Discussion 32: ???

SPECIAL REVIEW EDITION

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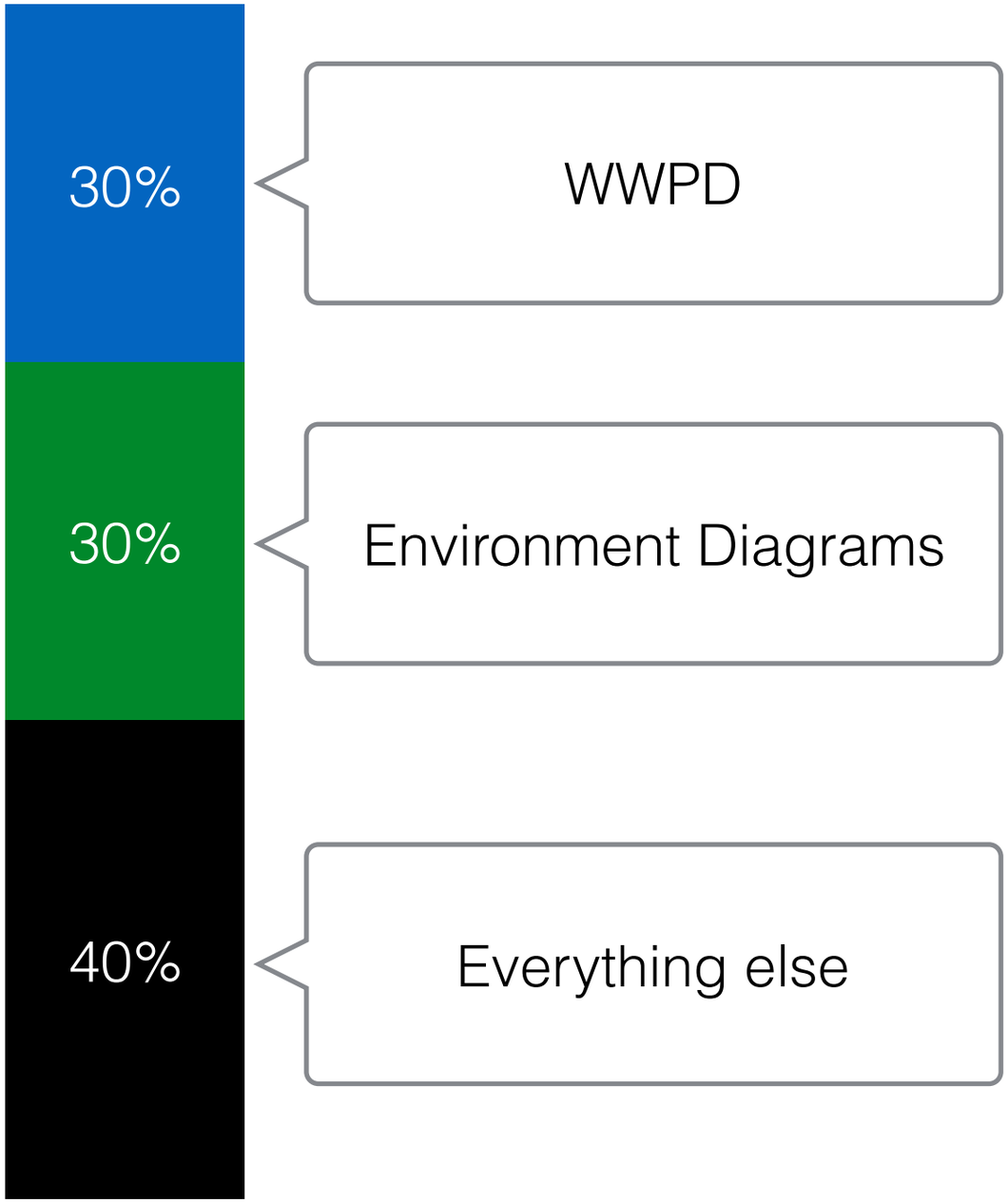
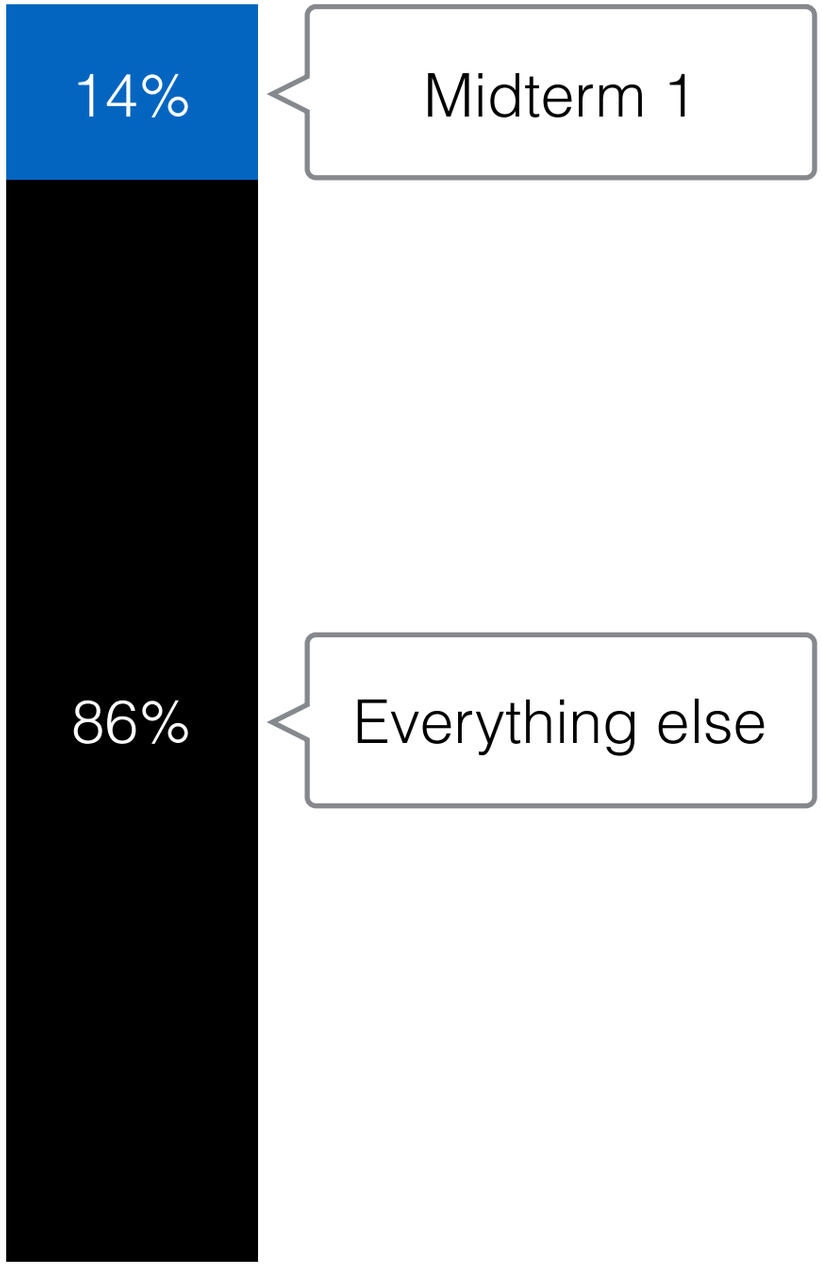
Agenda

