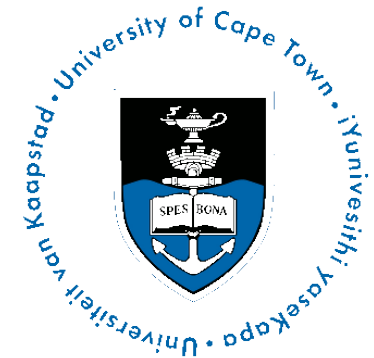


Computer Science at times of crisis:

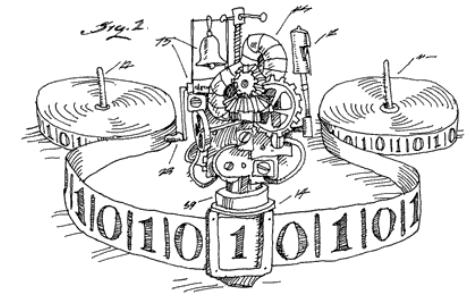
reflecting on societal drivers for software and algorithm design



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30 September 2020



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Standard Disclaimer

- ❑ These are my views, informed by my research.
- ❑ I am a Computer Scientist, so please forgive any gross simplifications or interpretations of aspects that are not Computer Science.

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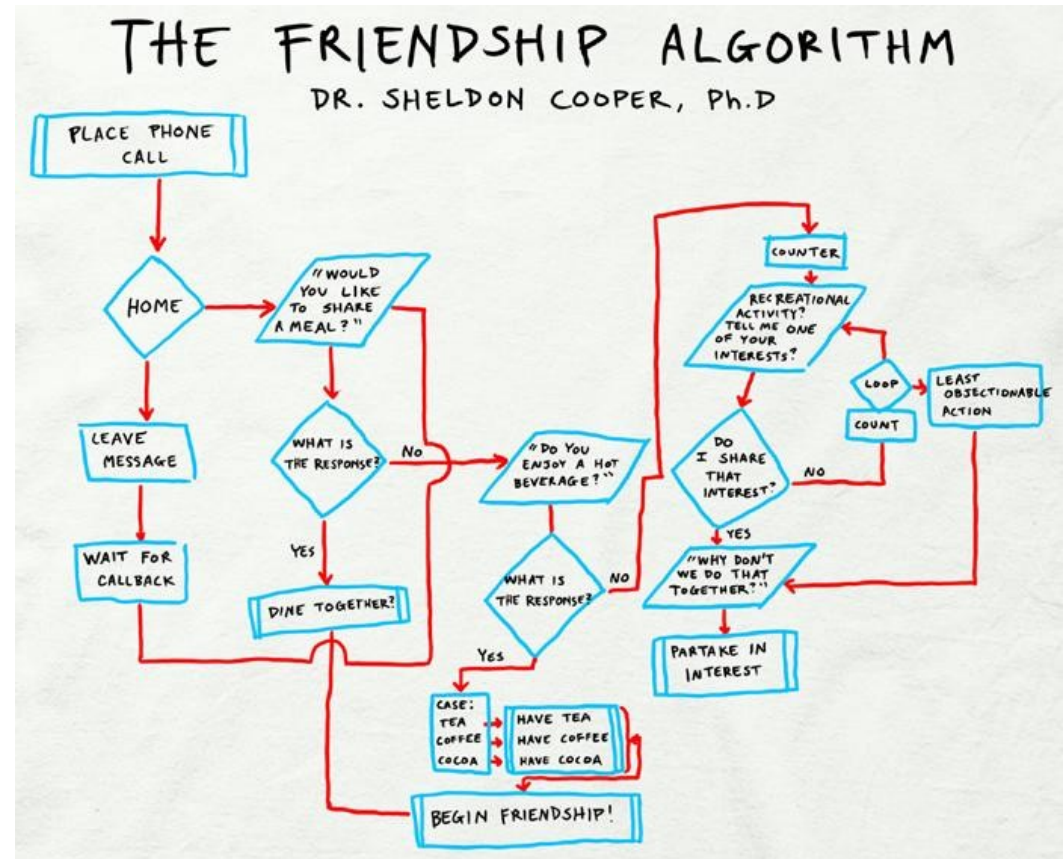
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Computer Science and ICT4D

