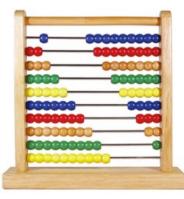


### CS-411 : Digital Education & Learning Analytics

# 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

How people learn

Learning theory -> Learning Technology How technology supports learning

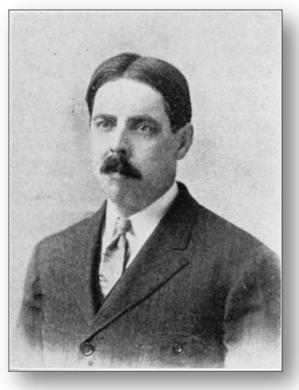


1. Behaviorism

→ Adaptive Instruction

2. Constructivism *→* simulations, microworlds

3. Social cognition  $\rightarrow$  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.

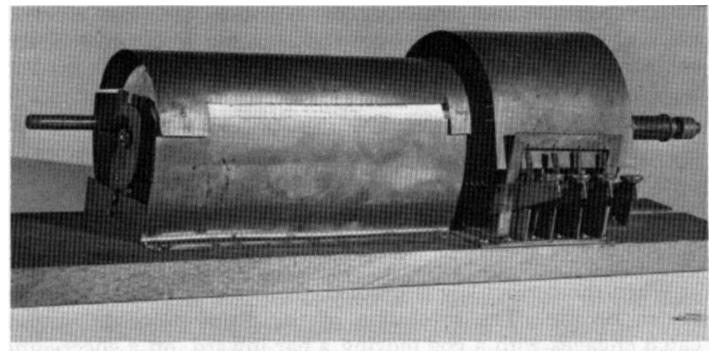


FIG. I. A multiple-choice device which omits items from further presentation once the student can consistently answer them correctly. 1927

#### 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

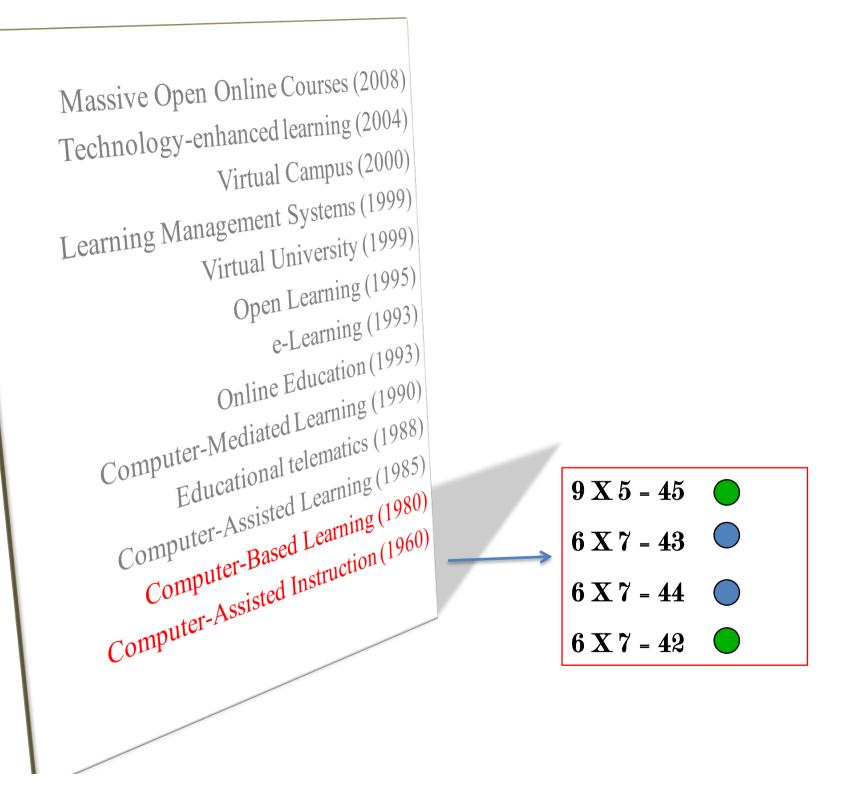
http://www.coe.uh.edu/courses/cuin6373/idhistory/pressey.html

