# Code Clones: Causes and Consequences

## Software Evolution — L5T1

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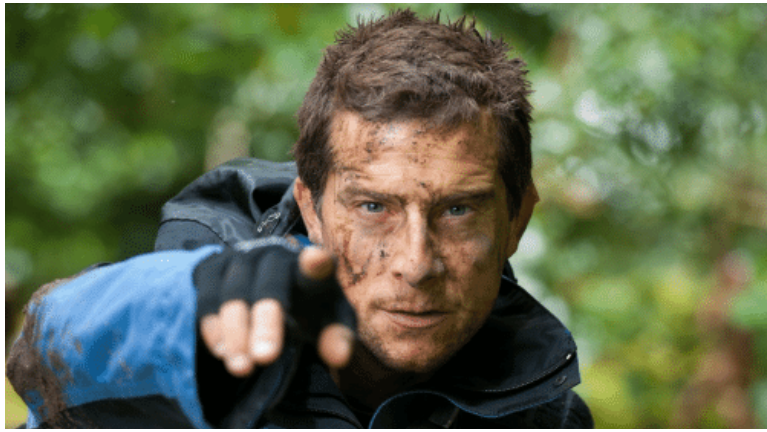
Formal Methods & Tools

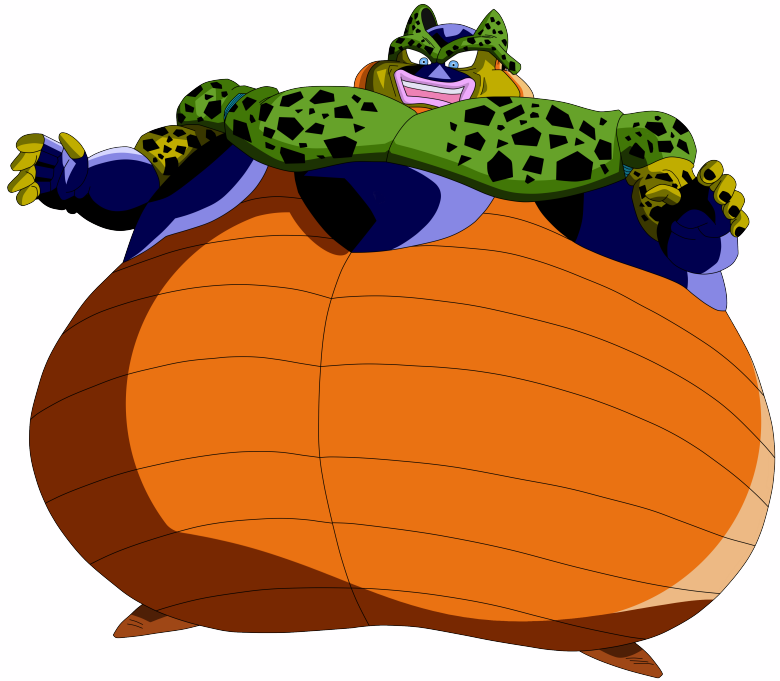
# Clones are Created for a Reason

- Understand
  - ⇒ adjust
    - ⇒ reuse
- Clone
  - ⇒ edit the copy



# Clones Make Codebases Larger

- Duplicate implementations of the same feature
  - ⇒ more code
- More code
  - ⇒ higher maintenance costs
- Clone removal
  - ⇒ refactoring effort
- Usually 10%–15%, up to 50%



# Cloning Leads to Dead Code

- Clones compete for internal usage
  - ⇒ can become disconnected
    - ⇒ technically not needed
- Not always trivial to be sure
  - ⇒ removal is forever
    - ⇒ can suprise other devs

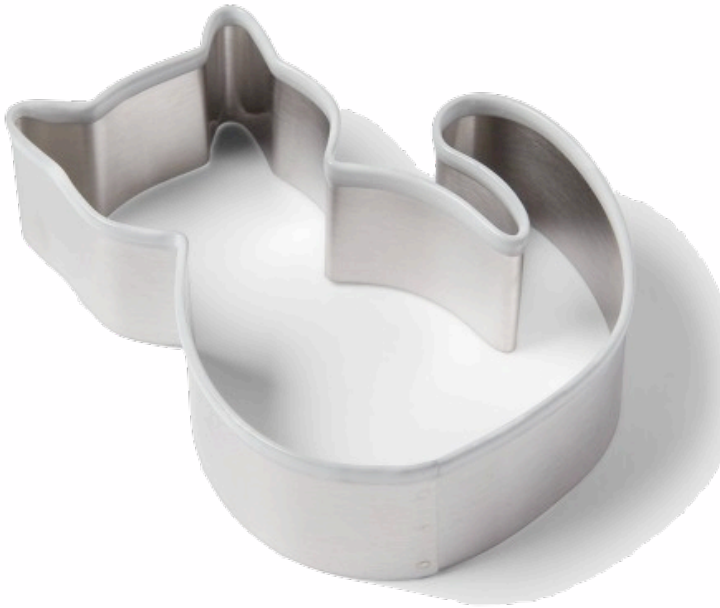
# Clones Must Coevolve

- Clones have the same bugs
  - ⇒ when found, needs to be fixed everywhere
- Is a bug always a bug?
  - sometimes a feature
- Bug fixing itself is error-prone
  - ⇒ divergence of bugs

cf. L2T2

# Templated Clones are OK-ish

- Language can be too inexpressive
  - type polymorphism
- Certain API expect call sequences
  - create the button
  - add to the container
  - assign action listeners
- Coding traditions
  - idioms, snippets, micropatterns…



Kapser, Godfrey, *“Cloning Considered Harmful” Considered Harmful*, WCRE’06.

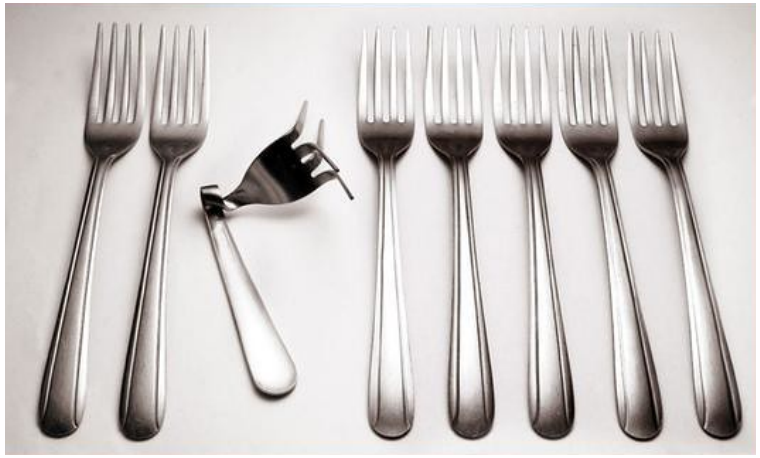
# Customised Clones are Inevitable

- Bug fixes or workarounds
  - the guilty class may not be editable
- Specialised replications
  - abstractions can be hard to build
  - if possible at all

Kapser, Godfrey, *“Cloning Considered Harmful” Considered Harmful*, WCRE’06.

# Forks are Less Evil

- Hardware variations in drivers
  - subtle changes, untestable original
- Platform variation
  - ported easier than portable
- Experimental variation
  - for performance
  - differential testing



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# Conclusion

- Clones lead to “software aging”
  - larger, less understood codebases ⇒ **legacy**!
- Forked, templated and customised clones *may* be OK
- Q&A Sessions @ Canvas
  - ⇒ v.zaytsev@utwente.nl
  - ⇒ https://discord.gg/n7VQAPNBPD