Emerging Technologies for the Circular Economy

Lecture 0: Organization

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M.Sc. Anant Sujatanagarjuna
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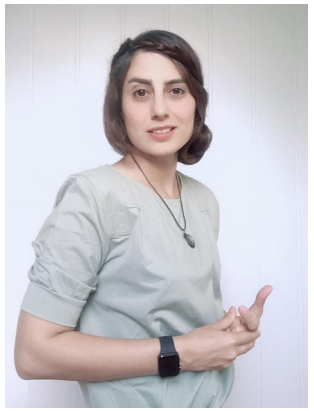
- Updated versions of these slides will be available in our Github repository.

Team

Prof. Dr. Benjamin Leiding

M.Sc. Anant Sujatanagarjuna



M.Sc. Shohreh Kia

ETCE Research Group

- **E**merging **T**echnologies for the **C**ircular **E**conomy → **ETCE**
- Research focus:
  - Intersection of IT and sustainability
  - Circular Economy
  - Self-organized, decentralized and distributed systems
  - Sustainable and resilient food production
- Other courses:
  - The Limits to Growth – Sustainability and the Circular Economy (WS – open for everyone)
  - Requirements Engineering (WS – M.Sc.)

ETCE Research Group

- ETCE Website – Link
  - Course material
  - Theses/project topics

- Our research in action:
  - ZDF documentary (German) – Link
  - Klartext Preis 2020 (German) – Link

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You want join us? Write us an email!

→ benjamin.leiding@tu-clausthal.de

Learning Outcome

- Basic understanding of the concept of the Linear Economy, the Circular Economy, the Performance Economy and sustainability

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- Basic understanding of the concept of the Linear Economy, the Circular Economy, the Performance Economy and sustainability
- Basic understanding of new technologies in the field of decentralized and smart systems
- Understanding and overview of the Internet of Things and related concepts
- Ability to design decentralized smart systems and applications in the context of connected sensor systems

Learning Outcome

- Basic understanding of the concept of the Linear Economy, the Circular Economy, the Performance Economy and sustainability
- Basic understanding of new technologies in the field of decentralized and smart systems
- Understanding and overview of the Internet of Things and related concepts
- Ability to design decentralized smart systems and applications in the context of connected sensor systems
- Knowledge of the design and consideration of privacy-preserving data processing procedures for smart and decentralized applications

Learning Outcome

- Basic understanding of the concept of the Linear Economy, the Circular Economy, the Performance Economy and sustainability
- Basic understanding of new technologies in the field of decentralized and smart systems
- Understanding and overview of the Internet of Things and related concepts
- Ability to design decentralized smart systems and applications in the context of connected sensor systems
- Knowledge of the design and consideration of privacy-preserving data processing procedures for smart and decentralized applications
- Experience in prototyping such applications and systems

Lectures

- 15.04.2024 → Organization (L00) + Introduction (L01)
- 22.04.2024 → Circular Economy (L02)
- 29.04.2024 → Lifecycle Assessment – LCA (L03)
- 06.05.2024 → Introduction to the Internet of Things (L04)
- 13.05.2024 → Internet of Things – Communication + Security and Privacy (L05)
- 27.05.2024 → Internet of Things – Data Processing and BigData (L06)
- 03.06.2024 → Industrial Internet of Things (L07)
- 10.06.2024 → Introduction to Blockchain Technology (L08)
- 17.06.2024 → Blockchain Technology – Consensus (L09)
- 24.06.2024 → Blockchain Technology – Ethereum and Smart Contracts (L10)
- 01.07.2024 → Blockchain Technology and Sustainability (L11)
- 08.07.2024 → The Machine-to-Everything Economy – A step towards the CE 2.0? (L12)
- 29.07.2024 → Exam Q&A

Exercises

- 15.04.2024 → Exercise 01 – Knowledge Test (MC)
- 22.04.2024 → Exercise 02 – Circular Economy (MC)
- 29.04.2024 → Exercise 03 – Lifecycle Assessment (LCA)
- 06.05.2024 → Exercise 04 – IoT Sensing and Gathering Data
- 13.05.2024 → Exercise 05 – IoT Security
- 27.05.2024 → Exercise 06 – IoT Data Processing
- 03.06.2024 → Exercise 07 – Industrial IoT
- 10.06.2024 → Exercise 08 – Blockchain (MC)
- 17.06.2024 → Exercise 09 – Blockchain Basics
- 24.06.2024 → Exercise 10 – Blockchain Conensus
- 01.07.2024 → Exercise 11 – Blockchain Tokens

Course Organization

- Organization of the lecture:
  - Slides are available on Github (Link)
  - Please report bugs!
  - Lectures and exercises as live stream (BBB – next slide)
  - Lecture recordings will be available on StudIP and on Github
  - Exercise time slots = Time for questions and eventual tutorials related to the exercises

Questions? Write us an email: etce-etce@tu-clausthal.de ← **We will only respond to emails written to this specific email address!**

Dates/Times/Locations

- Lecture:
  - Monday **2:15 pm to 3:45 pm** (Berlin time) – **15.04.2024** to **08.07.2024**
  - Location: Goslar Gotec (Am Stollen 19 C, 38640 Goslar, Germany) or via BigBlueButton (Link)

- Exercise / Q&A:
  - Monday **4 pm to 5 pm** (Berlin time) – **15.04.2024** to **08.07.2024**
  - Location: Goslar Gotec (Am Stollen 19 C, 38640 Goslar, Germany) or via BigBlueButton (Link)

Exercises

- Individual work → no group submissions
- Multiple-Choice or coding tasks
- 7-14 days to submit (depending on the task)
- Submission deadline is always Monday at 1:59pm (right before the next lecture)
- Submission of **each** exercise is **mandatory**
- **You pass by submitting an exercise – even if it is an empty page**
- You will receive feedback on your submission
- Exercise = learning feedback

Coding Exercise Submission and Grading

- Coding exercises are graded semi-automatically. Due to this it is highly important that you follow the required submission format. Otherwise the grading process will fail and you will receive 0 points.
- Code must use Python. Do not use any libraries beyond what is specified in the assignment as they may not be available in the grading environment.
- Follow the directory structure from the handout file **exactly**. Usually this means:
  - If the handout contains a folder ‘lab1’, your submission should have a folder ‘lab1’ in the archive with the files inside it. The folder must not be inside another folder and the files must not be directly in the archive outside the folder.
  - The archive must be an uncompressed **zip** archive, not tar, rar, tar.gz or anything else.

