



Hewlett Packard
Enterprise

Hewlett-Packard Enterprise

TPC Express Benchmark™ AI Full Disclosure Report

DL385 Gen11

with 1x ProLiant DL385 Gen11
using

Anaconda Pro

running on

Red Hat Enterprise Linux 8.6

TPCx-AI Version
Report Edition
Report Submitted

1.0.2
First
March 27, 2023

First Edition - March 2023

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All performance data contained in this report was obtained in a rigorously controlled environment. Results obtained in other operating environments may vary significantly. No warranty of system performance or price/performance is expressed or implied in this report.

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Abstract

HPE conducted the TPC Express Benchmark™ AI (TPCx-AI) on the DL385 Gen11. The software used included Anaconda Pro. This report provides full disclosure of the results. All testing was conducted in conformance with the requirements of the TPCx-AI Standard Specification, Revision 1.0.2.

Configuration Overview


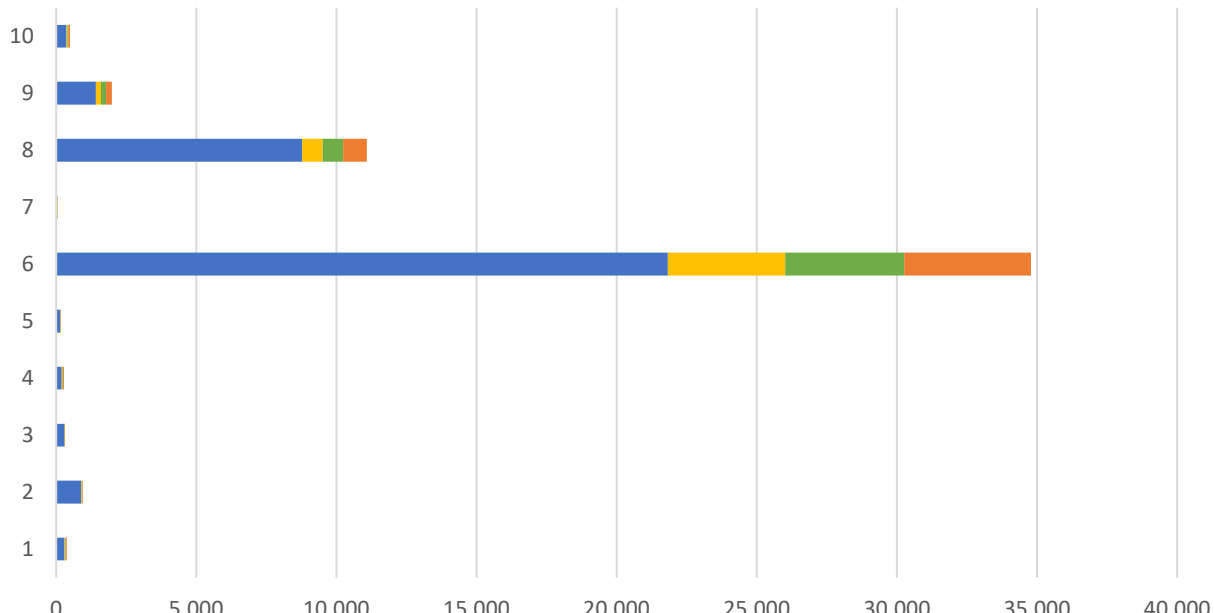
Test Sponsor	Node(s)	Operating System
HPE	1x ProLiant DL385 Gen11 (Server)	Red Hat Enterprise Linux 8.6


Metrics Overview


Total System Cost	Performance	Price/Performance	Availability Date
\$53,737 USD	422.33 AIUCpm@30	127.24 USD \$/AIUCpm@30	March 27, 2023

Executive Summary

The [Executive Summary](#) follows on the next several pages.

 Hewlett Packard Enterprise	<h1>DL385 Gen11</h1>		TPCx-AI 1.0.2 TPC Pricing 2.8.0 Report Date Mar. 27, 2023																																																								
TPCx-AI Performance 422.33 AIUCpm@30	Total System Cost \$53,737 USD	Price/Performance \$127.24 USD/AIUCpm@30	Availability Date March 27, 2023																																																								
Framework Anaconda Pro	Operating System Red Hat Enterprise Linux 8.6	Other Software N/A	Scale Factor 30	Streams 32																																																							
<div style="display: flex; justify-content: space-between;"> <div data-bbox="235 655 688 693"> <h3>Use Case Time (sec.) by Phase</h3> </div> <div data-bbox="850 661 1442 688"> ■ Training ■ Serving 1 ■ Serving 2 ■ Throughput (Avg) </div> </div>  <table border="1" style="display: none;"> <caption>Approximate Use Case Time (sec.) by Phase</caption> <thead> <tr> <th>Phase</th> <th>Training (sec)</th> <th>Serving 1 (sec)</th> <th>Serving 2 (sec)</th> <th>Throughput (Avg) (sec)</th> </tr> </thead> <tbody> <tr><td>1</td><td>1000</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>2</td><td>2000</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>3</td><td>1000</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>4</td><td>1000</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>5</td><td>1000</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>6</td><td>22000</td><td>4000</td><td>3000</td><td>3000</td></tr> <tr><td>7</td><td>1000</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>8</td><td>9000</td><td>1000</td><td>1000</td><td>1000</td></tr> <tr><td>9</td><td>1000</td><td>1000</td><td>0</td><td>0</td></tr> <tr><td>10</td><td>1000</td><td>0</td><td>0</td><td>0</td></tr> </tbody> </table>					Phase	Training (sec)	Serving 1 (sec)	Serving 2 (sec)	Throughput (Avg) (sec)	1	1000	0	0	0	2	2000	0	0	0	3	1000	0	0	0	4	1000	0	0	0	5	1000	0	0	0	6	22000	4000	3000	3000	7	1000	0	0	0	8	9000	1000	1000	1000	9	1000	1000	0	0	10	1000	0	0	0
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8	9000	1000	1000	1000																																																							
9	1000	1000	0	0																																																							
10	1000	0	0	0																																																							
Physical Storage / Scale Factor 32.00	Scale Factor / Physical Memory 0.04	Main Data Redundancy Model RAID 1																																																									
Servers: Total Processors/Cores/Threads	1 2 / 32 / 64																																																										
Server Type Processors Memory Storage Controller Storage Device Network Controller	1x ProLiant DL385 Gen11 (Server) 2x AMD EPYC 9174F 16-Core Processor GHz 768 GiB 1x NS204i-u Gen11 2x 480 GB NVMe 1x Mellanox MCX6314 10/25GbE 2p SFP28																																																										

