ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

CS-411 : Digital Education & Learning Analytics

# Chapter 7: The Edges Library

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## Edge Label

Why is $a_i$ a condition for $a_j$ ?

$E = \{ e_{ij}\} \mid e_{ij}: (a_i, a_j, \{\text{operators}\}, \textbf{label}, \textbf{weight})$

How much is $a_i$ a condition for $a_j$ ?

## Edge Weight

# Library of Edge Labels

Why is $a_i$ a condition for $a_j$ ?

| Preparation | Set | Translation | Generalization |
|---|---|---|---|
| (P) Prerequisite | (S+) Aggregation | (T) Proceduralization | (G+) Induction |
| (P) ZPD | (S+) Expansion | (T) Elicitation | (G+) Deduction |
| (P) Adv. organizer | (S–) Decomposition | (T) Alternate | (G+) Extraction |
| (P) Motivation | (S–) Selection | (T) Reframe | (G+) Synthesis |
| (P) Anticipation | (S=) Juxtaposition | (T) Reverse | (G=) Analogy |
| (P) Logistics | (S=) Contrast | (T) Repair | (G=) Transfer |
| (P) Data collection | (S=) Identity | (T) Teach | (G–) Restriction |

# Library of Edge Labels

## Why is $a_i$ a condition for $a_j$ ?

The preparation edges connect two activities when the learner has a higher probability of succeeding at $a_j$ if he carried out $a_i$ before $a_i$.

The set edges connect two activities when the skills or contents addressed in $a_i$ and $a_j$ are in relationship with each other; for example, subset/superset, whole/part, and siblings. (UP / DOWN)

The translation edges connect two activities in which the same content is addressed under different formats, representations, notations, or viewpoints. Learners therefore have to translate the representation used in $a_i$ into the representation used in $a_j$.

The generalization edges introduce variations of the content or skills across the space of generalization, namely introducing the student to more general, less general, or analogical contexts from $a_i$ to $a_j$. (UP / DOWN)

# Edge Library

## Preparation Edges

- Prerequisite
- ZPD
- Adv. Organizer
- Motivation
- Anticipation
- Logistics
- Data collection

Pre-requisites are common sense: You need to be able to do 5+7 ($a_i$), before trying 25+37 ($a_j$).

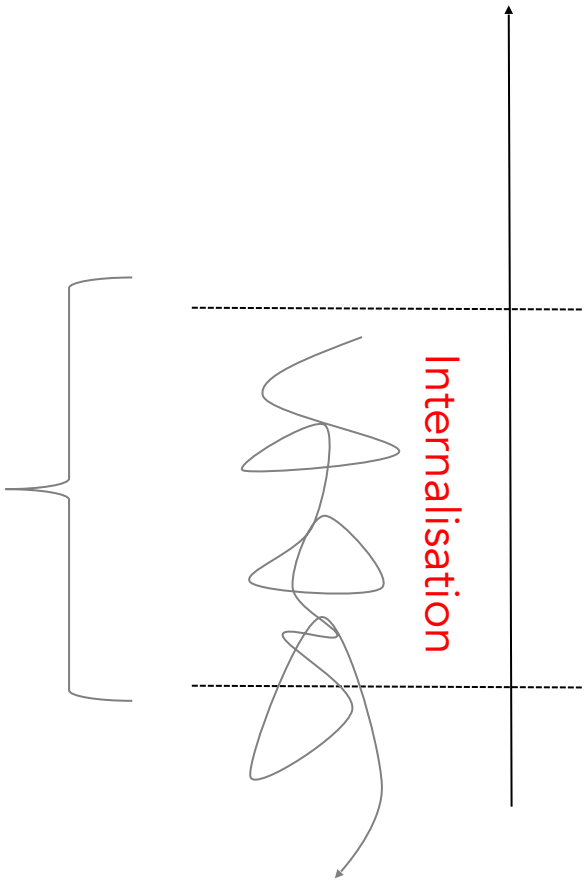
Nonetheless, a high portion of failure is explained the accumulation of small gaps in pre-requisites.

Mastery learning focused especially on this sequencing

# Edge Library

**Preparation Edges**

- Prerequisite
- Zone of Proximal Development
- ~~Adv. Organizer~~
- Motivation
- Anticipation
- Logistics
- Data collection




What I do ($a_i$)
in interaction with a more knowledgeable peer

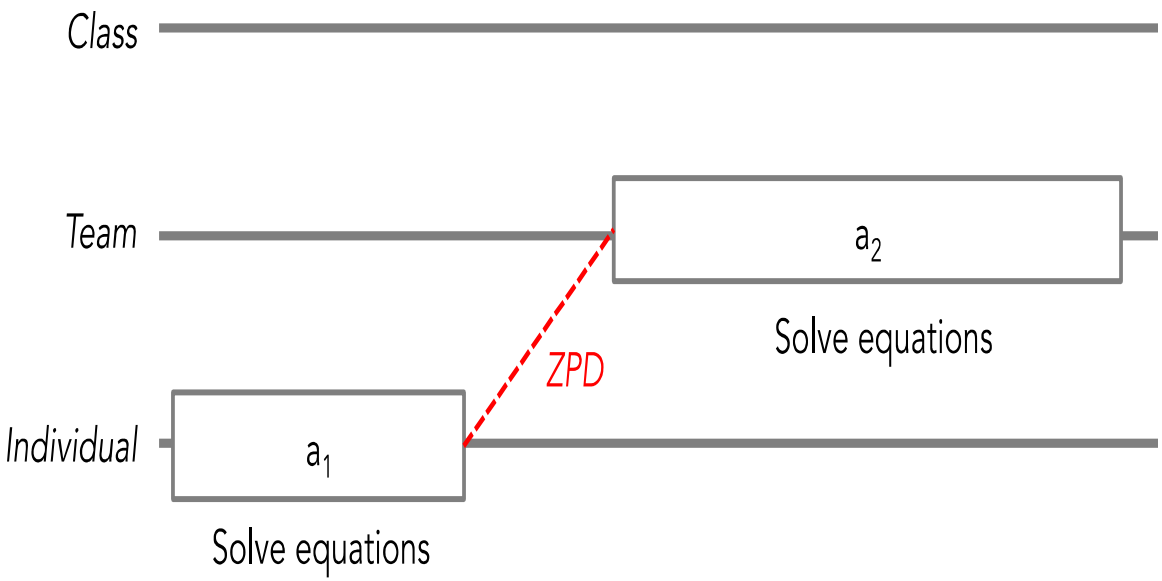
What I can do alone ($a_j$)

CHAPTER 6

# Edge Library

## **Preparation** Edges

- Prerequisite
- Zone of Proximal Development
- ~~Adv. Organizer~~
- Motivation
- Anticipation
- Logistics
- Data collection




In the first activity, students solve equations individually. The teacher analyzes their work and identifies those who concentrate on algebraic manipulations compared to those able to think in terms of problem-solving strategy. In the second activity, a student from the first category is asked to work with a student from the second category. The latter is expected to convey his strategies by arguing about the choice of equation manipulations proposed by the former.

