



RICE

ACT-R AS A USABILITY TOOL FOR BALLOT DESIGN



chil

THE COMPUTER-HUMAN
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ACKNOWLEDGMENTS

- National Science Foundation
 - ACCURATE Center

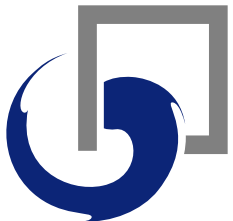


ACCURATE 

The word 'ACCURATE' is written in a bold, black, sans-serif font. To its right is a stylized star logo. The star is composed of two overlapping shapes: a blue one on top and a red one on the bottom, both with white outlines.

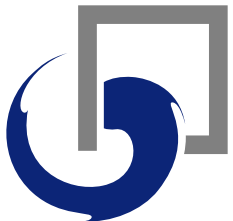
OVERVIEW

- Problem Basics
- Simple Model
- The Sarasota Problem
- Modeling Sarasota
- A Tool for Ballot Design

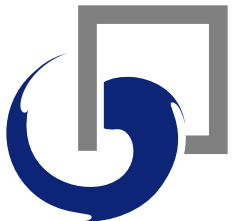
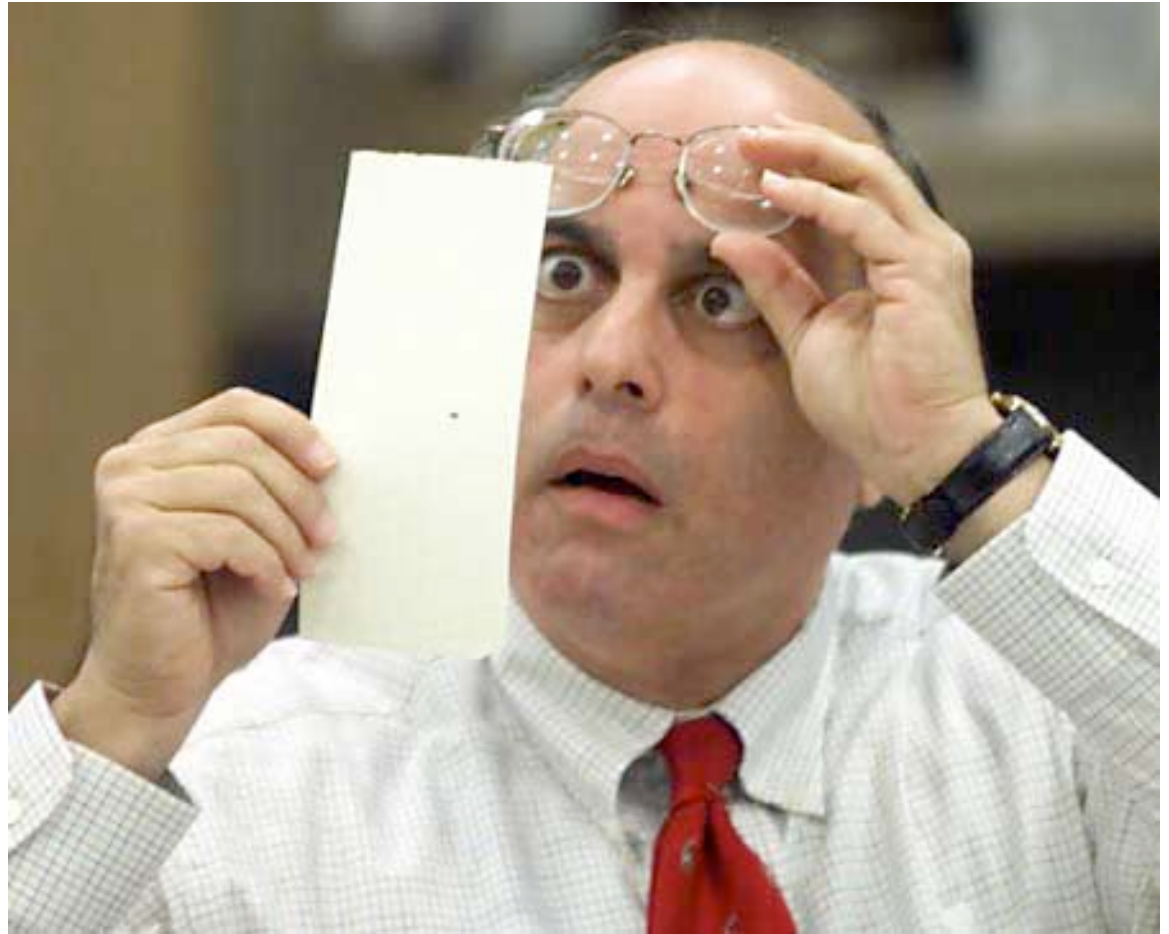


