An Analysis of Computational Efficiency in Azure App Service

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Introduction

This paper examines Microsoft Azure App Service, focusing on service tiers, thread counts, and computing efficiency. It explores the performance of single- and multi-threaded workloads, particularly in Fibonacci calculations, across different tiers. Results show that lower cost tiers often outperform premium ones in cost efficiency and computing, albeit with some inconsistencies. The study also addresses the inherent unknowns in Platform as a Service (PaaS), offering insights for Developers, DevOps, and Software Architects. Utilising heat maps and line charts, the research analyses the calculation time for Fibonacci numbers on servers across East US, West Europe, and Southeast Asia. It investigates the correlation between server-tier performance, costs, and regional architectural differences. The findings, presented through graphs and critical observations, underscore the importance of tier selection based on workload and location, concluding with recommendations for cloud service optimisation.

Azure Analysis

Thesis Structure

This study investigates Azure App Service's handling of single-threaded applications. Two key questions guide the research: 1) How does Azure handle concurrent HTTP requests in single-threaded architecture regarding core utilization? and 2) Are there performance differences in Azure deployments across regions? The research uses a Fibonacci calculation API to explore core utilisation and performance across service tiers and regions and cost-effectiveness in cloud applications.

Knowledge Gaps

Despite extensive Azure App Service learning resources, gaps remain in understanding the PaaS model's resource utilization. This thesis focuses on four key areas: Tier Performance, Real-World Application Scenarios, Impact of **Regional Variations**, and a **Detailed Cost**-**Benefit Analysis**. It examines explicitly the performance and cost of single-threaded versus multi-threaded workloads in Azure, addressing crucial knowledge gaps in cloud computing literature.

Methodology:

This research examines Azure App Service's performance using a FibonacciCalculationAPI. Tests were conducted across three regions (West Europe, East US, Southeast Asia) on nine Azure tiers, focusing on CPU and memory usage. The API, developed in ASP.NET Core, was monitored using Azure Application Insights. Custom C tests simulated different thread loads, with results analyzed in Power BI to understand efficiency and scalability in cloud environments and regional variation impacts.



Power BI analysis of Azure App Service tests revealed: 1) Higher performance in premium tiers, suggesting a price-performance correlation. 2) Single-threaded tasks are uniformly handled, while multi-threaded tasks show concurrency complexities. 3) The premium tier demonstrates efficient CPU utilization across varying loads. 4) Cost efficiency is crucial in computational power allocation. These insights guide IT professionals in understanding Azure's hardware management, aiding in informed service tier selection for applications.

Topic Overview

This matrix visualisation analyses thread count impact on Azure App Service performance, using Fibonacci computations as a metric. It shows average compute times across single, two, and four-threaded tests, visualised through a heat map indicating time from white (minimum) to red (maximum). Key insights include uniformity in single-threaded performance, variable multi-threaded behaviour, and the effect of thread failure on overall efficiency. The study highlights the nuances in resource allocation and thread management within Azure.

