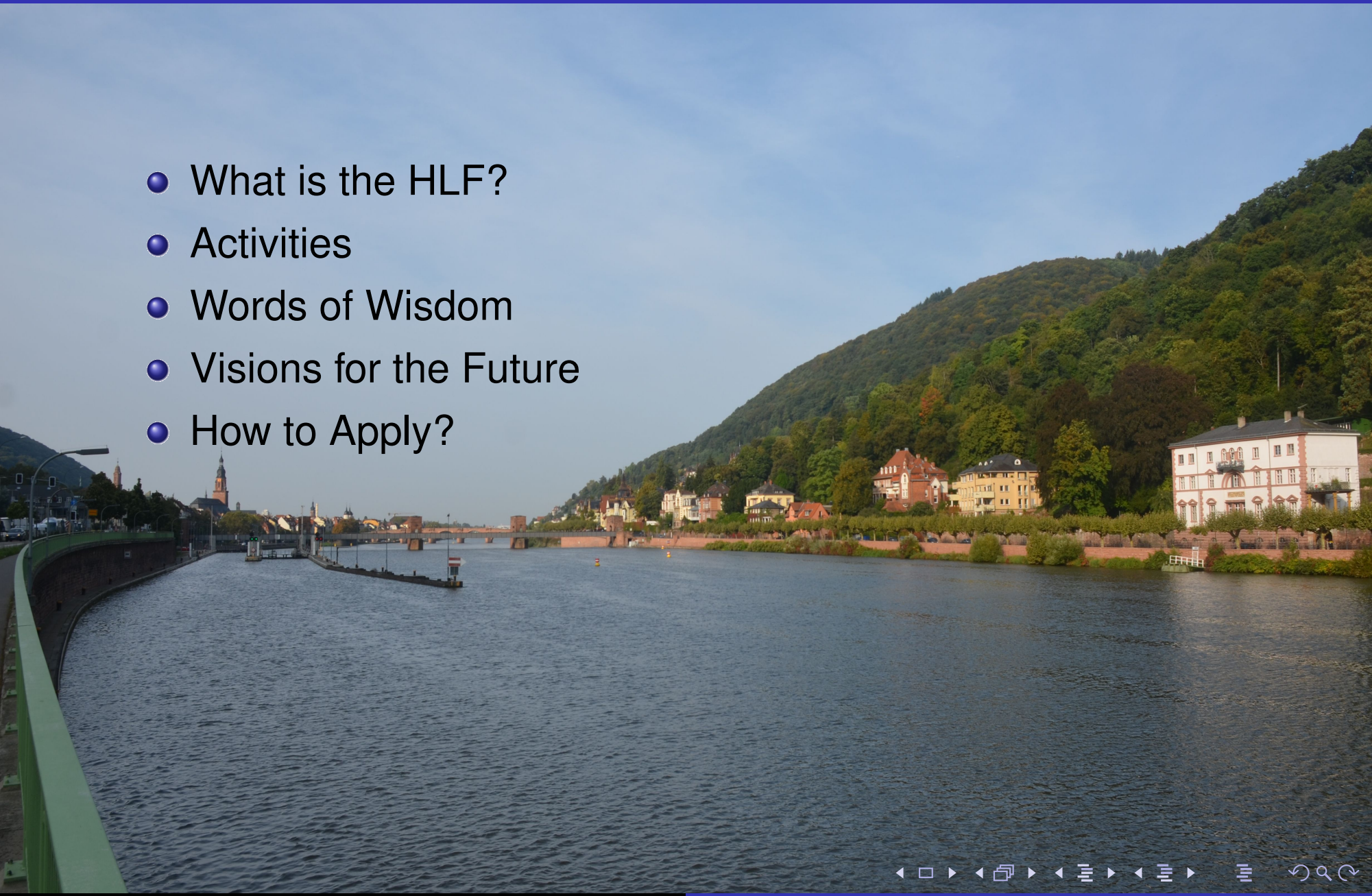
The Heidelberg Laureate Forum

A Bucket List of Heroes in Computer Science

Overview



- What is the HLF?
- Activities
- Words of Wisdom
- Visions for the Future
- How to Apply?

Heidelberg Laureate Forum

"*Communication is a key factor in the process of achieving scientific success and excellence*." HLF 2013

- Forum for early career researchers to meet with leading researchers in computer science and mathematics.
- "*Scientific heroes who can inspire the next generation*".

The Laureates

40 Laureates (30 Computer Science and 10 Maths):

- Turing Award (28)

  - Annual prize for contributions of a technical nature to the computing community

- Rolf Nevanlinna Prize (4)

  - Quadrennial prize for mathematical aspects of information sciences

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- Abel Prize (3)

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- Fields Medal (8)

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- Fields Medal (8)

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- 2 Laureates (TA+RNP) and 1 Laureate (AP+FM)

Who?

Fields Medal and Abel Prize:

Turing Award and Nevanlinna Prize:

Who?

