# The L³D Approach

## to Intelligence Augmentation

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**UNED, Madrid Spain**

**FIT**

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# Intro to me

- Who am I

  - An example of lifelong learning (3rd career)

  - PhD at the University of Colorado in 2006

  - Senior Researcher at Fraunhofer institute (FIT) in accessibility issues and DfA

- Where I studied

  - PhD in Computer Science with certificate in Cognitive Science with Gerhard Fischer

  - $L^3D$ = the centre for Lifelong Learning and Design

  - $L^3D$ is part of the Computer Science and Cognitive Science disciplines
    Basic research about real world problems

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# Me Too

- ## My interests

    - Developing and studying socio-technical systems supporting inclusiveness and independence for persons with disabilities and the elderly

    - Social analysis of information technology; mobile technologies; contextually aware technologies; "everyday" artefacts; situated cognition, technology adoption

- ## What I do now

    - Senior Researcher at the Fraunhofer Institute for Applied Information Technology (FIT) in the BIKA group

        o EU4ALL project - providing support for people with disabilities to effectively use eLearning

        o DfA@eInclusion - supporting and encouraging industry adoption of design for all principles

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# Intro to L³D

The Centre for Lifelong Learning and Design (L³D) is part of the Department of Computer Science and the Institute of Cognitive Science at the University of Colorado at Boulder. The mission of the centre is to establish, both by theoretical work and by building prototype systems, the scientific foundations for the construction of intelligent systems that serve as amplifiers of human capabilities.

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# Intro to L³D

## L3D has two parent organizations:

- the Department of Computer Science and
- the Institute of Cognitive Science

## L3D interacts with:

- other academic units at CU Boulder: College of Architecture and Planning,
- K-12 schools and community groups
- Government laboratories: NCAR/UCAR
- industrial partners: BEA, Siemens, IBM, Apple, PFU, SRA

## •L3D members are drawn from:

- Computer science
- Education
- Psychology
- Electrical engineering
- Architecture / urban planning
- Micro-biology
- Sociology / anthropology

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# How is this relevant to adaptive interfaces?

AI techniques are like technical proficiency in music

Unless you will work in a very big institution you will be thinking about design and about your end-user – as you are now doing in studying adaptive interfaces

To think about end-users you end up thinking about:

- The context of use

- The larger goal of use

So what does the L$^3$D approach have to say about this?

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# L3D general approach

- Artificial intelligence (AI) ⇨ intelligence augmentation (IA)

- Instructionist learning ⇨ constructionist learning

- Individual focus ⇨ social contexts

- Things that think ⇨ things that make us smart

- What computers can do ⇨ human and computer synergies

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# L3D general approach

## Artificial intelligence (AI) ⇨ intelligence augmentation (IA)

- replacement → empowerment

- emulate → complement (exploit unique properties of new media)

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# The Importance of representations

Solving a problem may simply mean representing it so as to make the solution transparent

