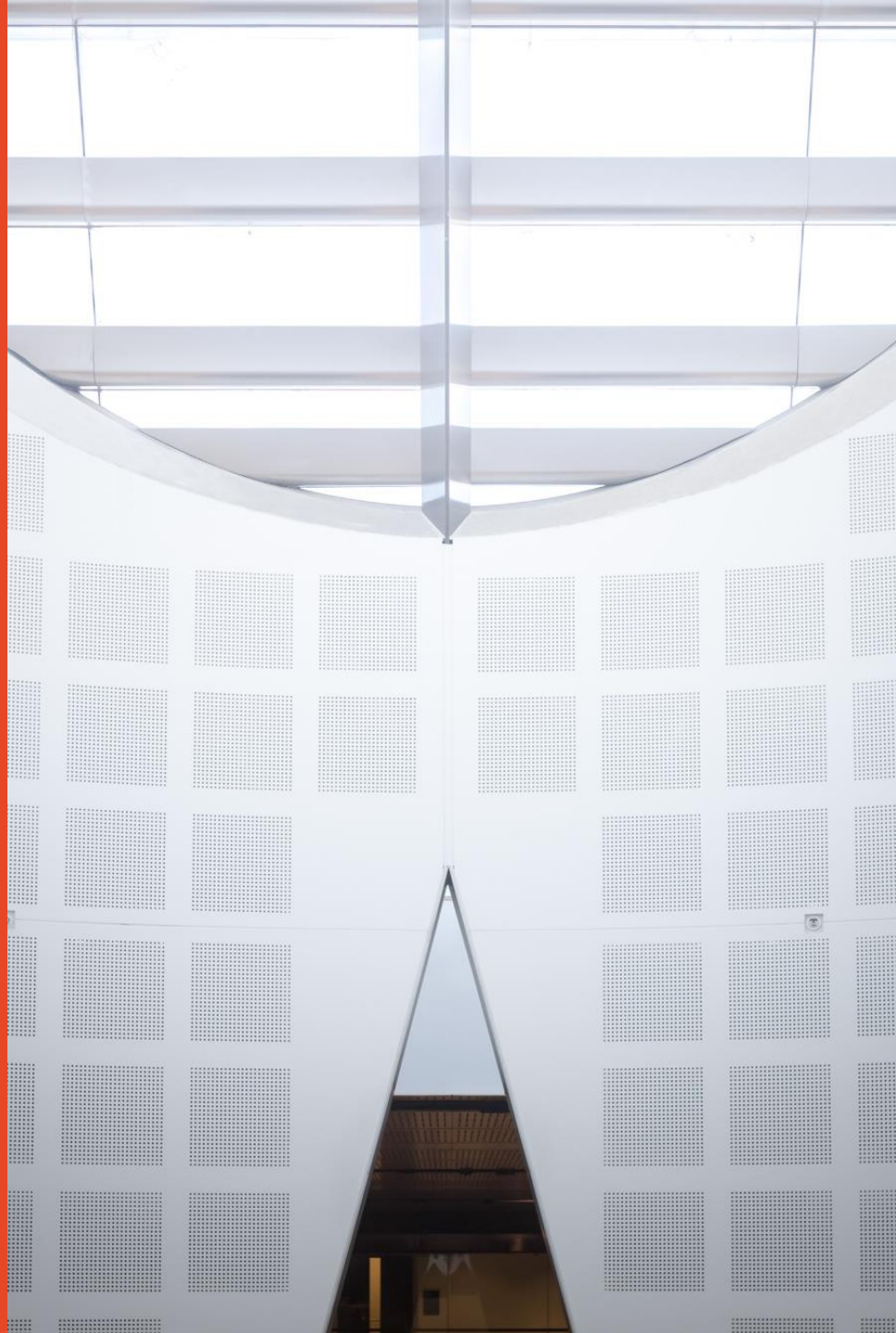
Mobile Computing
COMP4216/COMP5216

Week 06
Semester 2, 2023

Dr. Thilina Halloluwa
School of Computer Science

THE UNIVERSITY OF SYDNEY



Announcements

- Assignment 02 is available
- **Due date:** 24 Sep 2023 – duration 3 weeks

- **Programming Help Desk**
  - It will be conducted by the tutor Kshitiz Bhargava

Outline

- User Experience
- User Quality of Experience
  - What to avoid ?
- Challenges in Mobile computing
- Challenges in determining user location

