New tools for modeling for HCI evaluation

Bonnie E. John

Konstantine (Gus) Prevas

ACT-R Workshop 26jul03

Acknowledgements

- ONR
  - Bonnie John, CMU
  - Rick Lewis, University of Michigan
  - Mike Matessa, Roger Remington, Alonso Vera, NASA Ames
  - Ken Koedinger, Gus Prevas, & colleagues, CMU
- General Motors
  - Bonnie John, Gus Prevas, CMU
- Dario Salvucci & Frank Lee, ACT-Simple

New Tools for Modeling for *HCI Evaluation*

- *NOT* tools for *cognitive modeling*
  - Targeted at HCI evaluation models, like GOMS or KLM
- *NOT* tools for *cognitive modelers*
  - UI designers are the target audience
- But you may want to use these tools for your work or teaching, which is why I'm presenting them here

Some History

- NASA-sponsored Masters of HCI project two years ago identified 5 areas that made cognitive modeling hard (3 of which I remember)
  - Understanding what a complex model is doing and why

    Trace tool prototypes, Summer 2001
  - Building and maintaining an understanding of what the modeling community is doing

    Community website for Apex, Summer 2001
  - Building the "world" that the model interacts with

    Dreamweaver-based WorldBuilder for Apex, Summer 2002, Apex Tutorial CogSci 2002

Our user group: UI designers

- Often do not know how to program, nor do they want to
- Do not know how to build a model, nor do they want to (too much like programming???)
- So the cost must be low and the benefit high, for them to adopt predictive cognitive modeling as a UI design tool

UI designers

- Often use html to create an interactive storyboard of their ideas
- Are comfortable using commercially-available WYSIWYG html tools like DreamWeaver or GoLive.

So… knowing our users…

Our goals are to

1. Remove any activity that hints at programming
2. Exploit the use of html tools
3. Quickly produce useful, valid predictive models

