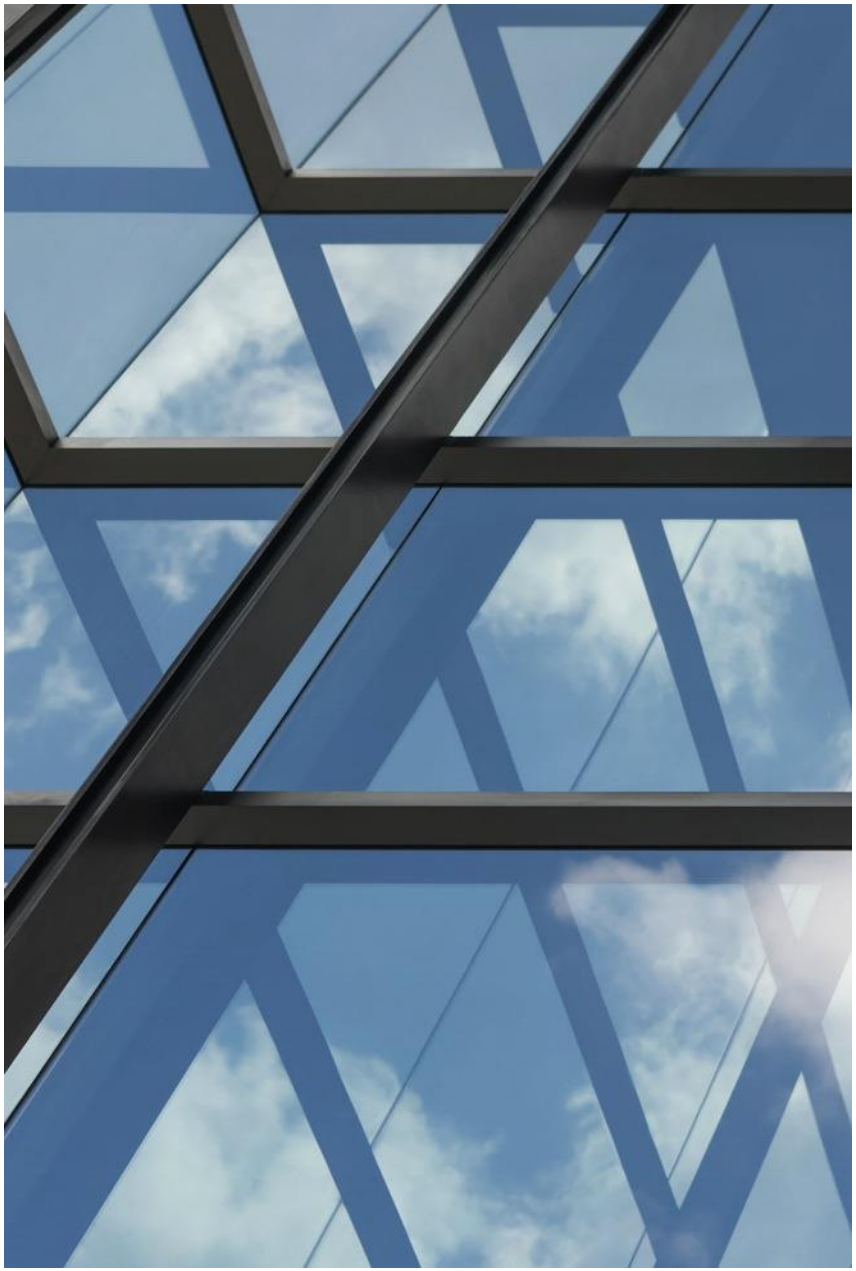
INFO3315 Human-Computer Interaction

Lecture 7 – Prototyping II and Evaluation I

Zhanna Sarsenbayeva



THE UNIVERSITY OF SYDNEY

Recap

- Conceptual models
- Interface metaphors
- Interaction types
- Many different envisionment techniques.
- Sketching is a powerful tool that is quick and cheap.
- Prototype is a manifestation of the design that users can interact.
- Prototyping – making decisions to balance trade-offs:
  - Fidelity – how 'finished' it is perceived (content/appearance/functions)
  - Depth or breadth

Prototyping tools

- Tools develop for the sole purpose of prototyping
  - Code-based
  - Code-free



Has a free version



Paid

Free



Paid

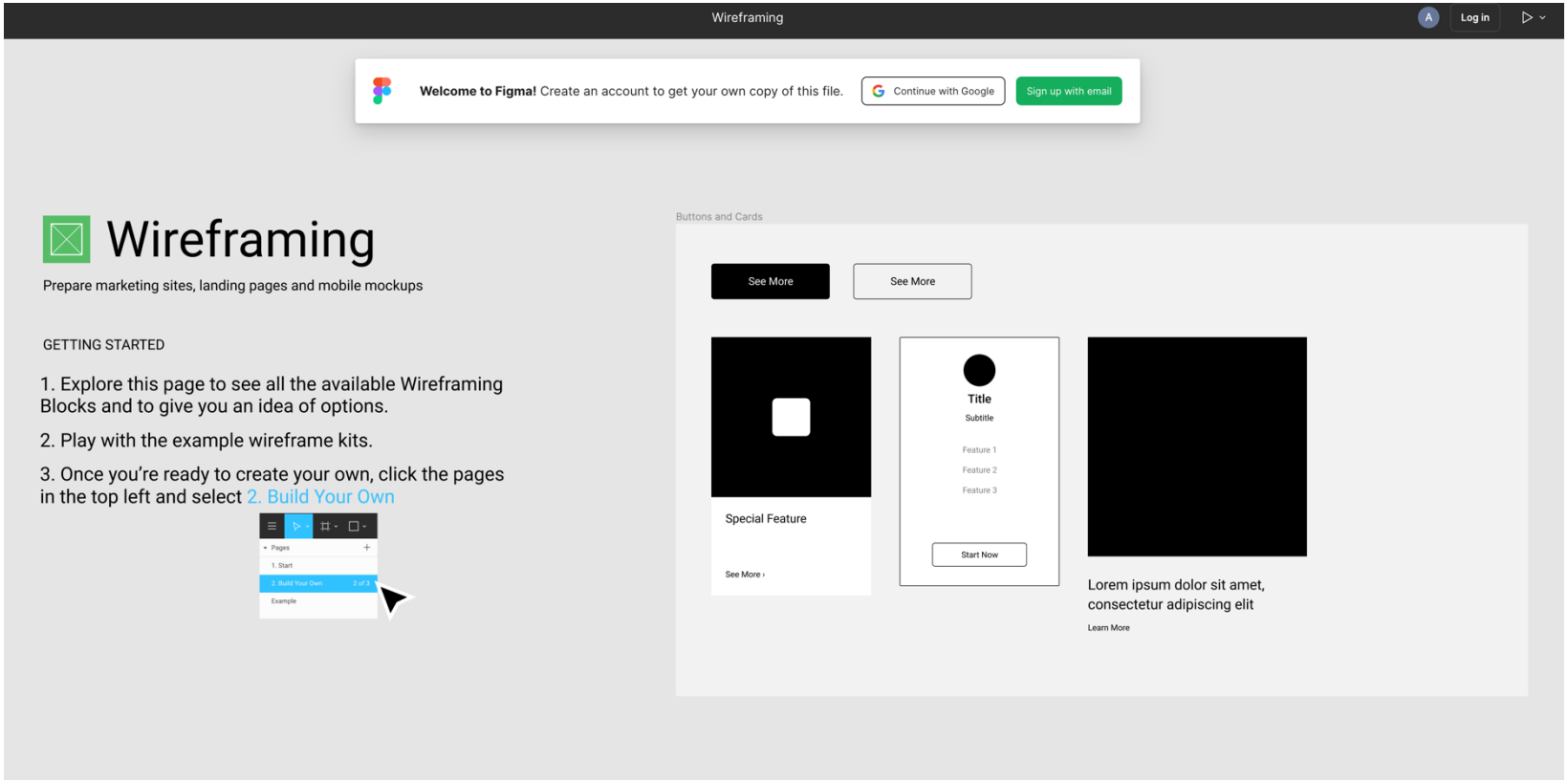




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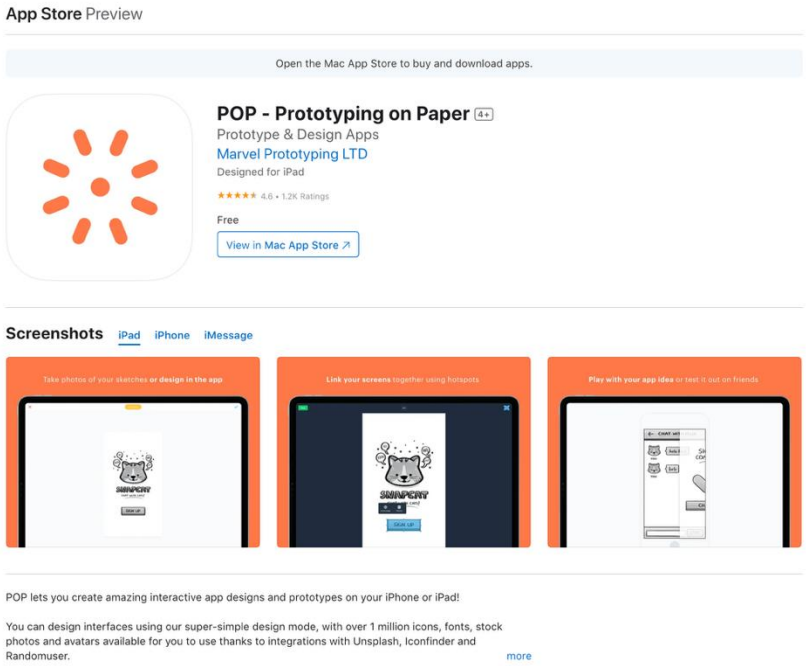
Best practices to create wireframes in Figma

