CS152 – Programming Language Paradigms
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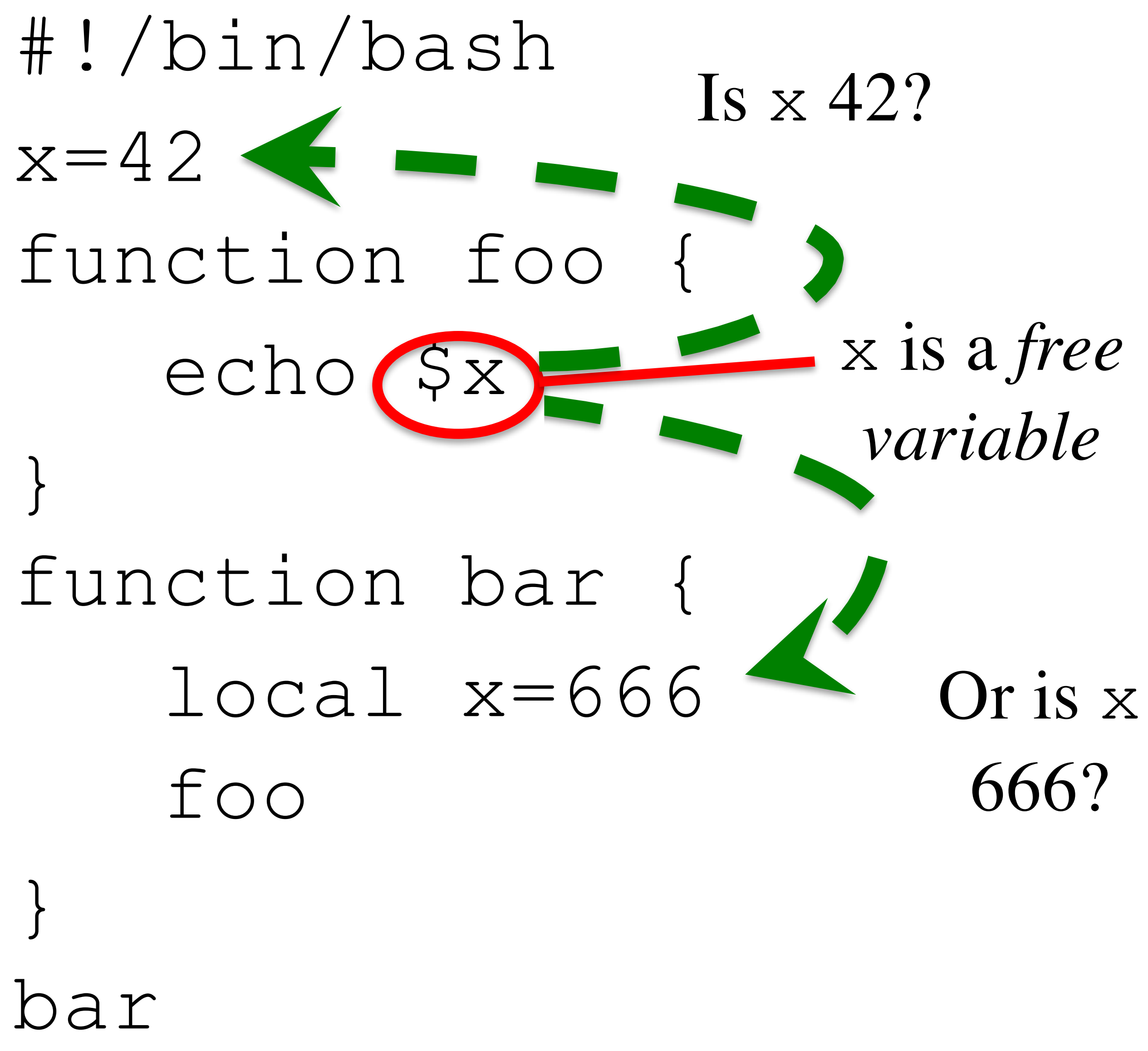
Closures & Scoping

Variables

- Parameters
- Local variables
- Free variables
  - Variables not defined in the current scope
  - e.g. global variables



```
#!/bin/bash
x=42
function foo {
    echo $x
}
function bar {
    local x=666
    foo
}
bar
```

Lab part 1

- Guess what the bash script should print
- Run the script
- Rewrite the script into a Java program as faithfully as you can. What does it return?

```
#!/bin/bash
x=42
function foo {
    echo $x
}
function bar {
    local x=666
    foo
}
bar
```

Most languages uses *static* or *lexical* scoping, so `x` would be 42.

But Bash uses dynamic scoping, so `x` is 666?

Scoping definitions

- In static or lexical scoping, name resolution depends on where the named variable is defined.
- In dynamic scoping, name resolution depends on the execution path of the code (the calling context).

Why do some languages use dynamic scoping?

Closures and Environments

- A closure is a pair of
  - a function, and
  - its environment
- An environment is a mapping of free variables to their values defined outside the function.

Simple example of closures

```
(define (make-adder x)
  (lambda (y) (+ x y)))

(let ([add-two (make-adder 2)])
  (add-two 3))
```

```
(define (make-counter)
  (let ([count 0])
    (lambda ()
      (set! count (+ count 1))
      count)))
(define my-count (make-counter))
(my-count)
(my-count)
(define ctr2 (make-counter))
(ctr2)
(my-count)
```

```
(define (box x)
  (cons
    (λ() x)
    (λ(y) (set! x y))))
(define (get-val bx)
  ((car bx)))
(define (set-val! bx new-val)
  ((cdr bx) new-val))
```

Using box

```
(let ([my-box (box 3)])
  (displayln (get-val my-box))
  (set-val! my-box 4)
  (displayln (get-val my-box)))
```

Lab, part 2

- Use `box` to create an Employee object.
- Details in Canvas.