# Edge Library

## Preparation Edges

- Prerequisite
- ZPD
- Adv. Organizer
- Motivation
- Anticipation
- Logistics
- Data collection

An advance organizer is information presented by an instructor that helps the student organize new incoming information (D. Ausubel):

- Reactivate previous knowledge
- Preactivate knowledge structures

# Edge Library

## **Preparation** Edges

- Prerequisite
- ZPD
- Adv. Organizer
- Motivation
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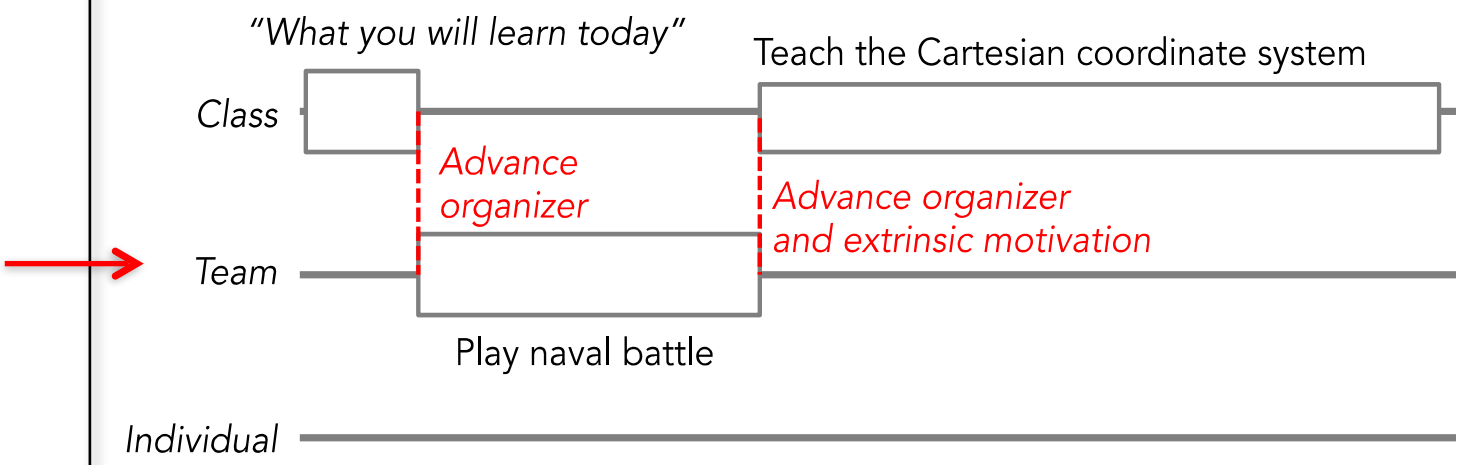
- Logistics
- Data collection

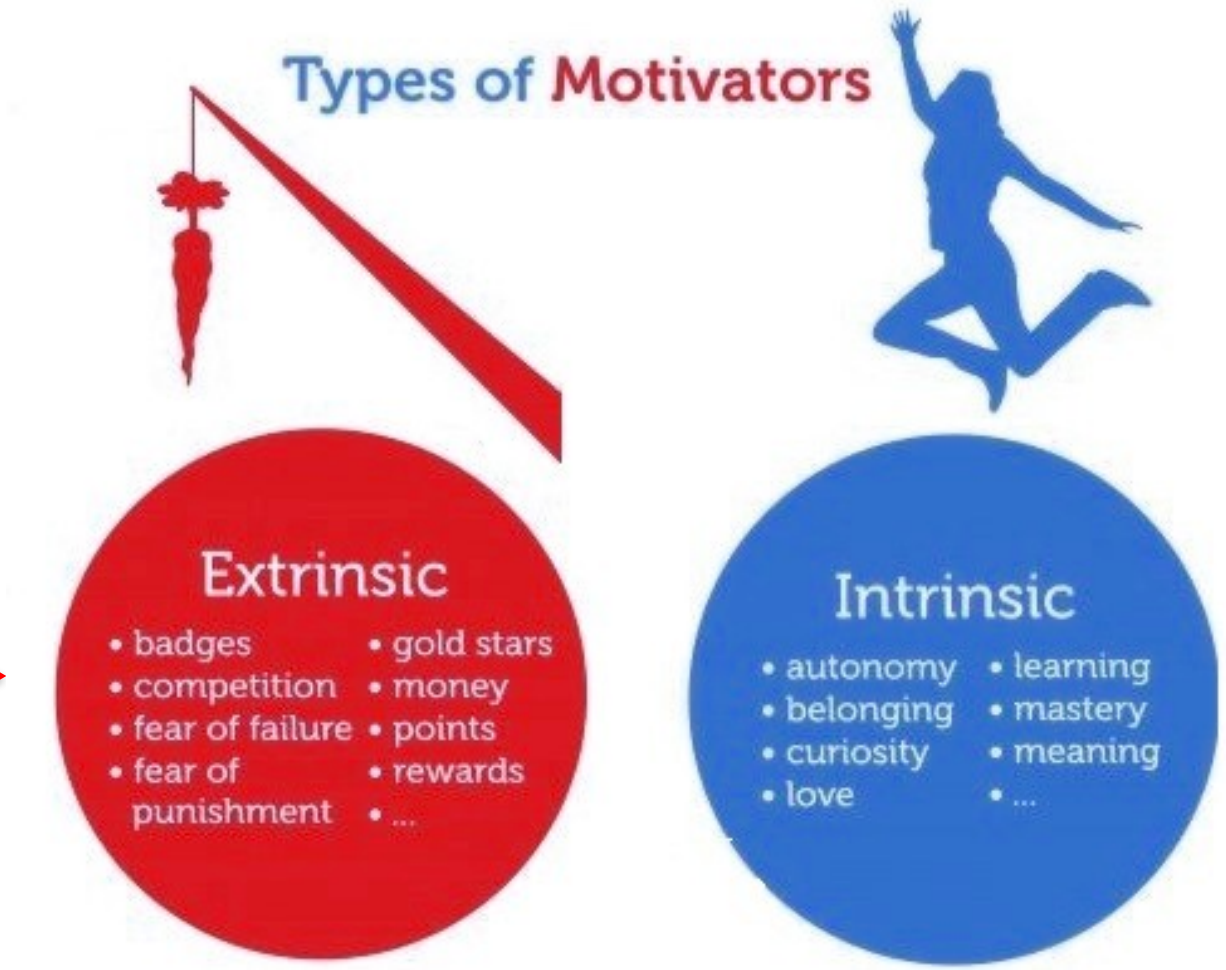


# Edge Library

## Preparation Edges

- Prerequisite
- ZPD
- Adv. Organizer
- Motivation
- Anticipation
- Logistics
- Data collection

http://b2bdiagram.com/tag/hr-courses/



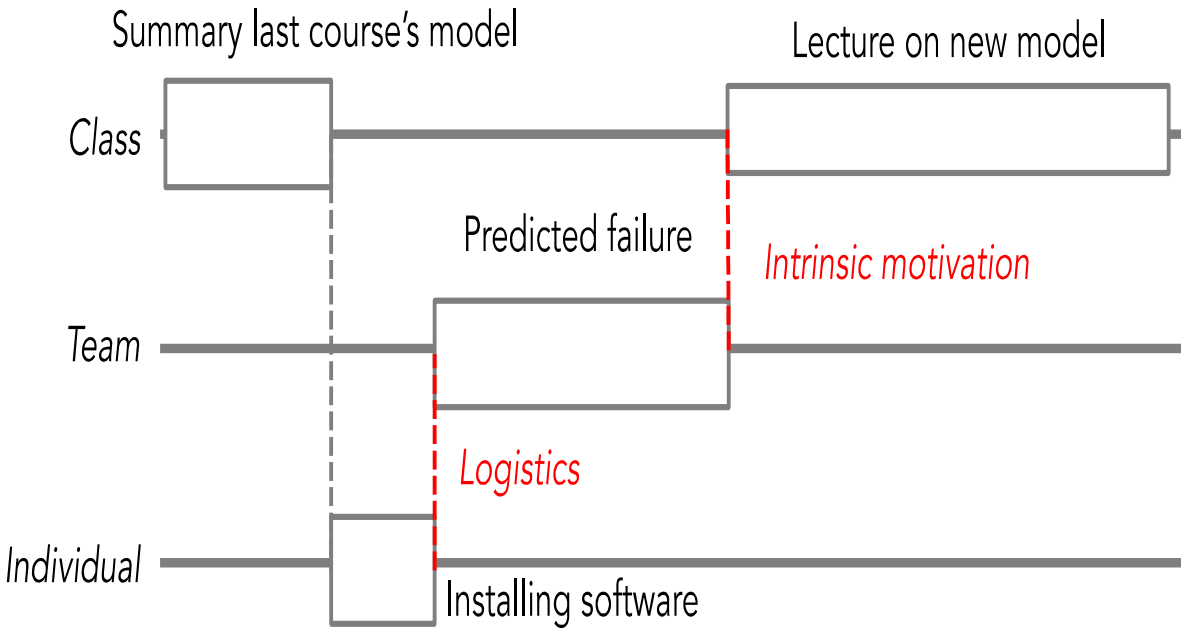

Students may try to get the reward without learning anythings

It is sometimes hard to demonstrate why some skills are useful.

