Elections, Computer Security, and Electronic Voting

CS 334 Fall 2012

Thanks to
David Wagner,
UC Berkeley
for providing these
slides.

For Delegate to Congress.

FRANCIS GEHON.

For Representatives.

John Houston

L. L. Lothrop

For County Commissioners.

Abner Wolcott

John Morford

For Treasurer.

John Aigins

For Surveyor.

Cyrus Sanders

For Assessor.

L. B. Mulholland

For Coroner.

John Hawkins

For Constable.

John Royal

David Eggers

Thos. F.

A. D. Stephens

REPUBLICAN TICKET.

For Mayor,

M. F. FAIRCHILD.

For City Solicitor,

J. P. DOLLIVER.

For City Assessor,

L. G. SPRING.

For City Treasurer,

BETH VINCENT.

For Councilman—4th Ward,

A. H. JOHNSON.

REPUBLICAN TICKET.

STATE TICKET.

For Governor,
WILLIAM LARRABEE,
Of Fayette County.

For Lieutenant Governor,
JOHN A. T. HULL,
Of Polk County.

For Judge of the Supreme Court,
GIFFORD S. ROBINSON,
Of Buena Vista County.

For Superintendent of Public Instruction,
HENRY SABIN,
Of Clinton County.

County Ticket

For Senator Thirty-sixth District,
J. P. PATRICK.

For Representative Seventieth District,
W. W. GOODWIN.

For Auditor,
JULIUS H. BUHLMAN.

For Treasurer,

For Sheriff,
WILLIAM WELLMAN.

For County Superintendent,
JAMES W. WYATT.

For Supervisor,
PATRICK COSTIGAN.

For Coroner,
L. L. RENSHAW.

For Surveyor,
SANFORD L. PECK.

Township Ticket.

For Trustee,

For Constable,

For Road Supervisor District No.....

10th District.

ADMINISTRATION

UNION TICKET

For Mayor,
CALEB T. FAY

For County Judge,
THOS. W. FREELON

For District Attorney,
CHARLES H. PARKER

For County Clerk,
JOHN A. MONROE

For Sheriff,
THOMAS J. POULTERER

For Recorder, to fill the vacancy for the unexpired term of G. W. Beckh, resigned.
GEORGE B. REEVE

For County Recorder,
GEORGE B. REEVE

For City and County Treasurer,
ASA T. LAWTON

For City and County Assessor,
THOS. D. MATHEWSON

For City and County Surveyor,
REED BIGLER

For Coroner
DR. B. A. SHELDON

For Harbor Master
CAPT. N. PROCTOR SMITH

For Superintendent of Common Schools,
JOHN H. BREWER

For Supervisor.....STEPHEN C. STORY
For School Director.....J. M. BUFFINGTON
Inspector of Election.....J. B. F. DAVIS
Judge of Election.....J. M. KEARNEY

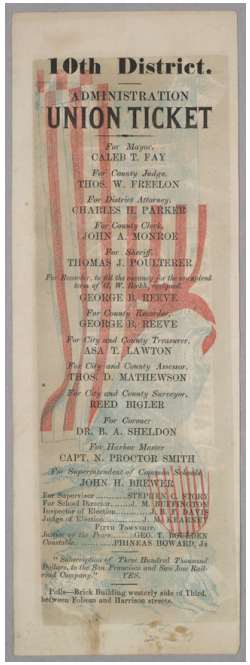
FIFTH TOWNSHIP.

Justice of the Peace.....GEO. T. BOULDEN
Constable.....PHINEAS HOWARD, Jr.

"Subscription of Three Hundred Thousand Dollars, to the San Francisco and San Jose Railroad Company." YES.

Polls—Brick Building westerly side of Third, between Folsom and Harrison streets.

Security Goals for an Election


10th District.

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For Mayor,
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For Coroner
DR. R. A. SHELDON

For Harbor Master
CAPT. N. PROCTOR SMITH

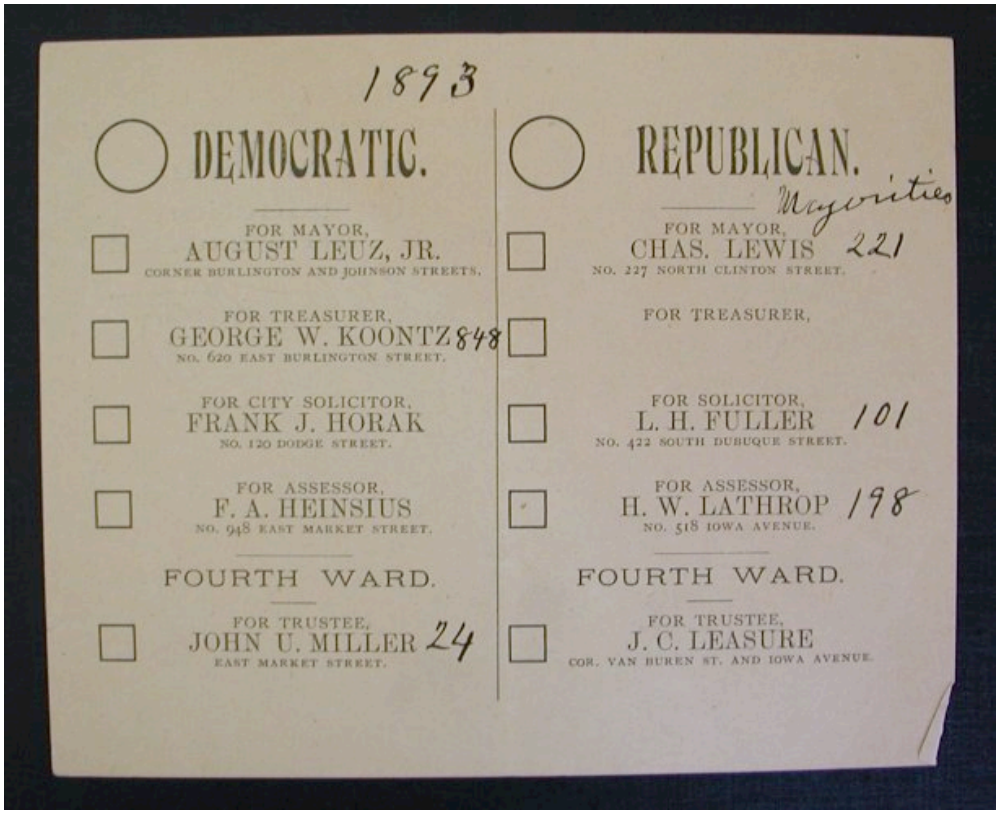
For Superintendent of Common Schools
JOHN H. BREWER

For Supervisor.....STEPHEN C. STORY
For School Director.....M. BRITTINGHAM
Inspector of Election.....A. B. PLATE
Judges of Election.....J. MARKLEY
FIFTH TOWNSHIP.
Justice of the Peace.....GEO. T. BOLDEN
Constable.....PHINEAS HOWARD, Jr.

"Subscription of Three Hundred Thousand Dollars, to the San Francisco and San Jose Railroad Company."
YES.

Polls—Brick Building westerly side of Third, between Folsom and Harrison streets.

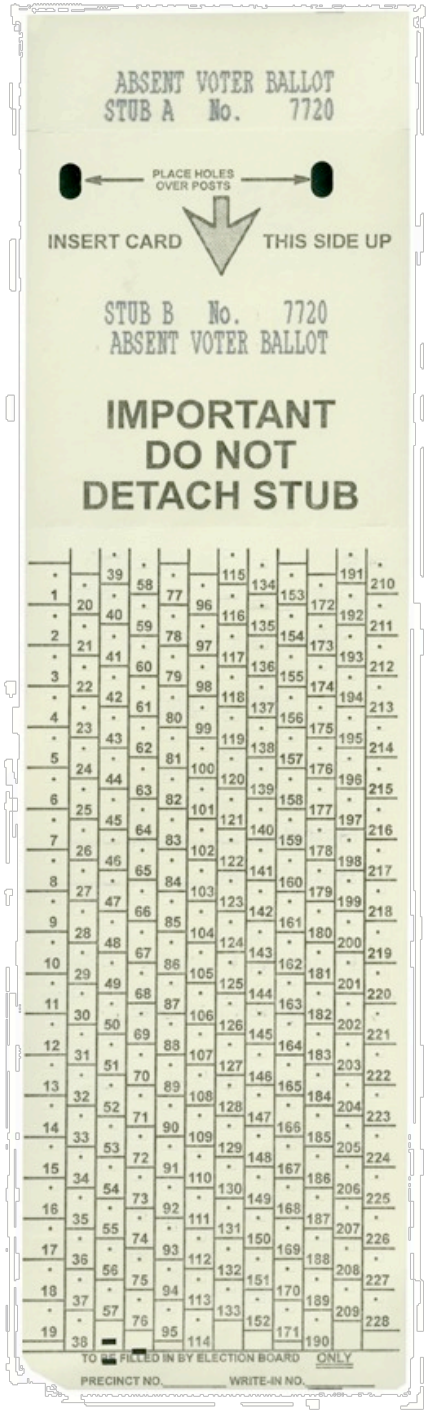
- Integrity: No election fraud
- Transparency: Everyone must be able to verify that the election was conducted appropriately
- Privacy: No one learns how the voter has voted
- Secret ballot: Voter cannot prove how she voted



Breakthrough! — the Australian secret ballot.

Ballot printed by govt. Ballot boxes monitored by observers. Ballots counted, by hand, in public. Competing interests keep each other honest.


