Greening DH&RSE Practices

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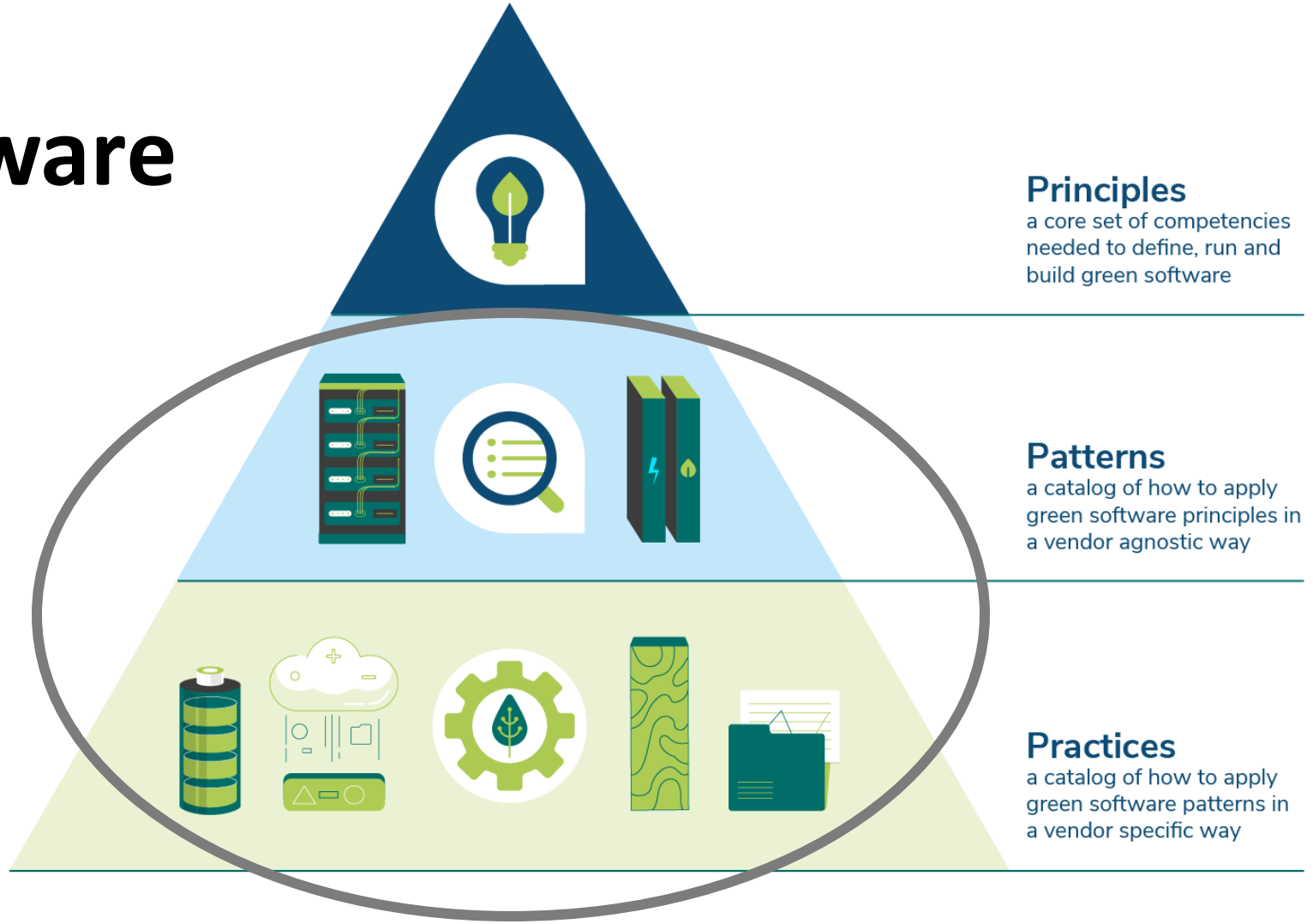
Green Software



