# 3. Basics of Classical Computer

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**Turing machine**

**Components of a Turing machine**

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**Operation of a Turing Machine**

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### Definition 1

A partial function $f : A^* \to A$ is computable if there exists a Turing machine $M$ such that $\delta_M = f$. In this case, we say that $f$ is computed by $M$.

### Church-Turing thesis

The class of functions computable by a Turing machine corresponds exactly to the class of functions which we would naturally regard as being computable by an algorithm.

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### Halting problem

Dose turing machine $M$ halt for given input $x$?
$\rightarrow$ *We can't compute halting problem by any turing machine!*

∗ <u>Proof</u>: (귀류법) Halting 문제를 풀 수 있는 TM HALT가 존재한다고 가정하자.

# Circuit model

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### Theorem 2

*Circuit model can solve every type of boolean function.*

$$f : \{0,1\}^n \rightarrow \{0,1\}^m$$

# Two computation model

## Definition 3 (uniform circuit family)

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## Can circuit model solve halting problem?

## References

- M. A. Nielson and I. L. Chuang, Quantum Computation and Quantum Information
- Lecture notes for QU511: Quantum Computing (Fall 2024)