Fields Medal and Abel Prize:

- Michael Atiyah

Turing Award and Nevanlinna Prize:

- Robert Tarjan
- Leslie Valiant

Heidelberg Laureate Forum

- 200 Early Career Researchers
  - 27 Undergraduates
  - 108 PhD Students
  - 64 Post Docs
  - $\approx$ 25% Female
  - $\approx$ 75% Male
- 49 Countries
- Australia
  - 2 Post Docs
    - Monash University (Graph Theory)
    - University of Sydney (Cloud Computing)
  - 2 PhD Students
    - ANU (Number Theory)
    - University of Adelaide (Computer Vision, Machine Learning)

Heidelberg Laureate Forum

- Laureates and partners
- ECRs
- Association for Computing Machinery
- International Mathematical Union
- Norwegian Academy of Science and Letters
- Heidelberg Institute for Theoretical Studies
- Mathematisches Forschungszentrum Oberwolfach
- Schloss Dagstuhl - Leibniz Centre for Informatics
- Journalists
- Bloggers
- Others

Activities

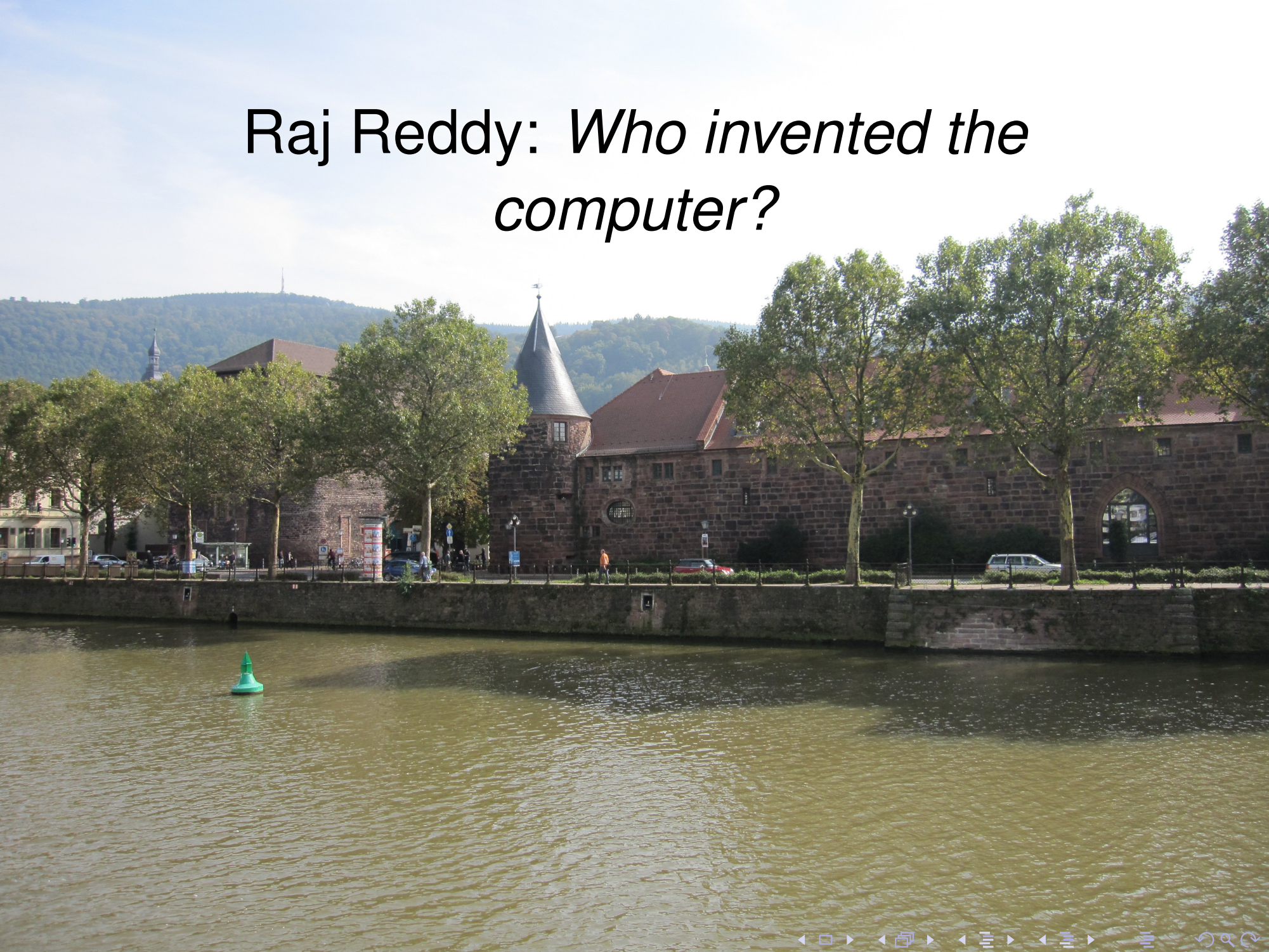
- Plenary talks
- Panel discussions
- Workshops
- Benefit Concert
  (SAP Symphony Orchestra)
- Neckar River Boat Trip
- Oktoberfest
- Heidelberg Castle
- Schwetzingen Castle
- Visits to Local Institutions

Plenary Talks

Plenary Talks

- Historical
  - *Who invented the computer?* Raj Reddy
- Challenging
  - *Learning as the source of life's phenomena.* Leslie Valiant
- Advisory
  - *Advice to a young mathematician.* Sir Michael Atiyah
- The Future
  - *Desperately needed remedies for the undebuggability of large-scale floating-point computations in science and engineering.* William Kahan
- Laureate's research
  - *Billiards and moduli spaces.* Curtis T. MacMullen

Raj Reddy: *Who invented the computer?*



Raj Reddy

- Binary arithmetic
- Programmable
- Electronic
- Impact
- Mechanism for input/output
- Stores programs as data
- Working prototype
- . . .

