Big numbers as safety belt in cookies

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for
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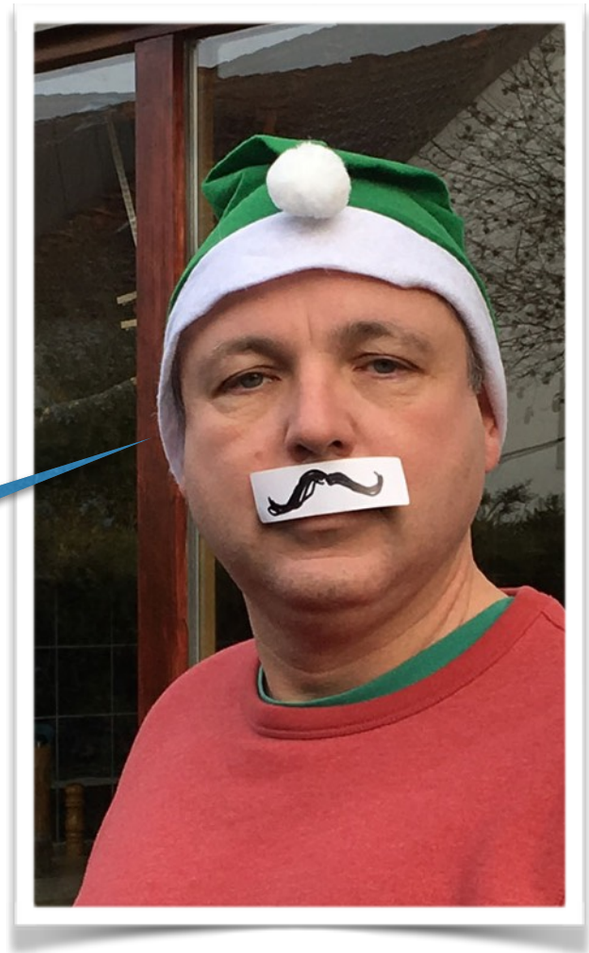
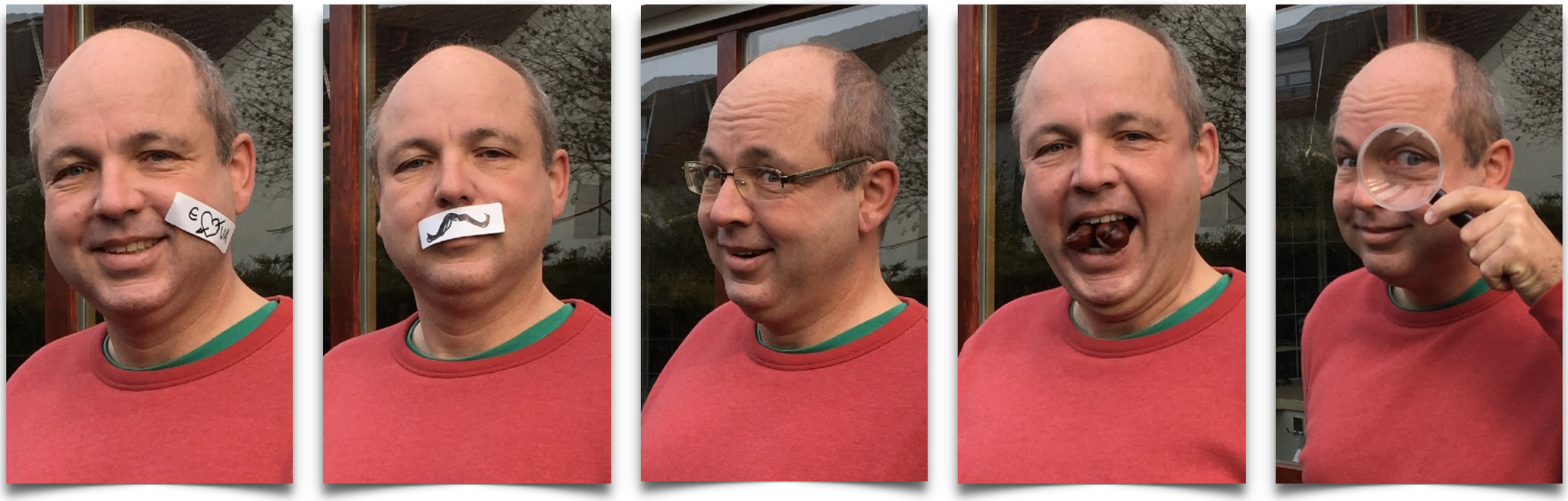
There is something wrong when you see a lot of dwarfs with green caps!