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Maintenance	Server Hardware							HPE DL385 Gen11 8SFF CTO Server	P53921-B21	1	\$3,829.00	1	\$3,829.00		AMD EPYC 9174F CPU for HPE	P53846-001	1	8273	2	\$16,546.00		HPE DL38X Gen11 Max Perf Heat Sink Kit	P58460-B21	1	280	1	\$280.00		HPE G11 6056DR PER FAN KIT	P58465-B21	1	257	1	\$257.00		HPE 32GB 2RX8 DDR5-4800 Smart kit	P50311-B21	1	2465	24	\$59,160.00		HPE 1600W FS Plat Ht Plug LH PS Kit	P38997-B21	1	685	2	\$1,370.00		HPE USB US Keyboard/Mouse Kit	631341-B21	1	32	3	\$96.00		MLX MCX6314 10/25GbE 2p SFP28 OCP3 Adptr	P42041-B21	1	1398	1	\$1,398.00		Add to Rack 48U 600mmx1075mm G2 Advanced Pallet	P9K19A	1	3023	1	\$3,023.00		HPE 3 Year Total Care Essential for DL385 Gen11	H79N7E	1	\$5,364.00	1		\$5,364.00					Subtotal	\$85,959.00	\$5,364.00	Storage							NS204i-u Gen11 OS Boot, RAID 1	P48183-B21	1	\$2,005.00	1	\$2,005.00		HPE DL3X5 Gen11 Ter WM enablement Kit	P57850-B21	1	\$75.00	1	\$75.00		HPE Gen 11 EI Rail Kit	P52351-B21	1	\$34.48	1	\$34.48		HPE DL385G11 Standard Riser	standardDL385G11Riser	1		1	\$0.00						Subtotal	\$2,114.48	\$0.00	Other							HP V22v G5 FHD Monitor	65P56AA	3	\$129.99	3	\$389.97						Subtotal	\$389.97	\$0.00	Software Components							RHEL Svr Sckt/2 Gst 1yr 24x7 E-LTU	J8J36A	1	\$1,299.00	1	\$1,299.00		Anaconda Pro Subscription	N/A	2	\$10,000.00	1		\$10,000.00					Subtotal	\$1,299.00	\$10,000.00					Total Extended Price	\$89,762.45	\$15,364.00					Total Discounts	\$48,440.00	\$2,950.00					Grand Total	\$41,322.45	\$12,414.00	<p>Pricing: 1 = HPE; 2 = Anaconda; 3 = Hewlett Packard, Inc.</p> <p>* Discount applies to all hardware line items where Key = 1. Discount based upon total system cost as purchased by a regular customer.</p> <p>Audited by Doug Johnson, InfoSizing</p>	<p>Total System Cost (USD): \$53,737</p> <p>AIUCpm@30: 422.33</p> <p>\$/AIUCpm@30: \$127.24</p>
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<p><i>Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated Line Items. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed Line Items. For complete details, see the pricing section of the TPC Benchmark Standard. If you find that the stated prices are not available according to these terms, please inform the TPC at pricing@tpc.org. Thank you.</i></p>																																																																																																																																																																																																													

