09. Mobile Devices and Safety-Critical Systems

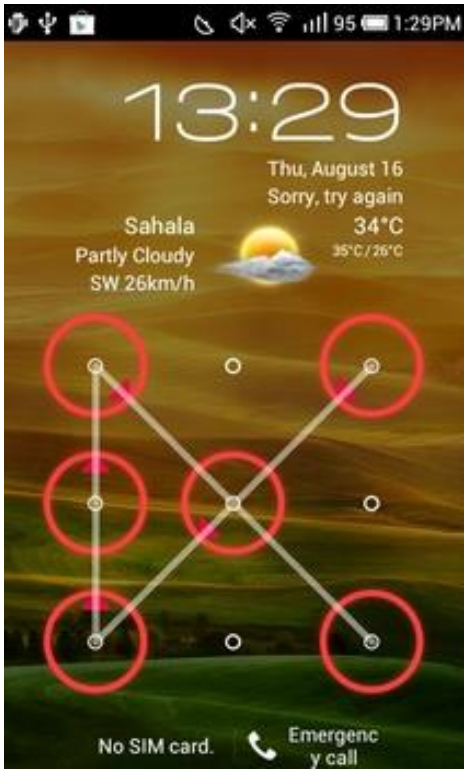
Blase Ur, April 30th, 2019
CMSC 23210 / 33210

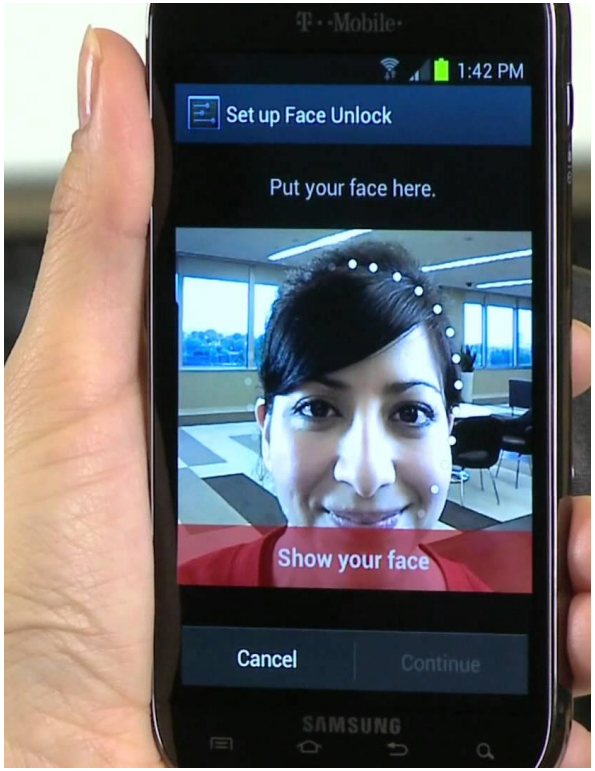
THE UNIVERSITY OF CHICAGO

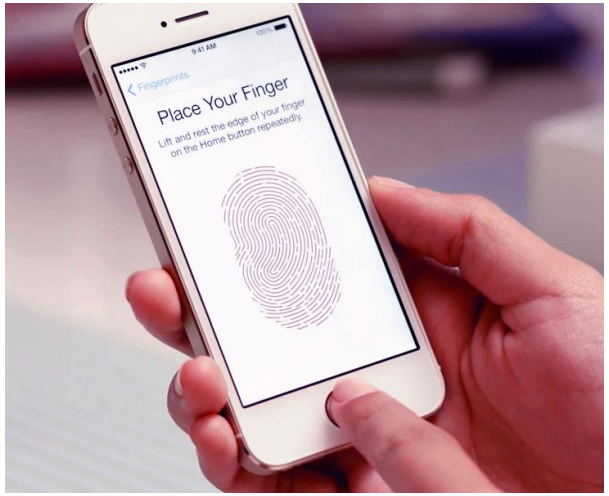
Security, Usability, & Privacy Education & Research