ACT-R COMES OF AGE

- Depending on how you count, ACT-R is somewhere between 19 and 21 years old
- That means the 2012 Presidential election will be the first one in which ACT-R would be eligible to vote
 - Except in Chicago, where it's been voting under the name ACT* for years



THE BACKSTORY: FLORIDA 2000



THE PROBLEM: FLORIDA 2000

Confusion at Palm Beach County polls

Some Al Gore supporters may have mistakenly voted for Pat Buchanan because of the ballot's design.

Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.

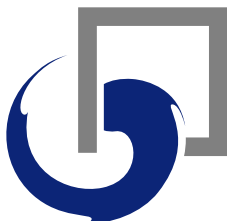
Punching the second hole casts a vote for the Reform party.

ELECTORS FOR PRESIDENT AND VICE PRESIDENT	
(REPUBLICAN)	3→
GEORGE W. BUSH - PRESIDENT DICK CHENEY - VICE PRESIDENT	
(DEMOCRATIC)	5→
AL GORE - PRESIDENT JOE LIEBERMAN - VICE PRESIDENT	
(LIBERTARIAN)	7→
HARRY BROWNE - PRESIDENT ART OLIVIER - VICE PRESIDENT	
(GREEN)	9→
RALPH NADER - PRESIDENT WINONA LA DUKE - VICE PRESIDENT	
(SOCIALIST WORKERS)	11→
JAMES HARRIS - PRESIDENT MARGARET TROWE - VICE PRESIDENT	
(NATURAL LAW)	13→
JOHN HAGELIN - PRESIDENT NAT GOLDBABER - VICE PRESIDENT	

(A vote for the candidates will actually be a vote for their electors.)
(Vote for Group)

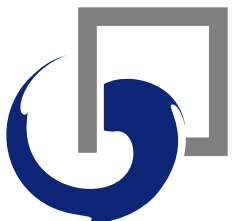
← 4	(REFORM) PAT BUCHANAN - PRESIDENT EZOLA FOSTER - VICE PRESIDENT
← 6	(SOCIALIST) DAVID McREYNOLDS - PRESIDENT MARY CAL HOLLIS - VICE PRESIDENT
← 8	(CONSTITUTION) HOWARD PHILLIPS - PRESIDENT J. CURTIS FRAZIER - VICE PRESIDENT
← 10	(WORKERS WORLD) MONICA MOOREHEAD - PRESIDENT GLORIA LA RIVA - VICE PRESIDENT
WRITE-IN CANDIDATE To vote for a write-in candidate, follow the directions on the long stub of your ballot card.	