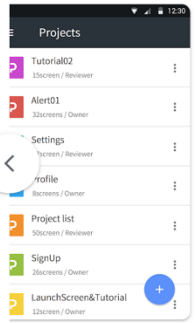
- https://www.figma.com/blog/how-to-wireframe/

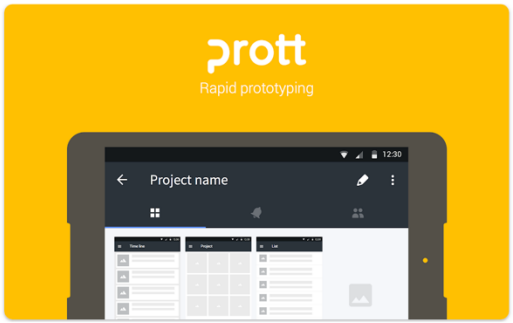


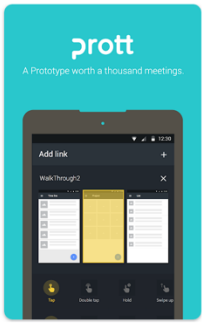
Linking to create Clickthroughs

- Prototype that links multiple screens together via **hotspots**
- **Hotspots – area that is interactable by the user**
- Moving from paper to digital prototype:
  - Upload existing images
  - Add hotspots
- How to link wireframes together in Balsamiq?
- Smartphone applications:
  - **POP by Marvel** for iPhones
  - **Prott App** for Android devices



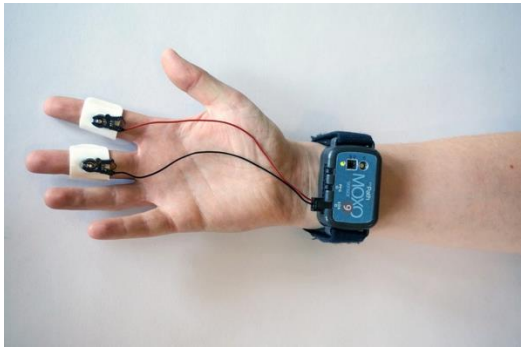






Physical prototyping

- Mostly focus on electronic products
  - Wearable technology
  - Tangible UI
- Same principle – test out ideas quickly
- Resources to support development
  - Physical computing kits
  - Rapid fabrication

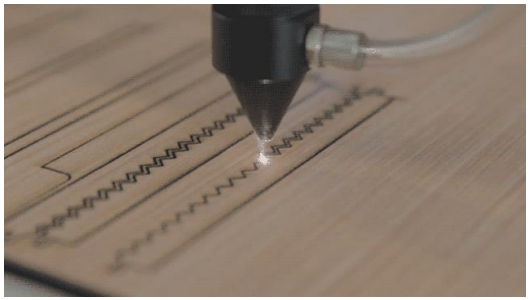


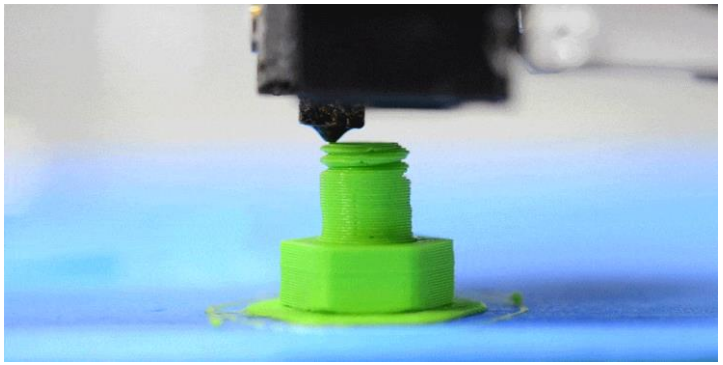


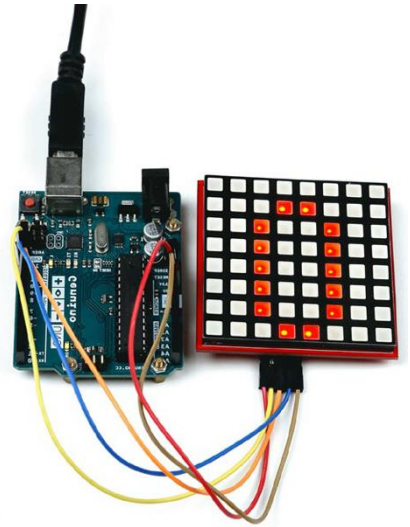
Physical prototyping - COMP5047 Pervasive Computing

- Computing kits – Build and code prototypes and devices using electronics
  - E.g., Arduino, BBC micro:bit, MaKey MaKey
- 3D printing
- Laser cutting
- Printed electronics

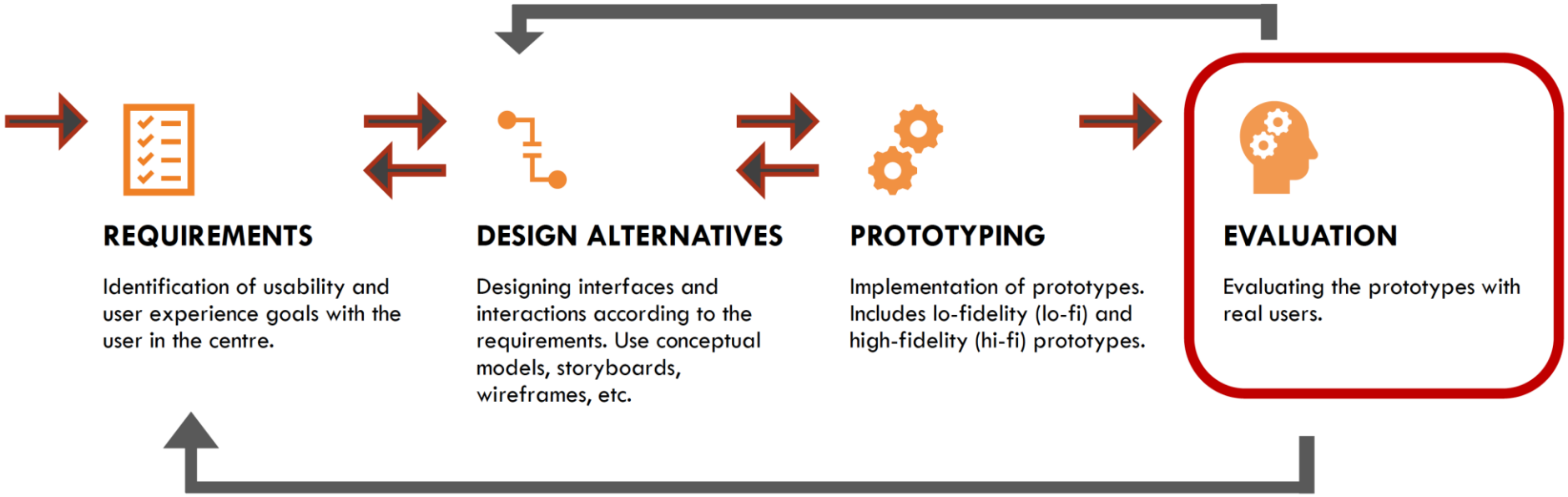






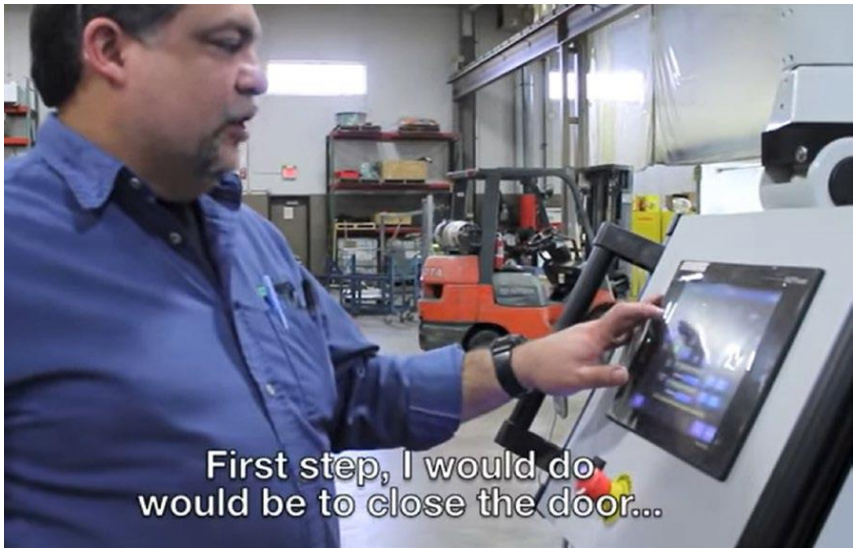


Evaluation


REQUIREMENTS
Identification of usability and user experience goals with the user in the centre.
DESIGN ALTERNATIVES
Designing interfaces and interactions according to the requirements. Use conceptual models, storyboards, wireframes, etc.
PROTOTYPING
Implementation of prototypes. Includes lo-fidelity (lo-fi) and high-fidelity (hi-fi) prototypes.
EVALUATION
Evaluating the prototypes with real users.