OFFICES
HANDICAPPED
ACCESS MACH
ASK AN INSPECTOR FO
ASSISTANCE IN LOWER
THE VOTING PANEL
FOR EASIER ACCESS


ABSENT VOTER BALLOT
STUB A No. 7720

PLACE HOLES OVER POSTS

INSERT CARD THIS SIDE UP

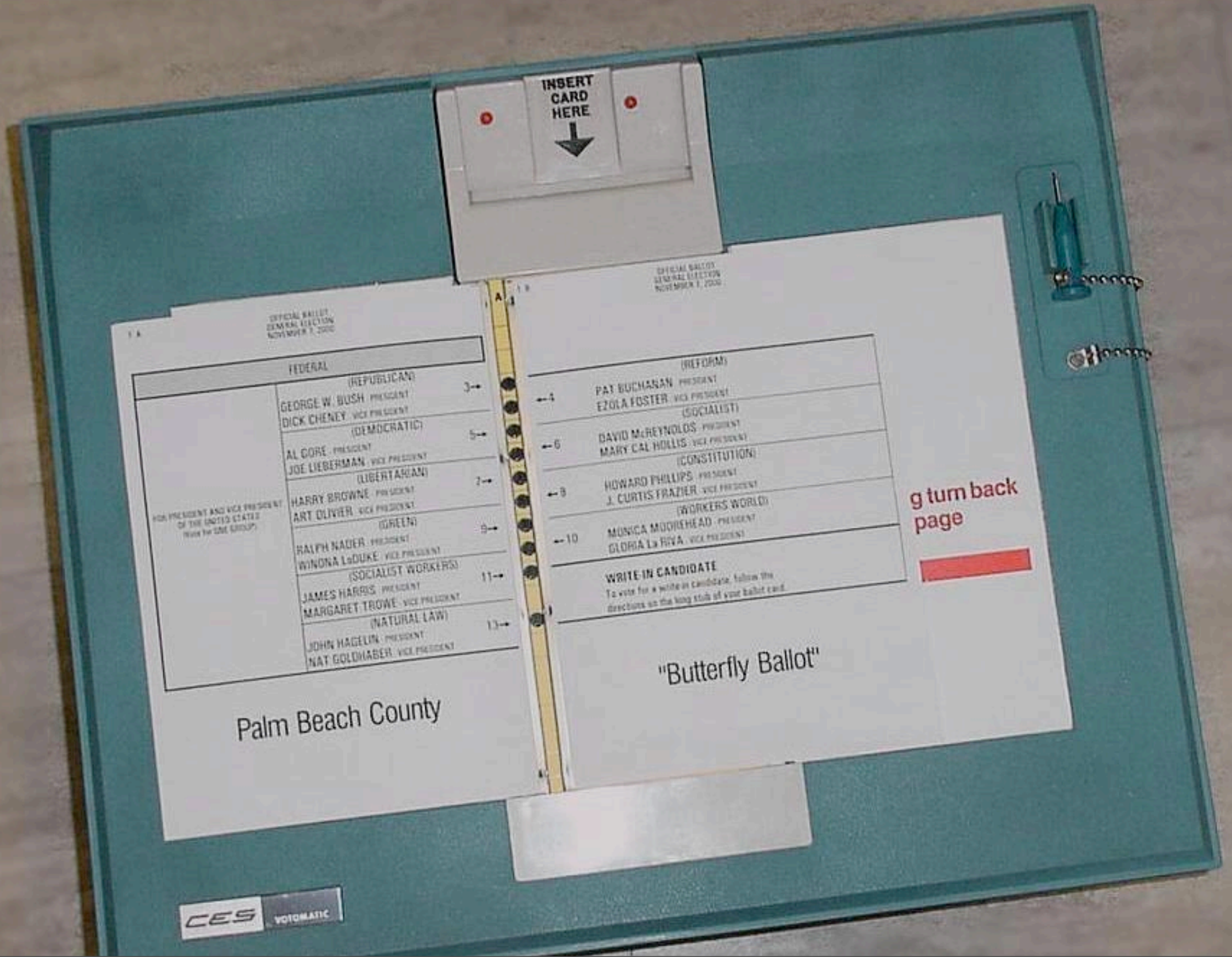
STUB B No. 7720
ABSENT VOTER BALLOT

IMPORTANT
DO NOT
DETACH STUB

TO BE FILLED IN BY ELECTION BOARD ONLY

PRECINCT NO._____ WRITE-IN NO._____


OFFICIAL SELF-SECURED BALLOT CARD
THIS SPACE PROVIDED FOR WRITE-IN VOTES
SEE CARD OF INSTRUCTION FOR SPECIFIC INFORMATION. DUPLICATE BY HAND FOR ADDITIONAL WRITE-IN VOTES.
PLACE HOLES OVER POSTS
INSERT CARD
THIS SIDE UP
5 6 7 8 9 10 11 12
PAGE 4
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
TURN PAGE

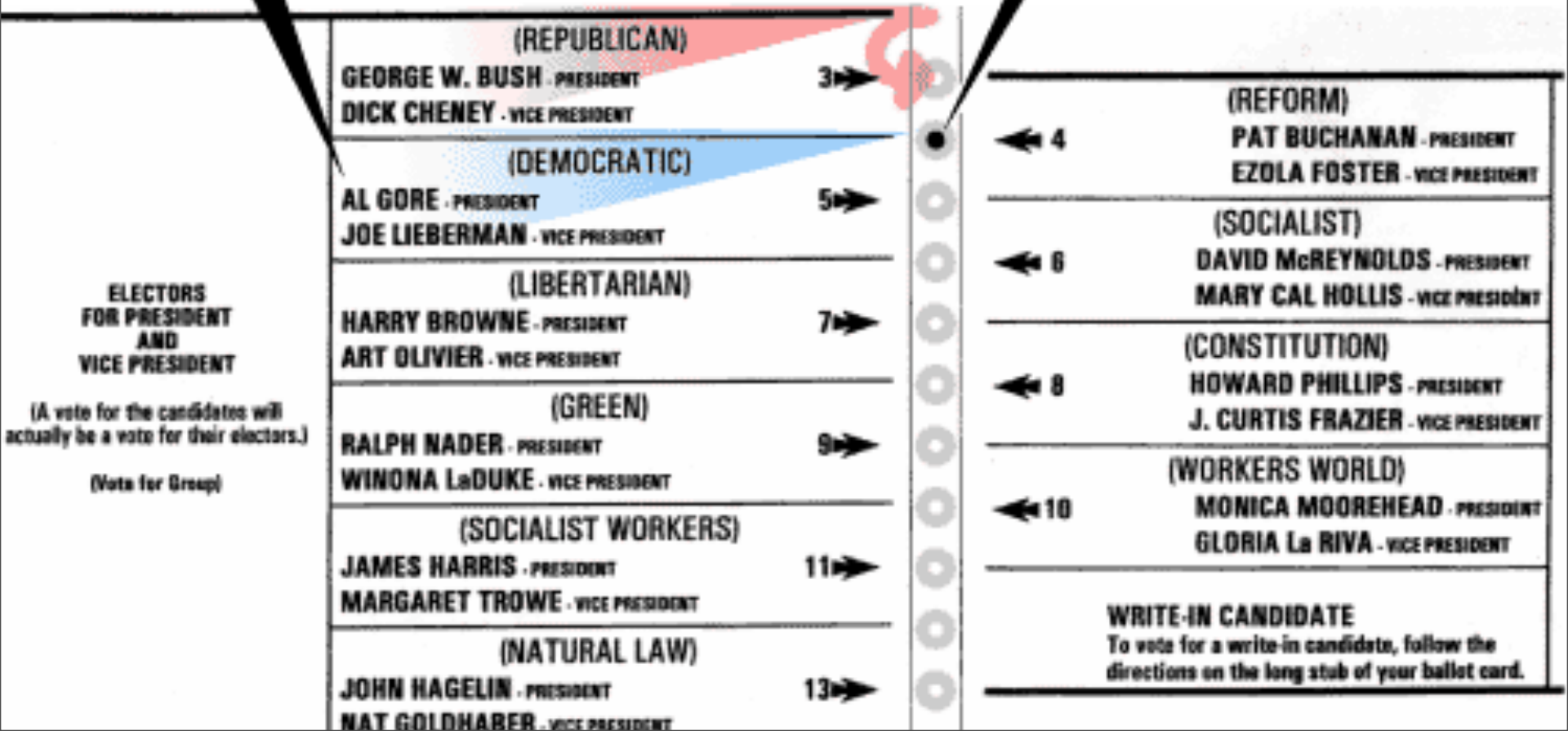

INSERT CARD HERE
FEDERAL
(REPUBLICAN)
GEORGE W. BUSH PRESIDENT
DICK CHENEY VICE PRESIDENT
3
(DEMOCRATIC)
AL GORE PRESIDENT
JOE LIEBERMAN VICE PRESIDENT
5
(LIBERTARIAN)
HARRY BROWNE PRESIDENT
ART OLIVIER VICE PRESIDENT
7
(GREEN)
RALPH NADER PRESIDENT
WINONA LaDUKE VICE PRESIDENT
9
(SOCIALIST WORKERS)
JAMES HARRIS PRESIDENT
MARGARET TROWE VICE PRESIDENT
11
(NATURAL LAW)
JOHN HAGELIN PRESIDENT
NAT GOLDHABER VICE PRESIDENT
13
(REFORM)
4
PAT BUCHANAN PRESIDENT
EZOLA FOSTER VICE PRESIDENT
(SOCIALIST)
6
DAVID McREYNOLDS PRESIDENT
MARY CAL HOLLIS VICE PRESIDENT
(CONSTITUTION)
8
HOWARD PHILLIPS PRESIDENT
J. CURTIS FRAZIER VICE PRESIDENT
(WORKERS WORLD)
10
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.
Palm Beach County
"Butterfly Ballot"
g turn back page
CES
VOTOMATIC

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.

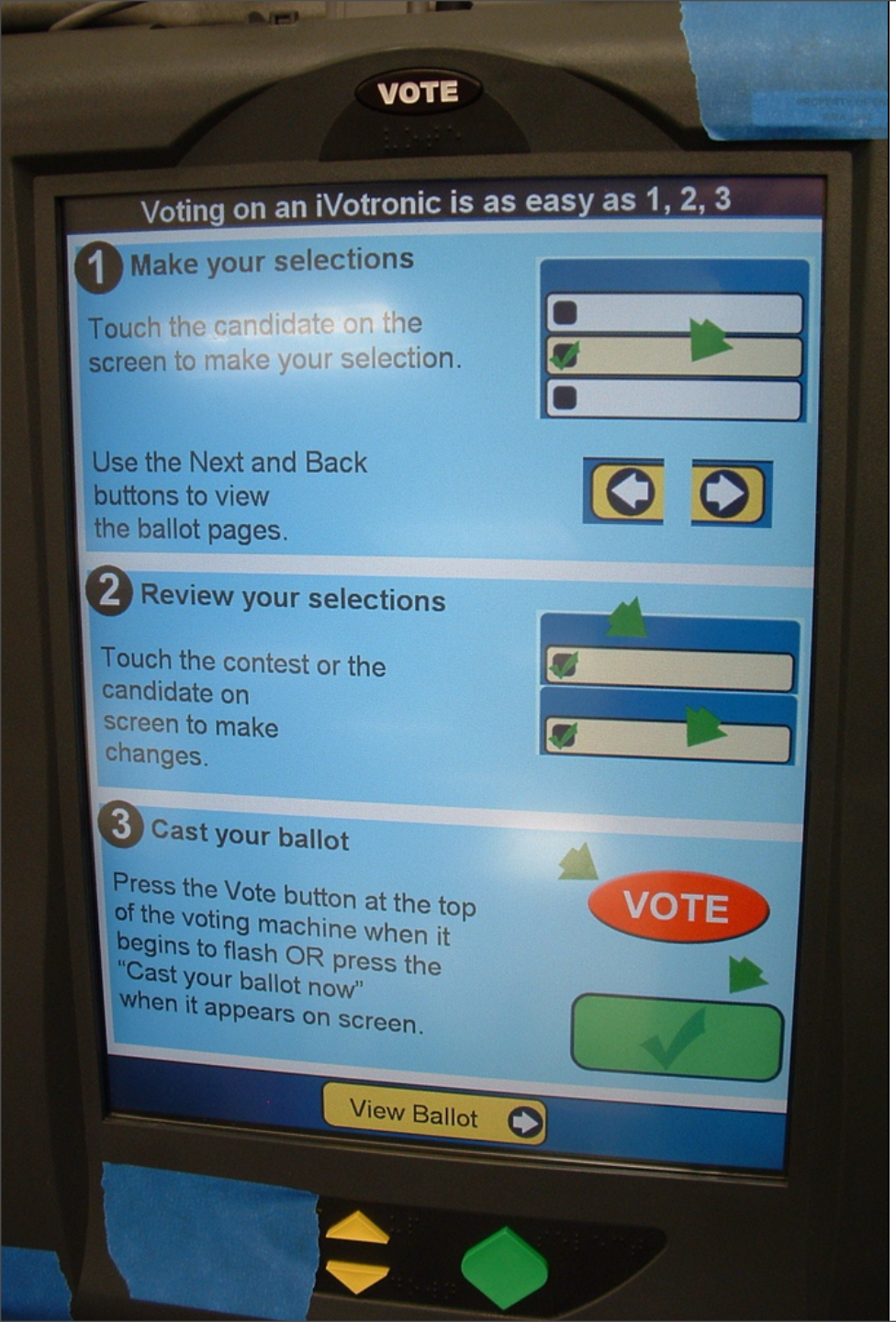
Punching the second hole casts a vote for the Reform party.

