

Election Security

COMP620

I understand some voting machines have been hacked. How do you hack a voting machine?

With this.



Many Voting Systems

- States and local jurisdictions usually control voting
- There are about 100,000 polling places in the U.S. grouped into about 8,000 precincts
- About 1 million people are involved in tabulating the results in the U.S.

- This level of diversity makes a coordinated attack against all systems much more difficult

Guilford County

- Charlie Collicutt is the Director of the Guilford County Board of Elections and Craig Fox is a member of the elections board
- Guilford county has 134 poling places

Registration

- You must be registered before you can vote
- Registration requirements and process varies across the country
- In North Carolina you can register or cancel registration by mail, at the Board of Elections or the DMV

Required	Optional
Name	NC driver license
Address	Last 4 of SS number
Date of Birth	State Voter Registration number

Voting Process

- When I walk into the polling place, a person at the table asks my name
- They find my name in a notebook or with a computer
- They either remove a sticker with my name and put it on a paper form or print a paper form, which I sign
- I give this paper to a poll attendant who takes me to an electronic polling machine

Voting Process (continued)

- The polling attendant inserts a block into the machine to activate it
- If I am early voting, the attendant enters my precinct information
- I press the buttons indicating my selections. My selections are printed on a roll of paper
- At the end, a summary is displayed
- After reviewing the summary, I press a button to cast my vote

Voting Machines

- The voting machines in Guilford County were purchased in 2006
- They do not have network connections (no Ethernet, wireless or modem)



Voting Machine Preparation

- The voting machines are programmed by Guilford Board of Elections personnel. No outside contractor is involved
- The computers used to program the voting machines do not have network connections and are stored in a vault when not in use
- The voting program is loaded on the voting machines with a memory card

Voting Machine Preparation (continued)

- Memory cards are carried to the voting site by election personnel
- Each memory card has an ID which must match the ID of the voting machine
- There is a password needed to start the machines
- The voting machines (without memory cards) are stored at voting locations before the elections

Voting Machine Operation

- When a voter makes a selection, the machine prints the choice on the paper roll and stores it electronically
- The paper is a Real Time Audit Log (RTAL)
- Nothing is finalized until the voter presses the final button

Collecting Information

- After the polls close, the results from each voting machine are loaded onto a flash memory card
- The machines prints two copies of an aggregate count of all races
 - Both copies are signed by the local election official
 - One copy is carried by that election official to the county election headquarters
 - The other copy is mailed the next day by a second election official

Auditing

- A statistically significant sample of the paper logs are audited
- The paper results are compared to the electronic results for randomly selected machines

Official and Press Results

- The Guilford County Board of Elections gives the press a copy of the results as soon as they are available from the precincts
- The official results must be given to the state within 10 days of the election