1. Remove any activity that hints at programming

- Use drag-and-drop to build the world
- Use demonstration to build the model

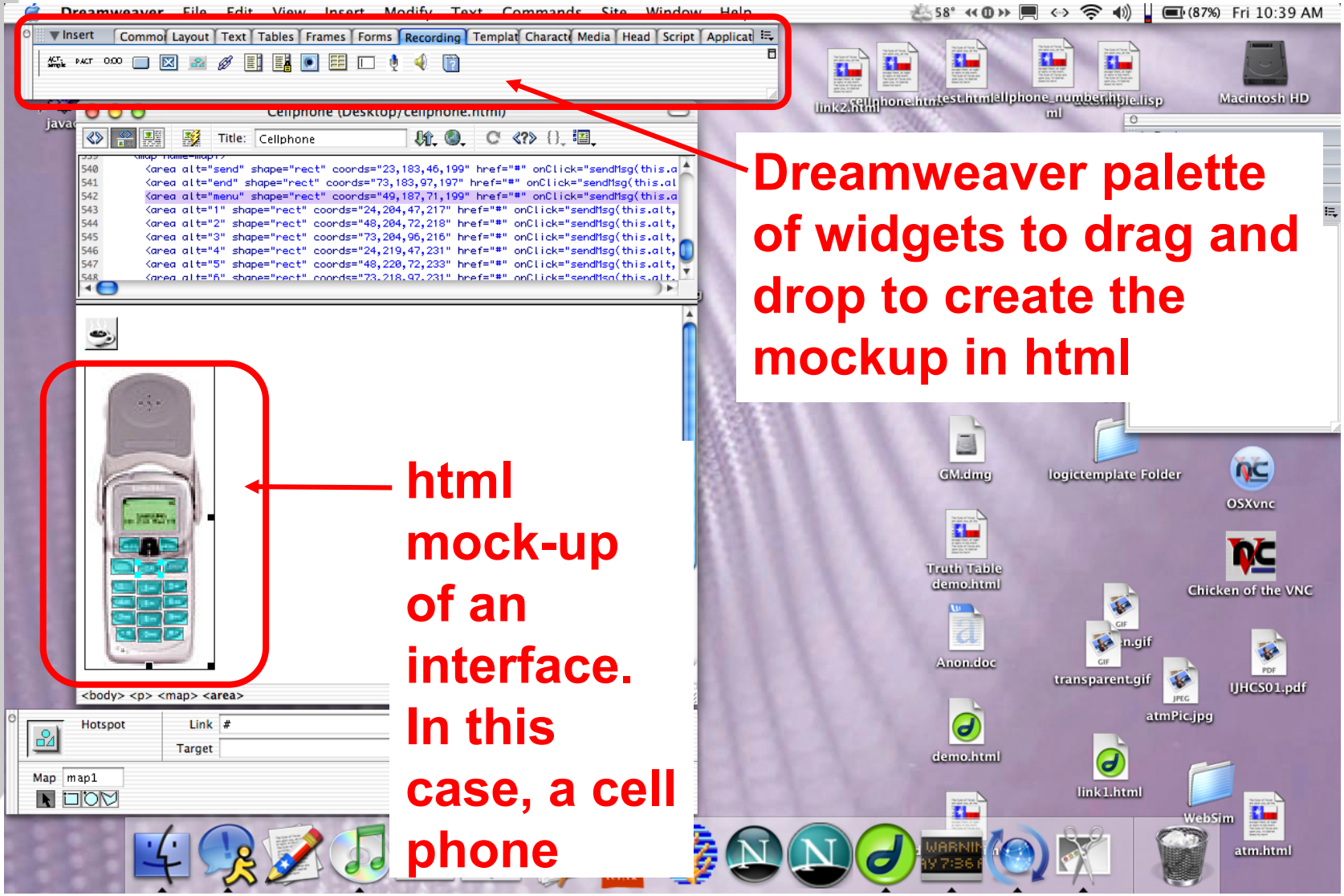
2. Exploit the use of html tools

- Extend Macromedia DreamWeaver to include a special widget palette
  - Build any html storyboard with this palette
