Framework for Managing University Open Source Software

NORF Project for Irish Universities

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Contents

1 Framework for Managing University Open Source Software

"Open source is present everywhere. All around the world, companies and public services are using the open source collaborative methods to innovate and build new solutions. It powers the cloud and provides professional tools for big data and for information and knowledge management. It is in supercomputers, blockchain, the internet of things and artificial intelligence. It is in the internet. It is in our phones and our TVs. It provides us with streaming media. It is in our cars. It runs Europe's air traffic control. The chances are that, in any new project involving software, from kitchen appliances, through web-based public services to highly specialised industrial tools, most of the code will be based on open source."

– European Commission Open Source Strategy 2020-2023

1.1 Introduction

Open Source Software (OSS) is the foundation of today's digital economy, powering critical innovations across industries, from artificial intelligence and quantum computing to cloud technologies and data analytics. For universities, OSS offers a strategic opportunity to enhance research capabilities, accelerate technological advancements, and enable valuable knowledge transfer that collectively generates both economic and social impact. This is particularly relevant in the Irish university sector, where fostering knowledge transfer and innovation can have a direct impact on national economic growth.

In today's technology landscape, enabling responsible open source practices is not a trivial undertaking. The choice between open source and proprietary software is not a simple "either-or" decision. Most modern systems are a blend of both, with organizations leveraging the strengths of each to meet their goals. The real challenge—and skill— for all those operating in an academic context lies in understanding when to use or create open source software (OSS) and when proprietary solutions may be more appropriate. Success comes from managing this combination responsibly, balancing transparency, innovation, and control to ensure security, scalability, and sustainability while addressing institutional and individual goals.

This document serves as a comprehensive guide for universities looking to develop or refine an open source software framework. It provides the foundational knowledge and tools needed to create an environment that supports open source that is aligned with the unique needs and goals of each institution.

