# Lecture 7: Lists

# Iterating over functions

So far:

```
set.seed(45)

# Simulate from a N(0,1)
assess_coverage(n = 100, nsim = 1000, beta0 = 0.5, beta1 = 1,
                noise_dist = rnorm)
```

```
[1] 0.949
```

```
# Simulate from Exp(1)
assess_coverage(n = 100, nsim = 1000, beta0 = 0.5, beta1 = 1,
                noise_dist = rexp)
```

```
[1] 0.96
```

```
# Simulate from chisquare(1)
assess_coverage(n = 100, nsim = 1000, beta0 = 0.5, beta1 = 1,
                noise_dist = function(m) {return(rchisq(m, df=1))})
```

```
[1] 0.946
```

What if I want to simulate from *many* distributions?

# Idea

- have something like a vector / list of functions

  rnorm  rexp  function(n) { ... }

- iterate thrugh the functions for noise_dist

```
for (i in ....){
    assess_coverage( ...., noise_dist = )
}
```

Creating a vector:

```
x <- c(0,1,2)

x <- c("a","b","c")
```

Want #s 1, ..., 10:

```
x <- c(0,1,2,3,4,5,6,7,8,9,10)
```

or

```
x <- seq(from=0, to=10, by=1)
```

or

```
x <- 0:10
```

```
for(i in (1:100)){
```

← creating 1, 2, 3, ..., 100

do something for each entry in this vector

# Vectors revisited

Vectors can contain numbers, booleans, characters, etc:

```
1 x <- c(0, 1, 2)
2 x
```

```
[1] 0 1 2
```

```
1 typeof(x)
```

```
[1] "double"
```

```
1 x <- c("a", "b", "c")
2 x
```

```
[1] "a" "b" "c"
```

```
1 typeof(x)
```

```
[1] "character"
```

The `typeof` function tells what *type* of object we have

# Vectors of multiple types?

```r
x <- c(0, 1, "a")
x
```

```
[1] "0" "1" "a"
```

```r
x[1] + 1
```

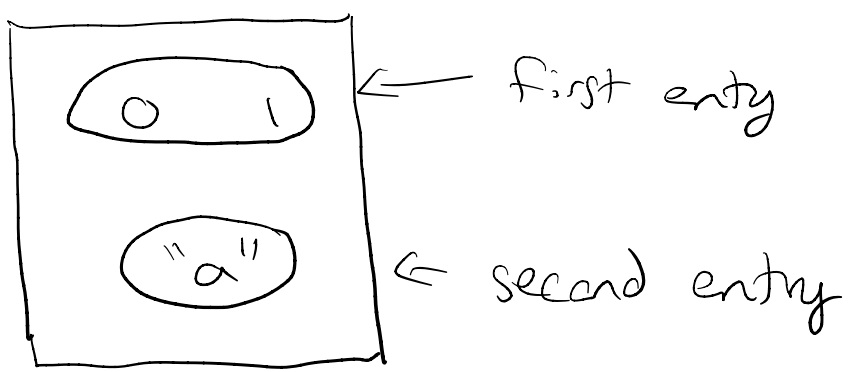
```
Error in x[1] + 1: non-numeric argument to binary operator
```

Basic vectors (called *atomic* vectors) only contain one type.

# Lists

```
1  x <- list(c(0, 1), "a")
2  x
```

```
[[1]]
[1] 0 1

[[2]]
[1] "a"
```



# Lists

```
1 x <- list(c(0, 1), "a")
2 x
```

```
[[1]]
[1] 0 1

[[2]]
[1] "a"
```

x[1]

[[1]]

[1] 0 1

```
1 x[[1]]
```

```
[1] 0 1
```

```
1 x[[1]][1]
```

```
[1] 0
```

x list

x[[1]] first entry of x

(in this case, x[[1]] is a vector)

↳ x[[1]] [1]

vector first entry of that vector

# Lists

```r
x <- list(c(0, 1), "a")
x
```

```
[[1]]
[1] 0 1

[[2]]
[1] "a"
```

```r
x[[1]]
```

```
[1] 0 1
```

```r
x[[1]][1]
```

```
[1] 0
```

```r
typeof(x[[1]])
```

```
[1] "double"
```

```r
x[[2]]
```

```
[1] "a"
```

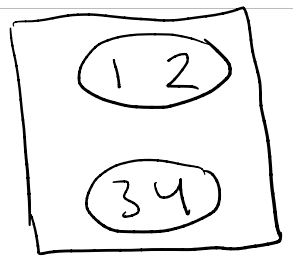
```r
typeof(x[[2]])
```

```
[1] "character"
```

