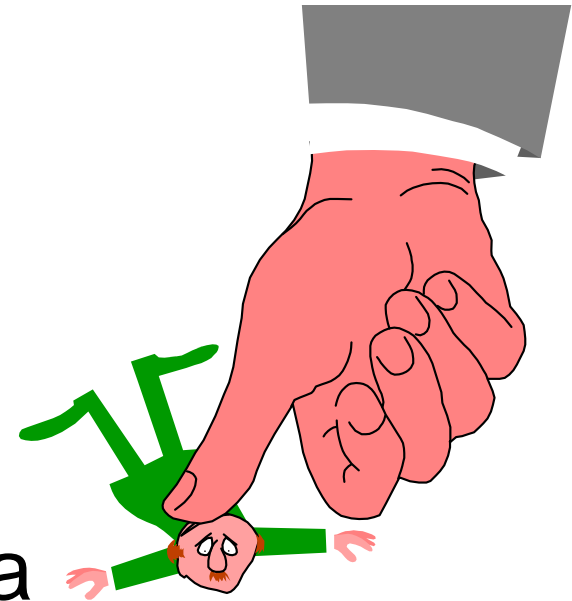# The World of Objects

Slides borrowed from **Maayan Geffet**
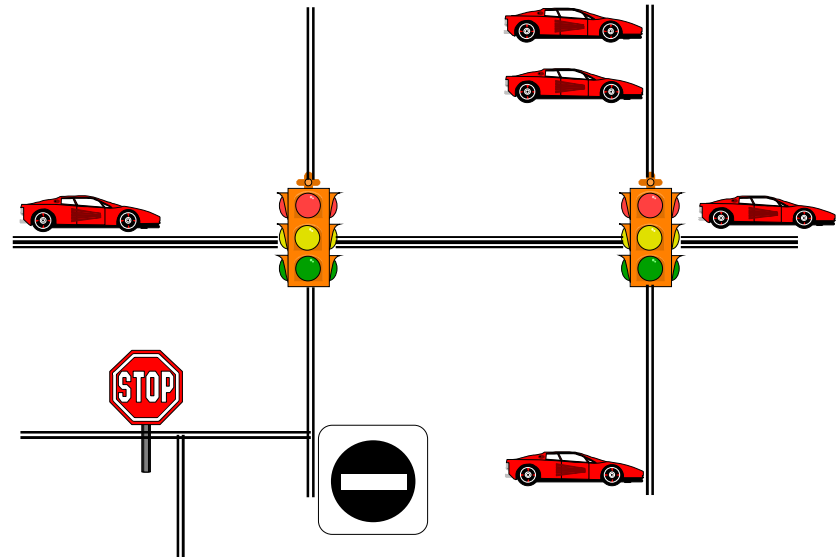
mary@cs.huji.ac.il

The World of Objects

- The World consists of Objects

- Objects are Nouns

- A System of Objects is usually what we want to *simulate* or *implement* with a program on a computer

Anything we can put a thumb on

Example 1

- Traffic System
- Simulate traffic flow, traffic jams
- Objects include:
  - Cars
  - Trucks
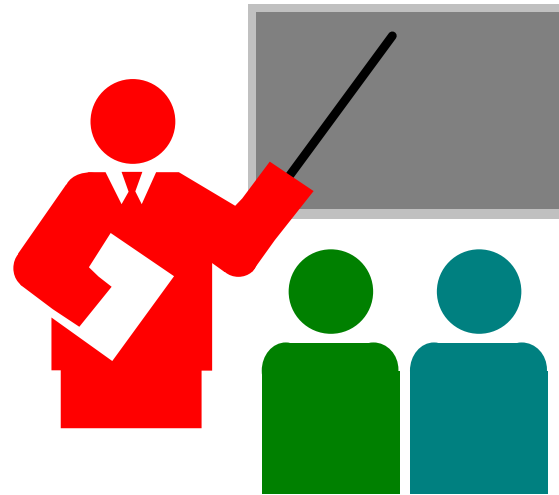 - Pedestrians
  - Traffic Lights
  - The Road itself!