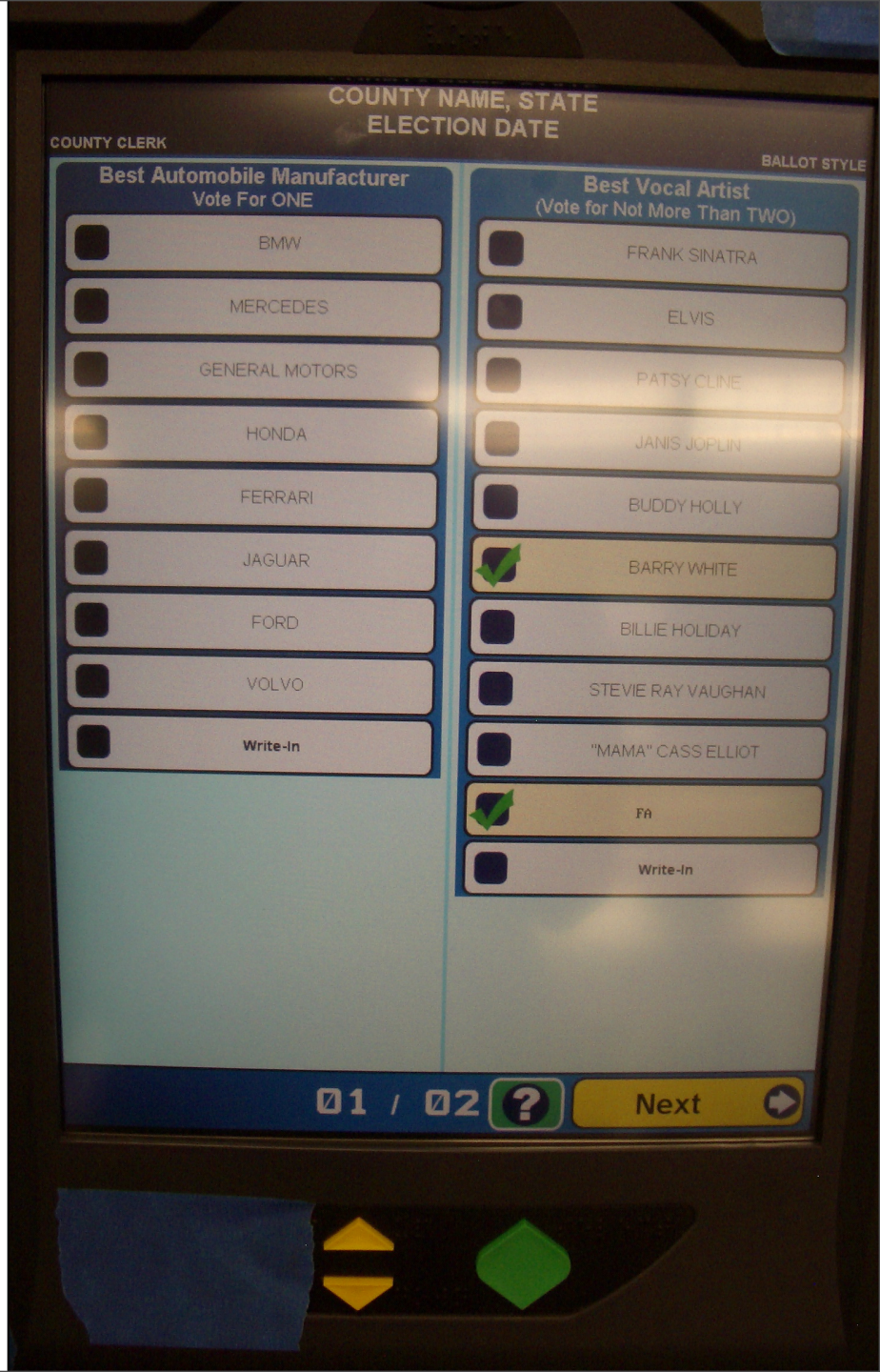


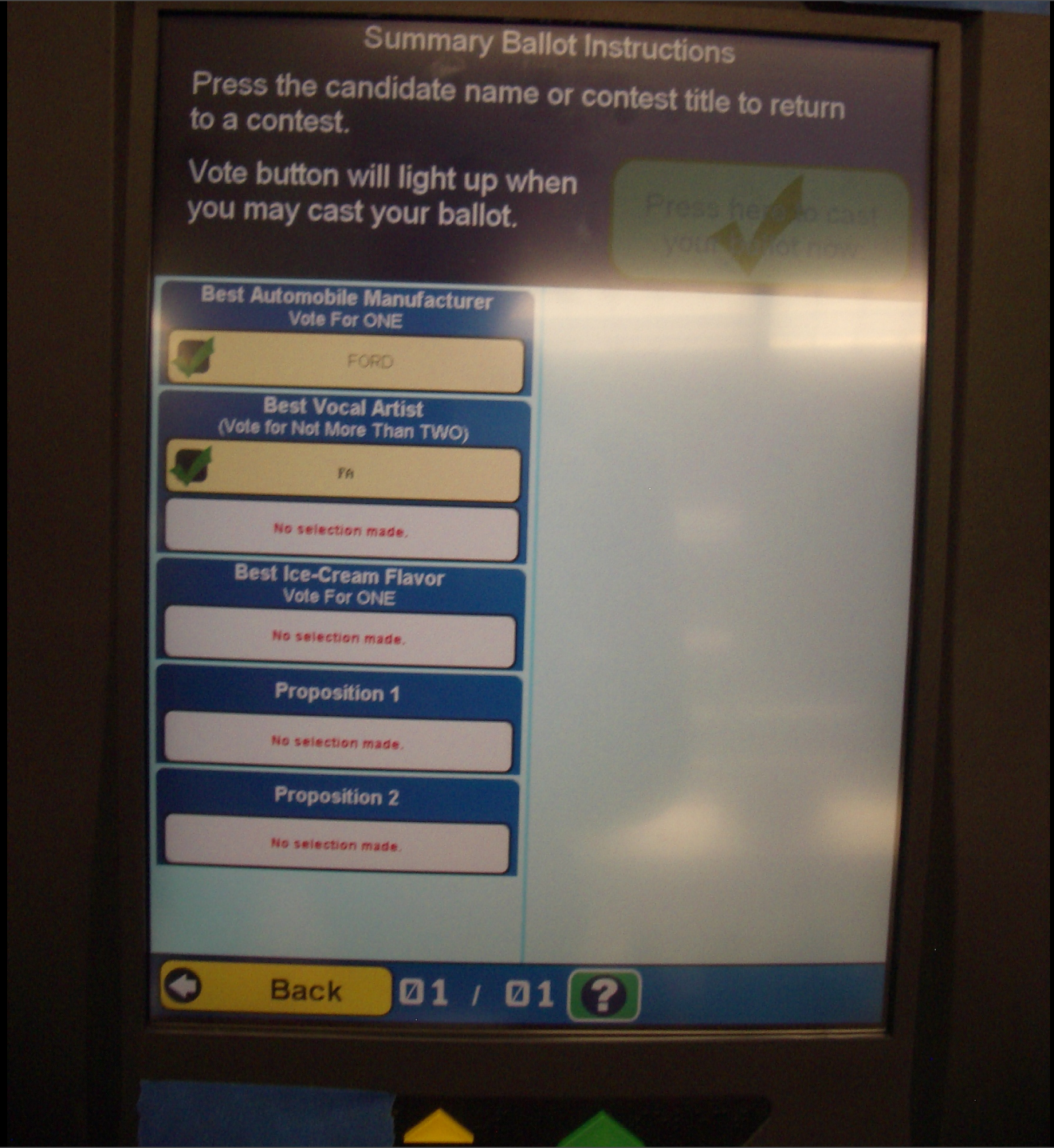

** TEST COUNTING MODE **
Election
Nov-05-2002
Vote Center
33
Line 0
Version 33
Copy 0
Count 0
Insert card to start
Please Insert
Your Card
System Information
SN 114905
System Total 366
Power High


09/07/2004


VOTE
You have already checked the maximum selections in this contest.
If you wish to select a different selection in this contest, you must first de-select a previous selection.
Return to ballot


VOTE
Voting on an iVotronic is as easy as 1, 2, 3
1 Make your selections
Touch the candidate on the screen to make your selection.
Use the Next and Back buttons to view the ballot pages.
2 Review your selections
Touch the contest or the candidate on screen to make changes.
3 Cast your ballot
Press the Vote button at the top of the voting machine when it begins to flash OR press the "Cast your ballot now" when it appears on screen.
VOTE
View Ballot


COUNTY NAME, STATE
ELECTION DATE
COUNTY CLERK
BALLOT STYLE
Best Automobile Manufacturer
Vote For ONE
BMW
MERCEDES
GENERAL MOTORS
HONDA
FERRARI
JAGUAR
FORD
VOLVO
Write-In
Best Vocal Artist
(Vote for Not More Than TWO)
FRANK SINATRA
ELVIS
PATSY CLINE
JANIS JOPLIN
BUDDY HOLLY
BARRY WHITE
BILLIE HOLIDAY
STEVIE RAY VAUGHAN
"MAMA" CASS ELLIOT
FA
Write-In
01 / 02
Next


Summary Ballot Instructions
Press the candidate name or contest title to return to a contest.
Vote button will light up when you may cast your ballot.
Best Automobile Manufacturer
Vote For ONE
FORD
Best Vocal Artist
(Vote for Not More Than TWO)
FA
No selection made.
Best Ice-Cream Flavor
Vote For ONE
No selection made.
Proposition 1
No selection made.
Proposition 2
No selection made.
Back
01 / 01

Question: How do election security goals apply to touchscreen (DRE) electronic voting machines?

1. Machine must allow each authorized voter to vote exactly once; must prevent tampering with votes after they are cast.

2. Machine should be verifiably trustworthy.

3. Machine must randomize the order in which votes were cast.

4. Machine must not give voter a "receipt".

- Security Goals for an Election:
  Integrity, Transparency, Privacy, Secret ballot

Nov 4, 2002:
State of Georgia votes on Diebold DREs.

March 18, 2003:
Diebold source code leaks.

July 23, 2003:
Tadayoshi Kohno, Adam Stubblefield, Avi Rubin, Dan Wallach, "Analysis of an Electronic Voting System".

The voter authorization protocol

QueryStatus →

← ACTIVE (0x01)

(record vote)

smartcard

SetStatus CANCELED (0x08) →

Status = CANCELED

← Succeeded

The voter authorization protocol

QueryStatus [Are you a valid card?]

ACTIVE (0x01) [Yup.]

(record vote)

smartcard

[Please cancel yourself.]

SetStatus CANCELED (0x08)

Status = CANCELED

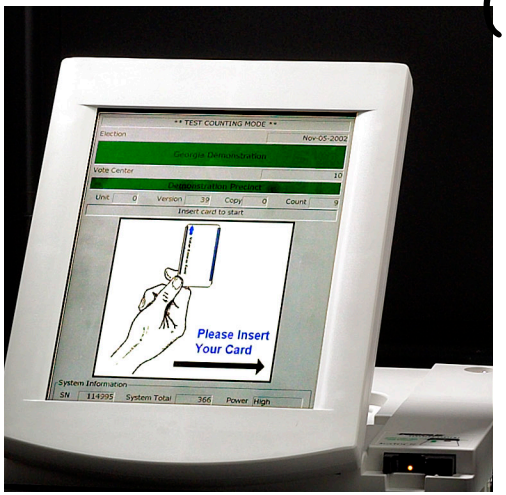
Succeeded [Ok.]

