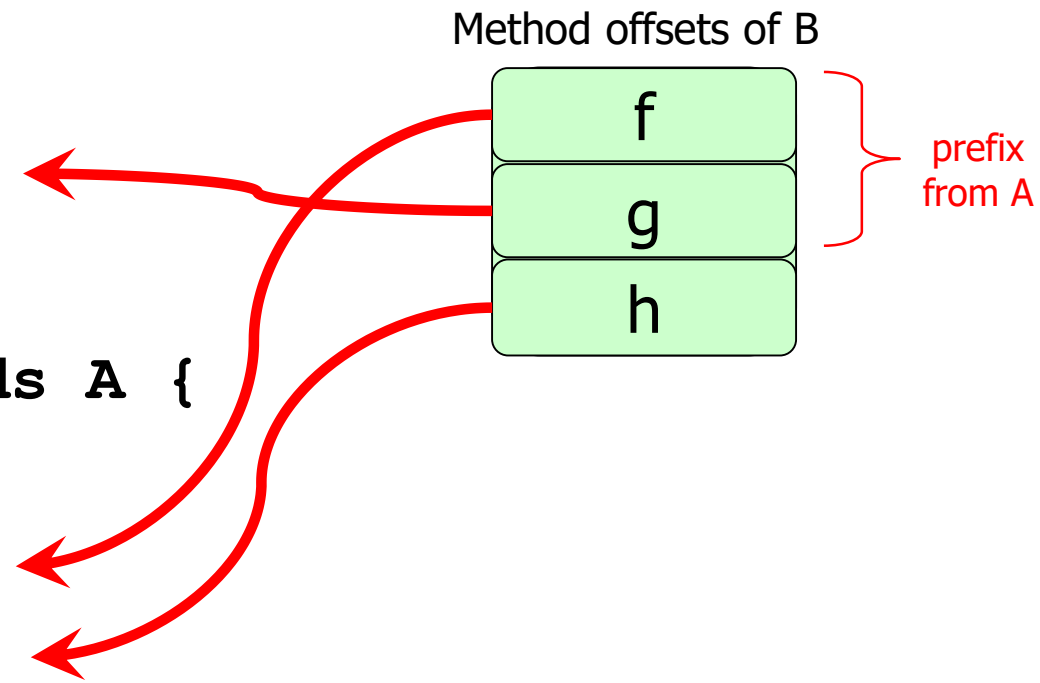
```
class A {
   int x;
   int y;
   void f() {…}
   void g() {…}
}
```

```
define i32 @A.f(i8* %this)
       …
define i32 @A.g(i8* %this)
       …
```



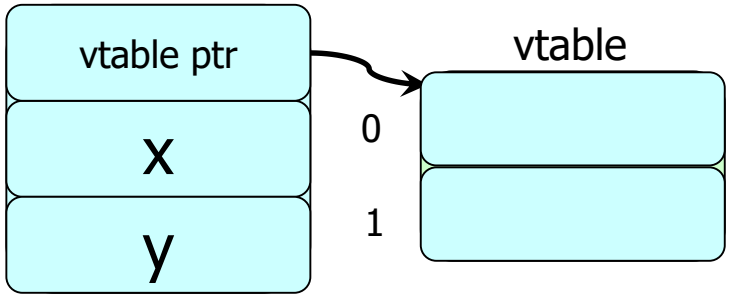
Methods and Inheritance

```
class A {
   int x;
   int y;
   void f()  {…}
   void g()  {…}
}
class B extends A {
   int z;
   void f()  {…}
   void h()  {…}
}
```



Object Creation

- Store vtable (e.g. global segment) with pointers to methods' code
- Allocate memory for vtable pointer + fields
- Set vtable pointer to the correct table



Runtime memory layout for object of class A

Now in LLVM!

Demo

LLVM Further Notice

- `this` implicit parameter
- Allocating method formal parameters on the stack

Summary

- arrays
- fields
- virtual method calls and vtable
- Ex. 2