

com/photo 115434623

https://www.123rf

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Prof. Dr. Frank J. Furrer

«Safety and Security of Cyber-Physical Systems»



Hauptseminar Sommersemester 2023





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SS 2023: Safety and Security of Cyber-Physical Systems





Principles of a good Paper

Next Steps

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Hauptseminar = A course, where a small number of students work intensely and interactively with the teacher

to acquire new skills and new knowledge



http://worldartsme.com



 ≤ 6



Your HS-Task:



Research and Select a specific cyber-physical system safety accident or security incident

- Web search: "satellite cyber attacks"
- Web search: "pacemaker cyber attacks"
- Web search: "Tesla truck crash"
- Web search: "water treatment plant cyberattack"
- Web search: "scada cyber attack"
- Web search: "airplane hacking"
- Web search: "hacking cars"
- Web search: "GPS spoofing"
- Web search: "cyber-physical system cyberattack"
- Web search: "industrial plant cyber attack"
- Web search: "drone hacking"
- Web search: "traffic light hacking"
- etc.



Identify and analyze the exploited vulnerability of the system and the cause of the accident or incident

Downloadable free of charge from SLUB



of Cyber-Physical Systems

17.04.2023

Research and decide which **violation** of which safety or security **principle(s)** caused the accident or incident

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Hauptseminar Objectives

Learning Outcomes:

- ✓ To do *focused research* in a specific area ("Safety and Security of Cyber-Physical Systems")
- ✓ To author a good *tutorial paper*
- \checkmark To hold a convincing *presentation*
- ✓ To experience the *peer-review process*
- ✓ To benefit from a considerable broadening of the *perspective* in the field of technology, software, and applications





Meeting Time-Table

Hauptseminar Day 1 (Introduction):

Monday, **April 17, 2023** / 09:20 – 10:50 in APB/INT 2101

Hauptseminar Day 2:

Monday, **May 22, 2023** / 09:20 – 10:50 & 11:10 – 12:40 in APB/INF 2101

Hauptseminar Day 3:

Monday, **July 3, 2023** / 09:20 – 10:50 & 11:10 – 12:40 in APB/INF 2101

<u>Exams</u>: Monday, **July 3, 2023** / 15:00 – 17:00 in APB/INF 2101 (Individual Appointments)





Prof. h.c. Dr. sc. techn. ETH-Z Frank J. Furrer

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Please ask questions **<u>anytime</u>** during my lecture

... I value the dialogue !





Short individual introduction:



Name: Origin: Studienrichtung: [Personal]: What do you expect from this Hauptseminar?



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SS 2023: Safety and Security of Cyber-Physical Systems





Principles of a good Paper

Next Steps

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It is our undeniable **responsibility** as engineers to build and operate **safe** and **secure** cyber-physical systems







water-treatment-plan

https://www.cityofames.org/government/departments

SW

Unmanned Aerial Vehicle Heart Pacemaker Water Treatment Plant City of Ames SW Freshwater Treatment Plant https://www.medicinenet.com SW

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Definition: Safety

Safety is the state of being protected against faults, errors, failures, or any other event that could be considered non-desirable to achieve an acceptable level of risk concerning the loss of property, damage to life, health or society, or harm to the environment.

Product safety refers to the operational safety <u>under normal conditions</u>, i.e. without failures.

Functional safety refers to the safety of the system when it <u>malfunctions</u>.

ISO 26262 [https://www.iso.org/standard/68383.html]







Security is a discipline to protect *information* and *functionality* of systems from threats:

By defining and implementing security controls,

To achieve defined *security objectives*, such as confidentiality, integrity, and availability (CIA),

And support the *organizational mission* and processes.





Part 4

Work Plan

Next Steps

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Part 1



Example: Crash Airbus A400M (9. May 2015) (Safety accident)



A400M: Military Transport Plane

Capacity: 37'000 kg

Range: > 3'000 km

Failure of the thrust control of 3 engines shortly after the start \Rightarrow Crash











Which principle was violated ?

Principle 12-6: Software Integrity

Code signing: Protect the integrity of all software and firmware artifacts by a digitally signed hash (applied by the creator/developer of the soft-/firmware using his private key);

Check the integrity and intactness of all software and firmware artifacts during boot/start-up (using the public key of the developer);

Protect the integrity of all configuration and information artifacts by a digitally signed hash (applied by the developer of the soft-/firmware using his private key);

Check the integrity of all software and firmware artifacts during boot/startup (using the public key of the developer);

Check the consistency (= match of the version numbers of all software, firmware, configuration files, etc.) of all artifacts during boot/start-up;

Implement correct error handling in case of detected integrity faults or configuration mismatches. In such a case, never start up the system!

At all times, keep all related software artifacts, such as source code, models, configuration files, and documentation synchronized. Use round-trip engineering (RTE) development tools that support RTE;

If the risk analysis shows a probability for malfeasant control flow alteration, then use control flow integrity techniques;

Define and consistently apply an unequivocal and comprehensive artifact numbering/versioning scheme and use it consistently for all work products and for thorough archiving. Use an industry-standard version control system;



Example: Attack on a water treatment plant (Safety accident)



Cyber attack on Florida's water treatment plant: A security wake up call



On February 5, 2021 a **water treatment plant** operator for the city Oldsmar of about 15,000 on Florida's west coast saw his cursor being moved around on his computer screen, opening various software functions that **control** the water being treated

The cyber-intruder boosted the level of *sodium hydroxide* in the water supply to 100 times higher than normal.

