

E4S Overview and Demo

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via Zoom

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<https://e4s.io>



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<https://e4s.io>

Challenges

- As our software gets more complex, it is getting harder to install tools and libraries correctly in an integrated and interoperable software stack.

E4S: Extreme-scale Scientific Software Stack

- Curated, Spack based software distribution
- Spack binary build caches for bare-metal installs
 - x86_64, ppc64le (IBM Power 9), and aarch64 (ARM64)
- Container images on DockerHub and E4S website of pre-built binaries of ECP ST products
- Base images and full featured containers (GPU support)
- GitHub recipes for creating custom images from base images
- GitLab integration for building E4S images
- E4S validation test suite on GitHub
- E4S VirtualBox image with support for container runtimes
 - Docker
 - Singularity
 - Shifter
 - Charliecloud
- AWS and GCP images to deploy E4S

<https://e4s.io>

Extreme-scale Scientific Software Stack (E4S)

- E4S: A Spack-based distribution of ECP ST and related and dependent software tested for interoperability and portability to multiple architectures
 - Provides distinction between SDK usability / general quality / community and deployment / testing goals
 - Will leverage and enhance SDK interoperability thrust
-
- Oct 2018: E4S 0.1 - 24 full, 24 partial release products
 - Jan 2019: E4S 0.2 - 37 full, 10 partial release products
 - Nov 2019: E4S 1.0 - 50 full, 5 partial release products
 - Jan 2020: E4S 1.1 – ppc64le and x86_64 release with 50 full (x86_64), 46 full (ppc64le) release products.



<https://e4s.io>

Spack

- E4S uses the Spack package manager for software delivery
- Spack provides the ability to specify versions of software packages that are and are not interoperable.
- Spack is a build layer for not only E4S software, but also a large collection of software tools and libraries outside of ECP ST.
- Spack supports achieving and maintaining interoperability between ST software packages.
- <https://spack.io>

Spack enables software distribution for HPC

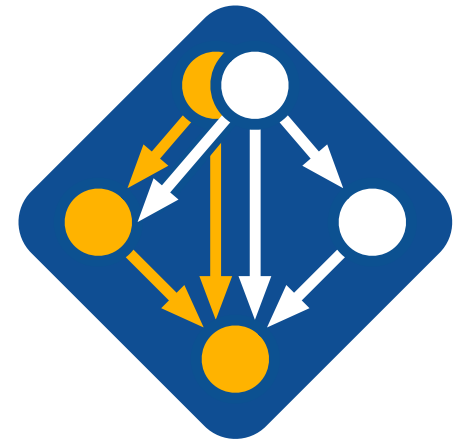
No installation required: clone and go

```
$ git clone https://github.com/spack/spack
$ spack install tau
```

```
$ spack install tau
$ spack install tau@2.29.1
$ spack install tau@2.29.1 %gcc@7.3.0
$ spack install tau@2.29.1 %gcc@7.3.0 +mpi+python+threads
$ spack install tau@2.29.1 %gcc@7.3.0 +mpi ^mvapich2@2.3~wrapperrpath
```

unconstrained
@ custom version
% custom compiler
+/- build option
^ dependency information

- Each expression is a **spec** for a particular configuration
 - Each clause adds a constraint to the spec
 - Constraints are optional – specify only what you need.
 - Customize install on the command line!
- Spec syntax is recursive
 - Full control over the combinatorial build space



E4S Components

- E4S is a curated release of ECP ST products based on Spack [<http://spack.io>].
- E4S Spack cache to support bare-metal installs at facilities and custom container builds:
 - x86_64, ppc64le, and aarch64
- Container images on DockerHub and E4S website of pre-built binaries of ECP ST products.
- Base images and full featured containers with support for GPUs.
- GitHub recipes for creating custom images from base images.
- e4s-cl for container launch and for replacing MPI in application with system MPI libraries.
- Validation test suite on GitHub provides automated build and run tests.
- Automates build process via GitLab Continuous Integration to ensure packages can be built.
- E4S Doc Portal aggregates and summarizes documentation and metadata by raking product repos.
- E4S VirtualBox image with support for Docker, Shifter, Singularity, and Charliecloud runtimes.
- AWS image to deploy E4S on EC2.
- GCP image to deploy E4S.

<https://e4s.io>

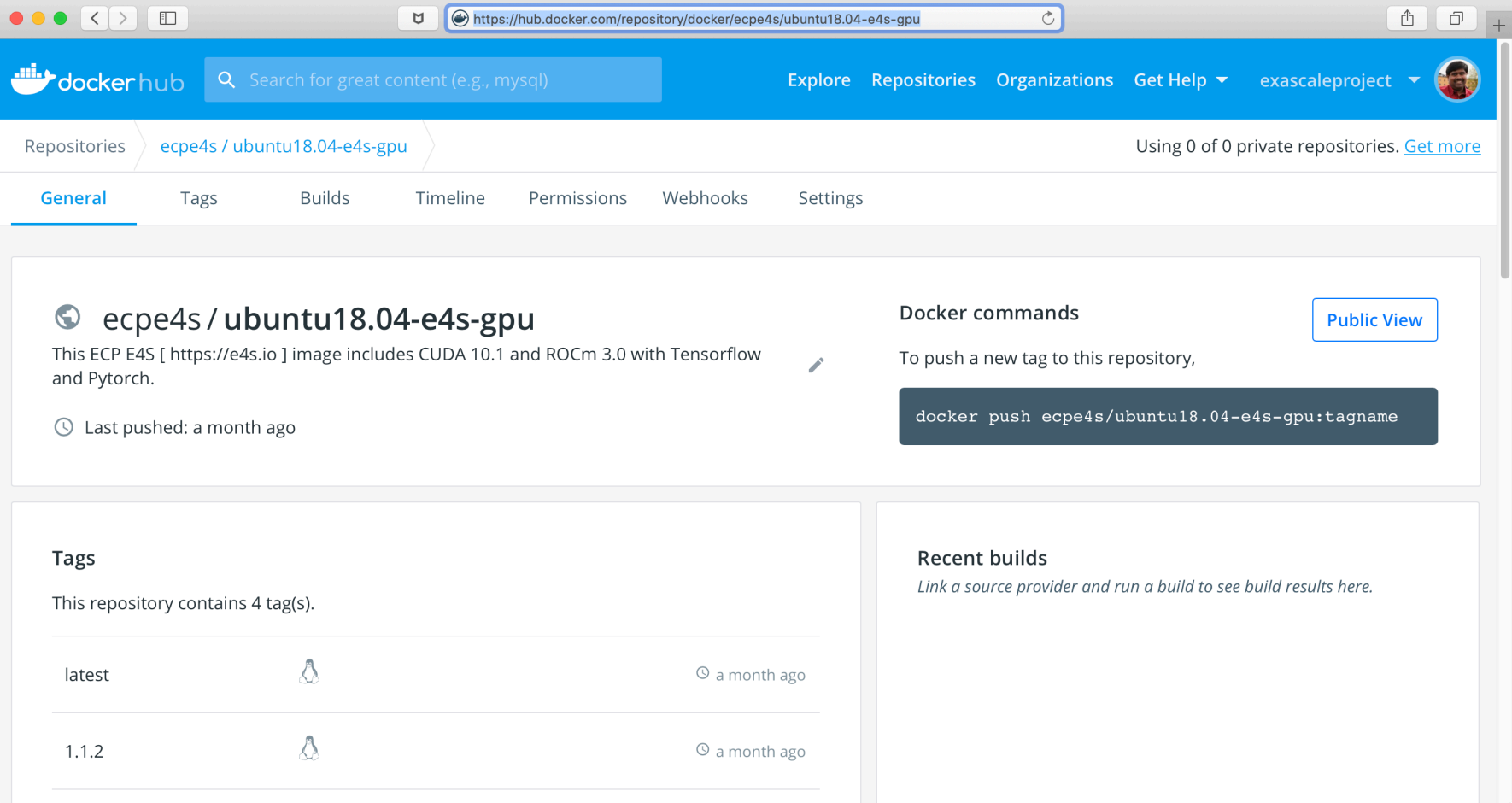
Download E4S v1.1 GPU image

Browser address bar: <https://e4s-project.github.io/download.html>

```
# docker pull ecpe4s/ubuntu18.04-e4s-gpu
```

OS	Image Type	Image Name	Links
RHEL 7	SPACK MINIMAL	ecpe4s/rhel7-spack	docker GitHub
	E4S COMPREHENSIVE	ecpe4s/rhel7-e4s	docker GitHub
	CUSTOM	ecpe4s/superlu_sc	docker GitHub
Ubuntu 18.04	E4S GPU IMAGE	ecpe4s/ubuntu18.04-e4s-gpu	docker GitHub
		x86_64 version: CUDA and ROCM	
		ppc64le version: CUDA	
	SPACK MINIMAL	ecpe4s/ubuntu18.04-spack	docker GitHub
	E4S COMPREHENSIVE	ecpe4s/ubuntu18.04-e4s	docker GitHub
CentOS 7	SPACK MINIMAL	ecpe4s/centos7-spack	docker GitHub
	E4S COMPREHENSIVE	ecpe4s/centos7-e4s	docker GitHub
	CUSTOM	----	

