How to get, setup and run SPEC benchmarks

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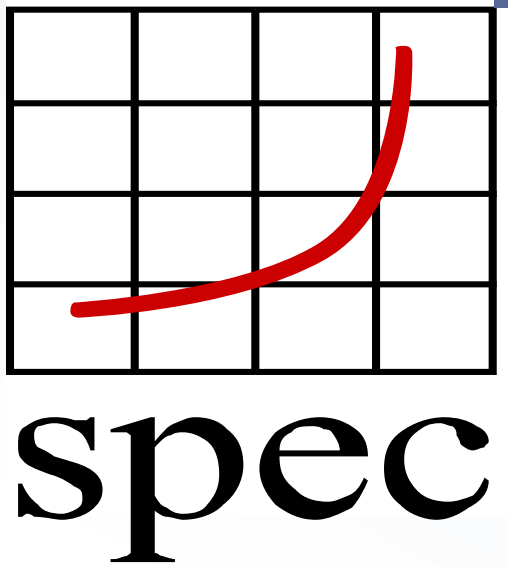

https://www.spec.org/hpg/publications
https://www.olcf.ornl.gov/sc20-spec-hpg-tutorial/

Contents

- Cluster login
- Overview of system requirements
- How to get SPEC benchmarks?
  - Benchmark acquisition & licensing
  - Download & unpacking
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  - Installation
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  - SPEC Accel
  - SPEC HPC2021

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Cluster login

- Login to the system:
  ssh <username>@ login1.ascent.olcf.ornl.gov
- Follow instructions in section “Setting up the SPEC ACCEL suite” in the handout
  - We will setup SPEC HPC2021 as the following exercise.
- Follow along interactive demo

- **Interactive demo time!**
- **We present SPEC Accel and HPC2021 config files**
- **Opportunity to follow instructions interactively (also see Ascent handout)**
- **Later: run benchmarks**
  Accel OpenACC on CPU and GPU
  (Note: OpenMP and MPI runs take long – not covered here)
- **Interpret results**

If you have any problems, let us know immediately! We are happy to help you!

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System Requirements

OpenMP: http://spec.org/omp2012/Docs/system-requirements.html
MPI: http://spec.org/mpi2007/Docs/system-requirements.html
ACCEL: https://www.spec.org/accel/Docs/system-requirements.html
HPC2021: Beta Release Candidate 2

- Different benchmarks suites
  → different requirements
  - SPEC OMP2012, SPEC MPI2007, SPEC ACCEL, SPEC HPC2021 (beta)
- Supported operating systems: AIX, Linux, MacOS, Solaris, Windows (except very old Windows)
  - Please do not use Windows/Unix compatibility products
- Compatible processors
  - CPU
  - GPU
  - APU
  - Xeon Phi

System Requirements

- Memory requirements
  - OpenMP: 28GB for the whole system
  - MPI: 1GB/rank (medium size) and 2GB/rank (large size)
  - ACCEL: 4GB of host mem + 2GB of device mem
  - Otherwise, you are measuring your paging file, not your system
- Disk space requirements
  - OpenMP: 8GB
  - MPI: 10GB (medium), 17GB (large, big endian), 24GB (large, little endian)
  - ACCEL: 9GB
- Support of compilers
  - C99, C++98 and Fortran-95 compilers + MPI library for SPEC MPI 2007

