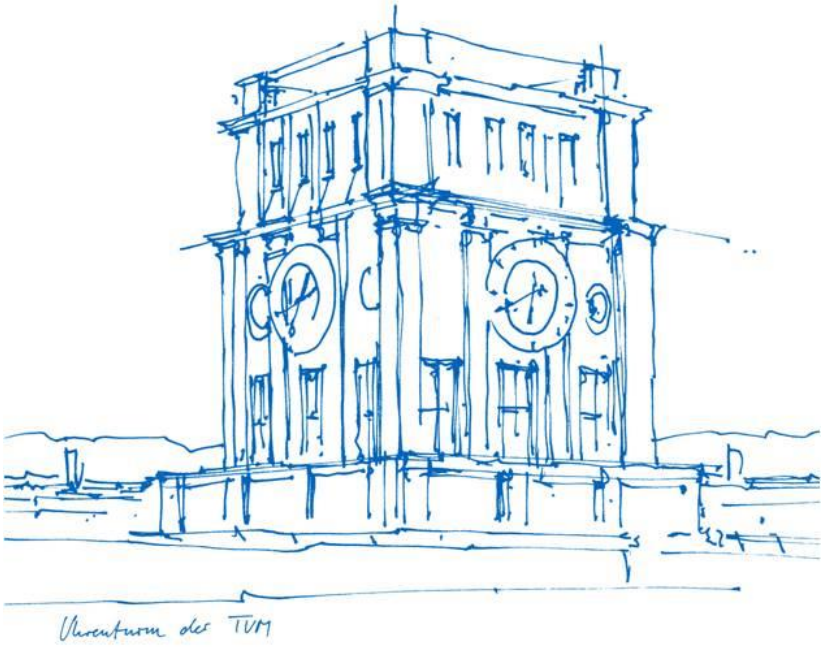
Chair of Network Architectures and Services
Faculty of Informatics
Technical University of Munich

Information Session for the Seminars “Future Internet” and “Innovative Internet Technologies and Mobile Communications”

Prof. Dr.-Ing. Georg Carle and I8 research staff
Organization: Daniel Raumer
Contact: seminar@net.in.tum.de

Challenging Topics!
Sometimes previous knowledge required!



Content

Administrative Things for all Seminars

- Basic Information
- Grading
- Responsibilities

Basic Information

- Lecturer:
  - Prof. Dr.-Ing. Georg Carle

- Organization: seminar@net.in.tum.de (only use this mail address!)
  - Daniel Raumer

- Overview
  - Extent: 2 SWS, (5 ECTS)
    - 5 ECTS * 30 hours = 150 working hours expected from you
  - Course Type:
    - For M.Sc. Students: Master's Seminar (Master-Seminar)
    - For B.Sc. Students: Advanced Seminar Course (Seminar)

- Languages: German and English
  - English only speakers are welcome to join (seminar will be split in two tracks if necessary)

English Only Track

- We offer an English only track if at least one non-German (native) speaker wants to attend the seminar

- The English only track will have separate sessions
  - Probably 1-2 sessions (depending on the number of students)

- Attendance not mandatory for talks in the “standard” track
  - Students in the “standard” track also don’t have to participate in the English track talks
  - You are still welcome to join the other track’s talks ☺

- Usually the English track is quite small
  - This means less attendance (if the opportunity to improve your English is not a good enough incentive for you…)

- This means: if there is an English only track, there are two tracks instead of one. We publish two different schedules. You just have to attend talks listed on your schedule.

Seminar Procedure

Talks and Papers can be in German or English!

