



UNIVERSITÀ DEGLI STUDI
DI MILANO

Computer skills advanced problem solving: other methodologies and representations

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Topic 1

- Problem solving
 - Introduction
 - Simple and complex problems
 - Reasoning abilities
 - Problem solving in psychology
 - Different contexts
- Problem solving and decision making
 - Interrelations
 - Decision making techniques
- Well-conditioned problems
- The Pareto's principle

Problem solving in psychology

Behaviourism and problem solving

- trial and errors

Gestalt psychology and problem solving

- an individual can find the solution of a problem through INSIGHT

Cognitivism and problem solving

- continuous feedback individual-environment

Computational approach: the space of the problem

- Newell and Simon: *Problem Space* theory

Anderson and the ACT model

Reciprocal interconnection of 3 components:

1. Declarative memory
2. Procedural memory
3. Working memory

Decision making techniques:

chatchball

- For group decisions

delphi

- For groups
- Expert panel geographically distant

Pareto's principle (or "rule 80/20")

Well-defined problem

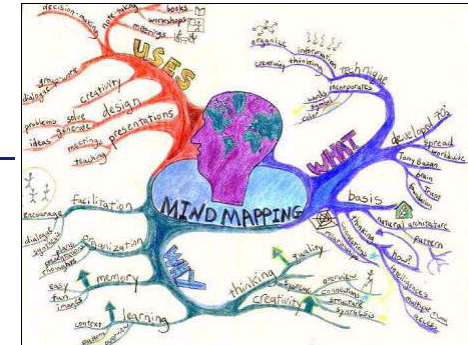
- Enlarged Lasswell (5 W and 1 H:
Who? What? Where? When? Why?
How?)

Topic 2

- Creativity and Problem solving
 - Representations
 - example of applications

- Brainstorming
 - Collective intelligence
 - Participants are encouraged to express ideas

