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HPE : DMaaS for Data Center Management (D2660)   Subscribe

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   Traditional way of manually operating and maintaining Enterprise datacenters demands both continuous available personnel and persistent vigilance. But with advancements in AI, enterprises are now actively moving to autonomous datacenters. Covid-19 panademic accelerated the need of prioritizing autonomous datacenters for resilience and continuity of business. Such solutions can be developed with AI and Machine Learning and deployed as a service to gradually move manual operations to full autonomy where a software can handle data center problems and apply solutions or provide recommendations. In the initial phases, it can partially relay on human analysis and decision making. HPE being one of them in this space, can build AI-driven autonomous data center for faster, cheaper, better and secure experience.

Expertise Required

| Artificial Intelligence | Data Center Management | Machine Learning |

What is the problem statement for your project?

Data center downtime is one of the critical, crippling and costly issue for enterprises.

Though there are Data Center Infrastructure Management (DCIM) softwares but they lack in giving granular insights and handle spanned data centers in different geographical areas.

It seeks for an improvement in traditional DCIM tools that can provide better detection and diagnostic about anomalies, Efficient resource allocation and predictive procurement to have resilient and continuous business. DMaaS takes the data-center world beyond DCIM. DMaaS is build on DCIM where DCIM collects data from various sources and DMaaS takes one step ahead to analyze that data to provide meaningful Insights and take possible corrective actions. Unlike DCIM needs installation on individual sites, DMaaS will be a cloud based solution.

Please describe the proposed solution

HPE's ongoing DC Transformation project can be extended to integrade below areas.

AI and Pattern Matching can be used to isolate and identify faults to control the temperature. In the HPE's everything as a service strategy, HPE can have it's own Data Center Infrastructure Management (DCIM) with the help of HPE's Data Center Management as a Service (DMaaS).

Mainly Three areas :

-    Anomaly Detection

Machine learning for risk analysis is the most critical, as it can detect anomalies and help to prevent downtime. Datacenter fire is the most dangerous abnormal occurrence, because failure to control it at an early stage can lead to huge disasters. Sensor based detection takes time to react and need sufficient amount of fire/smoke and those can't provide fire location and size. CCTV systems are already installed for surveillance and monitoring on top of which CNNs can be deployed for intelligent fire and smoke detection. A fine-tuned customized InceptionV3 or YOLO model on fire data with balanced efficiency and accuracy can be implemented. Experimentation and satisfactory results were presented

-    Smart and Optimized Maintenance

Now-a days data centers are well equipped with sensors that provide lot of real time and historic data on IT performance and environmental factors. An Optimized Smart cooling will lead to sites reduced cooling bill and function more efficiently and autonomously. Machine learning can be used for controlling temperature and adjusting cooling systems. Also, on usage statistics of hardware, user can be notified to shutdown unwanted devices to reduce unwanted power consumption especially in R&D and development centers.

-    Forecasting Based Planning

Forecasting Based Planning is one more area where AI based solutions can provide insights by giving early recommendations on planning, ordering and configurations to improve resiliency.

Provide the evidence that the proposed solution works

As a part of this idea, we have performed POC in below three areas -

1. Anomaly Detection - (Fire and Smoke Detection)

   We have used Fire Detecion Dataset, Fire Dataset & Fire-Smoke Dataset. Experimented customized CNN vs InceptionV3 models. With customized InceptionV3 model, we could get training and validation accuracy > 90%.
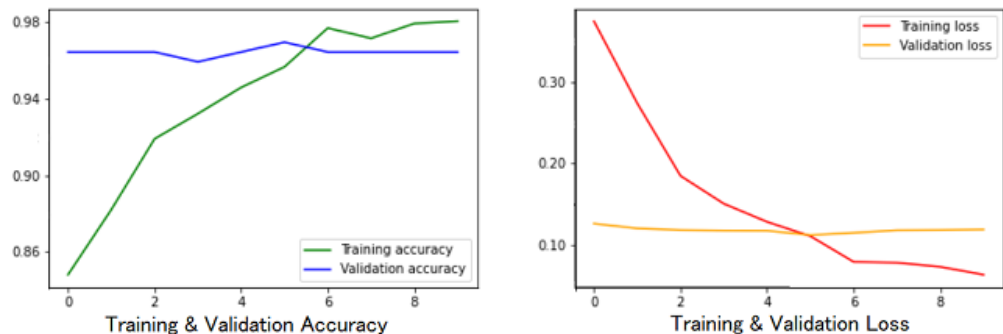
2. Smart and Optimized Maintenance- (Cooling Optimization)

Though enterprise are trying to come up with energy efficient servers, in addition to that with Neural Networks by analyzing attributes it's possible reduce the amount of energy used for cooling. This improvement in efficiency reduces emission in environment. cooling and power capacity in most data centers are significantly over-provisioned. With the help of power consumption, server workload and ambient and environmental attributes, cooling systems can be optimized.

