

Powering the trusted identities of
the world's people, places & things

NFIQ 2

From Excitement to Practice

About HID (formerly Crossmatch is part of HID)



HID Global powers the trusted identities of the world's people, places and things

NFIQ - Collaboration to address biometric challenges



- 1995 – start using digital fingerprints
- 2004 – NIST publish the NFIQ as part of their NIST Biometric Imaging Software
- 2015/2017 – ISO/IEC and NIST working on NFIQ 2 together with research partners
- 2018 – ISO/IEC and NIST publish NFIQ 2 as international standard ISO/IEC 29794-4
- 2021 – a revised NFIQ 2 becomes available

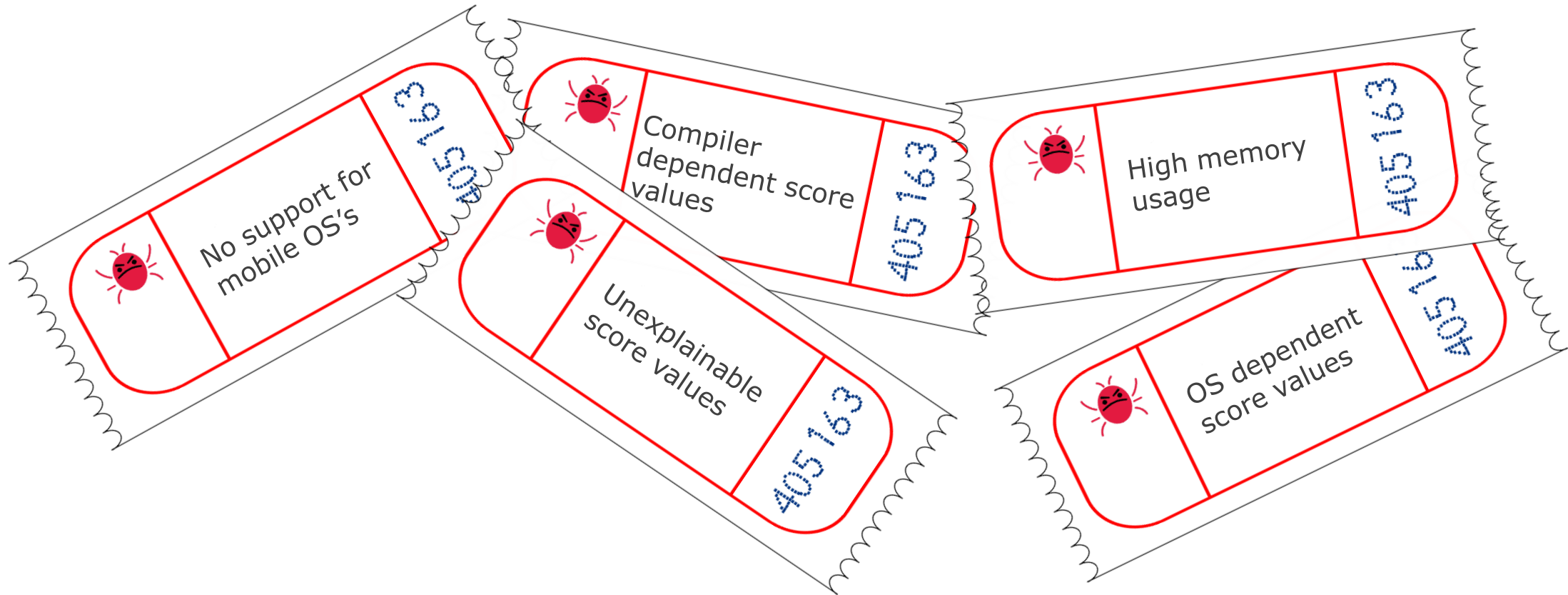
HID Livescan business started 1998

Biometric community is excited about the NFIQ 2 as result of a common effort and the many contributions to improve the fingerprint quality assessment.

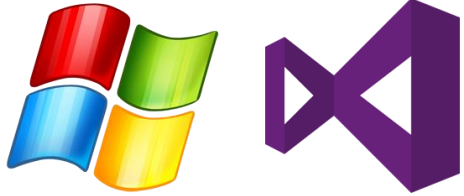
NFIQ 2 – Early adaption

- HID started 2018 to adapt the NFIQ 2
- Soon experienced initial problems of the NFIQ 2

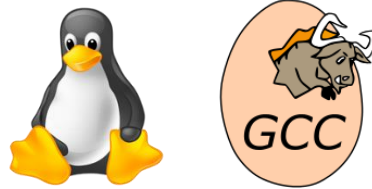
Enthusiasm gave way to disillusion but was leading to active contributions!



