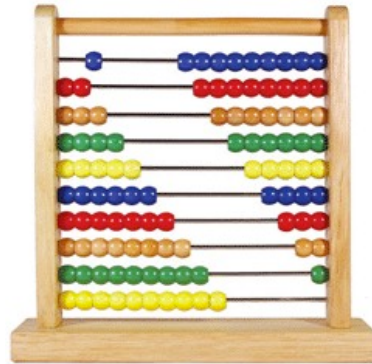


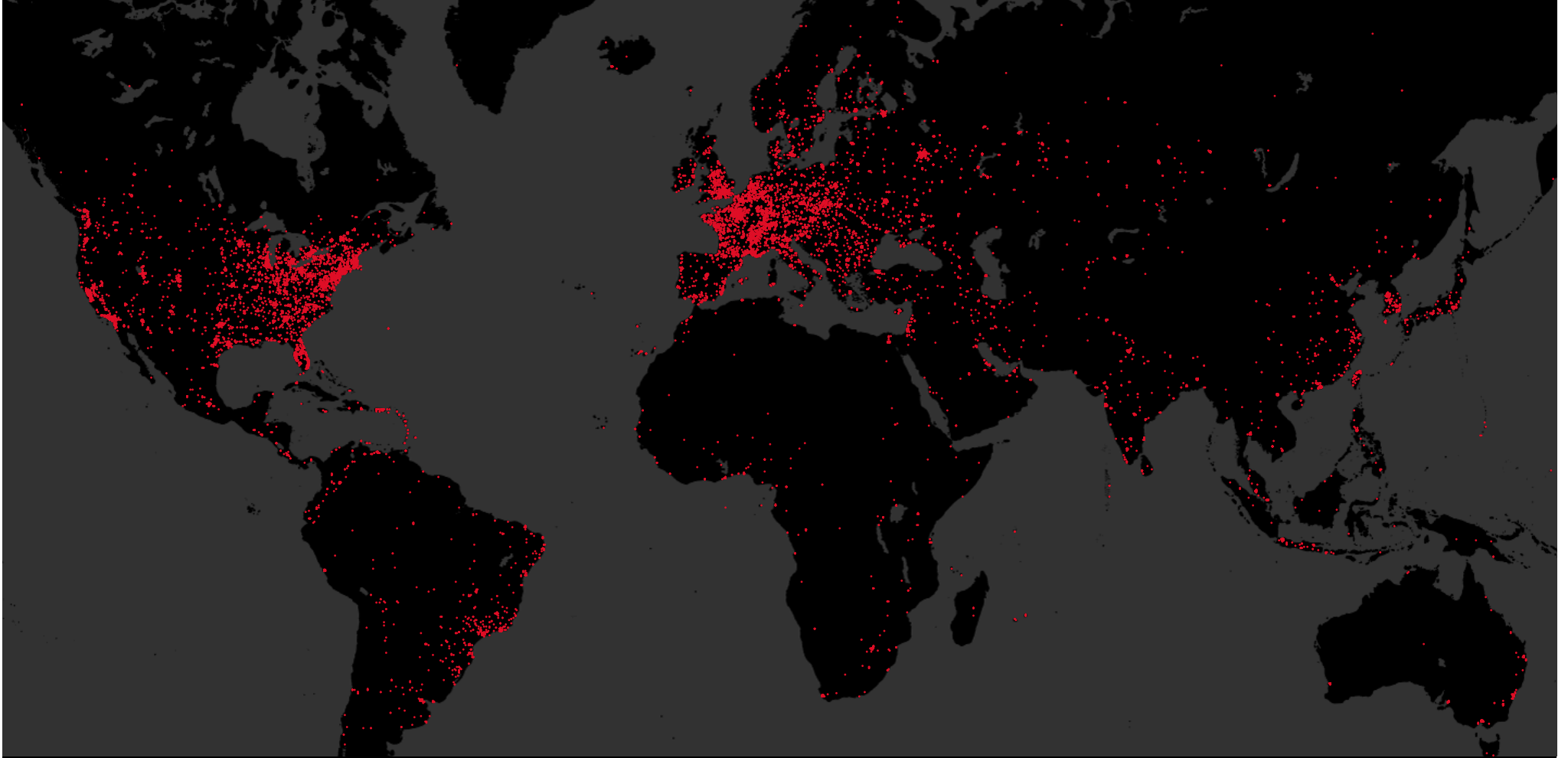
# CS-411 : Digital Education & Learning Analytics

## Chapter 1: Introduction



Pierre Dillenbourg, Patrick Jermann, Thanasis Hadzilakos & Stian Haklev

# EPFL MOOCs



1'400'0000

## Massive Open Online Courses (2008)

Technology-enhanced learning (2004)

Virtual Campus (2000)

Learning Management Systems (1999)

Virtual University (1999)

Open Learning (1995)

e-Learning (1993)

Online Education (1993)

Computer-Mediated Learning (1990)

Educational telematics (1988)

Computer-Assisted Learning (1985)

Computer-Based Learning (1980)

Computer-Assisted Instruction (1960)

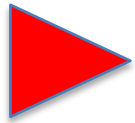
# CS-411 Part I: From theory to design

Learning theory → Learning Technology

*How people learn*

*How technology supports learning*

---



1. Behaviorism → Adaptive Instruction

2. Constructivism → simulations, microworlds

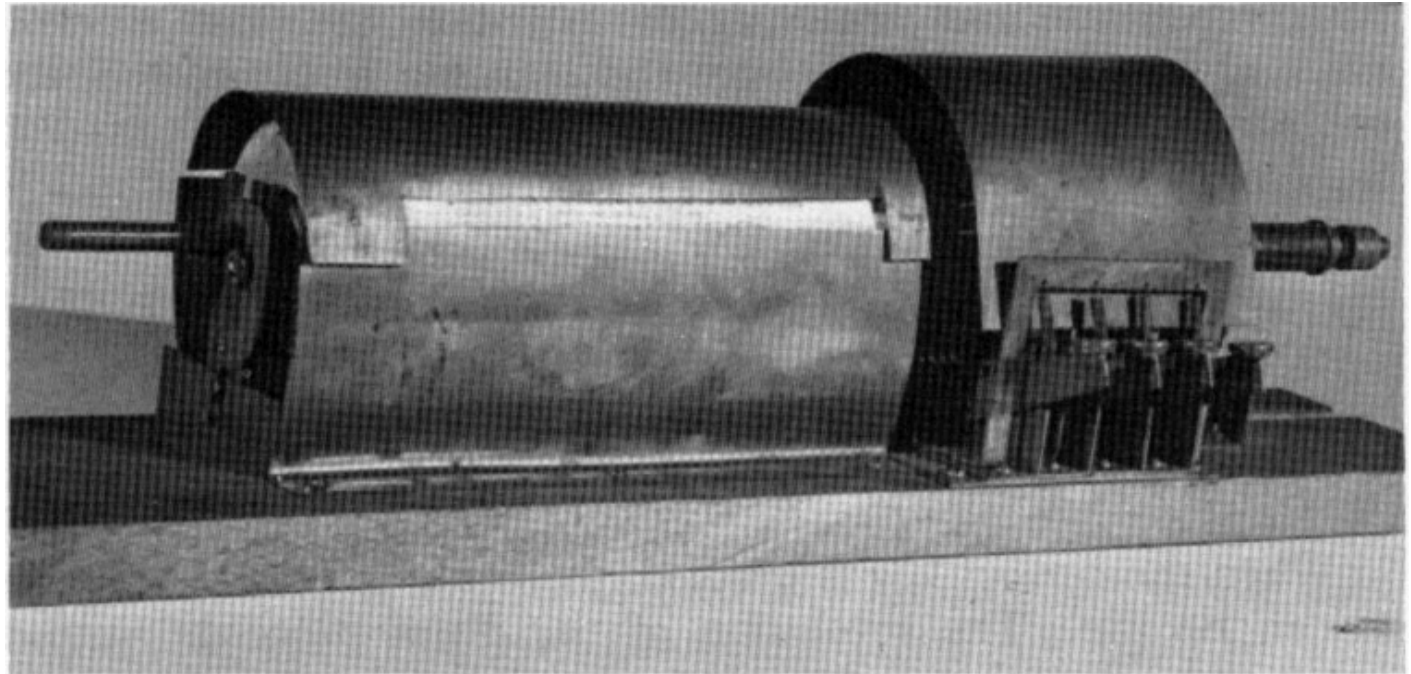
3. Social cognition → groupware, communication





“If, by a miracle of mechanical **ingenuity**, a book could be so arranged that **only** to him who had done what was directed on page one would page two become **visible**, and so on, much that now requires personal instruction could be managed by print. (page 165)”

Thorndike, E.L. (1912, published 1923). *Education: A First Book*. New York: Macmillan Co.



