Blockchains for Artificial Intelligence

Trent McConaghy

@trentmc0

BIGCHAINDB **iPDB**
INTERPLANETARY DATABASE

Blue Ocean Databases
Relational DBs: Oracle – 80s
Website DBs: MySQL – early 00s
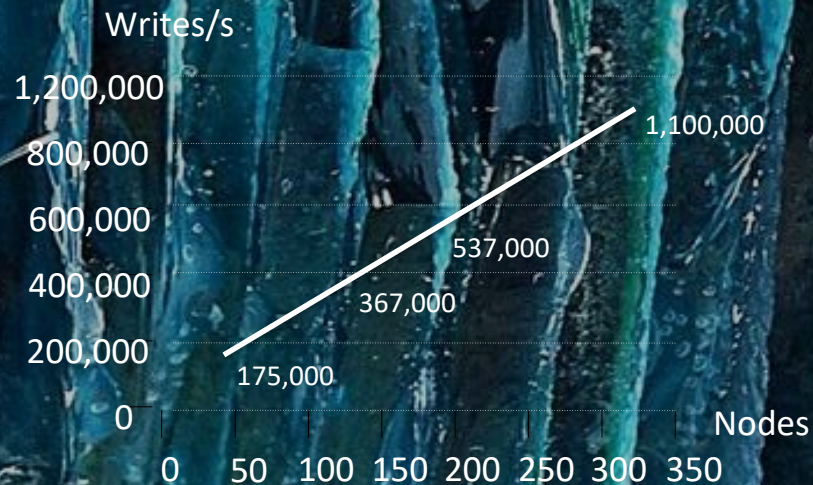Dist'd/NoSQL DBs: MongoDB -- late 00s

How do distributed ("big data") databases scale?
Answer: Distribute storage across many machines, i.e. **sharding**
And, a **consensus algorithm** keeps distributed nodes in sync.

Blockchains are databases with "blue ocean" benefits

Decentralized / shared control
Immutability / audit trail
Tokens / exchanges

How to build a scalable blockchain database (BigchainDB)

1. Start with an enterprise-grade distributed DB, e.g. MongoDB
2. Engineer in blockchain characteristics

Decentralized / Shared Control	• Each DB node is a federation node
Immutable / Audit Trails	• Hash Previous Blocks • Append-only
Native assets	• "Own" = have private key • Asset lives on the database

