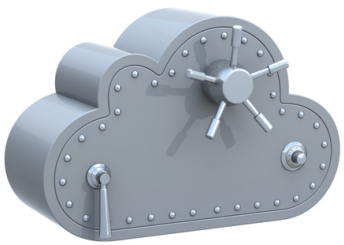


PhD thesis: Integrity issues on the cloud

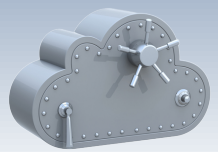
Jakub Muszyński (office E008)

22–23 November 2012

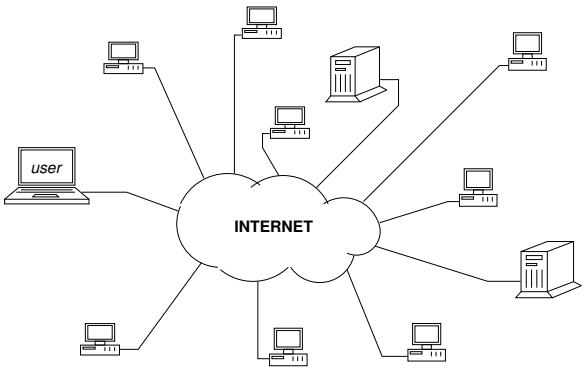
Computer Science and Communications

(CSC) Research Unit

Yes, it's **32** slides! ⇓

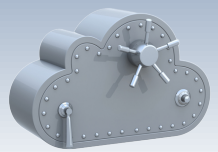


Volunteer Computing (VC) Platforms



- Desktop Grids (DG) or DGVCS
- **Ex:** BOINC
  - ↪ ≈ 2 500 000 users
  - ↪ ≈ 8 000 000 machines
  - ↪ ≈ 7 000 teraFLOPS

- Steal computing cycle from idle computers (the case ≃ 75% of the time)
  - ↪ No guarantees about the security of a given machine
  - ↪ Heterogeneous platform with high volatility
  - ↪ Usually with reward system (credit points, hall of fame *etc.*)



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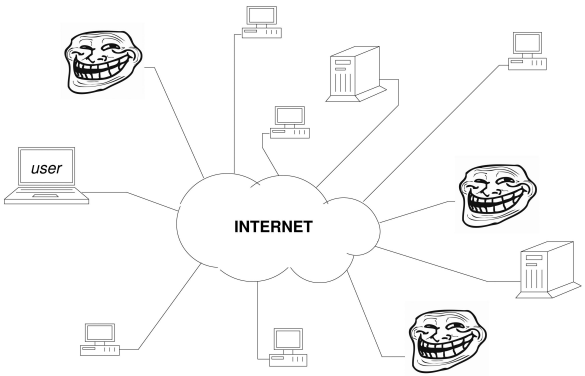

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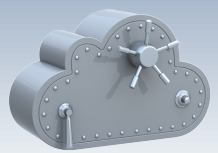
Incentives attract cheaters!

- Seek to obtain rewards with little/no contribution to the system
  - ↪ **Cheating Faults** (*fault by value*) modelled by result falsification



Cheating Faults[1]

- Typically done via software tampering/man-in-the-middle attack
  - ↪ Sub-class of byzantine failures, more complex than **Crash Faults**
- Cheater knows everything
  - ↪ Every cheater wants to be maximally effective in his actions

[Lazy] Cheating Fault Modelisation

- For every task T in the system, exists its cheated version T'
  - ↪ **Prototype of T' unaffected** by cheating (easy to detect)
  - ↪ Result of T' altered **with worst impact** (delay the execution)
  - ↪ **Don't work more at T'** than at T

[1] Introduced in: S. Varrette et al. *Nature inspired Algorithm-Based Fault Tolerance on Global Computing Platforms. Application to Symbolic Regression*. 2008

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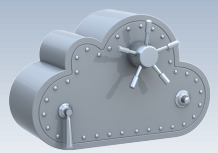

Fault Tolerance strategies

- Generic (*i.e.* algorithm-independent)
  - ↪ Checkpoint/rollback — crash faults
  - ↪ Duplication (result-checking etc.) — crash/cheating faults

Algorithmic Based Fault Tolerance (ABFT)

- Error detection/correction tailored to the algorithm performed
  - ↪ Resilience to byzantine failures producing falsified results.
- **Inherent tolerance of a limited number of faults**
  - ↪ Avoids overhead of checkpoint/restart methods
  - ↪ Mostly applied against **Crash Faults**

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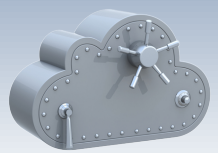
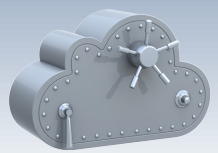


Done

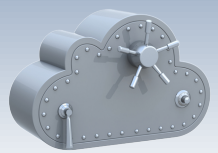
- **Convergence proofs** of dEAs despite crash-faults/cheaters published in [CAMWA12]
  - ↪ Based on Markov chains and transition kernels
- Hash function generation by means of Gene Expression Programming

[CAMWA12] J. Muszyński et al. *Convergence analysis of evolutionary algorithms in the presence of crash-faults and cheaters*. J. of Computers and Mathematics with Applications. 2012

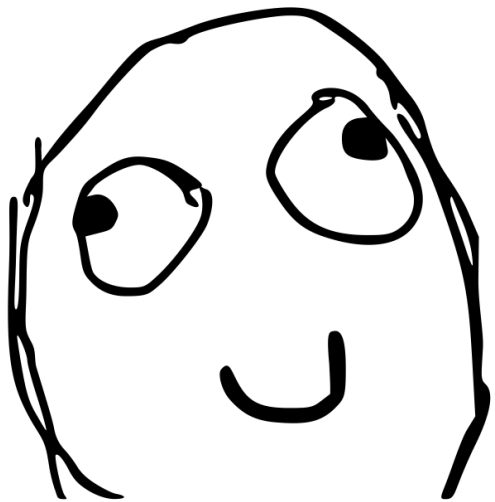


In progress & to do

- **Convergence time** of dEAs in presence of crash-faults/cheaters
  - ↪ Main focus on **distributed cEAs and island models**
    - ↪ Influence of communication topology on the resilience against faults
  - ↪ From **empirical results** to **theoretical proofs**
  - ↪ What is the **impact of faults**?
  - ↪ **Till what threshold** we can ignore them?



Thank you!



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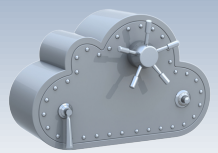

Appendix

DG	Desktop Grids
DGVCS	Desktop Grids and Volunteer Computing Systems
ABFT	Algorithmic Based Fault Tolerance
cEA	cellular Evolutionary Algorithm
EA	Evolutionary Algorithm
UL	University of Luxembourg