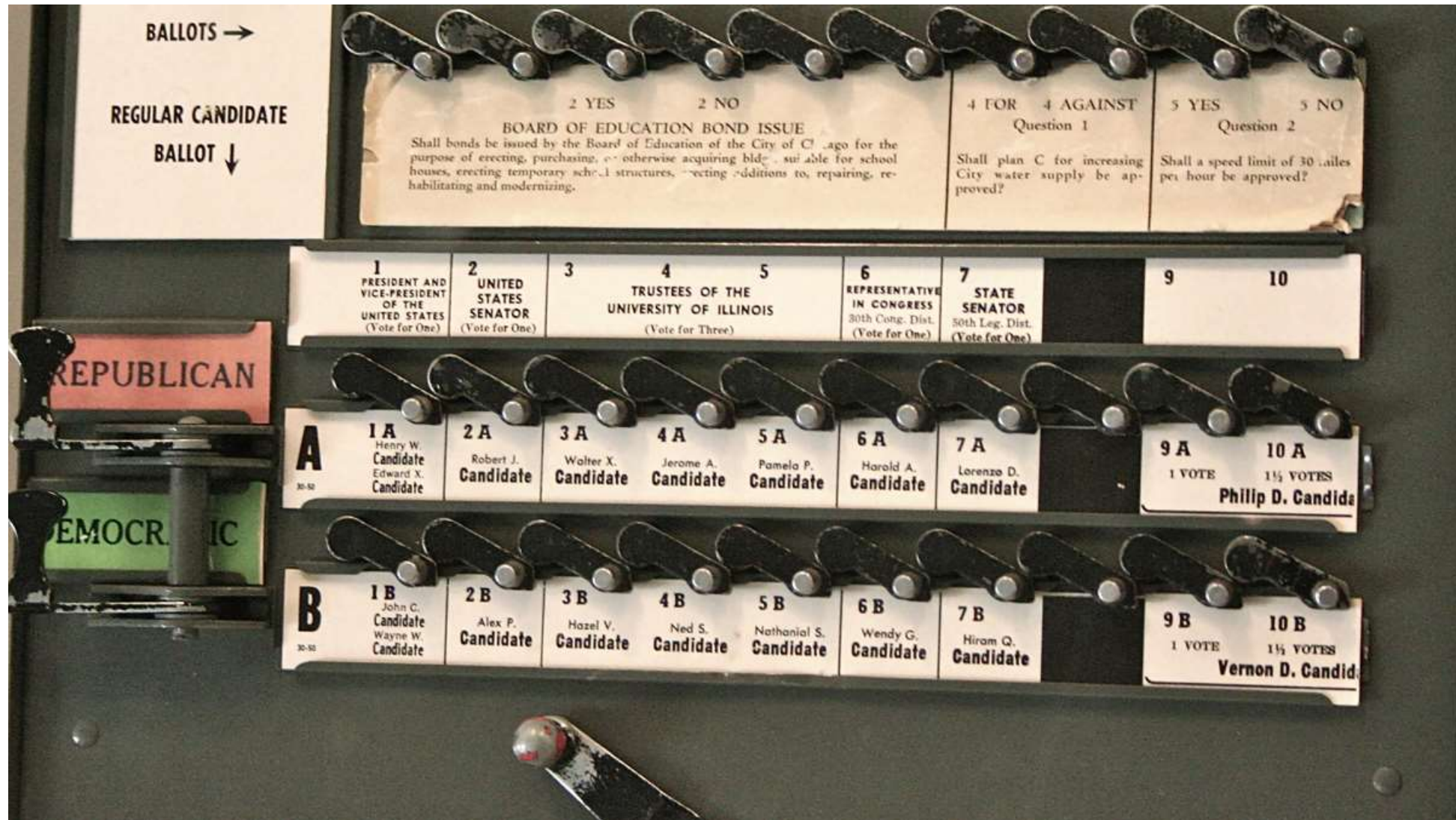
Scantron Voting Machines

- A voting system that combines paper ballots and electronic tabulation is the Scantron voting system
- Voters darken a circle next to their selection
- A machine reads the ballots and tabulates the results
- Similar to standardized exams



Old Voting Process

- In years past, I voted with older, non-electric machines



Old Voting Booths

- You went into a voting booth and closed the curtain by moving a large handle
- You pushed down a lever for your selections
- When you were done, you moved a large handle which added your votes to the total and opened the curtain



- An array of counters held the election results

Vote By Mail

- Used in Oregon, Washington and Colorado with California and Utah considering it
- Ballots are mailed to voters about three weeks before the election date
- The voter marks their ballot, puts it in a secrecy envelope and puts that in a mailing envelope
- The ballot must be sent or received by a specified date
- Ballots may be carried to drop off boxes
 - About half of Oregon voters drop off their ballot

Absentee Ballots

- Registered voters who expect they will not be able to personally go to the polling place on election day, can get an absentee ballot
- Proof requirements for absentee ballots vary widely
- In the 2016 election, about 25% of all ballots were by mail, either Vote By Mail or absentee

Absentee Ballot Security

“There isn’t evidence of a widespread problem, but inevitably, when there are stories of voter fraud, they show up in mail balloting and, in particular, in absentee balloting,” Charles Stewart III, MIT political science professor said. “It is rare for there to be a chain of custody of mail ballots.”

Hand Counting Paper Ballots

- Some people propose hand marked paper ballots
- The ballots would be publicly counted by hand
- Proponents point out the transparency of the process would reduce the possibility of fraud

What do you think about hand counted paper ballots?

- Are they accurate?
- Are they subject to fraud?
- Are they efficient?
- Would hand counting be better than our current electronic voting machines?

2016 Voting Irregularities

- Russian social media campaign to discredit Clinton
- Someone hacked into the Democratic National Committee's computers
- Someone stole Hilary Clinton's emails and gave them to WikiLeaks
- Russian government-linked hackers targeted as many as 21 states' election systems

Russian Social Media Campaign

- The US intelligence community concluded in a declassified report released Friday that Russian President Vladimir Putin ordered an “influence campaign” aimed at hurting Hillary Clinton and helping Donald Trump in the 2016 presidential election.
- Much of what the Russians were reported to have done would not be illegal if an American did it

Attack Against DNC Computers

- In September 2015 the FBI warned the DNC that their systems had been compromised
- In March 2016 Clinton campaign chairman John Podesta revealed his password to a phisher
- Hackers steal emails from DNC systems
- Days before the Democratic National Convention, WikiLeaks published 20,000 emails hacked from the DNC server

