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Planetary Limits, Anti-Limits in Computer Systems And The Missing Scenarios

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Planetary Limits, Anti-Limits in Computer Systems And The Missing Scenarios

Florence Maraninchi

`www-verimag.imag.fr/~maraninx`

Verimag / Grenoble INP - UGA / Ensimag
Campus d'Après Grenoble

June 4th, 2024 — GDR GPL, Strasbourg

Who Am I?

- Research at **Verimag**, background in critical embedded systems and high-level models for systems-on-a-chip, now working on the impacts of digital technologies
- Teaching at **Ensimag** (OSes, HW architecture, real-time systems, formal validation...), vice-director for Social and Environmental Responsibilities (RSE)
- In charge of the **VerIT project** (new curricula for future jobs in green ICT)



www-verimag.imag.fr

F. Maraninchi (Verimag/Ensimag)



ensimag.grenoble-inp.fr

Missing Scenarios



ensimag.grenoble-inp.fr/fr/1-ecole/projet-verit

GDR GPL 2024

2 / 63

Social and Environmental Responsibilities of the Digital World

Many concerns:

- Generalized surveillance, privacy matters
*Les mesures de vidéosurveillance algorithmique introduites par la loi JO 2024 sont contraires au droit international*¹
- Fragility of the infrastructures, cybersecurity, failures
- Illectronism, digital divide
- Algorithmic governmentality, inequalities, biases
*Notation des allocataires : l'indécence des pratiques de la CAF désormais indéniable*²
- This talk: **Planetary limits and the impacts on the environment**

¹<https://www.lemonde.fr/idees/article/2023/03/06/les-mesures-de-videosurveillance-algorithmique-introduites-par-la-loi-jo-2024-sont-contraires-au-droit-international>

²<https://www.laquadrature.net/2023/11/27/notation-des-allocataires-lindecence-des-pratiques-de-la-caf-desormais-indeniable/>

Impacts On The Environment

GHG only:

- Between 1.8 and 3.9% of total GHG emissions according to [1]
- Growth rate estimates: 6% per year according to the Shift Project

+ Other impacts...

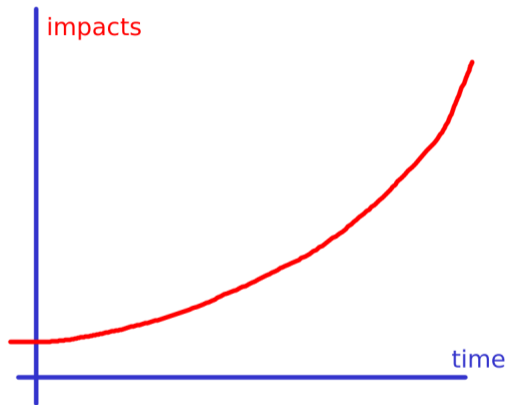
[1] Charlotte Freitag, Mike Berners-Lee, Kelly Widdicks, Bran Knowles, Gordon S Blair, and Adrian Friday. The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations. *Patterns*, 2(9):100340, 2021. <https://www.sciencedirect.com/science/article/pii/S2666389921001884>.

Impacts On The Environment: When and How Will It Stop?

GHG only:

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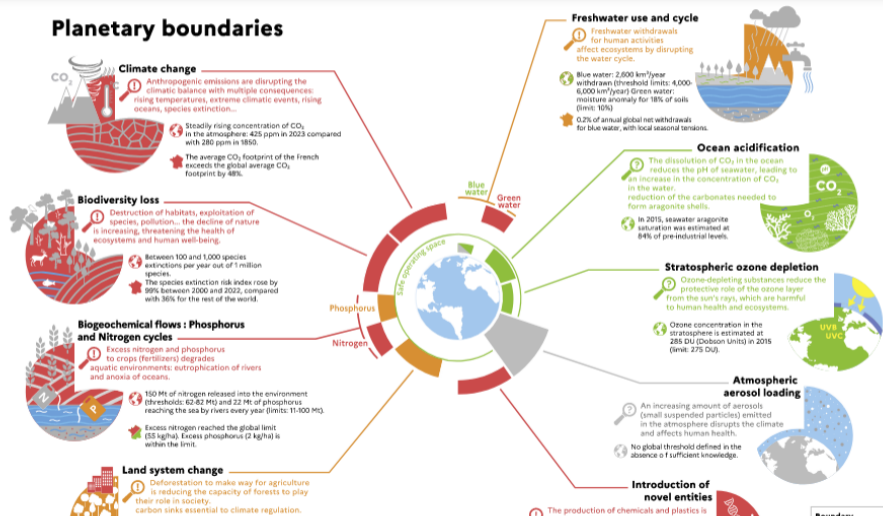
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A Few Words On Planetary Boundaries

<https://www.statistiques.developpement-durable.gouv.fr/edition-numerique/la-france-face-aux-neuf-limites-planetaires/en>



Absolute Sustainability

<https://orbit.dtu.dk/en/publications/downscaling-the-planetary-boundaries-in-absolute-environmental-su>

JOURNAL ARTICLE



Downscaling the planetary boundaries in absolute environmental sustainability assessments - A review

IN [Journal of Cleaner Production](#) — 2020, Volume 276, pp. 123287

DTU BY [Ryberg, Morten W.](#)^{1,2,3}; [Andersen, Martin Marchman](#)³; [Owsianiak, Mikołaj](#)^{1,2,3}; [Hauschild, Michael Zwicky](#)^{1,2,3}

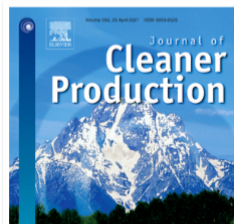


FROM Sustainability¹, Quantitative Sustainability Assessment², Department of Technology³ [details](#)

The safe operating space as defined by the Planetary Boundaries framework can be used as an environmental sustainability reference in absolute environmental sustainability assessments (AESAs). In AESAs, the safe operating space must be distributed among human activities so impacts associated with an activity can be related to its assigned share of the safe operating space to assess if the activity can be considered absolute sustainable.

