International Mathematics in the 21st Century

AMSI
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

AMSI MINI SYMPOSIUM June 15 2009

in recognition of

Professor Phil Broadbridge

Jonathan Borwein, FRSC www.cs.dal.ca/~jborwein

Canada Research Chair in Collaborative Technology

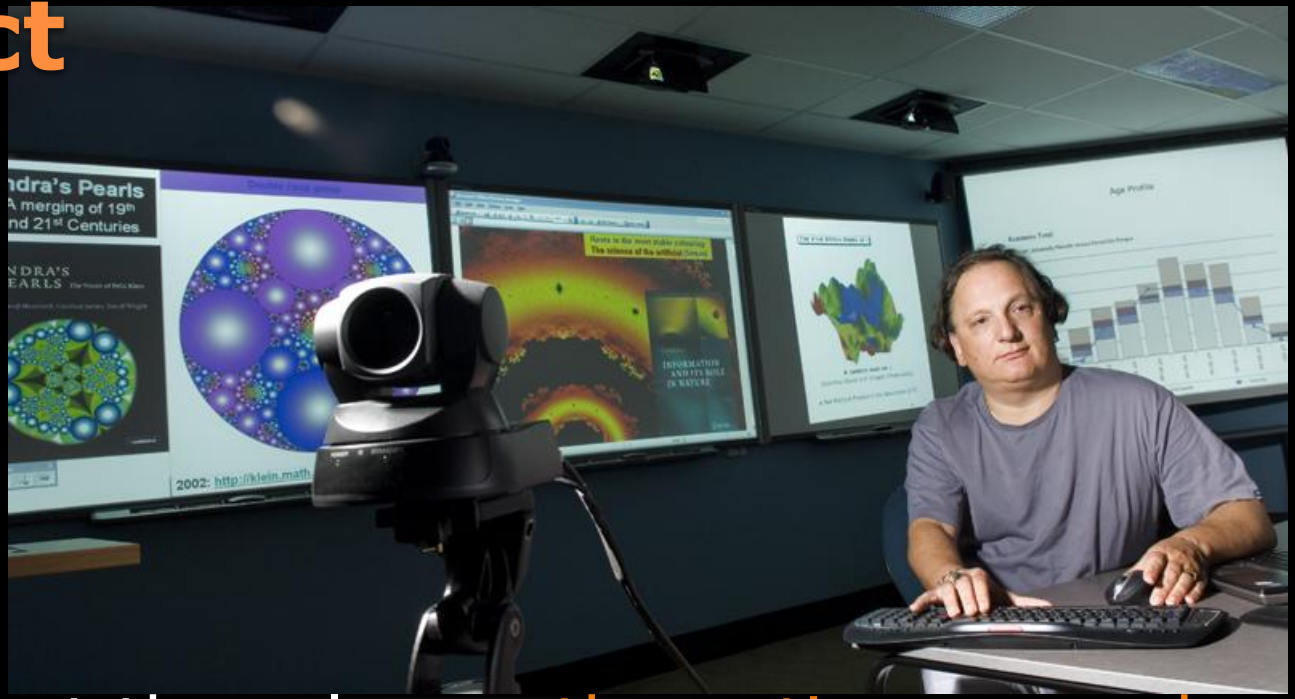
Laureate Professor University of Newcastle, NSW

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Revised 12-06-09

Abstract

Newcastle AGR
- thanks AMS1 !



- Let's look at the roles mathematics research institutes and their directors play
  - in the fast-moving, slowly-changing world we inhabit as scientists and as humans
- and try to identify the traits of "HEDOMAC's"

"We would encourage a mix of anecdotes and mathematics"

- Was Jan, Geoff and Kerry's request
  - "front load" your grant titles and your talks
- So here is one piece of maths
  - (a) "arcsin" known for two centuries
  - (b) used in Apéry's 1978 irrationality proof of

$$\zeta(3) := \sum_{n>0} 1/n^3$$

  - discovered as early as 1890 by Markov

$$(a) \quad \zeta(2) = 3\sum_{k=1}^{\infty} \frac{1}{k^2 \binom{2k}{k}}$$

$$(b) \quad \zeta(3) = \frac{5}{2}\sum_{k=1}^{\infty} \frac{(-1)^{k+1}}{k^3 \binom{2k}{k}}$$