**FIG. 1. A multiple-choice device which omits items from further presentation once the student can consistently answer them correctly. 1927**

## First « teaching machine »

Sidney PRESSEY, Professeur de psychologie de l'éducation, Ohio State University

- In some window appears 1 question and 4 answers
- The machine has 4 buttons, one per answer
- The machine records the answer and updates a counter
- Questions correctly answered are not re-proposed



B. F. Skinner

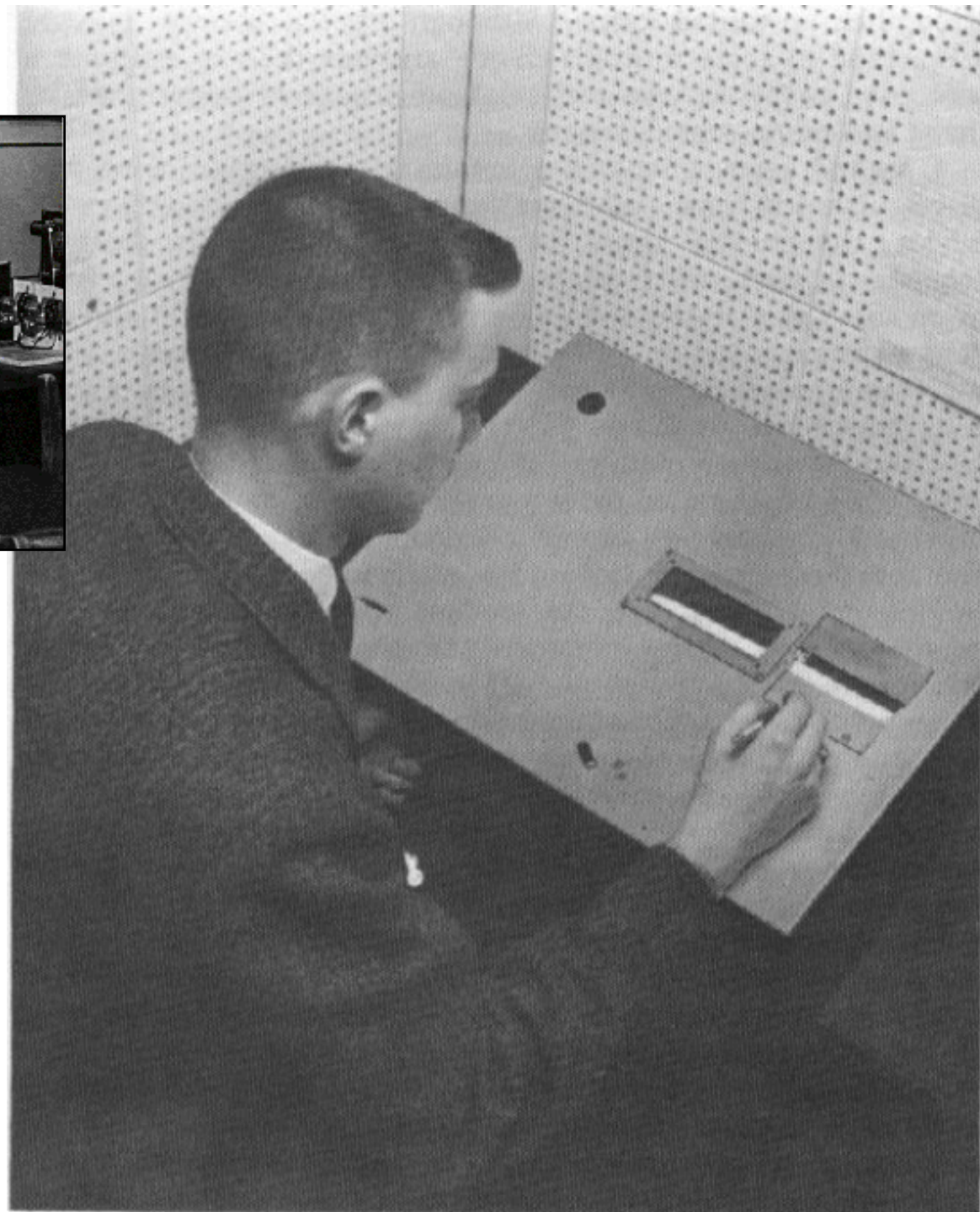


FIG. II. Student at work in the self-instruction room. Material appears in the left-hand window. The student writes his response on a strip of paper exposed at the right.

Massive Open Online Courses (2008)  
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Online Education (1993)  
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Educational telematics (1988)  
Computer-Assisted Learning (1985)  
**Computer-Based Learning (1980)**  
**Computer-Assisted Instruction (1960)**

$$9 \times 5 = 45$$



$$6 \times 7 = 43$$



$$6 \times 7 = 44$$



$$6 \times 7 = 42$$





Quitter

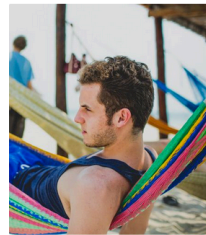


Choisis la traduction de "homme"



☐ apple

1



☐ man

2



☒ woman

3



**Solution correcte :**

man

Signaler un problème

Continuer

38 millions users  
App of the year 2013 Apple  
Top of the top App Android 2013

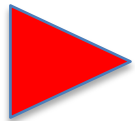
Learning theory → Learning Technology

*How people learn*

*How technology supports learning*

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2. Constructivism → simulations, microworlds

