Ubiquitous and Mobile Computing
CS 528: *Kotlin and NFC*

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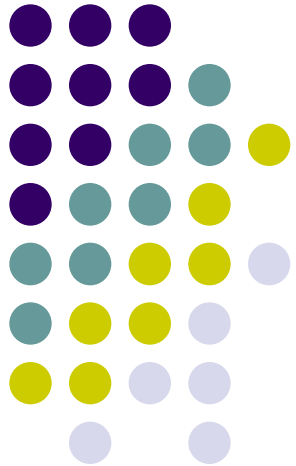
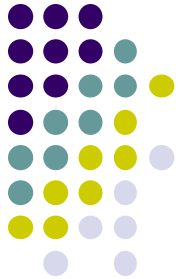




Kotlin

- History
  - First released in 2011
  - Developed by JetBrains
- Motivation
  - JVM is great
    - Runs everywhere! (no recompiling)
    - Android apps run on the JVM
    - A lot of libraries written for Java/JVM
  - Java syntax is verbose, repetitive
  - Want to leverage power and libraries of the JVM but use a cleaner and safer syntax

Kotlin: Issues Solved

- Kotlin is *null-safe*, any nullable variables must be explicitly marked
- *Type inference* means that types don't have to be explicitly written out if it's clear from context
- *Data classes* automatically implement some methods
- You can specify *default arguments* to functions
- You can provide *named arguments* to functions that take many parameters
- Many more small features

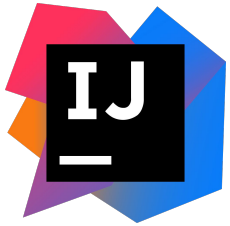
Kotlin-Typical use case

Tooling

- Android studio

- Eclipse

- IntelliJ IDE



Kotlin-Typical use case

Lyft 

Airbnb 

American Express 

Pinterest 

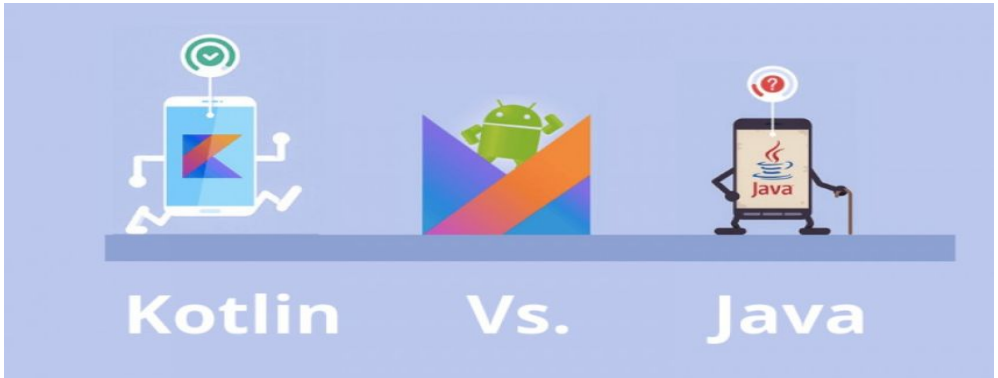
Wechat 

Expedia 

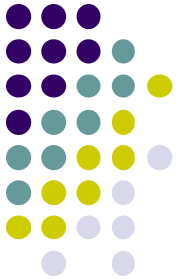
Kotlin-Typical use case

Kotlin vs Java

- Completely interoperable with Java
- More concise with fewer lines of code
- Safety prevents common programming mistakes
- Better support for functional programming
- Reduces errors and bugs
- Smarter and safer compiler



Kotlin

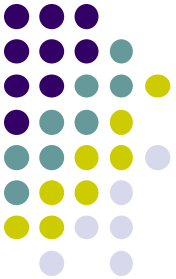


Basic Features

&

Comparison with Java

Kotlin - Key word Val & Var



val means an immutable value that does not change its value. However, **var** means variable, the value of a variable can change at any time.

```
package com.cwdoh.devfest2017

class Session {
    val speaker = "cwdoh"
    val title: String
            = "Kotlin: How it works"
    var room: Int? = null

    fun description()
            = "$speaker's talk: '$title' at room $room"
}
```

Kotlin - Var

var member itself can be read and modified by its class, i.e. there are **getter & setter** methods associated with it.

