

From Logic with Love

Aaron Stump
Computer Science

Outline:

1. What we talk about when we talk about
2. **Love**
3. (and some things we don't.)

The Linguistic Turn in Philosophy (early 20th century)

Ludwig Wittgenstein Gustav Bergmann



Caveat: Researchers should always be *beginners*.

Raymond Carver

Logic and the Foundations of Mathematics

The Dream of a Universal Language

Gottfried Leibniz (1646 - 1716)



Imagined a logical language suitable for solving all problems by calculation.

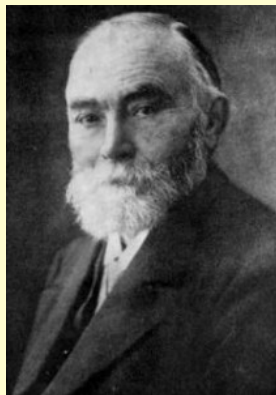
Calculus!

Invented binary notation and calculus (same time as Newton), mechanical calculator.

An early Computer Scientist?

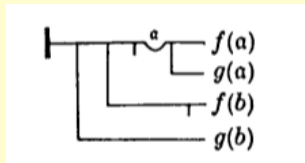
A Universal Logical Language

Gottlob Frege (1848-1925)



Explicitly following
Leibniz's dream, for logic.

Begriffsschrift



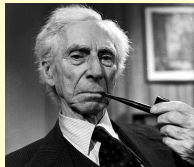
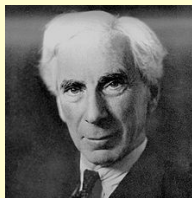
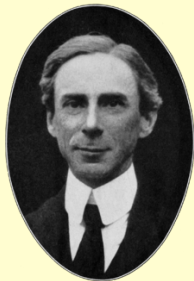
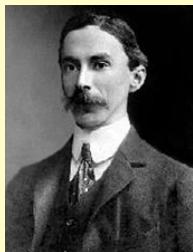
Sought to reduce
mathematics to pure logic.

The first of many great logicians to feel the burn of ...

A photograph of a large, multi-story building engulfed in flames at night. The building's structure is exposed, and a prominent tower at the top is exploding, sending a massive plume of fire and debris into the dark sky. The scene is illuminated by the intense orange and yellow fire, with some streetlights visible in the background. A black rectangular box with red text is overlaid on the center of the image.

Inconsistency!

The Arsonist: Bertrand Russell (1872-1970)



- Credited with co-founding analytic philosophy.
- Outspoken activist, liberal crusader, British aristocrat.
- Wrote 60 million words in his adult life, over 70 books.
- Critic of traditional morality and religion.
 - ▶ Against restrictions on birth control, divorce, pornography.
 - ▶ “The three human impulses embodied in religion are fear, conceit, and hatred”.
 - ▶ “Fear is the basis of religious dogma”.

Russell's Paradox

Background:

- **set**: a collection of objects, viewed as an object itself
- $\{x \mid F\}$: set of objects x satisfying property F
- $x \in y$: object x is a member of set y
- $x \notin y$: object x is not a member of set y

Consider the set

$$\{x \mid x \notin x\}$$

Call this set S .

$$S \in S \quad \text{if and only if} \quad S \notin S$$

Contradiction!

Russell on Love (Theory)

“The good life is one inspired by love and guided by knowledge.”

[What I Believe]

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“Love is something far more than desire for sexual intercourse; it is the principal means of escape from the loneliness which afflicts most men and women throughout the greater part of their lives.” [Marriage and Morals]

Hmm.

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[What I Believe]

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Hmm.

“Joy of life... depends upon a certain spontaneity in regard to sex.” [Marriage and Morals]

Well well...

Russell on Love (Practice)

Alys Pearsall Smith (wife)



Russell on Love (Practice)

Lady Constance
Malleon (lover)



Lady Ottoline
Morrell (lover)



Russell on Love (Practice)

Dora Black
(second wife)



Patricia Spence
(third wife)



Edith Finch
(fourth wife)



Undergrad.
He was 64 when
they married.