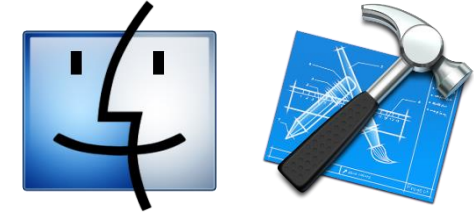
NFIQ 2 – Multi platform / multi compiler support



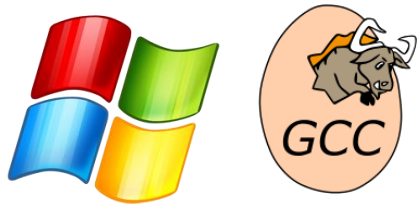
Windows 32/64 Bit + MSVC



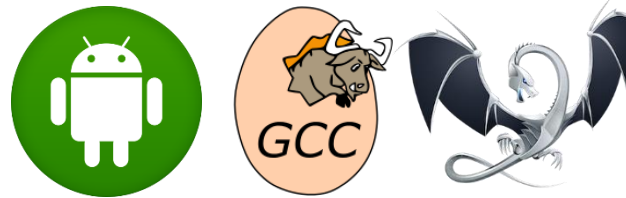
Linux 32/64 Bit + GCC



Macintosh OSX 64 Bit + XCode



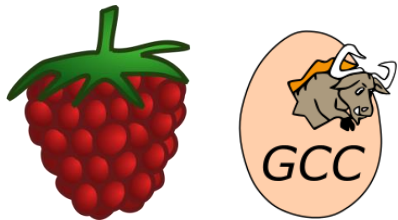
Windows 32/64 Bit + MinGW



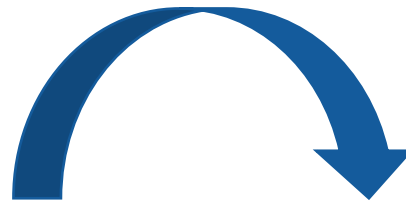
Android 32/64 Bit + GCC/Clang



iOS 64 Bit + XCode



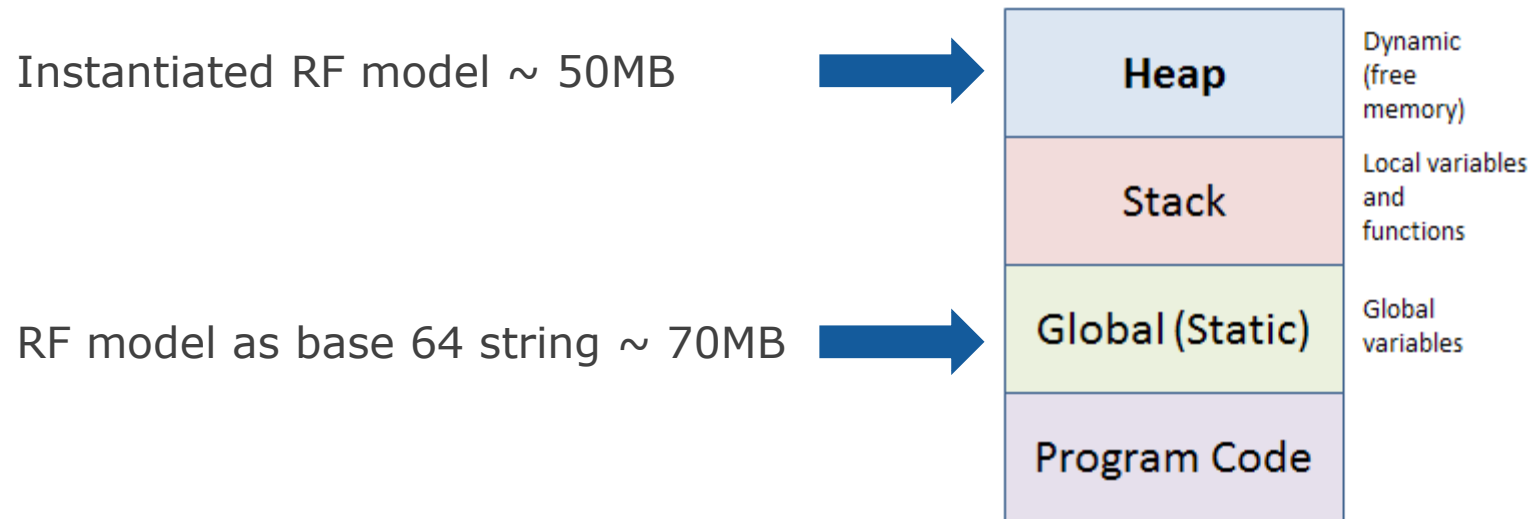
Raspberry PI 32/64 Bit + GCC



Problems were solved in revised NFIQ 2

NFIQ 2 – Memory considerations

- NFIQ 2 uses a random forest model to classify the data
- In the initial version of NFIQ 2 the RF model was compiled into the library as base 64 string



