

MATH3306

Set Theory & Mathematical Logic

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1 Introductory notes

1.1 Gödel's incompleteness theorem

Theorem 1.1.1 (Gödel's incompleteness theorem, baby version). *There are true mathematical statements that cannot be proven.*

“Proof”. Take the statement “This statement has no proof.”

Assume it is false. This implies that the statement has a proof. If the statement has a proof, it must be true, contradiction!

Assume it is true. This implies that the statement has no proof. Therefore, the statement cannot be proven. \square

1.2 The halting problem

The halting problem is undecidable.

TODO: Add context and proof.

1.3 Defining algorithms

In defining algorithms, Turing machines and recursive functions will be the primary focus. Grammars and code are also alternatives.

Definition 1.1 (Church-Turing thesis, informal). Any reasonable definitions of “algorithm” are equivalent.