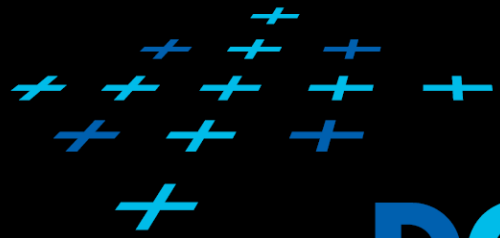
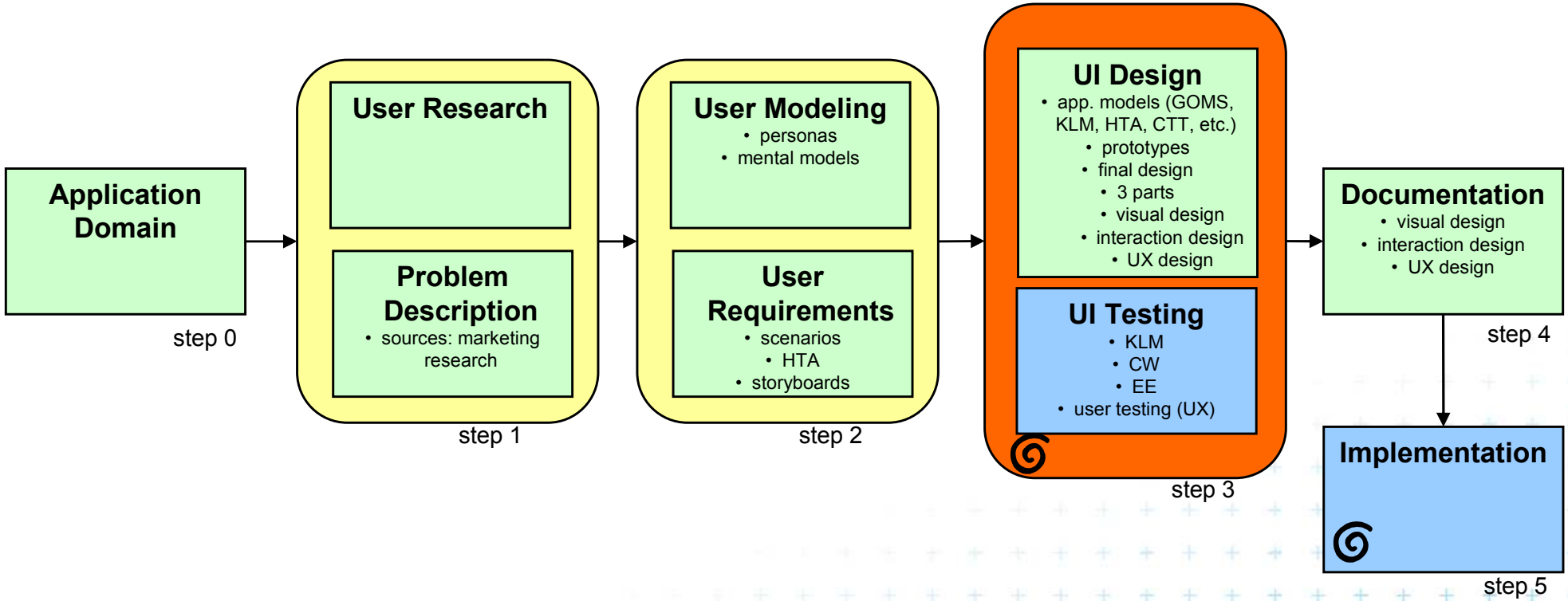


DCGI

KATEDRA POČÍTAČOVÉ GRAFIKY A INTERAKCE

NUR: MODELS AND ARCHITECTURE

User interface design - big picture



What is interaction?

communication

user ⟺ system

but is that all … ?

HCI = Human Computer Interaction

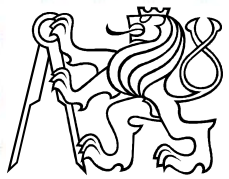
- Understanding of processes in both parts
- How to describe activities in these parts?
- What are links between these parts?
- How the communication is performed?

HCI

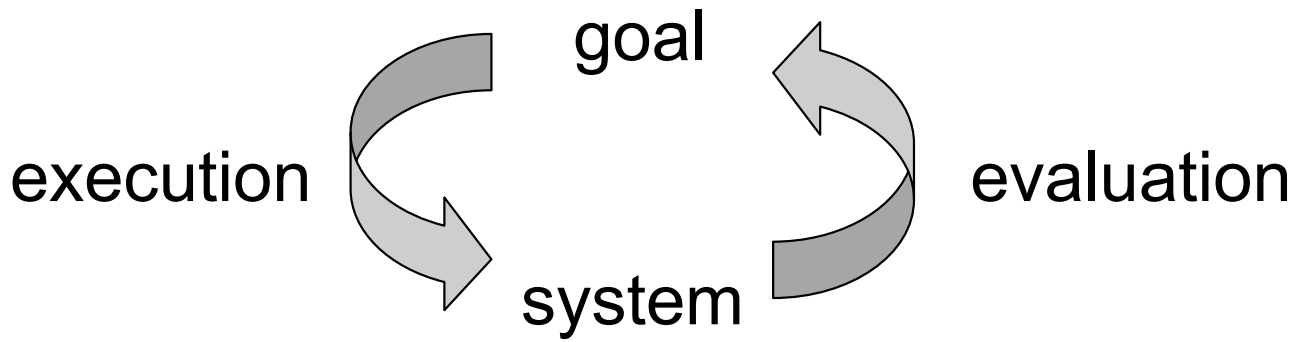
- Which formalisms can be used?
- Some formalisms have been already discussed
- Human side: HTA (task related)
- Computer side: STN (dialog structure described)
- What is missing?
- E.g.: info about implementation issues (what the structure of software product will look like)
- E.g.: how to prepare concept of the UI design
- Etc…

Structure of the dialogue

Does the structure of the dialogue influence the architecture?

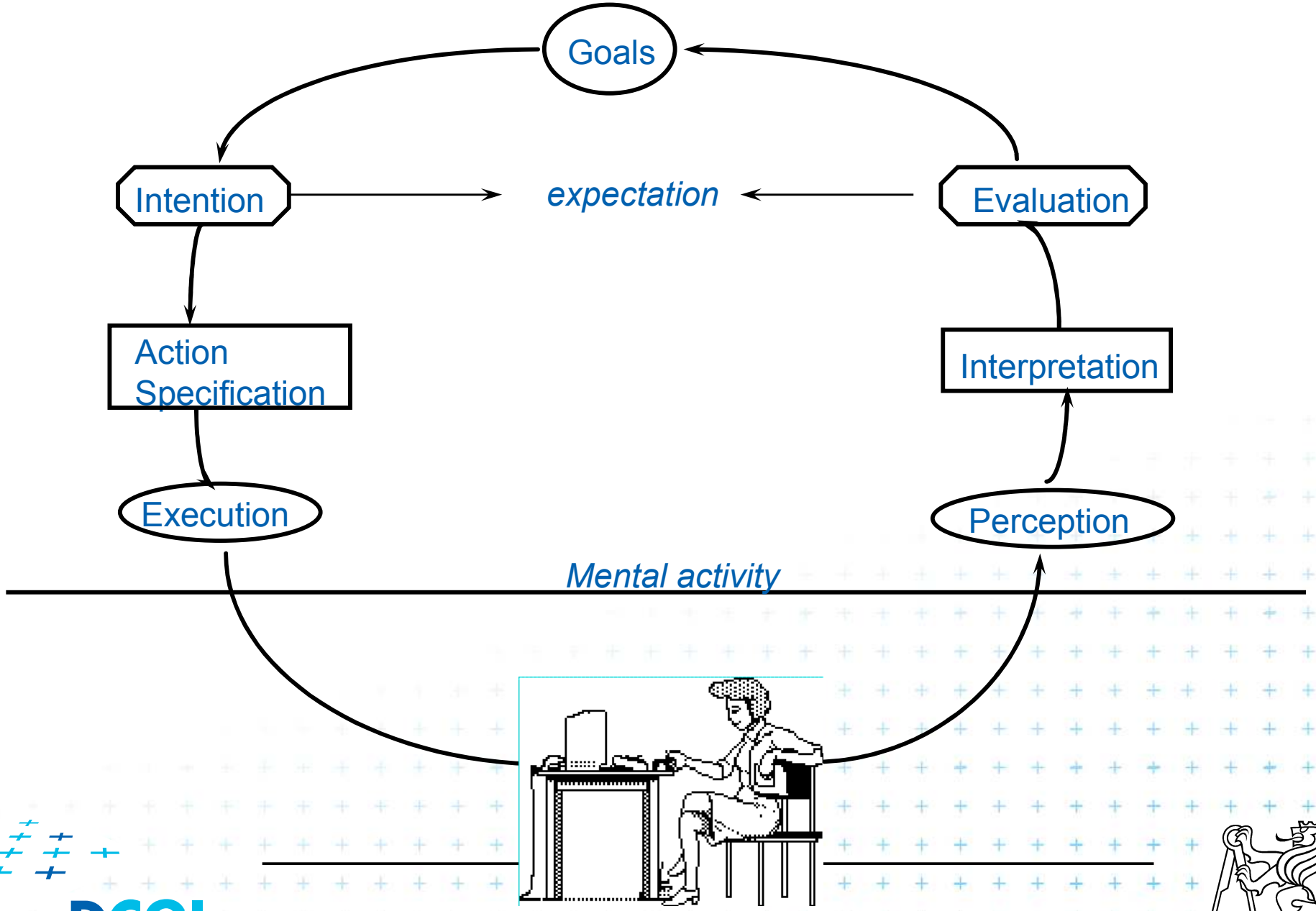


Execution/evaluation loop

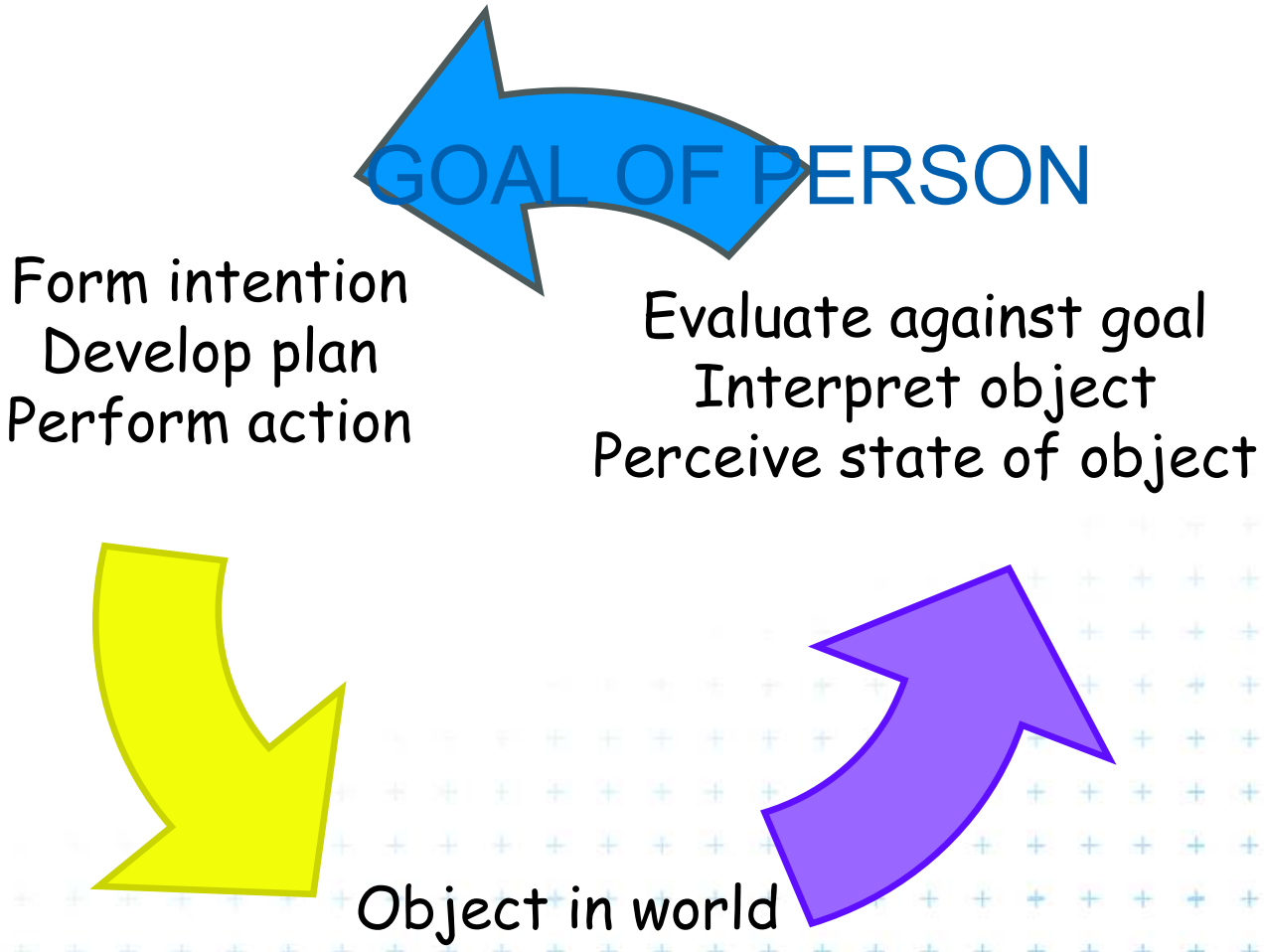


- user establishes the goal
- formulates intention
- specifies actions at interface
- executes action
- perceives system state
- interprets system state
- evaluates system state with respect to goal

