

HPC Ranking Based on Real Applications

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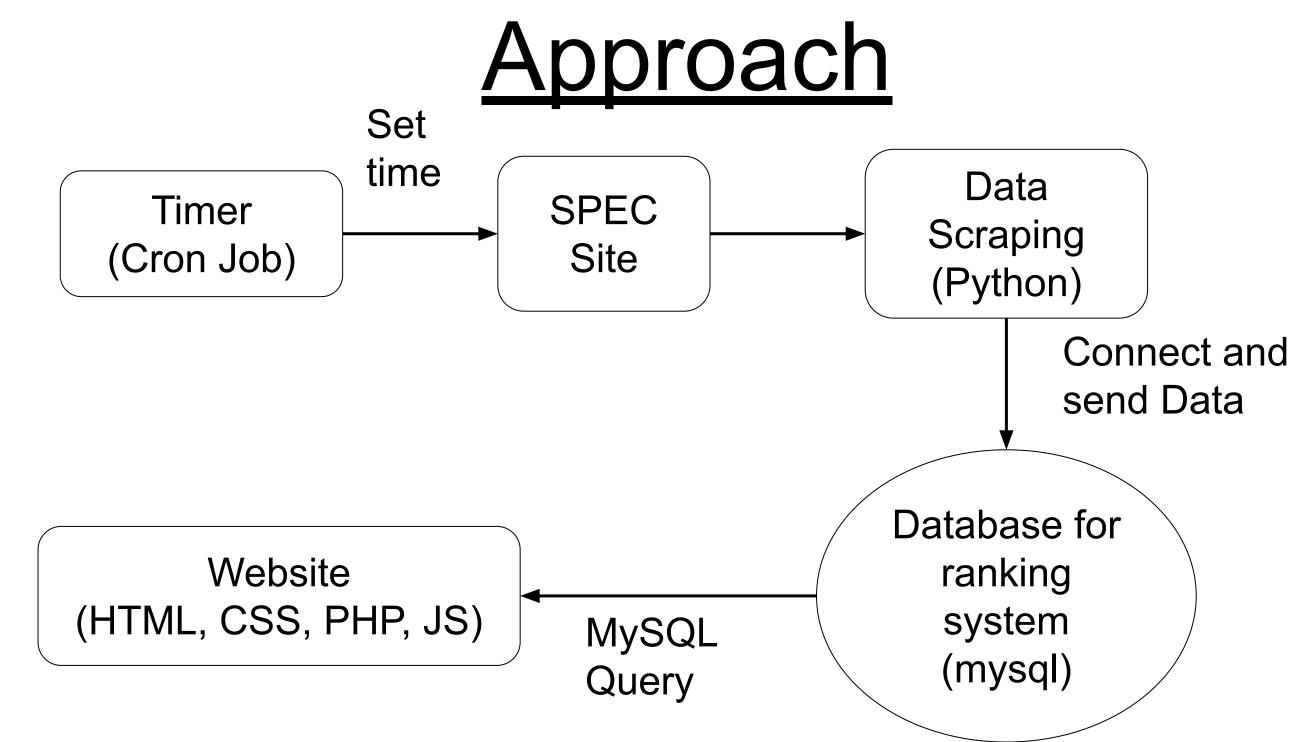


Introduction

Performance benchmarks are used to stress test hardware and software of large scale computing systems. A corporation known as SPEC has developed a benchmark suite, SPEC ACCEL, consisting of test codes representative of kernels in large applications. This project ranks the published results from ACCEL based on different criteria. The goal is to prepare a ranking website for the work-in-progress real-world SPEC HPG benchmark suite, HPC2021 that will soon be released (time frame 2020-2021).