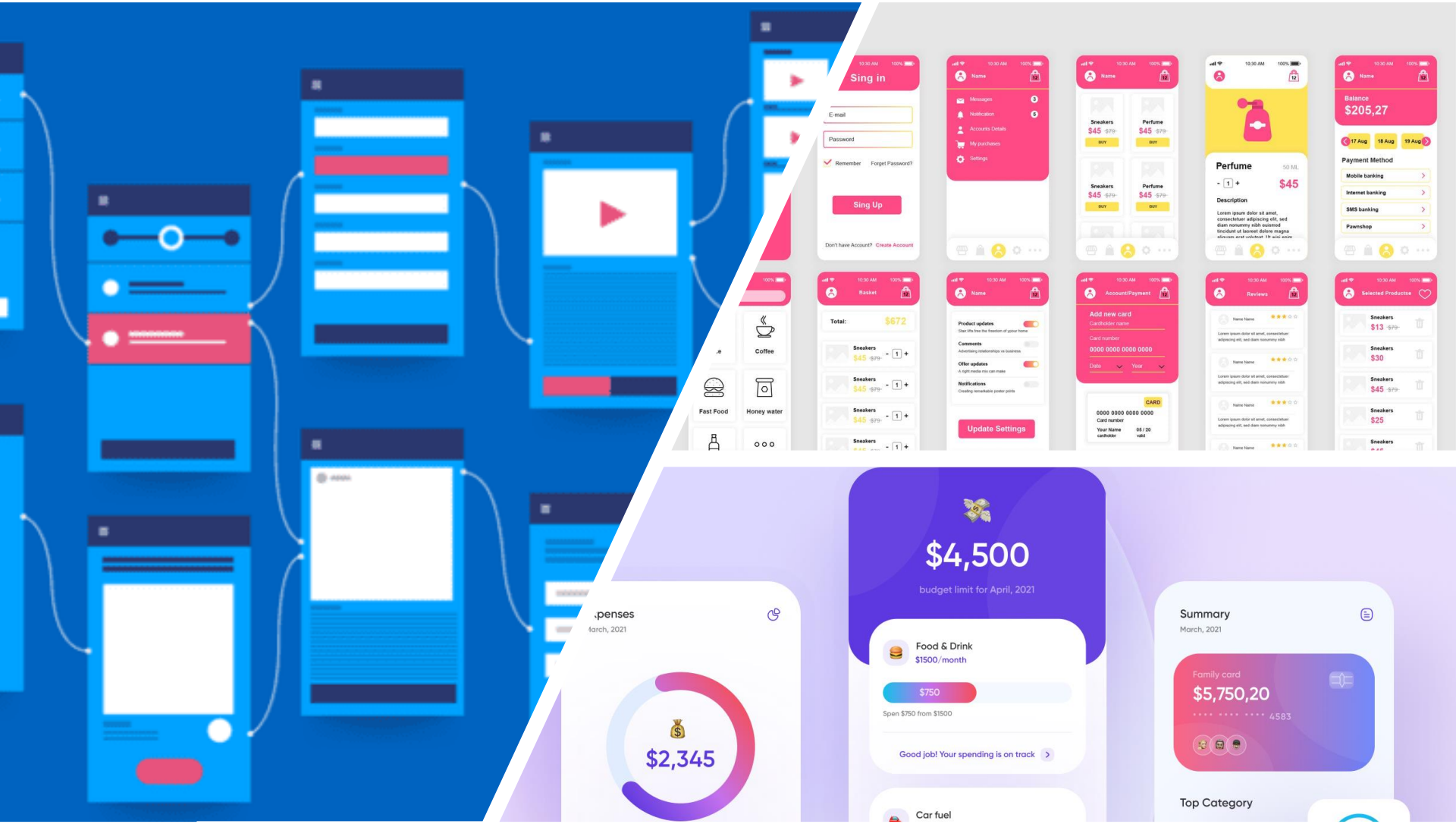
Recap of Week 5

– Explain a technique that can be used to implement the following functionalities in an Android app. If the proposed technique involves collecting data from a sensor or leveraging an API, those should be explicitly specified.

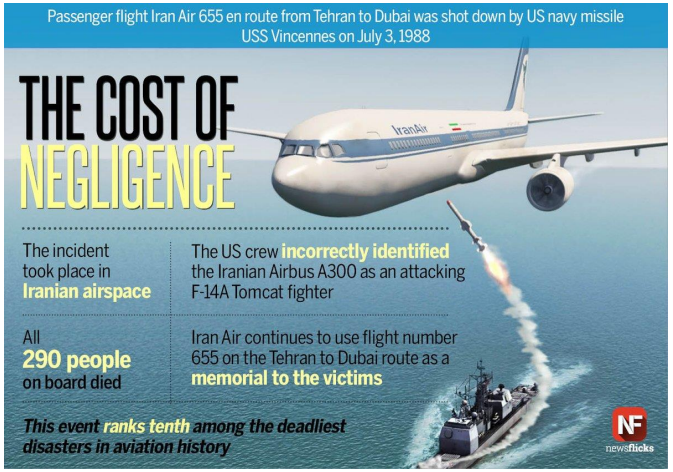
1. Dim the screen when a user puts the phone inside a pocket or a handbag.
2. Count the number of steps a person has climbed during the day.
3. Detect whether a person is indoors or outdoors.
4. Measure the size of physical objects or distances in the vicinity.

Past and the Present of UX

- In the past, computers were expensive & used by technical people only
- Now, computers are cheap and used by non-technical people (different backgrounds, needs, knowledge, skills)
- Interacting with technology has become an essential part of everyday life for most people.
- People are busy and may spend little or no time actually learning a new system.
- Therefore, computer systems should be easy to use, easy to learn and with no errors.
- To design and develop of such a system is a major concern of HCI


Sing in
E-mail
Password
Remember
Forget Password?
Sing Up
Don't have Account? Create Account
Name
Messages
Notification
Accounts Details
My purchases
Settings
Sneakers
$45
Perfume
$45
Balance
$205,27
17 Aug
18 Aug
19 Aug
Payment Method
Mobile banking
Internet banking
SMS banking
Pawnshop
Coffee
Fast Food
Honey water
Basket
Total:
$672
Sneakers
$13
$30
$45
$25
Account/Payment
Add new card
Cardholder name
Card number
0000 0000 0000 0000
Date
Year
CARD
Update Settings
Reviews
Selected Productse
$4,500
budget limit for April, 2021
Food & Drink
$1500/month
$750
Spen $750 from $1500
Good job! Your spending is on track
Car fuel
$2,345
Summary
March, 2021
Family card
$5,750,20
4583
Top Category

The Three Mile Island accident



USS Vincennes shot down a civilian roplane

Air Inter Flight 148 crashed while approaching an airport in Strasbourg

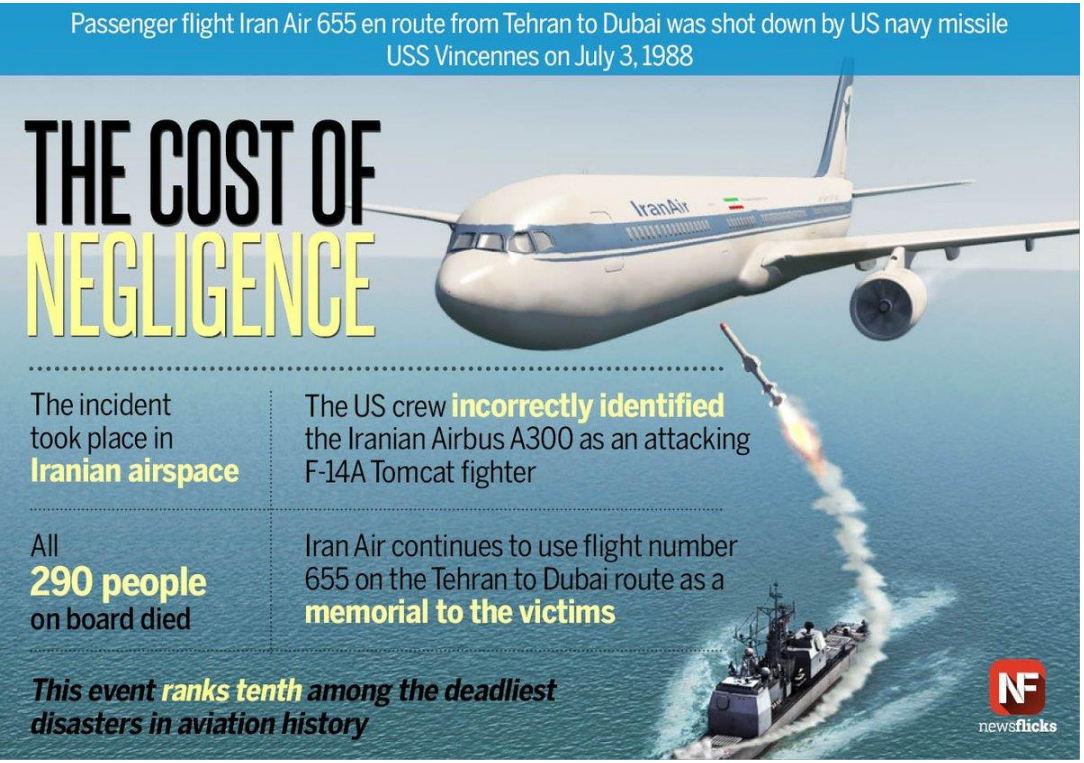
Incidents: Information Overload / User Attention.
Three Mile Island, 1979