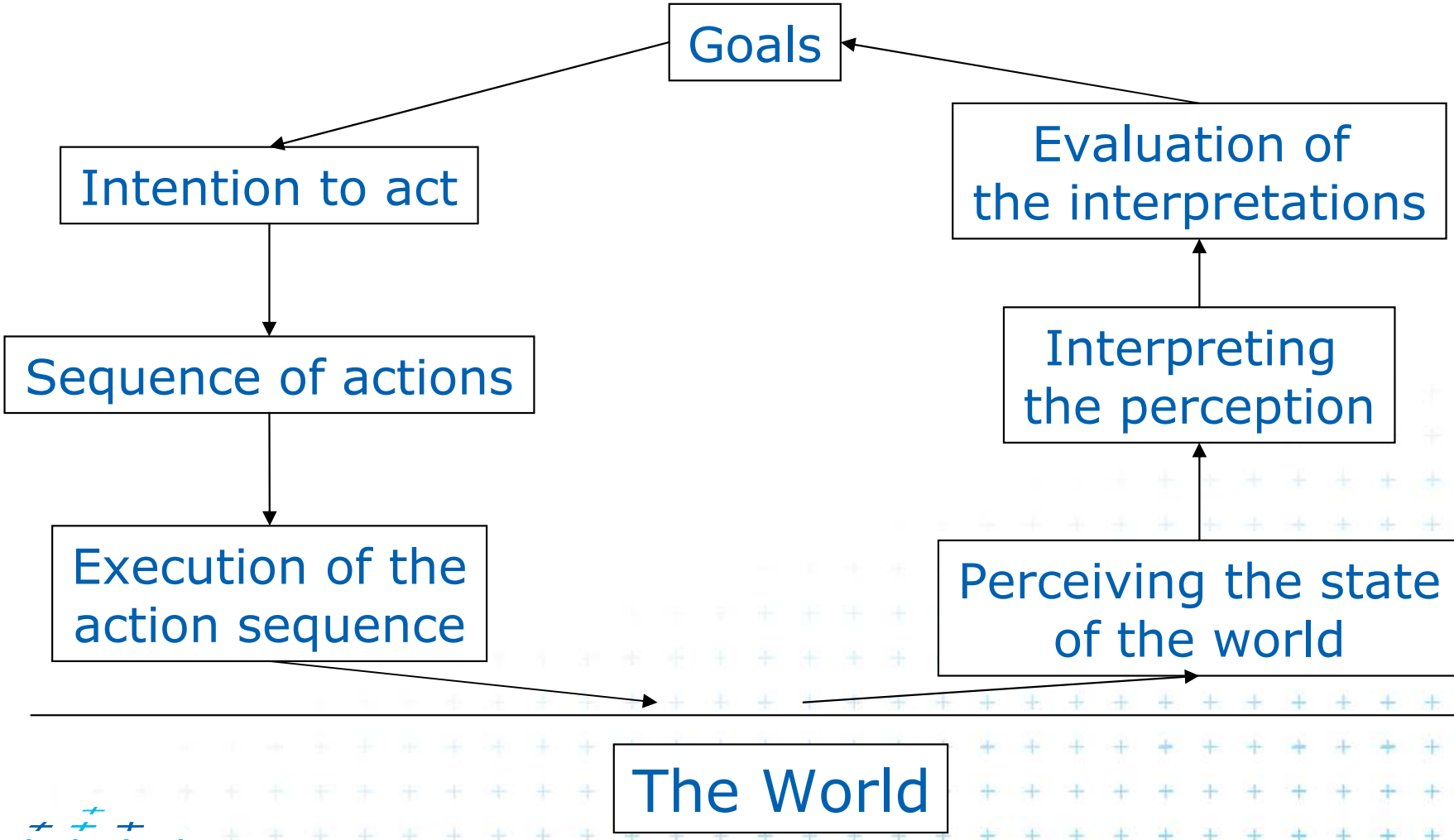
The stages of user activities when performing a task



Seven Stage Action Model [Norman, 1990]

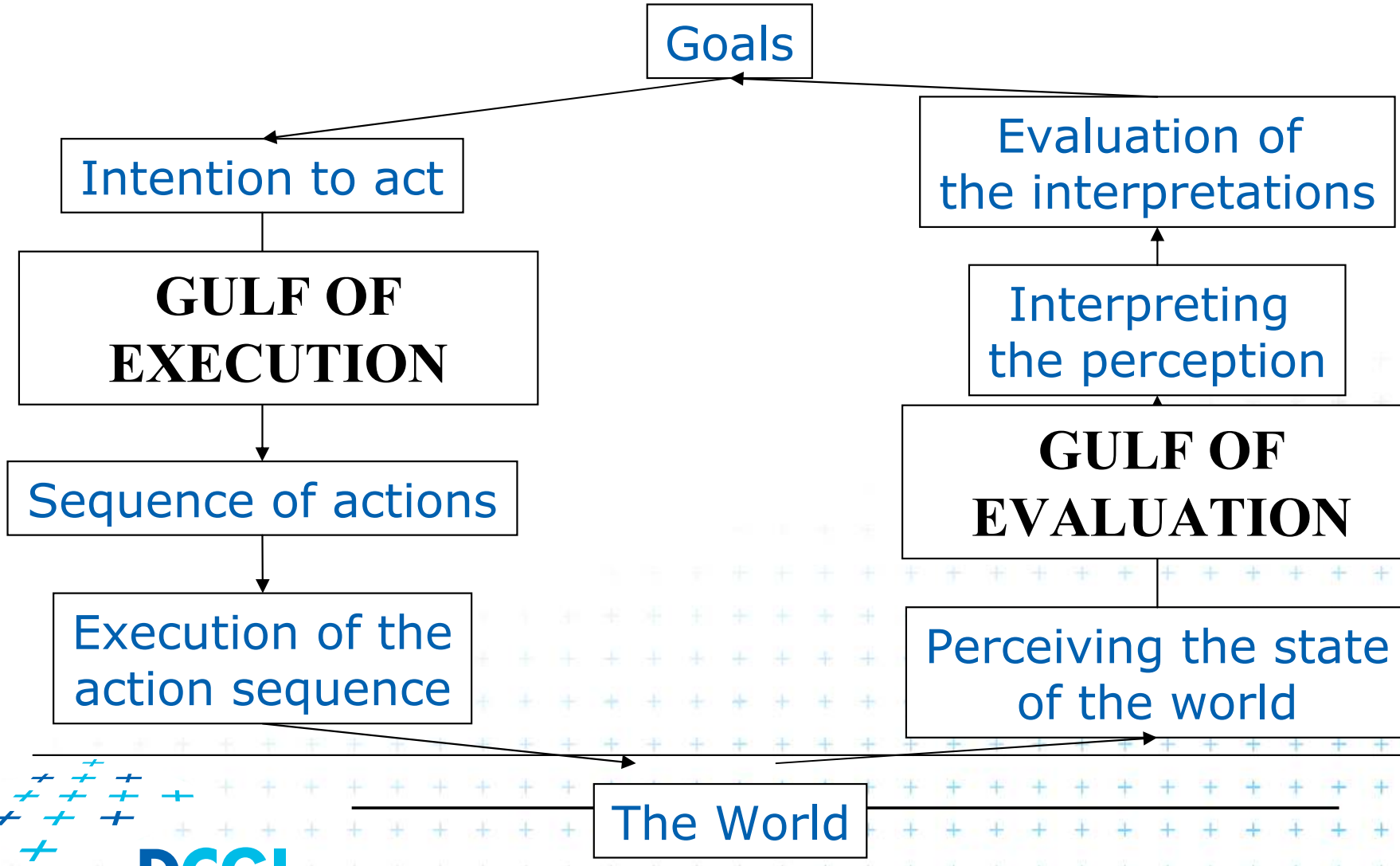


Seven Stages of Action



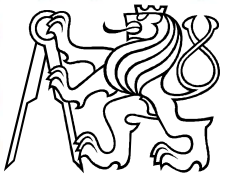
But things can go wrong at any of these stages

Gulfs of Execution & Evaluation



The Gulf of Execution

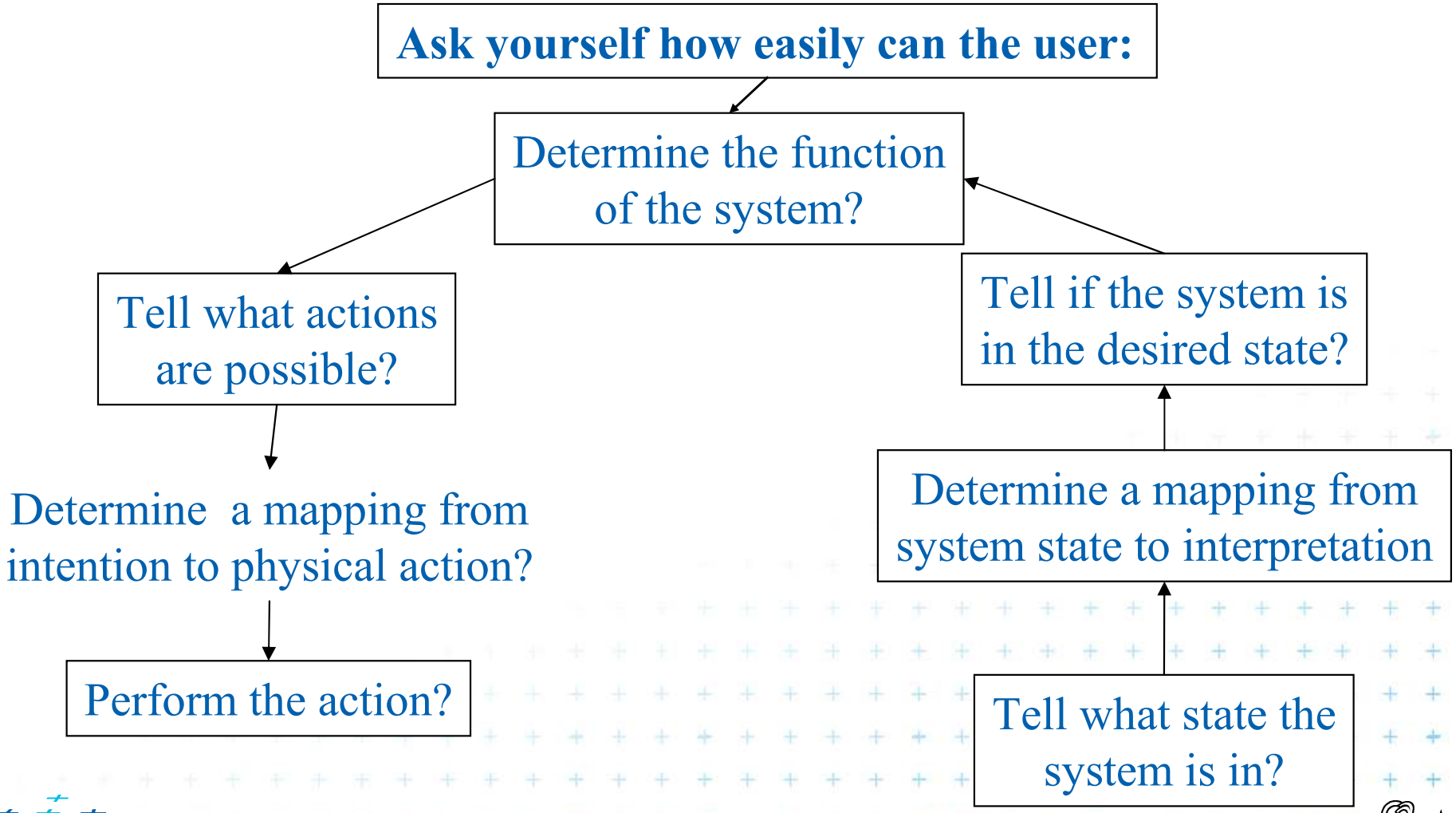
- Does the system provide actions that correspond to the user's intentions?
- The difference between intentions and allowable actions is the Gulf of Execution



