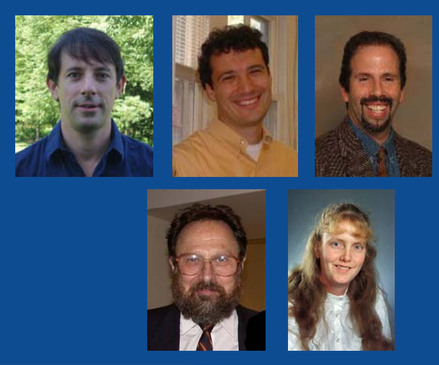
Collaborative Research: CT

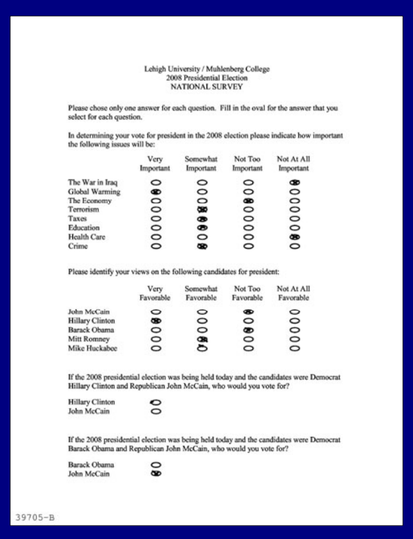
Following the Paper Trail: Reliable Processing of Voting Records for Trustworthy Elections

Daniel Lopresti, Ziad Munson, Christopher Borick, George Nagy, Elisa Barney Smith



Paper, in the form of hand- or machine-marked ballots, can play a fundamental role in guaranteeing safe and secure elections. The processing of such records raises its own set of issues, however, which span broad technical and social boundaries. Our work is aimed at making paper less of a nuisance and more of an integral component in election systems.

User Studies



Lehigh University / Muhlenberg College
2008 Presidential Election
NATIONAL SURVEY

Please chose only one answer for each question. Fill in the oval for the answer that you select for each question.

In determining your vote for president in the 2008 election please indicate how important the following issues will be:

	Very Important	Somewhat Important	Not Too Important	Not At All Important
The War in Iraq	○	○	○	●
Global Warming	●	○	○	○
The Economy	○	○	●	○
Terrorism	○	●	○	○
Taxes	○	○	○	○
Education	○	●	○	○
Health Care	○	○	○	●
Crime	○	●	○	○

Please identify your views on the following candidates for president:

	Very Favorable	Somewhat Favorable	Not Too Favorable	Not At All Favorable
John McCain	○	○	●	○
Hillary Clinton	●	○	○	○
Barack Obama	○	○	●	○
Mitt Romney	○	●	○	○
Mike Huckabee	○	○	○	○

If the 2008 presidential election was being held today and the candidates were Democrat Hillary Clinton and Republican John McCain, who would you vote for?

Hillary Clinton ●
John McCain ○

If the 2008 presidential election was being held today and the candidates were Democrat Barack Obama and Republican John McCain, who would you vote for?

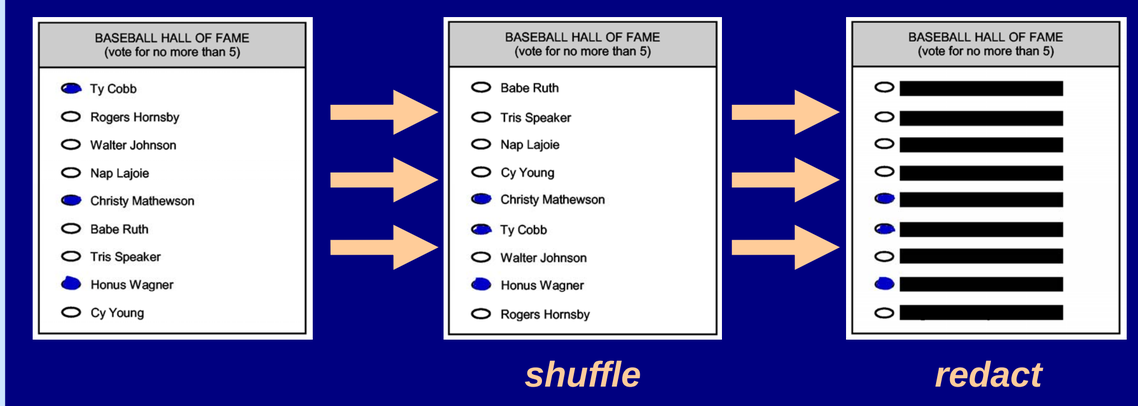
Barack Obama ○
John McCain ●

39705-B

Simulated Lehigh-Muhlenberg 2008 Presidential Election survey. Synthesized using markings that are randomly chosen, placed, and distorted (some intentionally "marginal").