Mobile Devices

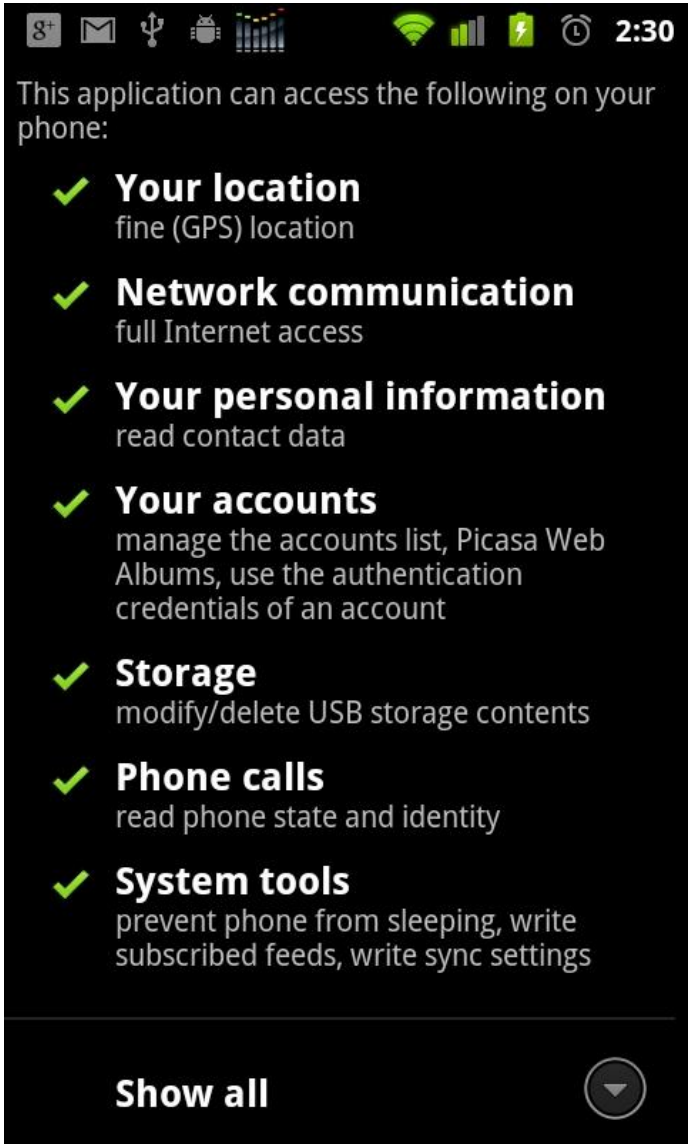
Authentication







Permissions Model for Apps



Phones in the Legal System

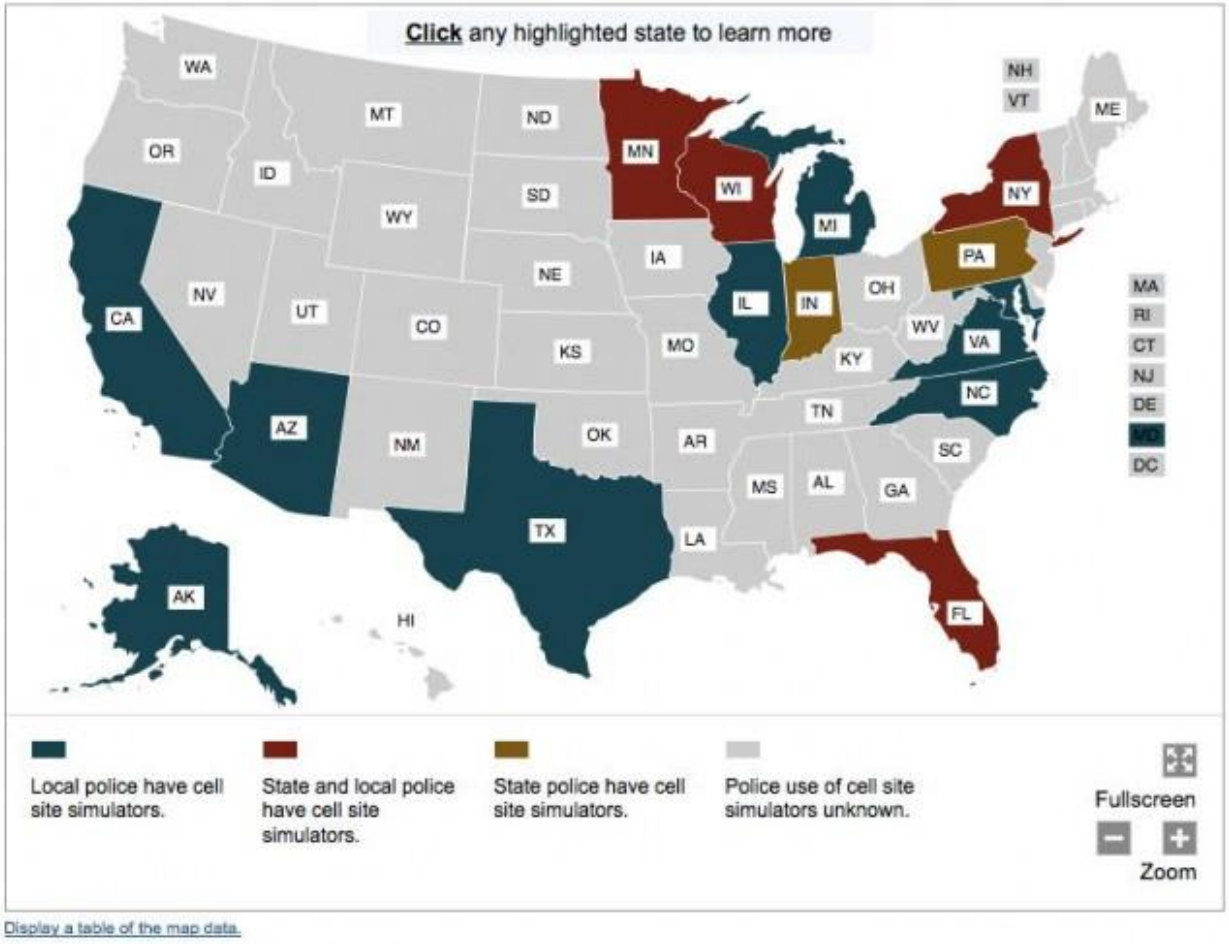
- Riley v. California
  - SCOTUS 2014
- Unanimous ruling that **warrantless** search of a phone during an arrest is unconstitutional

Mobile Devices

- What are some other key security and privacy challenges for mobile devices?
  - Tracking for advertising
  - Tracking using MAC address
  - Tracking using accelerometer
  - Lack of desktop-based tools
