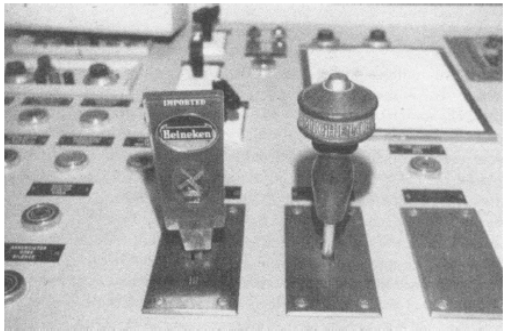
# Chapter 2

# Module 2 - Design



## Some fun



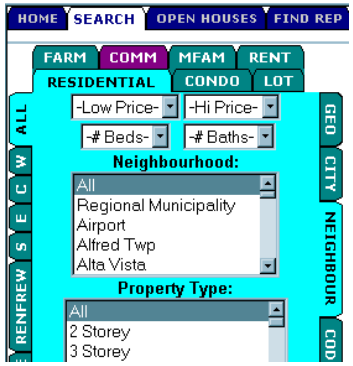



## General issues of design

- ✔ Must design large things
- ✔ Design approaches an art form
- ✔ Principal concern with *user*



## How not to design



## Rules

- Avoid doing things just because you know how to do them.
- Make your designs be driven by requirements.



## The design process

The design process involves both

- specification of the behaviour of a product, and
- specification of the detailed techniques used to implement the product.

In each area, there exist a range of tools and techniques that can benefit any software product.



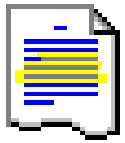
## Role of designer

- ✔ Designer interacts with people
- ✔ Must relate designs back to requirements and constraints.
- ✔ Design must be readable, understandable, implementable.
- ✔ Designer uses *abstraction.*



## Iconic abstraction

Text file using an icon:



## Higher level abstractions

- ✔ Desktop
- ✔ Wastebasket



## Building blocks

| Button | Testbox | Label |
|---|---|---|
| Dismiss | This window is a text widget. It displays one or more lines of text and allows you to edit the text. Here is a summary of the things yo | Perl/Tk |

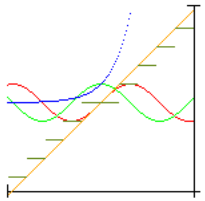


## Building blocks

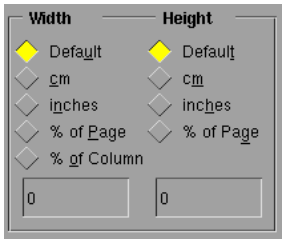
| Menu | Checkbox | Radiobutton |
|---|---|---|
| Open ...<br>New<br>Save<br>Save As ...<br>Setup ...<br>Print ...<br>Quit | Wipers OK<br>Brakes OK<br>Driver Sober | Point Size 10<br>Point Size 12<br>Point Size 18<br>Point Size 24 |



## Building blocks

| Scrollbar | Graph | Directory Tree |
|---|---|---|
| This window is a text widget. It displays one or more lines of text and allows you to edit the tex |  | DirTree, diplay directory tree.<br>/<br>home<br>hugh<br>BIBS |

## Containers






## Sundries

- ✔ Cursors
- ✔ Fonts
- ✔ Colours
- ✔ Drag-n-drop
- ✔ Cut-n-paste.



## Use cases

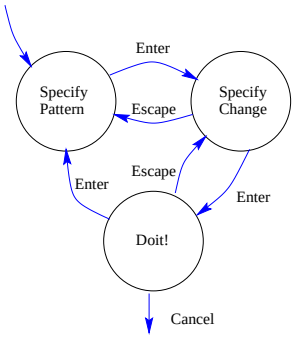
Designer imagines and proposes common scenarios[2], and

1. checks to see if the scenarios are *consistent*, and *complete*,
2. tries out the scenarios on people to see if they work,
3. tests the scenarios and attempts to quantify their behaviour.