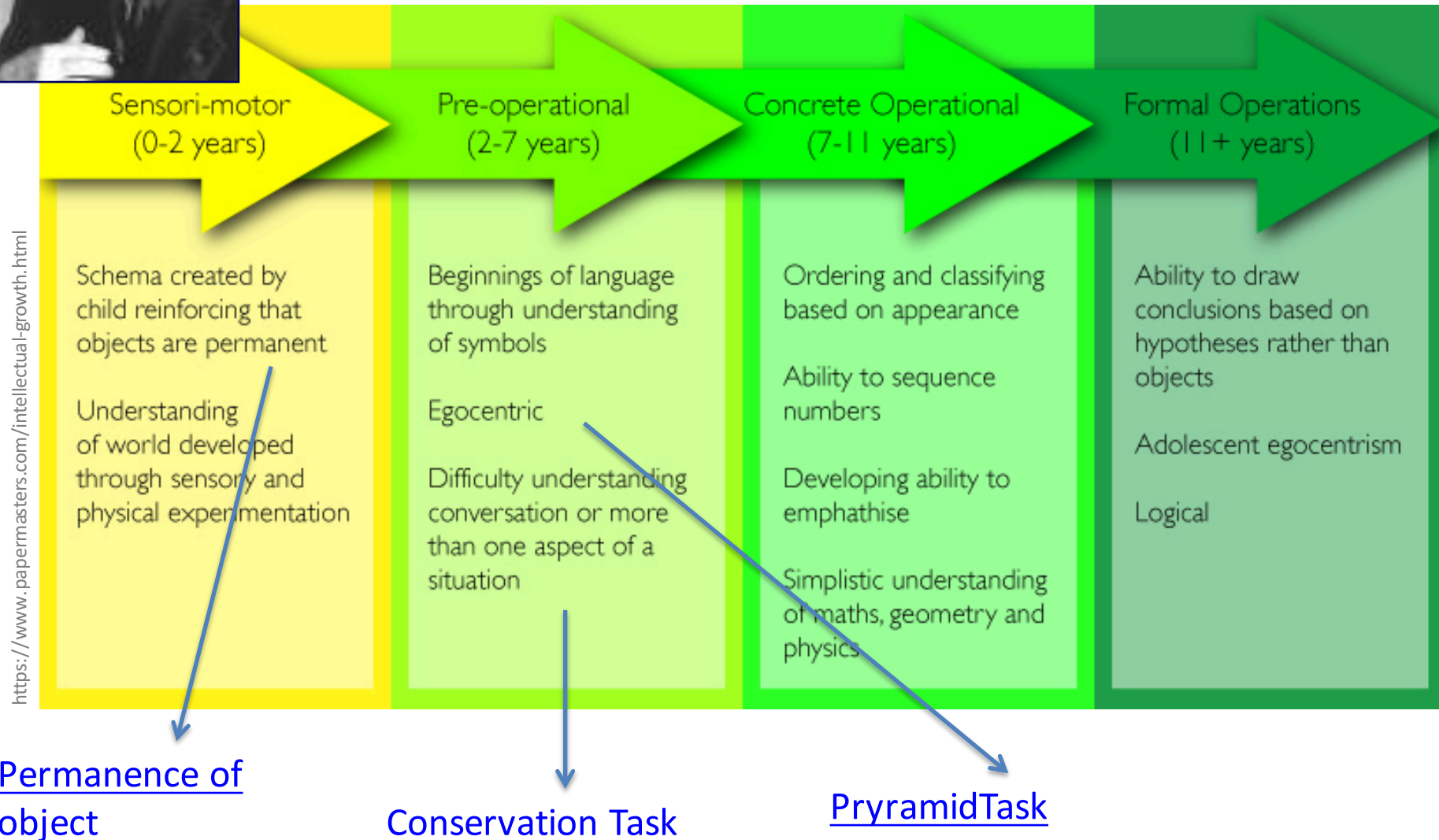
3. Social cognition → groupware, communication

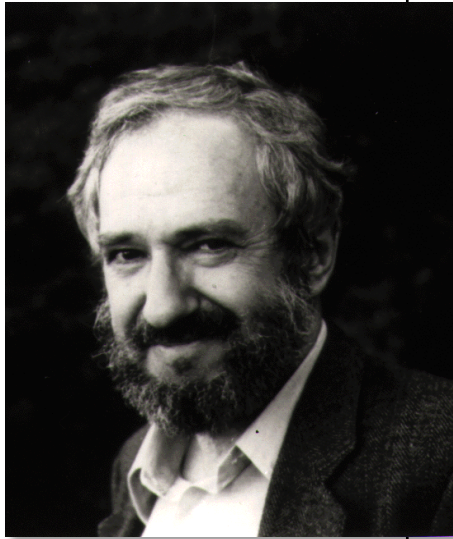




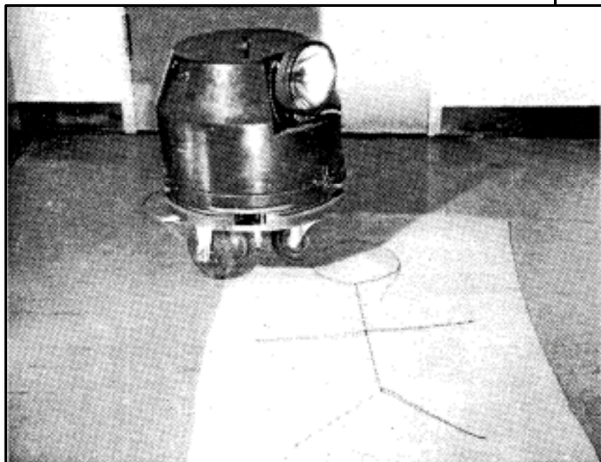
Jean Piaget

# Stages of development





S. Papert



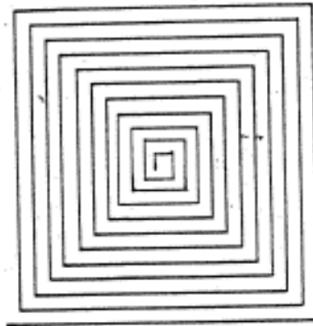
### 7. Draw Spirals

To change the procedure called POLY so as to draw spirals we make a very small addition to line 3. We also change the name -- but that is of course unnecessary.

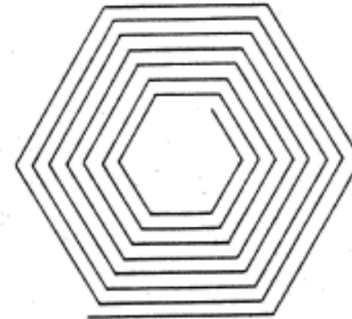
```
TO POLY :STEP :ANGLE
1 FORWARD :STEP
2 LEFT :ANGLE
3 POLY :STEP :ANGLE
END
```

```
TO POLYSPI :STEP :ANGLE
1 FORWARD :STEP
2 LEFT :ANGLE
3 POLYSPI :STEP+5 :ANGLE
END
```