Poor interfaces can lead to disaster

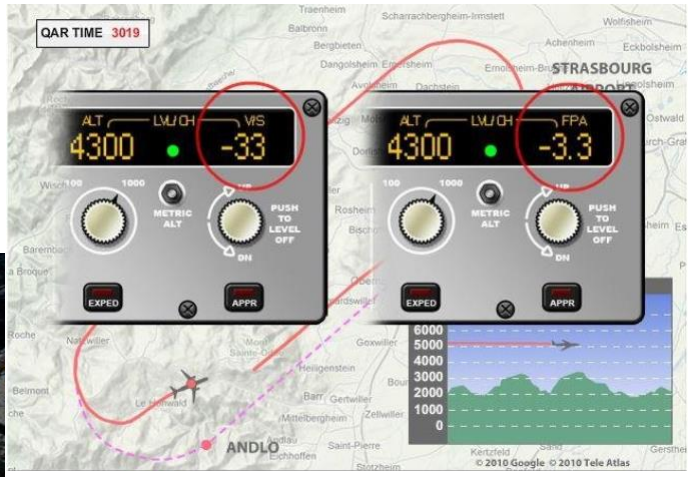
- What started as a minor malfunction in the system ended as the largest commercial **nuclear accident** in the USA.

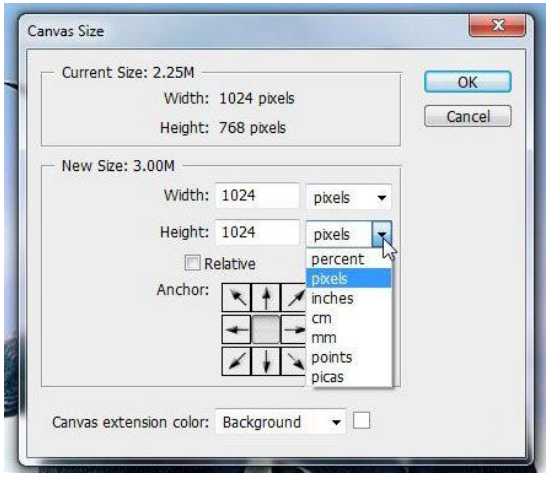
The **Three Mile Island accident** was a partial meltdown of reactor number 2 of Three Mile Island Nuclear Generating Station (TMI-2) in Dauphin County, Pennsylvania, near Harrisburg and subsequent radiation leak that occurred on March 28, 1979. It was the most significant accident in U.S. commercial nuclear power plant history.[2] On the seven-point International Nuclear Event Scale, the incident was rated a five as an "accident with wider consequences".[3][4]

Critical user interface engineering problems were revealed in the investigation of the reactor control system's user interface. Despite the valve being stuck open, a light on the control panel ostensibly indicated that the valve was *closed*. In fact the light did not indicate the position of the valve, only the status of the solenoid being powered or not, thus giving false evidence of a closed valve.[21] As a result, the operators did not correctly diagnose the problem for several hours.[22]


Passenger flight Iran Air 655 en route from Tehran to Dubai was shot down by US navy missile USS Vincennes on July 3, 1988
THE COST OF NEGLIGENCE
IranAir
The incident took place in Iranian airspace
The US crew incorrectly identified the Iranian Airbus A300 as an attacking F-14A Tomcat fighter
All 290 people on board died
Iran Air continues to use flight number 655 on the Tehran to Dubai route as a memorial to the victims
This event ranks tenth among the deadliest disasters in aviation history
NF
newsflicks

Air Inter Flight 148 crash





Fabuloso comes in a multitude of flavors like lavender, passion fruit, and citrus. Just don't drink it. (Photo: Maqroll/Flickr)

The colorfully packaged multi-purpose cleaner Fabuloso has a record of mistaken identity. In 2006, researchers looked at about four months of data from the Texas Poison Center Network and found 94 cases of people accidentally ingesting the household cleaner.

Human Error?

- Humans have limitations
- Need to understand these design in a way that human faults does not lead to a disaster

Modern day HCI – 3 Paradigms

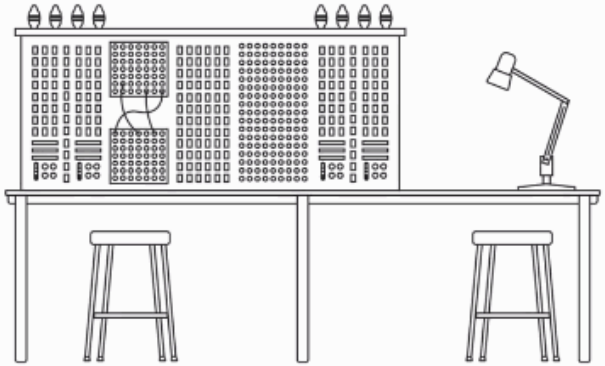
11

	Paradigm 1: Human Factors	Paradigm 2: Classical Cognitivism/ Information Processing	Paradigm 3: Phenomenologically Situated
Metaphor of interaction	Interaction as man-machine coupling	Interaction as information communication	Interaction as phenomenologically situated
Central goal for interaction	Optimizing fit between man and machine	Optimizing accuracy and efficiency of information transfer	Support for situated action in the world
Typical questions of interest	How can we fix specific problems that arise in interaction?	What mismatches come up in communication between computers and people? How can we accurately model what people do? How can we improve the efficiency of computer use?	What existing situated activities in the world should we support? How do users appropriate technologies, and how can we support those appropriations? How can we support interaction without constraining it too strongly by what a computer can do or understand? What are the politics and values at the site of interaction, and how can we support those in design?

Table 1: Paradigms compared

Harrison, S., Tatar, D., & Sengers, P. (2007, April). The three paradigms of HCI. In Alt. Chi. Session at the SIGCHI Conference on human factors in computing systems San Jose, California, USA (pp. 1-18)

Paradigm one

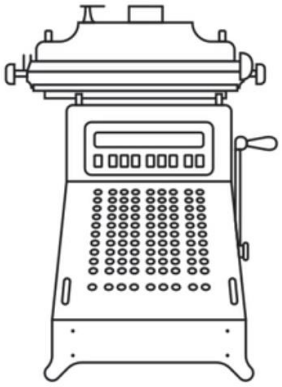


- Man- machine coupling
- **Goal :**
  - Optimize the fit between technology and man to minimize human error

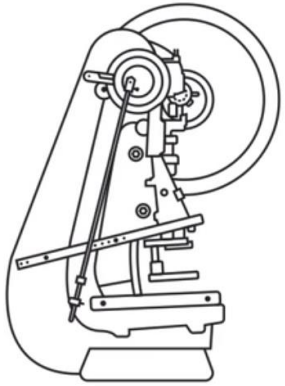
From Industrial revolution **to** World war II

Paradigm one - Questions

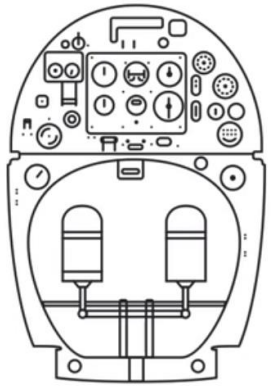
- How can we fix problems that arise in interaction?



