Algorithms & Models of Computation CS/ECE 374, Fall 2020

9.5 Turing complete

Equivalent to a program

Definition

A system is Turing complete if one can simulate a Turing machine using it.

- Programming languages (yey!).
- ② C++ templates system (boo).
- John Conway's game of life.
- Many games (Minesweeper).
- Post's correspondence problem.

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Post's correspondence problem

S: set of domino tiles.

abb bc

domino piece a string at the top and a string at the bottom.

Example:

$$S = \left\{ \begin{array}{|c|c|c} b \\ \hline ca \end{array}, \begin{array}{|c|c|c} a \\ \hline ab \end{array}, \begin{array}{|c|c|c} ca \\ \hline a \end{array}, \begin{array}{|c|c|c} abc \\ \hline c \end{array} \right\}$$

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Matching dominos

$$S = \left\{ \begin{array}{c|c} b \\ \hline ca \end{array}, \begin{array}{c} a \\ \hline ab \end{array}, \begin{array}{c} ca \\ \hline a \end{array}, \begin{array}{c} abc \\ \hline c \end{array} \right\}$$

<u>match</u> for S: ordered list of dominos from S, such that top strings make same string as bottom strings. Example:

a	b	ca	a	abc
ab	ca	a	ab	С

- (1) Can use same domino more than once.
- (2) Do not have to use all pieces of S.

Matching dominos

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Post's Correspondence Problem

<u>Post's Correspondence Problem</u> (PCP) is deciding whether a set of dominos has a match or not.

<u>modified Post's Correspondence Problem</u> (MPCP): PCP + a special tile. Matches for MPCP have to start with the special tile.

Theorem

The MPCP problem is undecidable.

THE END

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(for now)