E4S v1.1 Release Available at DockerHub

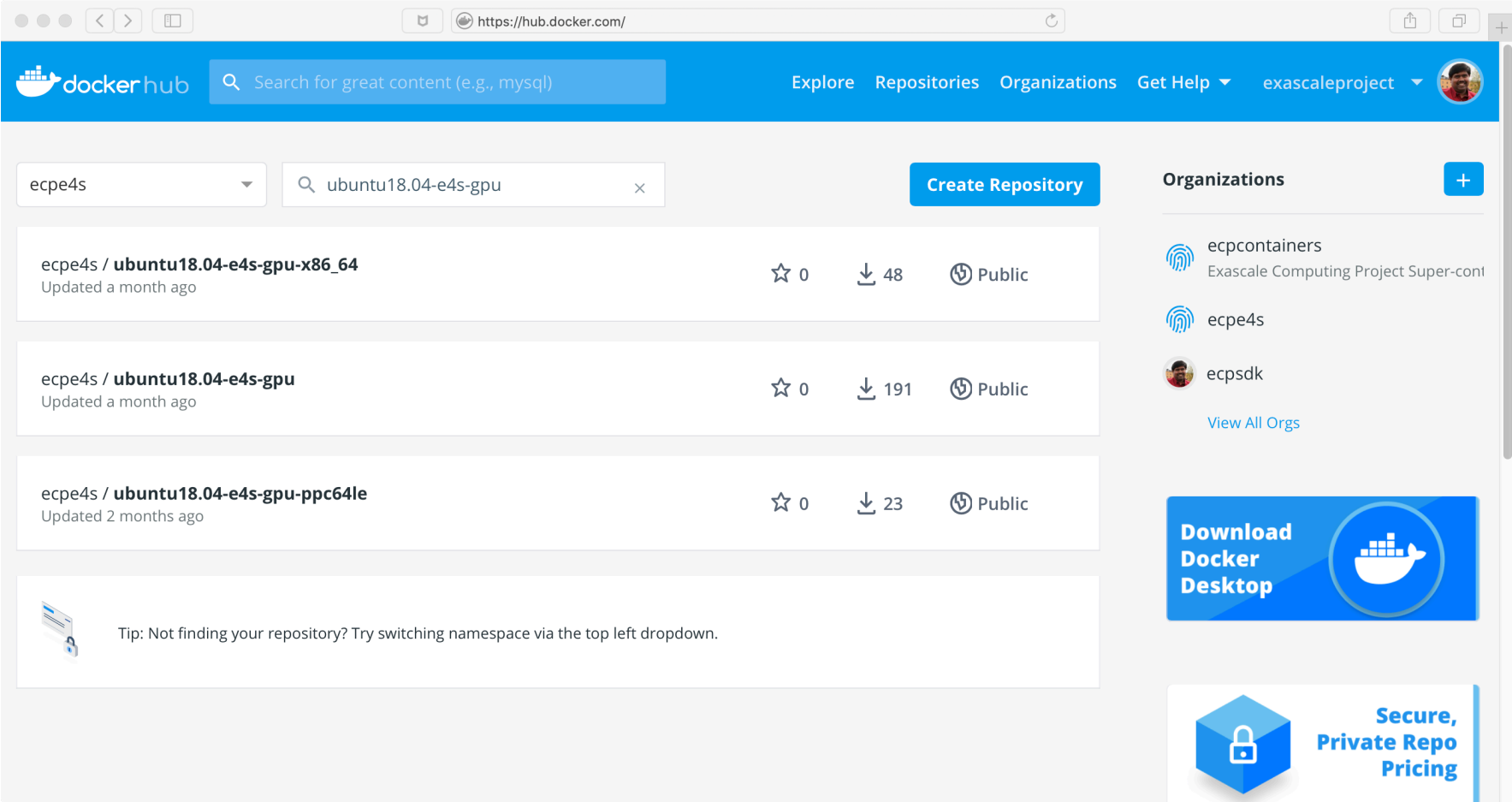


The screenshot shows the DockerHub interface for the repository `ecpe4s/ubuntu18.04-e4s-gpu`. The page includes a search bar, navigation tabs (General, Tags, Builds, Timeline, Permissions, Webhooks, Settings), and a description of the image: "This ECP E4S [https://e4s.io] image includes CUDA 10.1 and ROCm 3.0 with Tensorflow and Pytorch." It also displays Docker commands for pushing a new tag: `docker push ecpe4s/ubuntu18.04-e4s-gpu:tagname`. The "Tags" section lists two tags: `latest` and `1.1.2`, both pushed a month ago. The "Recent builds" section is currently empty.

- 50 ECP ST Products
- Support for GPUs
 - AMD (ROCm 3.0)
 - NVIDIA (CUDA 10.1)
 - x86_64

`% docker pull ecpe4s/ubuntu18.04-e4s-gpu`

E4S v1.1 Release at DockerHub: GPU Support



- 45+ ECP ST Products
- Support for GPUs
 - NVIDIA (CUDA 10.1.243)
 - ppc64le

% docker pull ecpe4s/ubuntu18.04-e4s-gpu

E4S v1.1.2 GPU Release for x86_64

```
1: adios /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/adios-1.13.1-debxoLyd5skx27s6ngtab7enrcsfq64
2: aml /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/aml-0.1.0-xdrekw6u7gr556xd6amxycerhg5v4wcs
3: argobots /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/argobots-1.0rc1-yrhx37ohi2vlxai6vcmtznqttletxejs
4: bolt /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/bolt-1.0rc2-danzb3khhuosggmdjapux4424rqr7zpa
5: caliper /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/caliper-2.0.1-hzze6uvf5e2eklzebxzatzjuxo3xgwkr
6: darshan-runtime /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/darshan-runtime-3.1.7-wscbtntqfiupsp7edyqsihbvm55a6vse
7: dyninst /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/dyninst-10.1.0-fttqy2zoqsbcqil6ur5cevssashha2c
8: faodel /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/faodel-1.1906.1-ky5irwwewec2bsml7w7x2szsvkxh7
9: flecsi /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/flecsi-develop-fxaq6sbr5oryertnaf4brpzs2ejshevbt
10: gasnet /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/gasnet-2019.3.0-47idkg4gcemcvtjschfcjka6c37164n
11: geomp /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/geomp-1.0.0-rc2-chxnuparg2hhaw4yworkqfhp36n7kxgk
12: globalarrays /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/globalarrays-5.7-b14hhz32b2yw64wjtoan3fafjkkj7nqk
13: gotcha /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/gotcha-1.0.2-gggaxidw2wboLux7q7n2m53nxcu3i2
14: hdf5 /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/hdf5-1.10.5-qqkkee6imkjoma5nd4jwbm6xphlkm4yp
15: hpctoolkit /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/hpctoolkit-2019.08.14-2iwdpemc4q64pvxm6y55oicmyr3lyr
16: hypre /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/hypre-2.18.1-3sh6dcavpdxd4ddykp4zer7fmgay54
17: kokkos /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/kokkos-2.9.00-jp35xv6moqehjrynoenj2kzpxski6cz
18: legion /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/legion-19.06.0-yf6lxznv47faxes2jf3etl74roskksvum
19: libnm /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/libnm-0.1.0-e7eixtdo6bz7o4derwvpo3sb2jxfxud
20: libquo /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/libquo-1.3-167575wypddp5tighcg2iu4kkaacmj3r
21: magma /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/magma-2.5.1-mtqtn6ad3qtfwwf5fvdc2igzccu43yhk
22: mercury /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/mercury-1.0.1-nena7d7vhiqm56abtr44jospogymau4t
23: mfem /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/mfem-4.0.0-ef2xjvix7qkdb6tmctih3yailtwjiul
24: mpich /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/mpich-3.2.1-yi7oup5retdgtafg3hyhrixwdjdnxtg
25: mpi4py /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/mpi4py-develop-4lo3yspw6662oc2o6oj7iv77kdh6vtt
26: ninja /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/ninja-1.9.0-rtsvov2vqkm5dscr3sbszigsqybm5f6c
27: openmpi /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/openmpi-3.1.4-suwdebrvnjs6zj7roh4577ggk2wnnp
28: papi /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/papi-5.7.0-bdebmgm5lypkvz3av4fmy2idvqsemb
29: papyrus /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/papyrus-develop-bknq744bwr4g24ucqhqk5o4bonwi4ws
30: parallel-netcdf /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/parallel-netcdf-1.11.2-lmkvcp7xspmgob2a6v4mgoso5whlxtg4
31: pdt /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/pdt-3.25.1-qn7v7q63nj4dxruluce7m2bqk4xatel2
32: petsc /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/petsc-3.12.1-u3ejzehj42b2t7s5xuitcuhn7x5s5rxi
33: py-jupyter-notebook /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/py-jupyter-notebook-4.2.3-styyzua7dtfm2bysot62suev4k4ezube
34: py-libensemble /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/py-libensemble-0.5.2-esfqkgd3gzpntocgoiwbgygxi5kbhy
35: qthreads /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/qthreads-1.14-wdbuioajj4j6pmw656nfy7qm3n7le6e
36: raja /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/raja-0.8.0-fojlfngsdkl53id5ennuioxy52y36sdp
37: rempi /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/rempi-1.1.0-lpcvnsu5oo77uubhrcbjrs3c5clfo3x
38: scr /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/scr-1.2.2-u3wzsilfsyh3aqpnxpiqxs22iqxwfuil
39: strumpack /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/strumpack-3.1.1-qrutcou5g3mf2efluktmbymbcjdxu2crv
40: sundials /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/sundials-5.0.0-4sx2ndxfzgwexkn72mqrnu6ouoetf33
41: superlu-dist /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/superlu-dist-6.1.1-sp4dikmr6lhm5vlemwhx6nsudxlm62
42: sz /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/sz-2.0.2-tvqs6j3rlfpl66kdwf5in3ofgdyllqsmw
43: tasmanian /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/tasmanian-7.0-ls2iqflhjstlrx5jqyfy5gvj6qbz7k7d
44: tau /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/tau-2.29-2eoagqfon3bjop6qd7tinnrj3wdydc6jj
45: trilinos /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/trilinos-12.14.1-zurt5mzx456bhtb2pc3w3na5atbqm6u3
46: umpire /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/umpire-0.3.3-om5obb6t6lu7xbksrcfhhittz2t6mzgl
47: unifyfs /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/unifyfs-develop-hlev5zptypluz37rkkeagmxwifdkplrr
48: upcxx /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/upcxx-2019.9.0-54ryimkhwecrhmsmgweev5ku5zvsdf7
49: veloc /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/veloc-1.1-j2x7hcg1j6grgi3w5kgcq6lomodvace3q
50: zfp /spack/opt/spack/linux-ubuntu18.04-x86_64/gcc-7.3.0/zfp-0.5.5-tlhrqw3ogejcrizc54kja3xruyrdvldw
```

- 50 ECP ST products
- Ubuntu v18.04 x86_64
- 5.3 GB compressed image
- AI/ML package support
 - TensorFlow
 - PyTorch
- Support for GPUs
 - AMD ROCm 3.1
 - NVIDIA CUDA 10.1.248

E4S v1.1 GPU Release for ppc64le

```
1: adios /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/adios-1.13.1-ryfsxpqaab6rkefscdy3qdba47eeh5fe
2: aml /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/aml-0.1.0-ftizegmvpbweuyzg75g3ndzhdyjx37op
3: argobots /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/argobots-1.0rc1-xjjrxwo2molgdesfwjyoiw24rxp3h
4: caliper /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/caliper-2.0.1-lzff2xp2eg7jrmgy4k2ifbii7zmpas
5: darshan-runtime /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/darshan-runtime-3.1.7-jgyzjuukvxpwjrzeaeweaukygyg7a6jxz
6: dyninst /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/dyninst-10.1.0-2ayefefqh74xwuadlbs3d6p2zyammmsf
7: flecsi /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/flecsi-develop-3v4qatztznja6dt4lr5pps3cxv3hy6to2
8: gasnet /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/gasnet-2019.3.0-n4tdzdz4hvy6zexy7bhe4qryzbcfkoif
9: globalarrays /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/globalarrays-5.7-ilibm5yzz6draxpkfo5t3d4csx5g64nu
10: gotcha /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/gotcha-1.0.2-h3qq2jz6a2ihwibdqndbfeh44pnmjr3z
11: hdf5 /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/hdf5-1.10.5-lgni fkbzs3p6ojothkkg53wf6hut4xqv
12: hpctoolkit /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/hpctoolkit-2019.08.14-vljantrum36jbdlzz37tynacw3ee2yhk
13: hypre /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/hypre-2.18.1-pj2krvlyc5bnjpa72a5xvk6k53r5ita
14: kokkos /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/kokkos-2.9.00-7h2cg7o3kdu23qymmfqswsewruvwkxgr
15: legion /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/legion-19.06.0-7ksiuqzq57y24t5kl6s2n4ffqdpnlupg
16: libnm /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/libnm-0.1.0-5yet3aafh2rp3wuapixphq3mwykiayqn
17: libquo /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/libquo-1.3-ul26vaqh6kl6vmqh4p4esm7zte1bpfo
18: mercury /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/mercury-1.0.1-akxk7fk6mddp2m5wxdaum31eh1b7dt24
19: mfem /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/mfem-4.0.0-bdte6oktrcnaktwi7qjj72psial5krb
20: mpich /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/mpich-3.2.1-sb2fna3i4s4feofy6swrr6wivzyyu7he
21: mpiutils /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/mpiutils-develop-r3s7t6qzgb4y4hpd5mzldbtskhv1qfj
22: ninja /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/ninja-1.9.0-pxjz2hyrn24ar65hqwcou7rvgafvyls
23: openmpi /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/openmpi-3.1.4-cty2bl5wikxipkgz1pu32xtmpqxzua2v
24: papi /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/papi-5.7.0-eaabymci f7c5dvjdejevnqkgat7recfp
25: papyrus /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/papyrus-develop-nu56mejweub56zjuexidml2t4o664zug
26: parallel-netcdf /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/parallel-netcdf-1.11.2-zxyjkdz4yxmyxcgyarcym5fqec4paj56
27: pdt /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/pdt-3.25.1-czegb3ismststym12wugki fojyb4cacs
28: petsc /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/petsc-3.12.1-q6pm6wyb43hlc6ndpvrkphvwntbt3xul
29: py-jupyter-notebook /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/py-jupyter-notebook-4.2.3-qky73g3q6kapsva7ishi rewe3qtapxhk
30: py-libensemble /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/py-libensemble-0.5.2-gz4rbjbd5lku5lt6ji6lyf2f6qoafuzt
31: qthreads /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/qthreads-1.14-jjprfqevnaccp6dhd5or6vz4obckmy4ah
32: raja /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/raja-0.8.0-mhamgpur67esmyekjpcflv1v6fdngod6
33: rempi /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/rempi-1.1.0-feg2oeofieeano1oaxulawxdeaqnfjtj
34: scr /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/scr-1.2.2-5sepujyr7dp5eioymphnqva4atcjc4e
35: strumpack /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/strumpack-3.1.1-jd7ytdr4sagdbx3khjy2jamlfbu4
36: sundials /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/sundials-5.0.0-cjkr7luit5jtm6eqd7mavwko5thr2w
37: superlu-dist /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/superlu-dist-6.1.1-6gklgz5snhaipunjttir1o46za76zd2d
38: sz /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/sz-1.4.12.3-7bnst7vnpua jazlagxtot46oih4caoaq
39: tasmanian /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/tasmanian-7.0-e3r2dvv5nnp7yaf5hzcocvkmxaf7pn
40: tau /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/tau-2.29-3eb5tlvcnukpkd2pls4z7ivhtc2ld7jm
41: trilinos /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/trilinos-12.14.1-jcikf6anps63huaohpymnm4xohgrral
42: umpire /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/umpire-0.3.3-bnxsv2cla4yc42mfvhwk7suy1mbcou
43: unifyfs /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/unifyfs-develop-fqzlm2dhtbnb2aeggadfcue2mkv74sco
44: upcxx /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/upcxx-2019.9.0-ndrqyemto1mj7i3dduekjbt4i3uo2jz
45: velox /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/velox-1.1-h723o37b5mowzewdzqburtrawnb5ynhi
46: zfp /spack/opt/spack/linux-ubuntu18.04-ppc64le/gcc-7.3.0/zfp-0.5.5-3r4a4s3qdeqbdabv1wlsrwig62yc6y
```

