INTRODUCTION TO iOS SECURITY
Lecture 16

COMPSCI 702
Security for Smart-Devices

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iOS SECURITY: MAIN TOPICS

- Introduction to iOS security
- iOS device and app trust evaluation
- Address Space Layout Randomisation (ASLR)
- iOS sandboxing
- iOS encryption
- Enterprise security in iOS
- iOS jailbreaking
- Recent iOS (in)security incidents
  - If we get some time

PORTABLE DEVICES

- What kind of portable devices do people carry?





- Are smartphones different from other devices?
  - How?

SMARTPHONES ARE DIFFERENT

- Always **with us**
  - Likely to be **lost** or stolen
  - Contain all sorts of useful **data**
    - E.g., Passwords, personal contacts, documents and emails
- Always **ON**
  - Present a continuous target
- Change **networks** repeatedly
  - **Multiple** wireless and cellular networks
  - Greater chance of Man-in-the-Middle (**MitM**) attacks
    - Especially on **FREE WiFi**
- **Password** protection
  - Less likely to use **long** pass phrases because of keyboard limitations

STANDARD SECURITY ATTACKS

- Smartphones are subject to almost all of the standard security attacks
  - Malicious websites
  - Trojan horses
  - Buffer overflow attacks
  - Social engineering
  - …

WHAT ARE WE TRYING TO PROTECT?

- **Data** on the device
- Data **sent or received** by the device
- Our applications (**apps**)
- Operating System (**OS**)
- Making sure the device **works properly**
- Making sure we do not get **charged** for services we have not intentionally used

IDEA BEHIND iPHONE

- Steve Jobs, CEO at Apple Inc. conceived an idea of **multi-touch screen**
  - Essentially removing the physical keyboard and mouse
- When Jobs reviewed the prototype, he came up with a second idea of implementing the technology onto to a **mobile**
  - The whole effort was called **Project Purple 2**, began in 2005
- Jobs introduced iPhone as a combination of
  - A **widescreen** iPod with touch control
  - A **revolutionary** mobile phone
  - A breakthrough Internet **communicator**

iPHONE OS 1.0 (2007)

- A cut down version of **OS X**
- Very **little** in terms of **security**
  - No privilege separation
    - All processes ran as root
  - No code signing
  - No Data Execution Prevention (DEP)
  - No Address Space Layout Randomisation (ASLR)
  - No sandboxing

iOS 1.0

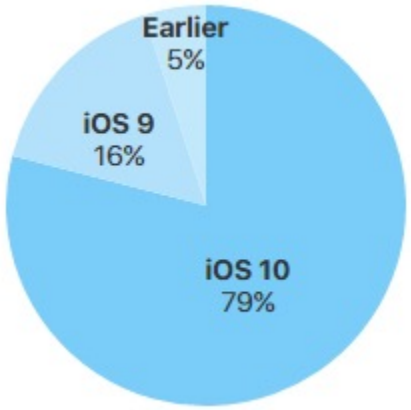
- There was an attempt to **reduce the attack surface**
- No support of flash or shell
- **Limited file formats**
  - MobileSafari cannot deal with all formats acceptable to Safari
    - Safari is the Apple web browser
  - PDF viewer only parses some features
    - PDF **rendering** has still been used in many **exploits**

