

No QR Codes in this presentation

No Web page URLs either

Nonetheless, if you want to save slides immediately, then you can do that.

In TA1, shoot a screen photo with your smart phone or tablet.

The next slide provides instructions for those watching via Zoom.

How to Save any screen image to review it now or later

<i>Device Type</i>	<i>Keyboard keys OR button combo</i>	<i>Screen image file is stored in folder</i>
Windows	Win+PRTSCR	Pictures/ Screenshots
Macintosh	Shift+Command+3	Desktop
Android	Power+Volume Up	Internal storage/ DCIM/Screenshots
iOS	Home+Volume Down or Power+Volume Down	Photos

INVISIBLE APPS

on your smart phone or tablet

A Learn in 30 Presentation

By

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For PATACS + OPCUG

March 18, 2023

A bit of tech jargon

- **CPU:** Central Processing Unit. The chip that executes the Operating System (OS) and software.
- **RAM:** Random Access Memory. The memory in which a CPU can find and execute instructions, and create and modify data. RAM is very fast.
- **Flash Memory:** Permanent storage, far greater in size and yet much slower than RAM. Where the OS, apps and data are stored permanently. Also where the **Swap Space** is located. On a computer, a Solid State Drive (SSD) or hard drive serves the same purposes.

Multi-tasking

- Multi-tasking means that your computer, tablet and smart phone can each run multiple applications concurrently.
- Personal computers came into our lives first, before tablets and smart phones.
- Windows, for instance, has taught us an easy way to *identify* applications that are running, even when we cannot see their screen windows: **the task bar**.



Portable devices: not so easy

- On a portable device, it is relatively easy to remove one app from the screen and run another app.
- The removed app is *still running*, still using part of the CPU time, still in device RAM, still using battery power, and perhaps still using the Internet.
- The apps still running are normally invisible, until you make them visible.
- I call them **Invisible Apps**.
- Running too many invisible apps causes severe consequences.

I learned the effect of too many Invisible Apps the hard way

- In 2012, I bought an iPhone 5, my first smart phone. I did not know about invisible apps.
- I kept my phone running all the time, 24/7. One of my kids was in college, 500 miles away.
- One day, the phone slowed to a crawl, and was very hot. I researched the cause online: **too many Invisible Apps were running.**
- **64 apps, as it turned out.**

RAM is the key

- Non-running apps are in flash memory.
- When you run an app, it occupies RAM, the only place where a CPU can execute the app's software.
- When RAM fills up, and you start another app, the OS (Android or iOS) moves (**swaps out**) the least recently used apps to flash memory, to make room in RAM. Swapping out or in is a relatively slow process.
- An OS process called the **Scheduler** gives each running app a portion of CPU time. When an app's turn for CPU time comes up, if the app is swapped out, then the app must first be swapped into RAM.

Visualize Swapping

INITIAL STATE:

RAM:

F
G
H
I
J

Flash
Memory
(swapped
out):

A
B
C
D
E

Scheduler chooses to run app E.

Least-recently used app in RAM is **J**.

Swapping out **J**, plus any RAM not used, does not provide sufficient space for app **K** in RAM.

The OS then decides to swap out both **J** and **I**, the next least recently used app.

J and **I** are swapped out to flash memory.

E is swapped into RAM, and resumes running.

NEXT STATE:

RAM:

E
F
G
H

Flash
Memory
(swapped
out):

I J
A B
C D
E

Consequences of swapping

- Swapping happens without your conscious involvement.
- Because flash memory is slower than RAM, swapping is time-consuming (**slow**).
- Swapping also uses a lot of battery power because writing to flash memory is energy intensive. The device **heats up**.
- If RAM is full, then swapping takes up most of the device's CPU time. Everything else slows down: your interactions with the screen, and even charging.

What has changed since 2012?