Two Discoveries: 1995 & 2005

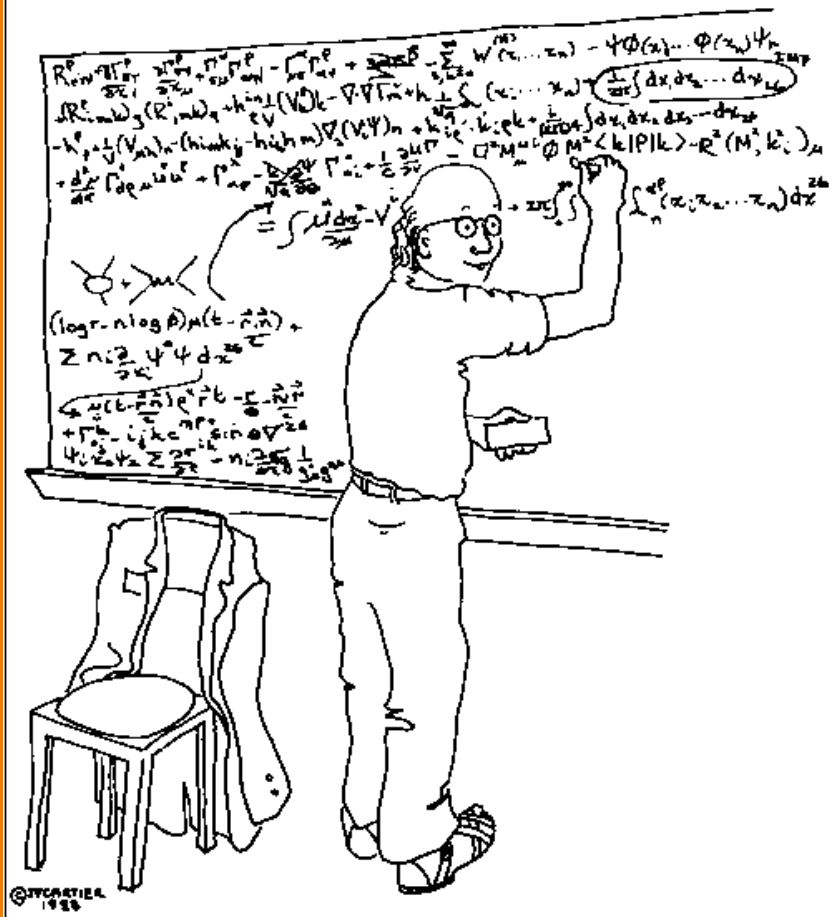
- computer-discovered generating functions
  - (1) was `intuited' by Paul Erdös
- and (2) was a designed experiment
  - was proved by the computer (Wilf-Zeilberger)
  - and then by people (Wilf included)

$$\sum_{k=0}^{\infty} \zeta(4k+3)\, x^{4k} \quad = \quad \frac{5}{2} \sum_{k=1}^{\infty} \frac{(-1)^{k+1}}{k^3 \binom{2k}{k} (1 - x^4/k^4)} \prod_{m=1}^{k-1} \left(\frac{1 + 4x^4/m^4}{1 - x^4/m^4} \right) \qquad (1)$$

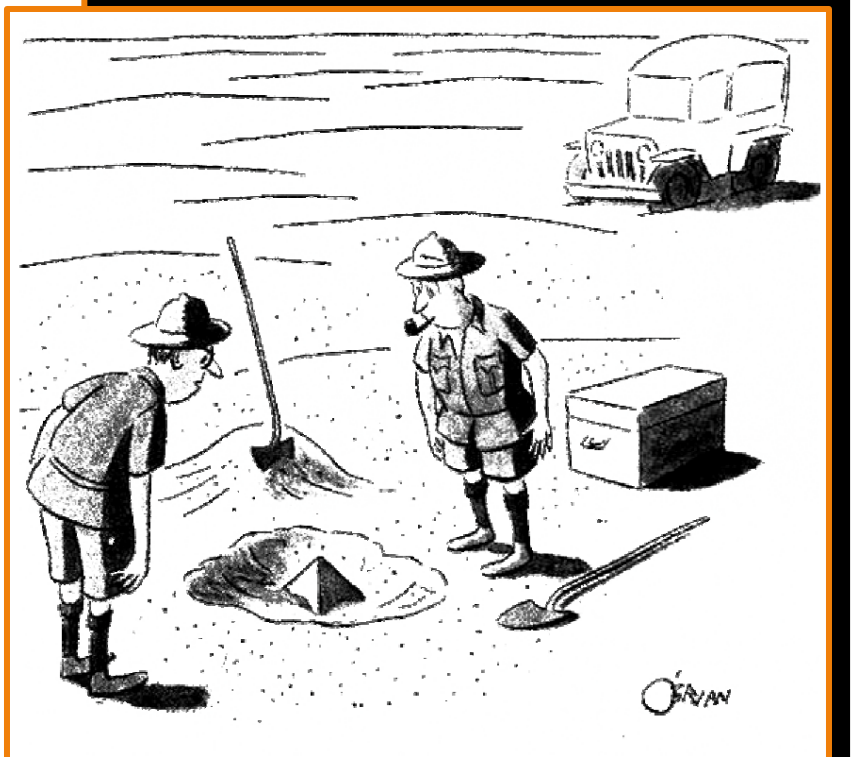
x=0 gives (b) and (a) respectively

$$\sum_{k=0}^{\infty} \zeta(2k+2)\, x^{2k} \quad = \quad 3 \sum_{k=1}^{\infty} \frac{1}{k^2 \binom{2k}{k} (1 - x^2/k^2)} \prod_{m=1}^{k-1} \left(\frac{1 - 4\,x^2/m^2}{1 - x^2/m^2} \right) \qquad (2)$$

Modern Geometry?