Sodium hydroxide, the main ingredient in liquid drain cleaners, is used to control water acidity and remove metals from drinking water in treatment plants. Sodium hydroxide poisoning can cause burns, vomiting, severe pain and bleeding

Source: <u>https://blogs.manageengine.com/corporate/manageengine/pam360/2021/02/17/</u> cyberattack-on-floridas-water-treatment-plant-what-it-means-to-globalorganizations.html

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Which principle was violated ?

<u>Principle</u> 14-9: Security Perimeter Protection

Unambiguously define, document, and update the boundary (= security perimeter) of the system under consideration;

Determine, document, and assess all intrusion-routes, i.e., all connections to the systems crossing the security perimeter;

Any usage of a public network (Internet, IoT, etc.) automatically and compulsory delineates the security perimeter, the public network belonging to the external, untrustworthy part;

Use a resilient network architecture;

Apply all modern defense technologies, such as Firewalls, Malware-detection, DeMilitarized Zones, Zero-Trust Architecture, Cryptography, Intrusion Detection System, Extrusion Detection Systems, etc.;

Patch and upgrade all defense technology products immediately whenever updates become available (automatic updating preferred);

Use cryptography as much as possible to secure your perimeter (for confidentiality, privacy, authentication, etc.);

Seriously protect your system against targeted attacks from Advanced Persistent Threats (APTs) – which in most cases needs specialized, competent consultants;

Investigate the possibility to apply Security Chaos Engineering to your systems;

Never take security for granted! Securing a system is a continuous, ongoing, responsible activity that must be explicitly supported and funded by the top management.



Example: The crash of Sriwijaya Air flight 182 (Safety accident)



Flight **SJ-182** plunged into the Java Sea on 9 January 2021 minutes after take-off from Jakarta, killing all on board.

Investigators said the plane - which was 26 years old - had an *automated throttle system* that suffered a malfunction shortly after take-off, resulting in asymmetric thrust.

That had caused *the jet to tilt* sharply off-course before it nosedived 3,000m (10,000 ft) into the sea.

Investigators also noted that those in the cockpit had **not** reacted to the plane's deviation in time perhaps due to complacency that resulted in "less monitoring" from the pilots.

https://www.bbc.com/news/world-asia-63579988





Which principle was violated ?



<u>Principle</u> 13-8: Safety Runtime Monitoring

Implement as much runtime monitoring as reasonably possible in the system (Detection, diagnosis, and mitigation of faults and failures during runtime);

Include runtime monitoring in the initial requirements and specifications;

Use risk-assessment to justify the runtime monitoring effort;

Automate the response to runtime faults as much as possible (real-time response);

Carefully define the safe states of a system. Use runtime monitoring to transfer to a safe state whenever possible;

In case or irrecoverable faults, gather sufficient forensic analysis information;

Use operating system/language support (exceptions, faults, errors) in runtime monitoring;



Example: Supply Chain Attack (Security threat)



December 13, 2020: Malicious actors are currently exploiting SolarWinds Orion products. The Orion platform is a suite of products to *monitor* the health of IT networks (<u>https://www.solarwinds.com</u>). SolarWinds acknowledged that hackers had inserted malware into its *software update distribution* mechanism. This security incident resulted in malicious code being pushed to more than 16'000 customers (industry & government)







Which principle was violated ?

SS 2023: Safe Principle 12-21: Supply Chain Confidence: Products

Write and enforce a 3rd party product acquisition and integration policy, including the specific risk identification/assessment/evaluation/mitigation/acceptance procedures;

Supplier Assessment

See Principle 12-20

b) Product Assessment

Evaluate the quality properties of the envisaged product with the same due diligence as the functionality. Do not accept any uncommitted assurances (contract);

Execute a thourough risk analysis for the integration and usage of the envisaged product. Use information available in the market or public networks. Ask for references and query them;

Carefully investigate the access privileges of the 3rd party products. Be especially distrustful if privileged accesses are claimed. Restrict the access rights to the absolute minimum necessary for correct operation. Ensure this restriction immediately for every new version of the 3rd party product;

Repeat and document (2)-(4) for each major relase of the product;

Trustworthy Product Integration

Strictly disable all unecessary or unused functionality of the product;

Execute extensive black box testing

Operational Monitoring

Comprehensively monitor and supervise the 3rd party product during operation. Have intervention mechanisms implemented for the case of misbehavior;

Exit Strategy

Prepare an exit strategy for the case of grave disputes with the vendor, deficits of the product (or its updates), or technological obsoleteness;

Cover such eventualities in the acquisition contract.



Safety Example: Automated Trading Big Loss



Knight Capital:

Computer-Trader

= high-frequency automated computer-trading

[10'000 Trades/sec Holding: Milliseconds]

Computer-traded Loss on 1.8.2012 (NYSE): **440 Million US\$** (in 20 minutes)



Safety Example: Automated Trading Big Loss



Reason: **Programming mistake** in the high-frequency automated trading algorithm after a software-update

On 1.8.2012 at 9:30 the computers generated (without human activity) millions of *faulty trades*

At 9:58 Knight Capital had lost **440** Millionen US\$



https://www.mytechlogy.com





Which principle was violated ?

Why is this a CPS?