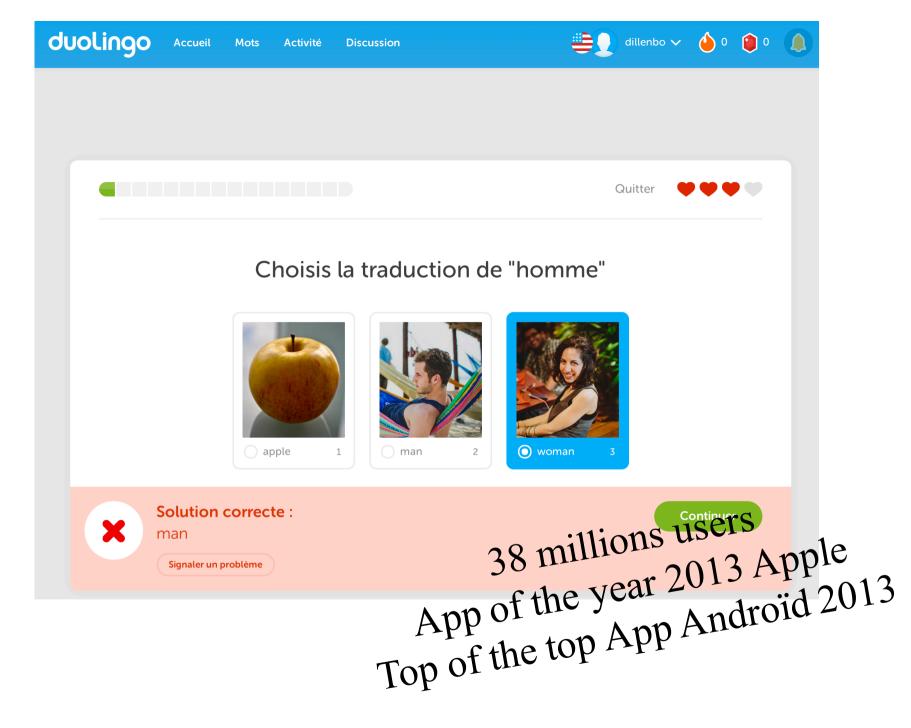


B. F. Skinner



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





https://www.duolingo.com/skill/en/Basics-1/1

Learning theory 

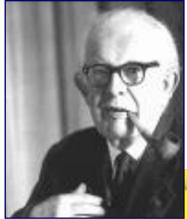
Learning Technology

How people learn How technology supports learning

1. Behaviorism -> Adaptive Instruction

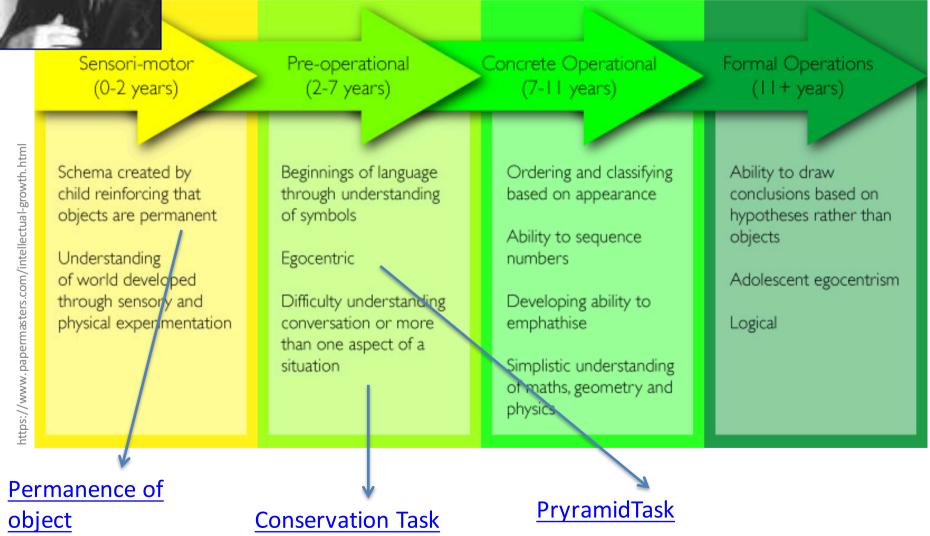
 $\rightarrow$  2. Constructivism  $\rightarrow$  simulations, microworlds

3. Social cognition  $\rightarrow$  groupware, communication



## Stages of development

### Jean Piaget





but that is of course unnecessary.

