M.Sc. Program High-Integrity Systems

Program Directors
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HIS Summer Semester 2025

Introduction Topics

Who is who?
The People behind the Program
Department and Examination Board

High-Integrity Systems
Safety Critical Systems (SCS)
Mission and Business Critical Systems (MCS)

Examples
Application Areas

HIS Curriculum
General Structure
Examinations and Credits
Requirements

The People behind the Program

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► Consultation: By appointment via e-mail

The People behind the Program

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The People behind the Program

► Mrs. Dagmar Ruehl, Head of the Secretary's Office: Computer Science

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High-Integrity Systems

Safety Critical Systems

▶ Safety Critical Systems (SCS) are able to endanger
  ▶ **human life**,
  ▶ **health** and
  ▶ the **environment** in case of malfunction or failure!

High-Integrity Systems

▶ Mission or Business Critical Systems are able to endanger the **existence of organisations** in case of malfunction or failure!

High-Integrity Systems

Computer Science Problem

► Main component of High-Integrity Systems:
  SOFTWARE

► Designing and building of High-Integrity Systems is largely
  a **Computer Science Problem**!

High-Integrity Systems

Areas of Application

▶ High-Integrity Systems grow in importance!

▶ Many fields of application for SCS:
- ▶ Aeronautics and space systems
- ▶ Automotive industry
- ▶ Production technology
- ▶ Railroad industry
- ▶ Power generation
- ▶ Medical technology
- ▶ Chemical industry
- ▶ Information Technology
- ▶ . . .

▶ and Mission Critical Systems (MCS)
- ▶ Enterprise Resource Planning
- ▶ Customer Relationship Management
- ▶ Financial Transaction Systems
- ▶ Airline Booking Systems
- ▶ . . .

Familiar Screen

Program Crash
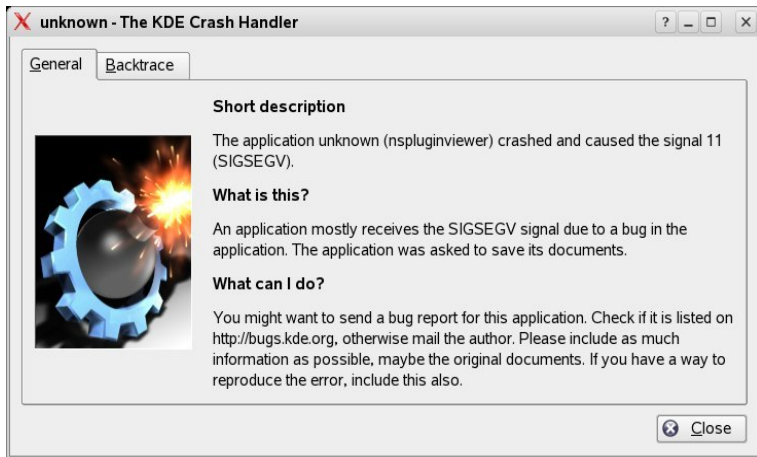
©by the author

Example

Modern Glass Cockpit

Example

Danger?

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Example

PFD Crash

[©Matthias Wagner]

Example

PFD Malfunction

[©Matthias Wagner]

Example

Frankfurt Mainstation

[©Matthias Wagner]

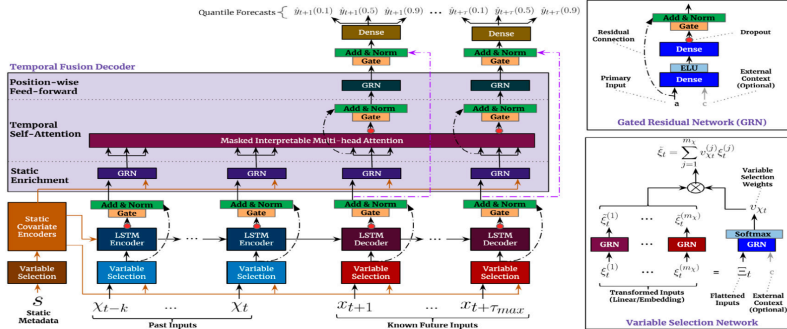# Example

Hamburg Harbor

[©Matthias Wagner]

Example

Financial System

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Technological Foundation, e.g. AI/ML

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HIS Curriculum

General Structure

- ► 2 year Master's program in applied computer science
- ► 3 semesters lectures, exercises, projects and seminars
- ► 1 semester Master's thesis in applied research
- ► All courses in English, including exams and thesis