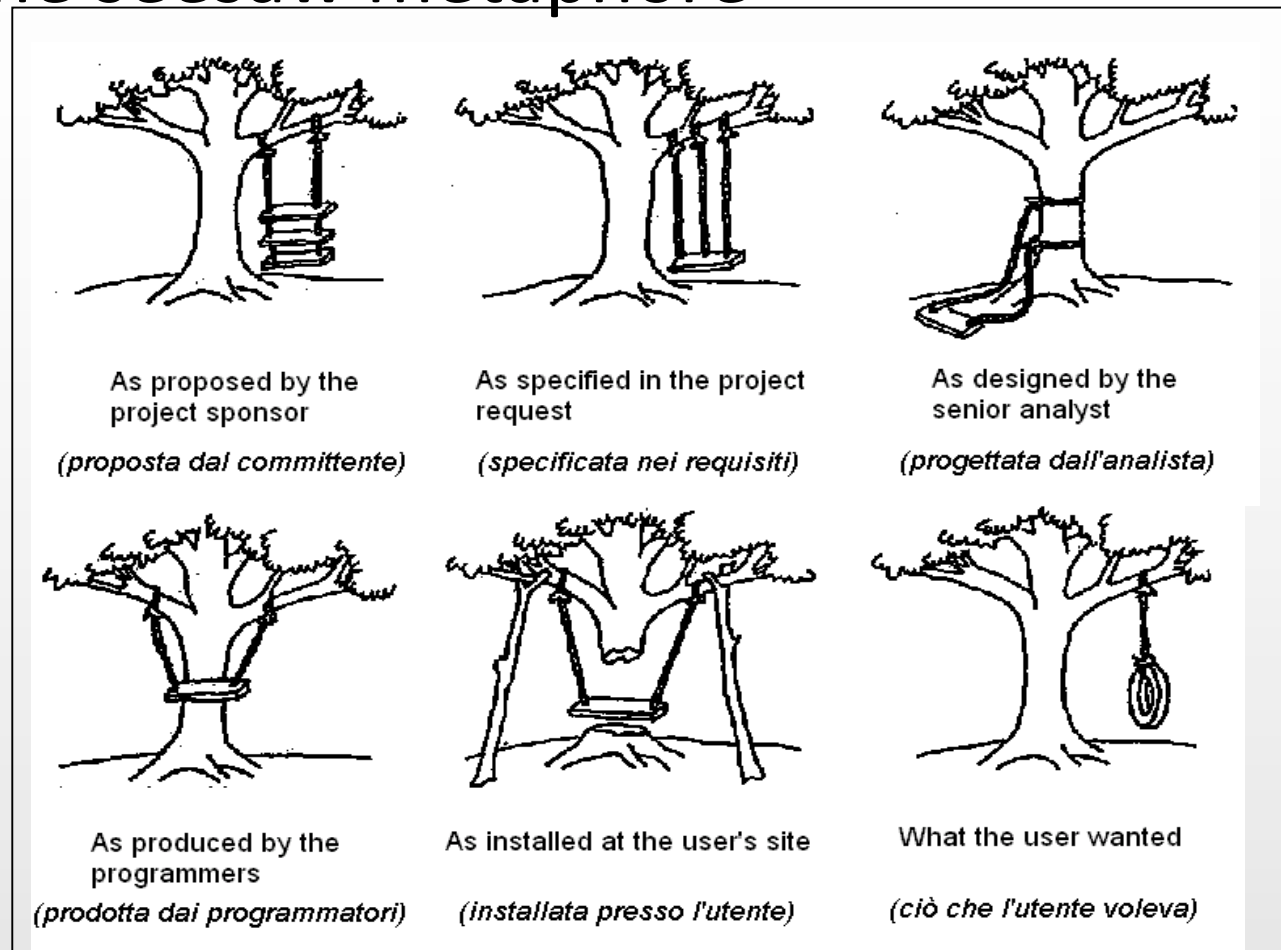
Mental maps



- Many applications: communication, problem analysis, efficient presentations, learning
- Also useful to solve complex problems
- Many free software at disposition in the Internet

Topic 3

- Many contact points between Problem Solving and Project Management
- The seesaw metaphore



- **WELL-DEFINED project:**
 - objectives,
 - context,
 - constraints (boundaries),
 - expectations,
 - Involved/to-be-involved resources.
 - Time

Problem solving in project management: many models

- USA defence
- The Murphy model (pharmaceutical PM)
- The spiral model
- The waterfall model

SWOT ANALYSIS

A matrix that examines:

- Strengths
- Weakness , concerning current and internal situation
- Opportunities
- Threats, from competitors or external factors

The what-if analysis

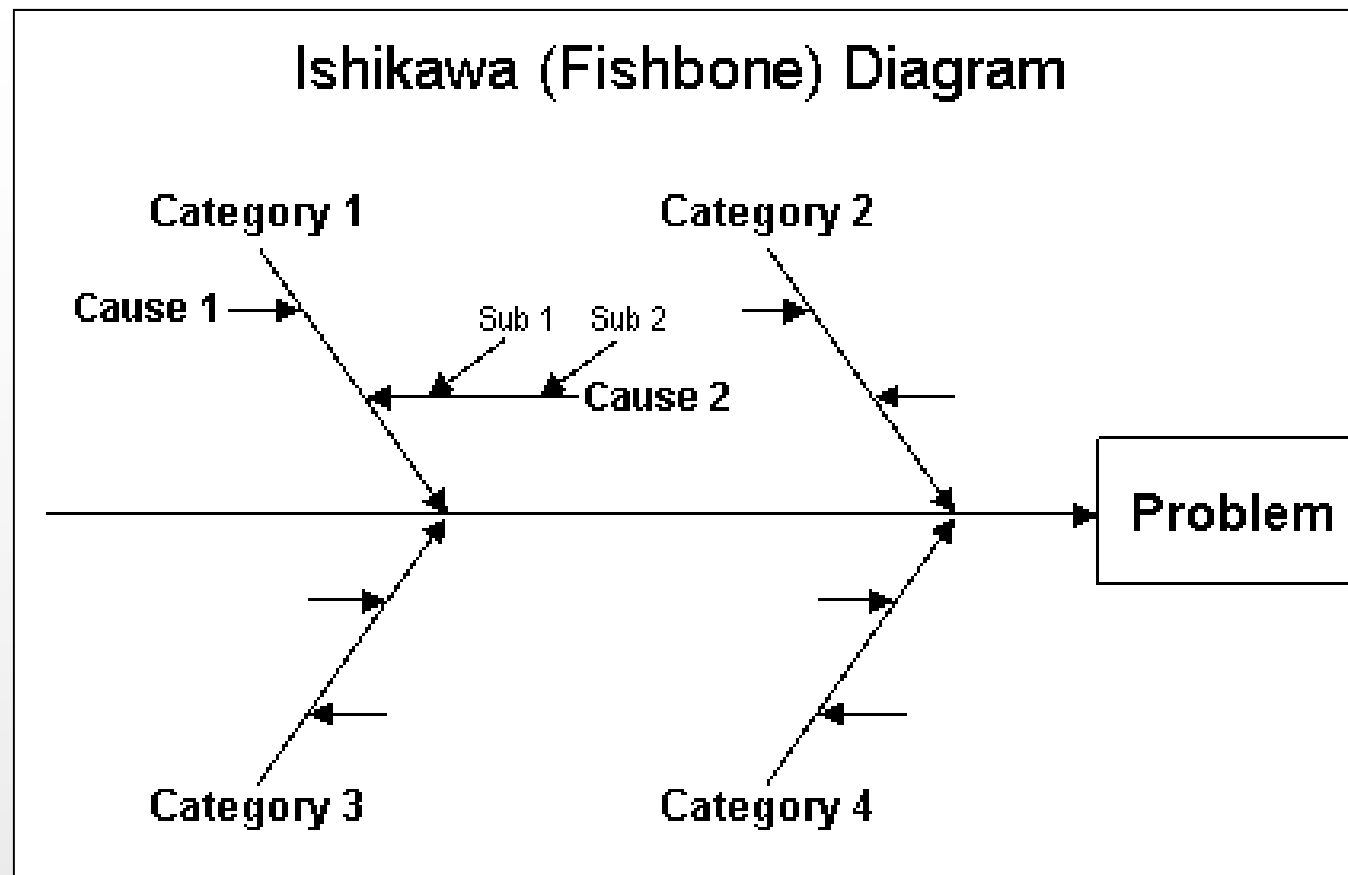
- The What-if analysis: current and forecast project status
 - Best and worst scenarios
 - Many IT tool at disposition
 - Also Excel