Principles
a core set of competencies needed to define, run and build green software

Patterns
a catalog of how to apply green software principles in a vendor agnostic way

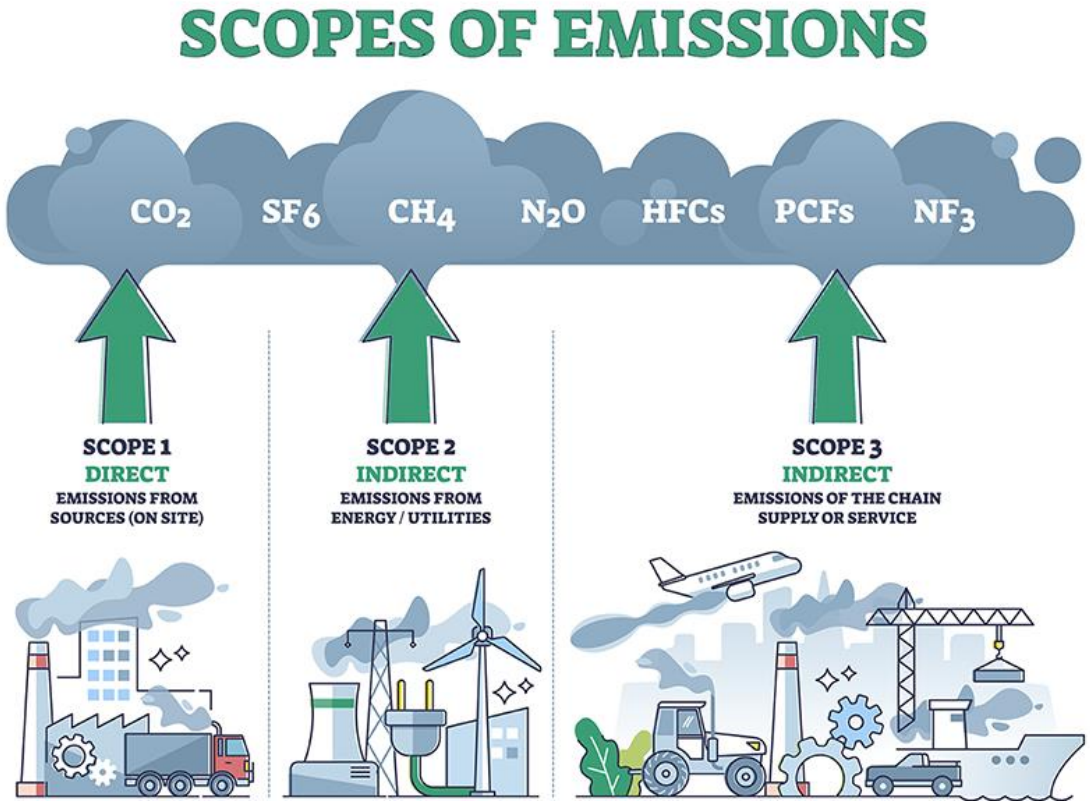
Practices
a catalog of how to apply green software patterns in a vendor specific way

Green Software Foundation
greensoftware.org

Direct environmental impacts of digital technology

- **Energy use** — powering our devices, powering data centres and network infrastructure. If this is “dirty” energy, e.g. coal power, then there are carbon emissions, contributing to global warming
- **Embodied carbon** — carbon emissions associated with manufacturing devices, networks, data centres, etc.
- **Tech metals and rare earth elements**
- **E-waste** — processing e-waste can be harmful to workers and environment
- **Water** used for cooling some data centres

The GHG protocol



- **Scope 1**: Direct emissions from **operations** owned by the organisation (e.g. fuel combustion or fleet vehicles).
- **Scope 2**: Indirect emissions related to **emission generation of purchased energy** (heat and electricity)
- **Scope 3**: Other indirect emissions from all the other activities. Split into two further categories
  - **Upstream Scope 3 Emissions**: All emissions from an organisation's supply chain, e.g. emissions from manufacturing and shipping a product
  - **Downstream Scope 3 Emissions**: Emissions resulting from the use of a product (e.g. the electricity customers may consume when using your product or waste output from the product)