- First version of your paper
  - Agree on the content with your advisor
  - Use the supplied paper template from the Moodle course
  - Keep in touch with your advisor
  - Try to finish well in time so you advisor can give you feedback

- Present your topic

- Write reviews
  - You will be given two papers of your fellow students

- Final version of your paper
  - Use the received reviews to improve your paper
  - You will also receive some feedback from your advisor
  - If you and your advisor agree → publication in the seminar proceedings

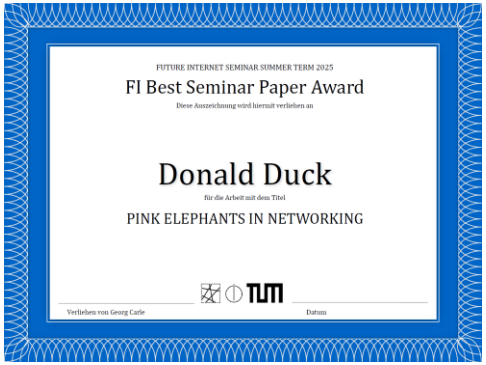
- Paper extent
  - Your paper MUST be 6-8 pages in ACM 2-column style (including references etc.)

Seminar Proceedings

We give the opportunity to publish your papers!
- If both you and your advisor agree
- Proceedings from the last years can be found on http://www.net.in.tum.de/publications/seminar%20proceedings/

Look at old proceedings
- Examples of papers we consider “good”
- Get an idea of the topics we cover

Best Paper Award
- We will choose a best paper in each seminar
- They will receive a certificate and a hardcopy of the proceedings



FI vs IITM

Both seminars offer similar topics
- Again, check the proceedings (link on previous slide)

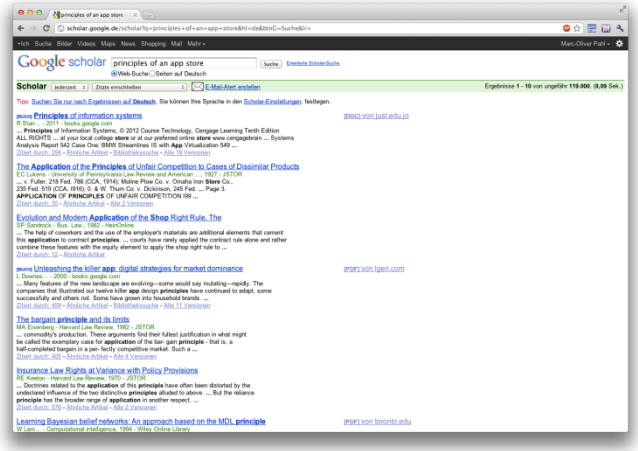
Future Internet
- Topic presentation: Monday, February 26th, 13:00, room 03.07.023
  - This is directly after the matching assignments are published!
- Seminar paper to be written in lecture free time (only few weeks until first version)
- Talks as block in the last week of the lecture free time (likely on April 5th/6th)
- Registration limited to 16 participants

Innovative Internet Technologies and Mobile Communications
- Topic presentation: Friday, April 13th, 14:00, room 03.07.023
- Seminar paper to be written during the semester (until summer holidays)
- Weekly sessions on Friday, 14:00, second half of the lecture time
- Registration limited to 14 participants

Topic Handling

- From your advisor(s) you may receive some literature.
  - This is just to get you started

- Find appropriate (scientific) sources yourself
  - scholar.google.com
  - acm.org
  - ieee.org
  - semanticscholar.org
  - You sources' sources
  - …



*) TUM provides access to non free papers via https://eaccess.ub.tum.de/

Just presenting the given literature is NOT enough

The Advisor’s Role

Advisors created topics within their research context.
→ They have broad knowledge about the context of your seminar topic.

Your task is to do research and write a scientific text about a specific topic beyond basic lecture content.
→ Your advisor is not responsible for your tasks.

Adhering to the deadlines is your responsibility.
→ Your advisor will not remind you.

Advisors will help you if you ask them to.
→ Keeping contact with your advisor allows you to write a much better seminar paper.

Advisor can give you feedback
→ Ask for feedback about your first paper version, the peer reviews, your slides for the talk, etc.

Talk Procedure

Talks and Papers can be in German or English!