Attack!

QueryStatus →

← ACTIVE (0x01)

(record vote)



SetStatus CANCELED (0x08) →

← Succeeded

malicious smartcard

QueryStatus →

← ACTIVE (0x01)

(record another vote)

SetStatus CANCELED (0x08) →

← Succeeded

Authenticating election officials

What kind of card are you?

An administrator card.

smartcard

What's the secret PIN?

2301

What's the secret PIN?

2301

Ok, you have admin access.

Source code excerpts: code to encrypt electronic vote files and audit logs

```
#define DESKEY ((des_key*)”F2654hD4”)


DESCBCEncrypt((des_c_block*)tmp,
(des_c_block*)record.m_Data, totalSize,
DESKEY, NULL, DES_ENCRYPT);
```

This parameter is the initialization vector (IV) for “cipher block chaining”. It is set to zero. That is a confidentiality flaw. How would you fix this confidentiality flaw?

Source code excerpts

```
// LCG - Linear Congruential Generator -
// used to generate ballot serial numbers
// A psuedo-random-sequence generator
// (per Applied Cryptography, Bruce Schneier)

int lcgGenerator(int lastSN) {
  return ((lastSN*1366) + 150889)%714025;
}
```

"Unfortunately, linear congruential generators cannot be used for cryptography."

— Applied Cryptography, p.369


HE STATE OF TEXA
THE COMPUTER
ATE MY VOT
TheComputerAteMyVote
DIEBOLD


http://denvervoice.org


LIVE FREE
ELECTRONIC VOTING IS UNRELIABLE
PAPER BALLOTS
THE COMPUTER ATE MY VOTE!


HOW LONG WILL IT TAKE TO GET IT RIGHT


ELECTION FRAUD
MEDIA BLACKOUT


VOTE
BUT
VERIFY!


VOTING WITHOUT AUDITING ARE WE INSANE?
SECRET SOFTWARE SECRET GOVERNMENT


LIVE FREE OR DIE BOLD
BE THE CHANGE!
VISUALIZE TRUE DEMOCRACY

Princeton E-vote Demo Video

Trojan Horses and the Insider Threat

Ronald Dale Harris

Employee, Gaming Control Board, 1983-1995

Arrested, Jan 15,1995
Convicted, Sept 23, 1997, for rigging slot machines

Attempted Trojan Horse in Linux Kernel

```
        ...
        schedule();
        goto repeat;
}
if ((options == (__WCLONE|__WALL)) && current->uid = 0)
        retval = -EINVAL;
retval = -ECHILD;
end_wait4:
current->state = TASK_RUNNING;
...
```

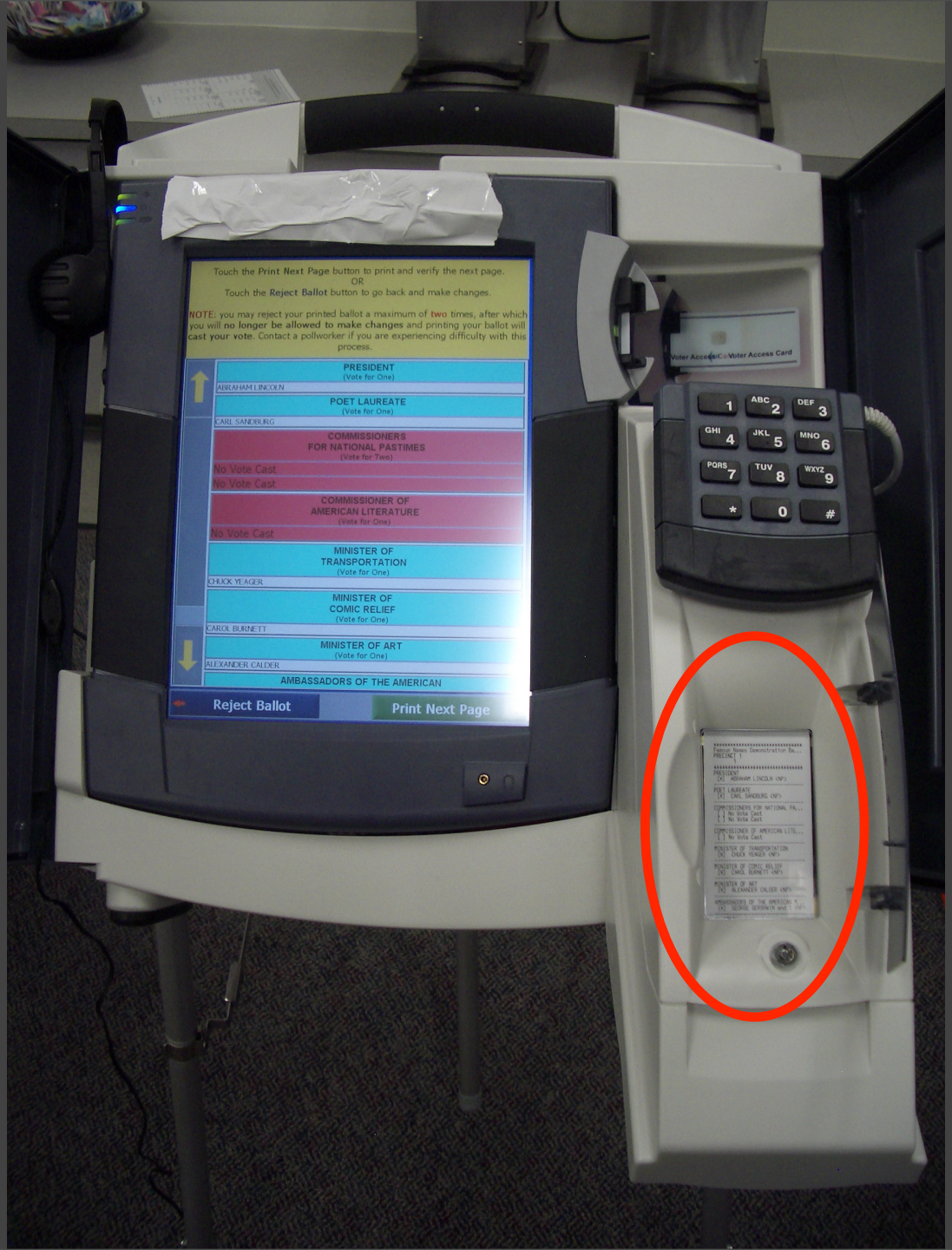
Trojan Horses and Voting Machines

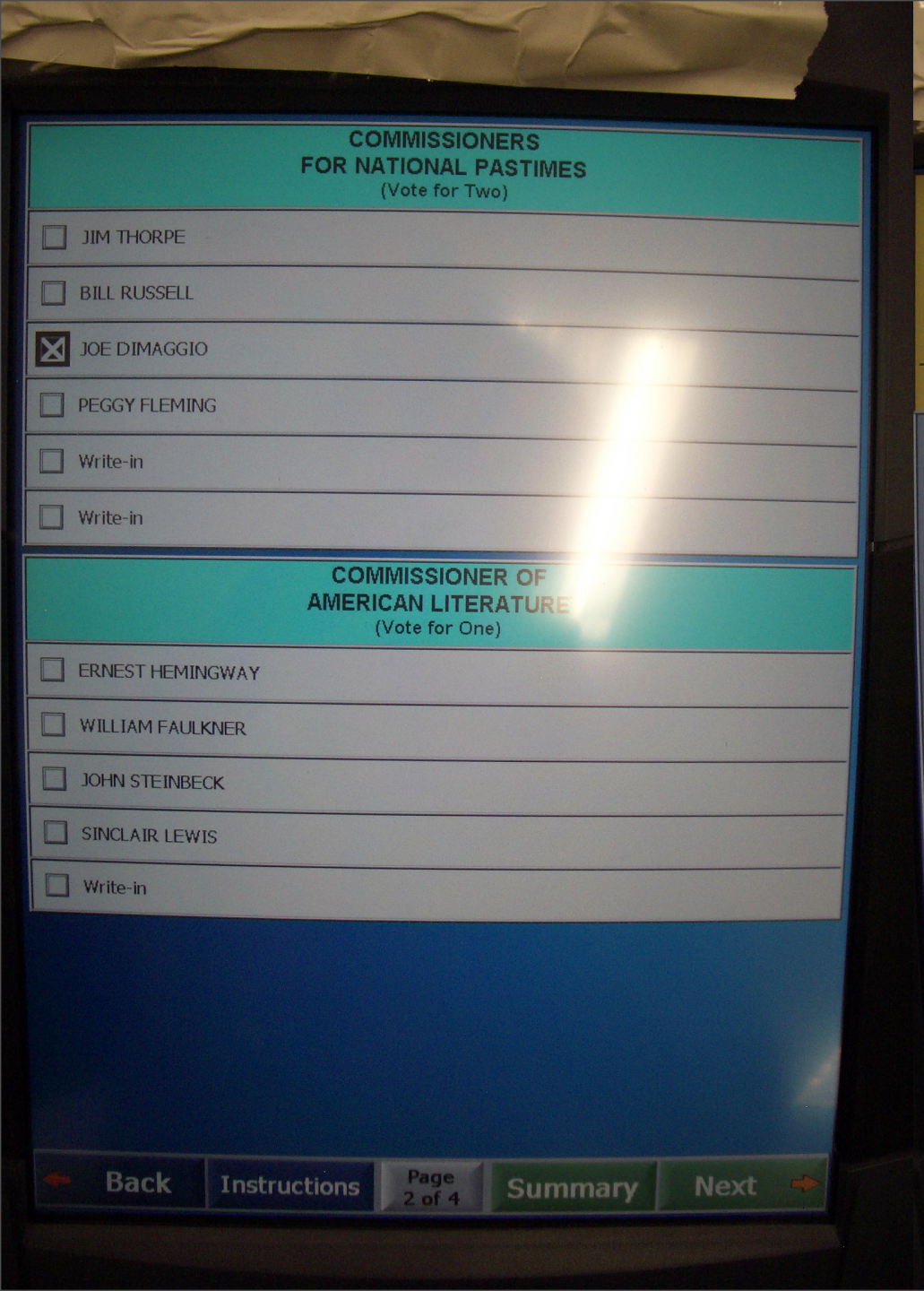
Malicious logic hidden by an insider might, e.g., record votes incorrectly to favor one candidate. Extremely difficult to prevent or detect.