the S.Q.U.I.D. formula

- To verify information and to evaluate the project
- The S.Q.U.I.D. formula:
- **Soon** (subito): how much faster we answered to the requirements
- **Quality** (qualità) of the product and of the ideas
- **Information** (informazioni) that need to be given
- **Date** (data) in which we will deliver the results or end the project

The cause-effect diagram

- Also called *Fishbone* or *Ishikawa diagram*

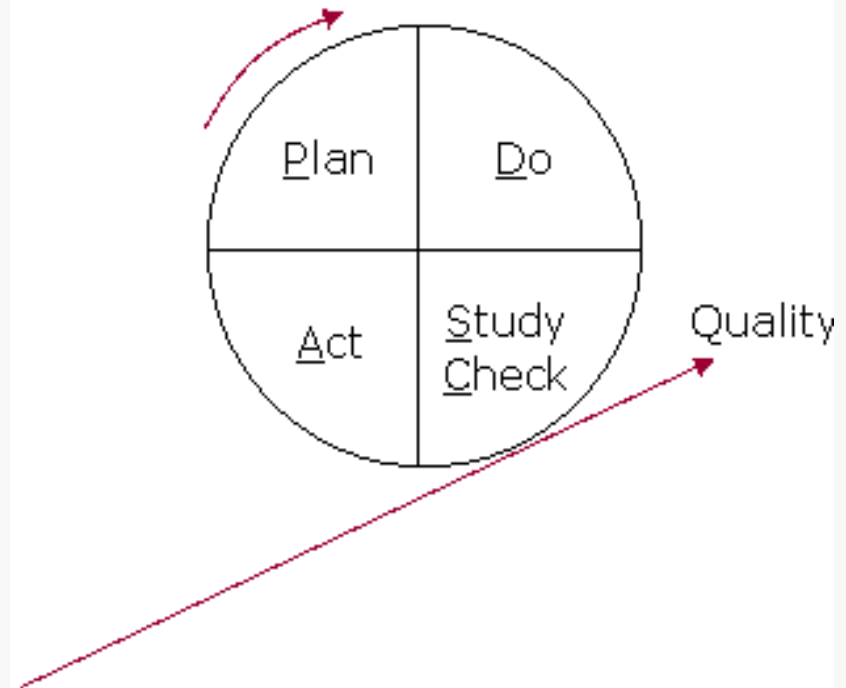


The Deming cycle

4 parts:

- **PLAN**: anticipate changes. Analyse and predict results.
- **DO**: execute the plan, through little steps in controlled circumstances.
- **STUDY** (control): study the results.
- **ACT**: act to standardize or improve the process.