The Emerging **Decentralized** Stack

PROCESSING
e.g. EC2, **Ethereum, Hyperledger, Tendermint, Lisk**

FILE SYSTEM
e.g. S3, HDFS, **WWW, IPFS**

DATABASE
e.g. MySQL, MongoDB
BigchainDB + IPDB
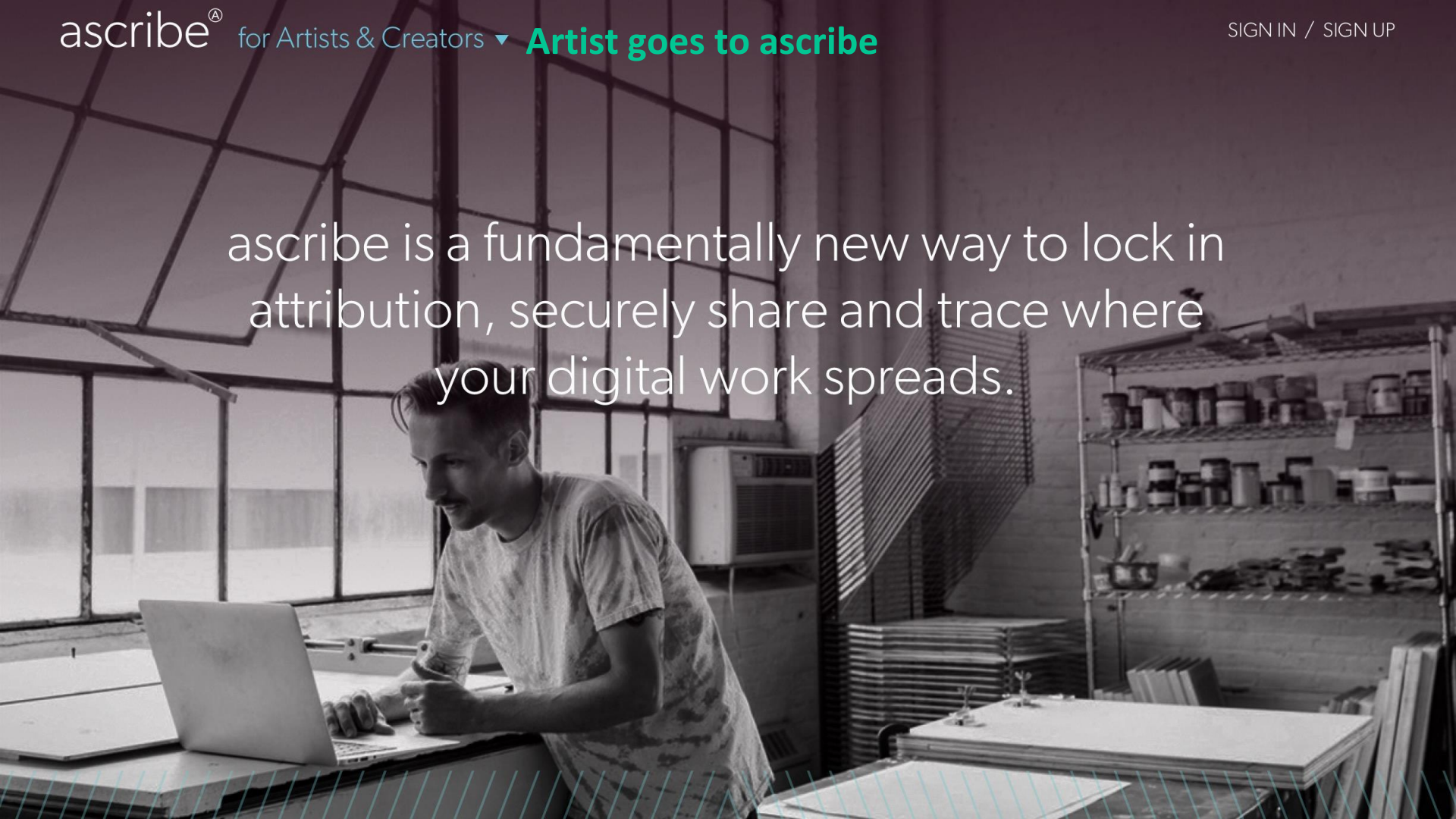
E-GOLD/CASH
Bitcoin, zcash

Example real-world use: ascribe

Artist creates piece

the scenery made most people ignore each other

ascribe is a fundamentally new way to lock in attribution, securely share and trace where your digital work spreads.

Register a new piece

https://www.ascribe.io/app/register_piece

ascribe®

+ NEW WORK   COLLECTION   TRENT ▾

Register your work

Your Work

Drag file here

or

choose a file to upload

Artist Name

(e.g. Andy Warhol)

Title

(e.g. 32 Campbell's Soup Cans)

Year Created

(e.g. 1962)

☐ Specify editions

Register work

ascribe®

.zip

[f Share] [🐦 Tweet] [Download .zip ☁]

Event Listeners

CREATED BY	Harm van den Dorpel
DATE	2015

EDITION	24 of 100
ID	1CbB2YEnBQUkHjWZvqfNNfjK8wh2cg69zQ
OWNER	Masha McConaghy
ACTIONS	EMAIL TRANSFER CONSIGN LOAN DELETE ❓

+ Certificate of Authenticity

- Provenance/Ownership History

Apr. 17, 2015, 16:15:21

Registered by mail@harmvandendorpel.com

Apr. 20, 2015, 20:54:16

Transferred to Masha McConaghy

+ Consignment History

+ Notes

Orbiting (A Melodrama)

cointemporary.com

contemporary

A temporary online exhibition of art for bitcoin

Marian Tubbs

Orbiting (A Melodrama)

