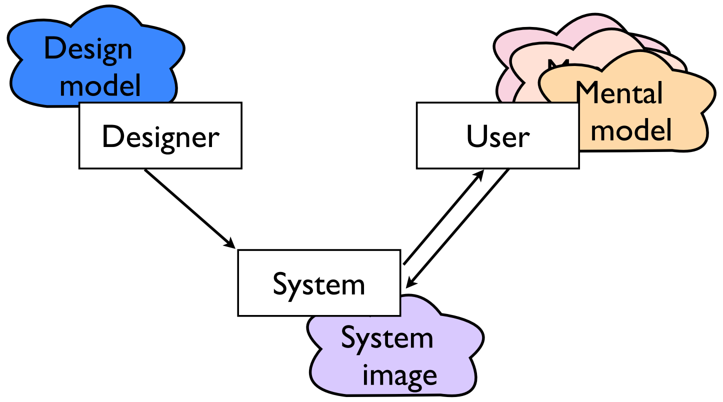
Review

- What are mappings, natural mappings? Types?
- What are constraints? How do they differ from affordances? Types?
- How are conceptual models of designer, system and user related to each other?

Conceptual Models



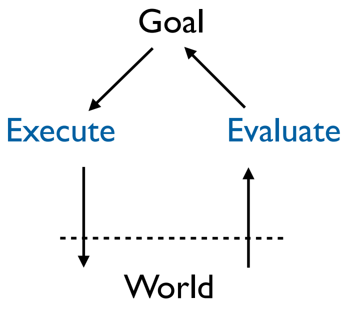
The Seven Stages of Action

The Seven Stages of Action

- What makes things hard to use?
- To answer this, ask: what happens when someone uses an object?
- We need a model for this activity
- The Seven Stages of Action are such a model

First Approach

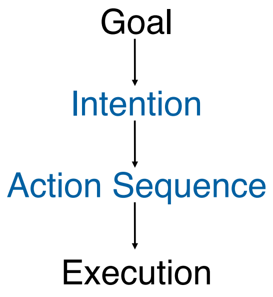
- To do something, you have to
  - 1. Formulate a goal (what do you want to do?)
  - 2. Execute an action (changing the environment)
  - 3. Evaluate the result (is the outcome the same as my goal?)



Goal Formulation in Detail

- Goals are often very vague, and problem-oriented
  - "I need more light"
- They need to be translated into goal-oriented intentions
  - "Operate the light switch"
- These then need to be translated into concrete action sequences
  - "Turn around, stretch out arm, put finger on switch"

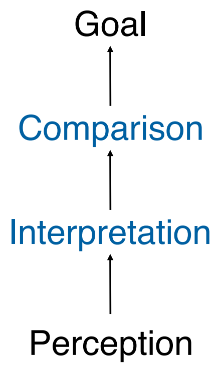
Goal Formulation



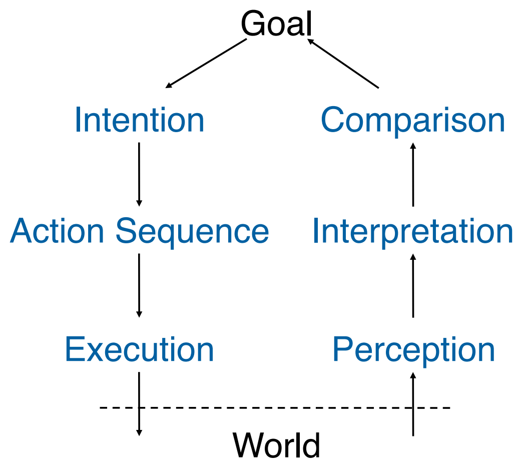
- Alternative intentions and action sequences are possible for the same goal
  - "Could you turn on the light please, dear?" :-)

Evaluation

- Evaluation also requires several steps:
  - Perceive the result
  - Interpret it
  - Compare to goal



Result: The Seven Stages of Action



More on the Seven Stages

- In reality, steps are hard to distinguish
- Complex tasks include sequences/hierarchies of goals (feedback loop)
- Goals are forgotten, discarded, changed
- Many actions are opportunistic, not planned
  - Meeting leads to talk, deadline-driven work
- Cycle can begin at any stage!

