

## *The Acceptance Problem*

It would be useful to have an algorithm that takes as input a TM and string, and tells one whether the TM will halt on that input. Unfortunately, such an algorithm does not exist.

## *The Acceptance Problem*

Define  $A_{tm} = \{ \langle M, w \rangle : M \text{ is TM that accepts } w \}$ .

It is easy to show by simulation that:

*$A_{tm}$  is r.e.*

## *The Acceptance Problem is Undecidable*

**Theorem.**  $A_{tm}$  is not recursive. That is, the acceptance problem is undecidable.

The theorem says that one cannot build a TM that will always halt and tell one whether a given machine accepts a given word or not. Using Church's thesis, this means that there is no algorithm that one can use to test beforehand whether a given machine/program on given input will halt.

We give two proofs.