

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

Applies to other computer technologies

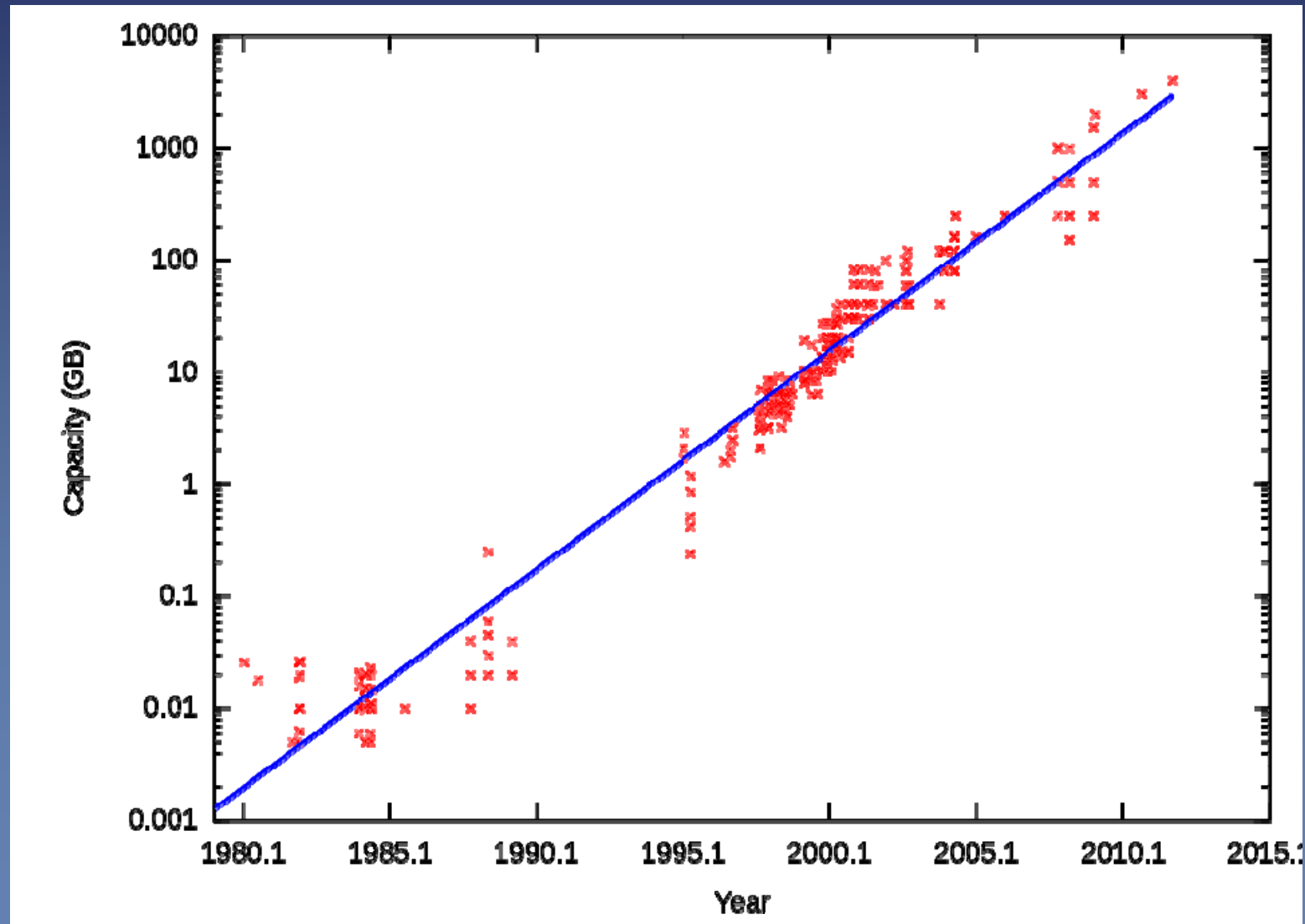
Here, disk drives

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

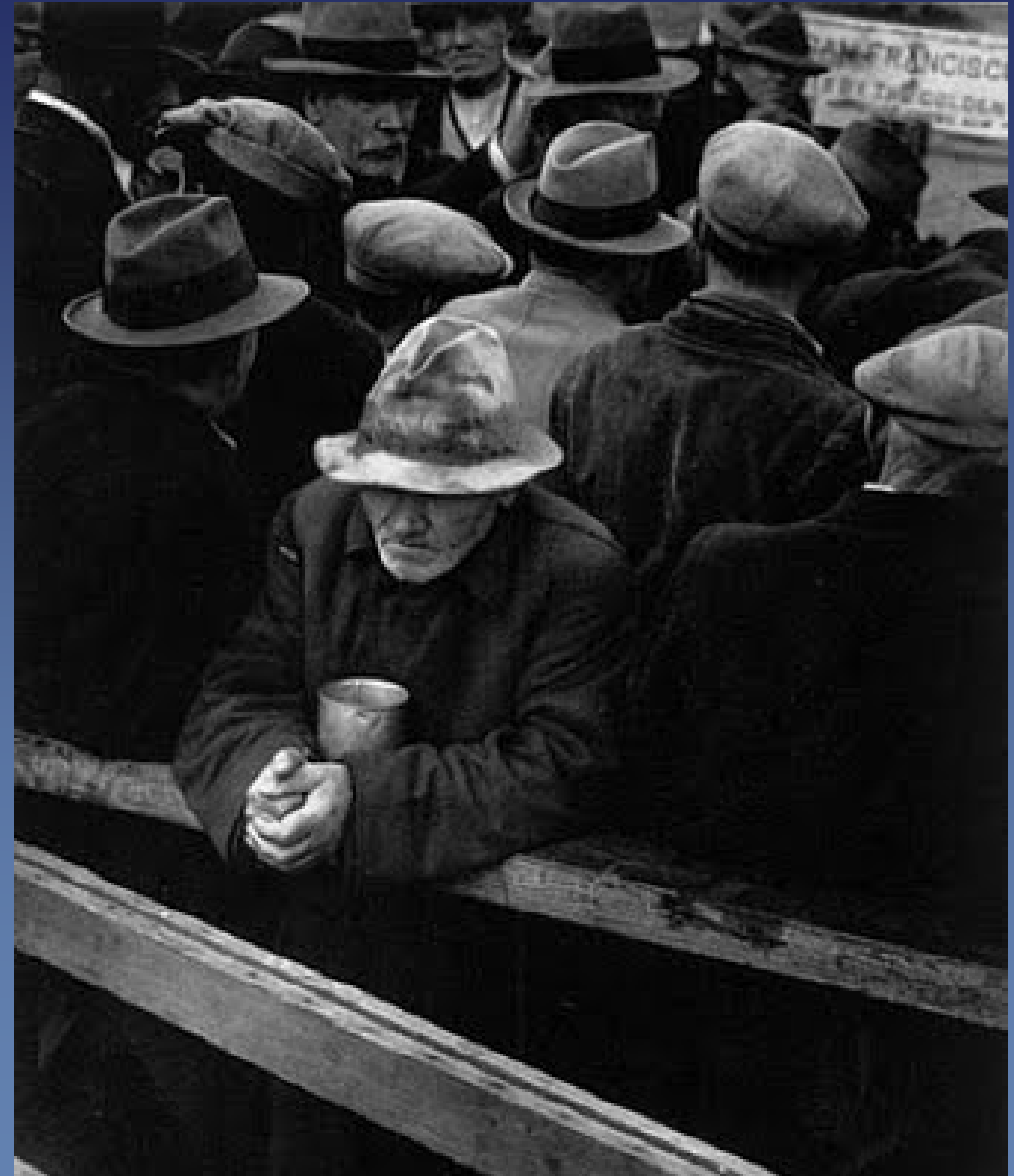
- Quantitative geography?
 - No need to review the history
 - Personal positionality
 - (Berry, Bunge, Haggett, Morrill, Sherman, Tobler, Warntz, and more)

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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