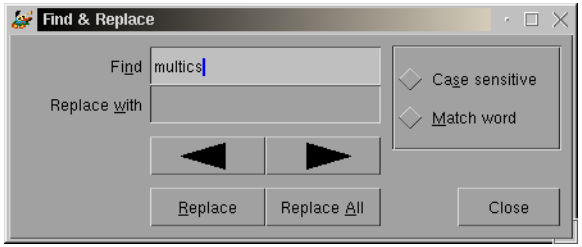
[2] Scenarios=Use_cases. Use_cases=scenarios.



## F&R state diagram

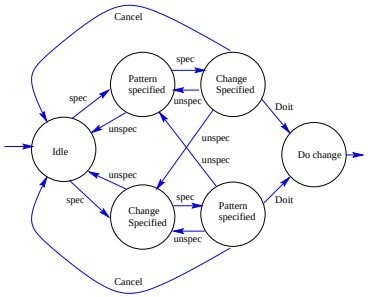


## GUI-style *find-and-replace*:






## State diagram






## Therac25

The focus on detail related to the state of a dialog is not trivial.

✔ There is a well known example of a poorly constructed dialog, that contributed to the death of cancer patients in the US

http://sunnyday.mit.edu/therac-25.html

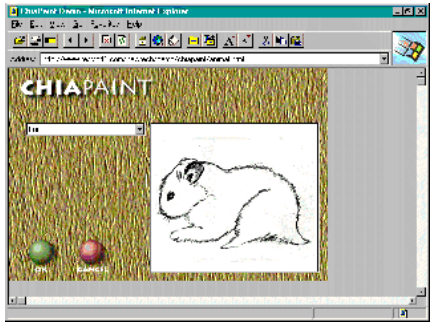


## Modelling

**Modelling:** - Used to demonstrate the UI, without actually implementing the *core* software.

Dan Bricklen's demo program (a demo copy is available at http://www.brickin.com/) is worth looking at for modelling a user interface. There is an amusing demo called **chiapaint**.

## Chiapaint






## Modelling

It is also relatively easy to model a new UI using Tcl/Tk.



## OO technology

The principle features of OO technology are as follows:

1. Abstraction,
2. Information hiding,
3. Inheritance,
4. Polymorphism, and
5. Genericity



## OO technology and design

Some of these OO features provide a mechanism which supports the construction of better software...

- ✔ Create library
- ✔ Generalize it
- ✔ Design becomes the detailing of new classes derived from the generalized ones...

## GUI design

GUI design has to meld four possibly conflicting elements:

1. **Software model** - structure of data and software
2. **User profile** - the types of users
3. **Product perception** - the mental image developed by user
4. **Product image** - the GUI - screenshots, descriptions or specifications

In general, a GUI is successful when the product perception matches the product image.



## GUI specification/design

Our concern is to:

> Develop a functional and behavioural response specification in terms of its cognitive aspects.

The functional and behavioural response specification is turned inside-out from a normal *software* specification. With a *software* behavioural model, we start with an analysis of states, events and actions, and specify the expected views as a result. With GUI specification, our orientation is to start with the views, and specify the states, events and actions associated with those views.



## Basis for GUI design

One of the most characteristic elements of many GUI programs is the use of the event-driven software architecture.

When the designer adopts this paradigm, the GUI program is viewed as a series of response routines for particular events.



## Design document

- User requirement
- Environment
  - Software constraints
  - Other constraints
- Interface design
  - Overview
  - Interface description
    - Prototype screens
    - Functional specifi cations
    - Behavioural specifi cations
- Testing methodology

## Formal GUI design

✔ Z can *formally* specify complex GUI interactions.

✔ Z tools test the specification

More details may be found in the handout, found at

http://www.cs.virginia.edu/~jck/publications/zum.97.pdf

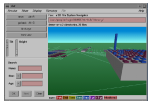
It describes the interface to a nuclear reactor.