To ensure choices concerning sharing principles in AESA are deliberate, there is a need for understanding the distributive justice theory underlying the sharing principles. This study provides a

framework for determining and communicating the distributive justice theory that underlies the choice

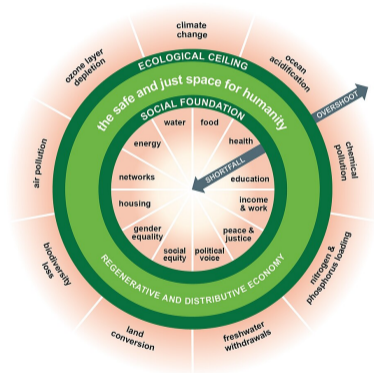


Global Limits: ICT In The Donut?³

There are already a lot of existing digital technology, we're not sure they "fit" in the donut;

Should we keep hoping for new "greener" objects (i.e., that would fit in the donut), or rather preserve what we can of the existing objects?

The sharing principles are necessarily political



³By DoughnutEconomics - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=75695171>

The Current Green × ICT Landscape

- **Green ICT:**

- Measures/estimations/modeling of (mainly) energy consumption
- Optimization (SW, HW, communication)

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 - Optimizations of existing non-IT domains (e.g, supply chain, smart-*)
 - New domains (e.g, car-sharing platforms)

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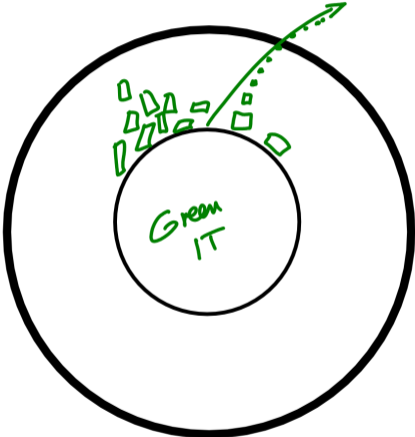
- But how does this address the exponential growth and the necessity to fit in the donut? what about rebound effects?^a and degrowth/postgrowth?

What if it's not sufficient, or even counter-productive?

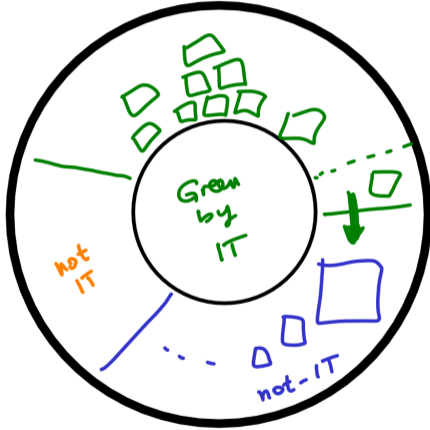
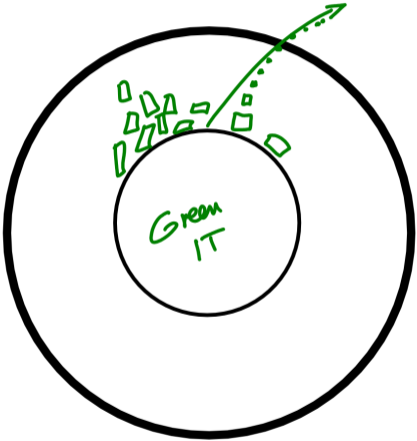
^a https://en.wikipedia.org/wiki/Jevons_paradox

ICT In The Donut? We Need To Change Perspectives

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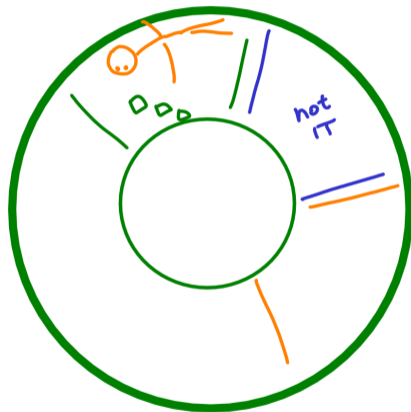
Green-ICT aims at designing *greener objects*. But we need **absolute sustainability**, not relative sustainability.

Green-by-ICT gives priority to ICT now and promises a better future for other activities.

ICT In The Donut? We Need To Change Perspectives

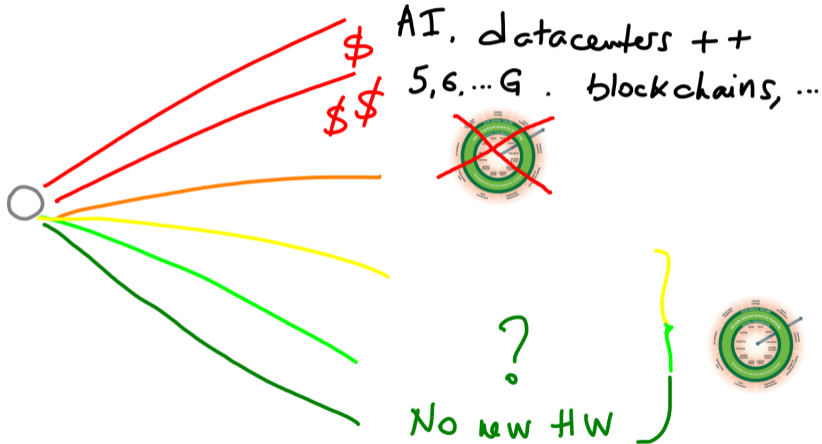
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return to Slide 42

Missing Research, Teaching, and Engineering Work



Research In CS Should Explore More Diverse Paths^{4 5 6}

COMMUNICATIONS ACM

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VIEWPOINT

Let Us Not Put All Our Eggs in One Basket

By Florence Maraninchi
Communications of the ACM, September 2022, Vol. 65, No. 9, Pages 1827
10.1145/3528288

COMMUNITY



Our colleagues at the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) have been telling us for years that the situation is serious. Last year saw both the publication of the sixth IPCC report, and the release of the findings of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report, and the release of the findings of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report. If you search the Internet for occurrences of "systemic digital sustainability" you will find a long list of declarations by universities worldwide, stating they will be carbon neutral by 2030 or 2040. I will not discuss here whether carbon neutrality objectives are desirable or even make sense at all (see [1]). I take this series of declarations as a sign that the academic world is hopefully starting to take scientific results seriously, at least concerning the impact of our work

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MORE NEWS & OPINIONS

Mobile Start Using Information Sharing Tools to Detect Financial Crime

Developing Quantum Barrier Algorithms

Can You Please Explain More Openstack?

