UC Berkeley EECS
Lecturer
Michael Ball

Computational Structures in Data Science

Lambdas

Learning Objectives

- Lambda are anonymous functions, which use expressions
  - We don't use return, they always return the value.
  - They are typically short and concise
  - They don't have an "intrinsic" name when using an environment diagram.

lambda

- Function expression
  - "anonymous" function creation
  - Expression, not a statement, no return or any other statement

lambda <arg or arg_tuple> : <expression using args>

```
inc = lambda v : v + 1
```

```
def inc(v):
    return v + 1
```

Lambdas

```
>>> def inc_maker(i):
...     return lambda x:x+i
...
>>> inc_maker(3)
<function inc_maker.<locals>.<lambda> at 0x10073c510>

>>> inc_maker(3)(4)
7
>>> map(lambda x:x*x, [1,2,3,4])
<map object at 0x1020950b8>

>>> list(map(lambda x:x*x, [1,2,3,4]))
[1, 4, 9, 16]
>>>
```

Lambda with HOFs

- **A function that returns (makes) a function**

```
def leq_maker(c):
    return lambda val: val <= c
```

```
>>> leq_maker(3)
<function leq_maker.<locals>.<lambda> at 0x1019d8c80>

>>> leq_maker(3)(4)
False

>>> filter(leq_maker(3), [0,1,2,3,4,5,6,7])
[0, 1, 2, 3]
```

UC Berkeley EECS
Lecturer
Michael Ball

Computational Structures in Data Science

Types and Universality

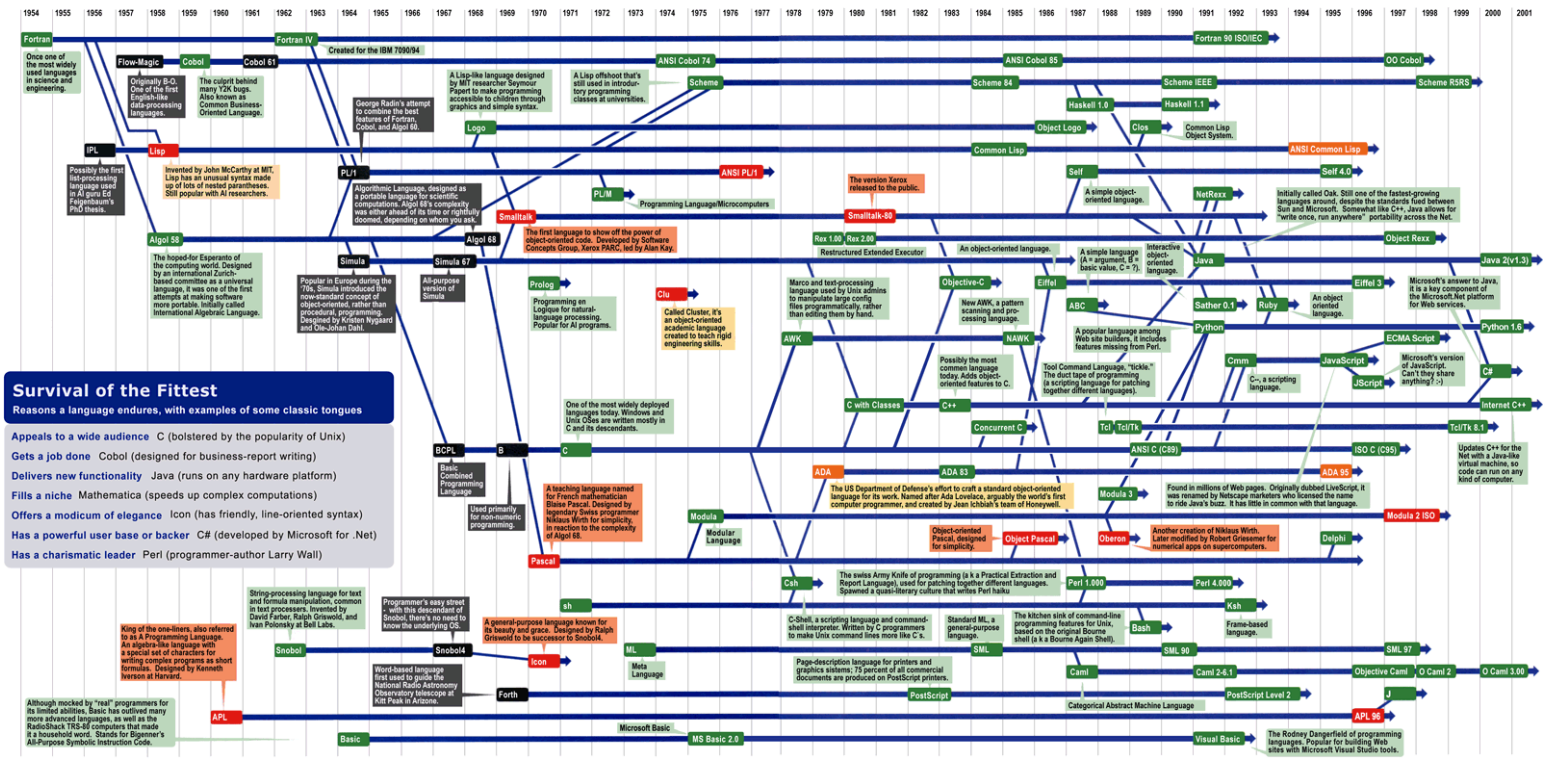
Learning Objectives

- Abstract Data Type:
  - Applying a name to a new concept.
  - Give us structure for organizing how we build and name functions
  - Write a simple ADT around a "point".