Sun-Sentinel graphic

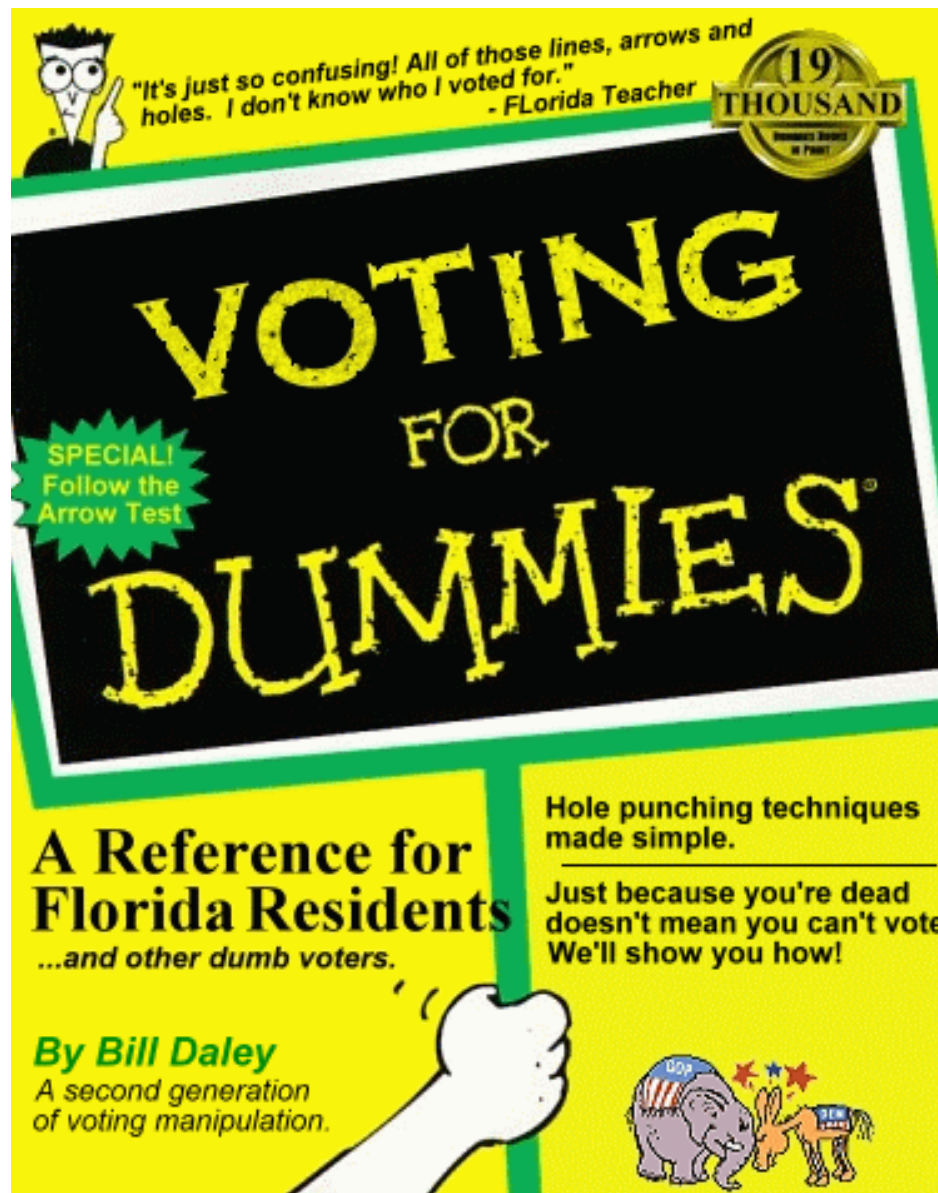


MAYBE VOTERS ARE THE PROBLEM?

Florida is ready for 2004



OH, THOSE VOTERS...



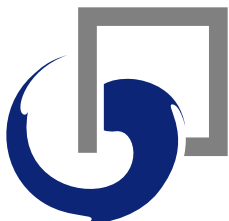
Proposed 2004 Election Ballot For Palm Beach County, Florida

Parties that had no trouble with the 2000 election ballot:

ELECTIONS FOR PRESIDENT AND VICE PRESIDENT (A vote for the candidates will actually be a vote for their electors.) (Vote for Group)	(REPUBLICAN) [presidential candidate] > <input type="text"/> [vice-presidential candidate] <input type="text"/>	(REFORM) [presidential candidate] <input type="text"/> [vice-presidential candidate] <input type="text"/>
	(LIBERTARIAN) [presidential candidate] > <input type="text"/> [vice-presidential candidate] <input type="text"/>	(SOCIALIST) [presidential candidate] <input type="text"/> [vice-presidential candidate] <input type="text"/>
	(GREEN) [presidential candidate] > <input type="text"/> [vice-presidential candidate] <input type="text"/>	(CONSTITUTION) [presidential candidate] <input type="text"/> [vice-presidential candidate] <input type="text"/>
	(SOCIALIST WORKER) [presidential candidate] > <input type="text"/> [vice-presidential candidate] <input type="text"/>	(WORKERS WORLD) [presidential candidate] <input type="text"/> [vice-presidential candidate] <input type="text"/>
	(NATURAL LAW) [presidential candidate] > <input type="text"/> [vice-presidential candidate] <input type="text"/>	WRITE-IN CANDIDATE Follow directions on your ballot stub