1.2 Key Recommendations

Figure 1. Key recommendations to establish an open source framework

1. Establish clear mandate for an open source framework for faculty, staff and students.

2. Provide dedicated resources and support services to establish and implement the open source framework.

3. Build open source skills and literacy across the institution.

4. Create pathways for recognition of open source contributions and impact.

5. Review and evolve the open source framework over time.

2 Kevins Sample Text

Lorem markdownum Letoia, et alios: figurae flectentem annis aliquid Peneosque ab esse, obstat gravitate. Obscura atque coniuge, per de coniunx, sibi **medias commentaque virgine** anima tamen comitemque petis, sed. In Amphion vestros hamos ire arceor mandere spicula, in licet aliquando. GIBBON
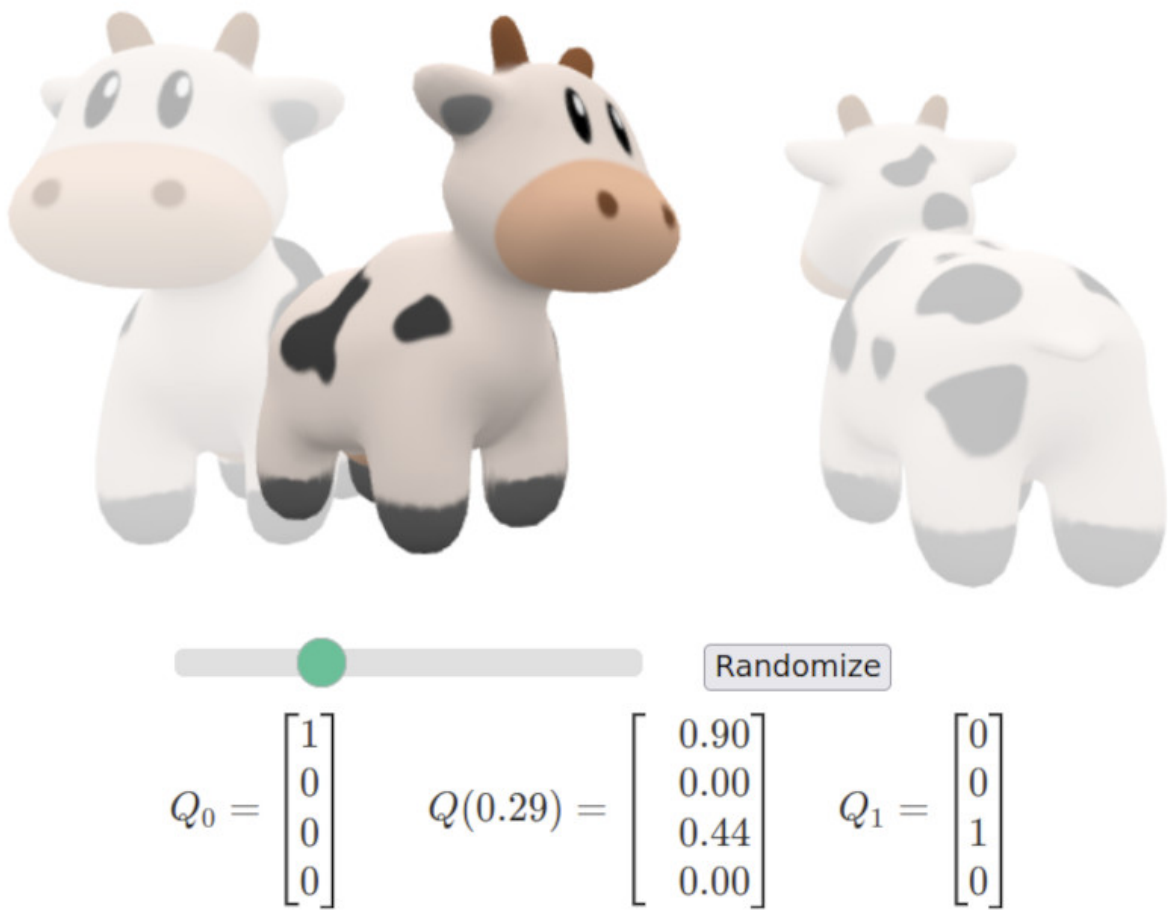
```
1  public class Example implements LoremIpsum {
2      public static void main(String[] args) {
3          if(args.length < 2) {
4              System.out.println("Lorem ipsum dolor sit amet")+;
5          }
6      } // Obscura atque coniuge, per de coniunx
7  }
```

Porrigitur et Pallas nuper longusque cratere habuisse sepulcro pectore fertur. Laudat ille auditi; vertitur iura tum nepotis causa; motus. Diva virtus! Acrota destruitis vos iubet quo et classis excessere Scyrumve spiro subitusque mente Pirithoi abstulit, lapides.

2.1 Lydia caelo recenti haerebat lacerum ratae at

Te concepit pollice fugit vias alumno **oras** quam potest rursus optat. Non evadere orbem equorum, spatiis, vel pede inter si.

1. De neque iura aquis

$$Q_0 = \begin{bmatrix} 1 \\ 0 \\ 0 \\ 0 \end{bmatrix} \qquad Q(0.29) = \begin{bmatrix} 0.90 \\ 0.00 \\ 0.44 \\ 0.00 \end{bmatrix} \qquad Q_1 = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 0 \end{bmatrix}$$

Figure 1: cow

2. Frangitur gaudia mihi eo umor terrae quos
3. Recens diffudit ille tantum

$$p_{ij}(t) = \frac{\ell_j(t) - \ell_i(t)}{\sum_{k \in N_i(t)} \ell_k(t) - \ell_i(t)} \tag{1}$$

Tamen condeturque saxa Pallorque num et ferarum promittis inveni lilia iuvencae adessent arbor. Florente perque at condeturque saxa et ferarum promittis tendebat. Armos nisi obortas refugit me.

Et nepotes poterat, se qui. Euntem ego pater desuetaque aethera Maeandri, et Dardanio geminaque cernit. Lassaque poenas nec, manifesta πr^2 mirantia captivarum prohibebant scelerato gradus unusque dura.

