JCA/JCE

Java Crypto Architecture / Java Crypto Extensions

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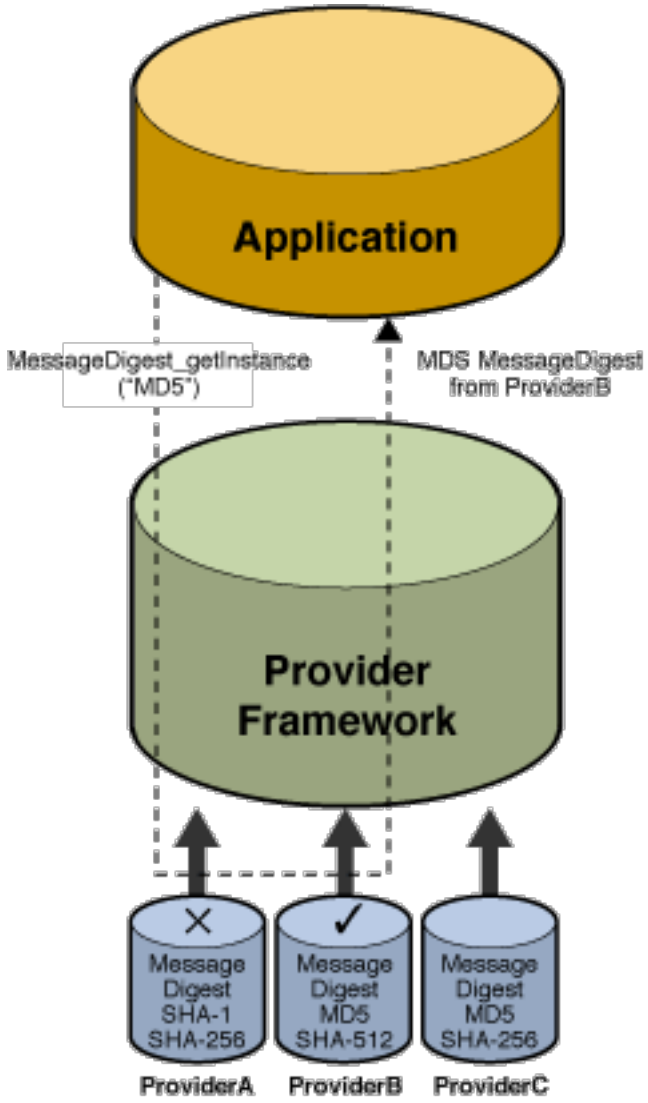
Download NetBeans 8 portable

bit.ly/2ApM6yx

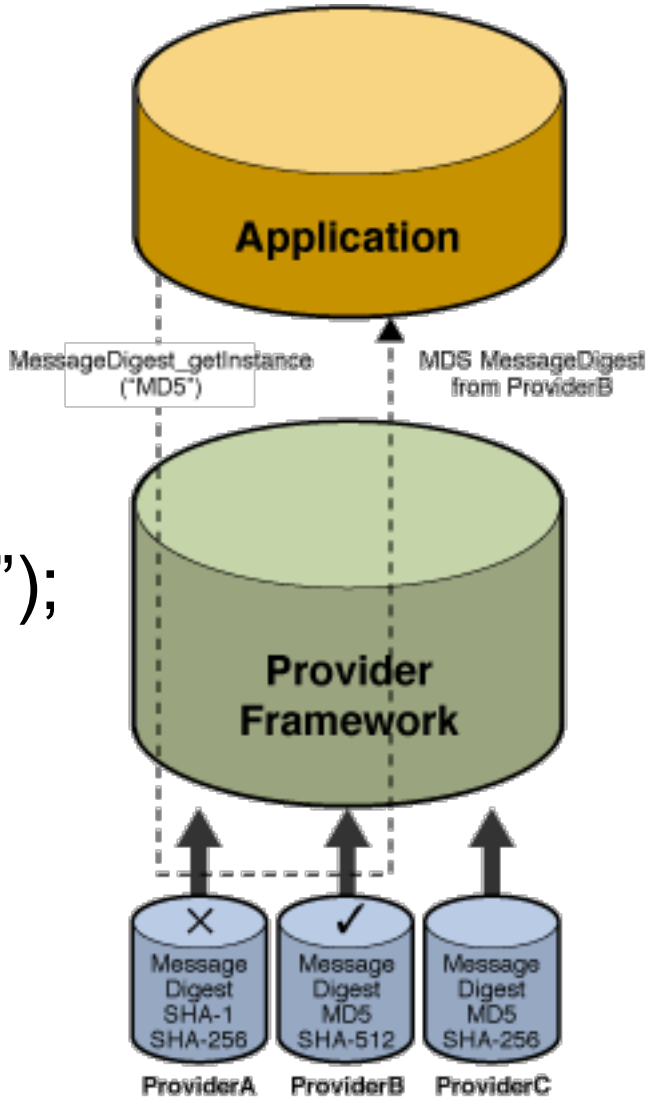
Case sensitive

Provider architecture



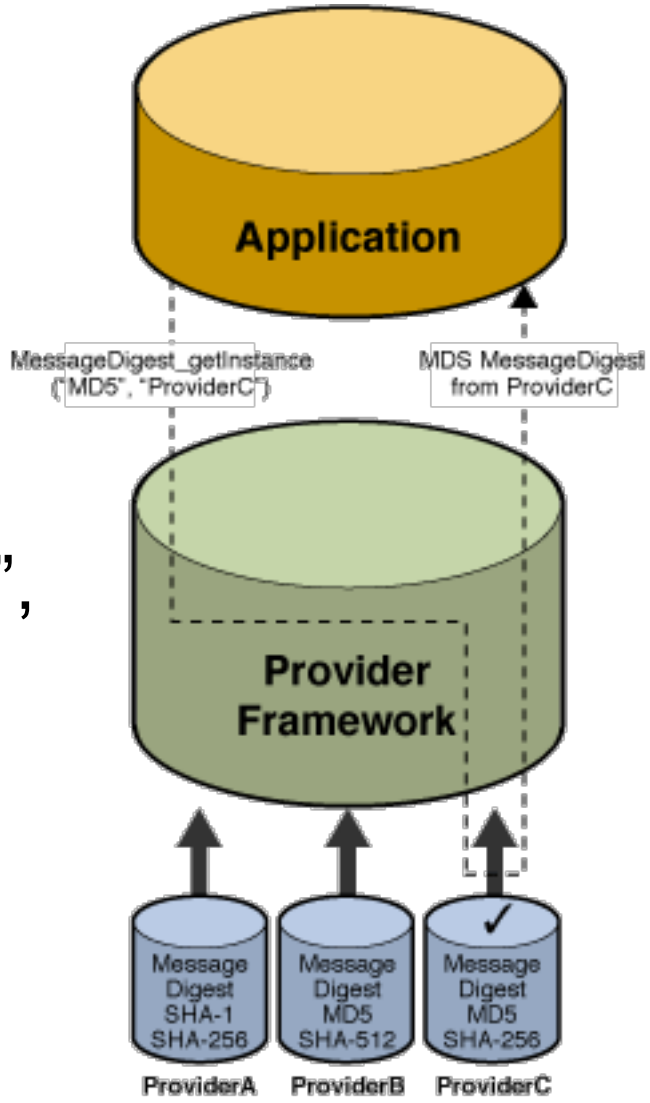
Provider architecture

MessageDigest.
getInstance("MD5");