Example 2

- Checkout Counter System
- Simulate throughput at grocery store
- Objects include:
  - Customers
  - Cashiers
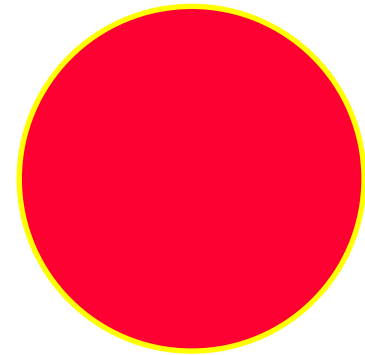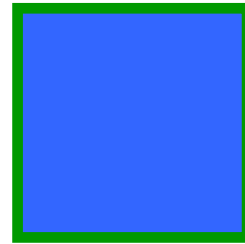 - Groceries

Example 3

- Class Scheduling System
- Assign students to classes
- Objects include:
  - Students
  - Classes
  - Time slots
  - Rooms

Example 4

- Graphical Drawing System
- Allow user to draw shapes and manipulate them on the screen
- Objects include:
  - Circles
  - Rectangles
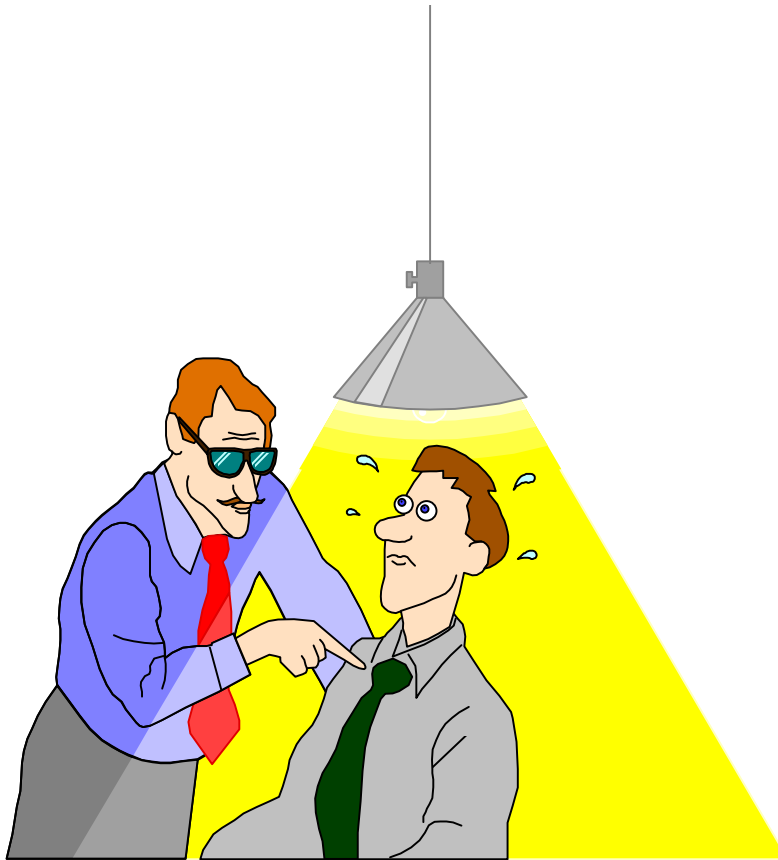 - Lines
  - Polygons

Objects have a State — Attributes

An *attribute* is any characteristic of an object

Objects Can *Do* Things — *Methods*

An object has operations it can perform — built right into it

Objects Can be Sent *Messages*

One object can ask another object for a service, by sending it a *message*

One object asks another to use a particular method

Basic Objects

- Objects
  - Nouns, things in the world

- Attributes
  - Properties each of those things have

- Methods
  - Actions that each of those things can do

- Message
  - Communication from one object to another, asking for a method to be used; the way methods are "triggered"

Example – Bank Accounts

Attributes:
    owner = John Doe
    balance = $142.30
    kind = Checking
Methods:
    deposit( )
    withdraw( )

Attributes:
    owner = Frank Oz
    balance = $2301.47
    kind = Savings
Methods:
    deposit( )
    withdraw( )