Gulf of Execution

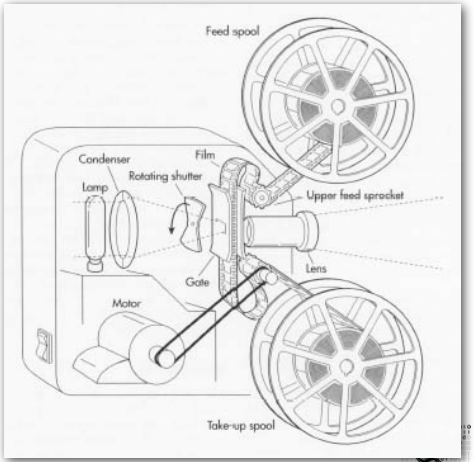
- Even simple actions can seem difficult
- Reason: Cannot see how system works or what to do
  - Example: Peanut bags…
- Connection between intention and execution unclear
- What is the problem? — Mappings!

Gulf of Execution

- Gulf of Execution opens up through differences between
  - Actions the user intends, and
  - Actions the system offers — affordances!
- Ideally, the system lets user execute intended actions directly, without any extra effort

Example: Film Projector Threading

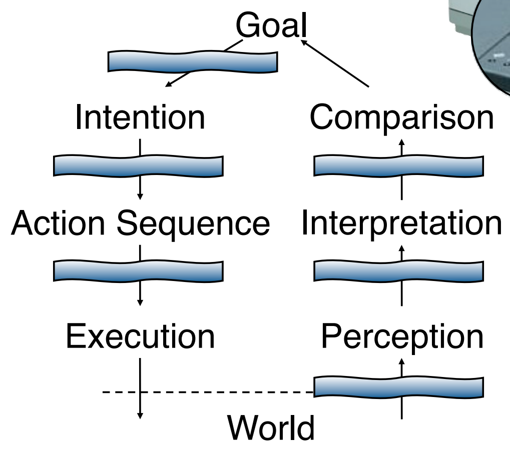
- Old projectors: unclear, difficult
- New projectors: automatic, but still visible
- VCR: invisible



Gulf of Evaluation

- It is often unclear whether an action was successful or what its effect was
- Problem: Missing feedback
- Ideal: System state is easy to perceive and interpret and matches conceptual model that the user has of the system
- Example: Blinking printer LED
  - Still working, or crashed?
- Example: Switches in Myst
  - Part of the fun of the game

The Gulfs



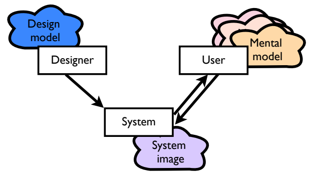
Seven Stages of Action as Design Guideline

- The model provides basic checklist of questions to avoid gulfs: “How easy is it to…”

• Perceive system functions?	(Goal)
• Determine executable actions?	(Intentions)
• Determine their mapping to basic actions?	(Action sequence)
• Perceive the system state?	(Perception)
• Map it to an interpretation?	(Interpretation)
• To decide if the goal was reached?	(Comparison)

Result: Some Design Principles

- Visibility (state and actions easy to determine)
- Good conceptual model
  - Operations and results are presented consistently
  - User gets a coherent image of the system



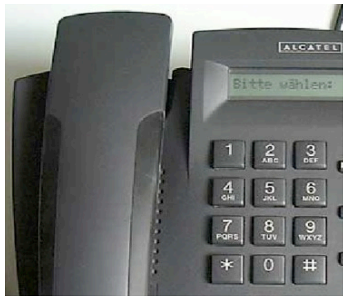
- Good (natural) mappings
  - Between actions and results
  - Controls and their effects
  - System state and its visualization
- Good feedback
  - About results, complete and continuous

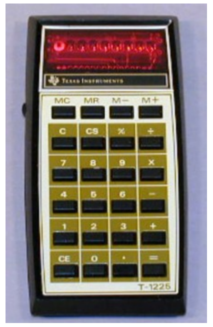
In-Class Exercise

- Sketch the seven stages of action to listen to a particular piece of music from a CD on your home stereo (or MP3 player, or…)
- What are goals, intentions, action sequences? Alternatives?
- What is perceived, interpreted, compared to the goal?
- Where are potential usability breakdowns (gulfs of execution or evaluation)? Own experience?

