Meeting 22 Notes

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Questions of Rationality

Summary of Meeting #21

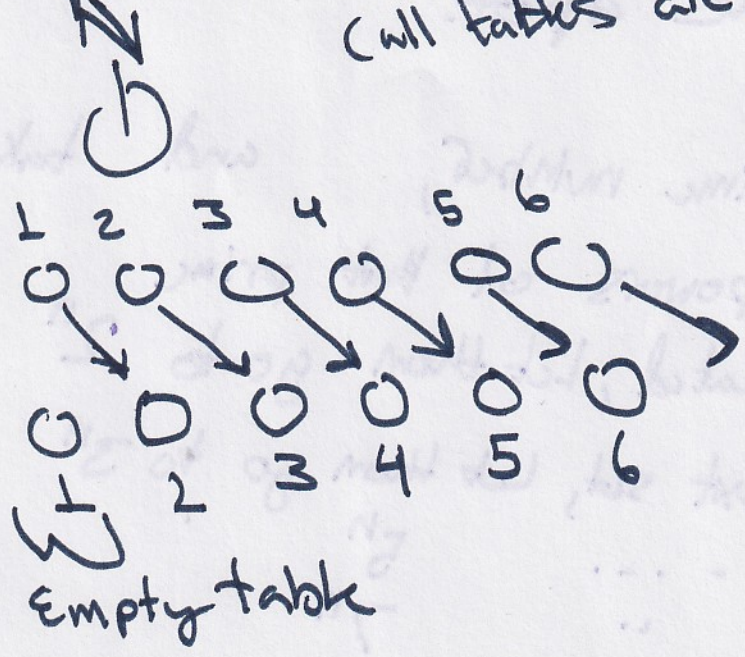
- The fundamental Theorem of Calculus describes the relationship between derivatives and Integrals

Bijection: A function $f: X \to Y$ that is one-to-one and onto.

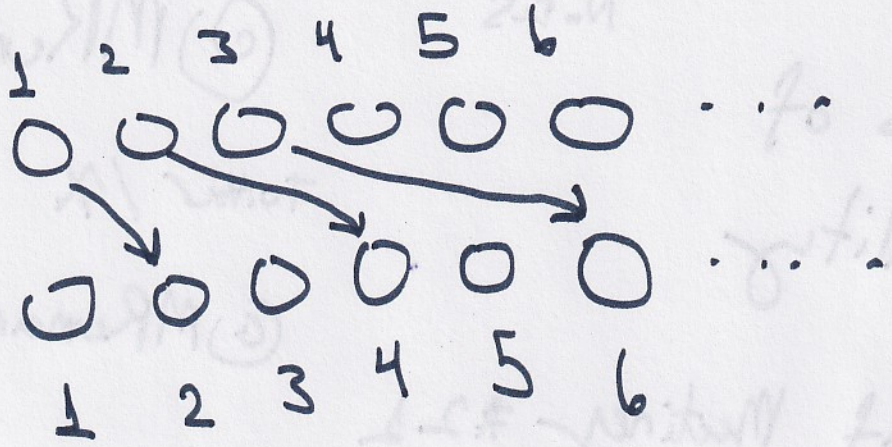
Cardinality: the number of elements in a set.

#1) population of the restaurant is infinity (all tables are filled)

a)