How to Secure the Foundations of Mathematics?

Build on the Rock

David Hilbert (1862-1943)



Brilliant and influential
German mathematician.

Hilbert's program:
formalize all mathematics
based on simple arithmetic
axioms.

A high-angle photograph of a construction or demolition site. The scene is dominated by a massive, billowing cloud of brown dust and debris that rises from the center-right. To the left, there is a steep, reddish-brown earthen embankment with some sparse green vegetation. In the foreground, there is a concrete ledge or wall, and a pile of light-colored sand and gravel. The overall atmosphere is one of intense activity and scale.

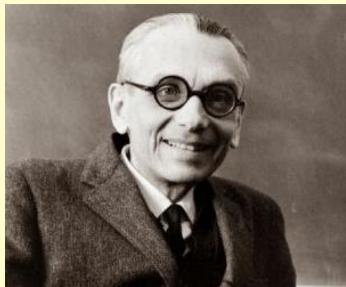
Impossible!

A photograph capturing the aftermath of a rock blasting operation. The scene is dominated by a massive, billowing cloud of brown and grey dust and fine rock particles that fills the right and upper portions of the frame. In the foreground and middle ground, there are piles of larger, dark grey and black rock fragments. To the left, a vertical face of reddish-brown soil or rock is visible, showing signs of erosion and some sparse green vegetation. The overall atmosphere is one of intense industrial activity and the raw power of controlled explosion.

Impossible!

(Rock blasting)

The Dynamiter: Kurt Gödel (1906-1978)



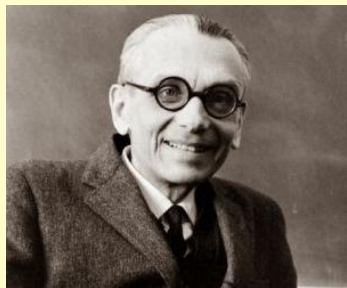
Austrian emigrée to the U.S.

Most brilliant logician of the 20th century.

Proved that arithmetic axioms cannot be used to prove their own consistency.

Destroyed Hilbert's program: consistency can only proved by a **stronger** theory.

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Tragically: paranoid fear of poisoning, died of starvation when his wife Adele was hospitalized.

Where Does All This Leave Us?

Investigating the foundations of mathematics is like putting a human on the moon.

Whatever the merits of the goal,

the view is amazing...



Logic in Computer Science

What is Computer Science?

- The mathematical science of software.
- Born from logic and electrical engineering.
- Facebook >60 million lines of code.
- How do we write software this complex so that
 - ▶ it can be understood, extended, and maintained?
 - ▶ execute efficiently?
 - ▶ and correctly?

Example: Vehicular Software

- High-end cars have 100 million lines of code.
- Is that much code vulnerable to hacks?

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Hmm...

Hacking Jeep Cherokees, Summer 2015

July 2015, Miller and Valasek announced remote hack of unaltered 2014 Jeep Cherokee.



Over the internet, they can control the dashboard, engage or disable the brakes.

Fiat Chrysler recalls 1.4 million vehicles.

SPY Car Study Act introduced Nov. 2015.

What's Logic Got to Do with It?

Security breaches are due to **bugs**.

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Not that kind!

What's Logic Got to Do with It?

Security breaches are due to **bugs**.

Errors in the program.

What's Logic Got to Do with It?

Proofs guarantee the absence of errors.

Mathematics is different from empirical science!

Idea: we can write proofs about **programs**.

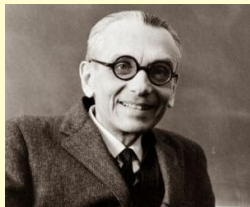
Even better: those proofs can be checked by a simple **proof-checking** program.

This is a powerful new weapon to **verify** software.

Apply the tools of logic to programming.



+



My research dream: new **programming languages** that allow programmers to **prove theorems** about their code.