iOS 2 – 10

- iOS 2 (2008) introduced the App Store
- Security was taken much more seriously

USAGE OF iOS

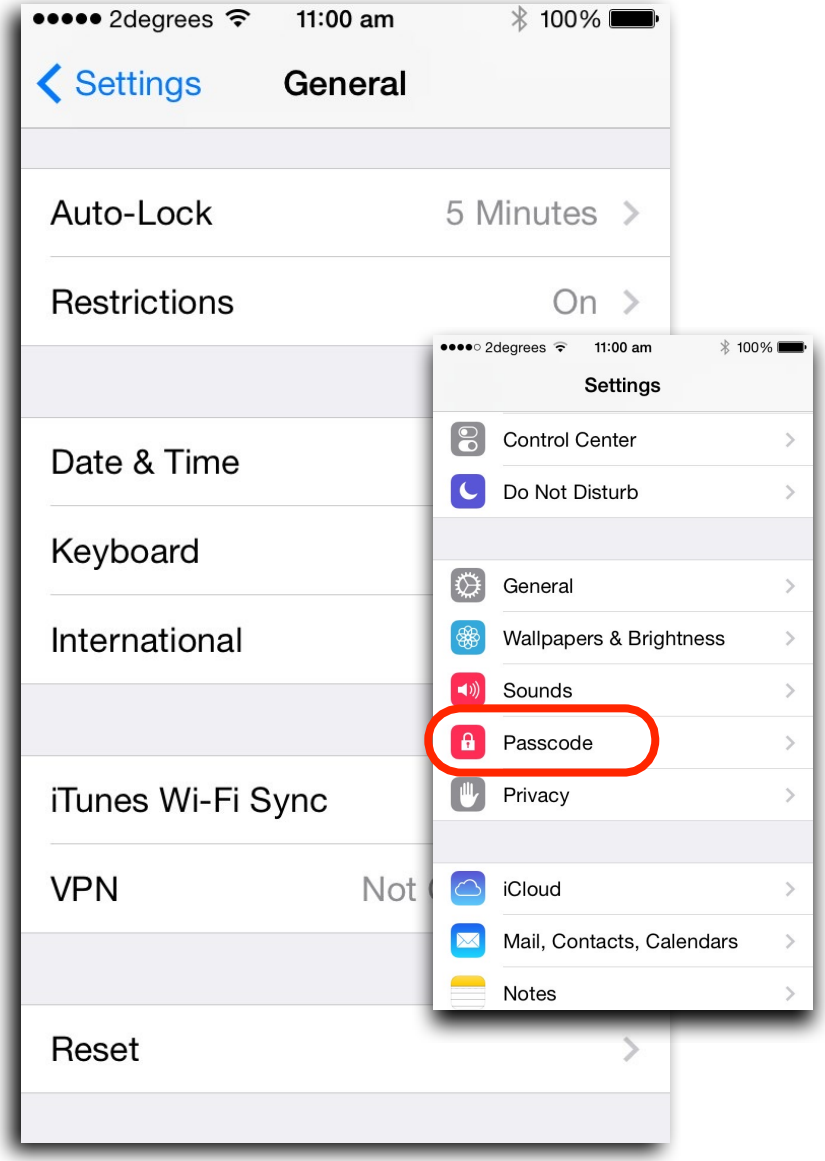
- As of February 20, 2017
  - 79% devices use iOS 10