Why do we need to evaluate?

- To judge system features / functionality
  - Does it facilitate users' tasks and match their requirements?
  - Does it offer the right features?
- To judge effects on users
  - How easy is the system to learn and use?
  - How do users feel about the system?
- To discover unforeseen problems
  - What unexpected / confusing situations come up?
- To compare your solution against competitors
  - Important for marketing / sales department



What to evaluate?

- Conceptual model
- Early and subsequent prototypes of a new system
- Final product



Examples

- **Evaluate early design**
  - Purpose – to get early feedback on the design
  - Use lo-fi prototypes
  - Helps to find and fix design issues in advance
- **Evaluate system's usability**
  - Focus is on (standard) usability issues
  - Product is close to final / feature rich
  - Provides comparative results (e.g. X is % faster than Y)
  - Example questions:
    - Can users find items faster with the new design?
    - Is the game fun and engaging and how long do users play it?
    - Is it safe for children to play with the toy?
    - Do users like color theme?
    - What is the market reaction to the new homepage design?
- **Evaluate for user groups**
  - Purpose to understand how product works for new markets / user groups
  - E.g., Can a system design for young adults support older adults?
  - Product designed for Australia, now emerging to African continent, how well will it work?

Where to evaluate?

- Usability lab
- Research lab
- Naturalistic settings
- Remote study

Usability lab

- Testing room constructed for usability testing
  - Instrumented
    - Camera, microphones, data recording, etc.
  - Separate observation room
    - Connected by one-way mirror



uqul.uq.edu.au

Usability lab

- **Benefits**
- Controlled situation
- Ideal to study one precise aspect
- Many equipment available
  - audio / video /data logging
- Only option if real location is dangerous or remote

- **Problems**
- Does not represent a natural situation
- Hard to generalize results

Naturalistic settings

- Observation occurs in realistic setting
- Real life
- Workplace / Home
- In-situ



en.wikipedia.org

Naturalistic settings

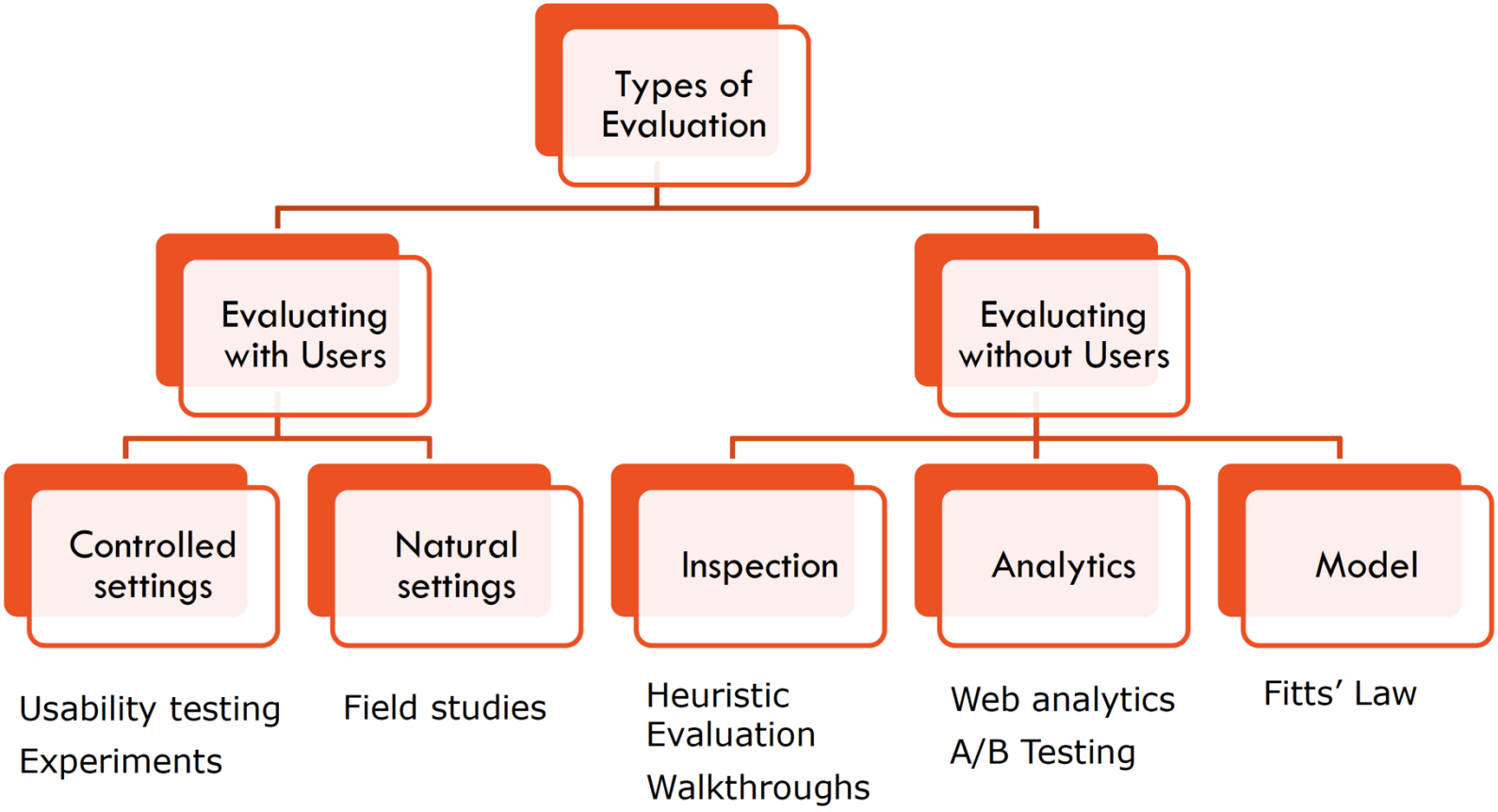
- **Benefits**
- More realistic (e.g. external effects)
- Situations and behaviour more natural
- Better suited for long-term studies
- Well-suited for user experience studies

- **Problems**
- Hard to arrange and run
- Time consuming
- Task is difficult to control
- Environment is difficult to control (e.g. distractions)

When to evaluate?

- During iterative design – check if
  - Design matches the requirements
  - Problems with the design
- Before deployment – for acceptance testing
  - Does the system meet expected performance
- Continuous evaluation after deployment
  - "Permanent beta"
  - Continuous evaluation
    - In the wild, bug reports, field studies

Types of evaluation



Selecting and combining methods

- Use a combination of methods to obtain richer understanding of users and product.
- Controlled – test hypothesis about specific features
- Uncontrolled – insight to people's experience of interacting with technology in the context of daily life.
- Example: Combination of usability testing in labs combined with field studies.
- Cognitive walkthrough to test-run the prototype before actual usability testing in the lab

Main steps in evaluation

1. Establish aims of evaluation.
2. Select evaluation methods. Good to have combination of participant (with users) and non-participant methods (without users).
3. Carry out non-participant methods first.
4. Use results from non-participant methods to plan participant testing
5. Plan session, recruit participants and setup equipment.
6. Carry out evaluation.
7. Analyse results, document and report.

Ethics

- Evaluation in HCI often (almost all the time) involve humans.
- Inform participants about their rights during the study
- Protect participants during study
  - Physical or emotional endangerment
  - Privacy of participants
    - How data is collected and treated?
- Ethics approval must be obtained before study is conducted.
- Check with your organisation rules on Ethics approval!

University Human Ethics Policy

- Ethics approval helps to:
  - protect the welfare, rights, dignity and safety of research participants
  - protect researchers' rights to conduct legitimate investigation
  - protect the University's reputation for research conducted and sponsored by it
  - Minimise the potential for claims of negligence made against individual researchers and the University.

- Make sure you are familiar with the university policies https://intranet.sydney.edu.au/research-support/ethics-integrity/human-ethics.html

- Other relevant documents
- https://www.nhmrc.gov.au/research-policy/ethics/national-statement-ethical-conduct-human-research
- https://www.nhmrc.gov.au/about-us/publications/australian-code-responsible-conduct-research-2018

University Human Ethics Policy

- Human research is
  - Research conducted with or about people, their biological materials or information.
- It covers activities such as:
  - taking part in surveys, interviews or focus groups
  - undergoing psychological, physiological or medical testing or treatment
  - being observed by researchers
  - accessing personal documents or other materials
  - collection and use of biological materials
  - access to personal information as part of an existing published or unpublished source.