Parties that DID have trouble with the 2000 election ballot:

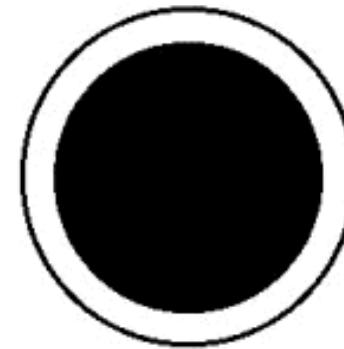
(DEMOCRATIC) [presidential candidate] > <input type="text"/> [vice-presidential candidate] <input type="text"/>
--



OH, THOSE VOTERS...

DEMOCRATIC RECOMMENDATION FOR
FLORIDA BALLOTS FOR THE ELDERLY:

AL GORE:



GEORGE W. BUSH:



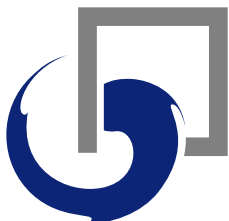
RALPH NADER:



PAT BUCHANAN:



HARRY BROWNE:



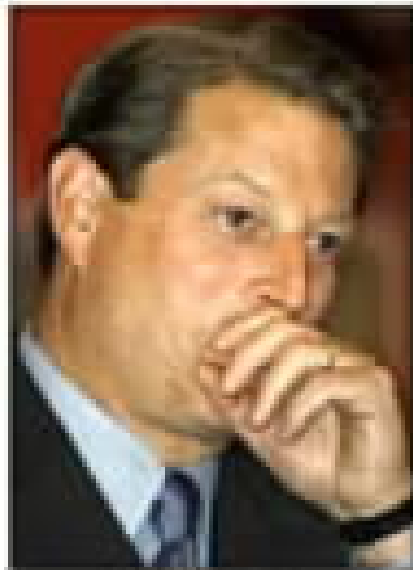
STILL MORE “SOLUTIONS”

Revised Florida Presidential Ballot

Directions: Using the provided crayon, please circle the picture of the person you want to vote for.

Please circle only one person.