Deepmind AI was able to brought down google data center cooling bill by 40%. Below is Power Usage Effectiveness (PUE) calculated when ML control on/off
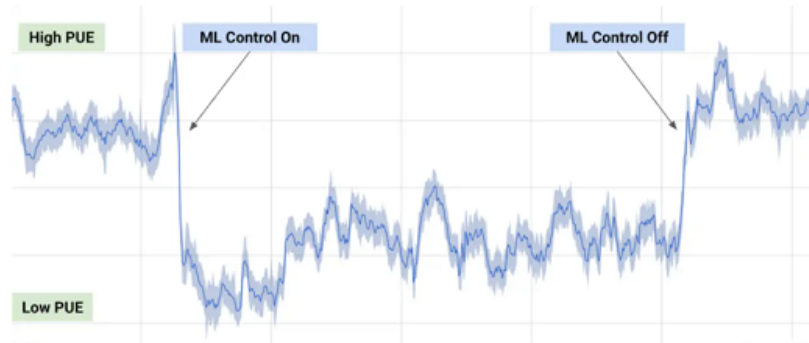
So there is significant potential in this area to use DNN to predict future temperature & power usage to optimize energy consumption.But to train such model for such problems, we need sufficient historic data with required parameters.

3. Predictive Planning: (Predicting Utilization for advance planning)

Enterprise companies are able to place orders only after realizing that the compute infrastructure has been exhausted. This introduces a delay in expansion plans as there is an inherent logistic delay from the time the orders are placed to the time the shipments are received. This solution is aimed to apply data science techniques on the compute utilization data of utilized servers to predict beforehand if a certain threshold is about to be reached.
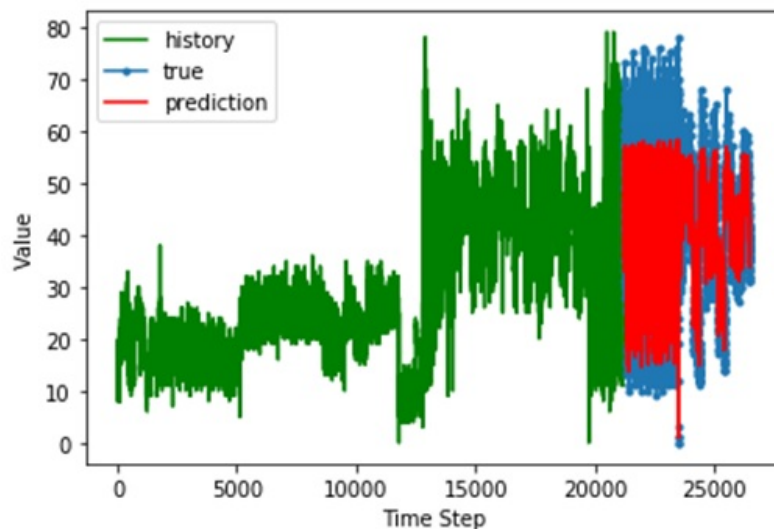
As a part of HPE's Data Center transformation initiative, data collected from thousands of servers is processed and stored in HDFS. By identifying key parameters contributing to compute utilization, training them can result in forecasting future compute requirements.
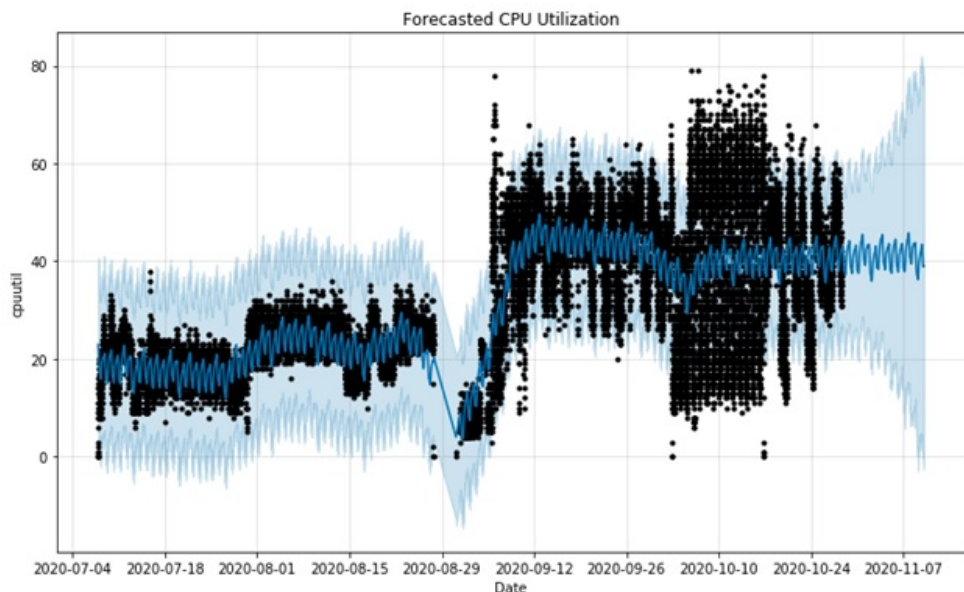
POC-