- Prepare your talk
  - Finished slides must be discussed with advisor 1 week before the talk
  - Advisors usually offer the opportunity of rehearsal talks

- Present your work
  - Scientific talk; build on knowledge from GRNVS and other basic lectures
  - Do not present your paper; present the main results & give an interesting talk

- Session chair for one talk
  - Introduce the speaker
  - Watch the time constraints
  - Try to get the discussion started after the talk (ask at least one question if nobody else does)

- Mandatory attendance on all sessions in your track
  - If you cannot attend for a good reason contact seminar@net.in.tum.de in advance
  - Attending the talks is mandatory for passing the course (schedule of talks is usually published after the first submission)

Grading

1. Both of your paper submissions (6–8 pages in ACM) (50%)
   - 1st version: 37,5%
   - 2nd version: 12,5%

2. Your talk (20–25min, following discussion and feedback) (25%)
   - Content is graded
   - Personal presentation style is not

3. Your reviews of papers from other seminar participants (25%)

Grading – Influencing Factors (1)

- First version of paper must be acceptable
  - Grade worse than 4.0 → disqualification (seminar graded as 5.0)
  - Less than 6 pages in the seminar template → disqualification

    (Not 5,1 + empty space; Not 8 + references)

- Observe the deadlines
  - Advisor meetings are compulsory
  - Use the upload form on Moodle course page for your submissions
  - 0.3 degrading per day for missed deadlines

Grading – Influencing Factors (2)

- No submission
  - 1st version of paper: disqualification (Seminar graded as 5.0)
  - Other submissions: grade 5.0 for the concerning part

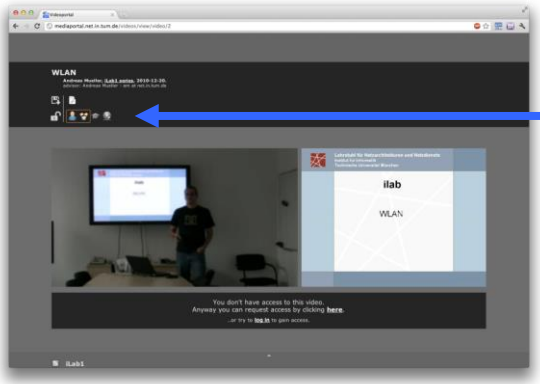
- Write the paper yourself
  - Plagiarism → disqualification (and we will check!)
  - Attempted cheating will be reported to the examination office
  - Summary when and why to cite: http://oxford.library.emory.edu/research-learning/citation-plagiarism/citing.html

- Unauthorized absence during talks
  - 0.3 degrading per missed talk on your presentation grade
  - Talk graded worse than 4.0 → disqualification (seminar graded as 5.0)

Improving Your Presentation Skills

You have the chance to get your talk recorded

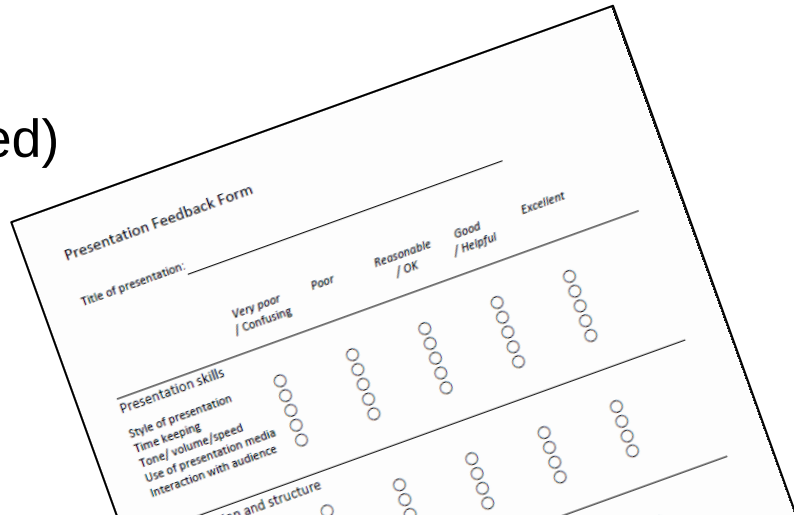
- Have a **look at yourself** after the talk!
- Your talk was great? Share it and show it to your friends.