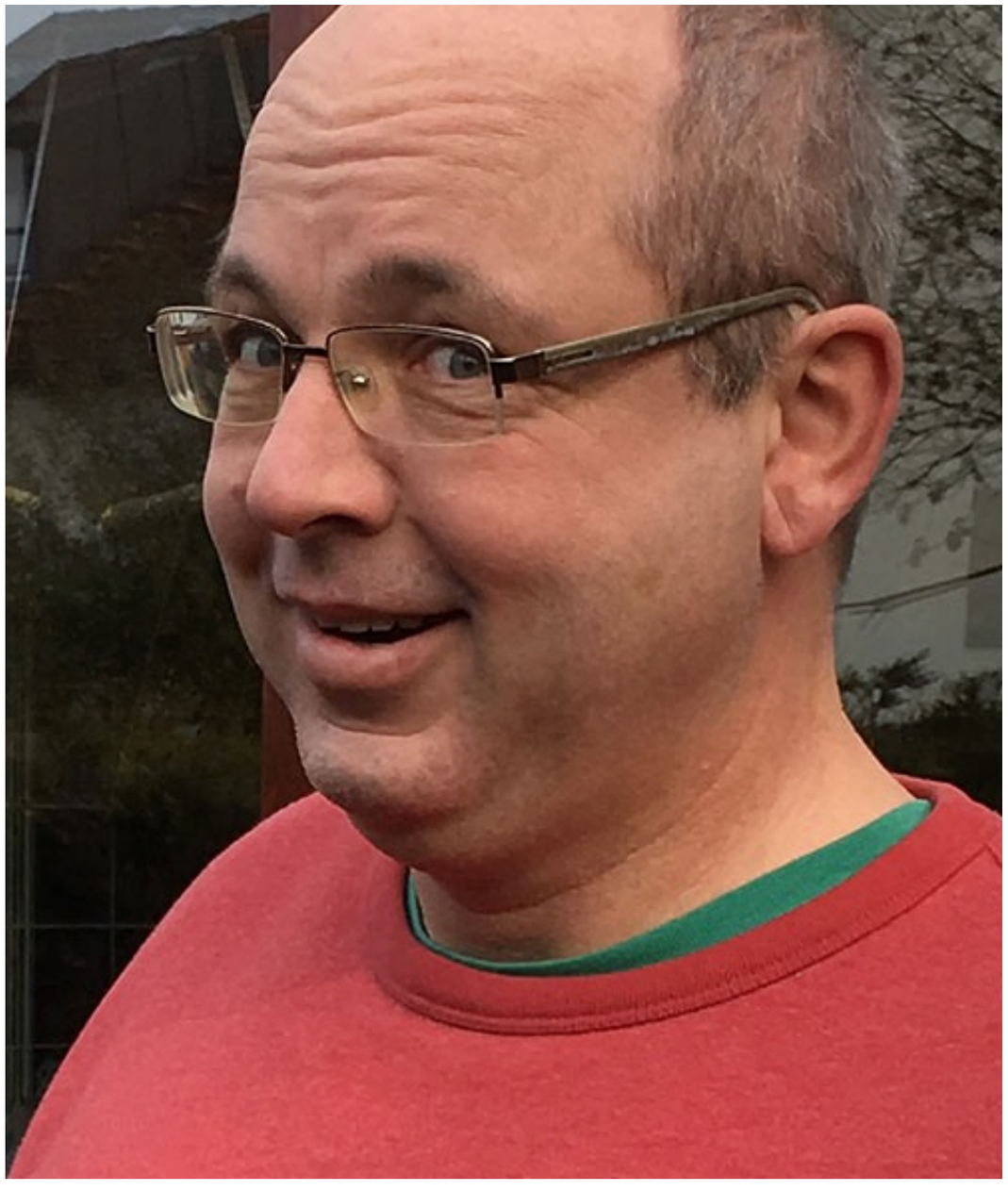


How does a server in a web-environment knows a user?



Cookies in web applications

- A server is talking to a lot of different users
- A user should be recognized in a secure way
- Also when being mobile
- Also when being behind a proxyserver
- …



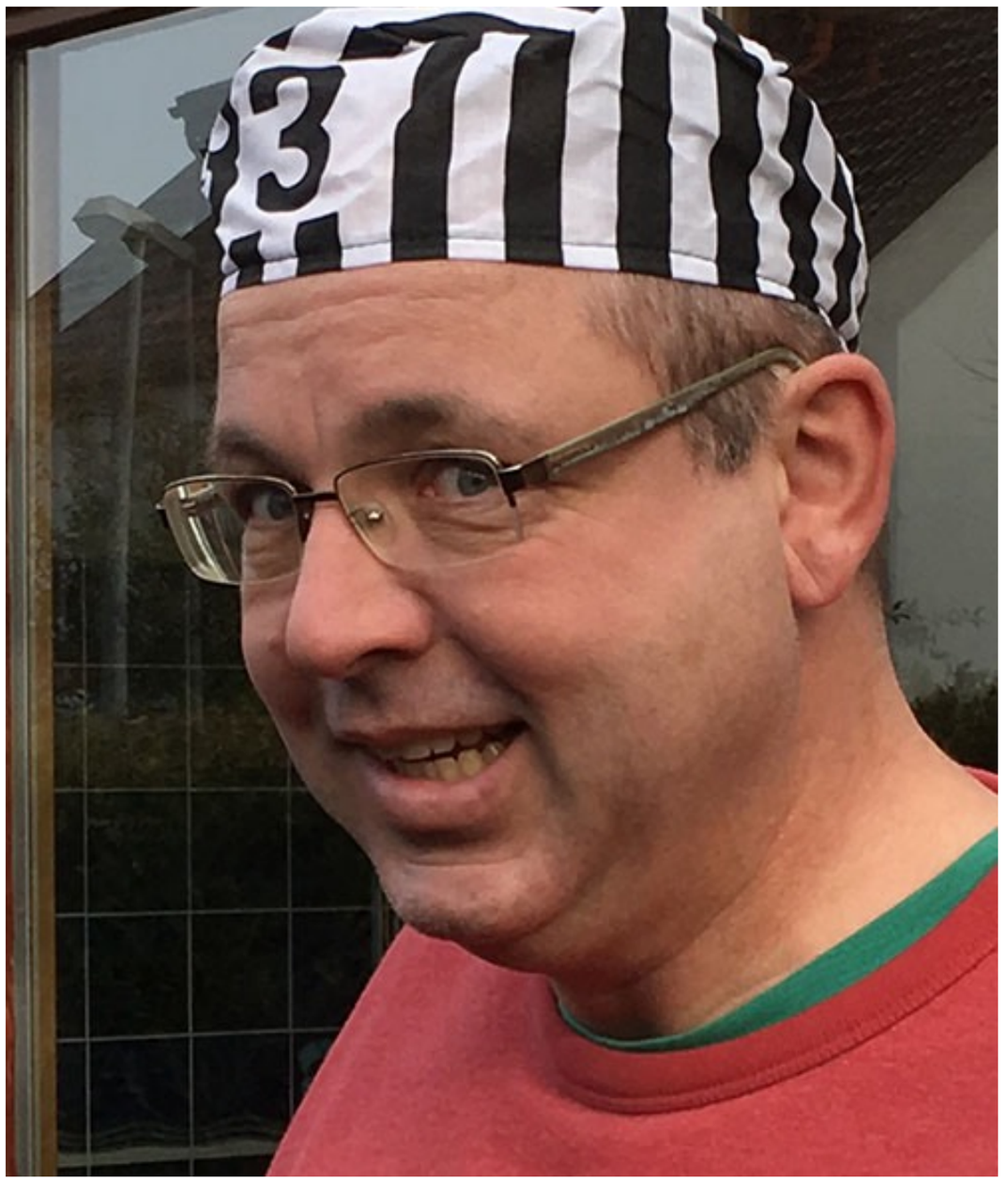
Cookies how I use them

- The user's web-browser get a cookie, this is a variable with some content in it