PRO

- Consistent RF model
- Easy handling, especially on mobile devices

CON

- High memory requirements, especially on mobile devices

NFIQ 2 – Memory refactoring

- Obvious solution, split program code and model data into two files
- Program code will load model data at runtime

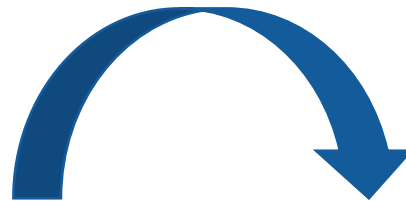


Inherited problems

- Consistent RF model origin
- Potential load errors (file not found)
- File loading on limited platforms (e.g.: Android)

Proposed solutions

- Secure RF model file with HASH code (e.g.: MD5)
- Application is responsible to locate RF model file
- Solved by platform specific solution



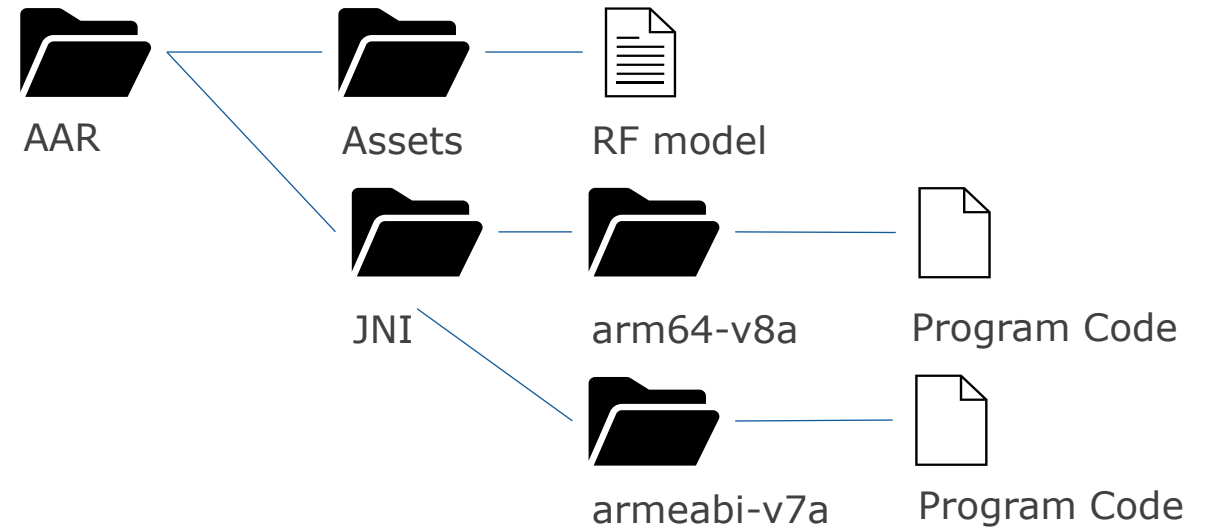
**Problems partially solved
in revised NFIQ 2**

NFIQ 2 – Loading the RF model from an AAR (Android Archive)

- Android uses AAR files to provide dynamic libraries for a mobile app
- Embed the RF model into the assets of an AAR file
- Android has a very restrictive policies for accessing files on the system
- RF model on Android cannot be instantiated by the NFIQ 2 code from an asset file
- Alternatives are:
 - Instantiate from memory buffer
 - Using the Android Asset Manager

Android Asset Manager

1. Java/Kotlin app needs to instantiate asset manager
2. Provide asset manager through JNI to the native code
3. Native code uses asset manager to read file from AAR assets folder



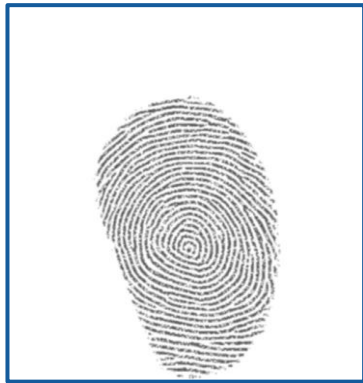
NFIQ 2 – Score observations

- When working with NFIQ 2 some interesting score values were observed
 - Visual better prints may get a lower score
 - Score may depend on canvas size