## GUI designs

✔ With Therac-25, we saw how a poorly constructed interface led to deaths of patients...

✔ By contrast, a good interface may result in the reverse...



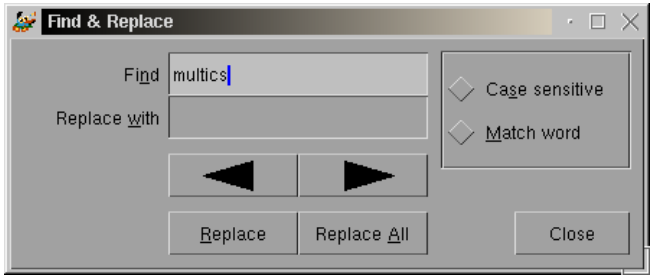


## Examples of GUI designs

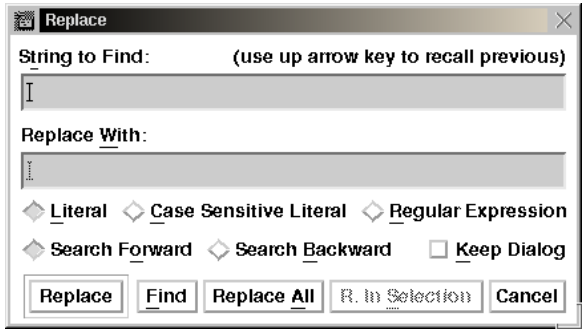
Here are some examples of different designs for similar things



## Lyx Find-and-replace:

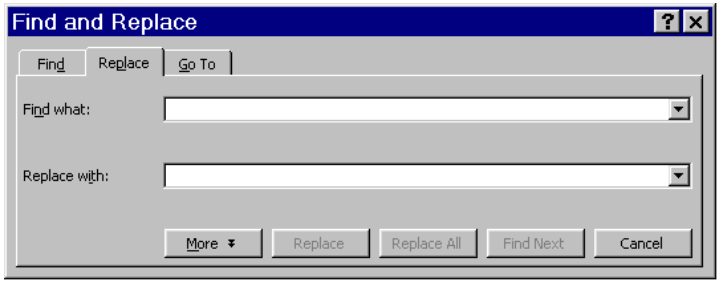


## Nedit find-and-replace



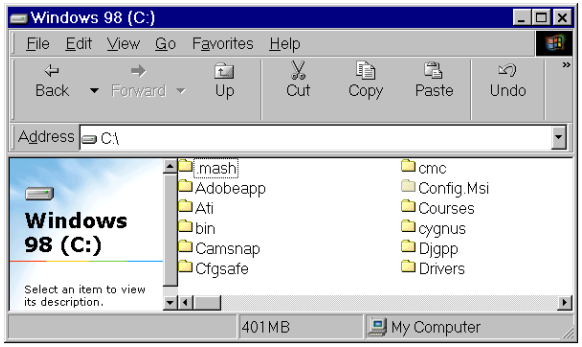



## Word find-and-replace



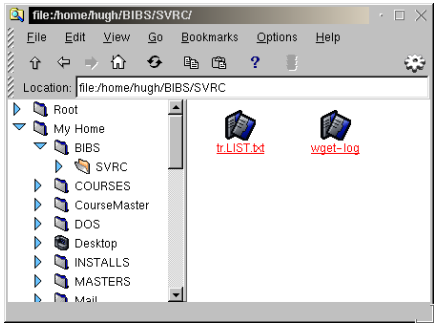



## Win98 file manager

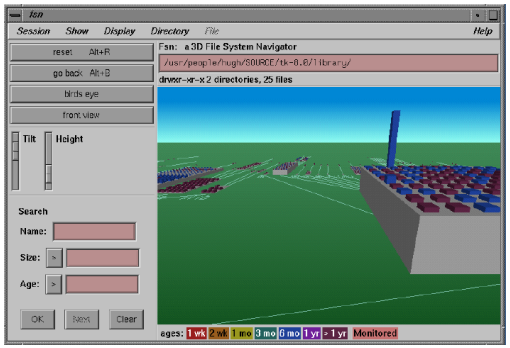





## KDE file manager



## FSN






## Vizualization design

Visualization design has a similar structure to GUI design - a difference being the focus on the use of *analogy*.



