# Week 3 Sequences and Series Lecture Note

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| **Cornell Notes** | **Topic:**<br><br>Sequences and Series | Course: BSc Computer Science<br><br>Class: Computational Mathematics[Lecture]<br><br>Date: May 01, 2020 |

**Essential Question:**

What are sequences?

**Questions/Cues:**

- What is a geometric sequence?
- What is an arithmetic sequence?
- What is the formal definition of a sequence?
- What is the Fibonacci Sequence?

Notes

- Geometric Sequence = has the property that the ratio between a value in the sequence and its previous value is constant, it can any number $q$ with $a$ being the initial value of the sequence. The general form of a geometric sequence is as followed:


- Arithmetic sequence = has the property where the nth term in the sequence is the sum of the previous term before it and a constant number $q$. In other words, the difference between each element of the sequence and its previous is constant.

## What is a sequence?

- Formal definition: given a set $X$ a sequence is a function $a: \mathbb{N} \to X$
  i.e. a set $a(0), a(1) \ldots a(n) \ldots$ denoted with $\{a_n\}_{n \in N}$

- Can be defined explicitly $a_n = f(n)$
  example: $a_n = 2n+1 \rightarrow 1,3,5,7,9\ldots$

- or by recursion i.e. $a_n = f(a_{n-1}, \ldots a_{n-k})$
  example 1: *Arithmetic sequence* $a_n = q + a_{n-1}$
  $\rightarrow a_0, a_0+q, a_0+2q, \ldots \rightarrow a_n = n \times q + a_0$
  example 2: *Geometric sequence* $a_n = q \times a_{n-1}$
  $\rightarrow a_0, a_0 q, a_0 q^2, a_0 q^3 \ldots a_0 q^n \ldots \rightarrow a_n = a_0 \times q^n$

- A sequence is said to be convergent, when upon increasing $n$ it approaches a finite constant value

$$\lim_{n \to \infty} a_n = L < \infty$$

  example: geometric seq. $q<1 \rightarrow q=1/2$
  1/2,1/4,1/8……1/64,…. converges to 0

- A sequence is said to be divergent when increasing $n$ it never reaches a constant finite value (either goes to $\infty$ or oscillates)
  example: geometric seq. $q>1 \rightarrow q=2$
  2,4,8,16,32,….256,…

## Examples:Fibonacci Sequence

- Definition by recursion: $a_0=0$, $a_1=1$, $a_n = a_{n-1} + a_{n-2}$
- 0,1,1,2,3,5,8,13,21,34,55,89,144….
- $\frac{a_n}{a_{n-1}} \rightarrow \varphi = \frac{1+\sqrt{5}}{2} = 1.618\ldots$ Golden Ratio

### Summary

In this week, we learned about what a sequence is and the two different kinds of sequences, Geometric and Arithmetic. Finally, in the end we look at a famous example of a sequence called the Fibonacci Sequence.