- Portable device CPUs and RAM are faster
- Portable device batteries have greater capacity
- iPhone 5: 1 GB RAM^{OK}, 16 GB flash memory
- iPhone 14: 6 GB RAM^{OK}(6x), 128 GB flash memory (8x)
- Galaxy S5: 2 GB RAM^{OK}, 16 GB flash memory
- Galaxy S23: 8 GB RAM^{OK}(4x), 128 GB flash mem (8x)

OK means I checked the RAM specification after the presentation, and the figure is accurate

Heat Up and Slow Down: still a real possibility

- Apps have grown faster than device RAM

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- Symptoms of running many invisible apps can include: very slow reaction to your taps, heat buildup because constant swapping is energy intensive, and very slow charging because the device consumes almost as much power as your charger gives to it.

Heat Up and Slow Down: still a real possibility

- Apps have grown faster than device RAM
- Symptoms of running many invisible apps can include: very slow reaction to your taps, heat buildup because constant swapping is energy intensive, and very slow charging because the device consumes almost as much power as your charger gives to it.
- Today you will learn how to: reveal and browse invisible apps, and shut down invisible apps, and resume use of an invisible app.

Invisible Apps on iPhone using iOS 16

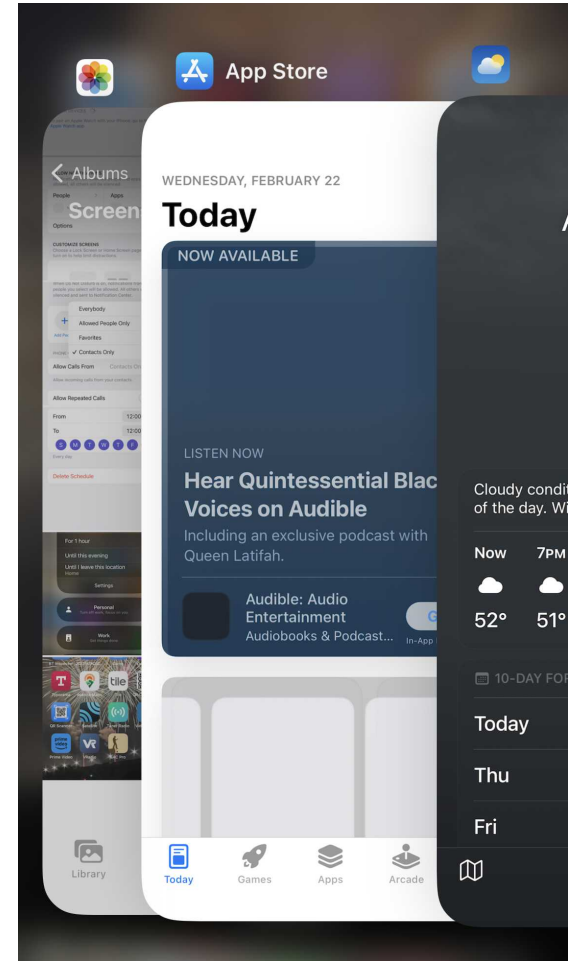
iPhone/iOS 16: Make your current app invisible

(show the Home screen)

- Gesture: place finger at center of app on the screen. Drag up and right.
- Older iPhones with Home button (pre-iPhone X): tap the physical Home button.
- App appears to shrink itself back into its screen icon.
- You might think that animated depiction means the app is no longer running. Not so!

iPhone/iOS 16: reveal Invisible Apps

- Gesture: Place finger at bottom center of screen. Drag straight up towards center.
- If any apps are invisible, then the Invisible Apps appear as a scrolling list of app tiles.
- Each Invisible App tile shows the icon for the app at top left.
- You can browse by swiping left and right through the list of app tiles.
- This list includes both apps in RAM and apps swapped out to flash memory.



iPhone: Resume Invisible App use

- To resume use of an invisible app in the list:
Tap the center of its tile in the list.
- To close the list: place finger at bottom center of screen.
Drag up and right. Pre-iPhone X: tap the Home button.
- When the Invisible Apps list is NOT visible, you can resume use of an invisible app by tapping its screen icon.
- When resuming invisible app use, if the invisible app is swapped out, then it must be swapped in to resume running. That may require the OS to swap out another app or two.