Raj Reddy

Who invented the computer?

- John Atanasoff
- Charles Babbage
- Alan Turing
- John von Neumann
- Konrad Zuse

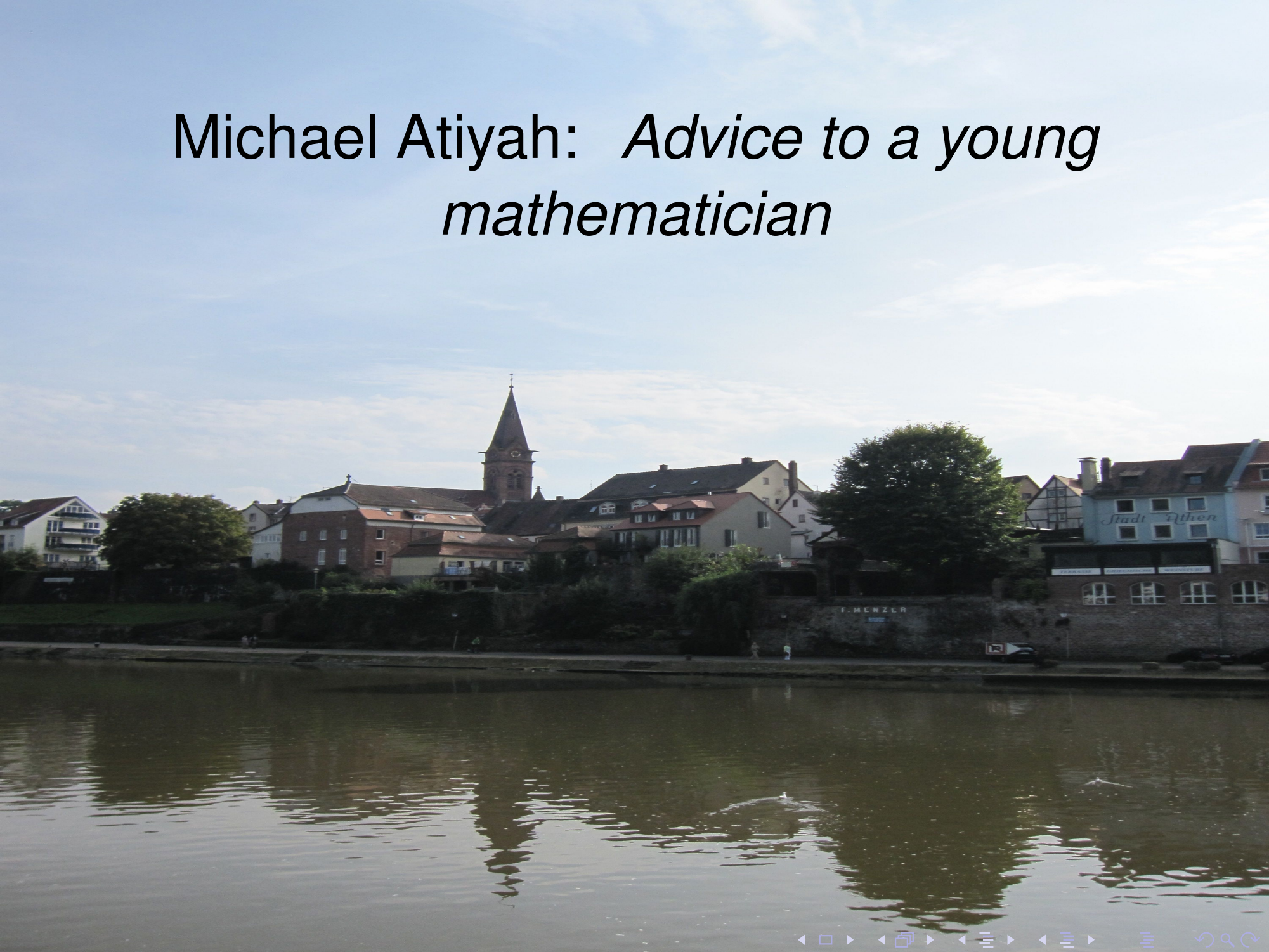
Each of these five had the fortitude to solve a problem alone with limited resources.

Raj Reddy

Some comments by Michael Rabin . . .

