CSCI 6610, Spring 2014 (Rod Canfield)

Text: *Intro. to the Theory of Computation* by M. Sipser.
Syllabus: Terminology, background, and proofs of the following ...

Theorem 1. (Myhill, Nerode) A language L is regular if and only if the associated equivalence relation R_L has finitely many equivalence classes.

Theorem 2. (Hennie) Let L be the language over the alphabet $\{a, b, c\}$ defined by

$$L \stackrel{\text{def}}{=} \{wc^{|w|}w^{\text{rev}} : w \in \{a, b\}^*\}.$$

If T is a deterministic Turing machine with q states that recognizes L, then for each integer $n \geq \log_2 q$ there is a string $w \in L$ of length $3n$ such that on input w the machine T executes at least $n^2/\log q$ steps before halting.

Theorem 3. (Shannon) For each $\epsilon > 0$, almost all Boolean functions of n variables have circuit complexity greater than $(1-\epsilon)2^n/n$.

Theorem 4. (Church) The theory $(\mathcal{N}, +, \times)$ is undecidable.

Theorem 5. (Jerrum, Sinclair, Vigoda) There is a fully polynomial randomized approximation scheme for computing the permanent of an $n \times n$ matrix with non-negative entries.

Theorem 6. (Savitch) For $f(n) \geq \log n$,

$$\text{NSPACE}(f(n)) \subseteq \text{SPACE}(f(n)^2)$$

Theorem 7. (Immerman, Szelepcsényi) NL $=$ *co*NL.

Theorem 8. (Shamir) IP=PSPACE.

Theorem 9. (Baker, Gill, Solovay) For suitable oracles A and B we have

$$\begin{aligned} \text{P}^A &= \text{NP}^A \\ \text{P}^B &\neq \text{NP}^B \end{aligned}$$

Theorem 10.(Agrawal, Kayal, Saxena) PRIMES $\in$ P.