UNiversitè de Grenoble Alpes Sciences Informatiques

Quelle recherche en informatique pour un numérique inscrit dans les limites planétaires ?

Florence Maraninchi

Les sciences informatiques sont-elles une partie du problème ou une partie de la solution à la crise environnementale ? Pour prolonger le Forum thématique de l'année 2023 sur les sciences informatiques écoresponsables, CNRS Sciences Informatiques vous propose ce billet de Florence Maraninchi, professeure à Grenoble INP, membre de Verimag, qui ouvre sur une réflexion autour de la soutenabilité de la recherche en sciences informatiques.

Impacts environnementaux du numérique et soutenabilité

Le droit de Rika Research illustre le notion de soutenabilité par deux cercles concentriques qui délimitent une zone indésirable. Le cercle intérieur représente un plancher minimal qui garantit

undone computer science

Nantes, France - 29 February 2024 - a celebration of digital science in the 1970s

Home | Programme | View, access & accessibility | Registration | Call for presentations (July 2023)

NEWS

- Attend remotely: the conference is broadcast at <https://undoneconf.sciencesconf.org/> since starting on Monday February 26 at 10:00 (UTC-1). No registration is needed to attend online.
- The [daily programme](#) for accepted talks is now available.
- Announcing our invited speakers: [Ben Green](#) (J. Mitchell) and [Kerem Ersovan](#) (Center for Internet and Society, CNRS).
- Due to a high number of quality submissions, the conference has been extended to a 3-day event.

UNDONE COMPUTER SCIENCE CONFERENCE

We are pleased to welcome you to the Undone Computer Science conference, organized by researchers from Université de Nantes, Inria, and LORIA Université de Lorraine.

The goal of our conference is to provide an opportunity to pause and reflect on the epistemological and ethical aspects of computer science. We propose as a theme the concept of *undone science* [1, 2], the intriguing yet still rather thin area of research that ranges

IMPORTANT DATES

Submission deadline: 18th October 2023 (AET)

18th October 2023

Author notification: 8th December 2023 (AET)

8th December 2023

Registration: 22nd January 2024

22nd January 2024

Conference: 26th February 2024

26th February 2024

PROGRAMME COMMITTEE

Elvira Drossopoulou (University of Edinburgh)

Markus J. Bader (University of Lorraine)

Erkka Ruuska (University of Lorraine)

⁴ <https://cacm.acm.org/opinion/let-us-not-put-all-our-eggs-in-one-basket/>

⁵ <https://www.ins2i.cnrs.fr/fr/cnrsinfo/quelle-recherche-en-informatique-pour-un-numerique-inscrit-dans-les-limites-planetaires>

⁶ <https://undonecs.sciencesconf.org/>

This Talk: Some Missing Research Topics in CS For The Non-Overly Techno-Optimistic Hypotheses

- 1 A Tale Of Three Futures (the Example of Mobile Communications 2005-2020)
- 2 Anti-Limits in CS and Implicit Futures
- 3 Example CS Research Topics For The “Fading ICT” Scenario
- 4 This is Not a Conclusion