1. Points
2. Currying
3. WWPD
4. Environment Diagrams
5. Rest of the Exam

Some Perspective



From MT1, Fall 2015



Total Grade

What Would Python Display?

Basic Facts

- Evaluated **in order** in the Python **interpreter**, not run from a `.py` file
- **If it errors, include everything before the error**
- Various other rules are on your exam

```
def square(x):
    return x * x

def argentina(n):
    print(n)
    if n > 0:
        return lambda k: k(n+1)
    else:
        return 1 / n

def germany(n):
    if n > 1:
        print('hallo')
    if argentina(n-2) >= 0:
        print('bye')
    return argentina(n+2)
```

Expression	Interactive Output
`5*5`	25
`print(5)`	5
`1/0`	Error
`print(1, print(2))`	
`argentina(0)`	

What Would Python Display?

Strategies

- **Practice!** A lot.
- Draw (hasty) environment diagrams

```
def square(x):
    return x * x

def argentina(n):
    print(n)
    if n > 0:
        return lambda k: k(n+1)
    else:
        return 1 / n

def germany(n):
    if n > 1:
        print('hallo')
    if argentina(n-2) >= 0:
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```

Expression	Interactive Output
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`argentina(0)`	

Currying

Currying is like onions:

~~They both make you cry~~ They have layers!

Lambdas and Currying

```
(lambda x, y: x + y * y)(4, 5)
```

Lambda definition

Lambda call

Result (after currying):

```
(lambda x = 4, y = 5: x + y * y)
```

More Currying

```
(lambda m, a: lambda: lambda p: m + a + p)(2, 4)()(4)
```

Lambda definition

Lambda call

```
m = 2, a = 4
>(lambda: lambda p: m + a + p)()(4)
>>(lambda p: m + a + p)(4)
p = 4
>>>m + a + p
```

Practice

```
def haskell_dream():
    arg = (lambda: lambda s: s + 2)
    return (lambda y: y()(10))(arg)
```

```
>>> haskell_dream()
```

???

Answer: 12

Review

The Return Value

```
(lambda y: y()(10))(lambda: lambda s: s + 2)
```

.....

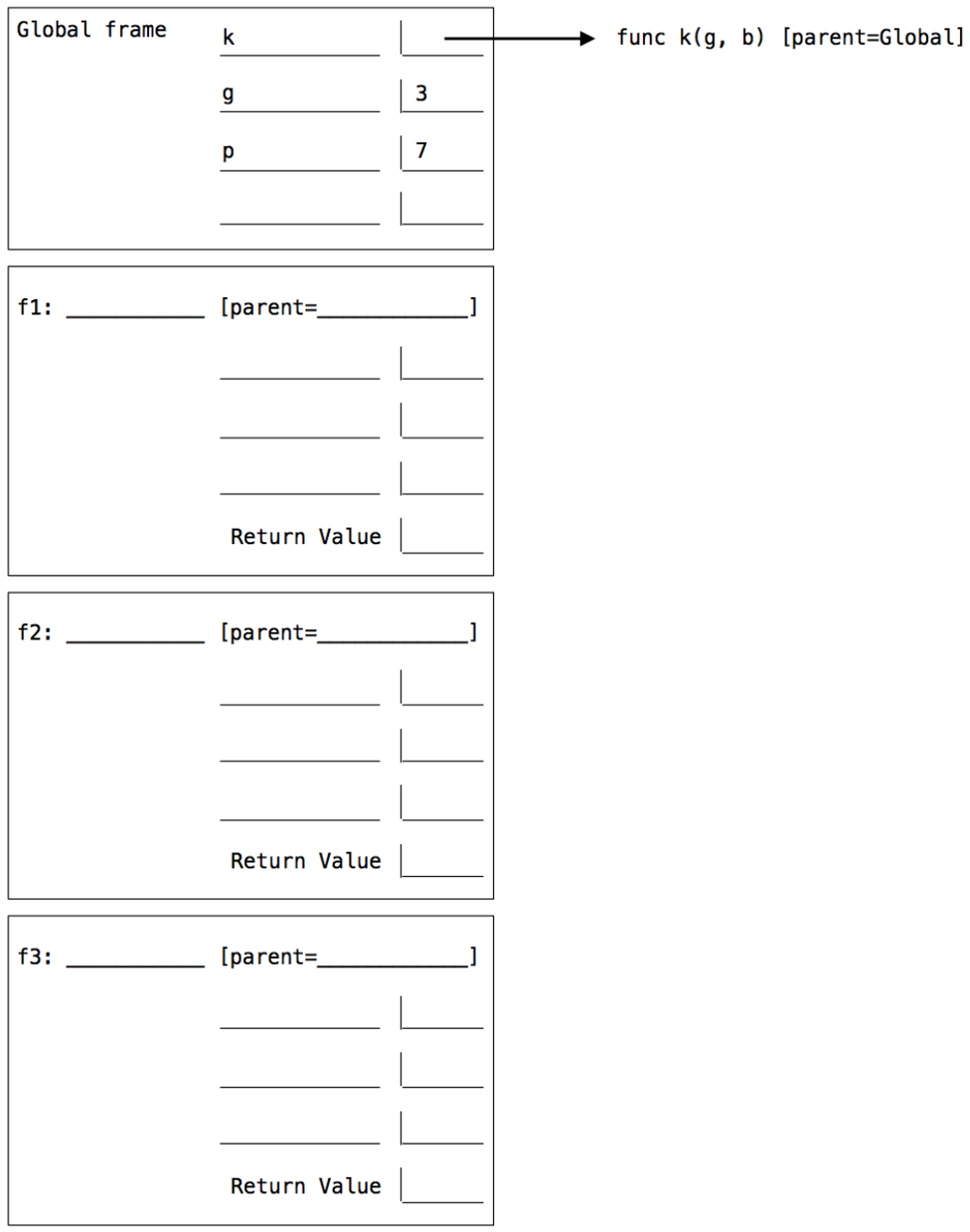
```
(lambda y: y()(10))
```