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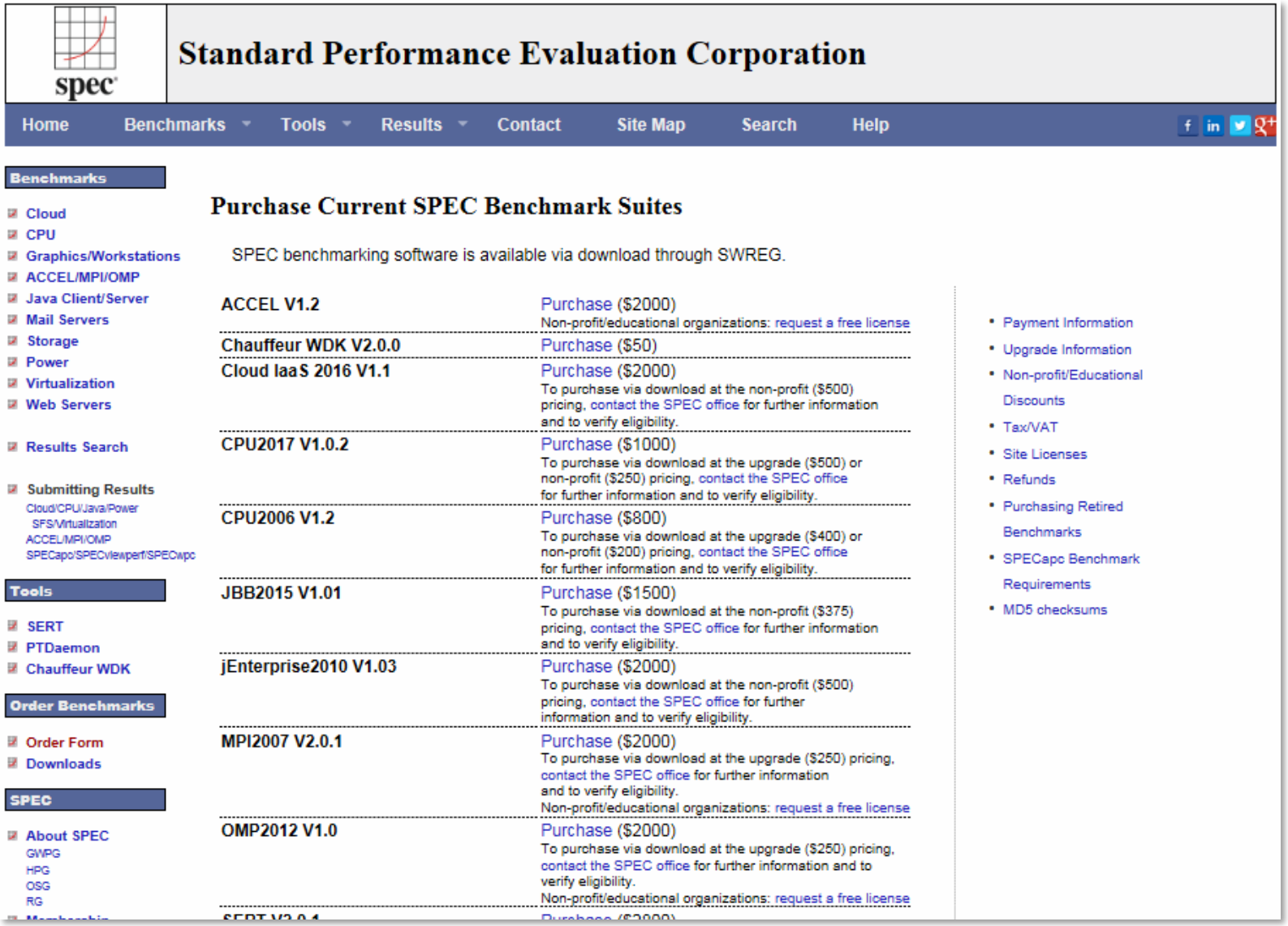
Acquisition of SPEC Benchmarks



http://spec.org/order.html
https://www.spec.org/hpg/joining.html

links

- Single SPEC suites
  - Commercial license
  - Non-profit license
- SPEC membership
  - Receive benchmarks for free

Let's go shopping!
Non-profit organizations get 100% off

Press Release 2018: https://www.spec.org/news/hpgnonprofitpricing.html

Non-commercial download + definition:
http://spec.org/hpgdownload.html

links

- Commercial license
  - Must be purchased via order form
  - Commercial enterprises (not being SPEC/HPG member) engaging in marketing, developing, testing, consulting for and/or selling computers, computer services, accelerator devices, drivers, software or other high performance computing systems or components in the computer marketplace
- Non-commercial license
  - Free of charge
  - Organizations that do not require a commercial license
  - Valid for the organization (not individual)
  - Institutional e-mail address required

Benchmark Suite	Non-Profit	Commercial
CPU2017 V1.0.2	$250	$1,000
ACCEL V1.3	free	$2,000
OMP2012 V1.0	free	$2,000
MPI2007 V2.0.1	free	$2,000
SPECpower_ssj2008 V1.12	$400	$1,600

SALE 100% OFF

Download

Order Form

Currency: US Dollar Locale: English

Product	Price	Qty	Delivery	Total
SPEC OMP2012 V1.0 - Retail download	US $2380.00	1	Download ISO (1.6 GB)	US $2380.00 including VAT (19%)

Add Extended Download Service for just US $26.12
> What is this? ADD

Why are Digital Downloads Green?

