Godel's Incompleteness Theorem

Exposition by William Gasarch—U of MD

Peano Arithmetic

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4) The usual logical rules of inference.

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Note All we use about PA is that it has a finite number of axioms and rules of inference.

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4) They were wrong.

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This theorem would not be so impressive if it was tied to PA. However, we will see after the proof that it applies to **any** proof system with a finite number of axioms and rules of inference.

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a) A lot of the proof involves coding math statements into numbers. Today we just assume that all works out.

b) We will use that Hilbert's Tenth Problem is undecidable.

Recall Hilberts' Tenth Problem

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Thm $H10$ is undecidable.

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Thm There exists a polynomial $p \in \mathbb{Z}[\vec{x}]$ such that

1) $(\forall \vec{a} \in \mathbb{Z})[p(\vec{a}) \neq 0]$.

2) Statement 1 cannot be proven in PA.

Proof of Godel's Inc. Thm: SLIDE TWO

Assume, BWOC, that for every polynomial $p \in \mathbb{Z}[\vec{x}]$ such that $(\forall \vec{a} \in \mathbb{Z})[p(\vec{a}) \neq 0]$, there is a proof in PA of this.

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DONE in two slides!

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