Today: Kick-Off Meeting 20-April-2016

Hauptseminar Website:
http://st.inf.tu-dresden.de/teaching/hs/auco16
Definition [1]:

A type of computing model in which the system is self-healing, self-configured, self-protected and self-managed (self-* properties).

An autonomic computing system functions with a high level of artificial intelligence while remaining invisible to the users.

The autonomic computing system operates autonomically in response to the inputs it collects and processes.

http://www.webopedia.com/TERM/A/autonomic_computing.html
Definition [2]:

Application of advanced technology to the *management* of advanced technology

[IEEE]
«The prime goal of autonomic computing is to enable computing systems to autonomously deal with (unpredictable) change, so as to fulfill the objectives they were constructed for»

Kick-Off Meeting Schedule:

Part 1: Seminar Organization

Part 2: «Autonomic Computing»: Introduction

Part 3: Principles of a good paper

Part 4: Principles of a good presentation
Part 1: Seminar Organization
What the Participants will learn:

1. Do focused research in a specific area («Autonomic Computing»)
2. Author a **good** paper
3. Learn (or perfect) the use of TeX®
4. Experience the peer-review process
5. Hold a **convincing** presentation
6. Broaden your perspective in Information Technology
Select topic:
- Autonomic architectures
- Future applications
- Impact

Vision & Mission statement

Draft 1 Paper

Draft 2 Paper

Final Paper

Kick-Off Lecture (1 DS)

Seminar 1 (1 day)

Seminar 2 (1 day)

Present Paper

Present Paper

Proceedings Volume (electronic, PDF)

Peer Review

Peer Review

Peer Review
**Formats:**

Paper: LaTeX  
Presentation: Powerpoint

Please use the **Template:**

“Springer LNCS” for your paper.

Downloadable from:

ftp://ftp.springer.de/pub/tex/latex/llncs/latex2e/llncs2e.zip

[last accessed: 05.03.2015]
[1] The seminal work:

[2] Introduction to the Architecture:

[3] The fundamental knowledge:
Kick-Off Meeting (Introduction): Wednesday, **April 20**, 2016 / 11:10 – 12:40 in APB/INF 2101


More information at (TUD HS Website):
http://st.inf.tu-dresden.de/teaching/hs/auco16

**Hauptseminar limited to 7 participants**
Hauptseminar SS 2016: «Autonomic Computing»

**Seminar:**
- We learn and work together
- We support each other
- We produce a common proceedings volume

Guidance
This seminar will work on the central question:

Which are the state of the art, the promises, and the impact of Autonomic Computing?

Each participant chooses one of the 3 topics:

Q1: Which are the promising software architectures and software technologies for Autonomic Computing?

Q2: How does Autonomic Computing enable future applications?

Q3: What is the impact of Autonomic Computing on people, work and society in 2025?
Part 2: «Autonomic Computing»

Introduction
A type of *computing model* in which the system is self-healing, self-configured, self-protected and self-managed (self-* properties).

An autonomic computing system functions with a high level of *artificial intelligence* while remaining invisible to the users.

The autonomic computing system *operates autonomically* in response to the inputs it collects and processes \( \leftarrow \) *interaction with the physical world.*
Fact:

... our dependency from **software** is nearly total!
Hauptseminar SS 2016: «Autonomic Computing»

e-Commerce
(Internet-Shopping)

On-Line Banking
(Financial Transactions)
Computerized Flying

Autonomous Vehicles

http://www.airlinereporter.com

http://www.motorauthority.com
Chirurgical Robots

Military Equipment
Hauptseminar SS 2016: «Autonomic Computing»

... and much, much more!
What is the Problem?

Problem 1: Growing Complexity of the Software

Problem 2: Increasingly Disruptive Environment
Problem 1: Growing Complexity of the Software

**Complexity Measures:**
- # of elements/# of relationships
- SLOCs (Source lines of code)
- # of applications
- # of network connections
- Functionality: # of FPs, UCPs
- ...
Problem 1: Growing Complexity of the Software

**Consequences/Risks of Complexity:**
- Much more effort for specification/design/testing/implementation
- Higher risk of functional and non-functional misbehaviour
- Difficult configuration-operation and error/fault-handling
- Complicated fault propagation chains
- Increasing dependency on external parties
- Bad emergent behaviour
- ...
Problem 2: Increasingly Disruptive Environment

- Malicious Activity
- Operating Mistake
- Communications Fault
- Network Failure
- Infrastructure Malfunction
- Partner Unavailability
- Resource Failure
- Interface Discrepancy
Resilience

Incident

Crash

Degraded operation

Malfunction

You CAN DO THIS!
The Big Question Today:

Can we humans successfully cope with these trends?
Can we humans successfully cope with the trends of:
- increasing complexity
- raising importance
- accelerating threats & risks

? 