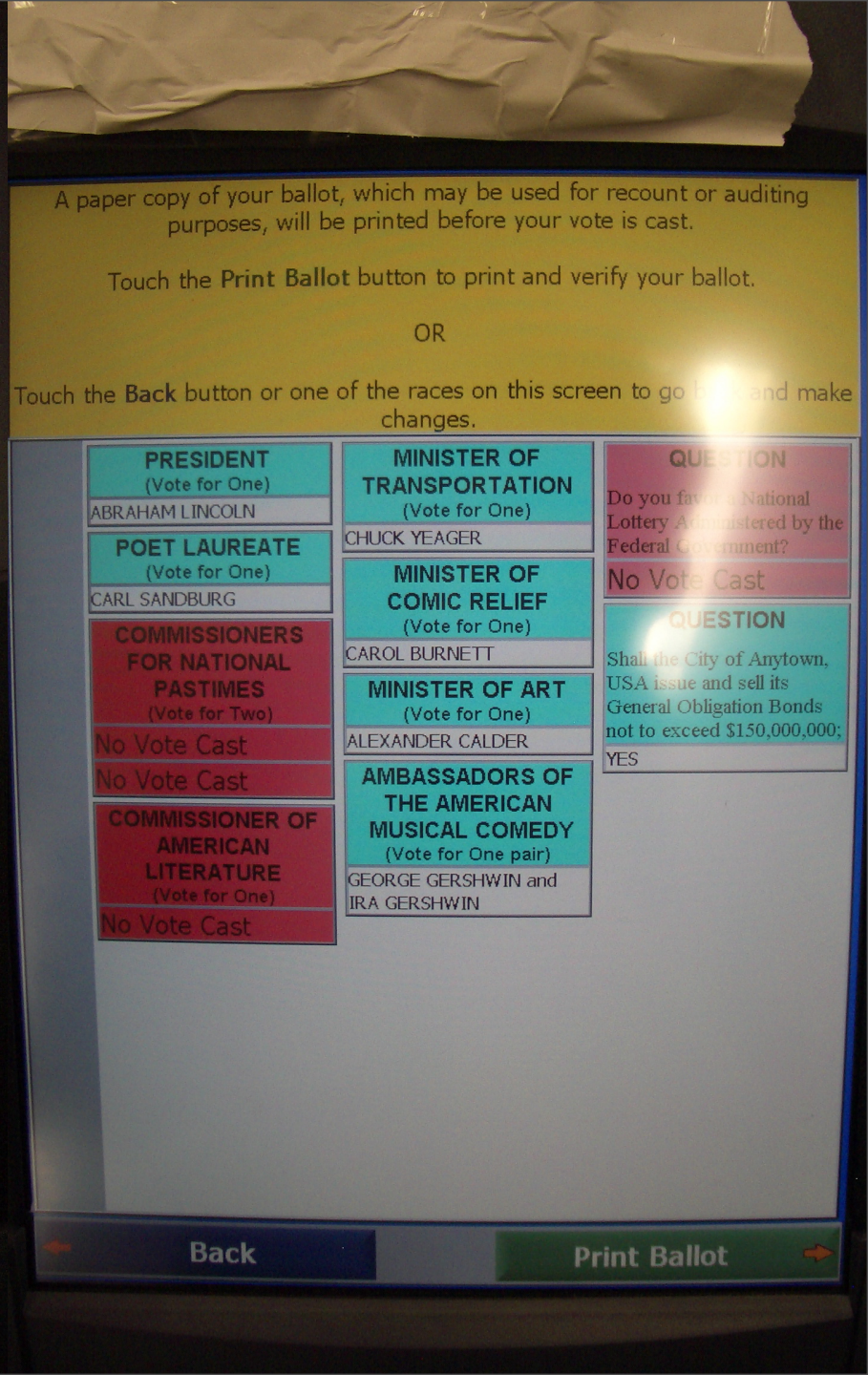
Potential solutions:

- Verify that the software is free of Trojans. (beyond the state of the art)

- Verify that output of the sw is correct.
  - Voter-verified paper audit trail, 1% audits
  - Optical scan (paper ballots)
  - Ballot marking devices (paper ballots)


Touch the Print Next Page button to print and verify the next page.
OR
Touch the Reject Ballot button to go back and make changes.
NOTE: you may reject your printed ballot a maximum of two times, after which you will no longer be allowed to make changes and printing your ballot will cast your vote. Contact a pollworker if you are experiencing difficulty with this process.
PRESIDENT
(Vote for One)
ABRAHAM LINCOLN
POET LAUREATE
(Vote for One)
CARL SANDBURG
COMMISSIONERS FOR NATIONAL PASTIMES
(Vote for Two)
No Vote Cast
No Vote Cast
COMMISSIONER OF AMERICAN LITERATURE
(Vote for One)
No Vote Cast
MINISTER OF TRANSPORTATION
(Vote for One)
CHUCK YEAGER
MINISTER OF COMIC RELIEF
(Vote for One)
CAROL BURNETT
MINISTER OF ART
(Vote for One)
ALEXANDER CALDER
AMBASSADORS OF THE AMERICAN
Reject Ballot
Print Next Page
Voter Access Card
1
ABC 2
DEF 3
GHI 4
JKL 5
MNO 6
PQRS 7
TUV 8
WXYZ 9
*
0
#


COMMISSIONERS
FOR NATIONAL PASTIMES
(Vote for Two)
JIM THORPE
BILL RUSSELL
JOE DIMAGGIO
PEGGY FLEMING
Write-in
Write-in
COMMISSIONER OF
AMERICAN LITERATURE
(Vote for One)
ERNEST HEMINGWAY
WILLIAM FAULKNER
JOHN STEINBECK
SINCLAIR LEWIS
Write-in
Back
Instructions
Page
2 of 4
Summary
Next


A paper copy of your ballot, which may be used for recount or auditing purposes, will be printed before your vote is cast.
Touch the Print Ballot button to print and verify your ballot.
OR
Touch the Back button or one of the races on this screen to go back and make changes.
PRESIDENT
(Vote for One)
ABRAHAM LINCOLN
POET LAUREATE
(Vote for One)
CARL SANDBURG
COMMISSIONERS FOR NATIONAL PASTIMES
(Vote for Two)
No Vote Cast
No Vote Cast
COMMISSIONER OF AMERICAN LITERATURE
(Vote for One)
No Vote Cast
MINISTER OF TRANSPORTATION
(Vote for One)
CHUCK YEAGER
MINISTER OF COMIC RELIEF
(Vote for One)
CAROL BURNETT
MINISTER OF ART
(Vote for One)
ALEXANDER CALDER
AMBASSADORS OF THE AMERICAN MUSICAL COMEDY
(Vote for One pair)
GEORGE GERSHWIN and
IRA GERSHWIN
QUESTION
Do you favor a National Lottery Administered by the Federal Government?
No Vote Cast
QUESTION
Shall the City of Anytown, USA issue and sell its General Obligation Bonds not to exceed $150,000,000;
YES
Back
Print Ballot

Touch the **Print Next Page** button to print and verify the next page.
OR
Touch the **Reject Ballot** button to go back and make changes.

NOTE: you may reject your printed ballot a maximum of **two** times, after which you will **no longer be allowed to make changes** and printing your ballot will **cast your vote**. Contact a pollworker if you are experiencing difficulty with this process.

PRESIDENT
(Vote for One)
ABRAHAM LINCOLN

POET LAUREATE
(Vote for One)
CARL SANDBURG

COMMISSIONERS FOR NATIONAL PASTIMES
(Vote for Two)
No Vote Cast
No Vote Cast

COMMISSIONER OF AMERICAN LITERATURE
(Vote for One)
No Vote Cast

MINISTER OF TRANSPORTATION
(Vote for One)
CHUCK YEAGER

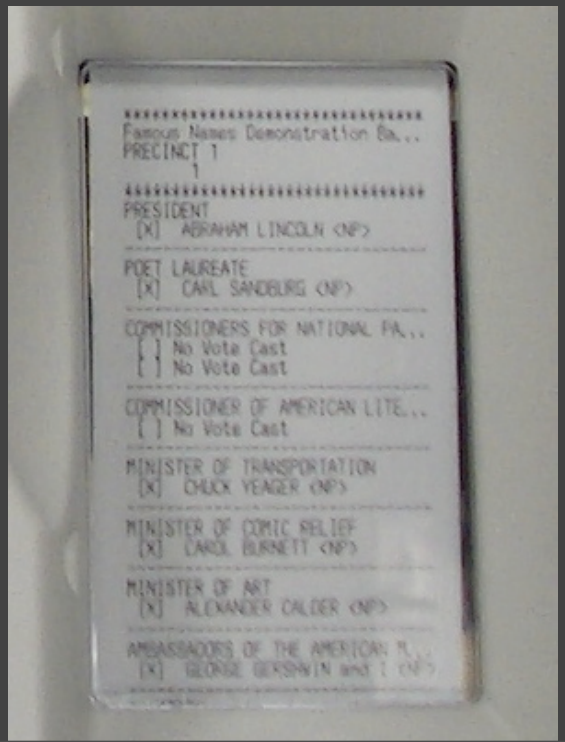
MINISTER OF COMIC RELIEF
(Vote for One)
CAROL BURNETT