  - Authentication of telephone networks

Mobile Devices

- Stingrays (cell site simulator)



Safety-critical devices

Cars

https://www.youtube.com/watch?v=oqe6S6m73Zw

https://www.youtube.com/watch?v=3jstaBeXgAs

Meta-issues with car privacy/security

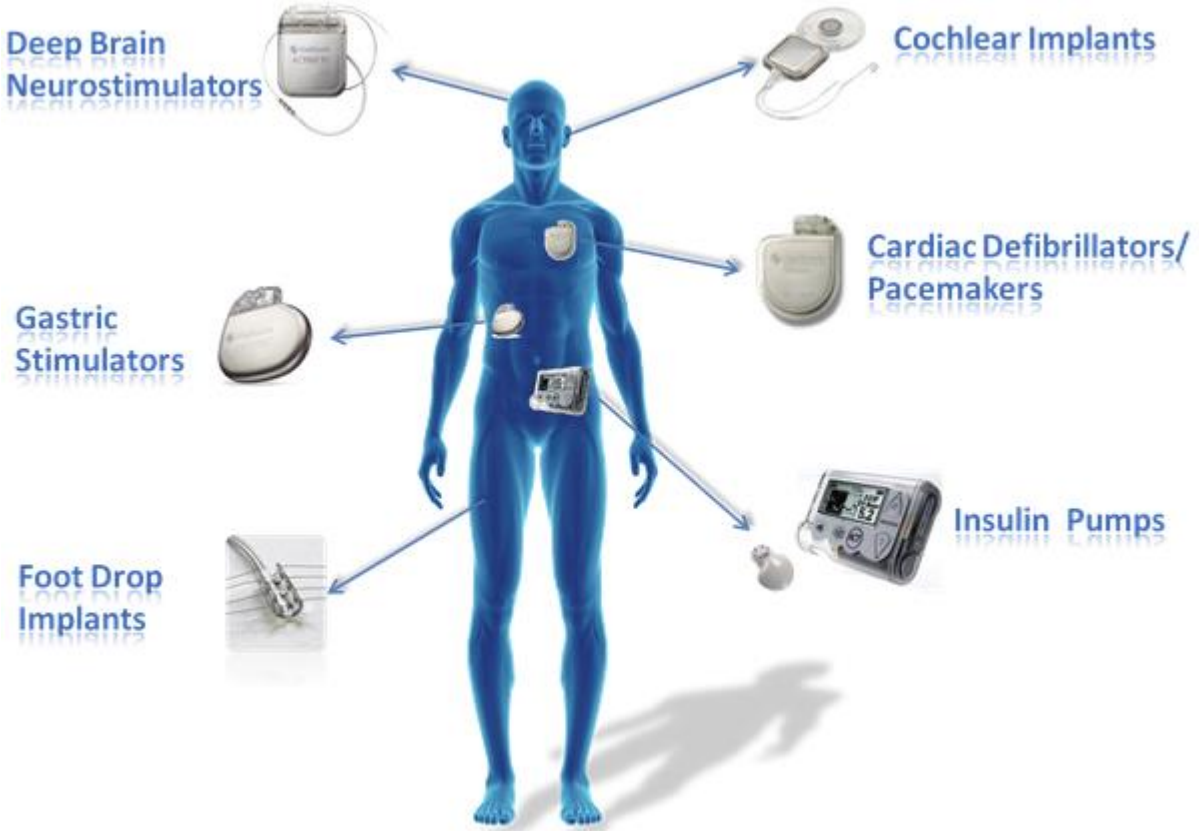
- Why are our cars run by computers?
- Why are we connecting our cars to the Internet?
  - Rich media content
  - Real-time traffic and safety info
  - OTA updates
  - Self-driving cars
  - (Surveillance)
- Are privacy/security issues the same?