ADDING MACHINES

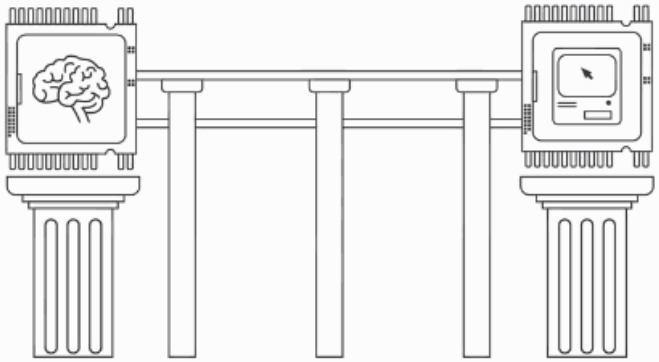


MUNITIONS MANUFACTURING



SUPERMARINE SPITFIRE COCKPIT

Paradigm Two

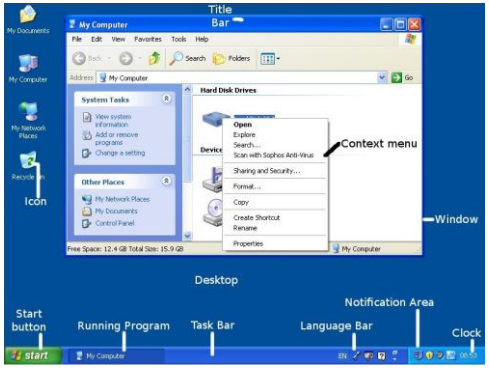


- Dual Processor approach
- Finds its roots at cognitive science
- **Goal:**
  - To bridge the gap between machine processor and human processor

From 1960 **to** 1980

Paradigm Two - Questions

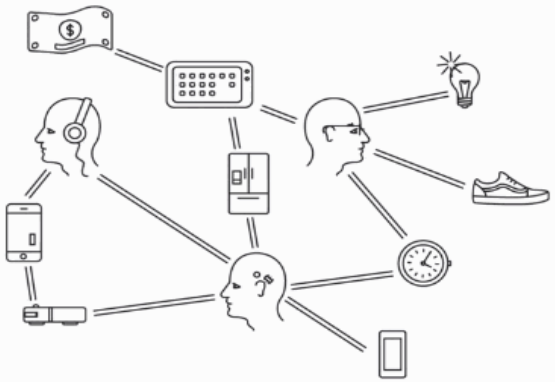
- What mismatches come up in communication between computer an people?
- How can we accurately model what people do?
- How can we improve the efficiency of computer use?



What's missing?

- Difficulty of addressing phenomena
  - a fact or situation that is observed to exist or happen, especially one whose cause or explanation is in question.

Paradigm Three

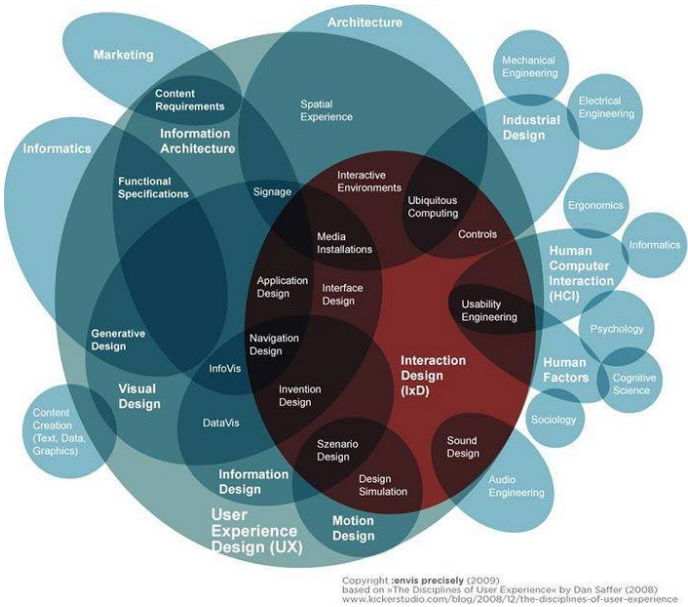


- Phenomenological matrix
- Embraces the complexity of interaction
- Humans are a part of a matrix
- Social sciences and User experience design

From 1990 **to** 2010 and beyond

Paradigm Three - Questions

- What existing situated activities in the world should we support
- How do users appropriate technologies
  - How can we support those appropriations
- How can we support interaction without constraining too strongly by what can computers do or understand?
- What are the values at the site of interaction and how can we support those in design



User Experience Design

“No product is an island. A product is more than the product. It is a cohesive, integrated set of experiences. Think through all of the stages of a product or service – from initial intentions through final reflections, from first usage to help, service, and maintenance. Make them all work together seamlessly.”

— Don Norman, inventor of the term “User Experience”

User experience (UX)

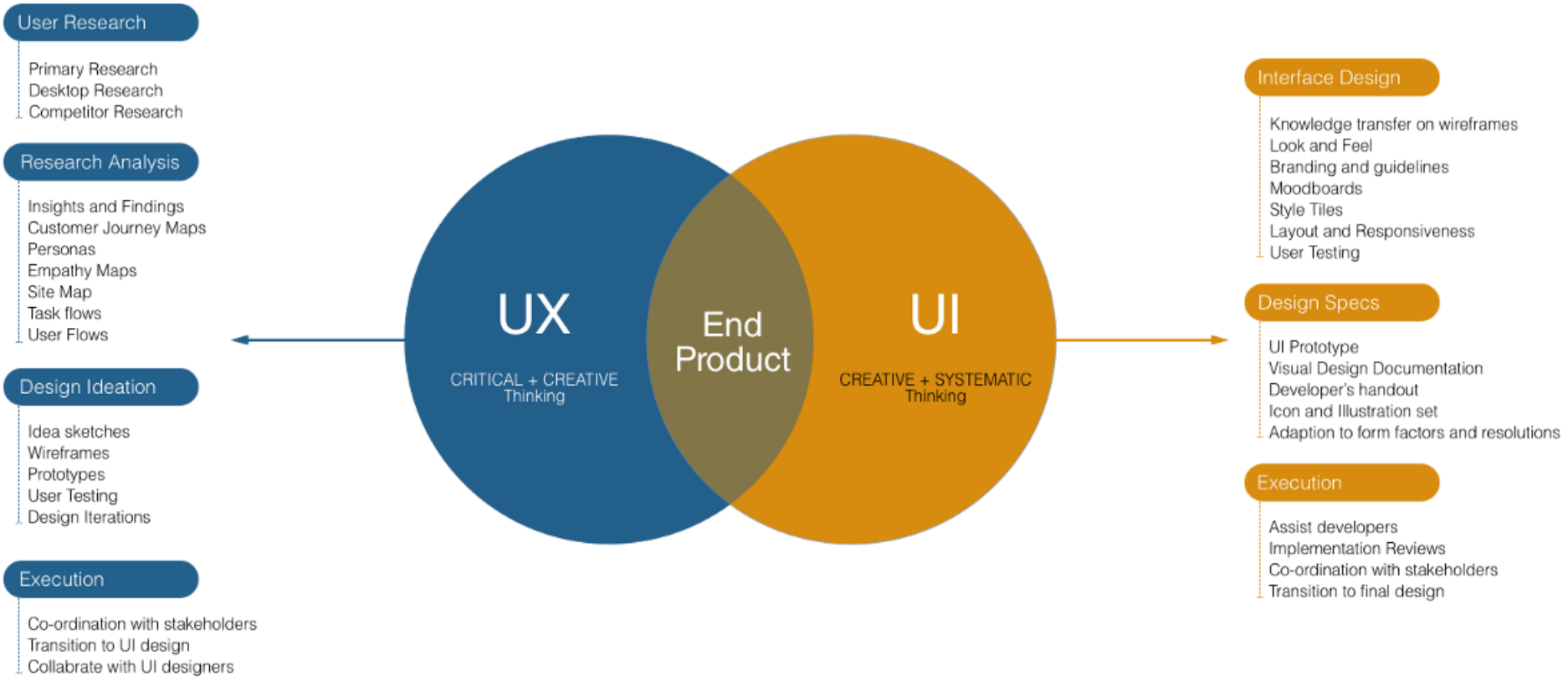
"User experience" encompasses all aspects of the end-user's interaction with the company, its services, and its products.