Knowledge in the World and in the Head

- Experiment: write down digit layout of telephone and calculator keyboards

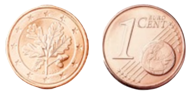




iTunes U: exclude

Knowledge in the World and in the Head

- Much knowledge is not in the head but in the world
- Despite less-than-perfect knowledge, precise behavior is possible—how?
- Behavior is determined by combination of knowledge in the world and in the head
- High precision of knowledge in the head is unnecessary
    - We only need knowledge to be precise enough to distinguish the right behavior from the others possible
    - Example: What is on the front and the back of the German 1 cent coin?



More Reasons Why This Works

- Constraints are in effect
    - Physical constraints limit the actions possible, e.g., what can be moved / combined / manipulated? (and if so, how?)
    - Cultural constraints are in effect

        Social rules are learned once and are then applicable in many situations

        Example: What to do upon entering a restaurant

        But: Cultural differences!

Knowledge in the Head & Constraints

- Traveling poets were able to recite poems with thousands of lines
    - Rhyme works as "linguistic constraint", and story works as semantic constraint
- Constraints limit the amount of knowledge that needs to be rote-learned

Results

- Humans can minimize the amount/precision/depth of information to remember
  - This can even help people cover missing abilities (analphabetism) or mental disabilities

Example: Typing

- Exercise: What kind of knowledge do beginners/intermediate/expert typists use?
- Beginner: Knowledge in the world (keyboard labeling)
- Intermediate: Knowledge in the world (peripheral vision, feeling keys) and in the head (knowing location of important keys by heart)
- Expert: All knowledge in the head, no eye contact to keyboard necessary anymore (cost/benefit tradeoff)

Example: City Map

- Exercise: Try to write down exactly how to get from this building to the “Hauptbahnhof”
- Result:
  - Nobody has a perfect street/building map in their head; often entire parts are forgotten in route descriptions
  - Nevertheless we can get from A to B safely
  - Why? Signage and constraints (e.g., street numbers) supply external knowledge

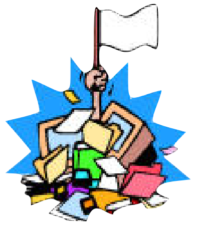
Types of Knowledge

- Declarative knowledge (“what”)
  - Facts (Bonn is southeast of Aachen)
  - Rules (stop at red traffic lights)
  - Easy to write down and teach (not learn!)
- Procedural knowledge (“how”)
  - How to play an instrument
  - Hard to write down, subconscious
  - Hard to teach, best by demo/training
- Design can easily convey declarative knowledge

How Much Can We Remember?

- Random unconnected facts: little
  - “Press Ctrl-Alt-Delete to log on”
  - Not learnable per se, only via associations
  - Example: First 1,000 digits of Pi
  - If your recipe fails, you are lost
- Connected facts: more
  - Using associations
  - Example: motor bike directional indicator
- Explained/understood facts: very much
  - Model emerges in the head
  - Can be reconstructed if needed
  - Very valuable in new situations where recipe fails

The Daily Struggle



- Exercise:
  - How many online accounts with passwords do you have?
  - How many of these can you remember the passwords to?
  - For how many of them do you use the same password?
- Credit cards, bank accounts with bank codes, number plates, phone numbers/addresses/birthdays/age of friends, clothing sizes,…
- We tend to move these things from the head into the world

Knowledge in the World: Characteristics

- Nothing to remember
- But: only there while you see it
- Especially difficult with things that are not immensely important to you
- Solution: Reminders
  - Paper agenda vs. PDA
  - Signal vs. message

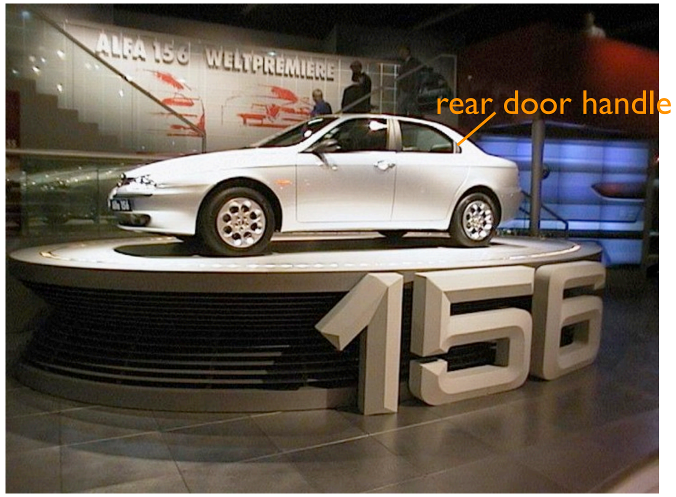
Comparing Knowledge in the Head and in the World