The Gulf of Evaluation

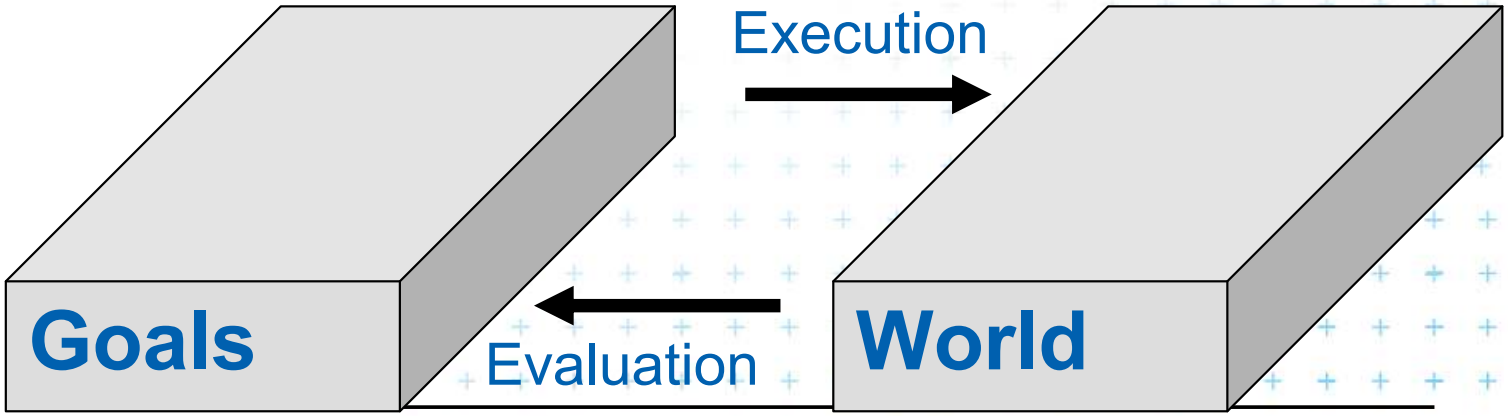
- Does the system provide a physical representation that can be readily perceived and interpreted in terms of the user's intentions and expectations?
- The Gulf of Evaluation reflects the amount of effort that the person must exert to interpret the physical state of the system and determine how well the intentions have been met.

The Seven Stages as Design Aids



Gulfs of execution and evaluation

- Gulf of execution:
  - How does the user translate intentions into action?
- Gulf of evaluation:
  - How does the user understand the effects of actions and does s/he tell when her/his goals are satisfied?



Bridging the gulfs

- Execution
  - Mappings:
    are actions designed so the users make the connection between the effects they intend to achieve and the actions provided by the system?
- Evaluation
  - Feedback:
    is information about the system state provided in a way that allows users to determine whether goals are satisfied?

Using Norman's model - Summary

Some systems are harder to use than others

Gulf of Execution

user's formulation of actions

≠ actions allowed by the system

Gulf of Evaluation

user's expectation of changed system state

≠ actual presentation of this state

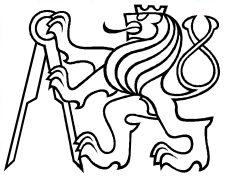
Exercise #1

- Use the Seven Stage model to represent the activities associated with withdrawing £20 from a cashpoint machine

UI and user behavior

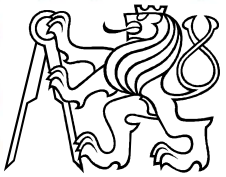
Concept of UI design

- Mental and conceptual models
- What kind of information they will deal with?
- Roughly speaking: they “force” the designer to take into account the user’s way of thinking



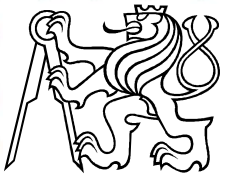
Mental and Conceptual model

- Need to first think about how the system will appear to users (i.e. how they will understand it)
- A **conceptual model** is the designer's intended mental model for the user of the system: a set of ideas how it is organized and how it operates (Norman calls it a design model)
- We form a mental model of the function, which we use to predict the likely result of our actions, and hence choose what to do for a desired outcome
- Example: heating in a "cold" home



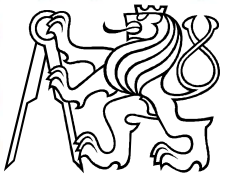
For either idea….

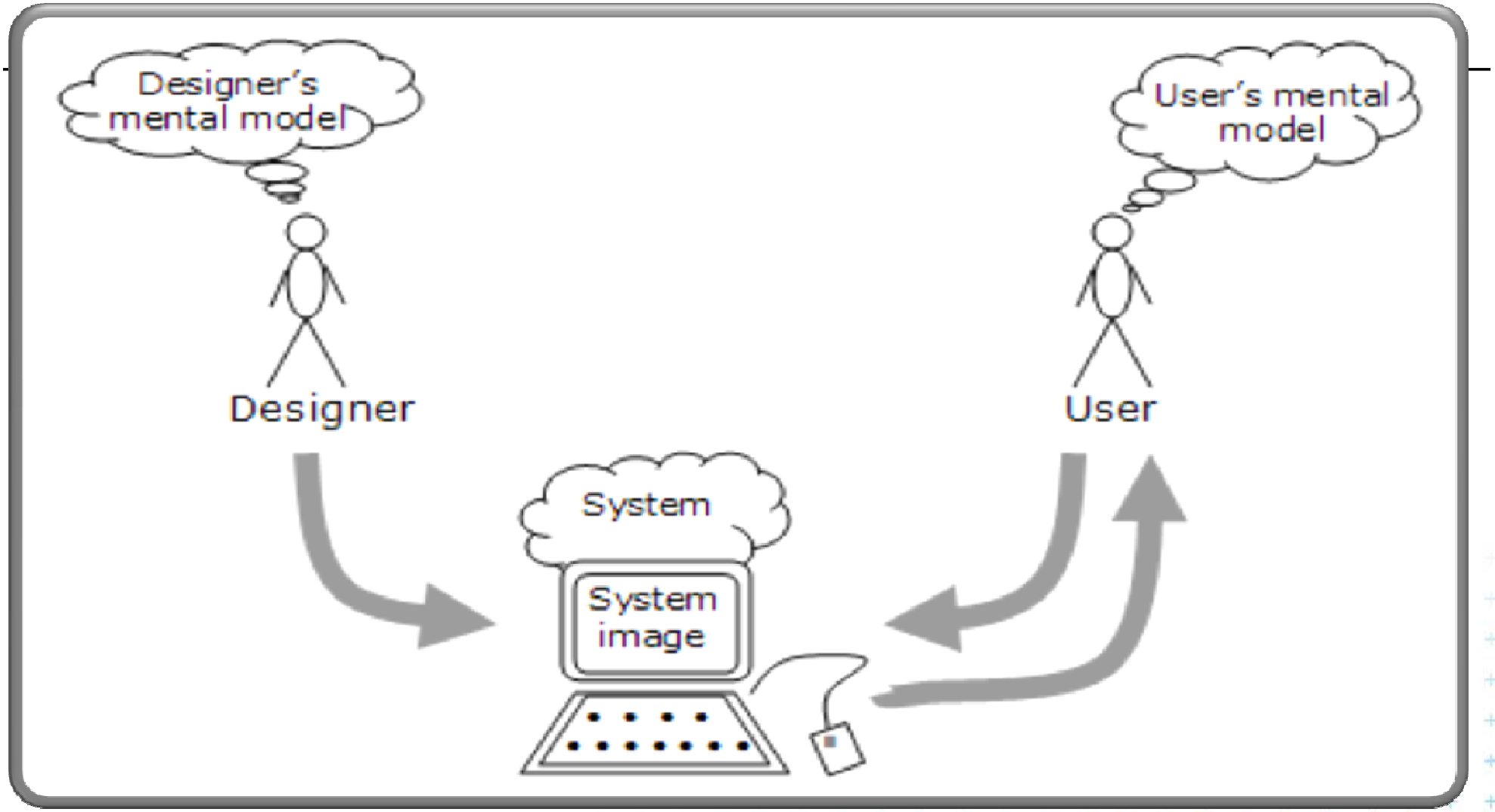
- You want to understand what the user already has in their head
- Then, you want to:
  - Maybe build your system in response to this
  - Work to create a different model in their head as they use your system
- Always keep in mind when making design decisions how the user will understand the underlying model



Mental Models

- A person's image about an artefact
- The user's image about the machine
- Making sense of the world from inside





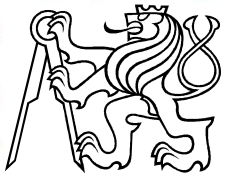
Mental-model in HCI

Mental Models

- An internal representation of a system that can be interrogated and manipulated.
- Mental models are concrete.
- Mental models can be run.
- Mental models are constructed from experience.
- Mental models are generally incomplete and inaccurate, but serve a purpose

Example Camera

- What are the components and how do they fit together?
- How does it work?
- What causes what?
- How do you use it?
- How do you use your understanding when something goes wrong?



Mental Models

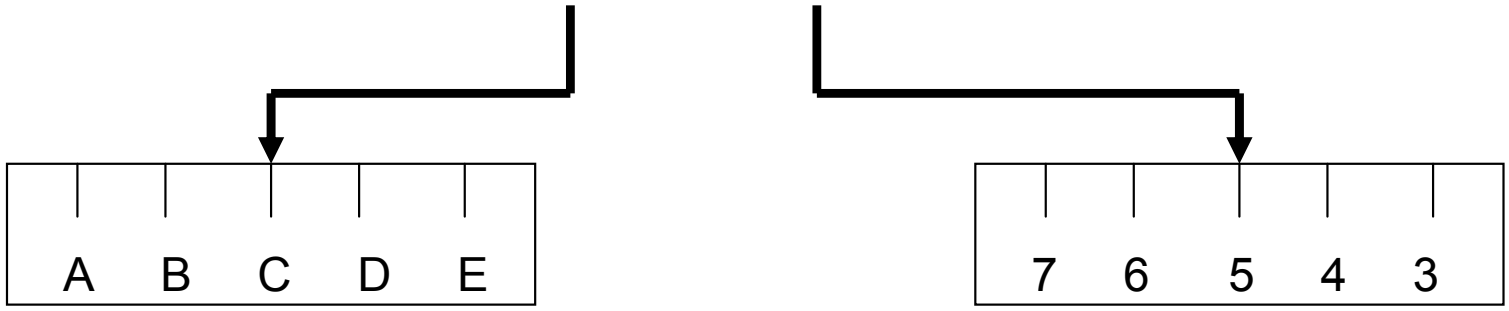
- A runable mental model = how-it-works knowledge + how-to-use-knowledge !
- How-it-works knowledge may be at various levels of detail.
- Strategic knowledge includes various strategies — e.g. inference, prediction, diagnosis. These are transferable skills.