Here is an example: two person game

Take the numbers from 1 to 9

Players alternate and take one of the numbers

The player who can add exactly three numbers in her/his possession to equal 15 will win
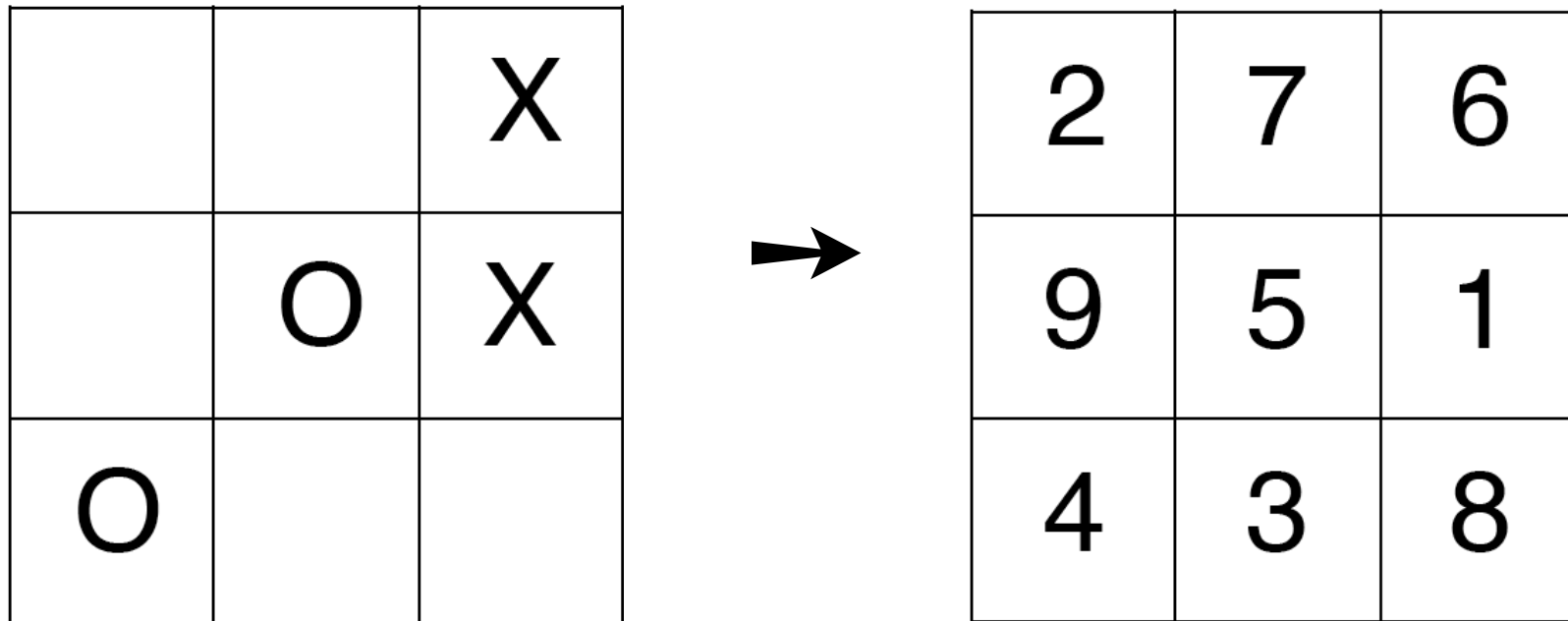
# 1,2,3,4,5,6,7,8,9

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# The Importance of representations$_2$

### Tic-Tac-Toe

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# The Importance of representations[3]

Tic-Tac-Toe ➙ The Same Game



| | | X |
|---|---|---|
| | O | X |
| O | | |

➡

| 2 | 7 | 6 |
|---|---|---|
| 9 | 5 | 1 |
| 4 | 3 | 8 |

12 year old kids can beat Graduate students

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## Instructionist learning ⇨ constructionist learning

### Learning about ⇨ Learning to be

More empowering to participate (with augmented skills) in knowledge construction than to be given knowledge*

When the answer is known ⇨ when the answer is not known (collaborative knowledge construction)

$$*\text{However: } \sqrt{2}$$

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# Individual Focus ⇨ Social Contexts

**Knowledge in the head ⇨ knowledge in the world**

Distributed intelligence

The "person + artefact" is smarter than either alone

Einstein: "My pencil is cleverer than I"
cockpit (pilot + computers) of an airplane

**Access ⇨ informed participation**

The curious word 'empowerment'

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# Things that think ⇨ things that make us smart

## What computers can do ⇨ Human and computer synergies

| Humans | Computers |
|---|---|
| creative, vague | dumb, precise |
| compliant, disorganized | rigid, orderly |
| attentive to change, distractible | insensitive to change, undistractable |
| resourceful, emotional | umimaginative, unemotional |
| flexible, inconsistent | consistent, inflexible |

(source: Norman, D. A. (1993) Things That Make Us Smart)

*black: human-centered view blue: computer-centered view*

## Computational ⇨ Computational and physical

- By moving input to tangible objects you change the metaphor and utilize existing affordances

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# Gift wrapping

**"gift-wrapping" with new media ⇨ co-evolution of media and new theories about thinking/working/learning / collaborating**

Two ways of seeing this:

1) Casting existing content and paradigm into new media does not automatically guarantee that it is better than the original way

2) By studying and experimenting with new media one can learn its inherent strengths and weakness

Examples:

digital often is more brittle (not graceful degradation)

really awful PowerPoint presentations

silver bullet mirage (CDrom or Ada anyone?)

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# L3D tool kit - a Sample of General tools

- Wicked problems

- Symmetry of ignorance

- Distributed Cognition

- Situated Action/Cognition

- Socio-technical environments

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# Wicked problems

Wicked problems have:
- incomplete,
- contradictory, and
- changing requirements.

The problem is not understood until after formulation of a solution.

Stakeholders have radically different worldviews and different frames for understanding the problem.

Constraints and resources to solve the problem change over time.

The problem is never solved but solutions to wicked problems are typically better, worse, or good enough (satisficing).

*Does this sound familiar?*

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# Wicked problems$_2$

What to do?