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- PAYPAL
- WIRE TRANSFER with Proforma Invoice

Download as member

Index of /private/hpg/benchmarks/omp

Name	Last modified	Size
Parent Directory		-
omp2001-3.2.iso	27-Jul-2010 18:32	679M
omp2001-3.2.iso.md5	06-Sep-2017 15:45	50
omp2001-3.2.iso.sha256	06-Sep-2017 15:46	82
omp2012-1.0.iso	17-Oct-2012 19:20	1.6G
omp2012-1.0.iso.sha256	28-Feb-2018 16:16	82
omp2012-1.0.iso.sha512	28-Feb-2018 16:24	146
omp2012-1.0.iso.xz	17-Oct-2012 19:20	695M
omp2012-1.0.iso.xz.md5	06-Sep-2017 15:46	53
omp2012-1.0.iso.xz.sha256	06-Sep-2017 15:47	85

Apache/2.2.15 (CentOS) Server at pro.spec.org Port 443

Typically an ISO image

Unpacking (when you can mount ISO images)

```
$> md5sum -c accel-1.3.iso.xz.md5

$> xz -d accel-1.3.iso.xz

$> mkdir spec-iso

$> mount -t iso9660 -o loop,ro accel-1.3.iso spec-iso
```

Check for correct download

Unpack archive

Mount ISO image in subdirectory

Useful hint:
Generate a subdirectory for every benchmark suite! Move the downloads there!

Unpacking (when you cannot mount ISO images)

- Use the tar.xz file (available to members and upon requests)

```
$> md5sum -c accel-1.3.tar.xz.md5

$> tar xvJf accel-1.3.tar.xz
```

Check for correct download

Unpack archive

- *OR*: Copy tar archive from the ISO
  - Use tools such as `isoinfo` or `mc`

List files in iso image

Extract md5 and tar ball from iso image
`-i`: iso image
`-x`: extracts to stdout, redirect needed

```
$> isoinfo -J -l -i accel-1.3.iso
S> isoinfo -J -i accel-1.3.iso -x /install_archives/accel.tar.xz.md5 >
   accel.tar.xz.md5
$> isoinfo -J -i accel-1.3.iso -x /install_archives/accel-1.3.tar.xz > accel-
   1.2.tar.xz
```

Then: unpack tar ball (see above)

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Installation

```
$> ./install.sh
```

Install SPEC suite
[-d <dest dir>]

```
SPEC ACCEL Installation

Top of the ACCEL tree is '/home/spec/accel-1.3'

Installing FROM /home/spec/accel-1.3
Installing TO /home/spec/accel-1.3

Is this correct? (Please enter 'yes' or 'no')
yes
```

Type `yes` and hit enter

https://spec.org/accel/docs/install-guide-unix.html

links

Installation

```
The following toolsets are expected to work on your platform.  If the
automatically installed one does not work, please re-run install.sh and
exclude that toolset using the '-e' switch.

The toolset selected will not affect your benchmark scores.

linux-suse10-amd64            For 64-bit AMD64/EM64T Linux systems running
                              SuSE Linux 10 or later, and other
                              compatible Linux distributions, including
                              some versions of RedHat Enterprise Linux
                              and Oracle Linux Server.

                              Built on SuSE Linux 10 with
                              GCC v4.1.0 (SUSE Linux)

linux-redhat72-ia32           For x86, IA-64, EM64T, and AMD64-based Linux
                              systems with GLIBC 2.2.4+.
                              Built on RedHat 7.2 (x86) with gcc 3.1.1

============================================================
Attempting to install the linux-suse10-amd64 toolset...
```

Attempt to automatically determine platform

https://spec.org/accel/docs/install-guide-unix.html

links

Installation

```
==============================================================================
Attempting to install the linux-suse10-amd64 toolset...

Checking the integrity of your source tree...


Checksums are all okay.

Removing previous tools installation

Unpacking binary tools for linux-suse10-amd64...

Checking the integrity of your binary tools...

Checksums are all okay.

Testing the tools installation (this may take a minute)

.....................................................................o.....................
.....................................................................................
.............................
```

Automatic unpacking of files

Automatic testing of installation

https://spec.org/accel/docs/install-guide-unix.html

links

Loading SPEC tools

```
[..]
Installation successful.  Source the shrc or cshrc in
/home/spec/accel-1.3
to set up your environment for the benchmark.
```

Hint how to proceed

```
>$ source ./shrc.sh
```

Source `shrc` or `cshrc`!
Without this nothing will work!!

Setup of environment variables and paths for SPEC, e.g., `$SPEC` to root path

https://spec.org/accel/docs/install-guide-unix.html

links

Setup SPEC Accel on Ascent

- Set the tutorial files variable:
  export TUTFILES=/gpfs/wolf/stf007/world-shared/vgv/sc20tut
- Change the directory:
  cd $MEMBERWORK/gen147
- Create a new directory to install the benchmark suite:
  mkdir accel && cd accel
- Install the spec suite into your scratch space:
  $TUTFILES/accel/install.sh -d $PWD
- Follow the prompt instructions