Principle 12-17: Code Quality

Development:

Establish a binding coding standard for all software development activities to support good code quality;

Carefully chose either an accepted industry-standard coding standard (e.g., CERT, MISRA, ...) or assemble an own coding standard;

Ensure that the chosen code standard supports the required quality standards of the respective industry (e.g. safety, security, or other quality standards);

Regularly train the engineering staff concerning the coding standard;

Strictly enforce the coding standard (no exceptions);

Run automatic conformance checks (static code checking) of all code before a review and before all unit tests;

Keep the coding standard updated, i.e., aligned with the progress of industrystandard coding standards;

Make use of artificial intelligence/machine learning tools as soon as they become available;

Testing:

Specifically devise test cases not only for the functionality, but with the same (or more) care for the quality properties (performance, safety, security); Specifically devise test cases for errors, exceptions, and faults; Test 3rd party products with the same depth and diligence; Runtime:

Install runtime monitoring on all layers of the system.



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SS 2023: Safety and Security of Cyber-Physical Systems



Part 4

Work Plan

Next Steps

Part 1

- Technology: Cyber-Physical Systems
- Engineering Safety & Security







A **cyber-physical system** (CPS) consists of a collection of computing devices communicating with one another and interacting with the physical world, often in a feedback loop Rajeev Alur, 2015 [ISBN 978-0-262-02911-7]





Cyber-Physical System









Cyber-Physical System

https://www.narayanahealth.org/procedures/heart-pacemakers









August 30, 2017: An estimated 465,000 people in the US are getting notices that they should **update the** *firmware* that runs their life-sustaining pacemakers or risk falling victim to potentially *fatal hacks*

© HS Prof. Dr. Frank J. Furrer – SS 2023 https://arstechnica.com/information-technology/2017/08/465k-patients-need-a-firmware-update-to-prevent-serious-pacemaker-hacks/


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Content Part 1 Seminar Objectives Explanation of Title Setting the Scene Technology: Cyber-Physical Systems Safety & Security Engineering Safety & Security Part 2

Doing Research

- Principles of a good Paper
- Principles of a convincing Presentation



- Work Plan
- Next Steps

Part 3





«The combination of physical systems with complex computer systems opens up new concerns and threats that are more than the sum of traditional safety engineering and computer security»

Marilyn Wolf & Dimitrios Serpanos

ISBN 978-3-030-25807-8







«The combination of physical systems with complex computer systems opens up new concerns and threats that are more than the sum of traditional safety engineering and computer security»

Marilyn Wolf & Dimitrios Serpanos

ISBN 978-3-030-25807-8





http://worldartsme.com

academy



Risk Managment = Decisive Part of Systems Engineering !





Security



Information Security

Information Security protects the confidentiality, integrity, and availability (CIA) of computer system data and functionality from unauthorized and malicious **accesses**

Functional Security

Functional security protects the software-system from **malicious**, **infiltrated code**, both from the outside and from the inside of the organization



Quality of Service Properties for **SECURITY**





Traditionally, safety and security were **two different** fields of engineering

http://tacsafe.net







Car Hacking



In 2016, the two cybersecurity researchers, Charlie Miller and Chris Valasek, **remotely compromised a Jeep Cherokee**. They were able to disable the car's transmission and brakes, and, while the vehicle was in reverse, take over the steering wheel https://www.theverge.com/2016/8/2/12353186/car-hack-jeep-cherokeevulnerability-miller-valasek



In August 2019, an engineer for a cyber-software company said he found serious security and safety flaws with the Boeing 787 jets.

The engineers said a code vulnerability in the jets software can **be hacked through the plane's** entertainment system

https://abc7chicago.com/5452768/





Content Part 1 Seminar Objectives • Explanation of Title ٠ Setting the Scene ٠ Technology: Cyber-Physical Systems • Safety & Security • Engineering Safety & Security Part 2 Doing Research ۲ Part 3 Part 4

- Principles of a good Paper
- Principles of a convincing Presentation

Work Plan

Next Steps

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Safety & Security: Central Concept: Risk

Definition: Risk

A **probability** or threat of damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through preemptive action

http://www.businessdictionary.com/definition/risk.html

Definition: Risk Management

The identification, analysis, assessment, control, and avoidance, minimization, or

elimination of unacceptable risks

ttp://w.businessdictionary.com/definition/riskmanagement.html



https://de.clipdealer.com

Risk Management = Fundamental responsibility in an CPSdevelopment/evolution ISBN 978-0-7494-8307-4

Fundamentals of Risk Management Sth Edition

Understanding, evaluating and implementing effective risk management

Paul Hopkin

irm



© HS Prof. Dr. Frank

Residual

Risk

17.04.2023

https://www.corporatecomplianceinsights.con



Risk Management Process Essentials



ok









Part 4

Part 1



Doing Research





Paul Johannesson - Erik Perjons







Key Concept: Research Questions



A research question is a question that a study or research project aims to answer. This question often addresses an issue or a problem, which, through analysis and interpretation of data, is answered in the study's result

Research Question(s) The research question(s) is the <u>starting point</u> of your work.

Its quality determines the <u>success</u> of your efforts.