An interesting feature of iOS

- For as long as I have used computers, tablets and smart phones, no running app would survive a power-down of the device.
- In iOS 16 on my iPhone X, I found by experiment that **all invisible apps survived a power-down and startup.**
- How does iPhone do this? At power-down, all apps in RAM are swapped out to flash memory Swap Space.
- This automatic behavior ensures that no data is lost when the iPhone battery runs out of power.

Invisible Apps on phones using Android 13

Evolution of Android buttons

- My first Android phone, the Samsung Galaxy S5, had a physical panel below the screen, with a physical Home button and two side “soft” buttons.
- As of the Galaxy S10, all three became “soft” buttons projected onto the screen itself.
- The function of each button did not change.

Android Buttons

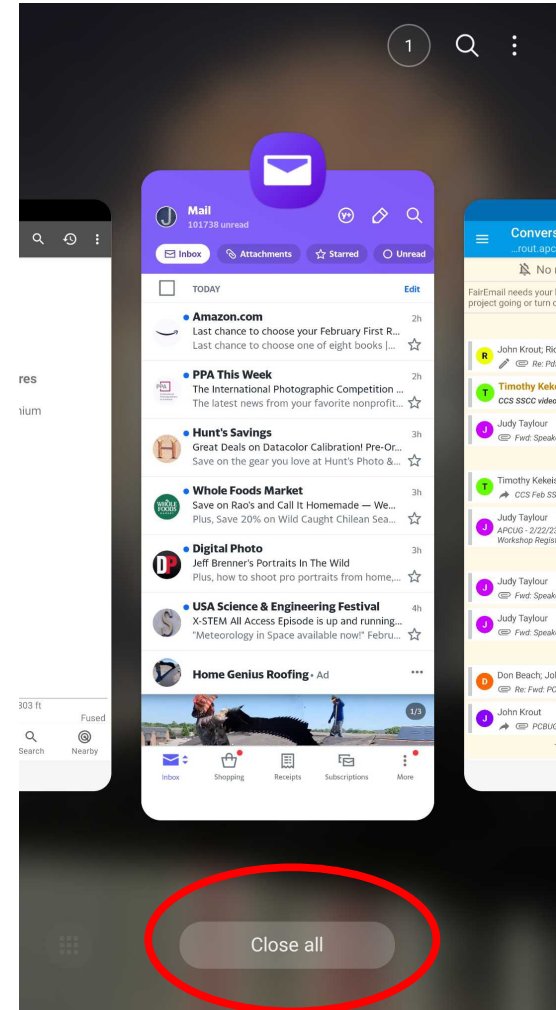
- Take a look at the Big Three at the bottom of the Android screen:



- If you do not see the Big Three, then tap&drag the bottom of the screen up.
- **Home** makes the home screen visible and the current app invisible. **Back** can do that in some contexts.
- **Task Changer** *display tiles of Invisible Apps*. The list include both apps in RAM and swapped-out apps.

Android 13 Invisible App tiles

- **Browse the list** of Invisible App tiles by scrolling left and right using a single finger.
- To **resume use** of an Invisible App, tap the app tile.
- To **close one Invisible App**, tap&drag its tile straight up.
- To **close ALL invisible apps**, tap the **Close All** button, or shut down and restart the Android phone.