Meta-issues with privacy/security

- Let's answer the same questions for medical devices

Implantable Medical Devices (IMD)

- Embedded computers
- 350K Pacemakers & 173K Cardiac Defibrillators in 2006

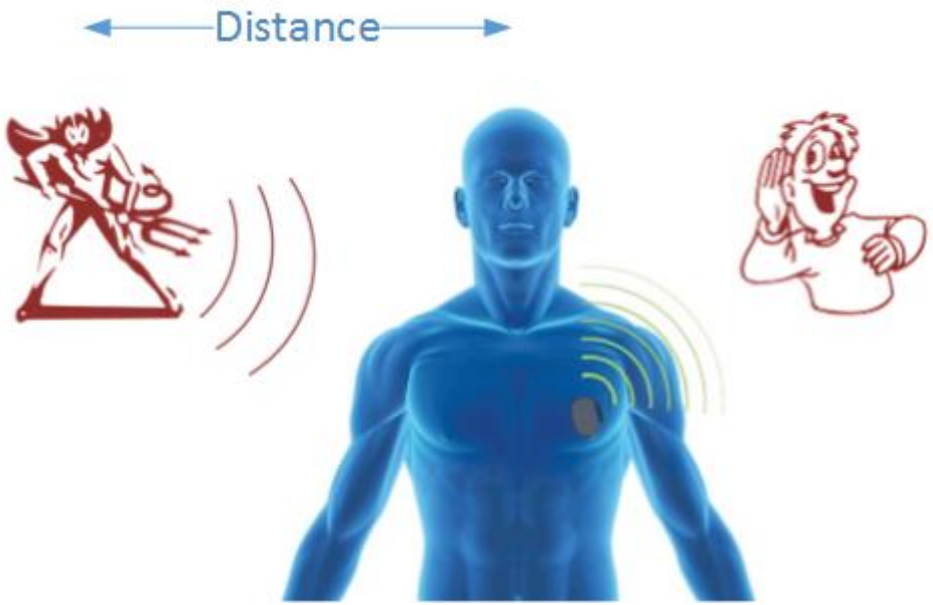


Operational Requirements

- Possible goals
  - Collect information (diagnostics)
  - Provide information (medical history)
  - Perform medical function
- Disable IMD before conducting surgeries
- Access in emergency situations
- Constraints
  - Limited capacity of battery (replacement = surgery)

Risks in Medical Devices

- Vulnerabilities
  - Authentication
- Attack Vectors
  - Passive
  - Active
- Risks / threats
  - DoS
  - Changes in configuration
  - Replace medical records -- someone having a different operation
  - Injuries, death