Fibonacci Nth No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1010000	119,870.85	106,660.13	37,714.52	104,661.98	94,207.37	49,702.95	93,930.29	88,456.82	44,434.84	201,380.33	196,333.23	78,157.21	109,550.18	115,193.31	42,313.90	102,233.43	101,057.54	46,926.88	188,892.88	122,366.78	162,063.96	93,955.72	180,248.78	111,339.30	115,500.47	119,584.84	49,675.63
1020000	123,603.65	113,996.06	39,412.57	111,377.20	101,108.37	50,746.53	97,445.98	92,755.34	47,038.70	126,698.71	128,630.24	86,084.42	119,277.96	125,457.53	44,082.50	108,615.11	105,212.89	48,245.76	202,855.32	120,727.33	170,203.14	96,817.85	189,669.75	117,059.70	123,655.14	127,622.47	53,576.90
1030000	133,341.46	119,982.34	40,999.54	116,417.65	104,514.77	54,502.94	103,395.11	96,456.16	49,962.60	111,075.75	107,655.11	86,269.80	131,259.34	126,449.41	45,558.11	115,127.40	113,088.30	50,320.75	124 057 46	131,594.05	158,005.22	100,084.44	193,673.09	120,779.08	134,614.06	134,414.20	55,820.57
1040000	146 007 21	121,745.02	42,258.52	115,144.10	112 100 05	53,115.29 63,420,49	110 202 26	100,760.39	52,608.99	120,878.95	132 275 27	91,505.55	142 002 62	146 220 56	47,557.00	172 749 70	121 609 04	55,456.17	124,057.40	142 045 40	142,820.10	100,587.25	200.005.14	121,708.50	141,917.05	142,779.40	53,043.48
1050000	140,007.01	139 436 44	44,244.70	119 175 16	115,135.05	65 153 45	121 284 58	111 843 41	58 093 47	122,577.22	128 287 25	99.011.43	145,095.02	151 227 95	50 978 37	122 525 21	132 560 28	62 841 13	118 255 85	150 281 69	150,900.20	111 672 40	128 529 87	128 225 22	159 440 93	160 382 70	66 755 88
1070000	152,887,51	135,446.86	47.350.44	131.828.36	125,457,90	68,144,38	121,450,19	109.697.94	61.297.62	135,246,60	133.064.19	110.540.72	156.290.81	156,787,30	53,604,83	137.903.86	140.023.77	67.488.56	119,427,13	158,485,46	161,907,27	113,476,77	117.333.02	139,802,48	169.080.04	165,177,91	71,205,15
1080000	171,489.94	155,645.35	49,059.83	146,118.47	123,061.22	71,513.67	125,953.54	113,539.45	63,814.64	141,898.42	145,507.69	110,082.55	160,387.13	161,728.16	55,770.26	144,674.65	147,247.90	66,476.22	125,247.43	159,960.59	173,533.96	120,822.96	118,973.59	151,736.81	176,986.99	171,344.64	74,450,41
1090000	169,866.25	155,364.43	50,098.42	150,101.30	133,872.04	72,248.61	131,279.47	122,331.50	66,895.79	148,860.52	151,317.44	111,651.28	162,816.34	167,454.73	57,284.93	161,662.02	152,994.72	72,787.74	127,497.36	171,435.26	163,783.60	119,909.34	124,491.69	159,335.91	182,798.51	182,053.27	77,343.26
1100000	181,211.31	162,739.81	53,261.26	135,663.21	139,754.94	76,644.31	134,830.76	126,133.20	70,095.76	152,505.35	148,271.37	130,969.12	172,368.61	172,104.29	59,233.10	168,593.63	157,545.48	73,890.36	138,073.22	177,496.12	160,877.19	128,706.33	127,386.49	160,094.93	196,924.37	188,381.58	81,572.24
1110000	179,509.16	167,781.72	53,611.04	140,632.84	144,890.78	82,995.30	139,032.31	131,179.98	72,446.14	164,712.44	159,262.13	117,323.77	177,763.07	183,230.36	62,295.22	169,688.65	165,171.77	78,035.00	144,070.90	185,611.11	173,012.48	126,941.80	133,029.92	160,358.82	205,671.21	198,741.71	85,744.36
1120000	185,406.74	172,926.63	55,585.32	154,497.52	149,223.23	73,285.63	146,647.33	141,801.36	78,541.24	168,196.86	161,447.90	120,128.51	185,255.40	192,400.76	63,827.37	177,643.72	167,961.41	80,875.99	146,766.75	191,199.57	187,525.33	133,200.56	148,317.18	159,644.36	197,630.59	208,116.33	88,585.34