RESEARCH.COM: *How to Write a Research Question - Types, Steps, and Examples* May 4, 2021. Free access: https://research.com/research/how-to-write-a-research-question



The research question(s) is the <u>starting point</u> of your work. Its quality determines the <u>success</u> of your efforts



Good, goal-oriented research question(s)

- Efficient research
- Rewarding progress
- Structured results
- Consistent paper
- Satisfying outcome

Bad, unspecific research question(s)

- Erratic research
- Unstructered results
- Multiple rework
- Unsatisfying results
- Review rejection









Content

- Seminar Objectives
- Explanation of Title
- Setting the Scene
- Technology: Cyber-Physical Systems
- Safety & Security
- Engineering Safety & Security

Part 2

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Doing Research

- Principles of a good Paper
- Principles of a convincing Presentation

Part 4Work Plan

• Next Steps

Part 3

Part 1



The 6 principles of a good paper

✓ A title with a **promise of value** to the reader



- ✓ A strong, interesting **message**
- ✓ Meaningful, specific **research questions**
- \checkmark A consistent, goal-oriented **storyline**



- ✓ A well organized, **understandable** paper
- ✓ A pleasurable **reading experience**

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https://aaccommunity.net/ccc/consider-understa

https://www.thesoulofenterprise.c

✓ A title with a **promise of value** to the reader

... Because I expect ot learn or understand an interesting topic

C The value of roles for unified modeling

☺ Thorium – The green energy of tomorrow

② 20 Most Popular Programming Languages to Learn in 2023

Why should I spend 2 hours of my valuable life time to read your paper?

😕 Cyber-Physical Systems

😕 Design It!



https://www.thesoulofenterprise.c



... Because I expect ot learn or understand an interesting topic

C The value of roles for unified modeling

ⓒ Thorium – The green energy of tomorrow

20 Most Popular Programming Languages to Learn in 2023

Why should I spend 2 hours of my valuable life time to read your paper?

ⓒ Structural modeling techniques for automotive cyber-physical systems

Using agile methods for architecture and design of modern DevOps

Dependable security measures for the DevOps chain

SS 2023: Safety and Security of Cyber-Physical Systems





✓ A strong, interesting **message**



<u>ittp://www.florian-ultra.de</u>



The message is what the reader/audience remembers 14 days after reading your paper or hearing your presentation

Message of this presentation:

Cyber-physical systems are made safe and secure by applying proven safety and security principles



✓ Meaningful, specific **research questions**

The Path to a Research Question: From Broad Topic to a Specific Question

Topic

Working knowledge of the topic (narrowed down through preliminary research)

Working questions (problematization, gap-spotting)

> Research question/s (after evaluation of questions)

How to Write a Research Question - Types, Steps, and Examples May 4, 2021. Free access: https://research.com/research/how-to-write-a-research-question



✓ Meaningful, specific **research questions RQ:** How do **roles** improve the The Path to a Research Question: From Broad Topic to a Specific Question expressiveness, variability, and comprehensiveness of business process models? Working knowledge of the topic (narrowed down through preliminary research) Working questions Cultivate your research questions (problematization, gap-spotting) with much care Research guestion/ - They are the foundation of your successful research!

Source:

https://research.com/research/how-to-write-a-research-question

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✓ A consistent, goal-oriented **storyline**



https://img.clipartfest.c

Storyline = Logical, seamless sequence of ideas



The reader must be **guided** gently and pleasurably through your written material

- Logical and no breaks
- Understandable terminology
- **NO** unnecessary concepts
- Short and concise
- -s Good language





A well organized, understandable paper

«Standard» architecture of a paper









Plagiarism is a serious Offence !



- Completely list **all** your references
- Carefully give credit to other authors
- Mark citations
- Add copyright notice (© xyz)
- Respect commercial rights

Intended Plagiarism

• Willfully done!

Unintended Plagiarism

Carelessly done!

Attention: Powerful Plagiarism Checkers exist, e.g.: https://www.grammarly.com
https://www.quetext.com/
https://plagiarismdetector.net/
https://plagiarismdetector.net/
https://copyleaks.com/plagiarism-checker
... etc.

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https://pbs.twimg.com

CUT &

PASTE



Correct Language is mandatory !

Language







mtontein.sites

.caxton.co.ze



Book Reviews

Newton as Author

340

e.177.4046.

doi/10.1126/scien

nttps://v

Isaac Newton's Philosophiae Naturalis Principia Mathematica. The Third Edition (1726) with Variant Readings. Assembled and edited by ALEXANDRE KOYRÉ and I. BERNARD COHEN with the assistance of Anne Whitman. Harvard University Press, Cambridge, Mass., 1972. In two volumes. xlviii, 916 pp., illus. \$60.

Introduction to Newton's 'Principia.' I. BERNARD COHEN. Harvard University Press, Cambridge, Mass., 1971. xxx, 380 pp. + plates. \$30.

Once when Isaac Newton was asked how he had come upon his discoveries, he replied simply, "Why, by always thinking unto them." It has become a historical commonplace that Newton accomplished most of his thinking unto the mechanical structure of the universe during two 18-month periods of intense, indeed frenetic, research. The first period stretched from the beginning of 1665 to the middle of 1666, when Newton retreated from plague-struck Cambridge to his isolated home in Woolsthorpe, Lincolnshire. During this enforced interruption of his studies, he invented his methods of series and of fluxions, carried out the experiments with a prism that were to issue in his new theory of colors, and made his first deductions concerning an inverse-square force of gravity that would hold the moon in its orbit (1). For a 23-year old student, these 18 months indeed constituted an annus mirabilis, a "marvelous year" (2). Some 20 years later, in August 1684, Newton, by then Lucasian Professor of Mathematics and Fellow of Trinity College at Cambridge, was approached by Edmond Halley on the question of the orbit a planet would follow if constrained by a centrally directed, inverse-square force. Newton had not only the answer to Halley's immediate inquiry but a good deal more besides. Urged by Halley to publish his results, Newton devoted the next 18 months to the writing of his magnum opus, the Philosophiae naturalis principia mathematica, which ap-

