



Classes and Objects

Introduction



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Computer science is the study of algorithms

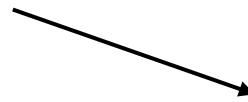
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Computer *programming* is about creating and
composing *abstractions*

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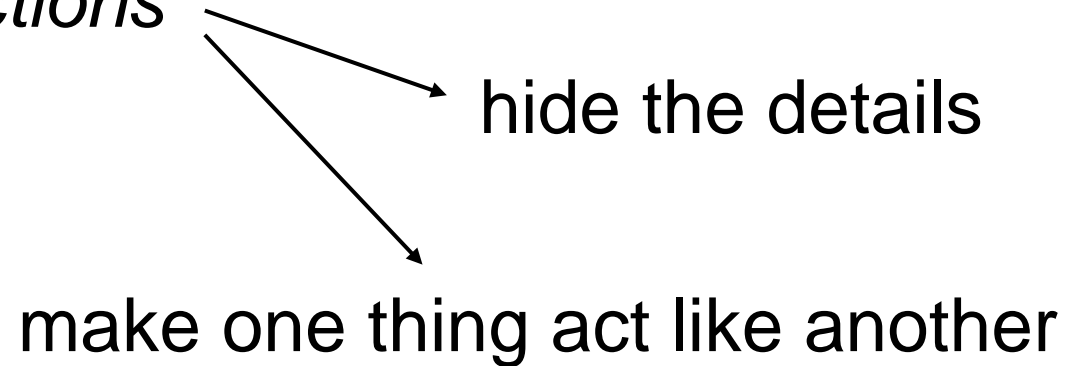
composing *abstractions*



hide the details

Computer science is the study of algorithms

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hide the details

make one thing act like another

Functions turn many steps into one (logical) step

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Classes and objects combine functions and data

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make one thing act like another

Functions turn many steps into one (logical) step

Libraries group functions to make them manageable

Classes and objects combine functions and data

And, if used properly, do much more as well

Simple simulation of aquarium containing

Simple simulation of aquarium containing plants

Simple simulation of aquarium containing plants snails

Simple simulation of aquarium containing

plants

snails

fish

Simple simulation of aquarium containing

plants

snails

fish

don't move

photosynthesize

Simple simulation of aquarium containing

plants

snails

fish

don't move

crawl in 2D

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Algorithm is simple

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Algorithm is simple

```
for t in range(timesteps):
    move(world, everything)
    eat(world, everything)
    show(world, everything)
```

Simple simulation of aquarium containing

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Algorithm is simple

```
for t in range(timesteps):
    move(world, everything)
    eat(world, everything)
    show(world, everything)
```

Program is more complicated

```
def move(world, everything):  
    for thing in everything:  
        if thing[0] == 'plant':  
            pass          # plants don't move  
        elif thing[0] == 'snail':  
            move_snail(snail)  
        elif thing[0] == 'fish':  
            move_fish(fish)
```

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def move(world, everything):  
    for thing in everything:  
        if thing[0] == 'plant':  
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            move_snail(snail)  
        elif thing[0] == 'fish':  
            move_fish(fish)
```

So far, so good

```
def eat(world, everything):  
    for thing in everything:  
        if thing[0] == 'plant':  
            photosynthesize(world, plant)  
        elif thing[0] == 'snail':  
            scavenge(world, snail)  
        elif thing[0] == 'fish':  
            prey = hunt(world, everything, thing)  
            if prey != None:  
                devour(world, everything, thing, prey)
```

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def eat(world, everything):
    for thing in everything:
        if thing[0] == 'plant':
            photosynthesize(world, plant)
        elif thing[0] == 'snail':
            scavenge(world, snail)
        elif thing[0] == 'fish':
            prey = hunt(world, everything, thing)
            if prey != None:
                devour(world, everything, thing, prey)
```

Hmm...

```
def show(world, everything):  
    show_world(world)  
    for thing in everything:  
        if thing[0] == 'plant':  
            show_plant(plant)  
        elif thing[0] == 'snail':  
            show_snail(snail)  
        elif thing[0] == 'fish':  
            show_fish(fish)
```



```
def show(world, everything):  
    show_world(world)  
    for thing in everything:  
        if thing[0] == 'plant':  
            show_plant(plant)  
        elif thing[0] == 'snail':  
            show_snail(snail)  
        elif thing[0] == 'fish':  
            show_fish(fish)
```

This is starting to look familiar...

Pessimist: code that's repeated in two or more places will eventually be wrong in at least one

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What about fish that eat plants? Or scavenge?

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To add starfish, we have to modify three functions

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What about fish that eat plants? Or scavenge?

Optimist: every pattern in a program is an opportunity to shorten that program

Wouldn't this be simpler?