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Typical Situation in 2005



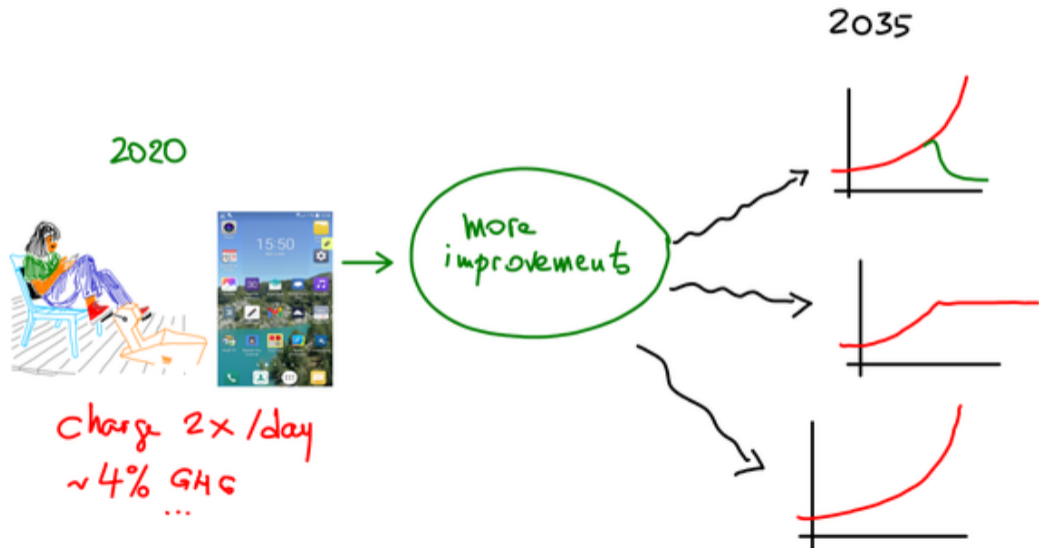
Typical Situation in 2020



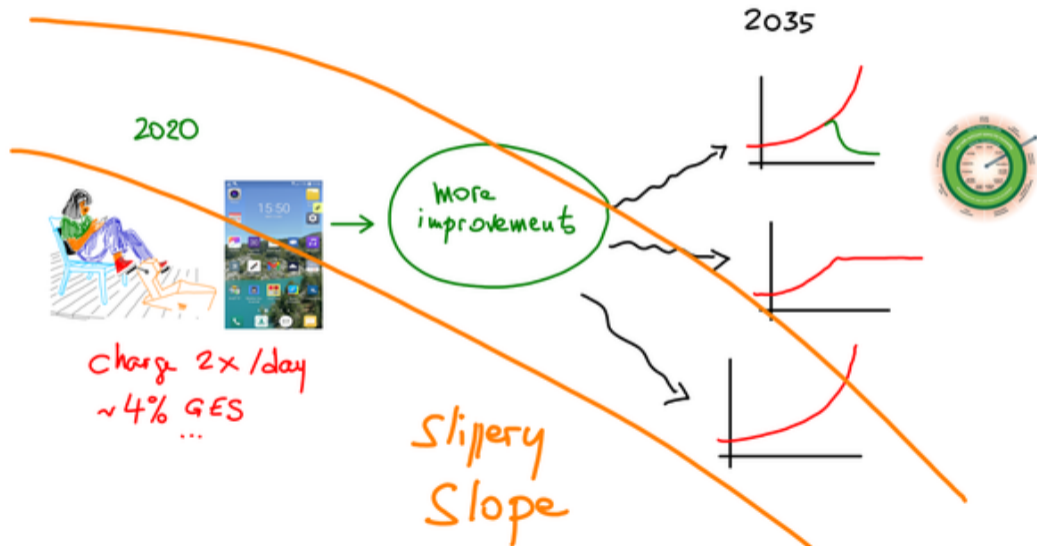
What Future For 2020 Did We Have in Mind Back In 2005?



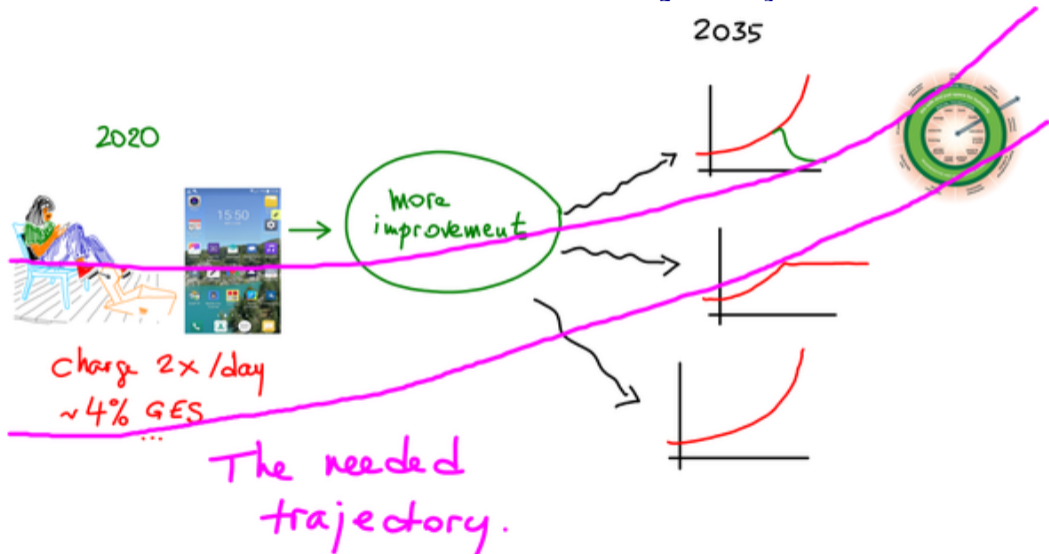
How Do We See The Future, say in 2035?



The Slippery Slope: Towards Increased Impacts



How To Set ICT On The Needed Trajectory?



Rebound Effects



WIKIPEDIA
The Free Encyclopedia

Main page
Contents
Current events
Random article
About Wikipedia
Contact us
Donate

Contribute

Help
Learn to edit
Community portal
Recent changes
Upload file

Tools

What links here
Related changes

Not logged in [Talk](#) [Contributions](#) [Create account](#) [Log out](#)

Article [Talk](#)

[Read](#) [Edit](#) [View history](#)

Jevons paradox

From Wikipedia, the free encyclopedia

In economics, the **Jevons paradox** (/ˈdʒɛvənz/; sometimes **Jevons effect**) occurs when **technological progress** or government policy increases the **efficiency** with which a **resource** is used (reducing the amount necessary for any one use), but the falling cost of use increases its **demand**, negating reductions in resource use.^[1] The Jevons' effect is perhaps the most widely known paradox in **environmental economics**.^[2] However, governments and **environmentalists**^[needs update] generally assume that efficiency gains will lower **resource consumption**, ignoring the possibility of the effect arising.^[3]

In 1865, the English economist **William Stanley Jevons** observed that technological improvements that increased the efficiency of coal use led to the increased consumption of coal in a wide range of industries. He argued that, contrary to common intuition, technological progress could not be relied upon to reduce fuel consumption.^{[4][5]}

The issue has been re-examined by modern economists studying consumption **rebound effects** from improved **energy efficiency**. In addition to reducing the amount needed for a given use, improved efficiency also lowers the relative cost of using a resource, which increases the quantity demanded. This counteracts (to some extent) the reduction in use from improved efficiency. Additionally,



Coal-burning factories in 19th-century Manchester, England. Improved technology allowed coal to fuel the **Industrial Revolution**, greatly increasing the consumption of coal.

Social Questions vs Computer Science Research Topics

Individual Behaviors or Regulations? Should we keep the videos of cats? How to choose democratically? ...

Even if we don't agree on the need to keep digital technologies within limits, even if we don't agree on what to keep/remove, we can and should ask:

intrinsic computer science questions on the mere feasibility of staying within limits; do we even know how not to grow?