- reader_cookie_id = 14

- Variable name „reader_cookie_id“ << always the same

- 14 << for every webbrowser a different number



Cookies, what I do not do

- Cookie-**Pinning** to a client's ip address
  - because mobile IP changes when user is moving
  - because IPv6 changes frequently
  - an enterprise-proxy serves many users (Siemens, cable provides with not enough ipv4-addresses)

A view behind the curtain

- Managing readers (of a public library) in the web-application in a database

reader_cookie_id	status	reader_passport_nr
14	unknown	-1
15	reader	15006
…		

A view behind the curtain

A. Server gets no cookie from user -> create new cookie in the database and send that with the server's answer to the user (problem: many write-access to the database, many many cookies for users who do not accept cookies)

B. Server gets no cookie from user, wrong name or already invalid because of time -> A

The fear of the server

- What if the user know how the system works and manipulates it?

- User gets cookie-value 14 and sends 15 back with the next request -> change his identity (see internal database table 2 slides before)

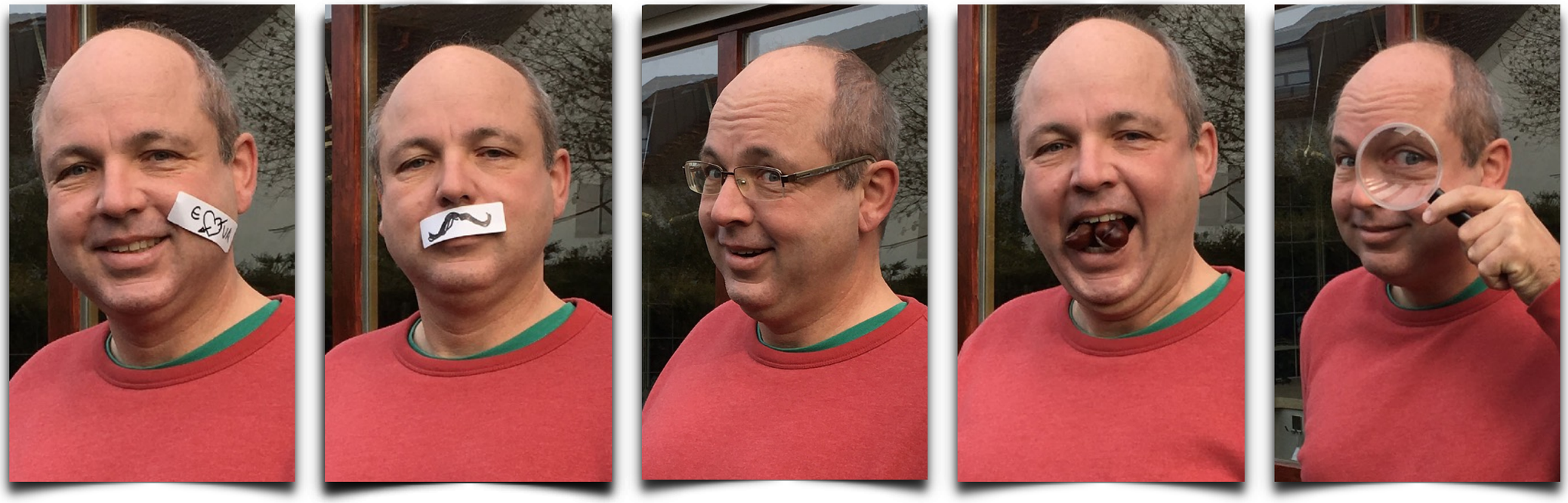
- solution: a (1) **very big** (2) **random** number as value for the cookie -> a hash value

What is a hash-value?

- A hash value is a very big number, for example MD5-hex
- 28 fe 14 b3 00 46 22 28 00 01 46 … 28 46
- The nice things about a hash value

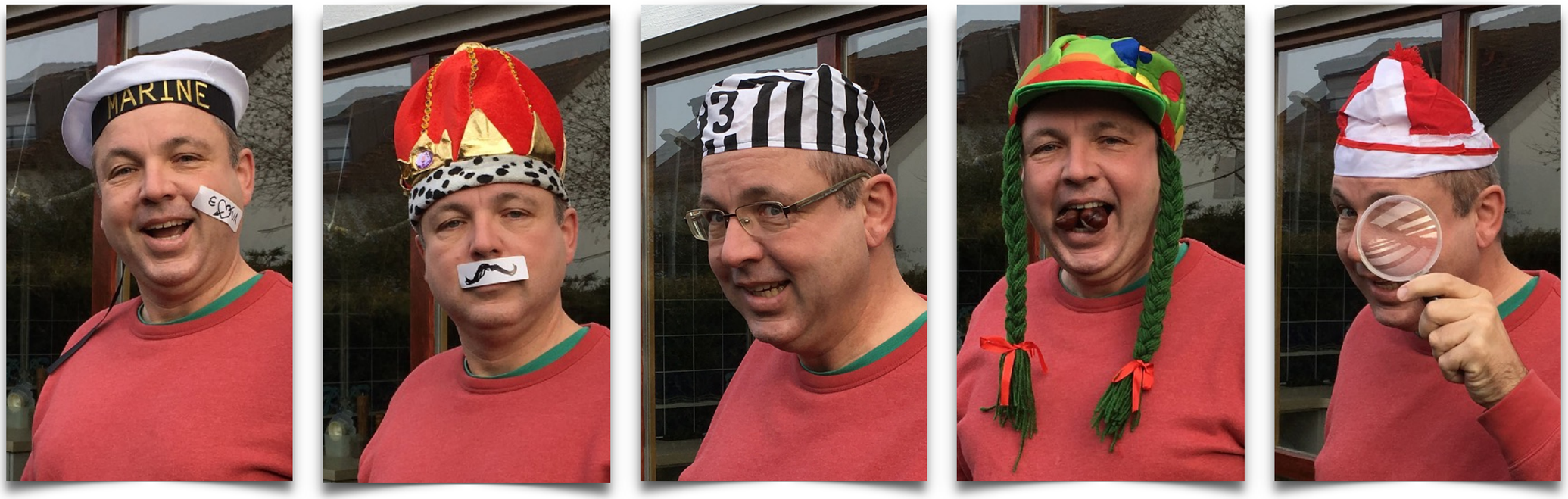
1. always the same length (32 characters for md5/hex), nice to save in a database
2. defined characters (0-9, a-f)
3. little changes in the input value create completely different hash-values
4. „relative“ collision-free (do I trust the hash-algorithm? rc4, md5, sha256, …)