peared under the auspices of the Royal

Society in the summer of 1687. The work almost immediately catapulted its author to fame and leadership of English science. It underwent two revised editions during Newton's lifetime, one in 1713 and another in 1726 just prior to his death. Although editorial responsibility for the second and third editions lay largely in the hands of Roger Cotes and Henry Pem-

berton, respectively, it was known from the outset that Newton himself actively participated in their preparation. Just

unto his discoveries,

As Cohen himself points out in his Introduction to Newton's 'Principia', a companion volume to the two-volume edition of the Principia itself, it is difficult to know just what to call the fruit of his and Kovré's efforts. Although subtitled "The Third Edition (1726) with Variant Readings" [whence the short form "variorum edition" (3)], the work does not present "variant readings" in the strict sense of the

term, for example, as it is used to characterize editions of medieval treatises. Rather, reproducing the third text, Cohen and Koyré record in a critical apparatus running at the foot of the page the precise manner in which that edition differs from each of the two earlier ones. The differences are not, however, variant readings; that is, they are not alternative ways of reading the text, among which the scholar may or must choose. They are conscious alterations made by Newton as he continually revised and refined his original work; Newton himself chose the prop-

er reading with each revision.

not limited to the three printed editions. Newton made most of his changes in the margins or on the interleaves of several of his personal copies of the Principia. In addition, the original manuscript printer's copy of the first edition, written by Newton's amanuensis, Humphrey Newton (no relation), is extant. The critical apparatus of the present variorum edition includes the readings of all these intermediate versions, a total of seven (4), with the result that one can not only determine the manner in which many revisions came about but also see revisions Newton contemplated but did not ultimately

undertake.

In short, scholars now have available in one work the three editions of the Principia that stem directly from Newton, brought together in a form that facilitates comparison among them. Through the critical apparatus one can

pursue the development of Newton's published thought in the years following 1687. One can, in fact, do more

than that, for the critical apparatus is

Cohen and Koyré first embarked on

this Herculean task in 1956. Since

Koyré's death in 1964, Cohen has

carried on with the assistance of Anne

Whitman. The final product is worth

the long wait. In its main purpose of

recording all variations among the

seven texts, it appears both complete

and accurate (5). In addition, by

how active a role he played, however, becomes clear only now with the appearance of I. Bernard Cohen and Alexandre Koyré's "variorum" edition of the Principia. Their painstaking collation and comparison of the first three editions of this scientific masterpiece afford tangible evidence that, whatever the changing intensity of Newton's efforts, he was indeed always thinking

edition as Newton's final, authoritative paratus.

judicious use of symbols and conventions, the editors have largely overcome the difficulties inherent in presenting the many different readings without confusion. With the help of a "Guide to the Apparatus Criticus" at the beginning of volume 1, the reader soon learns to follow the most intricate sequences additions, alterations, deletions, and of changes of mind contained in the seven texts. Furthermore, a host of supplements and appendices, both in the variorum edition and in Cohen's Introduction, supply additional information not adaptable to the critical ap-All this information is accessible, of

course, only to those who read Latin and understand the scientific and mathematical terminology of Newton's day. With the scholarly accuracy of Cohen and Koyré's edition comes also the limitation on its use outside the professional community of historians of science (and to some extent even within it). This variorum edition is a primary document that provides neither translation nor commentary, but rather Newton's own words as he wrote them. A

1687 Isaac Newton

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nitionibus explicui. In Mathefi inveftigandæ funt virium quantitates & rationes illa, qua ex conditionibus quibuícung; pofitis confequentur : deinde ubi in Phyficam defeenditur, conferendæ funt hæ rationes cum Phanomenis, ut innotefcat guznam virium conditiones fingulis corporum attractivorum generibus competant. Et tum demum de viriam speciebus, caufii & rationibus phyficis tutius difputare licebit. Videamus igitur quibus viribus corpora Spharica, ex particulis modo jum expetito attractivis confrantia, debeant infe mutuo agere, & quales motus inde confequantur.

SECT·XII

De Corporant Sphericorum Viribut attesSicois,

Prop. LXX. Theor. XXX.

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Sit HIKL fuperficies illa Spharica, & P corpufculum intus confiitutum. Per P agantur ad hanc fuperficiem linea dux HK. IL arcus quam minimos HI, KL intercipientes; & ob triangula HPI, LPK (per Corol. 2. Lem, VIL.) fimilia; arcus illi erunt diftantiis HP,LP proportionales, & fuperficiei Spharicz particule quavis, ad H1 & K L refrit per punctum P transcuntibut undig; terminate, crunt in duplicata illa ratione. Ergo virei harment

[193]

harom particularum in corpus P exercitie funt inter fe zenales, Sunt enim ut particula directe & quadrata diftantiarum inverie. Et hæ daæ rationes componunt ra-

tionem aqualitatis. Attractiones jeitur in contrarias partes aqualiter here femutuo deftruunt. Et fimili argumento attractiones omnes per totam Sphoricam fuperficiem a contrariis attractionibus deftruuntur. Proinde corpus P nullam in partem his attractionibus impellirar. Q. E. D.



Prop. LXXI. Theor. XXXI.

lifdem pofais, duco quod corpofenhan extra Sphericam foperfectam conflatarum attrabutur ad centrum Sphere, or reciproce proportionale quadrato deftantia fue ab codem centro.