What is Computer Science

- Design of algorithms
- Efficient algorithms



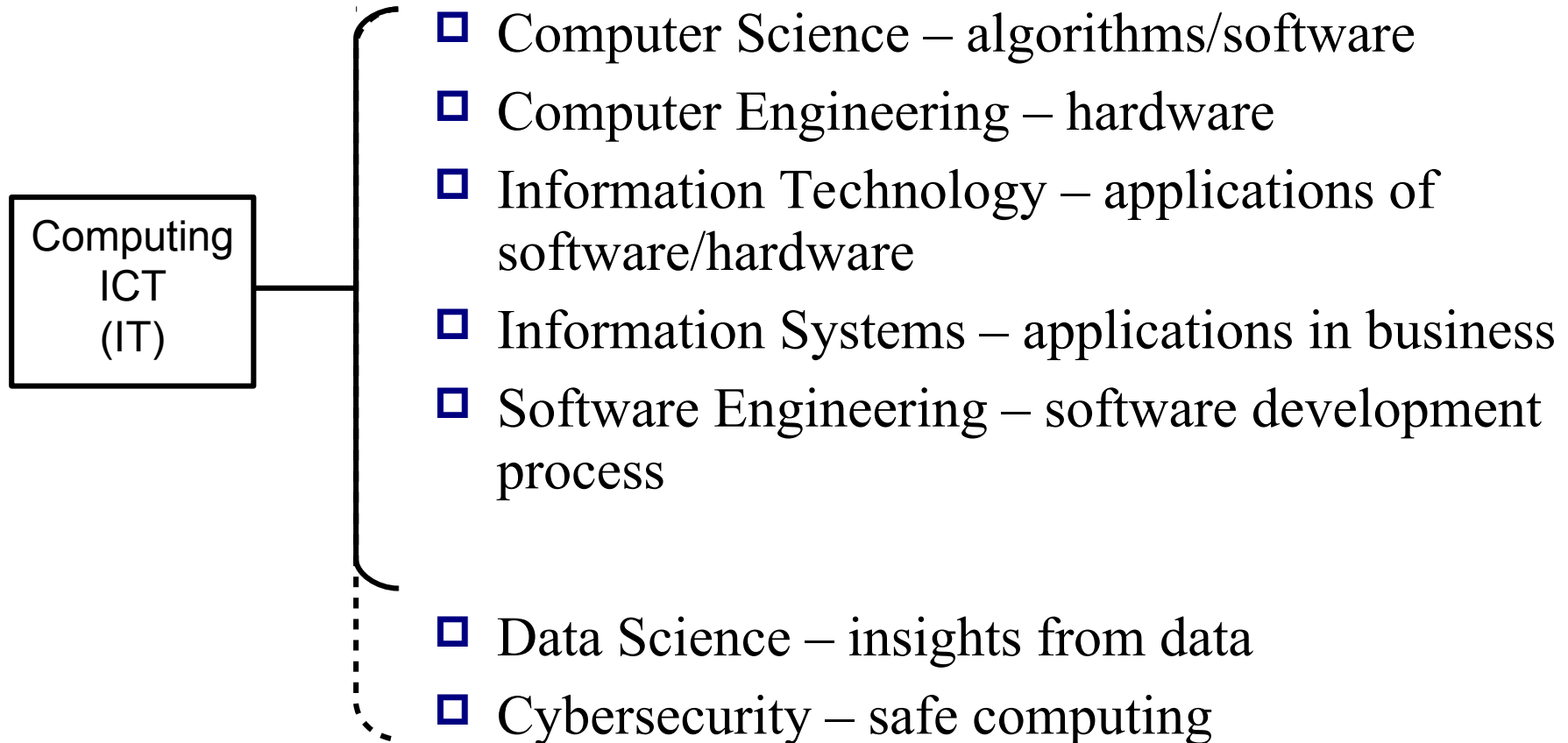
What is Computer Science

□ Design of software/programs

```
I A counter.pl (perl) $hostname Row 32 Col 1 11:15 Ctrl-k
# set up output flushing
$| = 1;

# parameter parsing
$_=$ENV{'QUERY_STRING'};
@parray=split (/[=&]/);
foreach (@parray)
{
    s/\+/ /g;
    s/\n//g;
    s/%[0-9A-F][0-9A-F]/sprintf("%c", hex (substr ($&, 1)))/ge;
    while (substr ($_ , 0, 1) eq ' ')
    { $_ = substr ($_, 1); }
    while (substr ($_, length ($_)-1, 1) eq ' ')
    { chop $_; }
    $_ = lc ($_);
}
%qarray=@parray;
$hostname=$ENV{'SERVER_NAME'};
```