Ethics – Before the Session

- Don't waste the user's time
  - Make sure experiment is designed well (e.g. use pilot studies)
  - Be prepared
- Make users feel comfortable
  - Communicate only the system will be tested, not the user
  - Indicate that the software may have problems
  - Inform that they can stop at any time
- Maintain privacy
  - Tell the user that results will be anonymized (if applicable)
- Inform the user
  - Explain what is being recorded (video, audio, data logging, etc.)
  - Answer user's questions (but avoid bias)
- Do not coerce users
  - Obtain informed consent

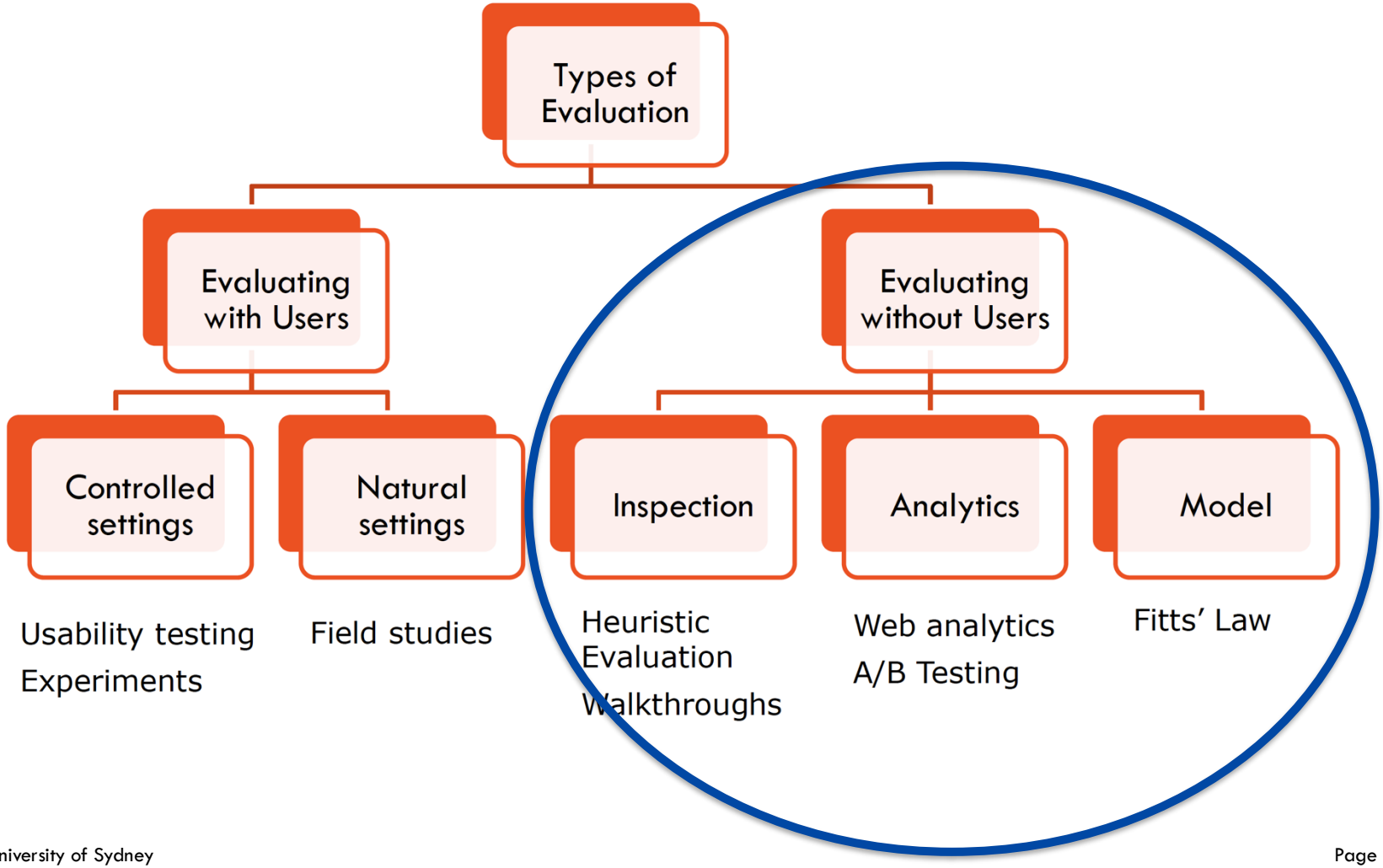
Ethics – During the Session

- Don't waste the user's time
  - Do not ask to perform unnecessary tasks
- Make users feel comfortable
  - Give early success experience (pre-trials)
  - Keep a relaxed atmosphere
  - Sufficient breaks (e.g. coffee breaks)
  - Hand out test tasks one at a time
  - Do not show displeasure
  - Avoid disruptions
  - Stop the test if participant show discomfort
- Maintain privacy
  - External people should not be present

Ethics – After the Session

- Make users feel comfortable
  - Thank the user and inform they have helped
- Provide additional information if necessary
  - Answer any other remaining questions user had
    - E.g. something that could have lead to a bias
- Maintain privacy
  - Report the data without compromising privacy
  - Only share audio visual data with expressed permission
  - Store all the data in a secure location
    - University has a dedicated research data storage
      - Research Computing Optimised Storage (RCOS)

Types of evaluation



Inspections

- Experts use their knowledge of users and technology to review software usability
- Expert critiques can be formal or informal
- Heuristic evaluation is a review guided by a set of heuristics
- Walkthroughs involve stepping through a pre-planned scenario noting potential problems



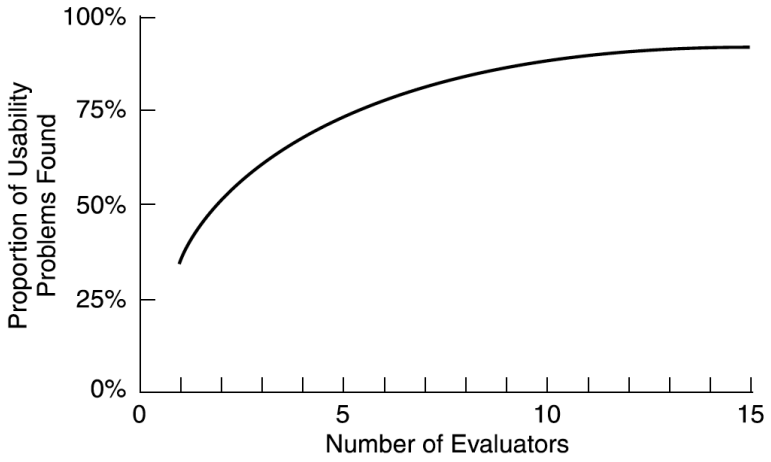
https://simpsons.fandom.com/wiki/Nuclear_Inspectors

Heuristic evaluation

- Small set of evaluators examine the interface and judge its compliance with recognized usability principles.
- Original heuristics – Nielsen's TEN Usability Heuristics derived empirically from an analysis of 249 usability problems.
- Do you remember the 10 Usability Heuristics?
- Watch:
  - http://youtu.be/hWc0Fd2AS3s

Number of evaluators

- Nielsen suggests that on average five evaluators identify 75-80 percent of usability problems



Curve showing the proportion of usability problems in an interface found by heuristic evaluation using different numbers of evaluators

Nielsen and Mack, 1994. Courtesy of Wiley

Choice of Heuristics

- Depends on goals of evaluation
- Guidelines can be used as heuristics for evaluating websites
- Governments and large corporations have to make their websites accessible by law
- Web Content Accessibility Guidelines (WCAG)

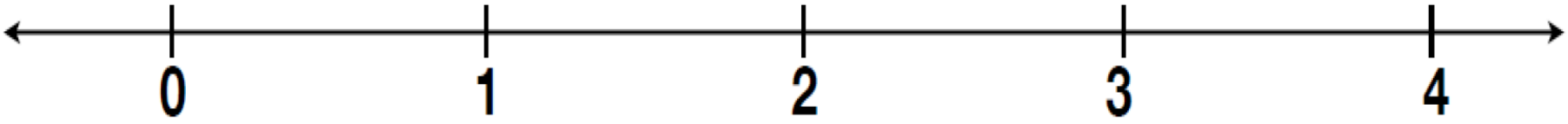
How to: Heuristic Evaluation

- Briefing session to tell experts what to do
- Evaluation period of 1-2 hours in which:
  - Each expert works separately
  - Take one pass to get a feel for the product
  - Take a second pass to focus on specific features
- Debriefing session in which experts work together to prioritize problems

How to: Heuristic Evaluation

– Severity ratings

- **0**: I don't agree that this is a usability problem at all
- **1**: Cosmetic problem only (need not to be fixed unless extra time is available)
- **2**: Minor usability problem (fixing has low priority)
- **3**: Major usability problem (important to fix)
- **4**: Usability catastrophe (must be fixed before product can be released)



Heuristic Evaluation

- **Benefits**
- Few ethical and practical issues to consider because users not involved
- Best experts have knowledge of application domain and users

- **Problems**
- Can be difficult and expensive to find experts
- Many trivial problems are often identified, such as false alarms
- Experts have biases

Cognitive Walkthrough

- Focus on ease of learning
- Designer presents an aspect of the design and usage scenarios
- Expert is told the assumptions about user population, context of use, task details
- One or more experts walk through the design prototype with the scenario

Cognitive walkthrough is a systematic way to think like the user by drawing on Norman's gulfs and a model of Exploratory Learning

Cognitive Walkthrough

User has task

0. will user understand this sub-task is needed?

Explores system for useful elements

1. **Will correct action be obvious?** e.g., button visible
2. **Will user understand instructions?** e.g., user understands the label on the button

Selects one to try

User interprets system response

3. **Will user interpret machine action correctly?**

Cognitive Walkthrough

- **Benefits**
- Can be done without users
- Considers user's task
- Quick and inexpensive to apply

- **Problems**
- Limited by skills of the evaluator
- Labour intensive – answering and discussing questions may take a long time.