Freezer/Refrigerator Controls

NORMAL SETTING	C	AND	5
COLDER FRESH FOOD	C	AND	6-7
COLDEST FRESH FOOD	B	AND	8-9
COLDER FREEZER	D	AND	7-8
WARMER FRESH FOOD	C	AND	4-1
OFF (FRESH FD & FRZ)			0

1 SET BOTH CONTROLS

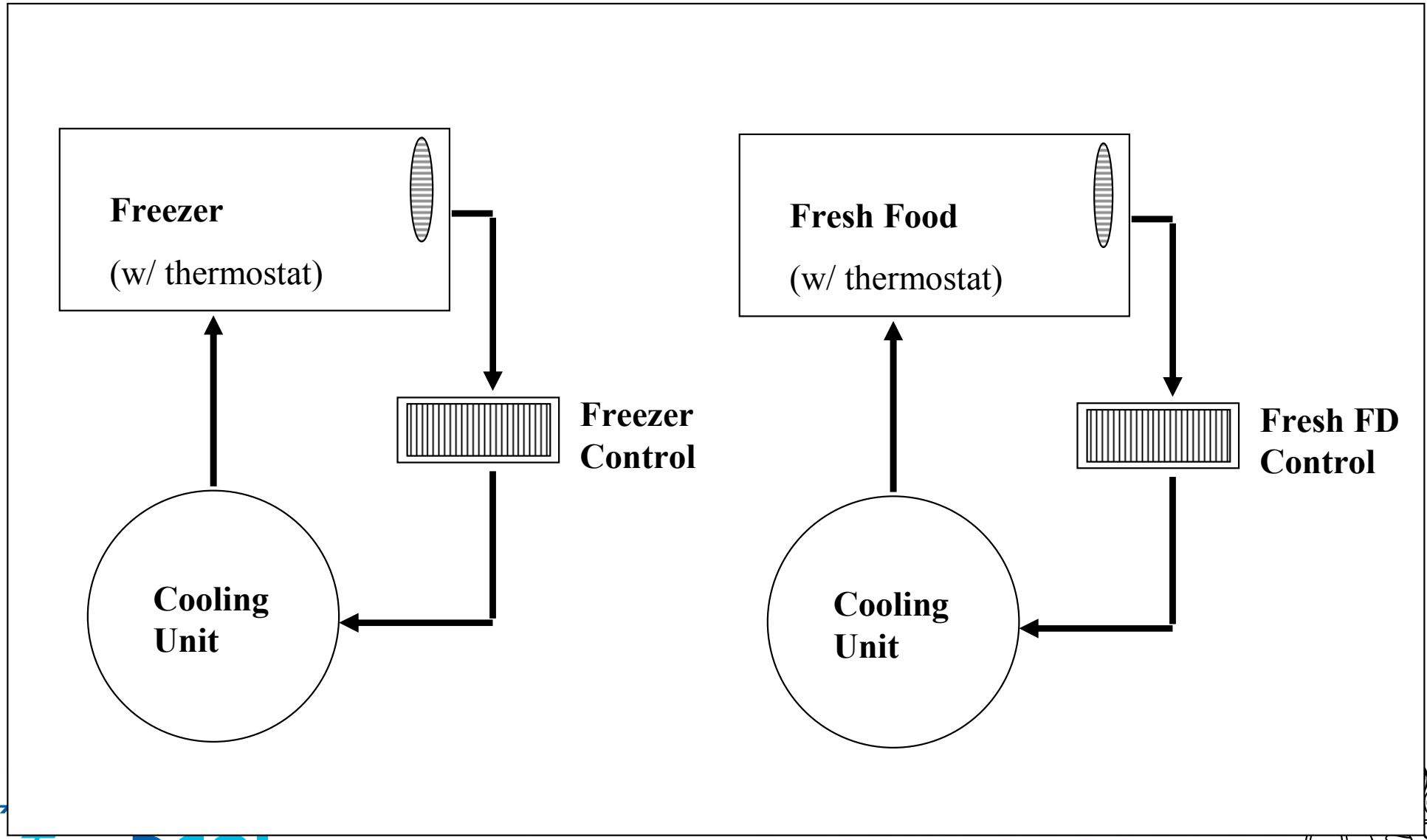
2 ALLOW 24 HOURS TO STABILIZE



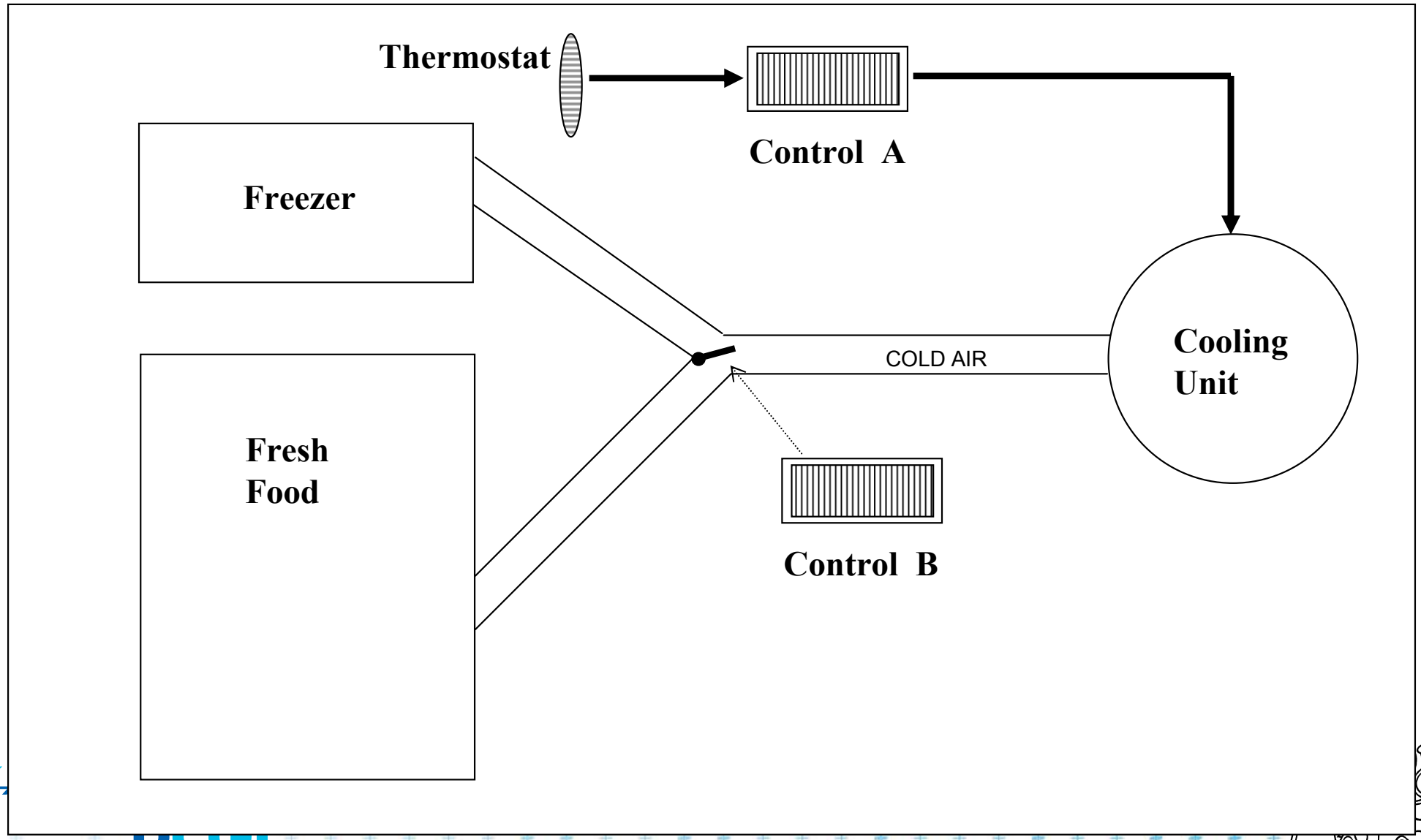
FREEZER **FRESH FOOD**

DCGI

A Conceptual Model of F/R

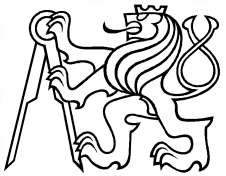


Correct Conceptual Model of F/R

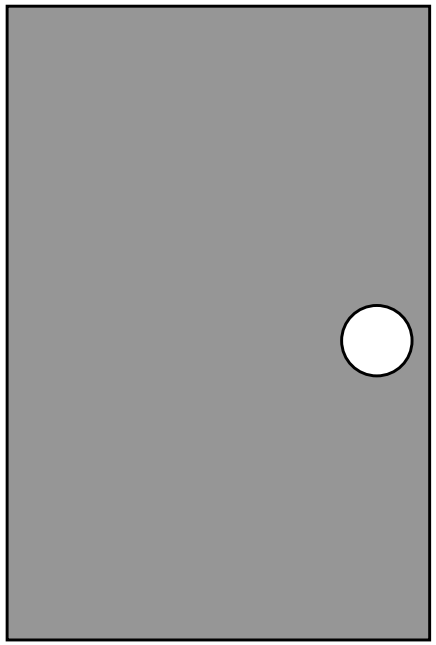


Mental models - Examples

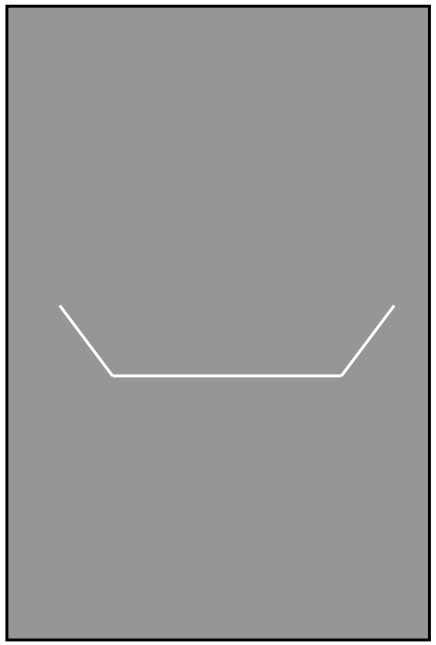
- Examples from everyday life
- User expects some behavior
- E.g. doors in coridor
- User tries to figure out how some device works
- AFFORDANCE



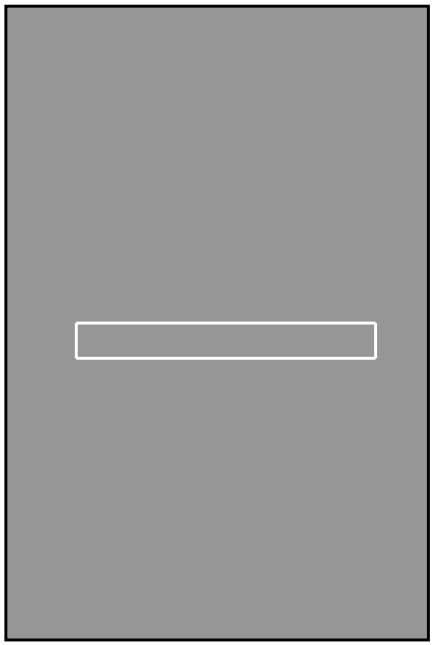
Doors (Good or Bad Affordances?)

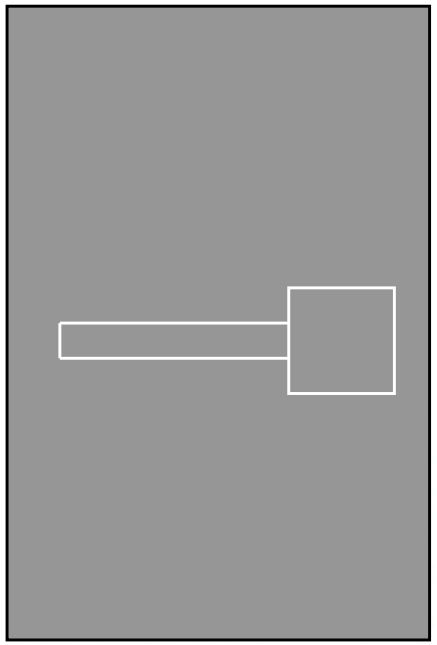


Push or pull?



Which side should I push?





Flat metal plate on one side tells me

Mapping

What Knob Goes Where?

