

Imperative Asteroid with Objects

- The “Hello World” program...

Load system module

Sentence terminator

```
1  load system "io".  
2    
3  println("Hello World!").
```

Iteration

- 'while', 'for', 'loop' constructs are all supported

```
1  -- compute the factorial~
2  ~
3  load system "io".~
4  load system "type".~
5  ~
6  function fact with n:%integer do~
7  ..let val = 1.~
8  ..while n > 1 do~
9  ....let val = val*n.~
10 ....let n = n-1.~
11 ..end~
12 ..return val.~
13 end~
14 ~
15 let x = tointeger(input("Enter a positive integer: ")).~
16 println ("The factorial of "+x+" is "+(fact x)).~
```

Constraint pattern

Iteration

Assignment

Type conversion

Data Structures

- Built-in lists
 - [1,2,3]
- Built-in tuples
 - (x,y)
- Element access
 - a@i

```
1  -- the bubble sort~
2  load system "io".~
3  ~
4  function bubblesort with a:%list do~
5  ...~
6  ..loop~
7  ....let i = 0.~
8  ....let swapped = false.~
9  ....for i in 0 to len(a)-2 do~
10     ....if a@(i+1) <= a@i do~
11         ....let (a@i,a@(i+1)) = (a@(i+1),a@i).~
12         ....let swapped = true.~
13     ....end~
14     ....end~
15     ....if not swapped do~
16         ....break.~
17     ....end~
18     ..end~
19 ~
20 ..return a.~
21 end~
22 ~
23 let l = [6,5,3,1,8,7,2,4].~
24 println("unsorted array: "+l).~
25 println("sorted array: "+(bubblesort l)).~
```

Structures & Objects

- Asteroid is object-based
- Bundle operations with data
- No inheritance
 - Construct new objects from other objects via object composition (and traits in the case of Rust)
- New languages with a full object-oriented type system are waning
 - Of the three “big” new languages (Rust, Go, Swift) only Swift supports OO, the others are object-based.

Structures

```
1  -- rectangle structure~
2  load system "io".~
3  ~
4  structure Rectangle with~
5  ··data xdim.~
6  ··data ydim.~
7  end~
8  ~
9  let r = Rectangle(4,2). — default constructor~
10 println ("Rectangle with x="+r@xdim+" and y="+r@ydim).~
```

- Structures consist of 'data' fields and are associated with a 'default constructor'
- Member access is via the '@' operator

Structure

```
1  -- rectangle structure
2  load system "io".
3  load system "type".
4
5  structure Rectangle with
6  ..data xdim.
7  ..data ydim.
8
9  ..-- member function
10 ..function area with none do
11   ...return this@xdim*this@ydim.
12 ..end
13
14 ..-- constructor
15 ..function __init__ with (x %if isscalar(x), y %if isscalar(y)) do
16   ...let this@xdim = x.
17   ...let this@ydim = y.
18 ..end
19 end
20
21 let r = Rectangle(4,2).
22 println ("The area of Rectangle (" + r@xdim + "," + r@ydim + ") is " + r@area()).
```

- Member functions
- Object identity is given with the 'this' keyword
- Member functions are called on objects with the '@' operator
 - E.g., r@area()

Structures: Rust & Go

```
#[derive(Debug)]
struct Rectangle {
    width: u32,
    height: u32,
}

impl Rectangle {
    fn area(&self) -> u32 {
        self.width * self.height
    }
}
```

Rust

```
type rect struct {
    width int
    height int
}
```

```
func (r *rect) area() int {
    return r.width * r.height
}
```

Go

Types in Asteroid

- Asteroid has a set of **primitive data types**:
 - integer
 - real
 - string
 - boolean
- Asteroid arranges these data types in a **type hierarchy** in order to facilitate automatic type promotion:
 - $\text{boolean} < \text{integer} < \text{real} < \text{string}$

Types in Asteroid

- Asteroid has two more built-in data types:
 - list
 - tuple
- These are **structured data types** in that they can contain entities of other data types.
- Lists and tuples themselves are also embedded in type hierarchies, although very simple ones:
 - list < string
 - tuple < string
- That is, any list or tuple can be viewed as a string. This is very convenient for printing lists and tuples.

Types in Asteroid

- Using the 'structure' keyword Asteroid also supports user defined types.
 - The name of the structure becomes a new type available in the program.

```
1  -- user defined types~  
2  structure Person with~  
3    ··data name.~  
4    ··data profession.~  
5  end~  
6  ~  
7  let p:%Person = Person("Fred","Carpenter").~
```

Types in Asteroid

- Finally, Asteroid supports one more type, namely the **none** type.
 - The none type has a constant named conveniently 'none'.
 - The empty pair of parentheses () can often be used as a convenient short-hand for the constant none.
 - The none data type does not belong to any type hierarchy.

Running Asteroid

- Install the interpreter on your machine
 - See <https://github.com/lutzhamel/asteroid>
- Run Asteroid in the cloud
 - <https://replit.com/@lutzhamel/asteroid>

Assignments

- Explore the links in the github readme
- Do Assignment #1 – see BrightSpace