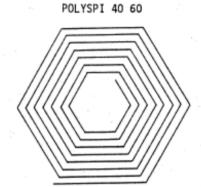
S. Papert

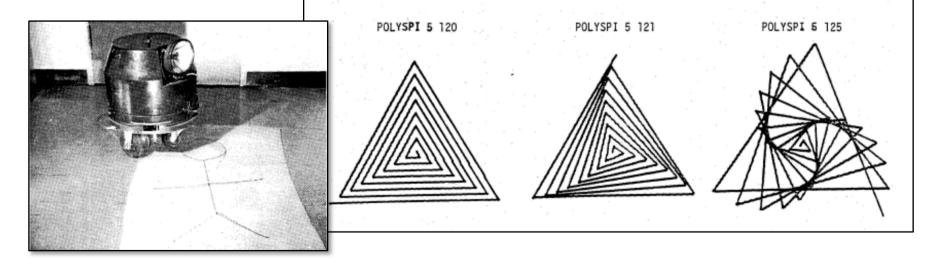
TO POLY :STEP :ANGLE 1 FORWARD :STEP 2 LEFT :ANGLE 3 POLY :STEP :ANGLE END

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

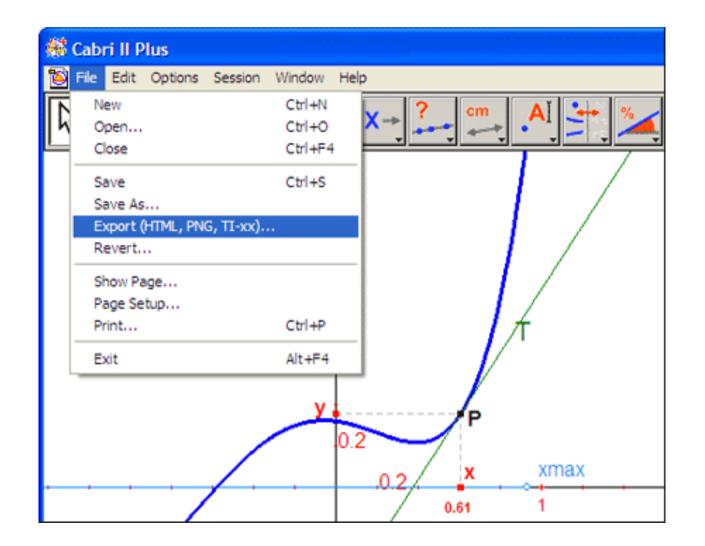
POLYSPI 5 90

we make a very small addition to line 3. We also change the name --

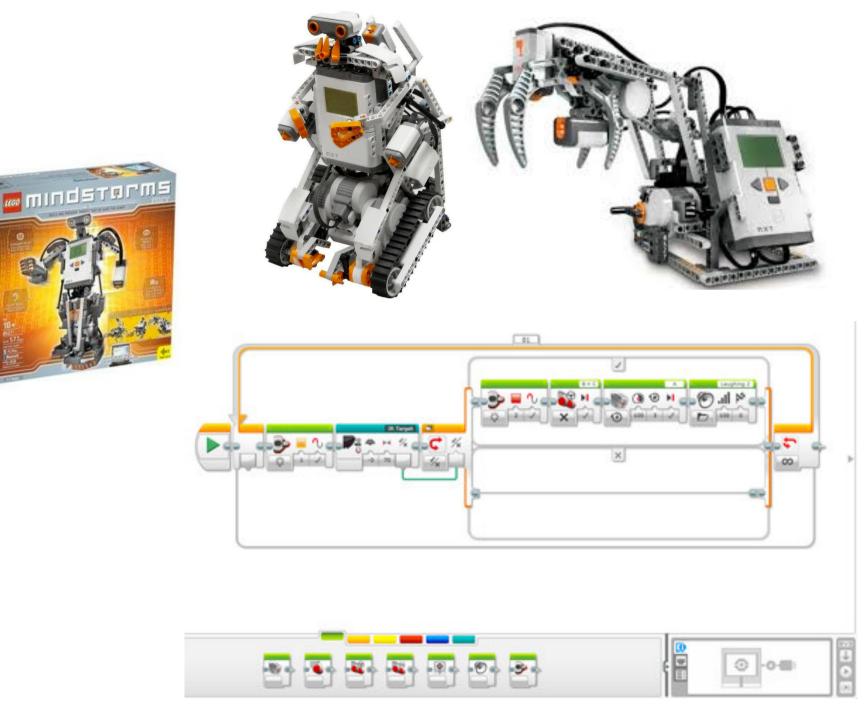




Papert, S. & Solomon, C. (1971, Twenty things to do with a computer, AI Memo 248, MIT

