Ernst Zermelo

Ernst Friedrich Ferdinand Zermelo (/zɜːrˈmɛloʊ/, German: [tsɛɐ̞ˈmeːlo]; 27 July 1871 – 21 May 1953) was a German logician and mathematician, whose work has major implications for the foundations of mathematics. He is known for his role in developing Zermelo-Fraenkel axiomatic set theory and his proof of the well-ordering theorem.

Contents

Life

Research in set theory

Zermelo's navigation problem

Publications

See also

References

External links

Life

Ernst Zermelo graduated from Berlin's Luisenstädtisches Gymnasium (now <u>Heinrich-Schliemann-Oberschule</u>) in 1889. He then studied <u>mathematics</u>, <u>physics</u> and <u>philosophy</u> at the <u>universities</u> of <u>Berlin</u>, <u>Halle</u> and <u>Freiburg</u>. He finished his doctorate in 1894 at the <u>University</u> of <u>Berlin</u>, awarded for a dissertation on the <u>calculus</u> of <u>variations</u> (*Untersuchungen zur Variationsrechnung*). Zermelo remained at the University of Berlin, where he was appointed assistant to Planck, under whose

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Ernst Zermelo in the 1900s

Born	27 July 1871 Berlin, German Empire
Died	21 May 1953 (aged 81) Freiburg im Breisgau, West Germany
Nationality	Germany
Alma mater	University of Berlin

guidance he began to study <u>hydrodynamics</u>. In 1897, Zermelo went to <u>Göttingen</u>, at that time the leading centre for mathematical research in the world, where he completed his <u>habilitation thesis</u> in 1899.

In 1910, Zermelo left Göttingen upon being appointed to the chair of mathematics at Zurich University, which he resigned in 1916. He was appointed to an honorary chair at the <u>University of Freiburg</u> in 1926, which he resigned in 1935 because he disapproved of <u>Adolf Hitler</u>'s regime. At the end of <u>World War II</u> and at his request, Zermelo was reinstated to his honorary position in Freiburg.

Research in set theory

In 1900, in the Paris conference of the <u>International Congress of Mathematicians</u>, <u>David Hilbert challenged the mathematical community with his famous <u>Hilbert's problems</u>, a list of 23 unsolved fundamental questions which mathematicians should attack during the coming century. The first of these, a problem of <u>set theory</u>, was the <u>continuum hypothesis</u> introduced by <u>Cantor</u> in 1878, and in the course of its statement Hilbert mentioned also the need to prove the well-ordering theorem.</u>

Zermelo began to work on the problems of set theory under Hilbert's influence and in 1902 published his first work concerning the addition of <u>transfinite cardinals</u>. By that time he had also discovered the so-called <u>Russell paradox</u>. In 1904, he succeeded in taking the first step suggested by Hilbert towards the continuum hypothesis when he proved the <u>well-ordering theorem</u> (*every set can be well ordered*). This result brought fame to Zermelo, who was appointed Professor in Göttingen, in 1905. His proof of the <u>well-ordering theorem</u>, based on the powerset axiom and the <u>axiom of choice</u>, was not accepted by

Known for	Zarmala Eraankal set	
Kilowii ioi	Zermelo–Fraenkel set	
	theory	
	Zermelo's navigation	
	problem	
	Well-ordering theorem	
	Zermelo's theorem	
	(game theory)	
	Zermelo ordinal	
Awards	Ackermann-Teubner	
	Memorial Award	
	(1916)	
Scientific career		
Fields	Mathematics	
Institutions	University of Zürich	
Doctoral	Lazarus Fuchs	
advisor	Hermann Schwarz	
Doctoral	Stefan Straszewicz	
students		

all mathematicians, mostly because the axiom of choice was a paradigm of non-constructive mathematics. In 1908, Zermelo succeeded in producing an improved proof making use of Dedekind's notion of the "chain" of a set, which became more widely accepted; this was mainly because that same year he also offered an axiomatization of set theory.

Zermelo began to axiomatize set theory in 1905; in 1908, he published his results despite his failure to prove the consistency of his axiomatic system. See the article on Zermelo set theory for an outline of this paper, together with the original axioms, with the original numbering.

In 1922, <u>Abraham Fraenkel</u> and <u>Thoralf Skolem</u> independently improved Zermelo's axiom system. The resulting 8 axiom system, now called Zermelo-Fraenkel axioms (ZF), is now the most commonly used system for axiomatic set theory.

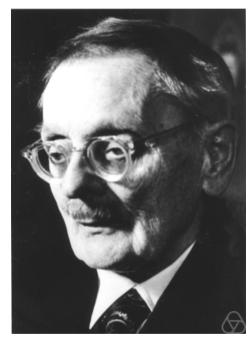
Zermelo's navigation problem

Proposed in 1931, the Zermelo's navigation problem is a classic optimal control problem. The problem deals with a boat navigating on a body of water, originating from a point O to a destination point D. The boat is capable of a certain maximum speed, and we want to derive the best possible control to reach D in the least possible time.

Without considering external forces such as current and wind, the optimal control is for the boat to always head towards D. Its path then is a line segment from O to D, which is trivially optimal. With consideration of current and wind, if the combined force applied to the boat is non-zero the control for no current and wind does not yield the optimal path.

Publications

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External links

Works by or about Ernst Zermelo (https://archive.org/search.php?query=%28%28subject%3A%22Zermelo%2C%20Ernst%22%20OR%20subject%3A%22Ernst%20Zermelo%22%20OR%20creator%3A%22Zermelo%2C%20Ernst%22%20OR%20creator%3A%22Ernst%20Zermelo%2C%20E%2E%22%20OR%20title%3A%22Ernst%20Zermelo%22%20OR%20OR%20des



Ernst Zermelo tombstone in Friedhof Günterstal, in Günterstal district of Freiburg im Breisgau

cription%3A%22Zermelo%2C%20Ernst%22%20OR%20description%3A%22Ernst%20Zermelo%22%29%20OR%20%28%221871-195 3%22%20AND%20Zermelo%29%29%20AND%20%28-mediatype:software%29) at Internet Archive

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