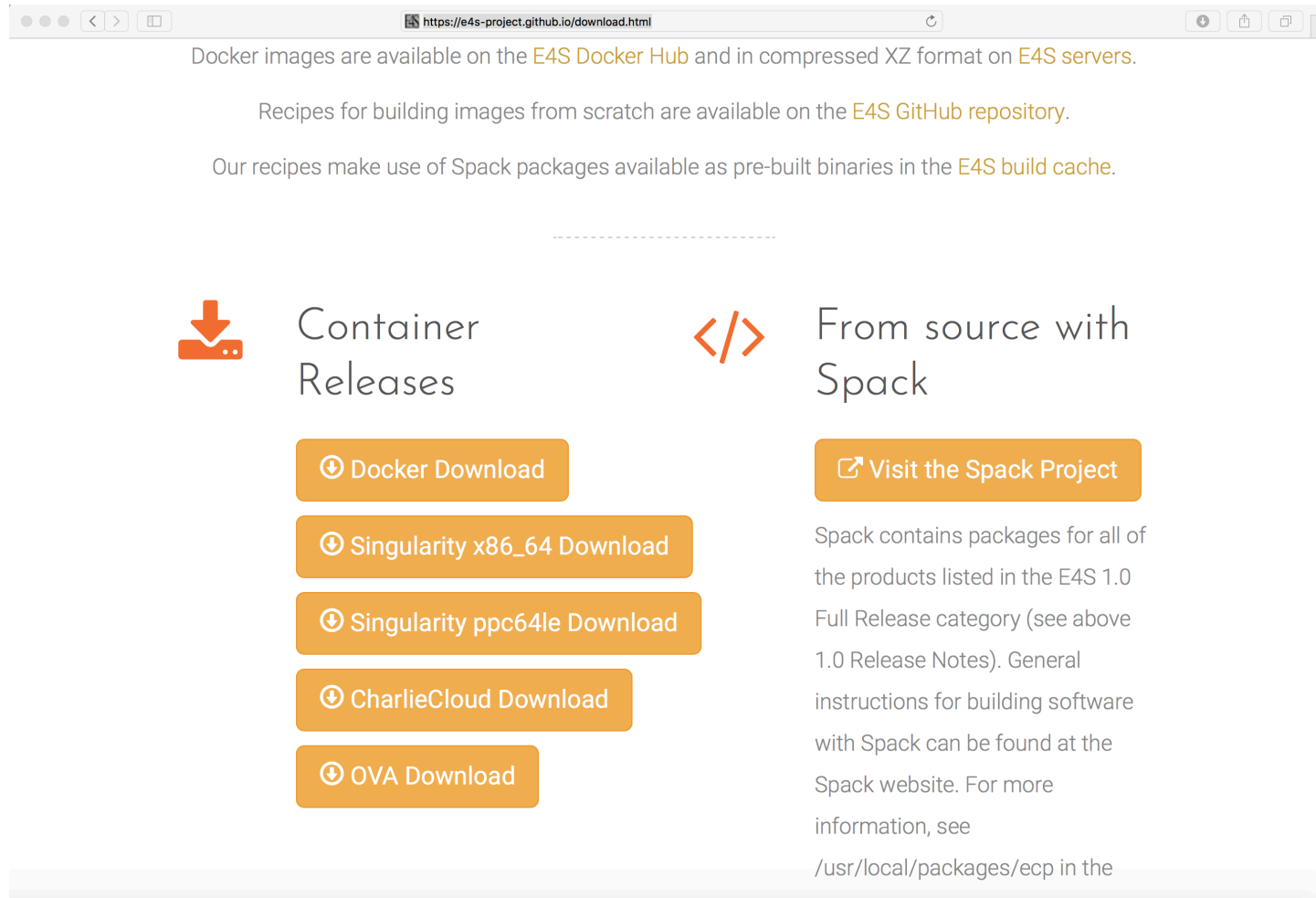
- 46 ECP ST products
- Ubuntu v18.04 ppc64le
- AI/ML package support
 - TensorFlow
 - PyTorch
- Support for GPUs
 - NVIDIA CUDA 10.1

`spack find` shows what is installed

```
sameer@minotaur:~$ docker run -v $HOME:/home/sameer -it ecpe4s/ubuntu18.04-ppc64le-e4s
root@3b983c57f123:/# which spack
/spack/bin/spack
root@3b983c57f123:/# spack find
==> 235 installed packages
-- linux-ubuntu18.04-ppc64le / gcc@7.3.0 -----
adios@1.13.1          hdf5@1.10.5          lua-luafilesystem@1_7.0_2  py-async-generator@1.10  py-pexpect@4.6.0      raja@0.8.0
aml@0.1.0            hdf5@1.10.5          lua-luaposition@33.4.0    py-babel@2.7.0          py-pickleshare@0.7.4   rankstr@0.0.2
argobots@1.0rc1     hdf5@1.10.5          lwgrp@1.0.2              py-backcall@0.1.0      py-pillow@6.2.0        readline@8.0
autoconf@2.69       hpctoolkit@2019.08.14 lz4@1.9.2                py-blinker@1.4         py-prometheus-client@0.7.1  redset@0.0.3
automake@1.16.1     hwloc@1.11.11        lzo@2.10                 py-certifi@2019.9.11   py-prompt-toolkit@2.0.9  rempi@1.1.0
axl@0.1.1           hypre@2.18.1         m4@1.4.18                py-certipy@0.1.3       py-ptyprocess@0.5.1     scr@1.2.2
binutils@2.32       intel-tbb@2019.4     margo@0.4.3              py-cffi@1.13.0         py-py@1.8.0            shuffle@0.0.3
bmi@develop         kokkos@2.7.00        matio@1.5.13             py-charDET@3.0.4       py-pycparser@2.19       snappy@1.1.7
boost@1.70.0        kokkos@2.9.00        mercury@1.0.1            py-cryptography@2.3.1  py-pygments@2.4.2      sqlite@3.30.1
boost@1.70.0        kokkos-kernels@2.7.00  mercury@1.0.1            py-cycler@0.10.0       py-pyjwt@1.7.1          strumpack@3.1.1
boost@1.70.0        kvtree@1.0.2         metis@5.1.0              py-cython@0.29.13      py-pyopenssl@19.0.0     suite-sparse@5.3.0
bzip2@1.0.8         leveldb@1.22         mfem@4.0.0               py-decorator@2.4.2     py-pyparsing@2.4.2     sundials@5.0.0
c-blosc@1.17.0     libarchive@3.3.2     mpich@3.2.1              py-entrypoints@0.3     py-python-dateutil@2.8.0  superlu@5.2.1
caliper@2.0.1       libbsd@0.9.1         mpi4py@2.0.0             py-idna@2.8            py-python-dateutil@2.8.0  superlu-dist@6.1.1
cmake@3.15.4        libcircle@0.2.1-rc.1  mumps@5.2.0              py-ipykernel@5.1.0     py-python-editor@1.0.4   sz@1.4.12.3
curl@7.63.0         libdwarf@20180129    nasm@2.14.02             py-ipython@7.3.0       py-python-oauth2@1.1.1   tar@1.32
darshan-runtime@3.1.7  libfabric@1.8.1     netcdf@4.7.1             py-ipython-genutils@0.2.0  py-pytz@2019.3          tasmanian@7.0
darshan-util@3.1.7   libffi@3.2.1         netlib-scalapack@2.0.2   py-jinja2@2.10.3       py-requests@2.22.0      tcl@8.6.8
diffutils@3.7       libiberty@2.31.1     nettle@3.4.1             py-joblib@0.14.0       py-scikit-learn@0.21.3  texinfo@6.5
dtcmp@1.1.0         libiconv@1.16        ninja@1.9.0              py-jsonschema@2.6.0     py-scikit-optimize@0.5.2  trilinos@12.14.1
dyninst@10.1.0      libjpeg-turbo@2.0.3  numactl@2.0.12           py-jupyter-client@4.4.0  py-scipy@1.3.1          umpire@0.3.3
elfutils@0.177     libmonitor@2018.07.18  openblas@0.3.7          py-jupyter-console@5.2.0  py-setuptools@41.4.0     unifyfs@develop
emacs@26.2          libnrm@0.1.0         openmpi@3.1.4           py-jupyter-core@4.4.0   py-setuptools@41.4.0     unzip@6.0
er@0.0.3            libpciaccess@0.13.5  openssl@1.1.1d          py-jupyter-notebook@4.2.3  py-simplegeneric@0.8.1   upcxx@2019.9.0
expat@2.2.9         libpfm4@4.10.1       papi@5.7.0              py-jupyterhub@1.0.0     py-six@1.12.0           util-macros@1.19.1
findutils@4.6.0     libpng@1.6.37        papyrus@develop         py-kiwisolver@1.1.0     py-six@1.12.0          velocc@1.1
flatcc@0.5.3        libpthread-stubs@0.4  parallel-netcdf@1.11.2  py-libensemble@0.5.2    py-sqlalchemy@1.3.9     xerces-c@3.2.2
flecsi@develop      libquo@1.3           parmetis@4.0.3          py-mako@1.0.4          py-tornado@6.0.3        xz@5.2.4
freetype@2.10.1    libsigsegv@2.12      pcre@8.42               py-markupsafe@1.1.1     py-traitlets@4.3.3     zeromq@4.3.2
gdbm@1.18.1        libsodium@1.0.17     pcre@8.42               py-matplotlib@3.1.1    py-urllib3@1.25.6       zfp@0.5.5
gettext@0.20.1     libtool@2.4.6        pdsh@2.31               py-mistune@0.7.1       py-vcversioner@2.16.0.0  zlib@1.2.11
git@2.21.0         libunwind@1.2.1      perl@5.30.0             py-mpi4py@3.0.1        py-wcwidth@0.1.7        zstd@1.4.3
glm@0.9.7.1        libunwind@2018.10.12  petsc@3.12.1           py-nbconvert@4.2.0     py-ytopt@0.1.0          python@3.7.3
globalarrays@5.7   libxml2@2.9.9        pkgconf@1.6.3           py-nbformat@4.4.0     python@3.7.4            python@3.7.4
gmp@6.1.2          libyogrt@1.24        py-alembic@1.0.7       py-numpy@1.17.3        python@3.7.4            qthreads@1.14
gotcha@0.0.2        lmod@8.1.5           py-asn1crypto@0.22.0   py-openssl@1.1.1      python@3.7.4
gotcha@1.0.2       lua@5.3.5            py-async-generator@1.10  py-openssl@1.1.1      python@3.7.4
```