POLYSPI 5 90



POLYSPI 40 60



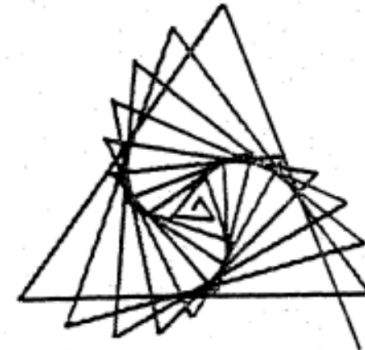
POLYSPI 5 120



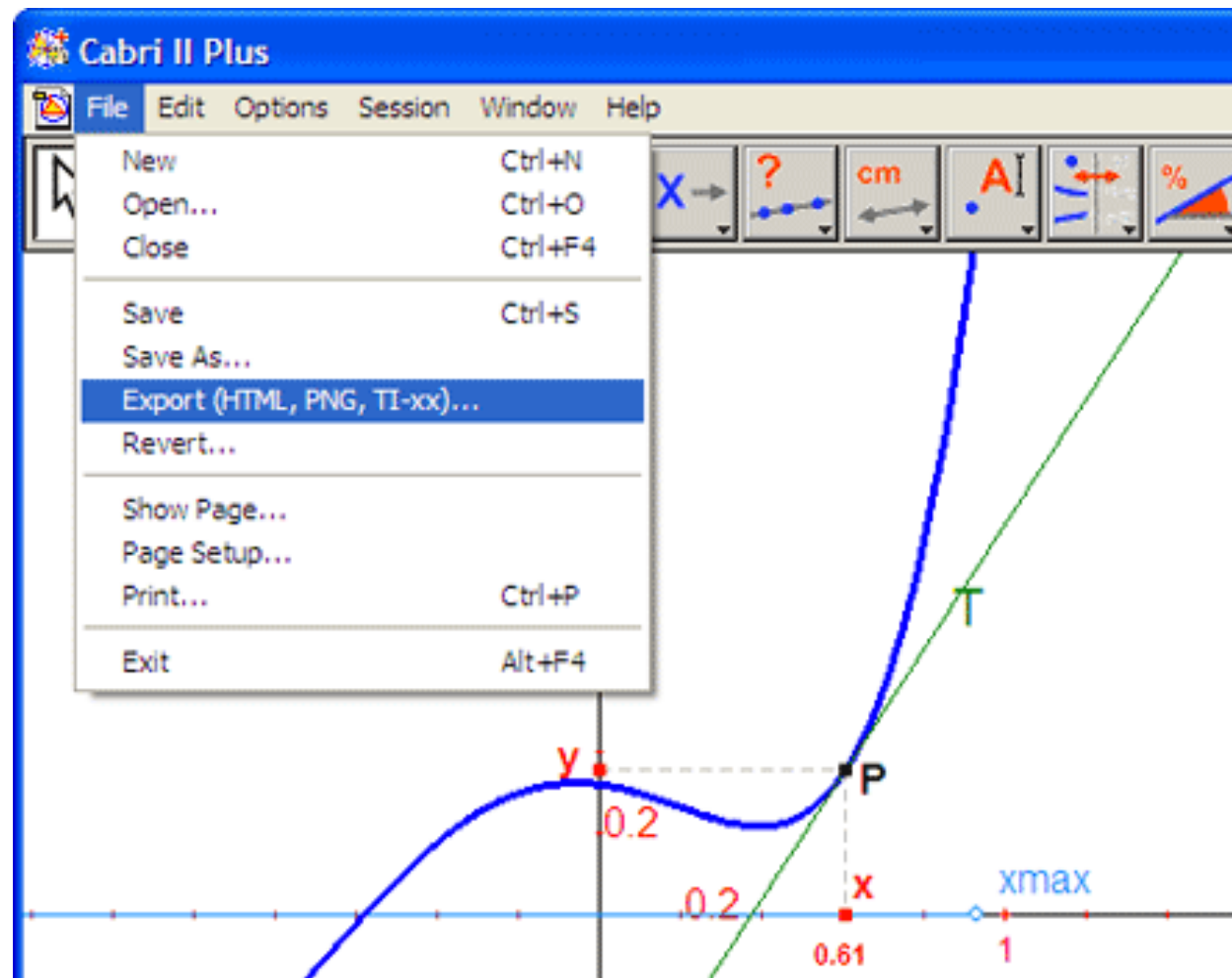
POLYSPI 5 121



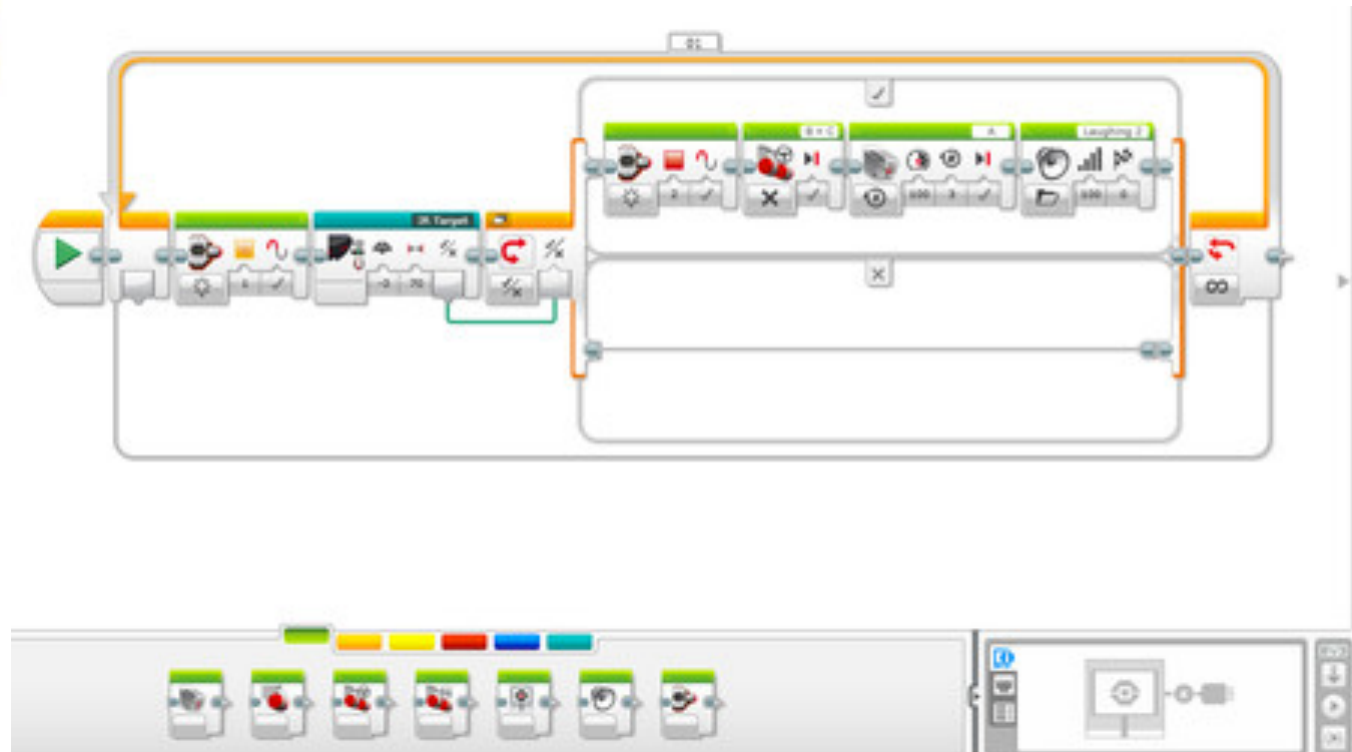
POLYSPI 5 125



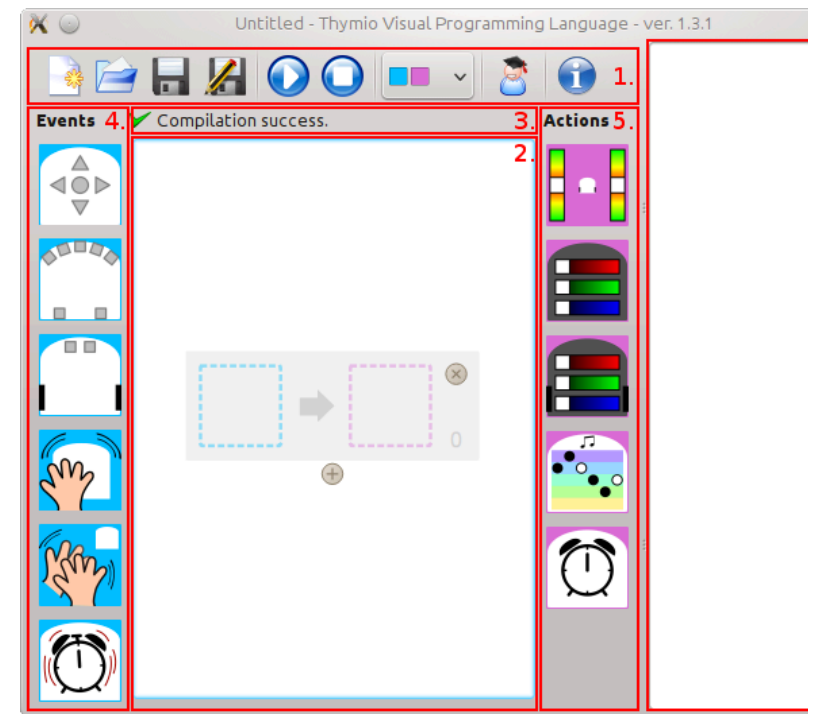




Cabri Géomètre



THYMIIO



<https://aseba.wikidot.com/fr:thymiovgl>

<https://www.youtube.com/watch?v=8RiEDT8bsOs>



# MINECRAFT



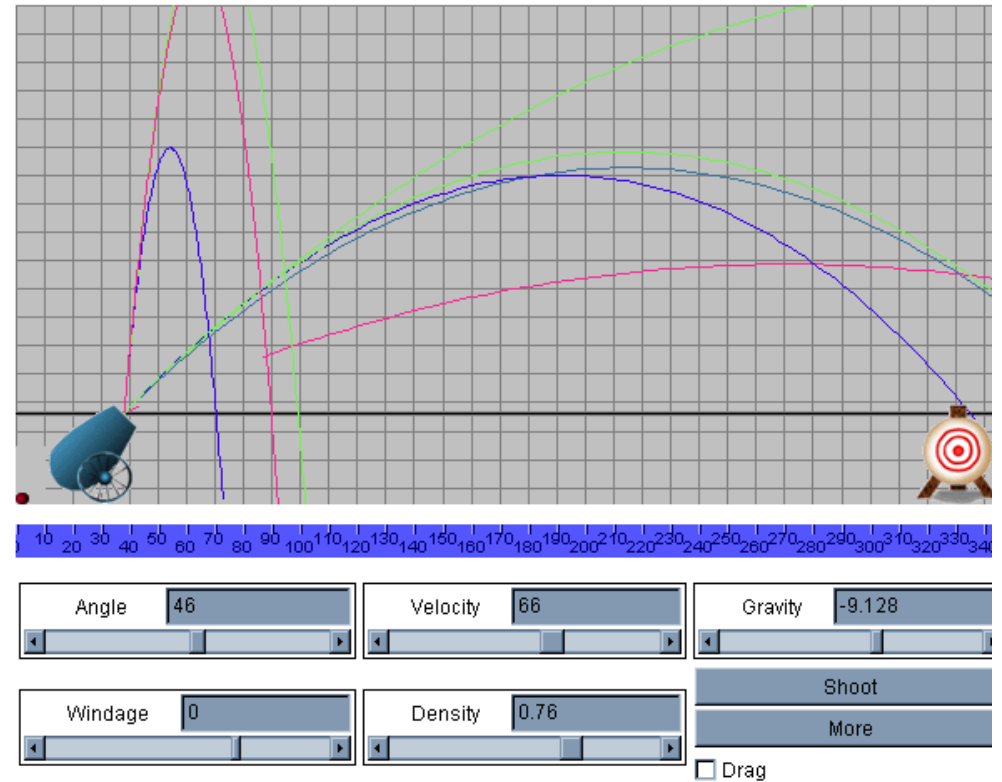
<http://inspiredtoeducate.net/inspiredtoeducate/?p=1079>

[MineCraft](#)

# Simulations



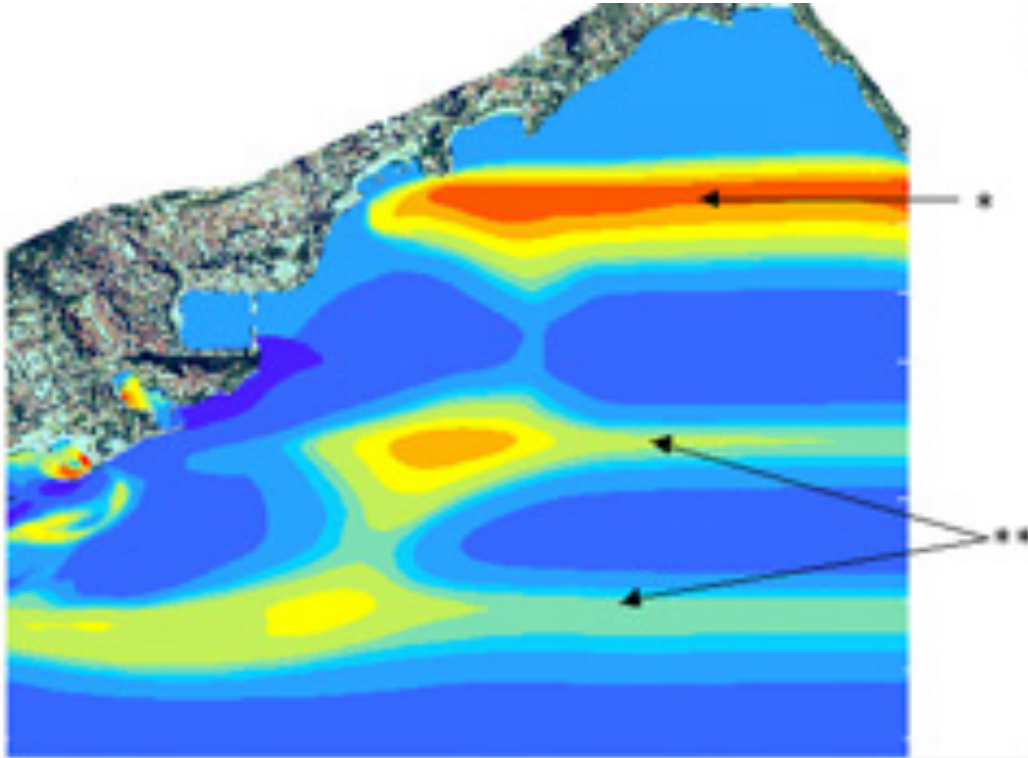
Acquire Skills



Discover underlying model

# Domains

- Physics
- Mechanics
- Biology
- Economy
- Politics
- Psychology
- ...