- ① A Tale Of Three Futures (the Example of Mobile Communications 2005-2020)
- ② Anti-Limits in CS and Implicit Futures
 - Anti-Limits
 - One More Anti-Limit: Digital Cartography
 - One More Anti-Limit: Total Recall
 - Questioning Implicit Scenarios And Their Effects On Digital Systems
- ③ Example CS Research Topics For The “Fading ICT” Scenario
- ④ This is Not a Conclusion

2 Anti-Limits in CS and Implicit Futures

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Anti-Limits *(from the CACM paper)*

An Anti-Limit is both a promise and a deliberate hypothesis that resources will grow as needed. There is an anti-limit if a digital system:

Anti-Limits *(from the CACM paper)*

An Anti-Limit is both a promise and a deliberate hypothesis that resources will grow as needed. There is an anti-limit if a digital system:

- ...
- Promises immediate service delivery, whatever the number of clients and usages (most of the cloud services)
- Promises unlimited storage in both space and time (Gmail in 2006), twitter, ...
- Is designed to allow for unlimited functional extensions
- ...

Anti-Limits And The Corresponding Limits

Each anti-limit leads to interesting socio-political or technical questions:

- Unlimited storage in both space and time (more examples later):

Mastodon vs Twitter: choose an expiration delay vs tweets are there forever

Do you have disk/email quotas at work?

Do you archive your conversations on social networks?

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- **Unlimited and concentrated cloud services:**
e.g., framasoftware refused to grow and supported the creation of other groups on the same model instead, slowing the expansion, and fighting concentration
- **Extensible systems (more details later):**
Is extensibility always a desirable property?
What about ad-hoc, non-extensible systems, by-design?
- ...

2 Anti-Limits in CS and Implicit Futures

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One More Anti-Limit: Digital Cartography

<https://write.tedomum.net/flomaraninchi/penser-le-numerique-dans-les-limites-planetaires-une-metaphore-visuelle-et>

<https://geoservices.ign.fr/lidarhd>



???

- IGN Lidar 50cm-precision
- Micro-mapping and now Panoramax (replacement for Google StreetView) in Open Street Map
- Real-time information (e.g., waze)

Is there a limit? And if yes, where?

A Quest For The Map Of The World At The Scale 1-1

https://fr.wikipedia.org/wiki/De_la_rigueur_de_la_science

En aquel Imperio, el Arte de la Cartografía logró tal Perfección que el mapa de una sola Provincia ocupaba toda una Ciudad, y el mapa del Imperio, toda una Provincia. Con el tiempo, estos Mapas Desmesurados no satisficieron y los Colegios de Cartógrafos levantaron un **Mapa del Imperio, que tenía el tamaño del Imperio y coincidía puntualmente con él**. Menos Adictas al Estudio de la Cartografía, las Generaciones Sigüientes entendieron que ese dilatado Mapa era Inútil y no sin Impiedad lo entregaron a las Inclemencias del Sol y los Inviernos. En los desiertos del Oeste perduran despedazadas Ruinas del Mapa, habitadas por Animales y por Mendigos; en todo el País no hay otra reliquia de las Disciplinas Geográficas.

Suárez Miranda, Viajes de Varones Prudentes, Libro Cuarto, Cap. XLV, Lérida, 1658.
Jorge Luis Borges.

Where Do We Stop?

If a new technology allowing for a precision of 1cm is developed, will we use it?

We already have a huge set of data, to be preserved forever, which grows with no visible limit because of all the things that people may want to include in maps, ...

What if the next “useful info” is real-time data about the whole territory?

The Implicit Scenario We Use To Justify The Quest

The implicit context for the **usefulness** of this precise (and real-time) information: people are alone in the wild, there's no public authority in charge of installing road signs and broadcasting real-time information, no one can help, or you don't trust them...

What does it tell us on our pre-conceptions of the public space?

2 Anti-Limits in CS and Implicit Futures

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The Case Of Windows 11 Recall

<https://arstechnica.com/gadgets/2024/05/microsofts-new-recall-feature-will-record-everything-you-do-on-your-pc/>

Recall uses Copilot+ PC advanced processing capabilities to take images of your active screen every few seconds, (...) The snapshots are encrypted and saved on your PC's hard drive. You can use Recall to locate the content you have viewed on your PC using search or on a timeline bar that allows you to scroll through your snapshots.

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*To use Recall, users will need to purchase one of the new "Copilot Plus PCs" powered by Qualcomm's Snapdragon X Elite chips, which include the necessary neural processing unit (NPU). There are also minimum storage requirements for running Recall, with a minimum of **256GB of hard drive space and 50GB of available space**. The default allocation for Recall on a 256GB device is 25GB, which can store approximately three months of snapshots. Users can adjust the allocation in their PC settings, with **old snapshots being deleted once the allocated storage is full**. me: Really?*

The *My Life Bits* Experiment 2001-2024

<https://en.wikipedia.org/wiki/MyLifeBits>

Remember the experiment **My Life Bits** by Gordon Bell (started in 2001)?

MyLifeBits

[Article](#) [Talk](#)

[Read](#) [Edit](#) [V](#)

From Wikipedia, the free encyclopedia

MyLifeBits is a [life-logging](#) experiment begun in 2001.^[1] It is a [Microsoft Research](#) project inspired by [Vannevar I Memex](#) computer system. The project includes [full-text search](#), text and audio annotations, and hyperlinks. The "subject" of the project is computer scientist [Gordon Bell](#), and the project will try to collect a lifetime of storage on Gemell of Microsoft Research and Roger Lueder were the architects and creators of the system and its software.

MyLifeBits is an attempt to fulfill [Vannevar Bush](#)'s vision of an automated store of the documents, pictures (included automatically), and sounds an individual has experienced in his lifetime, to be accessed with speed and ease. For documents he had read or produced, CDs, emails, and so on. He continued to do so through his death in 2024, ga browsed, phone and instant messaging conversations and the like more or less automatically. The book *Total Recall* vision and implications for a personal, lifetime e-memory for recall, work, health, education, and immortality.^[2] It was published in paperback.^[3] As of 2016, Bell was no longer using the [wearable camera](#) associated with the project, the rise of the [smartphone](#) as largely fulfilling Bush's vision of the Memex.^[4]

2 Anti-Limits in CS and Implicit Futures

- Anti-Limits
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Implicit Futures: Usages vs Core Development Principles

There are implicit infinite-growth futures (not so) hidden in the promises and subsequent uses of digital technologies: store without limits, until you lose any hope of finding anything significant (or you buy the idea that you need AI for that purpose).