... we will need the support of intelligent machines
⇒ of the software itself!
... we will need the support of intelligent machines

⇒ of the software itself!

Paul Horn, IBM, 2001
A type of computing model in which the system is self-healing, self-configured, self-protected and self-managed

⇒ self-* properties

= One approach to the engineering of software systems
Autonomic Computing: Convergence of Information Technology and Biology

The Autonomic Nervous System Monitors and Regulates:

Without requiring our conscious involvement - when we run, it increases our heart and breathing rate
Autonomic Computing (IBM Concept 2001)

Basic idea: Enable the software for self-defense
Definition:
An autonomic system configures and reconfigures itself in order to adapt to various, possibly unpredictable conditions, so as to continuously meet a set of business objectives.

Examples: Integration of new autonomic elements or reconfiguration of the run-time system (number of elements and topology)
USB was designed to standardize the *connection* of computer peripherals (including keyboards, pointing devices, digital cameras, printers, portable media players, disk drives, storage, network adapters, …) to personal computers, both to *communicate* and to supply electric power.
Auto-configuration or *self-configuration* is the automatic configuration of devices without manual intervention, without any need for software configuration programs or jumpers.

Auto-configuring devices just "**plug and play**".

When plugged in, the computer automatically **recognizes** a new device, loads new drivers for the hardware if needed, and begins to **work** with the newly connected device.
Definition:
An autonomic system detects, diagnoses and recovers from routine or extraordinary **problems** while trying to minimize service **disruption**

Examples: Identify and enable alternate resources, download software updates, restart failed elements, request human assistance, eliminate faulty elements
Self-Healing

Internet-Routing
Dynamic routing attempts to solve failure problems by constructing routing tables automatically, based on information carried by routing protocols, allowing the network to act autonomously in avoiding link and node failures and blockages.

**Failure:** Step 1 = Immediately select new path (no packet loss),
Step 2 = Repair ("heal") faulty element (may need human intervention)
Definition:
An autonomic system anticipates, detects, identifies and protects itself from internal and external threats, in order to maintain quality attributes, such as security, integrity, availability, safety, ...

Examples: Identify and enable alternate resources, download software updates, restart failed elements, request human assistance, eliminate faulty elements, neutralize malicious activities
For any given *software vulnerability*, the lengthy time window from initial bug report to widespread patch deployment puts cybersecurity analysts at a significant *disadvantage*.

In many cases a *race* ensues between miscreants intending to exploit the vulnerability and analysts who must assess, remediate, test, and deploy a patch before *significant damage* can be done.
DARPA has launched the **2016 Cyber Grand Challenge**: a competition that seeks to create automatic defensive systems capable of reasoning about flaws, formulating patches and deploying them on a network in real time.

By acting at *machine speed* and scale, these technologies may someday overturn today’s *attacker-dominated status quo.*
Definition:
An autonomic system continuously seeks ways and sizes opportunities to *improve its operation* with respect to multiple, possibly conflicting, *criteria*

Examples: Improve and maximise quality of service, performance, power consumption, resilience, etc.
Self-Optimizing

Response Time

Power

Hauptseminar SS 2016: «Autonomic Computing»
Self-Optimizing

Reponse Time

Power

$\tau_{\text{max}}$

$t$

$t$
How do we construct Autonomic Systems?

We need expertise from many fields:
- Software engineering
- Systems engineering
- Control theory
- Artificial intelligence
- Machine-learning
- Multi-agent systems

Foundation = Architecture!
**Foundation = Architecture**

**IT Architecture Definition:**

“The fundamental *organization* of a system embodied in its *parts*, their *relationships* to each other and to the environment, and the *principles* guiding its design and evolution”

[IEEE]
Autonomic System Reference Architecture

- **Sensors**
  - Managed Elements (Programs, ...)
- **MONITOR**
- **Knowledge**
- **ANALYZE**
- **PLAN**
- **EXECUTE**
- **Actuators**
- **Effectors**

- **Autonomic Manager**
- **Cyber-Physical World**
- **Autonomic Loop**
Control Objective

Controller

ANALYZE -> PLAN

MONITOR

EXECUTE

Autonomic Loop

Feedback Loop

Sensors

Effectors

Actuators

Plant

Managed Elements (Programs, ...)

Cyber-Physical World
Each participant choses one of the 3 topics:

Q1: Which are the promising software architectures and software technologies for Autonomic Computing?

Q2: How does Autonomic Computing enable future applications?