Coding Exercise Submission and Grading

- Before submitting, unpack your archive to a new folder and check that the Makefile runs correctly.
- For grading, we use a different test program, so, no, hardcoding the answers to the provided driver.py will not work.
- Code is submitted via a timed write-only StudIP submission folder. Only a single file can be submitted. The file name must follow the exact format ‘lab<n>_<matriculation number>.zip’, so for example ‘lab4_123456789.zip’, no extra space or _ symbols anywhere.

Multiple-Choice Exercises

Every student enrolled in this course is advised to take the knowledge quiz in first two weeks of the course.

- **Goal of the test:**
  - To check the knowledge level of the student that is relevant to this course of study.
- **Preparation:**
  - A review of basic concepts of Cryptography and Circular Economy is recommended for Week 1 and Week 2 respectively
  - Knowledge quiz for Week 1 only tests your existing knowledge.
- **THE TEST IS JUST FOR YOU → WE CANNOT CHECK THE TEST RESULTS**

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Link for all multiple-choice exercises → etce.etce-lab.de

Multiple-Choice

E01: Prior Knowledge

Introduction

This question is the exercise for *"L01 - Introduction"* of the "Emerging Technologies for the Circular Economy" course taught at the TU Clausthal. All the course material is hosted on our GitHub page. This multiple-choice quiz tests your prior knowledge of the topics that we will discuss during the course.

You must answer at least half **the questions** correctly to pass the exercise.

If you have any questions, you can contact us via e-mail: etce-etce@clausthal.de

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Question 01: Block ciphers are used in symmetric cryptography to encrypt and decrypt data. They operate on blocks of a fixed length (usually 64 or 128 bits). To encrypt some data, you could split it into block sized chunks and simply encrypt them separately. What which of the following properties are true?

Choose one or more options then select Submit.

- [ ] This is called ECB mode
- [ ] This is called CBC mode
- [ ] Patterns in the data will show up, which can impact security
- [ ] There is no integrity protection
- [ ] It will be easy to calculate the key

Submit

Multiple-Choice Exercises

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Choose one or more options then select Submit.

- This is called ECB mode
- This is called CBC mode
- Patterns in the data will show up, which can impact security
- ✓ There is no integrity protection
- It will be easy to calculate the key

Show correct answer ✗

Examination

- Prerequisite for admission to the final exam (all criteria have to be fulfilled):
  - Submit all exercises (except for the MC exercises).

- Final exam:
  - Written exam (120min) via Moodle
  - Date → Most likely **05.08.2024 from 2 pm – 4 pm**

Self-Study Star

Self-Study Star → 

- Slides with the self-study star indicate optional/additional study material that is **not** mandatory but could be helpful or interesting

Literature

- This course is not based on a single book and you **do not** need to buy a book to pass the exam.

- Donella H. Meadows, Jorgen Randers, and Dennis L. Meadows. *The Limits to Growth* (1972).
- Donella H. Meadows, Jorgen Randers, and Dennis L. Meadows. *Limits To Growth: The 30-Year Update* (2004).
- Baccini et al. *Metabolism of the Anthroposphere: Analysis, Evaluation, Design* (2012).
- Walter R. Stahel. *The Circular Economy: A User's Guide* (2019).
- W. Brian Arthur. *The Nature of Technology: What It Is and How it Evolves* (2011).
- David Wallace-Wells. *The Uninhabitable Earth, Annotated Edition* (2017).

Literature

- (German) Stefan Rahmstorf, Hans Joachim Schellnhuber. *Der Klimawandel* (2019).
- David Archer, Stefan Rahmstorf. *The Climate Crisis* (2010).
- Gabrielle Walker, David King. *The Hot Topic: How to Tackle Global Warming and Still Keep the Lights on* (2008).

Literature

- Satoshi Nakamoto. *Bitcoin: A Peer-to-Peer Electronic Cash System* (2008) – (Link).
- Gavin Wood. *Ethereum: A Secure Decentralized Generalised Transaction Ledger* (2014) – (Link).
- Andreas Schütz und Tobias Fertig. *Blockchain für Entwickler: Grundlagen, Programmierung, Anwendung* (2019).
- M.A. Khan, M.T. Quasim, F. Algarni, A. Alharthi. *Decentralised Internet of Things* (2020).
- Dimitrios Serpanos und Marilyn Claire Wolf. I*nternet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies* (2018).
- Perry Lea. *Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security* (2018).
- Dan Boneh, Amit Sahai und Brent Waters. *Functional Encryption: Definitions and Challenges* (2010).

Further Resources

- Climate University – Teaching and learning for a sustainable future – Link
- Circular Societies (German) – Link
- Server Infrastructure for a Global Rebellion – Link
- Podcasts:
  - Drilled (Link)
  - How to Save a Planet (Link)
  - 1,5 Grad – der Klima-Podcast mit Luisa Neubauer (German) (Link)

Questions?