

Decidable Problems

A decision problem has answer yes or no. It is decidable if there is algorithm/TM that always halts and always gives correct answer.

Acceptance Problem:
given machine/generator M and string w
does M accept w ?

Emptiness:
given machine/generator M
does M accept nothing?

Totality:
does M accept everything?

Equivalence
does M & N do same language?

Decidable

Regular

CF

TM

Acceptance

✓

✓

✗

Empty

✓

✓

✗

Totally

✓

✗

✗

Equiv

✓

✗

✗

"ALL"

"ALMOST
NONE"

— — — —

One way to prove Acceptance is decidable, even if machine can go on forever, is to prove there is bound Q so that if go beyond Q then must be in infinite loop. Then simulate for Q steps.

Encodings

Use angle brackets for
string encoding of machine etc.

decision problem is decidable

$\Leftrightarrow$
language of encodings of
yes-instances is recursive.

E.g. $A_{tm} = \{ \langle M, w \rangle : \text{TM } M \text{ accepts } w \}$

A_{tm} is set of strings
that represent TM machine
and string pair such that
that TM accepts that string.