

Biometric Identification: *Operation, Applications, Issues*

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Newsflash!

- eight fingerprints and face required to get new US Visa
- New ICAO passport standard requires biometric data in document
- UK will issue biometric based ID card

Newsflash - Canada

- ❑ Canadian passport office did large project to analyze face recognition technologies in 2003
- ❑ Department of Transport is piloting Iris recognition for airports
- ❑ CCRA had “biometrics forum” Nov. 2003
- ❑ Alberta implemented a face recognition based driver’s licence
- ❑ Ontario considers iris recognition based driver’s license

What are **Biometrics**

Automatic
identification
of an
individual
based on
behavioural or
physiological
characteristics

What are Biometrics

Automatic ←
identification
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Computer based
ie. fast

Forensics is the
science of humans
identifying humans

What are Biometrics

Automatic
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- Two types:
1. Verification
 2. Identification

What are Biometrics

Automatic identification of an **individual** based on behavioural or physiological characteristics

Biometrics is **only** about identity of individual. Other technologies manage security

What are Biometrics

Automatic identification of an individual based on **behavioural** or physiological characteristics

Behavioural biometrics:

- Gait
- Voice
- Typing dynamics
- Signature

What are Biometrics

Automatic identification of an individual based on behavioural or **physiological** characteristics

Physiological Biometrics

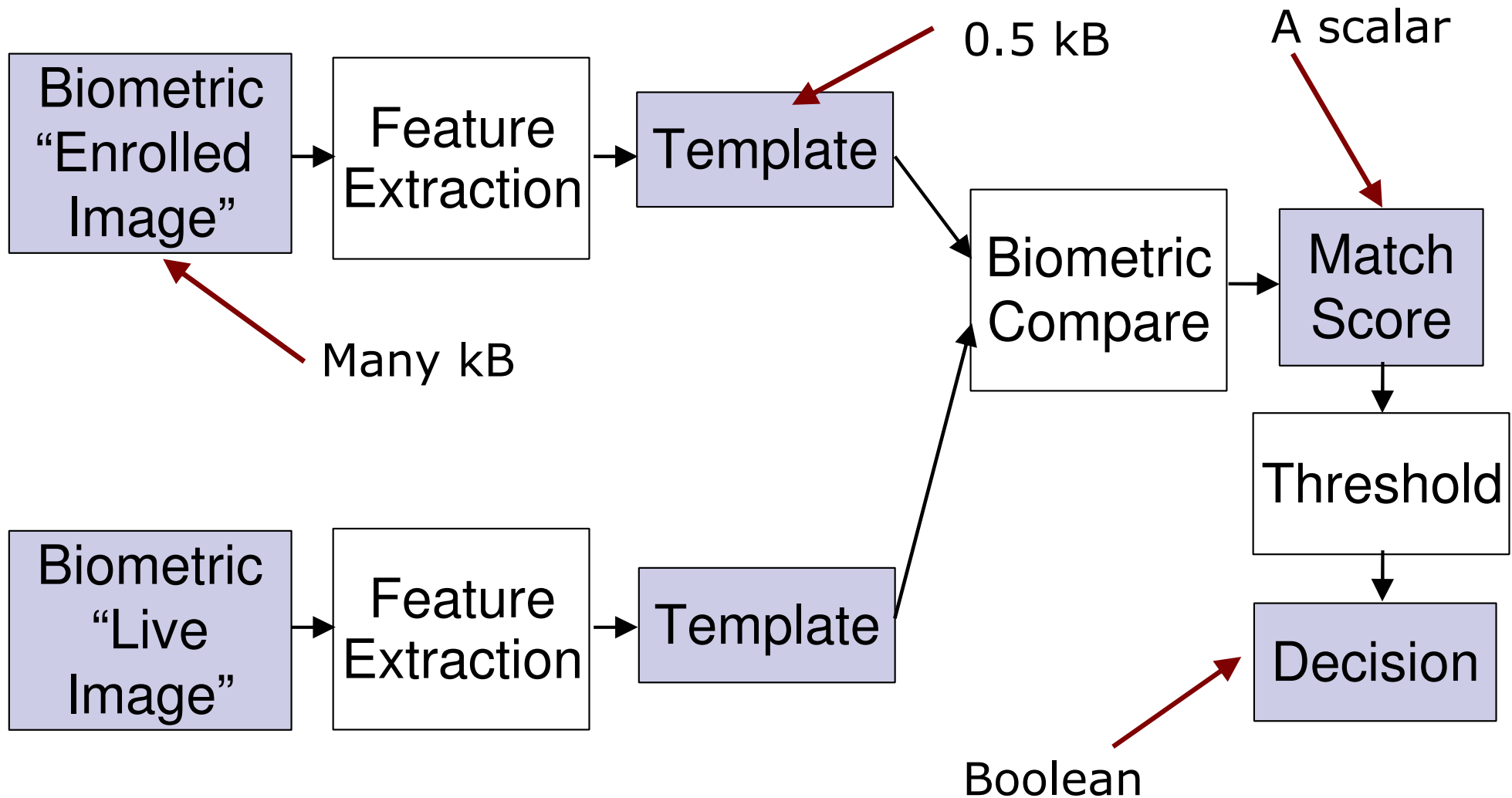
- Fingerprint
- Face
- Iris
- Retina
- Hand Geometry
- Dental shape
- DNA