Sint AHKB, a b kb aquales dux fuperficies Spharica, centris S. r. diametris AB, ab deferiptz, & P. p corputcula fita extrinfecus in diametris illis productis. Agantur a corpulculis lineze



PHK, PIL, pbk, pil, auferentes a circulis maximis AHB, abb, aquales areas quam minimos HK, bk& HL, bl: Et ad eas demittantur perpendicula SD, r d; SE, re; IR, re; quorum SD. 85

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SCIENCE, VOL. 177

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1687 Isaac Newton

Newton as Author

340

of words

Isaac Newton's Philosophiae Naturalis Principia Mathematica. The Third Edition (1726) with Variant Readings. Assembled and edited by ALEXANDRE KOYRÉ and I. BERNARD COHEN with the assistance of Anne Whitman. Harvard University Press, Cambridge, Mass., 1972. In two volumes. xlviii, 916 pp., illus. \$60.

Unstructered,

tedious flow

Introduction to Newton's 'Principia.' I. BERNARD COHEN. Harvard University Press, Cambridge, Mass., 1971. xxx, 380 pp. + plates. \$30.

Once when Isaac Newton was asked how he had come upon his discoveries, he replied simply, "Why, by always thinking unto them." It has become a historical commonplace that Newton accomplished most of his thinking unto the mechanical structure of the universe during two 18-month periods of intense, indeed frenetic, research. The first period stretched from the beginning of

peared under the auspices of the Royal

Book Reviews

Society in the summer of 1687. The work almost immediately catapulted its author to fame and leadership of English science. It underwent two revised editions during Newton's lifetime, one in 1713 and another in 1726 just prior to his death. Although editorial responsibility for the second and third editions lay largely in the hands of Roger Cotes and Henry Pemberton, respectively, it was known from the outset that Newton himself actively

participated in their preparation. Just how active a role he played, however, becomes clear only now with the appearance of I. Bernard Cohen and Alexandre Koyré's "variorum" edition of the Principia. Their painstaking collation and comparison of the first three editions of this scientific masterpiece afford tangible evidence that, whatever the changing intensity of Newton's ef-

not limited to the three printed editions. Newton made most of his changes in the margins or on the interleaves of several of his personal copies of the Principia. In addition, the original manuscript printer's copy of the first edition, written by Newton's amanuensis, Humphrey Newton (no relation), is extant. The critical apparatus of the present variorum edition includes the readings of all these intermediate versions, a total of seven (4), with the result that one can not only determine the manner in which many revisions came about but also see revisions Newton contemplated but did not ultimately undertake.

Cohen and Koyré first embarked on this Herculean task in 1956. Since Koyré's death in 1964, Cohen has carried on with the assistance of Anne Whitman. The final product is worth the long wait. In its main purpose of recording all variations among the seven texts, it appears both complete forts, he was indeed always thinking and accurate (5). In addition, by

In short, scholars now have available in one work the three editions of the

Principia that stem directly from New-

ton, brought together in a form that facilitates comparison among them.

Through the critical apparatus one can

pursue the development of Newton's published thought in the years following 1687. One can, in fact, do more

than that, for the critical apparatus is



ublish his results, Newton devoted the magnum opus, the Philosophiae naturalis principia mathematica, which ap-

terations made by Newton as he conwork; Newton himself chose the proper reading with each revision.

https://www.crosswalk.com

it). This variorum edition is a primar next 18 months to the writing of his tinually revised and refined his original document that provides neither translation nor commentary, but rather Newton's own words as he wrote them. A

SCIENCE, VOL. 177

Structure: Titles Subtitles

nitionibus explicui. In Mathefi inveftigandæ funt virium quanbraces & rationes ille, quæ ex conditionibus quibufcunq; po-fitis confequentur: dende ubi in Phyficam defeenditur, con-ferendæ funt hærationes cum Phanomenis, ut innotefcat quæ-nam vinium conditiones fingulis corporum attractivorum generibus competant. Et rum demum de viriam (peciebus, caufis & rationibus phyficis tur as difputare licebit. Videamus igitur qui-bus viribui corpora phoricz, ex particulir modo jam expedito attractivis conftantia debeant in fe mituo agere, & quales motus inde confequants

> ECT XII

De Corpornos Sphericornos Viribus atteactivois.

Prop. LXX. Theor. XXX.

Si ad Spherice fuperficie puncha forgula tendant cores equales con-tripete decrefecutes in duplicate ratione differentierum a punchise dies quod corpulcidion intra fuperficient conflitation bir viribus wallant in parten attrabitor.

Sit HIKL fuperficies illa Spharica, & P corpufculum intuconfiitutum. Per P agantur ad hanc fuperficiem linea dux HK. IL arcus quam minimos HI, KL intercipientes; & ob trianguh HP1, LPK (per Corol. 2. Lem, VIL.) fimilia; arcus illi erunt diftantiis HP,LP proportionales, & fuperficiei Spharicz patticule quavis, ad HI & K L refris per punctum P transcustibut undic; terminatz, crunt in doplicata illa ratione. Ergo virei



tur. Q. E. D.

Prop. LXXI. Theor. XXXI.

lifdem pofnis, dico quod corpafealum extra Sphericam faperficiem emfituanum attrahitur ad contram Sphare, ni reciproce proportionale quadrato diffantis fus ab codem centro.