# Visualizing list structure

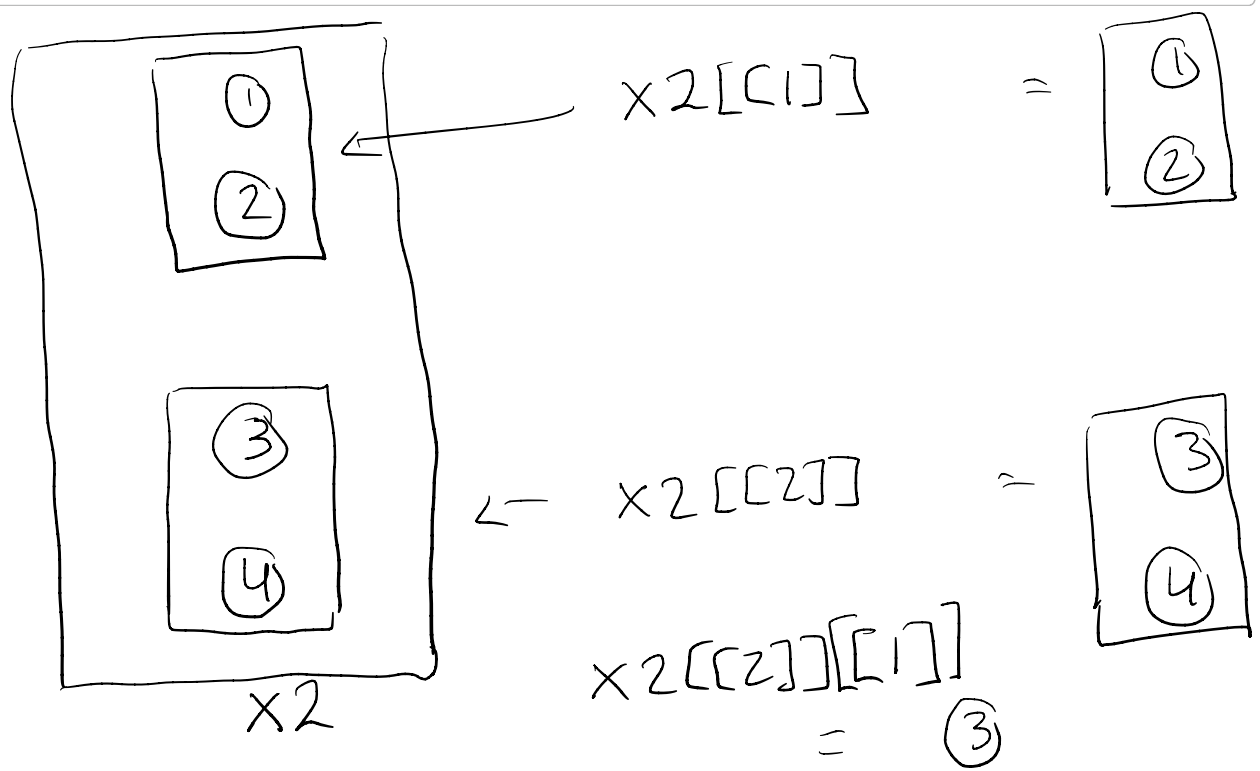
```
1  x1 <- list(c(1, 2), c(3, 4))
2  x1
```

```
[[1]]
[1] 1 2


[[2]]
[1] 3 4
```

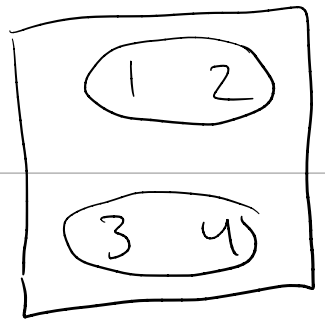



```
1  x2 <- list(list(1, 2), list(3, 4))
2  x2
```

```
[[1]]
[[1]][[1]]
[1] 1

[[1]][[2]]
[1] 2



[[2]]
[[2]][[1]]
[1] 3

[[2]][[2]]
[1] 4
```



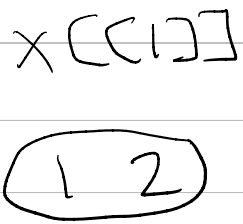
# Indexing lists





```
x <- list(c(1, 2), c(3, 4))

x[1]
```

```
[[1]]
[1] 1 2
```




```
typeof(x[1])
```

```
[1] "list"
```

```
x[[1]]
```

```
[1] 1 2
```

```
typeof(x[[1]])
```

```
[1] "double"
```

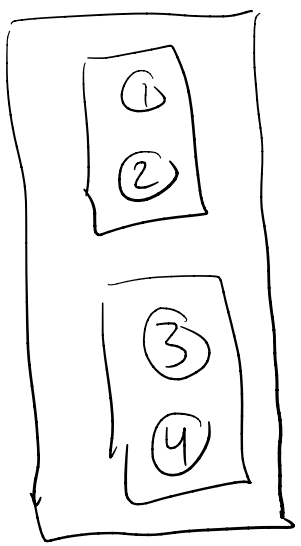
- `x[1]` returns a *list* which contains the first component of x
- `x[[1]]` returns the object stored in the first component

x[[1]][2] → 2

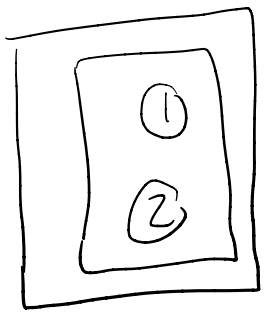
# Indexing lists

```
1  x <- list(list(1, 2), list(3, 4))
2  x[1]
```

