

Fundamental Principles in GIScience:

A reflection

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Fundamental Principles



Stripped down to basics

A moment to reflect

- Relationship between science and technology
 - And particularly the importance to recognize our temporal coordinates (historical situatedness)
 - *What seems evident depends on our viewpoint*

Beware of making the past a joke

- Star Trek movie: Scotty picks up the mouse to talk to the Mac...
- Chrisman bought a terminal with 30 cps modem to write PhD from home
- Many stories that now sound so distant.

Big Data?

- Yesterday, Jean-Philippe LAGRANGE set out the dilemma of an organization flooded with data.
- Years prior to 2007: 50 Tb total
- Now 100 Tb / year and increasing...

I am suspicious; demand out of balance.

Economic bubbles

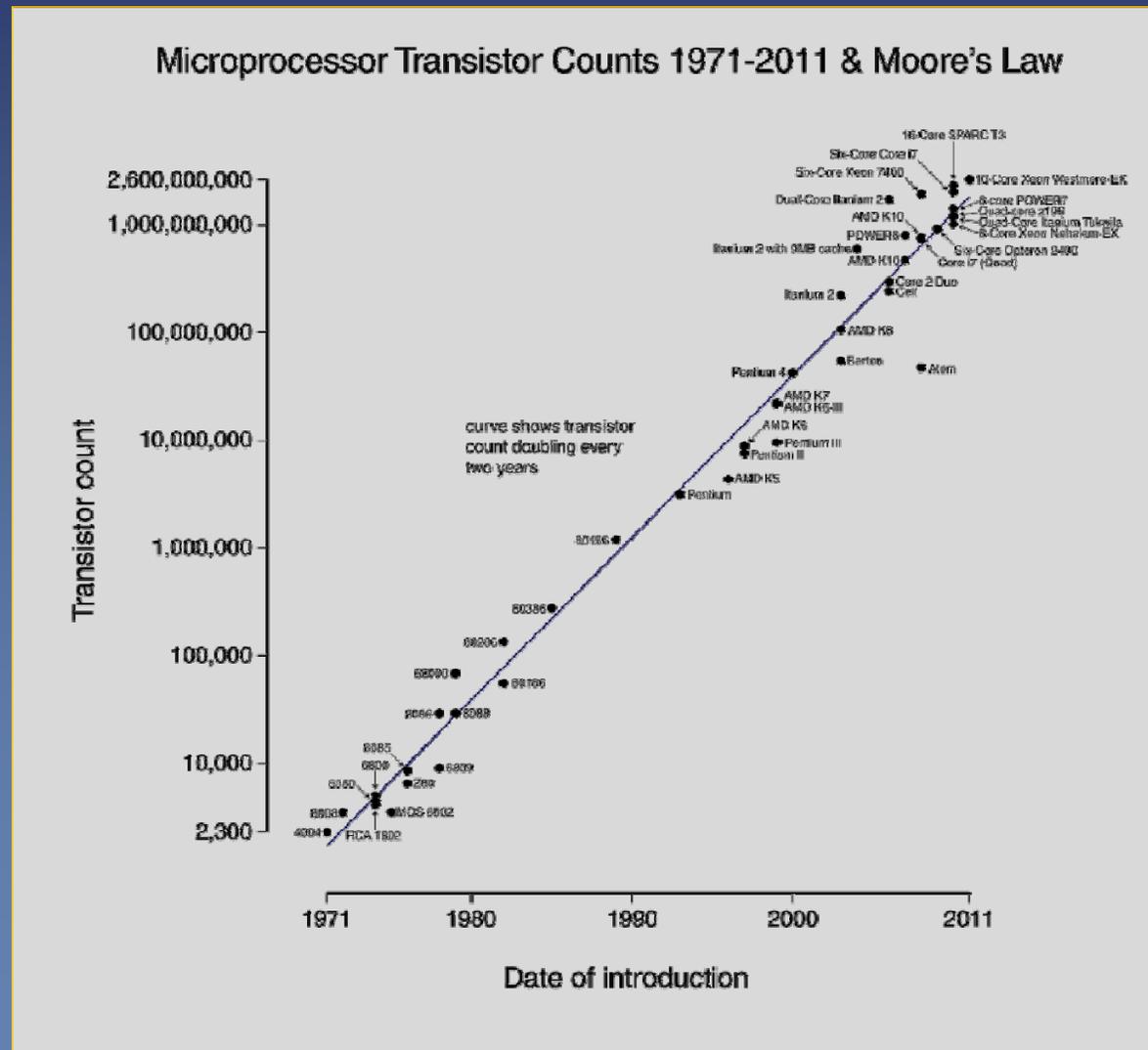
- Public enthusiasm (and greed) take charge
 - 1637: Tulipomania (Netherlands)
 - 1720: Compagnie perpetuelle des Indes (France)
 - 1720: South Seas Bubble (England)
 - And more recently...