# Edge Library

## Preparation Edges

- Prerequisite
- ZPD
- Adv. Organizer
- Motivation
- Anticipation
- Logistics
- Data collection




The teacher reminds students of the model taught the previous week and asks students to install a new simulation tool (logistics edge). He gives them a phenomenon for which the previous model produces incorrect results, which will justify a revision of the previous model.

# Edge Library

## **Preparation** Edges

- Prerequisite
- ZPD
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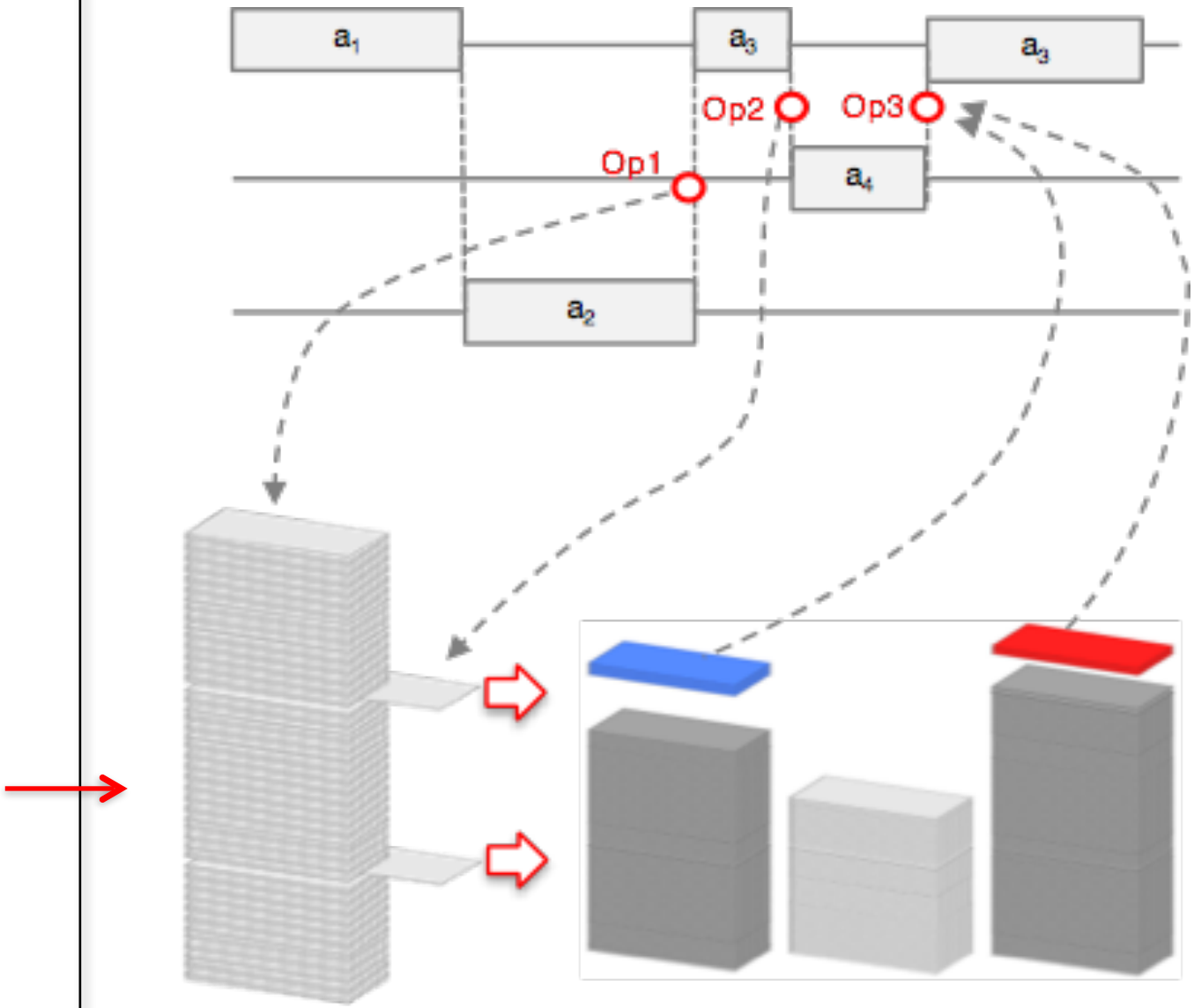


# Edge Library

**Set Edges**

(S+) Aggregation

(S+) Expansion

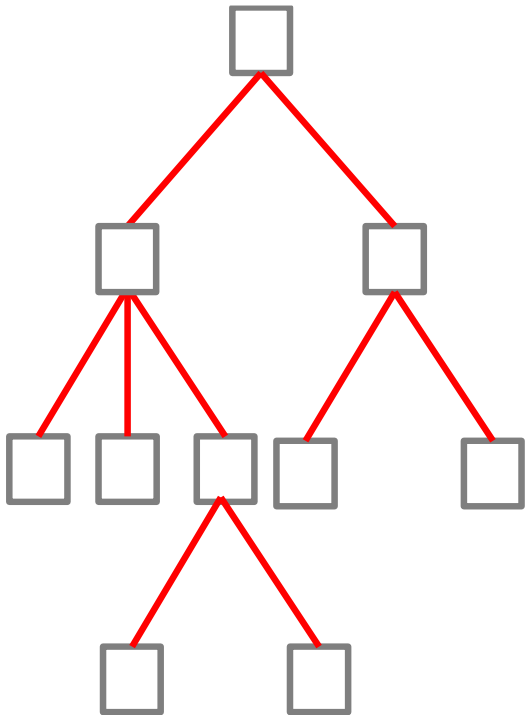
(S–) Decomposition

(S–) Selection

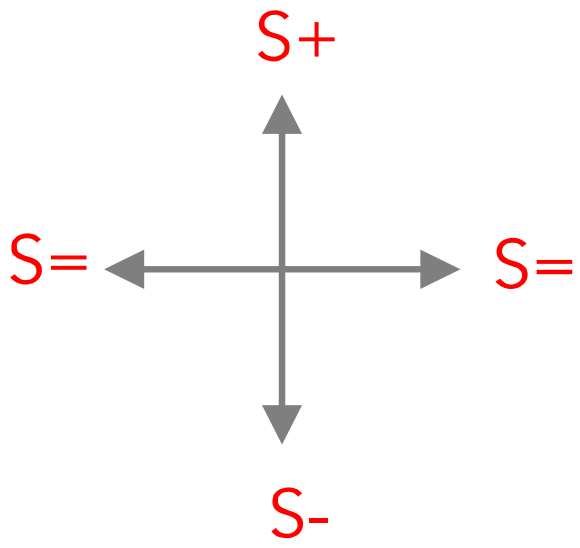
(S=) Juxtaposition

(S=) Contrast

(S=) Identity



Knowledge space or « Class-Structure » of the domain to be taught.




