

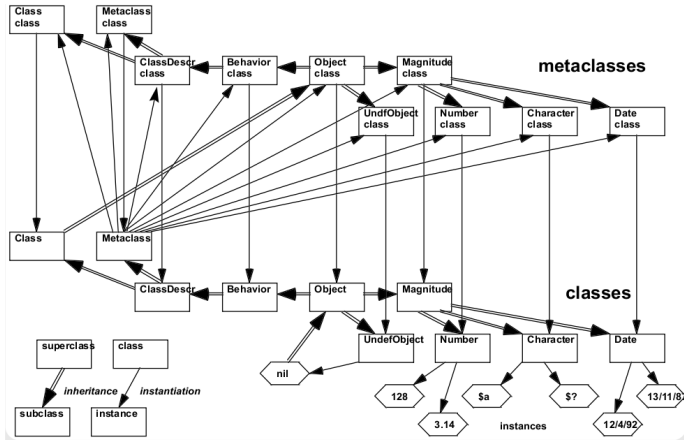
Object features implementation

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Smalltalk: Classes & Metaclasses



Outline

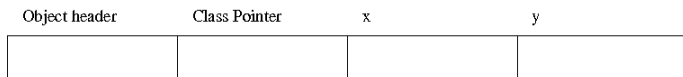
Object Layout

The World of Prototypes

Bootstrapping

Object layout

```
p ← Point new x: 3 y: 4.
```



Object Header

```
#else /* not 64bit */
/*
 * arrange so that a single long-store can set
 * space and clear the other flags - this saves
 * an instruction and a memory access in the
 * new-code (sigh - fighting for every cycle:-)
 */
# if defined(__MSBFIRST__)
#  define STX_OBJ_HEADER \
        OBJ          o_class; \
        unsigned INT  o_size; \
        unsigned char o_age; \
        unsigned char o_hashLow; \
        SIGNED char   o_flags; \
        unsigned char o_space;
# else /* LSB or unknown */
```

Immediate values

Observation

More than 70% objects are instances of SmallInteger

Immediate values

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Solution: immediate values

Immediate values

Observation

More than 70% objects are instances of SmallInteger

Solution: immediate values

Object pointer



Integer pointer



Object shape

Constant-sized objects

Object shape

Constant-sized objects

Variable-sized objects

Object shape

Constant-sized objects

Variable-sized objects

- Pointer-indexed objects

- Byte-indexed objects

Object shape

- Constant-sized objects

- Variable-sized objects

 - Pointer-indexed objects

 - Byte-indexed objects

 - Integer/Float/. . . -indexed objects

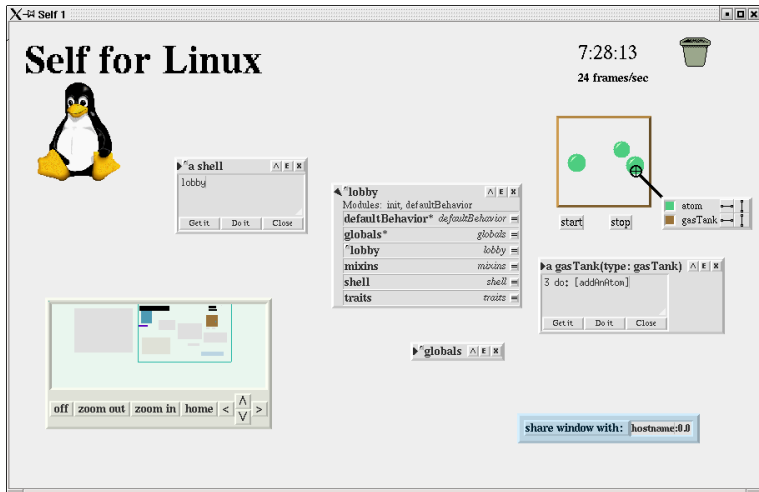
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Point



The SELF

No classes at all.