**TIDAL™** software package simulates the hydrodynamics and water quality behavior of **large scale water bodies** such as bays, estuaries, rivers, lakes and coastal waters. It incorporates the effects of a number of important physical processes on the water body; these include currents, tides, winds, gravitational and coriolis forces, bathymetry, friction, sources and sinks, and chemical reactions.

Relevance: manipulate and understand phenomena that are

- Too dangerous
- Too small or too large
- Hidden (e.g. inside engine)
- Too slow
- Too fast
- Too rare
- Too complex (➔ simplification)
- ...



EPFL  
ÉCOLE POLYTECHNIQUE  
FÉDÉRALE DE LAUSANNE



Powered By  
MrVinath.com

00:17

Teaser MOOC de Mécanique des Fluides  
C. Ancey, F. Gallaire et M. Ramaoli

03:42

HD  
is off

f

Twitter

<>



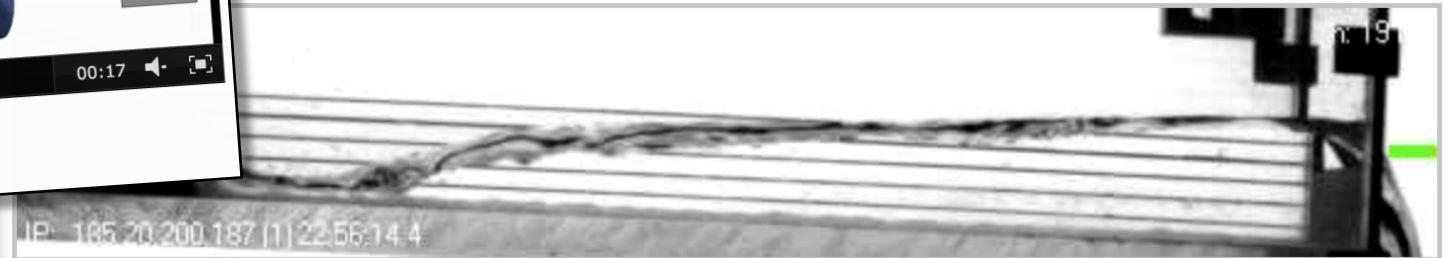
Position [mm]