Cognitive Walkthrough – Example

- *Design a **cash-operated machine** for quick, easy **purchase of train tickets** by passengers, without training*

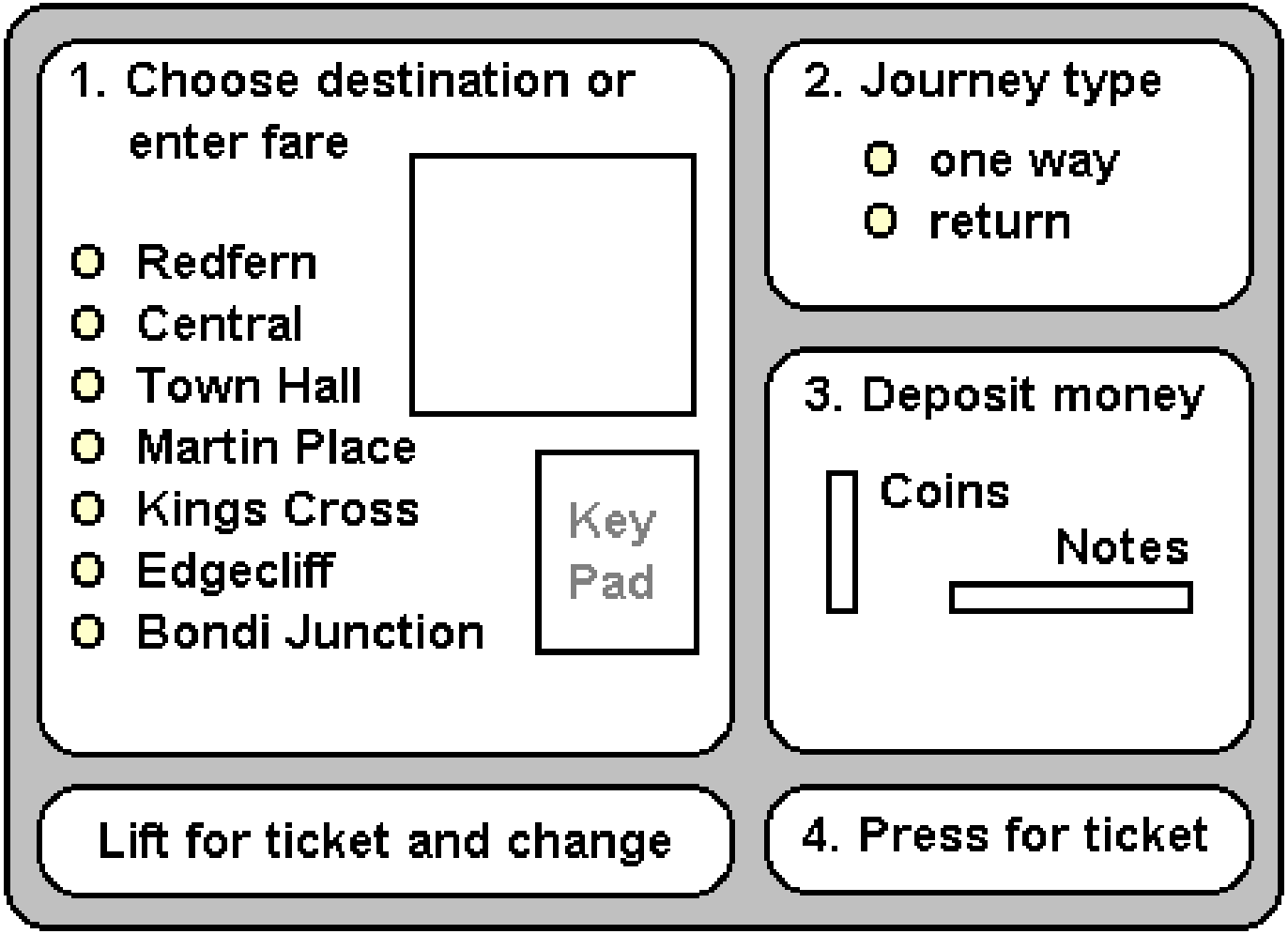
- **Abstract** user goals:
  - Determine whether I can afford to buy the ticket to a particular destination
  - Buy a ticket to the required destination

Cognitive Walkthrough – Example

- *Design a cash-operated machine for quick, easy purchase of train tickets by passengers, without training*

- Designer goal breakdown to subgoals:
  - Determine fare to pay
    - indicate destination
    - indicate one-way or return
  - Dispense ticket
    - pay money
    - get ticket and change

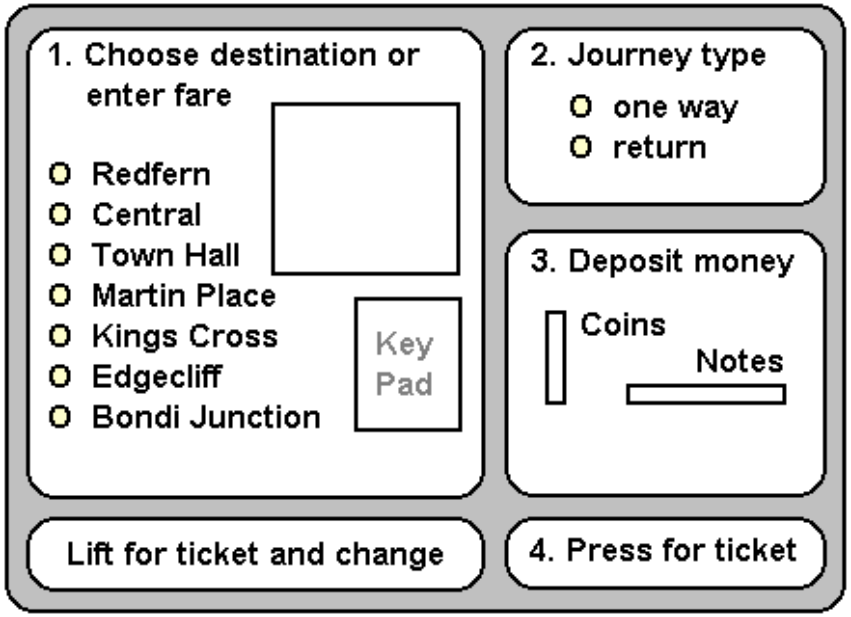
The interface – lo-fi prototype



Credit to Prof. Judy Kay

User task – Buy a one-way ticket to Town Hall

- Method 1 where user does not use keypad
  - Click destination
    - ie Town Hall
  - Click journey type
    - ie one way



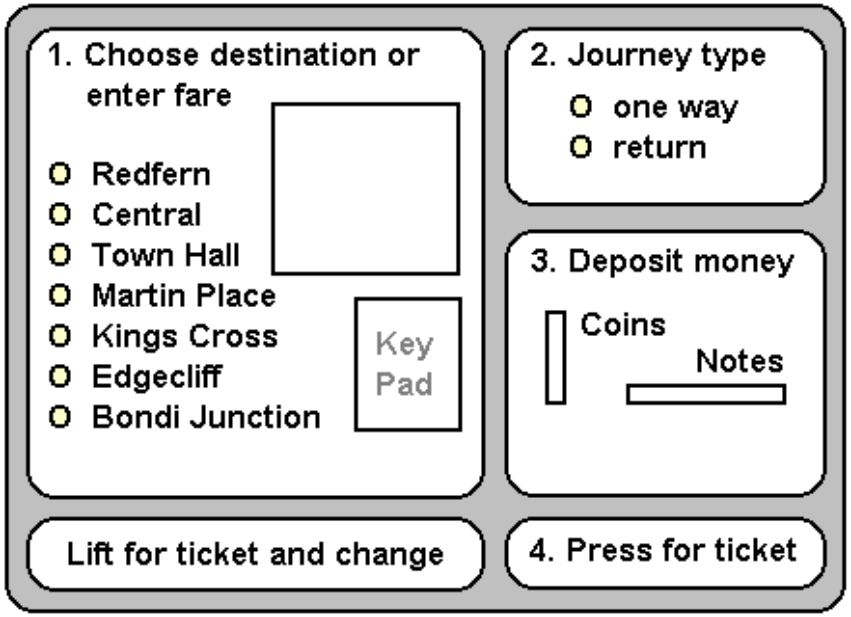
Credit to Prof. Judy Kay

Cognitive Walkthrough in action

1. Will correct action be obvious?

2. Will user understand instructions?

3. Will user interpret machine action correctly?

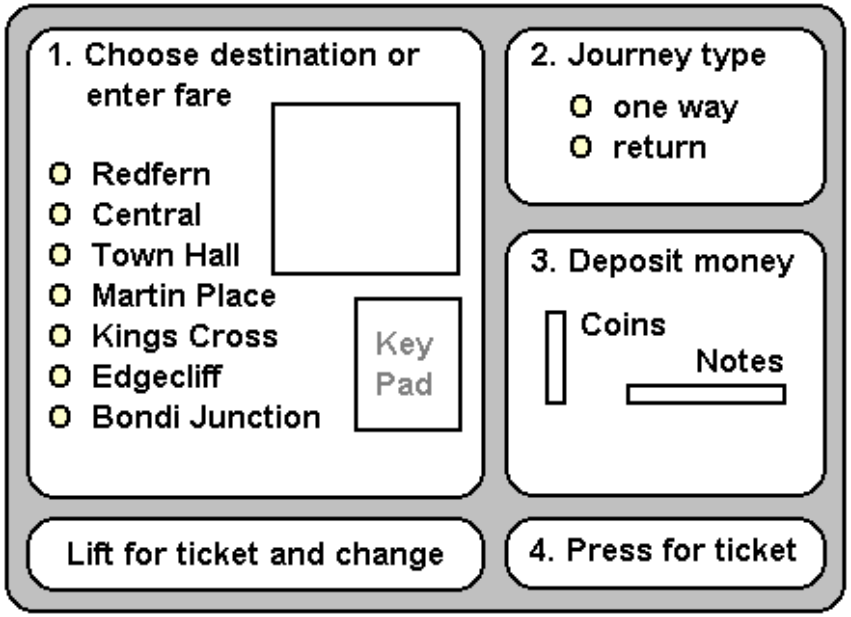


- Problem – user has to click both destination and journey type before there is feedback