...

Brief History

- 1980's: Automated fingerprint for FBI AFIS
- Early 1990's: National ID use
 - INSPASS/CANPASS system
- Mid 1990's: Biometrics became cheap
 - Fingerprint scanners <\$1000 in 1997
- Mid 1990's-2001: Commercial focus
 - Biometrics business have not (yet) seen significant takeup
- Strong focus on National security / Government applications after Sept 11 2001.

Biometrics Processing



Biometrics **Verification**

Question:

Are you who you say you are?

Test:

- ❑ Subject shows ID with *claimed identity*
- ❑ Compare *live image* to *enrolled image* for claimed identity => Calculate *match score*
- ❑ Compare *match score* to threshold.
Make decision

Biometrics **Verification**

Also called:

- ❑ 1:1 comparison

Applications:

- ❑ Verification of passport holder
- ❑ Bank card / credit card verification at point of sale
- ❑ Time and attendance

Verification **Testing**

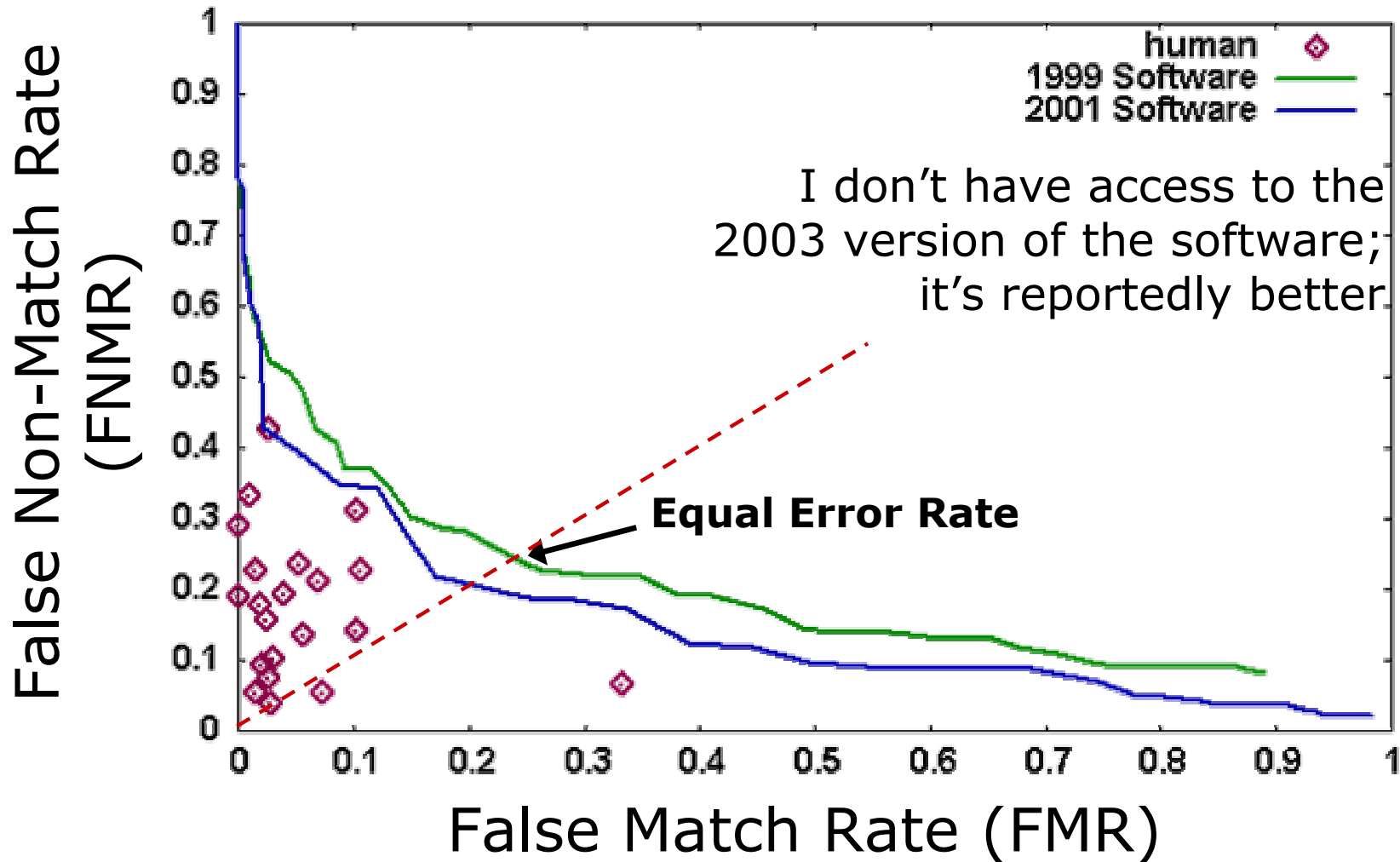
Two possible errors

- False Match (rate is FMR).
 - Also False Accept (FAR)
- False Non-Match (rate is FNMR)
 - Also False Reject (FRR)

Aside: FAR, FRR are *application* measurements. They don't necessarily refer to pure biometric events

Biometrics Interpretation

Face Recognition results on NIST Mugshot DB



Biometrics **Identification**

Questions:

Are you **not** who you say you are **not**?

Are you a person we're looking for?

Test:

- ❑ Subject does not present ID
- ❑ Compare *live image* to *enrolled image* for all records in DB => Calculate *match score*
- ❑ Sort *match score* for all records.
Display top candidates.

Biometrics **Identification**

Also called:

- 1:N comparison
- Watch list comparison

Applications:

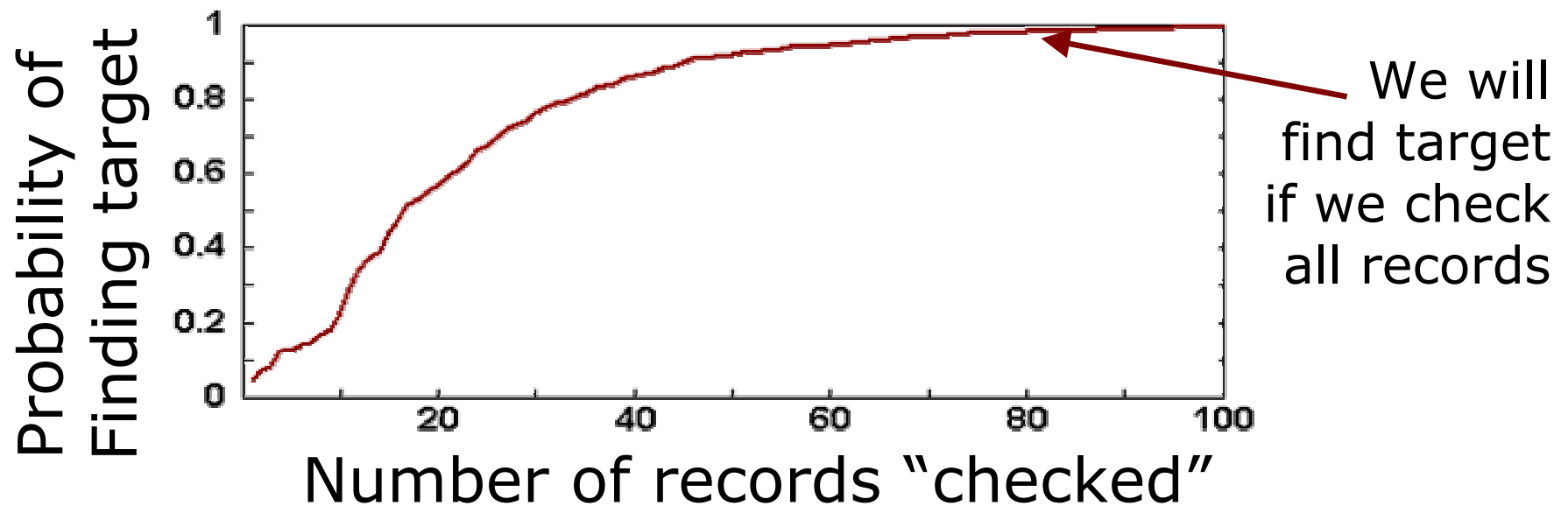
- Biometric only access control
- Detect duplicate application for government benefits
- Watch list comparison