When all is done well the server knows every user by it’s „hash“-hat easily



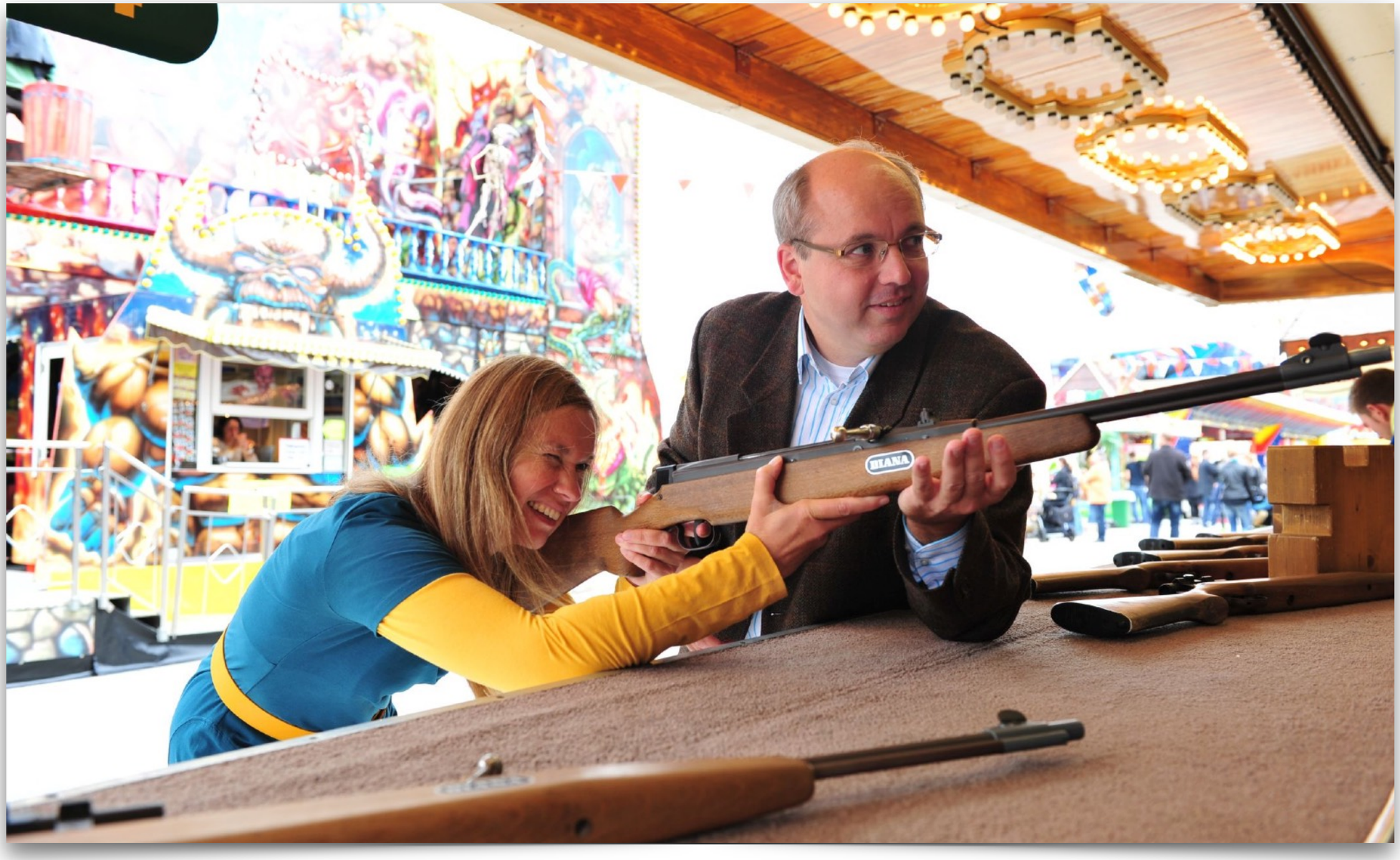
Perfect!

But how do we create different hashes for each user?



PID as hash-seed

- in my development environment there is a new process id (PID) for every request. PID is always different
- 1004 -> ab:cd:12:34:…
- 1005 -> 45:67:90:12:…
- 1006 -> 94:3f:5b:29:…