- When a human demonstrates a task using these widgets, (as UI designers already do to demonstrate their ideas to others), the actions are recorded
- The actions are post-processed to construct a cognitive model

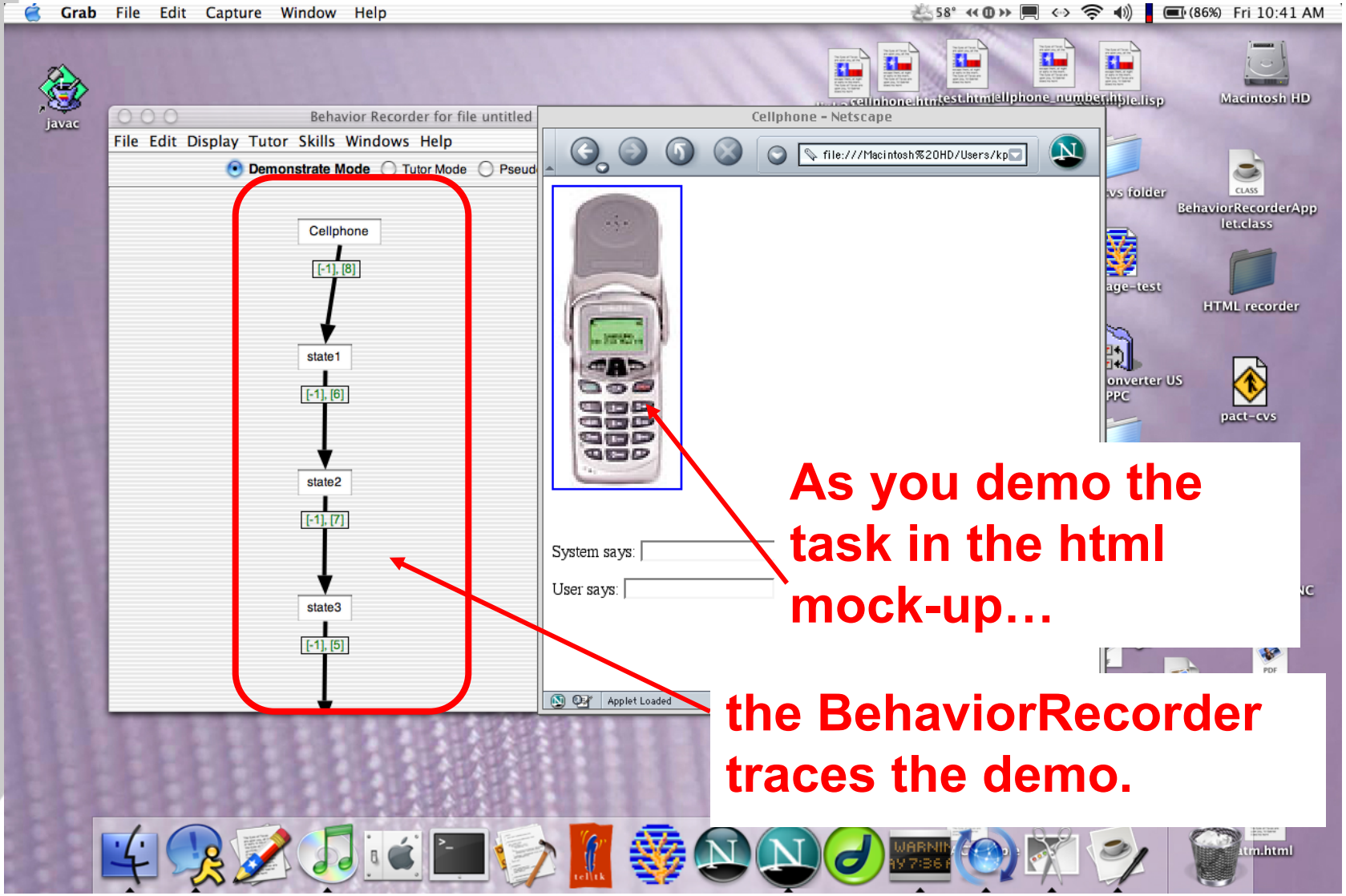
3. Quickly produce useful, valid predictive models

