

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 swapped = false.
8          for i in 0 to len(a)-2 do
9              if a@(i+1) <= a@i do
10                 let (a@i,a@(i+1)) = (a@(i+1),a@i).
11                 let swapped = true.
12             end
13         end
14         if not swapped do
15             break.
16         end
17     end
18
19     return a.
20 end
21
22 let l = [6,5,3,1,8,7,2,4].
23 println("unsorted array: "+l).
24 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
- New languages with a full object-oriented type system are waning
 - Of the three “big” new languages (Rust, Go, Swift) only Swift supports OO with inheritance, 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

Asteroid Exercises

- Ex1: Write an Asteroid program that prints out the integers 10 through 1.
- Ex2: Write an Asteroid program that has a structure for the type 'Circle' that holds the coordinates of the center of a circle and its radius.
 1. Your program should instantiate various object circles and print them out using the 'println' statement.
 2. Add a member function to your Circle structure that computes the circumference of the given circle using $2 \cdot \pi \cdot r$. Your program should instantiate a number of circles and print out their circumference.

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:
boolean < integer < real < 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.

```
let l = [6,5,3,1,8,7,2,4].  
println("unsorted array: "+l).
```

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