Data Center Scheduling Optimization Problem

Minimizaing the energy cost of Data Centers

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Inspiration

The large power consumption problem in Data centers.

Introduction

Problem Definition

- Data Center Cost refers to the cost of running servers, networking equipment, power, cooling.
- The average yearly cost to operate a large data center ranges from $10 million to $25 million, the avg cost rate is $.729Kwh.

Solution

- **Schedule the hardware working hours**
  - Minimize the power consumption of machines.
  - Reduce CO_2 Gas emission.

WHAT ARE WE WORKING ON

Save Power

Scheduling the machines on time to reduce power consumption
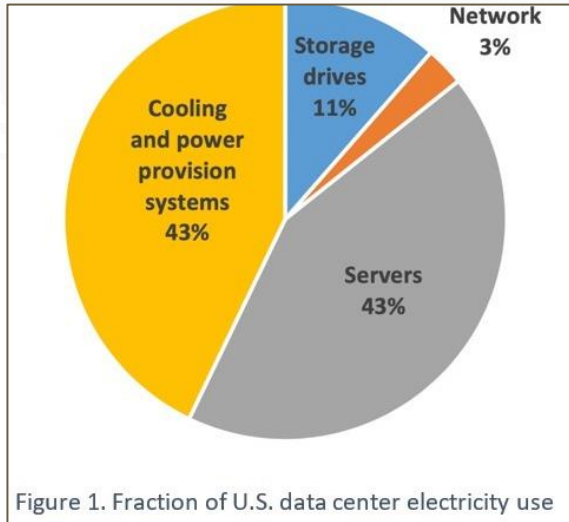
Reduce CO$_2$

Save the environment by reducing the CO$_2$ emission

Provide Service

Provide better Cloud Computing service with lower energy consumption

BUDGET

Figure 1. Fraction of U.S. data center electricity use

43%

Of Data Centers power is being consumed by Cooling systems.

43%

Of Data Centers power is being consumed by running servers.

Assumptions & Approximations

- Any X_{JK} variables can take 0 or 1.

- Demand is covered within six periods throughout the day, four hours each, for instance, T1 period demand is 7500 GB/4hr.

- Each rack must be OFF for two periods a day.

- Demand is transfer rate in MB/S.

- Each rack consists of different number of devices, for instance routers, servers, and firewalls.

- Each rack has can serve a different max transfer rate, for example, c1 can serve up to 7500 GB/4hr.

- One $/H costs differently for each rack, for instance, c1 rock has 15.225 $/h for one $/GB.

- Each rack contributes differently into the Co2 emission cost, for instance C3 costs 10.3 $/GB for 6gm Co2 emission.

PROJECT GOALS

Connect People

Run the Data Centers 24/7/365
with high efficiency & low power.

Save Energy

Reduce the energy consumption
of the Data Centers

Cover Demand

Cover the variable customer
demand over time.

Green Life

We aim to save environment by
reducing CO_2 emission

Solution Approach

Cover The Demand

- Reduce the number of running machines on each time period to cover the required demand.
- Choose the machines that will cover the demand with low cost.

Reduce CO_2 Emission

- Reduce CO_2 emission by reducing the number of running machines.
- Turning of machines on low-demand periods will save money, power and environment.

Results

- On low-demand periods, only one machine will work to serve the demand.
- By increasing the demand, more machines will be turned on to increase the supply.
- The total demand per day must be less-than or equal to the total machines power.

Periods	Periods	Demand GB/4hrs
12am : 4am	T1	30000
4am : 8am	T2	30000
8am : 12pm	T3	40000
12pm : 4pm	T4	40000
4pm : 8pm	T5	35000
8pm : 12am	T6	35000

			Supply	X1	X2	X3	X4	X5	X6	Total		
			T1	1	1	1	1	0	0	30000	=	30000
			T2	0	0	1	0	1	1	30000	=	30000
			T3	0	0	1	1	1	1	40000	=	40000
			T4	1	1	0	1	0	1	40000	=	40000
			T5	1	1	0	1	1	0	35000	=	35000
			T6	1	1	1	0	0	1	35000	=	35000
			Total	4	4	4	4	3	4			
				⇑	⇑	⇑	⇑	⇑	⇑			
				4	4	4	4	4	4			
Running Cost		1089.6										

Recommendations

We aim to:

- Add restart cost of machines to the problem.
- Track the on/off movement for each machine per day.

We also recommend to:

- Start using renewable energy sources on operating data centers.
- Reduce Cooling dependencies.

THANK YOU!

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