2016
video
1920 × 1080 pixels

Edition of 50

Learn more about Digital Editions

→ Artist Vita
→ Description of Work
→ Artist Website

03:56

Orbiting (A Melodrama), 2016
4 of 50
Offered for 0.07 ฿

ascribe®

Artist transfers to new owner

.zip

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Event Listeners

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>
> Transferred to Masha McConaghy

+ Consignment History

+ Notes

New owner gets a COA

Certificate Of Authenticity

As of 30 November 2015, 17:36:00 GMT, Masha McConaghy is the owner.
To verify current owner, please visit http://ascri.be/1luAOpo

Currency

Date: 2014
Edition: 3 of 100
Created by: Dan Perjovschi
Owner: Masha McConaghy

ARTWORK DETAILS

Artwork ID: 17uZBwSbLGfXy3vRRMWzF5PMjFVNc1tkQ2
File: currency-2014.jpg (499 KB)

PROVENANCE/OWNERSHIP HISTORY

Apr. 30, 2015, 12:36:19 - Registered by mail@cointemporary.com
May. 01, 2015, 09:46:08 - Transferred to admin
May. 08, 2015, 13:04:59 - Transferred to trent
Nov. 27, 2015, 19:35:14 - Transferred to Masha McConaghy

CRYPTOGRAPHIC STAMP

Use the summary and signature below to authenticate this certificate:
http://ascri.be/1Srz45Q

Summary: Dan Perjovschi*Currency*3/100*2014*2015Apr30-12:36:19

Signature: 438B24CE06182FA3AA82BC285F867D03FB73F3BCC0F73FDBA6
EC2BFF7088E011E60355B7DC75D5745A9D5CA2A8115512FF835
C4ABEF6869BF6A991668A820F3FB03A48C6A9E05834716F6500
68E8E07E5266620BA815948DC265605D23FAF016CB46ACD4BC
BE75F08D0DEBD7AF55E4CB085B9A0A14583F135DBB399121B24
ED1L

Authenticated by ascribe®

How can blockchains help AI?

Work off of each of the benefits…

Decentralized / shared control

Immutability / audit trail

Tokens / exchanges

Decentralized / shared control encourages data sharing
More data → better models

The Unreasonable Effectiveness of Data

Alon Halevy, Peter Norvig, and Fernando Pereira, *Google*

Eugene Wigner's article "The Unreasonable Effectiveness of Mathematics in the Natural Sciences"[1] examines why so much of physics can be neatly explained with simple mathematical formulas

behavior. So, this corpus could serve as the basis of a complete model for certain tasks—if only we knew how to extract the model from the data.

Learning from Text at Web Scale
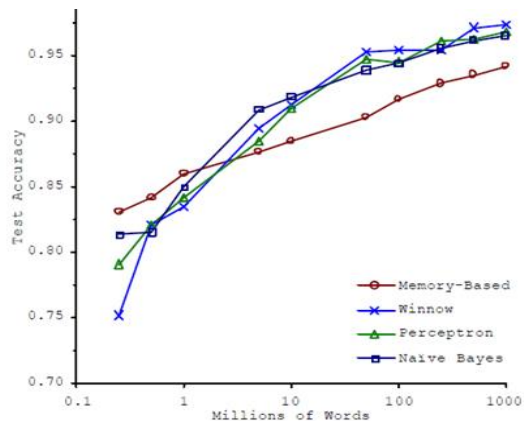
Figure 1. Learning Curves for Confusion Set Disambiguation

[Banko and Brill, 2001]