The Bottom Line

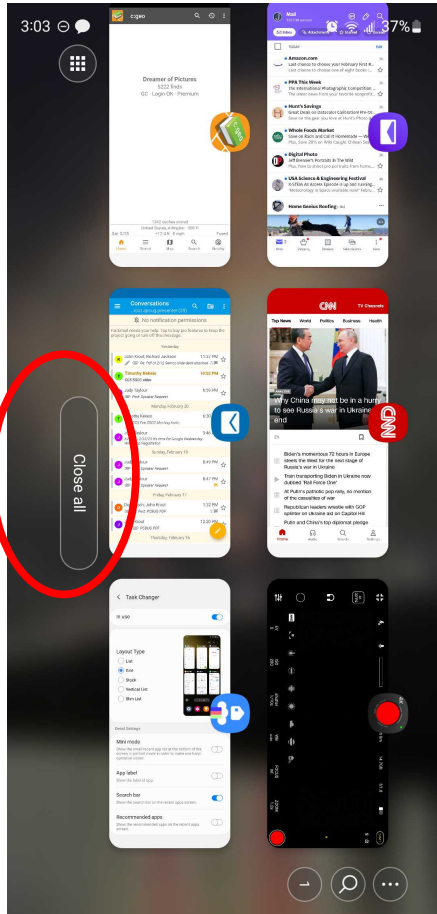
- The multi-tasking behaviors of Android and iOS are implemented in very similar ways.
- Mac OS, Android, iOS, Linux and Unix are descendants of the Multics OS that was developed in the 1960s by MIT, GE and Bell Labs.
- The best way to minimize delays due to swapping is to add RAM. You can do that on many Windows computers, but not on portable devices.

Customize the Task Changer list appearance on Samsung Galaxy phones

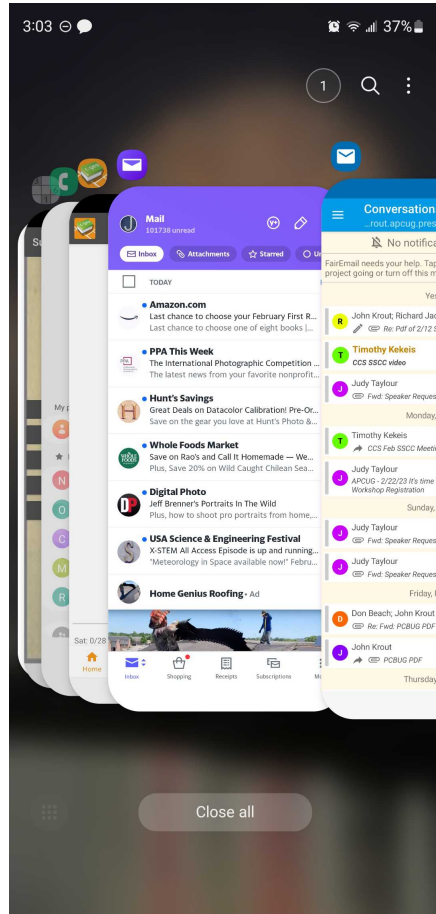
Samsung Galaxy phones

- Samsung Galaxy phones can download free apps to customize the appearance of Invisible App tiles.
- The default appearance and four others are available. You will see the others on the next slide.
- The free apps for this customization purpose are available on the Galaxy Store (NOT the Play Store).
- I happen to use the Slim List because that one can show as many as 11 Invisible App names on my Galaxy S20 phone screen.