  - 16% devices use iOS 9
  - 5% devices use earlier versions



  - Source: https://developer.apple.com/support/appstore/

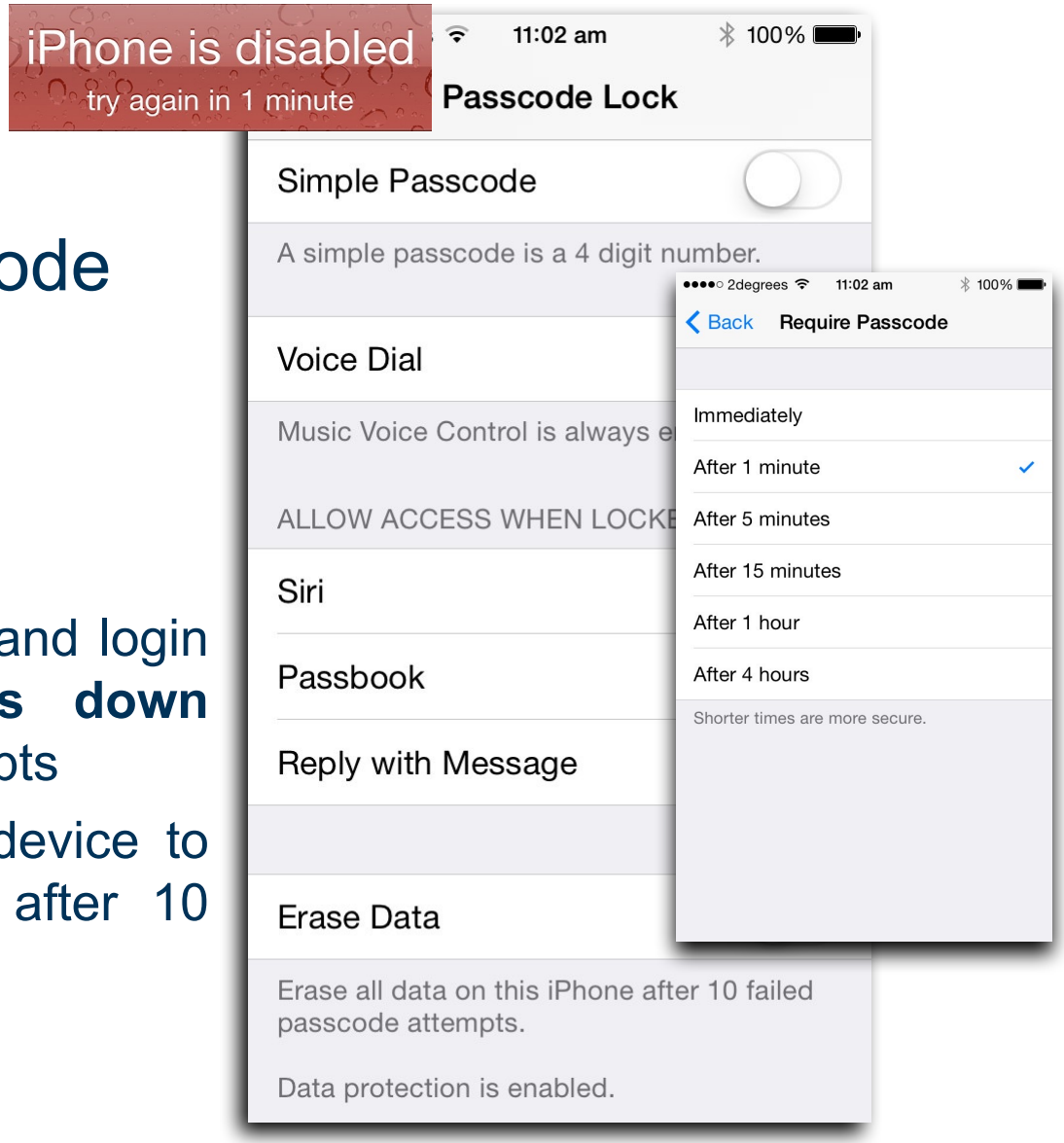
HOW CAN WE THE USER HELP?