b) N is unbounded

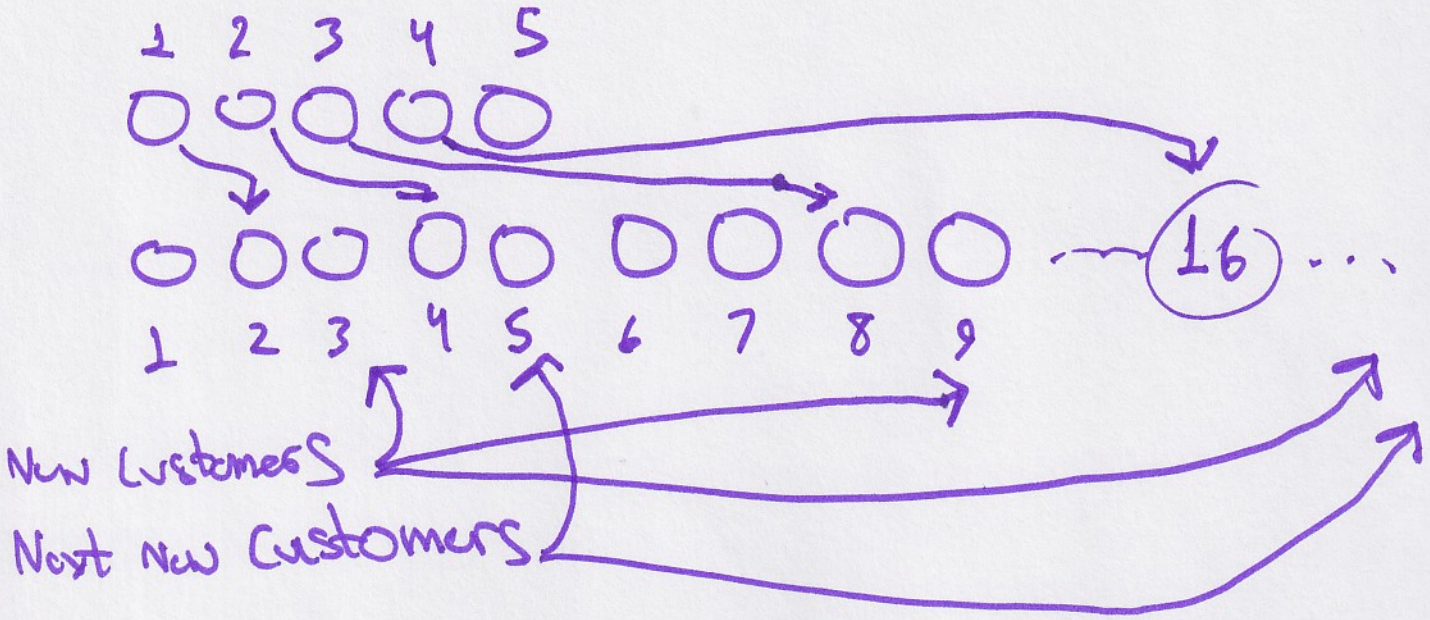


Now we have N free tables and still accommodate our current N tables

c) N groups of N parties come in and request tables. Can they all be accommodated? Why or Why Not?

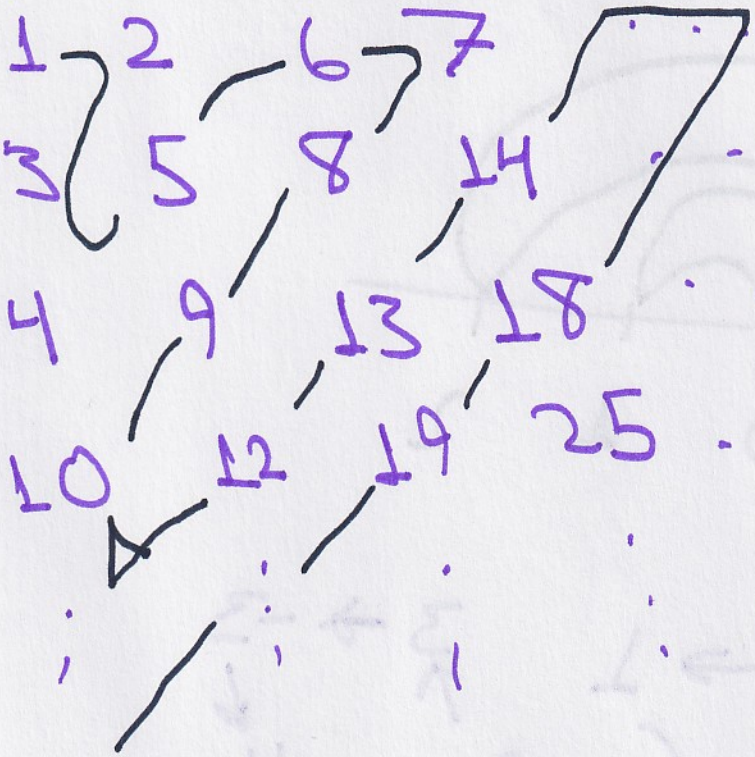
We want to make sure no one is going to the same spot.