- All the versions coexist!
 - Multiple versions of same package are ok.
- Packages are installed to automatically find correct dependencies.
- Binaries work *regardless of user's environment*.
- Spack also generates module files.
 - Don't *have* to use them.

E4S Support for Singularity Container Runtime [Sylabs.io]



The screenshot shows a web browser window with the URL `https://e4s-project.github.io/download.html`. The page content includes:

- Docker images are available on the [E4S Docker Hub](#) and in compressed XZ format on [E4S servers](#).
- Recipes for building images from scratch are available on the [E4S GitHub repository](#).
- Our recipes make use of Spack packages available as pre-built binaries in the [E4S build cache](#).

The page is divided into two main sections:

- Container Releases** (indicated by a download icon):
 - [Docker Download](#)
 - [Singularity x86_64 Download](#)
 - [Singularity ppc64le Download](#)
 - [CharlieCloud Download](#)
 - [OVA Download](#)
- From source with Spack** (indicated by a code icon):
 - [Visit the Spack Project](#)
 - Text: Spack contains packages for all of the products listed in the E4S 1.0 Full Release category (see above 1.0 Release Notes). General instructions for building software with Spack can be found at the Spack website. For more information, see `/usr/local/packages/ecp` in the...



- `wget http://oaciss.uoregon.edu/e4s/images/e4s_ubuntu1804_gpu_ppc64le_1.1.simg`
- `singularity exec --nv e4s_ubuntu1804_gpu_ppc64le_1.1.simg /bin/bash --rcfile /etc/bashrc`
- `spack find`

E4S v1.1 GPU Support for ppc64le

```
sameer@cyclops:~ — ssh zorak — 137x51
Singularity> which python
/usr/bin/python
Singularity> python
Python 3.6.10 |Anaconda, Inc.| (default, Jan 7 2020, 21:47:07)
[GCC 7.3.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import tensorflow
>>> import torch
>>> import cv2
>>> import pandas
>>> import sklearn
>>> import keras
Using TensorFlow backend.
>>> import matplotlib; import numpy; import scipy
>>> torch.cuda.current_device()
0
>>> tensorflow.test.is_gpu_available()
2020-02-20 19:46:00.714206: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1433] Found device 0 with properties:
name: Tesla V100-SXM2-32GB major: 7 minor: 0 memoryClockRate(GHz): 1.53
pciBusID: 0004:04:00.0
totalMemory: 31.72GiB freeMemory: 24.06GiB
2020-02-20 19:46:00.828521: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1433] Found device 1 with properties:
name: Tesla V100-SXM2-32GB major: 7 minor: 0 memoryClockRate(GHz): 1.53
pciBusID: 0004:05:00.0
totalMemory: 31.72GiB freeMemory: 31.41GiB
2020-02-20 19:46:00.937000: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1433] Found device 2 with properties:
name: Tesla V100-SXM2-32GB major: 7 minor: 0 memoryClockRate(GHz): 1.53
pciBusID: 0035:03:00.0
totalMemory: 31.72GiB freeMemory: 31.41GiB
2020-02-20 19:46:01.043356: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1433] Found device 3 with properties:
name: Tesla V100-SXM2-32GB major: 7 minor: 0 memoryClockRate(GHz): 1.53
pciBusID: 0035:04:00.0
totalMemory: 31.72GiB freeMemory: 31.41GiB
2020-02-20 19:46:01.043434: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1512] Adding visible gpu devices: 0, 1, 2, 3
2020-02-20 19:46:09.555187: I tensorflow/core/common_runtime/gpu/gpu_device.cc:984] Device interconnect StreamExecutor with strength 1 edge matrix:
2020-02-20 19:46:09.555313: I tensorflow/core/common_runtime/gpu/gpu_device.cc:990]      0 1 2 3
2020-02-20 19:46:09.555326: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1003] 0:  N Y Y Y
2020-02-20 19:46:09.555334: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1003] 1:  Y N Y Y
2020-02-20 19:46:09.555341: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1003] 2:  Y Y N Y
2020-02-20 19:46:09.555349: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1003] 3:  Y Y Y N
2020-02-20 19:46:09.555942: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1115] Created TensorFlow device (/device:GPU:0 with 22986
MB memory) -> physical GPU (device: 0, name: Tesla V100-SXM2-32GB, pci bus id: 0004:04:00.0, compute capability: 7.0)
2020-02-20 19:46:09.556909: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1115] Created TensorFlow device (/device:GPU:1 with 30132
MB memory) -> physical GPU (device: 1, name: Tesla V100-SXM2-32GB, pci bus id: 0004:05:00.0, compute capability: 7.0)
2020-02-20 19:46:09.557139: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1115] Created TensorFlow device (/device:GPU:2 with 30132
MB memory) -> physical GPU (device: 2, name: Tesla V100-SXM2-32GB, pci bus id: 0035:03:00.0, compute capability: 7.0)
2020-02-20 19:46:09.558067: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1115] Created TensorFlow device (/device:GPU:3 with 30132
MB memory) -> physical GPU (device: 3, name: Tesla V100-SXM2-32GB, pci bus id: 0035:04:00.0, compute capability: 7.0)
True
>>>
```

E4S: ppc64le Base Container Images

The screenshot shows the Docker Hub interface. At the top, there's a navigation bar with 'docker hub' logo, a search bar containing 'ppc64le', and links for 'Explore', 'Repositories', 'Organizations', and 'Get Help'. The user profile 'exascaleproject' is visible. Below the navigation, a dropdown menu shows 'ecpe4s' and a search bar contains 'ppc64le'. A 'Create Repository +' button is present. The main content area lists three repositories:

Repository Name	Stars	Downloads	Visibility
ecpe4s / ubuntu1804_ppc64le_base Updated 2 days ago	0	7	PUBLIC
ecpe4s / ubi7_ppc64le_base Updated 2 days ago	0	7	PUBLIC
ecpe4s / centos7_ppc64le_base Updated 2 days ago	0	10	PUBLIC

Below the list is a tip: "Tip: Not finding your repository? Try switching namespace via the top left dropdown." On the right side, there's an 'Organizations' section listing 'ecpcontainers', 'ecpe4s', and 'ecpsdk'. At the bottom right, there are two promotional banners: 'Download Docker Desktop' and 'Secure, Private Repo Pricing'.

- Hub.docker.com
- ecpe4s

- Ubuntu 18.04
- RHEL/UBI 7.6
- Centos 7.6

E4S Spack Build Cache and Container Build Pipeline



Reproducible, Customizable Container Builds & Spack Mirrors

- E4S provides base images and recipes for building Docker containers based on SDKs
 - Git: <https://github.com/UO-OACISS/e4s>
 - E4S provides **build caches for Spack for native bare-metal as well as container builds based on installation** of ST products
 - Build caches: <https://oaciss.uoregon.edu/e4s/inventory.html>
 - **The build cache model can be extended to target platforms**, and can be managed by facilities staff when appropriate.

E4S: Spack Build Cache at U. Oregon

E4S Build Cache for Spack 0.15.4

To use this build cache, just add it to your Spack

```
spack mirror add E4S https://cache.e4s.io
```

```
spack buildcache keys -it
```

Click on one of the packages below to see a list of all available variants.

All Architectures PPC64LE X86_64

All Operating Systems Centos 7 Centos 8 RHEL 7 RHEL 8 Ubuntu 18.04 Ubuntu 20.04

Last updated: 09-10-2020 08:45 PDT

21905 Spack packages

adiak@0.1.1 adios2@2.5.0 adios2@2.6.0 adios@1.13.1 adlbx@0.9.2 amg@1.2 aml@0.1.0 amrex@20.07 ant@1.10.0 ant@1.10.7
argobots@1.0 argobots@1.0rc1 argobots@1.0rc2 arpack-ng@3.7.0 ascent@develop autoconf@2.69 automake@1.16.1 automake@1.16.2
axl@0.1.1 axl@0.3.0 axom@0.3.3 bdftopcf@1.0.5 berkeley-db@18.1.40 berkeley-db@6.2.32 binutils@2.31.1 binutils@2.32 binutils@2.33.1
binutils@2.34 bison@3.4.2 bmi@develop bolt@1.0 bolt@1.0rc2 bolt@1.0rc3 boost@1.70.0 boost@1.72.0 boost@1.73.0 boost@1.74.0
butterflypack@1.1.0 butterflypack@1.2.0 bzip2@1.0.8 c-blosc@1.17.0 caliper@2.0.1 caliper@2.2.0 caliper@2.3.0 caliper@2.4.0
camtimers@master catalyst@5.6.0 cinch@develop cinch@master cmake@3.13.4 cmake@3.14.5 cmake@3.14.7 cmake@3.15.4 cmake@3.16.2

- 20,000+ binaries!
- S3 mirror
- No need to build from source code!

WDMapp: Speeding up bare-metal installs using E4S build cache

The screenshot shows a web browser displaying the WDMapp documentation page for Rhea machines. The page has a blue header with the ECP logo and 'WDMapp Whole Device Model application' text. A search bar is visible. The left sidebar contains a table of contents with 'Building WDMapp' highlighted. The main content area features a 'Note' box with terminal commands for setting up the E4S build cache, followed by sections for 'Building WDMapp' and 'Using E4S WDMapp docker container' with their respective terminal commands.

```
$ wget https://oaciss.uoregon.edu/e4s/e4s.pub
$ spack gpg trust e4s.pub
$ spack mirror add E4S https://cache.e4s.io/e4s
```

Building WDMapp

You should be able to just follow the generic instructions from [Building WDMAPP](#).