ICT/Computing Disciplines



ACM (2005) *Computing Curricula 2005*, ACM. <https://www.acm.org/education/curricula-recommendations>

What is a Crisis

Who \ When	Some times	All the time
Some people	Conflict, Famine, Natural Disaster	Poverty
Most people	Pandemics, World War	Climate Change

Computer Science during a pandemic

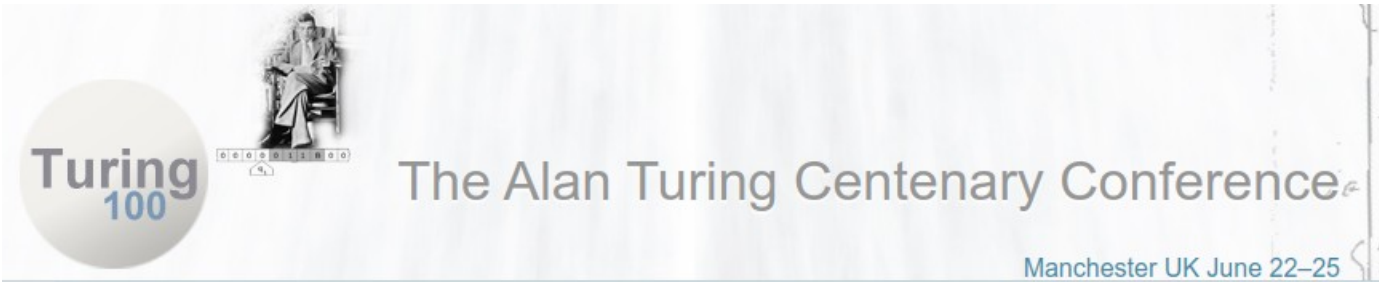
- ❑ Drug discovery – simulations
 - ❑ Contact tracing
 - ❑ Data analysis
 - ❑ Social media analysis
-
- ❑ ... but some problems cannot be solved by Computer Science
 - ❑ ... and some problems cannot be solved on-demand

What about other crises?

- How do we use Computer Science to address:
 - Famine?
 - Climate change?
 - Poverty?
 - Unemployment?
 - Conflict?

- Is this what Computer Scientists should care about?

Turing 100



ICTD 2013 Conference



 UNIVERSITY of the WESTERN CAPE

 **ISD** INSTITUTE FOR SOCIAL DEVELOPMENT

 **IDRC** | **CRDI**
International Development Research Centre
Centre de recherches pour le développement international

 **Canada**



 **ICTD**
CAPE TOWN 2013

Cape Town 7 - 10 December 2013
International Conference on Information and Communication Technologies and Development

A place of quality,
a place to grow, from hope
to action through knowledge

United Nations



SA National Development Plan 2012-2030

- ❑ The creation of jobs and the development of the economy
- ❑ Development of the economic infrastructure: coal and gas, water, electricity and telecommunications
- ❑ Environmental sustainability and management of environmental resources
- ❑ Development of an inclusive rural economy
- ❑ Regional and international trade
- ❑ Housing and urban/rural planning
- ❑ Education and training
- ❑ Medical care
- ❑ Safety and security
- ❑ Building capacity for a developmental state
- ❑ Fighting corruption
- ❑ Nation building for a unified society



