Scribe Notes for
Wednesday, September 22nd

- We reviewed the rules for making a Thue translation.
- We then took a quiz on Thue translations and grammar trees
- David presented :

<u>How to represent the Halting Problem using Thue's word problem</u>

--Review of what Haltcrazy is:

Halt(P,P) checks if a program stops
Haltcrazy(P) runs forever if P stops, and stops if P runs forever.

Halt(Haltcrazy, Haltcrazy) causes a problem, since it is not computable.

-- Review of a Thue Word Problem

There is a word:
$q_1q_2q_3q_4$

and a set of rules:
$q_1q_2 <=> q_2q_1$

and we want to know if we can use the rules to change the original word into a new word like for example:
$q_2\ q_1q_3q_4$

Thue claims that with a given set of rules, we can determine wether a word can be made into another. That is what is called a Word problem. We know that Halt doesn't always work, so if we can transpose it into a Thue problem, we'll know that we can't always find out if a Thue transformation is possible or not.

First, a word is made up of 0s and 1s.
A program has a set of instructions of any length, with a separate character representing each instruction: $q_1q_2q_3...q_i$

In order to denote which position we start from,
we put q_1 directly before the position in the word which we want.
for example:

h101$q_1$00h is the same as h1 0 1 0 0 h

Where ‘h’ denotes the start and end of a ‘word’.
All the rules necessary for transformations are as follows:

1)print 0
2)print 1
3)go left +not change
4)go right + not change
5)GOTO step i if 1 is scanned
6)GOTO step i if 0 is scanned
7)STOP

5) and 6) are needed for loops.

Each step can be represented via program as such:

1) $q_1 1 <=> q_2 0$
2) $q_1 0 <=> q_2 1$
3) $1q_1 0 <=> q_2 10$
4) $0q_1 1 <=> 01q_2$
5) $q_6 1 <=> q_3 1$
6) $q_6 0 <=> q_3 0$
7) $1q_i <=> q_i$ (then go right until entire word is empty and its hq_ih)

We can represent any program as a word problem: a Haltcrazy program can be transcribed into a word made up of 0s and 1s.
For example:

Let h10101001h be the program Haltcrazy
and let the word which we wan to convert it to be hq_ih (or empty).
Which is essential asking wether Haltcrazy will Halt.

SInce we know that that is isn’t computable, we know that not any Thue word problem is computable, since this specific one isn’t.