Attributes:
    owner = Bill Budd
    balance = $29.88
    kind = Checking
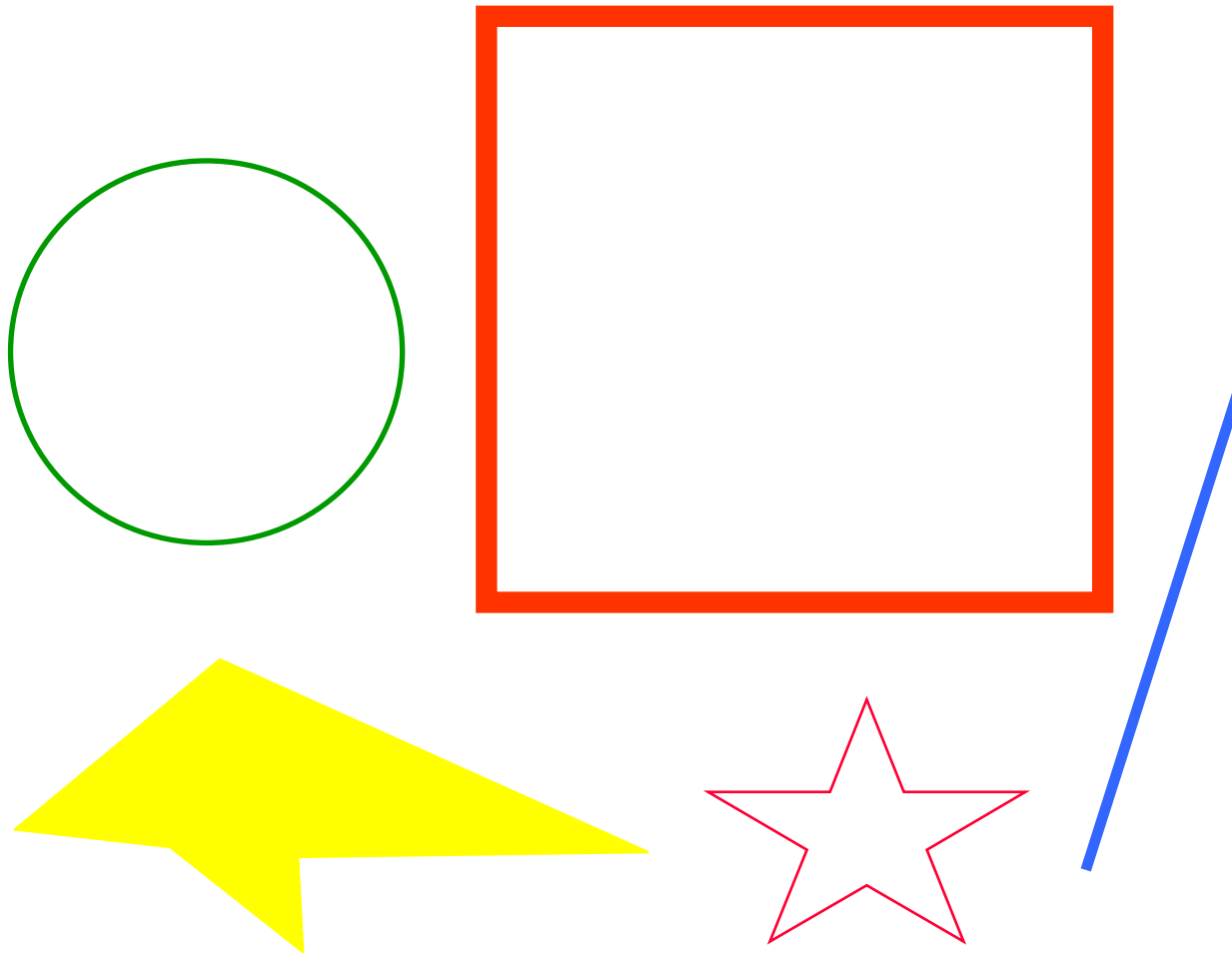**Methods:**
    deposit( )
    withdraw( )

- Bank accounts have a state — attributes, like owner, balance, kind of account

- Bank accounts (in OOP) can *do* things — methods, like deposit( ) and withdraw( )