- Focus on models that have been successfully used (though painstakingly constructed) in HCI in the past:
  - GOMS, KLM, CPM-GOMS
  - Inherit their usefulness, validity
  - Predict performance time (initially)
- ACT-Simple is a KLM-like language that compiles into ACT-RPM productions (Salvucci & Lee, 2003)

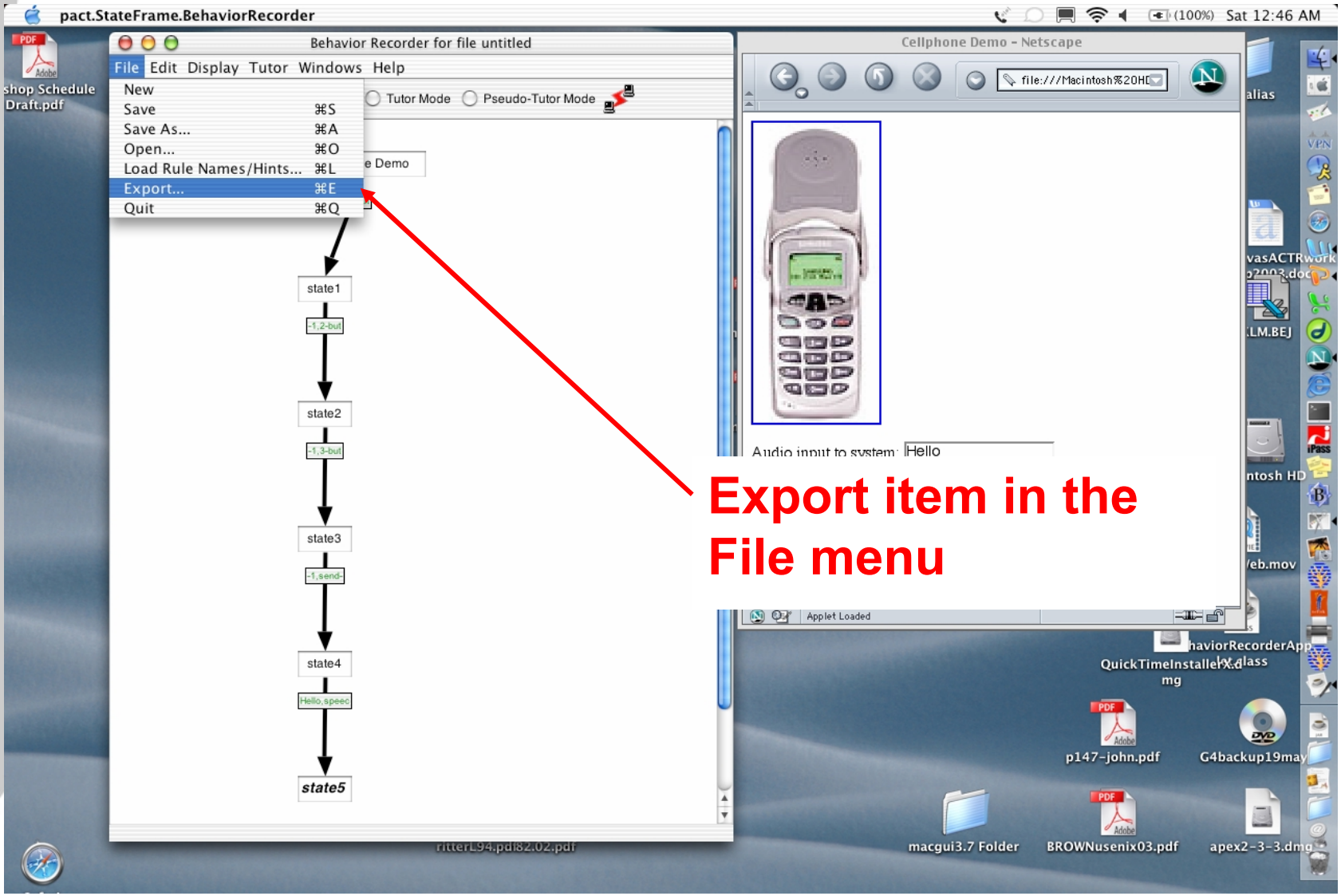
DreamWeaver Extensions



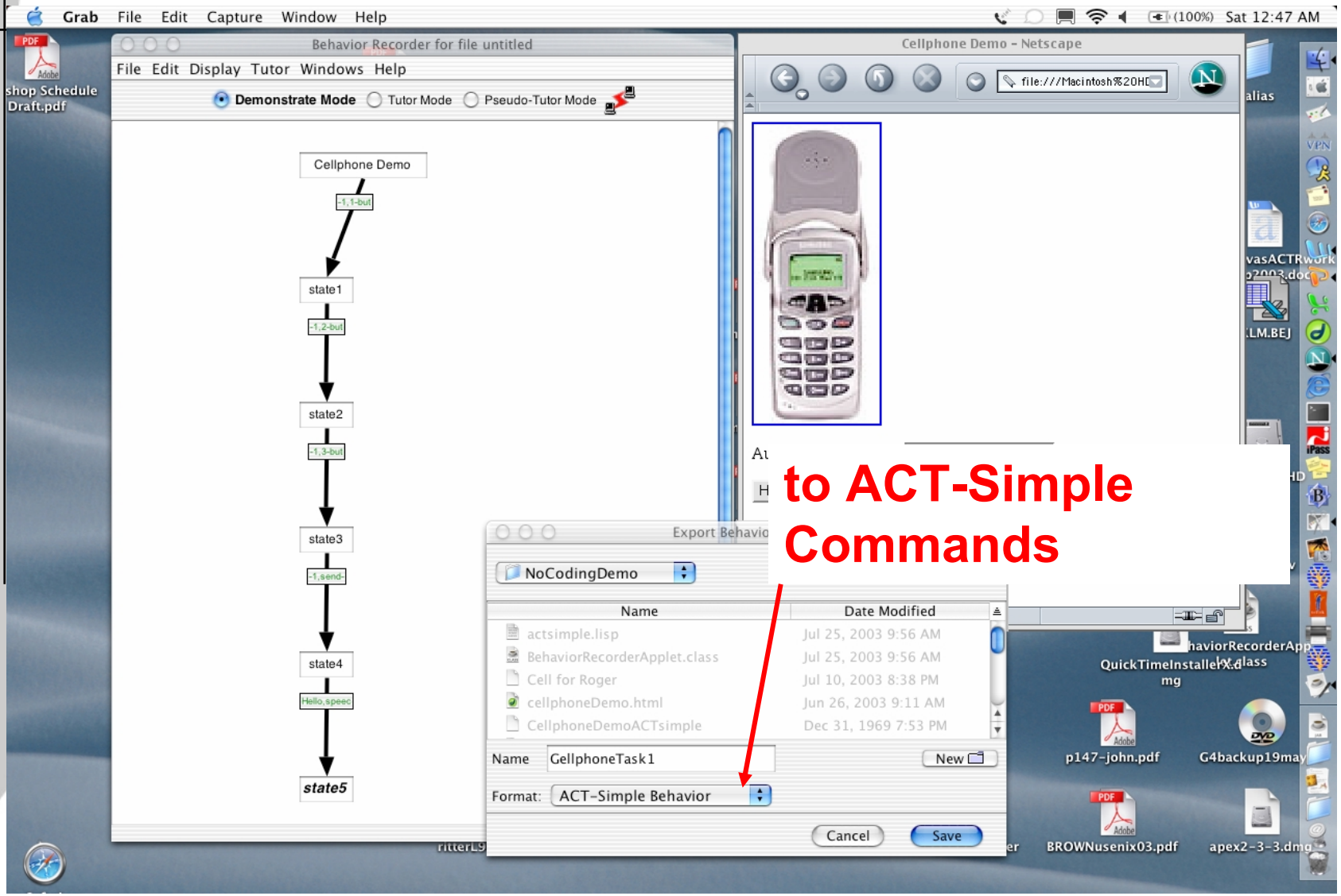
Demonstrate a task



Export to ACT-Simple



Export to ACT-Simple



ACT-Simple code resulting from demonstration

```
(klm-p klm (klm-goal klm
(look-at "1-button")
(move-mouse "1-button")
(click-mouse)
(look-at "2-button")