- by Don Norman and Jakob Nielsen

- User experience (UX) focuses on having a deep understanding of users, what they need, what they value, their abilities, and also their limitations.
- It also takes into account the business goals and objectives of the group managing the project.
- UX best practices promote improving the quality of the user's interaction with and perceptions of your product and any related services.

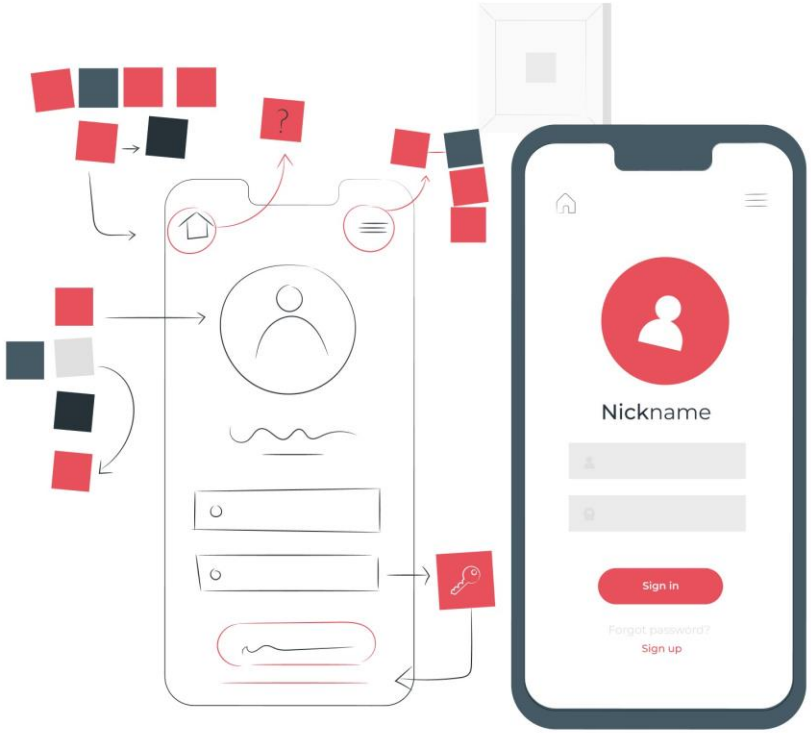
User Interface (UI) Design vs User Experience (UX) Design

- A successful product is a result of good UI and UX



UI vs UX ?? UI and UX

- User experience (UX) design focus more about how a product functions, and how users interact with it
- The user interface design complements user experience



"A UI without UX is like a painter slapping paint onto a canvas without thought, while UX without UI is like the frame of a sculpture with no paper mache on it. A great product experience starts with UX, followed by UI. Both are essential for the product's success."

User Quality of Experience (QoE)

- The main challenge
- Extremely difficult to measure – why ?
  - It is highly personal

  - Perception
  - Culture
  - Age
  - Gender
  - Mood

User Quality of Experience (QoE)

- How users react to apps also depends on…
  - Time of the day
    - Check social media in the morning vs checking at night
  - Season
    - Winter holiday vs Summer holiday
  - Current activity
    - Driving vs standing on board crowded train

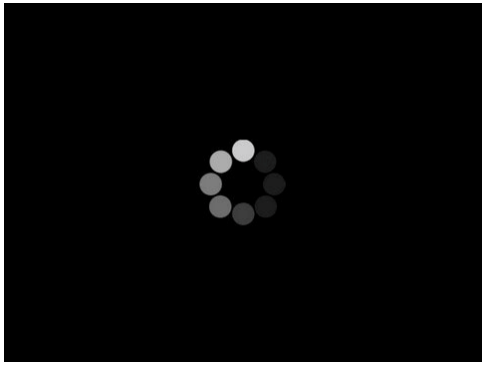
the app's core functionality remains constant, but user behavior and needs change based on the time of day, season, and their immediate activity.

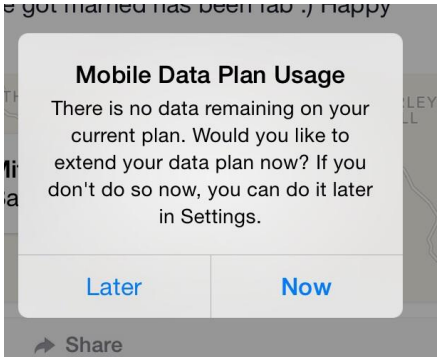
Understand your user base

- Target a specific customer segment at the beginning
  - Tik Tok → Teenagers
  - Uber → Busy urban professionals

What are the common things that annoy us ?

What to avoid ?





