




## Week 5: *Iteration*

 EMSE 4571 / 6571: Intro to Programming for Analytics

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# Quiz 4

10:00

Write your name on the quiz!

## Rules:

- Work alone; no outside help of any kind is allowed.
- No calculators, no notes, no books, no computers, no phones.

# Common problems in homeworks

Use `all.equal()` in test cases with numbers

This could fail:

```
stopifnot(getTheCents(2.45) == 45)
```

Instead, use:

```
stopifnot(all.equal(getTheCents(2.45), 45))
```

# Common problems in homeworks

## Check your full script for errors

- Restart R and run your whole code from the top
- **Sequence matters:** Have you called a function before defining it?

# Read homework feedback on Box

Go to [box.com](https://box.com)

Search for folder named [netID-p4a](#) (e.g., [jph-p4a](#))

The tricky `isNumericLooking(n)` problem

# Week 5: *Iteration*

1. for loops

2. breaking and skipping

**BREAK**

3. while loops

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# "Flow Control"

Code that alters the otherwise linear flow of operations in a program.

Last week:

- `if` statements
- `else` statements

This week:

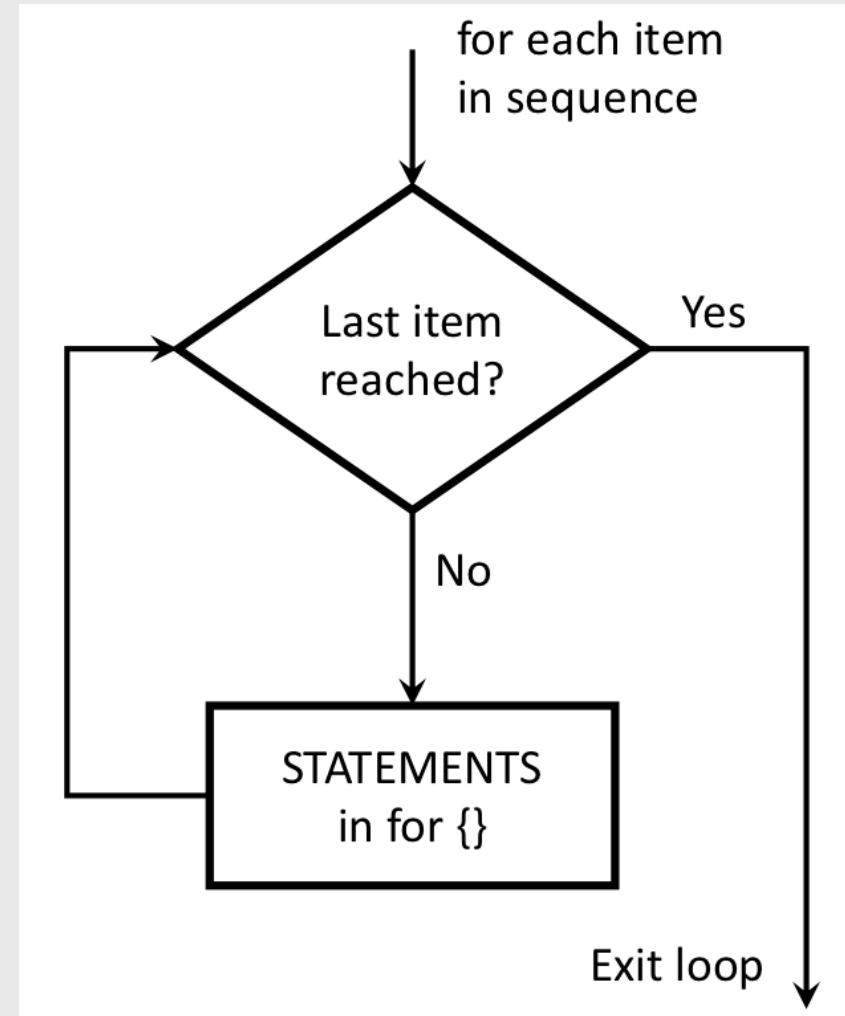
- `for` loops
- `while` loops
- `break` statements
- `next` statements

# The `for` loop

Basic format:

```
for (item in sequence) {  
    # Do stuff with item  
  
    # Loop stops after last item  
}
```

Flow chart:



# Making a sequence

(Side note: these are vectors...that's next week - read ahead!)