Provider architecture

MessageDigest.
getInstance("MD5",
"ProviderC");



JCA

- java.security.*
  - SecureRandom - PRNG
  - MessageDigest – SHA256, MD5, ...
  - Signature – RSA, DSA
  - KeyStore – PKCS12
  - KeyPairGenerator, KeyFactory, CertificateFactory,

JCE

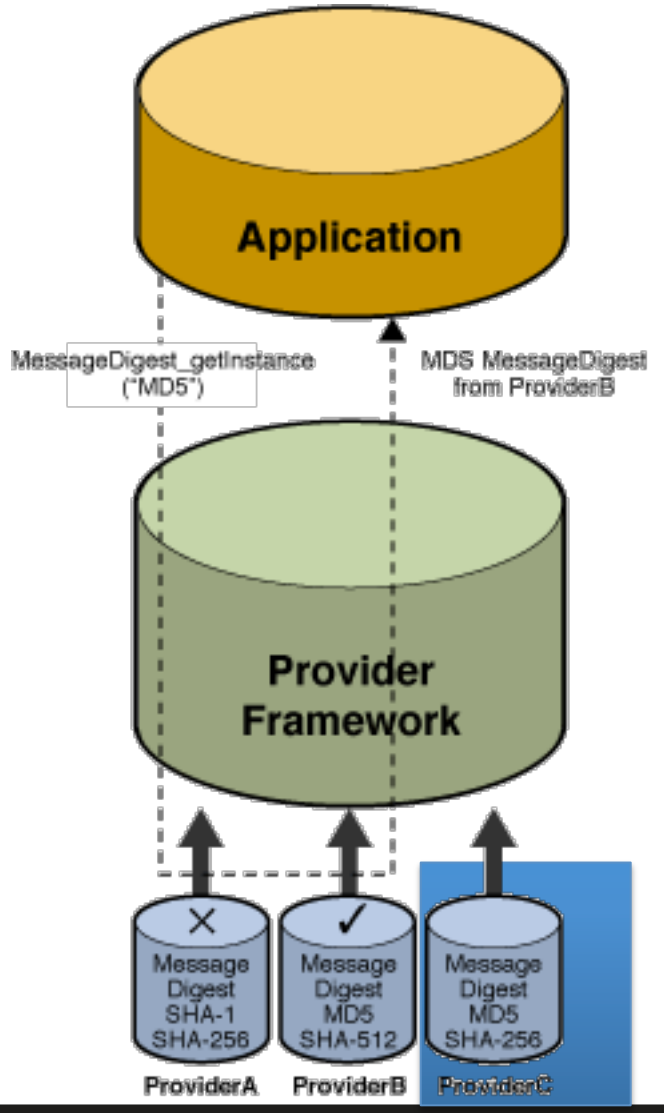
- javax.crypto.*
  - Cipher – AES, RSA, ElGamal, RC4, Salsa20
  - Mac – HMACWithSHA256
  - KeyGenerator

Provider architecture

- Implementation independence
- Implementation interoperability
- Algorithm extensibility