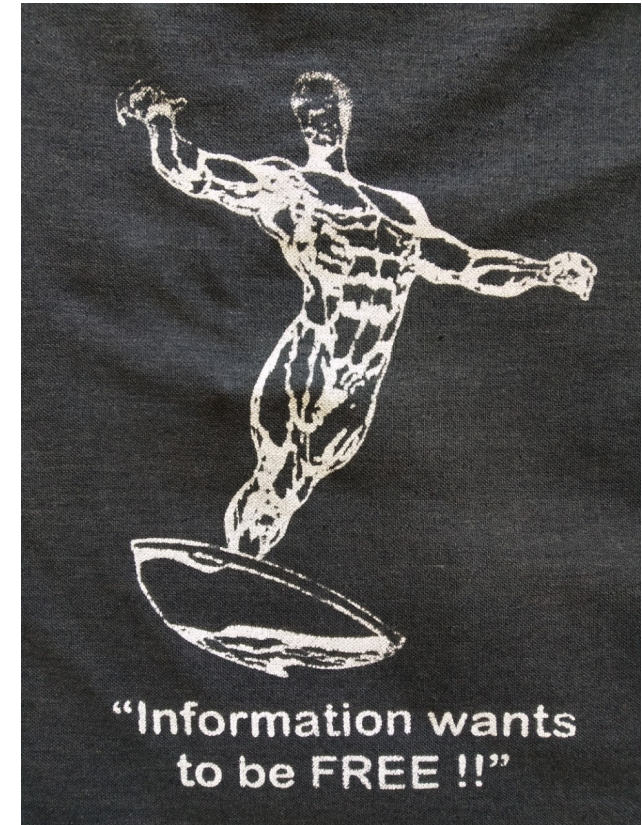
Computer Scientist as Tool Builder / Maker

- ❑ Build the tools for others to solve problems
- ❑ Myth of the Decontextualised Tool
 - We bear no responsibility for its use
 - It is not informed by any specific requirement



What do I think Computer Scientists can do

- ❑ Understand context
- ❑ Enable: Access, Opportunity, Agency
 - Make technology accessible
 - ❑ Mobile devices
 - ❑ Open hardware
 - Make information accessible
 - ❑ Search engines
 - ❑ Digital libraries/archives
 - Education
- ❑ Sen: removal of “unfreedoms”





Digital Archiving Tools

Digital Libraries/Archives 1/2


UCT Computer Science Research Document Archive

<http://pubs.cs.uct.ac.za/>

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Digital Libraries/Archives 2/2

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<http://search.ndltd.org/>

NDLTD Global ETD Search New Search

NDLTD

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Spelling suggestions: "creator:suleiman creator:hussierl type:thesis type:dissertation" "creator:sulene creator:hussierl type:thesis type:dissertation"

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creator:suleman creator:hussien typ

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Publication year

Start year to End year

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- ☐ English 628126
- ☐ En_us 261883

1 **Open Digital Libraries**
Suleman, Hussein 26 November 2002 (has links)

Digital Libraries (DLs) are software systems specifically designed to assist users in information seeking activities. Stemming from the intersection of library sciences and computer networking, traditional DL systems impose library philosophies of structure and management on the sprawling collections of data that are made possible through the Internet. DLs evolve to keep pace with innovation on the Internet so there is little standardization in the architecture of such systems. However, in attempting to provide users with the highest possible levels of service with the minimum possible effort, many systems work collaboratively with others, e.g., meta-search engines. This type of system interoperability is encouraged by the emergence of simple data transfer protocols such as the Open Archives Initiative's Protocol for Metadata Harvesting (OAI-PMH). Open Digital Libraries are an extension of the work of the OAI. It is proposed in this dissertation that the philosophy and approach adopted by the OAI can easily be extended to support inter-component interaction within a componentized DL. In

Read more

open archive component system architecture digital library interoperability protocol

2 **Genetic Programming in Mathematica**
Suleman, Hussein 01 1900 (has links)

GP has traditionally been implemented in LISP but there is a slow migration towards faster languages like C++. Any implementation language is dictated not only by the speed of the platform but also by the desirability of such an implementation. With a large number of scientists migrating to scientifically-biased programming languages like Mathematica, such provides an ideal testbed for GP. In this study it was attempted to implement GP on a Mathematica platform, exploiting the advantages of Mathematica's unique capabilities. Wherever possible, optimizations have been applied to drive the GP algorithm towards realistic goals. At an early stage it was noted that the standard GP algorithm could be significantly speeded up by parallelisation and the distribution of processing. This was incorporated into the algorithm, using known techniques and Mathematica-specific knowledge.