Merge

Build models

$- 5.72e+7 - 2.50e+11 * (id1*id2) / vgs2 + 5.53e+6 * vds2 / vgs2 + 109.72 * id1$

$10^{\wedge}(5.68 - 0.03 * vsg1 / vds2 - 55.43 * id1+ 5.63e-6 / id1)$

$90.5 + 190.6 * id1 / vsg1 + 22.2 * id2 / vds2$

$2.36e+7 + 1.95e+4 * id2 / id1 - 104.69 / id2 + 2.15e+9 * id2 + 4.63e+8 * id1$

Low accuracy

Build model

$-10.3 + 7.08e-5 / id1 + 1.87 * \ln(-1.95e+9 + 1.00e+10 / (vsg1*vsg3) + 1.42e+9 *(vds2*vsd5) / (vsg1*vgs2*vsg5*id2))$

High accuracy

Decentralized / shared control encourages data sharing
Qualitatively new ecosystem-level data → qualitatively new models

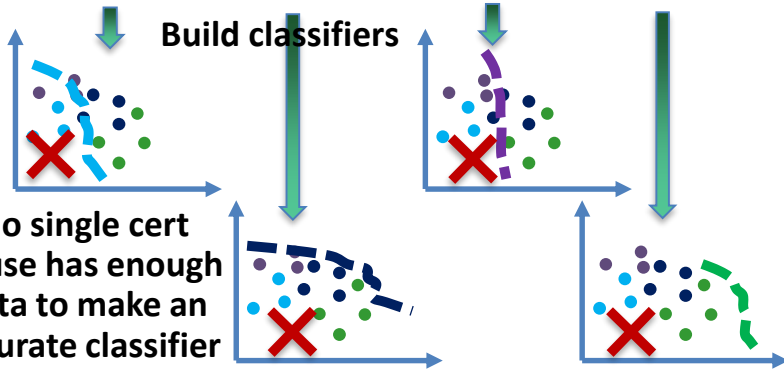Example: shared diamond certification houses data → makes fraud id possible

Decentralized / shared control encourages data sharing
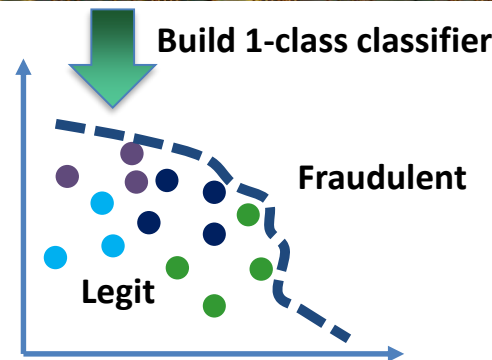Qualitatively *new planet-level* data → qualitatively new models

"IPDB is kibbles for AI"
        --David Holtzman

Immutability for An Audit Trail on Training/Testing Data & Models

For greater trustworthiness of the data & models
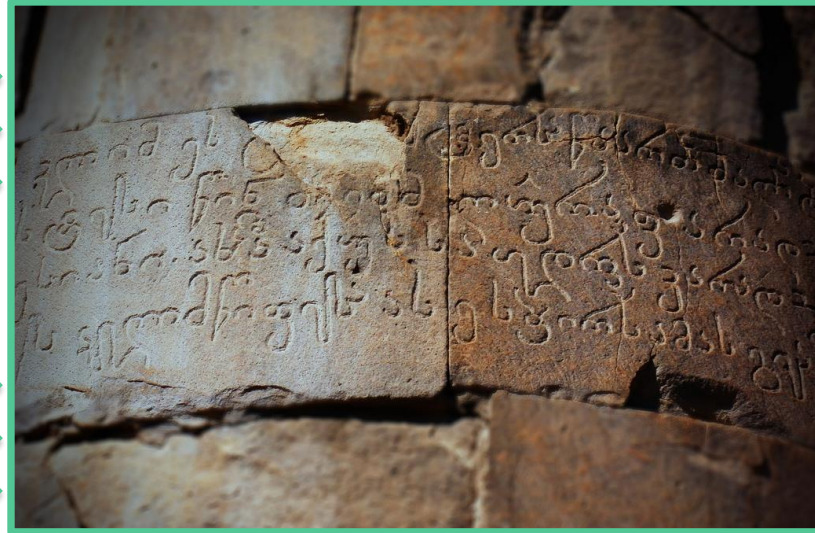## (Avoid garbage-in, garbage-out)