Property: var

```
class Session {
    var name = "cwdoh"
}
```


```
public final class Session {
   @NotNull
   private String name = "cwdoh";

   @NotNull
   public final String getName() {
      return this.name;
   }

   public final void setName(@NotNull String var1) {
      Intrinsics.checkParameterIsNotNull(var1, "<set-?>");
      this.name = var1;
   }
}
```

Kotlin - Val

val member itself only can be read by its class, i.e. there is **getter** method associate with it but not setter method.
PS: we can modify subfields of a val member if the subfields are **var** type.

Property: val

```
class Session {
    val name = "cwdoh"
}
```

Java

```
public final class Session {
   @NotNull
   private final String name = "cwdoh";

   @NotNull
   public final String getName() {
      return this.name;
   }
}
```

Kotlin - Key word “open”

Unlike other languages, Kotlin’s classes are limited to inherit by default.

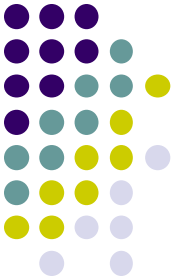
Keyword open

```
class NotOpenedClass
open class OpenedClass
```


```
public final class NotOpenedClass {
}

public class OpenedClass {
}
```

Kotlin - String Templates



String templates allow you to include variable references and expressions into strings.

```
val greeting = "Kotliner"

println("Hello $greeting")                    // 1
println("Hello ${greeting.toUpperCase()}")   // 2
```

```
Hello Kotliner
Hello KOTLINER
```

Kotlin - Nullable & NotNull

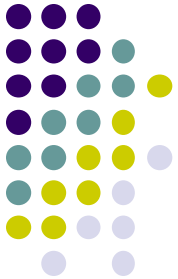
Kotlin is null-safe. Variable types in Kotlin don't normally allow the assignment of null**.**

```
var neverNull: String = "This can't be null"          // 1

neverNull = null                                      // 2
```

```
Null can not be a value of a non-null type String
```

Kotlin - Nullable & NotNull

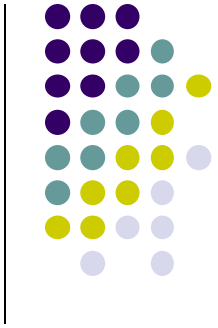


What if we need a variable can be null?

Declare it nullable by add “?” at the end of its type

```
var nullable: String? = "You can keep a null here"      // 3
nullable = null                                          // 4
```

Why Kotlin?



```
public class Person {
    private String name;
    private String email;
    private int age;

    public Person(String name, String email, int age) {
        this.name = name;
        this.email = email;
        this.age = age;
    }

    public String getName() {
        return name;
    }

    public String getEmail() {
        return email;
    }

    public int getAge() {
        return age;
    }
```

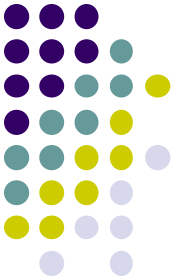
```
    @Override
    public String toString() {
        return name + " - " + email + " - " + age;
    }

    @Override
    public int hashCode() {
        int result = 17;
        result = 31 * result + name.hashCode();
        result = 31 * result + email.hashCode();
        result = 31 * result + age;
        return result;
    }

    @Override
    public boolean equals(Object obj) {
        if (obj != null && obj.getClass() == this.getClass()) {
            Person castObj = (Person) obj;

            if (this.name.equals(castObj.getName())) return
false;
            if (this.email.equals(castObj.getEmail())) return
false;
            if (this.age != castObj.getAge()) return false;
        }
        return false;
    }
  }
```

Why Kotlin?

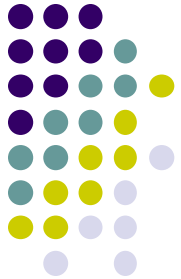


```
data class
        Person(val name: String,
               val email: String,
               val age: Int)
```

Near Field Communication

(NFC)

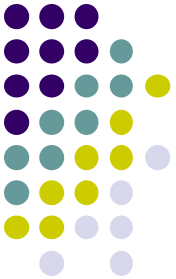
What is NFC?