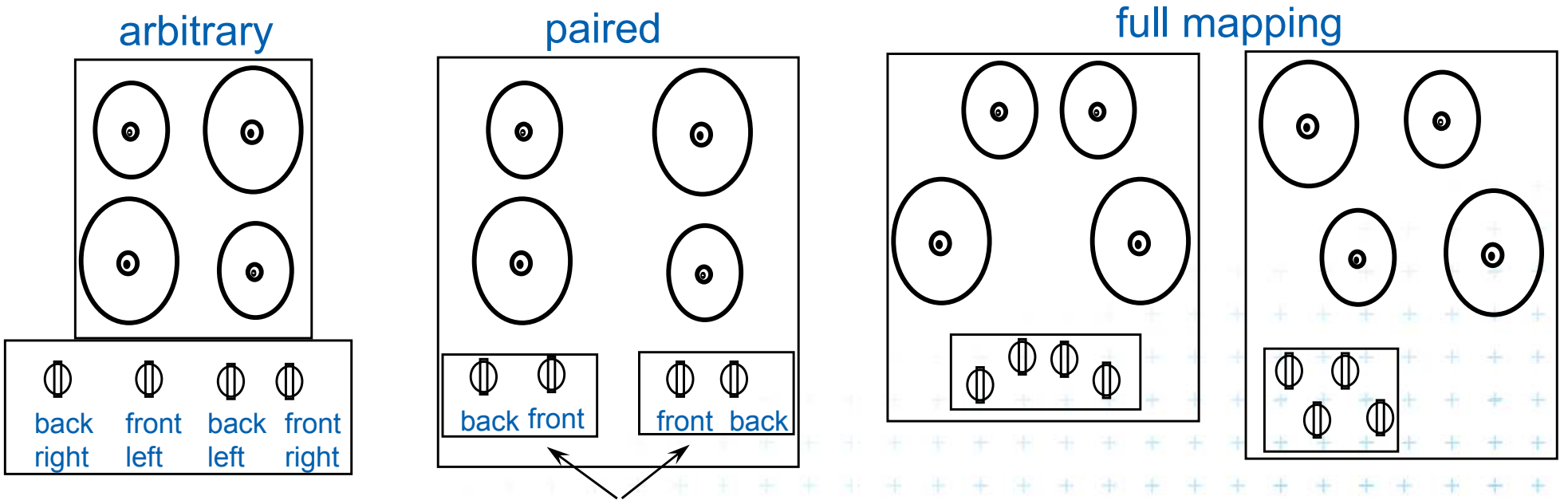
Mapping

Exploiting Natural Mapping

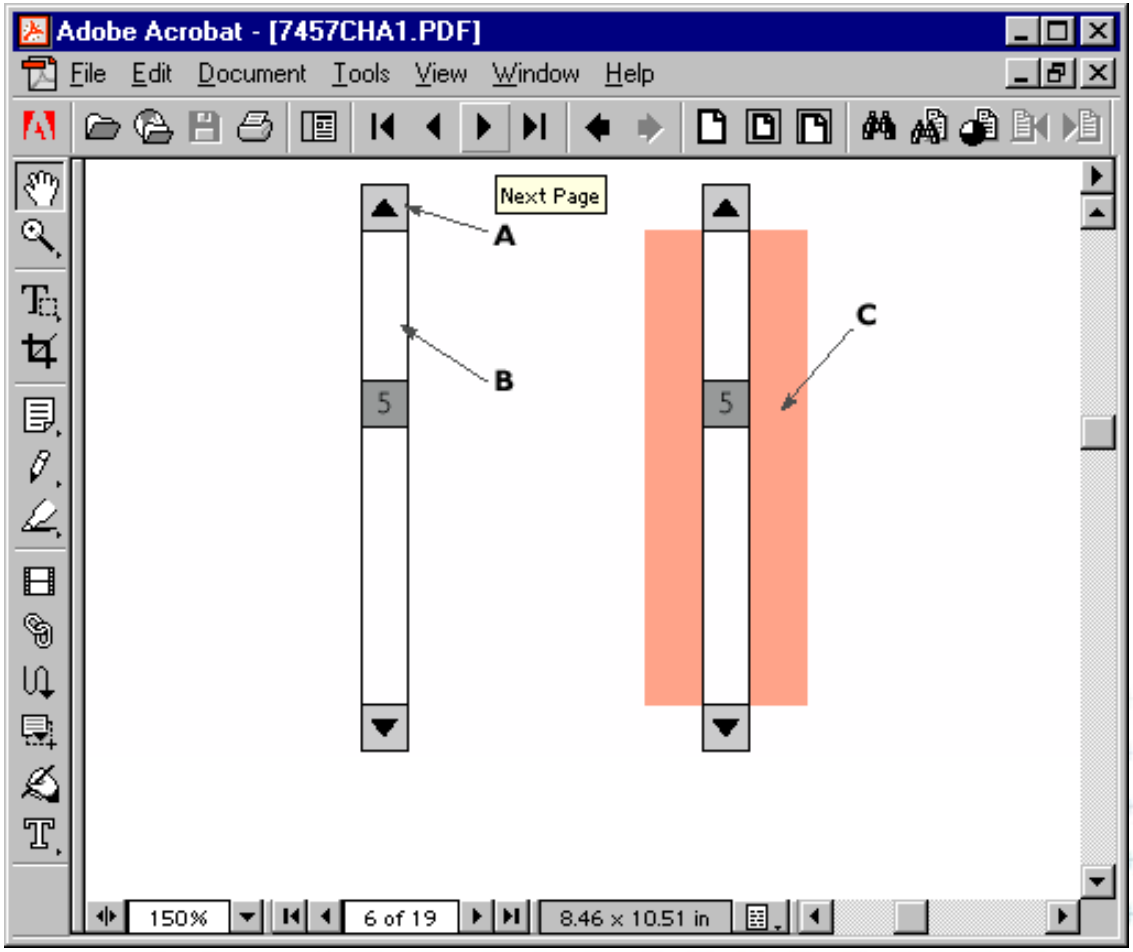
Affordance


OFF
OFF
OFF
OFF
OFF
OFF
HI
LO
HI
LO
HI
LO
HI
LO
HI
LO
250
100
200
150
ON
200 230 260
400 450 500
OVEN
HOTPLATES
GRILL
Centenary

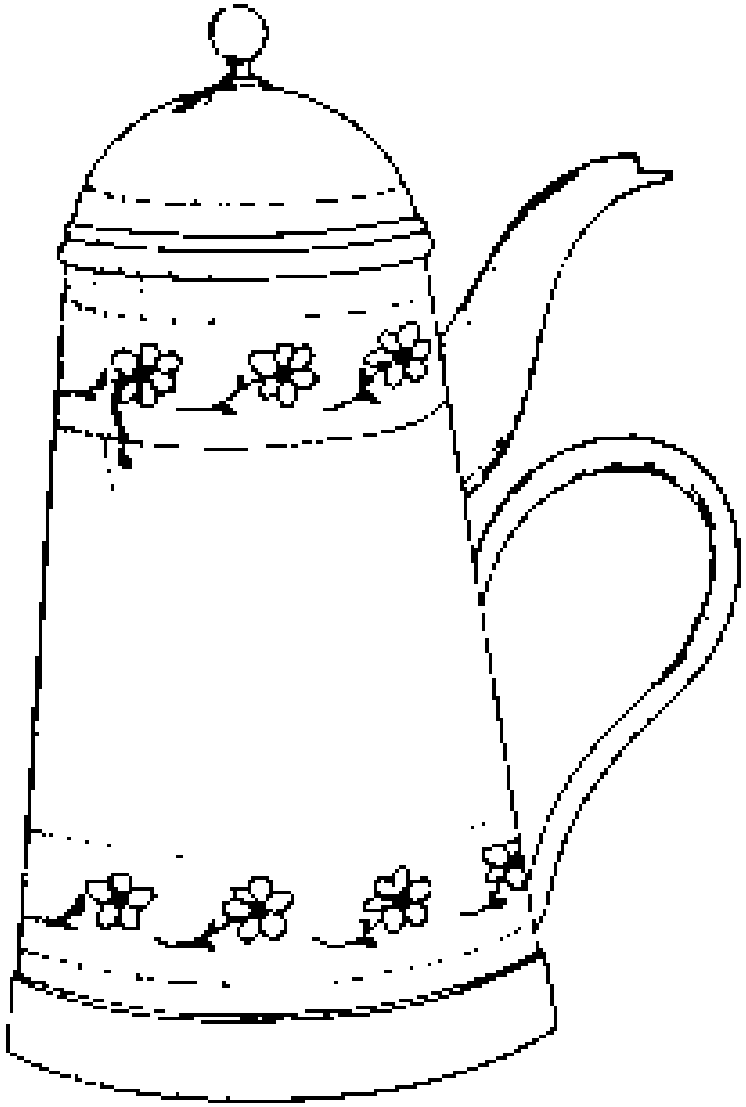
Mapping controls to physical outcomes



Visual affordances of a scrollbar



Bad design

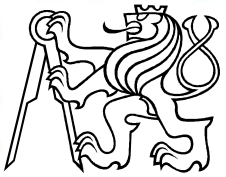


Transfer Effects

- People transfer their expectations from familiar objects to similar new ones
  - positive transfer: previous experience applies to new situation
  - negative transfer: previous experience conflicts with new situation

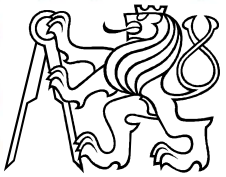
Errors

- Need to design for human capabilities and traits
  - Human speech is riddled with “errors”
- Reduce Gulfs of Execution and Evaluation!



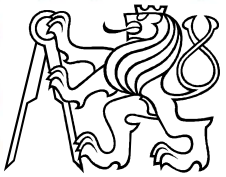
Error Types

- Forgetting
  - lock keys in car
  - don’t save file
- Modes
  - car in drive vs. reverse
  - digital watch in stopwatch mode rather than normal display mode
- Association
  - looking at room number, dial that instead of phone number



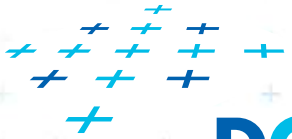
Reducing Errors

- Design constraints into the interface
  - Can't activate toaster unless it is plugged in
  - Can't exit program without saving files
  - Grey out inappropriate commands
    - Flexibility vs. Robustness tradeoff
    - Allow overrides?
- Reminding devices
  - place keys on papers, book by door



Error Correction

- Semantic
  - abort operation underway
  - undo previous command(s)
- Lexical
  - typing mistakes (automatic in MS Word)

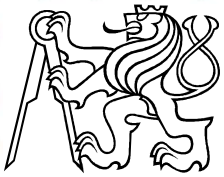


DCGI

Adapted from slide by

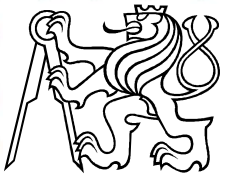
Error Correction

- Things *not* to do
  - Accusatory error messages
  - Lots of simultaneous conflicting warning messages
  - Rely on a statement somewhere in the manual of what is correct and incorrect



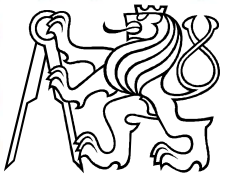
Semantic Consistency

- Global commands always available
  - Help
  - Abort (command underway)
  - Undo (completed command)
- Operations valid on all reasonable objects
  - if object of class “X” can be deleted, so can object of class “Y”



Lexical Consistency

- Coding consistent with common usage
  - red = bad, green = good (*)
  - left = less, right = more
- Consistent abbreviation rules
  - equal length or first set of unambiguous chars.
- Mnemonic names rather than codes
- Devices used same way in all phases
  - character delete key is always the same

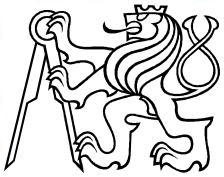


Human Error -- mistake

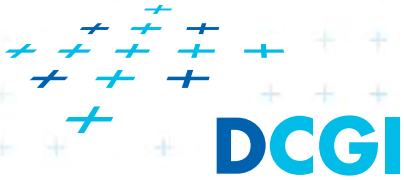
- Mistake: wrong goal and intention but right action
  - Why it happens?
  - Types of mistake
    - mistaken similarity,
    - misjudged probability,
    - rationalizing small events,
    - social pressures/cultural factors and $