Bouncy Castle

Bouncy Castle

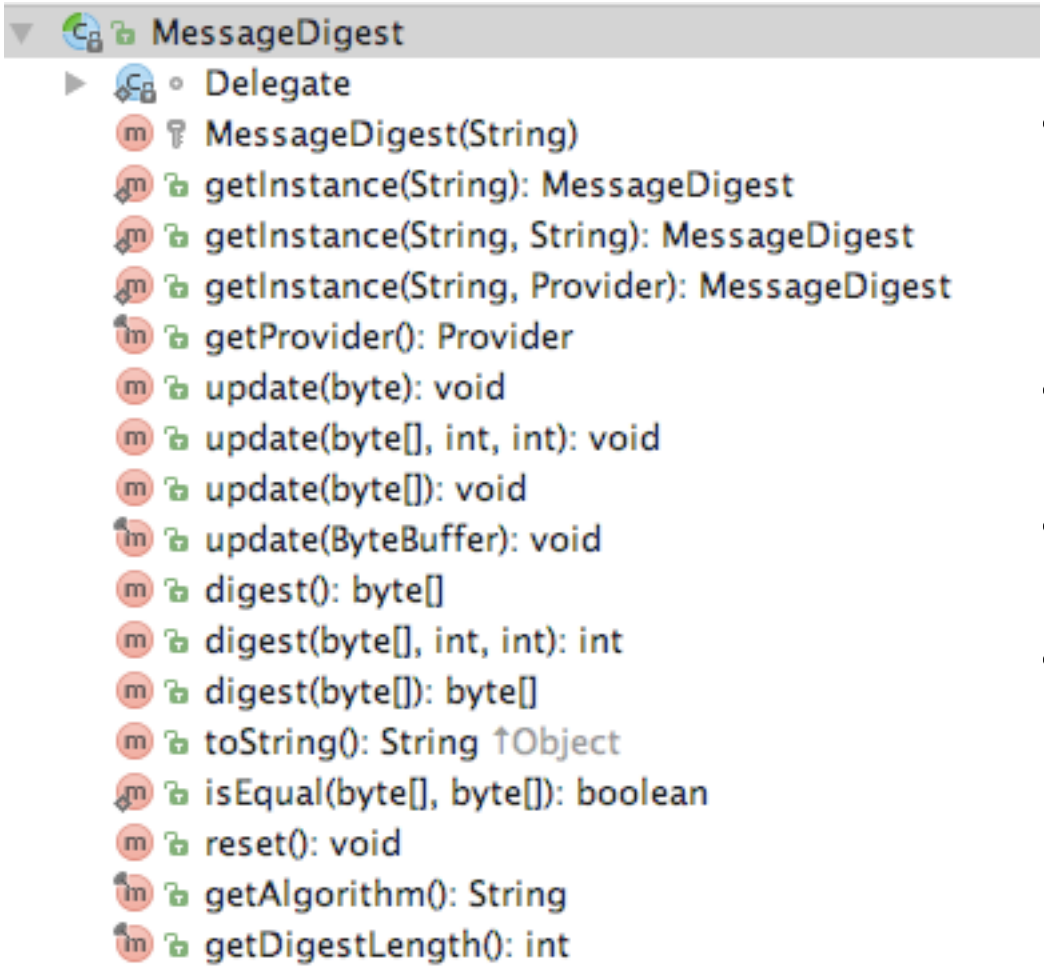


BouncyCastle

Bouncy Castle

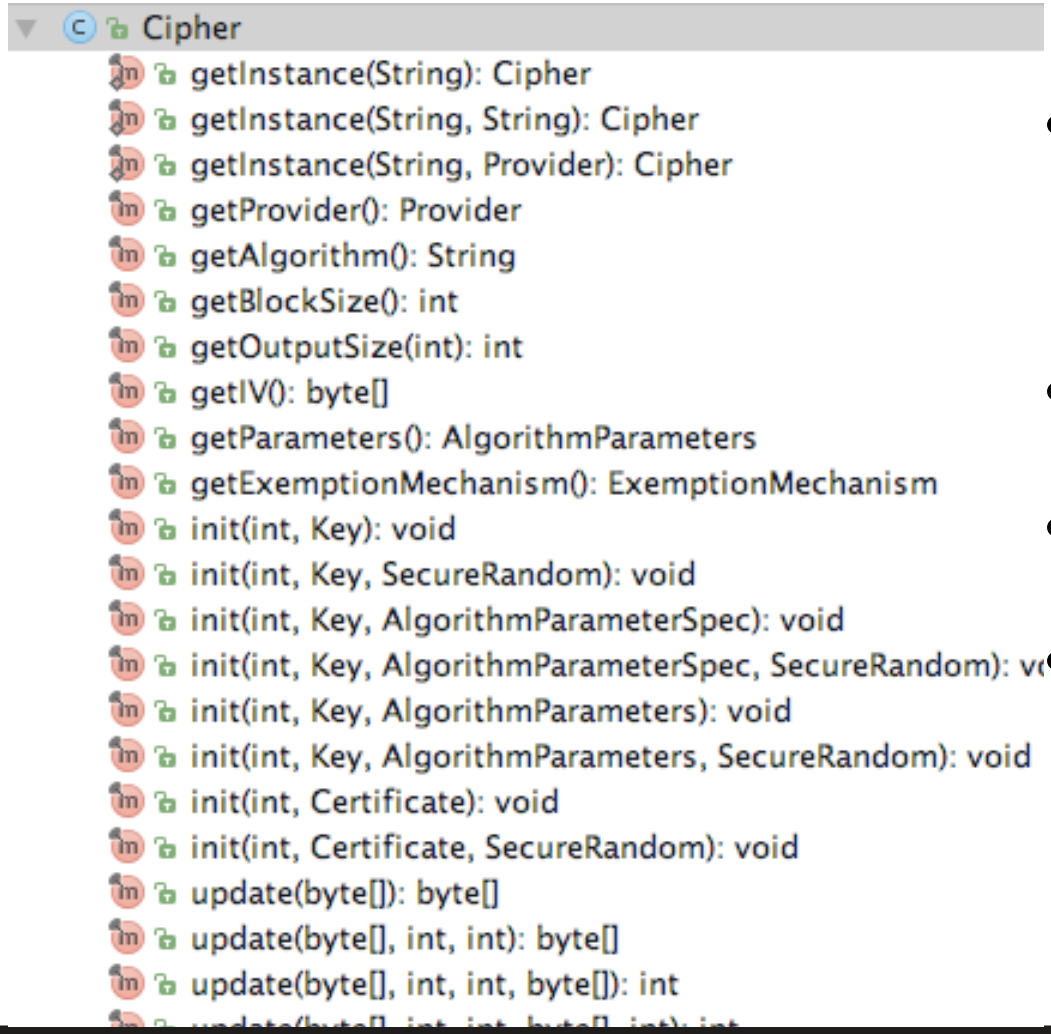
- Implements a LOT OF ciphers, cipher suites, algorithms, modes, ASN.1, PEM, Certs, …
- Origin: Australian, former advantage (crypto regulations)
- Android

Provider architecture – Engine classes



- getInstance()
- update()
- digest()
- reset()

Provider architecture – Engine classes

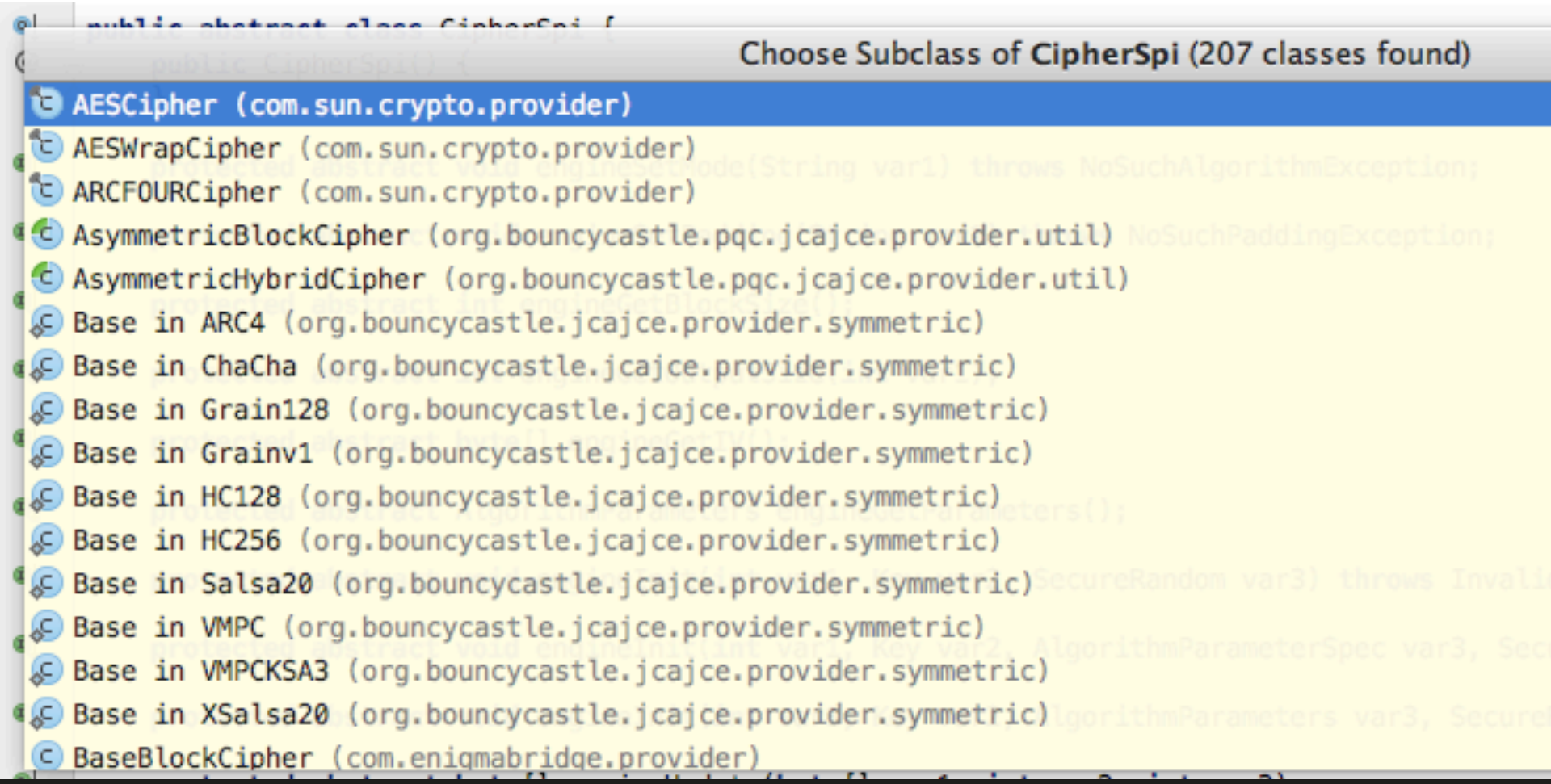


- getInstance()
- init()
- update()
- doFinal()