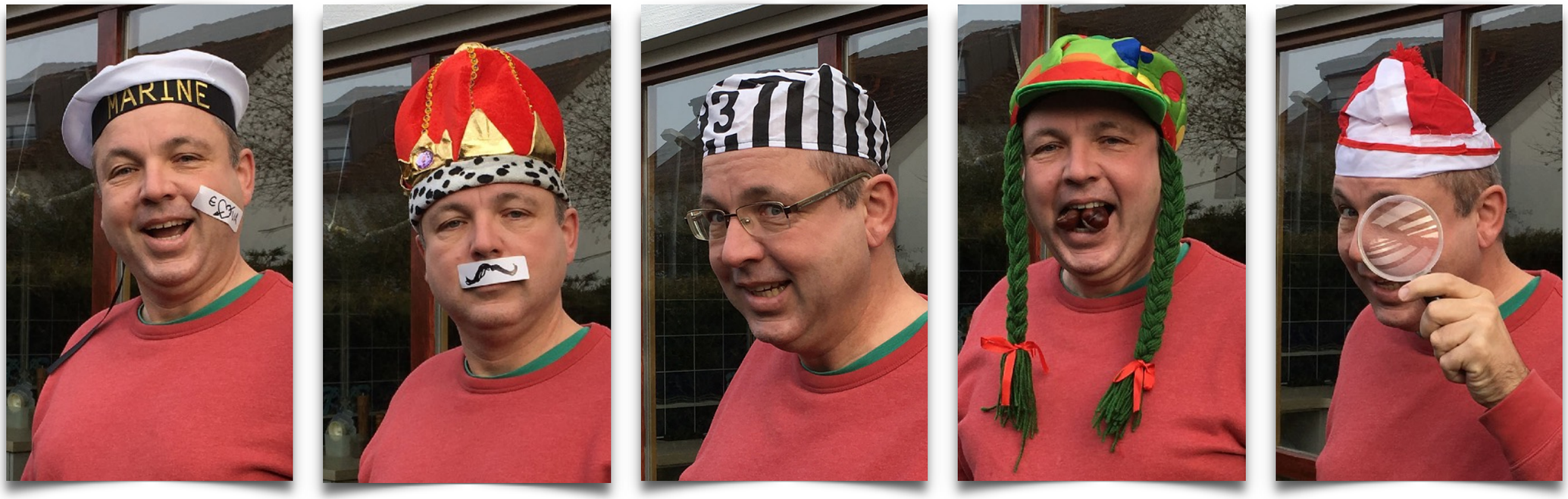


Checking reality #1

PID as hash-seed - **development** environment

Perfect!

Every user gets a different cookie-hash because PID is always different

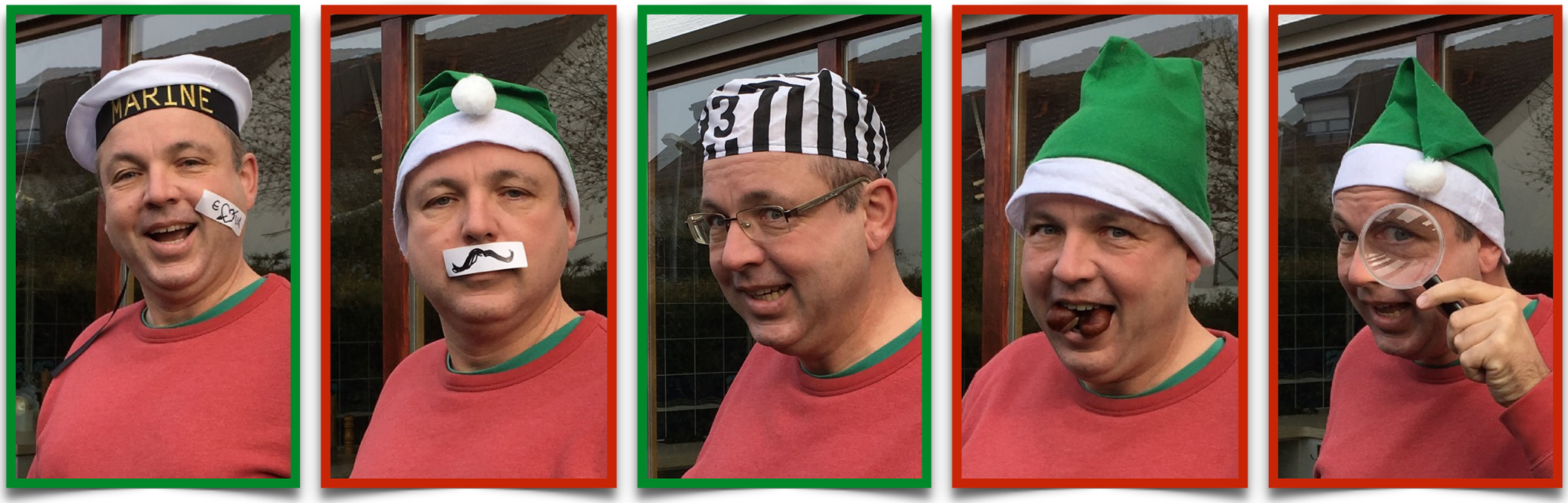


Checking reality #2

PID as hash-seed - **production** environment

NOT Perfect!

Long-living processes give their long-living PID as cookie-hash to the user



Problem:
PID as hash-seed

- Problem: there are only three long-living Fast-CGI-Processes in production environment which are having their PID for a long to (decreasing startup-time-lag)

- Problem: there are only 65.536 PIDs, then the operating system starts from „0“ again.

- The seed of the hash is not “random” enough

„A hash is a recipe to calculate something. a defined input gives always the same output.“