Q3: What is the impact of Autonomic Computing on people, work and society in 2025?
Q1: Which are the promising software architectures and software technologies for autonomic computing?
MAPE-K: IBM Reference Architecture

- **Monitor** – Analyze – Plan – Execute

**Application specific AC-architecture**

**Artificial Intelligence Technologies:**
- Modeling
- Reasoning
- Data Analysis
- Machine Learning
- Agent systems
- Inference
- Control theory
- **...**
Q2: How does autonomic computing enable future applications?
Examples:

• Run-time models for Self-Managing Systems and Applications
• Autonomic Network Management
• Real-time defense against malicious activities (virus, ...)
• Self-optimizing systems, e.g. energy, safety, security, ...
• ...
Q3:
What is the impact of autonomic computing on people, work and society?
[Time horizon: 2025]
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Impact?

New autonomic application

Work

People

Society
An Autonomic Computer may take Decisions – based on its Artificial Intelligence
Example: Impact on people, work and society

Autonomic Application \hspace{1cm} Decision \hspace{1cm} Impact

Part 3: Principles of a Good Paper
A good paper has:

- A *valuable* message that will be *remembered*
- A *pleasurable* experience while reading it

http://florian-ultra.de

http://gibloemfontein.sites.caxton.co.za
Key element = An interesting, consistent and complete storyline

1. Storyline
   - Context
   - Vision
   - Mission
   - Focus
   - Material/body
   - Message

2. Paper
   - Title
   - Abstract/summary
   - Introduction
   - Existing work, state-of-the-art
   - Chapters
   - Conclusions, Recommendations
   - References

Logical, seamless sequence of ideas
Storyline:

- **Context**
- **Vision**
- **Mission**
- **Focus**
- **Material/body**
- **Message**

**What we want to achieve**

„... how do we see an improved world“  
(State [Utopia])

**What we want to do**

„... how do we improve the world“  
(Action [Way to ...])

**Example:**

Modern individual traffic
VISION

The vision is to keep traffic fluid, efficient and with low rates of accidents.

One promising approach is to support – or even replace – the drivers by electronic driving assistance systems.

Clear and comprehensive statement of the long-term goal
⇒ Vision Statement
This paper demonstrates the feasibility and implementation of one important electronic driving assistance system.

We present and discuss the sensor-based collision-avoidance systems.

Many such systems are under development - some of them can even be found in modern production cars.

Our target audience are graduate students in mechanical, electronics and computer science.

Precise statement of the work

⇒ Mission Statement
### Storyline:

<table>
<thead>
<tr>
<th>Context</th>
<th>Vision</th>
<th>Mission</th>
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<th>Material/body</th>
<th>Message</th>
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</table>

#### CONTEXT

Individual traffic using trucks and private cars forms an important element of our economy and of our individual life-style.

In the last decades the amount of traffic has increased considerably.

The results are daily congestions and higher accident rates.

They cause significant damage to the economy and to our individual mobility.
FOCUS

Sensor-based collision-avoidance systems is a wide field of research.

It encompasses sensor-, software-, image processing- and safety engineering.

We focus on one specific system: The system developed by Mercedes-Benz which can be found in most of their current production cars.

We explain its architecture, functionality, features and limitations.
<table>
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<th>Storyline:</th>
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**Restrict, restrict, restrict!**

**Organize, organize, organize!**

**Avoid all unnecessary concepts.**

**Establish a clear state-of-the-art, of prior work and of relevant references.**

This paper has demonstrated the great value of collision-avoidance systems. Such systems could greatly be improved by using real-time environmental information. Therefore, research should continue into car-to-car and car-to-infrastructure communications.
The **content** of your paper is:

- **correct**
- **precise**
- **clear**
- **brief**
- **ethical**

Your material must be free from error and in accordance with facts

- If it is vague, it is not scientific writing
- If it is unclear or ambiguous, it is not scientific writing either
- If it is long-winded and unnecessarily discursive, it is poor scientific writing
- Fair, truthful, respectful, references, copyrights, …
Many terms are highly ambiguous, context-dependent, author-dependent, time-dependent etc.

System, element, module, component, domain, ...

Term „Human“ [Definition]:
We are bilaterally, symmetrical, sexually differentiated bipeds located on one of the outer spirals of the Milky Way, capable of recognising the prime numbers …

[NASA Deep Space Probe]
Clear is more important than brief

Acronyms and abbreviations are poison for the reader
⇒ Avoid them (whenever possible)
If necessary, introduce them (1x or 2x) at the beginning:

„This paper introduces the concept of System-of-Systems (SoS)“.
An SoS ...

The vehicle can be seen as an SoS, with many CS, such as ABS, ESC, BA and possibly a CAS.
Part 4: Principles of a Good Presentation
Principle 1: **Understand** your audience

- Background?
- Prior Knowledge?
- Expectations?
- Reason for attendance?

Tailor your presentation to the background and needs of your audience
Principle 2: **Key Message**

What is your message?

Why is it important?

What does it mean to your audience?

What do you want them to remember?

