1) Given a cloud DC with m_1 type1 machine, m_2 type2 machines, and total M $(= m_1+m_2)$ machines. Power consumption model of type1 and type2 machines are given as $P_{type1} = 200 + 20*u^3$ and $P_{type2} = 50 + 100*u^3$, where u is normalized utilization of the machine ($0 < u \leq 1$). There are N webserver tasks (which runs forever) and each task t_i have machine utilization u_i. Map these webserver tasks onto these machines such that total power consumption of the DC is minimized.

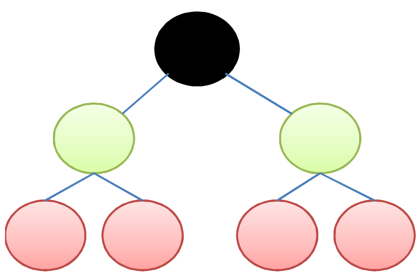
- Ans: Calclulation of Pmax and critical utilization
  - For type 1 machine $P_{type1} = 200 + 20*u^3$ **.** Pmax=220 at u=1, $U_c=\sqrt[3]{(200/20*2)}=1.7099>1$
  - For type 2 machine $P_{type2} = 50 + 100*u^3$ **.** Pmax=150 at u=1, $U_c=\sqrt[3]{(50/2*100)}=0.6299<1$
    - Case I : if sum of utilization of all the tasks **Σu_i < 0.62299*m2**, **run the required number of type2 machine at utilization 0.6299** and tries to fit all the tasks on the machine using any Optimal approach (bin-packing/ILP) if possible. Otherwise increase utilization a bit and tries to fit.
    - Case II: if sum of utilization of all the tasks **Σu_i > 0.62299*m2** but **Σu_i < m2**, then tries to fit all the tasks **on the all m2 type2 machines** using any Optimal approach (bin-packing/ILP) by increasing the utilization with step by step starting from 0.6299 upto 1. Motivation here is to save energy by running at lower utilization.
    - Case III: if all the type 2 machines are exhausted (Σu_i > m2) than f**irst utilze all the type2 machine and then utilize the type 1 machine, one after another**.

1) Suppose you are using an EWMA predictor ***E(t) = α*E(t-1) + (1-α) *O(t-1)*** with ***α*** =0.5, where ***E(t)*** and ***O(t)*** are estimated and observed values at time ***t*.** There is another person X, who knows that you use the EWMA model and X wants you to make the maximum prediction error and X is the person who decides the observed values (0 to 100). Assume the initial estimated value is 0 and this value is known to X. In a long run, what will be the prediction error in %?

•Ans: In long run it will settle at 2/3*100, which is 66.66% error in prediction.

E(t)	0	50	75	32.5	66.25	33.125	66.xxx	33.xxx	66.xxx	32.xxx
O(t)	100	100	0	100	0	100	0	100	0	100
Error	100	50	75	77.5	66.25	72.975	66.xxx	66.xxx	66.xxx	66.xxx

1) Suppose with budget B and given an APP with seven tasks (with equal execution time or length) with complete tree dependency. Assume we have infinitely many VM types, the VM type with cost D have compute power D MIPS and D in $\mathbb{R}^{+}$. Our aim is to minimized the execution time of the applications, formulate the problem and solve.



Suppose we allocate x, y and z amount to level 0, level 1 and level 2 tasks: x budget per task in L0, y/2 budget per task in L1 and z/4 budget for L2; As cost is per unit time and if we fixed the unit (what ever value ms/s/m/h).

We need to minimize

$$\text{Time}=\lceil L/x \rceil + \left\lceil L/\left(\frac{y}{2}\right)\right\rceil * \frac{y}{2} + \left\lceil L/\left(\frac{z}{4}\right)\right\rceil * \frac{z}{4}$$

With constraints : C1: $x, y, z \geq 0$ and C2: $x + y + z \leq B$

As we have many ceil functions in time, the curve is not smooth, we cannot get minimum with simple differentiation. We need to test all possible values of combinations of x, y and z, In real axis, which is a difficult problem.