- Near-field Communication or NFC is a short-range radio technology that operates with data transfers of up to 424 kilobits per second.
- NFC communication is triggered when two NFC-compatible devices are brought within close proximity, around four centimeters.

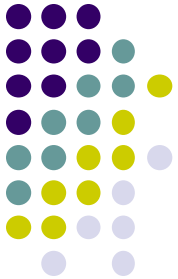
- https://www.oracle.com/technical-resources/articles/javame/nfc.html

What is NFC?



	NFC	RFID	IrDa	Bluetooth
Set –up time	<0.1ms	<0.1ms	~O.5s	~6 sec
Range	Up to 10cm	Up to 3m	Up to 5m	Up to 30m
Usability	Human centric Easy, intuitive, fast	Item centric Easy	Data centric Easy	Data centric Medium
Selectivity	High, given, security	Partly given	Line of sight	Who are you?
Use cases	Pay, get access, share, initiate service, easy set up	Item tracking	Control & exchange data	Network for data exchange, headset
Consumer experience	Touch, wave, simply connect	Get information	Easy	Configuration needed

What is NFC?



- The NFC Standard defines three types of communication:
  - **Peer-to-peer mode** which allows two NFC-enabled devices to exchange information between each other.
  - **Read/write mode** is a one way data transmission commonly used for passive NFC devices like NFC tags
  - **Card emulation** allows the NFC device to be used like a smart or contactless credit card in order to make payments or tap into public transport systems.

- https://www.androidauthority.com/what-is-nfc-270730/

NFC - History

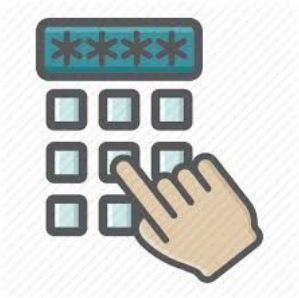
- Inspired by RFID
  - Charles Walton - 1983
- First appearance in 2002
  - Sony and NXP semiconductors
- 2004
  - Rise of mobile phones
  - Companies start putting in NFC chips
  - Doesn’t have much use yet
  - Mostly unidirectional

NFC - History (cont'd)

- 2006
  - Usage and abilities increase
  - Users can now receive music, photos, media, etc.
- 2009
  - Peer to peer (P2P) communication
  - Bidirectional transmissions
    - Users can now receive and ***send*** data with NFC

NFC - Issues that it solves

- The need to transfer sensitive data quickly, securely, and wirelessly over short distances
  - Swiping cards/entering PIN's have visibility risks
  - Much more room for error
    - Forgotten PIN, broken magnetic strip, etc
- Better proof of purchase
  - Receipts are not reliable
    - Can be forged, easily lost, destroyed, etc.



EYE OF THAI-GER
3077 Stone Lane
Philadelphia, PA

9/12/2018 11:54 AM
TAB49
AMEX HOST ALIA

QTY	DESC	AMT
1	31. Part Ka Pow	$8,99
1	Steam Rice	$4,00
1	Red Curry	$8,99
1	add Beef	$0,00
1	19. Pad Thai	$8,99
2	Thai Ice Tea w/boba	$13,00
1	water	$0,00

AMT $43,97

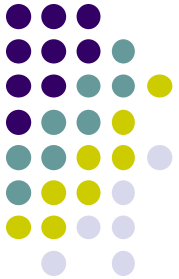
SUB-TOTAL	$43,97
TAX	$3,34
BALANCE	$47,31

NFC - Typical use case

- Making payments with a phone
- Sharing images
- Certain fitness devices
- Finding your location more precisely

NFC - Real world example

- Google Pay
- Apple Pay
- YubiKey 2FA
- Android Beam File share
- Nike NFC jerseys



NFC Demo

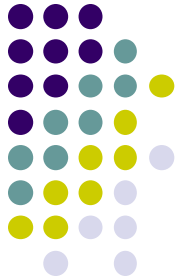
NFC

- How it works
  - Peer-to-peer NFC Messages are structured in the **NDEF format** (NFC Data Exchange Format)
  - Command-response and read-write NFC messages are use the **APDU format** (application protocol data unit)
    - Some APDU messages are compatible with devices using the NDEF specification