## Basis for visualization design

Eick proposes the following guidelines:

1. Focus the visualization on task-specific user needs.
2. Use a whole-database overview display.
3. Encode the data using colour, shape, size, position.
4. Use drill-down, filters and multiple linked views
5. Use smooth animation for time



## Visualization document

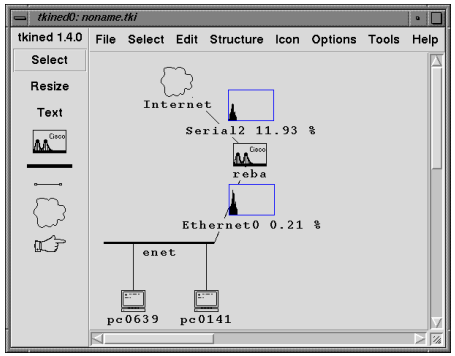
- User requirement
- Environment
  - Software constraints
  - Other constraints
- Interface design
  - Overview
  - Interface description
    - Drill-down and other displays
    - Encoding
- Testing methodologies

## Examples of visualization

There are many examples of data visualizations, and I have just taken some from the world of network management - starting from simple graphical displays through to 3D images.

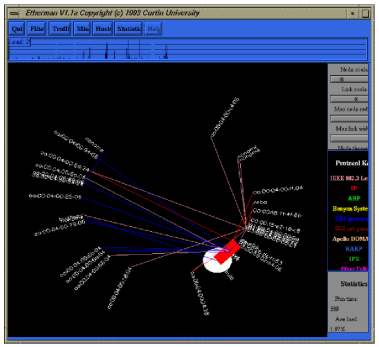


## Graphs and diagramming



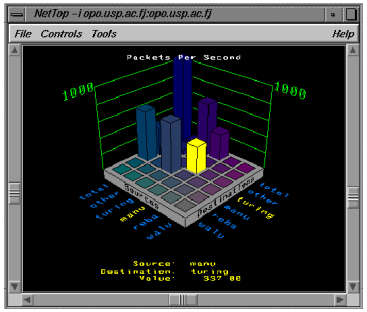



## Compact visualization

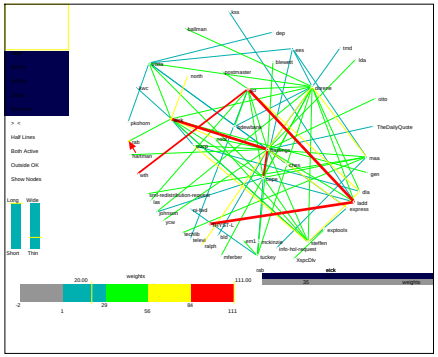




## 3D graph

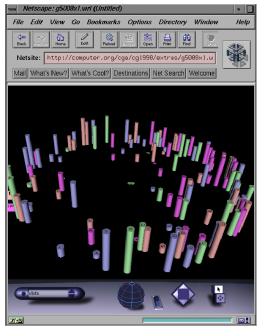


## Abstract 3D view - SeeNet



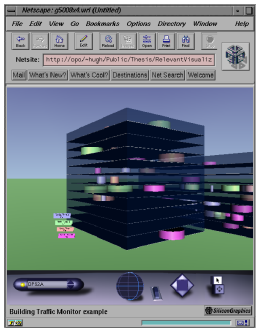


## Abstract 3D view - Flodar





## 3D world-view






## Summary of topics

In this module, we introduced the following topics:

- The designer's mindset
- Specification and design, tools and methods
- Examples of successful designs