Turing Machines

- Turing Machine: Model of Computation
- Turing Machine: Anatomy and Working
- Turing Machine: Formal Definition and Rules of Computation
- Recognizable and Decidable Languages
- Turing Machine: Levels of Abstraction
- Varaints of Turing Machine and The Church-Turing Thesis
- Non-Deterministic Turing Machine

Imdad ullah Khan

Formalizing Computation

Hilbert's 10th problem (1900)

*Devise a **finite procedure** to check if a diophantine equation has integral solution*

diophantine equation (e.g. multivariate polynomial) with integer coefficients

e.g. $ax + by = c$, $aw^4 + bx^4 + cy^4 + dz^4 = 0$ $a, b, c, d \in \mathbb{Z}$

Entscheidungsproblem Problem [Hilbert and Ackermann (1928)]

*Devise a **finite procedure** to determine the validity of a logical expression*

$\neg\exists x, y, z \in \mathbb{Z} : (x^n + y^n = z^n) \wedge (n \geq 3)$

Can Mathematics be mechanized? ▷ automatic theorem proving

Formalizing Computation

Alonzo Church (1935/1936)

Lambda Calculus is a reasonable notion of **finite procedure** "=algorithm"

Alan Turing (1936)

Turing Machine is a reasonable notion of **finite procedure** "=algorithm"

AN UNSOLVABLE PROBLEM OF ELEMENTARY NUMBER THEORY.[1]

By Alonzo Church.

ON COMPUTABLE NUMBERS, WITH AN APPLICATION TO THE ENTSCHEIDUNGSPROBLEM

By A. M. Turing.

Alan Turing (1937)

Turing Machine = Lambda Calculus

Formalizing Computation

Hilbert's 10th problem (1900)

Devise a **finite procedure** to check if a diophantine has integral solution

Matiyasevich-Robinson-Davis-Putnam (1970)

There is no algorithm to solve this problem

Entscheidungsproblem Problem [Hilbert and Ackermann (1928)]

Devise a **finite procedure** to determine the validity of a logical expression

Turing (1936)

There is no algorithm to solve this problem