Russian Probing of State Election Systems

- Some state election system were scanned for vulnerabilities
- Some state systems were breached allowing the intruders access to voting records
- No election results were accesses or manipulated

Computers in Election Tabulation

- The individual voting machines are often isolated
- Results are aggregated with county and state computer systems
 - There is no national vote aggregation system
 - The Electoral College representatives decide the election
- County and state computers could be vulnerable

Two Party System

- In most elections on the NC ballot, there are only two candidates running for each position

Number of Candidates	Occurrences
1	13
2	22
3	3
4	1
9	1

Run Off Elections

- When there are only two candidates, the winner should be the candidate with the most votes
- When there are more than two candidates, there are several systems for deciding who wins
- Some systems require the winner to get more than 50% of the votes
- If no body gets more than 50%, a run off election is held against the top two candidates

Ranked Voting Systems

- Election in some other states or countries, there are many people running for a position
- Instead of voting for their one favorite candidate, they rank the candidate in preference order
- There are several ways to determine the winner

Rank any number of options in your order of preference.

- Joe Smith
- 1 John Citizen
- 3 Jane Doe
- Fred Rubble
- 2 Mary Hill

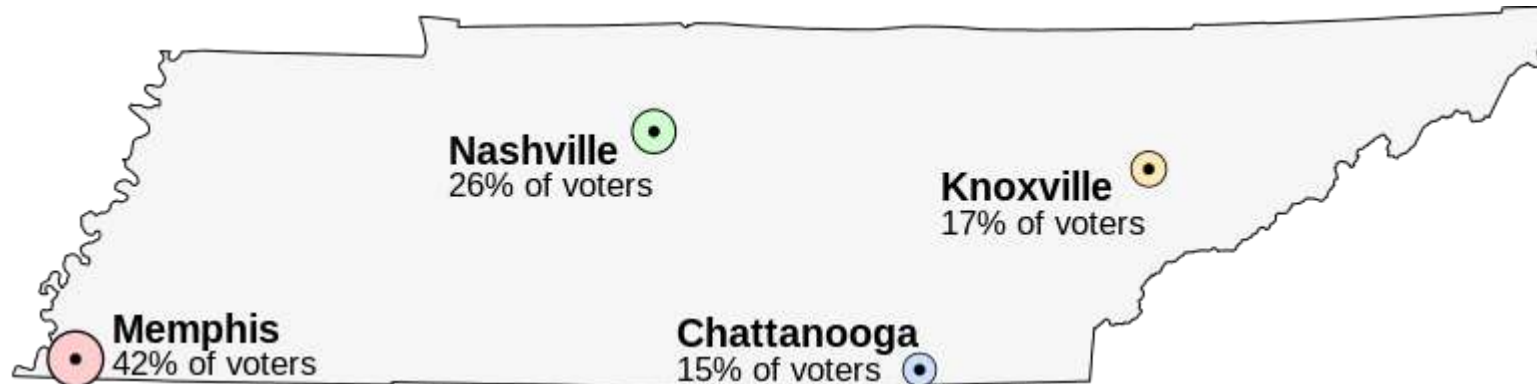
Condorcet method



- Devised by the 18th-century French mathematician and philosopher Marie Jean Antoine Nicolas Caritat, the Marquis de Condorcet
- The winner is the candidate who would beat all other candidates in a pairwise election
- While this usually works, there are certain situations where it does not work

Condorcet Example

- Assume voters are trying to select a capital for Kentucky and voters always pick the closest city



Voting Results

42% of voters (close to Memphis)	26% of voters (close to Nashville)	15% of voters (close to Chattanooga)	17% of voters (close to Knoxville)
1.Memphis 2.Nashville 3.Chattanooga 4.Knoxville	1.Nashville 2.Chattanooga 3.Knoxville 4.Memphis	1.Chattanooga 2.Knoxville 3.Nashville 4.Memphis	1.Knoxville 2.Chattanooga 3.Nashville 4.Memphis

- Pairwise winners summing each time one city gets more votes than the other

Pair	Winner
Memphis (42%) vs. Nashville (58%)	Nashville
Memphis (42%) vs. Chattanooga (58%)	Chattanooga
Memphis (42%) vs. Knoxville (58%)	Knoxville
Nashville (68%) vs. Chattanooga (32%)	Nashville
Nashville (68%) vs. Knoxville (32%)	Nashville
Chattanooga (83%) vs. Knoxville (17%)	Chattanooga