You fully control the access!
(Initially only you can access it!)

Get feedback from your colleagues (not graded)

- Feedback forms to be filled out during the talks



Registration

Registration is handled centrally on a dedicated web platform

1. You enter your seminar preferences into a dedicated web platform
2. We enter our student preferences
3. The system computes a **student-optimal** matching

- More info: http://docmatching.in.tum.de

If you want to be preferred by us write your matriculation number in the list before you leave.

- We will prefer you for both IITM and FI seminar
- The list is closed after this event!

The result of the matching is binding, i.e. **you cannot step down** from the course afterwards

- Only enter courses that you really want to participate in
- We accept withdrawal only for special reasons

  (e.g. not getting any of your topic preferences)

Matching – Example 1

Your preferences

1. $your_favorite_seminar
2. $i8_seminar
3. $not_so_interesting_seminar

Putting your matriculation number on our list does **not** reduce your chance of being assigned to $your_favorite_seminar

It will however increase your chance of being assigned to $i8_seminar if you can’t be assigned to $your_favorite_seminar

Matching – Example 2

- Preferences Student A
  1. $very_popular_seminar
  2. $popular_seminar
- Preferences Student B
  1. $popular_seminar

Chances of getting assigned (to any course) are not higher for Student B compared to Student A

The Matching System works best **for you** if you honestly enter all your preferences
- Giving same priority to multiple courses is possible

Topics are part of research at our group

- Usually they can be continued as thesis, IDP, guided research, GEP, etc.

- You may have a look at the research areas of our members:
  http://www.net.in.tum.de/members/

- Topics are often continuations of previous seminar topics

- Proceedings from the last years can be found on
  http://www.net.in.tum.de/publications/seminar%20proceedings/

Topics will be assigned according to your preferences similar to the faculty-wide process of seminar matching

- Each topic is unique and moved to the next seminar only if not selected previously
- We aim for +20% topics compared to seats in the seminar

- The following slides show topics that will be offered in the next seminar
  (more topics will be presented in the topic presentation session.

Preview on topics that will be offered in the next seminar

Impact of GDPR on Website Behavior (Quirin)

EU's *General Data Protection Regulation* (GDPR) will impose a drastic set of new rules to protect user privacy.

Your job: Lookat GDPR specifically with website's in mind.

What will websites have to do differently in the future? (E.g. cookies, trackers, third-party-plugins?) How to do have to inform their users? How to store dissent/consent? How to make use possible even with dissent?

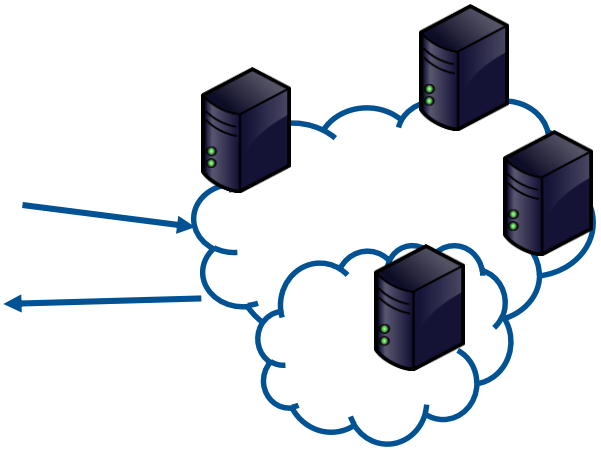
What possibilities does a user have to complain? What sanctions will there be?

Outline:

1) Overview of GDPR and its meaning for web sites
2) Specific changes web site operators have to implement, and how to check those
3) What is the way to complain/sanction?

Secure File Systems for the Cloud (Heiko)

You want to store your data on the Internet.