 Hewlett Packard Enterprise	<h1>DL385 Gen11</h1>		TPCx-AI	1.0.2
			TPC Pricing	2.8.0
			Report Date	Mar. 27, 2023
<u>Numerical Quantities</u>				
AIUCpm@30	422.33	T_{Load}		6.34
Scale Factor	30	T_{LD}		6.34
Streams	32	T_{PTT}		600.27
		T_{PST1}		47.36
Kit Version	1.0.2	T_{PST2}		47.66
Execution Status	Pass	T_{PST}		47.66
Accuracy Status	Pass	T_{TT}		18.20
Test Times				
Overall Run Start Time				2023-02-10 08:37:26.882
Overall Run End Time				2023-02-10 22:47:36.897
Overall Run Elapsed Time				51,010.015
Load Test Start Time				2023-02-10 08:41:09.990
Load Test End Time				2023-02-10 08:41:16.346
Load Test Elapsed Time				6.356
Power Training Start Time				2023-02-10 08:41:16.347
Power Training End Time				2023-02-10 18:12:02.398
Power Training Elapsed Time				34,246.051
Power Serving 1 Start Time				2023-02-10 18:12:02.400
Power Serving 1 End Time				2023-02-10 19:39:08.188
Power Serving 1 Elapsed Time				5,225.788
Power Serving 2 Start Time				2023-02-10 19:39:08.189
Power Serving 2 End Time				2023-02-10 21:07:04.435
Power Serving 2 Elapsed Time				5,276.246
Scoring Start Time				2023-02-10 21:07:41.970
Scoring End Time				2023-02-10 21:10:32.328
Scoring Elapsed Time				170.358
Throughput Start Time				2023-02-10 21:10:32.334
Throughput End Time				2023-02-10 22:47:36.896
Throughput Elapsed Time				5,824.562

 Hewlett Packard Enterprise	DL385 Gen11	TPCx-AI	1.0.2
		TPC Pricing	2.8.0
		Report Date	Mar. 27, 2023

Numerical Quantities (continued)

Use Case Times & Accuracy

Use Case	Training (sec)	Serving 1 (sec)	Serving 2 (sec)	Throughput (avg)	Accuracy
UC01	295.723	25.499	25.397	33.241	0.000
UC02	895.770	14.794	14.821	24.856	0.433
UC03	297.004	3.761	3.788	6.247	3.553
UC04	192.556	22.416	22.317	36.757	0.706
UC05	139.438	10.352	10.660	13.854	0.449
UC06	21,823.298	4,195.064	4,249.867	4,514.790	0.544
UC07	28.270	9.191	9.427	12.802	1.007
UC08	8,777.929	732.649	727.185	844.576	0.758
UC09	1,422.794	177.613	178.432	215.157	1.000
UC10	373.183	34.381	34.280	47.208	0.817

Use Case Serving Times (sec.)

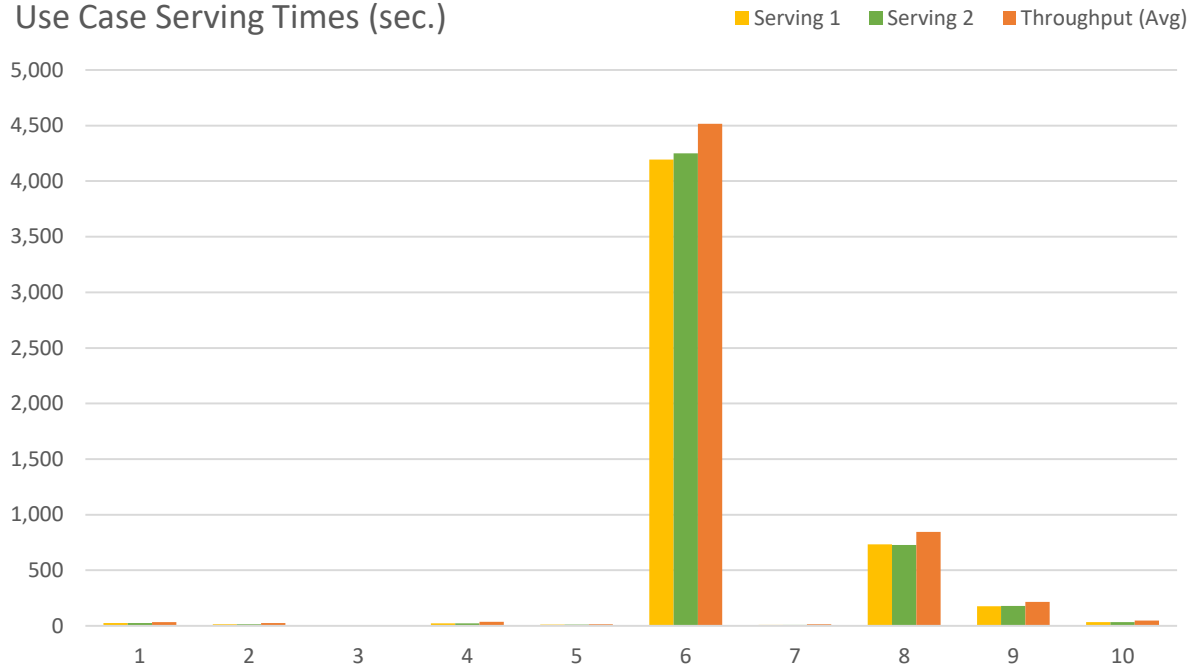


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Clause 0 – Preamble

0.1 TPC Express Benchmark™ AI Overview

Artificial intelligence (AI) has become a key transformational technology of our times. Advances in neural networks and other machine learning techniques have made it possible to use AI on a variety of use cases. From the public sector to aerospace, defense and academia, new and improved ways to use AI techniques are changing the way we harness data and analytics. This along with advances in compute, interconnect and memory technologies have made possible to solve complicated challenges that will ultimately benefit customers in production datacenter and cloud environments.