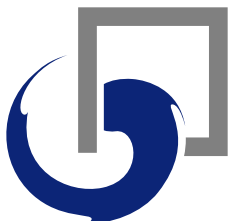
A circle looks like 



Al Gore



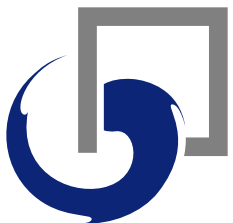
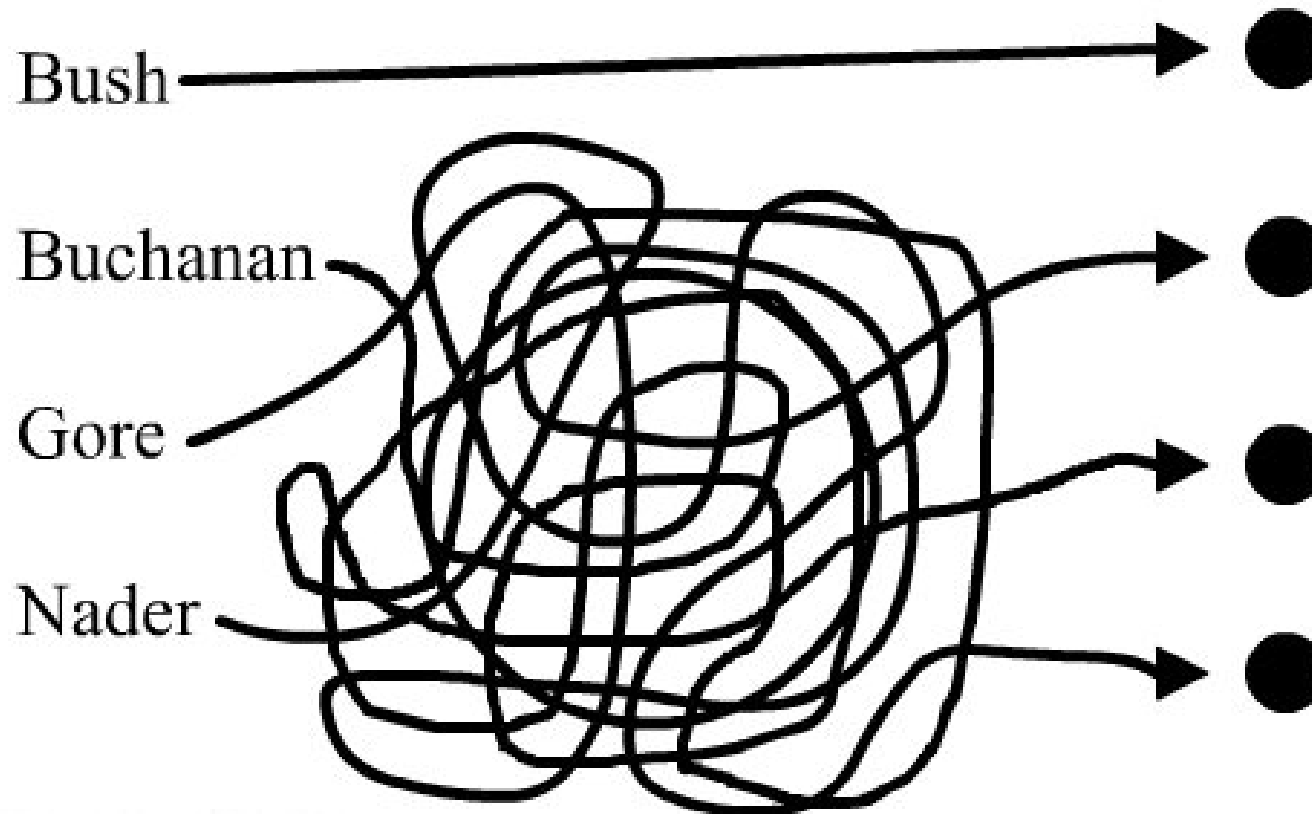
George Bush



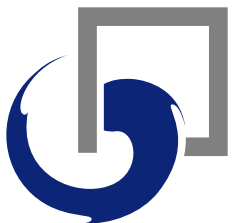
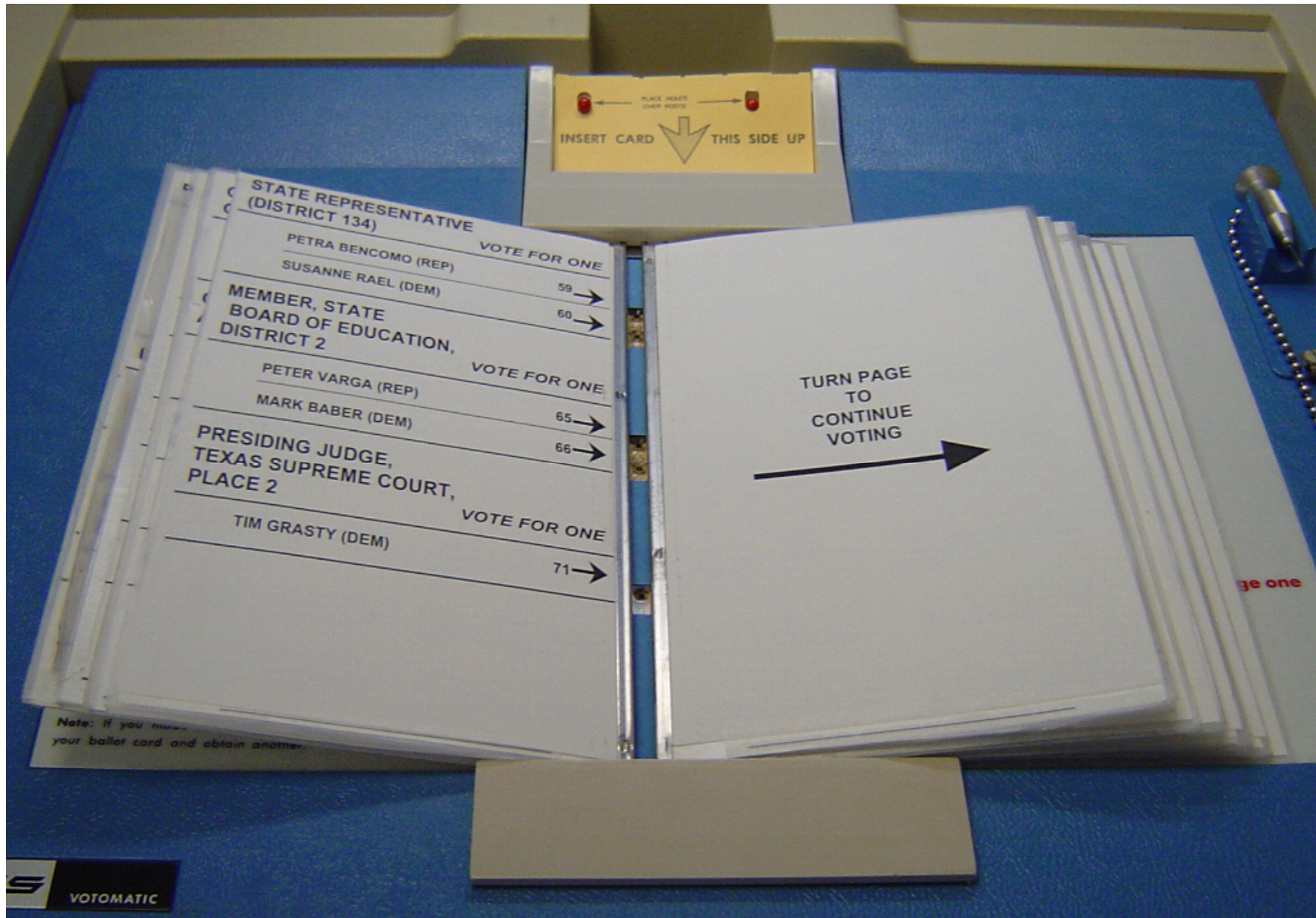
OR MAYBE NOT?