**Question:** What will `x[1]` return?







# Indexing lists

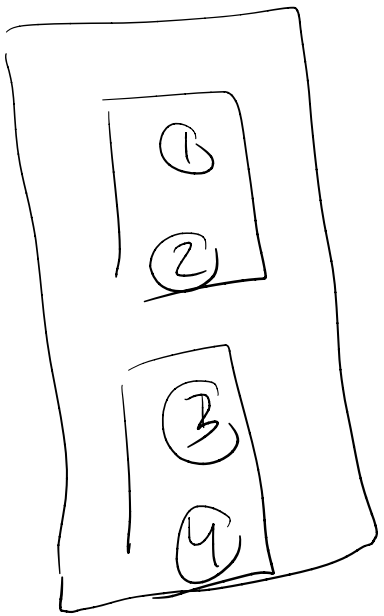
```
1  x <- list(list(1, 2), list(3, 4))
2  x[1]
```

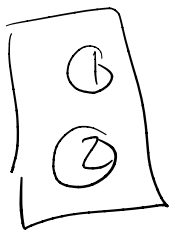
```
[[1]]
[[1]][[1]]
[1] 1

[[1]][[2]]
[1] 2
```

# Indexing lists

```
1  x <- list(list(1, 2), list(3, 4))
2  x[[1]]
```

**Question:** What will `x[[1]]` return?



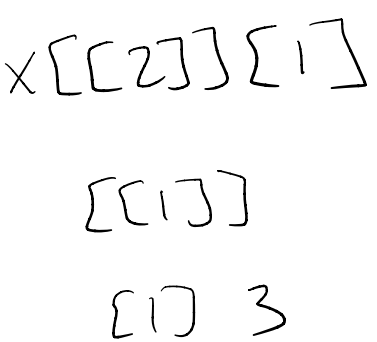



# Indexing lists

```
1 x <- list(list(1, 2), list(3, 4))
2 x[[1]]
```

```
[[1]]
[1] 1

[[2]]
[1] 2
```

**Question:** How do I get just the 3?




# Indexing lists

```
1 x <- list(list(1, 2), list(3, 4))
2 x[[2]][[1]]
```

```
[1] 3
```

# Vectors of functions?

## Can we make a vector of *functions*?

```
1  x <- c(rexp, rnorm, function(m) {return(rchisq(m, df=1))})
2  x
```

```
[[1]]
function (n, rate = 1)
.Call(C_rexp, n, 1/rate)
<bytecode: 0x7fd50901b778>
<environment: namespace:stats>

[[2]]
function (n, mean = 0, sd = 1)
.Call(C_rnorm, n, mean, sd)
<bytecode: 0x7fd508c3e718>
<environment: namespace:stats>

[[3]]
function(m) {return(rchisq(m, df=1))}
```

# Lists of functions

```
1  x <- list(rexp, rnorm, function(m) {return(rchisq(m, df=1))})
2  x[1]
```

```
[[1]]
function (n, rate = 1)
.Call(C_rexp, n, 1/rate)
<bytecode: 0x7fd50901b778>
<environment: namespace:stats>
```

```
1  x[1](10)
```

```
Error in eval(expr, envir, enclos): attempt to apply non-function
```

**Question:** Why does this cause an error?

x[1] list

x[[1]] function

# Lists of functions

```
1 x <- list(rexp, rnorm, function(m) {return(rchisq(m, df=1))})
2 x[[1]]
```

```
function (n, rate = 1)
.Call(C_rexp, n, 1/rate)
<bytecode: 0x7fd50901b778>
<environment: namespace:stats>
```

```
1 x[[1]](10)
```

```
 [1] 1.24406908 0.07592609 0.57794348 1.02337796 0.43257139 0.73254842
 [7] 1.28476853 1.47824260 1.50658414 1.71665563
```

# Iterating over functions

```r
set.seed(45)

noise_dists <- list(rnorm, rexp,
                    function(m) {return(rchisq(m, df=1))})
ci_coverage <- rep(NA, length(noise_dists))

for(i in 1:length(noise_dists)){
  ci_coverage[i] <- assess_coverage(n = 100, nsim = 1000,
                                    beta0 = 0.5, beta1 = 1,
                                    noise_dist = noise_dists[[i]])
}

ci_coverage
```

```
[1] 0.949 0.960 0.946
```

# Class activity

https://sta279-f23.github.io/class_activities/ca_lecture_7.html