- Each bank account is represented by an object

- Send an object a message to get it to add or subtract money

Let's Consider Shapes

- Shapes have a state — attributes
- Shapes can *do* things — methods
- Attributes of a shape:
  - Filled, line width, line color, fill color, location
- Methods of a shape:
  - Fill, Empty, Move, Grow
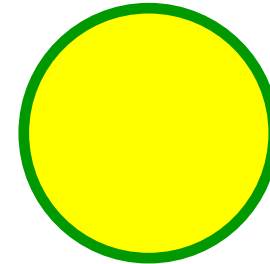
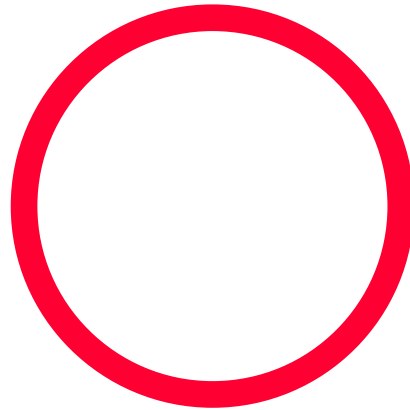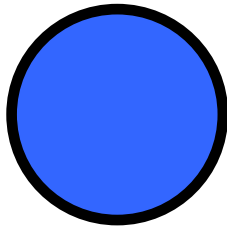# Fun with Shapes
Each Shape is an Object

- **Properties of a shape:**
  - filled
  - line width
  - line color
  - fill color
  - location
- **Methods of a shape:**
  - Fill
  - Empty
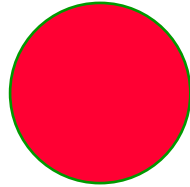 - Move
  - Grow

There is a Structure Here

- There are certain shapes of a related kind
- This *prototype* is called a Class

- **Each circle is different, but they are all instances of the class Circle**

Each Object is an *Instance* of a *Class*

- An Instance of the Class "Circle"

- Two Instances of the Class "Square"

- An Instance of the Class "Line"

Classes

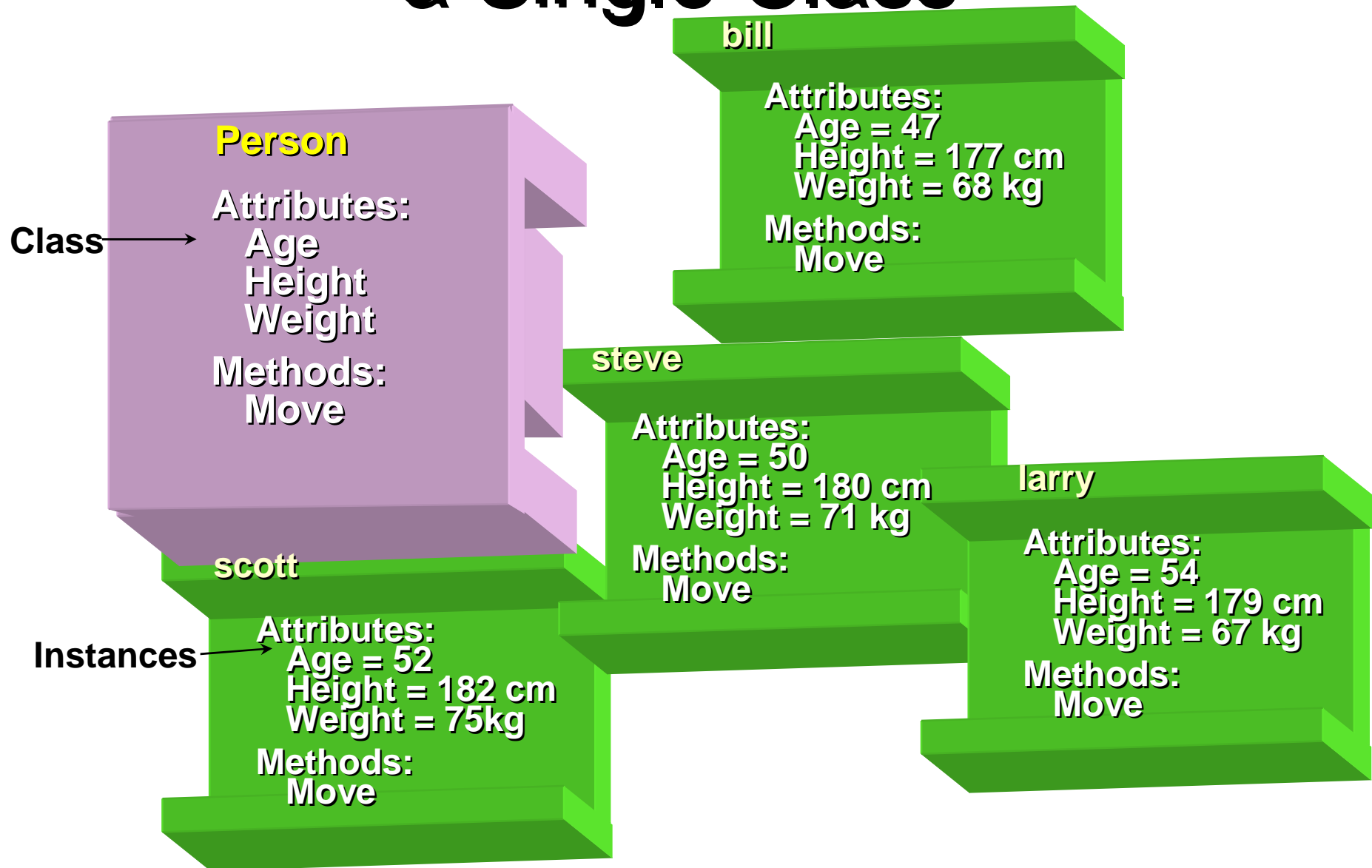- A *Class* is an abstract description of objects having the same attributes and methods
- A specific Object is an instance of a Class
- A Class is the cookie cutter —
  An Object is the cookie