HIS Curriculum

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- Success in each course earns 5 credits (ECTS). Typical scenario:
  - **Each semester application necessary for admission to the examinations!**
  - Successful and *continous* participation in exercises, lab-work and seminars
  - Final written or oral examination at the end of term
  - Workload approximately 150 hours per semester per module!
- 3rd term HIS project earns 10 credits
- Master's thesis results in 30 credits
  - 6 months scientific work
  - Thesis in English
  - Final colloquium
- **Urgent advice: Study the program according to the curriculum plan!**

HIS Curriculum

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1. Safety Critical Computer Systems (SCS) (Lectures/Exercises)
2. Compulsory Elective Subjects III:
   - Advanced Distributed Systems (Lectures/Exercises)
   - Advanced Testing Methods (Lectures/Exercises)
3. Advanced IT-Security (Lectures/Exercises)
4. Compulsory Elective Subjects IV:
   - Human Machine Interaction (Project)
   - Smart Sensor Network Systems (Project)
5. Data Mining Methods (Lectures/Exercises)
6. Compulsory Elective Subjects V:
   - System Theory and Modeling (Lectures/Exercises)
   - Transaction Management (Lectures/Exercises)
   - Learning from Data (Project)

1. Mathematics Update (Lectures/Exercises)
2. Advanced Formal Modeling (Lectures/Exercises)
3. Introductory Data Analysis (Lectures/Exercises)
4. Compulsory Elective Subjects I
   - ► Advanced Real-Time Systems (Project)
   - ► Machine Learning (Lectures/Exercises)
5. Implementation of DBMS (Lectures/Exercises)
6. Compulsory Elective Subjects II
   - ► Pattern Oriented Software Architecture (Lectures/Exercises)
   - ► Quantum Information Science (Lectures/Exercises)

HIS Curriculum

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1. Compulsory Elective Subjects VI:
   - ▶ Multivariate Data Analysis (Lectures/Exercises)
   - ▶ Simulation Methods (Lectures/Exercises)
   - ▶ Artificial Intelligence (Lectures/Exercises)

2. Compulsory Elective Subects VII:
   - ▶ Standards and Certification (Seminar)
   - ▶ Current Topics in High-Integrity Systems (Seminar)
   - ▶ Internet of Things (Seminar)

3. Formal Specification and Verification (Lectures/Exercises)

4. Compulsory Elective Subjects VIII:
   - ▶ Selective Subjects in Current Web Egineering (Lectures/Exercises)
   - ▶ Mobile Systems and Applications (Lectures/Exercises)
   - ▶ Cloud Computing (Lectures/Exercises)

5. **HIS Project (Project)**

1. Research in applied computer science
   ▶ Frankfurt University of Applied Sciences Professors
   ▶ Frankfurt University of Applied Sciences Research Groups
   ▶ Industrial partners
   ▶ International research institutes
   ▶ Collaborating universities, f.i. Universidad de Cadiz
   ▶ ...

Essentials

▶ **Deep interest** in computer science **and** fields of application!

▶ Good reading, writing and speaking skills in English
  - ▶ The literature is almost completely in English
  - ▶ Examinations are in English
  - ▶ Master's thesis in English
  - ▶ **But**:German language is **a must** for activities of daily life and later career in German companies! → Take German classes in our University Language Center!

▶ **Self-reliant** working style is essential!
  - ▶ **You are required to learn and work hard on your own!**
  - ▶ You should contribute to the lectures too!

▶ Teamwork is important in projects
  - ▶ Preparation for industrial and scientific working style

▶ Use of e-learning tools
  - ▶ Good Internet access at home necessary!

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Future Perspectives

▶ **This is a tough program requiring a lot of hard work and all your time!**

▶ A M.Sc. degree in High-Integrity Systems enables for a rewarding career in all high-tech fields in and relating to computer science!

▶ A M.Sc. degree enables to *survive* the AI revolution!

▶ High-integrity systems gain importance in all areas of application.

▶ A M.Sc. is a prerequisite for entering a Ph.D. program!

Further Reading I

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[Lim-2021] Lim, B., Arık, S.Ö., Loeff, N. and Pfister, T., 2021. Temporal fusion transformers for interpretable multi-horizon time series forecasting. International Journal of Forecasting, 37(4), pp.1748-1764.
All web resources checked on March 31st 2025.