Identification **Testing**

Identification is a much more difficult problem.
Typically preprocessing is used to “bin” records rather than compare all.

Basic Measure:

- Cumulative Match Curve (CMC).



Biometrics **Verification**

Many successful implementations:

- Required processing is low
- Distributed architecture
 - Template can be carried on ID card
- Cheating is more difficult
 - Need to look like another person, rather than different from yourself
- A well designed system offers incentives to users

Biometrics **Verification**

Some problems with verification

□ Enrollment:

- Need to “train” users for equipment.
- Enrolled image is most important, but users are least trained
- Template ageing => need to re-enroll.

Biometrics **Verification**

Some problems with verification

□ Choice of threshold:

- High FMR irritates valid users
- High FNMR compromises security
- How to weigh costs?

□ Staff fatigue:

- If FMR is 1:1000, and “bad people” are 1:10,000
- good:bad people = 10:1 at security

Biometrics **Identification**

No current large scale successes:

- Required processing is high
- Centralized architecture
- Cheating is easier
 - Need to look unlike yourself
 - Dependent on accurate central DB data
 - How to enroll the “bad guys”?
- How to offer incentives to valid users?

Identification **issues**

- Adequacy of data:
 - US VISIT: Are 8 fingerprints enough to distinguish 6 billion people?
 - How to ensure adequate quality data?
- Staff fatigue:
 - “bad people” are 1:10,000
 - If FMR is 1:10 billion, and DB size is 100 million
 - good:bad people =100:1 at security

Technologies: Fingerprint



Numerous algorithm and capture devices



Standardized storage formats, APIs



Well regarded independent tests

~~1/2~~

Independent research community



Successful implementations

- Only truly mature biometric technology
- Many people (2-5%) don't have fingerprints
- Criminal implications

Technologies: Face Recognition



Numerous algorithm and capture devices



Standardized storage formats, APIs



Well regarded independent tests



Independent research community



Successful implementations

- Ease of enrolment (even unwilling)
- Well accepted by people
- However, error rates are high

Technologies: Iris recognition

- ✗ Numerous algorithm and capture devices
 - ✗ Standardized storage formats, APIs
 - ✗ Well regarded independent tests
 - ✗ Independent research community
 - ? Successful implementations
-
- Error rates in the 1:billion
 - Possible distance data capture
 - I suspect it may not work as well as claimed

Other technologies

- Lots of other biometrics:
 - Voice
 - Gait
 - 3D face recognition
 - Typing dynamics
 - ...

- Many have lots of potential
- However, it takes 10 years for a technology to become mature

Issues that need research

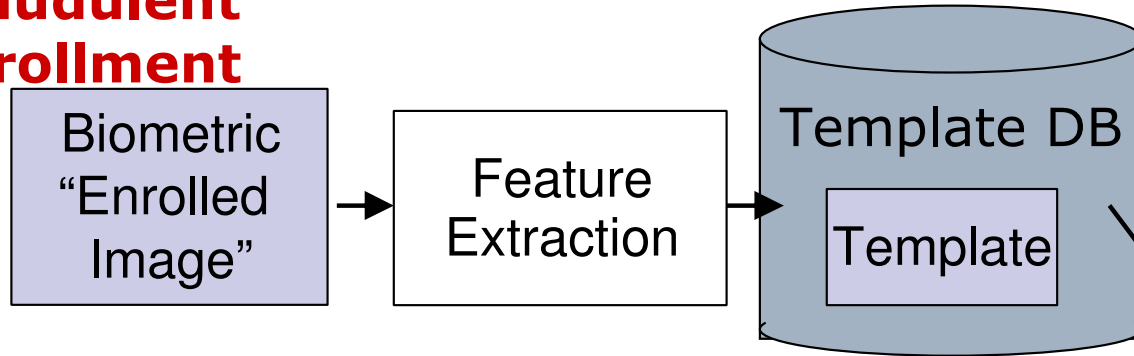
- Better performing algorithms
 - Better feature detection
 - Better feature extraction
- Combination biometrics
 - What's the best way to use results from different vendors and different algorithms
 - What's the best way to use other information (eg. biographical)

Issues that need research

- Proper studies of performance
 - Operational assessment
 - Large database tests
 - Template ageing
 - How does it compare to human performance?
- Privacy and security analysis
 - Biometric processing and data storage is complicated. What are the weak points?