Using E4S WDMapp docker container

Alternatively, the [E4S project](#) has created a docker image that mirrors the Rhea environment, which can be used for local development and debugging. To run this image, you need to have docker installed and then do the following:

```
$ docker pull ecpe4s/ubi7.7_x86_64_base_wdm:1.0
$ docker run -rm -it ecpe4s/ubi7.7_x86_64_base_wdm:1.0
```

In order for the image to get the access controlled components, you need to provide it with your private SSH key that provides access to the respective private github repos. In the image, do the following in the docker image:

```
# cat > .ssh/id_rsa # Then copy&paste your private key
# chmod 600 .ssh/id_rsa
```

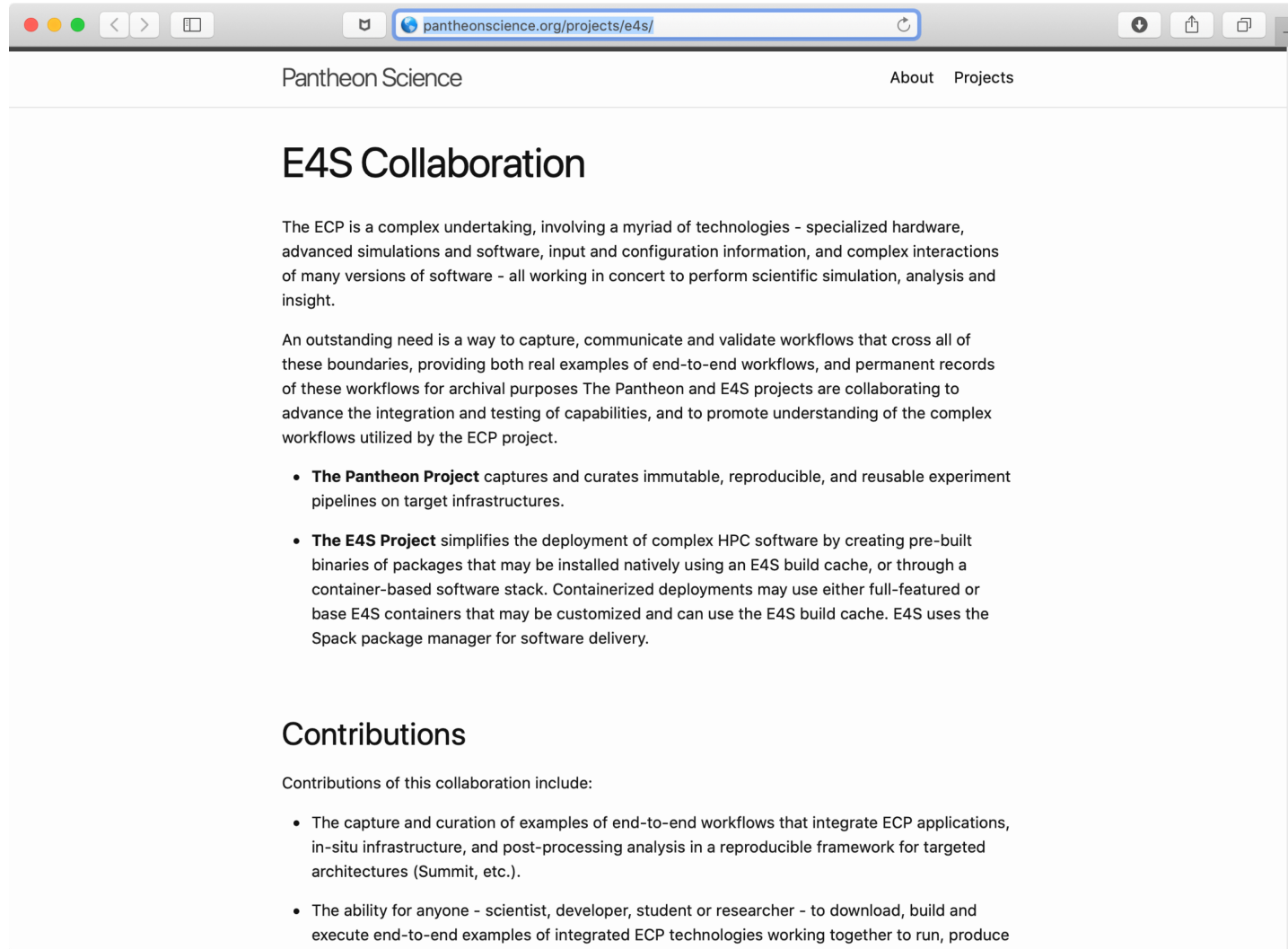
This provides an development environment with everything but the private codes preinstalled. All that's needed to complete building and installing them is:

```
# spack install wdmapp target=x86_64
```

- E4S Spack build cache
- Adding E4S mirror
- WDMapp install speeds up!

- <https://wdmapp.readthedocs.io/en/latest/machines/rhea.html>

Pantheon Science at LANL



The screenshot shows a web browser window with the URL pantheonscience.org/projects/e4s/. The page title is "Pantheon Science" and the navigation menu includes "About" and "Projects". The main heading is "E4S Collaboration".

The ECP is a complex undertaking, involving a myriad of technologies - specialized hardware, advanced simulations and software, input and configuration information, and complex interactions of many versions of software - all working in concert to perform scientific simulation, analysis and insight.

An outstanding need is a way to capture, communicate and validate workflows that cross all of these boundaries, providing both real examples of end-to-end workflows, and permanent records of these workflows for archival purposes. The Pantheon and E4S projects are collaborating to advance the integration and testing of capabilities, and to promote understanding of the complex workflows utilized by the ECP project.

- **The Pantheon Project** captures and curates immutable, reproducible, and reusable experiment pipelines on target infrastructures.
- **The E4S Project** simplifies the deployment of complex HPC software by creating pre-built binaries of packages that may be installed natively using an E4S build cache, or through a container-based software stack. Containerized deployments may use either full-featured or base E4S containers that may be customized and can use the E4S build cache. E4S uses the Spack package manager for software delivery.

Contributions

Contributions of this collaboration include:

- The capture and curation of examples of end-to-end workflows that integrate ECP applications, in-situ infrastructure, and post-processing analysis in a reproducible framework for targeted architectures (Summit, etc.).
- The ability for anyone - scientist, developer, student or researcher - to download, build and execute end-to-end examples of integrated ECP technologies working together to run, produce



- E4S Spack build cache
- Adding E4S mirror
- Pantheon spack install 10x speedup!

New E4S Spack Cache Website (under development)



E4S Spack Cache

Search Packages

- All
 - Ubuntu 18.04
 - RHEL 7
 - RHEL 8
 - CentOS 7
 - CentOS 8
- All
 - X86_64
 - PPC64LE

Showing 306 packages representing 8607 binaries

adiak Adiak collects metadata about HPC application runs and provides it to tools.
adios The Adaptable IO System (ADIOS) provides a simple, flexible way for scientists to describe the data in their code that may need to be written, read, or processed outside of the running simulation.
adios2 The Adaptable Input Output System version 2, developed in the Exascale Computing Program
adlbox ADLB/X: Master-worker library + work stealing and data dependencies
aml

E4S Spack Environment - Current Examples

- Building on **AWS Cloud** as part of Spack PR and Release Testing
 - CI Dashboard available @ <https://cdash.spack.io>
- Building at **University of Oregon**
 - ppc64le and x86/64 systems with mpich
- Building at **OLCF Ascent**
- Working on **NERSC Cori** and **ALCF Theta** currently
- See examples of how the environment is tailored for existing sites:
 - <https://github.com/UO-OACISS/e4s/tree/master/e4s-facility-environments>
- Binaries available in the E4S Build Cache
 - <https://oaciss.uoregon.edu/e4s/inventory.html>
 - Improved inventory page currently under development
- Google Cloud Platform (GCP) integration

E4S Dashboard for Spack Pull Request (PR) testing

Latest PR Testing - E4S *237 builds* [view timeline]

Site	Build Name	Update	Configure		Build		Start Time ▼
		Revision	Error ▼	Warn ▼	Error	Warn ▼	
Cloud Gitlab Infrastructure	pdt@3.25.1%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	11f2d0	1	0	0	0	Aug 07, 2020 - 18:23 UTC
Cloud Gitlab Infrastructure	globalarrays@5.7%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	84837c	0	26	0	0	12 hours ago
Cloud Gitlab Infrastructure	openmpi@3.1.6%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	84837c	0	20	0	14	12 hours ago
Cloud Gitlab Infrastructure	dyninst@10.2.0%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	11f2d0	0	9	0	49 ⁺⁴⁹ ₋₄₉	Aug 07, 2020 - 19:02 UTC
Cloud Gitlab Infrastructure	sundials@5.3.0%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	84837c	0	7	0	0	11 hours ago
Cloud Gitlab Infrastructure	mpich@3.2.1%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	84837c	0	6	0	2	12 hours ago
Cloud Gitlab Infrastructure	libtool@2.4.2%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	11f2d0	0	6	0	0	Aug 07, 2020 - 18:50 UTC
Cloud Gitlab Infrastructure	trilinos@12.18.1%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	84837c	0	5	0	49 ⁺⁴⁹ ₋₄₉	13 hours ago
Cloud Gitlab Infrastructure	libyogrt@1.24%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	33e7c8	0	4	0	0	10 minutes ago
Cloud Gitlab Infrastructure	libquo@1.3.1%gcc@7.3.0 arch=linux-ubuntu18.04-x86_64 (PR Testing - E4S)	84837c	0	3	0	1	11 hours ago

E4S Tailored to DOE Facility Environments

Branch: master **e4s** / e4s-facility-environments /

File	Commit Message	Time
..		
README.md	Update README.md	4 days ago
nersc-cori-spack.yaml	rename to e4s-facility-environments	4 days ago
olcf-ascent-spack.yaml	rename to e4s-facility-environments	4 days ago
uo-prl-spack.yaml	rename to e4s-facility-environments	4 days ago

E4S Spack Environments for Facility Builds

Here you will find E4S environment files designed to be used with Spack at the different facilities. Each environment file consists of mostly the same E4S Spack packages. Where the environments differ is in how external packages, compilers, and architecture targets are configured.

For general information on Spack Environments and External Packages, refer to the Official Spack documentation:

- Spack Tutorial on Environments - https://spack-tutorial.readthedocs.io/en/latest/tutorial_environments.html
- Spack Environments Reference - <https://spack.readthedocs.io/en/latest/environments.html>
- Spack External Packages - https://spack.readthedocs.io/en/latest/build_settings.html

E4S Build Pipeline Summary on Cori, NERSC

software.nersc.gov/ecp/e4s/-/pipelines

NERSC Projects Groups More

Search or jump to...