Deming Cycle (PDSA)(PDCA)
Dr. W. Edwards Deming



8D methods

- 8D = 8 Disciplines
- Methodology to represent (and solve) problems about the improvement of products and processes
- Also known as Global 8D, Ford 8D or TOPS 8D

Topic 4

Algorithmic Problem solving

- **Different symbolic representations:**
 - Flow diagram (diagramma a blocchi)
 - Top-down, down-top

Natural language

- Another way to represent a problem
 - Top-down (decomposing the main problem in simple sub-problems)
 - Down-top (starting from the bottom)

Computational thinking

- Seymour Papert, 1996.

The problem solving process is characterized by:

- Formulating problems to which a PC can give support
- Automation of solution through the algorithmic thinking

Topic 5

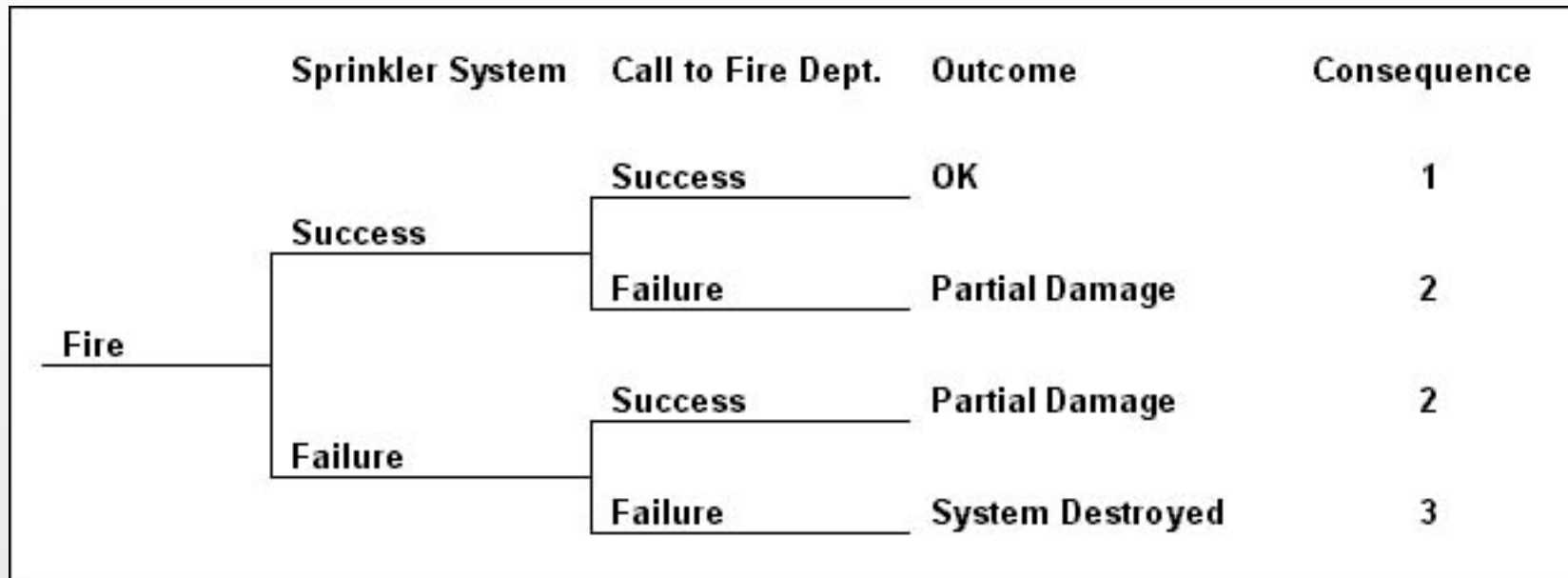
Other methodologies to solve and represent a problem

- Pyramid diagram
- Onion diagram
- Decision tree
- Also many others. Here are some:
 - Kaizen method (from quality control)
 - BPR (Business Process Reengineering)
 - Event Tree (event description)
 - Constraints Theory (cause-effect recognition)
 - etc. etc....