Credit to Prof. Judy Kay

Cognitive Walkthrough in action

- Indicate extra information needed
- Indicate steps 1 and 2 can be done in either order
- Give some feedback on effect of each select action
- Reorganise layout so that Steps 1 and 2 are followed by the fare display



- So we revise the prototype…

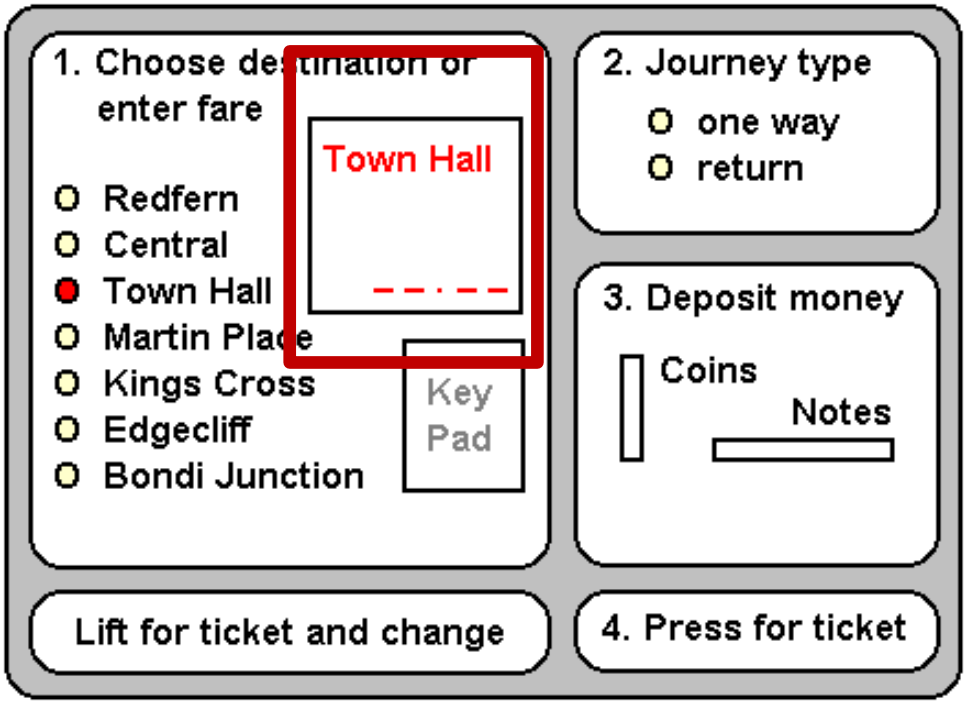
Credit to Prof. Judy Kay

Revised lo-fi prototype

2. Will user understand instructions?

then after the user tries to act…

3. Will user interpret machine action correctly?



Credit to Prof. Judy Kay

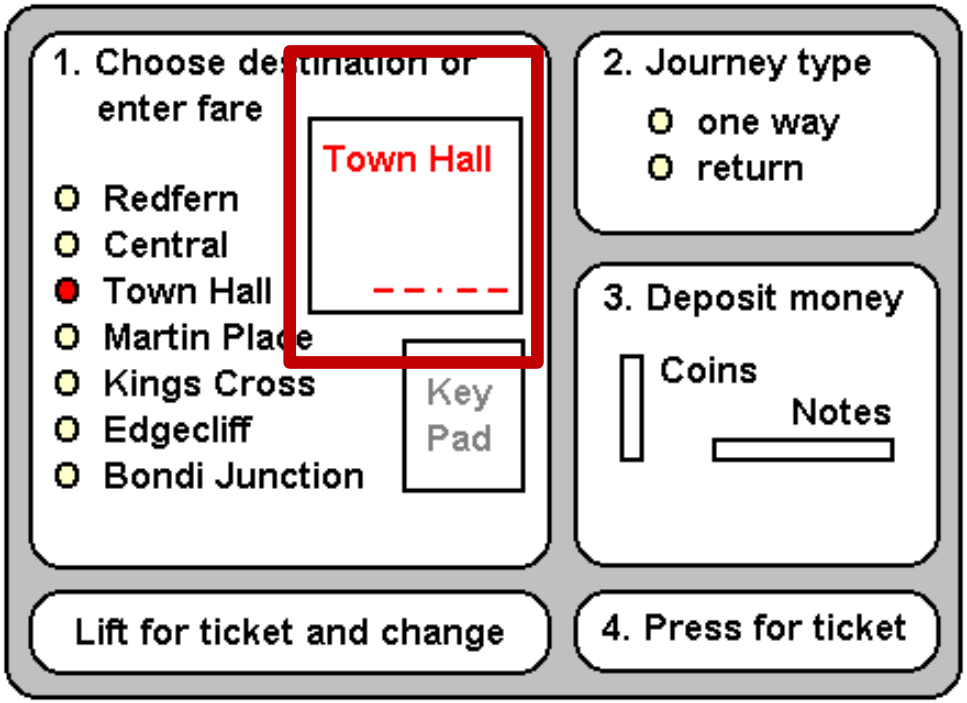
Cognitive Walkthrough in action

2. Will user understand instructions?

- Yes
- due to labels and instructions

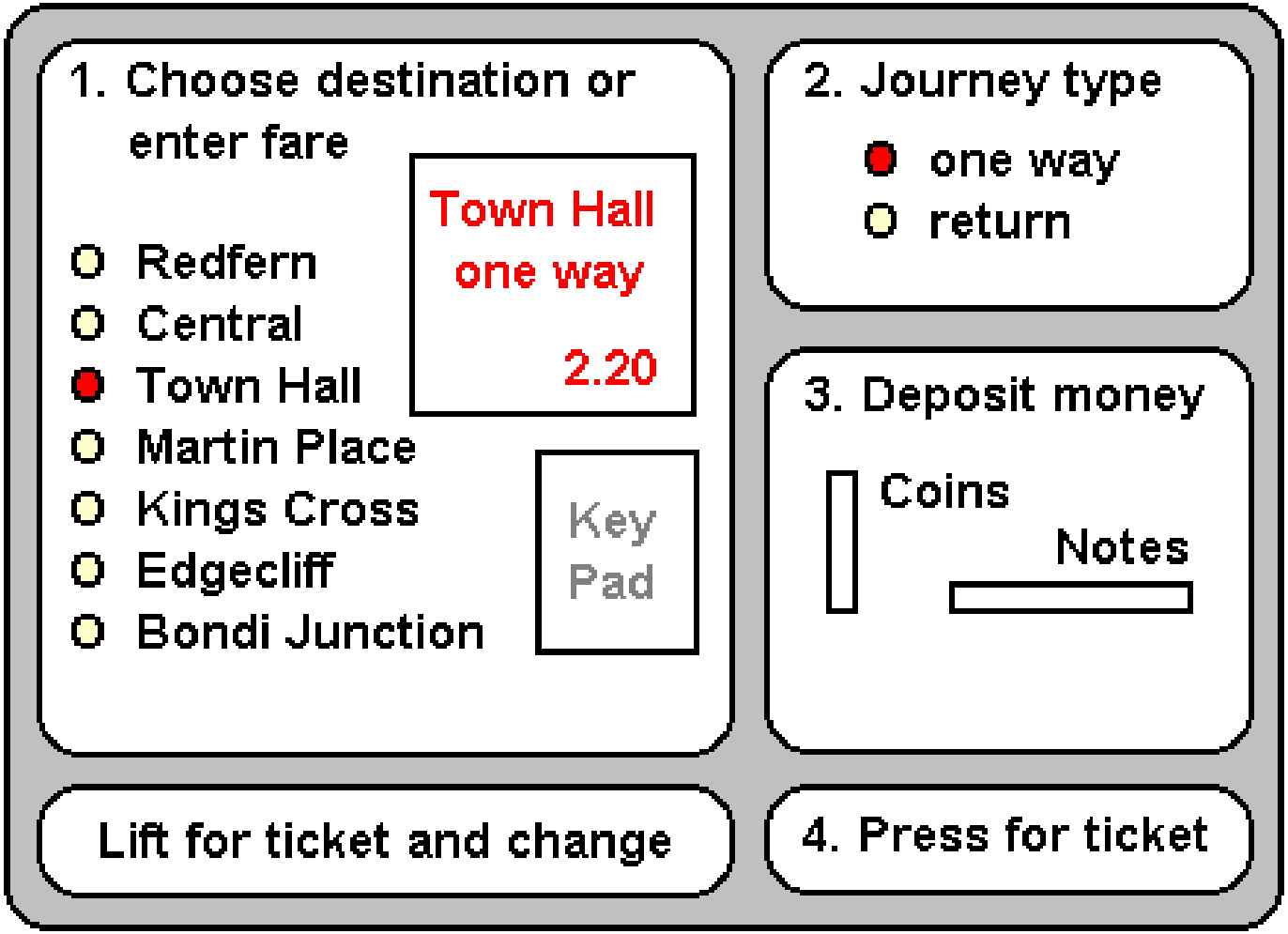
3. Will user interpret machine action correctly?

