

Virtualization of scientific software based on Arch Linux in GitPod

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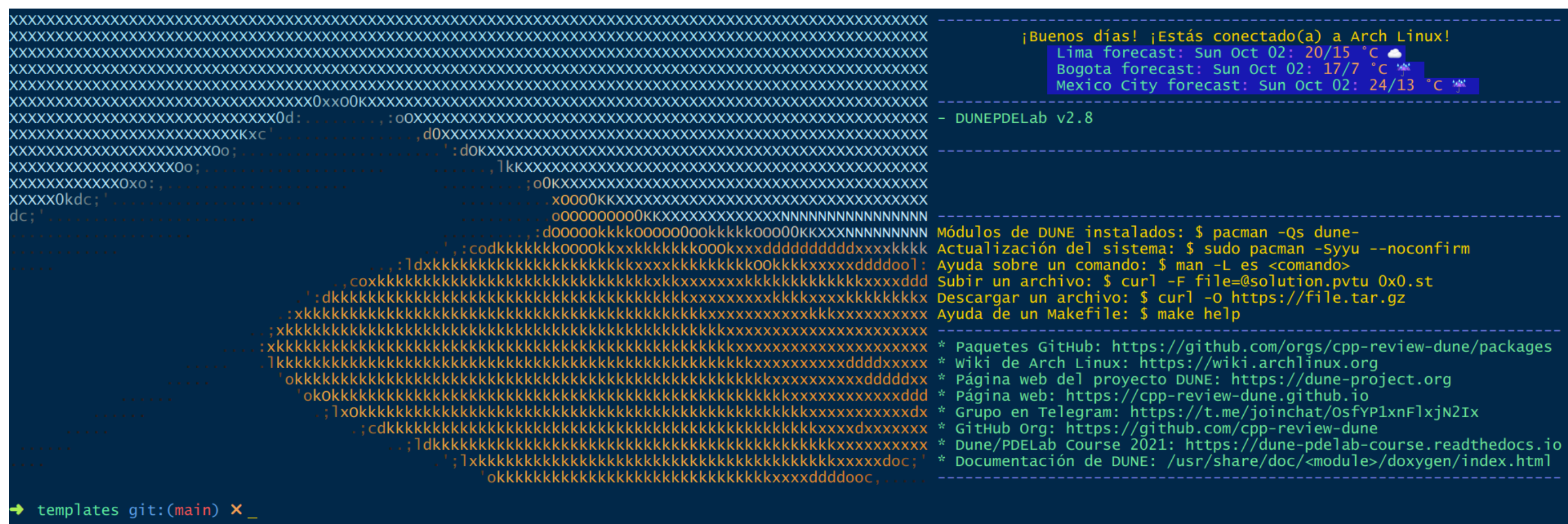
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Abstract

We developed an open source repository hosted on GitHub to use scientific software based on the Arch Linux distribution, with an up-to-date software ecosystem that includes DUNE python bindings, DuMu^x, FEniCS, deal.II, Gmsh, preCICE adapters, among others. Unlike other projects such as BioArchLinux [3] or Arch Linux for education [4], we include some tutorials on GitHub Classroom to allow the practice to any newcomer. Automated deployed and available for free use allowing virtualization inside GitPod [5].

C++ Review DUNE

Teachers and students from Peru, Colombia and Mexico participated in the Dune PDELab course 2021 with the aim of modeling physical phenomena using scientific programming in C++. Arch Linux distribution was chosen since have a lot of up-to-date scientific software, e.g. the Dune modules were packaged in this distribution. Moreover, available in Arch Linux for Education repository.



