Trends in Computer Science at TSU: Elementary Problems From Our Viewpoint

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4th Georgian-German School and Workshop in Basic Science

Outline

- General Ideas
- CS Stucture at TSU
- Current Projects and Perspectives

General Ideas

Alles Gescheite ist schon gedacht worden, man muß nur versuchen, es noch einmal zu denken

Everything clever has been thought already, we should just try to rethink it

Goethe

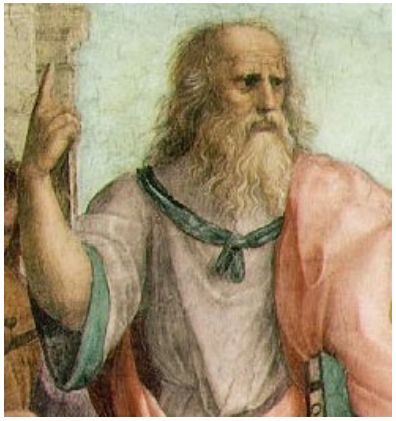
General Ideas

- Rethink Old Ideas in New Light !!!
  - Application to Actual Problems
  - New Interpretation of Old Ideas

General Ideas

What seems random to a layman,
should not seem random to me;

What seems random to me,
should not seem random to Gods!



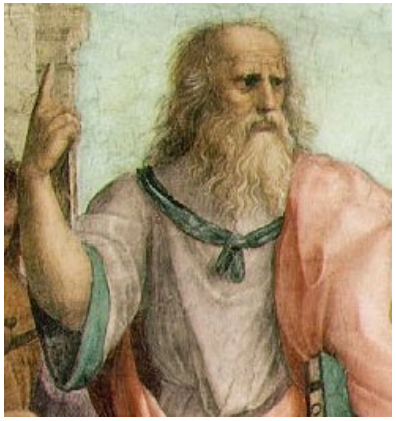
Plato

General Ideas

- First Hierarchical System Ever

- Chomsky Hierarchy
- Automata Hierarchy
- Complexity Classes
- Formal Systems

etc.



Plato

General Ideas: Case Study

- Gordian Knot Problem

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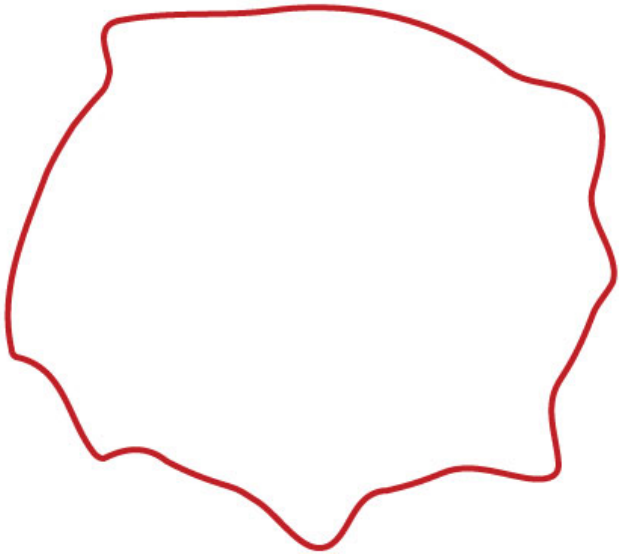
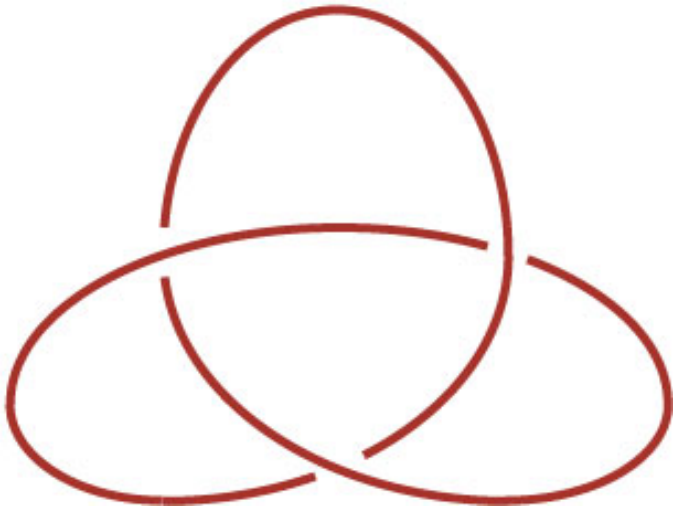
General Ideas: Case Study

