Objects, Object-Oriented Design, Methods

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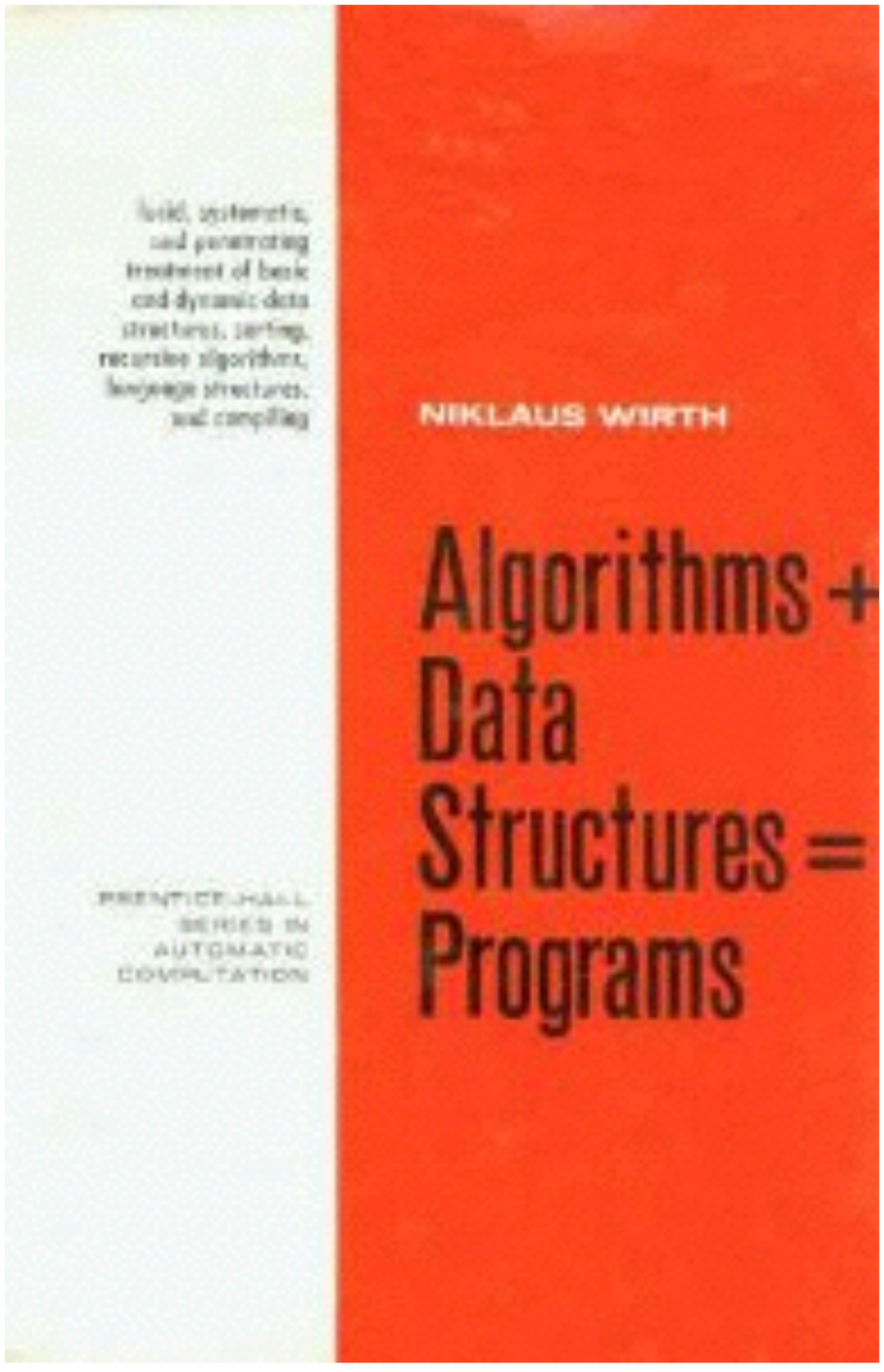
“Objects”