- In the world:
  - Available as soon as visible
  - No learning needed
  - Low efficiency (interpreting needed)
  - High initial usability
  - Aesthetics difficult with much to display
- In the head:
  - Less available
  - Less suitable for beginners
  - Harder to learn
  - But efficient
  - Invisible (less labels)
- Remember: Natural mappings can save both learning and labeling

Visibility and Feedback

- Computer on/off switches on the rear are invisible
- VCRs without on-screen programming required lengthy programming instructions without much visible feedback
- There is nothing like a good display to improve visibility, and therefore often usability
- This becomes more feasible as technology progresses: Augmented Reality / Ubicomp

Visibility: A Bonus Feature



(thanks to Konrad)

Sound

- Exercise: Listen to everyday objects and their acoustic feedback (or think about it if not readily available in class)
- Examples: Pen cap, hard drive, bike lock, car door, telephone, software
- Sound is a unique information channel
  - Omnidirectional: blessing and curse
- But use to convey meaning if possible!
- More on sound in DIS II!

Theory

⇒Models of interaction
  - Affordances, mappings, constraints, types of knowledge, errors
- Design principles
- Human cognition and performance
- History and vision of HCI

Practice

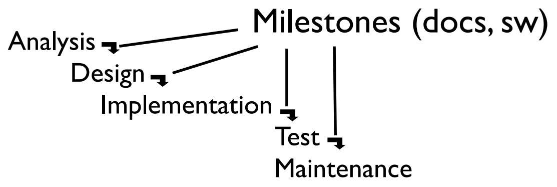
✓ Sketching

✓ User observation

⇒Iterative design
- Prototyping
- Ideation
- User study and evaluation

Design Process

The Wrong Way



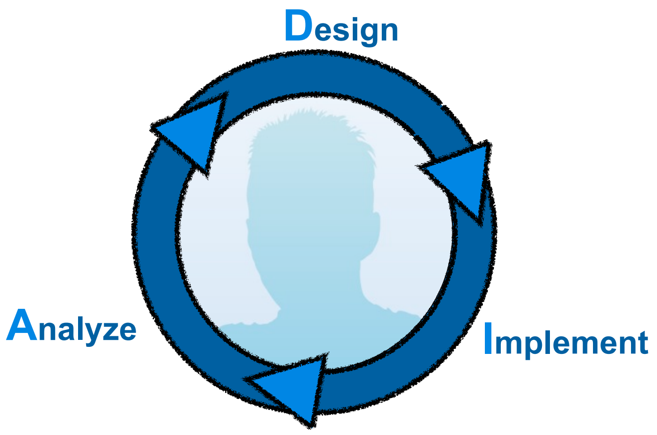
- Waterfall Model (since 80s)
- Phases idealistic, reality requires backtracking
  - Plans change
- Usage scenarios often too abstract
- Wrong assumptions hard to detect & fix early

User-Centered Design

- Standard software process easily misses users' needs

⇒Involve users during entire process
  - Questionnaires and interviews
  - Usability tests and observation
- Goal: more usable, more successful systems

The Right Way: DIA Cycle



DIA Cycle

- Usually many iterations necessary
- With each iteration:
  - Design becomes more concrete & precise
  - Implementation (prototype) gets more detailed and technically complex
  - Analysis and user feedback focuses on smaller and smaller problems
- Fix big design bugs first, small ones later

Prototyping in DIA iterations

Project start

D: Brainstorm different representations

I: Low fidelity paper prototypes

D: Choose a representation

D: Rough out interface style

A/D: Task centered walkthrough&redesign

I: Medium fidelity prototypes

A/D: Fine tune interface, screen design

A/D: Heuristic evaluation and redesign

A/D: Usability testing and redesign

I: High fidelity prototypes

A: Limited field testing

A: Alpha/Beta tests

I: Working systems

Project End

The First Two Questions

- Whenever designing an interactive system, ask the following two questions first:
  1. **Who are the users?**
  2. **What do they want to do with the system?**
- Many projects fail because these questions have not been answered!
- Both questions requires asking!

