Yikes! Moles!

CRDTs

Data types designed for use in replicated systems.

They provide eventual consistency.

There are two kinds.

Distributed Systems

Are all around you!

How Distributed Systems Go BAD.

They forget
What you did
last summer.

(in) consistent.

(un) available — (late) nt.

Par-ti-tions!

Choice #1

I’m a Bank.

Fuck latency.

Choice #2

I’m not a bank.
Maybe I can be a little
bit inconsistent so users
Don’t have to wait?

Eventual Consistency

Enter the hero.

I can tell you what
You did last summer,
But I might be a year or two
behind.

Conflicting Updates

I went to Hawai’i.

After that,
to Zanzibar.

After that,
to Thailand.

A little extra information…

I went to Hawai'i in 2014.

To Zanzibar in 2015.

To Thailand in 2016.

CRDTs

Tada!

Conflict-Free Replicated Data Type

CmRDTs

Commutative RDTs.

Built on commutative update operations.

CvRDTs

Convergent RDTs.
Built on convergent state merges.

CmRDTs	vs	CvRDTs
Need guaranteed delivery, but that's achievable.		Maybe okay to miss some updates.
Only need to send updates.		Need to send the whole state everytime.
Can be converted to a CvRDT by sending the set of all operations.		Can be converted to a CmRDT by sending state diffs.

Increment / Decrement Counter

Example 1.

CmRDT

Operation: +X.

Apply: Current +X.

CvRDT

State:

$P = [0,0,0, \ldots], N = [0,0,0, \ldots]$

Merge:

$Pi = \max(Pi), Ni = \max(Ni)$

Value:

$V = \mathrm{sum}(Pi) - \mathrm{sum}(Ni)$

2P Set

Example 2.

CmRDT

Operation: Add or remove X.

Apply:

Add X to A

or add X to R.

CvRDT

State:

$A: \emptyset$, $R: \emptyset$

Merge:

$A = A1 \cup A2$, $R = R1 \cup R2$

Value:

E in A but not in R.

Ancient Lore

We are not the first
To dream such things.

Operational Transform

Document editing.

GROVE, 1989.

Writely, 2005.

Google Spreadsheet, 2006.

Apache Wave, 2009.

Humans vs Moles

Where I am currently.

Pygame CFFI

Crossbar.io

Autobahn

Using CvRDT so
New players don’t
Need anything special.

Updates can be Applied locally Straight away.

Tracking dead moles
Was a bit tricky.
Using a hyperloglog
counter.

Aiming for a
Game where humanity
Has to whack
1 000 000 moles.