Command APDU						
Command APDU Header				Lc	Data	Le
CLA	INS	P1	P2			
CLA: Class byte (command-ID), INS: Instruction, P1, P2: Parameter, Lc: Length of command data, Data: Command data, Le: Length of expected data						

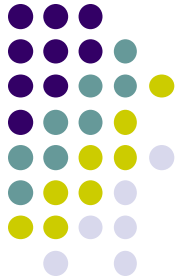
Response APDU		
Data	SW1	SW2
Data: Response data, SW1, SW2: Status Word		

NFC



- Use **android.nfc.NfcAdapter** to facilitate communications
  - supports NDEF and APDU message transmission
- Depending on what you are planning on doing, code may be vastly different
  - Peer to peer, card reading, and read-write modes have inherently different security, device, and data requirements

NFC



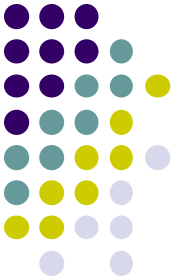
- Different operations require different levels of programming
  - Many high-level libraries are available for simple NFC tag communication
    - https://github.com/Rgghgh/NfcActivity
  - Peer-to-peer large file transfer can be done using the middle-level Android Beam API
    - https://developer.android.com/training/beam-files
  - Complex NFC tab interactions, such as YubiKey OTP and HMAC-SHA1 require low-level manually-crafted nfc commands
    - https://developers.yubico.com/OATH/YKOATH_Protocol.html

NFC

- Code Example for Android Tag communication using **com.rgghgh.nfcactivity**:
  - https://github.com/Rgghgh/NfcActivity

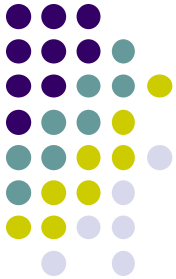
```
 5
 6    import com.rgghgh.nfcactivity.NfcActivity;
 7    import com.rgghgh.nfcactivity.NfcConnection;
 8    import com.rgghgh.nfcactivity.NfcTester;
 9
10    public class MainActivity extends NfcActivity
11    {
```

NFC



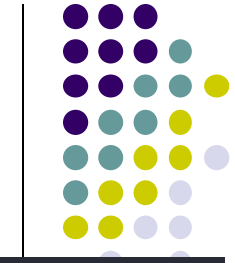
```
20      @Override
21      protected void onStart()
22      {
23          super.onStart();
24          runNfcTest();
25      }
```

NFC

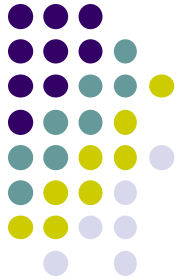


```
50    public void runNfcTest()
51    {
52      // NfcTester object usage:
53      NfcTester tester = new NfcTester(this);
54      if(!tester.hasNfc()){
55        Toast.makeText(getApplicationContext(),"Device does not support NFC!",Toast.
          LENGTH_LONG).show();
56        return;
57      }
58      if(!tester.isNfcEnabled()) {
59        Toast.makeText(getApplicationContext(),"Device NFC is not enabled!",Toast.
          LENGTH_LONG).show();
60      }
61    }
```

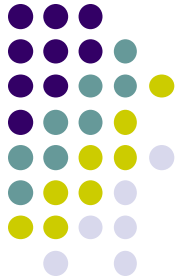
NFC



```
@Override
public void onNfcStart(NfcConnection conn)
{
    try
    {
        String id = conn.getTagId(); // get unique tag id
        String data = conn.read(); // get string data from tag
        // write website link to NFC Tag
        conn.writeUri("https://example.com");
        // make tag "read only"
        conn.makeReadOnly();
    }
    catch (Exception e)
    {
        Toast.makeText(getApplicationContext()
        ,e.toString(),Toast.LENGTH_LONG).show();
    }
```



Questions?



References

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- https://www.quora.com/What-are-the-best-use-cases-of-NFC
- https://www.nike.com/us/en_us/c/connected-jerseys
- https://medium.com/til-kotlin/explanation-hey-kotlin-how-it-works-c98da63c59b0