Our Plan for today

Greening the Software Life Cycle

Greening your Code

Digital Sustainability Cards Game

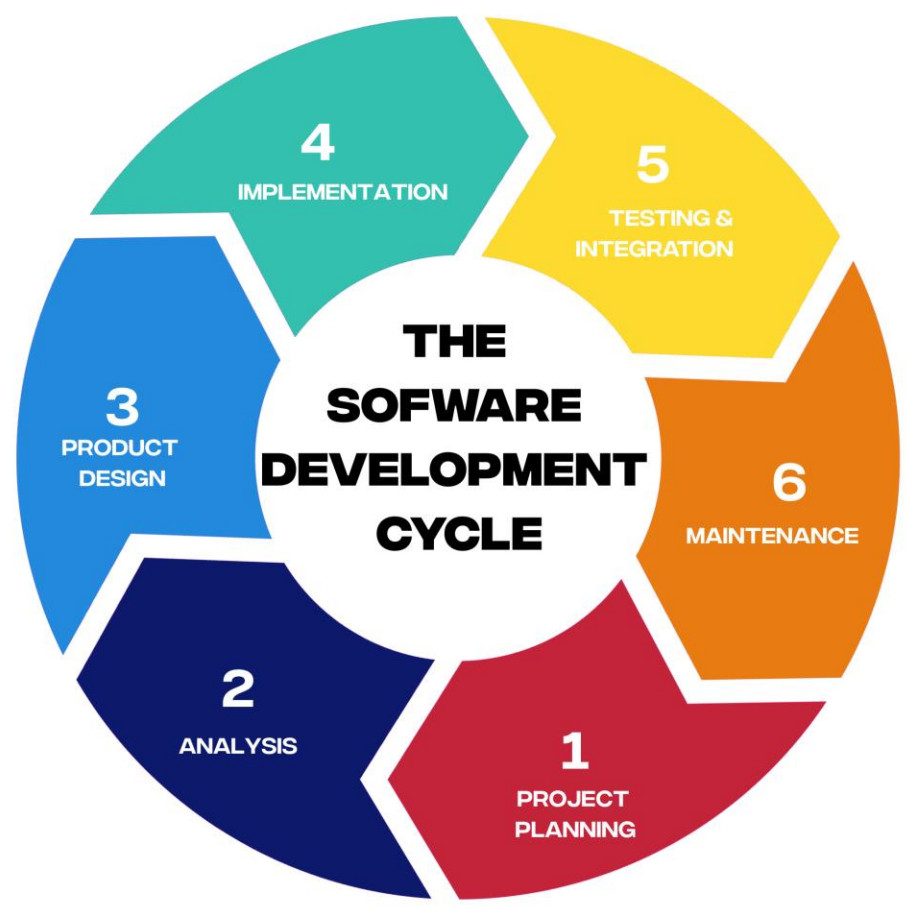
Ice-breaker

1. How many smart devices (WIFI-Connectable) does your household own (e.g. laptops, phones, pads, mp3 , Ebooks, Alexa etc..)

2. What percentage of them do you use on daily/weekly bases? How many are non-functional anymore

3. Calculate the average of smart device per group

Software Development Cycle



1. Identify client needs, conduct feasibility studies, and define initial goals, scope, and budget.
2. Gather and document detailed functional and technical requirements based on client input and system evaluation.
3. Propose and finalize system architecture and design, documented in a Design Specification.
4. Write and integrate code based on the design. This phase produces the working product.
5. Perform rigorous QA to find and fix bugs, ensuring performance, security, and reliability.
6. Release the product to users and provide ongoing support, updates, and issue resolution.