- Use a **passcode**
  - Prevents easy access to others
  - Used to encrypt files on the device
- Combined with **auto-lock** and require passcode after
  - It means that an attacker probably has to enter a passcode
  - Even if the device was unlocked when taken



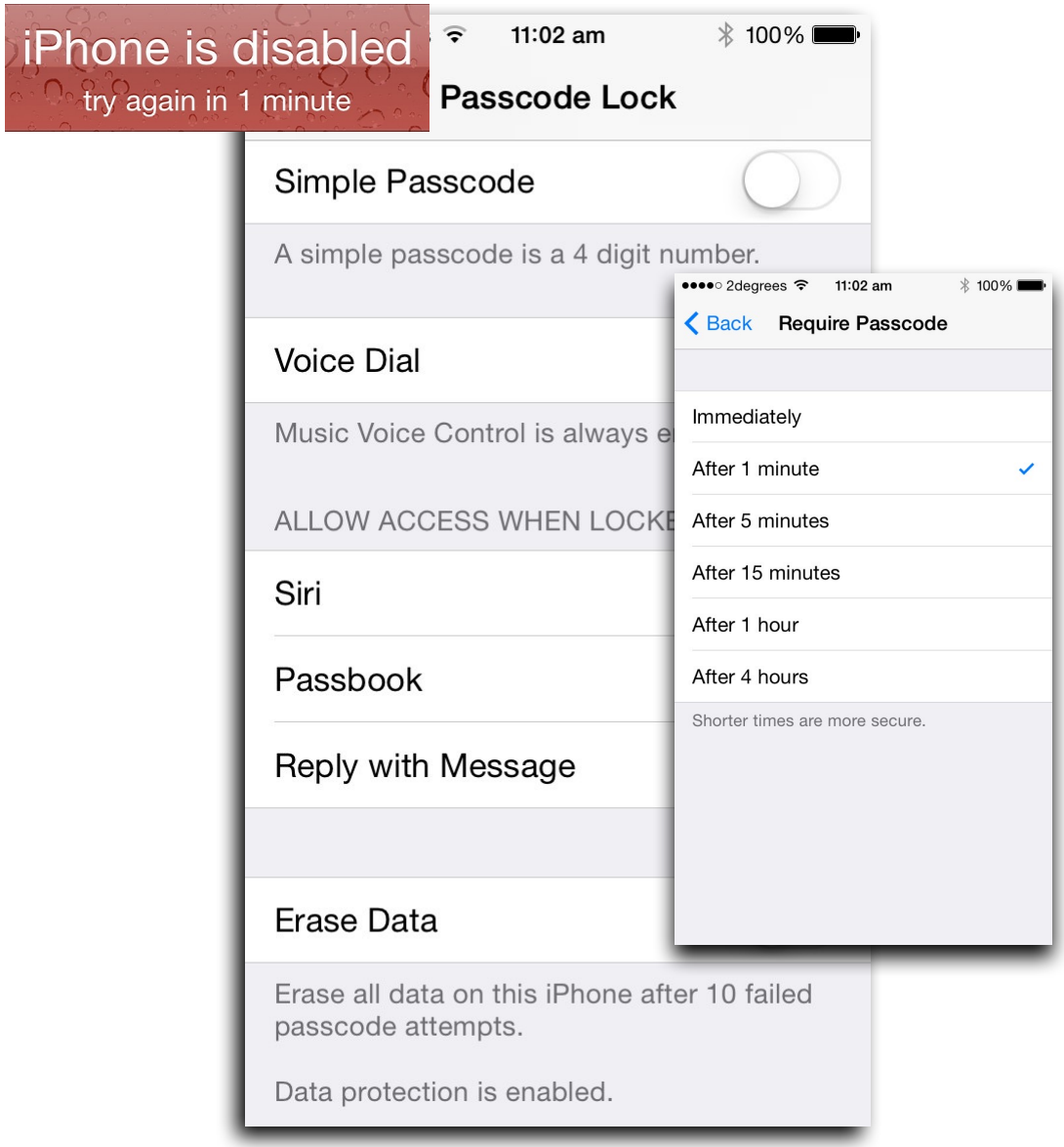
PASSCODES

- Use a strong passcode
  - Simple passcode off
- Brute-forcing
  - Springboard (home and login screen app) **slows down** after repeated attempts
  - Users can set the device to erase data quickly after 10 attempts