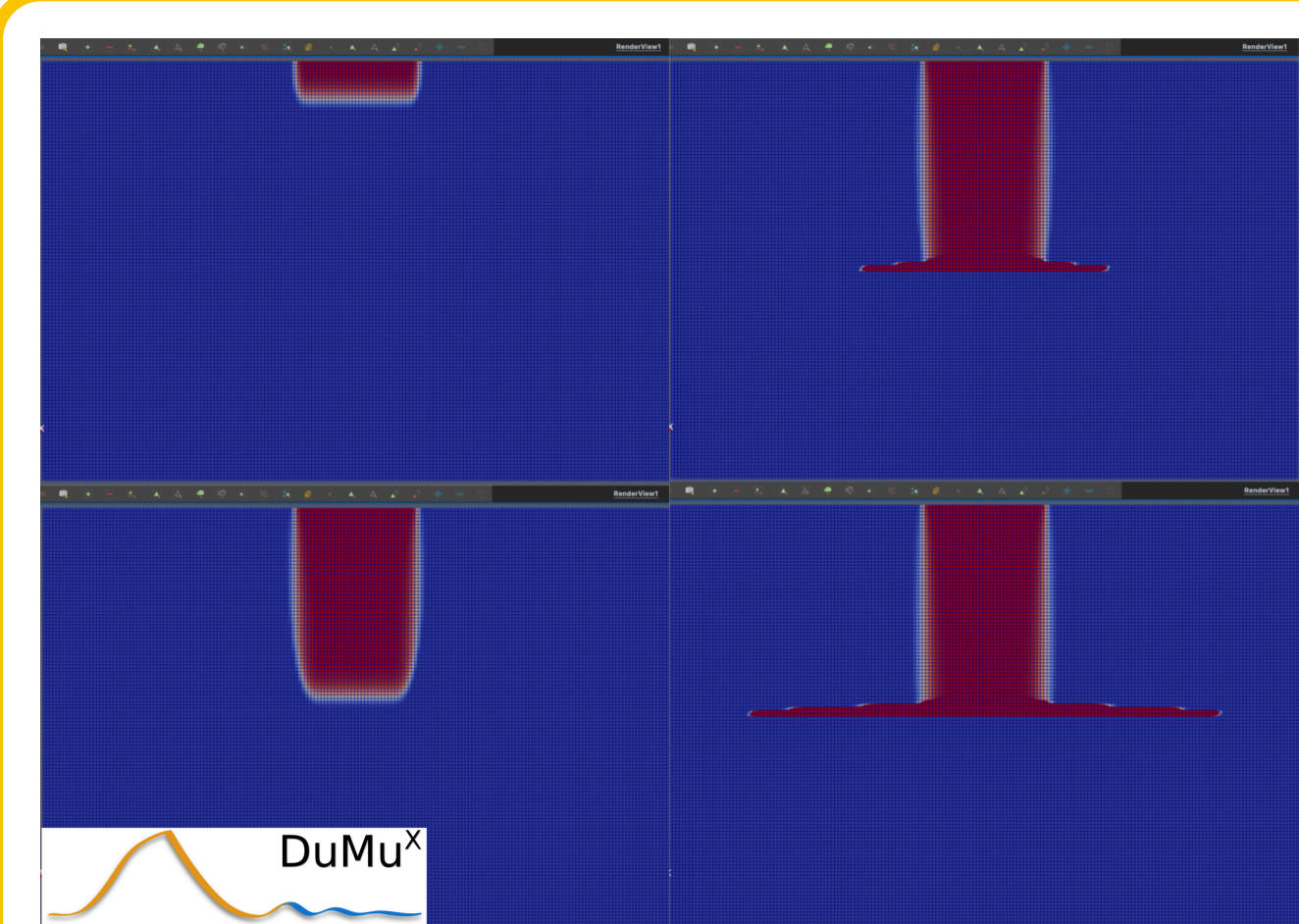
```
buenos días! [Estás conectado(a) a Arch Linux!
lma Forecast: Sun Oct 02: 20/15 °C
Bogotá Forecast: Sun Oct 02: 17/7 °C
Mexico City Forecast: Sun Oct 02: 24/13 °C

DUNE PDELab v2.8
Módulos de DUNE instalados: $ pacman -Qs dune-
Actualización del sistema: $ sudo pacman -Syu --noconfirm
Ayuda sobre un comando: $ man -L es -comando
Subir un archivo: $ curl -F file=@solution.pytu (x).st
Descargar un archivo: $ curl -O https://file.tar.gz
Ayuda de un Makefile: $ make help

* Paquetes GitHub: https://github.com/orgs/cpp-review-dune/packages
* Wiki de Arch Linux: https://wiki.archlinux.org
* Página web del proyecto DUNE: https://dune-project.org
* Página web: https://cpp-review-dune.github.io
* Grupo en Telegram: https://t.me/joinchat/G5yP1nF1xh2ix
* GitHub Org: https://github.com/cpp-review-dune
* Dune/PDELab Course 2021: https://dune-pdelab-course.readthedocs.io
* Documentación de DUNE: /usr/share/doc/medialv/donyen/index.html
```