1) Explicitly involve all stake holders

2) Under design solutions (allow for  seed,evolve, reseed)

3) Design for change (see metadesign)

Just knowing that the problem is wicked helps

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# Symmetry of ignorance

Symmetry of ignorance (or asymmetry of knowledge)

A way of describing situations in which several participants or roles in an endeavour each individually have parts of the knowledge needed to accomplish the task, but none has enough to accomplish the task independently

Example: Hotel reservation system - designed by programmers alone it might run and be robust , but totally useless for making hotel reservations. Designed by hotel reservationists it has a totally fitting interface and supports everything you might want - but it continuously crashes

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# Symmetry of ignorance$_2$

Symmetry of ignorance is part of why domain spanning initiatives might be so successful

An acknowledgement of symmetry of ignorance is the concept of a Community of Interest

Communities of interest are groups of people (typically coming from different disciplines) which engage in a joint activity.instead of being obstructed by lack of expertise one gets a synergistic coverage of the domain

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# Distributed Cognition

Knowledge does not reside solely in our head.

Knowledge exists distributed between head and artefact:

- Books
- Maps
- Computers
- Street signs

Distributed cognition changes the task
  memorizing --> reading
  store clerks --> barcodes

De-skilling tradeoffs
  GPS navigation in Paris
  bookshelf of nautical navigation text

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# L3D projects

# EDC (The Envisionment and Discovery Collaboratory)

# CLever

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# EDC / PITA- board

New interaction approaches for small groups

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# Pita video

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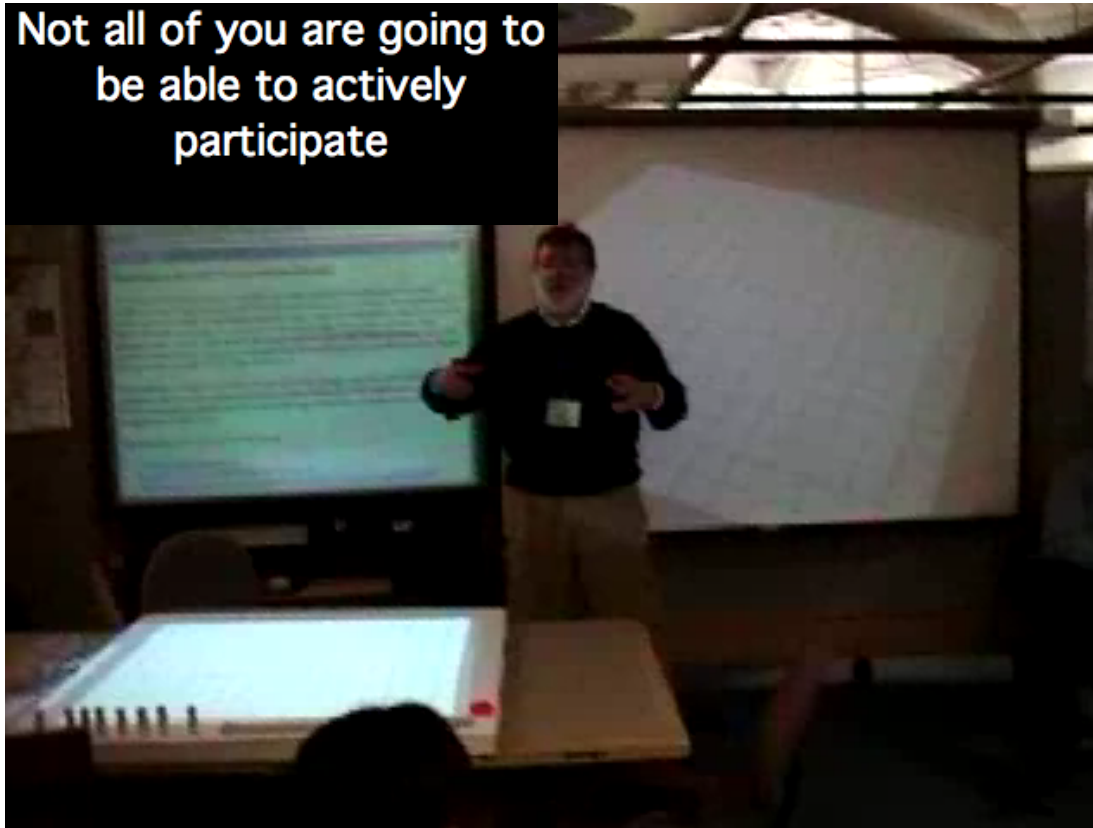
# PITA - EDC

What did you see:

Action / reflection spaces

tangible interactions

critics

agents

What was happing:

constructed knowledge

making the tacit explicit

participate rather than inform

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# CLever

## CLever: Building Cognitive Levers to Help People Help Themselves

The mission of the Cognitive Lever, or CLever, project is to develop computationally enhanced environments designed to assist not only people with a wide range of cognitive disabilities, but also their support community.
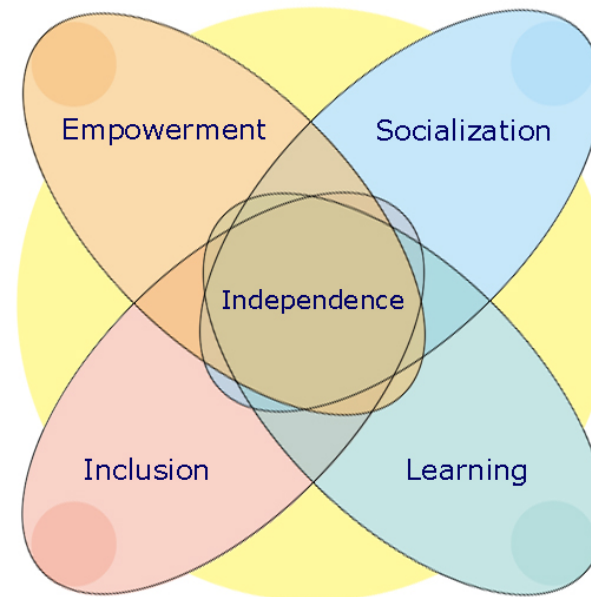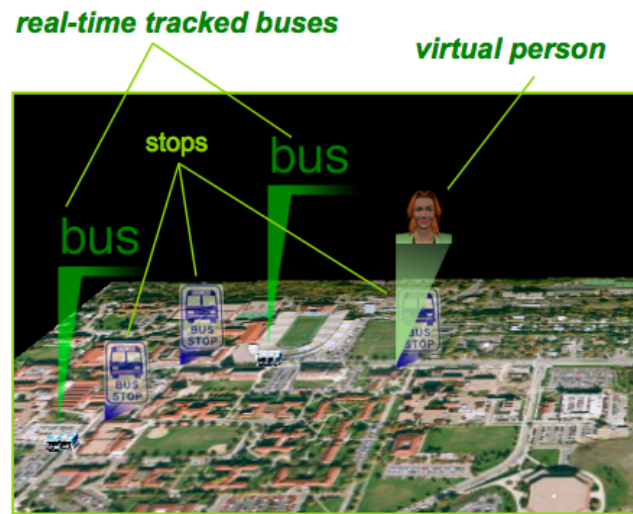
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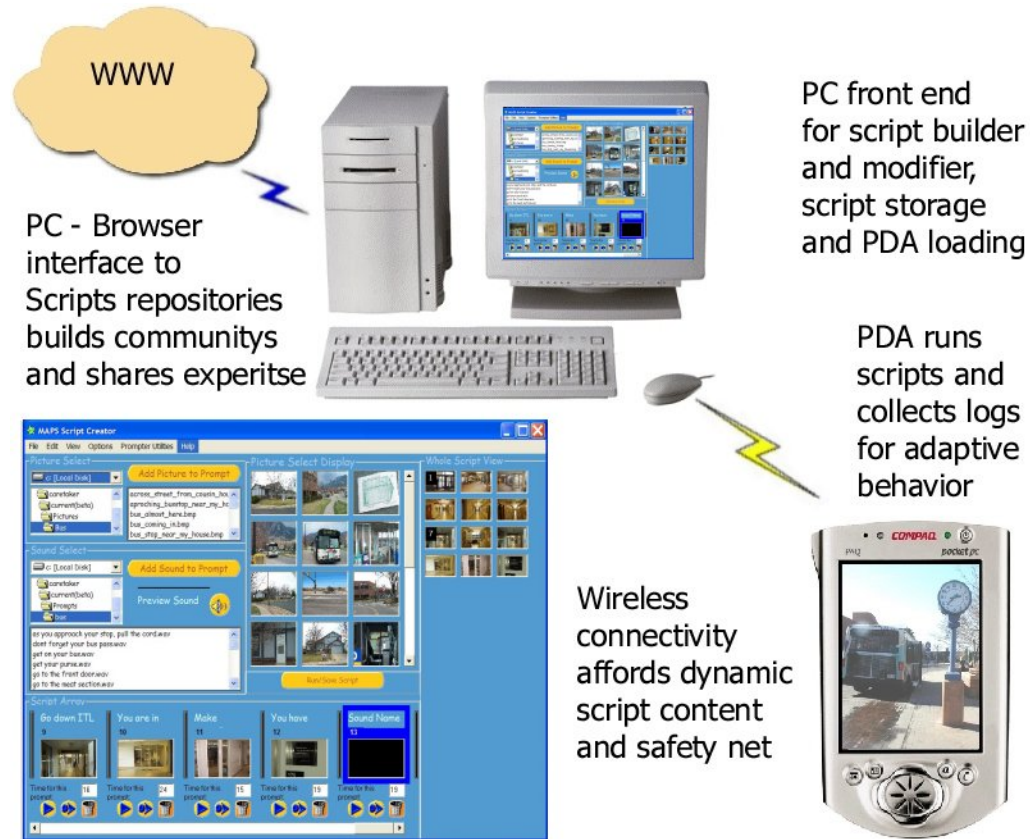
Cognitive Lever Project
*Helping people help themselves*