- Yes
- buttons light up, new state appears)



Credit to Prof. Judy Kay

Cognitive Walkthrough in action



Credit to Prof. Judy Kay

Now repeat the Cognitive Walkthrough

– *Buy a one-way ticket to Town Hall*

1. Correct action obvious?

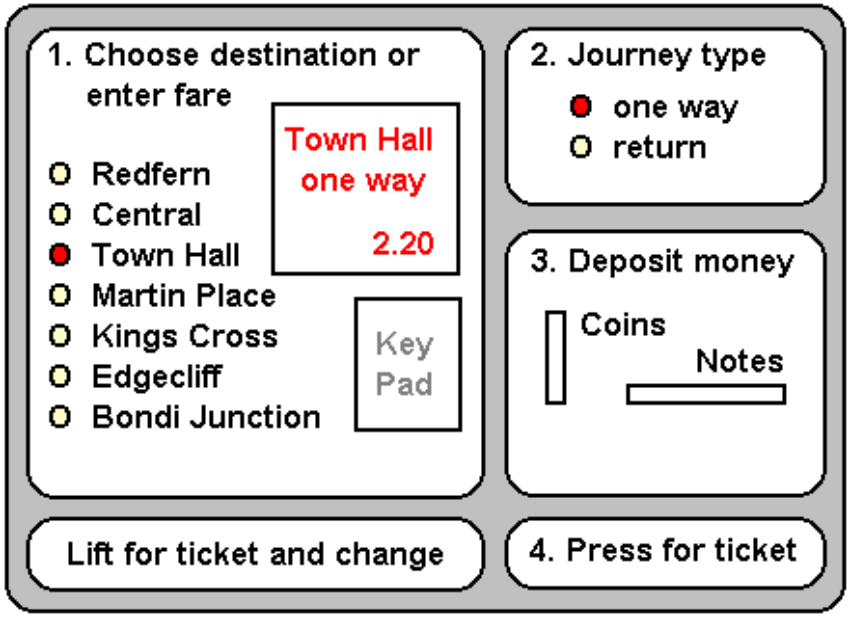
Yes

2. Will user understand instructions?

Yes

3. Will user interpret machine action correctly?

Yes



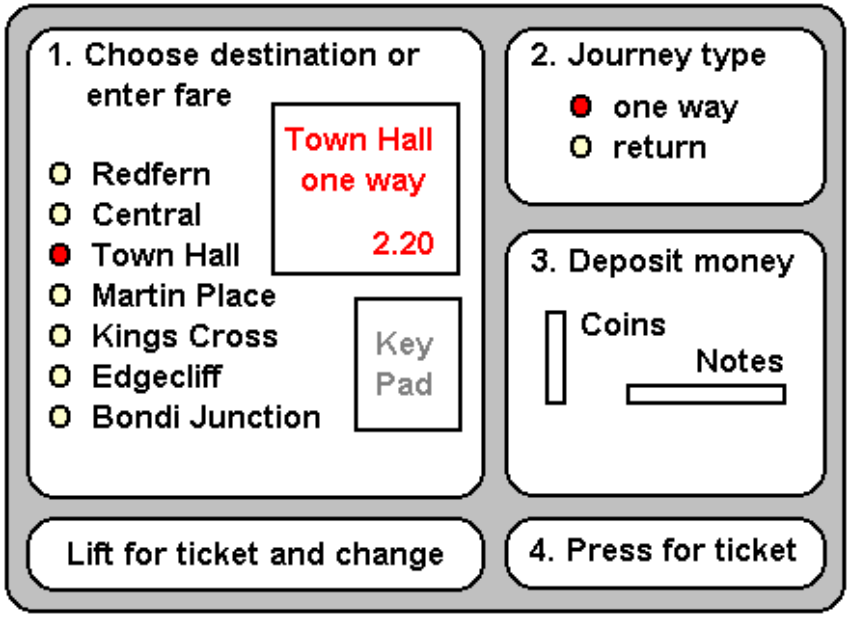
Credit to Prof. Judy Kay

Cognitive Walkthrough in action

– *Buy a one-way ticket to Town Hall*

Paying

1. Is the correct action obvious?
2. Will user understand instructions?
3. Will user interpret machine action correctly?



Credit to Prof. Judy Kay

What are the cases to consider for payment (in cash)
Consider case where user has exact change

Cognitive Walkthrough in action

- *Buy a one-way ticket to Town Hall*

Paying

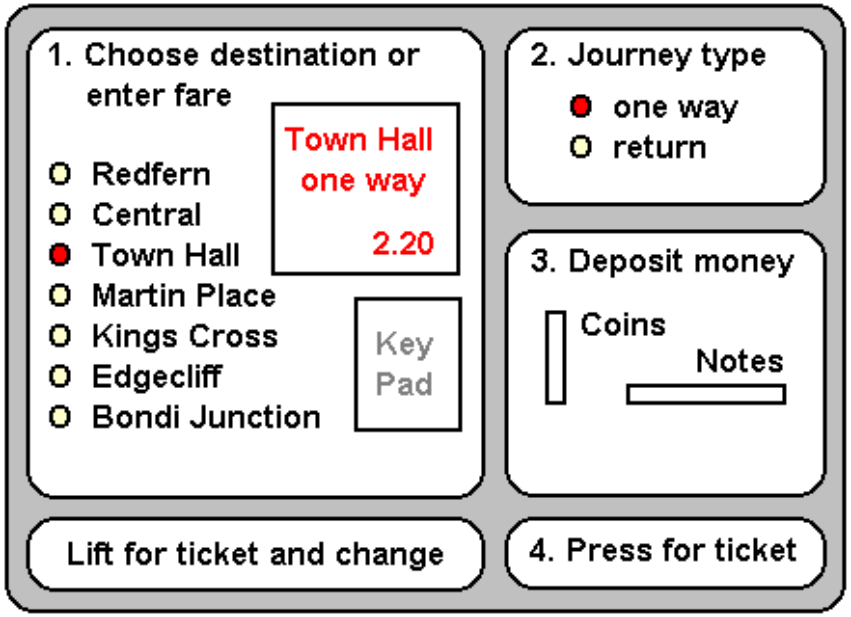
Designer intends user to

- Pay in money

and then click:

"4. Press for ticket"

- User then lifts flap to collect the ticket



Credit to Prof. Judy Kay

Cognitive Walkthrough in action

– *Buy a one-way ticket to Town Hall*

Paying

1. Correct action obvious?

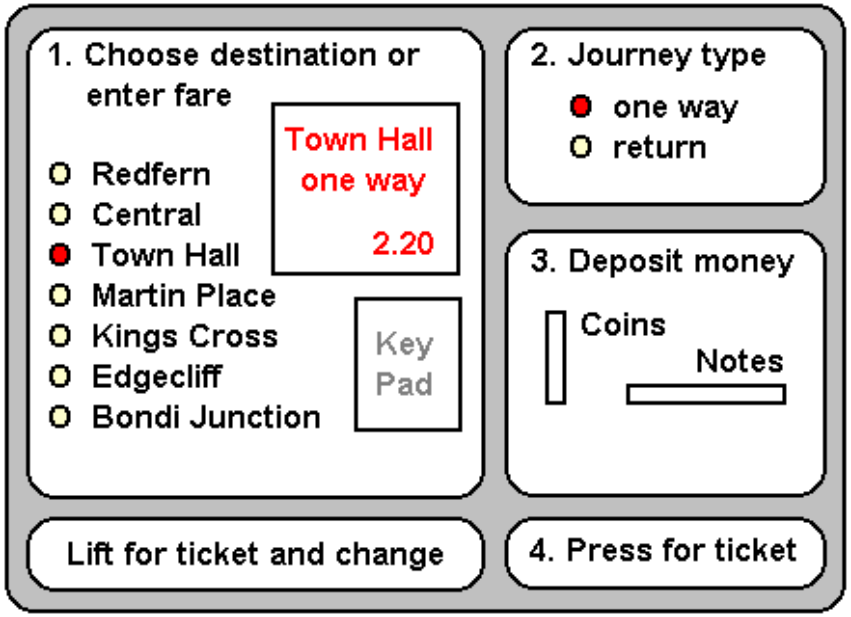
– Yes

2. Will user understand instructions?

– Yes

3. Will user interpret machine action correctly?

– Unclear (no feedback on money accepted so far)