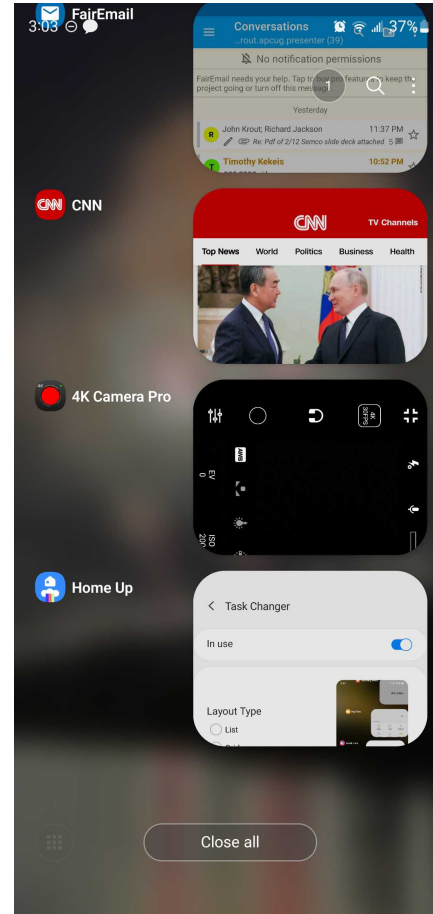
Samsung Galaxy app tile forms



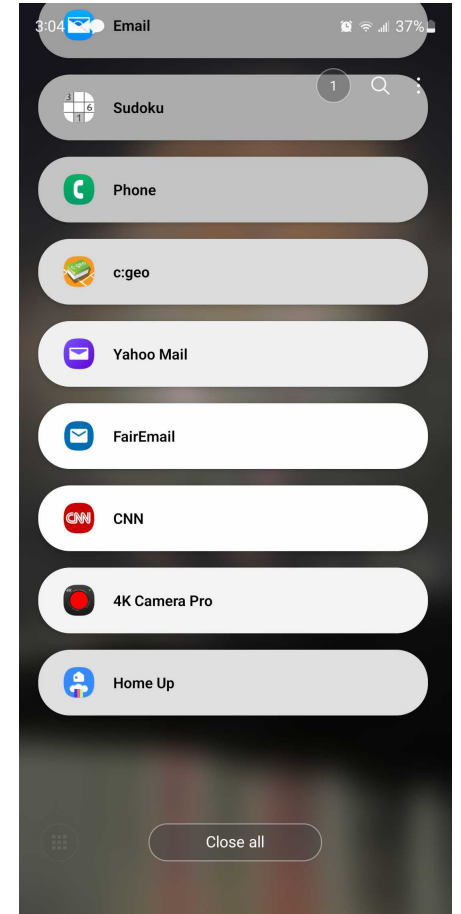
GRID



STACK

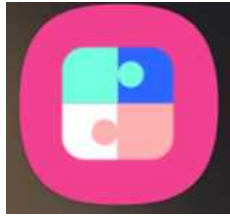


VERTICAL LIST

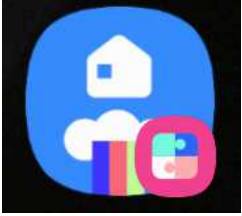


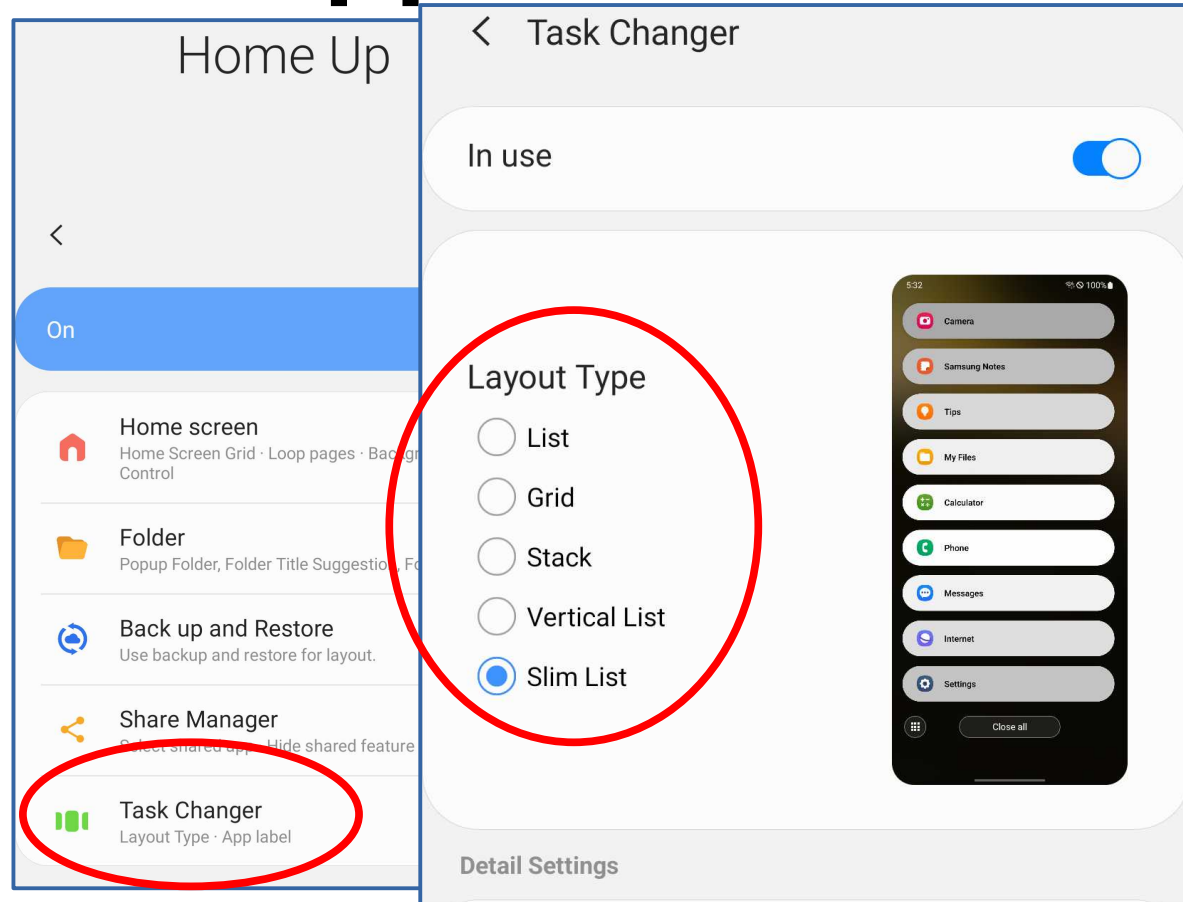
SLIM LIST

How to add those optional Invisible App tile forms

- These instructions are specific to Android 13 Samsung Galaxy phones. Other techniques are available for Galaxy phones running prior Android versions.
- Download and install the **GOOD LOCK** app from the Galaxy Store. The icon for the Good Lock app, which is a square with rounded corners. It has a pink background and a white square in the center. The white square is divided into four quadrants: top-left is light blue, top-right is light blue, bottom-left is light blue, and bottom-right is light blue. There are also small circles in each quadrant: a light blue circle in the top-left, a light blue circle in the top-right, a light blue circle in the bottom-left, and a light blue circle in the bottom-right.
- Open that app. In the first screen, tap **Make Up**.
- In the second screen, tap **Home Up**.
- **Follow the screen instructions to install the Home Up app.**

How to use those app tile forms

- Run the **Home Up** app. 
- On its first screen, tap **Task Changer**.
- Another screen opens.
- Tap the **Layout Type** radio button for the form you prefer.
- **Done!** Close the app.



Recommended practices

- Remember: iPhone Invisible Apps survive a shutdown and startup.
- If you shut down your iPhone at night, then first review and remove all unwanted Invisible Apps before you shut down your iPhone.
- If you use phone apps frequently, and your computer is nearby, then **consider using your computer** to access weather, news, email etc instead of your phone.

The Capacity of a portable device

- Manufacturers advertise the flash memory size as device Capacity.
- That capacity gives you a good idea of the space available for your apps and your data.
- ***That capacity has nothing to do with the amount of RAM included.***

Gabe Goldberg provided a valuable insight

- During Q&A at the end of the presentation, Gabe Goldberg noted that a navigation app such as **Google Maps** uses a network connection constantly as you walk about, even if the app is invisible.
- If that is among Invisible Apps, then its constant use of network time depletes your phone battery quickly.
- Also, if your carrier contract imposes a monthly quota on your use of cell phone network data, then several hours of map use can exhaust your monthly data quota.