JavaScript
fwdays

Password Hashing

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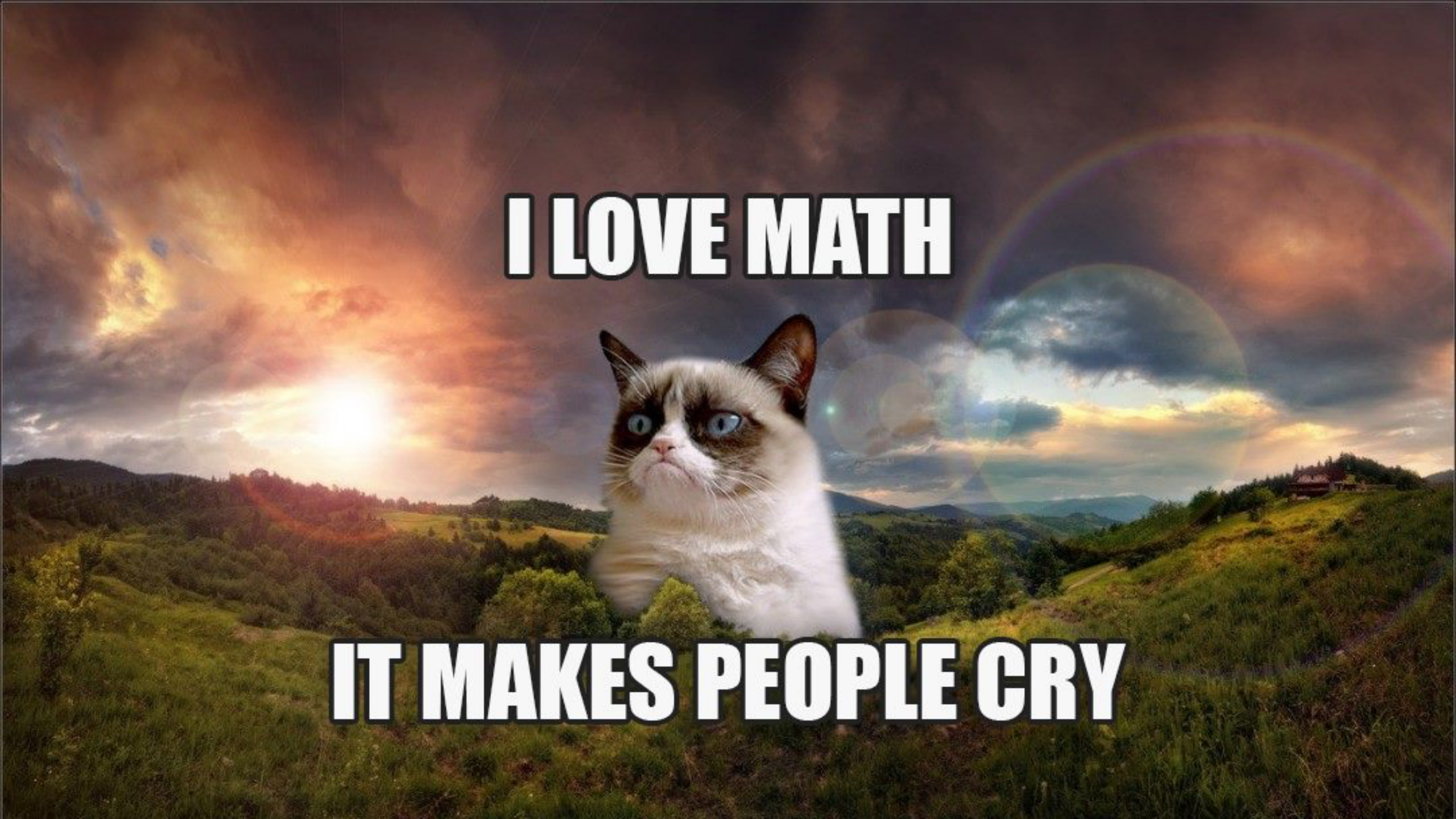
I LOVE MATH
IT MAKES PEOPLE CRY