C++ Review DUNE meets Arch Linux Repository for Education

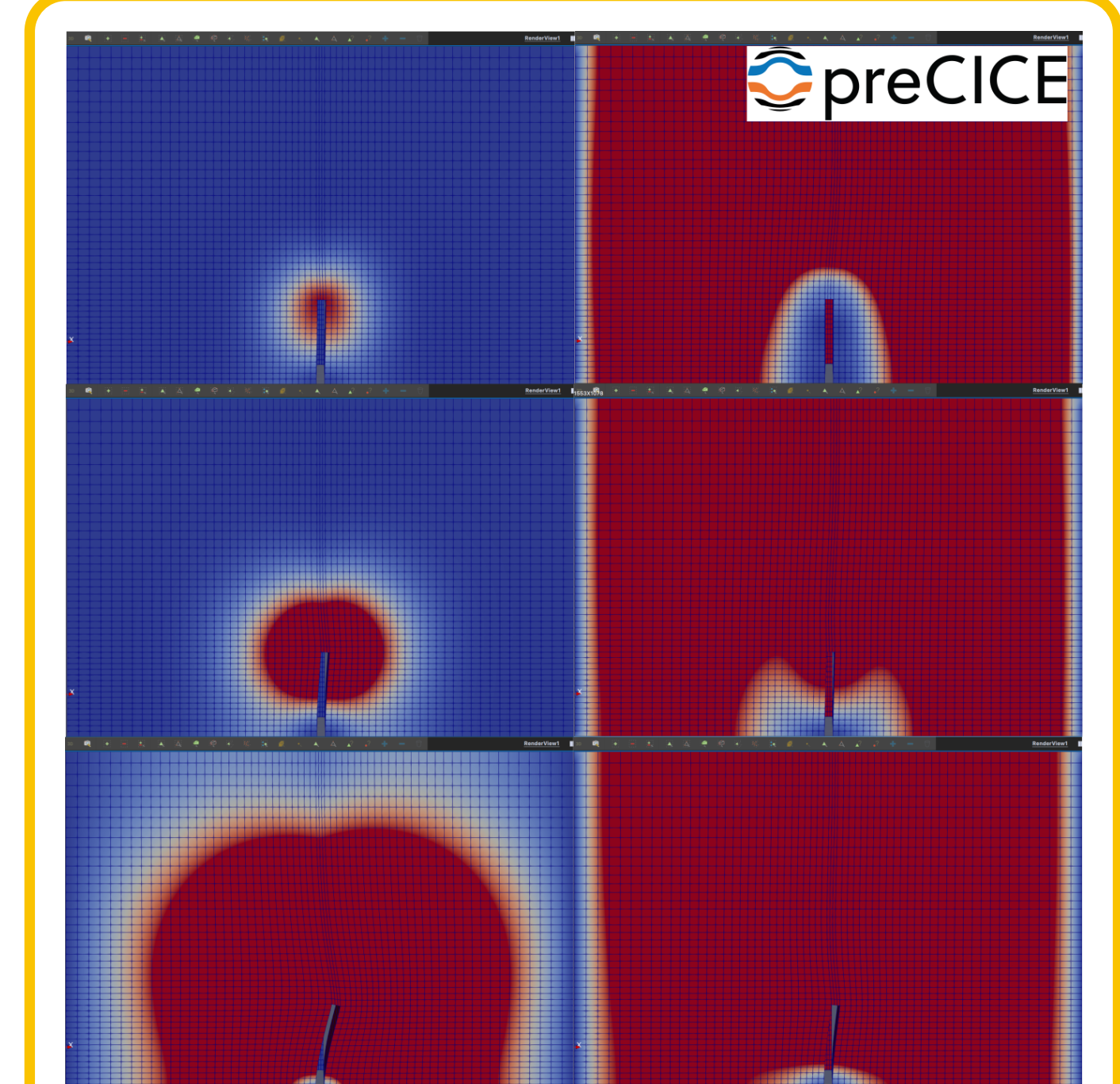
```
gitpod ~ $ pacman -Ss dumux
arch4edu/dumux 3.5.0-1
An open-source simulator and research code in modern C++
arch4edu/python-dumux 3.5.0-1
An open-source simulator and research code in modern C++ (python bindings)
gitpod ~ $ █
```