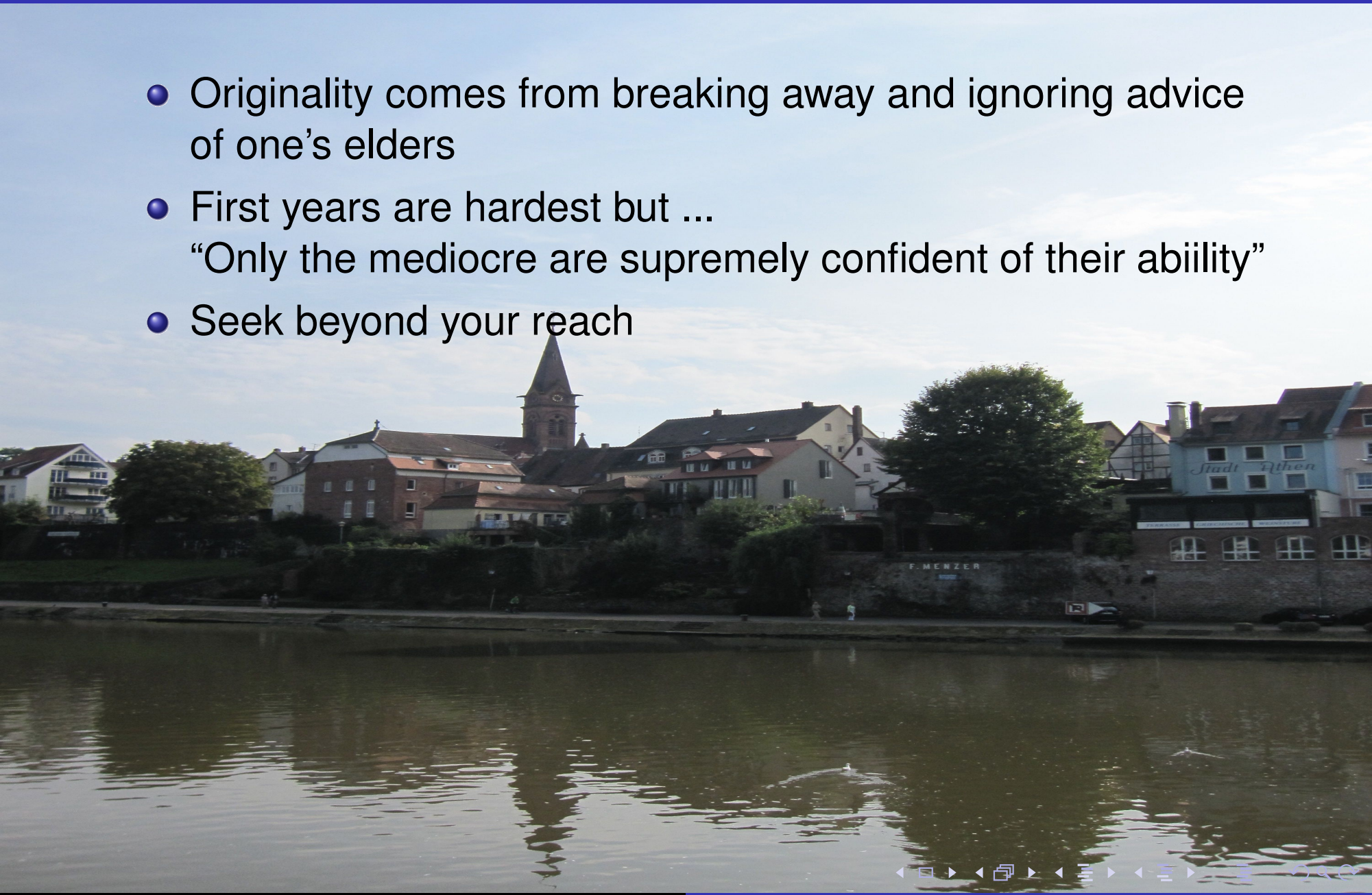
- A contribution by Turing
  - UTM had 30–40 instructions
  - Von Neumann architecture ✓
- Story of a Princeton graduate student
  - Talked to people near von Neumann when building machine
  - Definitely greatly influenced by Turing
  - Invited Turing to Princeton in 1936
  - EDVAC had several fingerprints with the letter “T” on them

Michael Atiyah: *Advice to a young mathematician*



Michael Atiyah: Advice to a young mathematician

- Originality comes from breaking away and ignoring advice of one's elders
- First years are hardest but ...
  "Only the mediocre are supremely confident of their abiility"
- Seek beyond your reach