Project Goals

- Organize and display HPC systems based on SPEC ACCEL benchmarks suite
- Compare HPC systems more holistically
- Enable visualization of the differences between each HPC system
- Base & Peak score: Denotes the default benchmark output and optimized benchmark output.
- Hardware speed and size: Shows their impact on benchmark performance.
- **Developers**: Vendors such as Intel, NVIDIA, AMD, etc., which allows the end-user to see who they may choose to buy parts from.
- Location: Where are the HPC systems hosted



Architecture diagram showing data flow

Cron Job:

Runs web-scraper periodically

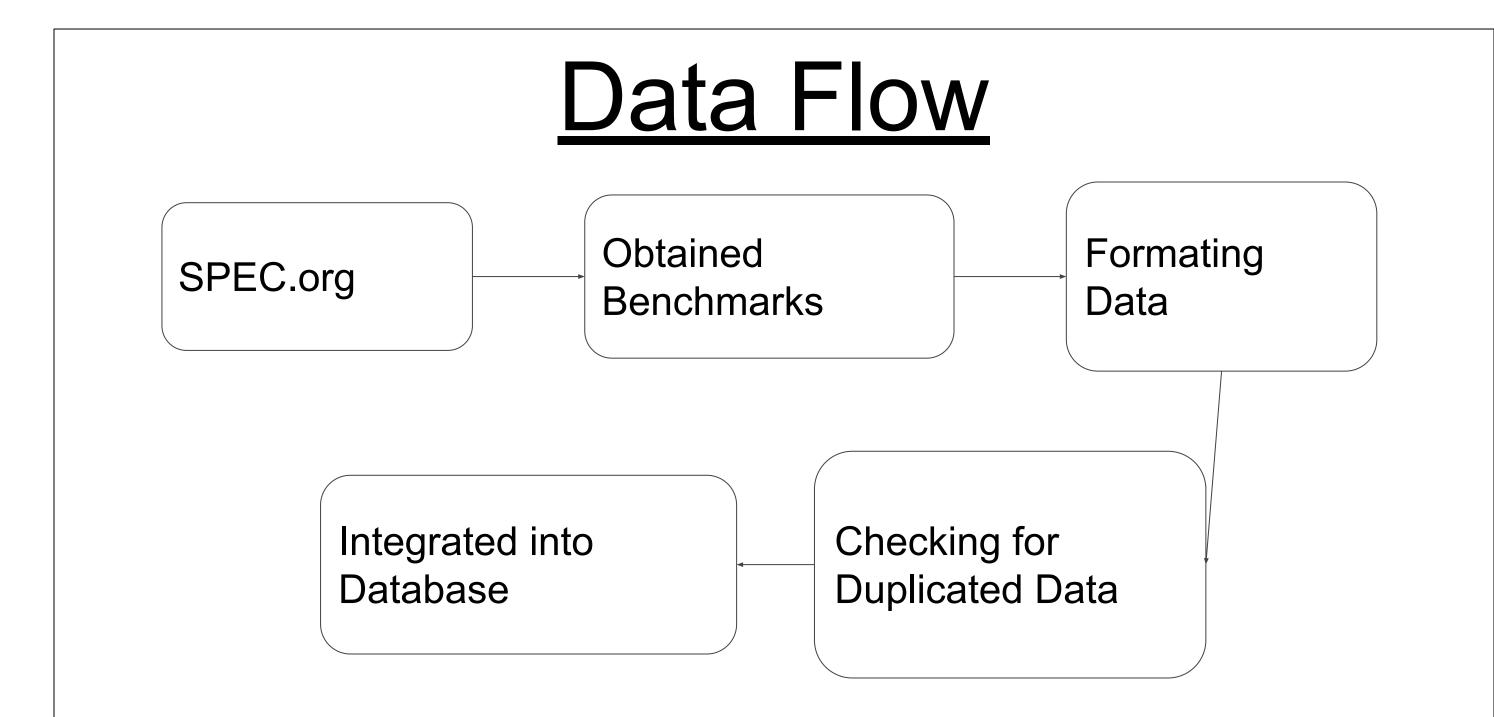
Web-Scraper:

- Takes data from SPEC.org website
- Organizes and formats data
- Inputs benchmark data into database