1130000	196,419.09	179,957.77	58,463.04	159,441.98	154,330.77	90,727.71	154,659.85	134,264.77	77,977.51	174,318.50	169,675.95	126,022.67	191,800.71	192,212.60	66,945.74	183,033.15	173,859.00	83,089.18	149,656.79	195,242.24	66,049.42	139,883.99	141,073.34	172,884.68	141,431.79		93,541.40
1140000	205,594.32	190,108.52	59,849.36	167,441.10	161,111.60	94,028.87	157,794.90	145,781.71	81,013.63	182,272.43	169,968.72	132,712.14	197,279.08	204,143.01	69,042.57	189,443.19	185,047.19	88,152.57	157,621.61	195,249.62	67,847.30	139,351.28	158,911.27	172,166.98	144,833.46		96,385.18
1150000	207,200.49	193,347.42	60,364.15	170,006.31	156,821.84	97,116.22	163,866.51	141,687.48	85,321.71	181,527.66	180,492.71	138,101.04	203,239.30	204,870.69	69,567.19	200,729.28	192,479.54	91,452.35	160,875.22	207,778.35	72,025.66	143,942.43	162,925.55	181,285.02	152,874.03		101,570.55
1160000		203,678.34	63,530.67	155,557.15	162,382.93	103,794.89	168,519.51	150,010.17	87,371.71	194,293.91	183,646.36	156,478.28	206,459.41	200,804.87	74,436.97	206,679.95	193,134.28	94,729.15	166,554.11	210,884.58	73,448.27	147,920.10	168,902.71	176,622.13	152,978.67		102,867.59
1170000			73,790.02	155,785.80	166,886.30	106,234.47	171,232.96	151,970.64	89,955.95	194,803.48	189,053.91	147,809.61	169,202.63	181,220.74	75,023.87	209,311.82	200,898.27	95,256.25	166,817.19		73,804.17	151,274.45	158,411.95	182,630.40	157,295.47		105,202.76
1180000			14,129.83	168,458.17	170,920.12	112,018.48	175,402.30	159,394.95	95,886.15	206,260.63	107 762 96	102,834.48	175,515.61	180,366.70	01.000.63	172 401 24	207,852.24	95,781.34	180,403.78		/5,6/4.68	154,113.59	163,750.32	182,470.55	101,050.30		108,013.07
120000			71 296 17	160 010 24	101 400 42	117,274,00	170 102 57	166 597 99	100 200 56	215,515.57	211.074.26	162 021 05	194 097 77	103,470.33	01,000.02	172,401.34	209.004.45	97,190.44	100,105.50		01,003.54	175 502 25	160 640 42	202 442 57	172,155.40		110 545 25
1210000			84 261 36	170 560 05	187 419 47	122 727 14	181 999 87	179 856 06	103 547 59		211,014.20	158 444 69	178 017 22	200 985 10	82 626 55	172 493 09	167 777 75	95 958 15	188 815 85		82 138 82	177 733 49	168 836 42	198 265 78	174,133.34		121 859 76
1220000			75.863.35	176.442.29	190,957.07	104.392.38	190.320.24	183,413,93	106,907,37			180.572.84	198,193,70	190.618.39	85.374.57	187,608,40	177,118,79	96,964,21	195,104,11		86.979.00	185,598,45	177.894.60	203.805.62	184,201.68		126.458.46
1230000			90,540.20	176,625.88	194,800,40	102,890.25	195,917.60	184,116,13	109,482.85			171,597.99	189,316.53	188.073.10	89,271,96	193,546.32	175,749.30	101,143,46	203,348.64		87,549.09	188,214,87	176.019.64	200,904.24	185,122.96		130.651.87
1240000			90,512.11	184,587.64	198,399.82	113,740.03	200,540.82	178,922.05	113,252.99			189,583.95		192,655.04	91,576.67	202,143.98	199,526.47	114,293.39	210,179.63		90,321.14	195,080.21	177,828.80	204,738.92	189,907.58		134,467.84
1250000			85,486.81	189,619.48		116,161.47	207,468.86	194,296.37	118,982.97			183,386.09		204,730.64	92,263.09	202,634.51	190,904.10	100,238.80			92,053.07	196,452.45	179,988.77	213,080.22	193,497.93		141,039.68
1260000			97,752.13	189,625.51		120,037.54	207,301.72	211,155.53	119,210.89			192,458.64		210,986.00	93,783.59	211,453.63	195,463.47	107,344.08			93,955.47	202,074.15	190,349.32	195,799.93	199,658.26		143,441.29
1270000			101,112.55	195,288.91		131,382.78		210,527.52	112,297.93			200,350.91		176,131.71	96,500.42		202,018.04	119,205.49			97,038.89	193,365.38	193,973.40	160,958.54			148,312.01