```
y          = lambda: lambda s: s + 2

y()        = lambda s: s + 2

y()(10) = 12
```

Environment Diagrams

Basic Facts

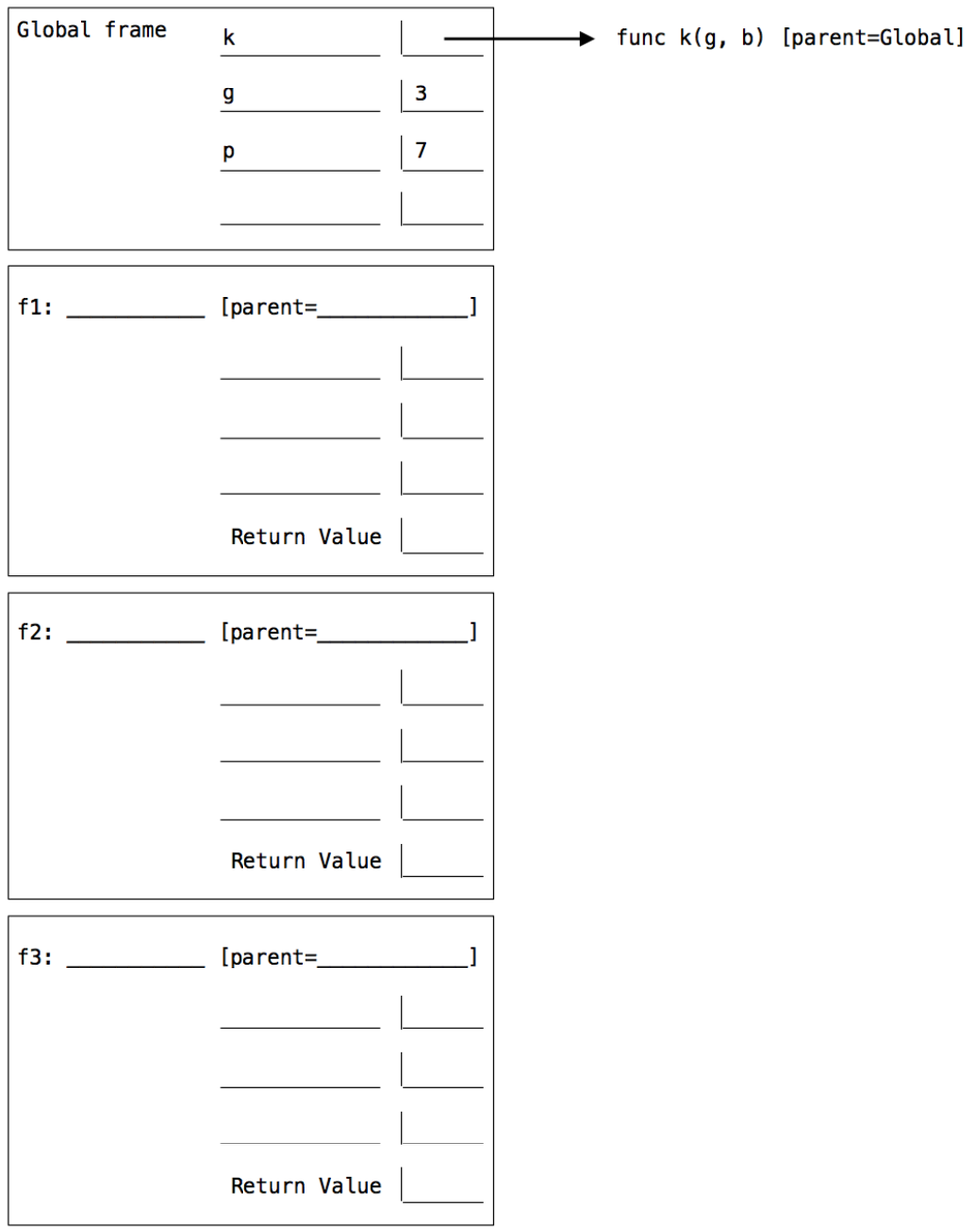
- If you practice, it's probably the closest thing to free points
- **If it errors**, you (likely) did something wrong!



Environment Diagrams

Strategies

- **Practice!** A lot.
- Don't duplicate names
- Don’t forget to label parent frames!
- Fill in **ALL return values**



Practice