Hacking Tests (1)

- **2008:** wireless access to a combination heart defibrillator and pacemaker (within two inches of the test gear)
- Disclose personal patient data
- Reprogram IMD to shut down and to deliver jolts of electricity that would potentially be fatal

Hacking Tests (2)

2011-2012-2013

- Hacking Insulin Pumps

-- insulinpump.com

2013 -- Black Hat /Defcon:

- "Implantable medical devices: hacking humans"
  - At 30 feet by compromising their pacemaker
  - Transmitter to scan for and interrogate individual medical implants
  - Security techniques for manufacturers

-- ioactive.com

Defense Approaches

- How do we achieve resistance to attacks?
  - What are the classes of attacks?
- What can go wrong?
- How do we balance utility and security/privacy?

Authentication Methods

- Passwords: how to make them available?
  - Tattooed passwords (visible, UV visible)
  - Bracelet
- Biometrics (face recognition)
- Smart Cards
- Touch-to-access policy
- Key-based systems
- Shields
  - Necklace
  - Computational wristband

-- Figures from Denning et al.

Electronic Medical Records

- Why do we want *electronic* medical records?
- What are privacy/security concerns about electronic medical records?
- How do we mitigate those concerns?

Designing for Usability


What to do about hazards?

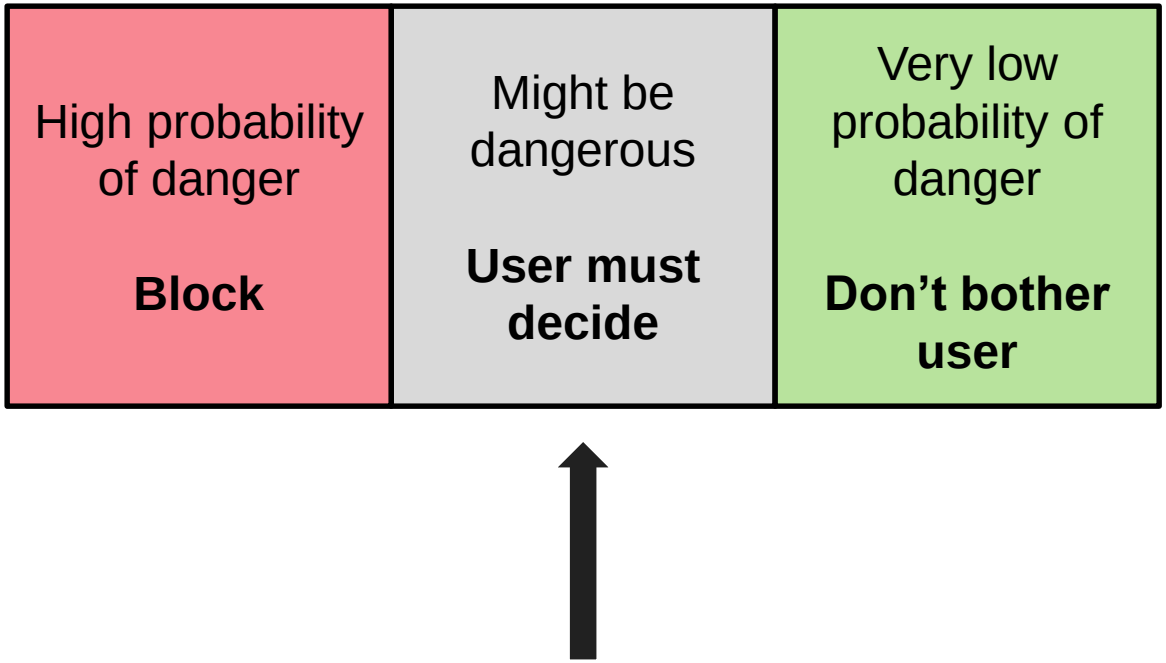

Best solution: remove hazard

If all else fails: warn

A better solution would be to add a spring so the door won’t slam

HOW

Support users' decisions



Help user decide by asking question user is qualified to answer

Image courtesy of Johnathan Nightingale

Bad question

Your web browser thinks this is a phishing web site. Do you want to go there anyway?

