

# Week Omega: Rap/Poem

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Theory of Computation

Let me tell you how it be

Struggling week from week

Escape, that's a fantasy

Three, One, O, Two

There's just too much to do

It's an adventure with my cohort

Trying to learn content in time that is so short

Discrete helped with me with proofs and sets

Surjective, Injective, Bijection, all that I do get

Take input, Produce Output, that how you Compute

Making computation efficient, that's this class's root

We think about infinity, countability, and complexity

Manipulating bits and strings with so much dexterity

One-to-one mapping from  $S$  to  $N$ , make its countable

Just don't forget that Zero a natural number, and any problem is surmountable

So many options for modeling computers that I was taught

Let's start with ANDs, ORs, and NOTs

Straight Line programs that use logic

Substitute with NANDS, that's an equivalency that seems like magic

Use logical gates in a boolean circuit

$n$  inputs,  $m$  outputs, and  $s$  gates, we'll work it

That's a directed acyclic graph

Graphs? There is so much to this other half

Vertices and edges, graphs help with abstraction

In computing, representation and execution are the main attraction

Wires carry values and nodes are labelled by operation

From this, new functions and languages can come into creation

Its sweet and beautiful, that syntactic sugar  
Easier to program, but our computation limit is not any bigger  
LOOKUP and EVAL, now things are getting harder  
Soon our computation limit will go farther

Convert your program into bits  
Stick around, things get difficult but refuse to call quits  
We'll talk about costs and asymptotic operators  
Measuring complexity and behaviors, they are great indicators

Alert: there's a new model of computing  
Finite state automata and regular expression are awaiting  
We are beyond finite functions and parameter limits  
This is the real deal, no more gimmicks

Initial state, final states, and transition functions are the formalization  
DFAs and NFAs to suit all your occasions  
You can describe languages with regular expressions  
But recall that FSAs are an equally powerful possession

Nondeterminism allows us to split reality  
Moving in parallel with multiple states, it lives a life carefree  
Powerset construction to prove NFA = DFA  
How about we learn about the most powerful model? What do you say?

Turing machines!  
Their power is simply obscene  
With memory and the capacity for infinity  
Be careful though, with busy beavers it may run for eternity

It can read, write, and do all we can  
Uncomputable numbers, we need a concrete plan  
Self-reject, acceptance, and HALT — so many more problems  
Proof by reduction make it easier even when we can't solve em

If after all that, your brain isn't fried,  
There's a final problem not yet tested but many tried  
Prove NP does not or does equal P  
Then glory, fame, and money is all you will see

In this class, it's clear you will learn a lot  
Truthfully there is no concern to be distraught  
With the guidance of Nate and Dave  
You only need to be slightly brave