take a prime number, and take sequential powers of that prime
For those seated, Let them go to 2^n
For the next set, Let them go to 3^n
5^n
7^n


1 2 3 4 5
16
1 2 3 4 5 6 7 8 9
New Customers
Next New Customers

There are some paradoxes with infinity

#2 Here's an (infinite) table with natural numbers. Are all of the natural numbers listed in this table? Why or why not?



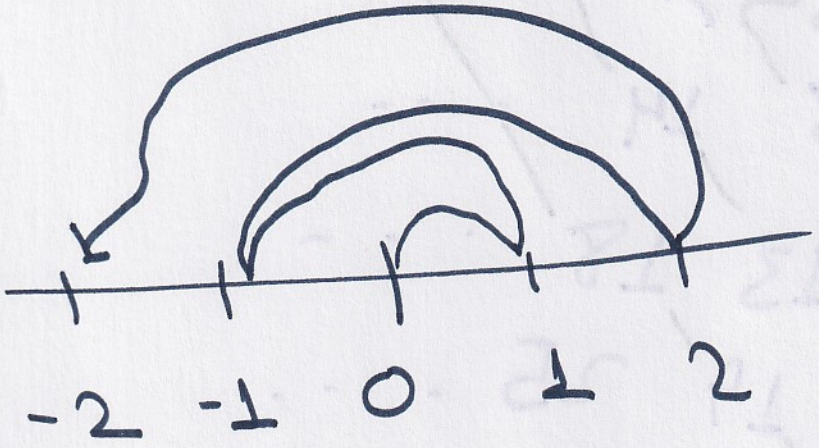
Countable: There is a bijection between set A and $\mathbb{N}$

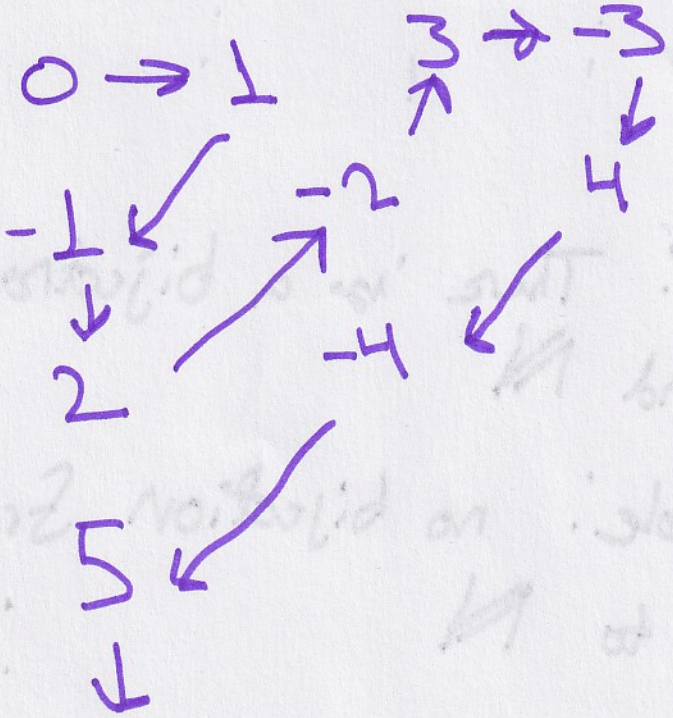
Uncountable: no bijection from set A to $\mathbb{N}$