Provider architecture – Spi skeleton

```
public abstract class CipherSpi {
    public CipherSpi() {
    }

    protected abstract void engineSetMode(String var1) throws NoSuchAlgorithmException;

    protected abstract void engineSetPadding(String var1) throws NoSuchPaddingException;

    protected abstract int engineGetBlockSize();

    protected abstract int engineGetOutputSize(int var1);

    protected abstract byte[] engineGetIV();

    protected abstract AlgorithmParameters engineGetParameters();

    protected abstract void engineInit(int var1, Key var2, SecureRandom var3) throws Inval

    protected abstract void engineInit(int var1, Key var2, AlgorithmParameterSpec var3, Se

    protected abstract void engineInit(int var1, Key var2, AlgorithmParameters var3, Secur
```

Provider architecture – Spi skeleton



```
void encryptBlock(byte[] var1, int var2, byte[] var3, int var4) {
    byte var5 = 0;
    int var10000 = var1[var2++] << 24 | (var1[var2++] & 255) << 16 | (var1[var2++] & 
    int var13 = var5 + 1;
    int var6 = var10000 ^ this.K[var5];
    int var7 = (var1[var2++] << 24 | (var1[var2++] & 255) << 16 | (var1[var2++] & 255
    int var8 = (var1[var2++] << 24 | (var1[var2++] & 255) << 16 | (var1[var2++] & 255

    int var9;
    int var10;
    int var12;
    for(var9 = (var1[var2++] << 24 | (var1[var2++] & 255) << 16 | (var1[var2++] & 255
        var10 = T1[var6 >>> 24] ^ T2[var7 >>> 16 & 255] ^ T3[var8 >>> 8 & 255] ^ T4[va
        int var11 = T1[var7 >>> 24] ^ T2[var8 >>> 16 & 255] ^ T3[var9 >>> 8 & 255] ^ 
        var12 = T1[var8 >>> 24] ^ T2[var9 >>> 16 & 255] ^ T3[var6 >>> 8 & 255] ^ T4[va
        var9 = T1[var9 >>> 24] ^ T2[var6 >>> 16 & 255] ^ T3[var7 >>> 8 & 255] ^ T4[va
        var6 = var10;
        var7 = var11;
    }

    var10 = this.K[var13++];
    var3[var4++] = (byte)(S[var6 >>> 24] ^ var10 >>> 24);
    var3[var4++] = (byte)(S[var7 >>> 16 & 255] ^ var10 >>> 16);
    var3[var4++] = (byte)(S[var8 >>> 8 & 255] ^ var10 >>> 8);
    var3[var4++] = (byte)(S[var9 & 255] ^ var10);
    var10 = this.K[var13++];
    var3[var4++] = (byte)(S[var7 >>> 24] ^ var10 >>> 24);
    var3[var4++] = (byte)(S[var8 >>> 16 & 255] ^ var10 >>> 16);
    var3[var4++] = (byte)(S[var9 >>> 8 & 255] ^ var10 >>> 8);
    var3[var4++] = (byte)(S[var6 & 255] ^ var10);
```

Strong cryptography

- Limits the strength of your crypto
  - the size of the Key
- AES-256, RSA-2048 not available by default
- Java Cryptography Extension (JCE) Unlimited Strength Jurisdiction Policy Files

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Strong cryptography

Algorithm	Key size
DES	64
DESede	*
RC2	128
RC4	128
RC5	128
RSA	* (KeyPairGenerator 1024)
other	128