Bleek and Lloyd Collection

<http://lloydbleekcollection.cs.uct.ac.za/>



THE DIGITAL BLEEK AND LLOYD

HOME

This digital publication is part of a Llarec project to digitise, research and publish the Bleek and Lloyd Archive. The Digital Bleek and Lloyd includes scans of every page of the 110 Lucy Lloyd !xam notebooks, 17 Lloyd (mostly) !kun notebooks and 28 Wilhelm Bleek !xam notebooks. It also includes Jemima Bleek's solitary Korana and !kun notebook and four Lloyd Korana notebooks in the Maingard collection of the Library at the University of South Africa, as well as Dorothea Bleek's 32 notebooks. All the drawings and watercolours made by !han#kass'o, Dia!kwain, Tamme, Juma, !nanni and Da are also in the digital collection. The digital archive includes a 280 000-word searchable index, cross-referenced and including notes and summaries for each of the stories listed. Notes in italics are direct quotes from the reports of Bleek and Lloyd in which they detailed the progress of their research.

Llarec (the Lucy Lloyd Archive, Resource and Exhibition Centre) is part of the Centre for Curating the Archive, a University of Cape Town research centre directed by Pippa Skotnes and located at the Michaelis School of Fine Art. The initial "Digital Bleek and Lloyd" accompanied the publication "Claim to the Country: the Archive of Wilhelm Bleek and Lucy Lloyd" by Pippa Skotnes (2007), published by Jacana Media and Ohio University Press. Subsequently Jemima Bleek's and Dorothea Bleek's notebooks have been added, as well as the Digital Stow, featuring the rock art copies of George Stow. The search index and summaries have also been extended and currently the Bleek and Lloyd dictionaries are being digitised. Please refer to the CCA website at <http://www.cca.uct.ac.za> for updates.

The project has been made possible by funding provided by the Andrew W. Mellon Foundation and De Beers; and is the result of the cooperation of the four curating institutions: University of Cape Town, Unisa, Iziko South African Museum and The National Library of South Africa.

These scans of the documents and images that comprise the Bleek and Lloyd archive may not be used or reproduced for any purpose without permission of the copyright holders.

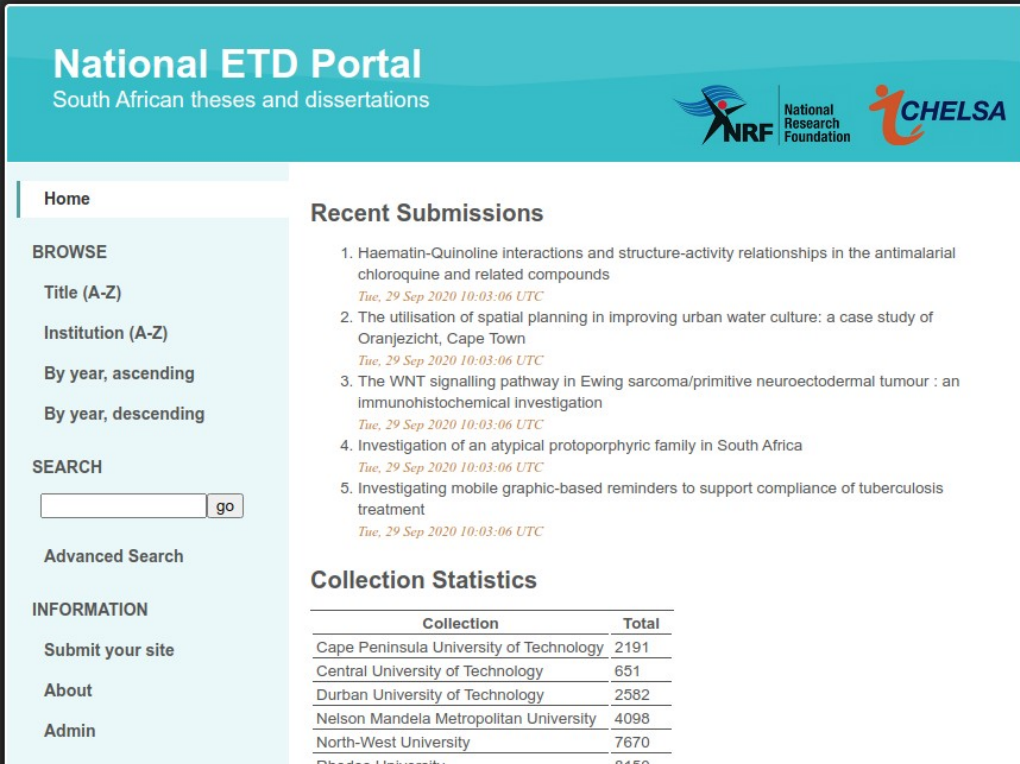


How to Create More Archives

- ❑ “2 million euros and 2 years and we can build any system”
- ❑ Should we host archives in the *cloud*?
- ❑ Can we use free and open source software instead?
(DSpace/AtoM/etc.)
- ❑ Can we develop skills locally?