(move-mouse "2-button")
(click-mouse)
(look-at "3-button")
(move-mouse "3-button")
(click-mouse)
(look-at "send-button")
(move-mouse "send-button")
(click-mouse)
(speak "hello")
))
(pm-start-hand-at-mouse)
(pm-set-params :output-speech t)
```

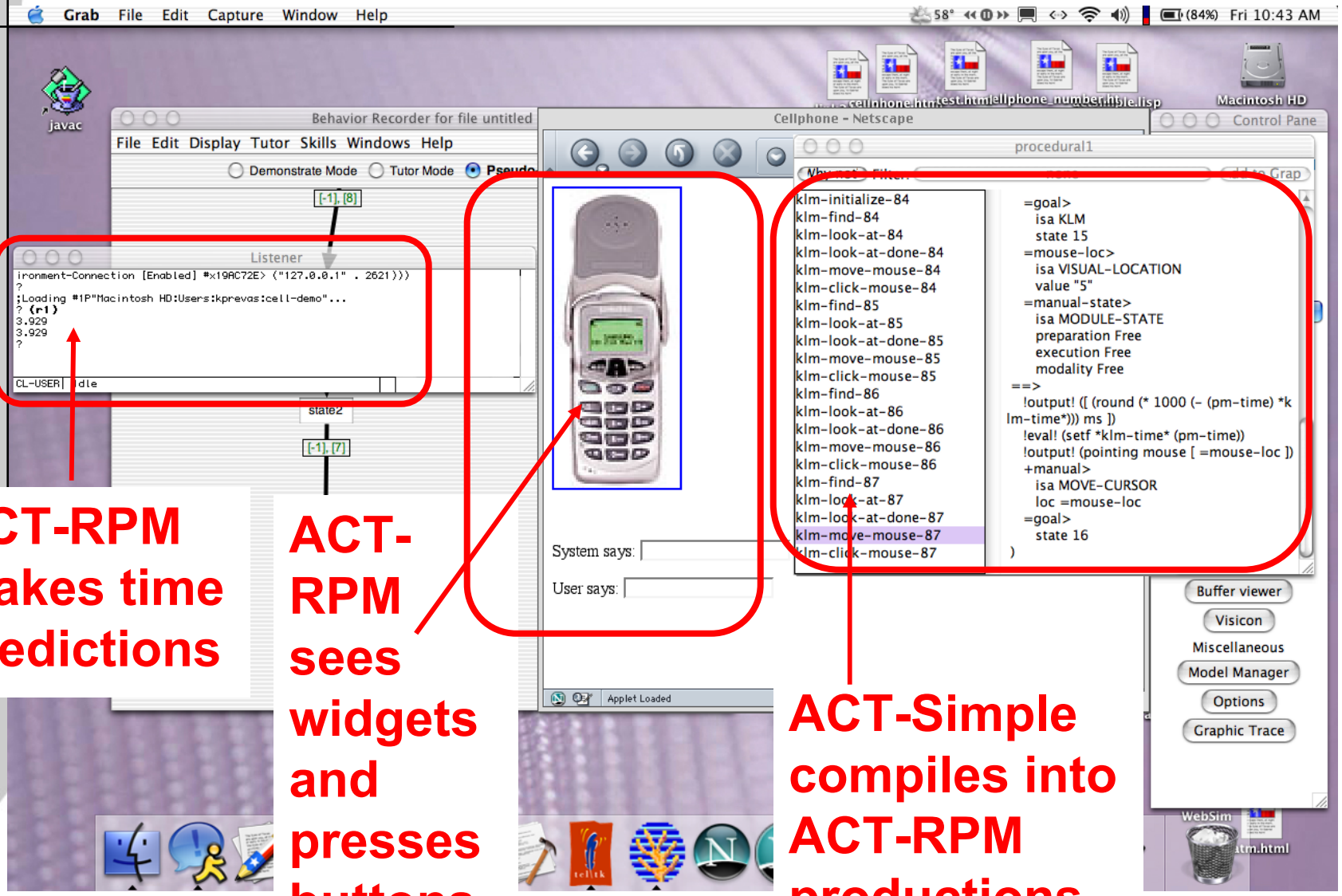
ACT-Simple command set and translation to ACT-RPM