Abundant volumes of rich data from text, images, audio and video are the essential starting point for creating a benchmark that would represent the myriad of use cases and customers. TPC Express Benchmark™ AI (TPCx-AI) is created in keeping with the TPC tradition of emulating real world AI scenarios and data science use cases. Unlike most other AI benchmarks, the TPCx-AI uses a diverse dataset and is able to scale across a wide range of scale factors. TPCx-AI may later expand with additional use cases and add additional flexibility for a greater variety of implementations.

The benchmark defines and provides a means to evaluate the System Under Test (SUT) performance as a general-purpose data science system that:

- Generates and processes large volumes of data.
- Trains preprocessed data to produce realistic machine learning models.
- Conducts accurate insights for real-world customer scenarios based on the generated models.
- Can scale to large scale distributed configurations.
- Allows for flexibility in configuration changes to meet the demands of the dynamic AI landscape.

The benchmark models real-life examples of companies and public-sector organizations that use a range of analytics techniques, both AI and more traditional machine learning approaches, as well as the potential application of these techniques in situations like those in which they have already been successfully deployed. In addition, the benchmark measures end to end time to provide insights for individual use cases, as well as throughput metrics to simulate multiuser environments for a given hardware, operating system, and data processing system configuration under a controlled, complex, multi-user AI or machine learning data science workload.

The purpose of TPC benchmarks is to provide relevant, objective performance data to industry users. To achieve that purpose, TPC benchmark specifications require benchmark runs be implemented with systems, products, technologies and pricing that:

- Are generally available to users.
- Are relevant to the market segment that the individual TPC benchmark models or represents (e.g., TPCx-AI models and represents complex, high data volume, decision support environments).
- Would plausibly be implemented.

The TPCx-AI kit is available from the TPC website (see www.tpc.org/tpcx-ai/ for more information). Users must sign up and agree to the TPCx-AI End User Licensing Agreement (EULA) to download the kit. All related work (such as collaterals, papers, derivatives) must acknowledge the TPC and include the TPCx-AI copyright. The TPCx-AI kit includes: TPCx-AI Specification document (this document), TPCx-AI Users Guide (README.md) documentation, scripts to set up the benchmark environment, code to execute the benchmark workload, Data Generator, use case related files, and Benchmark Driver.

The use of new systems, products, technologies (hardware or software) and pricing is encouraged so long as they meet the requirements above. Specifically prohibited are benchmark systems, products, technologies or pricing (hereafter referred to as "implementations") whose primary purpose is performance optimization of TPC benchmark results without any corresponding applicability to real-world applications and environments. In other words, all "benchmark special" implementations that improve benchmark results but not real-world performance or pricing, are prohibited.

The rules for pricing are included in the TPC Pricing Specification.

Further information is available at www.tpc.org.

Clause 1 – General Items

1.1 Test Sponsor

This benchmark was sponsored by Hewlett-Packard Enterprise.

1.2 Parameter Settings

The [Supporting Files Archive](#) contains the parameters and options used to configure the components involved in this benchmark.


1.3 Configuration Diagrams

The measured configuration diagram is shown below. In addition, any differences between the measured and the priced configurations are described.

1.3.1 Measured Configuration


Nodes:	1		
Processors/Cores/Threads:	2/32/64	Storage Devices:	2
Total Memory:	768 GiB	Storage Capacity:	960 GB

HPE ProLiant DL385 Gen11



HPE ProLiant DL385 Gen11
2 x AMD EPYC 9174F (4.1GHz/16-core)
768 GB MEM: 24x32GB DIMMs

1 x HPE NS204i-u Gen11 hot-plug NVMe boot device Operation System, benchmark kit and data
 2 x 480GB NVMe (RAID 1)



	<u>Server</u>
Server	1x ProLiant DL385 Gen11:
Procs/Cores/Threads:	2/16/32
Processor Model:	2x AMD EPYC 9174F 16-Core Processor
Memory:	768 GiB
Storage Controller:	1x NS204i-u Gen11
Storage Devices:	2x 480 GB NVMe
Network Controller:	1x Mellanox MCX6314 10/25GbE 2p SFP28

The distribution of software components over server nodes is detailed in [Clause 2](#).

1.3.2 Differences Between the Measured and the Priced Configurations

There are no differences between the measured configuration and the priced configuration.

Clause 2 – SW Components & Data Distribution

2.1 Roles and Dataset Distribution

Table 2-1 describes the distribution of the dataset across all media in the SUT.

Server	Host Name	SW Services	Storage	Contents
1x ProLiant DL385 Gen11	ankit385g11	All	2x 480 GB NVMe	OS, Data

Table 2-1 Software Components and Dataset Distribution

2.2 File System Implementation

A local file system provided by Red Hat Enterprise Linux 8.6 / Anaconda Pro was used for data generation and the Load Test. The data set was not relocated after generation and before the Load Test.

2.3 Execution Engine, Frameworks, Driver & Libraries

Anaconda Pro consisted of the following components.