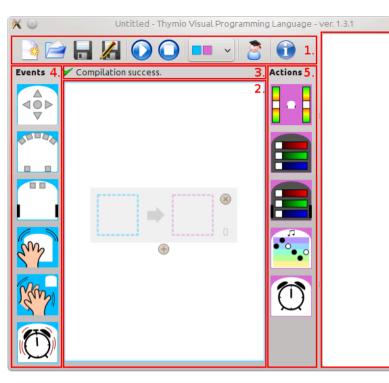


Cabri Géomètre









https://aseba.wikidot.com/fr:thymiovpl

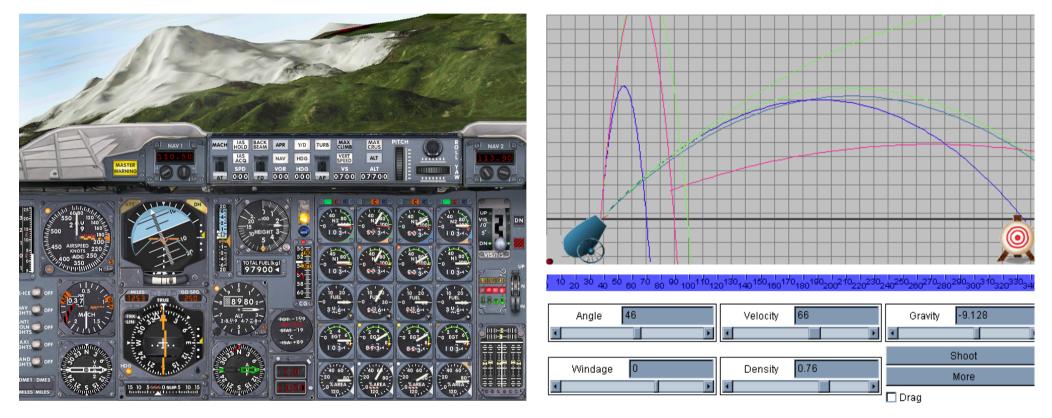
https://www.youtube.com/watch?v=8RiEDT8bsOs