Example of water contamination due loses leaky oil while parking.

$$v = -\frac{1}{\mu} K (\nabla p + \rho g \nabla z).$$

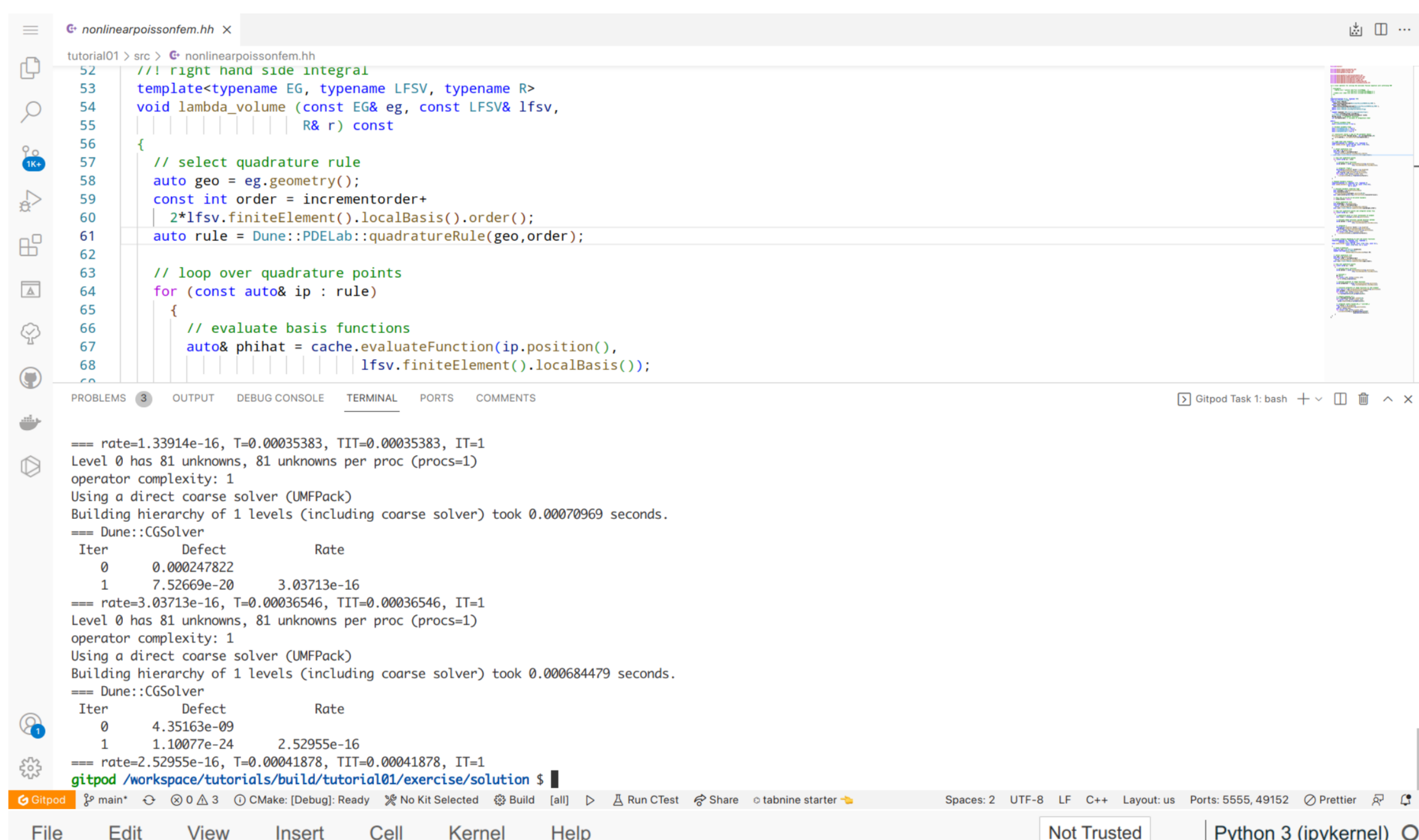
p pressure, K absolute permeability, μ viscosity, ρ density.