South African National ETD Project - Vision

- All universities have thesis/dissertation archives.
- Community of skilled staff.
- Internal training.



National ETD Portal
South African theses and dissertations

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Tue, 29 Sep 2020 10:03:06 UTC
3. The WNT signalling pathway in Ewing sarcoma/primitive neuroectodermal tumour : an immunohistochemical investigation
Tue, 29 Sep 2020 10:03:06 UTC
4. Investigation of an atypical protoporphyric family in South Africa
Tue, 29 Sep 2020 10:03:06 UTC
5. Investigating mobile graphic-based reminders to support compliance of tuberculosis treatment
Tue, 29 Sep 2020 10:03:06 UTC

Collection Statistics

Collection	Total
Cape Peninsula University of Technology	2191
Central University of Technology	651
Durban University of Technology	2582
Nelson Mandela Metropolitan University	4098
North-West University	7670
Rhodes University	8150

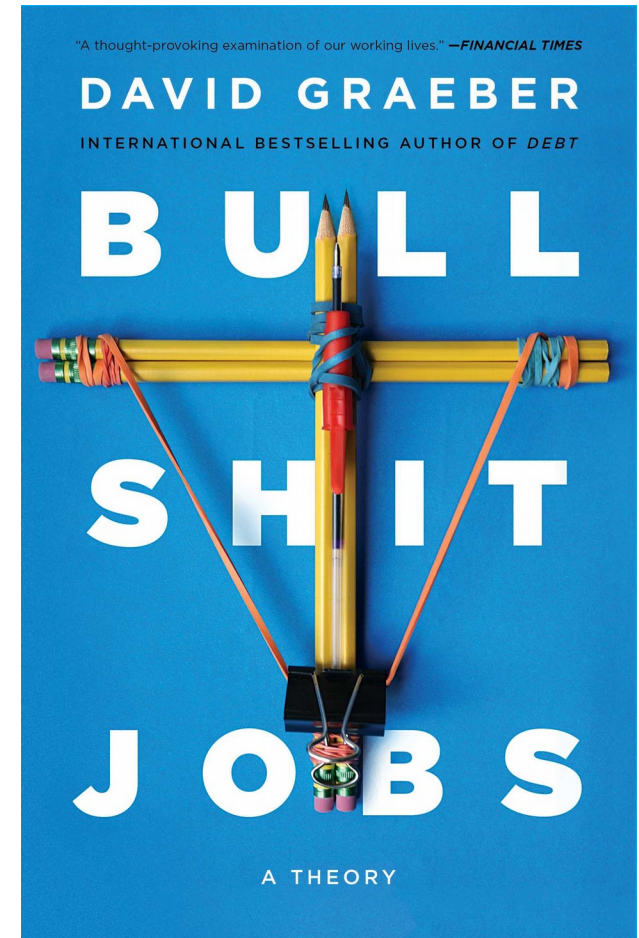
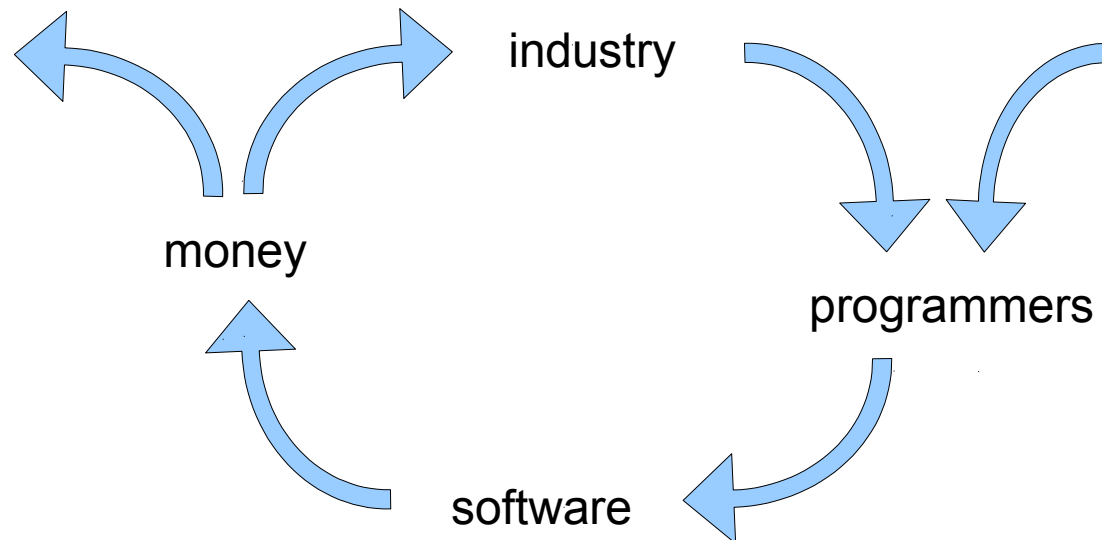
<http://www.netd.ac.za/>