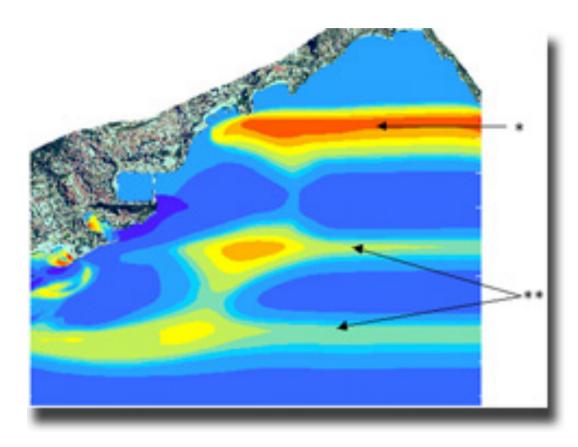


## Simulations



Acquire Skills

Discover underlying model



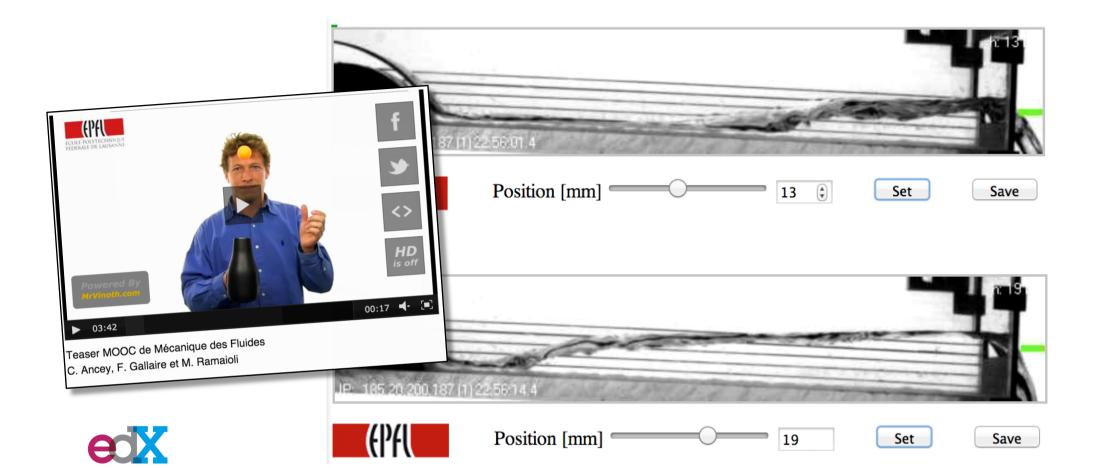
# Domains

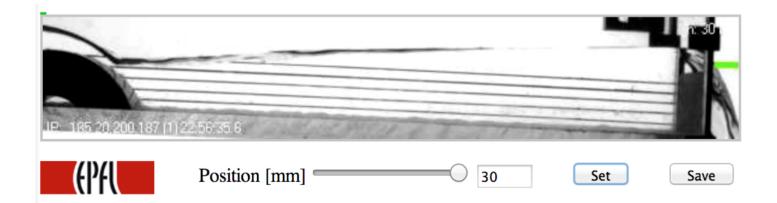
- Physics
- Mecanics
- Biology
- Economy
- Politics
- Psychology

**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)
- •





Learning theory 

Learning Technology

How people learn How technology supports learning

1. Behaviorism -> Adaptive Instruction

2. Constructivism *→* simulations, microworlds

 $\rightarrow$  3. Social cognition  $\rightarrow$  groupware, communication

### **SocioCultural Theories**

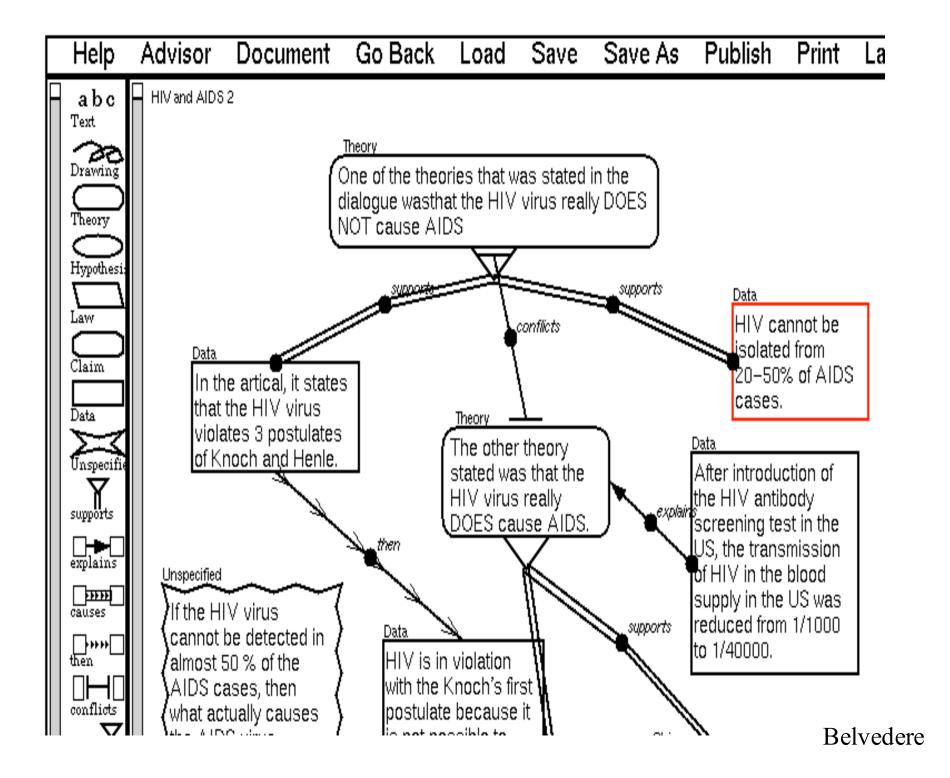
Internalisation : Thinking as a dialogue with oneselve

# Social Speech

Private Speech (Vygotsky) Egocentric Speech (Piaget)