MINISTER OF ART
(Vote for One)
ALEXANDER CALDER

AMBASSADORS OF THE AMERICAN

Reject Ballot

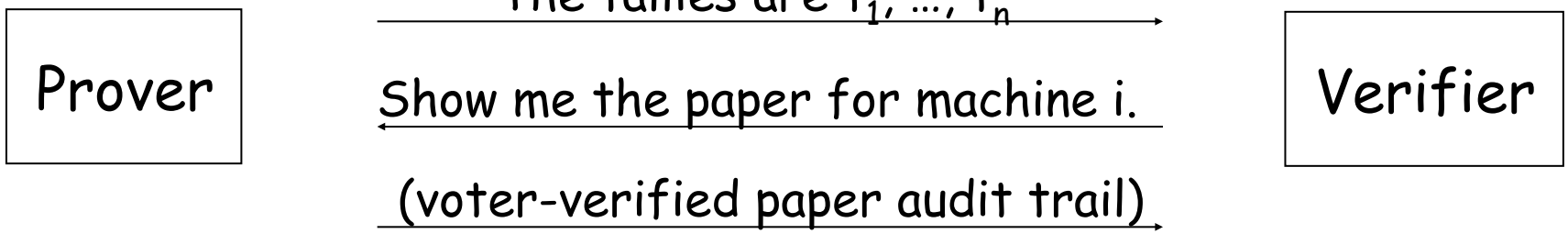
Print Next Page

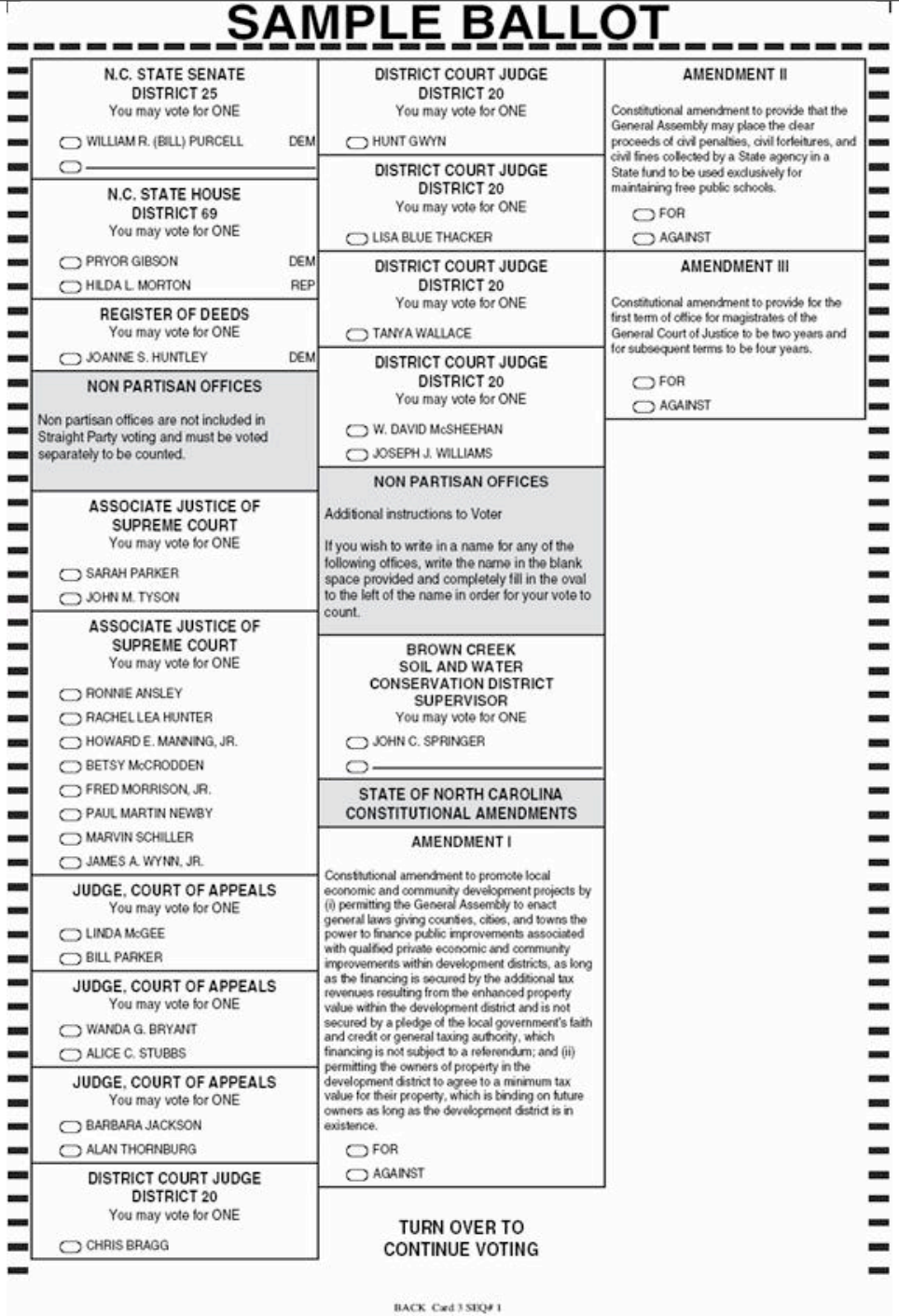


Statistical audit

- After election, randomly choose 1% of machines and manually recount the paper records on those machines. If paper count ≠ electronic count, there was fraud.

- If » 100 machines cheat, detection is likely. Consequently: If paper count = electronic count, then no more than ~100 machines cheated.





SAMPLE BALLOT

N.C. STATE SENATE
DISTRICT 25
You may vote for ONE

- ◯ WILLIAM R. (BILL) PURCELL — DEM
- ◯ _____

N.C. STATE HOUSE
DISTRICT 69
You may vote for ONE

- ◯ PRYOR GIBSON — DEM
- ◯ HILDA L. MORTON — REP

REGISTER OF DEEDS
You may vote for ONE

- ◯ JOANNE S. HUNTLEY — DEM

NON PARTISAN OFFICES

Non partisan offices are not included in Straight Party voting and must be voted separately to be counted.

ASSOCIATE JUSTICE OF SUPREME COURT
You may vote for ONE

- ◯ SARAH PARKER
- ◯ JOHN M. TYSON

ASSOCIATE JUSTICE OF SUPREME COURT
You may vote for ONE

- ◯ RONNIE ANSLEY
- ◯ RACHEL LEA HUNTER
- ◯ HOWARD E. MANNING, JR.
- ◯ BETSY McCRODDEN
- ◯ FRED MORRISON, JR.
- ◯ PAUL MARTIN NEWBY
- ◯ MARVIN SCHILLER
- ◯ JAMES A. WYNN, JR.

JUDGE, COURT OF APPEALS
You may vote for ONE

- ◯ LINDA McGEE
- ◯ BILL PARKER

JUDGE, COURT OF APPEALS
You may vote for ONE

- ◯ WANDA G. BRYANT
- ◯ ALICE C. STUBBS

JUDGE, COURT OF APPEALS
You may vote for ONE

- ◯ BARBARA JACKSON
- ◯ ALAN THORNBURG

DISTRICT COURT JUDGE
DISTRICT 20
You may vote for ONE

- ◯ CHRIS BRAGG

DISTRICT COURT JUDGE
DISTRICT 20
You may vote for ONE

- ◯ HUNT GWYN

DISTRICT COURT JUDGE
DISTRICT 20
You may vote for ONE

- ◯ LISA BLUE THACKER

DISTRICT COURT JUDGE
DISTRICT 20
You may vote for ONE

- ◯ TANYA WALLACE

DISTRICT COURT JUDGE
DISTRICT 20
You may vote for ONE

- ◯ W. DAVID McSHEEHAN
- ◯ JOSEPH J. WILLIAMS

NON PARTISAN OFFICES

Additional instructions to Voter

If you wish to write in a name for any of the following offices, write the name in the blank space provided and completely fill in the oval to the left of the name in order for your vote to count.

BROWN CREEK SOIL AND WATER CONSERVATION DISTRICT SUPERVISOR
You may vote for ONE

- ◯ JOHN C. SPRINGER
- ◯ _____

STATE OF NORTH CAROLINA CONSTITUTIONAL AMENDMENTS

AMENDMENT I

Constitutional amendment to promote local economic and community development projects by (i) permitting the General Assembly to enact general laws giving counties, cities, and towns the power to finance public improvements associated with qualified private economic and community improvements within development districts, as long as the financing is secured by the additional tax revenues resulting from the enhanced property value within the development district and is not secured by a pledge of the local government's faith and credit or general taxing authority, which financing is not subject to a referendum; and (ii) permitting the owners of property in the development district to agree to a minimum tax value for their property, which is binding on future owners as long as the development district is in existence.

- ◯ FOR
- ◯ AGAINST

AMENDMENT II

Constitutional amendment to provide that the General Assembly may place the clear proceeds of civil penalties, civil forfeitures, and civil fines collected by a State agency in a State fund to be used exclusively for maintaining free public schools.

- ◯ FOR
- ◯ AGAINST

AMENDMENT III

Constitutional amendment to provide for the first term of office for magistrates of the General Court of Justice to be two years and for subsequent terms to be four years.

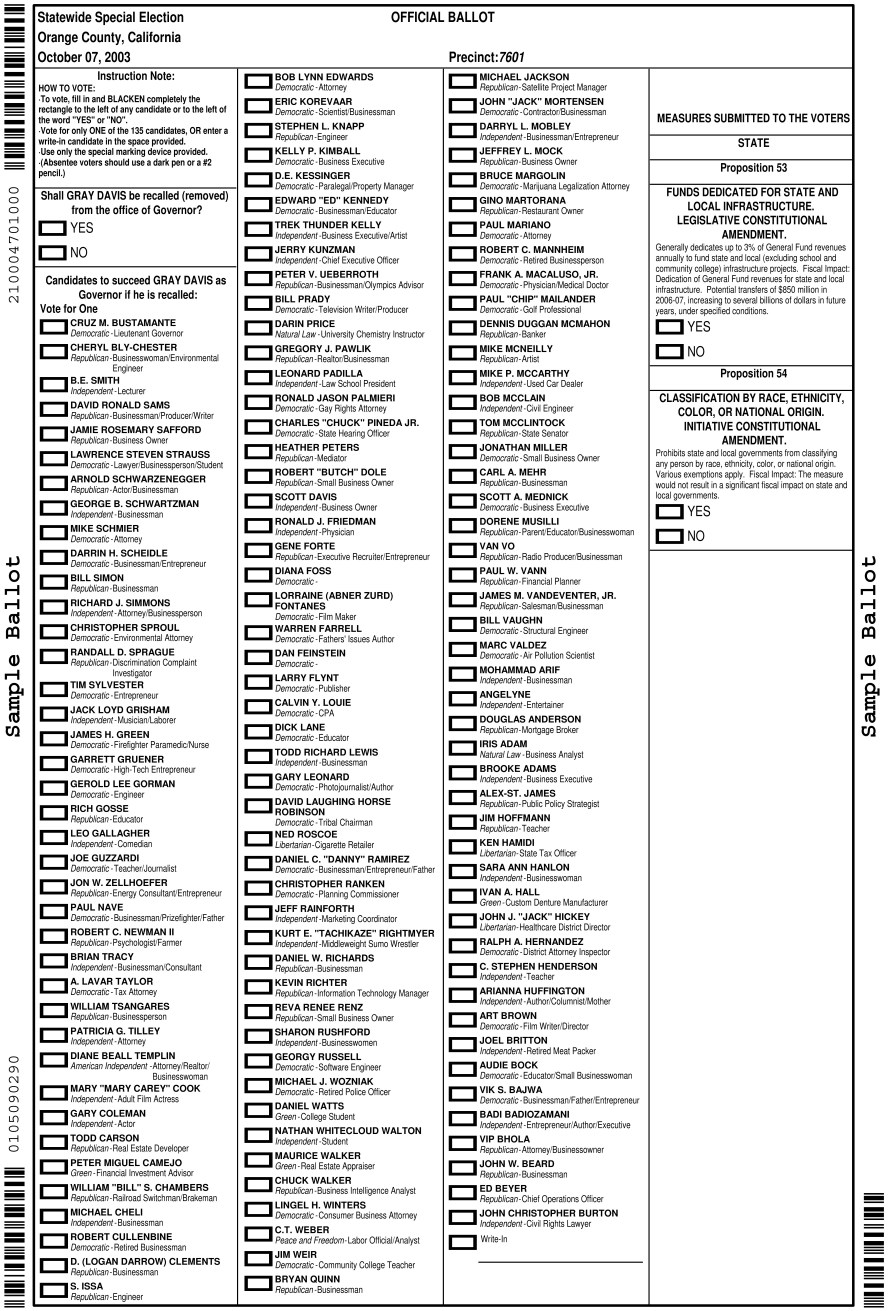
- ◯ FOR
- ◯ AGAINST

TURN OVER TO CONTINUE VOTING

BACK Card 3 SEQ# 1


VOTING
SYSTEM
D


OPTECH 400 Eagle
INSERT BALLOT HERE



Statewide Special Election
Orange County, California
October 07, 2003

OFFICIAL BALLOT

Precinct: *7601*

Instruction Note:

HOW TO VOTE:
·To vote, fill in and BLACKEN completely the rectangle to the left of any candidate or to the left of the word "YES" or "NO".
·Vote for only ONE of the 135 candidates, OR enter a write-in candidate in the space provided.
·Use only the special marking device provided.
·(Absentee voters should use a dark pen or a #2 pencil.)

Shall GRAY DAVIS be recalled (removed) from the office of Governor?