South African National ETD Project - Reality

- ❑ Some staff with **skills** moved on.
- ❑ Some institutions outsourced support to international service providers.
 - Paid in EUR/USD
- ❑ Some places have always had **funding** issues.
- ❑ Some are just hanging in there.
- ❑ NRF no longer supports the project with staff/funds.

Capitalism of Software Development

- “3 programmers and 20 support staff”
- Graeber: half of all software developers have bullshit jobs.



Computer Science without Money

□ The Social Dilemma

- Tech industry focus is on money
- No ethics, no context
- No human-centric values

□ If we remove money:

- Fewer programmers?
- More innovation?
- More societal benefit?



eMandulo

<http://emandulo.apc.uct.ac.za/>

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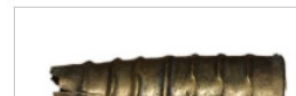
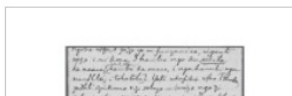


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27 of 37

IT | SCHOOL OF IT

Low-Resource Environments

- Poor countries
 - Most of Africa?
- Specific areas
 - Rural areas all over the world
- Specific organisations
 - NGO/NPOs relying on donor funding all over the world

Principles of Low-Resource Design

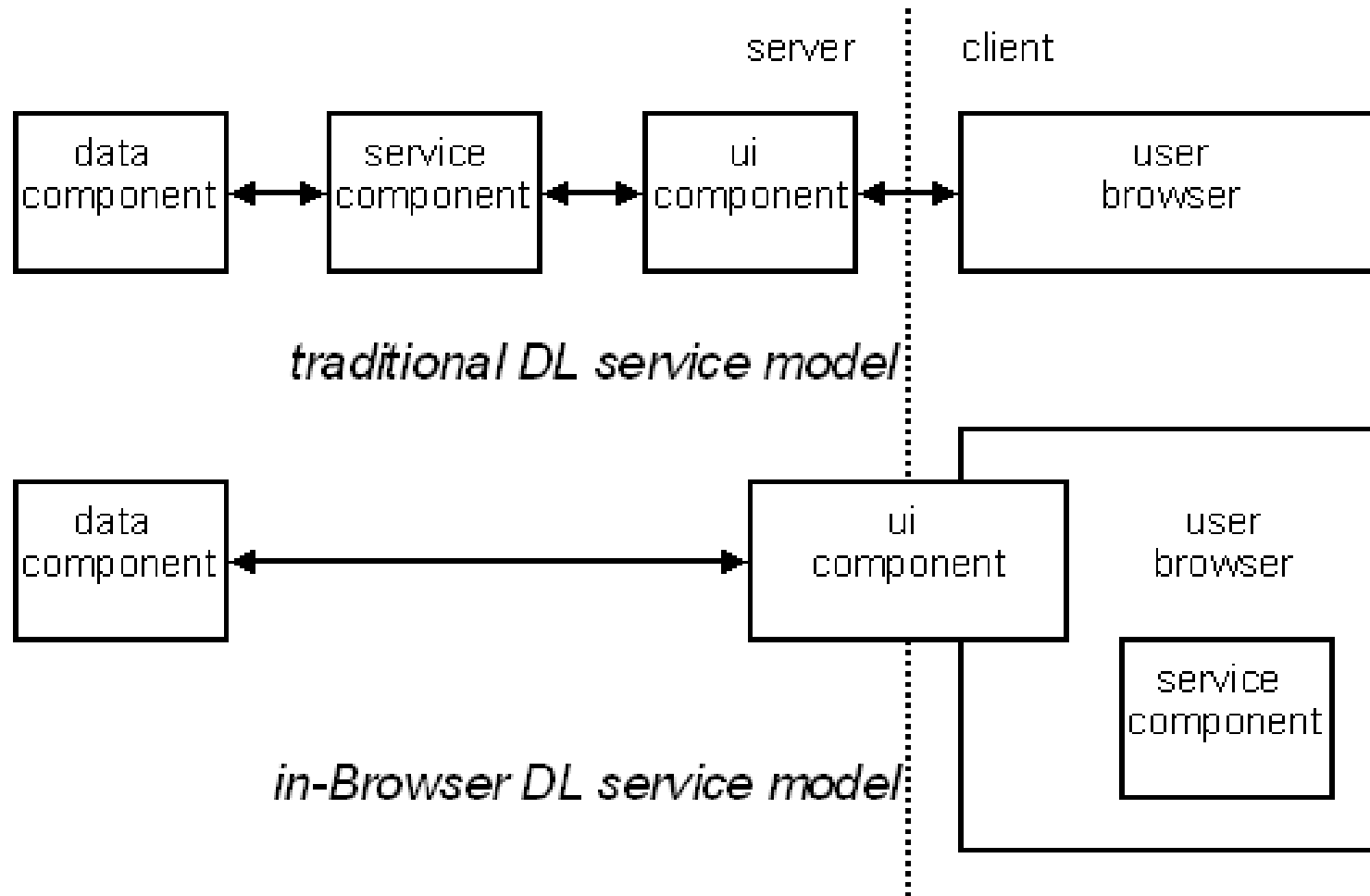
- ❑ Simplicity / Minimalism
- ❑ Flexibility in objects/services
- ❑ Internet or No Internet
- ❑ Simple preservation / rescue
- ❑ Superimposed and hierarchical information
- ❑ All platforms
- ❑ Minimise computation / Pre-processing