Provenance in building models:

- Sensor / input stream data
- Training X/y data
- Model building convergence

Provenance in testing / in the field:

- Testing X data
- Model simulation
- Testing yhat data

Time-stamp / store

Applications:
- you can tell if a sensor is lying
- you know the "story" of a model
- catch leaks in the data chain

Another Opportunity:
A shared global registry of training data & models

All the Kaggle datasets

All the Kaggle models

All the ImageNet datasets

All the ImageNet models

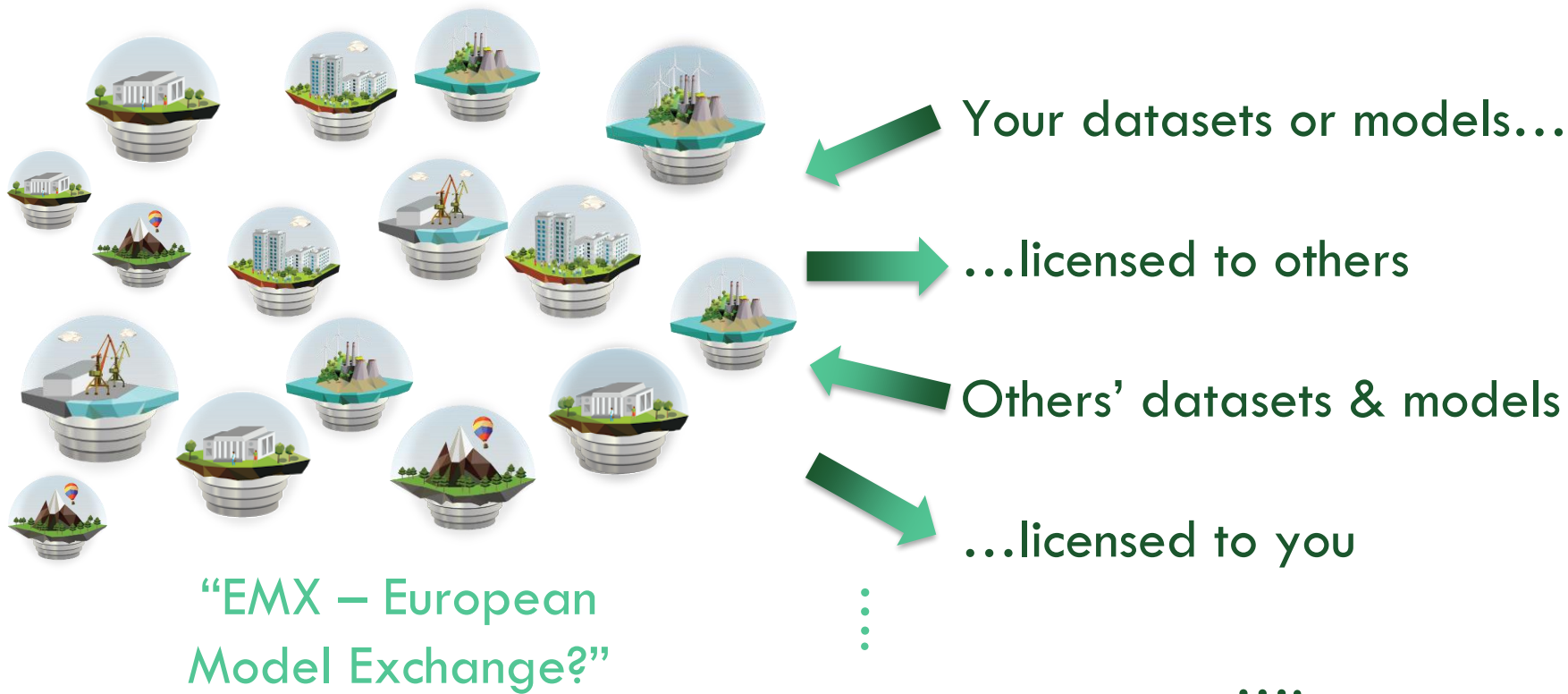"Models are owned by the planet"

….