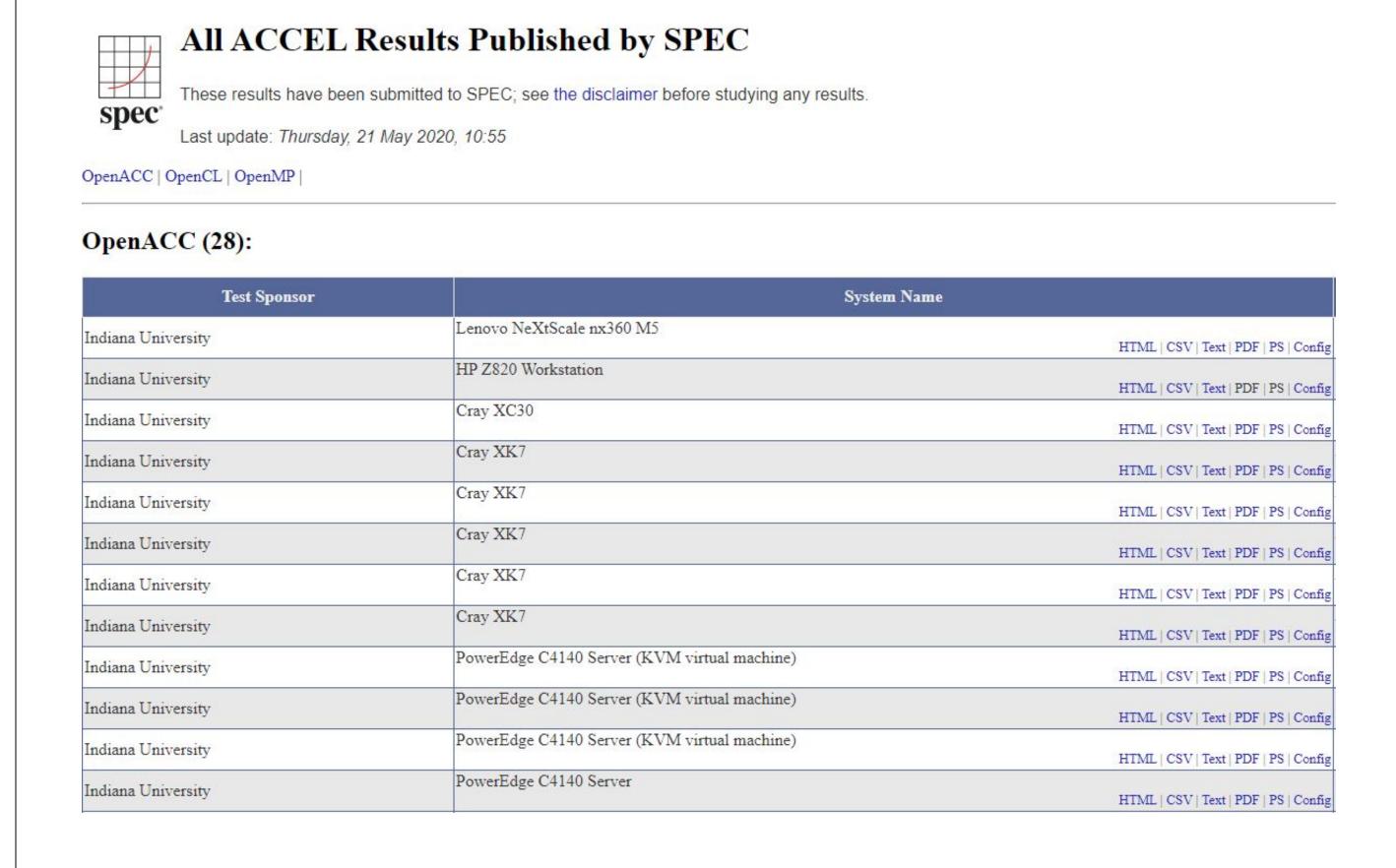
MySQL Database:

- Easy-to-use
- Large documentation for use with websites

Data is taken from the SPEC.org website, condensed and formatted, and transferred into the database.



- Visualization of the data movement within the web-scraper.
- Cron job triggers the web-scraper to move necessary data from SPEC.org to the database.