Person

Attributes:
Age
Height
Weight

Methods:
Move

Class ⟶

bill

Attributes:
Age = 47
Height = 177cm
Weight = 68 kg
Methods:
Move
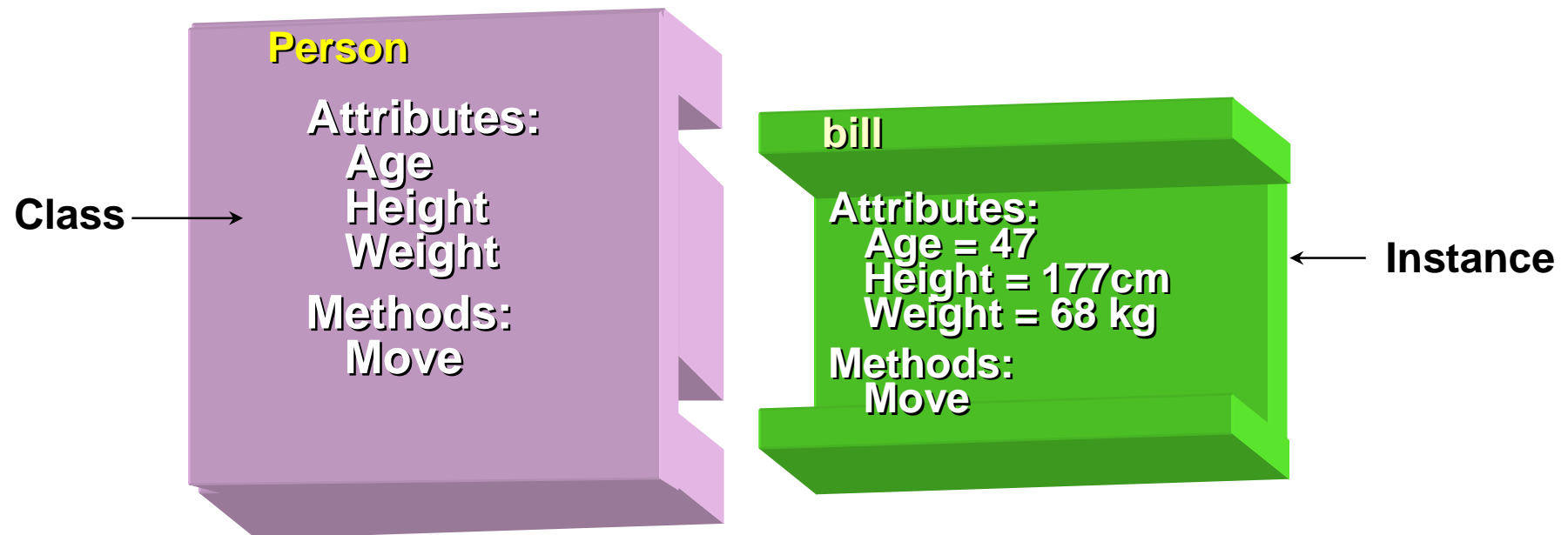
⟵ **Instance**