Training/testing data & models as intellectual property assets
→ Decentralized data & model *exchanges*

Your datasets or models…

…licensed to others

Others' datasets & models

…licensed to you

"EMX – European Model Exchange?"

….

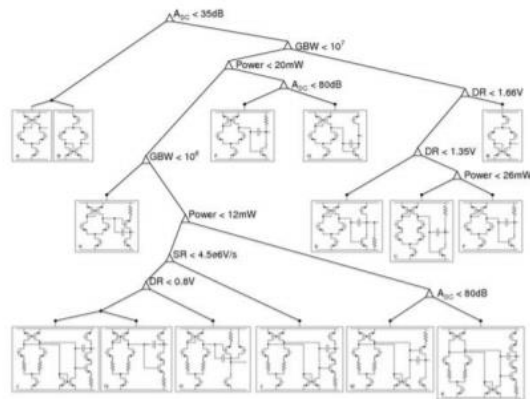**Sell your CARTS?**

Certificate of Authenticity

As of Nov. 06 2016, 19:10:42, trent is the owner.
To verify current owner, please visit https://www.ascribe.io/app/coa_verify/

Circuit Decision Tree

Edition: 1/3
Created by: Trent McConaghy
Owner: trent

ARTWORK DETAILS

Artwork ID: 136UbLGSHNHqY9kJxQ3tDy83K7P69zDJeN
File Extension: .png
File Size: 87090 bytes

PROVENANCE/OWNERSHIP HISTORY

Nov. 06, 2016, 19:10:42 - Registered by trent

CRYPTOGRAPHIC STAMP

Use the summary and signature below to authenticate this certificate on:

Link: https://www.ascribe.io/app/coa_verify/

Summary: Trent McConaghy*Circuit Decision Tree*1/3*2008*2016Nov06-19:10:42

Signature: C38D56C823CEC09E40B35B9D27D48B9C8EF9ADECC9592F469
CE0144CF9ECA406B3ABF1D976ADB7813895379A66F9F7C327B
B0EE090A52F6A8274F3F4AC9EE3D7DF0FA98964C834678A6F4
8EF4FE687E7B4243F8F65FF57315CB7391A03874CD4BDFCB357
18F1742AB5256B72A4C2D2593F3492372A66C82679263E39BA
B9996EL

AI DAOs by Example: The ArtDAO

Algorithm, running on decentralized compute substrate…

1. Run AI art engine to generate new image, using GP or deep

2. Claim attribution in blockchain, using ascribe

3. Create multiple editions, using ascribe

4. Post editions for sale onto a marketplace, using Getty (centralized), or OpenBazaar (decent.)

5. Sell the editions. $ goes to ArtDAO using built-in cryptocurrency like Ether. IP go from ArtDAO using ascribe.

6. Repeat!

AI DAOs by Example: The ArtDAO

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Over time, if ArtDAO makes more money from sales
than from generating new art, then
it will accumulate wealth. And, you can't turn it off.

Blockchains for Artificial Intelligence

A planetary-scale blockchain database (IPDB) unlocks opportunities:
1. Data sharing → Better models
2. Data sharing → Qualitatively new models
3. Audit trails on data & models for more trustworthy predictions
4. Shared global registry of training data & models
5. Data & models as IP assets → data & model exchange
6. AI DAOs – AI that can accumulate wealth, that you can't turn off

