Amalie Emmy Noether
a Mathematician

"If one proves the equality of two numbers a and b by showing first that "a is less than or equal to b" and then "a is greater than or equal to b", it is unfair, one should instead show that they are really equal by disclosing the inner ground for their equality"

-Emmy Noether

Pushya Mitra

Image source: Wikipedia

Early Life

- Born: 23 March 1882
  - Erlangen, Bavaria, Germany
- Father: Max Noether
  - prominent mathematician in algebraic geometry
- Mother: Ida Amalia Kaufmann
- 1900: beacame language teacher at girls school in Erlnagen
  - teaching French, German and English
- Getting acquainted with Mathematics was a turning point in her life

Later Life

- Could not enroll at the university of Erlangen but still managed to pass her Diplom

- 1904: applied to the graduate School at Erlangen and finally, was accepted

- 1907: wrote her Ph.D. on „Invariants of biquadratic forms" under the supervision of famous Paul Gordon (Later on she was not much impressed by her Ph.D. thesis and called it Formelgestrüpp) which dealt with invariants which was a driving thread throughout her research

Source: Convergence public lecture (Perimeter institute of theoretical physics)

Later Life (continued)

- 1918: published her paper on „Invariante Variationsproblem"

  - contained Noether's theorem

- 1919: applied for habiliation at university of Göttingen

  - intially rejected

- 1922: eventually got the position of Privat Dozent at university of Göttingen

- 1933: relieved from her duties

  - the price she had to pay being a jewish woman

Contributions

- „Theory of Ideals" with W. Schmeidler

- „Idealtheorie in Ringbereich" which led to the terms in the modern literature like Noetherians.

- Apart from above she had enormous contributions which had direct or indirect implications on topics like General Relativity, Electrodynamics (transformations like Gauge and Lorentz), etc.

- Her biggest contribution what we know today is Noether's Theorem. This has shaped the face of modern theoretical Physics in a great way that we know today.

Noether's Theorem

- Every **continuous symmetry** of a physical system has a corresponding **conservation law**

- Some examples:

Characteristic of Reference-frame	Property of Lagrangian	Conserved Quantity
Time Homogeneity	No explicit function of time	Total Energy
Space Homogeneity	Invariant to the translation	Linear Momentum
Space isotropic	Invariant to rotation	Angular Momentum

Noetherian Ring

- A ring R is Noetherian if the following proposition are equivalent
  - Every ideal in R is finitely generated

  - Acsending chain of ideals becomes constant

  - Every non-empty set of ideals in R has a maximal element

Emmy's Life through time

- 1882: Born on 23 March 1882

- 1900: Received teacher's certificate

- 1904: Allowed to study at University of Erlangen at graduate School

- 1907: Ph.D. under a famous mathematician Paul Gordon

- 1907-1914: Taught at uni-Erlangen but without a pay as she was a women

- 1915: Invited by F.Klein and D.Hilbert to Göttingen to discuss relativity which was the most significant topic at that time

- 1918: Around this time she published what we call ''Noether's Theorem'' today

- 1919: Received Habilitation (Strongly opposed by faculty of History in Philosophy)

- 1919-1935: Worked on abstract algebra which included Ideals, groups, rings, representation theory, etc

- 1922: Around this time she got the position of Private Dozent at the university of Göttingen

- 1923: Got her first pay i.e her first academic Income

- 1928-29: Invited by Pavel Alxandrov at Moscow State University

- 1933: She was relieved from her duties, the price she had to pay of being Jew and a women in Germany

- 1933: In the same year she went to USA

- 1935: 14 April 1935, She died in an unsuccessful Surgery