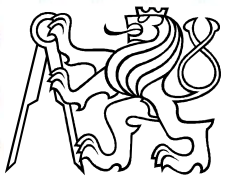
Human Error -- slips

- Slip: right goal and intention but wrong action,
  - Mostly occurs with skilled behavior (WHY?)
  - Mode Error: right action in wrong mode *(therefore the action becomes WRONG)*



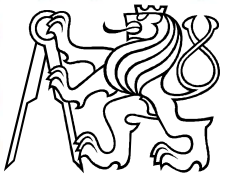
UI implementation issues – Architecture of a System





Interface layers / logical components

- linguistic: lexical/syntactic/semantic
- Seeheim
- Arch/Slinky

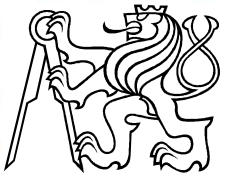


Monolithic Reference Architecture

Problem with monolihic architecture

- Difficult to modify/maintain
- Every single change is propagated to other parts of the system
- When this problem became an urgent one?
- Solution:

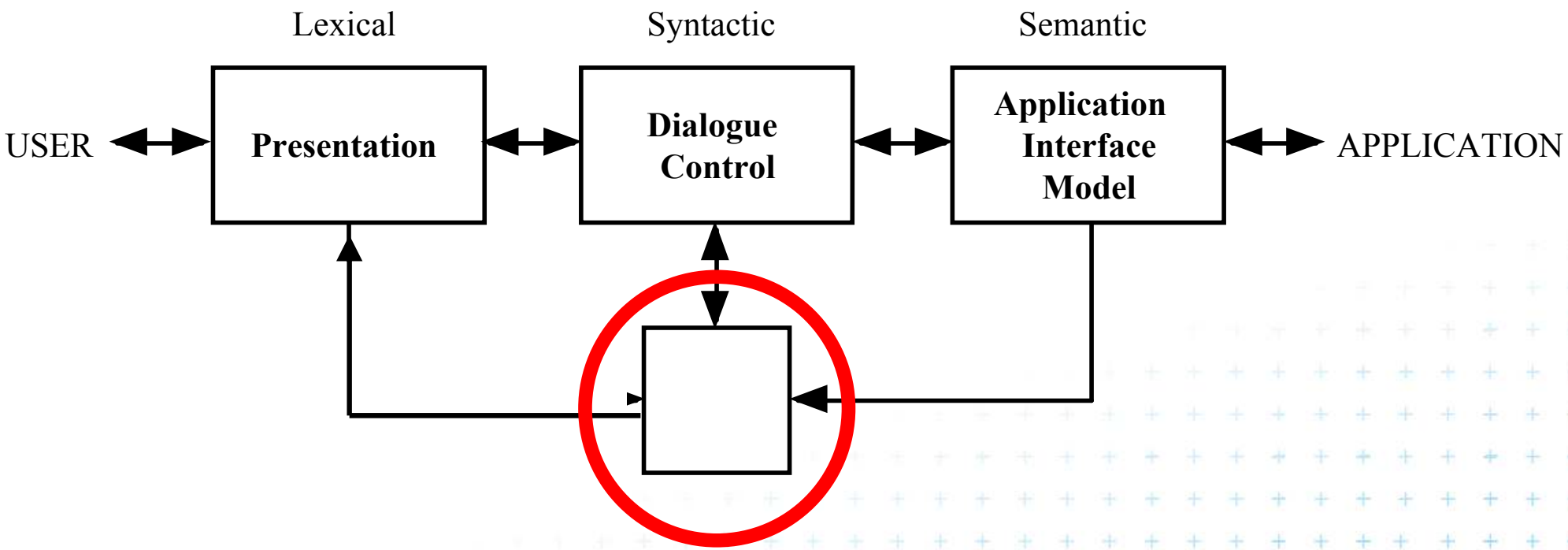
  - separation of UI part from application
- Existence of several models (no universal model exists)



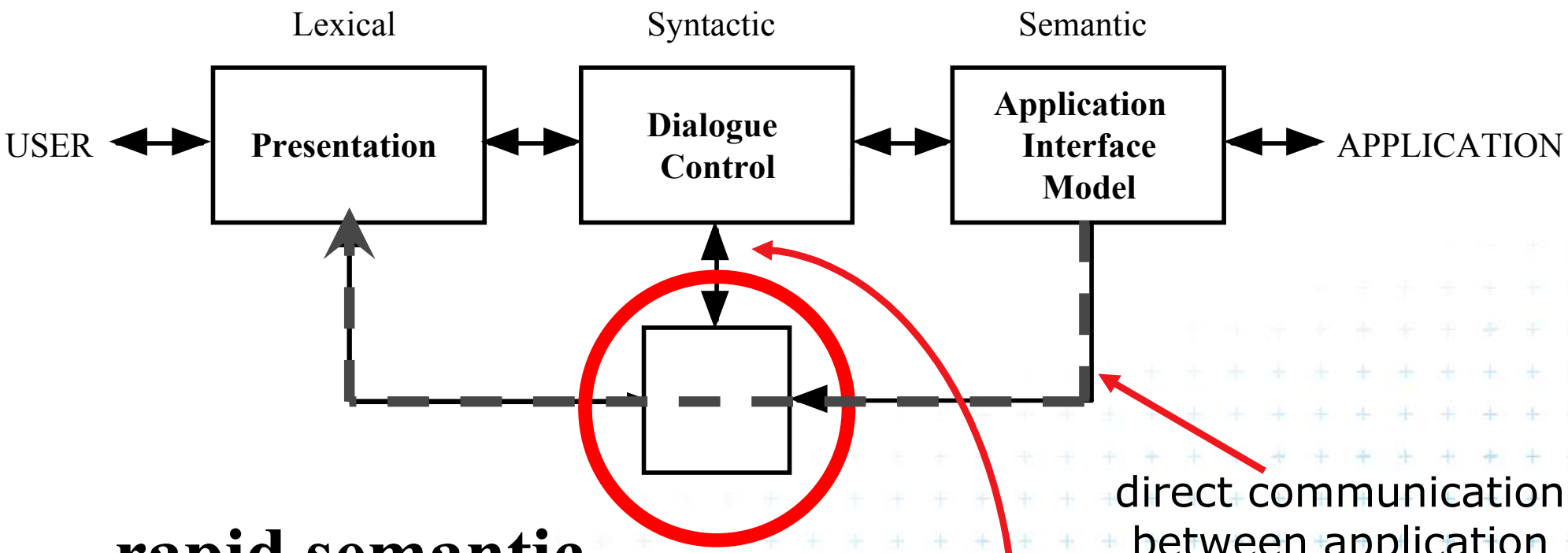
semantic feedback

- different kinds of feedback:
  - lexical – movement of mouse
  - syntactic – menu highlights
  - semantic – sum of numbers changes
- semantic feedback often slower
  - use rapid lexical/syntactic feedback
- but may need rapid semantic feedback
  - freehand drawing
  - highlight trash can or folder when file dragged

Seeheim model



the bypass/switch



rapid semantic feedback

direct communication between application and presentation

but regulated by dialogue control

DCGI

conceptual vs. implementation

Seeheim

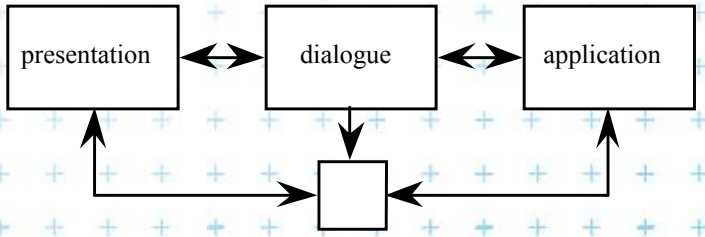
- arose out of implementation experience
- but principal contribution is conceptual
- concepts part of ‘normal’ UI language

… because of Seeheim …

… we think differently!