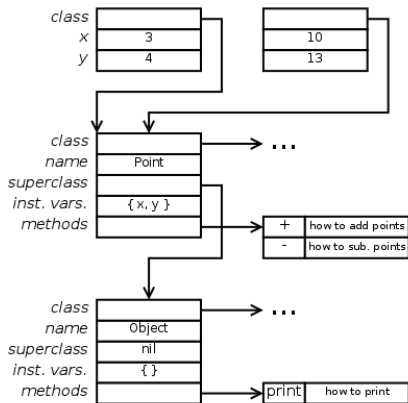
Every object is conceptually a hash map mapping slot name to its value

Object-based inheritance

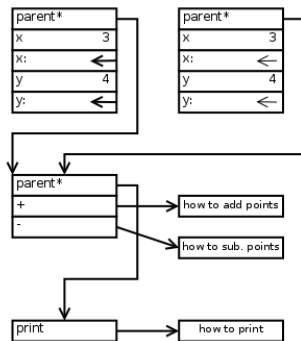
Objects are created by cloning

Point

Smalltalk instances and classes



SELF objects



Slots in SELF

Slot kinds

- data slot

- assignment slot

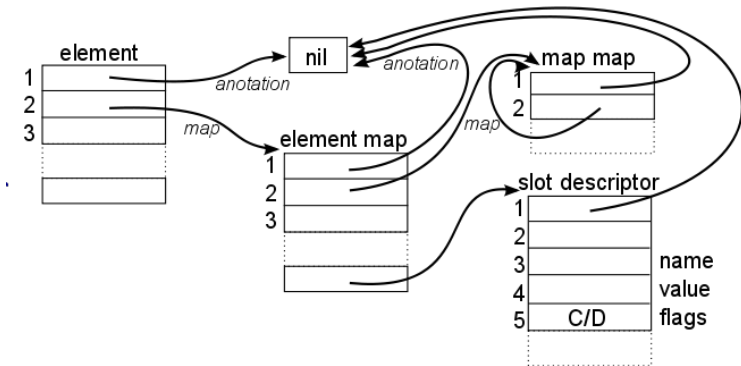
- constant slot

Other properties

- parent slot

- method slot

Maps: A Space-efficient Implementation Of Prototypes



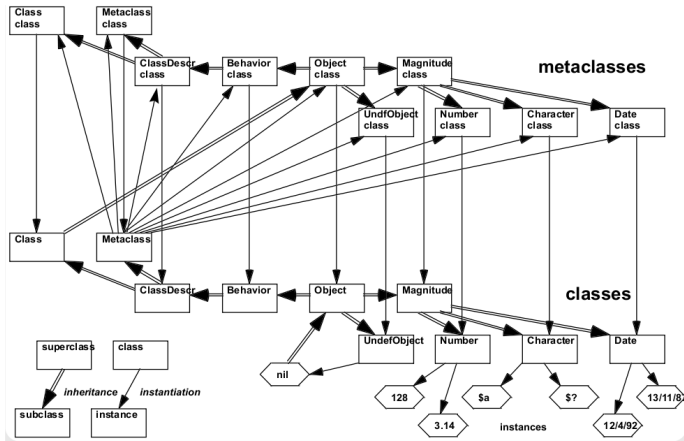
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Object Layout

The World of Prototypes

Bootstrapping

Smalltalk Kernel Objects



Bootstrapping Kernel Objects

Approaches

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1. No bootstrap – Squeak, VisualWorks

Bootstrapping Kernel Objects

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2. Hard-coded bootstrap – GNU Smalltalk, Smalltalk/X, SELF

Bootstrapping Kernel Objects

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References

GNU Smalltalk : `libgst/dict.c`

```
void _gst_init_dictionary() (line 816)
```

SELF : `vm/src/any/memory/universe.cpp`

```
void universe::genesis() (line 80)
```