- YES
- NO

Candidates to succeed GRAY DAVIS as Governor if he is recalled:
Vote for One

- **CRUZ M. BUSTAMANTE** *Democratic* - Lieutenant Governor
- **CHERYL BLY-CHESTER** *Republican* - Businesswoman/Environmental Engineer
- **B.E. SMITH** *Independent* - Lecturer
- **DAVID RONALD SAMS** *Republican* - Businessman/Producer/Writer
- **JAMIE ROSEMARY SAFFORD** *Republican* - Business Owner
- **LAWRENCE STEVEN STRAUSS** *Democratic* - Lawyer/Businessperson/Student
- **ARNOLD SCHWARZENEGGER** *Republican* - Actor/Businessman
- **GEORGE B. SCHWARTZMAN** *Independent* - Businessman
- **MIKE SCHMIER** *Democratic* - Attorney
- **DARRIN H. SCHEIDLE** *Democratic* - Businessman/Entrepreneur
- **BILL SIMON** *Republican* - Businessman
- **RICHARD J. SIMMONS** *Independent* - Attorney/Businessperson
- **CHRISTOPHER SPROUL** *Democratic* - Environmental Attorney
- **RANDALL D. SPRAGUE** *Republican* - Discrimination Complaint Investigator
- **TIM SYLVESTER** *Democratic* - Entrepreneur
- **JACK LOYD GRISHAM** *Independent* - Musician/Laborer
- **JAMES H. GREEN** *Democratic* - Firefighter Paramedic/Nurse
- **GARRETT GRUENER** *Democratic* - High-Tech Entrepreneur
- **GEROLD LEE GORMAN** *Democratic* - Engineer
- **RICH GOSSE** *Republican* - Educator
- **LEO GALLAGHER** *Independent* - Comedian
- **JOE GUZZARDI** *Democratic* - Teacher/Journalist
- **JON W. ZELLHOEFER** *Republican* - Energy Consultant/Entrepreneur
- **PAUL NAVE** *Democratic* - Businessman/Prizefighter/Father
- **ROBERT C. NEWMAN II** *Republican* - Psychologist/Farmer
- **BRIAN TRACY** *Independent* - Businessman/Consultant
- **A. LAVAR TAYLOR** *Democratic* - Tax Attorney
- **WILLIAM TSANGARES** *Republican* - Businessperson
- **PATRICIA G. TILLEY** *Independent* - Attorney
- **DIANE BEALL TEMPLIN** *American Independent* - Attorney/Realtor/Businesswoman
- **MARY "MARY CAREY" COOK** *Independent* - Adult Film Actress
- **GARY COLEMAN** *Independent* - Actor
- **TODD CARSON** *Republican* - Real Estate Developer
- **PETER MIGUEL CAMEJO** *Green* - Financial Investment Advisor
- **WILLIAM "BILL" S. CHAMBERS** *Republican* - Railroad Switchman/Brakeman
- **MICHAEL CHELI** *Independent* - Businessman
- **ROBERT CULLENBINE** *Democratic* - Retired Businessman
- **D. (LOGAN DARROW) CLEMENTS** *Republican* - Businessman
- **S. ISSA** *Republican* - Engineer
- **BOB LYNN EDWARDS** *Democratic* - Attorney
- **ERIC KOREVAAR** *Democratic* - Scientist/Businessman
- **STEPHEN L. KNAPP** *Republican* - Engineer
- **KELLY P. KIMBALL** *Democratic* - Business Executive
- **D.E. KESSINGER** *Democratic* - Paralegal/Property Manager
- **EDWARD "ED" KENNEDY** *Democratic* - Businessman/Educator
- **TREK THUNDER KELLY** *Independent* - Business Executive/Artist
- **JERRY KUNZMAN** *Independent* - Chief Executive Officer
- **PETER V. UEBERROTH** *Republican* - Businessman/Olympics Advisor
- **BILL PRADY** *Democratic* - Television Writer/Producer
- **DARIN PRICE** *Natural Law* - University Chemistry Instructor
- **GREGORY J. PAWLIK** *Republican* - Realtor/Businessman
- **LEONARD PADILLA** *Independent* - Law School President
- **RONALD JASON PALMIERI** *Democratic* - Gay Rights Attorney
- **CHARLES "CHUCK" PINEDA JR.** *Democratic* - State Hearing Officer
- **HEATHER PETERS** *Republican* - Mediator
- **ROBERT "BUTCH" DOLE** *Republican* - Small Business Owner
- **SCOTT DAVIS** *Independent* - Business Owner
- **RONALD J. FRIEDMAN** *Independent* - Physician
- **GENE FORTE** *Republican* - Executive Recruiter/Entrepreneur
- **DIANA FOSS** *Democratic* -
- **LORRAINE (ABNER ZURD) FONTANES** *Democratic* - Film Maker
- **WARREN FARRELL** *Democratic* - Fathers' Issues Author
- **DAN FEINSTEIN** *Democratic* -
- **LARRY FLYNT** *Democratic* - Publisher
- **CALVIN Y. LOUIE** *Democratic* - CPA
- **DICK LANE** *Democratic* - Educator
- **TODD RICHARD LEWIS** *Independent* - Businessman
- **GARY LEONARD** *Democratic* - Photojournalist/Author
- **DAVID LAUGHING HORSE ROBINSON** *Democratic* - Tribal Chairman
- **NED ROSCOE** *Libertarian* - Cigarette Retailer
- **DANIEL C. "DANNY" RAMIREZ** *Democratic* - Businessman/Entrepreneur/Father
- **CHRISTOPHER RANKEN** *Democratic* - Planning Commissioner
- **JEFF RAINFORTH** *Independent* - Marketing Coordinator
- **KURT E. "TACHIKAZE" RIGHTMYER** *Independent* - Middleweight Sumo Wrestler
- **DANIEL W. RICHARDS** *Republican* - Businessman
- **KEVIN RICHTER** *Republican* - Information Technology Manager
- **REVA RENEE RENZ** *Republican* - Small Business Owner
- **SHARON RUSHFORD** *Independent* - Businesswomen
- **GEORGY RUSSELL** *Democratic* - Software Engineer
- **MICHAEL J. WOZNIAK** *Democratic* - Retired Police Officer
- **DANIEL WATTS** *Green* - College Student
- **NATHAN WHITECLOUD WALTON** *Independent* - Student
- **MAURICE WALKER** *Green* - Real Estate Appraiser
- **CHUCK WALKER** *Republican* - Business Intelligence Analyst
- **LINGEL H. WINTERS** *Democratic* - Consumer Business Attorney
- **C.T. WEBER** *Peace and Freedom* - Labor Official/Analyst
- **JIM WEIR** *Democratic* - Community College Teacher
- **BRYAN QUINN** *Republican* - Businessman
- **MICHAEL JACKSON** *Republican* - Satellite Project Manager
- **JOHN "JACK" MORTENSEN** *Democratic* - Contractor/Businessman
- **DARRYL L. MOBLEY** *Independent* - Businessman/Entrepreneur
- **JEFFREY L. MOCK** *Republican* - Business Owner
- **BRUCE MARGOLIN** *Democratic* - Marijuana Legalization Attorney
- **GINO MARTORANA** *Republican* - Restaurant Owner
- **PAUL MARIANO** *Democratic* - Attorney
- **ROBERT C. MANNHEIM** *Democratic* - Retired Businessperson
- **FRANK A. MACALUSO, JR.** *Democratic* - Physician/Medical Doctor
- **PAUL "CHIP" MAILANDER** *Democratic* - Golf Professional
- **DENNIS DUGGAN MCMAHON** *Republican* - Banker
- **MIKE MCNEILLY** *Republican* - Artist
- **MIKE P. MCCARTHY** *Independent* - Used Car Dealer
- **BOB MCCLAIN** *Independent* - Civil Engineer
- **TOM MCCLINTOCK** *Republican* - State Senator
- **JONATHAN MILLER** *Democratic* - Small Business Owner
- **CARL A. MEHR** *Republican* - Businessman
- **SCOTT A. MEDNICK** *Democratic* - Business Executive
- **DORENE MUSILLI** *Republican* - Parent/Educator/Businesswoman
- **VAN VO** *Republican* - Radio Producer/Businessman
- **PAUL W. VANN** *Republican* - Financial Planner
- **JAMES M. VANDEVENTER, JR.** *Republican* - Salesman/Businessman
- **BILL VAUGHN** *Democratic* - Structural Engineer
- **MARC VALDEZ** *Democratic* - Air Pollution Scientist
- **MOHAMMAD ARIF** *Independent* - Businessman
- **ANGELYNE** *Independent* - Entertainer
- **DOUGLAS ANDERSON** *Republican* - Mortgage Broker
- **IRIS ADAM** *Natural Law* - Business Analyst
- **BROOKE ADAMS** *Independent* - Business Executive
- **ALEX-ST. JAMES** *Republican* - Public Policy Strategist
- **JIM HOFFMANN** *Republican* - Teacher
- **KEN HAMIDI** *Libertarian* - State Tax Officer
- **SARA ANN HANLON** *Independent* - Businesswoman
- **IVAN A. HALL** *Green* - Custom Denture Manufacturer
- **JOHN J. "JACK" HICKEY** *Libertarian* - Healthcare District Director
- **RALPH A. HERNANDEZ** *Democratic* - District Attorney Inspector
- **C. STEPHEN HENDERSON** *Independent* - Teacher
- **ARIANNA HUFFINGTON** *Independent* - Author/Columnist/Mother
- **ART BROWN** *Democratic* - Film Writer/Director
- **JOEL BRITTON** *Independent* - Retired Meat Packer
- **AUDIE BOCK** *Democratic* - Educator/Small Businesswoman
- **VIK S. BAJWA** *Democratic* - Businessman/Father/Entrepreneur
- **BADI BADIOZAMANI** *Independent* - Entrepreneur/Author/Executive
- **VIP BHOLA** *Republican* - Attorney/Businessowner
- **JOHN W. BEARD** *Republican* - Businessman
- **ED BEYER** *Republican* - Chief Operations Officer
- **JOHN CHRISTOPHER BURTON** *Independent* - Civil Rights Lawyer
- Write-In _____

MEASURES SUBMITTED TO THE VOTERS

STATE

Proposition 53

FUNDS DEDICATED FOR STATE AND LOCAL INFRASTRUCTURE. LEGISLATIVE CONSTITUTIONAL AMENDMENT.

Generally dedicates up to 3% of General Fund revenues annually to fund state and local (excluding school and community college) infrastructure projects. Fiscal Impact: Dedication of General Fund revenues for state and local infrastructure. Potential transfers of $850 million in 2006-07, increasing to several billions of dollars in future years, under specified conditions.

- YES
- NO

Proposition 54

CLASSIFICATION BY RACE, ETHNICITY, COLOR, OR NATIONAL ORIGIN. INITIATIVE CONSTITUTIONAL AMENDMENT.

Prohibits state and local governments from classifying any person by race, ethnicity, color, or national origin. Various exemptions apply. Fiscal Impact: The measure would not result in a significant fiscal impact on state and local governments.

- YES
- NO

Sample Ballot

Sample Ballot

FAMOUS NAMES DEMONSTRATION BALLOT

Darken in the oval ⬬ provided to the left of the candidate indicating the way you desire to vote.

