## True/False Questions

1. True or False. T = true, F = false, and O = open, meaning that the answer is not known science at this time. In the questions below, $\mathcal{P}$ and $\mathcal{NP}$ denote $\mathcal{P}$-TIME and $\mathcal{NP}$-TIME, respectively.

   (i) **T** Every finite language is regular.

   (ii) **T** A language is regular if and only if it is accepted by some DFA.

   (iii) **T** A language is regular if and only if it is accepted by some NFA.

   (iv) **T** A language is regular if and only if it is generated by some regular grammar.

   (v) **F** The programming language C++ is regular.

   (vi) **T** The union of any two regular languages is regular.

   (vii) **T** The intersection of any two regular languages is regular.

   (viii) **T** The concatenation of any two regular languages is regular.

   (ix) **T** The Kleene closure of any regular language is regular.

   (x) **T** The intersection of any two regular languages is regular.

   (xi) **O** There exists a polynomial time algorithm which finds the factors of any positive integer, where the input is given as a binary numeral.

   (xii) **F** Every problem that can be mathematically defined has an algorithmic solution.

   (xiii) **T** The intersection of two $\mathcal{NP}$ languages must be $\mathcal{NP}$.

   (xiv) **O** $\mathcal{P} = \mathcal{NP}$.

   (xv) **O** $\mathcal{NP} = \mathcal{P}$-SPACE

   (xvi) **T** Every language is countable.

   (xvii) **T** There exists a mathematical proposition which is true but cannot be proven.

   (xviii) **T** There exists a machine that runs forever and outputs the string of decimal digits of $\pi$ (the well-known ratio of the circumference of a circle to its diameter).

   (xix) **O** There is a polynomial time algorithm which determines whether any two regular expressions are equivalent.

   (xx) **F** Every subset of a regular language is regular.

   (xxi) **T** Every subset of any countable set is countable.

   (xxii) **T** The complement of any $\mathcal{P}$-TIME language is $\mathcal{P}$-TIME.

   (xxiii) **F** For any infinite countable sets $A$ and $B$, there is a 1-1 correspondence between $A$ and $B$.

(xxiv) **T** If $L_1$ is a language, $L_2$ is an $\mathcal{NP}$ langage, and there is a $\mathcal{P}$–TIME reduction of $L_1$ to $L_2$, then $L_1$ must be $\mathcal{NP}$.

(xxv) **F** Every function $\mathcal{N} \to \mathcal{N}$ can be computed by some machine.

We say that two finite automata $M_1$ and $M_2$ are *isomorphic* if $M_1$ can be changed into $M_2$ by just renaming the states.

(xxvi) **T** Given any regular langauge $L$, any two minimal DFA which accept $L$ are isomorphic.

(xxvii) **F** Given any regular langauge $L$, any two minimal NFA which accept $L$ are isomorphic.

(xxviii) **T** Given any NFA $M$ with $n$ states, there is a DFA equivalent to $M$ with $2^n$ states.

(xxix) **T** Given any two positive integers $n$ and $m$, the set of all binary numerals for positive integers which are equivalent to $n$ modulo $m$ is a regular language.