Michael Atiyah: Advice to a young mathematician

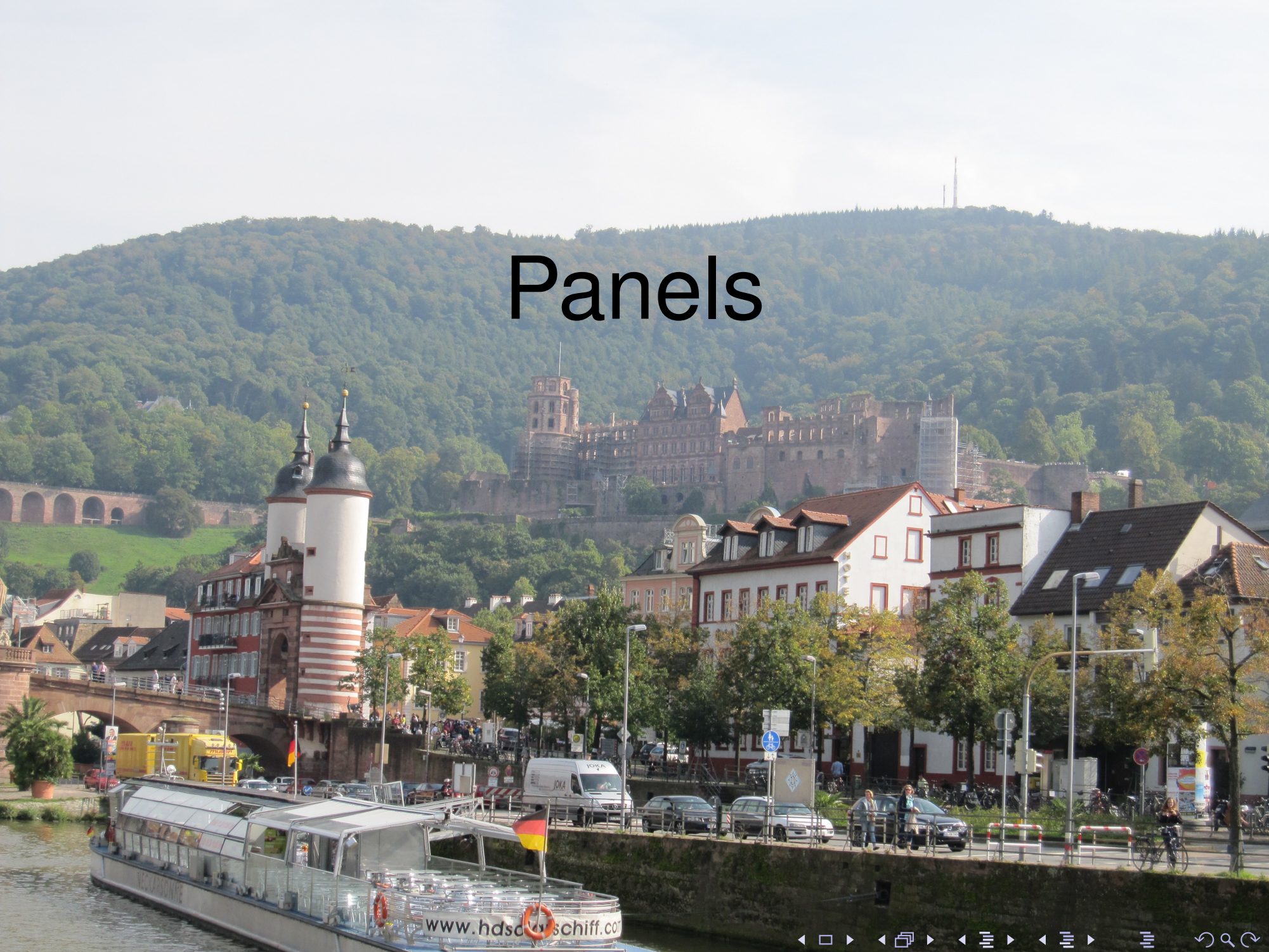
- Welcome diversity
- Conferences and seminars
- Cultivate friends and collaborations

Michael Atiyah: Advice to a young mathematician

How to get ideas?

- Follow sidetracks
- Friends and collaborations
- Bad seminars
- Find a user friendly expert

Panels



Computer Science Panel

- Edward Feigenbaum
- Shafrira Goldwasser
- Butler Lampson
- Leslie Valiant
- John Hopcroft
- Alan Kay

Computer Science Panel

Advice to Young Computer Scientists

- Put yourself in environment of real genius (Only a handful – align with their research)
- Go to a first rate institution
- Be alert to good research opportunities
- Don't do incremental research, work on the frontier
- Interact with other disciplines
- The past: make the computer useful
  The future: how the computer interacts with other disciplines

Edward Feigenbaum

Visits to Local Institutions

Visits to Local Institutions

- BioQuant
- The European Molecular Biology Laboratory (EMBL)
- German Cancer Research Center (DKFZ)
- Heidelberg Institute for Theoretical Studies (HITS)
- Interdisciplinary Center for Scientific Computing (IWR)
- Mathematical Institute of Heidelberg University and The Mathematics Center Heidelberg (MATCH)
- Max Planck Institute for Astronomy and Center for Astronomy Education and Outreach
- Max Planck Institute for Nuclear Physics
- SAP
- SAS

Wish List

Michael Atiyah, Charles Bachman, Manuel Blum, Fred Brooks, Vinton Cerf, Edmund Clarke, Stephen Cook, Fernando Corbato, Gerd Faltings, Charles Fefferman, Ed Feigenbaum, Shafrira Goldwasser, Juris Hartmanis, John Hopcroft, William Kahan, Richard Karp, Alan Kay, Butler Lampson, Curtis McMullen, Silvio Micali, Peter Naur, Michael Rabin, Raj Reddy, Ron Rivest, Dana Scott, Adi Shamir, Joseph Sifakis, Stephen Smale, Richard Stearns, Madhu Sudan, Ivan Sutherland, Endre Szemeredi, Robert Tarjan, Charles Thacker, Leslie Valiant, Srinivasa Varadhan, Cedric Villani, Vladimir Voevodsky, Avi Wigderson, Efim Zelmanov.

Wish List

- Stephen Cook — *SAT* $\in$ *NP*-Complete.
- John Hopcroft — Planarity testing (with Tarjan) and Matchings (with Karp).
- Richard Karp — *NP*-Complete Problems.
- Michael Rabin — Hash Functions (with Karp).
- Robert Tarjan — Planar Separator Theorem.
- Leslie Valiant — Complexity of Counting Problems.