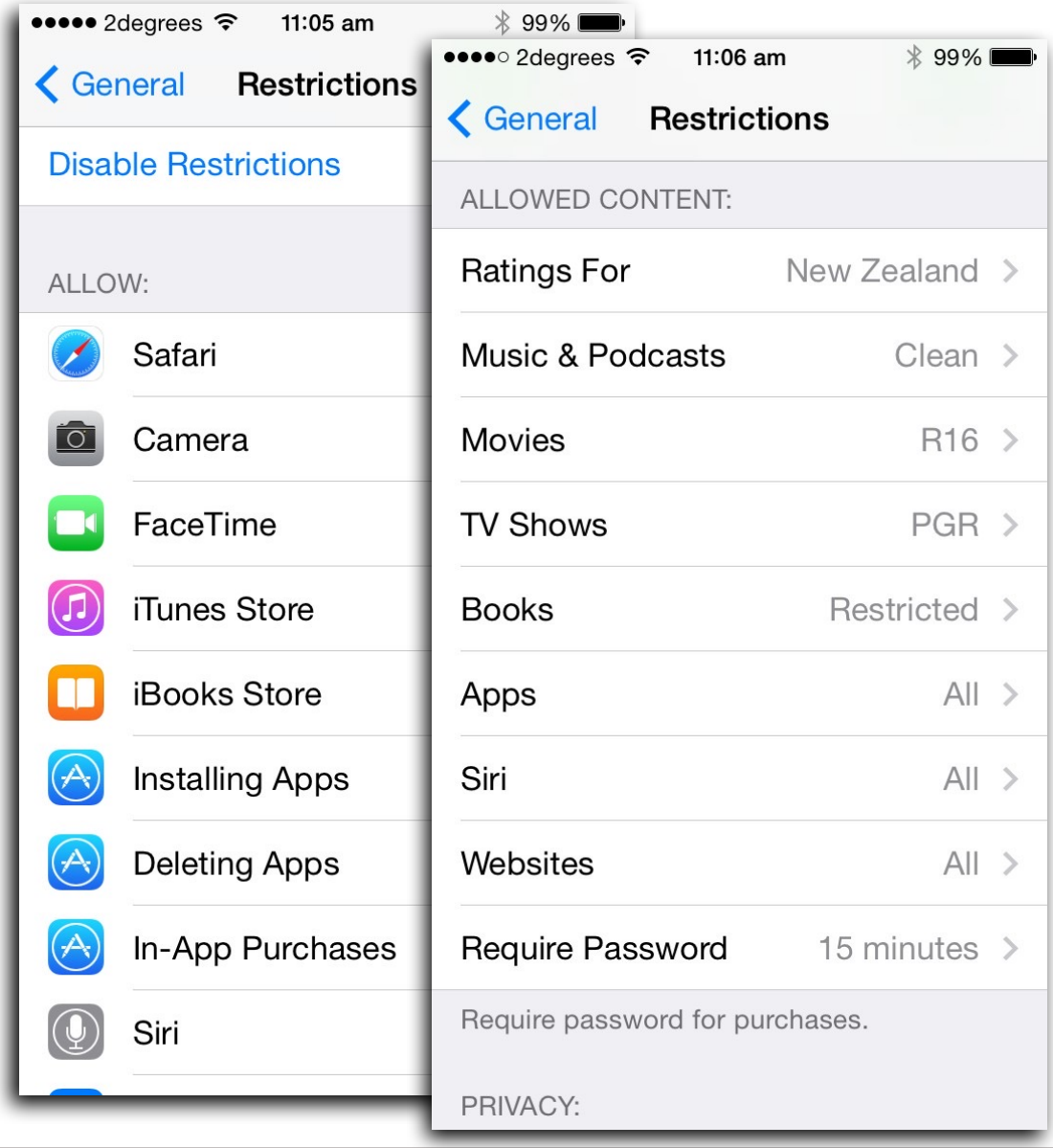
DELAYS BETWEEN PASSCODE ATTEMPTS

Attempts	Delay Enforced
1-4	None
5	1 minute
6	5 minutes
7-8	15 minutes
9	1 hour



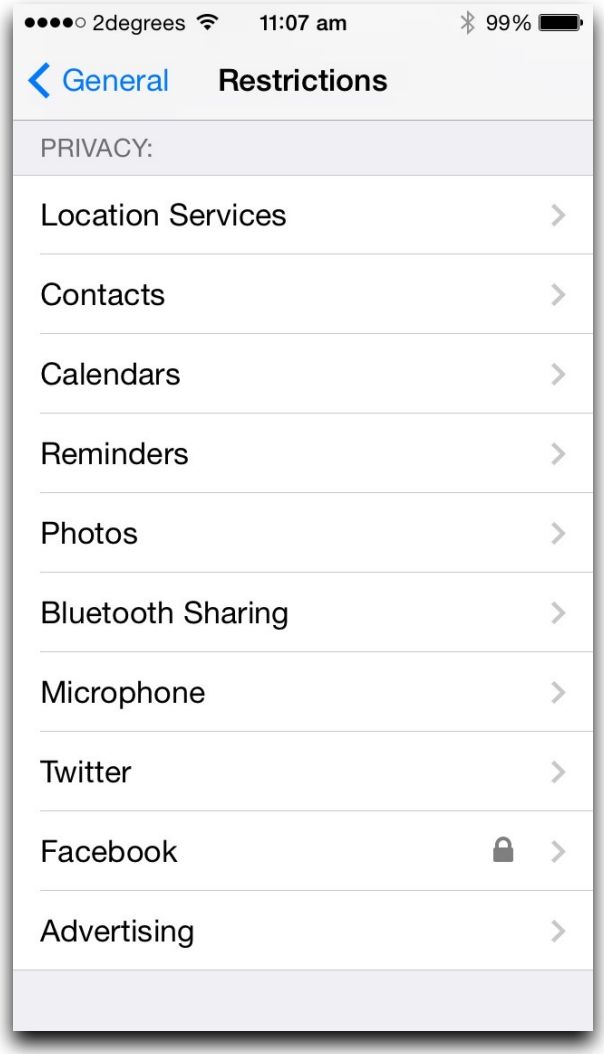
OTHER RESTRICTIONS

- To change these, you need the restrictions passcode
  - Different from device passcode