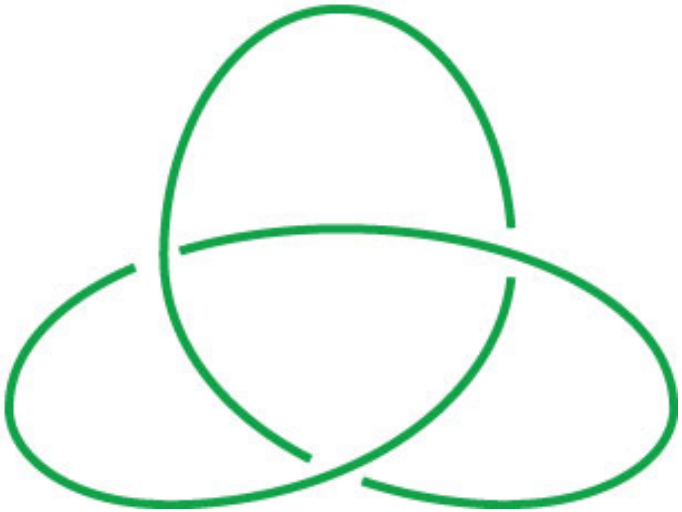
- Knot Problem



General Ideas: Case Study

- Knot Problem





General Ideas: Case Study

- Importance in Science:

- Topology (Mathematics)
- Genetics (Biology)
- Astrophysics (Physics)
- Complexity Theory (Computer Science)

General Ideas: Case Study

- Important Questions:

- Efficient Knot Invariants?

- Efficient Description of Knots?

Actual Problems

- Finite-Type Invariants
- Holonomic Description Of Knots

Actual Problems

- Finite-Type Invariants:

V. Vassiliev, 1989

M. Kontsevich (Fields Medal, 1998)

Actual Problems

- Holonomic Representation of Knots

V. Vassiliev, 1997

Actual Problems

- Holonomic Representation of Knots

- Natural Connection To Finite-Type Invariants

- Minimal Energy Loss

Actual Solution

- Holonomic Representation of Knots

Carl Friedrich Gauß

Kurt Reidemeister

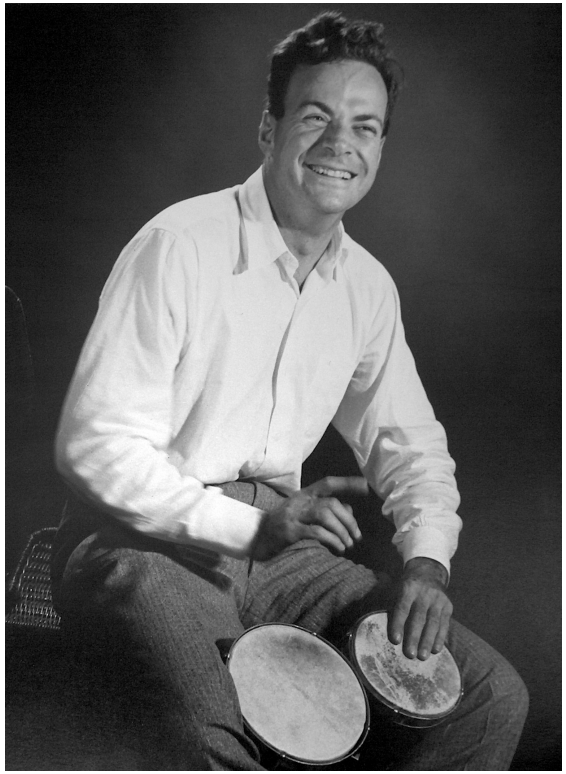
Actual Solution

- Holonomic Representation of Knots

Efficient Algorithm to compute the Holonomic Parametrization of Knots

First Idea

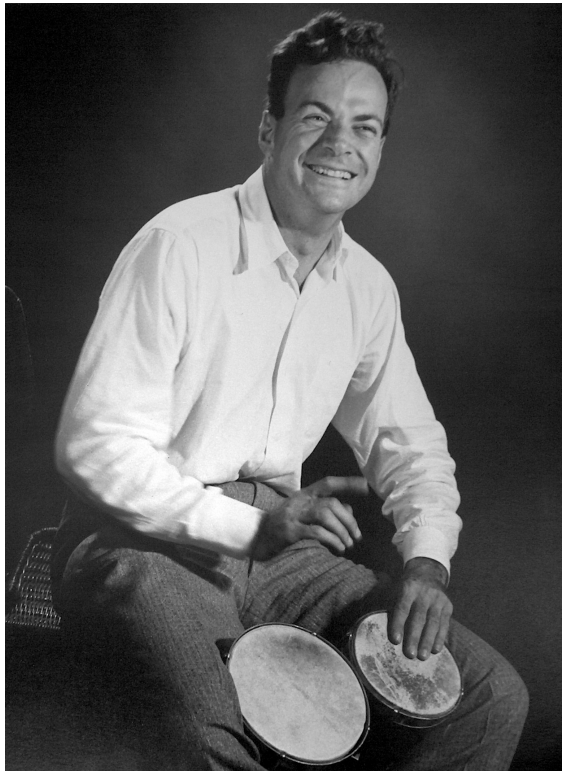
Can we develop
Theory of Relativity
without the main idea
of Einstein?