Don’t go there

Go there anyway


CREDIT CARD
ONLY
DEBIT CARD
ONLY
Cash Only
VISA
Pay with cash or credit
CANCEL
NO
YES
NO CASH
ACCEPTED

People were confused until they posted instructions

Design communicates function

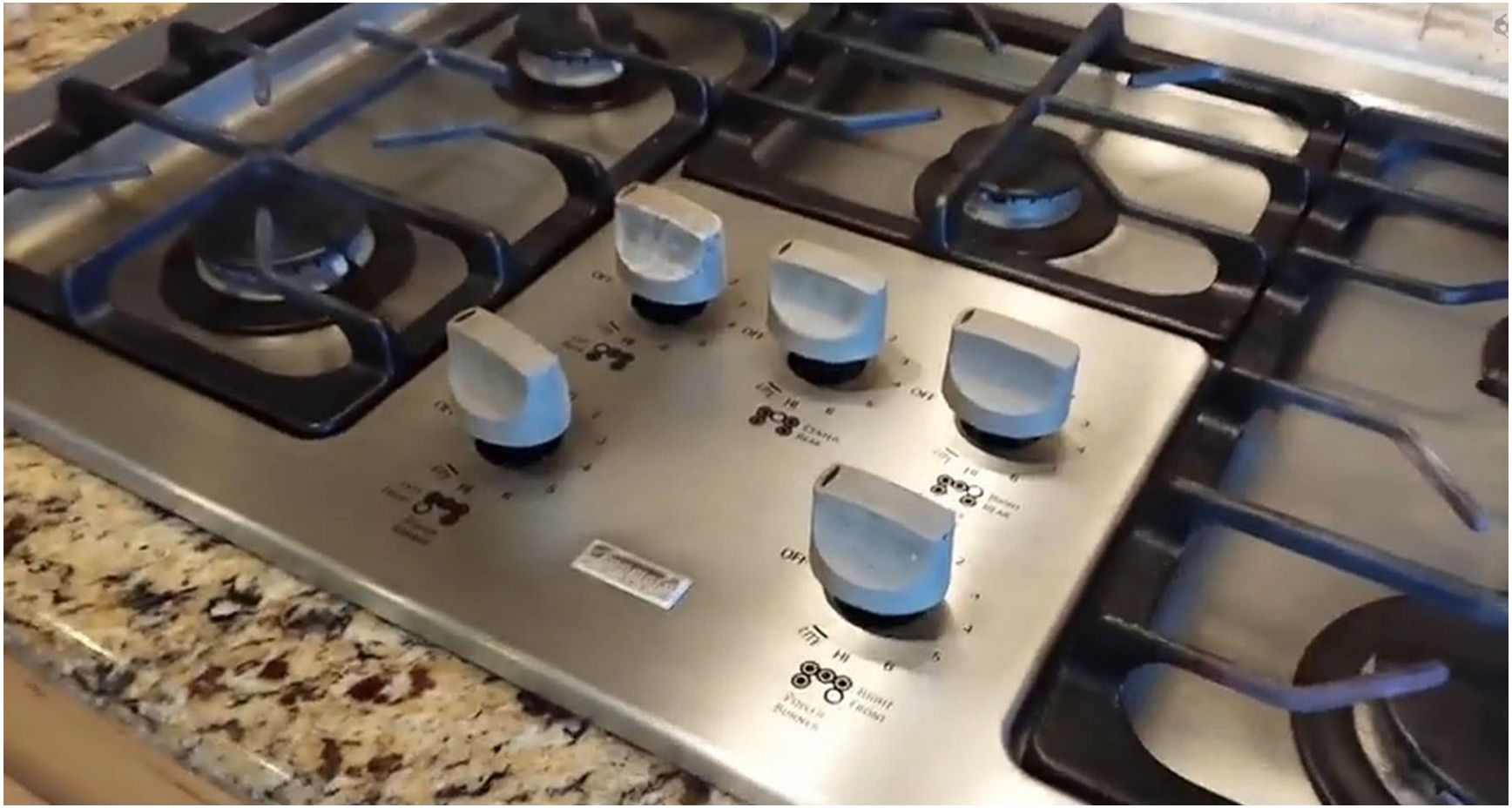
How do you unplug the sink?

How do you turn on this shower?

Stove layout

Stove layout

Stove layout



Doors


Please Use
Electronic Directory
For Contact Information
Wine & Chee
Party

Doors

Doors