Sint AHKB, a b kb aquales dux fuperficies Spharica, centris S, s, diametris AB, ab deferipta, & P, p corpulcula fita extrinfecus in dumetris illis productis. Agantur a corpufculis lincae



reus pam minimos HK, bk & HL, bl: Et ad perpendicula SD, r d; SE, re; IK, ir; quorum abb, aquales areas a eas demittantue SD.



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* * * * * * * * * * * * * * * * * * *	

Language: English

Your Paper:

Use Microsoft Word (If not available: pdf)

word count	
Pages	13
Words	6480
Characters	44373
Characters excluding spaces	37980
Close	

Length: 8 ... 10 pages

Use of a **template** (IEEE, Springer, ACM, ...) <u>voluntary</u>



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Automatic Speal Time Doma Cla:	ker Ident in Featu ssificatic	ification res and H n Appro-	through Robust Iierarchical ach	
Radial Jahangir Department of Information Systems, Paosity of Computer Science and Information Technology. University of Malaya Radia Lampur, Malaysia mahid Jahangir Centrelain sheght	Henry Fri Department of C Eirogri Stat Abskelik henryavske20	lay Nweke xapazor Scionce, University Nigena Aliganail.com	Christopher Henryi Eke Department of Computer Science, Family of Science, Federal University Lafin, Nyaerus cickecos (ganatil.com	
Adotorst — Speaker Densification system of lations: research is recent system bits to applications in when matching historical id- access scentrijs, hashib rare management a The major challenge in speaked identification robust and compatibility of Efficient forth captures products' unique discuss for the approach for upstate identifications singer features. In hierarchical discussion for the approach for upstate identifications singer distiller identifies the gender voice (identifies in addition, the second level (challer if identifies)	a have become area its wide range of milification, asobile and transportation, its how to pravide see that accurately igher generalized hierd chrosification obset than domain ach, the first level is or female voice), millies the specific	dependent and tex approach utilize the linguistic words independent appro- identification syste data for training as system [2, 3]. The major chall are how to extrac characterize the spo	i independent approach. Test-dependent some speech data for training and testing to identify opendent. Therefore, test- its wirdly used for mecanic speaker as it is wirdly used for mecanic speaker as a stables the use of different sample testing and independent evaluation of the larges in autocastic speaker identification of discriminative features that accurately on ignation discriming apprendment.	

grammarly Check with Grammarly

Version the paper and the filename




•

SS 2023: Safety and Security of Cyber-Physical Systems





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Principles of a good Paper



https://violentmetaphors.files.wordp



What is the *difference* between a good paper and a convincing presentation?

... same basic principles





FOCUS

17.04.2023



Paper \Leftrightarrow Presentation ?





Paper \Leftrightarrow Presentation ?





Paper \Leftrightarrow Presentation ?

Illustrations/pictures

Animations

Personal style

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





Specific principle 1: **Understand** your audience

Background ?

Prior Knowledge ?

Expectations ?

Reason for attendance ?



Tailor your presentation to the background and needs of your audience



Specific 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







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
- \bullet \cdots and some more

Garr Reynolds: **Presentation ZEN** – *Simple Ideas on Presentation Design and Delivery.* New Riders Publishing, Berkeley CA, USA, 2008. ISBN 978-0-321-52565-9 Copyrighted Materia

FOREWORD BY GUY KAWASAKI

presentationzen

Simple Ideas on Presentation Design and Delivery

2nd Edition revised & updated





http://www.wfs.org

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What is the sure **death** of a good presentation ?

Time overrun !





Peer Review

Peer reviewer = Equal ranking, qualified, independent individual

- ✓ Reading & understanding the paper
- ✓ Pointing out weak or missing points & arguments
- ✓ Making suggestions for improvement

 \rightarrow Delivering a review report

- Examine the importance of the research question(s) addressed in the manuscript (e.g., are objectives and justification clearly stated?).
- Assess the originality (contribution, addition of knowledge to scientific literature or field) of the manuscript.
- Clearly identify the strengths and weaknesses of the method described in the manuscript.
- Make specific useful comments on the writing of the manuscript (e.g., writing, organization, figures, etc.).
- Offer specific comments on the author's interpretation of the results and conclusions drawn from the results.
 https://www.elsevier.com/reviewers/how-to-review

Please take reviewing seriously and invest sufficient time - It is an essential service to your peers











Workplan 1/3

Activity		Date/Deadline	Remarks
1)	Read the lecture flyer	Sunday, April 16, 2023	All available on the HS
2)	Understand the workplan		WebsiteHS-Website
3)	Prepare a short introduction of yourself to the other participants		
4)	Prepare your questions related to the course material and workflow		
5)	Read the mandatory literature ["Safety and Security of		
	Cyber-Physical Systems – Engineering dependable		
	Software using Principle-based Development"]		Can be downloaded free of
			charge
Ha	uptseminar Day 1 Meeting	Monday, April 17, 2023:	Introduction of the
[In	personam, no remote participation]	09:20 – 10:50 (2. DS),	participants
		Room APB/INF 2101	• Introductory Lecture by
			Prof. Dr. Frank J. Furrer
		$\overline{1}$	• Confirmation of contact information (= List of participants)
		N N	Discussion of Workplan
			• Q/A
			Commitment of Participants