- Top-down design: start from the big problem and break it into smaller problems, writing a function for each of the smaller problems

- Another useful way of thinking: describe the organization of your data and have that reflected in your program.
  - A contact management program will manipulate **Contacts**
  - A drawing program will manipulate a **Canvas**, and perhaps **Lines**, **Colors**, and **Shapes**
  - Facebook will manipulate **Users**, **Posts**, and **Advertisements**
  - Twitter will manipulate **Tweets**, **Users**, **Advertisements**

- These are the “nouns” of these programs.

These two ways of thinking complement each other



Objects + Operations

- Once you've decided on the "nouns", you choose the "verbs" that apply to those nouns.

- Example:

Your "noun" is a Tweet:

```
type Tweet struct {
    text string
    time uint64
    who *User
}
```

- Get Hashtags in Tweet
- Get Direct Mentions in Tweet
- Shorten URL in Tweet
- Get URLs in Tweet
- Get Short Version of Tweet

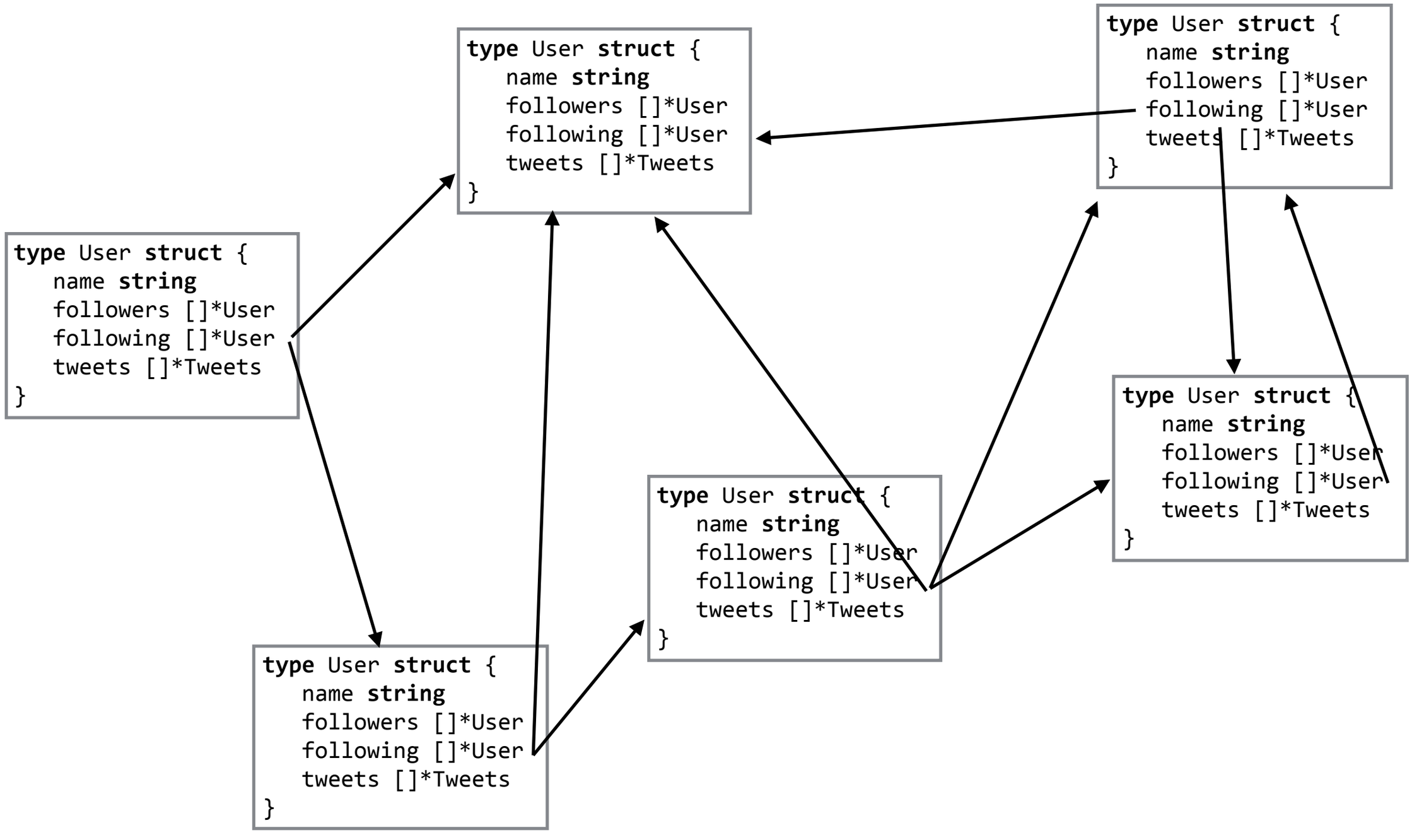
Your "noun" is a User:

```
type User struct {
    name string
    followers []*User
    following []*User
    tweets []*Tweets
}
```