Universality

- Everything that can be computed, can be computed with what you know now.
- "Turning Completeness"
- Poorly or Well

Evolution of Programming Languages



Examples Data Types You have seen

- Lists
  - Constructors:
    - » list(...)
    - » [<exps>,...]
    - » [<exp> for <var> in <list> [if <exp>]]
  - Selectors: <list> [<index or slice>]
  - Operations: in, not in, +, *, len, min, max
    - » Mutable ones too (but not yet)
- Tuples. [We have only briefly used these.]
  - Constructors:
    - » (<exps>,...)
  - Selectors: <tuple> [<index or slice>]
  - Operations: in, not in, +, *, len, min, max

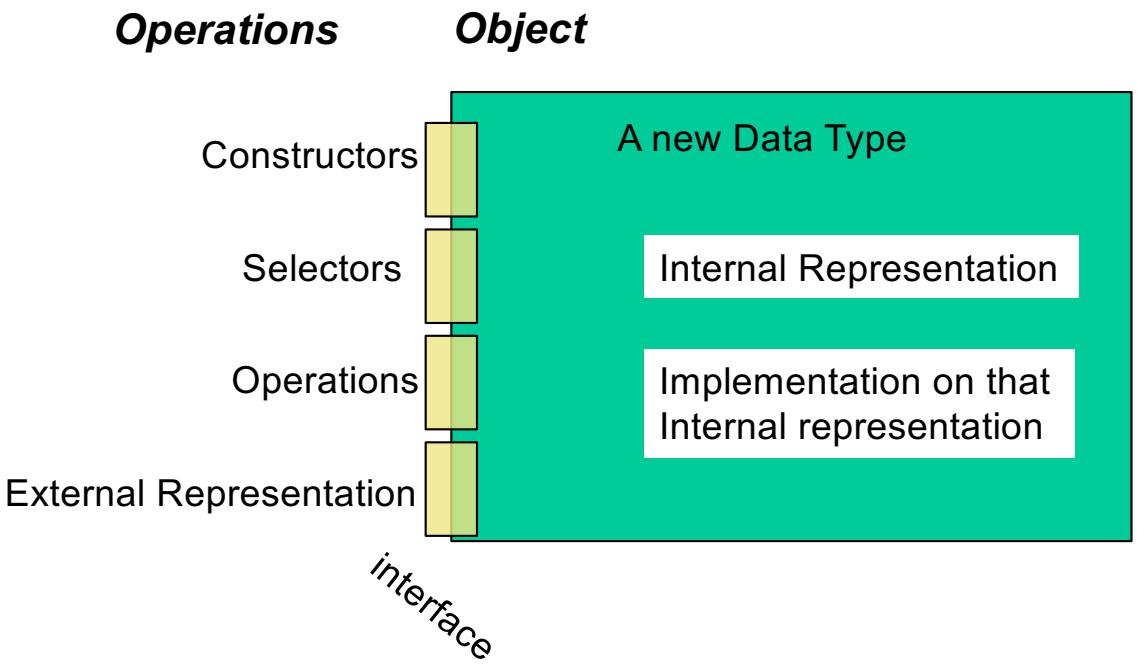
More "Built-in" Examples

- Strings
  - Constructors:
    - »str(…)
    - »"<chars>", '<chars>'
  - Selectors: <str> [<index or slice>]
  - Operations: in, not in, +, *, len, min, max
- Range
  - Constructors:
    - »range(<end>), range(<start>,<end>), range(<start>,<end>,<step>)
  - Selectors: <range> [<index or slice>]
  - Operations: in, not in, len, min, max

Abstract Data Type

- We have "built-in" types, but we can use functions to represent some similar kind of data.
- Today we're going to look at a "point"
- Functions are lightweight. Later we will build more complex structures.

Abstract Data Type



Example: A "Point"

- A point (in Geometry) is typically an x-y pair. (Though, we could define another interface...)

- Constructor: point()
- Selectors: x(), y()
- Operations: distance()
- Implementation: Could be anything! This uses a tuple.

- Python Tutor

UC Berkeley EECS
Lecturer
Michael Ball

Computational Structures in Data Science

Dictionaries

Learning Objectives

- Dictionaries store key-value pairs
  - ”a” maps to some value “b”
  - Each key in each dictionary maps to one value.
  - `{ ‘a’, 1, ‘b’: 2 … }`
- You can change the values of the dictionary
- You can change the keys, including adding and removing

Dictionaries are Mutable, too

- Immutable – the value of the object cannot be changed
  - integers, floats, booleans
  - strings, tuples
- Mutable – the value of the object can change
  - Lists
  - Dictionaries

```
>>> alist = [1,2,3,4]
>>> alist
[1, 2, 3, 4]
>>> alist[2]
3
>>> alist[2] = 'elephant'
>>> alist
[1, 2, 'elephant', 4]
```

```
>>> adict = {'a':1, 'b':2}
>>> adict
{'b': 2, 'a': 1}
>>> adict['b']
2
>>> adict['b'] = 42
>>> adict['c'] = 'elephant'
>>> adict
{'b': 42, 'c': 'elephant', 'a':
1}
```

Dictionaries – by example

Constructors:

```
dict( hi=32, lo=17)
dict([('hi',212),('lo',32),(17,3)])
{'x':1, 'y':2, 3:4}
{wd:len(wd) for wd in "The quick brown fox".split()}
```

Selectors:

```
water['lo']
<dict>.keys(), .items(), .values()
<dict>.get(key [, default] )
```

Operations:

```
in, not in, len, min, max
'lo' in water
```

Mutators

```
water['lo' ] = 33
```