13

Set

Save



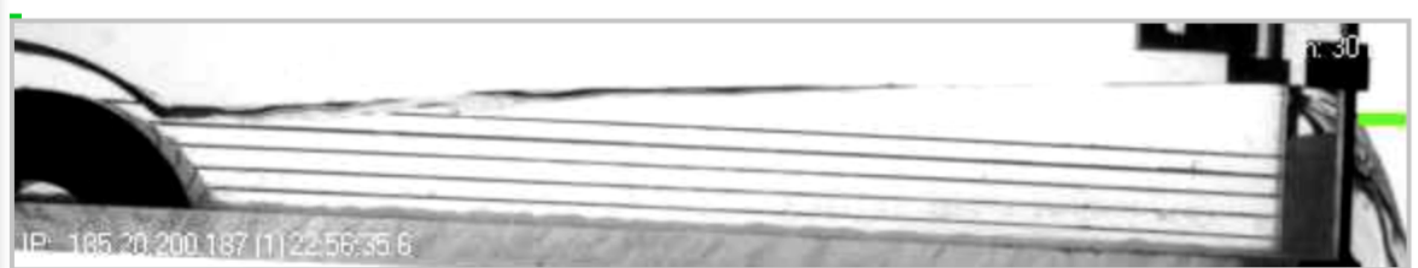
Position [mm]



19

Set

Save



Position [mm]



30

Set

Save



Learning theory → Learning Technology

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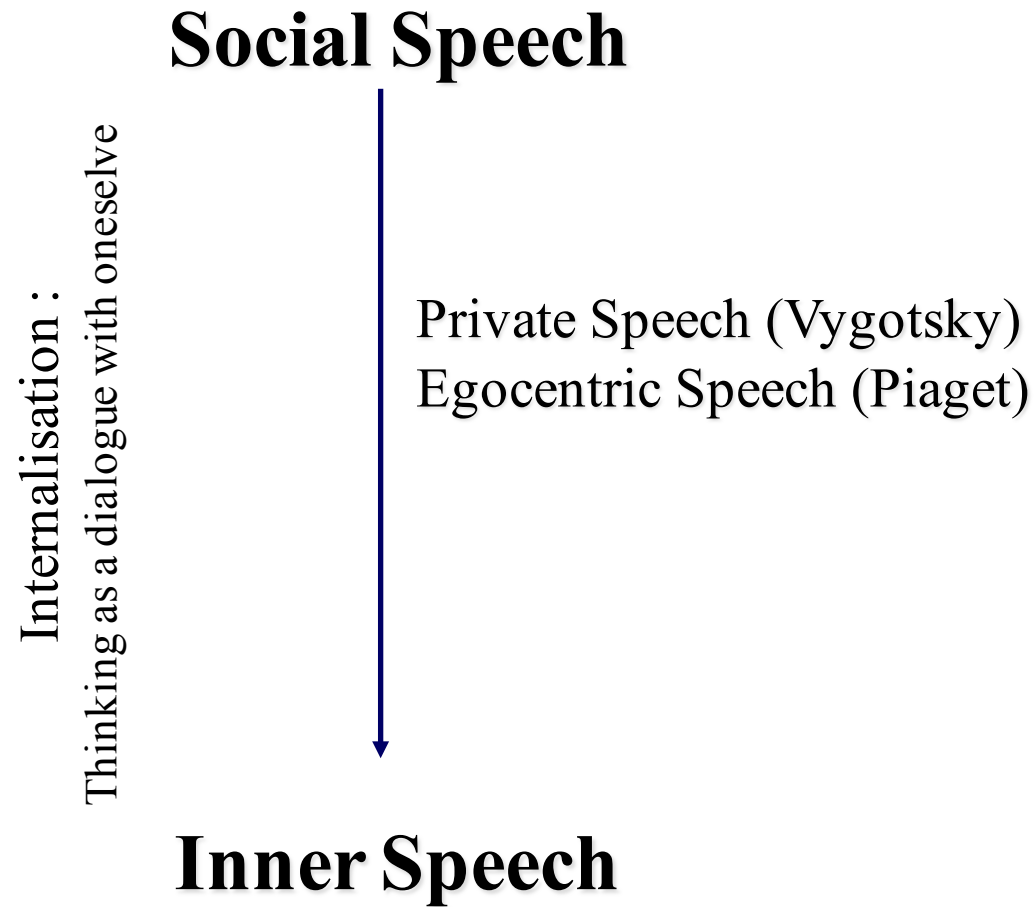
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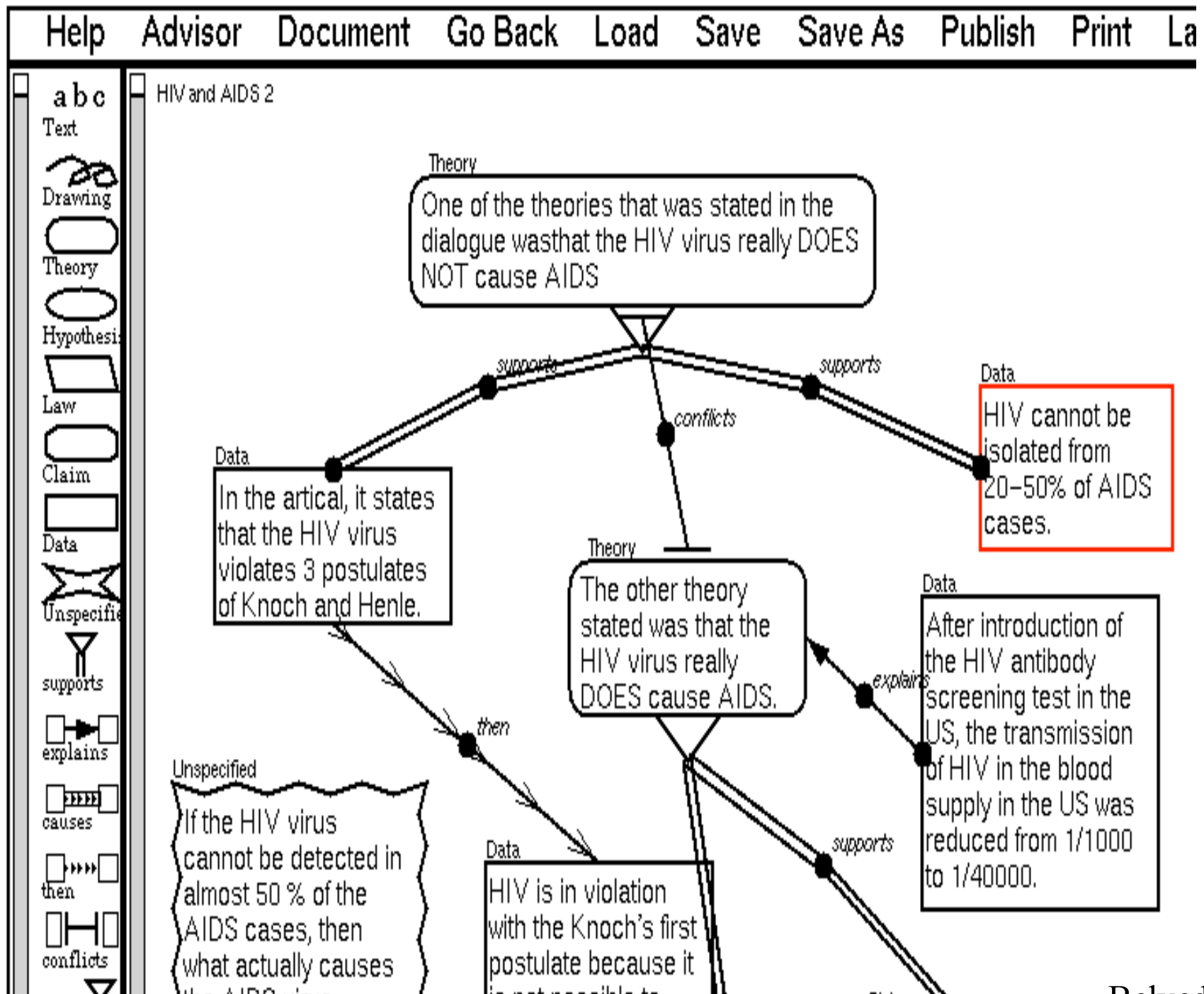
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# SocioCultural Theories