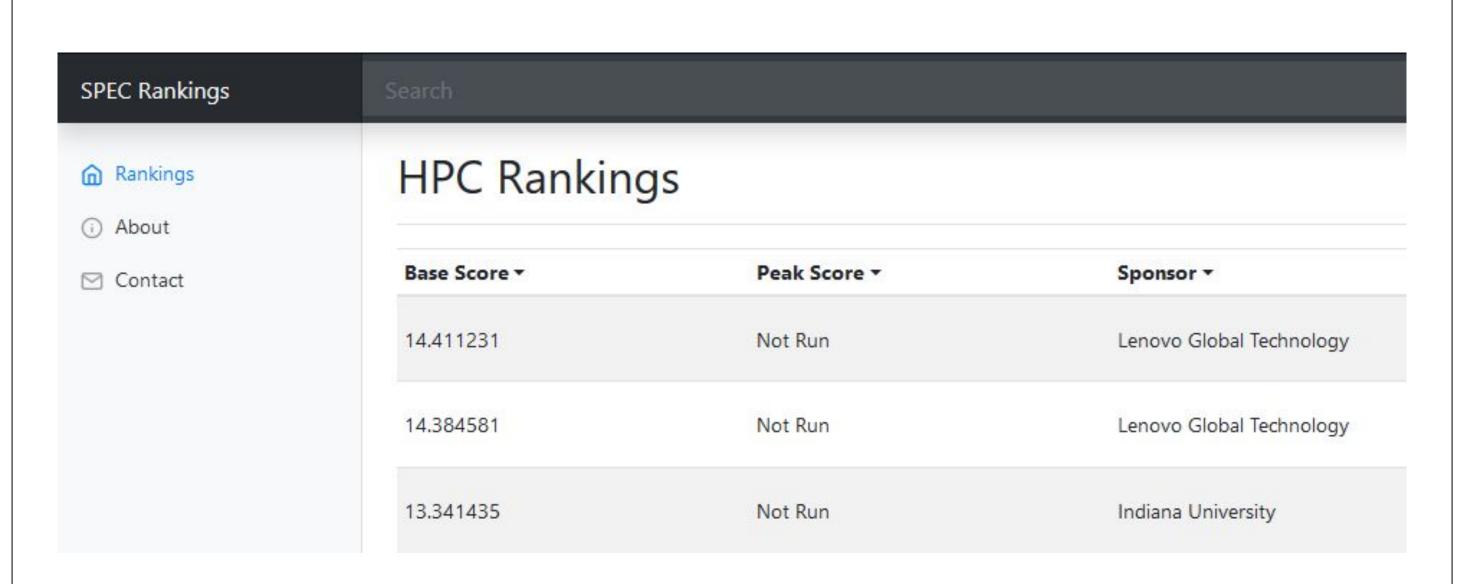
- The snapshot partial image of the original benchmarks organized on SPEC.org.
- All the results are located within different locations CSV, text, and other files.
- The scraper looks into each CSV file and takes the appropriate benchmark to copy into a table.