There are also implicit futures hidden in the core design principles of digital systems. Example: extensibility.

Implicit Futures Hidden in The Definitions Of Extensibility

Extensibility is a software engineering and systems design principle that provides for **future growth**. Extensibility is a measure of the ability to extend a system and the **level of effort** required to implement the extension^a.

^a<https://en.wikipedia.org/wiki/Extensibility>

Software extensibility encapsulates the software's innate ability to absorb fresh features, capabilities, or alterations, all **without requiring an extensive reconstruction** of its core architecture. Think of this as building with a **"future-proof" mindset** (...)^a.

^a<https://www.codium.ai/glossary/software-extensibility/>

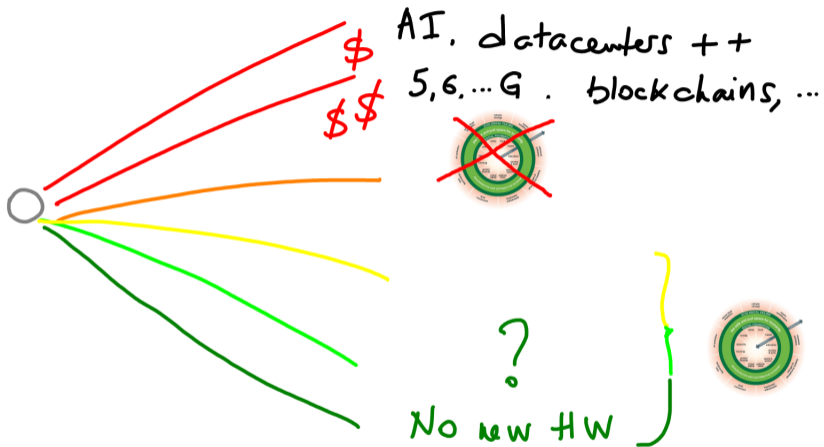
Extensibility is almost always considered a desirable property.

But **what futures do we have in mind?**

(goto slide 53)

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 - What Is “Fading” ICT?
 - Self-Obviating Systems
 - Limits-First Design
 - + Non-Extensible Systems/Shrinkability Principle
 - + Tools for Deconstructing ICT
- 4 This is Not a Conclusion

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 - + Tools for Deconstructing ICT



ICT in Prospective Scenarios (A. Bugeau et A.-L. Ligozat)

<https://ensimag.grenoble-inp.fr/fr/1-ecole/conferences-et-ateliers-le-numerique-dans-les-limites-planetaires-quelles-nouvelles-formations-p>

<https://hal.science/hal-04486589>

Conference Papers Year : 2024

Analysing ICT in prospective scenarios to help reveal undone computer science

Aurélie Bugeau (1, 2, 3) , Anne-Laure Ligozat (4, 5, 6)

Show details



- 1 IUF - Institut universitaire de France
- 2 LaBRI - Laboratoire Bordelais de Recherche en Informatique
- 3 UB - Université de Bordeaux
- 4 ENSIIE - Ecole Nationale Supérieure d'Informatique pour l'Industrie et l'Entreprise
- 5 LISN - Laboratoire Interdisciplinaire des Sciences du Numérique
- 6 STL - Sciences et Technologies des Langues - LISN

Abstract en

Computer science is often mentioned as a solution to solve climate change (e.g. [Rolnick et al., 2019]). But at the same time, it is now acknowledged that ICT has its own environmental impacts. Several authors have tried to estimate future information and communication technologies (ICT) energy

Keywords en

future of ICT prospective scenario sustainable ICT

future of ICT

prospective scenario

Fading ICT: An Hypothesis and A Scenario

What if, at some point in the future, **we stopped manufacturing new HW?**

We should explore this hypothesis, just in case...

- **Scenario: how to get there? the "fading-ICT" scenario**
- Several existing research topics are relevant for this hypothesis: **fighting SW obsolescence; Self-Obviating Systems; Limits-First Design; Permacomputing; ...**
- I propose to add: Non-Extensible Systems/Shrinkability Principle; Tools for Deconstructing ICT

Studying this hypothesis and its consequences is also a way to change perspectives.

goto Slide 10.

- ### 3 Example CS Research Topics For The “Fading ICT” Scenario
- What Is “Fading” ICT?
 - Self-Obviating Systems
 - Limits-First Design
 - + Non-Extensible Systems/Shrinkability Principle
 - + Tools for Deconstructing ICT

Use The Current ICT Abundance To Build Non ICT-Dependent Solutions (“Back To The Trees” Project)

LIMITS '23, June 14–15, 2023,

Back to the trees: Identifying plants with Human Intelligence

Simon Castellan
Inria, Centre de l'université de
Rennes; Univ Rennes
France
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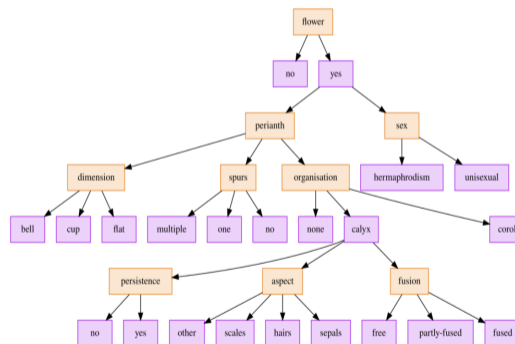
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ABSTRACT

We investigate a way to build a convivial plant identification tool halfway between the complex determination keys of botanists and the more recent but poorly explainable approaches based on AI image recognition. Our approach consists of a formal language to organize morphological traits and a Bayesian technique to de-

termine [Tannier et al., 2001] for instance) as precise tools to identify an unknown plant, despite some limits: (1) they require an expertise in plant morphology; (2) they suppose the ability to answer questions concerning all the organs (and in particular the flower) even if these organs are not observable (because of seasonality for example) on the considered plant; and (3) they leave little place for errors or uncertainties, both