1280000			105,529.14	197,577.50		116,687.40			115,026.71			104,298.37		167,685.33	98,299.86			123,135.55			101,110.64	200,564.26	194,792.85	170,521.03			150,379.60
1290000			103,976.88	206,161.75		154,980.68			124,719.89			111,876.19		186,878.05	102,399.57			128,725.49			102,976.34	200,558.80		168,429.40			151,509.37
1300000			108,608.16	210,531.25		153,442.32			120,043.36			110,327.46		194,777.13	104,051.36			132,778.44			106,162.65	206,826.53		177,923.96			156,606.70
1310000			110,784.56	212,085.78		162,462.99			122,432.24			116,270.96		192,243.09	105,813.06			140,446.14			109,371.00	210,701.52		177,073.03			162,502.06
1320000			115,202.91			165,981.55			140,441.39			120,520.62		185,551.50	110,040.56			144,852.57			114,723.88			174,592.75			167,252.88
1240000			116 600 66			179 402 51			142,005.04			117 269 22		197,047.00	112 741 60			151 270 42			117 141 00			104 412 47			176,005,16
1350000			116 765 95			174 616 90			132 742 95			122 611 13		194 523 88	115 796 41			165 077 87			117 355 84			189 982 10			178 533 29
1360000			122.523.62			179,928,43			136.820.52			126,287,71		200.331.20	118,808,53			146.919.92			121,228,59			189,782.36			185.061.10
1370000			123,193.96			172,191.07			139,388.51			125,311.14		208,923.92	121,673.88			143,248.22			124,105.08			195,811.79			185,725.31
1380000			130,665.95			175,563.47			141,022.03			129,709.26		208,705.44	124,649.66			163,559.53			127,035.17			198,748.73			193,260.71
1390000			133,589.80			158,046.55			145,365.36			132,883.69			126,832.47			157,590.95			129,734.87			200,949.45			197,195.35
1400000			132,540.25			182,387.48			170,080.80			132,862.20			126,748.43			166,163.01			131,747.70			211,296.34			201,429.22
1410000			137,490.55			171,354.05			172,112.09			138,705.23			132,644.30			168,107.06			135,620.55			212,187.78			208,573.57
1420000			141,488.06			194,317.10			175,988.83			139,007.46			136,676.30			168,286.65			136,768.64			216,045.68			213,467.67
1430000			145,927.03			174,438.63			183,547.86			149,140.37			135,375.04			163,293.16			141,676.71			185,048.42			213,956.03
1440000			147,290.58						184,317.65			150,182.92			143,025.25			166,761.36			143,947.01			147,148.32			205,107.06
1450000			157,998.19						186,366.64			149,787.99			145,648.16			174,212.12			147,515.97			155,333.14			213,643.33
1460000			157,438.67						167,782.12			150,008.90			147,624.03			178,799.25			153,811.89			154,364.54			194,692.73
1470000			162 004 26						107 302 04			160,816.98			140.055.70			201 115 54			156,505.32			155,400.10			202.015.72
1480000			162,0045.15						206 124 42			161 745 45			152 509 71			205,891,60			162 299 40			162 967 00			171 8/2 92
1500000			153 295 11						204 255 76			163 262 22			156.040.69			203,031.00			163 674 45			168 929 97			176 364 12
1200000			133,233,11						204,233.10			103,202.23			130,040.03						103,014,43			100,020.07			110,304.13



Conclusions and Future Work

This thesis concludes by synthesizing Azure App Service test findings, addressing how Azure handles concurrent requests and regional performance variations. It confirms Azure's finesse in managing core utilization, especially in premium tiers, and notes regional disparities in resource usage. The study guides developers in service tier and region selection, enriching academic understanding of single-threaded applications in serverless environments. Future work suggests broader, real-time analyses and comparative cloud provider studies for more profound insight.

QR Code for Recording