Bringing the learner up/down and left/right in this knowledge space

# Edge Library

## Set Edges

(S+) Aggregation

(S+) Expansion

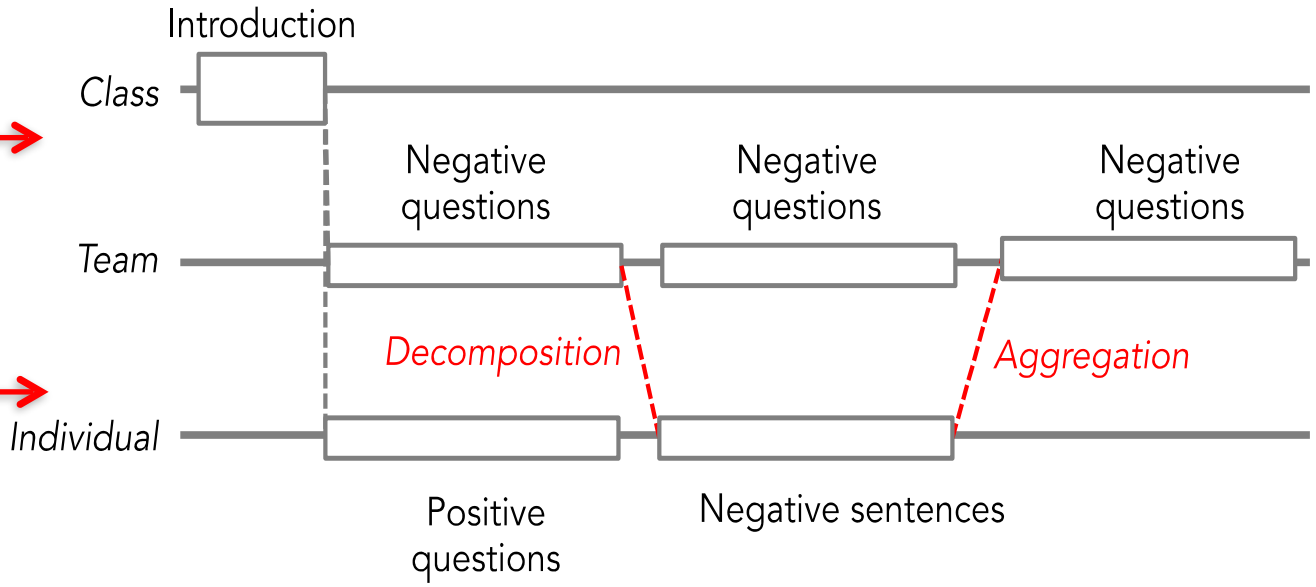
(S–) Decomposition

(S–) Selection

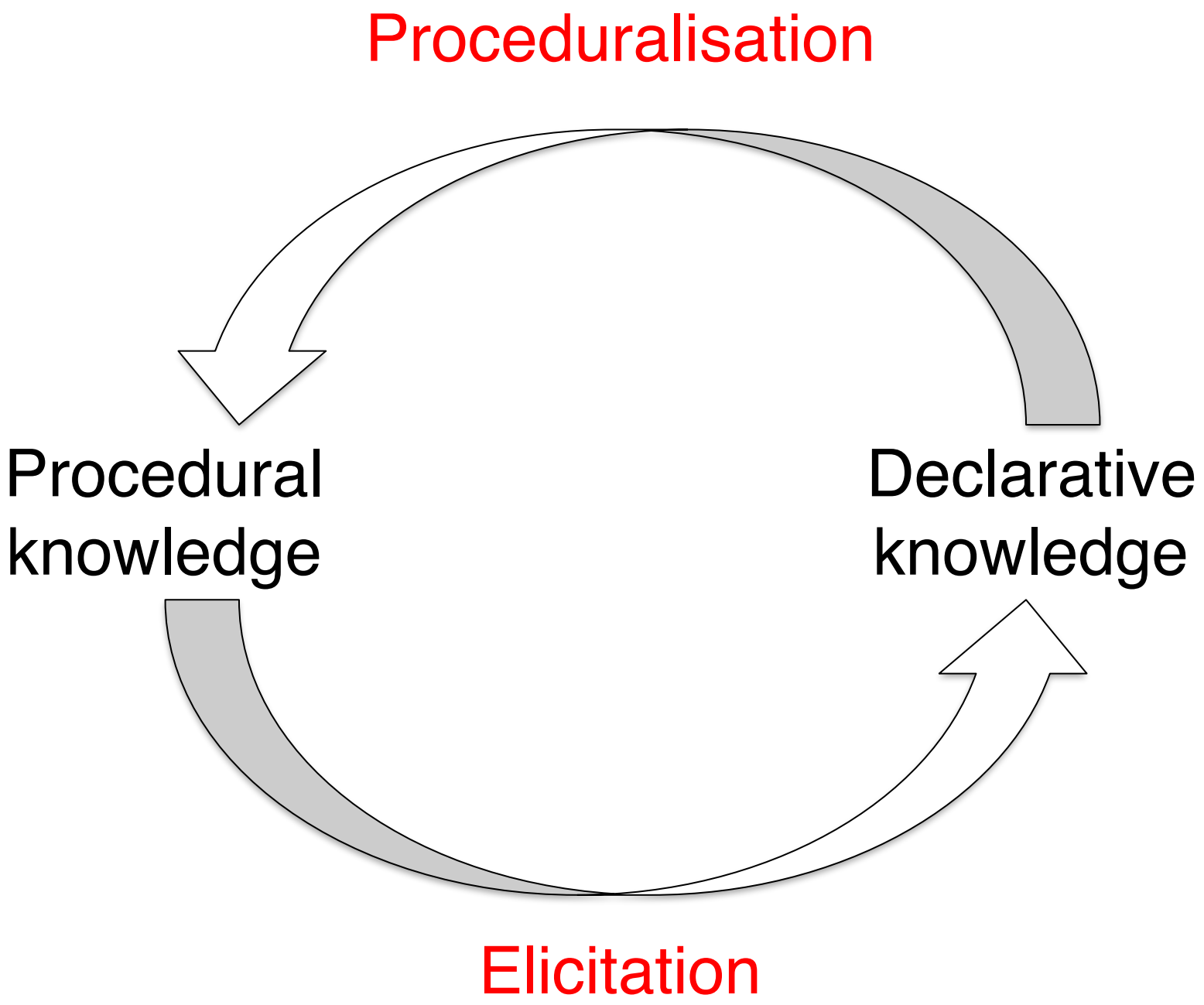
(S=) Juxtaposition

(S=) Contrast

(S=) Identity



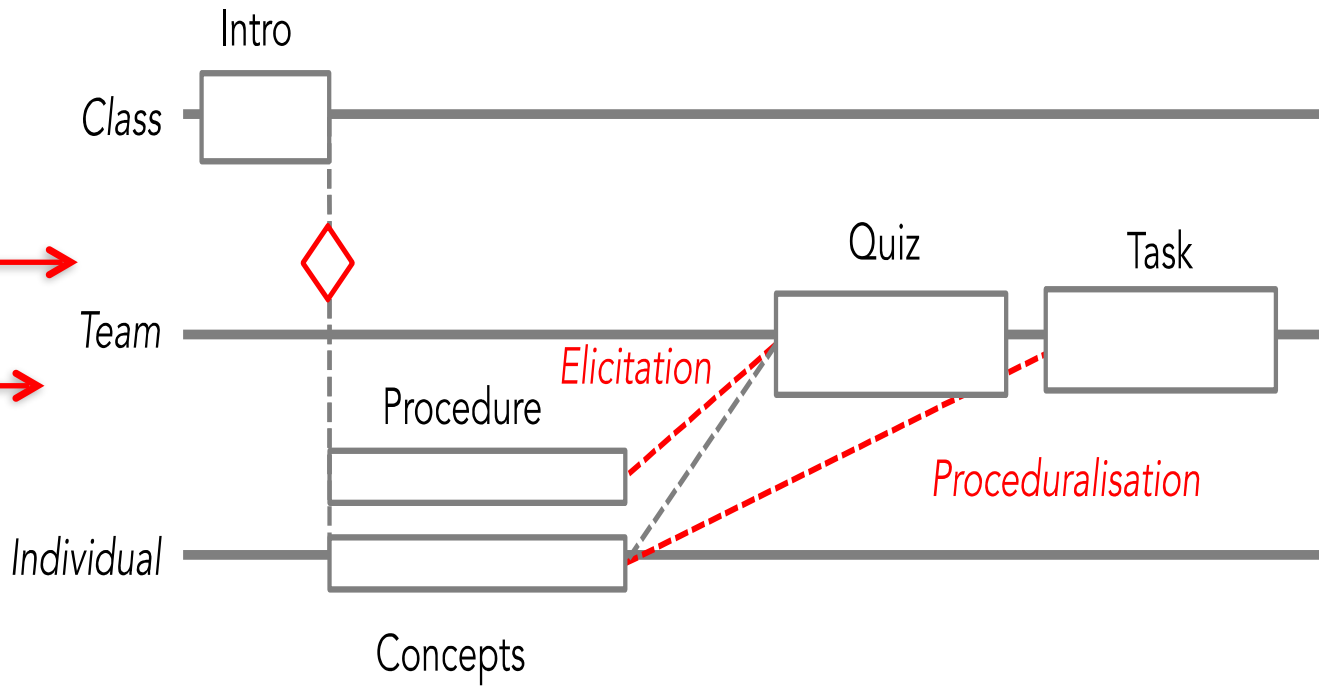

After an introduction, the teacher splits the class into two subclasses, those who have already studied how to form questions and negative sentences in English, and those who have not. The novices do individual exercises on each skill (first questions and then negative sentences), and finally these two skills are aggregated during pair dialogue exercises that include negative questions. The more experienced subclass starts directly with the pair dialogue exercises, but the students who encounter difficulties are then redirected towards individual exercises on each skill.


Proceduralisation
Procedural knowledge
Declarative knowledge
Elicitation

# Edge Library

## Translation Edges

- Proceduralization
- Elicitation
- Alternate
- Reframe
- Reverse
- Repair
- Teach

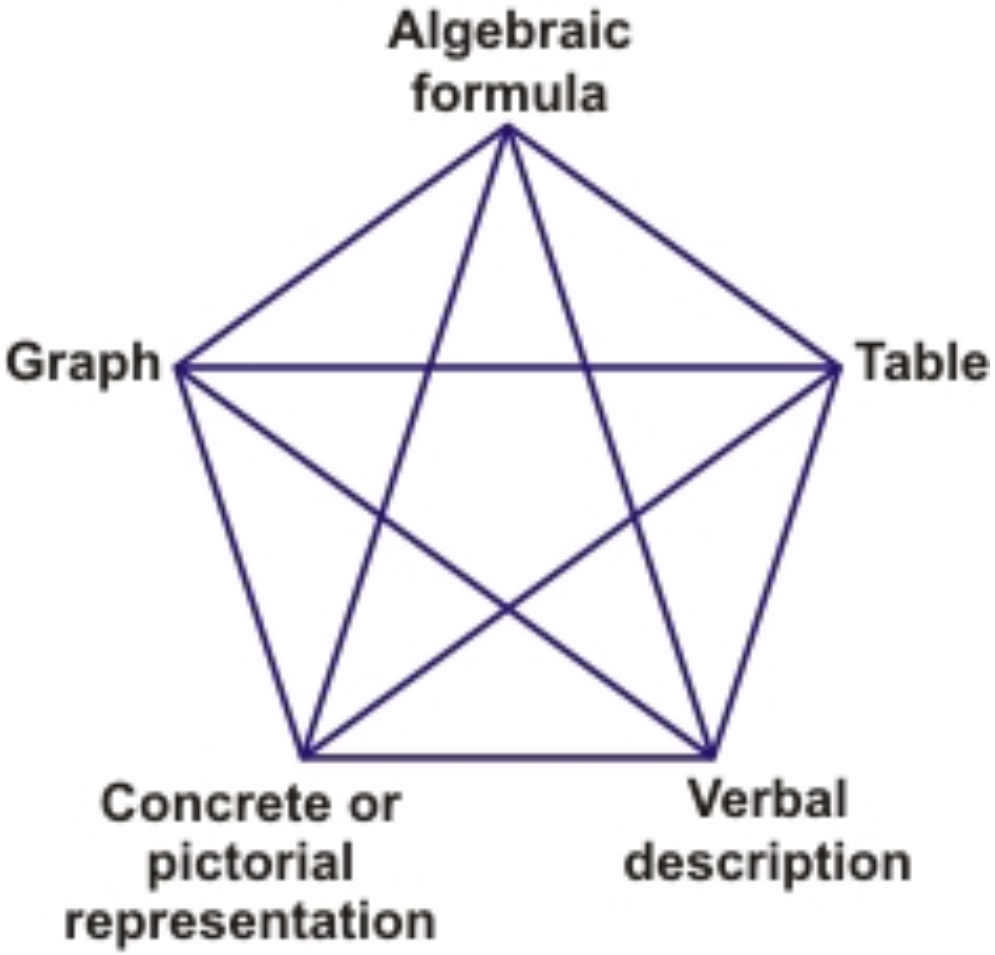



After an introductory video, the participants in this MOOC, "*Introduction to statistics*," are split into 2 subclasses for individual activities. In the first subclass, students acquire procedural knowledge—how to manually calculate the standard deviation for a set of 20 data points. In the second subclass, students acquire declarative knowledge—the concepts of dispersion, heterogeneity and variance, and illustrated graphical representations. Then, each student from a subclass is paired with a student from the other subclass, and collaboratively they first have to do a quiz that measures declarative knowledge and then a task that requires procedural knowledge. To be able to collaborate with their peer, those who acquired declarative knowledge individually have to proceduralize it with the help of their peer, and those who acquired procedural knowledge individually have to elicit it (next edge label).

# Edge Library

## Translation Edges

- Proceduralization
- Elicitation
- Alternate
- Reframe
- Reverse
- Repair
- Teach




http://www.nctm.org/classroom-resources/lessons/Graphical-Representations-for-the-Number-of-Hits/