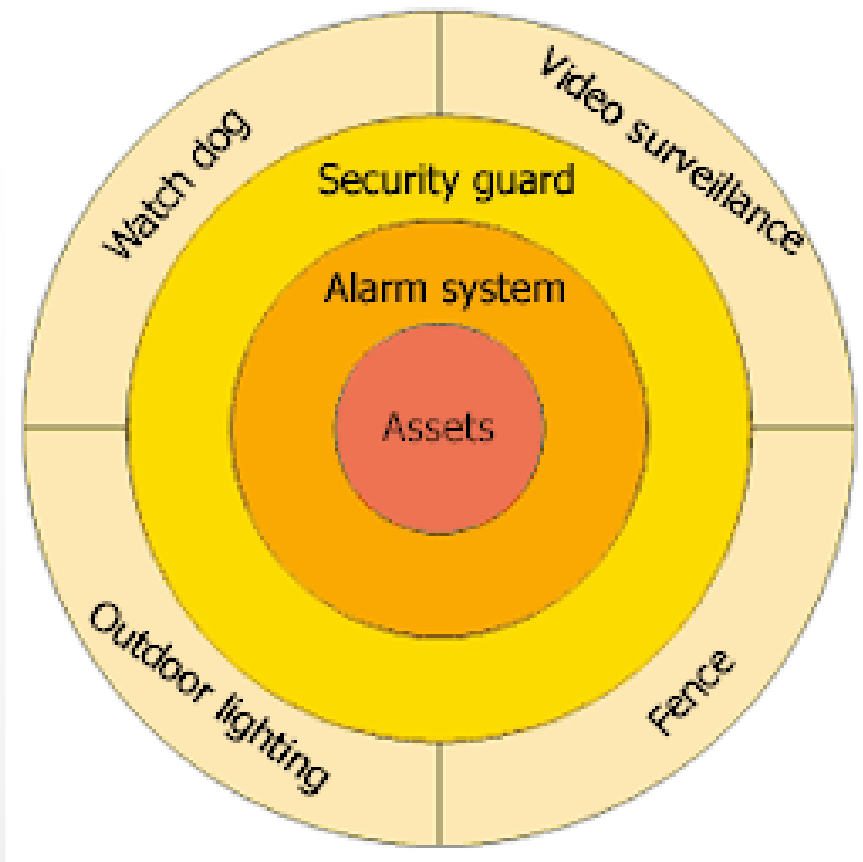
Event Trees

- Event Tree = representation of all the events which can happen in a business system
- Also used in other fields
- It allows to explore all the options that can happen



Simple diagrams: Onion Diagram

- Concentric circles
- Each circle represents a process or a problem component depending from its internal circle
- In the centre we put the main concept (problem) that is the root.
- Advantage: it visualizes in a simple and efficient way a problem but it is not used in the detail phases of a problem (it is useful only in the initial phases of identification)

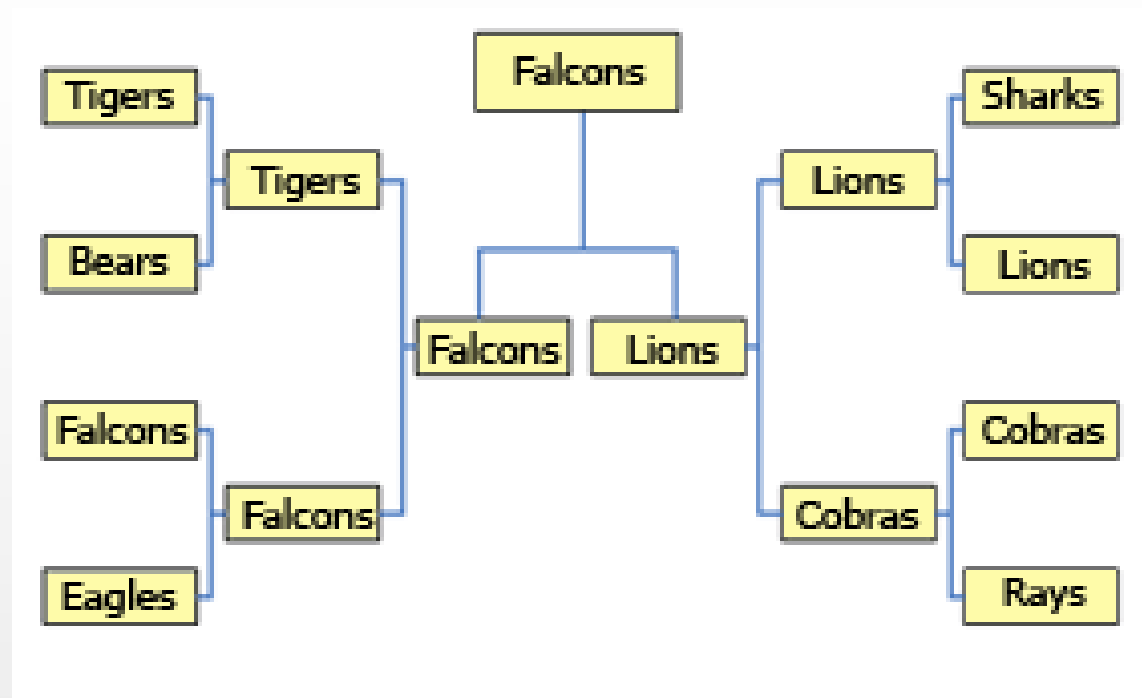




Simple diagrams: Tree Diagram

- It consists in decomposing (as in a classification) the problem in more simple sub-problems
- Useful when there is an information hierarchy or a process composed of many parts.