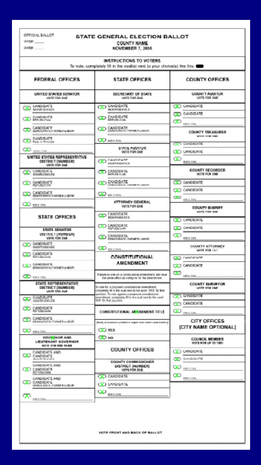
- **Study human bias in hand recounts.**
- **Identify factors that affect voter trust.**

"Blind" Auditing



- **Bias-free method for semi-automating hand recounts of op-scan ballots.**

Mark Characterization



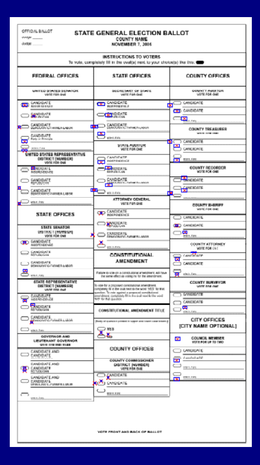
STATE GENERAL ELECTION BALLOT
COUNTY NAME
NOVEMBER 7, 2006

INSTRUCTIONS TO VOTERS

FEDERAL OFFICES | STATE OFFICES | COUNTY OFFICES

Identified locations of voting ovals

Identified locations of voting marks



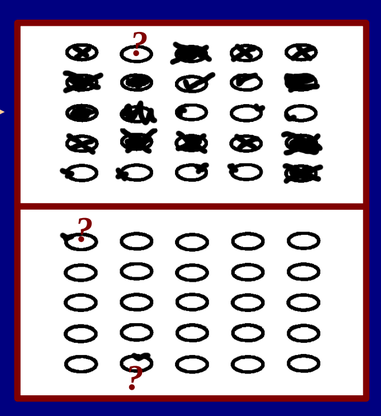
STATE GENERAL ELECTION BALLOT
COUNTY NAME
NOVEMBER 7, 2006

INSTRUCTIONS TO VOTERS

FEDERAL OFFICES | STATE OFFICES | COUNTY OFFICES

- **Ballot mark characterization for consistent op-scan specification, testing, and certification.**

Homogeneous Class Display

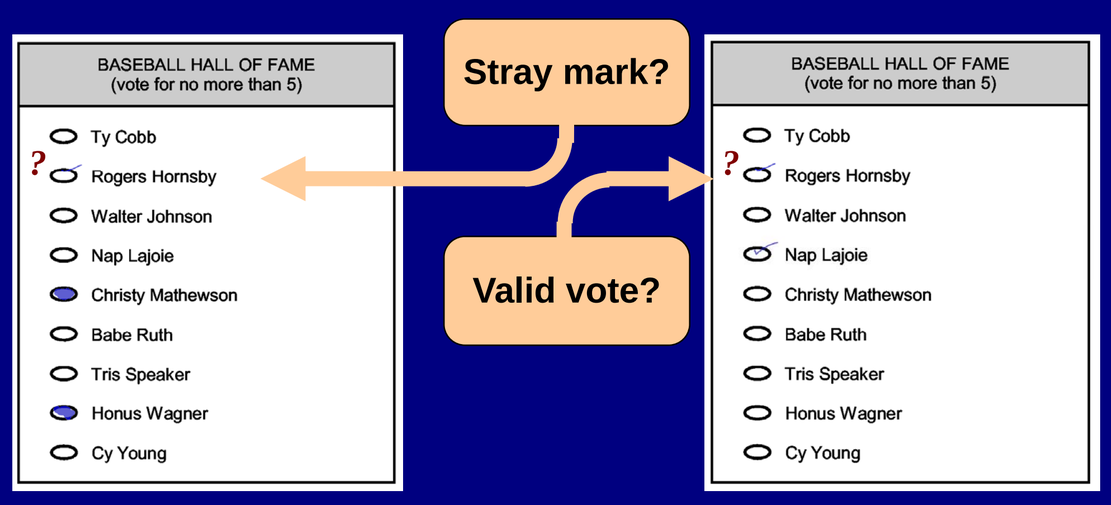


Classified as votes

Classified as non-votes

- **Marks grouped as "vote" or "non-vote" based on software classification.**
- **Makes it easier to identify anomalous results by quick inspection.**

Whole Ballot Recognition



- **Voter intent is better modeled by evaluating all marks on same ballot together (context-sensitivity).**

Any marking is potentially a valid vote. We are analyzing how mark shapes, sizes, and intensities inform the ability of automated systems to locate and identify marks as votes.

Creation of a public database of ballots (marked, classified, ground-truthed) is an essential part of our infrastructure effort.

FROM A LEGAL STANDPOINT, VOTER INTENT IS KEY!

National Science Foundation
WHERE DISCOVERIES BEGIN

NSF Cyber Trust Principal Investigators Meeting
March 16-18, 2008
New Haven, CT

LEHIGH UNIVERSITY
Rensselaer
MUHLENBERG COLLEGE
BOISE STATE UNIVERSITY