Official Florida Presidential Ballot

Follow the arrow and Punch the appropriate dot.

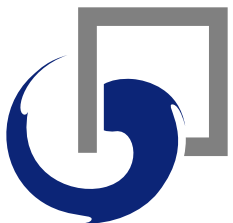


PUNCH CARD UI IN REAL LIFE



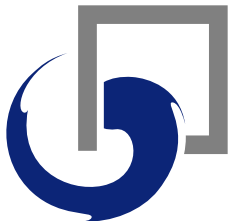
THE USABILITY PROBLEM

- Despite demonstrable security vulnerabilities
 - There is no evidence that the outcome of any election has ever been decided by computer hackers
 - Not that there would be
- However, there **is** clear evidence that elections have been decided by usability failures
 - Florida 2000 is only one of many examples
 - Multiple “epic failures” have been documented
 - Personal favorite: Sarasota in 2006, which we’ll get back to



MODELING VOTING

- Not worried about the decision about who to vote for
 - That's a Political Science problem
- A simpler problem:
 - How do people fill out the ballot?
- Turns out even for this simple problem, the strategy space is substantial:
 - Recall candidate name and search for that
 - Read list of candidates and rely on recognition
 - Use of parties
- It's almost certain that individual voters vary their strategies within a single ballot



STEP 1
Read Instructions

You are now on
STEP 2
Make your choices

STEP 3
Review your choices

STEP 4
Record your vote

President and Vice President of the United States

To make your choice, click on the candidate's name or on the box next to his/her name. A green checkmark will appear next to your choice. If you want to change your choice, just click on a different candidate or box.

President and Vice President of the United States <i>(You may vote for one)</i>	
<input type="checkbox"/> Gordon Bearce Nathan Maclean	REP
<input type="checkbox"/> Vernon Stanley Albury Richard Rigby	DEM
<input type="checkbox"/> Janette Froman Chris Aponte	LIB