Secure File Systems

- Tahoe, …

Secure File Systems using Network / Clouds

- DepSky
- Real ones…

Your Task:

- Idea of secure file systems
- How does transfer to networked file systems using Clouds?
- Give an example
- What's real?

[1] Wilcox-O'Hearn, Zooko, and Brian Warner. "Tahoe: the least-authority filesystem." *Proceedings of the 4th ACM international workshop on Storage security and survivability*. ACM, 2008.

{2} Bessani, Alysson, et al. "DepSky: dependable and secure storage in a cloud-of-clouds." *ACM Transactions on Storage (TOS)* 9.4 (2013): 12.

Flow-based Network Monitoring (Simon)

Network flows are sequences of packets between two communication entities, also referred to as end points. Flow monitoring is purposed to identify communicating end points in the network, to detect anomalies in the network traffic and to understand reliability and performance incidents.

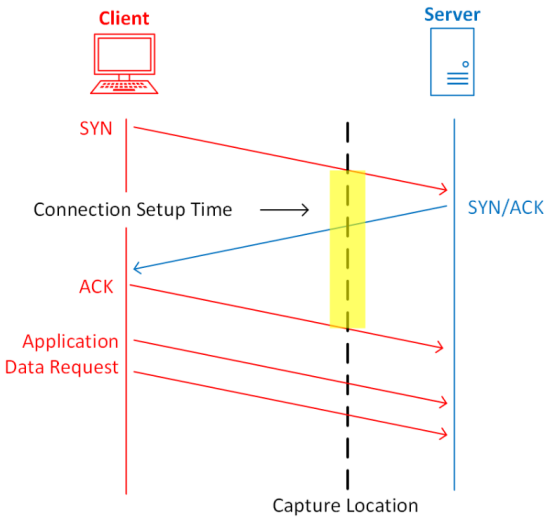
Your task:

- Research existing literature and tools for flow-based network monitoring (e.g. nProbe, ntop, Vermont, …)
- Compare scope and features of considered tools
- Understand required functionality (export, collect, analyse) to process metadata of flows and identify different implementation approaches
- What are problems and weaknesses of flow-based network monitoring (in the future)?

Image: http://www.quartetservice.com/wp-content/gallery/network/Network2.png

Key Performance Indicators of TCP Flows (Simon)

The specification of TCP allows to collect specific metrics and metadata. The processing of collected metadata results in key performance indicators of flows, that are used to assess quality of connections and the state of the network.
A simple example is the time period a 3-way-handshake takes, also referred to as Connection Setup Time.



Your task:

- Research existing literature
- Overview of measurable metrics and metadata
- How to derive KPIs from measured data?
- How do KPIs describe network performance?

Image: https://media.licdn.com/mpr/mpr/shrinknp_800_800/AAEAAQAAAAAAAALDAAAAJDRjN2Y5MTc4LWE0OWItNDE4YS05NWRlLTEwYmQ4MzE3ZDI1YQ.png

Workload Generation for Anomaly Detection (Simon)

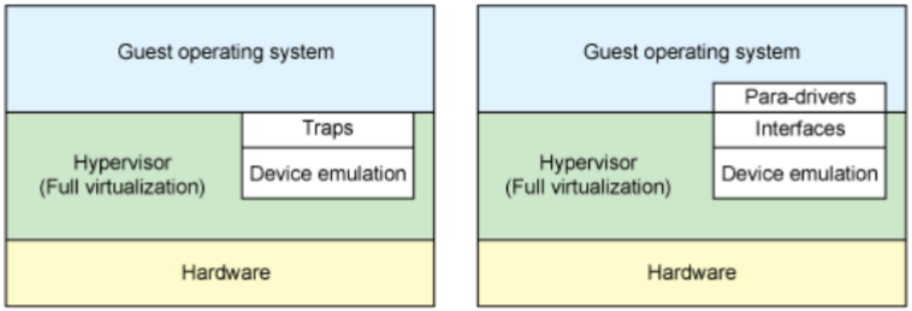
Targeting higher flexibility, usability, and affordability, packet and workload generation has found its way to software.
To benchmark and test anomaly detection and deep packet inspection systems it is required to generate appropriate workload. This concerns traffic payload, used protocols, and traffic distributions/patterns, while generators should be capable to achieve high packet rates.