Many Different Objects from a Single Class

Class →

Person

Attributes:
  Age
  Height
  Weight

Methods:
  Move

bill

Attributes:
  Age = 47
  Height = 177 cm
  Weight = 68 kg

Methods:
  Move

steve

Attributes:
  Age = 50
  Height = 180 cm
  Weight = 71 kg

Methods:
  Move

larry

Attributes:
  Age = 54
  Height = 179 cm
  Weight = 67 kg

Methods:
  Move

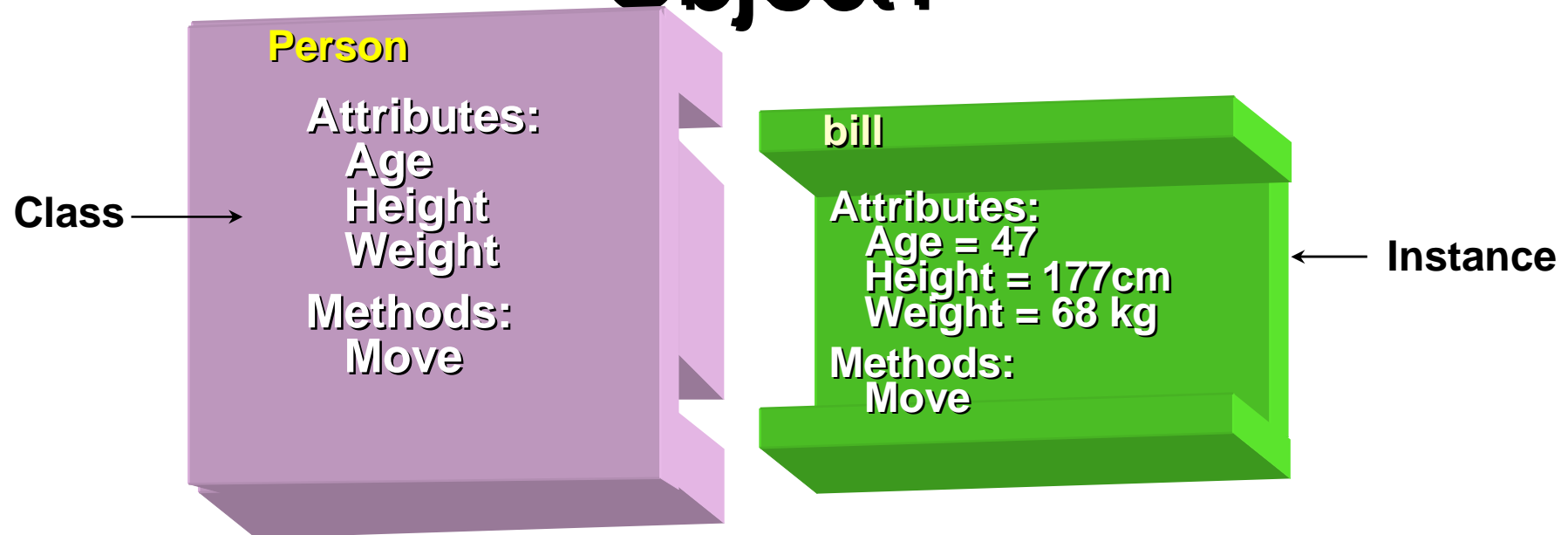**scott**

Instances →

Attributes:
  Age = 52
  Height = 182 cm
  Weight = 75kg

Methods:
  Move

How Do We Create an Object?

- We use a *constructor*
- This takes a Class and creates an Instance of the class, an object, perhaps with certain properties
- "Construct an Instance of the Class Person, give it the name "bill", and make its Age be 47, its Height be 177 cm, and its Weight be 68 kg."

How Do We Create an Object?

Person

Attributes:
Age
Height
Weight

Methods:
Move

Class →

bill

Attributes:
Age = 47
Height = 177cm
Weight = 68 kg

Methods:
Move

← Instance

- Presto! We now have an object "bill", with certain attributes, and with the method Move
- The object "bill" can now be sent the message "Move"

Object Vocabulary

- *Classes* — Prototypes for objects
- *Objects* — Nouns, things in the world
- *Constructor* — Given a Class, the way to create an Object (that is, an *Instance* of the Class) and initialize it
- *Attributes* — Properties an object has
- *Methods* — Actions that an object can do
- *Messages* — Communication from one object to another, asking for a method to be used