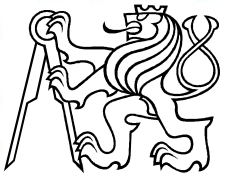
e.g. the lower box, the switch

- needed for implementation
- but not conceptual

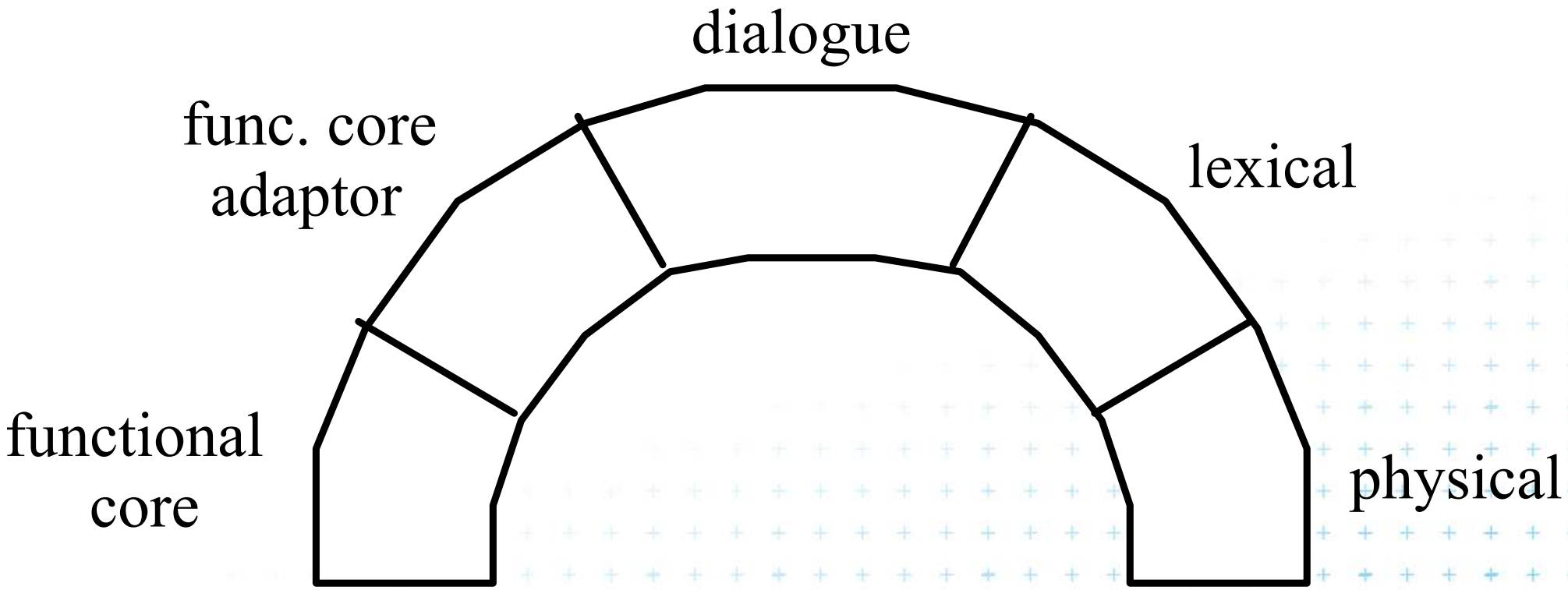


Seeheim problem

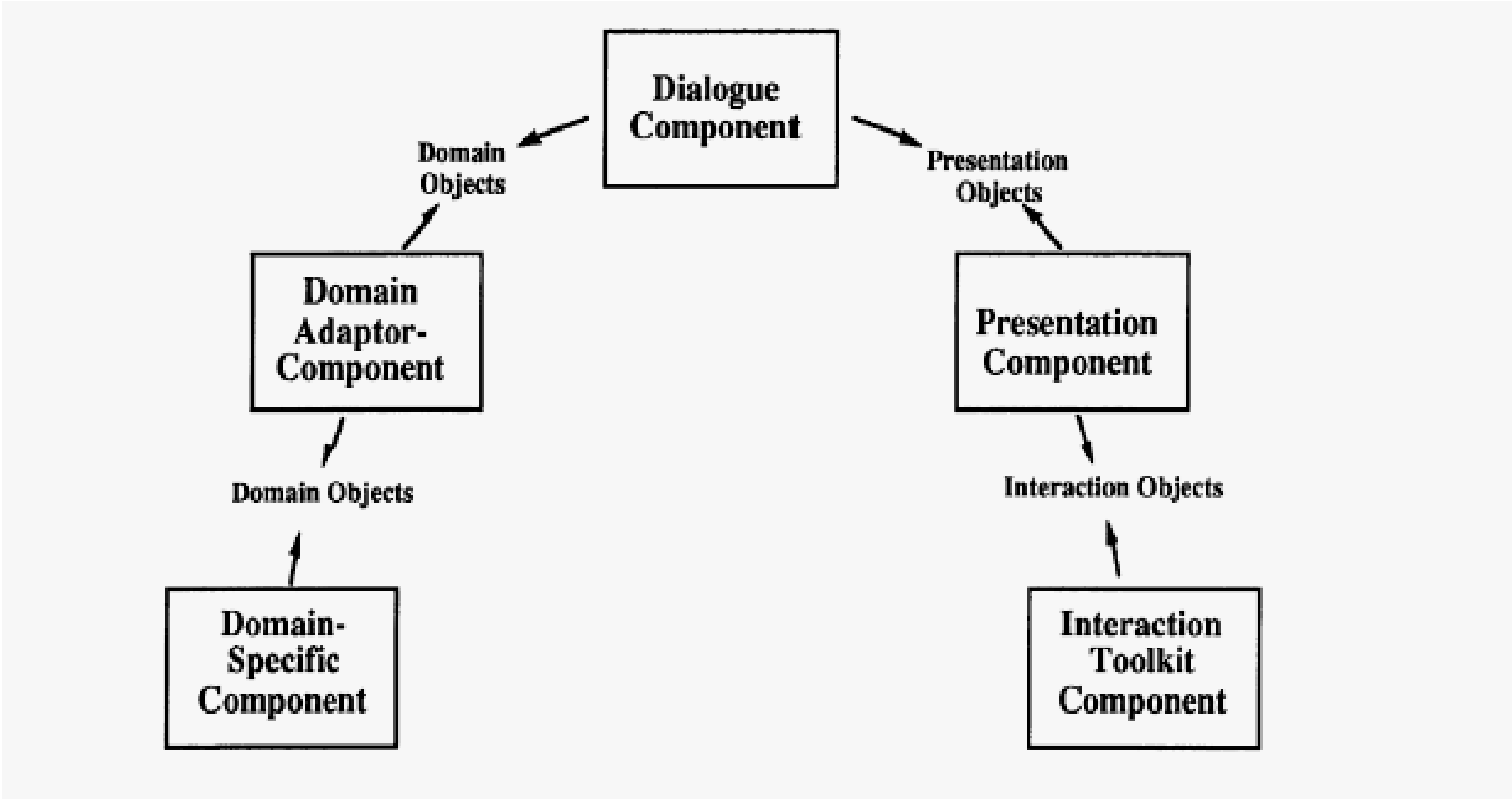
- Low granularity
- Result: problem with software modification



more layers!

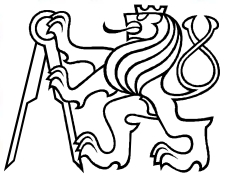

dialogue
func. core
adaptor
lexical
functional
core
physical

Arch model

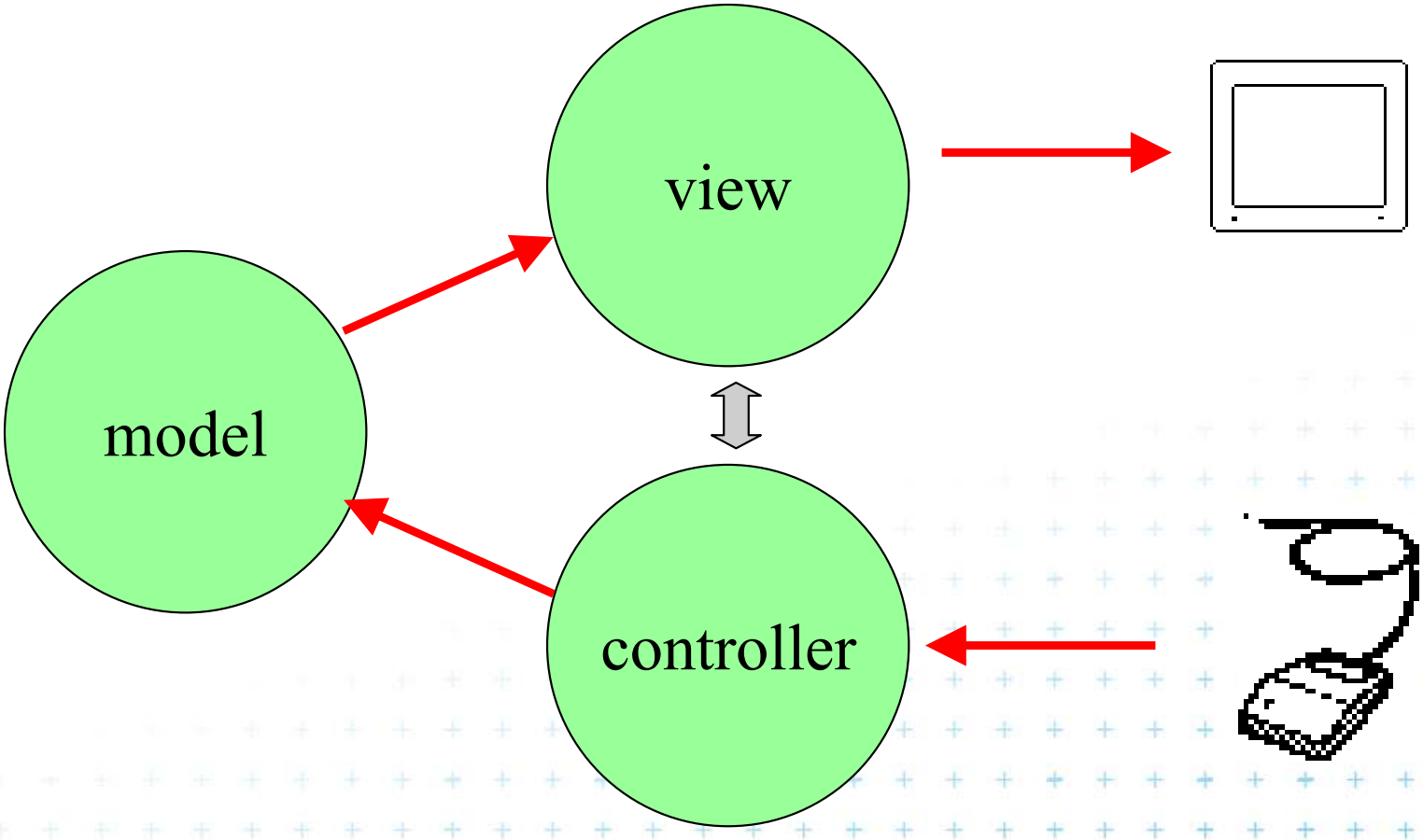

Dialogue Component
Domain Objects
Presentation Objects
Domain Adaptor-Component
Presentation Component
Domain Objects
Interaction Objects
Domain-Specific Component
Interaction Toolkit Component

Architecture: monolithic vs. components

- Seeheim has big components
- often easier to use smaller ones
  - esp. if using object-oriented toolkits
- Smalltalk used MVC – model–view–controller
  - model – internal logical state of component
  - view – how it is rendered on screen
  - controller – processes user input



MVC model - view - controller



MVC issues

- MVC is largely pipeline model:

  input → control → model → view → output

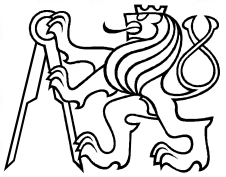
- but in graphical interface
  - input only has meaning in relation to output

  e.g. mouse click
  - need to know *what* was clicked
  - controller has to decide what to do with click
  - but view knows what is shown where!
- in practice controller ‘talks’ to view
  - separation not complete

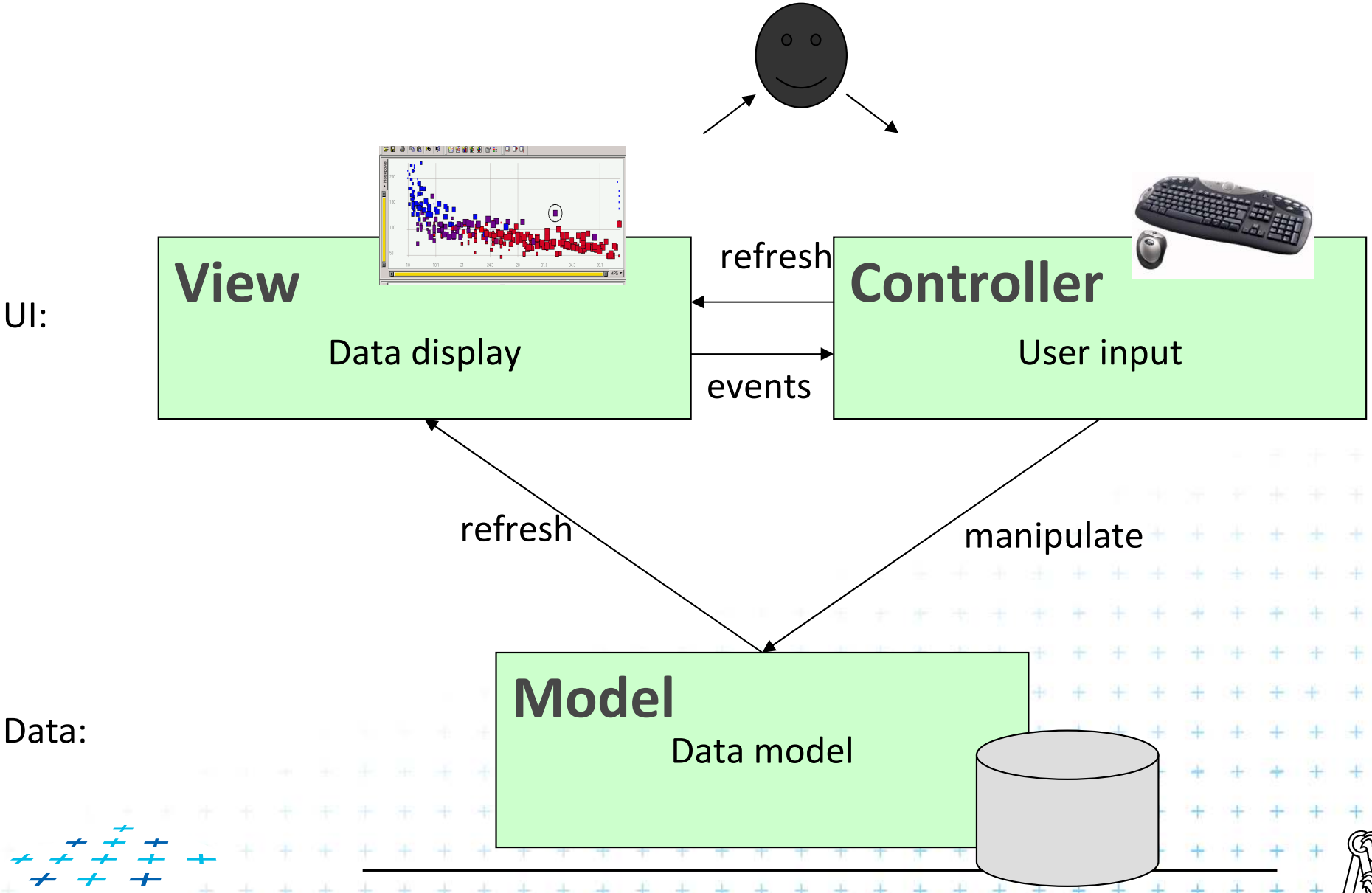
MVC

- The application is divided in three parts: the model, views and controllers
- The model is normally implemented so that it is independent of the views and the controllers
- There can be several views and controllers linked to one model

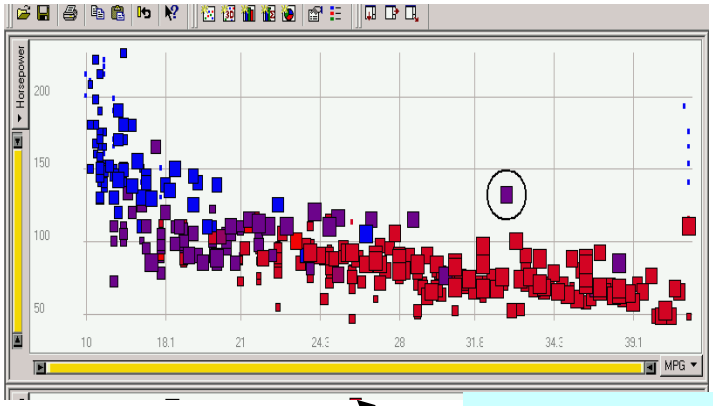
Example?