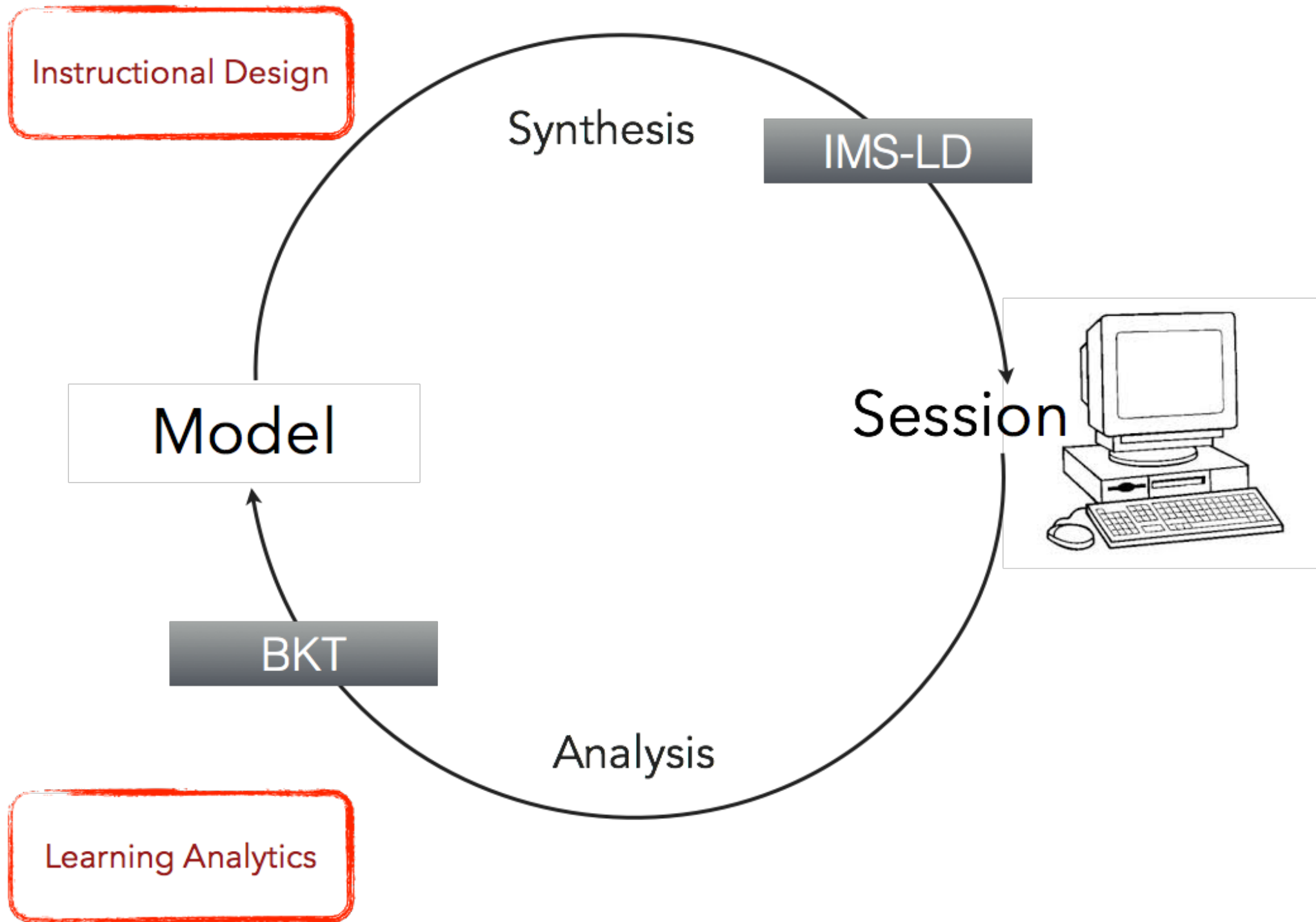


## Multi Input Devices

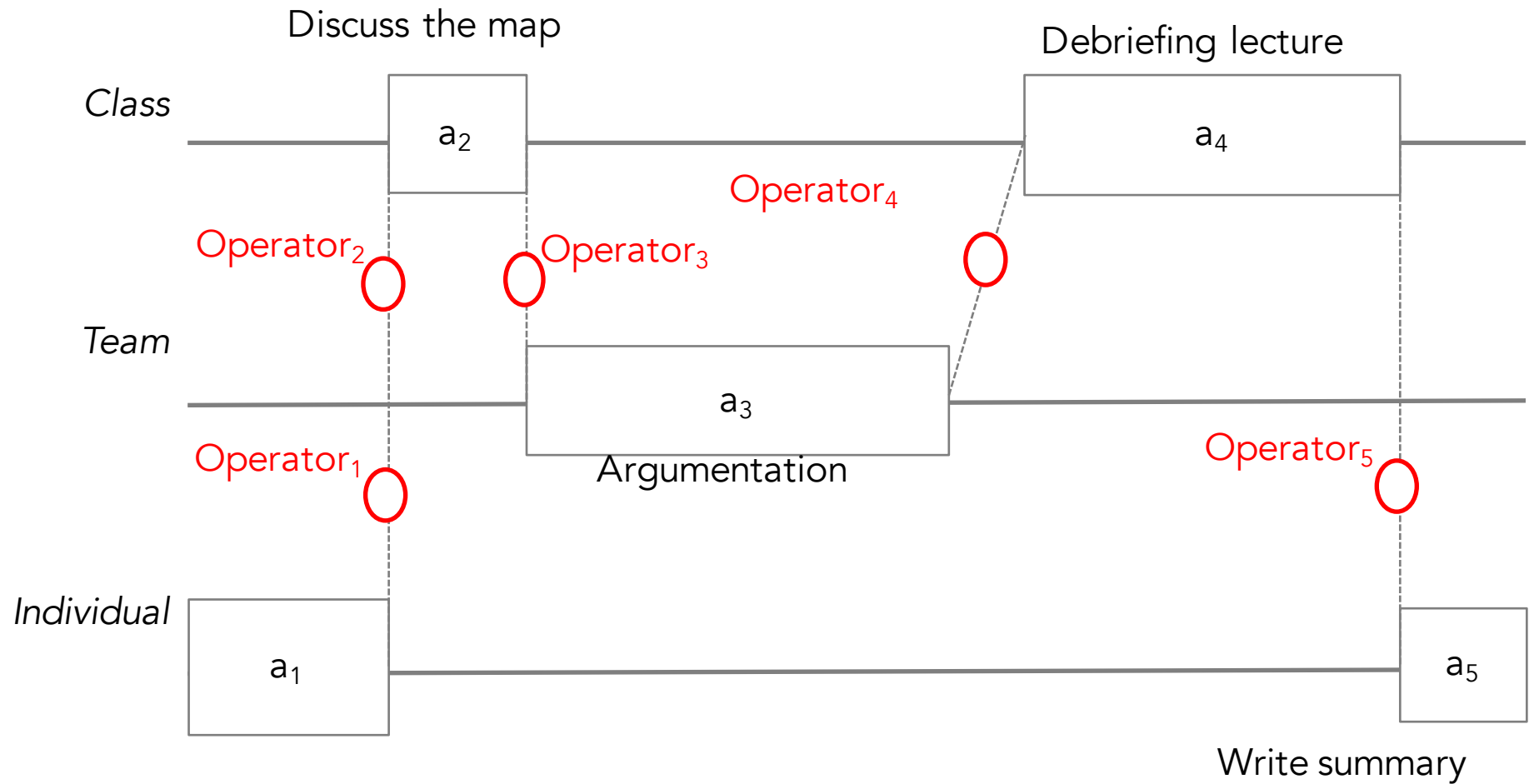


M. Nussbaum, UC Chile









# Orchestration Graph

Instructional Design

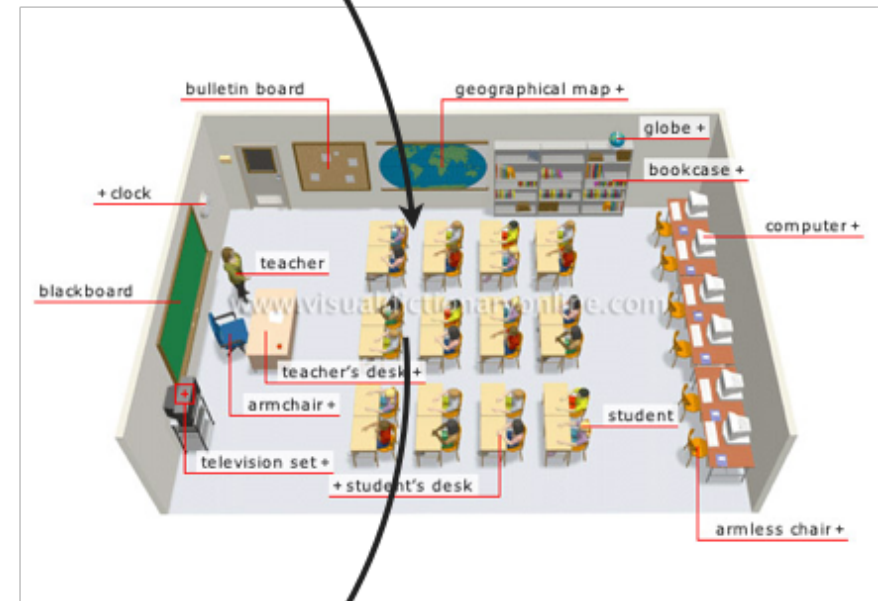
Synthesis

Orchestration  
Graphs

Model

Analysis

Learning Analytics

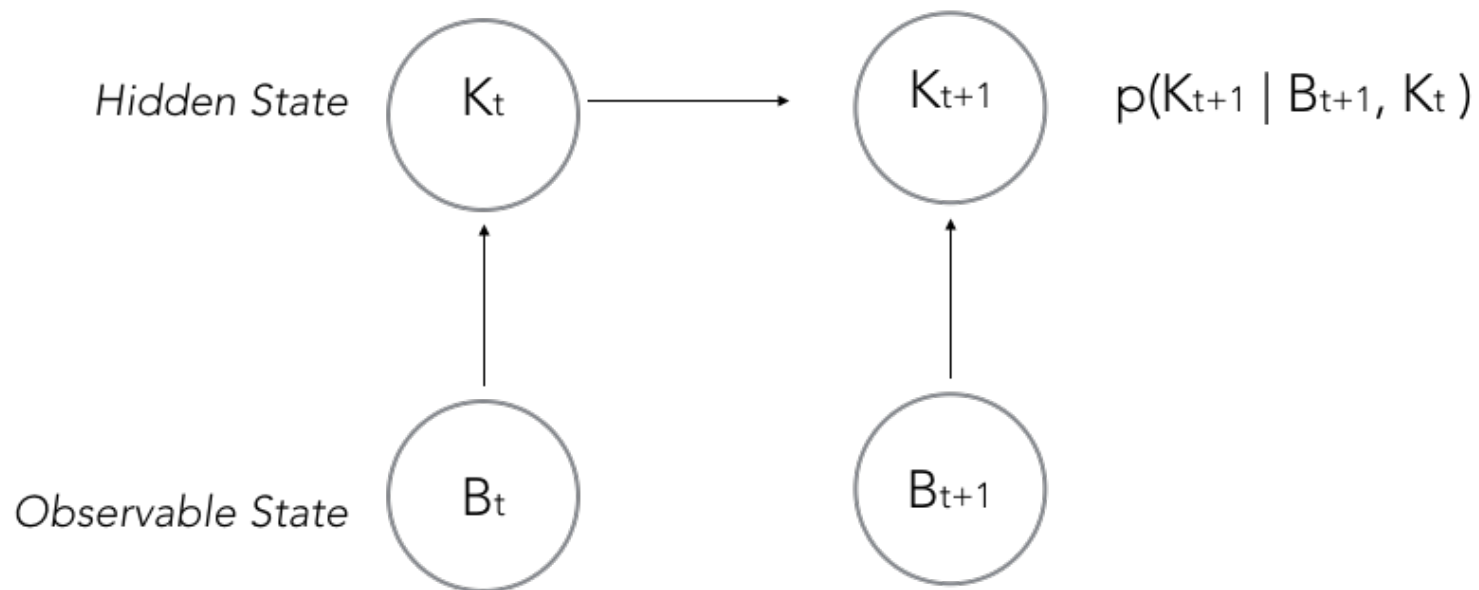




# CS-411 Part II: Learning Analytics

## *Bayesian Knowledge Tracing*

Corbett, Anderson, Aleven, Koedinger,....



$p(K_t = \text{'skill-x'} | B_t = \text{'correct answer'}) = 1 - \text{Guess}$

$p(K_t = \text{'skill-X'} | B_t = \text{'incorrect answer'}) = 0 + \text{Slip}$

$p(K_t = \text{'understand-X'} | B_t = \text{'nods'}) = \text{not much}$

## Design Project (20%)

- Design an orchestration graph (teams of 2)

## Data Project (30%)

- Learning Analytics Report (teams of 2)
- Kaggle Competition on last day

## Exam (50%)

- Oral: 15 min prep + 15 defense (with notes)
- Applied questions

	08:15 → 10:00	10:15 → 12:00
20/09	CH1. Course overview CH2. Orchestration graphs	Extracting the OG from 3 scenarios described in a narrative format.
27/09	CH3: Graph edge labels CH4: From behaviourism to mastery learning	Designing a graph to be uploaded on Moodle as a pdf by Thursday midnight.