Trent McConaghy
@trentmc0

bigchaindb.com
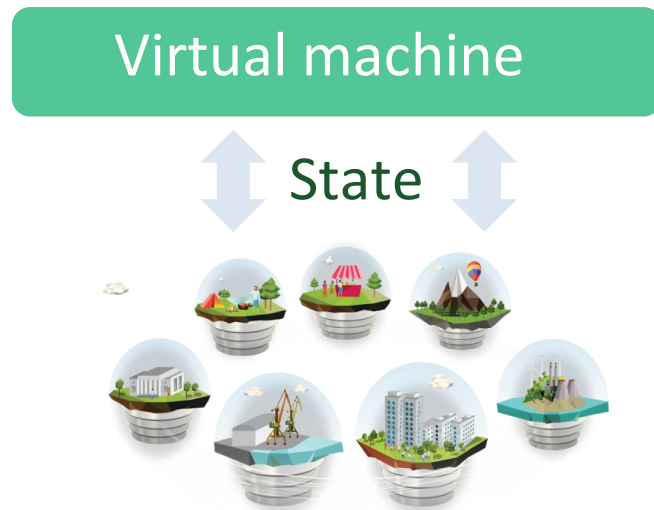ipdb.foundation

Appendix
Details of AI DAOs

What if you used a blockchain
to store *state* of a state machine?

Then you get
decentralized processing.

aka "smart contracts"

Virtual machine

State

What if you used a blockchain
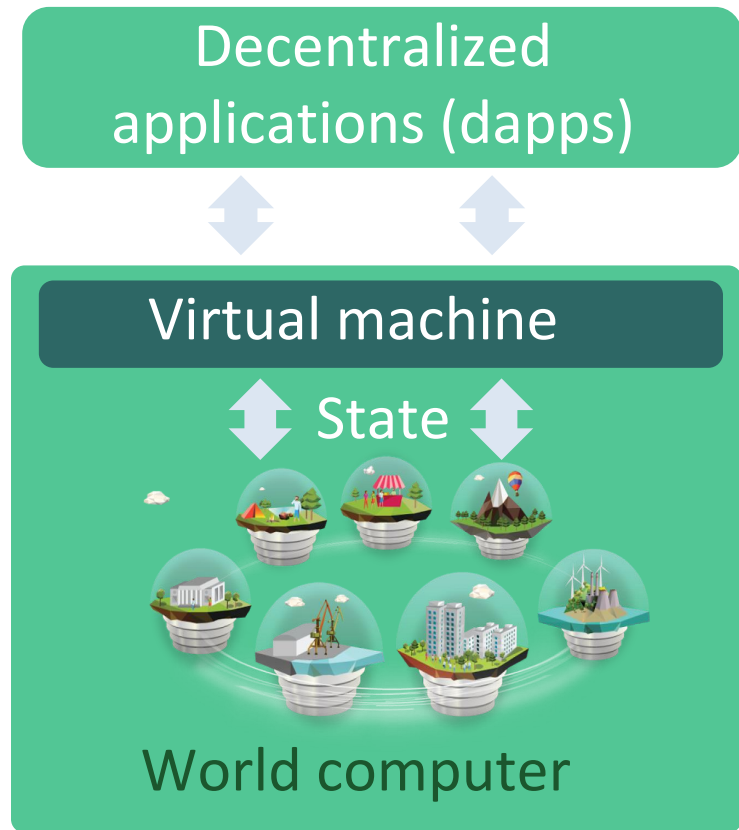## to store *state* of a state machine?

Then you get
decentralized processing.

And you can build a

world computer

having decentralized processing,
storage, and communications

(e.g. Ethereum vision)

Decentralized
applications (dapps)