# Edge Library

**Translation Edges**

- Proceduralization
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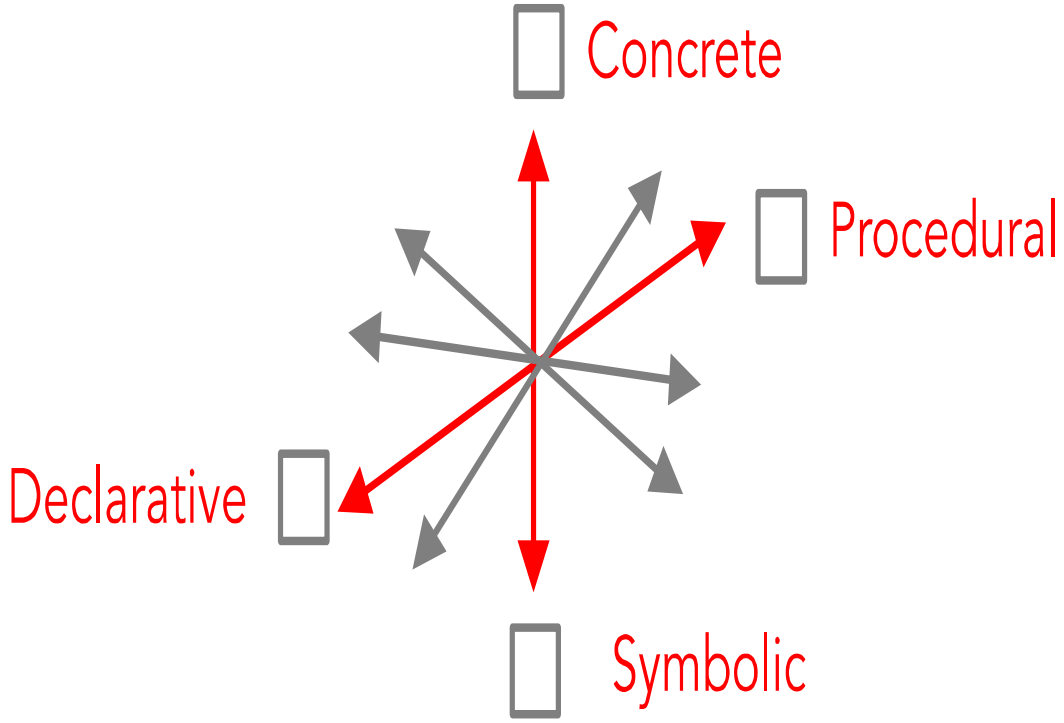
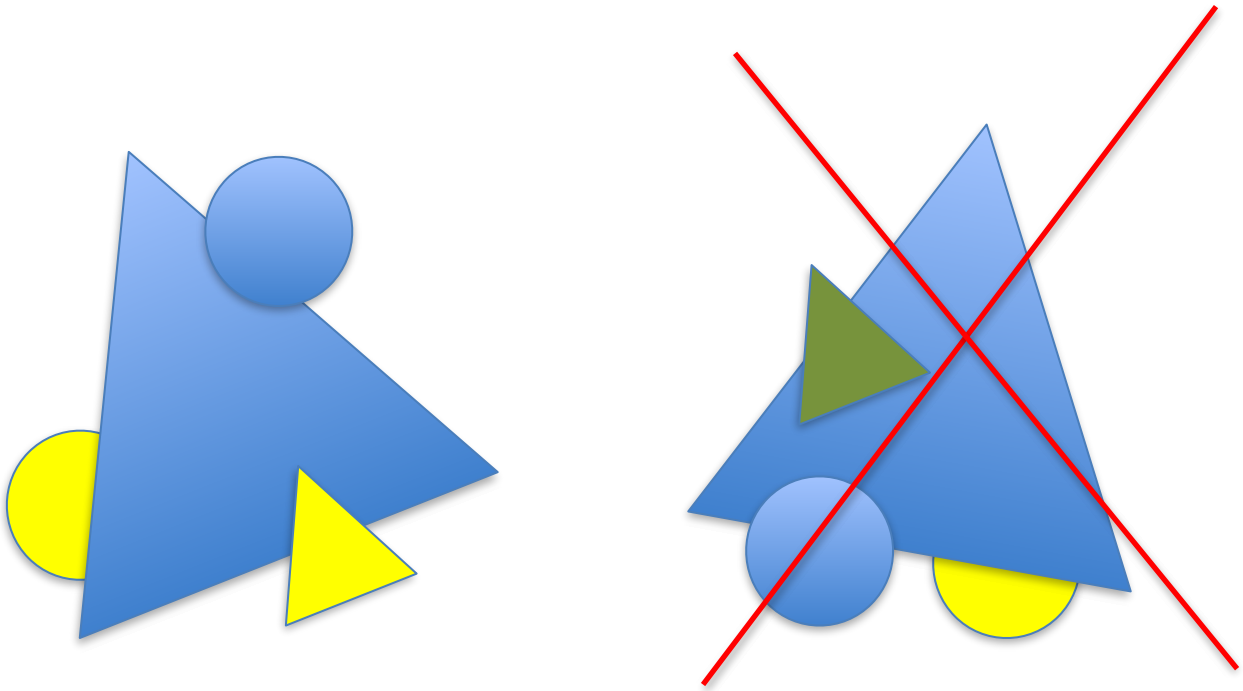



- Multiple types (procedural, declarative)
- Mutliple levels of abstraction (concret, abstract)
- Multiple representations
- Multiple viewpoints
- Multiple scales
- Multiple methods
- ….

# $A_1$

A **splountz** is a triangle with 3 smaller shapes placed on different sides, one in the same color as the triangle and the two others in a different color.



# $A_2$

A **splountz** is a triangle with 3 smaller shapes placed on different sides, one in the same color as the triangle and the two others in a different color.

Is this a Splountz ?