Seems to be one to one and onto

#3 Consider the table in prompt 2

a) is it possible to fill the same table with Integers ($\mathbb{Z}$) ~~rather~~ rather than natural numbers

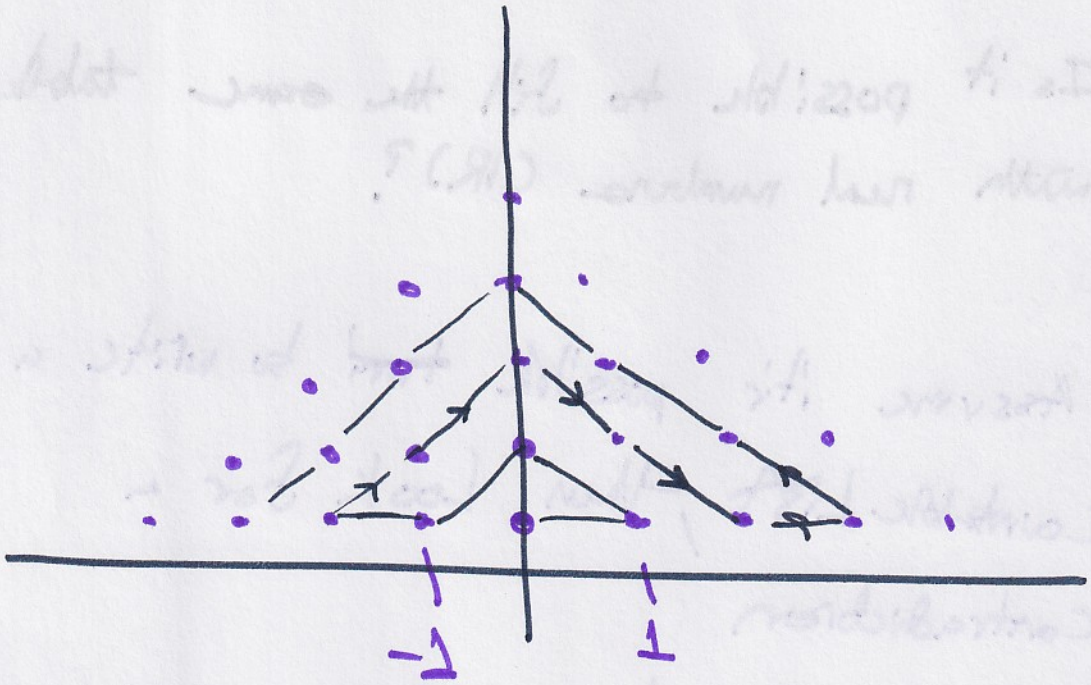




we can't start at $\mathbb{N}$

can't go to an infinite direction before going into another direction

b) Is it possible to fill the same table with rational numbers ($\mathbb{Q}$)?



we will hit all rational numbers eventually but we will have <u>duplicates</u>

which means we don't have bijection from $\mathbb{N}$ to $\mathbb{Q}$

So it would be uncountable

6 Is there an algorithm where we don't count the duplicates

Throw away the duplicates, so it's countable but there is no bijection

() Is it possible to fill the same table with real numbers (IR)?

Assume it's possible to write a countable List, then Look for a contradiction

you can construct a number that's not on the list.

Constructing an irrational number from irrational numbers)

A 'complete' List of irrational numbers are not complete because we can construct a new irrational number that isn't on the list.

#4) True or false:

The cardinality of the set $(0,1)$, is equal to the set $(1,\infty)$

$$f(0,1) \longrightarrow (1,\infty)$$

$$y = \frac{1}{x}?$$

We can say there's a bijection of $(0,1)$ to $(1,\infty)$

The set sizes are different, but there is a bijection.

So it's True