Component	Version
python	3.9.13
setuptools	58.0.4
pandas	1.5.2
scikitlearn	1.2.0
xgboost	1.5.0
numpy	1.23.4
nose	1.3.7
scipy	1.9.3
statsmodels	0.12.2
patsy	0.5.2
tqdm	4.64.1
keras	2.10.0
tensorflow	2.10.0
joblib	1.1.1
pyyaml	6
jinja2	3.1.2
opencv	4.5.5

Table 2-2 Software Components

For a detailed listing of installed libraries, please see the envInfo logs in the [Supporting Files](#).

2.4 Applied Patches

No additional vendor-supported patches were applied to the SUT.

Clause 3 – Workload Related Items

3.1 Hardware & Software Tuning

The [Supporting Files](#) archive contains all hardware and software configuration scripts.

3.2 Kit Version & Modifications

Table 3-1 shows the version of the TPCx-AI used to produce this result along with any kit files that were modified to facilitate system, platform, and framework differences.

TPCx-AI Kit Version	1.0.2
<u>Modified File</u>	<u>Description of Changes</u>
tools/python/dataRedundancyInformation.sh	Added platform-specific data collection.
tools/python/python-ks.yaml	Adjusted for software versions used.
See Auditor’s Note	

Table 3-1 Kit Version & Modifications

3.3 Use Case Elapsed Times

Below are the elapsed times for each use case. Use cases are grouped based on whether they use Deep Learning or Machine Learning techniques.

Type	UC ID	P1	P2	T1	T2	T3	T4
Deep Learning	2	14.794	14.821	65.654	16.919	23.857	19.314
	5	10.352	10.660	12.380	12.817	12.569	13.589
	9	177.613	178.432	235.160	215.162	208.618	210.718
Machine Learning	1	25.499	25.397	27.286	33.828	32.306	30.389
	3	3.761	3.788	5.113	4.039	6.896	4.571
	4	22.416	22.317	28.691	28.432	30.079	29.324
	6	4,195.064	4,249.867	4,517.801	4,506.697	4,504.738	4,510.000
	7	9.191	9.427	11.243	12.764	12.553	11.649
	8	732.649	727.185	814.355	873.160	869.535	870.420
	10	34.381	34.280	41.746	36.615	42.347	41.458

Type	UC ID	T5	T6	T7	T8	T9	T10
Deep Learning	2	27.065	22.774	27.752	25.417	22.642	19.866
	5	11.551	12.163	15.229	12.632	12.685	12.623
	9	207.258	224.240	224.196	224.717	206.235	206.197
Machine Learning	1	33.553	34.872	32.462	40.153	29.368	32.361
	3	4.971	6.073	9.569	4.866	4.321	4.040
	4	32.256	30.052	56.331	29.395	81.263	24.983
	6	4,542.437	4,536.132	4,494.239	4,484.778	4,516.632	4,514.919
	7	14.627	11.263	13.328	14.034	20.044	17.653
	8	839.481	836.842	822.009	826.454	810.893	879.042
	10	51.423	46.274	42.610	78.079	51.161	42.924

Type	UC ID	T11	T12	T13	T14	T15	T16
Deep Learning	2	20.594	16.932	22.632	17.030	20.429	67.631
	5	12.149	21.217	12.264	13.470	12.109	12.396
	9	266.765	203.862	207.658	212.528	218.094	212.894
Machine Learning	1	31.630	31.438	35.238	32.486	35.668	27.965
	3	4.027	41.285	4.346	6.854	4.482	4.963
	4	26.390	28.190	31.216	26.859	31.367	35.541
	6	4,502.430	4,514.423	4,514.123	4,511.205	4,512.363	4,497.586
	7	9.923	12.624	10.512	11.172	10.956	11.571
	8	819.284	806.358	856.806	884.963	851.410	820.766
	10	37.146	53.316	43.887	43.125	43.483	42.827

Type	UC ID	T17	T18	T19	T20	T21	T22
Deep Learning	2	24.119	22.899	19.318	25.526	26.786	24.991
	5	12.597	11.815	13.475	17.639	11.756	12.643
	9	219.212	212.858	214.169	207.342	210.534	209.049
Machine Learning	1	32.098	28.982	29.170	33.128	26.848	29.957
	3	4.360	4.311	4.675	5.245	6.283	4.400
	4	86.855	30.383	24.114	78.862	44.787	24.975
	6	4,482.041	4,510.871	4,511.392	4,487.089	4,525.292	4,511.833
	7	14.533	10.665	10.066	14.084	17.192	11.969
	8	837.400	862.341	896.742	841.588	870.245	843.596
	10	43.937	42.539	38.255	48.418	47.036	43.307

Type	UC ID	T23	T24	T25	T26	T27	T28
Deep Learning	2	31.005	20.029	18.845	15.135	23.342	19.767
	5	8.967	11.544	11.895	11.946	12.485	13.792
	9	215.574	201.704	219.305	224.203	205.302	221.969
Machine Learning	1	76.492	33.437	28.925	37.345	32.452	27.116
	3	3.943	5.377	3.967	4.011	4.844	5.172
	4	25.932	25.886	25.850	32.732	25.200	32.780
	6	4,523.156	4,512.449	4,510.280	4,554.298	4,506.112	4,515.831
	7	12.208	13.455	10.600	13.622	12.727	15.420
	8	807.962	819.265	864.048	836.521	867.940	829.015
	10	59.301	78.071	46.104	45.397	45.334	36.498