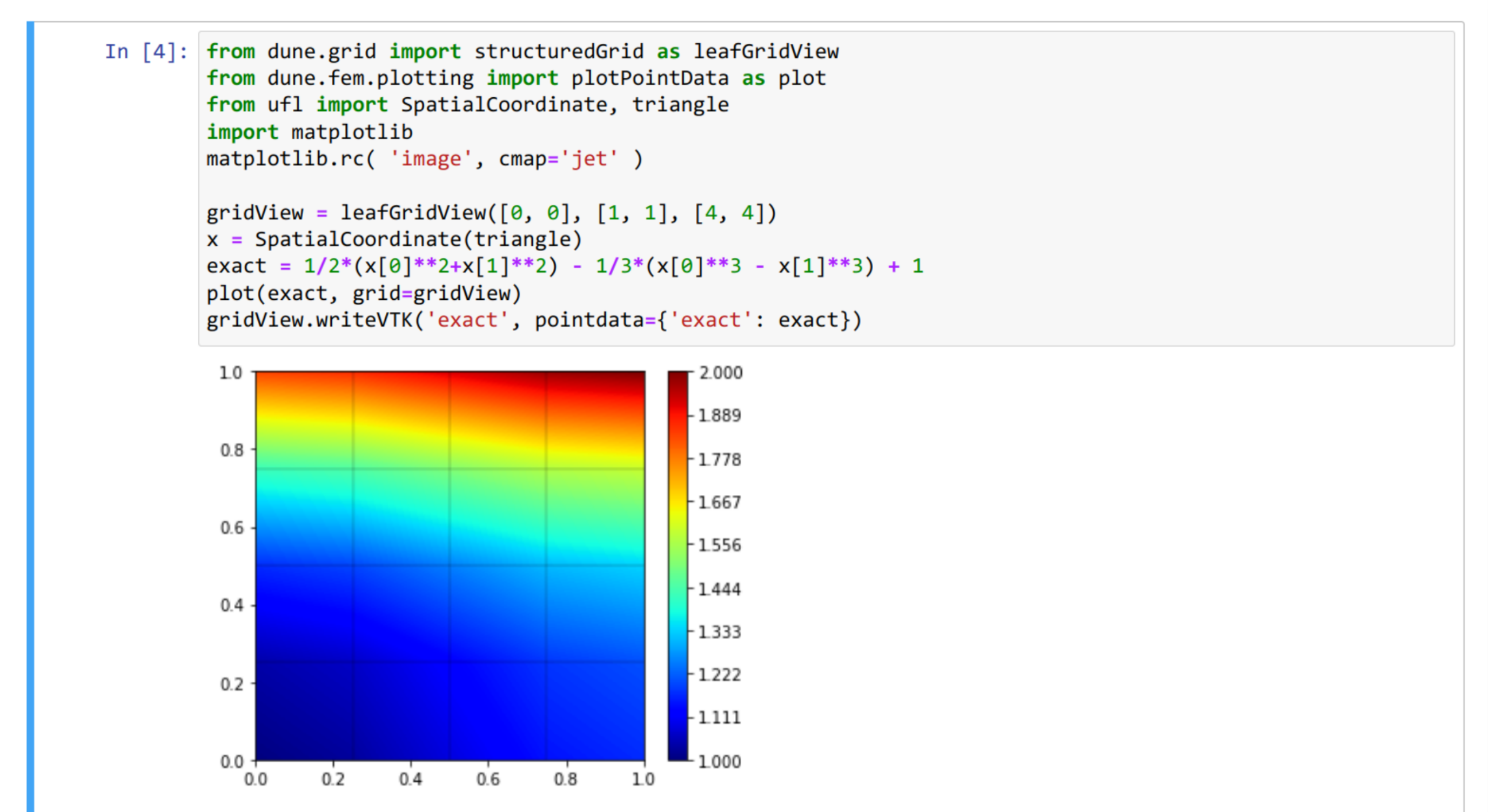
Example of a fluid-structure interaction, e.g. fluid flowing through a channel in 2D.