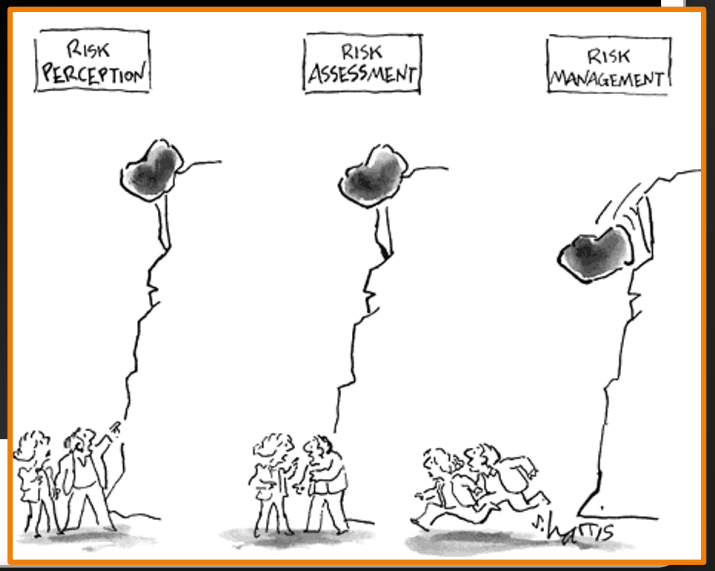
"At this point we notice that this equation is beautifully simplified if we assume that space–time has 92 dimensions."



"This could be the discovery of the century. Depending, of course, on how far down it goes."

Why Institutes Matter?

- Support
  - scientific, moral and financial,...
- Advocacy
  - government, Councils, DVC's, private sector,...
- Communication
  - public/press, other fields, ourselves, ...
- Innovation
  - with all due haste
  - anticipates needs, desires, and trends
- Expecting the Unexpected

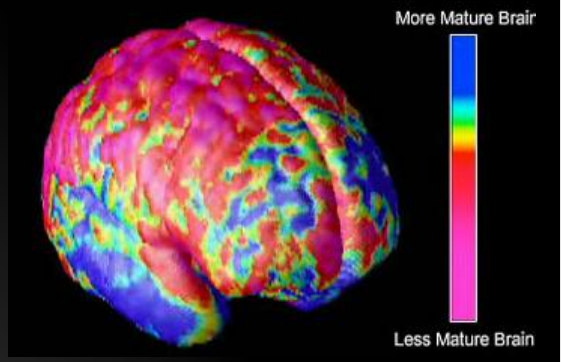


What are good directorial skills?

- Wears dress clothes well
  - Phil can, I can't
- Travels well
  - ability to work in airport lounges, hotels, ...
- Remembers and correctly uses acronyms
  - AMSI, DIMACS, IMU, IMO, IMA, ERA, CEIC, ...
- Has high tolerance for repetition
  - with feeling---to same or different groups
  - stays on message
- Knows the community
  - Phil does, not all directors do:

Some do's and don'ts

- Ekeland at PIMS
  "Harry Potter is dangerous"
- Thurston at MSRI
  - no Fields medal for organizational skills
  - my favourite complement
- Marsden at Fields
  - should live in same country some of the time
- Friedman and Arnold at IMA
  - got all the intricacies right
  - NSF gave them more $$'s than they requested
- Some final Maths ...



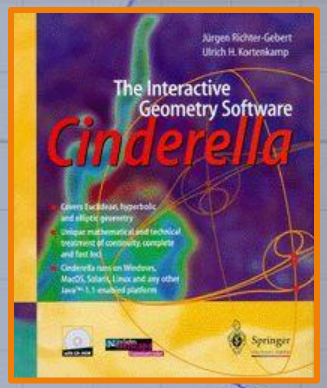
Two more do's and don'ts

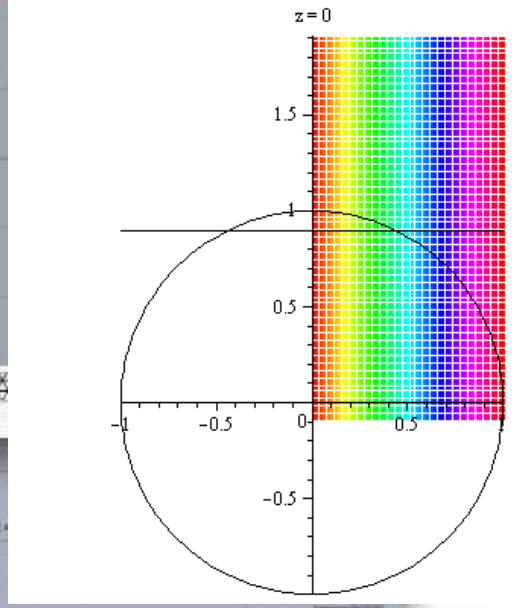
CAS+IGP: the Grief is in the GUI

Divide –and-Concur
before and after accessing numerical output from Maple

After Maple

Numerical errors in using double precision





"Good Night and Good Luck"

- Phil, thanks for your energy and leadership
  - thanks for hiring Russell and Anya Luke
- Best of luck with your next adventures