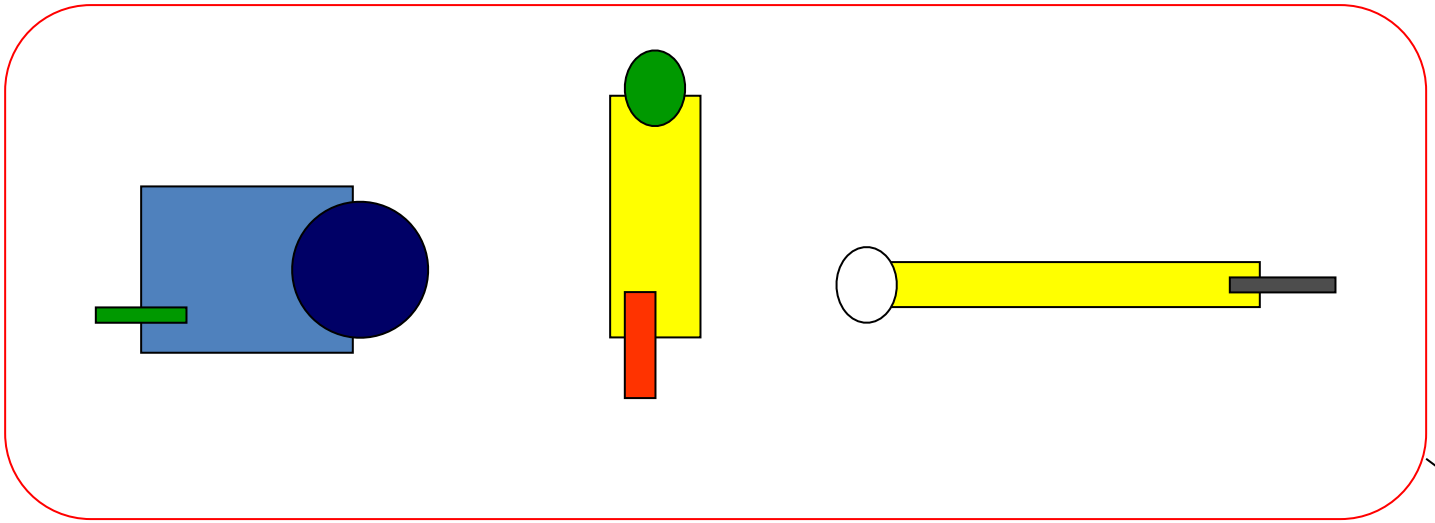
✔ ○ Yes

○ No

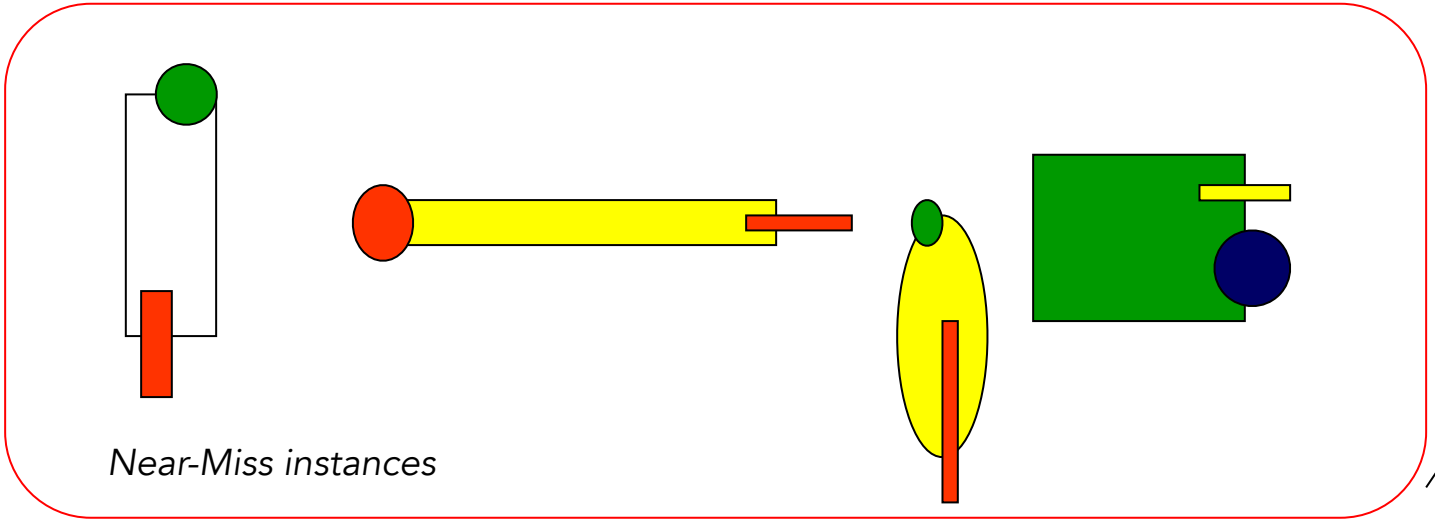
Label ($A_1$, $A_2$)= deduction

From the general to the particular

# $A_1$ SPUCs



Positive instances



*Near-Miss instances*

Negative instances

# $A_2$

What is a  SPUC ?

Label ($A_1$, $A_2$)= induction

From the particular to the general

# Edge Library

**Generalisation Edges**

(G+) Induction

(G+) Deduction

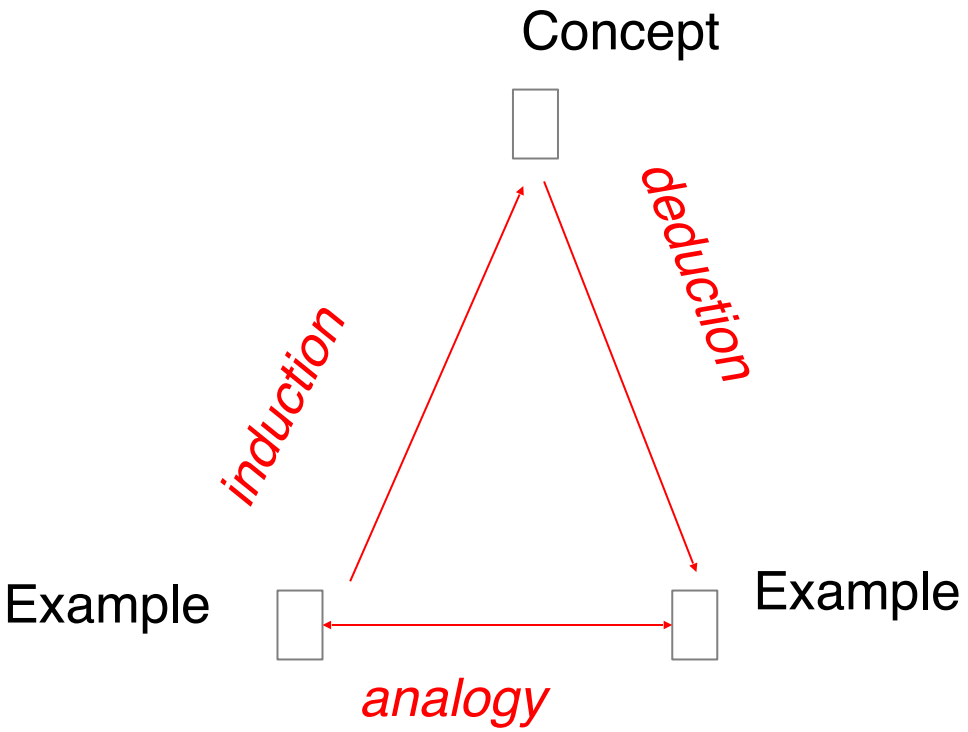
(G+) Extraction

(G+) Synthesis

(G=) Analogy

(G=) Transfer

(G–) Restriction



# The problem of transfer

"If 1 bottle of milk costs 5 francs, how many can I buy for 35 francs"

Near transfer

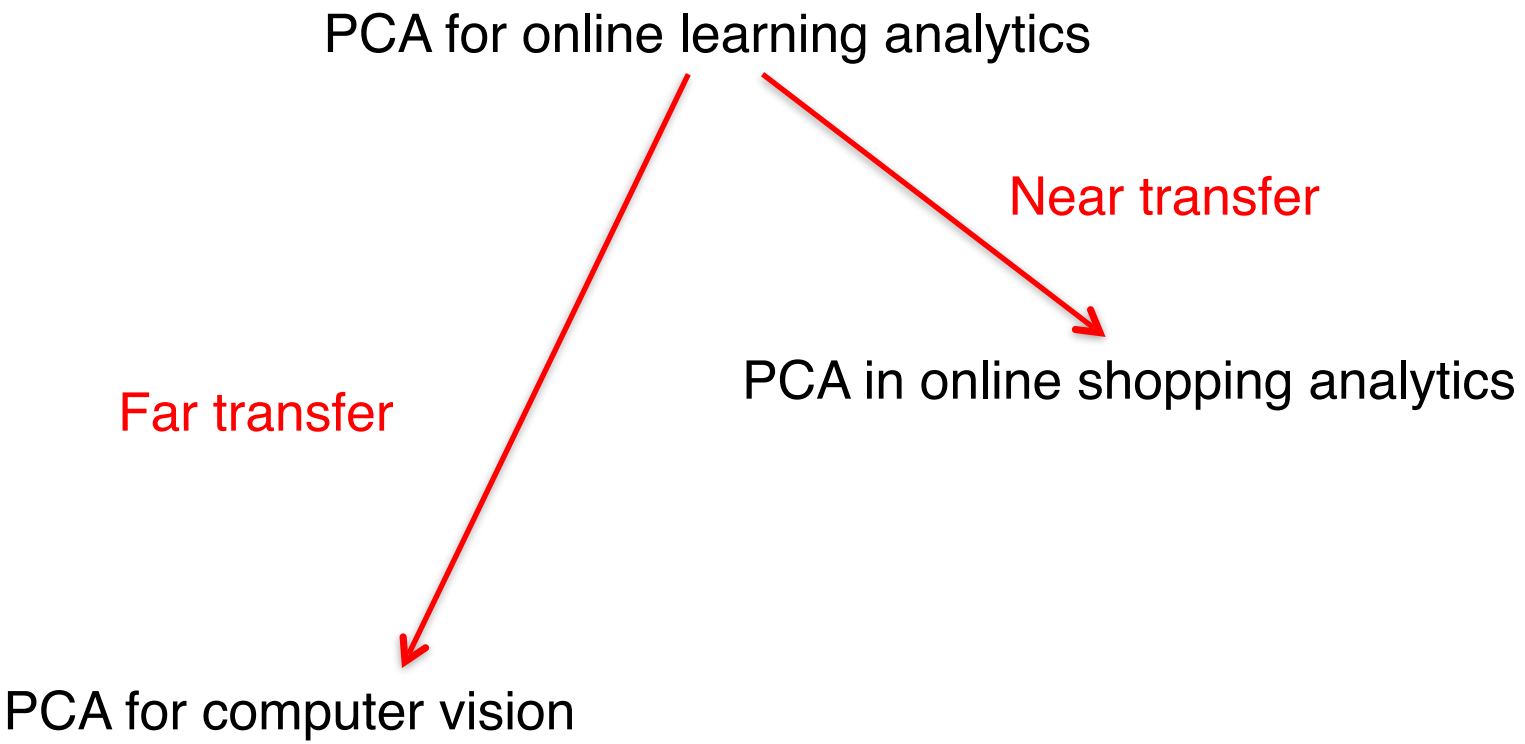
"If 2 books 10 francs, how many can I buy for 50 francs"

Far transfer

"If a car travels a distance of one kilometer in 5 minutes, how many kilometers will the car travel if it continues at the same speed for 35 minutes."

