

Network Application Diagnostics

B2M32DSA

(Diagnostika síťových aplikací)

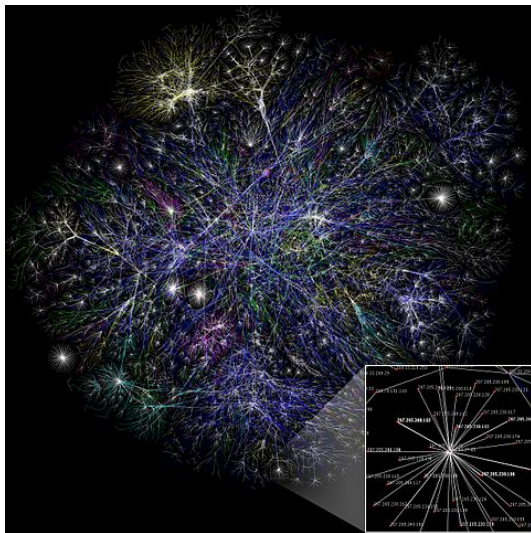
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Internet map in 1995 ^[Bri95]



Synopsis

- Introduction to complex network structures.
- Network characteristics identification.
- Recognition of both structural static and dynamic patterns
- Anomaly detection.
- Specification methods of static and dynamic behavior.
- Model verification.
- Diagnostic process automation.
- Examples dealing with digital network application issues.

Prerequisites

- Knowledge of linear algebra, graph theory, algorithms.
- Knowledge of network application and protocol fundamentals.

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Outline of Lectures

- 1 Introduction to diagnostics, testing, and verification of network applications.
- 2 Fundamental characteristics of networks, models of random graphs.
- 3 Power distribution and preferential linking.
- 4 Network structure identification.
- 5 Community detection.
- 6 Ties prediction and network inference.
- 7 Network dynamics and dynamic network processes.
- 8 Specification system Alloy and its usage for network applications.
- 9 Dynamic behavior specification using timed automata (UPPAAL).
- 10 Specification and verification of protocols using system UPPAAL.
- 11 Checking sequence of finite state machines.
- 12 Finite state machine behavior identification.
- 13 Tools for network testing and diagnostics, automation of processes.
- 14 Diagnostics of network and cloud applications.



Tentative Outline of Seminars

- 1 Student teams creation, development framework setting, basic libraries tutorial, an APSP path searching assignment.
- 2 Variety type graph generation.
- 3 Rich club network nodes identification.
- 4 Computer communication network reconstruction.
- 5 Network partitioning and community detection.
- 6 Communication patterns detection
- 7 Sensor network dynamic assessment.
- 8 Protocol specification and verification using Alloy.
- 9 Dynamic system specification using UPPAAL.
- 10 Protocol verification using UPPAAL.
- 11 State determination using special sequence of finite machines.
- 12 Finite machine reconstruction using active learning.
- 13 Test case design for multilayer network.
- 14 Seminar evaluation.

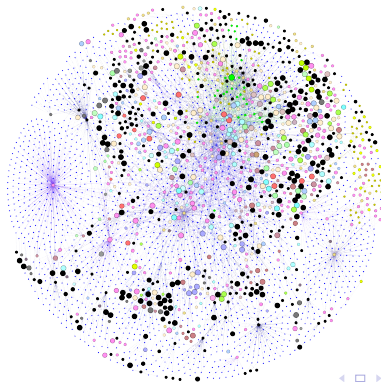
- <https://moodle.fel.cvut.cz/course/view.php?id=2318>
... Moodle, a redirection to CW
- <https://cw.fel.cvut.cz/wiki/courses/b2m32dsa/start>
... CourseWare (CW), BRUTE/Upload
- Seminars (max. 40 points)
- Examination (max. 60 points)
 - a written part, 24 points, 2 problems, 1 hour, accessible resources
 - a written part, 24 points, 4 questions, 1 hour, resources not accessible
 - an oral defense, 12 points

CW Lectures

- [EK10] Networks, Crowds, and Markets: Reasoning about a Highly Connected World, Easley, D., Kleinberg, J.; Cambridge University Press, 2010
- [New10] Networks: An Introduction, M. E. J. Newman, Oxford University Press (2010)
- [Jac06] Software Abstractions - Logic, Language, and Analysis. Jackson, D. MIT Press, 2006
- [Jac14] Alloy, <http://alloy.mit.edu/alloy/>
- [UPP10] UPPAAL, <http://www.uppaal.org/>



- Ancient Egypt society analysis - algorithms
- Complex network analysis applied to telecommunication networks
- Complex network analysis in telecommunication - educative problems preparation
- Protocol formalization and verification



References I

- [Bri95] [Matt Britt](#). Partial map of the internet 1995, accessed 28.1.2014.
http://en.wikipedia.org/wiki/Wikipedia:Featured_picture_candidates/Internet_Map, 1995.
- [EK10] [David Easley and Jon Kleinberg](#). *Networks, Crowds, and Markets. Reasoning About a Highly Connected World*. Cambridge University Press, July 2010.
- [Jac06] [Daniel Jackson](#). *Software Abstractions: Logic, Language, and Analysis*. MIT Press, ISBN 978-0-262-10114-1, 2006.
- [Jac14] [Daniel Jackson](#). Alloy: a language & tool for relational models. <http://alloy.mit.edu/alloy/>, February 2014.
- [New10] [M. Newman](#). *Networks: an introduction*. Oxford University Press, Inc., 2010.
- [UPP10] Tool environment for validation and verification of real-time systems (UPPAAL pamphlet).
<http://www.it.uu.se/research/group/darts/papers/texts/uppaal-pamphlet.pdf>, September 2010.