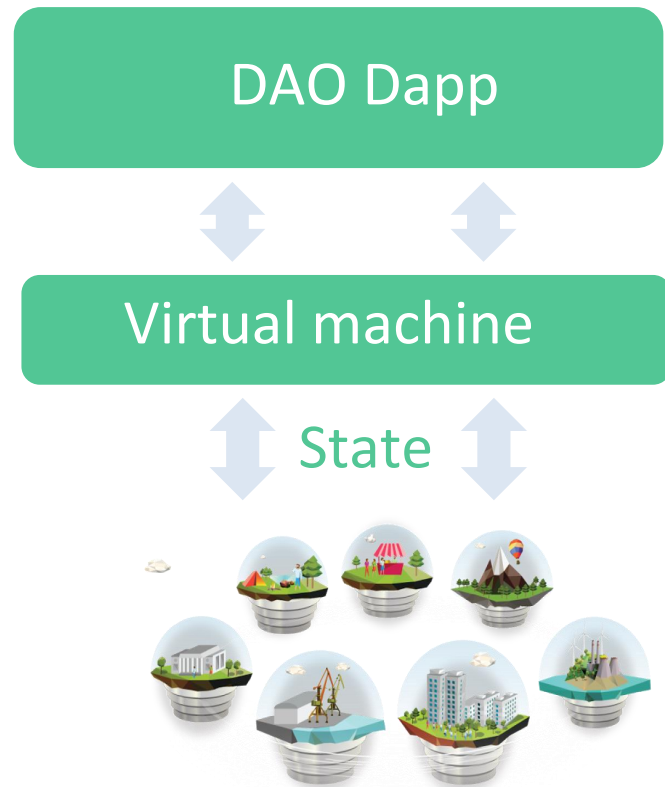Virtual machine

State

World computer

DAO: Decentralized Autonomous Organization

DAO: a computational process that

- runs autonomously,

- on decentralized infrastructure,
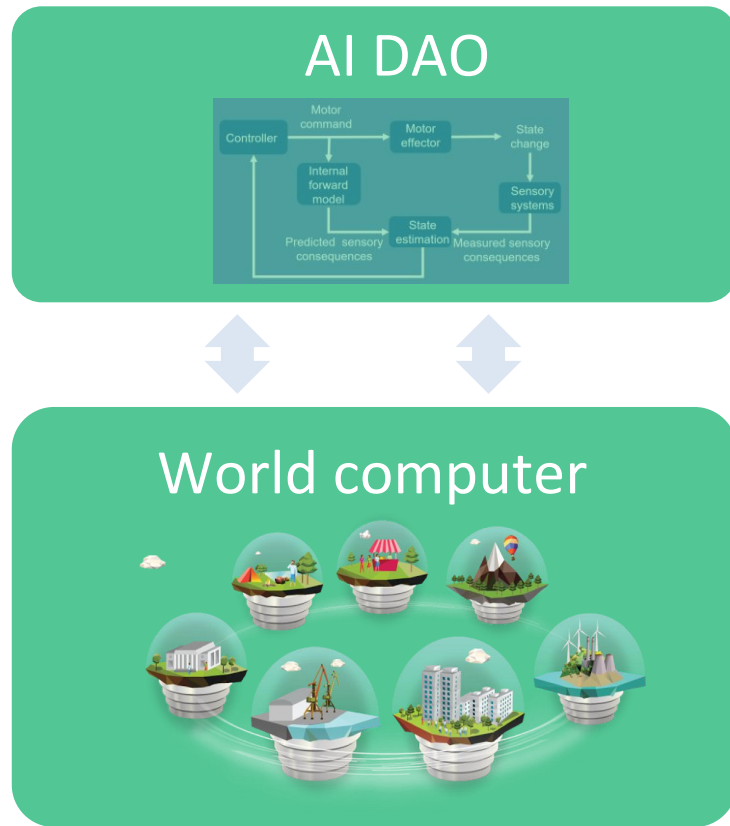
- with resource manipulation.

It's code that can *own* stuff!

AGI on a DAO?

AI entity is a feedback control system. That is, AGI.

Its feedback loop would continue on its own, taking inputs, updating its state, and actuating outputs, with the resources to do so continually.

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Angles to Making AI DAOs

- **DAO → AI DAO**. Start with DAO, add AI. E.g. Plantoid

- **AI → AI DAO**. Start with AI, add DAO. E.g. numer.ai

- **SaaS → DAO → AI DAO**. Convert SaaS to DAO. Then add AI

- **Physical service → AI DAO**. E.g. Uber self-*owning* cars