- Direct Message User
- Add Follower
- Remove Follower
- Add Following User
- Remove Following User
- Get All Tweets from Followed Users

Twitter Graph

User structs are nodes
Pointers represent edges



Example 2: Contacts

Your “noun” is a Contact:

```
type Contact struct {
    name string
    id int
    salary float64
    friends []*Contact
    phone []int
}
```

Operations you will need to perform on a Contact:

- Get First Name
- Get Last Name
- Set First Name
- Set Last Name
- Get Formatted Phone Number
- Call
- Count Friends
- Add Friend
- Give Raise

Example 3: Spatial Games

```
type Field struct {
    cells [][]Cell
}
```

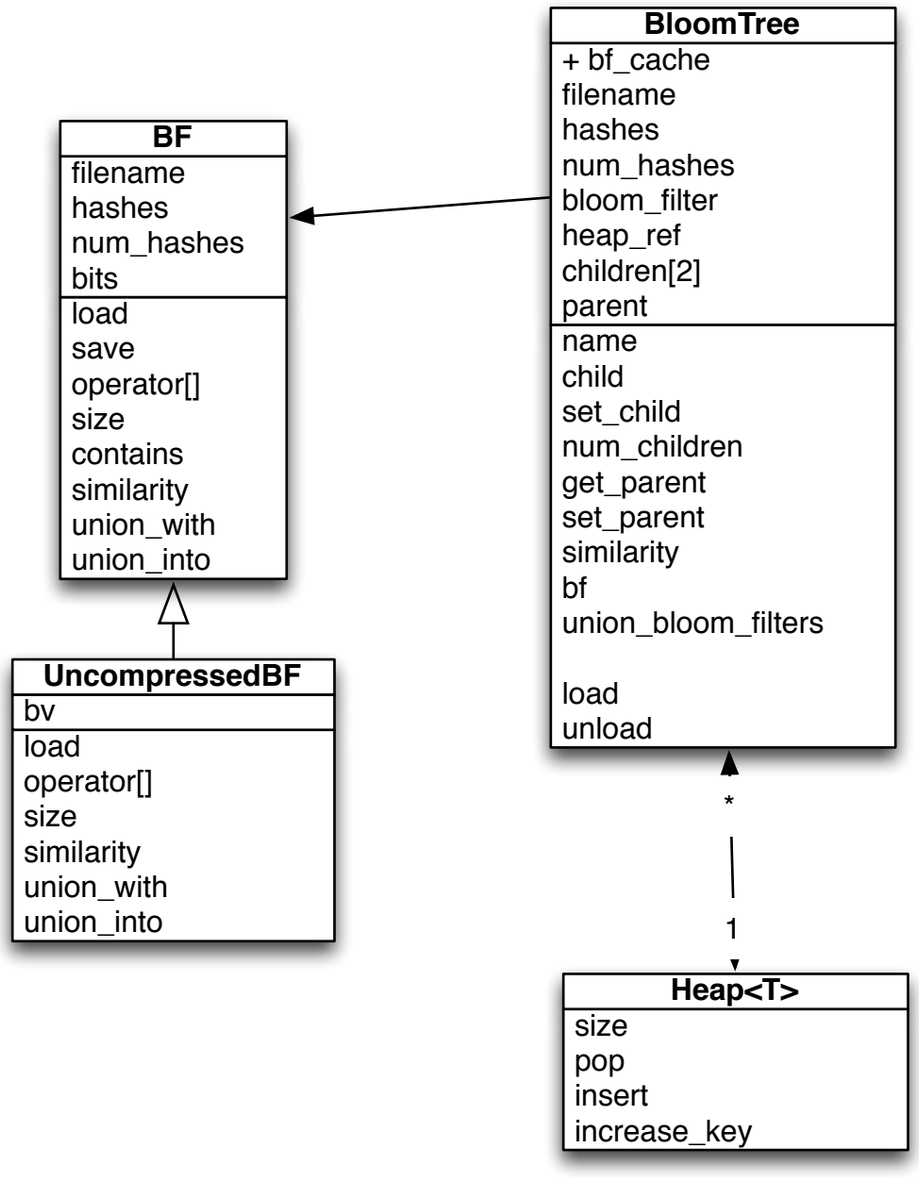
- Count Cell Kinds in Neighborhood
- Read Field From File
- Evolve Single Step
- Save Field To File
- Draw Field
- Check Field is Valid
- Zero All Scores

```
type Cell struct {
    kind  string
    score float64
    prevKind string
}
```