Same image, but different canvas



Score 62



Score 76



Score 67

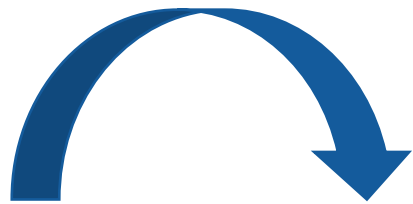


**Score jitter marginal
impacts the classification
accuracy**

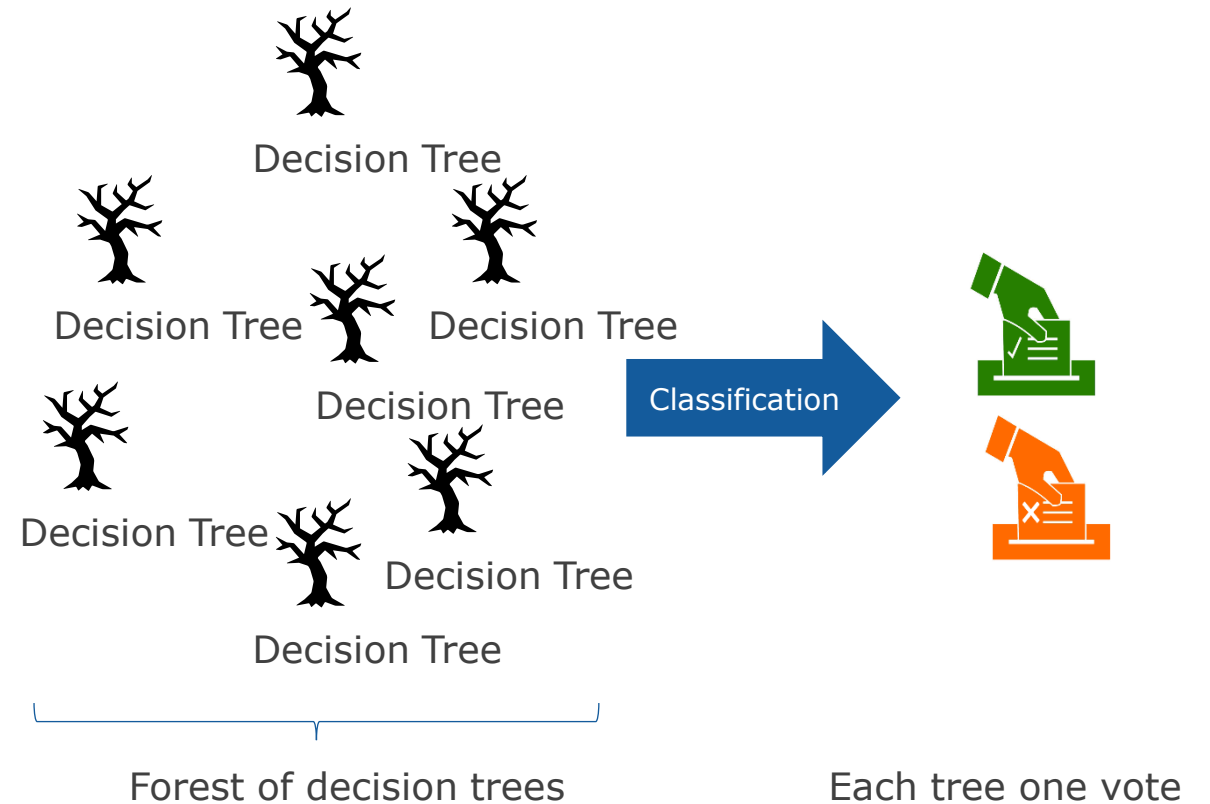
*This slide
uses artificial
prints!*

NFIQ 2 – Looking behind the scores

- NFIQ 2 is a binary classifier
- The classification uses a random forest model
- Scores are derived from the random forest decision
- Each decision tree uses a random subset of the feature vector
- When using 100 decision trees, each vote is one score point
- The distribution of votes/score points is not linear, and not necessarily uncorrelated



NFIQ 2 shall not be used to rank image data



NFIQ 2 - Summary

What we have...

- State of the art and industry proven algorithm
- Good multi platform support
- Reliable classification

What we wish...

- Better support for mobile applications

What we shall know...

- Meaning of quality score values
- Do not use NFIQ 2 to rank fingerprint image

Question and Answers

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Working Group 3 & 4



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Thank you

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