Practical Actions Cards

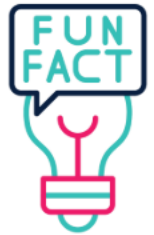
REVIEW & ADJUST PURCHASING POLICY

Created by Purple iconn from Noun Project

IDEAS:

-
-
-

When it comes to choosing suppliers, university workers may feel like we have our hands tied: by IT Services policies, procurement policies, long-term contracts or legal frameworks. But procurement teams typically seek expertise across the university, so there may be opportunities to influence them, and projects typically have a little more leeway for non standard purchases.



Rules are made to be broken!

Instructions

1. Look at the 12 cards and decide where it best fits
2. Add 2-3 ideas that you or your institution can adopt to put the actions into fruition

TIP: Writing down the possible ideas can help your discussion on where the card best fit into the Software Life Cycle

Cards for Digital Sustainability

- Company Charter Sheet

Coffee Break

- Please if you haven't already make sure that you can access Google Colab!

- Remember to start thinking about what company you want to be for the final game

Greening Code

- Not a single answer
- Always difficult to properly evaluate
- Some Languages better than other
- Basically reduce calculations!

Greener Code = Efficient Code

Greening Code

1. **Optimize Data Structures:**
    - Encode variable to the most effective type (integer vs float)
    - Minimize memory usage and access time
2. **Reduce Redundancy:**
    - Avoid unnecessary computations. Cache results when possible
    - Eliminate duplicate code
3. **Minimize I/O Operations:**
    - Reading and writing data
    - Only read the data you actually need
4. **Use Efficient Libraries and Frameworks:**
    - Performance and efficiency
    - Computationally intensive tasks (e.g., NumPy, TensorFlow, PyTorch)

Greening Code

5. **Manage Memory Effectively:**
    - Release memory when it's no longer needed
    - Remove unused objects and avoid creating large unneeded ones
6. **Parallelise and Distribute When Appropriate:**
    - Distribute computations across multiple cores or machines
7. **Reduce Redundancy:**
    - Use tools to find bottlenecks and improve execution
8. **Prototyping:**
    - Work on subset of the code when developing
9. **Be Mindful of Loops :**
    - Limit number of iteration and unnecessary loops
10. **Code Review:**
    - Review code with efficiency in mind

Greening Python Code

- Go to https://colab.research.google.com/
- https://github.com/kingsdigitallab/dh-rse-summer-school-2025

Cards for Digital Sustainability

- Company Charter Sheet
- Actions and Events cards
- Progress and Sustainability Chips

Instructions

1. Together decide which company are you and fill out the company sheet
2. Each Team always have 5 cards at any round
3. You can play either **two** action cards or **one** actions card and **an** event card (but **not two** events cards)