- Zero Score
- Set Kind
- Get Kind
- Get Previous Kind
- Get Cell Color

Example 4: Real World Example

- Too complex to be a good example for class, but I wanted to show that this kind of thinking is actually used:



Example 5: Canvas

```
type Canvas struct {
    gc      *draw2d.ImageGraphicContext
    img     image.Image
    width   int
    height int
}
```

Pointer to an object that represents the pen

An object that represents the image

Operations you can perform on a Canvas:

- MoveTo(c *Canvas, x, y float64)
- LineTo(c *Canvas, x, y float64)
- SetStrokeColor(c *Canvas, col color.Color)
- SetFillColor(c *Canvas, col color.Color)
- SetLineWidth(c *Canvas, w float64)
- Stroke(c *Canvas)
- FillStroke(c *Canvas)
- Fill(c *Canvas)
- ClearRect(c *Canvas, x1, y1, x2, y2 int)
- SaveToPNG(c *Canvas, filename string)
- Width(c *Canvas)
- Height(c *Canvas)

These operations are logically related: they are the things you can do to a Canvas

They are functions called “methods”.

They all take a *Canvas as their first parameter.

Go provides a special syntax for this situation (next slide)

Go's Method Syntax

- Same as a function definition, with one addition:

Move the logical "first" parameter to before the name of the function

```
func (c *Canvas) SetStrokeColor(col color.Color) {
    c.gc.SetStrokeColor(col)
}
```

Can use "c" just like any other parameter

- Now use "dot" syntax to call the method:

```
var pic *Canvas = MakeCanvas()
pic.SetStrokeColor(blue)
```

What's the Point?

- Logically groups operations with the data they operate on
- Supports the "noun" / "verb" way of designing programs directly
- Let's you use the same function name for different object types:
  - (c *Canvas) Draw()
  - (b *Button) Draw()

are different functions.

Method Summary

- Methods are functions that are associated with a type.

- If you have a variable X, you can call any of its methods using:

```
X.methodName(param1, param2)
```

  This works like a normal function call.

- This is “object-oriented programming”

Object-Oriented Design Summary

- Create types for the things your program will manipulate
- Write methods for each of those types that perform the operations on those things that you will need.
- Use those methods to solve the tasks you are aiming to solve.