

identifying emergence
in complex systems

@thejunglejane

if you put 50 ants on a table

if you put 500,000 ants on a table

adding more ants

relatively simple

foraging for food

building nests

raising livestock

waging war

burying their dead

innate immune system
adaptive immune system

take the lower levels for granted

principle of computational irreducibility

the collective is irreducible to the individual

the whole must be greater than the sum of its parts

emergence

disorganized v. organized complexity

Per Bak

Chao Tang

Kurt Wiesenfeld

self-organized criticality

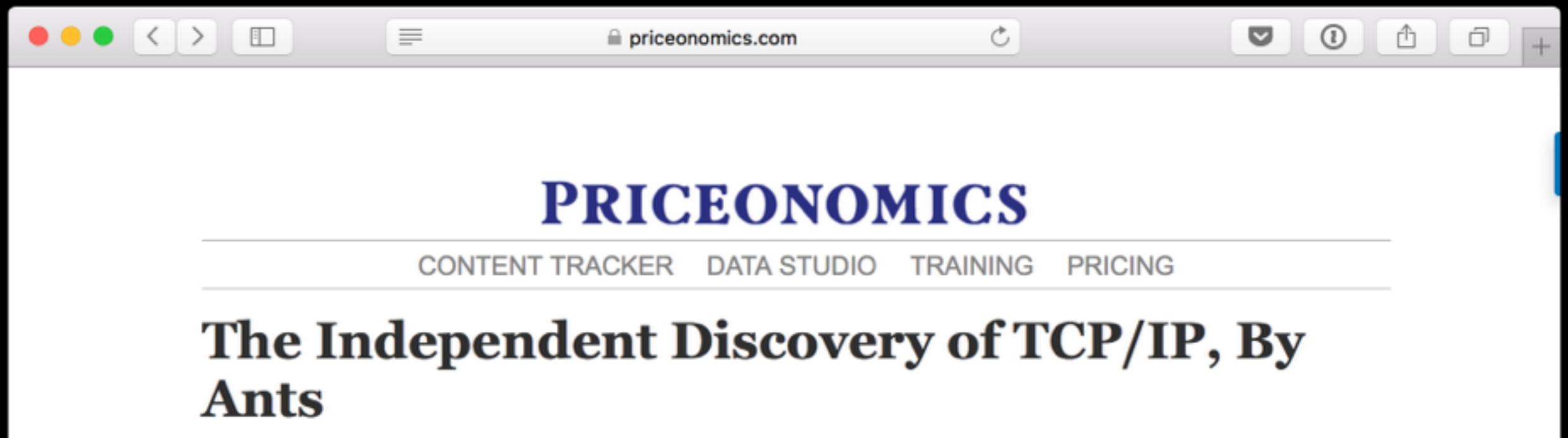
simple
distributed
scalable

spend water to get water

collective regulation

ants are doing TCP

the independent discovery
of TCP/IP, by humans



David Winter
keepturningleft.co.uk

consensus

scale-free correlation

high signal-to-noise ratio

effective perceptive range

seven nearest neighbors

robustness

many evolutionary cycles
in many different environments

natural selection for collective behavior

we have many biological analogs
of computational problems

ants and congestion control

starlings and consensus

slime mold and network-routing

swarms and distributed search

neuronal spiking and probabilistic inference

fly brains and max independent sets

problem of representation

top-down feedback

simple and abstract

thank you

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