Time as hash-seed

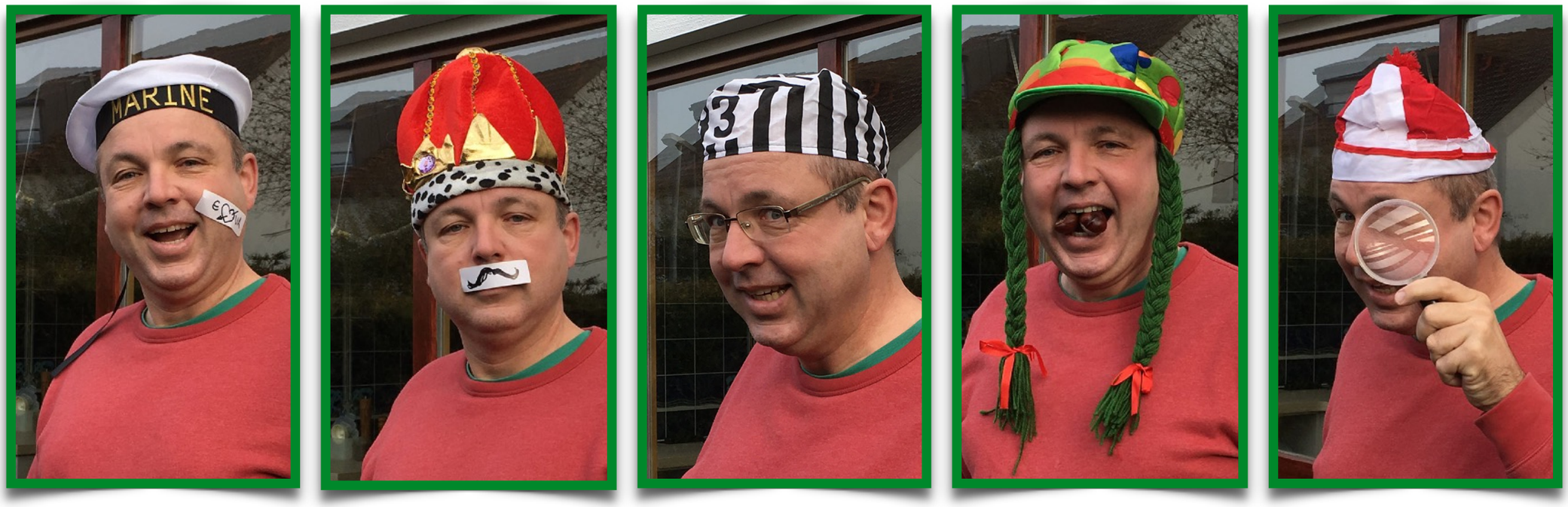
- How can we habe an input which is more different all the time?
- Time! 2016-12-31 14:18:32 << changes every second
- Hash: a small change in the seed changes the hash-output very much:
  - 2016-12-31 14:18:**32** -> ab:cd:…
  - 2016-12-31 14:18:**33** -> 45:12:…

Checking reality #3

Time as hash-seed - a user from time to time

Perfect!

Every user gets a different cookie-hash because time is always different

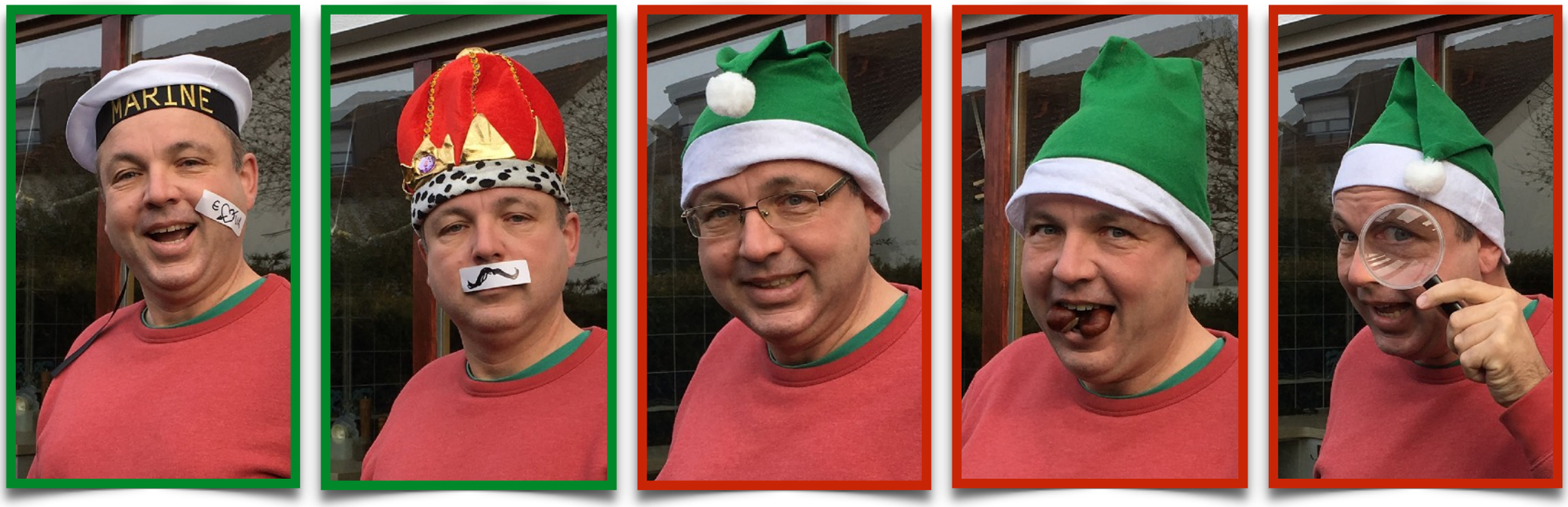


Checking reality #4

Time as hash-seed - clumps of users

NOT Perfect!