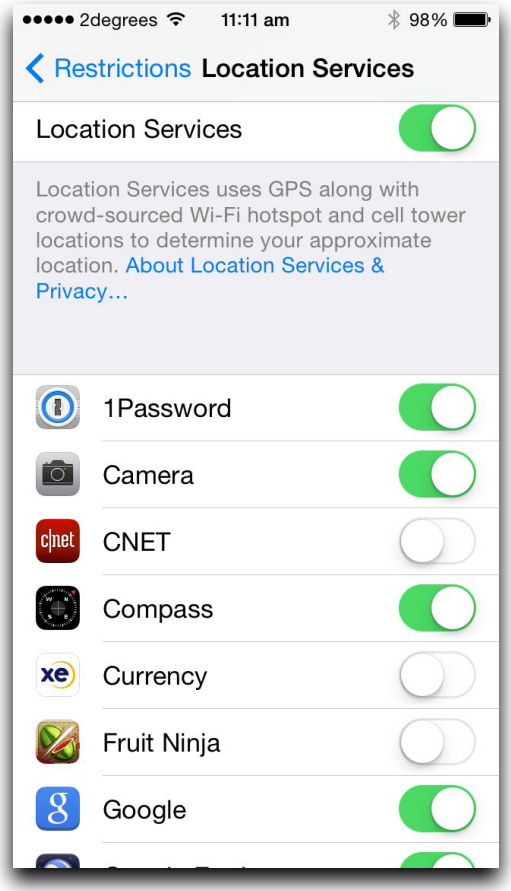
APP PRIVILEGES

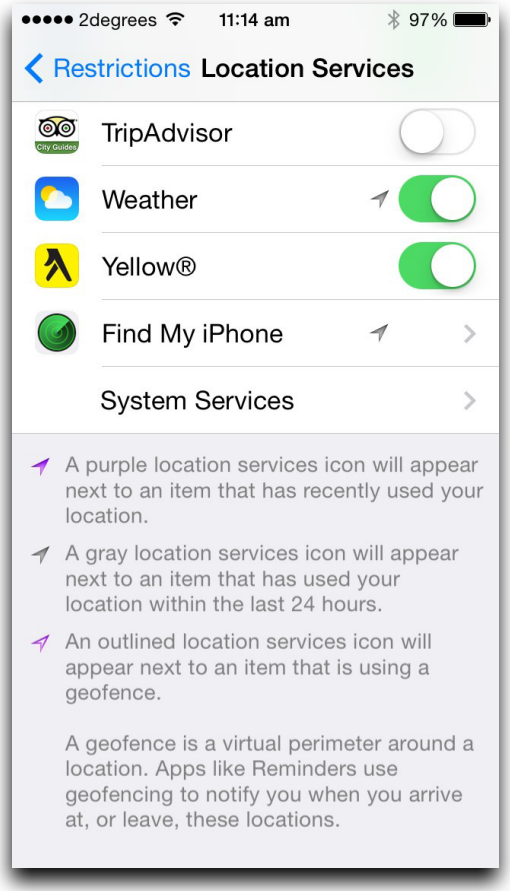
- Since iOS 6, the user is asked when apps first attempt to use “private” information
- Restrictions can be applied or lifted at any time



E.G. LOCATION SERVICES

- Every time you leave the Restrictions screen and return to it, you are required to re-enter your restrictions passcode





FIND MY iPHONE

- Must be set up on the device
  - Uses the user's Apple ID
- **Lock** – lost mode
  - If no passcode, will ask for one
  - Can put a message and phone number on the lock screen
- **Tracking** of the device begins
- Email sent to user's account when any event happens
- **Erase** contacts, email, music, and settings
  - Done very quickly by deleting the file system encryption key

STOP THIEF

- Mobile phone theft is a major **problem**
- Manufacturers now prevent device erasure without the correct password
- iOS 7 has "**Activation Lock**" turned on with "Find my iPhone"
  - Apple ID stored on Apple's activation servers
  - Cannot turn off "Find my iPhone", erase, reactivate or use without the ID and password
  - For details, see: https://support.apple.com/en-us/HT201365

REMOTE DISABLING/ DELETION OF APPS

- The infamous **kill** switch – Apple can disable or delete an app on your device
  - Not clear that it has been used at all
  - Google used it on Android devices
  - Windows 8 app store apps also can be removed remotely