Some things we **don't** talk about
when we talk about love.

Pornography

- So many arguments against
 - ▶ exploitative (>\$13 billion/year)
 - ▶ poisons relationships
 - ▶ decreases interest in relational sex
 - ▶ addictive
 - ▶ immoral
- Here's one I bet you don't know...



Sexual Addiction & Compulsivity: The Journal of Treatment & Prevention

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/usac20>

Pornography Viewing among Fraternity Men: Effects on Bystander Intervention, Rape Myth Acceptance and Behavioral Intent to Commit Sexual Assault

John D. Foubert ^a, Matthew W. Brosi ^a & R. Sean Bannon ^a

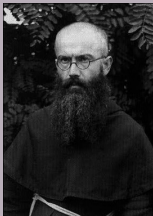
^a Oklahoma State University, Stillwater, Oklahoma

Published online: 28 Nov 2011.

From love as self-indulgence to...

Sacrificial Love

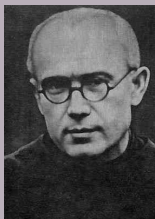
Maximilian Kolbe (1894 - 1941)



Born Raymond Kolbe,
poor Polish parents.

Intellectual talents
recognized young.

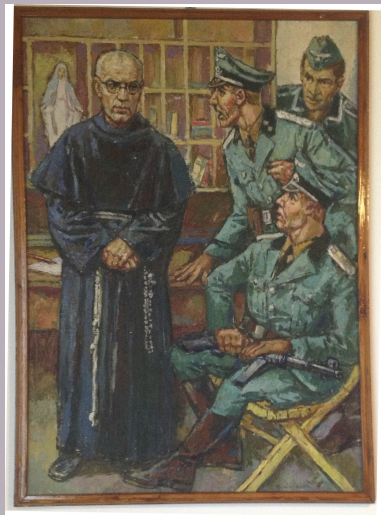
Joins Franciscans, takes
two doctorates in Rome.



Major Marian publishing
effort (circulation over
350,000 monthly in
Poland).

Niepokalanow: largest
friary in the world.

From Interrogation...



Auschwitz



A Saint in Hell



Prisoner 16670, at Auschwitz May 28 - August 14, 1941

The Sacrifice

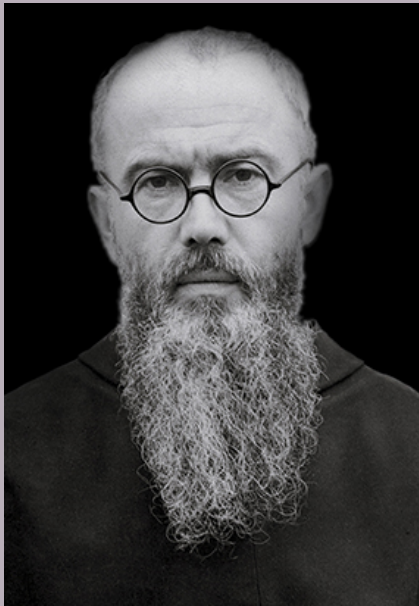


Asks SS-Hauptsturmführer Karl Fritzsch to take place of Franciszek Gajowniczek in starvation bunker.



After two weeks, killed by carbolic acid injection.

*paintings by Auschwitz survivor
Mieczysław Kościelniak*



“Love is the very heart of holiness”

To Conclude

From foundations of mathematics [Bertrand Russell]

To Logic and Computer Science –

An admonishment,

A saint.

~~*“Fear is the basis of religious dogma”.*~~

One more connection to be made...

Logos

Εν αρχη ην ο Λογος

In principio erat Verbum

In the beginning was the Word

What inspired Kolbe, of course, was living spiritual experience of Jesus of Nazareth.

Almost two millenia before, John the Evangelist was also inspired,

To identify the Logos (cf. Philo of Alexandria) with Jesus.

From Logos we get our word “logic”.

From Logic to Love