Click to go back to instructions

← Previous Page

Click to go foward to next race

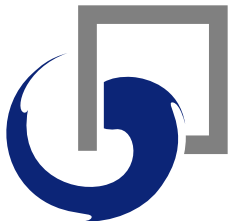
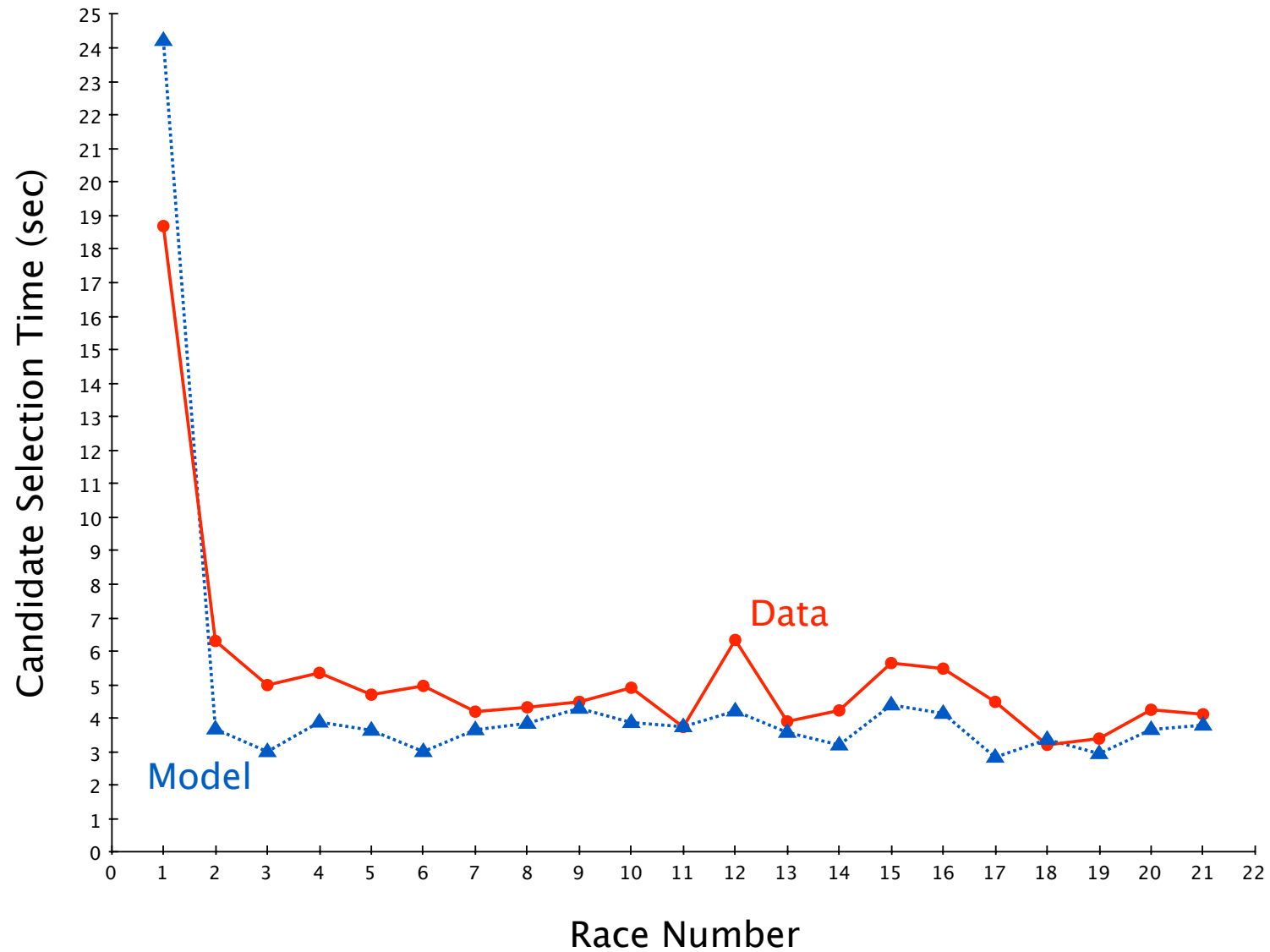
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SIMPLE MODEL

- This model
 - Semi-random visual scan of candidates/parties
 - Relies primarily on recognition of candidate names, but may also use parties
- Demo time!
- Interesting side note
 - Model and voting UI implemented originally in MCL, but now running that code under ClozureCL/Cocoa
 - Expect the release of a device for ClozureCL/Cocoa end of summer
 - ❖ Including libraries to enable running old MCL code