e4s

Project overview

Repository

Issues 0

Merge Requests 0

CI / CD

Pipelines

Jobs

Schedules

Operations

Analytics

Members

Settings

Collapse sidebar

ecp > e4s > Pipelines

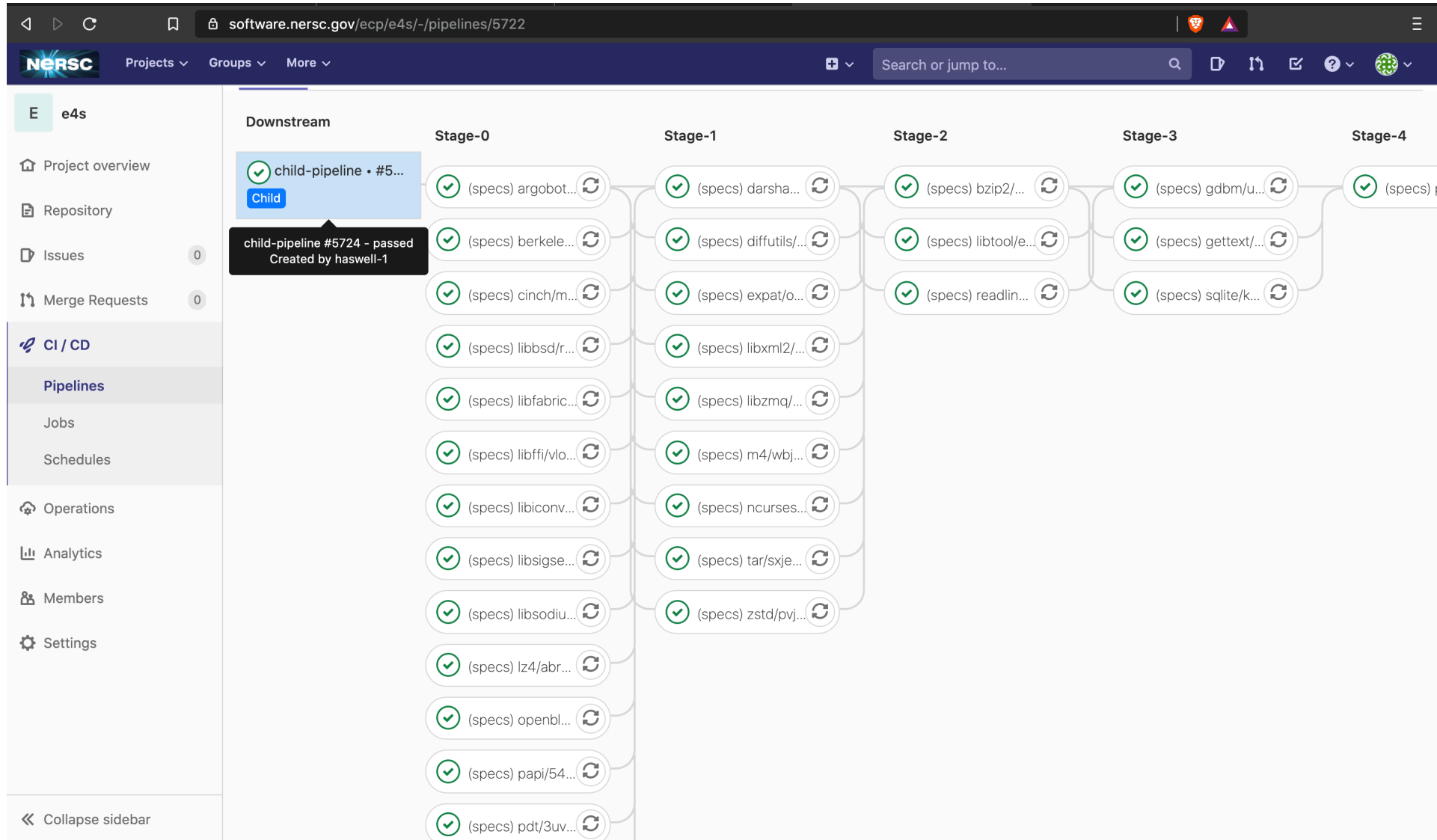
All 82 Finished Branches Tags

Run Pipeline Clear Runner Caches CI Lint

Filter pipelines

Status	Pipeline	Triggerer	Commit	Stages	Duration	Time Ago	Actions
passed	#5722 latest	github	master -> 942523d1 explain turbine and unifies bu...	✓✓	00:05:37	1 day ago	Download
failed	#5718	github	master -> 4ff76874 add build failure comments +...	✓✗	00:06:08	1 day ago	Download
failed	#5655	github	master -> 2d8c82be uncomment adios	✓✗	00:06:01	1 day ago	Download
failed	#5590	github	master -> 5655221d fresh mirror: \$HOME/e4s-20...	✓✗	00:08:20	3 days ago	Download
failed	#5587	github	master -> b5445f04 increase scheduler paramete...	✓✗	00:06:20	3 days ago	Download
failed	#5565	github	master -> b5445f04 increase scheduler paramete...	✓✗	00:07:37	4 days ago	Download
passed	#5559	github	master -> b5445f04 increase scheduler paramete...	✓✓	00:04:49	5 days ago	Download

Multi-stage E4S CI Build Pipeline on Cori, NERSC



E4S CI on Cori, NERSC

The screenshot displays the NERSC E4S CI pipeline dashboard. The browser address bar shows `software.nersc.gov/ecp/e4s/-/pipelines/5722`. The dashboard features a sidebar on the left with navigation options: Project overview, Repository, Issues (0), Merge Requests (0), CI / CD (selected), Pipelines, Jobs, Schedules, Operations, Analytics, Members, and Settings. The main area is a grid of stages (Stage-7 to Stage-12) and jobs. Each job is represented by a circular icon with a green checkmark, indicating a successful build. A tooltip for the job '(specs) metis/fzli3al 5.1.0 intel@19.1.1.217 cray-cn17-haswell - passed' is visible. The URL at the bottom of the page is `https://software.nersc.gov/ecp/e4s/-/jobs/22796`.

Job Name	Stage-8	Stage-9	Stage-10	Stage-11	Stage-12
(specs) bolt/gr6...	✓	✓	✓	✓	✓
(specs) gotcha/...	✓	✓	✓	✓	✓
(specs) kokkos/...	✓	✓	✓	✓	✓
(specs) kokkos/...	✓	✓	✓	✓	✓
(specs) libtool/p...	✓	✓	✓	✓	✓
(specs) metis/fz...	✓	✓	✓	✓	✓
(specs) metis/fzli3al 5.1.0 intel@19.1.1.217 cray-cn17-haswell - passed	✓	✓	✓	✓	✓
(specs) numact...	✓	✓	✓	✓	✓
(specs) py-bac...	✓	✓	✓	✓	✓
(specs) py-entr...	✓	✓	✓	✓	✓
(specs) py-ipyt...	✓	✓	✓	✓	✓
(specs) py-pan...	✓	✓	✓	✓	✓
(specs) py-defu...	✓	✓	✓	✓	✓

E4S CI on Cori, NERSC

The screenshot shows a web browser at `software.nersc.gov/ecp/e4s/-/pipelines/5722`. The interface includes a sidebar with navigation options like 'Project overview', 'Repository', 'Issues', 'Merge Requests', 'CI / CD', 'Operations', 'Analytics', 'Members', and 'Settings'. The main content area displays the pipeline details for #5722, which was triggered 1 day ago by Christopher Peyralans. The pipeline title is 'explain turbine and unifyfs build failures with comments [ci skip]'. It shows 2 jobs for the 'master' branch completed in 5 minutes and 37 seconds. A DAG (Directed Acyclic Graph) diagram is visible, showing a 'Generate' stage with jobs 'haswell-0' and 'haswell-1', and a 'Downstream' stage with a 'child-pipeline' job. The pipeline is marked as 'passed' and has a 'Delete' button.

E4S: Build Pipeline for Creating Spack Build Cache at U. Oregon

The screenshot shows a GitLab CI/CD pipeline for the 'e4s' project. The pipeline is named 'Pipeline' and has 17 jobs. It is organized into four stages:

- Spack Generate:** Contains 8 jobs for generating Spack environments on various operating systems and architectures (e.g., centos7-ppc64le, centos7-x86_64, centos8-x86_64, rhel7-ppc64le, rhel7-x86_64, rhel8-x86_64, ubuntu18.04-ppc64le, ubuntu18.04-x86_64). All jobs in this stage are shown as successful (green checkmarks).
- Spack Build:** Contains 8 jobs for building the Spack environments. These jobs are shown as pending (orange pause icons).
- Final:** Contains one job named 'update-inventory', which is shown as pending.
- Downstream:** Contains 6 jobs for downstream builds, labeled 'ci-build' with IDs #116 through #125. These jobs are shown as pending.

The pipeline is triggered by a commit to the 'latest' branch with the commit ID 'f335336d'. The interface also shows a sidebar with navigation options like 'Project overview', 'Repository', 'CI / CD', 'Pipelines', 'Jobs', 'Schedules', 'Charts', 'Operations', and 'Settings'.

- GitLab
- Multi-platform builds

ORNL GitLab Build Pipeline for E4S Spack Build Cache

The screenshot displays a GitLab CI/CD pipeline for the 'e4s' project. The pipeline is structured into five stages, each containing multiple jobs. All jobs are marked as successful with green checkmarks. The jobs are as follows:

- Stage-0:** (specs) cinch/bf..., (specs) libbsd/cr..., (specs) libffi/3iz2..., (specs) libiconv/..., (specs) libsigseg..., (specs) openbla..., (specs) pkgconf/..., (specs) xz/alc3lz..., (specs) zlib/fmat...
- Stage-1:** (specs) diffutils/r..., (specs) expat/so..., (specs) hdf5/kiw..., (specs) hypre/slr..., (specs) libxml2/d..., (specs) m4/nxjk..., (specs) ncurses/..., (specs) tar/kiurer...
- Stage-2:** (specs) bzip2/cj..., (specs) libtool/lz..., (specs) matio/ek..., (specs) netcdf-c..., (specs) readline/...
- Stage-3:** (specs) boost/gx..., (specs) boost/s..., (specs) gdbm/6..., (specs) gettext/e..., (specs) sqlite/jb7...
- Stage-4:** (specs) perl/lbit...

- ppc64le (Ascent @ ORNL)
- Reproducible container builds

E4S VM Image for Google Cloud Project (GCP)

- VM Image for Google Compute Engine
 - Ubuntu 18.04
 - Intel Cascade Lake
- Spack v0.15.4
- Pre-configured to use E4S Cloud Build Cache
- 53 E4S Packages
 - SuperLU
 - Sundials
 - Trilinos
 - UPCXX
 - ... and more

E4S GitLab via Google Kubernetes Engine

- E4S GitLab running via Google Kubernetes Engine (GKE)
 - GitLab Version 13.3.5 with updates deployed via Helm Chart
- GitLab Continuous Integration (CI)
 - Build E4S Spack packages using University of Oregon runners
- E4S package binaries automatically pushed to E4S Cloud Build Cache upon successful build
 - Spack mirror URL: <https://cache.e4s.io>
 - Spack mirror inventory: <https://oaciss.uoregon.edu/e4s/inventory.html>

E4S Container Images via gcr.io

- Pre-release container images deployed to Google Container Registry (gcr.io)
- Use of private registry eases collaboration burden during pre-release testing
- Shields end-users from potential bugs
- Image types:
 - Base layers
 - Base Spack images
 - GitLab CI Runner images
 - Full E4S images

E4S Repositories on GCP

Container Registry

Images

Repositories REFRESH

ECP-E4S

Filter All hostnames

Name	Hostname	Visibility
centos7-base-ppc64le	gcr.io	Private
centos7-base-x86_64	gcr.io	Private
centos7-runner-ppc64le	gcr.io	Private
centos7-runner-x86_64	gcr.io	Private
centos8-base-ppc64le	gcr.io	Private
centos8-base-x86_64	gcr.io	Private
centos8-runner-ppc64le	gcr.io	Private
centos8-runner-x86_64	gcr.io	Private

E4S VM Instances on GCP used by GitLab

The screenshot shows the Google Cloud Platform interface for VM instances. A notification at the top indicates that 2 instances could be resized to save up to an estimated \$121 per month. The main table lists several instances, including three GitLab instances and two Ubuntu E4S instances.