| | index | | | Hardware Model: Lenovo NeXtScale nx360 M5 | | | | by: Indiana | | | | Name | | | | C | CPU Characteristics | | | | | | |
|-------------------|-----------------------|------------------------|---|---|-----------|--|--------|-----------------------|---|-----------------------------|--|--|--------------------------|-----------------|--------------------------|-------------------------------------|---------------------|-------------------|--|--|--|--|----------|
| | | | | | | | | | | | Intel Xeon E5-2680 v3 | | | | | Intel Turbo Boost Technology on, | | | | | | | |
| ardware | Tested by: | CPU Name | CPU Characteristics | 100000000000000000000000000000000000000 | FPU | CPU(s) enabled | CPU(s) | | Secondary | L3 Cache | Memory | Disk Subsystem | Accel Model | Accel Vendor | Accel Name | Type | Accel Connection | Does Accel | Accel Description | Accel | Operating System | Compiler | SPECacce |
| enovo eXtScale | Indiana University | Intel Xeon | Intel Turbo Boos Technology on, | | Integrate | | | 32 KB I + | | 30 MB I+D on | 256 GB (16 x 16 GB 2Rx4 PC4-2133P-R) | | Intel Xeon E5-2680 | Intel | Intel Xeon E5-2680 v3 | Accel | | Use ECC yes | Intel Xeon E5-2680 v3 @2.5~3.3GHz | None | Red Hat | PGI Professional | 1.708258 |
| ⊃ Z820 | Indiana University | Intel Xeon | Hyperthreading on, Turbo Boos is off | is 2000 t | Integrate | | | per core 32 KB I + | 256 KB I+D on chip per | chip 20 MB I+D off | 64 GB (4 x 16 | 2000 GB Seagate ST2000DM00 7200 RPM | v3 Intel Xeon | Intel | Intel Xeon E5-2640 v2 | | N/A | Yes | Intel Xeon E5-2640 v2 @ 2.0 GHz | | release 7.3 Ubuntu | PGI Professional Edition, Release 17.5 | 0.661609 |
| ay XC30 | Indiana University | | Intel Turbo Boo Technology off, | st 2700 | Integrate | threads/cor ed 24 cores, 2 chips, 12 cores/chip, 2 | | 32 KB I + | 256 KB I+D on chip per core | 30 MB I+D on | 64 GB (8 x 8 GB | SATA3 | Intel Xeon E5-2697 | Intel , | Intel Xeon E5-2697 v2 | CPU | N/A | Yes | Intel Xeon E5-2697 v2 @ 2.7 GHz | None ! | | | 1.179653 |
| ay XK7 | Indiana University | AMD Opteron 6276 | AMD Turbo CORE Technology up t 3.2GHz, Turbo | | Integrate | threads/cor ed 16 cores, 1 chip, 16 cores/chip | | 16 KB D on chip | 16 MB I+D on chip per chip, 2 MB shared / 2 cores | I+D on | PC3L-12800R-11, ECC) | None | Tesla K20 | NVIDIA | NVIDIA Tesla K20 | GPU | PCle 2.0 16x | yes | | NVIDIA UNIX x86_64 Kernel Module 352.68 | SUSE Linux Enterprise Server 11 (x86_64), Cray | PGI Accelerator Fortran/C/C++ Server, Release 14.1 | 1.708379 |
| ay XK7 | Indiana University | AMD Opteron 6276 | AMD Turbo CORE Technology up t 3.2GHz, Turbo | | Integrate | ed 16 cores, 1 chip, 16 cores/chip | 1 chip | 16 KB D on chip | 16 MB I+D on chip per chip, 2 MB shared / 2 cores | 16 MB I+D on | 2Rx4 PC3L-12800R-11, ECC) | | Tesla K20 | NVIDIA | NVIDIA Tesla K20 | GPU | PCle 2.0 16x | yes | NVIDIA Tesla K20m GPU, 2496 CUDA cores, | NVIDIA UNIX x86_64 Kernel Module 352.68 | SUSE Linux Enterprise Server 11 (x86_64), Cray | PGI Accelerator Fortran/C/C++ Server, Release 15.3 | 1.784006 |
| ay XK7 | Indiana University | AMD Opteron 6276 | AMD Turbo CORE Technology up t 3.2GHz, Turbo | | Integrate | ed 16 cores, 1 chip, 16 cores/chip | 1 chip | 16 KB D on chip | 16 MB I+D on chip per chip, 2 MB shared / 2 cores | 16 MB I+D on | PC3L-12800R-11, ECC) | None | Tesla K20 | NVIDIA | NVIDIA Tesla K20 | GPU | PCle 2.0 16x | yes | NVIDIA Tesla K20m GPU, 2496 CUDA cores, | | SUSE Linux Enterprise Server 11 (x86_64), Cray | PGI Accelerator Fortran/C/C++ Server, Release 16.4 | 1.998554 |
| ay XK7 | Indiana University | AMD Opteron 6276 | AMD Turbo CORE Technology up t 3.2GHz, Turbo | | Integrate | ed 16 cores, 1 chip, 16 cores/chip | 1 chip | | 16 MB I+D on chip per chip, 2 MB shared / 2 cores | 16 MB I+D on | 32 GB (4 x 8 GB 2Rx4 PC3L-12800R-11, ECC) | None | Tesla K20 | NVIDIA | NVIDIA Tesla K20 | GPU | PCle 2.0 16x | yes | NVIDIA Tesla K20m GPU, 2496 CUDA cores, | NVIDIA UNIX x86_64 Kernel Module 352.68 | SUSE Linux Enterprise Server 11 (x86_64), Cray | PGI Professional Edition, Release 17.1 | 2.014046 |
| ay XK7 | Indiana University | AMD Opteron 6276 | AMD Turbo CORE Technology up t 3.2GHz, Turbo | | Integrate | ed 16 cores, 1 chip, 16 cores/chip | 1 chip | 16 KB D on chip | on chip per | 16 MB I+D on chip per | PC3L-12800R-11, | None | Tesla K20 | NVIDIA | NVIDIA Tesla K20 | GPU | PCle 2.0 16x | yes | NVIDIA Tesla K20m GPU, 2496 CUDA cores, | UNIX x86_64 | Server 11 (x86_64), | Professional | 2.072126 |

- After being scraped the benchmarks are organized and inserted into a MySQL database which is shown above.
- This visual is from PHPMyAdmin, which allows for the data to be easily accessed to display on the website.