Setup SPEC Accel on Ascent

- We provided a configuration file to help you get started. Copy it into your install `config` directory:
  ```
  . shrc
  cp $TUTFILES/accel/configs/* ./config/
  ```
- We also provided sample job scripts. Copy them to your `accel` directory:
  ```
  cd ..
  cp $TUTFILES/accel/scripts/* .
  ```

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Run Accel OpenACC on GPU

batch script: accel-pgi.sh

```
$> runspec --config=ascent-pgi --tune=base --size=ref 353 370
```

Name of the config file

- Run in **base** mode
- Use ref data set
- Execute benchmarks 353.clvrleaf (Hydrodynamics) and 370.bt (PDE solver)

```
$> bsub  accel-pgi.sh
```

Submit to batch system.
Note: Machine is only available on day of tutorial

Timing on Ref

	353.clvrleaf	370.bt
V100 GPU	37s	10s

Run Accel OpenACC: published results

https://www.spec.org/accel/results/res2018q3/accel-20180814-00114.html

SPEC® ACCEL™ ACC Result

IBM Corporation (Test Sponsor: NVIDIA Corporation)
Tesla V100
IBM Power Systems AC922 for High Performance Computing (8335-GTH)

SPECaccel_acc_base = 11.9
SPECaccel_acc_peak = 11.9

ACCEL license: 019
Test sponsor: NVIDIA Corporation
Tested by: NVIDIA Corporation

Test date: Aug-2018
Hardware Availability: May-2018
Software Availability: Aug-2018

https://www.spec.org/accel/results/res2018q3/accel-20180814-00113.html

SPEC® ACCEL™ ACC Result

IBM Corporation (Test Sponsor: NVIDIA Corporation)
Power9
IBM Power Systems AC922 for High Performance Computing (8335-GTH)

SPECaccel_acc_base = 3.02
SPECaccel_acc_peak = 3.02

ACCEL license: 019
Test sponsor: NVIDIA Corporation
Tested by: NVIDIA Corporation

Test date: Aug-2018
Hardware Availability: May-2018
Software Availability: Aug-2018

Results available on www.spec.org

Run the full SPEC Accel OpenACC suite on GPU

batch script: accel-pgi.sh

```
$> runspec --config=ascent-pgi --tune=base --size=ref openacc
```

Run the whole OpenACC suite

- Run in base mode
- Run ref data set
- Execute entire OpenACC suite (replace benchmark “353 370” by “openacc”)

```
$> bsub  accel-pgi.sh
```

Submit to batch system.
Note: Machine is only available on day of tutorial

Run HPC2021 OpenACC on GPU

batch script: hpc-pgi.sh

```
$> runhpc --config=ascent-pgi.cfg --iterations 1 --ranks=12 --threads=1 --define
pmodel=acc --action run 618 635
```

Name of the config file

- Run in **base** mode
- Use ref data set
- Execute benchmarks 618.tealeaf and 635.weather

```
$> bsub  hpc-pgi.sh
```

Submit to batch system.
Note: Machine is only available on day of tutorial

Timing on Ref

	618.tealeaf	635.weather
V100 GPU		

Run HPC2021 OpenMP Target on GPU

batch script: hpc-xl.sh

```
$> runhpc --config=ascent-xl.cfg --iterations 1 --ranks=12 --threads=1 --define
pmodel=ompacc --action run 618 635
```

Name of the config file

- Run in **base** mode
- Use ref data set
- Execute benchmarks 618.tealeaf and 635.weather

```
$> bsub  hpc-xl.sh
```

Submit to batch system.
Note: Machine is only available on day of tutorial

Timing on Ref

	618.tealeaf	635.weather
V100 GPU		

Run the full SPEC HPC2021 OpenACC suite on GPU

batch script: accel-pgi.sh

```
$> runhpc --config=ascent-pgi.cfg --iterations 1 --ranks=12 --threads=1 --define
pmodel=acc --action run small
```

Run the whole OpenACC suite

- Run in base mode
- Run ref data set
- Execute entire OpenACC suite (replace benchmark “618 635” by “small”)

```
$> bsub  accel-pgi.sh
```

Submit to batch system.
Note: Machine is only available on day of tutorial

Summary

- SPEC ACCEL for accelerators
  - Including benchmarks implemented using OpenACC, OpenCL and OpenMP target
  - --device to choose device number
  - works with a wide range of accelerators (NVIDIA GPU, AMD GPU, Xeon Phi), also CPU.
- SPEC HPC2021 Beta Release Candidate 2
  - Includes benchmarks implemented in several parallel programming models:
    - MPI, MPI+OpenMP (threads and offloading), MPI+OpenACC
  - --ranks to choose number of ranks used
  - --threads to choose the number of threads used
  - works beyond a single node and supports various programming models and accelerators

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Thank you!

Questions?

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