(move-hand [position])
(move-mouse)
(click-mouse)
(press-mouse)
(release-mouse)
(press-key [key])
(speak [string])
(look-at)
(listen [time])
(think [time])

Table 2: Sample translation of (press-key *a*).

```
(p do-task-press-key-102
      =goal>
            isa do-task
            state 1
      =manual-state>
            isa module-state
            modality free
==>
      +manual>
            isa press-key
            key a
      =goal>
            state 2
)
```

Load ACT-Simple into ACT-R and run!



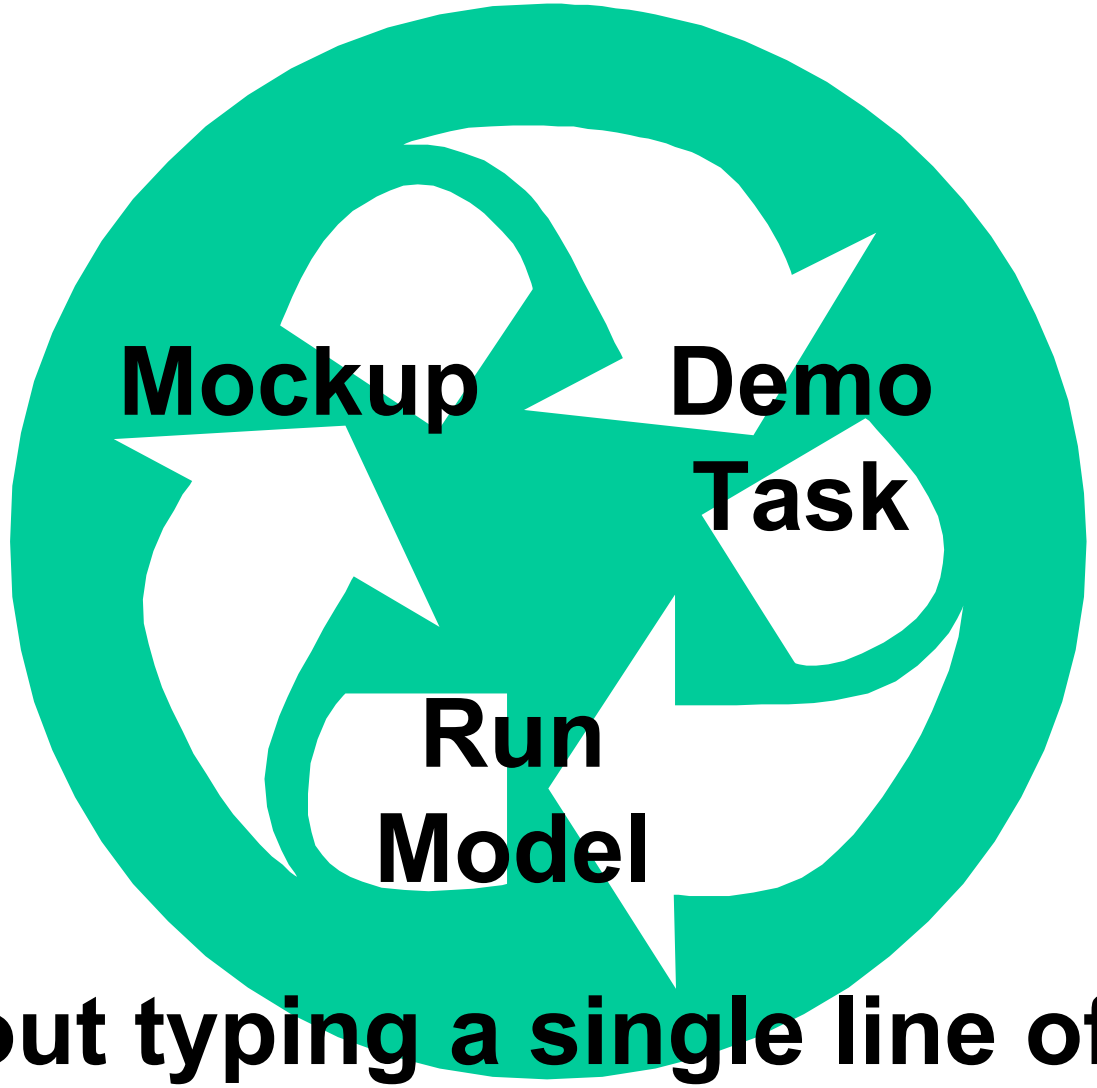
What ACT-RPM "sees" on the html storyboard

Loc	Att	Kind	Value	Color	ID
(16 16)	NIL	WEB-IMAGE	""	BLACK	WIDGET79
(16 704)	NIL	WEB-BUTTON	"Help"	BLACK	WIDGET80
(41 929)	NIL	WEB-BUTTON	"send-button"	BLACK	WIDGET81
(41 952)	T	WEB-BUTTON	"1-button"	BLACK	WIDGET82
(64 953)	T	WEB-BUTTON	"2-button"	BLACK	WIDGET83
(90 952)	NIL	WEB-BUTTON	"3-button"	BLACK	WIDGET84