- Useful also to explain data structures or details in systems integrations.



Problem solving in your disciplines?

- Why you need to know problem solving principles and different related methodologies?
- This approach is necessary because is part of multidisciplinary advanced skills needed in international relationship involving Countries, international organizations or private companies. You need to know decision making, creative problem solving, algorithmic problem solving, project management.
- These are skills ever requested in this field



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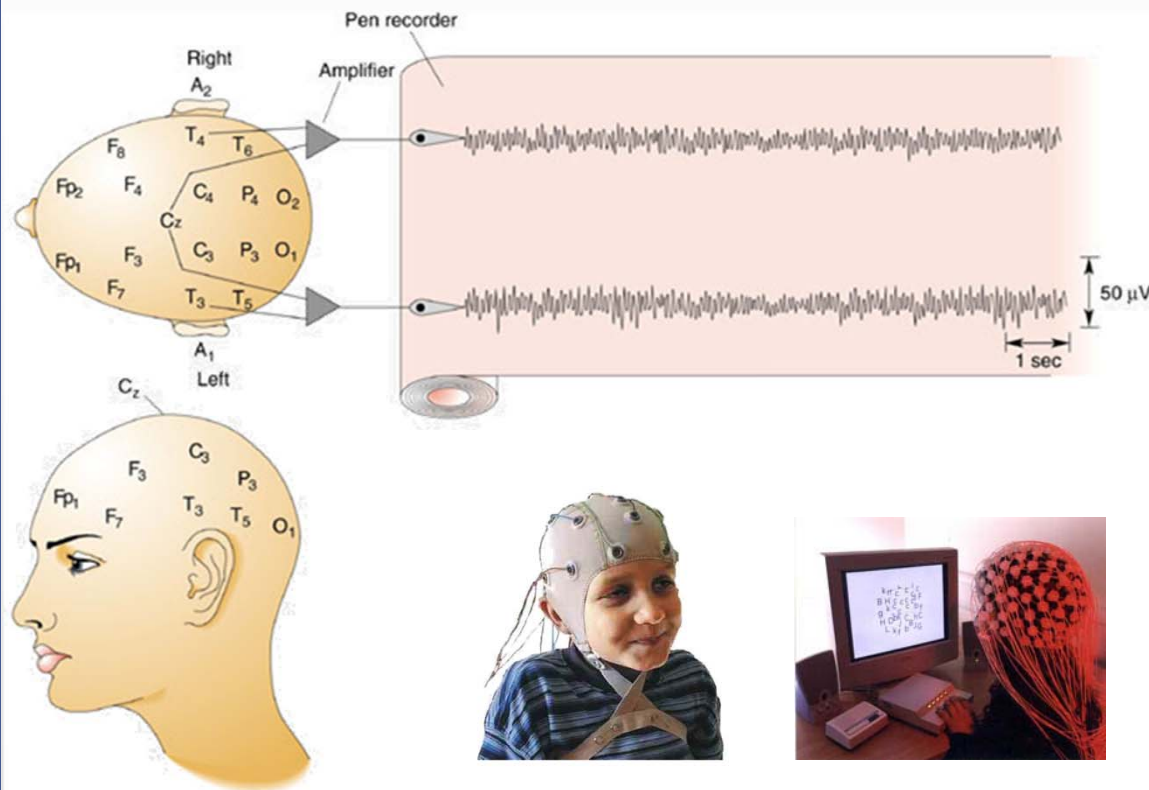
New perspective in problem solving

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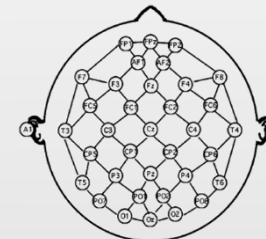
DEAS, Dipartimento di Scienze Economiche, Aziendali e Statistiche