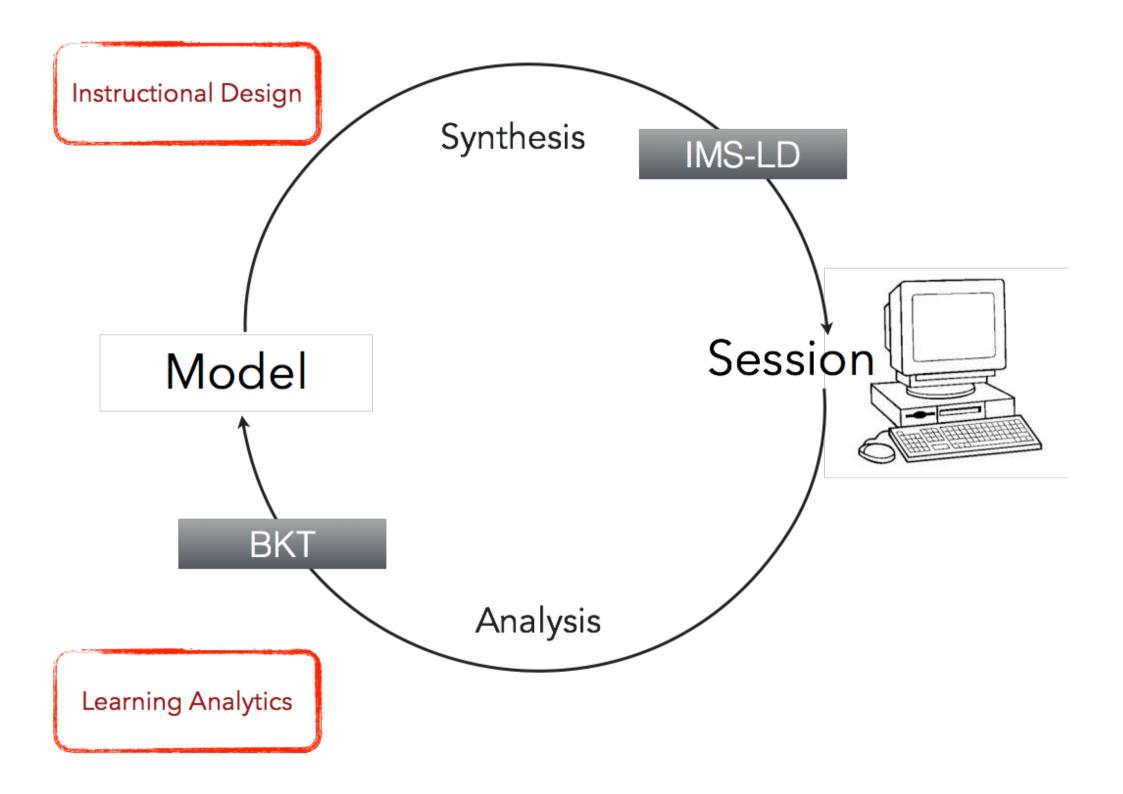
### **Inner Speech**

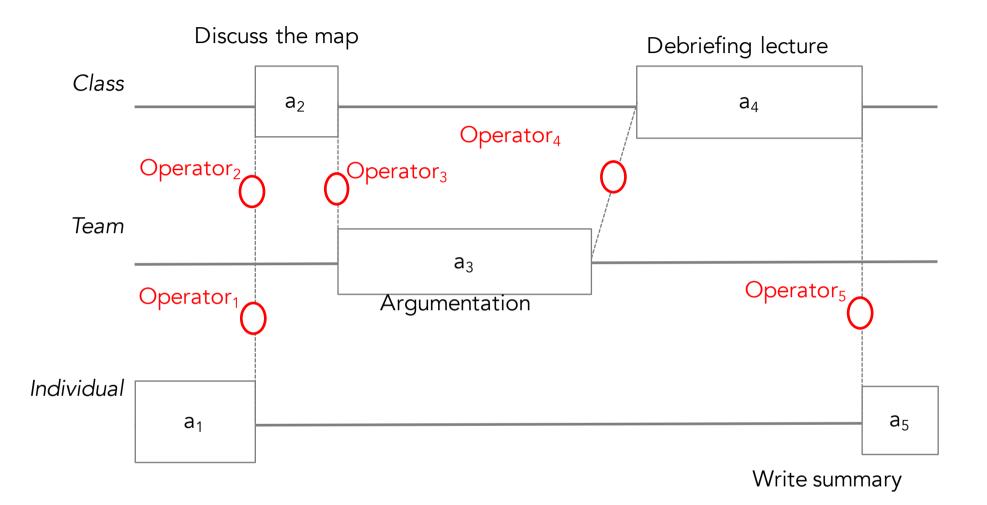




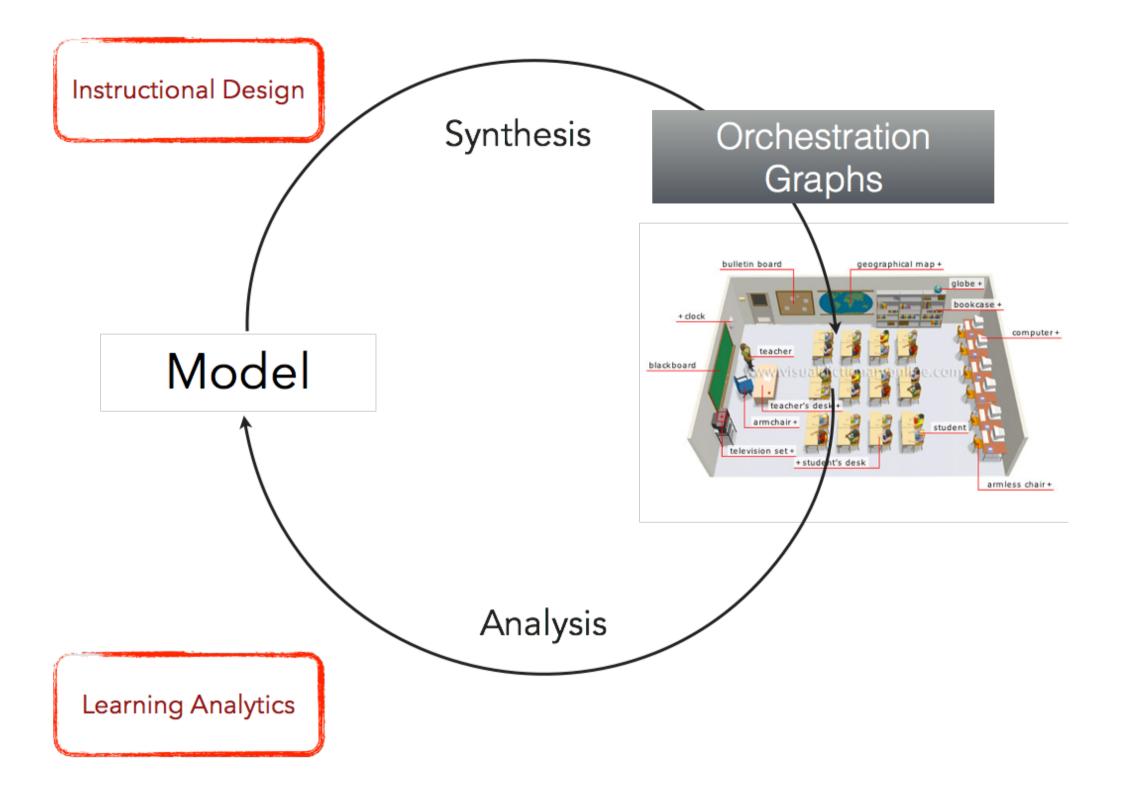
<i>⊐</i> Powered by	MEDIRESOURCE HOME	DRUG LIBRARY	DISEASE LIBRARY	COMMUNITY SUPPORT	
MediResource	HEALTH FEATURES	HEALTH NEWS	HEALTH TOOLS	HEALTH VIDEOS	
Sympatico / MSN Home	e > Sympatico / MSN H	lealth > MediResourc	e > Health Channe	els: Multiple Sclerosis	
January 21, 2005	FREE Health Net		Email to a Friend	l .	
QUICK SEARCH	MULTIPLE SCLEROS	IS			
GO	Mult	iple Sclerosis New	S		
HEALTH CHANNELS					
Allergy	A PAR	Select a	rticle from list below.		
Breast Cancer					
Cancer	Page 1 of 6.		<u>1</u> ·	2:3:4:5:6	
Cardiovascular	Emotional response	to music can reduce p	ain <u>, suggests</u>	Jan. 13, 2005	
Children's Health	<u>Montreal study</u>				
Cholesterol NEW!	BioMS Medical receives approval for key multiple sclerosis trial Dec. 10, 2004 in Britain				
Diabetes NEW!				_	
Erectile Difficulties NEW!	Take control of Monthly Newsle	your health. Subscri tter for FREE!	be to Multiple Scle	rosis	
First Aid NEW!					
Flu	V TI W	Preferred Fe	ormat ⓒ HTML C	Text	
Healthy Skin			ead and accept term	s of the	