Type	UC ID	T29	T30	T31	T32
Deep Learning	2	19.984	22.995	26.345	17.812
	5	12.456	11.942	43.959	12.581
	9	214.218	207.880	206.708	210.699
Machine Learning	1	32.435	30.198	36.083	28.042
	3	5.073	8.111	5.733	3.994
	4	28.822	76.909	32.704	29.051
	6	4,543.910	4,508.862	4,492.598	4,596.773
	7	10.796	13.845	13.320	9.235
	8	856.411	811.110	835.886	864.571
	10	46.808	44.721	56.035	50.473

Table 3-2 Use Case Elapsed Times

3.4 SUT Validation Test Output

<u>Validation Run Report</u>			
AIUCpm@1	280.91	T _{Load}	0.59
Scale Factor	1	T _{LD}	0.59
Streams	32	T _{PTT}	23.77
Kit Version	1.0.2	T _{PST1}	3.42
Execution Status	Pass	T _{PST2}	3.44
Accuracy Status	Pass	T _{PST}	3.44
		T _{TT}	0.43
Test Times			
Overall Run Start Time	2023-02-10 07:49:54.520		
Overall Run End Time	2023-02-10 08:18:17.257		
Overall Run Elapsed Time	1,702.737		
Load Test Start Time	2515-07-30 10:52:47.326		
Load Test End Time	2515-07-30 10:52:48.391		
Load Test Elapsed Time	1.065		
Power Training Start Time	2515-07-30 10:52:48.396		
Power Training End Time	2515-07-30 11:47:20.720		
Power Training Elapsed Time	3,272.324		
Power Serving 1 Start Time	2515-07-30 11:47:20.729		
Power Serving 1 End Time	2515-07-30 11:49:25.751		
Power Serving 1 Elapsed Time	125.022		
Power Serving 2 Start Time	2023-02-10 08:12:16.553		
Power Serving 2 End Time	2023-02-10 08:13:36.865		
Power Serving 2 Elapsed Time	80.312		
Scoring Start Time	2515-07-30 11:52:38.280		
Scoring End Time	2515-07-30 11:54:37.610		
Scoring Elapsed Time	119.330		
Throughput Start Time	2515-07-30 11:54:37.624		
Throughput End Time	2515-07-30 11:57:46.701		
Throughput Elapsed Time	189.077		
(continued on next page)			

Validation Run Report (continued)

Accuracy Metrics					
Use Case	Metric Name	Metric	Criteria	Threshold	Status
1	N/A	0.000	N/A	0.00	Pass
2	word_error_rate	1.286	<=	0.50	Pass
3	mean_squared_log_error	4.582	<=	5.40	Pass
4	f1_score	0.701	>=	0.65	Pass
5	mean_squared_log_error	2.367	<=	0.50	Pass
6	matthews_corrcoef	0.462	>=	0.19	Pass
7	median_absolute_error	0.895	<=	1.80	Pass
8	accuracy_score	0.717	>=	0.65	Pass
9	accuracy_score	1.000	>=	0.90	Pass
10	accuracy_score	0.817	>=	0.70	Pass

3.5 Configuration Parameters

The [Supporting Files](#) archive contains all Global Benchmark Parameter and Use Case Specific Parameter settings.

Clause 4 – SUT Related Items

4.1 Specialized Hardware/Software

No Specialized Hardware/Software was used in the SUT.

4.2 Configuration Files

The [Supporting Files](#) archive contains all configuration files.

4.3 SUT Environment Information

All envInfo.log files are included in the [Supporting Files](#) archive.

4.4 Data Storage to Scale Factor Ratio

The details of the Data Storage Ratio are provided below.

Node Count	Disks	Size (GB)	Total (GB)
1	2	480	960

Total Storage (GB)	960
Scale Factor	30
Data Storage Ratio	32.00

4.5 Scale Factor to Memory Ratio

The details of the Memory to Scale Factor Ratio are provided below.

0	Memory (GiB)	Total (GiB)
1	768	768

Scale Factor	30
Total Memory (GiB)	768
SF / Memory Ratio	0.04

4.6 Output of Tests

The [Supporting Files](#) archive contains the output files of all tests.

4.7 Additional Sponsor Files

The [Supporting Files](#) archive contains any additional files that were used.

4.8 Model Optimizations

The [Supporting Files](#) archive contains any model optimization files that were used.

Clause 5 – Metrics and Scale Factor

5.1 Reported Performance Metrics

Metric Overview

TPCx-AI Performance Metric	422.33	AIUCpm@30
TPCx-AI Price/Performance Metric	127.24	\$/AIUCpm@30
TPCx-AI Scale Factor	30	
TPCx-AI Stream Count	32	