Brain Imaging technologies: EEG

- electroencephalography (EEG) measures the **activity of neuron populations**.
- EEG is non-invasive and relatively low cost.
- The electrodes measure on the scalp differences in voltage in microvolt (μV)



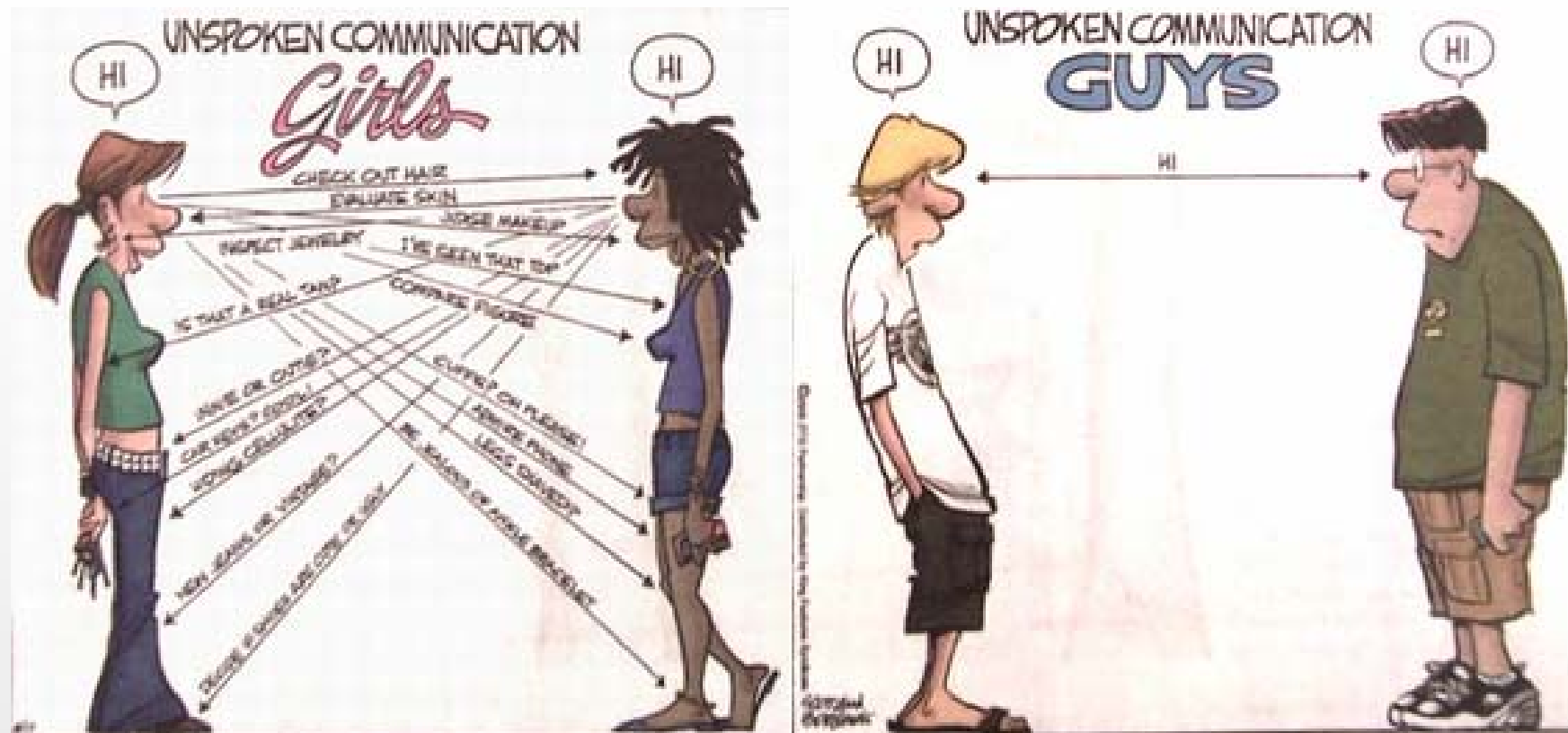
10-20 system: A, auricle; C, central; F, frontal; Fp, frontal pole; O, occipital; P, parietal; T, temporal.