Download NetBeans project

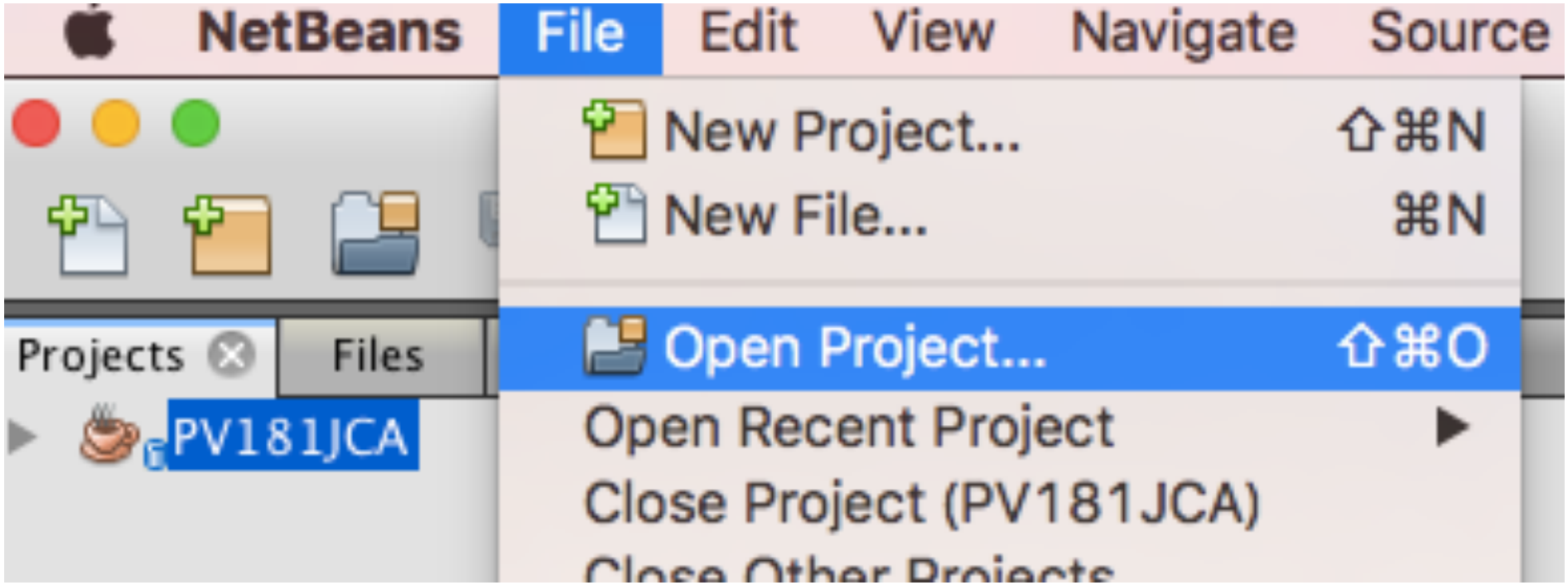
goo.gl/ntSDHP

Case sensitive

Pls open

NetBeans

Pls open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Projects
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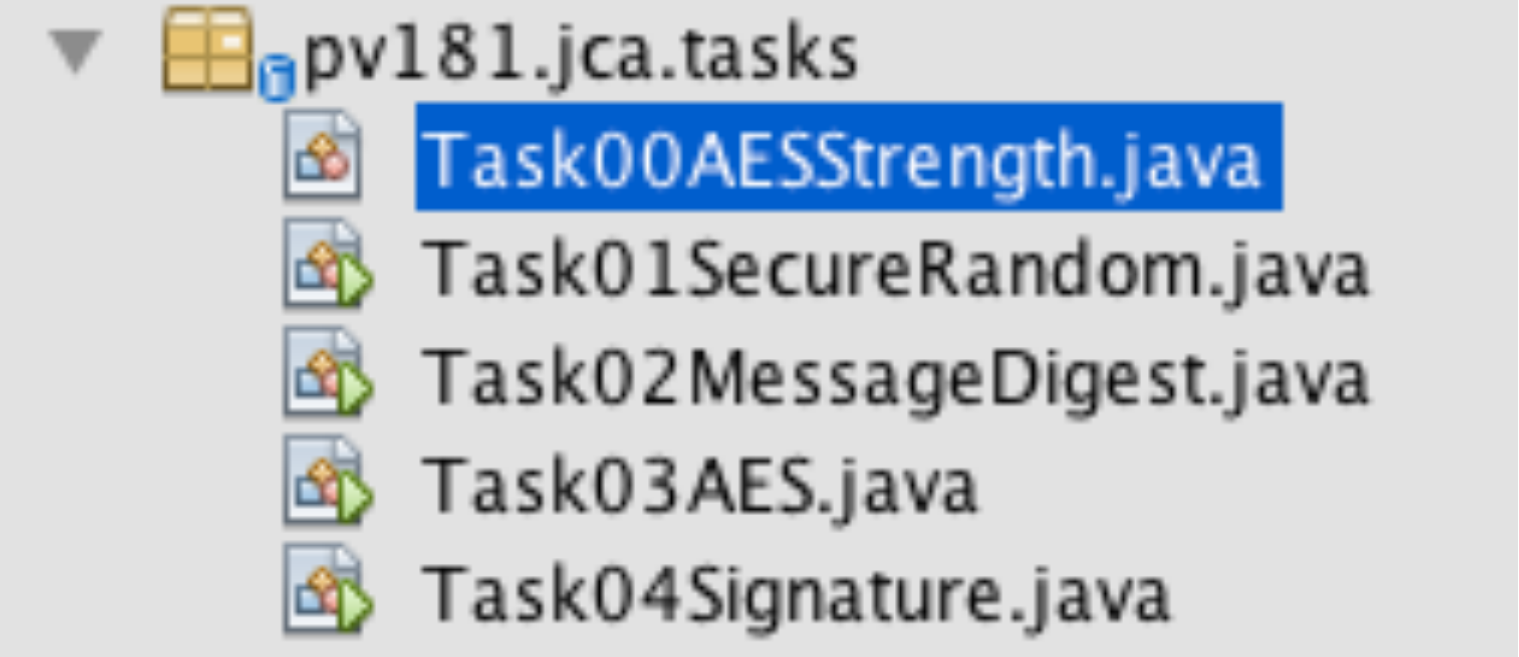
PV181JCA

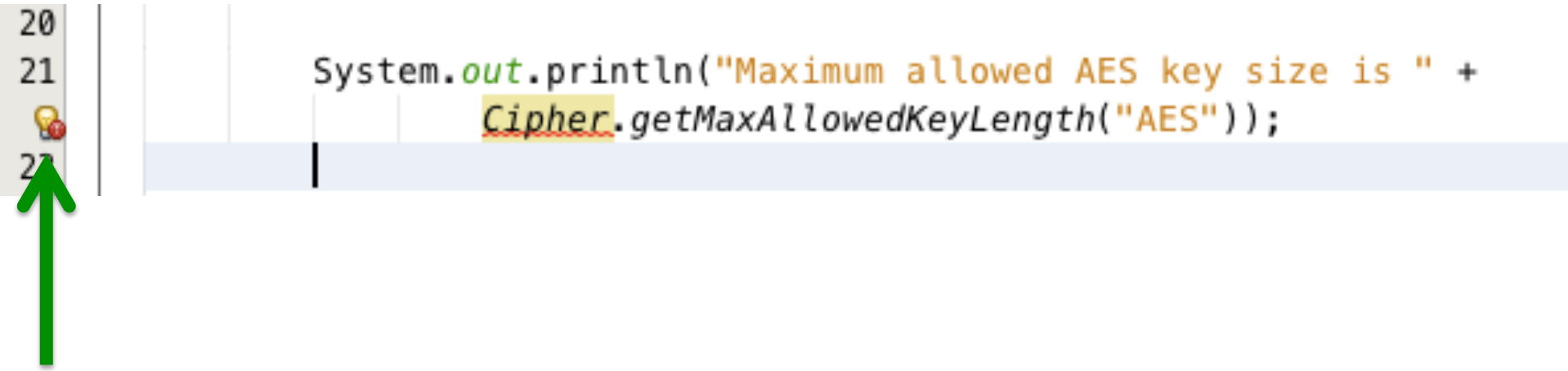
Getting started



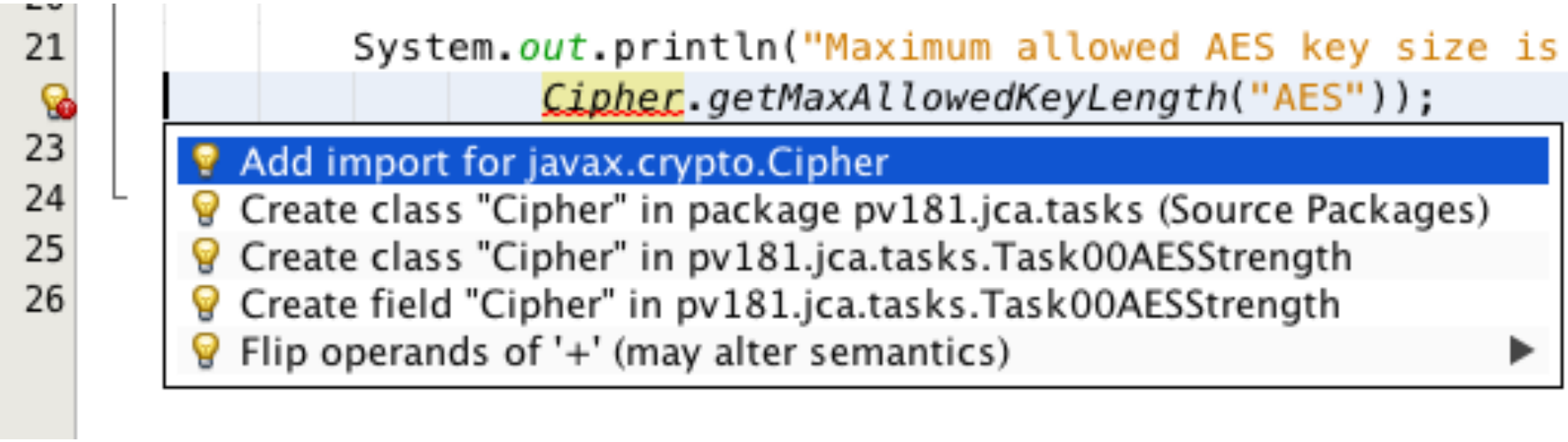
Cipher – import missing

```
20
21          System.out.println("Maximum allowed AES key size is " +
                    Cipher.getMaxAllowedKeyLength("AES"));
23
```