7

⁷<https://assets.pubpub.org/v16f148a/61686158341995.pdf>

Valérie d'Acremont: Digital Technologies for Health

[https://steep.inria.fr/comprendreagir/technologies-et-sante-quels-compromis-](https://steep.inria.fr/comprendreagir/technologies-et-sante-quels-compromis-entre-ethique-environnement-et-climat-actions-et-questions-basees-sur-l'experience-terrain/)

[entre-ethique-environnement-et-climat-actions-et-questions-basees-sur-l'experience-terrain/](https://steep.inria.fr/comprendreagir/technologies-et-sante-quels-compromis-entre-ethique-environnement-et-climat-actions-et-questions-basees-sur-l'experience-terrain/)

Technologies et santé : Quels compromis entre éthique, environnement et climat ? Analyse réflexive et expérience de terrain



Date : 27 septembre 2021

3 Example CS Research Topics For The “Fading ICT” Scenario

- What Is “Fading” ICT?
- Self-Obviating Systems
- **Limits-First Design**
- + Non-Extensible Systems/Shrinkability Principle
- + Tools for Deconstructing ICT

Offline-First Design^{8 9}

Designing Offline-First Web Apps

by **Alex Feyerke** · December 04, 2013

Published in [Application Development](#), [Mobile/Multidevice](#), [Responsive Design](#)

When it comes to building apps, we often assume our users are very much like us. We picture them with the latest devices, the most recent software, and the fastest connections. And while we may maintain a veritable zoo of older devices and browsers for testing, we spend most of our time building from the comfort of our modern, always-online desktop devices.

⁸<https://alistapart.com/article/offline-first/>

⁹<https://aaltodoc.aalto.fi/items/653b4059-85f0-4a4e-a321-80783da1fe51>

Designing for Slow Devices or Slow Connections^{10 11 12}

URL	Size MB	Load time in seconds							
		FIO	Cable	LTE	3G	2G	Dial	Bad	👤
http://bellard.org	0.015	0.40	0.59	0.60	1.2	2.9	1.8	9.5	7.6
http://danluu.com	0.022	0.20	0.20	0.40	0.80	2.7	1.6	6.4	7.6
news.ycombinator.com	0.031	0.30	0.49	0.69	1.6	5.5	5.0	14	27
danluu.com	0.032	0.20	0.40	0.49	1.1	3.6	3.5	9.3	15
http://jvns.ca	0.147	0.49	0.69	1.2	2.9	10	19	29	108
jvns.ca	0.154	0.50	0.80	1.2	3.3	11	21	31	97
fgiesen.wordpress.com	0.3712	1.0	1.1	1.4	5.0	16	66	68	FAIL
google.com	0.596	0.80	1.8	1.4	6.8	19	94	96	236
joelonsoftware.com	0.7219	1.3	1.7	1.9	9.7	28	140	FAIL	FAIL
bing.com	1.312	1.4	2.9	3.3	11	43	134	FAIL	FAIL
reddit.com	1.326	7.5	6.9	7.0	20	58	179	210	FAIL
signalvnoise.com	2.17	2.0	3.5	3.7	16	47	173	218	FAIL
amazon.com	4.447	6.6	13	8.4	36	65	265	300	FAIL
steve-yegge.blogspot.com	9.719	2.2	3.6	3.3	12	36	206	188	FAIL
blog.codinghorror.com	2324	6.5	15	9.5	83	235	FAIL	FAIL	FAIL

¹⁰<https://danluu.com/slow-device/>

¹¹<https://danluu.com/web-bloat/>

¹²<https://tonsky.me/blog/js-bloat/>

Self-Imposing Limits In Advance

What kind of limit can we define/self-impose to fight the growth of digital cartography?

3 Example CS Research Topics For The “Fading ICT” Scenario

- What Is “Fading” ICT?
- Self-Obviating Systems
- Limits-First Design
- + Non-Extensible Systems/Shrinkability Principle
- + Tools for Deconstructing ICT

Open/Extensible Systems Are Meant For Growth Scenarios That (Almost) Never Realize

- There are perfectly ad-hoc digital systems that have been running unchanged for more than 30 years (examples in nuclear power-plants)
- But the most versatile HW/SW object ever (the smartphone) has to be replaced every 2-5 years

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- But the most versatile HW/SW object ever (the smartphone) has to be replaced every 2-5 years

About “technological” objects in general:

- SW is expected to make things extensible/reusable/... but 10 years is already considered very long!
- 300-year-old Stradivarius violins are still usable

To Stay Within Limits We Might Need Closed/Shrinkable Systems

Closed (Ad-Hoc) Systems:

We could design digital systems from early precise specifications and a few *planned extensions*, not for unexpected extensions.

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Shrinkable: If you do not know what the future will be, plan for smaller (instead of bigger) systems. Hence design for shrinkability rather than extensibility.

Tentative Definitions of Shrinkability

(See slide 37)

Shrinkability is a software engineering and systems design principle that provides for **future degrowth**. It is a measure of the ability to reduce or reconfigure the functionalities if the resources available decrease, and the **level of effort** required to implement this functional reduction.

