Lecture #11: Multi-Tape Turing Machines, Nondeterministic Turing Machines, and the Church-Turing Thesis

Supplement for Lecture Presentation

The first problem discussed, during the lecture presentation, concerns the development of a Turing machine that is based on the following algorithm.

On input $\omega \in \Sigma_1^\star$:

1. `if` $(\omega == \lambda)$ `{`
2. `  return` λ
3. `}` `else if` (ω starts with 0) `{`
4. `  if` $(|\omega| == 1)$ `{`
5. `  return` 1
   `}` `else {`
6. `  return` λ
   `}`
7. `}` `else if` (ω includes at least one copy of 0) `{`
8. Return the string obtained from ω by replacing the ***rightmost*** copy of 0 with 1, and by replacing every copy of 1 to the right of that symbol with 0

   `}` `else {`
9. `  return` 10^h, where $h = |\omega|$

   `}`

The second problem discussed, during the lecture presentation, concerns the development of a multi-tape function that is based on the following algorithm.

On input $\omega \in \Sigma_1^\star$:

1. `if` ($\omega \in L_{\text{pair}}$) `{`
   // Let $\mu, \nu \in \{0,1\}^\star$ such that $\omega = \mu\#\nu$
2. $\widehat{\mu} := \mu$
3. $\widehat{\nu} := \nu$
4. `while` ($\widehat{\nu} \neq 0$) `{`
5. $\widehat{\mu} := f_{+1}(\widehat{\mu})$
6. $\widehat{\nu} := f_{-1}(\widehat{\nu})$
   `}`
7. `return` $\widehat{\mu}$

   `} else {`
8. `return` λ

   `}`