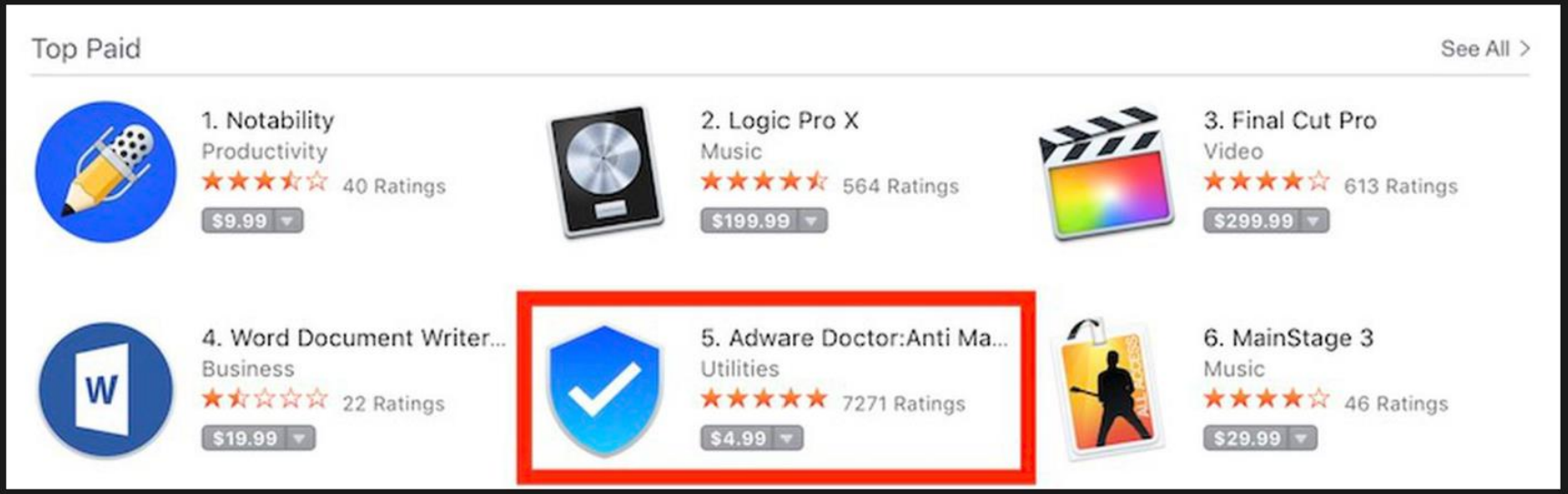
- Potential causes
  - Faulty battery or device
  - Network issues
  - Trying to download too much data
  - Not the right data flow
  - Too complex data processing
  - Unsecure communication and storage
  - Malicious ad library
  - Too frequent communication

- **Network**
- **Computing**
- **Energy**
- **Security**

Mac App Store App 'Adware Doctor' Discovered Stealing User Browsing History [Update: Removed]

Friday September 7, 2018 7:27 am PDT by Mitchel Broussard

The number one top-selling paid Utilities app on the Mac App Store in the United States has been found to steal the browser history of anyone who downloads it, and is still on the App Store as of this article. A video posted in August gave a proof of concept to how the app "Adware Doctor" steals user data, and security researcher Patrick Wardle has now looked into the app and shared his findings with *TechCrunch*.



Question: Communication

- You design your app to transfer 1KB of data to your app server at every one 10 seconds.
  - What are the consequences ?

Course Schedule

- We are going to have one lecture for each challenge

Lectures
Mobile Networking
Mobile Security & Privacy
Mobile Cloud & Energy

- There are other challenges:
  - User Interaction
  - Policies and regulations
  - Advertising
  - App analytics
  - Monetization

Challenges in Mobile App Development

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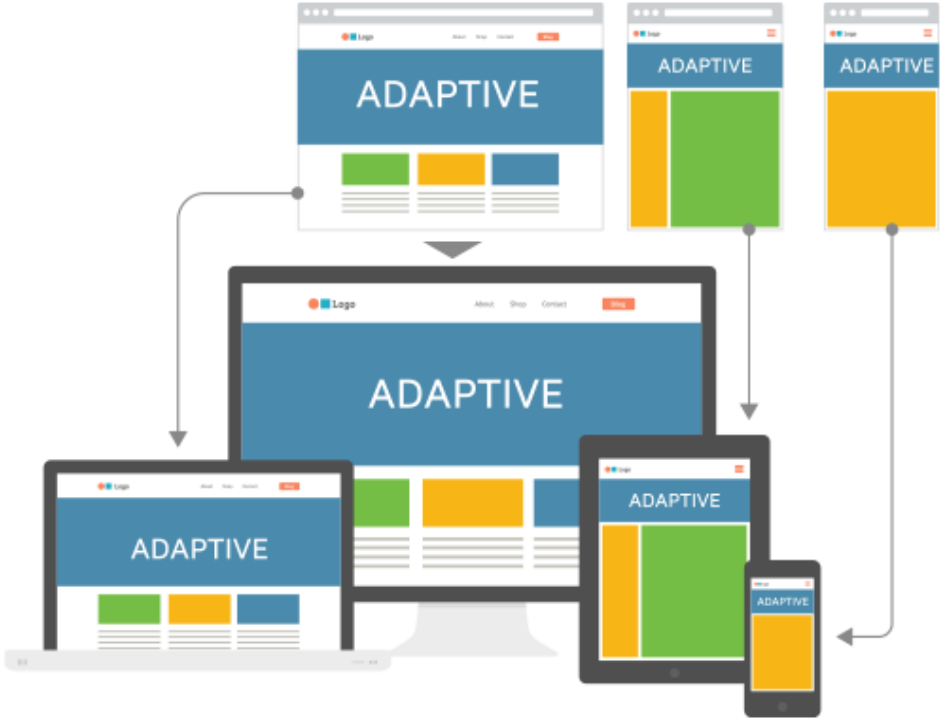
Compatibility Issues with Some Devices

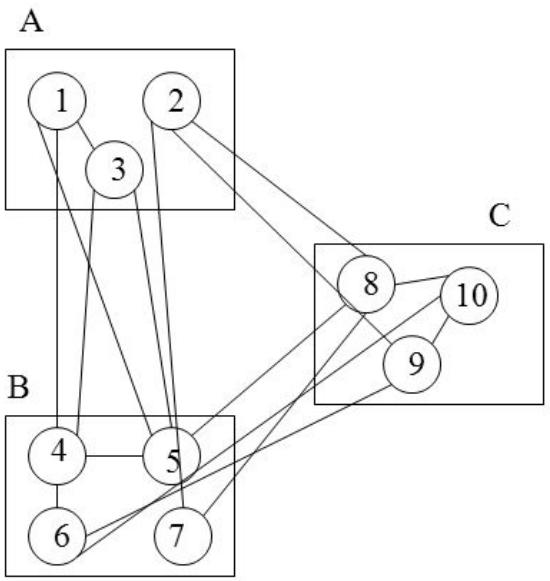
- App must be the same across all devices
  - Up to 80% of mobile users will leave a website that doesn't display correctly on their device
  - Adaptive design vs Responsive design

- Pros and Cons (HW)
  - Adaptive vs. Responsive Design | IxDF (interaction-design.org)

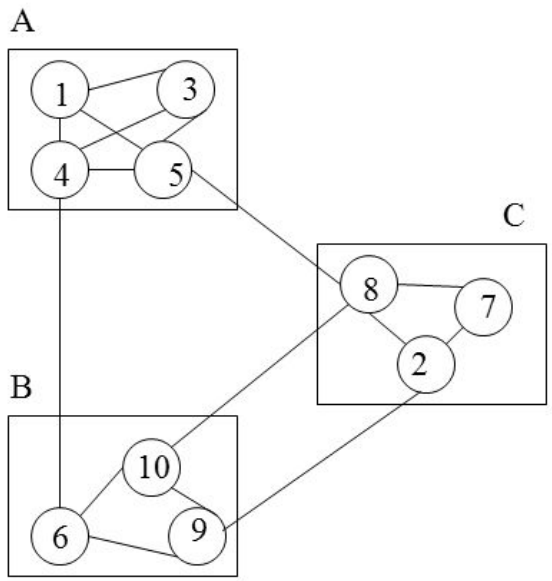


Code Maintenance

- Frequent updates increase the code base size and makes it challenging to maintain the code quality.
  - Using coding standards
  - Preventing ripple effects