Low Testosterone NEW!	Privacy Policy. Email Sign up! →				
Medications and You					
Men's Health				_	
Mental Health	FDA approves new (	drug to treat multiple :	<u>sclerosis</u>	Nov. 24, 2004	
Multiple Sclerosis	<u>Popular MS drug ma</u>	<u>y lack evidence</u>		Nov. 22, 2004	
About MS		tions in three-week as:		Nov. 3, 2004	
1-877-MS-INFO-5	<u>Medical users spurnir</u> Canada marijuana	ng new batch of 'stror	<u>nger' Health</u>	Jul. 12, 2004	
Treatment Options		<u>y favours some, other</u>	s must wait until	Jun. 25, 2004	
What to Ask Your MD	<u>2006</u>				
FAQ's About MS	<u>Bayer bids to marke</u> treatment in Canada	<u>t marijuana-based mult</u> <u>a</u>	tiple sclerosis	May. 11, 2004	
Resource Centre	Alberta Tories, families, guestion adeguacy of \$855 monthly May. 9, 2004				
Related Conditions	<u>disabled income</u> Researchers set out	to identify triggers for	r multiple sclerosis	May. 5, 2004	
Health Features	<u>Nearly a third of leq</u> a	al marijuana users rejec		Apr. 29, 2004	
Community Support  Health News	<u>pot</u> Sick Kida rocoprebor	s show strong associat	ion botwoon MC	Apr. 20, 2004	
	<u>DILK NIUS (ESEdfüttet)</u>		ION DELWEEN MOL	мрг. 20, 2004 	