Classifying Users

- Experience: Most central criterion
  - Newbies (no task knowledge) / first-time users (task knowledge): don't know UI, anxiety
    - ⇒ simple UI, few features, small consistent vocabulary, extensive feedback, help, and documentation
  - Average experienced users: know task well, UI so-so, forget functions
    - ⇒ clear menu structures, consistency, see & choose instead of remember & type, continued error protection
  - Experts, regular users: know task & UI well
    - ⇒ speed, efficiency, short nonintrusive feedback, shortcuts, macros, customizability, extendability

More Dimensions to Classify Users

- Background
  - Name, age, sex, nationality, education, income
- Computer experience
  - Particular apps, duration, depth (see before), special functions (printing, …)
- Task experience
  - Leader, decision maker, motivation
- Personality
  - Introvert/extrovert, systematic/spontaneous, risk threshold, early/late adopter
- Impressions after use
  - Confused/OK, frustrated/controlled, bored/excited, reasons for (not) liking system

Persona: Who Are the Users?

- Precise description of the users
- Acts as a stand-ins for real users
  - Guide design decisions
- Fictitious, but based on knowledge of real users from observations
- Personas are not elastic
  - Avoid stretching users' ability instead of making a good design

Preece et al., Interaction Design, 3ed., 2011

BACKGROUND

- 15, Female
- Ongoing Private Education
- Ambitious
- Comfortable using technology to communicate

MOTIVATIONS

- Keeping in touch with her network
- Fashion/street cred
- Keeping up with peers.

FRUSTRATIONS

- Sad people trying to be 'friends' on Facebook
- Having to be in bed @ 11pm
- Being swamped in friends update
- Missing important status updates

Ginnie

CAPLIN

Receives private tutoring in Maths and English as these are not her strong subjects. Enjoys playing for the school's 2nd teams for netball and Lacrosse and is good at art.

She loves recording her favourite shows: ER and Sun Valley High on Sky+ and spends some of her time on her laptop that Daddy bought her watching videos on YouTube, downloading music, keeping up to date with her friends on Facebook and chatting via MS IM to her cousin who is at University in Leeds.

She loves Ugg boots and Abercrombie & Fitch and uses the Internet to shop and find the cheapest prices.

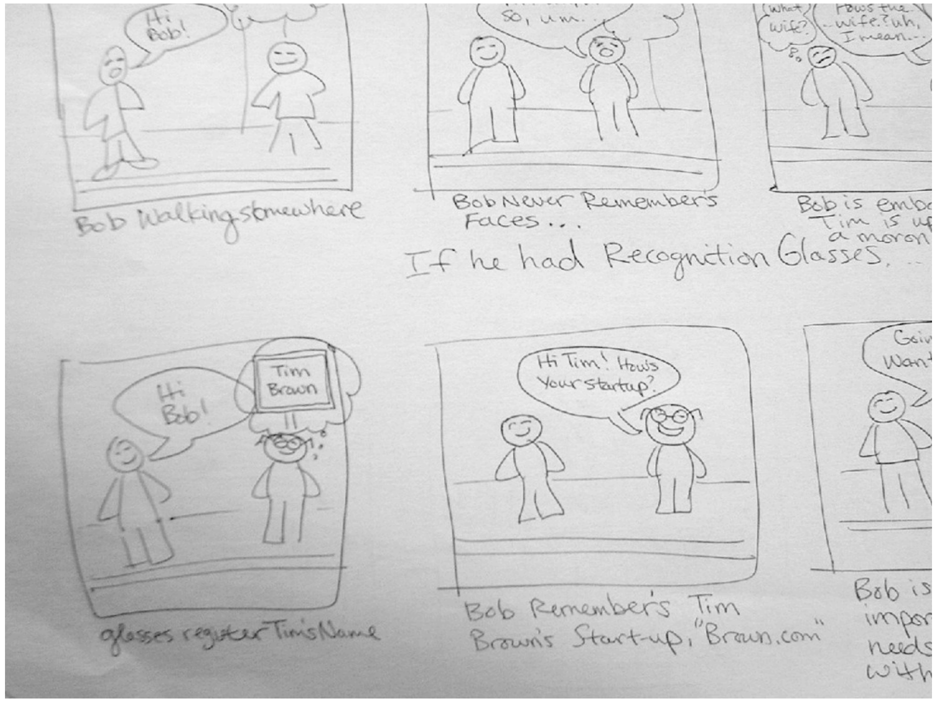
"I want to easily hook up with my friends whilst watching TV"

