STAT 33B Lecture – April 15

Topics:

- Object-oriented Programming
- The S3 Object System
- The S4 Object System

Object-Oriented Programming

Object-Oriented Programming (OOP)

A style (or *paradigm*) for solving programming problems.

Main idea – Break down problems in terms of **objects**.

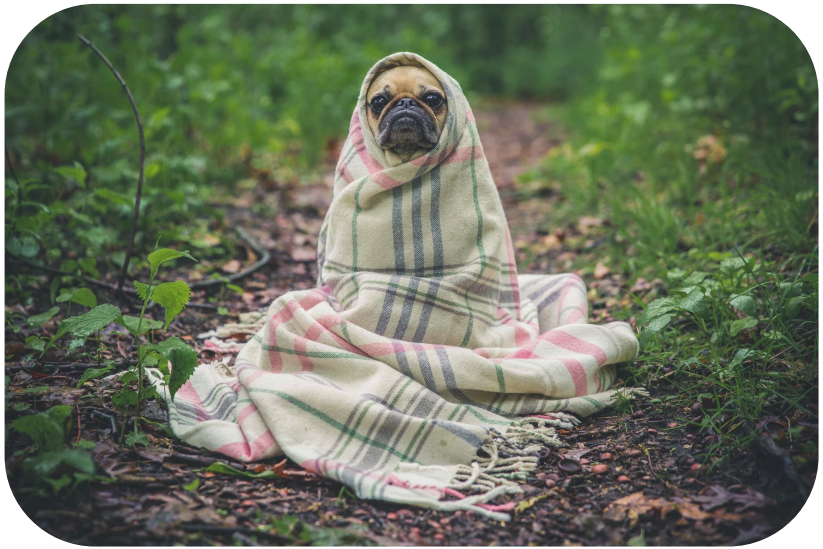
Objects can:

- Contain data
- Have predefined actions or behaviors

OOP Example, Part 1

Program to track patients at a veterinarian's office.

- Cat objects
  - Data: name, breed, weight
  - Actions: move(), meow()
- Dog objects
  - Data: name, breed, weight
  - Actions: move(), bark()



Classes

A **class** is a definition of an object.

Specifically, a class can define:

- **Fields**, the data the object contains
- **Methods**, the actions the object can take

Each object is an *instance* of a class.

OOP Example, Part 2

Cat Class

Name:

Breed:

Weight:

Instantiate

Instantiate

Cat Object

Name: Fluffy

Breed: Maine Coon

Weight: 14

Cat Object

Name: Zog

Breed: A. Longhair

Weight: 8

OOP in R

OOP in R

Built-in systems:

- S3
- S4
- Reference Classes (or *R5*)

There are also packaged OOP systems.

S3 and S4 are the most prevalent.

Methods in S3 and S4

In most OOP systems, methods “belong” to classes:

```
fluffy.meow() # calls cat class’ meow() method
```

In S3 and S4, methods “belong” to **generic functions**.

Generic functions select a method based on the classes of the arguments:

```
meow(fluffy) # selects meow()’s “cat” method
```

The S3 System

An S3 object is any R object with a “class” attribute.

- Classes are implicit – no class definitions.
- Fields and methods can be changed at any time.
- Single inheritance.
- Method selection based on one argument, called **single dispatch**.

Works surprisingly well in practice.

The S4 System

Compared to S3:

- Less popular.
- Classes are explicit – formal class definitions.
- Fields are called **slots** and accessed with the `@` operator.
- Multiple inheritance.
- Method selection based on multiple arguments, called **multiple dispatch**.

Great for complex systems. Use S3 for everything else.