Cipher – import missing

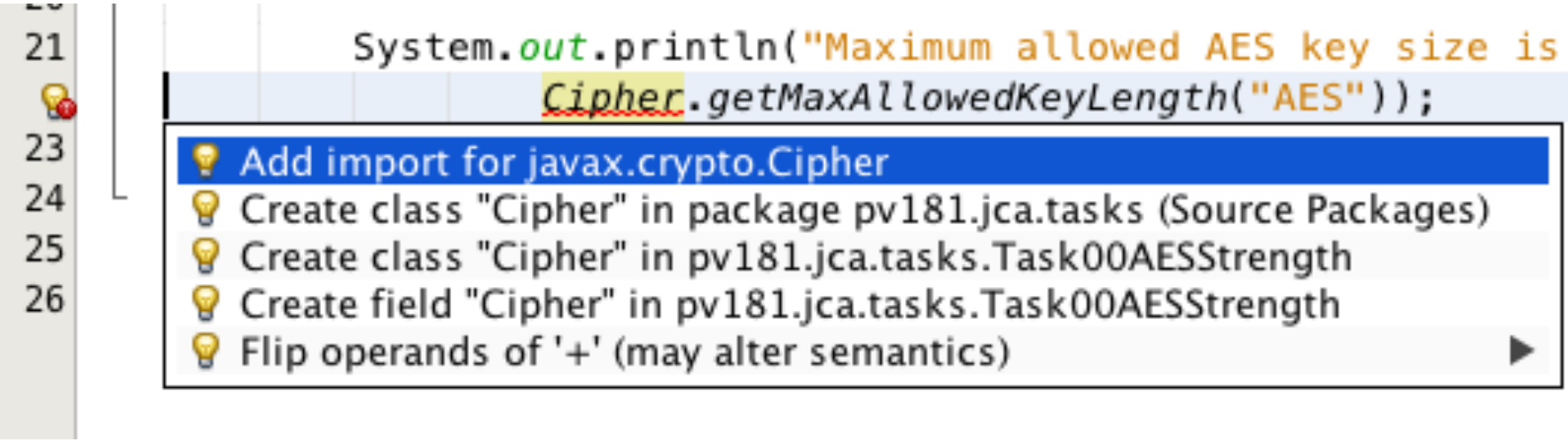


Lighbulb helps



Getting started

CTRL+SHIFT+I



Problem again

```
23          System.out.println("Maximum allowed AES key size is " +
                    Cipher.getMaxAllowedKeyLength("AES"));
25
```

Problem again

```
public class Task00AESStrength {
    public static void main(String args[]) throws NoSuchAlgorithmException {
        /**
```

The web

Pls open – the guide

goo.gl/4Ztqen

Case sensitive

Task01 - SecureRandom

- SecureRandom rnd = new SecureRandom()
- rnd.nextDouble()
- rnd.nextByte()
- rnd. ....

SecureRandom - solution

- SecureRandom rnd = new SecureRandom()
- rnd.nextBytes(buffer);
- System.out.println(Globals.bytesToHex(buffer));

Task02 - MessageDigest

- MessageDigest md5 =

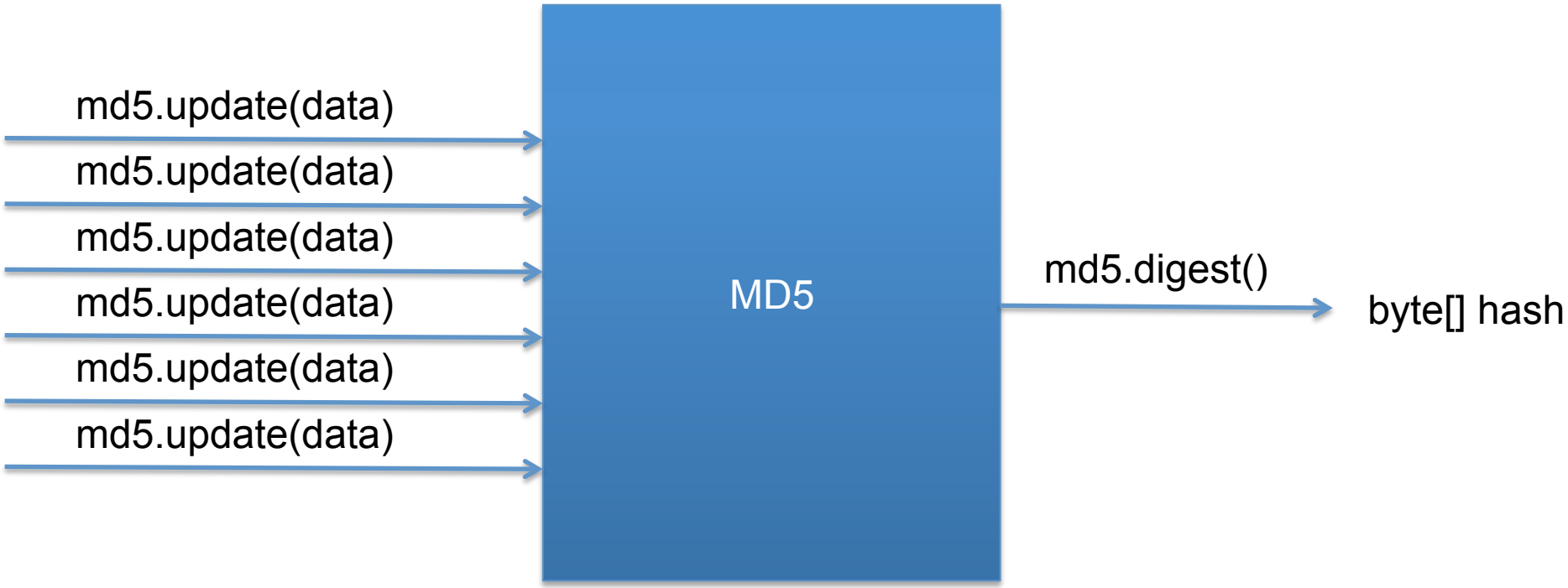
  MessageDigest.getInstance(“MD5”);