17.04.2023

SS 2023: Safety and Security of Cyber-Physical Systems

Workplan 2/3

Prof. Furrer selects 2 peer reviewers for each participant <u>Note</u> : All papers will also be reviewed by F.J. Furrer (as 3 rd peer reviewer)	Friday, April 21, 2023	Notification of participants by e-Mail
Deliver your choice of cyber-physical system safety accident or security incident	Friday, April 28, 2023	e-mail your choice to:
Note: only <i>one</i> topic (either F1 or F2 topic)		 Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Deliver your research question(s)	Friday, April 28, 2023	e-mail your RQs to:
		 Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Feedback from Reviewers to Topic choice & Research questions	Wednesday, May 3, 2023	By e-mail from: • Your peer reviewers • <u>frank.j.furrer@bluewin.ch</u>
Deliver your Paper-Checklist (available as WORD-File from the HS-Website)	Friday, May 12, 2023	By e-mail to: • Your peer reviewers • <u>frank.j.furrer@bluewin.ch</u>
Feedback from Reviewers	Wednesday, May 17, 2023	e-mail from: • Your peer reviewers • <u>frank.j.furrer@bluewin.ch</u>
Deliver the 1st draft of you paper [And have your ppt-presentation ready for 22.5.2023]	Friday, May 19, 2023	By e-mail to: • Your peer reviewers • <u>frank.j.furrer@bluewin.ch</u>
Hauptseminar Day 2 Meeting [In personam, no remote participation]	Monday, May 22, 2023: 09:20 – 10:50/11:10 - 12:40 (2. + 3. DS), Room APB/INF 2101	 Participants presentations Peer discussions, Feedback on style & content



Workplan 3/3

Feedback to paper 1 st draft from Reviewers	5	Friday, May 26, 2023	e-mail from:
			 Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Deliver Final Paper		Friday, June 16, 2023	By e-mail to:
			 Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Feedback to final paper from Reviewers		Friday, June 23, 2023	By e-mail from:
			 Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Deliver final presentation (as ppt or pdf)		Friday, June 30, 2023	By e-mail to:
			• <u>frank.j.furrer@bluewin.ch</u>
Hauptseminar Day 3 Meeting		Monday, July 3, 2023:	• 2 nd participants
[In personam, no remote participation]		09:20 - 10:50/11:10 - 12:40 (2. + 3. DS), Room APB/INF 2101	 Peer discussions, Feedback on style and content
Oral Exams	a de la companya de la		By individual appointment
Receive assessment and grade			Important Note : If the final paper and the final presentation are not received before the oral exam, the confirmation and the grade of the exam will delayed
© H	HS Prof. Dr. Frank J. Fu		88



Workplan 3/3

Feedback to paper 1st draft from Reviewers	Friday, May 26, 2023	e-mail from:
		 Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Deliver Final Paper	Friday, June 16, 2023	By e-mail to:
		• Your peer reviewers
		• <u>frank.j.furrer@bluewin.ch</u>
Feedback to final paper from Reviewers	Friday, June 23, 2023	By e-mail from:
		 Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Deliver final presentation (as ppt or pdf)	Friday, June 30, 2023	By e-mail to:
		• <u>frank.j.furrer@bluewin.ch</u>
Hauptseminar Day 3 Meeting [In personam, no remote participation]	Monday, July 3, 2023: 09:20 - 10:50/11:10 - 12:40 (2. + 3. DS), Room APB/INF 2101	 2nd participants presentation Peer discussions, Feedback on style and content
Oral Exams	Monday, July 3, 2023: 15:00 – 17:00, Room APB/INF 2101	By individual appointment
Receive assessment and grade	Mo: Aft exa 210	Important Note : If the final paper and the final presentation are not received before the oral exam, the confirmation and the grade of the exam will delayed





http://hqwallbase.pw/82449-a-step-forward/

Content

- Setting the Scene
- Explanation of Title
- Seminar Objectives
- Technology: Cyber-Physical Systems
- Safety & Security
- Engineering Safety & Security

- Principles of a good Paper
- Principles of a convincing Presentation



Part 2

Part 1



Next Steps	Please	respect the dates!
Prof. Furrer selects 2 peer reviewers for each participant <u>Note</u> : All papers will also be reviewed by F.J. Furrer (as 3 rd peer reviewer)	Friday, April 21, 2023	Notification of participants by e- Mail
Deliver your choice of cyber-physical system safety accident or security incident Note: only <i>one</i> topic (either F1 or F2 topic)	Friday, April 28, 2023	 e-mail your choice to: Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Deliver your research question(s)	Friday, April 28, 2023	 e-mail your RQs to: Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
Feedback from Reviewers to Topic choice & Research questions	Wednesday, May 3, 2023	By e-mail from: • Your peer reviewers • <u>frank.j.furrer@bluewin.ch</u>
Deliver your Paper-Checklist avail 11 WODD BY 6 the HS-Website)	Friday, May 12, 2023	By e-mail to: • Your peer reviewers • <u>frank.j.furrer@bluewin.ch</u>
Feedback from Reviewers	Wednesday, May 17, 2023	 e-mail from: Your peer reviewers <u>frank.j.furrer@bluewin.ch</u>
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17.04.2023	. Frank J. Furrer – SS 2023	9





Hauptseminar «Safety and Security of Cyber-Physical Syste

Prof. Dr. Frank J. Furrer / Sommersemester 2023

PAPER-CHECKLIST

Name: _____

Version: _____

Date: _____

Item	Description	Comments/Assessment
Title		
Abstract		
Research Questions		
Storyline	[Sequence of Ideas]:	
	•	
Chapter Titles	1.	
Key	[Literature, papers & Web]	
References	•	
My Contribution		



Committment



Who wants definitely to participate in the Hauptseminar?