Two ways to make a sequence:

1. Use the `seq()` function

```
seq(1, 10)
```

```
#> [1] 1 2 3 4 5 6 7 8 9 10
```

```
seq(1, 10, by = 2)
```

```
#> [1] 1 3 5 7 9
```

2. Use the `:` operator (step size = 1)

```
1:10
```

```
#> [1] 1 2 3 4 5 6 7 8 9 10
```

```
10:1
```

```
#> [1] 10 9 8 7 6 5 4 3 2 1
```

# Quick code tracing

What will this function print?

```
for (i in 1:5) {  
  if ((i %% 2) == 0) {  
    cat('--')  
  } else if ((i %% 3) == 0) {  
    cat('----')  
  }  
  cat(i, '\n')  
}
```

# Quick code tracing

What will this function print?

```
n <- 6
for (i in seq(n)) {
  cat('|')
  for (j in seq(1, n, 2)) {
    cat('*')
  }
  cat('|', '\n')
}
```

# Your turn

1) `sumFromMToN(m, n)`: Write a function that sums the total of the integers between `m` and `n`.

**Challenge:** Try solving this without a loop!

- `sumFromMToN(5, 10) == (5 + 6 + 7 + 8 + 9 + 10)`
- `sumFromMToN(1, 1) == 1`

2) `sumEveryKthFromMToN(m, n, k)`: Write a function to sum every `k`th integer from `m` to `n`.

- `sumEveryKthFromMToN(1, 10, 2) == (1 + 3 + 5 + 7 + 9)`
- `sumEveryKthFromMToN(5, 20, 7) == (5 + 12 + 19)`
- `sumEveryKthFromMToN(0, 0, 1) == 0`

3) `sumOfOddsFromMToN(m, n)`: Write a function that sums every *odd* integer between `m` and `n`.

**Challenge:** Try solving this without a loop!

- `sumOfOddsFromMToN(4, 10) == (5 + 7 + 9)`
- `sumOfOddsFromMToN(5, 9) == (5 + 7 + 9)`

# Week 5: *Iteration*

1. for loops

2. **breaking and skipping**

**BREAK**

3. while loops



# Breaking out of a loop

Force a loop to stop with `break`

**Note:** `break` doesn't require `()`

```
for (val in 1:5) {  
    if (val == 3) {  
        break  
    }  
    cat(val, '\n')  
}
```

```
1  
2
```



# Quick code tracing

What will this code print?

```
for (i in 1:3) {  
  cat('|')  
  for (j in 1:5) {  
    if (j == 3) {  
      break  
    }  
    cat('*')  
  }  
  cat('|', '\n')  
}
```

# Skipping iterations

Skip to the next iteration in a loop with `next`

**Note:** `next` doesn't require `()`

```
for (val in 1:5) {  
    if (val == 3) {  
        next  
    }  
    cat(val, '\n')  
}
```

```
1  
2  
4  
5
```

# Quick code tracing

What will this code print?

```
for (i in 1:3) {  
  cat('|')  
  for (j in 1:5) {  
    if (j == 3) {  
      next  
    }  
    cat('*')  
  }  
  cat('|', '\n')  
}
```

# Your turn

`sumOfOddsFromMToNMax(m, n, max)`: Write a function that sums every *odd* integer from `m` to `n` up until the sum is less than or equal to the value `max`.

Your solution **must** use both `break` and `next` statements.

- `sumOfOddsFromMToNMax(1, 5, 4) == (1 + 3)`
- `sumOfOddsFromMToNMax(1, 5, 3) == (1)`
- `sumOfOddsFromMToNMax(1, 5, 10) == (1 + 3 + 5)`

# *Intermission*

05:00

# Week 5: *Iteration*

1. for loops

2. breaking and skipping

BREAK

3. **while loops**

## Lame joke time:

A friend calls her programmer roommate and said, "*while* you're out, buy some milk"...

...she never returned home.