Name	Zone	Recommendation	In use by	Internal IP	External IP	Connect
gke-gitlab-default-pool-e3d45b69-eo4i	us-west1-a		gke-gitlab-default-pool-e3d45b69-grp, a7fc640118d674333bbd0535c911838c	10.138.0.20 (nic0)	35.197.91.99	SSH
gke-gitlab-default-pool-e3d45b69-nhmv	us-west1-a		gke-gitlab-default-pool-e3d45b69-grp, a7fc640118d674333bbd0535c911838c	10.138.0.19 (nic0)	35.233.151.110	SSH
gke-gitlab-default-pool-e3d45b69-vet3	us-west1-a		gke-gitlab-default-pool-e3d45b69-grp, a7fc640118d674333bbd0535c911838c	10.138.0.18 (nic0)	34.83.132.213	SSH
ubuntu-e4s	us-west1-b	Save \$46 / mo		10.138.0.17 (nic0)	34.83.209.245	SSH
ubuntu-e4s-docker	us-west1-b	Save \$75 / mo		10.138.0.16 (nic0)	34.82.153.41	SSH

E4S Components



E4S DocPortal

- Provide a single online location for *accurate* product descriptions for ECP software products.
- Derived requirements:
 - Sustainable: Must be integrated into software team workflows.
 - Incremental: Must build on community approaches to providing this kind of information.
 - Extensible: Must be usable by any open source software team.
- Strategy:
 - Use the open source community approach of specially-name files in software repositories.
 - Adopt commonly used file names when available.
 - Identify new information items not already being requested.
 - Develop new special file names for information beyond what is already captured.
 - Create web-based raking tool to capture information from product repositories and present in summary form on a webpage.
 - Aggregates and summarizes documentation and metadata for E4S products
 - Regularly updates information directly from product repositories
 - Prototype: <https://e4s-project.github.io/DocPortal.html>

E4S DocPortal

The screenshot shows a web browser window with the URL `e4s-project.github.io`. The navigation bar includes links for HOME, EVENTS, ABOUT, DOCPORTAL, CONTACT US, and FAQ, along with a prominent orange DOWNLOAD button. The main heading is "E4S Products". Below the heading, there is a search bar and a "Show 10 entries" dropdown. A table lists five products, each with a green plus icon in the first column, indicating they are member products.

	Name	Area	Description
+	ADIOS2	Data & Viz	I/O and data management library for storage I/O, in-memory code coupling and online data analysis and visualization workflows.
+	AML	PMR	Hierarchical memory management library from Argo.
+	ARCHER	Tools	Data race detection tool for OpenMP applications
+	ASCENT	Data & Viz	Flyweight in situ visualization and analysis runtime for multi-physics HPC simulations
+	BEE	Software Ecosystem	Container-based solution for portable build and execution across HPC systems and cloud resources

<https://e4s-project.github.io/DocPortal.html>

E4S: DockerHub Images: ecpe4s

ecpe4s/tensorflow ☆
By ecpe4s • Updated 16 days ago
Container
Pulls 56
Manage Repository

Overview Tags

Filter Tags Sort by Latest

IMAGE	DIGEST	OS/ARCH	COMPRESSED SIZE
latest Last updated 16 days ago by esw123	0ab7a486b0ee 69a70b3b3693	linux/amd64 linux/ppc64le	3.99 GB 3.82 GB
cuda10.2-builder Last updated 16 days ago by esw123	35f84789e921 606b5d6589b0	linux/amd64 linux/ppc64le	5.47 GB 5.2 GB
cuda10.2 Last updated 16 days ago by esw123	0ab7a486b0ee 69a70b3b3693	linux/amd64 linux/ppc64le	3.99 GB 3.82 GB

- Dockerhub
- Tensorflow 2.2
- CUDA 10.2
- ppc64le

E4S: Multi-platform Reproducible Docker Recipes

The screenshot shows a GitHub repository page for 'UO-OACISS / e4s'. The repository is on the 'master' branch, specifically in the 'docker-recipes / ubi7 / ppc64le / base' directory. The file list includes:

- ..
- modules (9 days ago)
- Dockerfile (18 hours ago)
- README.md (2 days ago)
- build.sh (9 days ago)
- packages.yaml (29 days ago)
- spack.lock (18 hours ago)
- spack.yaml (9 days ago)

The 'README.md' file is currently selected and open at the bottom of the view.

- E4S base images
- x86_64
 - ppc64le
 - aarch64

University of Oregon GitLab CI

August 10, 2020

E4S Builds:

- Ubuntu 18.04
- Ubuntu 20.04
- RHEL 7.6
- RHEL 8
- CentOS 7
- CentOS 8

Architectures:
ppc64le and x86_64

The screenshot shows a GitLab CI pipeline for a project named 'e4s'. The pipeline is divided into three stages: 'Concretize', 'Trigger Builds', and 'Downstream'. Each stage contains multiple jobs, all of which are shown as completed with green checkmarks. The 'Downstream' stage consists of a vertical sequence of jobs, each labeled 'Child'.

Stage	Job Name	Status
Concretize	centos7-amd64-0	Completed
	centos8-amd64-0	Completed
	rhel7-amd64-0	Completed
	rhel7-ppc64le-0	Completed
	rhel8-amd64-0	Completed
	ubuntu18.04-amd64-0	Completed
	ubuntu18.04-ppc64le-0	Completed
	ubuntu20.04-amd64-0	Completed
Trigger Builds	centos7-amd64-1	Completed
	centos8-amd64-1	Completed
	rhel7-amd64-1	Completed
	rhel7-ppc64le-1	Completed
	rhel8-amd64-1	Completed
	ubuntu18.04-amd64-1	Completed
	ubuntu18.04-ppc64le-1	Completed
	ubuntu20.04-amd64-1	Completed
Downstream	e4s #881	Completed
	e4s #882	Completed
	e4s #883	Completed
	e4s #885	Completed
	e4s #884	Completed
	e4s #886	Completed
	e4s #887	Completed
	e4s #888	Completed
	e4s #889	Completed

E4S Validation Test Suite

- Provides automated build and run tests
- Validate container environments and products
- New LLVM validation test suite for DOE LLVM

The screenshot shows the GitHub repository page for `E4S-Project/testsuite`. The repository is on the `master` branch. The file tree for the `validation_tests/magma` directory is displayed, listing files such as `Makefile`, `README.txt`, `clean.sh`, `compile.sh`, `example_f.F90`, `example_sparse.c`, `example_sparse_operator.c`, `example_v1.c`, `example_v2.c`, `run.sh`, and `setup.sh`. The `README.txt` file is selected and its content is shown below. The README text includes instructions on getting started with MAGMA, a simple standalone example, and the inclusion of the MAGMA header.

```
Getting started with MAGMA.

This is a simple, standalone example to show how to use MAGMA, once it is
compiled. More involved examples for individual routines are in the testing
directory. The testing code includes some extra utilities that we use for
testing, such as testings.h and libtest.a, which are not required to use MAGMA,
though you may use them if desired.

-----
C example

See example_v2.c for sample code.

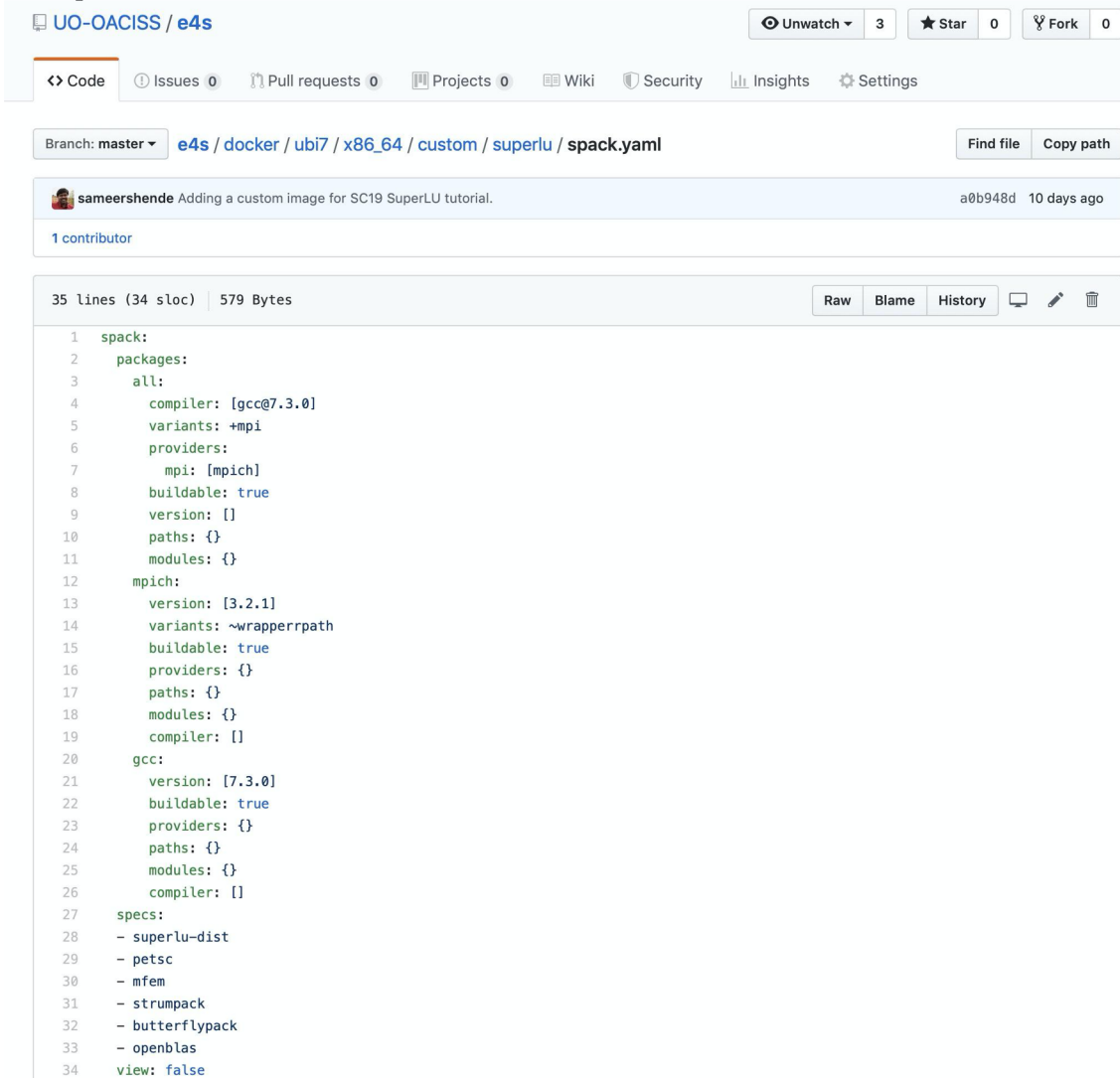
Include the MAGMA header:

#include "magma_v2.h"

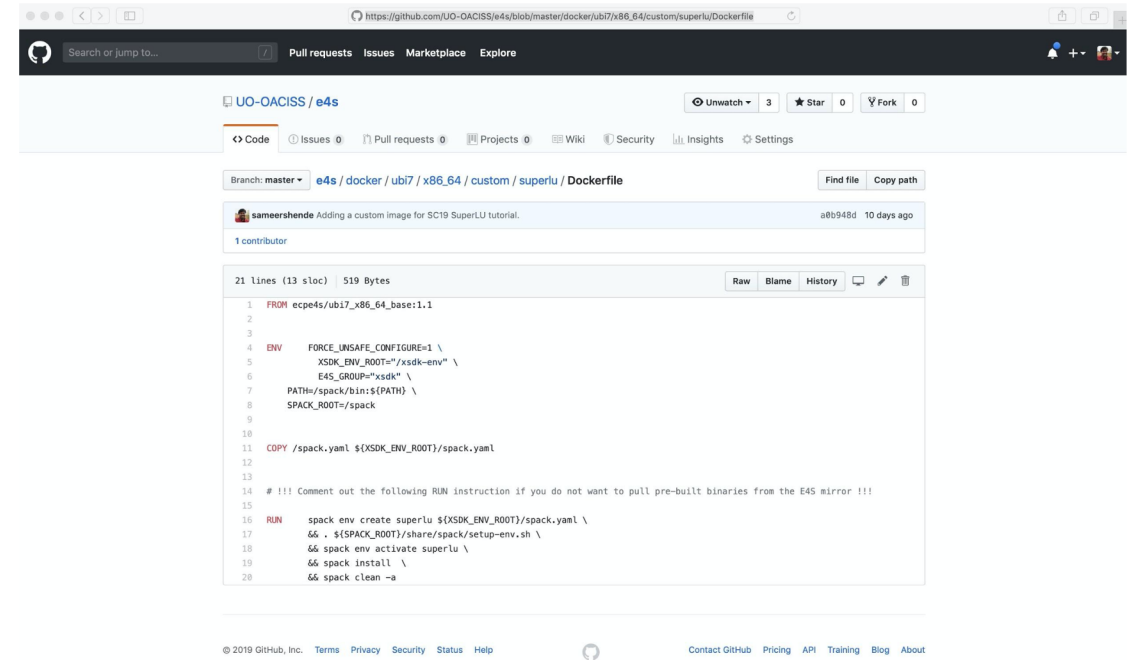
(For the legacy MAGMA v1 interface, see example_v1.c. It includes magma.h
instead. By default, magma.h includes the legacy cuBLAS v1 interface (cublas.h).
You can include cublas_v2.h before magma.h if desired.)
```