Has Moore's Law been
protecting us from
our lack of innovation?

Paper submitted to AGILE 2012

Moore's Law

- Gordon Moore (Fairchild Semiconductors)
- 1965: density of transistors doubles in 2 years
- Converted to chip power doubles in 18 months
- Or something like that...



Applies to other computer technologies

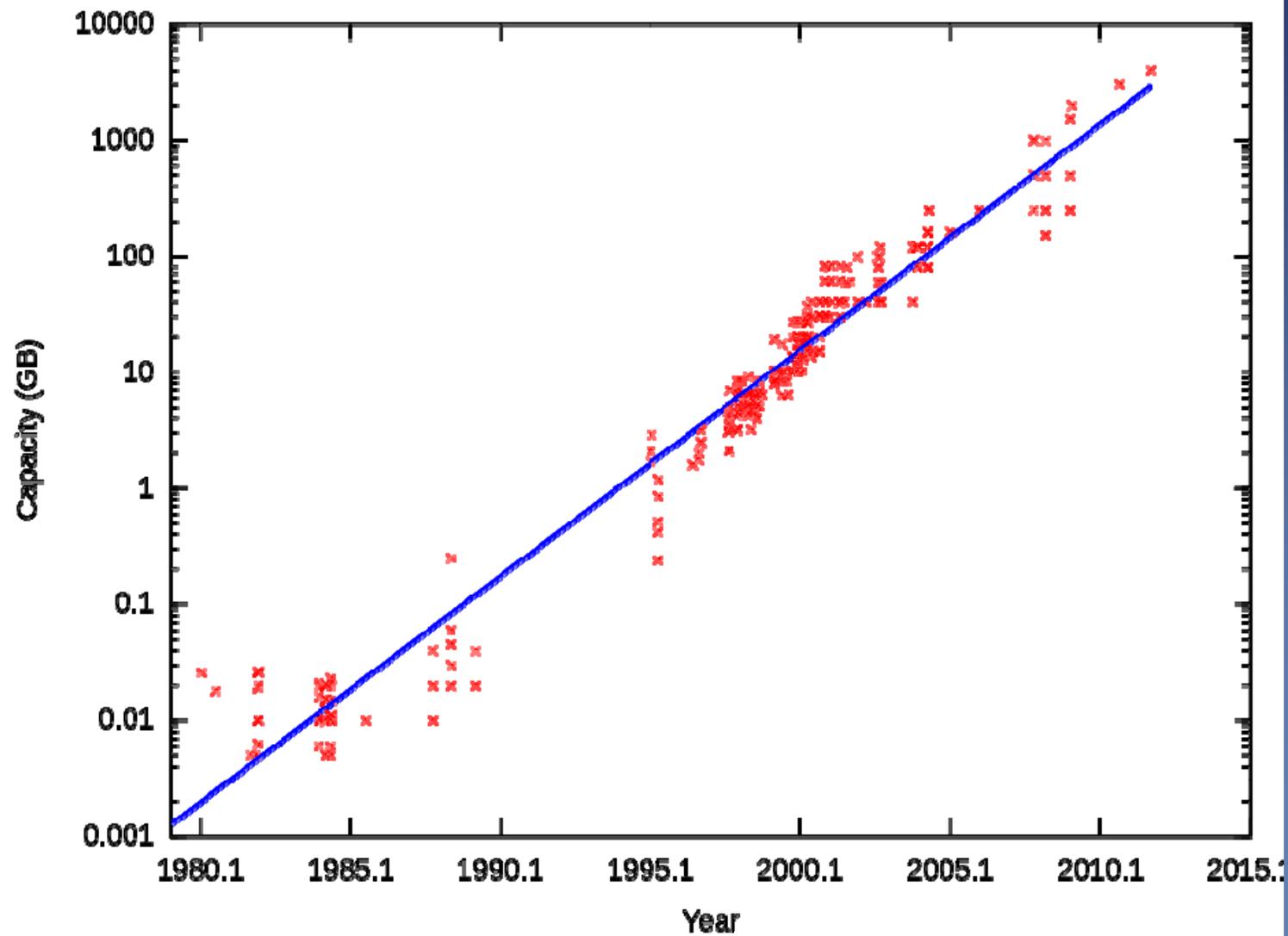
Here, disk drives

Also memories,

USB

sticks,

etc.



The Great Moore's Law Compensator (TGMLC)

- “Software is getting slower more rapidly than hardware becomes faster” (Wirth 1995)
- Other versions attributed with ironic reference to various devils (Bill Gates, etc.)