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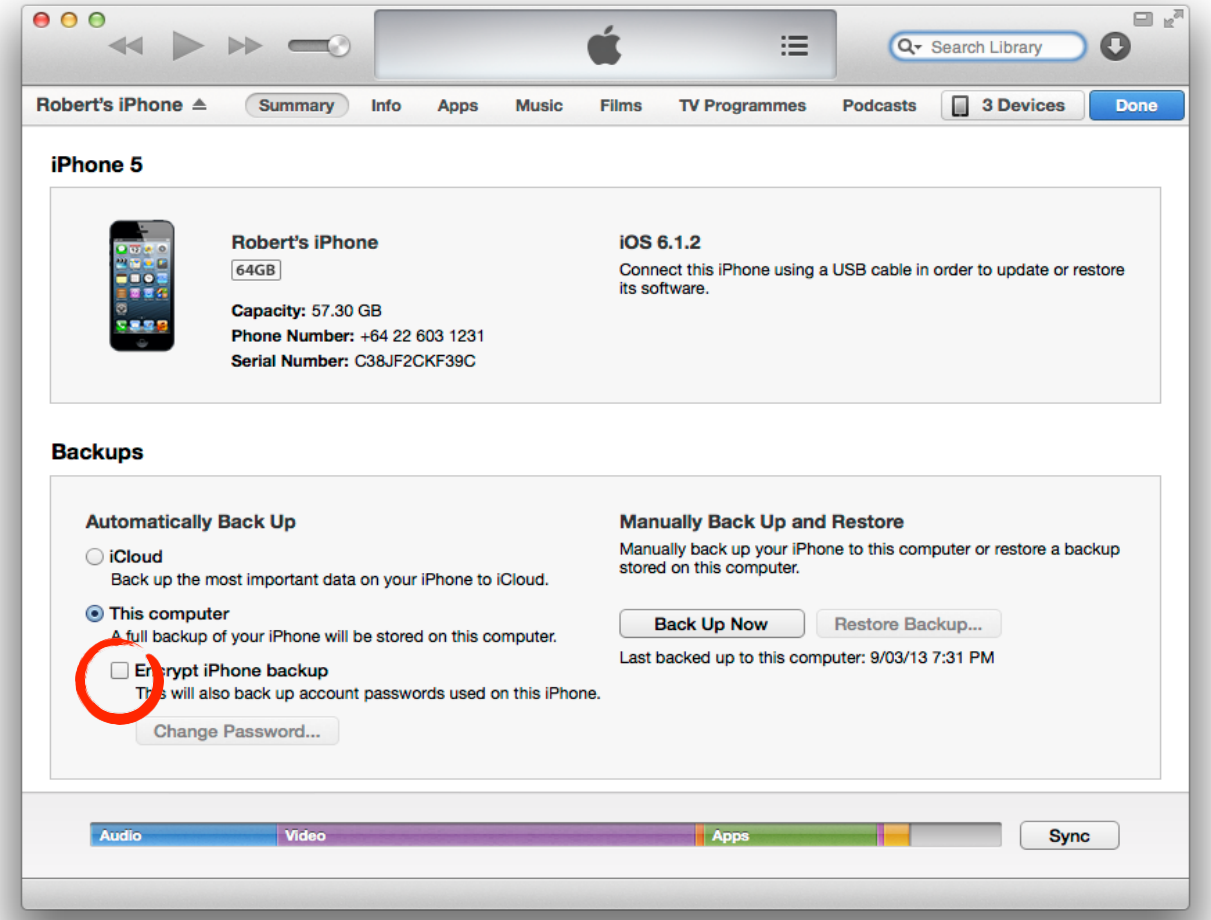
SECURITY PROVISIONS

- iOS now has many provisions to keep devices secure
  - Mandatory **code signing** and code signing enforcement
    - Protects against the execution of unauthorised native code
  - Address Space Layout Randomisation (**ASLR**)
    - Makes Return Oriented Programming (**ROP**) attacks harder
  - **Sandboxing** of apps
  - Data **encryption**
    - On the device and in the backups created with iTunes
      - Vulnerabilities in the backup restore process are one of the main ways to break into a device

RESTORING BACKUP



Cannot restore backup without the password (different from device passcode)

KNOWN VULNERABILITIES

- All versions of iOS before 4.3.5 are vulnerable to an **SSL MitM** attack
  - Many Android devices are also susceptible to this
  - Since iPhone(1), 3G and 1st and 2nd gen iPod cannot be upgraded beyond this, they will always be susceptible
- All iOS devices before October 2009 (up to and including many iPhone 3GS devices) are vulnerable to the 24kPwn or 0x24000 **segment overflow** exploit
  - This allowed the bootrom signature checks on the low-level bootloader to be avoided
    - Great for jailbreaking
- Several new bugs, flaws and vulnerabilities discovered for all new versions of iOS
  - The basis for more recent jailbreaks

TO BE CONTINUED

- See the next lecture

Questions?

Thanks for your attention!