Test Times

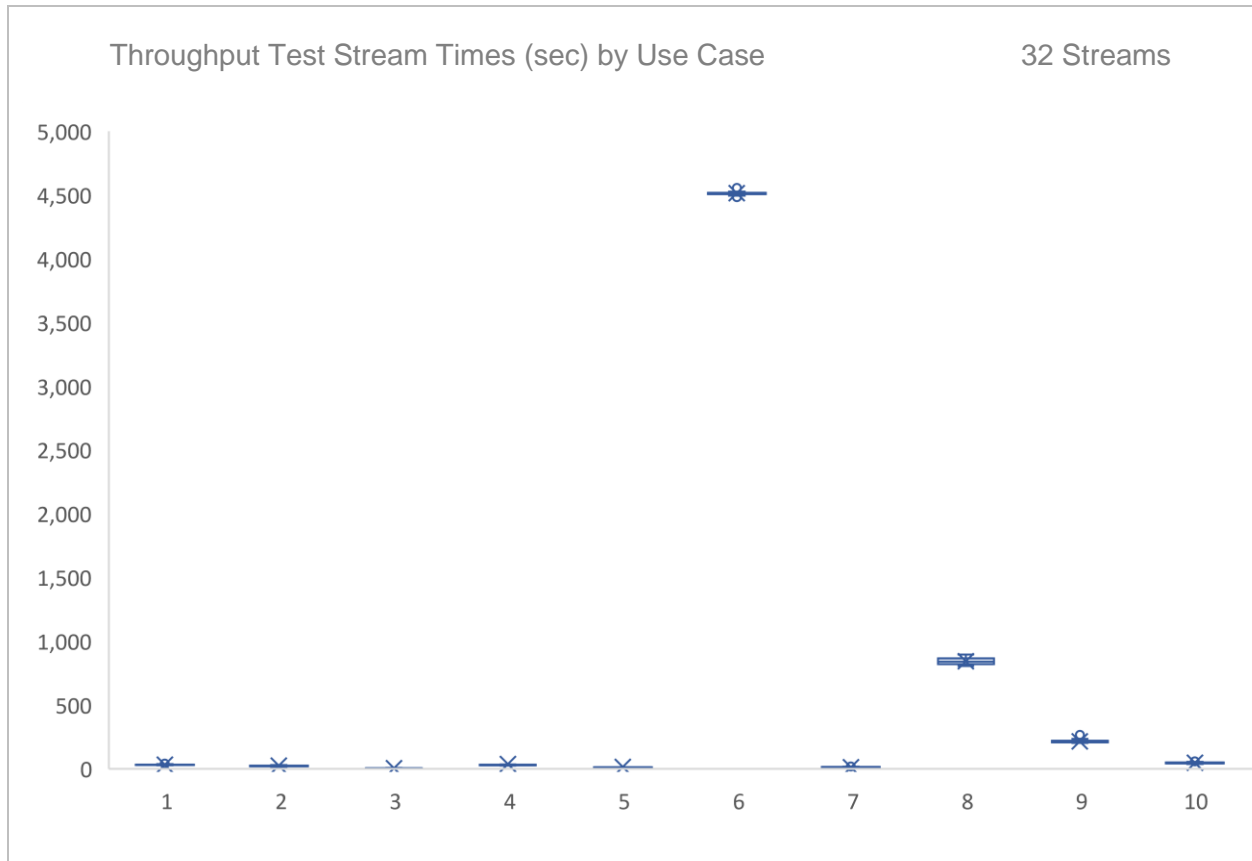
Overall Run Start Time	2023-02-10 08:37:26.882
Overall Run End Time	2023-02-10 22:47:36.897
Overall Run Elapsed Time	51,010.015
Load Test Start Time	2023-02-10 08:41:09.990
Load Test End Time	2023-02-10 08:41:16.346
Load Test Elapsed Time	6.356
Power Training Start Time	2023-02-10 08:41:16.347
Power Training End Time	2023-02-10 18:12:02.398
Power Training Elapsed Time	34,246.051
Power Serving 1 Start Time	2023-02-10 18:12:02.400
Power Serving 1 End Time	2023-02-10 19:39:08.188
Power Serving 1 Elapsed Time	5,225.788
Power Serving 2 Start Time	2023-02-10 19:39:08.189
Power Serving 2 End Time	2023-02-10 21:07:04.435
Power Serving 2 Elapsed Time	5,276.246
Scoring Start Time	2023-02-10 21:07:41.970
Scoring End Time	2023-02-10 21:10:32.328
Scoring Elapsed Time	170.358
Throughput Start Time	2023-02-10 21:10:32.334
Throughput End Time	2023-02-10 22:47:36.896
Throughput Elapsed Time	5,824.562

Accuracy Metrics

Use Case	Metric Name	Metric	Criteria	Threshold	Status
1	N/A	0.000	N/A	0.00	Pass
2	word_error_rate	0.433	<=	0.50	Pass
3	mean_squared_log_error	3.553	<=	5.40	Pass
4	f1_score	0.706	>=	0.65	Pass
5	mean_squared_log_error	0.449	<=	0.50	Pass
6	matthews_corrcoef	0.544	>=	0.19	Pass
7	median_absolute_error	1.007	<=	1.80	Pass
8	accuracy_score	0.758	>=	0.65	Pass
9	accuracy_score	1.000	>=	0.90	Pass
10	accuracy_score	0.817	>=	0.70	Pass

5.2 Throughput Test Stream Times

The following chart shows the minimum, 1st quartile, median, mean (X), 3rd quartile, and maximum stream times by use case for the Throughput Test. Outliers are marked with “o”.



Auditor's Information

This benchmark was audited by Doug Johnson, InfoSizing.

www.sizing.com
63 Lourdes Drive
Leominster, MA 01453
978-343-6562.

