

## The Universal Turing Machine

The Language

$A_{TM} = \{ \langle M, w \rangle \mid M \text{ is a Turing Machine and } M \text{ accepts } w \}$

is Turing Recognizable

Given the description of a TM and some input, can we determine whether the machine accepts it?

- Just Simulate/ Run the TM on the input

M Accepts w: Our Algorithm will Halt & Accept

M Rejects w: Our Algorithm will Halt & Reject.

M Loops on w: Our Algorithm will not Halt.



## The Universal Turing Machine

Input:  $M$  = the description of some TM

$w$  = an input string for  $M$

Action: - Simulate  $M$

- Behave just like  $M$  would (may accept, reject or loop)

The UTM is a recognizer (but not a decider) for

$A_{TM} = \{ \langle M, w \rangle \mid M \text{ is a TM and } M \text{ accepts } w \}$