Your task:

- Research existing literature and workload generation tools (MoonGen, N-Ngen, D-ITG, …)
- Compare supported features and use cases of selected tools
- Identify implementation approaches and assess their pros and cons
- What are limitations of more complex workload generators?

Increasing VM networking performance with virtio

(Paul, Daniel)



Source: M. Tim Jones, "Virtio: An I/O virtualization framework for Linux Paravirtualized I/O with KVM and lguest", 2010

Background/Interest in OS/network driver helpful advised

Your Task:

- What virtio?
- Why virtio?
- How virtio?
- additionally: older/full virtualization and newer/scientific alternatives

Starting Point: Google Deutschland

Recent Activity in P4 (Scholz, Gallenmüller)

Programming Protocol-independent Packet Processing

- Softwareization of the data plane
- **Domain specific language for low-level packet processing**
- Featured on more and more conferences, workshops, summer schools, …
- Extensions, reworks, sample programs, target platforms, …

Your Task:

- P5
- P4-16 and beyond
- Analysis of P4 **hardware implementations**
  - NetFPGA/Verilog
  - Netronome SDK
  - P4FPGA
- **Simulation/emulation** environments
  - Mininet
  - ns-2, ns-3 network simulators
- Applicability to **other domains**
  - Cryptography
  - Quality of Service

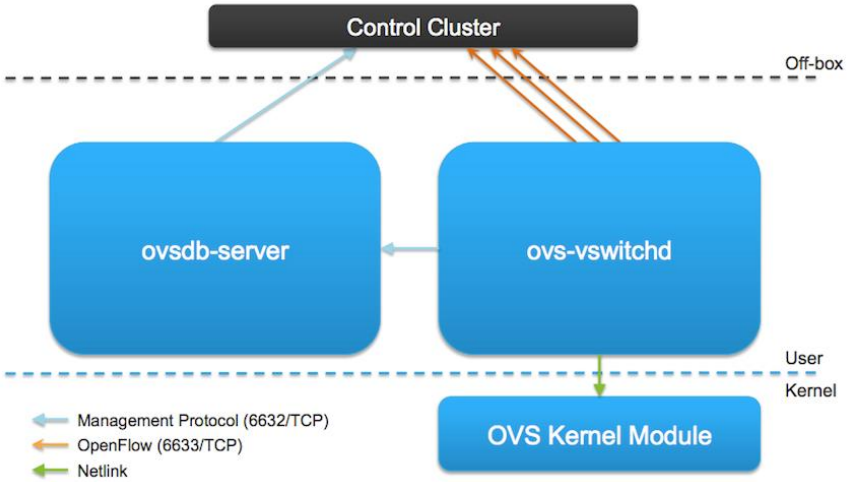
Advanced topic, previous knowledge required (SDN, OpenFlow)!

- http://lists.p4.org/pipermail/p4-dev_lists.p4.org/
- https://github.com/p4lang/behavioral-model
- https://github.com/p4lang/p4-spec
- Dang, Huynh Tu, et al. "Whippersnapper: A P4 Language Benchmark Suite." *Proceedings of the Symposium on SDN Research*. ACM, 2017.
- https://github.com/NetFPGA/NetFPGA-public/wiki/NetFPGA-Developers-Summit-2017
- http://conferences.sigcomm.org/sigcomm/2017/tutorial-P4-NetFPGA.html

In-band SDN with Open vSwitches (OVS) (Sulovic)

Pure SDN architecture assumes decoupling of control and data planes, with all network intelligence centralized in SDN controller. The most commonly used protocol for control channel communication between the SDN controller and network infrastructure is OpenFlow.