Tutorials available on Gitpod

<https://cpp-review-dune.github.io/tutorial>



```
nonlinearpoissonfem.hh
52 //! Finite: name side integral
53 template<typename EG, typename LFSV, typename R>
54 void lambda_volume(const EG& eg, const LFSV& lfsv,
55                  R& r) const
56 {
57     // select quadrature rule
58     auto geo = eg.geometry();
59     const int order = incrementorder<
60     2>::ifv::finiteElement::localBasis().order();
61     auto rule = Dune::PDELab::quadratureRule(geo, order);
62
63     // loop over quadrature points
64     for (const auto& ip : rule)
65     {
66         // evaluate basis functions
67         auto& phi_hat = cache.evaluateFunction(ip.position(),
68         ifsv::finiteElement::localBasis());
69     }
70 }
```



GitHub's Docker registry

<https://github.com/orgs/cpp-review-dune/packages>

We use GitHub's continuous integration and Docker registry for use GitPod's environment with tutorials about Dune Python bindings, DuMu^x, Gmsh, preCICE, TeX Live to name a few, also users can run a USB stick or virtualization software from sourceforge.net/projects/dune-archiso. On the other hand, the Dune modules are tested in gitlab.com/dune-archiso/testing/aur/dune-makepkg.

References

- [1] DuMu^x 3 - an open-source simulator for solving flow and transport problems in porous media with a focus on model coupling. *Computers & Mathematics with Applications*, 2020.
- [2] G Chourdakis, K Davis, B Rodenberg, M Schulte, F Simonis, and B Uekermann. preCICE v2: A sustainable and user-friendly coupling library. *Open Research Europe*, 2(51), 2022.
- [3] Zhang G. and Hu Y. BioArchlinux: bioinformatics community with Arch Linux <https://doi.org/10.7490/f1000research.1119039.1>, July 2022.
- [4] Jingbei Li and Carlos Aznarán. Arch Linux Repository for Education <https://github.com/arch4edu/arch4edu>, September 2022.
- [5] Christian Weichel and Manuel de Brito Fontes. Gitpod an open-source Kubernetes application for ready-to-code developer environment <https://github.com/gitpod-io/gitpod>, July 2018.

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