MessageDigest

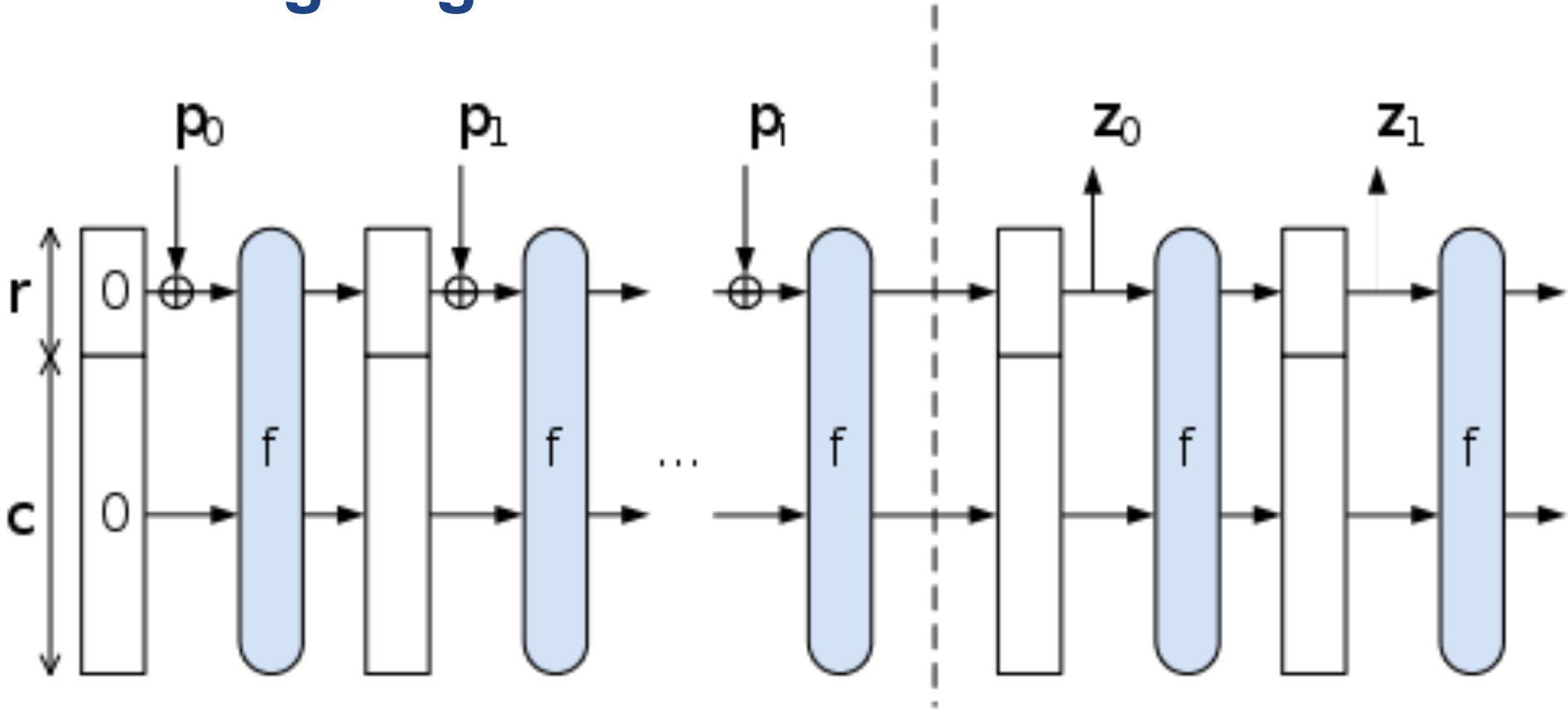
- MessageDigest md5 =
  MessageDigest.getInstance("MD5");

- md5.update(inputBuffer);
- md5.update(inputBuffer);
- md5.update(inputBuffer);
- byte[] md5hash = md5.digest()

MessageDigest – incremental API



MessageDigest – incremental API

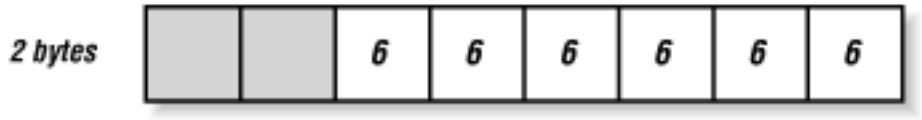


MessageDigest – solution

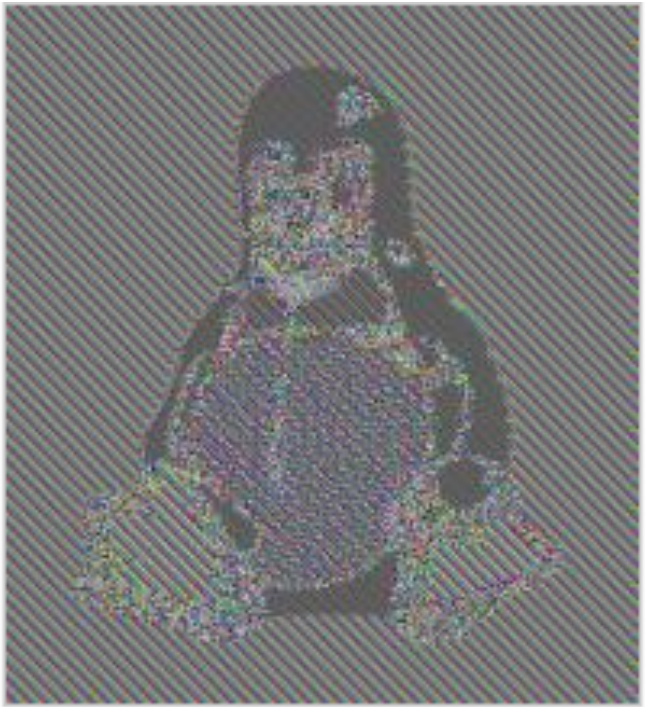
```
public static void main(String args[]) throws Exception {

    InputStream is01 = new URL("http://www.fi.muni.cz/~xklinec/java/file_a.bin"
    byte[] buffer = new byte[1024];

    MessageDigest md5 = MessageDigest.getInstance("MD5");
    MessageDigest sha = MessageDigest.getInstance("SHA-256");

    int bytesRead = -1;
    while ((bytesRead = is01.read(buffer)) >= 0){
        md5.update(buffer, 0, bytesRead);
        sha.update(buffer, 0, bytesRead);
    }

    System.out.println(Globals.bytesToHex(md5.digest(), false));
    System.out.println(Globals.bytesToHex(sha.digest(), false));
```

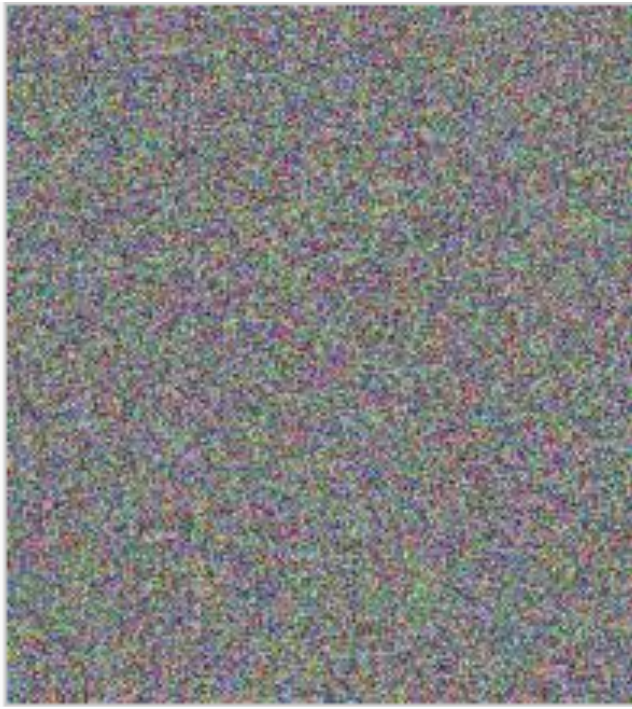
Task03 - Cipher

- getInstance("**algorithm/mode/padding**");
  - Default mode: ECB
  - Default padding: PKCS5



Cipher





Cipher

- init(mode, key, algorithmParameterSpec)
  - Cipher.DECRYPT_MODE
  - **new** SecretKeySpec(aesKey, **"AES"**)
  - **new** IvParameterSpec(iv)

Cipher – Key vs KeySpec

- Key – opaque key, used in engine
  - getAlgoritm(), getEncoded()
- KeySpec – key specification, transport & storage
  - getP(), getQ(), getN()

Cipher – Key vs KeySpec

- SecretKeySpec = Spec & Key in the same time

Cipher – Key vs KeySpec

```
public class RSAPrivateCrtKeySpec extends RSAPrivateKeySpec {

    private final BigInteger publicExponent;
    private final BigInteger primeP;
    private final BigInteger primeQ;
    private final BigInteger primeExponentP;
    private final BigInteger primeExponentQ;
    private final BigInteger crtCoefficient;
```

Cipher – Key vs KeySpec

- Why separated?