Humans are not very good at transfer because knowledge structures are very much anchored into a specific context.

# The problem of transfer



# Edge Library

**Generalisation Edges**

(G+) Induction

(G+) Deduction

(G+) Extraction

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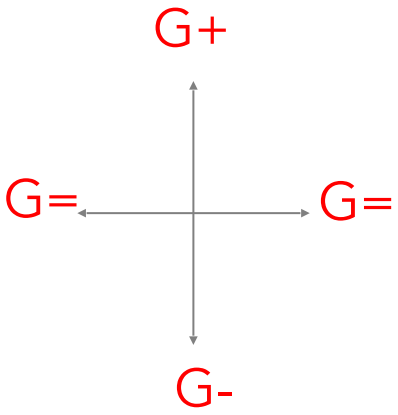
(G=) Analogy

(G=) Transfer

(G–) Restriction

The learners become better in transfer if ,
during the learning scenario,
the teacher paid attention
to vary systematically the context
of the examples/exercises presented.



# Library of Edge Labels

| Preparation | Set | Translation | Generalization |
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| (P) Anticipation | (S=) Juxtaposition | (T) Reverse | (G=) Analogy |
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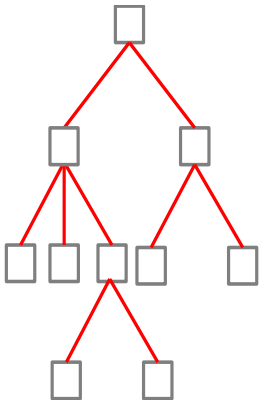
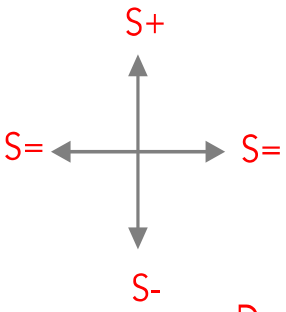
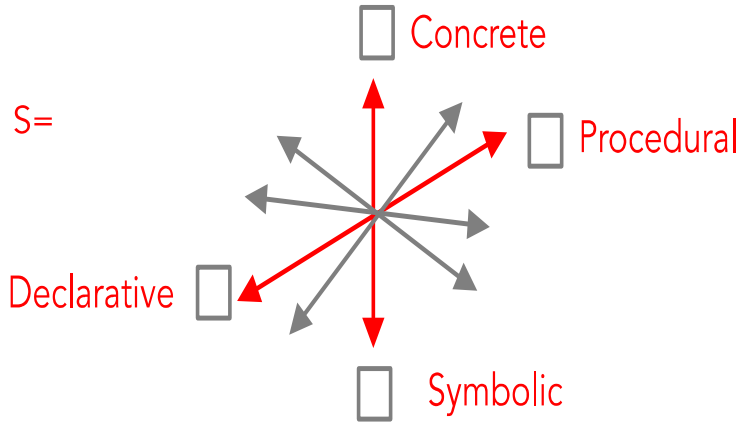
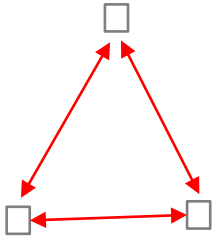
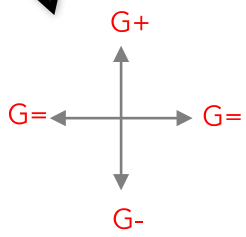
| (P) Data Collection | (S=) Identity | (T) Teach | (G-) Restriction |

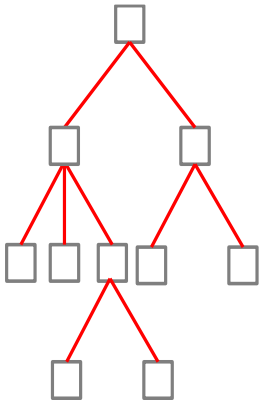


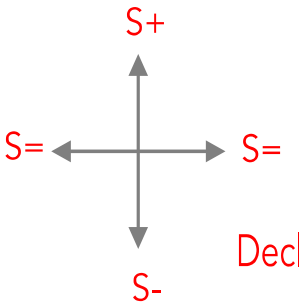


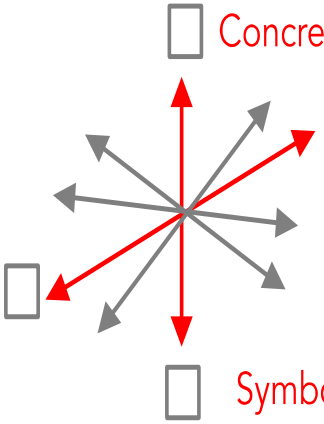



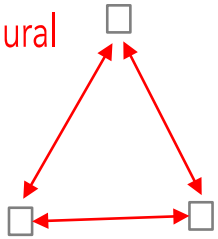



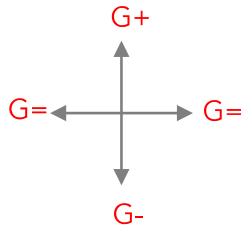




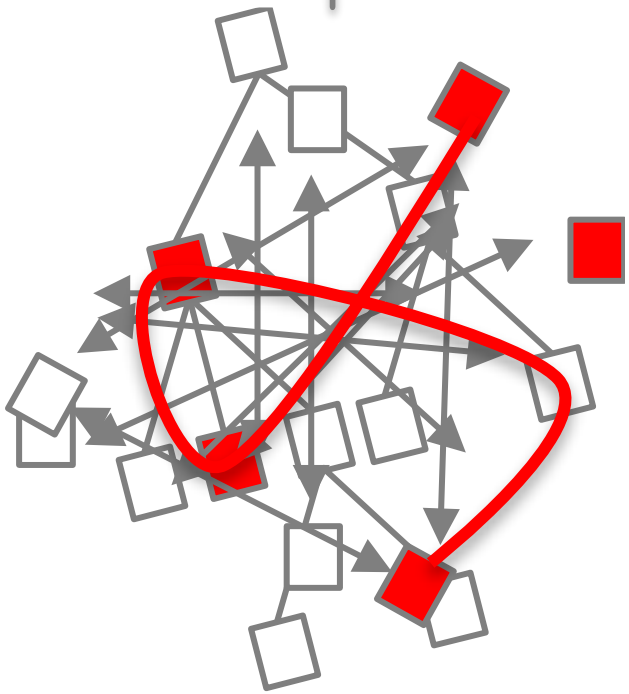


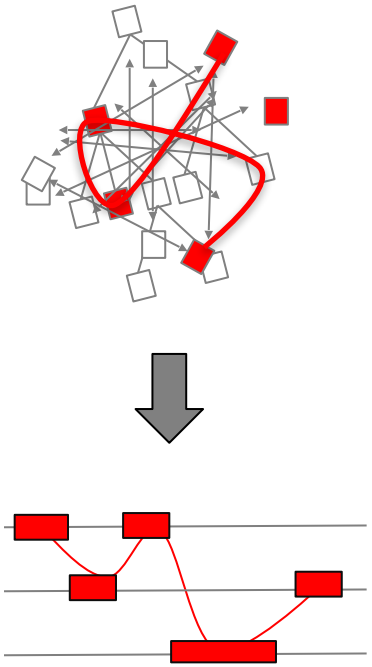



A learning scenario must explore the knowledge mesh in multiple ways, creating multiple pathways between various formats of knowledge.



*You don't know a forest if you walk around it or across it but only if you have crossed it in many ways, many directions, etc.*

The orchestration graph translates this multidimensional exploration into a linear path, because time is linear.



Knowledge Mesh

Orchestration Graph