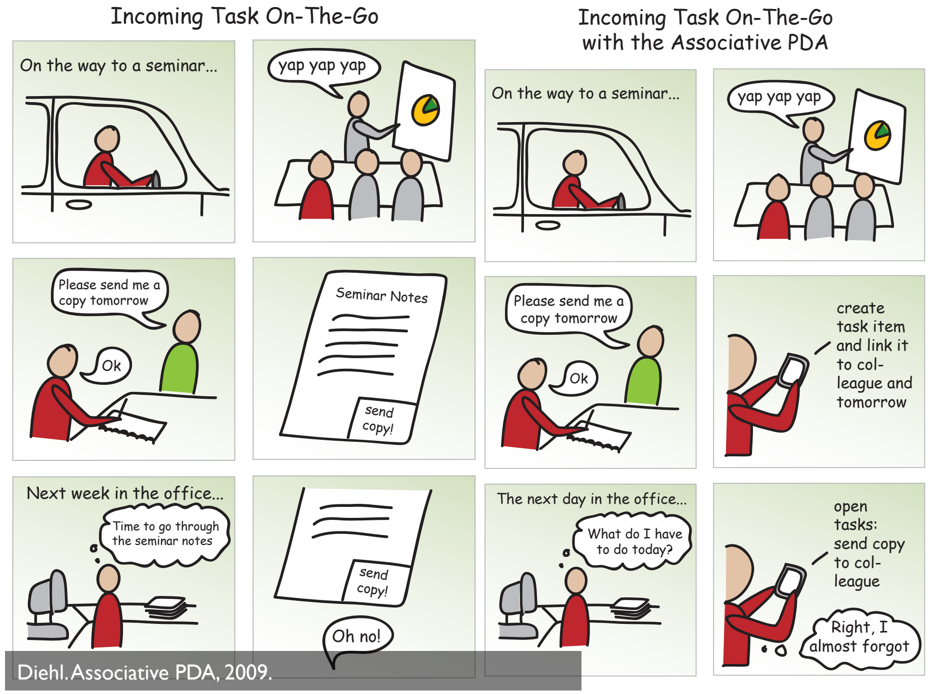
Storyboard:
What Do They Want to Do with the System?

- What?
  - Sequence of single images
  - Visual representation of a script
  - Illustrates interaction
  - Like visual outline of a film
- Why?
  - Describes task showing environment, user, and computer
  - Or describes UI as series of screen images (but include user representation)
  - Helps working out interaction details
  - Great at-a-glance overview of interaction
  - Helps developing usage scenarios, tasks, and tools

Storyboard:
What Do They Want to Do with the System?

- When?
  - After describing a task, storyboard it, then take back to user. Did you get the story right?


Hi Bob!
Bob Walking somewhere
so, um...
Bob Never Remember's Faces...
What wife?
Hows the wife? uh, I mean...
Bob is emb
Tim is u
a moron
If he had Recognition Glasses, ..
Hi Bob!
Tim Brawn
glasses register Tim's Name
Hi Tim! How's Your startup?
Bob Remember's Tim Brown's Start-up, "Brawn.com"
Goi
Wan
Bob is
impor
needs
with


Incoming Task On-The-Go
On the way to a seminar...
yap yap yap
Please send me a copy tomorrow
Ok
Seminar Notes
send copy!
Next week in the office...
Time to go through the seminar notes
send copy!
Oh no!
Incoming Task On-The-Go with the Associative PDA
On the way to a seminar...
yap yap yap
Please send me a copy tomorrow
Ok
create task item and link it to colleague and tomorrow
The next day in the office...
What do I have to do today?
open tasks: send copy to colleague
Right, I almost forgot

Diehl. Associative PDA, 2009.

Summary

- The Seven Stages of Action let you debug your design
- Knowledge in the World relieves users from having to remember everything
- Iterative process allows the design to evolve with user feedback
- The first two questions
  - Who are the users? ⇒ User classification, personas
  - What do they want to do with the system? ⇒ Storyboard