Each widget also has a size,
so Fitts's Law can be calculated for movement times

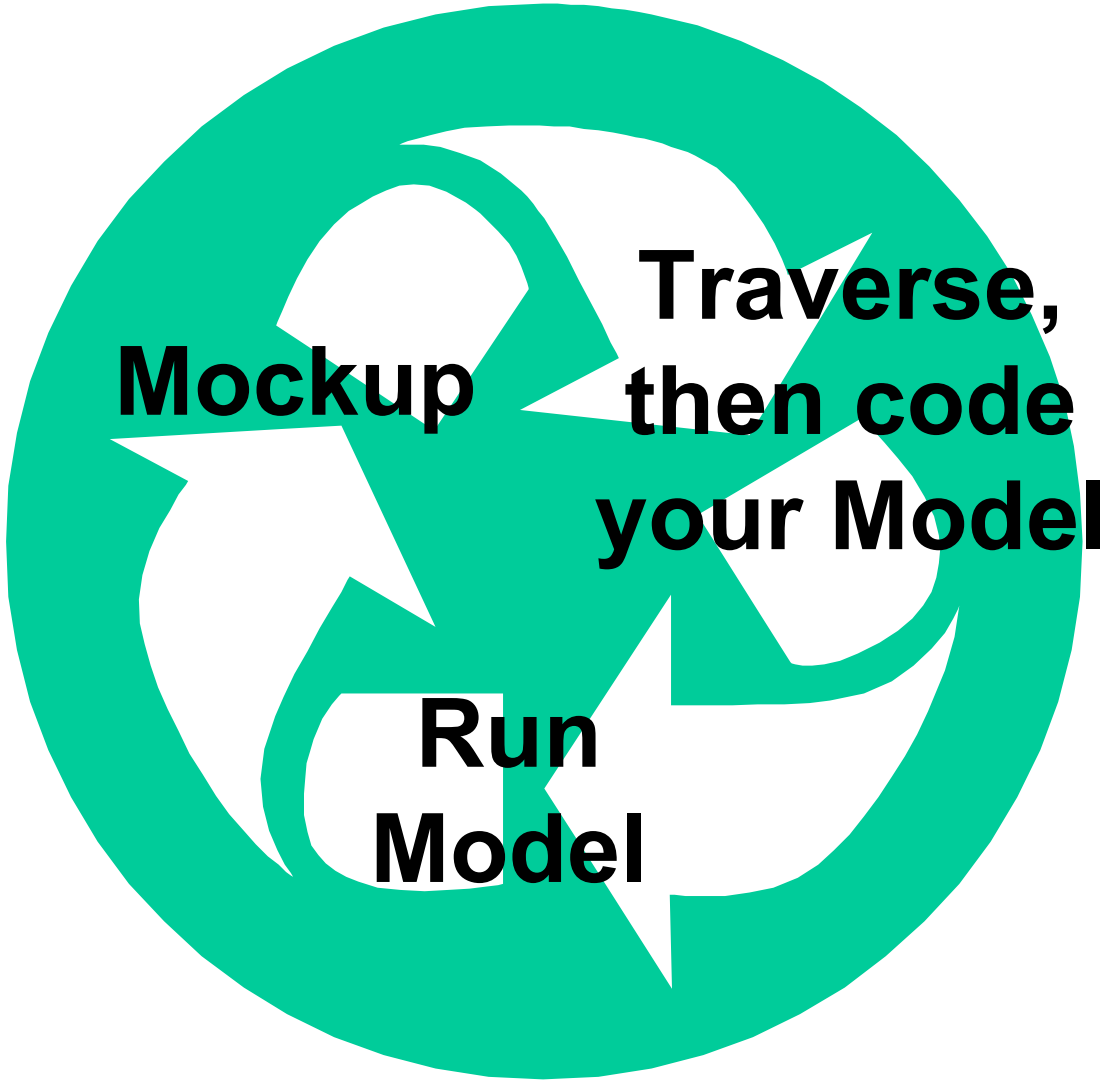
Thanks to Mike Byrne for helping me get ACT-RPM to tell me these things

Summary:
We've Closed the Loop!



Without typing a single line of code

You could open it back up again, if you want a different type of model



What's to come (1)

- Figuring out the relationship between KLM's M operators and ACT-RPM's operations
  - KLM M = 1.35 sec
  - Lot's of ACT-RPM going on in 1.35 sec
    - Look-at
    - Retrieval
    - Verify???
    - Other???
- Automatically placing KLM-like Ms
  - Experience doing this in CRITIQUE (Hudson, John, Knudsen, & Bryne, UIST 99)
  - Use the html widgets to inform the placement

What's to come (2)

- Validating the automatic ACT-Simple models
  - Reproduce published KLM models from the past, e.g., text-editing, CAD, Atropos
- Automatically integrating with Dario Salvucci's driving model
- More widgets, ACT-Simple commands, RPM operators, to simulate other than computer-based devices

What's to come (3)

- Fixing our technical problems
  - Currently exploiting a security hole in Netscape 7.0 for MacOS 9 (ugh)
- Fix our usability problems
  - Widget icons
  - Using too many programs, files, operating systems
  - User testing with UI designers
- Getting it out for others to use

Added bonus

- The same BehaviorRecorder is also a tool for rapid cognitive tutor construction
- So you can tutor on the same tasks you model

…but that's another talk by Ken Koedinger

Want a Demo? See Gus