04/10	Review of uploaded graphs CH 5: From Piaget to Augmented reality	Designing a graph to be uploaded on Moodle as a pdf by Thursday midnight.
11/10	Review of uploaded graphs CH 6: From Vygostky to Social Networks	Designing a graph to be uploaded on Moodle as a pdf by Thursday midnight.
18/10*	Review of uploaded graphs All you need to know about MOOCs (Patrick Jermann) <i>Mapping MOOCs to Orchestration Graphs (Stian Haklev)</i>	Introduction to R (Patrick Jermann)
25/10	Models and methods in instructional design (Thanasis)	Introduction to R (Patrick Jermann)
01/11	Measuring learning	Introduction to R (Patrick Jermann) M1 : → Deliver an orchestration graph
08/11	Learning Analytics M1 : Feedback on M1 Pierre Dubuc, Open Classrooms	Presentation of the data set
15/11*	Eye Tracking : principles and methods	Eye tracking experiment
22/11	Learning Analytics Jean-Marc Tasseto, CoopAcademy	Project
29/11	Learning Analytics	Project
06/12	Learning Analytics	Visit and testing of the MOOC studios
13/12	Classroom Modelling	Project
20/12	Synthesis	

# Design

Prof. Thanasis Hadzilacos



Dr. Stian Haklev

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Dr. Patrick Jermann



# Analytics



Mina Shirvani Boroujeni

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