Paper review [1]

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1. The Problem

The paper proposed Dominant Resource Fairness, which is a generation of max-min fairness for the multiple resources. Here the multiple resources mean resource of different types instead of the multiple instances of the same interchangeable resource. What's more, the paper compared DRF with other policies and use experiment to evaluate the DRF

2. Challenge

There are some challenges of the system to solve the problem. First, it is hard to allocate the resource with heterogeneous demands. Existing fair scheduler allocate resources at the granularity of slots, this will cause the inefficient allocation as the slot can not match the task demand. What's worse, modifying the number of slots per machine will not solve the problem because of over utilization. Second is it is hard to give a fair evaluation for the allocations.

3. Key Insight

To evaluate the allocation policies, they define some properties that a good allocation policy for multiple resources should have. And use these properties as the judgement criteria.

The paper gives the DRF scheduling algorithm which gives each user a demand vector, if it could be satisfied, the task will be launched. And the algorithm could be implemented using a binary heap. Each scheduling decision take $O(\log n)$ time for n decision. This is very acceptable. Although DRF is great, sometimes the resource allocation should not always be equal. So the paper combined both DRF and weighted max-min fairness to the weighted DRF. When the weights of all users are set to 1, weighted DRF is just like the DRF.

For different fairness understanding, the paper proposed two alternative fair allocation policies. One is Asset Fairness, which is a simple and intuitive policy where equal shares of different resources are worth the same. While it seems compelling in its simplicity, it violates the sharing incentive property. The other is competitive Equilibrium from Equal Incomes, where each user could trade their resources with others in a perfectly competitive market. While CEEI is envy-free and Pareto efficient, it turns out that it is not strategy-proof.

And the paper compared the three kind of fairness by the properties they have proposed and use micro and macro benchmarks to evaluate the DRF.

4. Limitation [2]

There are two main limitation. First, the paper did not give the specific format or standard about the settings, which will cause the concern under different using circumstance. The other limitation is the evaluation criteria defined in the paper is not accurate enough. For example, if there are two fairness both have same property, it is hard to evaluate which one is better.

5. Future Work

DRF algorithm could still be optimized, like which should consider about the maximize the resource utilization. Under the fairness, there still will be some idle resource, which is kind of waste. What's, more, like solving the problem of no need for one specific kind of resources.

[1] A. Ghodsl, M. Zaharia, B. Hindman, A. Konwinski (2011). Dominant resource fairness : fair allocation of multiple resource types. *Proceedings of the 8th USENIX. 323-336*

[2] D. C. Parkes, A. D. Procaccia, N. Shah (2015). Beyond Dominant Resource Fairness : Extensions, Limitation, and Indivisibility. *PACM TEAC Special Issue on EC'12*