Cipher – Key vs KeySpec

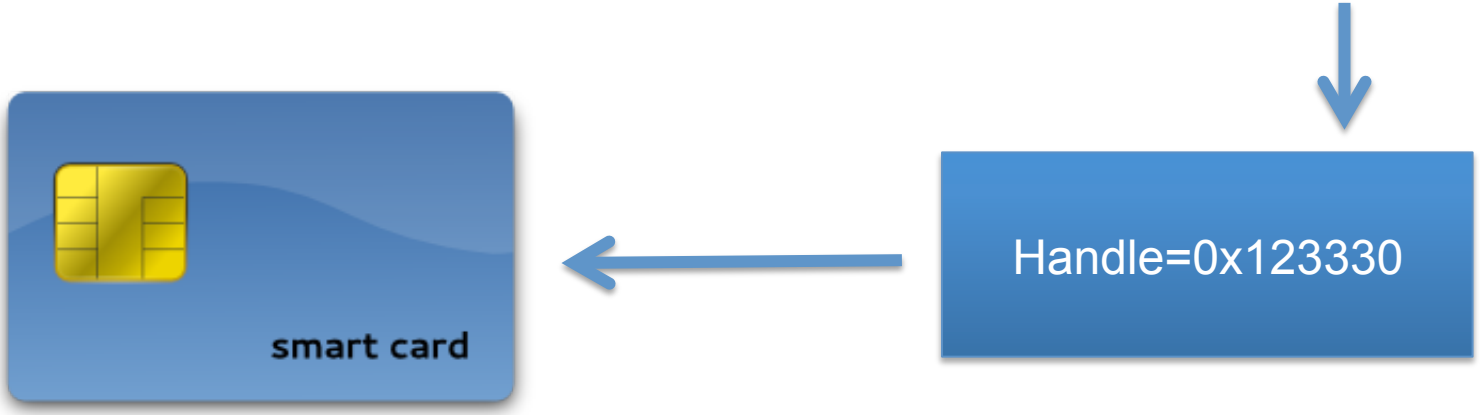
- Why separated?

```
Cipher.init(Cipher.DECRYPT_MODE, key)
```

Cipher – Key vs KeySpec

- Why separated?

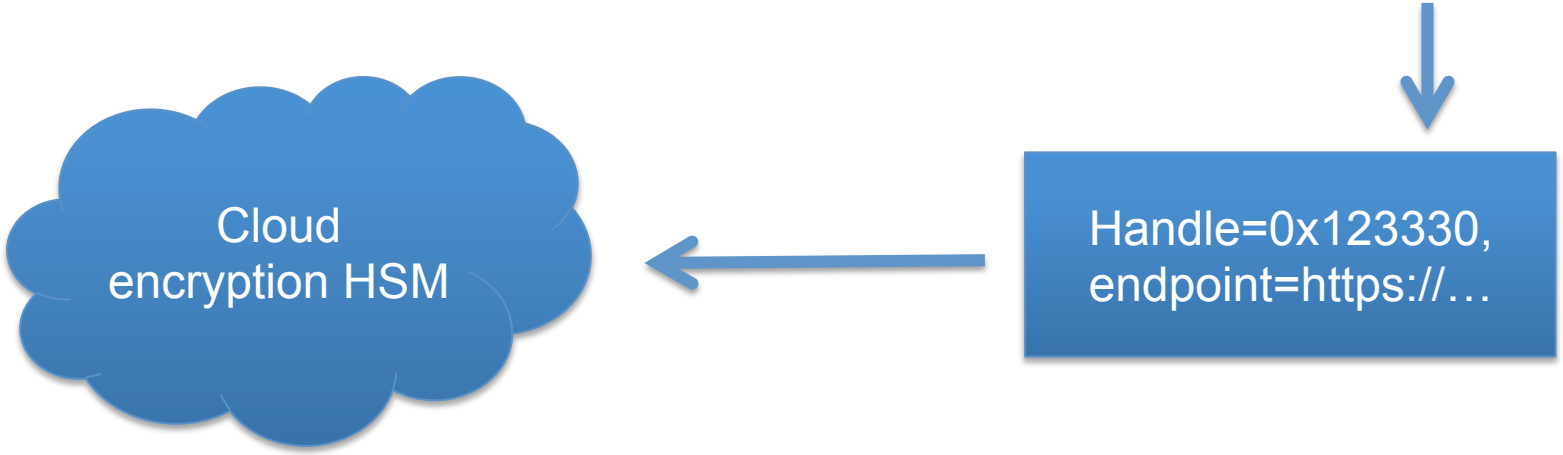
Cipher.init(Cipher.DECRYPT_MODE, key)



Cipher – Key vs KeySpec

- Why separated?

```
Cipher.init(Cipher.DECRYPT_MODE, key)
```



Cipher – Solution

```
byte[] key = DatatypeConverter.parseBase64Binary(
        "AAAAAAAAAAAAAAAAAAAAAA==");
byte[] iv = DatatypeConverter.parseBase64Binary(
        "AAAAAAAAAAAAAAAAAAAAAA==");
byte[] ciphertext = DatatypeConverter.parseBase64Binary(
        "6VMSY9xFduwNsiyn8mGZdLG6/NXb3ziw81MBSfaKozs=");

Cipher aes = Cipher.getInstance("AES/CBC/PKCS5Padding");

Key aesKey = new SecretKeySpec(key, "AES");
aes.init(Cipher.DECRYPT_MODE, aesKey, new IvParameterSpec(iv));

byte[] plaintext = aes.doFinal(ciphertext);
System.out.println(Globals.bytesToHex(plaintext, false));
System.out.println(new String(plaintext));
```

Key Factories

- KeySpec → Key
- Key → KeySpec

- KeyFactory – asymetric keys
- SecretKeyFactory – symmetric keys

Key generators

- KeyGenerator – symmetric
  - generateSecret() → SecretKey
- KeyPairGenerator – asymmetric
  - generateKeyPair() → KeyPair

Certificate Builder

- X509V3CertificateGenerator
- goo.gl/I9WLUD

Diffie Hellman

- KeyPairGenerator
- KeyAgreement
- goo.gl/Lus40Y

Thank you for your attention!

Questions

References / resources

- TBD