Model-View-Controller (MVC)

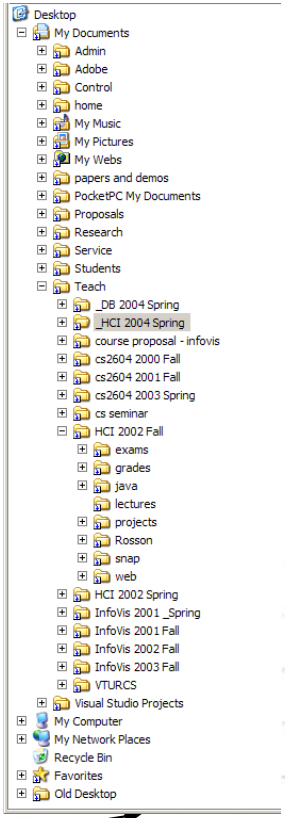


Multiple Views



View

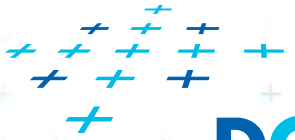
Controller



View

Controller

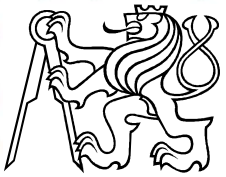
Model



DCGI

Implementation issues

- Techniques for dialogue controller
  - menu networks
  - grammar notations
  - declarative languages
  - graphical specification
  - state transition diagrams
  - event languages
  - constraints

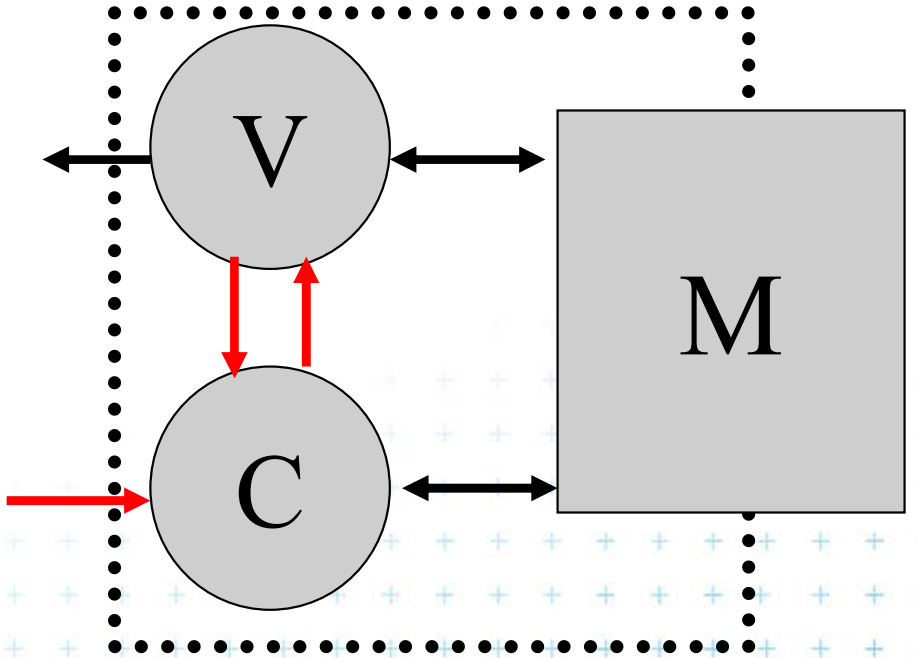


Controller Examples

- Textual commands
- Mouse (point and click) commands

MVC Dynamics

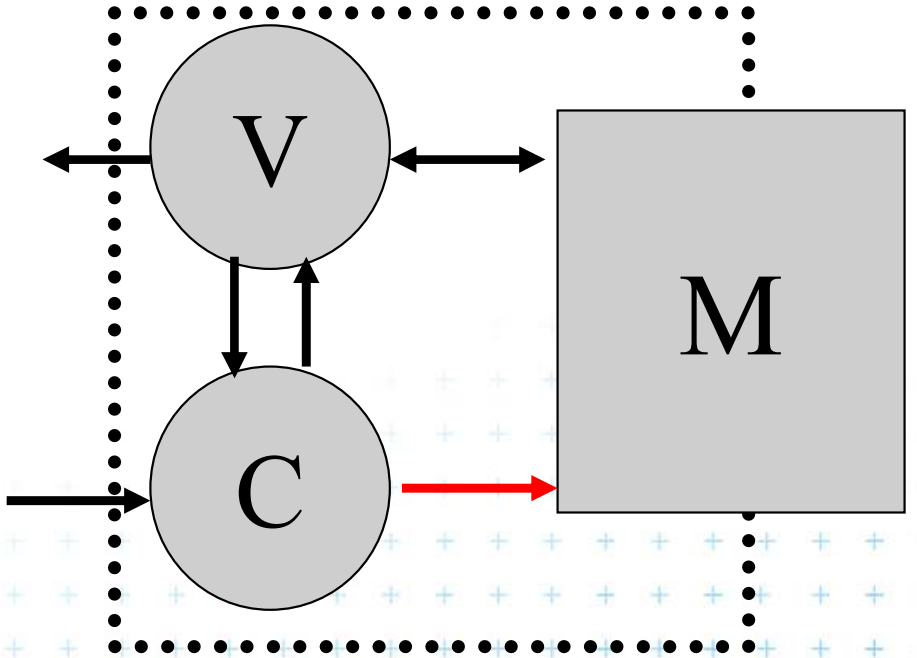
- 1. User input event routed by Window System to appropriate Controller.
- 2. Controller may require View to “pick” object of focus for event.



MVC Dynamics

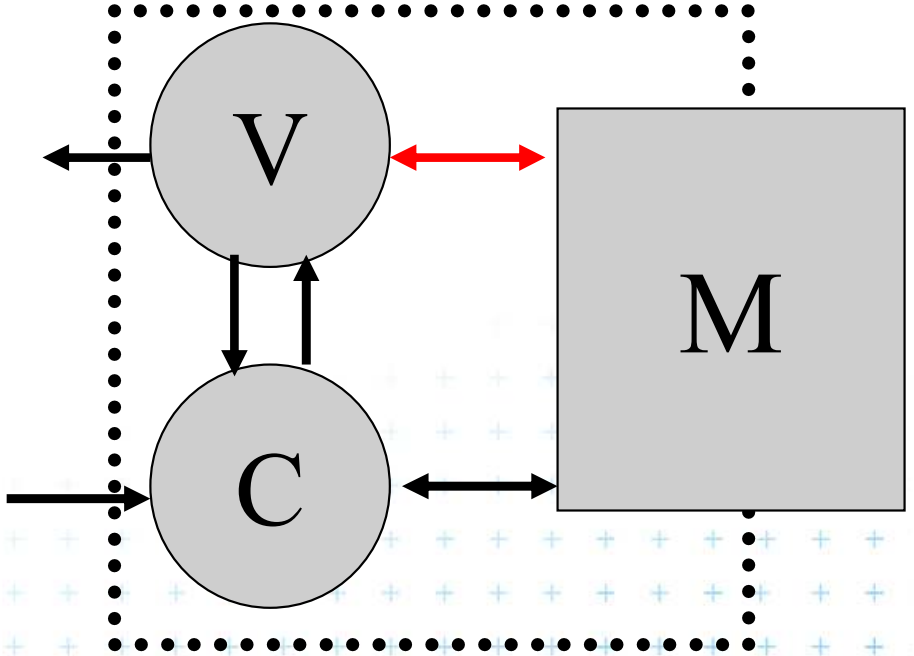
- 3. Controller requests method of Model to change its state.

- 4. Model changes its internal state



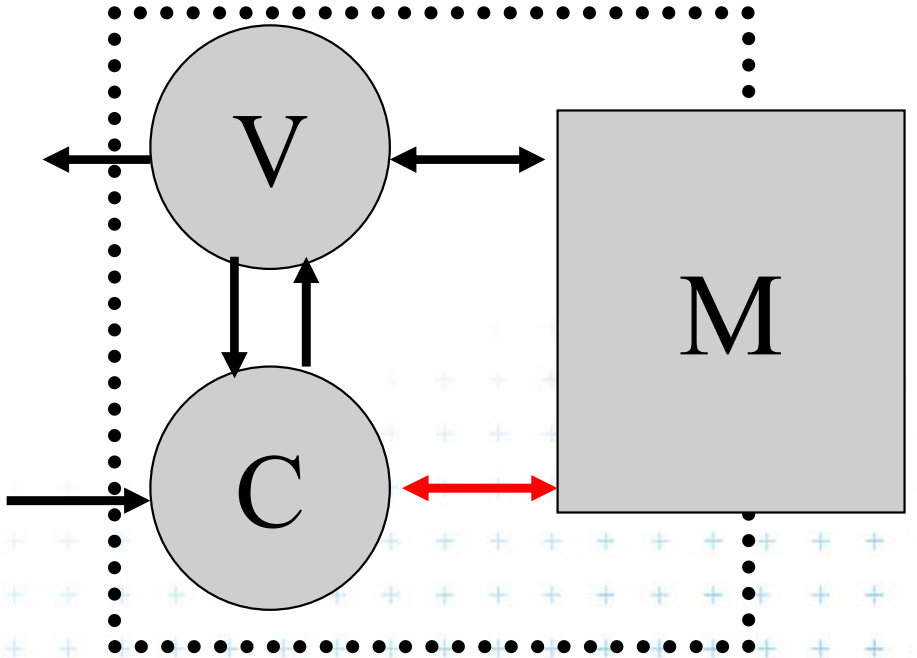
MVC Dynamics

- 5. Model notifies all dependent Views that data has changed.
- 6. View requests from Model current data values.



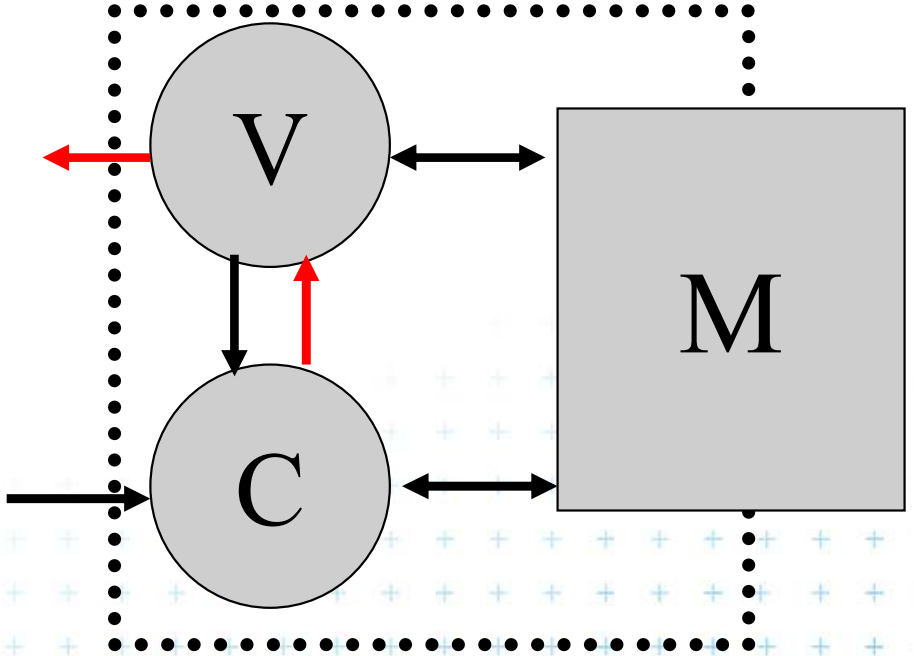
MVC Dynamics

- 7. Model notifies all dependent Controllers that data has changed.
- 8. Controller requests from Model current data values.



MVC Dynamics

- 9. Controller informs View if elements are disabled.
- 10. View requests redraw



Thank you for your attention