Laudatio for Ronald Fagin

A short story of a long brilliant research career

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A brilliant scientist

Ron's research career is a much peculiar example of:

- high intensity and long time-span
- remarkable vastity
- astonishing variety and depth
- enduring influence

Ron's career by Subjects

- Logic in computer science
- Relational database theory
- Data exchange
- Fuzzy databases
- Database updates and repairs
- Finite model theory
- Information retrieval and rank aggregation
- Information extraction and entity linking
- Reasoning about knowledge
- Markov chains and probability
- Data structures

Ron's career by Numbers

- 40+ years of activity
- 86 journal papers, among which:
  - 15 JACM
  - 13 ACM TODS
  - 7 JCSS

  and, moreover, 22 papers in PODS, 10 in ICDT, 8 in STOC
- 31431 citations with h-index = 71
- 36 papers with more than 250 citations of which 13 with more than 500
- about 130 co-authors

Ron's career by Awards

- Godel Prize
- Docteur Honoris Causa from the University of Paris
- IEEE W. Wallace McDowell Award
- IEEE Technical Achievement Award
- ACM SIGMOD Edgar F. Codd Innovations Award
- IBM granted him eight Outstanding Innovation Awards, two IBM supplemental Patent Issue Awards, the IBM Outstanding Technical Achievement Award, and two IBM Corporate Awards
- 10-year Test-of-Time Awards at PODS-2011, ICDT-2013 and PODS-2014

Ron's career by Honors

- Member of the National Academy of Engineering
- Member of the American Academy of Arts and Sciences
- IBM Fellow
- Fellow of the American Association for the Advancement of Science

Ron's career by Honors - cont'ed

- ACM Fellow
- IEEE Life Fellow
- a "Ron Fagin Special Event" was held at the 2016 ACM SIGMOD/PODS Conference "in honor of Ron Fagin's influential and long-lasting research contributions to the principles of database systems"

Ron's career by "Things named after him"

- Fagin's theorem
- Fagin's hierarchy
- Fagin's algorithm
- Fagin's 0-1 law
- Fagin's games
- Fagin's inverse

Ron's career by Research Pearls

A difficult problem....

- too many of them to discuss them all
- all so relevant that discarding some of them from discussion sounded sinful

As for the first point, I decided to limit myself to just three research pearls.
As for the second, I decided to simply follow my "research taste".

Ron's career by Research Pearls

... and here are the pearls I chose:

Pearl 1 *Fagin's theorem and hierarchy*
Pearl 2 *Fagin's algorithm*
Pearl 3 *Fagin's 0-1 law*

Ron's career by Research Pearls - Pearl 1

Fagin's theorem: *The set of all properties expressible in existential second-order logic is precisely the complexity class NP.*

This is a quite surprising characterization of the class NP since it does not refer any model of computation (such as, e.g., a Turing machine)

Ron's career by Research Pearls - Pearl 1

Fagin's hierarchy:

- Imposing bounds on the maximum allowed arity of second order predicates, a hierarchy naturally pops out within NP by restricting the arity of second order predicates.
- Surprisingly, the separators of this *proper* hierarchy are very simple problems, like telling the eveness of the number of tuples included in a relation.

For instance, monadic existential second-order logic allows to express 3-colorability (a well-known NP-complete problem) but not to tell if a relation with two columns contains an even numer of tuples!

Ron's career by Research Pearls - Pearl 2

Fagin's algorithm:

- The algorithm solves the problem of providing answers to queries in multimedia systems where different data-type subqueries are involved
- An example is one of a query that is a conjunction of a standard relational subquery with one that asks for retrieving, from an image data server, objects, say, colored someway, like in "Give me all Beatles' albums whose covers are mostly red"

Ron's career by Research Pearls - Pearl 2

Fagin's algorithm:

- The problem here is that a set (the result of the first subquery) must be conveniently combined with a list (the result of the second subquery)
- Fagin's algorithm, based on fuzzy logic, has a $\sqrt{n}$ time complexity, where n is the database size, which matches the problem lower bound

Ron's career by Research Pearls - Pearl 3

Fagin's 0-1 law:

- It says that first order sentences are "either almost always true or almost always false".
- In words, as the size of the finite structures involved in the first order sentence gets larger and larger, the fraction of structures that satisfy the sentence will converge, and it will converge to either 0 or 1.

This result uncovers a surprising and extreme neatness in the structure of the theory: indeed the probabilities might not converge or do converge to any value in between 0 and 1; instead, they always converge and always to 0 or 1!

Concluding, it is "common knowledge" in our community that we owe great many thanks to Ron for his incredible contribution to the advancement of our science.

For this reason, the Laurea Honoris Causa he is awarded with today is definitely well deserved