11/29/2020
Notes

Last class of the semester.

Let's continue the loops.
While loop:
```
x<- 1
while(x<=10){
print(x)
x<-x+1          you need to update x or else the loop while never end
}
```

```
for(i in 1:10){
if(i==3){
Next      so if x is 3 it will skip this iteration and print out 1 2 4 5 6 7 8 910
}
print(i)
}
```

```
for(i in 1:10){
if(i==3){
break      so if x is 3 it will stop and end the loop and print out 1 2
}
print(i)
}
```

This is a very long and complex function and with the Sys.time calls, it can find out how long it takes to run it
```
t<-Sys.time()
x<-0
for(i in 1:1000000){
x<-x+i^2
}
Sys.time() -t
```

Avoid using nested looping in R as it will take a long time to run
```
Example: for(i in 1:10){
            for(j in 1:10){
            print(i+j)}}
```

Question: In the first homework, we tried to calculate the sum of all digits of a given number. However, we only did that for numbers having up to 4 digits. Use loops to build a function to calculate the sum of digits for any number. (nchar() returns the number of digits)

```
sum_of_digits1<-function(x){
sum<- 0
for(i in 1:ncharx){
Sum <- sum + x%/%10^{i-1}%%10
}
return(sum)
}
```

sum(x%/%10^seq(0,nchar(x)-1)%%10)

Program
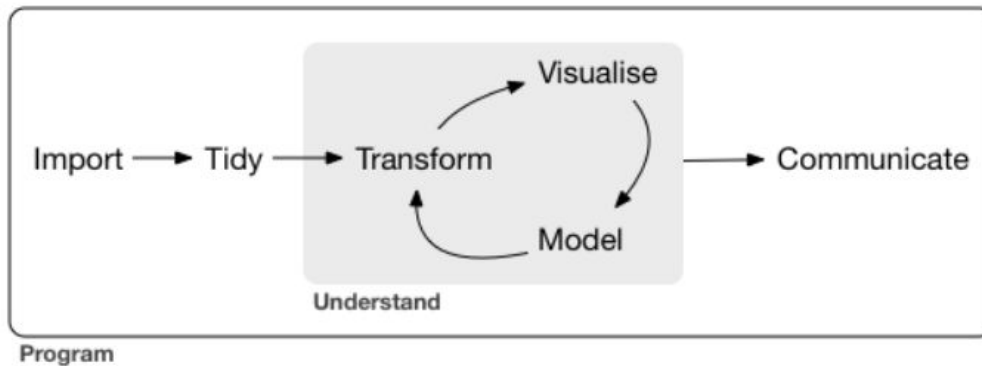
This is how you can use R for data science.

Causal inference
 Using the kidney data
```
ggplot(kidney)+
geom_bar(aes(x=treatment,fill=result),position="fill")+
facet_wrap(~size)
```
This shows the treatment rate of each treatment with each stone size.
When you break down the rates for each size and then overall, it gives complicated information.
That's what sometimes happens when you have too many variables and information. You might get opposite conclusions.

Association does not necessarily imply causation
Difference between causation and association

Casual interference = A comparison between potential outcomes under treatment and control for the same units → what if X?
1. What would happen to the stones if the patient received treatment A instead of B?
2. What would happen to unemployment if the government increased minimum wages?
3. What would your life be like if you did not accept UMass?

Why is causal inference important?
Any decision and action requires causal inference → different from passive observation and prediction.

A causal effect is defined to be the comparison of the potential outcomes on the same units.
Individual causal effect: $Y_i(A)-Y_i(B)$ This is difficult to estimate
Average causal effect (ACE): $mean(Y_i(A)-Y_i(B))$