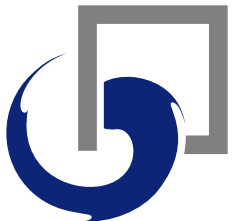


BASIC VOTING MODEL



THE SARASOTA PROBLEM

- 2006 Congressional Election
- At the time, the most expensive non-presidential election ever



OFFICIAL GENERAL ELECTION BALLOT
SARASOTA COUNTY, FLORIDA
NOVEMBER 7, 2006

CONGRESSIONAL

UNITED STATES SENATOR
(Vote for One)

Katherine Harris	REP	<input type="checkbox"/>
Bill Nelson	DEM	<input type="checkbox"/>
Floyd Ray Frazier	NPA	<input type="checkbox"/>
Belinda Noah	NPA	<input type="checkbox"/>
Brian Moore	NPA	<input type="checkbox"/>
Roy Tanner	NPA	<input type="checkbox"/>
Write-In		<input type="checkbox"/>

U.S. REPRESENTATIVE IN CONGRESS
13TH CONGRESSIONAL DISTRICT
(Vote for One)

Vern Buchanan

REP

☐

Christine Jennings

DEM

☐

STATE

GOVERNOR AND LIEUTENANT GOVERNOR
(Vote for One)

Charlie Crist

REP

☐

Jeff Kottkamp

Jim Davis

DEM

☐

Daryl L. Jones

Max Linn

REF

☐

Tom Macklin

Richard Paul Dembinsky

NPA

☐

Dr. Joe Smith

John Wayne Smith

NPA

☐

James J. Kearney

Karl C.C. Behm

NPA

☐

Carol Castagnero

Write-In

☐

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ERRORS IN SARASOTA

- Not the most subtle problem ever, but missed by election officials
- So, how many votes in Sarasota were really lost?
 - “Residual vote” rate was approximately 14%
 - 18,413 votes lost. Margin of victory was 369 votes!
- What are residual votes?
 - Any difference between the number of voters who show up in the polls and the total votes cast in a race
 - Long-standing “coin of the realm” in Political Science
- Problematic measure, yes, but strong indicator of a problem
 - Rate for absentee ballots and in other counties in district was more like 2.5%



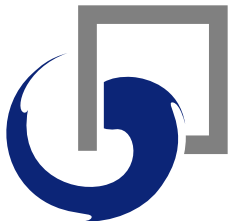
SO WHAT HAPPENED?

- The \$64million question: **Why** did voters miss it?
- Conducted an experiment that examined:
 - Highlighting of race headers
 - ❖ No effect!
 - Number of races on the first screen
 - ❖ Two races on first screen: 11% initial omission rate
 - ❖ Single race on first screen: 30% initial omission rate
 - Note that most subjects self-corrected
 - ❖ In the actual election, most probably didn't because of *intentional* ~200 ms lag in touchscreen response
- But what's the mechanism?



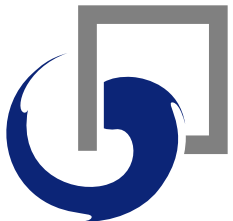
MODELING SARASOTA

- Model uses experience with initial screen to set expectations:
 - When it's time to go to the next screen
 - ❖ That is, after making one selection
 - Where to look for things
 - ❖ Why start at the top if the top is just header stuff?
- Demo #2 (if time)



THE GENERAL PROBLEM

- This was a useful exercise; however
 - We won't significantly impact the problem with one-off post-hoc analyses
 - Nor will 3,000 county clerks will ever become HF experts
- Need a tool that can automatically evaluate ballot layouts and identify potential problems
- Sounds like a job for a model!
- What would the model look like?



BALLOT LAYOUT TOOL

- Need a way to make ballots visible to ACT-R
- Cover the strategy space
 - Cognitive strategies for candidate choice
 - Visual search strategies
 - Navigation strategies
- Cover the candidate choice space
 - Use polling to estimate proportions (don't have to be perfect)
- Develop expectations based on experience with the ballot
- Need substantial Monte Carlo simulation across that space
- Challenging but would be a big win
 - Many potential applications outside of voting, too



QUESTIONS?