```
def haskell_nightmare():
    carrot = 10
    potato = 20
    def onions(onions):
        def carrot(onions, carrot):
            return lambda onions: onions(carrot)
        return carrot
    cook = lambda onions: onions + carrot + potato
    return onions(carrot)(onions, potato)(cook)
```

```
>>> haskell_nightmare()
???
```

Review

```
>>> haskell_nightmare()
50
```

Environment Diagram: http://goo.gl/7eQHKM

Coding Questions

Expect lots of recursion

~Three possibilities:

- **Skeleton code**
- **Cross-outs**
- **Free write** (unlikely?)

Coding Questions

Skeleton Code

- Almost definitely gonna happen
- Iteration and recursion are fair game
- **Look for clues** in the skeleton
- **Test** after you think you are done!

(b) (5 pt) Fill in the blanks of the following functions defined together in the same file. **Assume that all arguments to all of these functions are positive integers that do not contain any zero digits.** For example, 1001 contains zero digits (not allowed), but 1221 does not (allowed). You may assume that `reverse` is correct when implementing `remove`.

```
def combine(left, right):
    """Return all of LEFT's digits followed by all of RIGHT's digits."""
    factor = 1
    while factor <= right:
        factor = factor * 10
    return left * factor + right

def reverse(n):
    """Return the digits of N in reverse.

    >>> reverse(122543)
    345221
    """
    if n < 10:
        return n
    else:
        return combine(_____________________________ , _____________________________)

def remove(n, digit):
    """Return all digits of N that are not DIGIT, for DIGIT less than 10.

    >>> remove(243132, 3)
    2412
    >>> remove(243132, 2)
    4313
    >>> remove(remove(243132, 1), 2)
    433
    """
    removed = 0
    while n != 0:
        ____________, ____________ = ____________________, ____________________
        if ____________________________________________________________________:
            removed = ____________________________________________________________
    return reverse(removed)
```

Coding Questions

Cross-outs

- First, get a **general feel of everything**
- Cross out anything that obviously stands out
- **Test** after you think you are done!