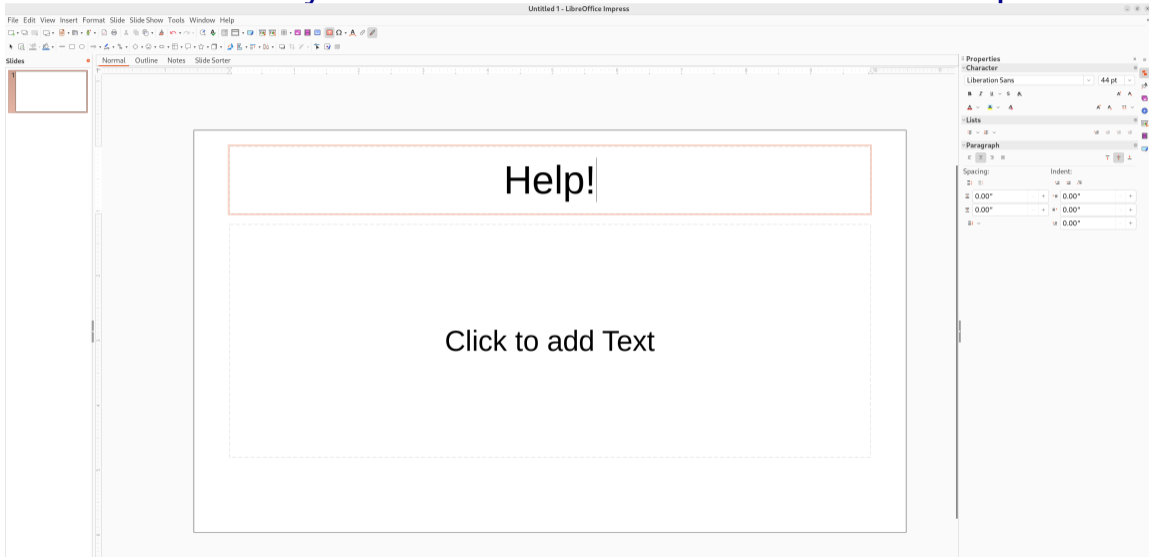
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Software shrinkability encapsulates the software's innate ability to be simplified by removing features or capabilities, all **without requiring an extensive reconstruction** of its core architecture. Think of this as building with a **"future-proof" mindset**.

I Would Definitely Vote For A Shrinkable Libreoffice Impress



- 3 Example CS Research Topics For The “Fading ICT” Scenario
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Why Dismantle Complex Digital Systems?

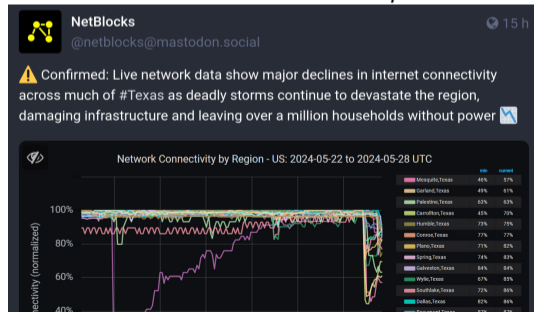
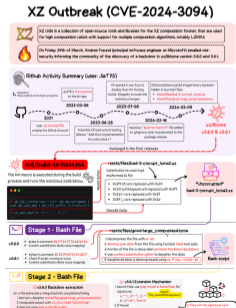
<https://research.swtch.com/xz-timeline>

<https://www.editionsdivergences.com/livre/a-bout-de-flux>

Recent libxz SW
supply-chain attack

Digital world ⇔
Electrical
infrastructure

@netblocks@mastodon.social: *major declines in internet connectivity across much of Texas as deadly storms continue to devastate the region, damaging infrastructure and leaving over a million households without power*



How To Dismantle Complex (Digital) Systems?



Analysing the impact of removing one “component” somewhere, towards:

- Less dependencies / coupling
- More redundancy / technodiversity
- Simpler versions of useful components
- Non-optimal systems
- Reduced dependency on ICT

Low-Tech? Right-Tech? Less Tech!

- 1 A Tale Of Three Futures (the Example of Mobile Communications 2005-2020)
- 2 Anti-Limits in CS and Implicit Futures
- 3 Example CS Research Topics For The “Fading ICT” Scenario
- 4 **This is Not a Conclusion**

Take-Home Messages

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- We cannot keep betting on the fact that ICT will reduce the impact of some other sectors in sufficient proportions so as to be freed from reduction objectives for itself
- Limiting ICT requires social and political changes, computer scientists/engineers are not particularly legitimate to drive them, but...
- Even if we don't agree on the need to reduce ICT, even if we don't agree on what to keep/remove, we should ask **do we even know how not to grow? Let us stop feeding the growth.**

Technologie partout, démocratie nulle part



Technologies partout,
démocratie nulle part.
Plaidoyer pour que les choix
technologiques deviennent
l'affaire de tous



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Computer Science Research for the “Fading ICT” Scenario

Starting event: at some point in time we stop manufacturing new HW
What will we need from then (or to prepare for this event)?

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- Studying how to become ICT-independent
- Making reuse of existing HW easier, by reverting the growth-oriented SW development principles
- (Re)Designing systems with limits as the first and main objective
- Working on deconstruction design principles

Computer Science Research for the “Fading ICT” Scenario

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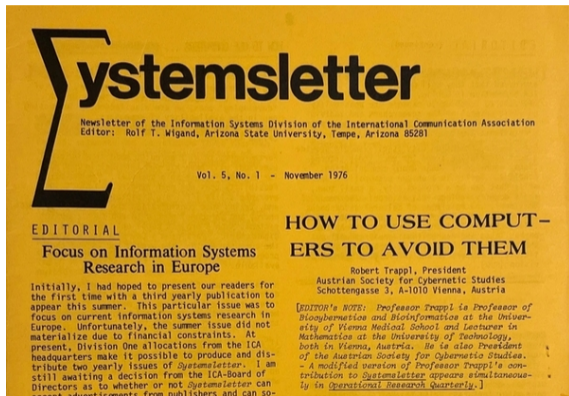
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Collateral benefits:

- it would make the whole ICT infrastructure more robust
- IMHO it's more interesting than the “wait-for-a-bigger-machine” attitude

All Of This Is Quite Old! (1976)¹³



However, there is one significant difference between these two problems: contrary to the energy problem we can use information processing machines to reduce the necessity to use them. We should therefore concentrate our efforts upon using them to develop or improve strategies which help us deal with problems without the use of computers.

¹³ <https://uniqueatpenn.wordpress.com/2024/03/13/the-international-communication-association-and-the-history-of-communication-studies/>

The End. Thank you.
Questions ?