Technical Solution: Static Generation

- ❑ Store everything in files.
- ❑ Store files in directories.
- ❑ Generate and store Web pages once.

- ❑ Advantages:
 - Easier to rescue.
 - Easier to backup / copy / migrate.
 - Failure of software does not make data inaccessible.

Technical Solution: in-Browser Services



No-name Software

- ❑ Toolkit to create simple archives.
 - Any suggestions of names will be appreciated.
- ❑ Unfunded project (I work on it when I have time).
- ❑ Based on success of earlier projects (B&L).
- ❑ Experimental but:
 - Can change how we develop systems.
 - Is strongly based on resource constraints.
 - At the very least, it may solve some South African problems :)



Reflections

Reflections on Software/Algorithm Design

- ❑ Algorithm and Software design are fast evolving fields.
 - But too much focus on profit-making.
 - Not enough focus on human values-driven innovation.
- ❑ In low-resource environments, developmental projects suffer the most.
 - Cannot hire skilled staff.
 - No funding.
- ❑ Need to re-align Computer Science with societal needs.
- ❑ One size does not fit all.
- ❑ Context matters.

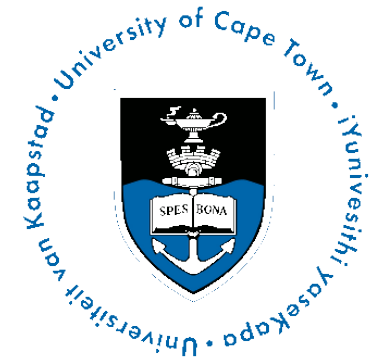
Reflections on Computer Science graduates

- ❑ We cannot feed graduates into the Tech Industry endlessly.
- ❑ Industry is increasingly focused on training.
 - “work-ready” directed training programmes.
 - Less support for critical education in Computer Science.
 - Less support for non-commercial research.
- ❑ If almost none of the graduates we produce can be hired to meet critical societal needs, where does this leave us?

Concluding Remarks

- ❑ More critical Computer Scientists – may reduce the need for so many software engineers.
- ❑ More human and societal focus – going back to our roots and tackling crises now and designing for future crises.
- ❑ More context-sensitive innovation – better algorithms/systems that can benefit everyone in the world.

Thank you for listening!



Questions, comments and suggestions are welcome...

Contact me at: hussein@cs.uct.ac.za

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