CPU Utilization data from Jul to Oct :
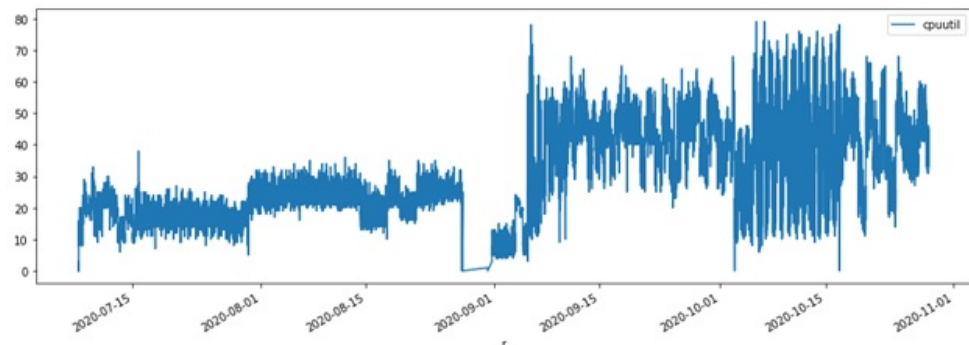
LSTM Prediction :

After further analysis and study of other forecasting models it was identified that Facebook's Prophet[4] model was more efficient in forecasting the trend of CPU utilization. Below is the final chart generated, consisting of the forecast of the CPU utilization.

With this forecasting results, HPE can perform predictive planning to order required resources in advance.

Provide details of competitive approaches

HPE Servers are managed by HPE Integrated Lights-Out (HPE iLO). HPE iLO is built into HPE ProLiant servers is an autonomous secure management component embedded directly on the server motherboard.

Currently HPE InfoSight is the industry's most advanced Artificial Intelligence for infrastructure. Every second, it collects and analyzes millions of sensors from systems across the globe. But it's not yet built with capabilities to support some of the interesting use cases mentioned above.

Also there is ongoing project in HPE - Data Center Transformation which aims to store such data on HDFS and to build end to end pipeline to run analytics. So proposed use cases can be integrated with the analytics engine (module).

Current Status

Considering above mentioned services, POCs are performed on two of the cases.

1. Fire and Smoke Detection - We have CCTV surveillance system already in place in labs. Live Stream/Recorded Videos can be trained and tests with current model and efficiency can be validated.

2.Cooling Optimization - we are looking for power and temperature data. And we are looking to figure out complete information on how cooling system works at HPE and how they are configurable considering optimized resource consumption.

3. Predictive Planning - we have experimented on 2 months data for HPE server and performed forecasting. With threshold based approached it can be utilized to recognize resource crunch in data center.

Next Steps

This POC has helped to prepare base line to start analytics in mentioned areas.

Some next steps are listed below :

1. Validate and Test real-time data (or some of the YouTube videos) against Fire-Smoke Detection model.

2. Prediction on temperature and Power consumption.

3. Train Prophet on multiple servers with more than 2 months of data.

4. Create a framework that exposes these services.

Acknowledgements

Thanks to Shantamurty Rupesh for guidance and support in this proposed solution.

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Facebook's prophet - https://facebook.github.io/prophet/

What is the Status of Your Project (Development Field)

What is the Final result of your project (Development Field)

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