COMP4141 Homework 4

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Exercise 1 Show that $L = \{a^n b^m a^n b^m \mid n, m \in \mathbb{N}\}$ is Turing-recognisable, by precisely describing a Turing machine M with $L(M) = L$.

Exercise 2 Suppose we define a deterministic two-stack PDA to be a machine with a finite stack alphabet, a finite set of control states, and two stacks. Such a machine is initialised by loading the input into one of the stacks (backwards, so that the left of the word sits at the top of the stack), and starting the machine in its initial state. It then computes at each step of computation reading the top of the two stacks, and deterministically performing a push or pop onto each of the stacks, and changing the control state. The machine has an accept and a reject state. Show that two-stack PDA's are equivalent to Turing machines: a language L is accepted by some two-stack PDA iff it is accepted by some deterministic Turing Machine.

Exercise 3 Show that that a language A over alphabet Σ is Turing-recognisable iff there exists a Turing-decidable language B such that

$$A = \{\ x \in \Sigma^* \mid \text{there exists a string } y \text{ such that } x\#y \in B\}$$

where $\#$ is any symbol not in Σ. (Note that you are free to choose any alphabet for B that is convenient.)