Due Date: January 23rd, 2020.
Problems due: 3,4

1. Finish the inclass worksheet.
2. Evaluate the following by hand and check your results in R

```
> 5 | 4
> !3
> x = c(0, 5, 3, 7); y = c(0, 2, 8, 7); u = x[(x>y) & (x>4)];u
> A = matrix(1:8,nrow=2)
> B = matrix(1,6,7)
```

3. Write the R statements that use a loop and the print command to produce the following table(the format of the numerical values should agree exactly with those printed in the table):

theta	sin(theta)	cos(theta)
0	0.0000	1.0000
60	0.8660	0.5000
120	0.8660	-0.5000
180	-0.0000	-1.0000

4. `myage`
   (a) Write down a function `myage`, that returns your age in years.
   (b) Extend the above `myage` function with an optional input argument, `onDate`, can be provided for testing. Your program should correctly compute your age on the following test dates:
      i. The day you first encountered Siva.
      ii. One day before your first birthday.
      iii. On the day the assignment is due: January, 23rd, 2020.

   Hint: you may use built-in as.Date function
   (c) Extend the `myage` function developed so far in the preeceding problem to provide an optional return of the months and days since you were born.
5. *Extra Credit*[1]
   (a) (*R and Floating point number line*) In a file called EC23102020.Rnw, write a note that explains double precision Floating point number line and all the issues that come with it including that identified in Problems 5 and others such as numbers missed, machine precision etc.
   (b) (*p-nary expansions*) Consider the sequence of real numbers $\{a_k\}_{k\geq 1}$ such that $a_k \in \{0, 1, 2\}$.
      i. Show that $T_n = \sum_{k=1}^{n} \frac{a_k}{3^k}$ converges to a real number $x \in [0, 1]$. We will say in such a case $x \leftrightarrow \{a_k\}_{k\geq 1}$.
      ii. Define
      $$C = \{x \in [0, 1] : x \leftrightarrow \{a_k\}_{k\geq 1} \text{ with } a_k \in \{0, 2\}\}$$
      Describe $C^c \cap [0, 1]$ as a union of disjoint open intervals.
      iii. Show that for any $x, y \in C$ there exists a $r \notin C$ such that $x < r < y$.
      iv. Show that C is closed with no isolated points.
      v. Show that Cardinality(C) = Cardinality$([0, 1])$

   We have produced as set $C \subset [0, 1]$ with the same cardinality of $[0, 1]$ and it is compact, nowhere dense, totally disconnected, with no isolated points. *Ofcourse this should be the famous set ?*
   (c) Can you generalise (b) by changing 3 with any other number $p \geq 4$?

[1] These are not part of the credit towards this Homework. You may attempt any of them as you feel appropriate and you can discuss solutions with me before writing it up. Selected solutions will be posted on the course website. If attempted with enthusiasm and solutions given precisely then I will bake a chocolate cake at the end of the semester for the class.