```
class STree(Tree):
    """A smart tree that knows its depth and whether or not it is
    balanced.

    >>> s = STree(6, STree(2, STree(1)), STree(7))
    >>> s.depth
    3
    >>> s.is_balanced
    True
    >>> s.left.right = STree(4, STree(3), STree(5))
    >>> s.depth
    4
    >>> s.is_balanced
    False
    """
```

```
def __init__(self, entry, left=None, right=None):
    Tree.__init__(entry, left, right)
    Tree.__init__(self, entry, left, right)
    self.entry = entry
    self.left = left
    self.right = right
    self.depth = depth(self)
    self.is_balanced = is_balanced(self)
    self.depth = depth
    self.is_balanced = is_balanced
@property
def depth(self):
    return depth(self)
@property
def is_balanced(self):
    return is_balanced(self)
```

Coding Questions

Free write

- Probably **not** gonna happen
- Treat like a lab/homework problem
- **Test** after you think you are done!

(b) (4 pt) The function `equal` takes two differentiable single-argument functions `f` and `g` and returns an `x` for which `f(x)` is equal to `g(x)`. Implement the support function `equal_update` that completes the implementation. You may use `derivative` above, along with `newton_update` from your study guide. You **cannot** use any assignment (`=`), conditional (`if`), `for`, or `while` statements.

```
def equal(f, g):
    """Return an x for which f(x) == g(x).

    >>> def cube(x):
    ...     return x * x * x
    ...
    >>> def plus_six(x):
    ...     return x + 6
    ...
    >>> equal(cube, plus_six)
    2.0
    """
    def close(x):
        return approx_eq(f(x), g(x))
    return improve(equal_update(f, g), close)