Consequences for Geographic Information Science

- Databases expand to fill the available space
- Operating systems and user interfaces consume more and more cycles
- Overall laziness propped up by expanding power and capacities

Inability to choose

- For now, we are storing everything.
- Delaying the moment when we will have to return to the old rules of selection, compilation;
- Hard truth that information has to be extracted, reducing the data

- Another consequence:
 - Living with solutions that ‘worked’ on small datasets;
 - Porting old software because it exists;
 - Rereading the whole file to redraw because a spatial index is too much trouble;
 - Applying brute force because the interface is easy to write...

*Reduced attention to
algorithmic complexity*

Quick reminder

- For example polygon overlay:
 - (from 1992 SDH paper: base case 3000 X 3000 polygons)

	Base case (Wisconsin)	Reduction factor	Times 1000
Brute Force (N squared)	900,000,000	--	X 1,000,000
Band sweep	19,000,000	1/47	X 30,000
Band sweep with spatial index	2,000,000 Intersection checks	1/450	X 2000

Persistence

- Early software for least-cost surfaces (eg. MAP Package) used Dykstra's algorithm (1959)
- Code persists, even though alternatives are well-known (eg. Fredman and Tarjan, 1984)

Lessons?

- Is the technology really the issue?
- Is it important to use resources sparingly (intelligently)?
- Is calculation essentially 'free'?

Fundamental Principles in GIScience:

A deflationary approach

(AAG Tobler Lecture, New York February 2012)

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Fundamental Principles



Stripped down to basics

Discussions - a long affair



1976 Tobler

Analytical Cartog.

1986 Burrough

Principles of GIS

1987 AUTO-CARTO 8

Frank; Chrisman

2004 AAG discussion on
Tobler's First Law

And then AAG Tobler Lecture 2012, New York...

2012 Tobler Lecture

- Organized by Francis Harvey (AAG Specialty Group on GIScience)
- Topic: Fundamental Principles
- Invited speakers
 - Andrew Frank
 - Nick Chrisman
- Invited commentator: Dan Sui
- *(A return of the dinosaurs?)*

Fundamental Principles

- Key question: *What endures?*
 - Motivation: *Tobler's half-life (1976)*
 - *Tested in 2001*
- Two (at least) approaches:
 - Universalist (*Andrew Frank*)
 - Historical, empiricist (*me- surprised?*)

The universalist stance

- « We hold these truths to be self-evident... »
- Search for principles that can stand some 'test of time'
- Consequence: *paradigms drill all the way down*

Been there, done that

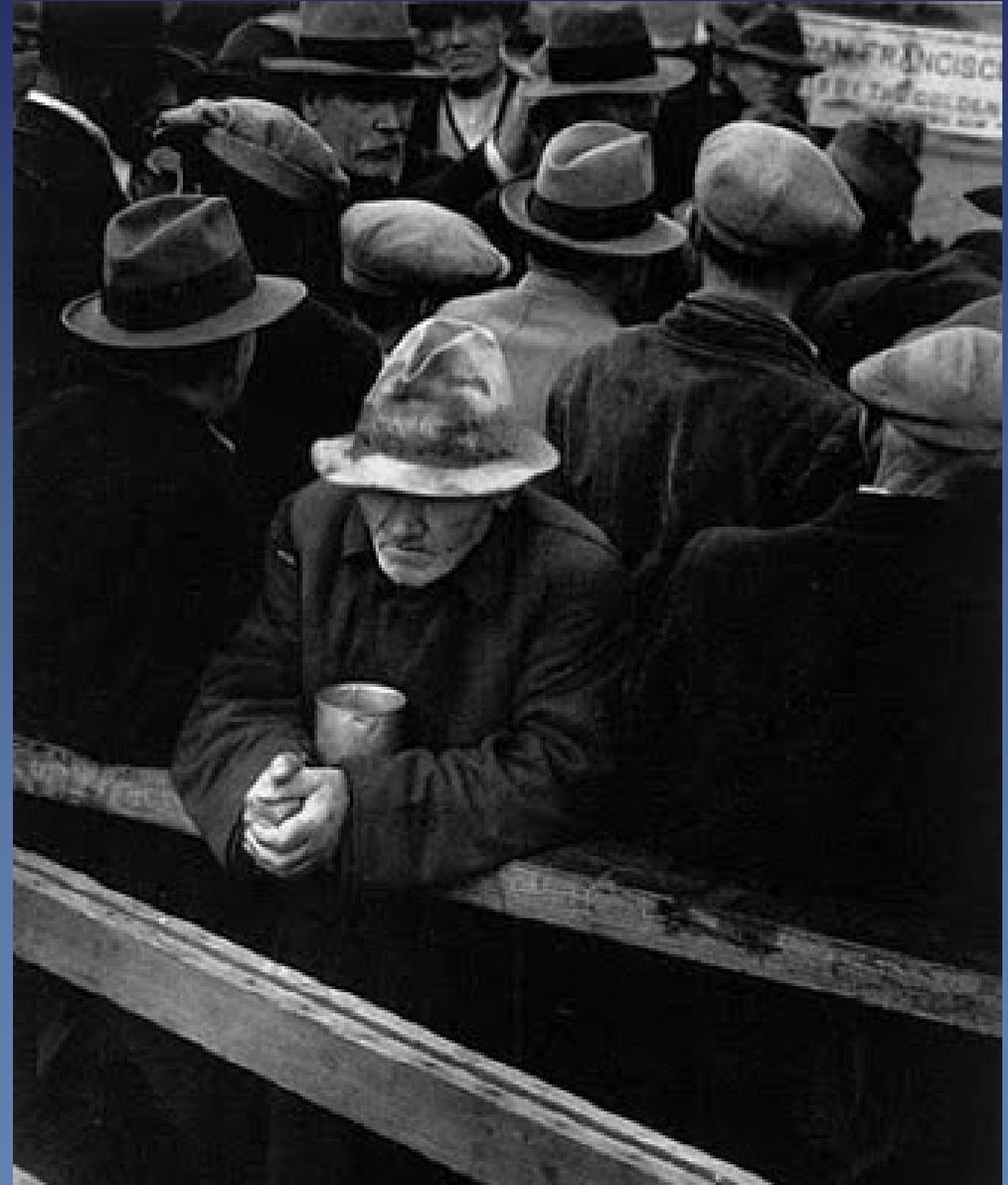
- Quantitative geography?
 - No need to review the history
 - Personal positionality
 - (Berry, Bunge, Haggett, Morrill, Sherman, Tobler, Warntz, and more)

