COMP302: Programming Languages and Paradigms

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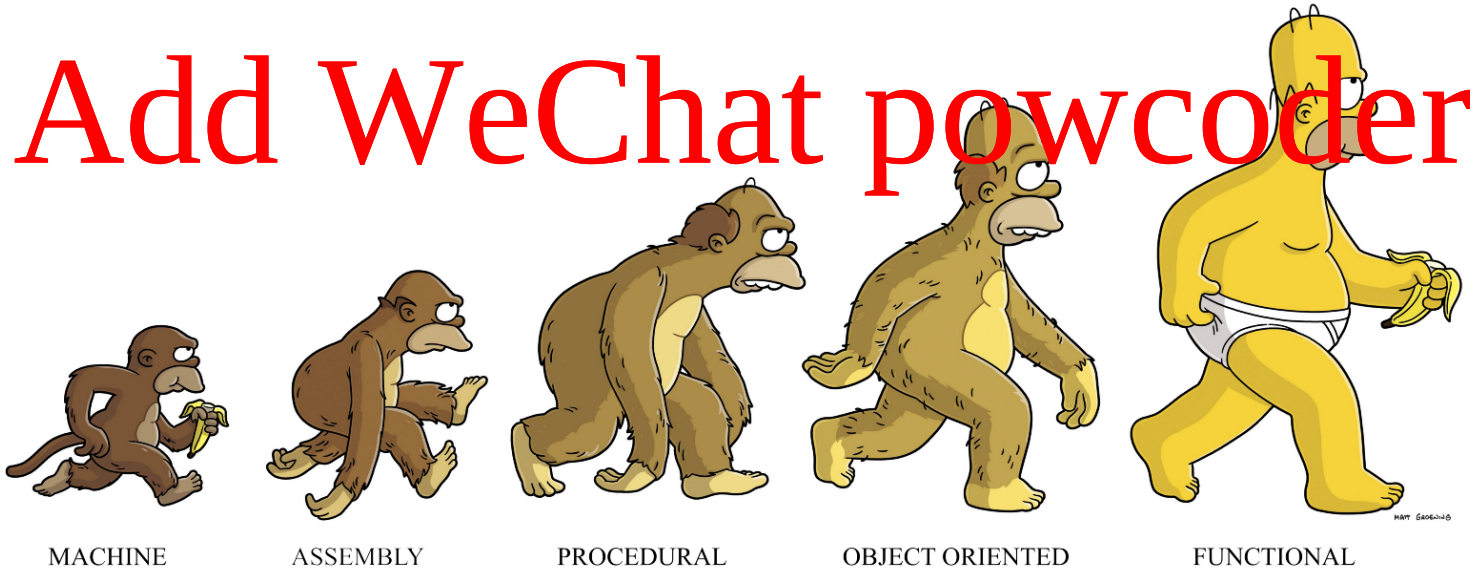
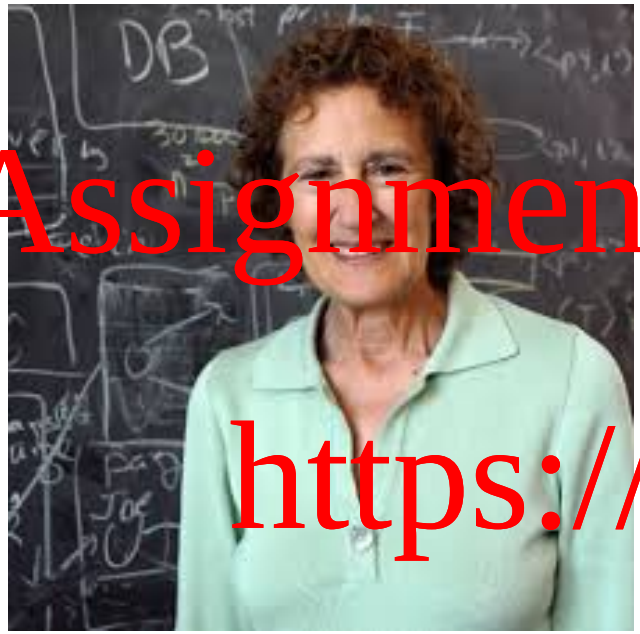
Week 1-2, Fall 2017



