Introduction to Python

DataLab

November 5, 2016

Outline

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Conceived by Guido Van Rossum in the late 1980's

Benevolent dictator for life!!!

- "Things should be as simple as possible, but no simpler" (Einstein)
- Do one thing well (The "UNIX philosophy")
- Don't fret too much about performance–plan to optimize later when needed
- Don't fight the environment and go with the flow
- Don't try for perfection because "good enough" is often just that

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$\lambda-$Calculus

The formal system in mathematical logic for expressing computation based on

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Furthermore

Reduce

A function for performing some computation on a list and returning the result.

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We have several

CPython

- This is the classic and we will reference it every time we explain something!!!

- Quite interesting to use a semi-interpreted language on top of a virtual machine

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Is Python Interpreted or Compiled?

Python is compiled

- Not compiled to machine code ahead of time
  - "only" compiled to bytecode!!!

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The Memory Management System

Why do we care about this?

- Once you know the memory management system
    - You can build more efficient code
    - How does this fact affect Python?

You have NAMES pointing to references and objects

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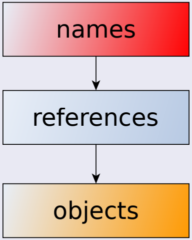

What do you have?

Memory management in Python

- It involves a **private heap** containing all Python objects and data structures.
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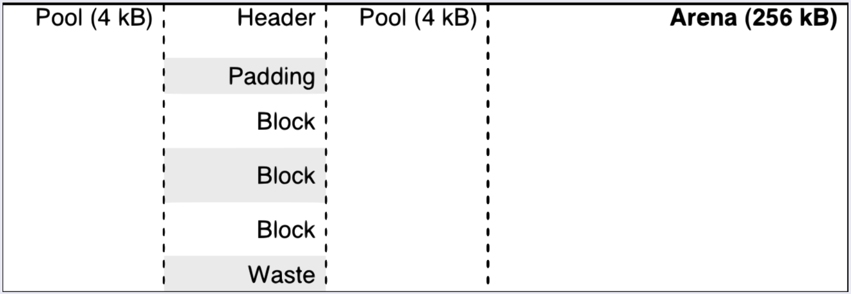
This allows

To Python to determine when

The memory occupied by an object can be reclaimed.

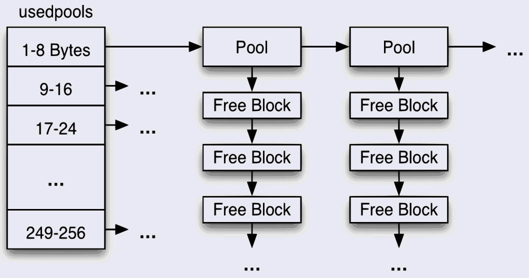
The pymalloc Allocator

It has memory allocated in the following chunks of 256 Kb called Arenas



Allocating Space for Python Objects

There is a list of free blocks



1. If there is a free element's pool, we pop a free block off of its list
2. If the pool is full, the pool is popped off out of the available free block
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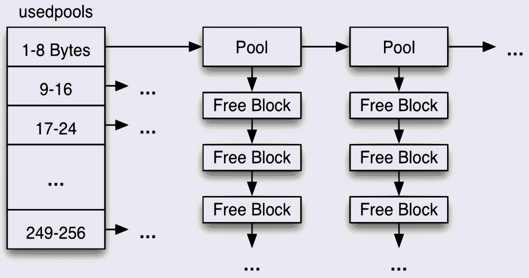

Instantiation of an Object

1. Each of the pools has a **singly linked** list of available blocks.
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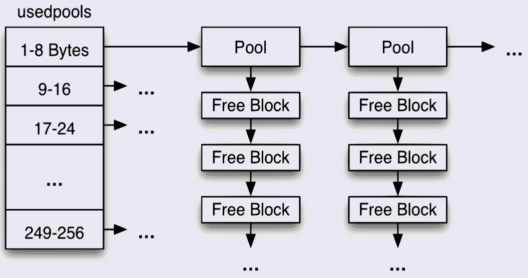

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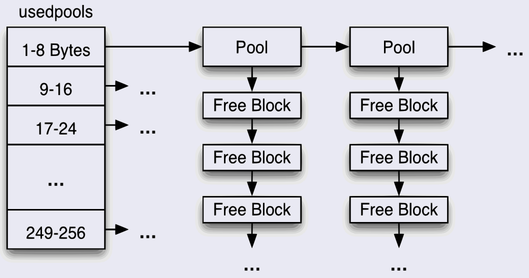

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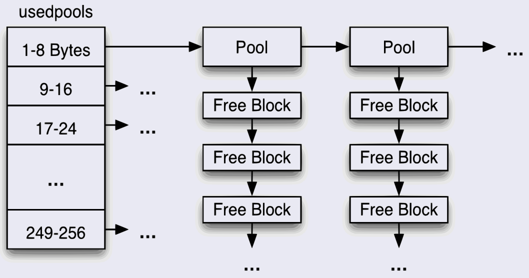

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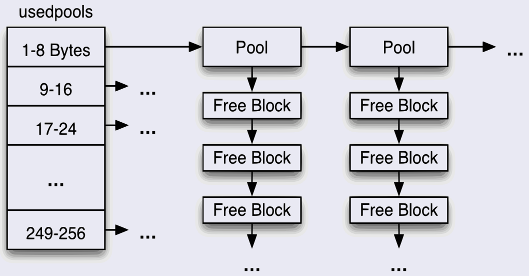

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If there is no space

We allocate a new arena using malloc() from CPython implementation.

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Main Ideas of CPython's Garbage Collector

Maintain reference count.

- For every object, there is a count of the total number of references to that object.
- If that count ever falls to 0, then it deallocate that object because it is no longer alive.

- Deallocating when the reference count falls to 0 does not work for all cases.

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- It could be the case that these are no longer live and so that both A and B should be garbage collected.
- However, this is not possible because the reference has not gone to zero!!!

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- Thus every time an entire arena was in partially_allocated arenas the arena can be released

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Mark and Sweep

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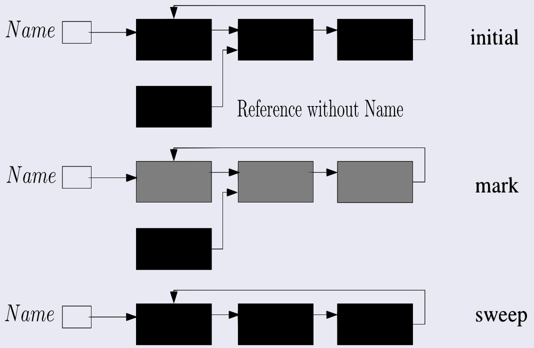

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We are done with the theoretical part

We are ready for the real stuff!!!

Now, we are ready for the practical stuff!!!