# Mobility for All

# Memory Aiding Prompting System

# Tools from CLever

- Universe of one

- Dyads

- Low hanging fruit

- Metadesign

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# MetaDesign

Design for designers

- Design approach  to making artifacts that can be used to design further artifacts

End-users use metadesign tool to do design thus changing the tool

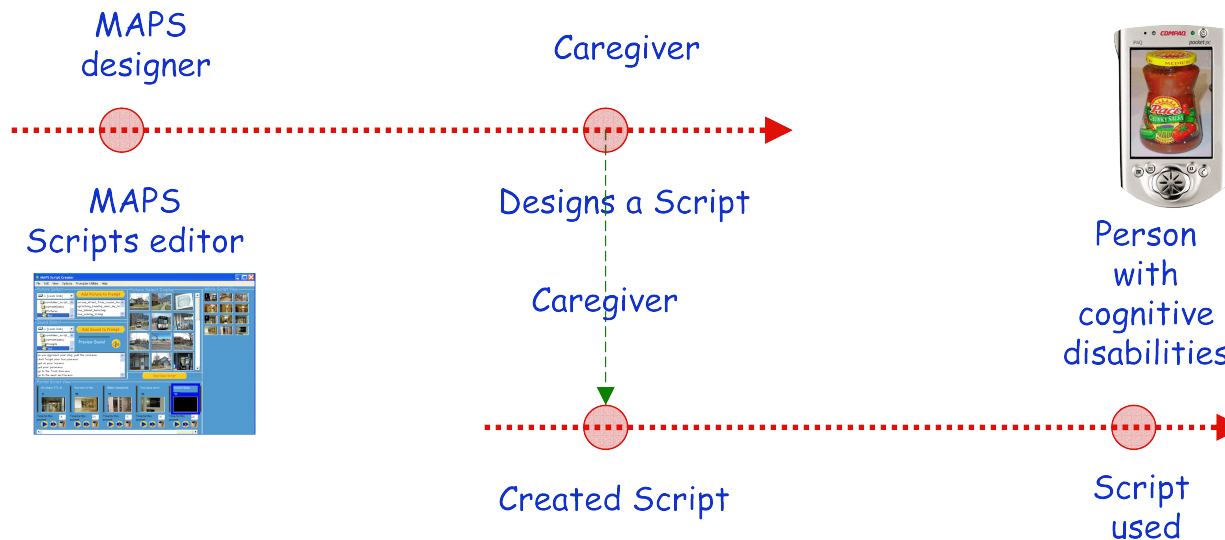- Design at tool design time

- Design at metadesign tool use time

Metadesign tools are typically under-designed

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# MetaDesign$_2$

Because persons with cognitive disabilities cannot design their own scripts the end-user must be composed of the person with cognitive disabilities *and* the caregiver

Editor must be designed to:

- tightly fit the problem of making scripts ⊠ immediate usefulness

- loosely fit enough to allow deep customization of scripts ⊠ no ceiling on possible scripts



MAPS designer

Caregiver

MAPS Scripts editor

Designs a Script

Caregiver

Person with cognitive disabilities

Created Script

Script used

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Carmien, S. (2005) "End User Programming and Context Responsiveness in Handheld Prompting Systems for Persons with Cognitive Disabilities and Caregivers," Proceedings of CHI'05 Conference on Human Factors in Computing Systems, Portland Oregon, pp. 1252 - 1255.

# What is the goal of all this theory…..

If we understand socio-technical environments as complex interweaving of man, artefact and technological infrastructure, we can better assist in truly supporting the aspirations of our end-users

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## Conclusion

Thanks for coming to my talk
and my thanks to Professor Boticario for inviting me.

If you have any questions or comments later I'm at

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