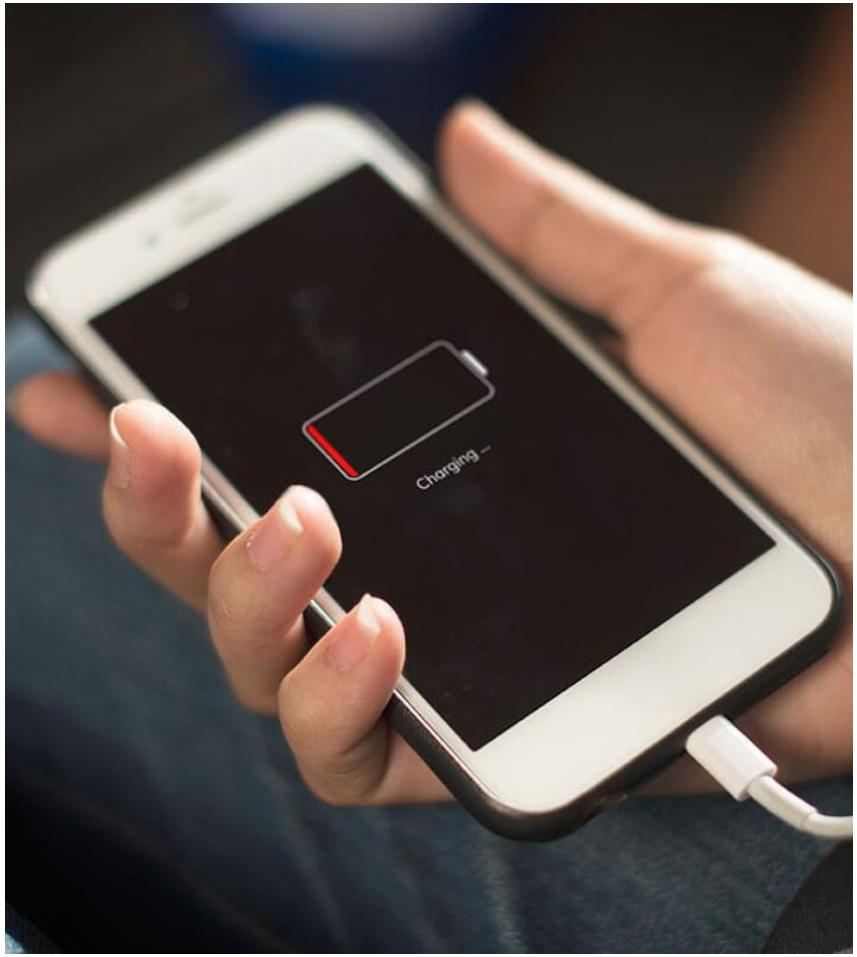
Bad modularization:
low cohesion, high coupling



Good modularization:
high cohesion, low coupling

Battery Consumption

- An ideal mobile app consumes less battery without degrading its performance.
  - Beta versions
  - Use of background services



Security

- Research reveals 50% of apps have security vulnerabilities
  - Research reveals 50% of apps have security vulnerabilities | 2021-02-19 | Security Magazine
- Tactics
  - Securing data transmission
  - Using a data encryption method.
  - Check third-party modules used in the application almost thrice.
  - Let users utilize multi-factor authentication.

Maintain better UX

- 52% of people say a bad mobile experience makes them lose faith in a company.
- 53% of mobile users will leave a website that doesn't display correctly after only three seconds

- User Research
- Mockups
- Journey Maps

Mobile UX Design Best Practices - From Start to Finish | Toptal®

Challenges in determining device location

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Challenges in determining device location

- Location adds **"Context"** to every action.
- The biggest challenge - User is moving.

- Various sources to determine the location.
  - GPS
  - Assisted-GPS
  - Cell towers
  - …
  - …

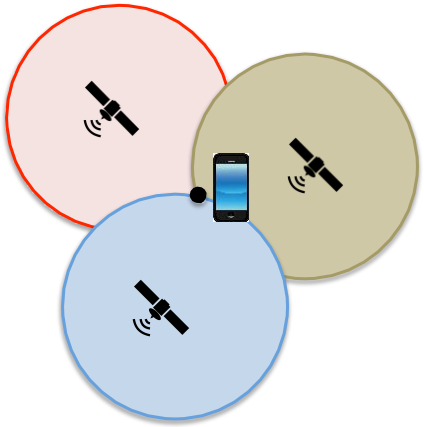
- **Each source comes with different accuracy, availability, resource requirement and efficiency**

- Dependent on the environmental factors.

The Global Positioning System (GPS) Location

- **Use the signals received from satellites for localisation.**
- Each location in the world is covered by at least four satellites.
- User device receives the signal and measure the time lag to estimate the distance to each satellite.

- No data connection is required.
- Longer time-to-fix.
  - Identifying the satellites
  - Synchronizing the clocks.



GPS Accuracy

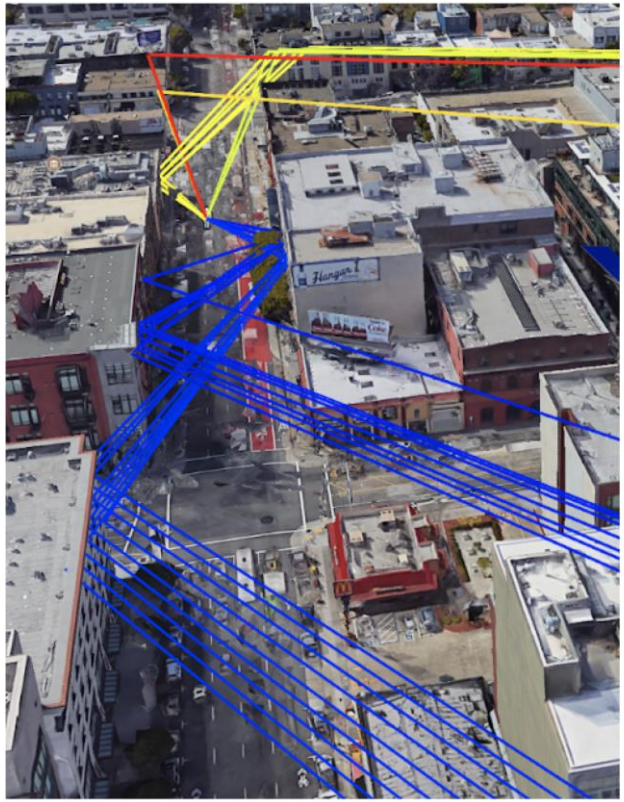
- Standard Positioning Service (SPS)
  - Available to all users
  - No restrictions or direct charge
  - high-quality receivers have accuracies of 3m and better horizontally
  - **In the level of 5-10m in worst case.**