Passwords

Proves your identity

1. No security holes
2. Unique passwords
3. Safer storage

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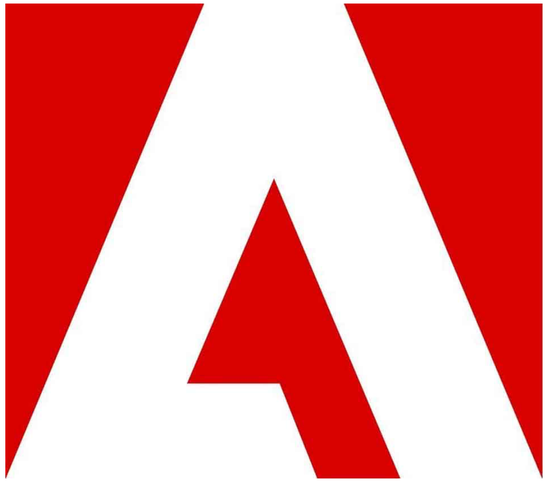
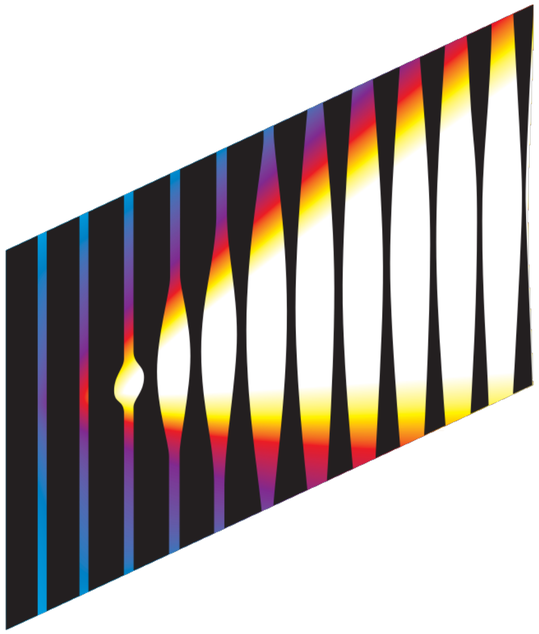
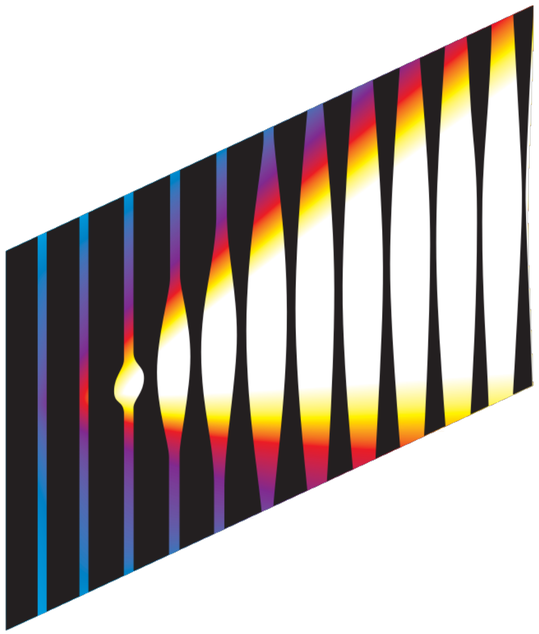


Bell



Johannes Bader, hacker_two, CC BY 2.0

Plaintext



SONY
PICTURES

Bell

Problems:

Plaintext!

Solution:

Obscure password

Hash

1. Deterministic
2. Pre-image resitant (one-way)
3. Second pre-image resitant (voluntary collisions)
4. Collision resistance (involuentary collisions)

$$\{0,1\}^* \mapsto \{0,1\}^n$$

~~MD5~~

~~SHA-1~~

SHA-2 (SHA-256 & SHA-512)

Blake2

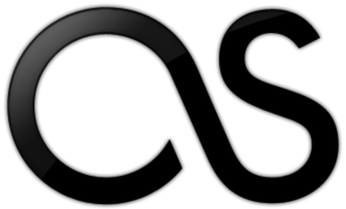
SHA-3 (Keccak)

bcrypt, scrypt

Argon2

```
var crypto = require('crypto')

var hash = crypto.createHash('md5')
  .update(password)
  .digest()
```



```
var words = //...

var rainbowTable = words.map(function (word) {
  return crypto.createHash('md5')
    .update(word)
    .digest()
})

var idx = indexOf(hash, rainbowTable)
var plaintext = words[idx]
```

Problems:

Rainbow Tables

Solution:

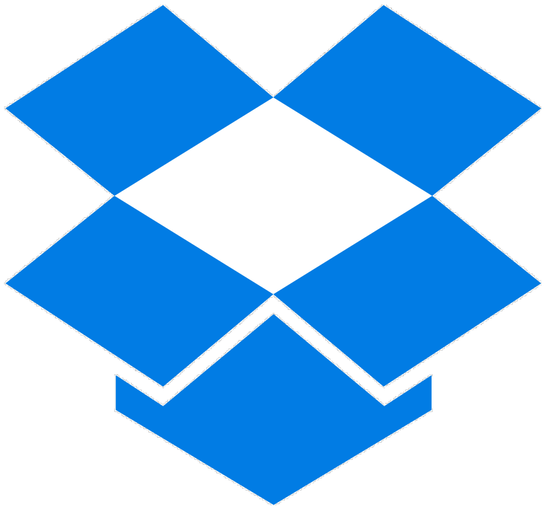
Make identical passwords unique hashes

Salted Hash

Makes precomputation impractical
aka Rainbow Tables

```
var crypto = require('crypto')

var salt = crypto.randomBytes(64)
var hash = crypto.createHash('md5')
  .update(salt)
  .update(':')
  .update(password)
  .digest()
```



Problems:

Still too efficient

Solution:

Expend more resources

Iterated Hash

NIST compliant

```
var crypto = require('crypto')

var salt = crypto.randomBytes(128)
var iter = 10000
var hashLen = 512
var algo = 'sha512'

crypto.pbkdf2(password, salt, iter, hashLen, algo, function (err, hash) {
  // ...
})
```

Problems:

Very easy to parallelize

Solution:

Make even more expensive!

KDF

*Key Derivation Function
Purposefully slow
Uses lots of memory and computation

```
npm install secure-password
```

Argon2

Winner of PHC

Problems:

- Blocks event loop

Solution:

- Use async API

```
var pwd = require('secure-password')()

var userPassword = Buffer.from('my-password')
pwd.hash(userPassword, callback)
```

```
var sodium = require('sodium-native')
```

```
var sodium = require('sodium-universal')
```

```
var SecurePassword = require('secure-password')
```

```
var SecurePassword = require('secure-password')
```