This benchmark's Full Disclosure Report can be downloaded from www.tpc.org.

A copy of the auditor's attestation letter is included in the next two pages.



Ankit Chouksey
 Hewlett-Packard Enterprise
 192 Mahadevapura,
 Whitefield Road
 Bangalore, India 560048

March 11, 2023

I verified the TPC Express Benchmark™ AI v1.0.2 performance of the following configuration:

Platform: 1x ProLiant DL385 Gen11
 Operating System: Red Hat Enterprise Linux 8.6
 Additional Software: Anaconda Pro

The results were:

Performance Metric 422.33 AIUCpm@30

Secondary Metrics	T _{LD}	6.34
	T _{PTT}	600.27
	T _{PST}	47.66
	T _{TT}	18.20

System Under Test 1x ProLiant DL385 Gen11 with:

CPU	2x AMD EPYC 9174F 16-Core Processor		
Memory	768 GiB		
Storage	Qty	Size	Type
	2	480 GB	NVMe

In my opinion, these performance results were produced in compliance with the TPC requirements for the benchmark.

The following verification items were given special attention:

- All TPC-provided components were verified to be v1.0.2.
- All checksums were validated for compliance.
- Any modifications to shell scripts were reviewed for compliance.
- No modifications were made to any of the Java code.
- The generated dataset was properly scaled to 30 GB.

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- The generated dataset used for testing was protected by RAID 1.
- The elapsed times for all phases and runs were correctly measured and reported.
- The Storage and Memory Ratios were correctly calculated and reported.
- The system pricing was verified for major components and maintenance.
- The major pages from the FDR were verified for accuracy.

Additional Audit Notes:

Two files were erroneously reported as having incorrect checksums. This is due to a minor issue in the TPC-provided kit. The TPCx-AI Subcommittee is aware of this and will correct it in a future release of the kit.

Respectfully Yours,

A handwritten signature in cursive script that reads "Doug Johnson". The signature is written in black ink and has a long, sweeping horizontal line extending to the right.

Doug Johnson, Certified TPC Auditor

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Third-Party Price Quotes

Anaconda



Anaconda Support Quote

Effective Date: March 27, 2023

This is a quote for a 1 year subscription to Anaconda Pro, including support. This quote will remain valid for 120 days following the effective date listed above.

Anaconda will support the packages listed on the following page. Packages other than those listed will not be included in this support offer.

Quote:

\$ USD:

Software Components	Unit Price	Qty	Total Price
Anaconda Pro Subscription - 1 year with Premium Support	\$10,000	1	\$10,000



Included packages:

package name	source	version
python	main-anaconda	3.9.13
setuptools	main-anaconda	58.0.4
pandas	main-anaconda	1.5.2
scikitlearn	main-anaconda	1.2.0
xgboost	main-anaconda	1.5.0
numpy	main-anaconda	1.23.4
nose	main-anaconda	1.3.7
scipy	main-anaconda	1.9.3
statsmodels	main-anaconda	0.12.2
patsy	main-anaconda	0.5.2
tqdm	main-anaconda	4.64.1
keras	main-anaconda	2.10.0
tensorflow	main-anaconda	2.10.0
joblib	main-anaconda	1.1.1
pyyaml	main-anaconda	6
jinja2	main-anaconda	3.1.2
opencv	main-anaconda	4.5.5



Contact Sales: sales@anaconda.com | (512) 222-5440

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Hewlett Packard, Inc.

The screenshot displays the HP website's product page for the HP V22v G5 FHD Monitor. The browser address bar shows the URL: hp.com/us-en/shop/odp/hp-v22v-g5-fhd-monitor#specialOffers. The HP logo and navigation links (Explore, Shop, Support) are at the top. The breadcrumb trail reads: HOME / ACCESSORIES / HP V22V G5 FHD MONITOR. The product image shows a monitor with a green and black abstract pattern. Below the image is a 'SPECIAL OFFERS' banner with the text: 'Presidents' Day Sale | Presidents' Day deal! Buy more, save more!' and a 'LEARN MORE' link. To the right, the product title is 'HP V22v G5 FHD Monitor' with a 3.8 (25) star rating. The price is \$99.99, with a 'SAVE \$30.00' tag and an 'Earn 1X HP Rewards Points' icon. An 'ADD TO CART' button is prominent. Below this, there are warranty options: '1-Year Standard Warranty' (Included) and 'HP 2 Year Next Day Exchange Service for Consumer Monitors' (Save \$18.75). The product is marked as 'IN STOCK Ships in 1 business day'. At the bottom right, there is an 'Add to compare' link and a product ID: #65P56AA#ABA. The Windows taskbar at the bottom shows the time as 12:53 PM on 20 Feb 23.

Supporting Files Index

The Supporting Files archive for this disclosure contains the following structure.

Supporting Files Directory	Description
CheckIntegrity/...	Output of CHECK_INTEGRITY test (if the phase is not done as part of the Validation and Performance Test).
PerformanceTest/...	Performance Test output files.
ValidationTest/...	Validation Test output files.
Additional files used by HPE	
Sponsor/ModelOptimization/...	Details of model optimization.
Sponsor/ModifiedKitFiles/...	2 modified file(s).
Sponsor/Tuning/...	All tuning files used.