Long-living processes give their long-living PID as cookie-hash to the user



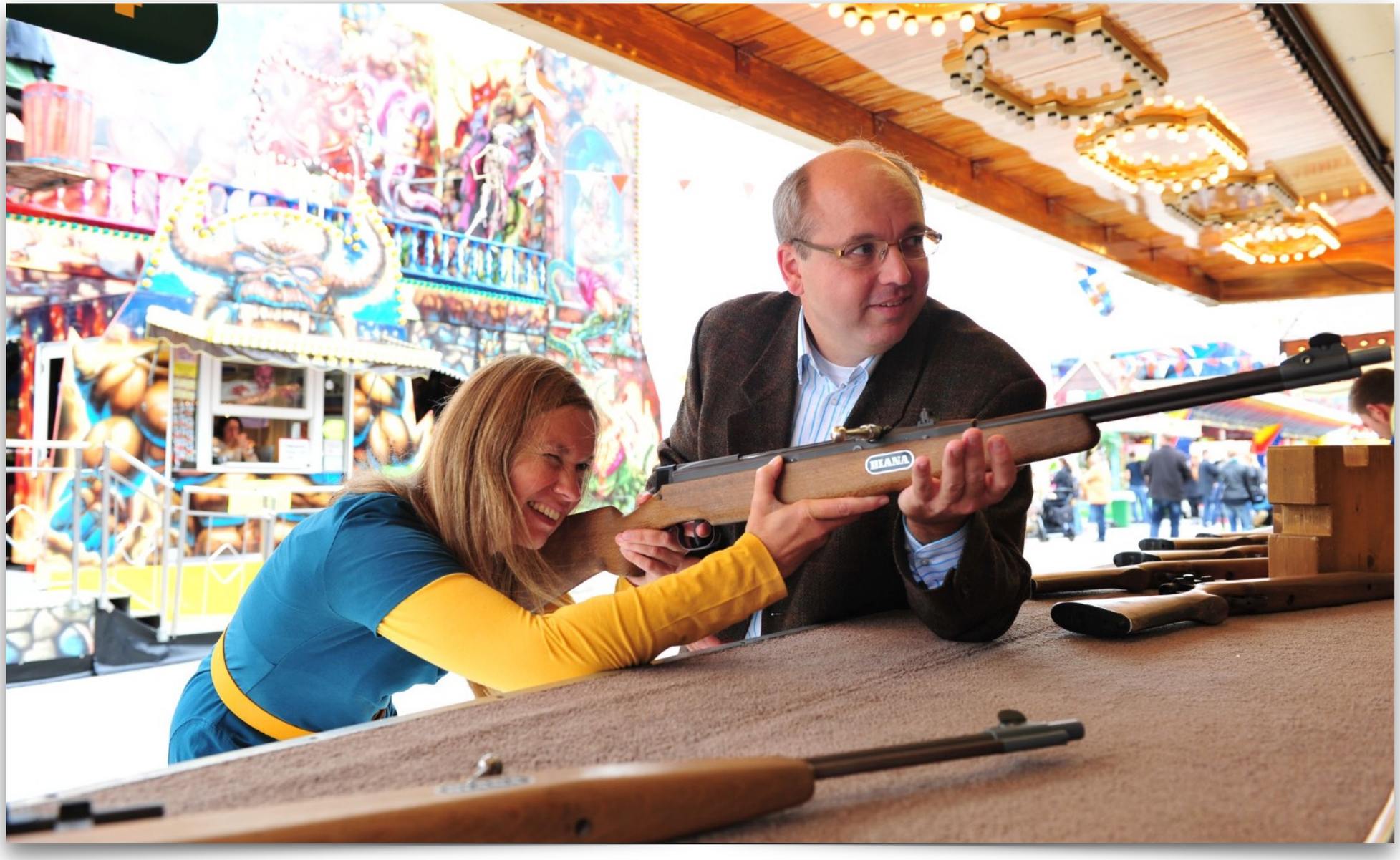
Problems:
time as hash-seed

- Time is not changing fast enough. A resolution in seconds is too rough
- With a big quantity of users (a whole country, world-wide) also a finer granularity is not enough
- There is a time which repeats: changing local time from summer-time to winter-time in Europe. Can you test this?
  - 30.10.2016 2:00 … summer-time
  - 30.10.2016 2:01
  - …
  - 30.10.2016 2:59
  - 30.10.2016 2:00 !!!! winter-time, uh, oh, local time repeats!!!!

A counter as hash-seed

- Can I have something that changes continuously?
- A persistenter counter, for example a number in a database-table cookie_seed

number(int)
14600

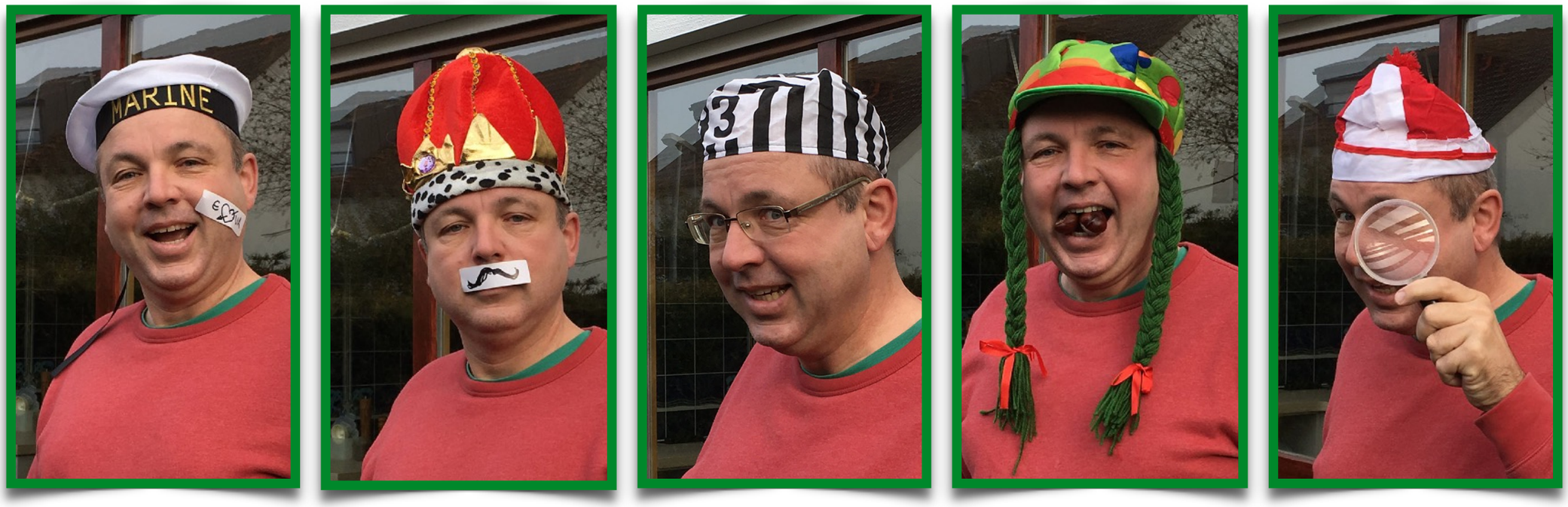


Checking reality #5

counter as hash-seed - little number

Perfect!