Security issues

Fraudulent Enrollment

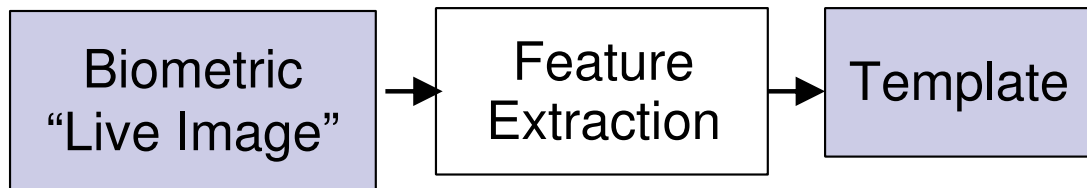


Extract image from template

Database integrity

Confusing value

Replay Attack

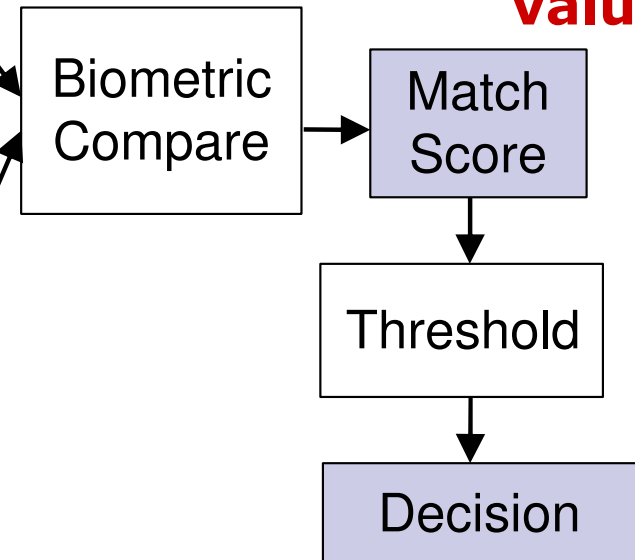


Lookalike

Change Appearance

Confuse Algorithm
(tilt head,
Squash finger)

Fatigued operator



Security issues: continued

- ❑ Biometrics only provide identity
- ❑ These systems are also vulnerable to all of the traditional security threats
- ❑ Advantage is that people don't need to remember passwords
- ❑ However, even though there are good crypto solutions to replay, I predict this will become a serious issue.

Privacy issues

- There are widespread privacy concerns about biometrics.
- This is not really a biometrics issue. Governments have proved themselves irresponsible with personal data. Now people are stonewalling.
- Have you ever checked your credit record?
Mine is about 25% inaccurate.

Epilogue: Our future?

Operator: "Thank you for calling Pizza Hut."

Customer: "Two All-Meat Special..."

Operator: "Thank you, Mr. Sheehan. Your voice print verifies with your National ID Number: 6102049998"

Customer: (Sighs) "Oh, well, I'd like to order a couple of your All-Meat Special pizzas..."

Operator: "I don't think that's a good idea, sir."

Customer: "Whaddya mean?"

Operator: "Sir, your medical records indicate that you've got very high blood pressure and cholesterol. Your Health Care provider won't allow such an unhealthy choice."

Customer: "Darn. What do you recommend, then?"

Epilogue:

Operator: "You might try our low-fat Soybean Yogurt Pizza. I'm sure you'll like it"

Customer: "What makes you think I'd like something like that?"

Operator: "Well, you checked out 'Gourmet Soybean Recipes' from your local library last week, sir."

Customer: "OK, lemme give you my credit card number."

Operator: "I'm sorry sir, but I'm afraid you'll have to pay in cash. Your credit card balance is over its limit."

Customer: "@#%/\$@&?#!"

Operator: "I'd advise watching your language, sir. You've already got a July 2006 conviction for cussing ... "