- git clone <https://github.com/E4S-Project/testsuite.git>

Reproducible Container Builds using E4S Base Images



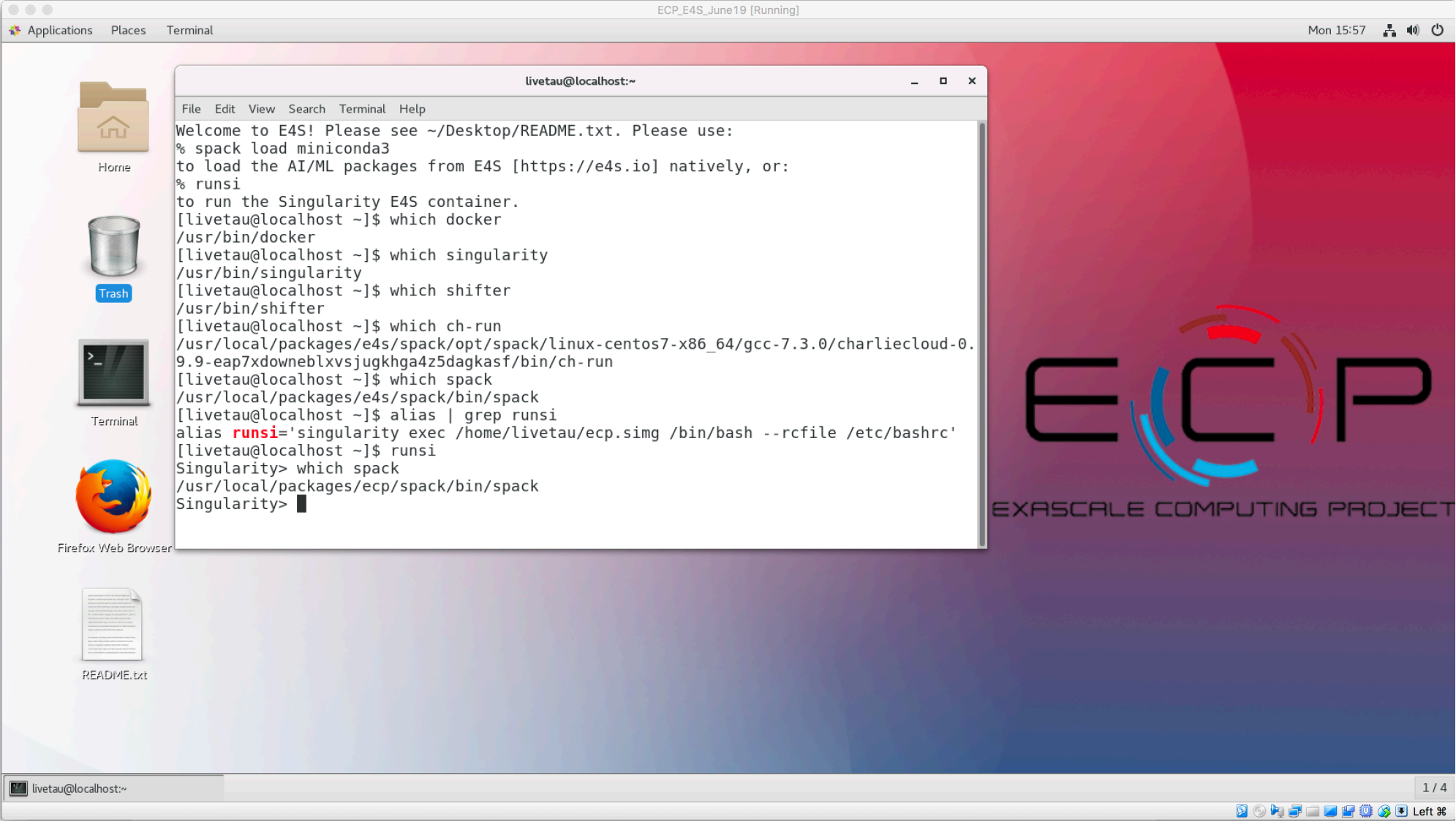
```
1 spack:
2   packages:
3     all:
4       compiler: [gcc@7.3.0]
5       variants: +mpi
6       providers:
7         mpi: [mpich]
8       buildable: true
9       version: []
10      paths: {}
11      modules: {}
12    mpich:
13      version: [3.2.1]
14      variants: ~wrapperrpath
15      buildable: true
16      providers: {}
17      paths: {}
18      modules: {}
19      compiler: []
20    gcc:
21      version: [7.3.0]
22      buildable: true
23      providers: {}
24      paths: {}
25      modules: {}
26      compiler: []
27    specs:
28      - superlu-dist
29      - petsc
30      - mfem
31      - strumpack
32      - butterflypack
33      - openblas
34    view: false
```



```
1 FROM ecpe4s/ubi7_x86_64_base:1.1
2
3
4 ENV FORCE_UNSAFE_CONFIGURE=1 \
5     XSDK_ENV_ROOT="/xsdk-env" \
6     E4S_GROUP="xsdk" \
7     PATH="/spack/bin:${PATH}" \
8     SPACK_ROOT="/spack"
9
10
11 COPY /spack.yaml ${XSDK_ENV_ROOT}/spack.yaml
12
13
14 # !!! Comment out the following RUN instruction if you do not want to pull pre-built binaries from the E4S mirror !!!
15
16 RUN spack env create superlu ${XSDK_ENV_ROOT}/spack.yaml \
17     && . ${SPACK_ROOT}/share/spack/setup-env.sh \
18     && spack env activate superlu \
19     && spack install \
20     && spack clean ->
```

- PMR SDK base image has Spack build cache mirror and GPG key installed.
- Base image has GCC and MPICH configured for MPICH ABI level replacement (with system MPI).
- **Customized container build using binaries from E4S Spack build cache for fast deployment.**
- **No need to rebuild packages from the source code.**
- Same recipe for container and native bare-metal builds with Spack!

E4S VirtualBox Image

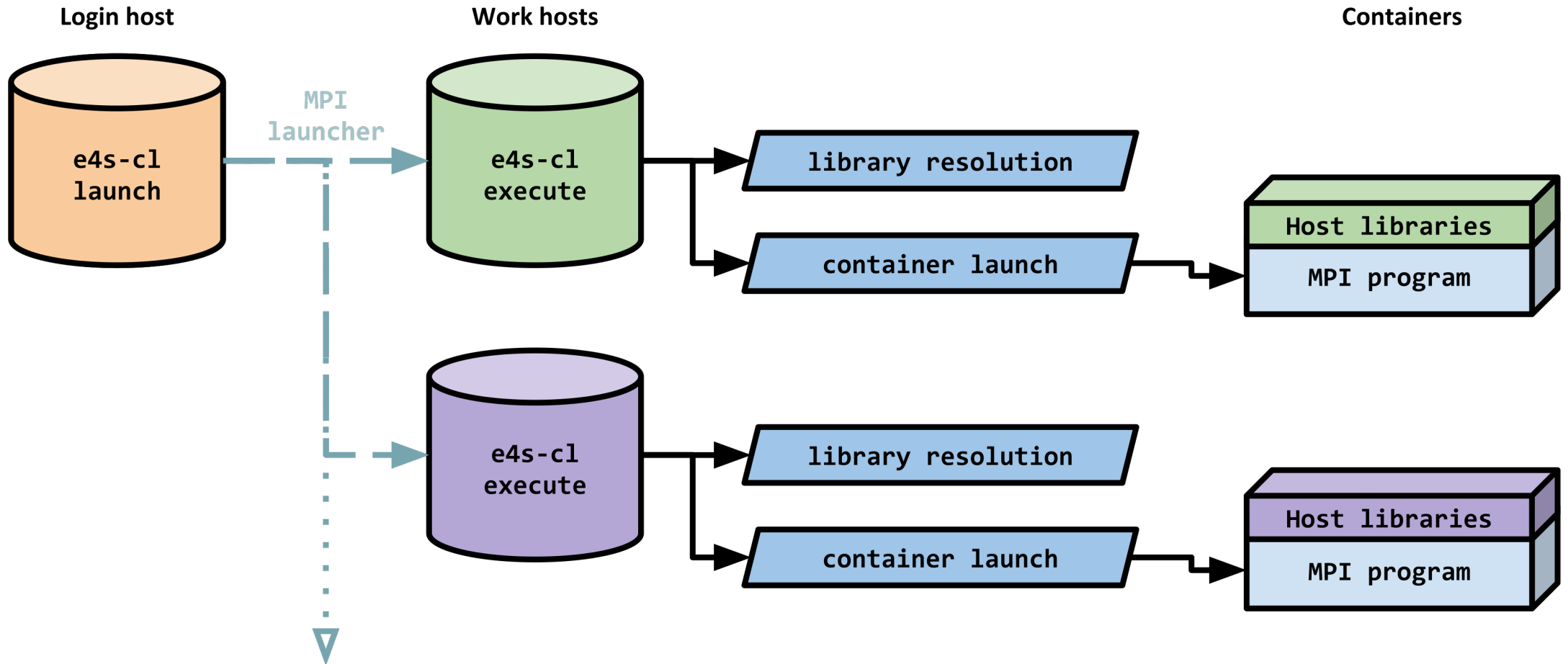


- Container Runtimes
- Docker
 - Shifter
 - Singularity
 - Charliecloud

e4s-cl: A tool to simplify the launch of MPI jobs in E4S containers

- E4S containers support replacement of MPI libraries using MPICH ABI compatibility layer.
- Applications binaries built using E4S can be launched with Singularity using MPI library substitution for efficient inter-node communications.
- e4s-cl is a new tool that simplifies the launch and MPI replacement.
- Under development. Usage:
 1. `e4s-cl profile detect -o <profile> <MPI executable>`
 2. `e4s-cl profile select <profile>`
 3. `e4s-cl launch mpirun -np <> -hosts <> <command>`

e4s-cl Container Launcher



Acknowledgment



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