Results

The following design demos a simplistic view:



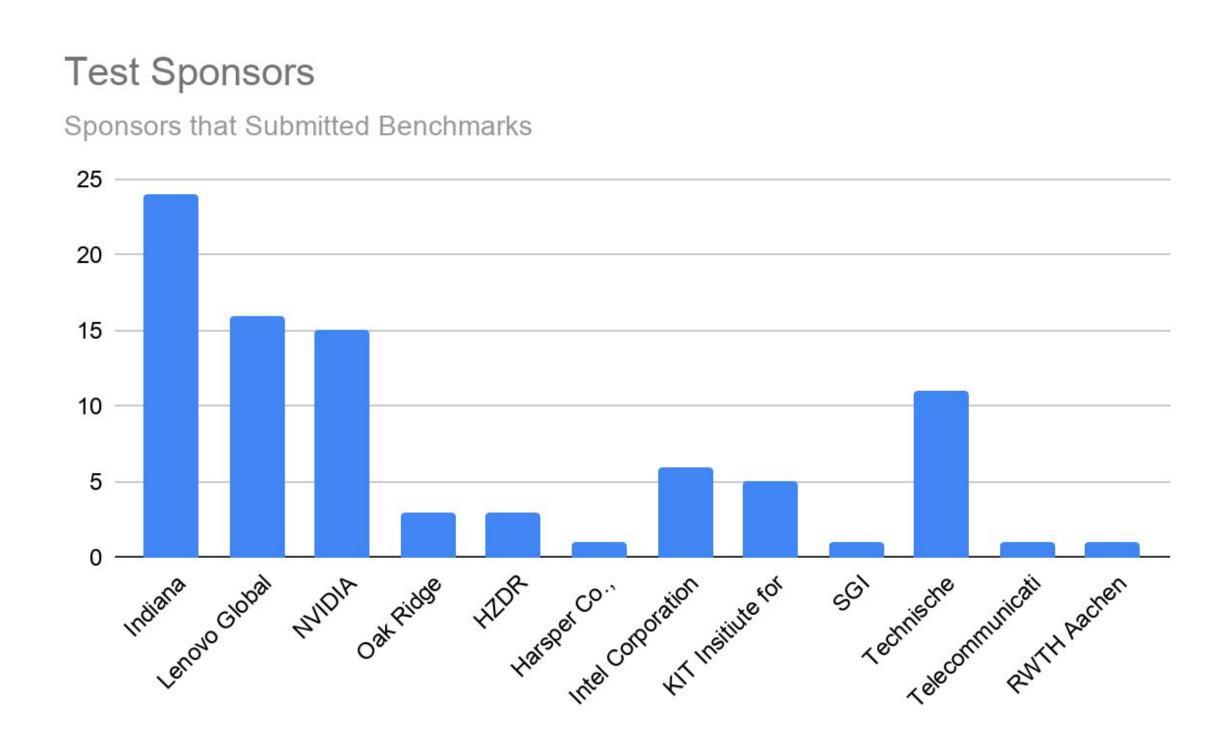
Key features of the website are as follows:

- A filter button, which allows for the changing of which default columns are shown.
- A search function, which allows for computers, locations, etc. to be searched for and displayed.
- More information for each HPC, which is shown by clicking on the sponsor & name. This shows every computer specification.
- A contact page, which allows for the user to provide feedback about features or errors on the website.
- An about page, which shows background information about the website.

The website shows the **key specifications** of each HPC system while giving the user tools to delve deeper into each one.

Future Work

- The methods and approaches will be applied to the upcoming new benchmark suite from SPEC, i.e. SPEC HPC2021
- When needed, the data can easily be tweaked through PHPMyAdmin, as the data output from SPEC is not always standardized.
- Other benchmarks besides SPEC can also be implemented into the website. For example, the SPEC CPU 2017 benchmark, which specifically focuses on a system's CPU performance, could be added.



 Finally, informative graphs could be added to the website. These graphs would provide another means to visualizing data, allowing for data to be simply compared. For example, the image above shows a graph comparing test sponsors.

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