HEIDELBERG
LAUREATE
FORUM
1st Heidelberg Laureate Forum
DEM LEBENDIGEN GEIST
Stunde der Kirchenmusik
Blechbläser
und Orgel

Some Laureates I Met

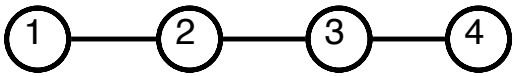
- Charles Bachman — Database Diagrams.
- Stephen Cook — Graph Isomorphism Problem.
- John Hopcroft — Similarity of graphs.
- Michael Rabin — Large Data Collection.
- Raj Reddy — Anybody know Harry Hancock?
- Avi Wigderson — Practical Life Advice.

Stephen Cook

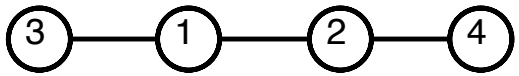
Stephen Cook

Graph isomorphism:
Is *G*1 isomorphic to *G*2?

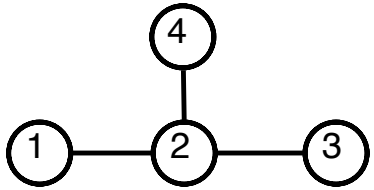
- *NP*
- *P*?
- *NP*-complete?



G1



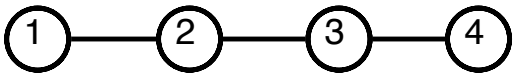
G2



G3

Stephen Cook

Chromatic equivalence:
Is $G1$ chromatically equivalent to $G3$?



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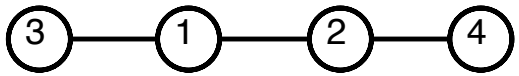
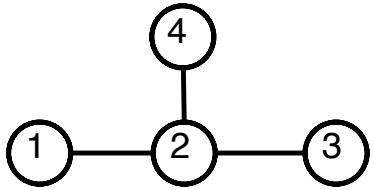