- Precise Positioning Service (PPS)
  - Used by US and Allied military users
  - Use more satellites than public service

GPS Location

- Smartphones can connect to multiple constellations to improve the accuracy: GPS or GLONASS & use the combined result.
  - Many apps in Google Play Store to check the status of GPS signals

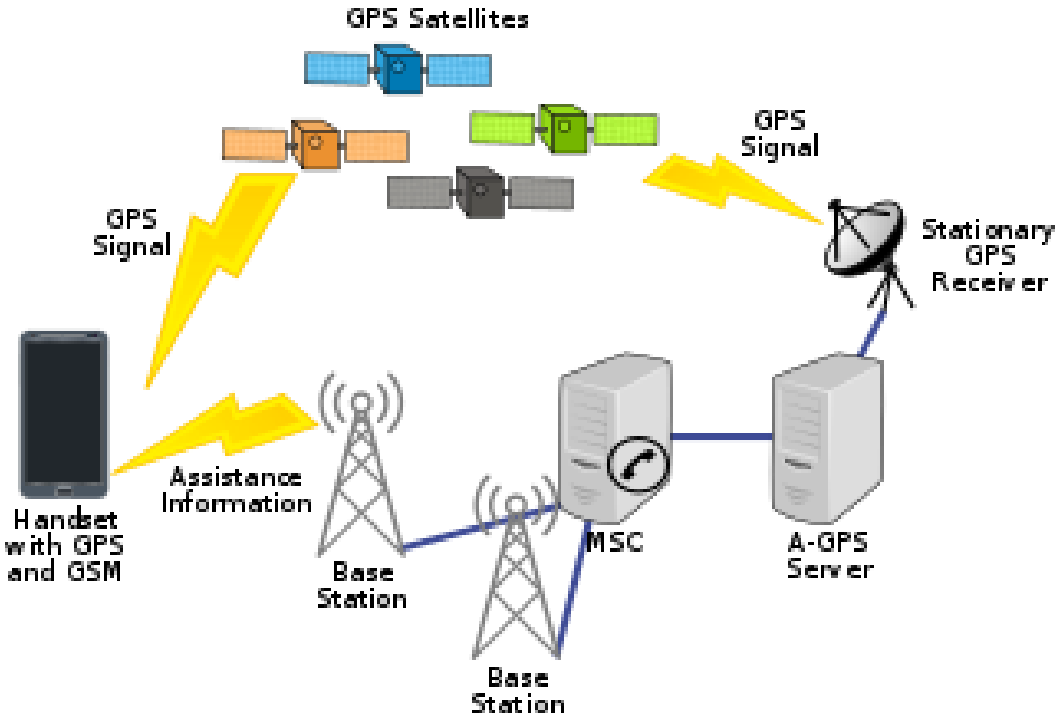
- However, GPS is not available everywhere, especially indoors.



GPS signals bouncing off facades in an urban environment.

Assisted GPS (HW)

- Tries to address some of the problems in GPS.
- Faster set-up time by getting satellite information through data connection.
- Lower energy consumption



Network Location

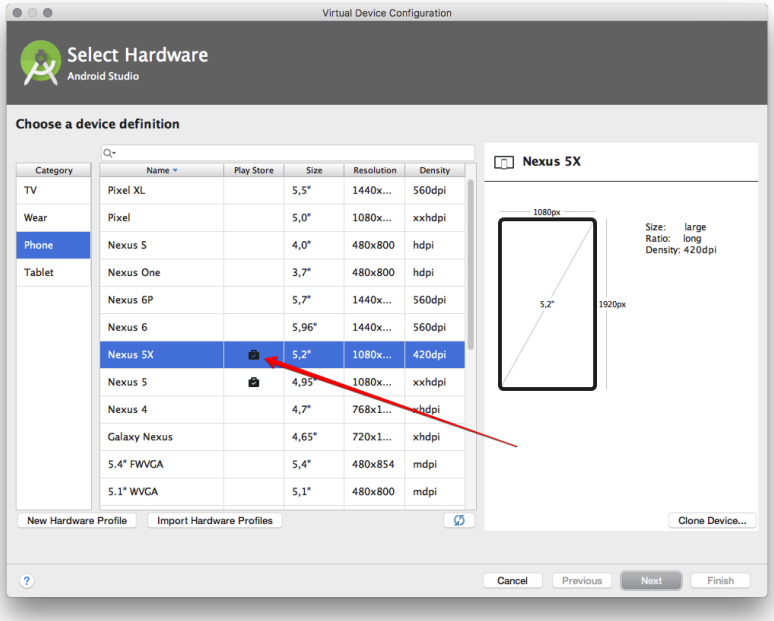
- Use near by cell tower & WiFi access point information to query a geo tagged database.

- Energy Efficient.
- Needs a user data connection.
- Who provide data to the geo DBs?
  - Everyone
  - It has been happening for sometime now https://www.zdnet.com/article/how-google-and-everyone-else-gets-wi-fi-location-data/

https://android-developers.googleblog.com/2020/12/improving-urban-gps-accuracy-for-your.html

How to get location in Android

- **FusedLocationProviderClient**
  - Current method [**Recommended by Google**].
    - https://developer.android.com/training/location
    - Google Play Services
    - Provides a much higher level view for the developer.
    - Automatically changing the appropriate Location Provider, e.g. GPS or WiFi
    - Better accuracy and power management.
    - Setting Permissions




```
<uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION" />
<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION" />
```

Accuracy

- Specify location accuracy using the `setPriority()` method
- **`PRIORITY_HIGH_ACCURACY`**
  - Most accurate
  - Use as many providers as necessary (GPS, WiFi, Cell-towers, etc.)
- **`PRIORITY_BALANCED_POWER_ACCURACY`**
  - Accurate location
  - Rarely uses GPS.
- **`PRIORITY_LOW_POWER`**
  - Coarse (city-level) accuracy
  - Mostly using on cell towers
- **`PRIORITY_NO_POWER`**
  - Passive location
  - Rely on location computed by other apps

Frequency & Latency

- `setinterval()` method
  - The interval at which *location is computed for your app.*
  - Larger the better for battery
- setFastestInterval() method
  - sets the **fastest** rate in milliseconds at which your app can handle location updates.
  - Unless your app benefits from receiving updates more quickly than the rate specified in setInterval(), you don't need to call this method.

```
mLocationRequest = new LocationRequest();
mLocationRequest.setInterval(10);
mLocationRequest.setFastestInterval(10);
mLocationRequest.setPriority
                    (LocationRequest.PRIORITY_BALANCED_POWER_ACCURACY);
```

Today's Takeaway

- **How can we take advantage of capabilities of smartphones ?**

- Example Question 2: (open-ended)
- You started a new company to sell small electronic items online. Smartphones can be used in numerous ways to enhance the efficiency of every business. How to do design an innovative mobile app to improve your productivity of your new business?

What' Next ?

- Next week
  - How to respect and effectively manage Mobile Networking resources when you develop apps?
- Happy learning !