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```
for thing in everything:  
    thing.move()  
    prey = thing.eat(everything)  
    if prey:  
        thing.devour(preay)  
        everything.remove(preay)
```


Wouldn't this be simpler?

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for thing in everything:  
    thing.move()  
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Easier to understand (after some practice)

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for thing in everything:  
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```

Easier to understand (after some practice)

Much easier to add new kinds of things

Nothing is free

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Simple programs become slightly more complex

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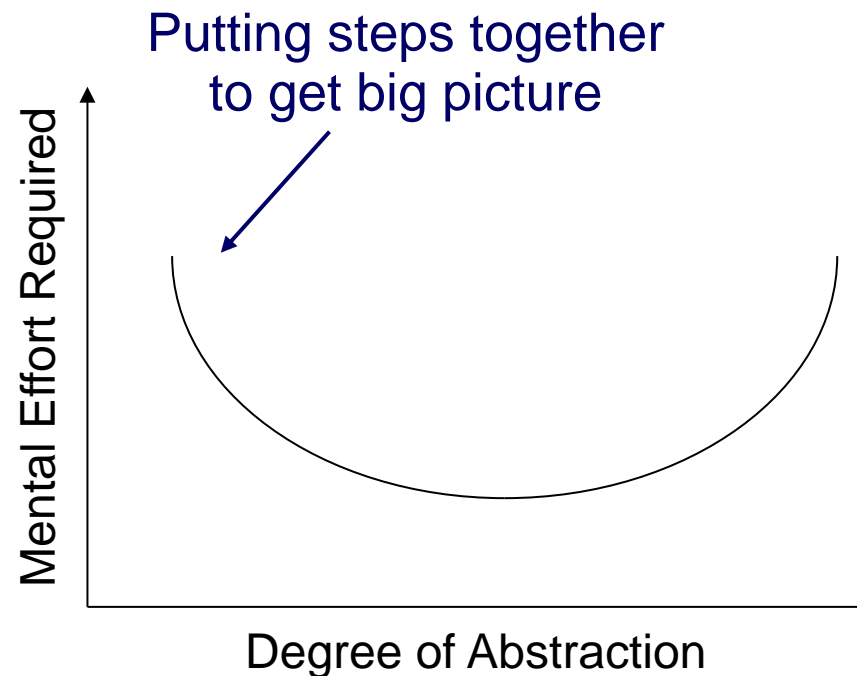
Simple programs become slightly more complex

And too much abstraction creates as big a mental
burden as too little

Nothing is free

Simple programs become slightly more complex

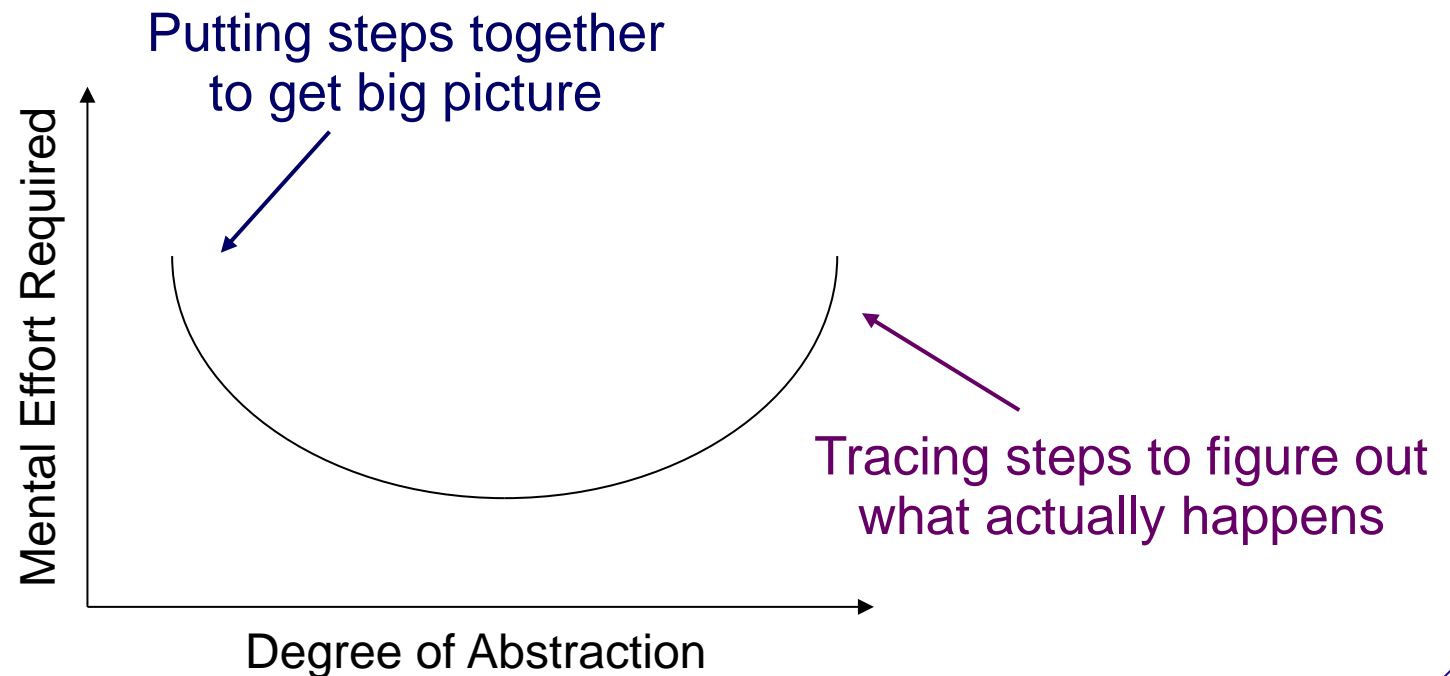
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created by

Greg Wilson

January 2011



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