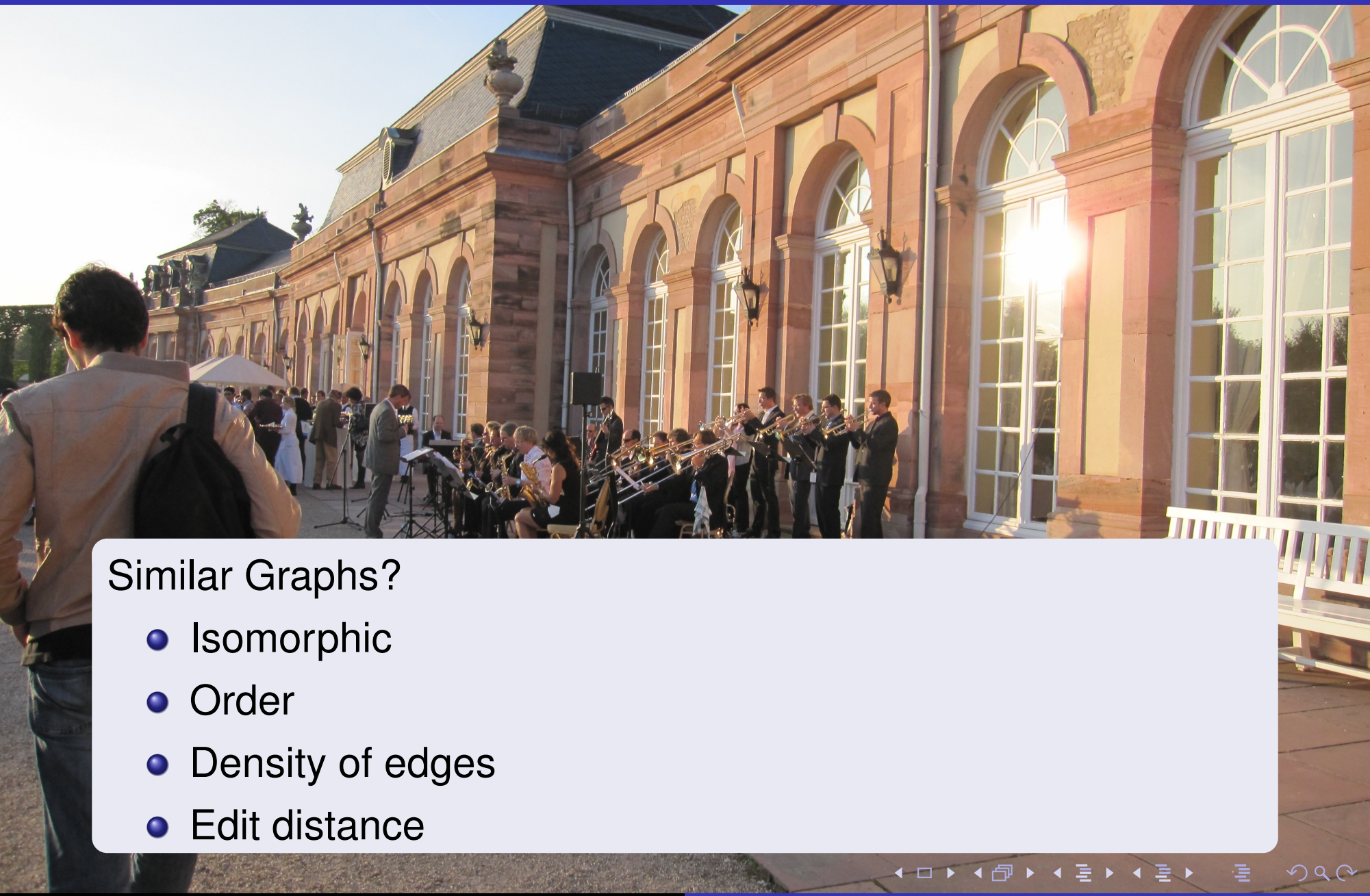
G2



G3


John Hopcroft

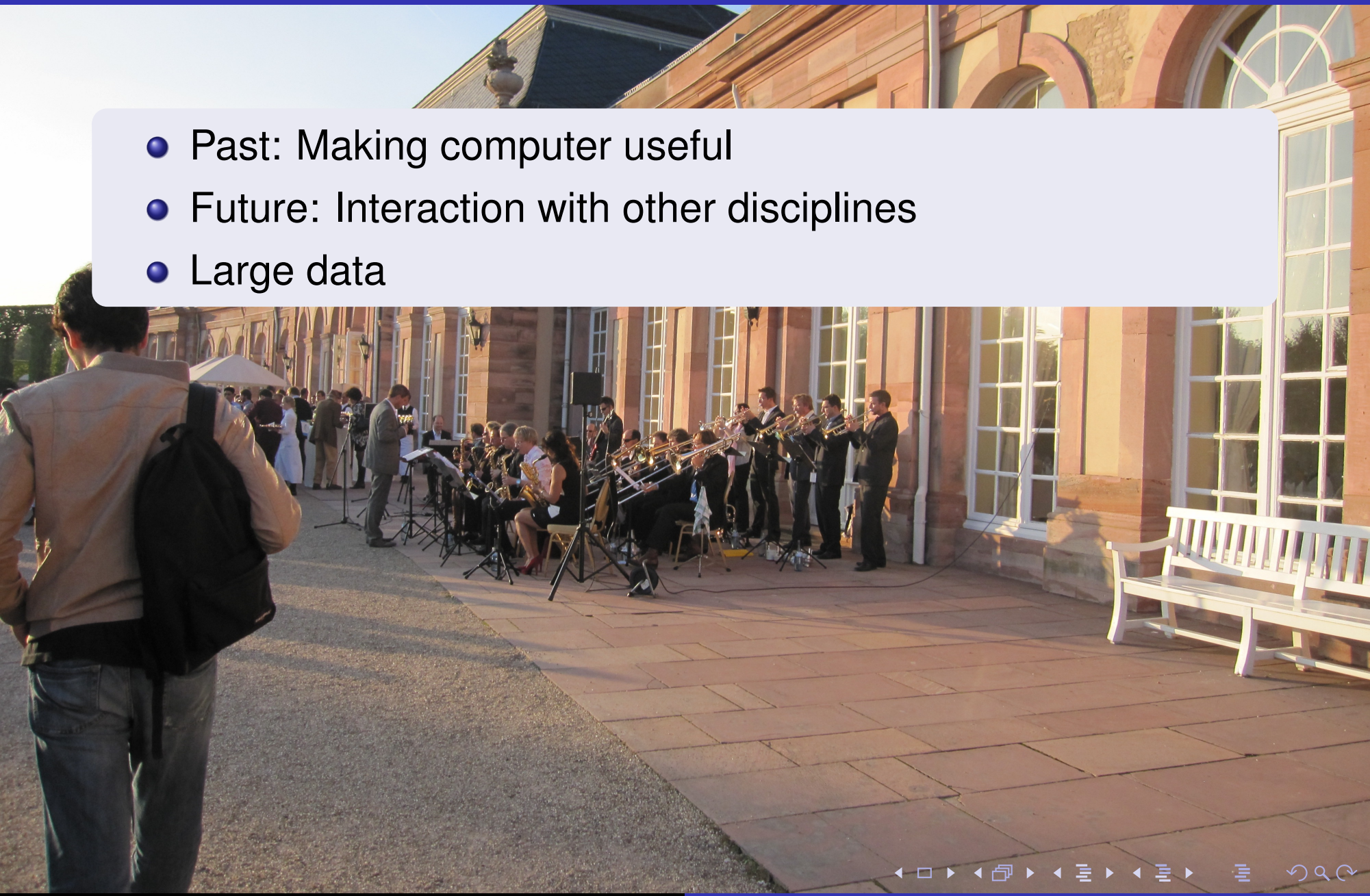
John Hopcroft



Similar Graphs?