#### **Online Communities**





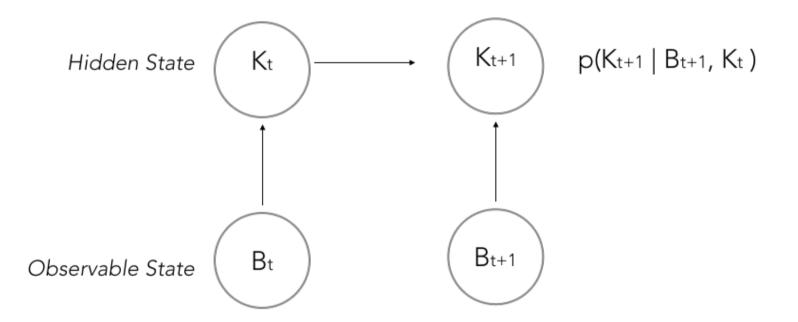
Orchestration Graph



### CS-411 Part II: Learning Analytics

#### Bayesian Knowledge Iracing

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



p(Kt = 'skill-x' | Bt= 'correct answer')= 1 - Guess p(Kt = 'skill-X' | Bt= 'incorrect answer')= 0 + Slip p(Kt = 'understand-X' | Bt= 'nods') = 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	Extracting the OG from 3 scenarios
	CH2. Orchestration graphs	described in a narrative format.
27/09	CH3: Graph edge labels	Designing a graph to be uploaded on
	CH4: From behaviourism to mastery learning	Moodle as a pdf by Thursday midnight.
04/10	Review of uploaded graphs	Designing a graph to be uploaded on
	CH 5: From Piaget to Augmented reality	Moodle as a pdf by Thursday midnight.
11/10	Review of uploaded graphs	Designing a graph to be uploaded on
	CH 6: From Vygostky to Social Networks	Moodle as a pdf by Thursday midnight.
18/10*	Review of uploaded graphs	Introduction to R (Patrick Jermann)
	All you need to know about MOOCs (Patrick Jermann)	
	Mapping MOOCs to Orchestration	
	Graphs (Stian Haklev)	
25/10	Models and methods in instructional	Introduction to R (Patrick Jermann)
	design (Thanasis)	
01/11	Measuring learning	Introduction to R (Patrick Jermann)
		M1 : → Deliver an orchestration graph
08/11	Learning Analytics	Presentation of the data set
	M1 : Feedback on M1	
	Pierre Dubuc, Open Classrooms	
15/11*	Eye Tracking : principles and methods	Eye tracking experiment
22/11	Learning Analytics	Project
	Jean-Marc Tasseto, CoorpAcademy	
29/11	Learning Analytics	Project
06/12	Learning Analytics	Visit and testing of the MOOC studios
13/12	Classroom Modelling	Project
20/12	Synthesis	

#### Prof. Thanasis Hadzilacos



Dr. Stian Haklev

	08:15 → 10:00	10:15 -> 12:00
20/09	CH1. Course overview	Extracting the OG from 3 scenarios
	CH2. Orchestration graphs	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) Mapping MOOCs to Orchestration Graphs (Stian Haklev)	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 experiment
22/11	Learning Analytics Jean-Marc Tasseto, CoorpAcademy	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	

#### Dr. Patrick Jermann





Mina Shirvani Boroujeni

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