So we alter the lo-fi prototype and continue Cognitive Walkthrough

Credit to Prof. Judy Kay

Cognitive Walkthrough in action

– *Buy a one-way ticket to Town Hall*

Paying

1. Correct action obvious?

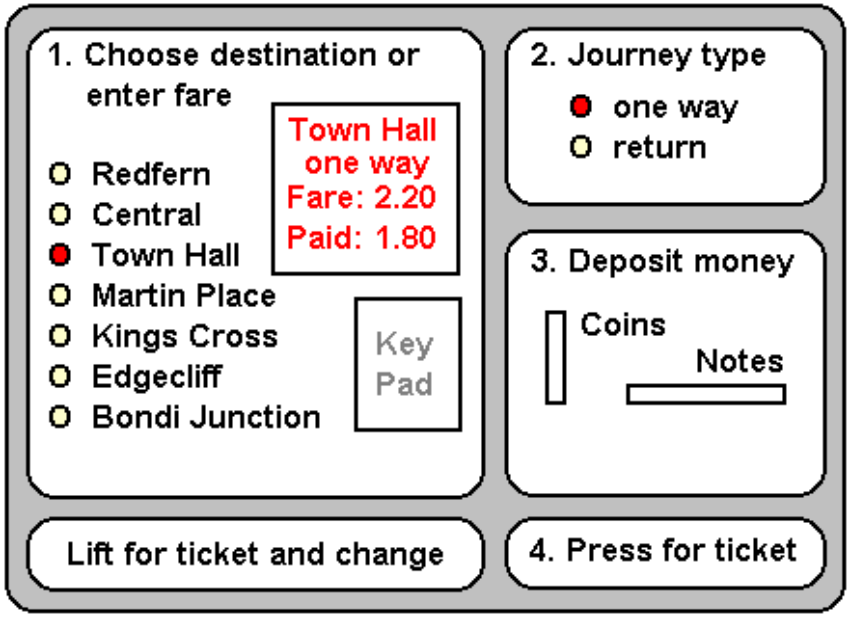
– Yes

2. Will user understand instructions?

– Yes

3. Will user interpret machine action correctly?

– Yes. We know how much we paid



Credit to Prof. Judy Kay

In-class activity in pairs (10 min) – Perform cognitive walkthrough for the case when user does not have sufficient amount of money

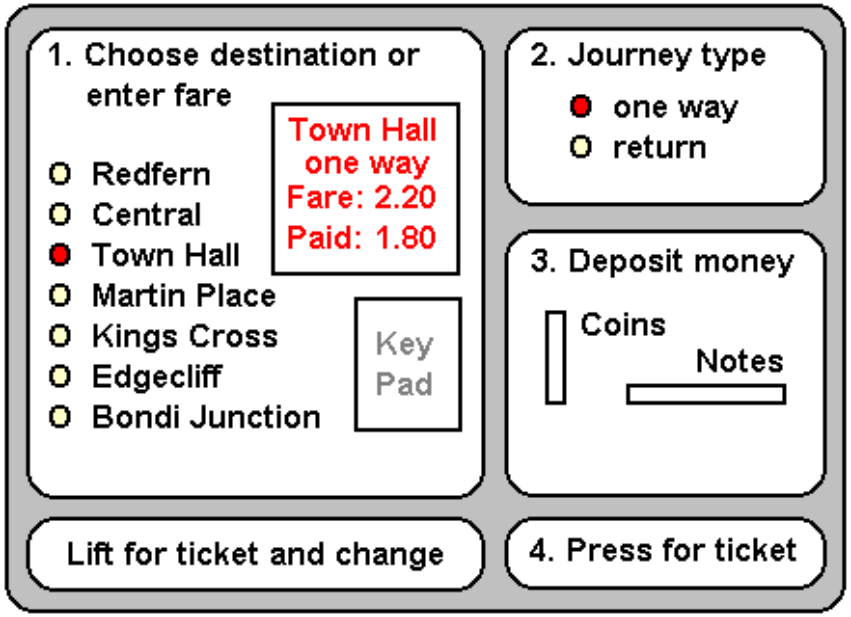
– *Buy a one-way ticket to Town Hall*

Paying – money insufficient

1. Correct action obvious?

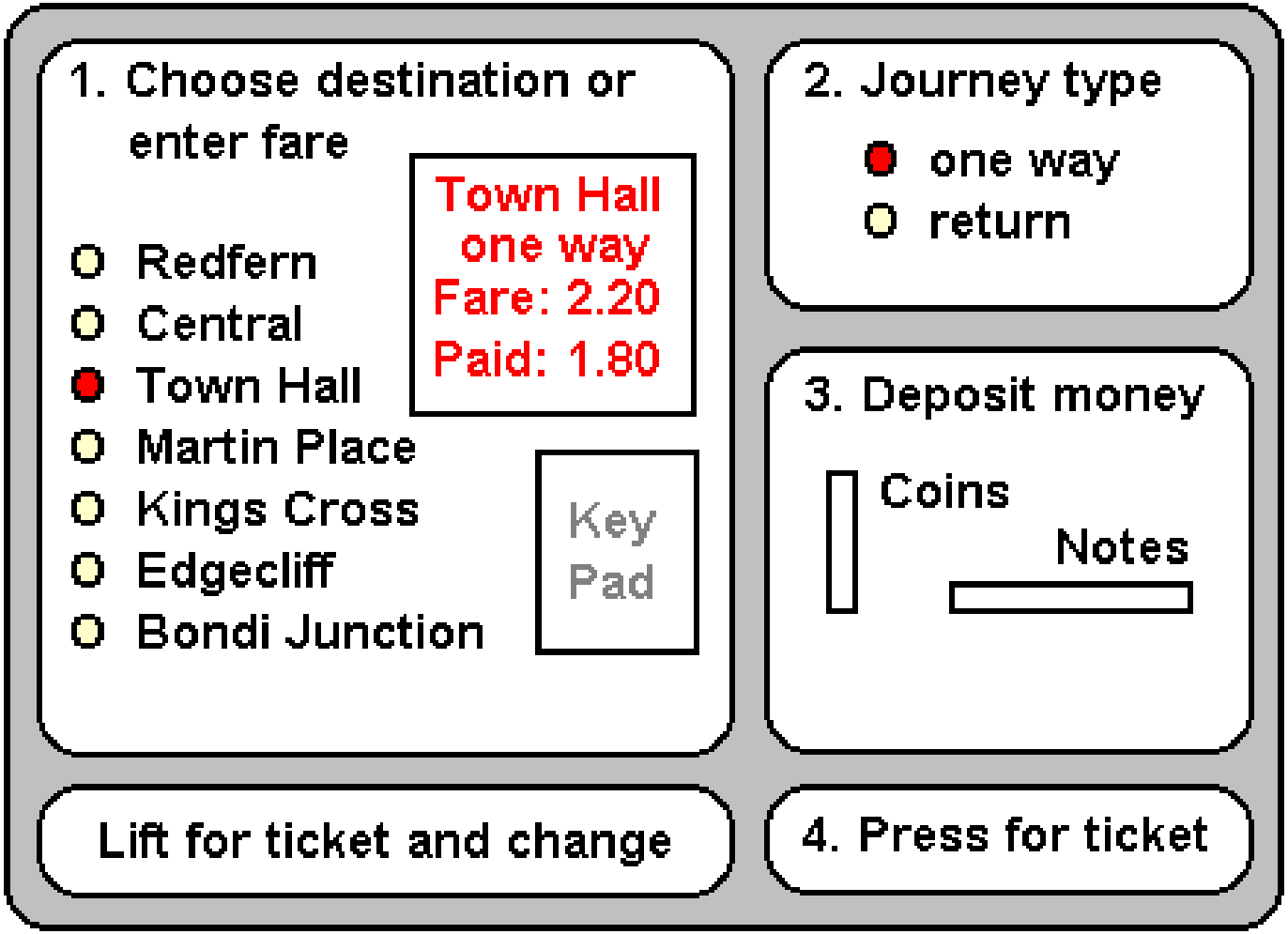
2. Will user understand instructions?

3. Will user interpret machine action correctly?



Credit to Prof. Judy Kay

What are the problems with the interface for this case?



Credit to Prof. Judy Kay

Analytics

- A variety of users' actions can be recorded by software automatically – key presses, time spent searching web page, looking at help systems.
- Unobtrusive provided system's performance not affected
- Large volumes logged automatically, explored and analysed
- Ethical issues – observing without knowledge

Web analytics

- A form of interaction logging that analyses users' activities on website
  - Total number of people
  - Length of stay
  - Content site visits
- Outcomes can be used to improve their designs
- When designs don't meet users' needs, users will not return to the site (one-time users)

Other analytics

- Learning analytics
  - Web analytics applied to field of education.
  - Learner's activity in massive open online courses (MOOCs) and Open Education Resources (OERs).
- Visual analytics
  - Display and manipulate 'big data' visually

A/B Testing

- A large-scale experiment
- Offers another way to evaluate a website, application or app running on a mobile device
- Often used for evaluating changes in design on social media applications
- Compares how two groups of users perform on two versions of a design

Model-based evaluation

- Predictive models evaluate a system without users being present.
- Use formulas to derive various measures of user performance.
- Fitts' Law
  - Time taken to hit a screen target is dependent on distance of cursor and size of target
- Example research
  - Comparison of dogs' ability to interact with touchscreen vs humans' performance
  - https://doi.org/10.1145/2642918.2647364

Required reading

- Preece, J., Rogers, Y., & Sharp, H. (2019). Interaction design: beyond human-computer interaction (Fifth edition). Wiley. Chapter 12.6
- Preece, J., Rogers, Y., & Sharp, H. (2019). Interaction design: beyond human-computer interaction (Fifth edition). Wiley. Chapter 16