The key message is the continuous focus of your presentation.
Example: Thorium Nuclear Energy

Audience: YOU!

• **Background:** mathematical-physical-engineering education
• **Prior knowledge:** basic nuclear physics
• **Expectations:** Possible solution to world’s energy problem?
• **Reason for attendance:** critical assessment, gain of knowledge

Key message:

«THORIUM – The Green Energy Source of the Future»

Richard Martin: *Superfuel – Thorium, the green energy source of the future.*
Illustrations/pictures
Animations
Personal style

- emotion
- feeling
- provocation

Paper ⇔ Presentation?

http://www.thanod.com
Illustrations/pictures
Animations
Personal style

Cloud Definitions:

Software as a Service (SaaS)
Platform as a Service (PaaS)
Infrastructure as a Service (IaaS)

Don’t overdo it!
Hauptseminar SS 2016: «Autonomic Computing»

- Illustrations/pictures
-Animations
-Personal style

- relate to your audience
- be highly present
- be strongly engaged

http://dailygrail.com
Elements of a bad presentation:

- Small (< 22 pt) or unreadable fonts
- Too dense slides
- Few illustrations, pictures
- Excessive animations
- (Extensive) use of bullet point lists
- Unclear message, bad storyline
- Introduction of superfluous concepts
- … and some more

Garr Reynolds: Presentation ZEN – Simple Ideas on Presentation Design and Delivery.
Elements of a bad presentation:

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- … and some more

Garr Reynolds
Presentation ZEN – Simple Ideas on Presentation Design and Delivery.

http://img.galerie.chip.de
What is the sure death of a good presentation?

Time overrun!
Next Steps
Please send an e-mail to: frank.j.furrer@bluewin.ch confirming your participation and state:

- Full name
- Reason for attending
- Studiengang

Latest Saturday, April 23, 2016 – Thank you

Hauptseminar limited to 7 participants
### Next Steps

<table>
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<tr>
<td>Select 2 <strong>peer reviewers</strong> from the participants</td>
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<tr>
<td><strong>Note:</strong> All papers will also be reviewed by Dr. F.J. Furrer (as 3(^{rd}) peer reviewer)</td>
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<td>Monday, April 25, 2016</td>
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<tr>
<td>Deliver your <strong>choice of topic</strong> (i.e. Question 1, 2 or 3) and a short <strong>vision/mission statement</strong> to the 2 peer reviewers and to F.J. Furrer</td>
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<td><strong>Note:</strong> Content and structure of the “vision/mission statement” will be explained in the Kick-Off Meeting</td>
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<td>Friday, April 29, 2016</td>
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<td>Feedback from Reviewers</td>
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<td>Friday, May 6, 2016</td>
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<tr>
<td>Deliver 1(^{st}) draft of both your storyline and your paper to your peer reviewers</td>
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### Next Steps

| **1st Seminar Day** | **Wednesday, June 8, 2016: 09:20 – 10:50/11:10 - 12:40 (2. + 3. DS)**  
| **Room APB/INF 2101** |
| Deliver 2\textsuperscript{nd}, improved draft of your paper to your peer reviewers | Friday, June 17, 2016 |
| Feedback from Reviewers | Monday, June 27, 2016 |
| **2\textsuperscript{nd} Seminar Day** | **Wednesday, July 13, 2016: 09:20 – 10:50/11:10 - 12:40 (2. + 3. DS)**  
| **Room APB/INF 2101** |
| Deliver final version of your paper | Latest: Friday August 5, 2016 |
| pdf-volume of collected papers ready | September 2016  
[may be delayed because of TUD procedures] |
## References:

<table>
<thead>
<tr>
<th>Author(s)</th>
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<th>Publisher</th>
<th>Year</th>
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**References:**

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<tr>
<td>Huebscher08</td>
<td>Markus C. Huebscher, Julie A. McCann</td>
<td>A survey of Autonomic Computing — Degrees, models and applications. ACM Computing Surveys (CSUR) Surveys Homepage archive, Volume 40 Issue 3, August 2008. Downloadable from: <a href="https://spiral.imperial.ac.uk/bitstream/10044/1/5738/1/autonomic-computing.pdf">https://spiral.imperial.ac.uk/bitstream/10044/1/5738/1/autonomic-computing.pdf</a> [last accessed 19.3.2016]</td>
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## References:

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<tr>
<td>TTU16</td>
<td>Cloud and Autonomic Computing Center</td>
<td></td>
<td>Texas Technical University (TTU)</td>
<td><a href="http://www.depts.ttu.edu/cac/">http://www.depts.ttu.edu/cac/</a></td>
</tr>
</tbody>
</table>
Contact Details:

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frank.furrer@mailbox.tu-dresden.de
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http://st.inf.tu-dresden.de/teaching/hs/auco16