Time to
reduce
the
baggage



Deflationary turn

- **Based on**
« **deflationary realism** »
- Avoids essentialism and interpretations
- Statements are 'true' if there is sufficient evidence to support them.
- Avoids '**T**ruth' and other metaphysics



Essentialism?

- Attributes some core unalterable 'nature' to concepts
- If this deep structure is so real, why is it so hard to observe and agree upon?
- *Maybe truth is less intrinsic, and more relational...*

Example: cadastre in time

- Property boundaries, measured at different times, with different techniques
- Various efforts to decide how to update older measurements with new information (Buyong, 1992; Karnes, 1995)
- Eschew essentialist interpretation

Avoiding hasty interpretation

- For example: Mercator projection
 - A reasonable solution for navigators
 - Lousy solution for diplomats locating maritime boundaries
 - *(Midpoints are hard to construct, since scale varies with latitude)*

Mathematics

- Is there some parallel world in which mathematics are permanently True?
 - *(if so why is it so hard to observe?)*
- A deflationary view considers mathematics a game we play with logic and symbols to make our point.
 - *Discourse by other means*

Historical embedding

- Science works incrementally
 - « on the shoulders of giants »
- *Our ways of knowing may be path-dependent; conditional on how we climbed on these shoulders.*

Tobler's First Law

« *Everything is related to everything else, but near things are more related than distant things.* »

- Hardly precise or predictive, simply ordinal
- Perhaps troublesome for a formalist
- Not troubling for a deflationist

Spiraling debate on TFL

- For example Barnes (2004) argues on the basis of ‘anti-philosophy of science’
- But the concept of a ‘law’ treated with deflationary caution is quite consistent with numerous philosophers of science
- Goodchild responds with Boyle’s Law – ‘universal, true and eminently useful’

Let's deflate the rhetoric

Moderate the claims and the table-thumping

- Certain basic concepts serve us well
- We don't need to know if they are for 'all time'
- We can't eliminate path-dependency
- One world is hard enough to manage...

Let's pay attention to the world around us

- From crisis events, we must modify Tobler's First Law:
- 'donut effect' (*Sophia Liu AAG on hazards*)
 - *Less information available in proximity to a catastrophic event*
- Synoptic view only works from afar

Let's take advantage of mathematics

- Working out the consequences of assumptions is crucial
- Distinguishing between necessary and sufficient conditions
- Understanding transformations and invariances; process and pattern
- *BUT without metaphysics*

Let's be careful about imposing hierarchies

- Notion of 'tiered ontology' (Frank)
 - *Maybe more about epistemology*
- Imperfection arises in each domain, not ordered by discipline/approach
 - *More an issue of common agreement? boundary objects?*

Let's relearn forgetting

- Increase in storage delays the inevitable
- Some day we will have to make choices
- Deletion is required, even a good thing

A few (modest) suggestions

- Square degrees are not pixels
- All calculations should operate on ellipsoidal coordinates
- Beware hidden priorities in tiered ontologies

Value

- Comes from use
- NOT inherent in the data

Conclusion

- A deflationary stance can play a role in reducing the rhetoric
- A role for fundamental principles exists
- Don't carve anything in stone – yet...

It's a long process



Toward Los Angeles; Dorothea Lange, 1937

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