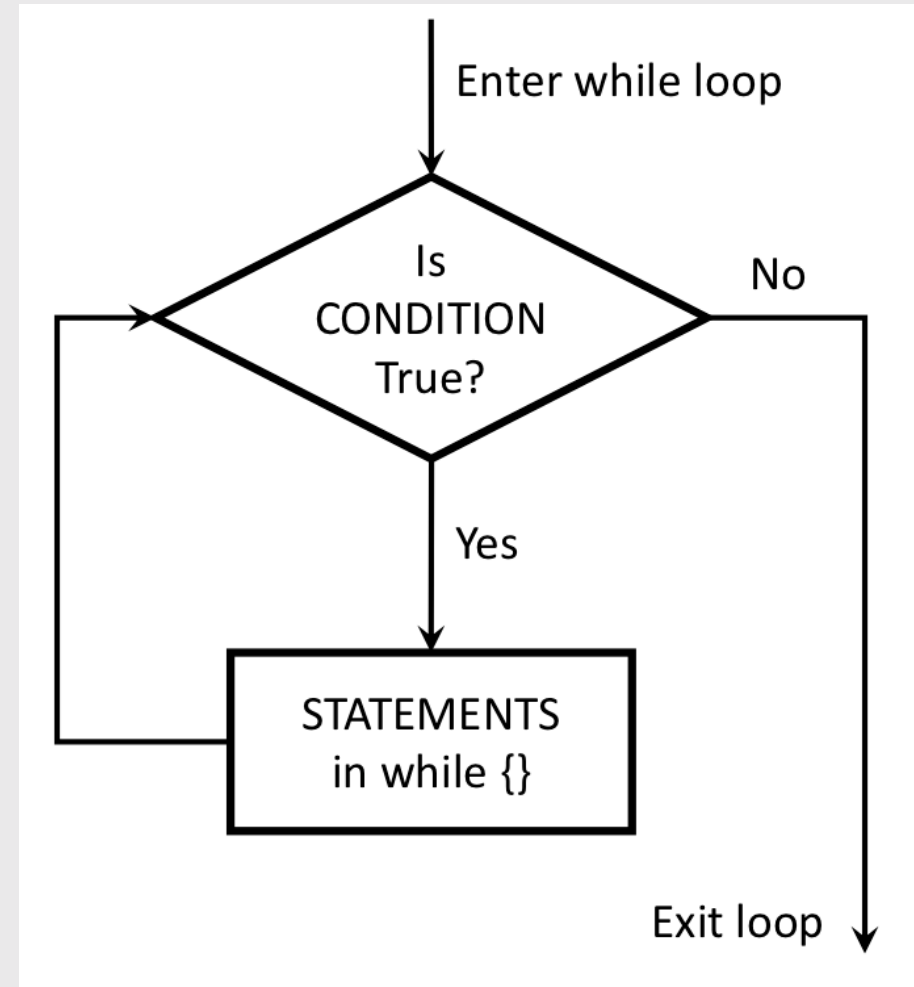


# The `while` loop

Basic format:

```
while (CONDITION) {  
    # Do stuff here  
  
    # Update condition  
}
```

Here's the general idea:



# Quick code tracing

02:00

Consider this function:

```
f <- function(x) {  
  n <- 1  
  while (n < x) {  
    cat(n, '\n')  
    n <- 2*n  
  }  
}
```

What will this code print?

```
f(5)  
f(10)  
f(50)  
f(60)  
f(64)
```



# for vs. while

Use **for** loops when the number of iterations is **known**.

1. Build the sequence
2. Iterate over it

```
for (i in 1:5) { # Define the sequence
  cat(i, '\n')
}
```

```
#> 1
#> 2
#> 3
#> 4
#> 5
```

Use **while** loops when the number of iterations is **unknown**.

1. Define stopping condition
2. Iterate until condition is met

```
i <- 1
while (i <= 5) { # Set stopping condition
  cat(i, '\n')
  i <- i + 1 # Update condition
}
```

```
#> 1
#> 2
#> 3
#> 4
#> 5
```

# Mystery Function

What does this function do?

(You can assume that `n` is a number)

```
mystery_function <- function(n) {  
  if (n == 0) {  
    cat(0)  
  }  
  n <- abs(n)  
  while (n > 0) {  
    cat(n %% 10, '\n')  
    n <- n %/% 10  
  }  
}
```

# Your turn: Write functions

In your practice file, you have the solution for the function `isPositiveEven(n)`, which returns `TRUE` if `n` is a positive even number and `FALSE` otherwise.

- `isPositiveEven(1) == FALSE`
- `isPositiveEven(4) == TRUE`
- `isPositiveEven(7) == FALSE`
- `isPositiveEven(28) == TRUE`
- `isPositiveEven(-1) == FALSE`
- `isPositiveEven(-2) == FALSE`

Your job is to write `nthPositiveEven(n)`:

A function that returns the `n`th positive even integer in the sequence of all positive even numbers

- `nthPositiveEven(1) == 2`
- `nthPositiveEven(2) == 4`
- `nthPositiveEven(3) == 6`
- `nthPositiveEven(4) == 8`
- `nthPositiveEven(5) == 10`
- `nthPositiveEven(6) == 12`

# Your turn

`isPrime(n)`: Write a function that takes a non-negative integer, `n`, and returns `TRUE` if it is a prime number and `FALSE` otherwise. Here's some test cases:

- `isPrime(1) == FALSE`
- `isPrime(2) == TRUE`
- `isPrime(7) == TRUE`
- `isPrime(13) == TRUE`
- `isPrime(14) == FALSE`

`nthPrime(n)`: Write a function that takes a non-negative integer, `n`, and returns the `n`th prime number, where `nthPrime(1)` returns the first prime number (2). Hint: use the function `isPrime(n)` as a helper function!

- `nthPrime(1) == 2`
- `nthPrime(2) == 3`
- `nthPrime(3) == 5`
- `nthPrime(4) == 7`
- `nthPrime(7) == 17`

# HW 5

- Trickier turtles
- Read about [Happy Numbers](#)