Results

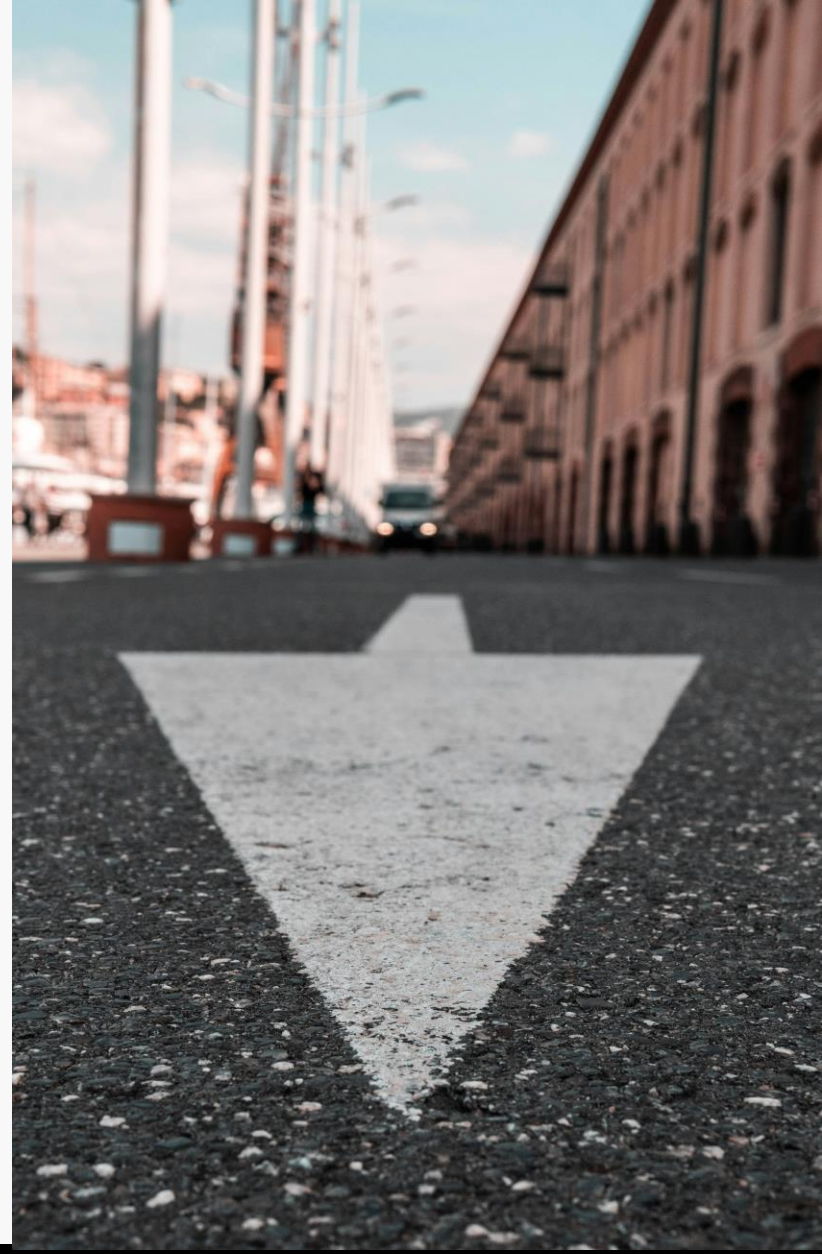
	0-12 Progress Points	13+ Progress Points
0-9 Sustainability Points	Oh no! The world really is in flames! Tech has a lot to answer for. Now what? Revenge?	Despite best efforts, things are falling apart. There are still a few glimmers of hope, but it's bleak.
10-17 Sustainability Points	Unfortunately, despite passionate efforts and groundbreaking innovations, the big picture remains bleak.	Progress has come too slowly, and growth has outpaced efficiency gains. The social cost of delay has been enormous.
18-25 Sustainability Points	There is more to do, but we have shown real leadership in shaping a sustainable and just digital future.	Nice work. Progress could have been more rapid, but we have a firm foundation, and the future is now looking very bright!
26-29 Sustainability Points	Wow, we did it. We achieved a rapid and just climate transition. Tech can be proud of the part that it played.	Wow! Things have turned out better than anyone could have imagined. And there's even better on the horizon …
30+ Sustainability Points	Incredible! Radical, deep change has been achieved. You must have been smart *and* lucky.	Incredible! Radical, deep change has been achieved. You must have been smart *and* lucky.

Final Reflection

- Which of the Actions that you have played can you do in your own work/life in less than a month ?
- Which of the Actions that you have played can you do in your own work/life in the long term?
- Which are the barriers that prevent you?

Further Resources

- Green Software Foundation | GSF
- The Digital Collage - A workshop to understand the impact of digital technologies on the environment and how to reduce it
- Green HPC system use: Summary and Setup
- DHCC toolkit - Home | DHCC
- Sustainable IT MOOC by Institute for Sustainable IT (ISIT)
- Green DiSC: a Digital Sustainability Certification | Software Sustainability Institute



Questions?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