Open vSwitch (OVS) is commonly used as an SDN switch. It can establish both, „out-of-band" and „in-band" control channel with the SDN controller.



Your Task:

- Describe the benefits of out-of-band and in-band control plane
- What are the prerequisites for in-band control plane establishment in SDN
  - How is the in-band control plane implemented in OVS
  - Which legacy protocols are used and what is their influence to the overall performance of SDN
- Describe how packets of legacy protocols (i.e., STP) are processed by OVS to bypass OpenFlow processing

Starting point:

[1] Pfaff, Ben, Justin Pettit, Teemu Koponen, Ethan J. Jackson, Andy Zhou, Jarno Rajahalme, Jesse Gross et al. "The Design and Implementation of Open vSwitch." In NSDI, pp. 117-130. 2015.

[2] www.openvswitch.org/

Machine Learning for Networking (Fabien)

Machine learning has shown successful in many computer science tasks (computer vision, NLP), and shows some benefit in various areas of networking:

- Network intrusion detection
- Traffic classification
- Traffic control and routing

Your task:

- ➢ Review existing literature (e.g. [1]) on machine learning techniques applied to networking
- ➢ Understand which areas of networking can benefit from machine learning approaches
- ➢ Select a recent paper and try to *(partially)* reproduce the results

[1] Fadlullah et al., *State-of-the-Art Deep Learning: Evolving Machine Intelligence Toward Tomorrow's Intelligent Network Traffic Control Systems*, 2017, IEEE Comm. Surv.

Machine Learning on Mobile/Embedded Devices (Stefan)

While Machine Learning (ML) has many use cases in traditional/cloud computing it often requires lots of processing power and data input. Going to smaller devices ML is still a relevant technology, e.g. for:

- Typing auto-completion
- Voice recognition
- Camera optimization
- …

Your task:

- ➢ Research existing literature for ML on mobile devices
- ➢ Describe potential use cases for mobile ML.
- ➢ Understand what the relevant differences between running ML algorithms on mobile devices compared to powerful servers are
- ➢ Select one or more example frameworks and explain how they are optimized for mobile devices (e.g. Tensorflow vs tensorflow lite [1])

Background in Machine Learning is beneficial but not required

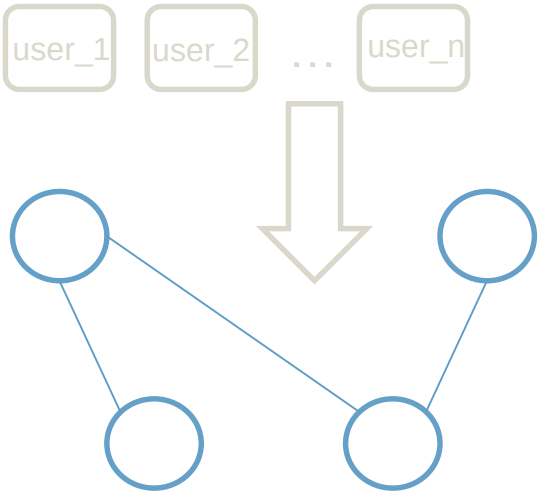
[1] Google Tensorflow white papers https://www.tensorflow.org/about/bib

Resource management with learning algorithms

(Cora)

Recent works [1] have shown that learning algorithms can be used to

- Decentralise network resource management
- Dynamically and opportunistically allocate resources depending on demand
- Improve maximum number of network requests



Your Tasks:

- Get familiar with network resource management and Q-learning
- Find related work (e.g. using different algorithms). How does it compare to the results presented in [1]?
- What are the advantages of using learning algorithms compared to traditional methods?
- What limitations are there to the proposed approach? How could these be remedied?

[1] R. Mijumbi, J. L. Gorricho, J. Serrat, M. Claeys, F. De Turck and S. Latré, "Design and evaluation of learning algorithms for dynamic resource management in virtual networks," *2014 IEEE Network Operations and Management Symposium (NOMS)*, Krakow, 2014, pp. 1-9.

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