Function Tidbit: Barbara Liskov

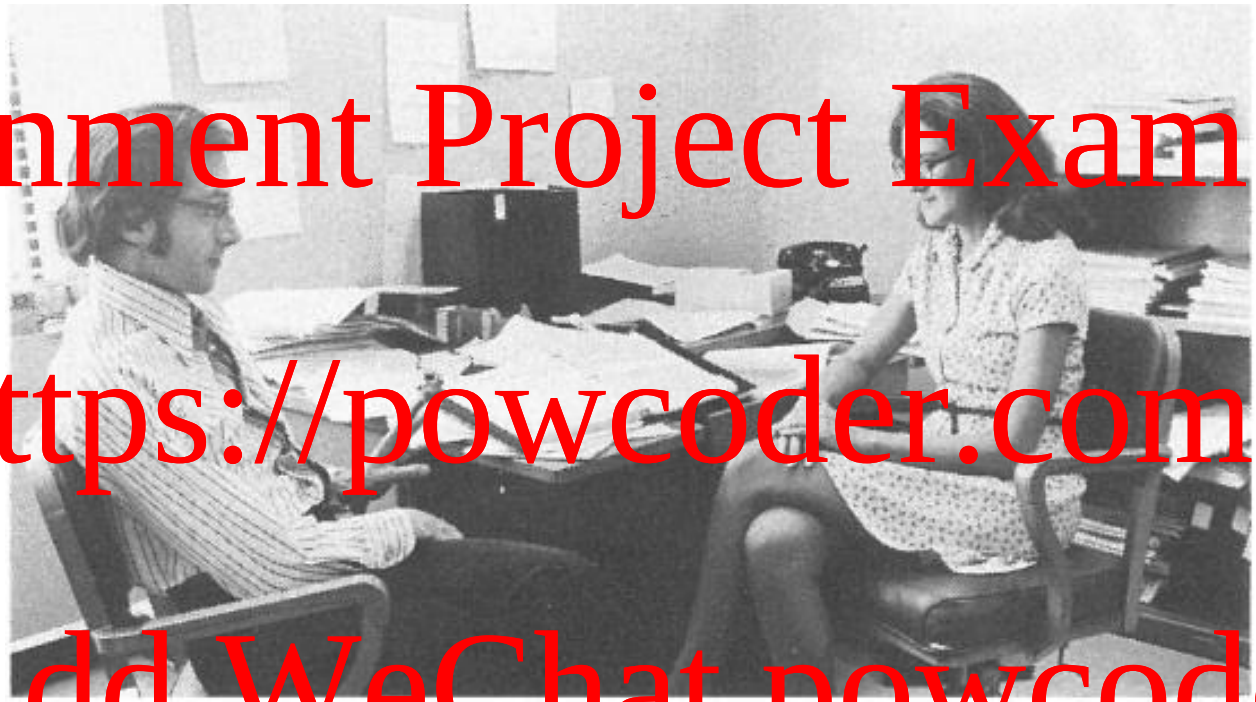


- Professor at MIT
- John von Neumann Medal [2014]
- Turing Award for her work in the design of programming languages and software methodology [2008]

"The motivation behind the work in very-high-level languages is to ease the programming task by providing the programmer with a language containing primitives or abstractions suitable to his problem area. The programmer is then able to spend his effort in the right place; he concentrates on solving his problem, and the resulting program will be more reliable as a result. Clearly, this is a worthwhile goal."

B. Liskov [1974]

Function Tidbit: Barbara Liskov (in the 70's)



Functions

- Functions are values
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- Recursive functions are declared using the keyword `let rec`

```
let rec fact n =
  if n = 0 then 1
   else n * fact (n-1)
```

DEMO

Tail-recursive Functions

A function is said to be "tail-recursive", if there is nothing to do except return the final value. Since the execution of the function is done, saving its stack frame (i.e. where we remember the work we still in general need to do), is redundant.

- Write efficient code
- All recursive functions can be translated into tail-recursive form!

Example: Rewriting Factorial

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```
1 let rec fact_tr n =
2   let rec f (n, m) =
3     if n=0 then
4       m
5     else f(n-1, n*m)
6   in
7     f(n, ?)
```


- Second parameter to accumulate the result; in the base case we simply return its result
- Avoids having to return a value from the recursive call and subsequently doing further computation.
- Avoids building up a runtime stack to memoize what needs to be done once the recursive call returns a value

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What value shall we put in for the questionmark?

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What is the type of `f`?

Passing Arguments

- Passing all arguments at the same time

```
'a * 'b -> 'c
```

- Passing one argument at a time

```
'a -> 'b -> 'c
```

- **Remark:** We can translate any function of type `'a -> 'b -> 'c` to a function of type `'a * 'b -> 'c` and vice versa. This is called *currying* (*uncurrying* resp.)

Data Types and Pattern Matching

Playing Cards

How can we model a collection of cards?

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Declare a new type together with its elements

```
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- Constructors must begin with a capital letter in OCaml.

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- The order in which we declare these elements does not matter.
- We call `Clubs`, `Spades`, `Hearts`, `Diamonds` constructors.
- Constructors must begin with a capital letter in OCaml.
- Use pattern matching to analyze elements of a given type.


```
match <expression> with
      | <pattern> -> <expression>
      | <pattern> -> <expression>
      ...
      | <pattern> -> <expression>
```


A pattern is either a variable, underscore (wild card), or a constructor.

Comparing Suits

Write a function `dom` of type `suit*suit -> bool`

`dom(s1,s2) = true` iff suit `s1` beats or is equal to suit `s2` relative to the ordering

`Spades` > `Hearts` > `Diamods` > `Clubs`

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Demo