def equal_update(f, g):
    """Return an update function that completes the implementation of equal."""
```

Write It

1. (Don't) panic!

2. Read the doctests and instructions very carefully

3. Before looking at blanks, plan out your own solution

    - More often than not, you can fit your solution to the blanks!

Test It

1. Check **domain** and **range**

    - Do inputs/outputs make sense?

2. Check the **margins**

    - Did I loop one too many/few times?

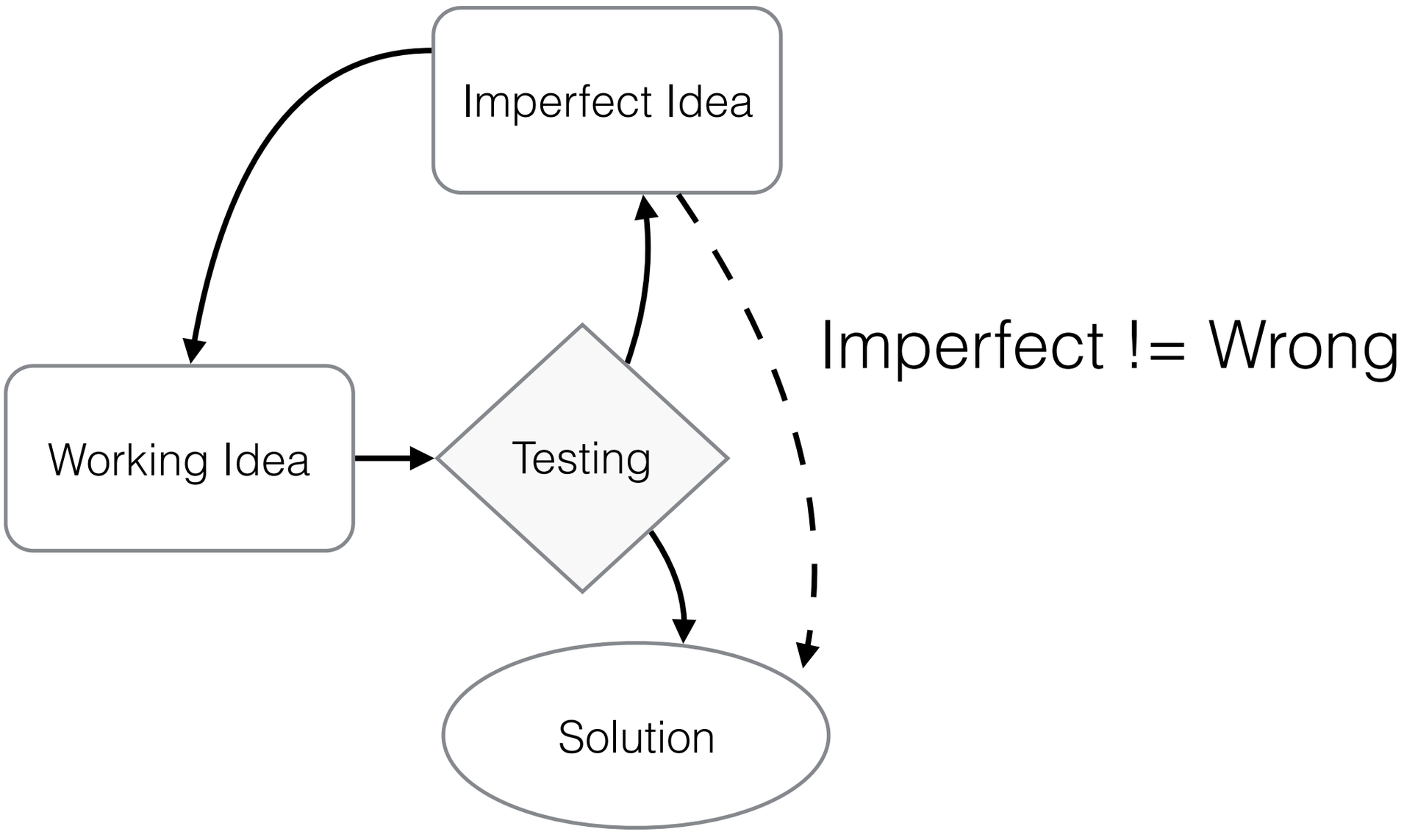
3. Check the **syntax**

    - Correct number of parens, commas, etc?

4. Check it all again

Efficient Workflow

Shortcut: Assume everything has a **“nice” solution**



Recursion

Rules of Recursion

1. Define a **base case**
    - If it's not immediately obvious, pick one anyways
2. Break the problem into **smaller but similar subproblems**
3. Actually **solve the problem**

Mutual Recursion

```
def mouse(n):
    if n >= 10:
        squeak = n // 100
        n = frog(squeak) + n % 10
    return n
```

```
def frog(croak):
    if croak == 0:
        return 1
    else:
        return 10 * mouse(croak + 1)
```

```
>>> mouse(21023508479)
???
314159
```

From Andrew Huang's 61A Wiki: https://www.ocf.berkeley.edu/~shidi/cs61a/wiki/Guides#Miscellaneous_2

Review

```
def mouse(n):
    if n >= 10:
        squeak = n // 100
        n = frog(squeak) + n % 10
    return n

def frog(croak):
    if croak == 0:
        return 1
    else:
        return 10 * mouse(croak + 1)

>>> mouse(21023508479)
```

"Starting" n gets updated

Get the last digit

All but last two! (what's lost?)

Shift up a digit

Increments last digit

Cheat Sheets

"Less is more"

What to write?

1. **Nothing** — study guide is quite comprehensive!

2. **Code examples**

3. Rules — env diagrams, recursion fundamentals

Final Logistics

- Eat a meal or a light snack beforehand!
- I hope you had a good night's sleep
- Arrive on time or early, **not Berkeley time**
- Also, it would be great if you could remember discussion time/TA :)

Final Thoughts

Go back and look at the "perspective" slide

I will repeat this before (and after) every exam —

"One test will not define who you are and whether or not you'll be a successful computer scientist."