Every user gets
a different cookie-hash
because counter always increases

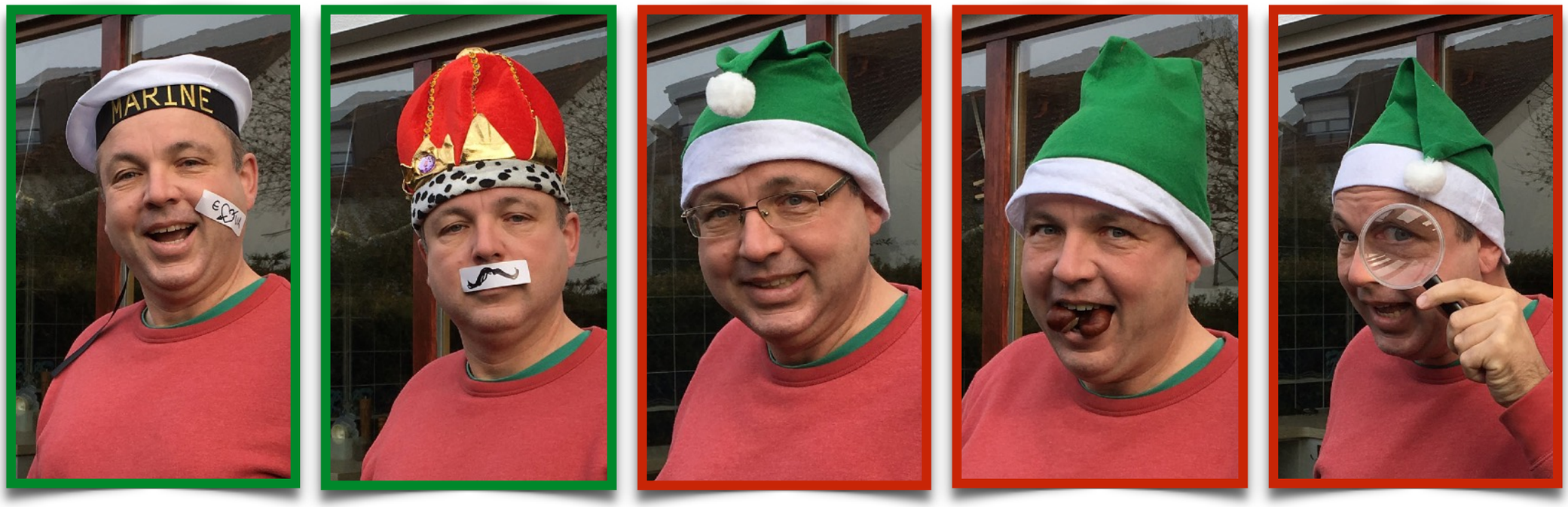


Checking reality #6

counter as hash-seed - max int

NOT Perfect!

Counter does not increase when reaching max(int)



A counter as hash-seed

number(int)
2.147.483.646

- update cookie_seed set number=number+1
- select number from cookie_seed
- gives 2.147.483.647
- increase -> gives 2.147.483.647
- increase -> gives 2.147.483.647
- increase -> gives 2.147.483.647

Problems:
counter hash-seed

- All numbers have a maximum value on your computer depending on processor, operating system, database. You have to find out what happens when you reach that number

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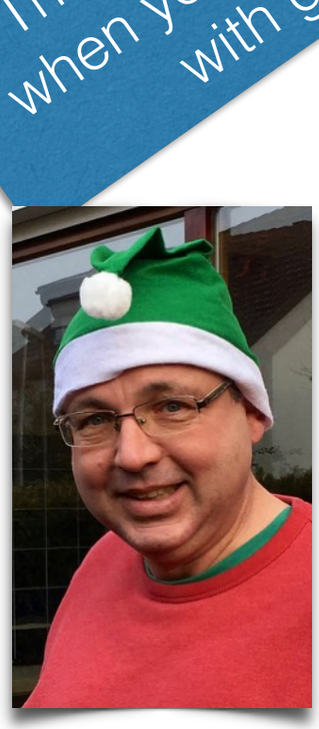

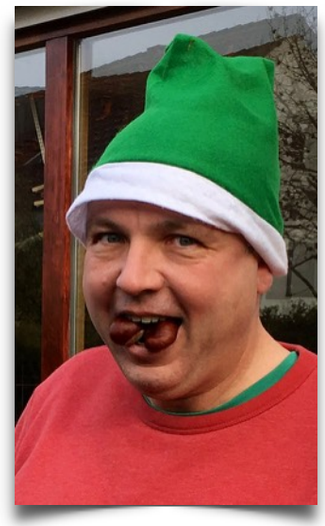

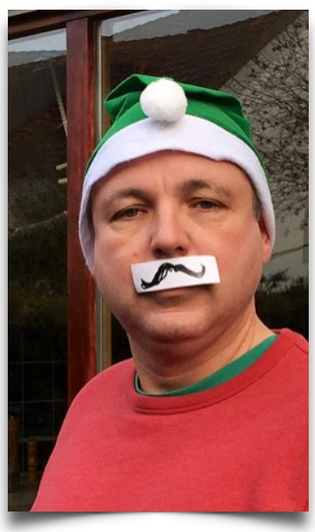

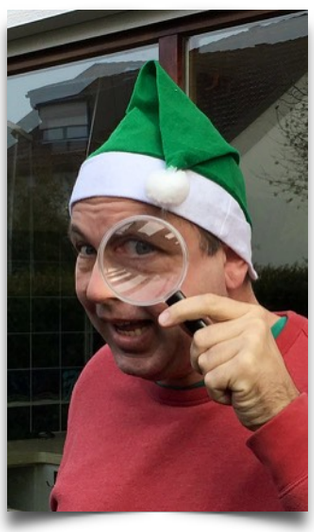

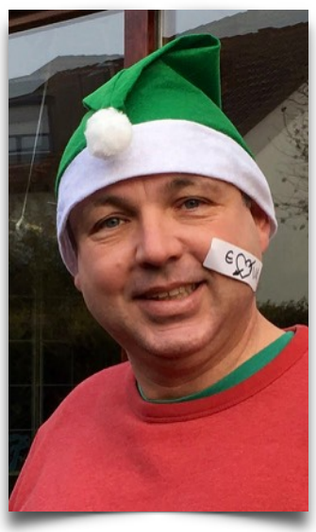

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