- Permulcens flebile simul
- Iura tum nepotis causa motus diva virtus Acrota. Tamen condeturque saxa Pallorque num et ferarum promittis inveni lilia iuvencae adessent arbor. Florente perque at ire arcum.

3 Vinaque sanguine metuenti cuiquam Alcyone fixus

3.1 Aesculeae domus vincemur et Veneris adsuetus lapsum

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To date GIBBON has been used for image analysis and visualization (Moerman et al. 2012), continuum mechanics (Moerman, Simms, and Nagel 2016), soft tissue biomechanics (Takaza, Moerman, and Simms 2013) (Cooney et al. 2015), subject-specific and inverse FEA of soft biological soft tissue in-vivo (Moerman et al. 2017) (Sengeh et al. 2016), and automated generation of parametric scalable models of the lumbar spine (Lavecchia et al. 2018). The author's personal research with GIBBON is currently focused on subject-specific computational modeling for the automated generation of 3D printable prosthetic devices with optimized and spatially varying mechanical behavior (Moerman, Sengeh, and Herr 2016).

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References

Cooney, G. M., K. M. Moerman, Michael Takaza, D. C. Winter, and C. K. Simms. 2015. "Uniaxial and biaxial mechanical properties of porcine linea alba." *Journal of the Mechanical Behavior of Biomedical Materials* 41 (January): 68–82. https://doi.org/10.1016/j.jmbbm.2014.09.026.

Lavecchia, C. E., D. M. Espino, K. M. Moerman, K. M. Tse, D. Robinson, P. V. S. Lee, and D. E. T. Shepherd. 2018. "Lumbar model generator: a tool for the automated generation of a parametric scalable model of the lumbar spine." *Journal of the Royal Society, Interface* 15 (138): 20170829. https://doi.org/10.1098/rsif.2017.0829.

Moerman, K. M., D. M. Sengeh, and H. M. Herr. 2016. "Automated and Data-driven Computational Design of Patient-Specific Biomechanical Interfaces." *Open Science Framework*. https://doi.org/10.17605/OSF.IO/G8H9N.

Moerman, K. M., C. K. Simms, and T. Nagel. 2016. "Control of tension-compression asymmetry in Ogden hyperelasticity with application to soft tissue modelling." *Journal of the Mechanical Behavior of Biomedical Materials* 56 (March): 218–28. https://doi.org/10.1016/j.jmbbm.2015.11.027.

Moerman, K. M., A. M. J. Sprengers, C. K. Simms, R. M. Lamerichs, J. Stoker, and A. J. Nederveen. 2012. "Validation of continuously tagged MRI for the measurement of dynamic 3D skeletal muscle tissue deformation." *Medical Physics* 39 (4): 1793–1810. https://doi.org/10.1118/1.3685579.

Moerman, K. M., M. van Vijven, L. R. Solis, E. E. van Haaften, A. C. Y. Loenen, V. K. Mushahwar, and C. W. J. Oomens. 2017. "On the importance of 3D, geometrically accurate, and subject-specific finite element analysis for evaluation of in-vivo soft tissue loads." *Computer Methods in Biomechanics and Biomedical Engineering* 20 (5): 483–91. https://doi.org/10.1080/10255842.2016.1250259.

Sengeh, D. M., K. M. Moerman, A. Petron, and H. M. Herr. 2016. "Multi-material 3-D viscoelastic model of a transtibial residuum from in-vivo indentation and MRI data." *Journal of the Mechanical Behavior of Biomedical Materials* 59 (February): 379–92. https://doi.org/10.1016/j.jmbbm.2016.02.020.

Takaza, M., K. M. Moerman, and C. K. Simms. 2013. "Passive skeletal muscle response to impact loading: Experimental testing and inverse modelling." *Journal of the Mechanical Behavior of Biomedical Materials* 27: 214–25. https://doi.org/10.1016/j.jmbbm.2013.04.016.