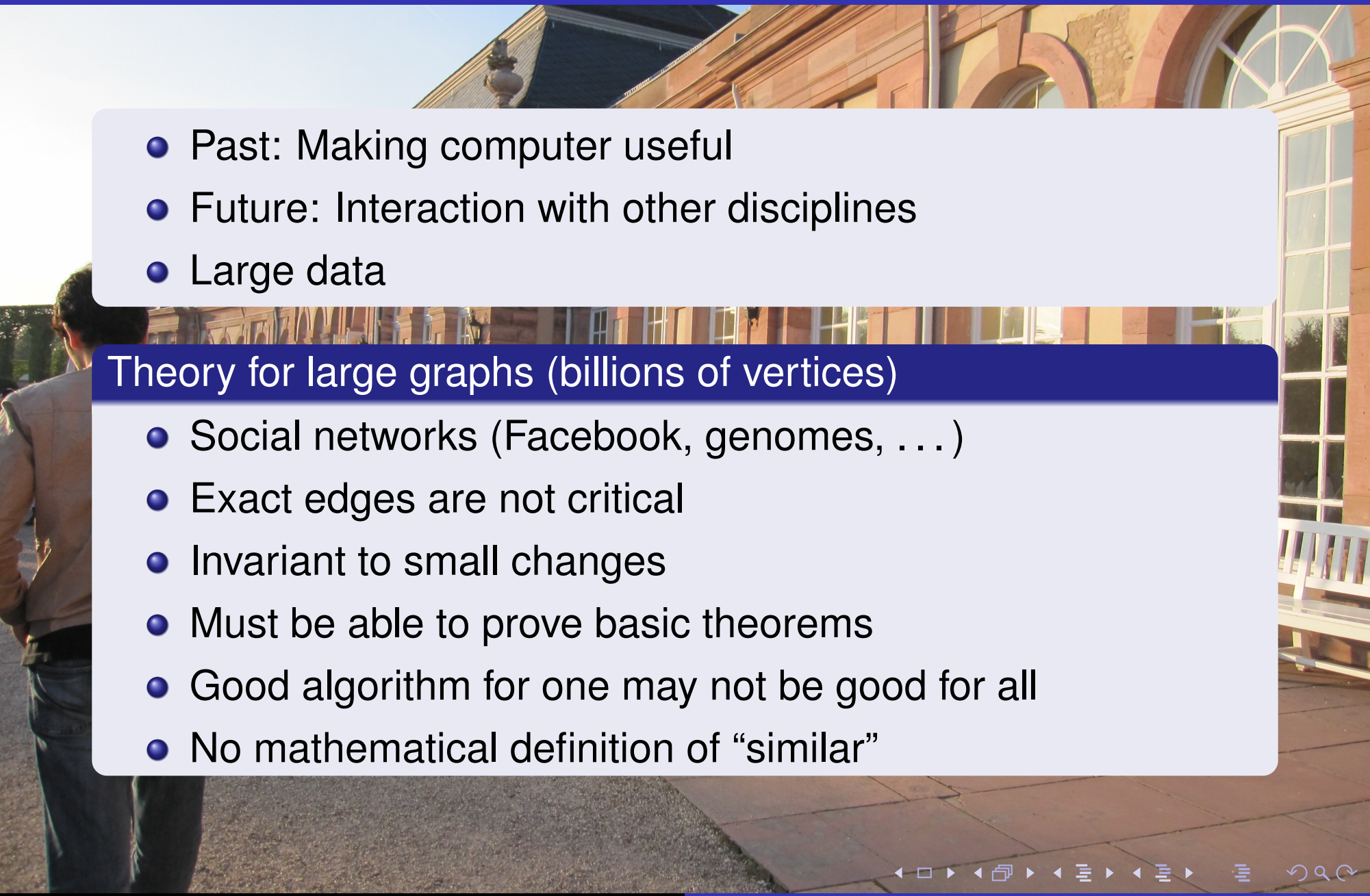
- Isomorphic
- Order
- Density of edges
- Edit distance

John Hopcroft



- Past: Making computer useful
- Future: Interaction with other disciplines
- Large data

John Hopcroft



- Past: Making computer useful
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Theory for large graphs (billions of vertices)

- Social networks (Facebook, genomes, . . .)
- Exact edges are not critical
- Invariant to small changes
- Must be able to prove basic theorems
- Good algorithm for one may not be good for all
- No mathematical definition of “similar”


Charles Bachman

Charles Bachman

First Turing Award without a PhD

- General Electric
- Integrated Data Store
- Bachman Diagrams

"*My work has been my play*"
(Bachman, Oral History Interview by Thomas Haigh, 2004)


An ex-Monash student . . .


Tim Conrad,
Project: “Metabolic Pathway”
School of Computer Science,
Monash University, 2004.

Benefits?

What are the benefits?

- New ideas.
- Insights into how the laureates think.
- Open mindedness.
- Lack of boundaries:
  - Theory and practical.
  - Pure and applied.
  - Computer science and maths.

How to Apply


AVIS
AUTOVERMIETUNG
01806 - 55 77 55
P 13
Karlsplatz / Rathaus
frei
VA 9927

How To Apply

- CV
- Awards
- Referees
- Thesis Summary
- Publications
- Workshop Proposal
- Motivation

How To Apply

Motivation

- How can I contribute?
- How can I (and others) benefit?
- Supporting evidence and examples.

Motivation

- Area of research is well suited to benefit from interaction with Laureates.
- Value input from other disciplines in my work.
- Meaningfully contribute in many areas at the Forum.
- Actively seek new areas where I can apply my research strengths and new researchers to work with.
- Good team player and have demonstrated skills in being a useful contributor.
- I will ensure others will benefit from my attendance.
- Career building advice from the Laureates.