PRESIDENT
(Vote for One)

- THOMAS JEFFERSON
- ABRAHAM LINCOLN
- JOHN F. KENNEDY
- DWIGHT D. EISENHOWER
- FRANKLIN D. ROOSEVELT
- _____

COMMISSIONER OF AMERICAN LITERATURE
(Vote for One)

- ERNEST HEMINGWAY
- WILLIAM FAULKNER
- JOHN STEINBECK
- SINCLAIR LEWIS
- _____

MINISTER OF [illegible]
(Vote for One)

- LUCILLE BALL
- BOB HOPE
- CAROL BURNETT
- LILY TOMLIN
- _____

POET LAUREATE
(Vote for One)

- MARIANNE MOORE
- ROBERT FROST
- CARL SANDBURG
- T.S. ELIOT
- EZRA POUND
- _____

COMMISSIONERS FOR NATIONAL PASTIMES
(Vote for Two)

- JIM THORPE
- BILL RUSSELL
- JOE DIMAGGIO
- PEGGY FLEMING
- _____
- _____

MINISTER OF TRANSPORTATION
(Vote for One)

- AMELIA EARHART
- CHUCK YEAGER
- ORVILLE WRIGHT
- NEIL ARMSTRONG
- _____

MINISTER OF ART
(Vote for One)

- ANDREW WYETH
- ALEXANDER CALDER
- _____

VOTE BOTH SIDES

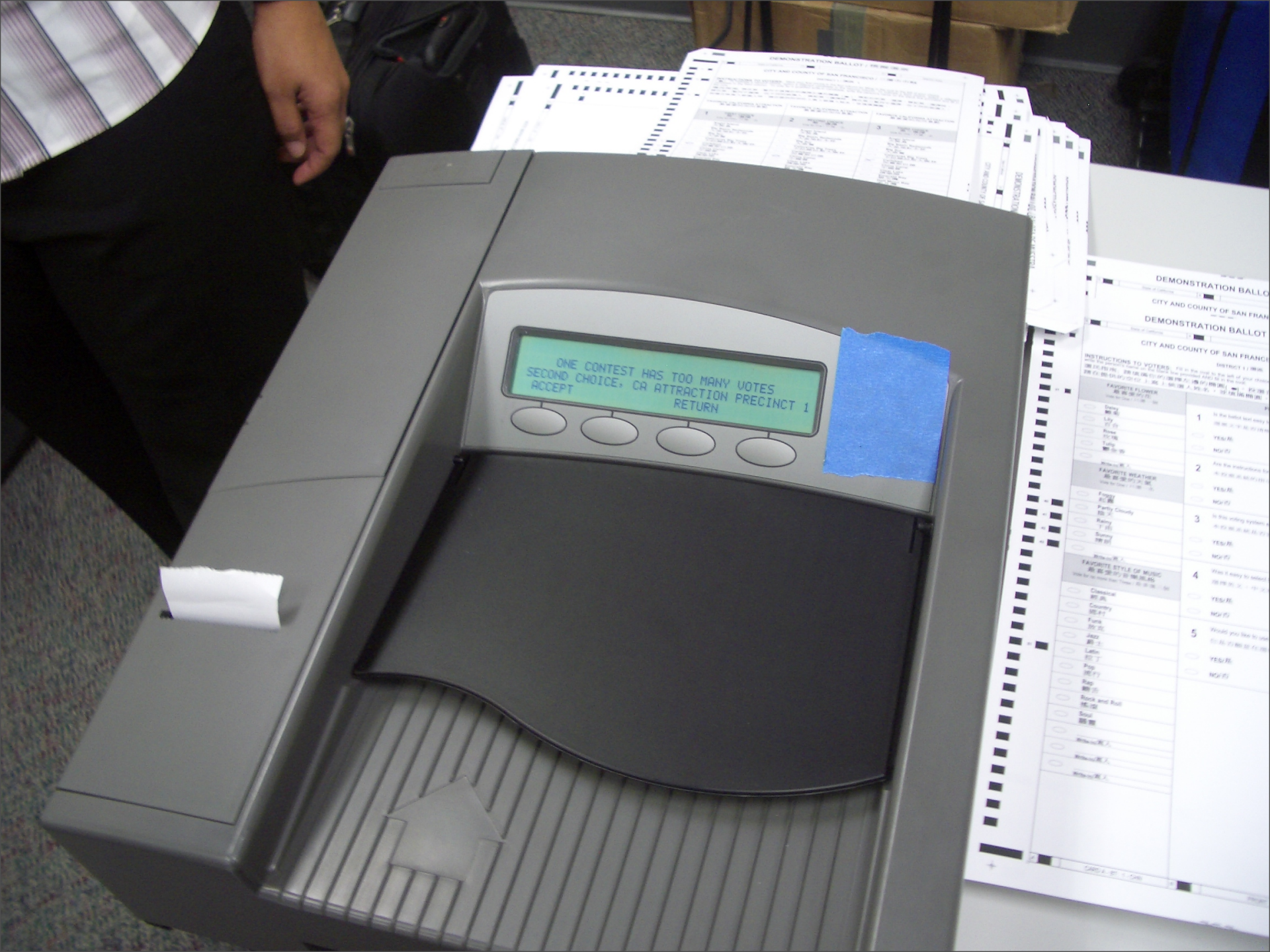
FRONT Card 1 RptPct 10 "PRECINCT 1" English

Conclusions

- E-voting security is hard, because computers aren't transparent.
- All known solutions use paper. Secure paperless voting is an open research problem.
- Computer science is deeply relevant to democracy.

- Technical principles:
  - Two-person control, separation of duties
  - Statistical audit
  - Security against malicious insiders
  - Security through obscurity


THE HAZARDS OF ONLINE VOTING . . .
HORSEY
PRESIDENT OF THE UNITED STATES
GEORGE W. BUSH R
JOHN F. KERRY D
RALPH NADER I
LOW-COST HOME MORTGAGE
GENERIC VIAGRA
ENLARGE YOUR THINGY
GREETINGS! I AM NDUGU SCAMU, EX-INTERIOR MINISTER OF NIGERIA, AND I NEED YOUR HELP TO TRANSFER $150,000,000 IN FUNDS TO A BANK


ONE CONTEST HAS TOO MANY VOTES
SECOND CHOICE, CA ATTRACTION PRECINCT 1
ACCEPT
RETURN
DEMONSTRATION BALLOT
CITY AND COUNTY OF SAN FRANCISCO
INSTRUCTIONS TO VOTERS
FAVORITE FLOWER
FAVORITE WEATHER
FAVORITE STYLE OF MUSIC

More than 4,500 North Carolina votes lost because of mistake in voting machine capacity

JACKSONVILLE, N.C. (AP) — More than 4,500 votes have been lost in one North Carolina county because officials believed a computer that stored ballots electronically could hold more data than it did. Scattered other problems may change results in races around the state.

Officials said UniLect Corp., the maker of the county's electronic voting system, told them that each storage unit could handle 10,500 votes, but the limit was actually 3,005 votes.

Machine error gives Bush 3,893 extra votes in Ohio

By John McCarthy, Associated Press

COLUMBUS, Ohio — An error with an electronic voting system gave President Bush 3,893 extra votes in suburban Columbus, elections officials said.

Franklin County's unofficial results had Bush receiving 4,258 votes to Democrat John Kerry's 260 votes in a precinct in Gahanna. Records show only 638 voters cast ballots in that precinct. Bush's total should have been recorded as 365.

Broward Vote-Counting Blunder Changes Amendment Result

POSTED: 1:34 pm EST November 4, 2004

BROWARD COUNTY, Fla. -- The Broward County Elections Department has egg on its face today after a computer glitch misreported a key amendment race, according to WPLG-TV in Miami.

Amendment 4, which would allow Miami-Dade and Broward counties to hold a future election to decide if slot machines should be allowed at racetracks, was thought to be tied. But now that a computer glitch for machines counting absentee ballots has been exposed, it turns out the amendment passed.

"The software is not geared to count more than 32,000 votes in a precinct. So what happens when it gets to 32,000 is the software starts counting backward," said Broward County Mayor Ilene Lieberman.

Broward County Mayor Ilene Lieberman says voting counting error is an "embarrassing mistake."

That means that Amendment 4 passed in Broward County by more than 240,000 votes rather than the 166,000-vote margin reported Wednesday night. That increase changes the overall statewide results in what had been a neck-and-neck race, one for which recounts had been going on today. But with news of Broward's error, it's clear amendment 4 passed.

Exhibit

November 8, 2004

George Gilbert
Director of Elections
Guilford County Board of Elections
Greensboro, NC

Dear George,

As you know, Tuesday's election drew an unprecedented number of voters to the polls. This unanticipated level of voter participation was a challenge that we believe was managed very well in Guilford County.

On behalf of the team at Election Systems & Software, I would like to congratulate you and your staff on running a very successful election. And, all of us at ES&S want to thank you for the opportunity to partner with you to carry out our important roles in the democratic process. The success of this election was the result of a tremendous amount of hard work from everyone involved. Where challenges did arise, we worked together to address them quickly and effectively so the election process continued uninterrupted. The countless hours of preparation paid off, and all in all, it was a very good day.

One challenge we did face was the incorrect information contained in preliminary and unofficial returns for certain contests in the Guilford County "One Stop" precinct used to collect totals for early voting. As you know, this occurred because exceptional voter participation generated a number of ballots and votes cast that exceeded the capacity of single precinct vote counters accepting this amount of data in the Election Reporting Manager results reporting software.

This limitation in the results reporting software was previously documented and known to ES&S. To clarify further, the limitation has nothing to do with the Votronic tabulation systems. No votes were lost. All ballot data and vote counts were correctly captured and reported by the Votronic touch screen tabulation systems.

We regret any confusion the discrepancy in early vote totals has caused.

We would like to explain in further technical detail what caused this issue, should you or others at the county have questions. The 32,767 capacity limitation at a single precinct level is a function of the design and definition of the results database used by ERM. The data storage element used to record votes at the precinct level is a two byte binary field. 32,767 is 2 to the 15th power, which is the maximum number held by a two byte word (16 bits) in memory, where the most significant bit is reserved as the sign bit (a plus or minus indicator). Additionally, ERM precinct

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www.essvote.com

count level data is stored in a binary computer format known as two's complement. Data on ERM results reports are printed as the absolute value of the two's complement of the associated data in the ERM database. This means that once the 32,767 limitation is reached, additional incremental tallies of vote results would not be printed correctly (32,768 through 65, 536 would actually be represented as 65,536 to 32,768).

While this value, 32,767 is certainly higher than any practical value that could be tabulated in a single election day precinct, the consideration of reporting all absentee ballots or early voting into a single absentee or "One Stop" precinct does hold the possibility of yielding much higher totals than what may be possible in single election day precincts.

While the discrepancy in preliminary vote totals did cause some early confusion, it is very important to note that the final results reported to the state were accurate and complete. Final counts based on the Votronic systems and paper tapes were fully accurate and correct.

To avoid this limitation in elections where the One Stop early voting totals may exceed the 32,767 limitation, ES&S would recommend one of the following:

1. Using the Unity EDM software, code multiple precincts to support the larger counts. Create a split for each ballot style for each precinct. Configure early voting terminals and follow vote collection procedures that would ensure no individual precinct totals would approach the 32,767 limitation.

2. Collect early voting "One Stop" and other absentee votes into Election Day precincts.

3. Upgrade systems and software to the Unity 2.5 or Unity 3.0 versions, when available in North Carolina. The ERM database has been expanded in these versions to accommodate vote totals in excess of millions of votes in any individual precinct.

Heretofore, in previous elections, Guilford County had configured, collected and distributed the early voting results into multiple separately defined precincts (as suggested above, avoiding this limitation). ES&S was not aware that this practice had changed. Had we been aware of this change, we would have advised Guilford County of this limitation and suggested one of the other configuration options.

ES&S shares Guilford County's commitment to making sure every vote cast is counted accurately. We are absolutely confident in the accuracy of the final results that were reported. If you have additional questions on this issue, please do not hesitate to contact me.

Sincerely,

Ken Carbullido
Senior Vice President, Product and Software Development
Election Systems & Software Inc.

Maintaining Voter Confidence. Enhancing the Voting Experience

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