New perspective in problem solving: the cognitive approach

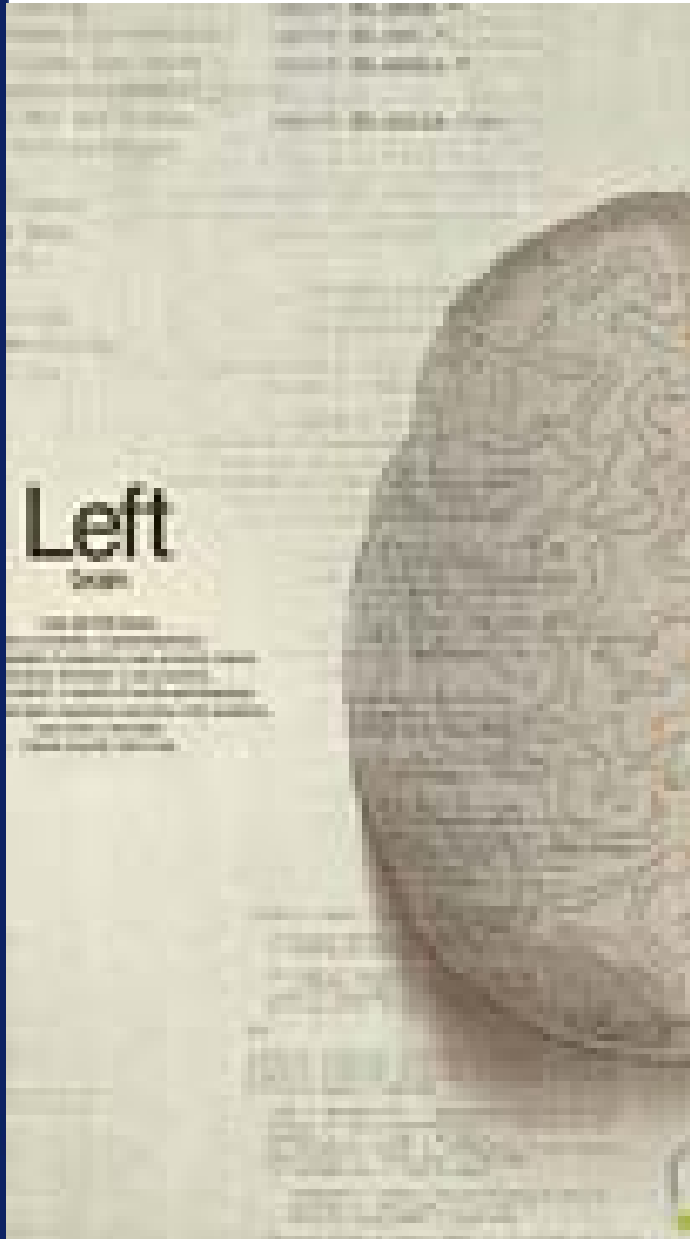
The cognitive approach of individuals to problem solving become visible



the invisible becomes visible



TECHNOLOGICAL interested disciplines



- Artificial Intelligence
- Virtual Reality
- Game Design
- Web Science
- Digital Communication
- Machine Learning
- Robotics
- Bioinformatics
- Biotechnology
- User experience
- ...



NON-TECHNOLOGICAL interested disciplines

- Communication
- Psychology
- Economics
- Marketing
- Decision Making
- Education
- Linguistic
- ...



Brainomics and Problem Solving

- Possibility to
 - Investigate the brain mechanisms in problem solving... the brain in action!
 - Achieve a deep comprehension of the “human information processing”
 - measure thought, approaches and emotions

BCI?

BCI = Brain Computer Interface

- Based on data (signals) from EEG
- Two kinds of BCI:
 - Invasive Technology
 - Electrodes implanted directly in the brain
 - Non-invasive technology
 - Sensors placed on headband





Signals registered from BCI

- Rhythms grouped by frequency (max 100 μ V)

Type	Frequency	Location	Use
Delta	<4 Hz	everywhere	occur during sleep, coma
Theta	4-7 Hz	temporal and parietal	correlated with emotional stress (frustration & disappointment)
Alpha	8-12 Hz	occipital and parietal	reduce amplitude with sensory stimulation or mental imagery
Beta	12-36 Hz	parietal and frontal	can increase amplitude during intense mental activity
Mu	9-11 Hz	frontal (motor cortex)	diminishes with movement or intention of movement
Lambda	sharp, jagged	occipital	correlated with visual attention
Vertex			higher incidence in patients with epilepsy or encephalopathy

Non-invasive BCI: main models

Main commercial models:

- Emotiv Epoc
- Mindwave Neurosky



- Created for entertainment, games applications.
- Now used in research.
- Tool for development and research:
 - Data registration
 - Libraries for applications and interfaces
- They register signals which after need to be elaborated

All's well
that ends
well