Richard P. Feynman

First Idea

Yes !!!



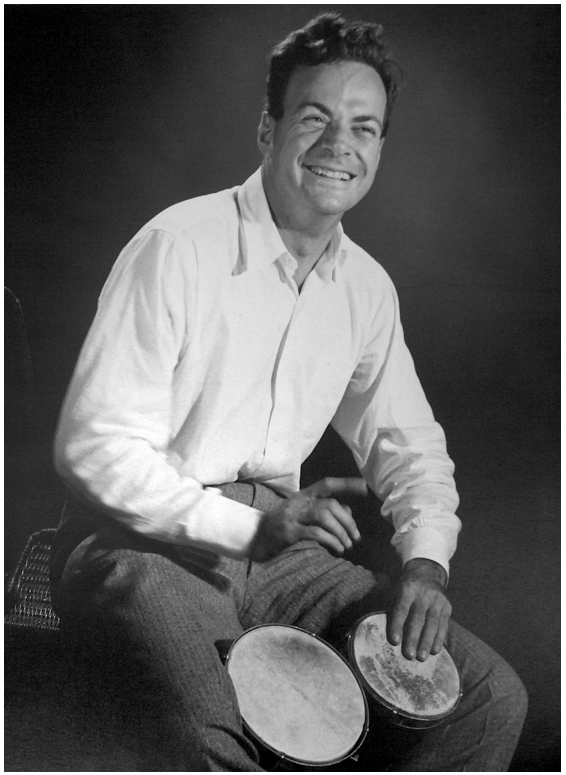
Richard P. Feynman

First Idea

No nice formulae

$E = mc^2$

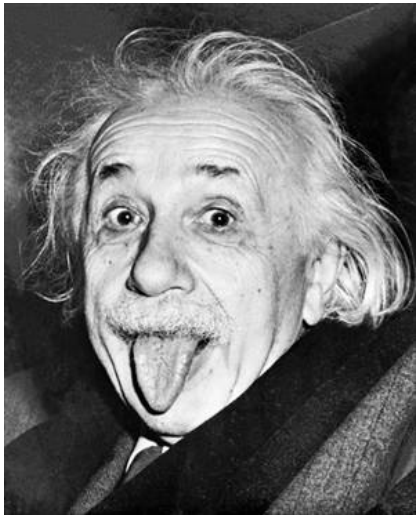
$E = \sum P(m,c)$



Richard P. Feynman

First Idea

The right initial idea is crucial !



CS Stucture at TSU

- Faculty of Applied Mathematics and Cybernetics
- Faculty of Applied Mathematics and Computer Science
- Department of Computer Science

Ilia Vekua

CS Stucture at TSU

Department of Computer Science

- Theoretical Computer Science
- Practical Computer Science
- Technical Computer Science
- Applied Computer Science

CS Stucture at TSU

- Theoretical Computer Science

- Computational Complexity
- Efficient Algorithms
- Theoretical Aspects of VLSI Design

CS Stucture at TSU

- Practical Computer Science

- Programming Languages
- Programming Techniques
- Data Structures

CS Stucture at TSU

- Technical Computer Science

- Databases
- Computer Networks
- Computer Hardware

CS Stucture at TSU

- Applied Computer Science

- Fuzzy Logic and Systems
- Decision-Making Systems
- Cryptography

Current Projects and Perspectives

- Cooperations:

- University of Saarland
- Max-Planck Institute for Computer Science
- Max-Planck Institute for Software Systems
- ETH Zürich

In progress: TU München

Current Projects and Perspectives

- Education:

- University of Saarland
- Max-Planck Institute for Computer Science

Max-Planck Research School

Master‘s degree

Current Projects and Perspectives

- Education:

- Max-Planck Institute for Software Systems
- ETH Zürich

Internship

Perspectives:

Questions ???

Danke vielmals !