# 分布式机器学习 同步/异步/拓扑

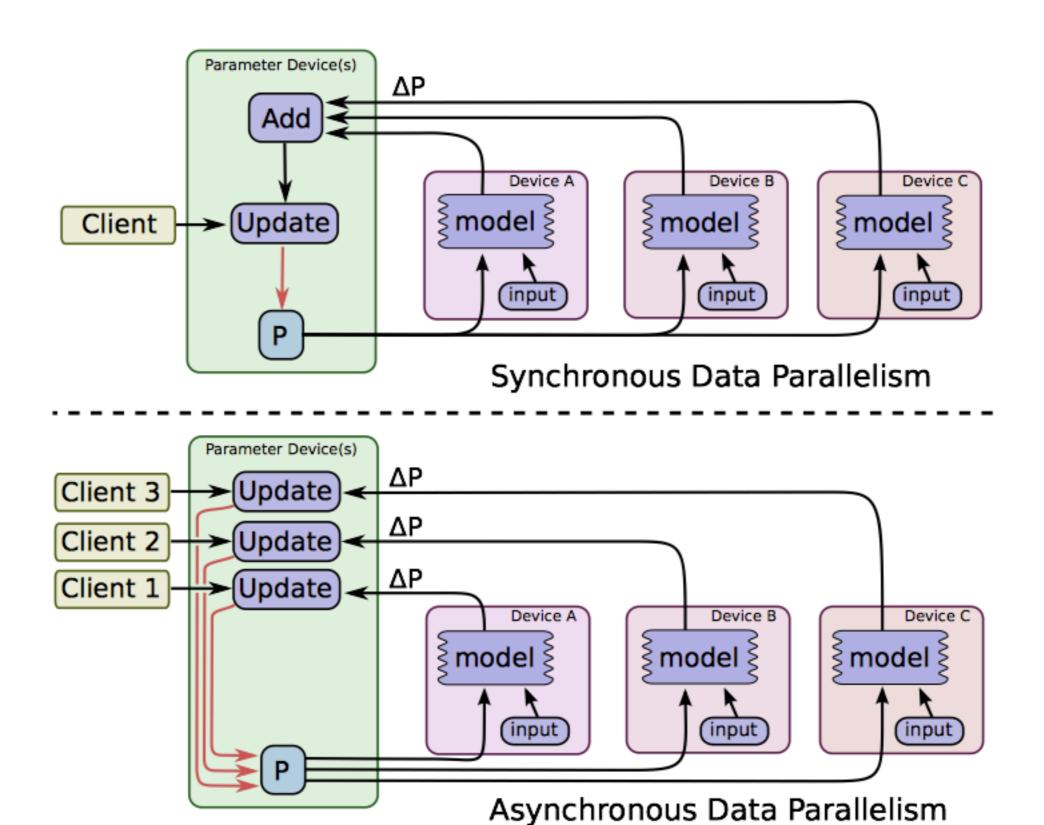
张海鹏 2017-12-09 Solution = ML expertise + data + computation

Solution = data + 100X computation

@南大周志华:机器学习进步使我们从"不能"到"能",计算能力进步

使我们从"能"到"更好"

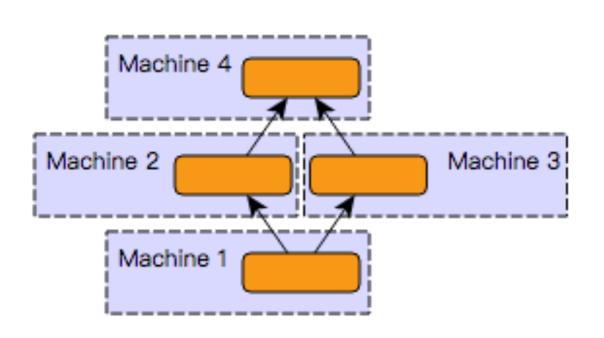
怎样看待Ali Rahimi 获得 NIPS 2017 Test-of-time Award后的演讲?

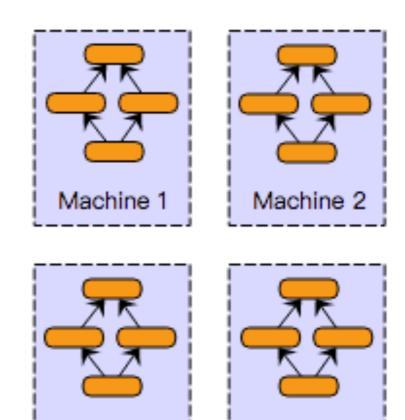


图片来自:《TensorFlow: Large-Scale Machine Learning on Heterogeneous Distributed Systems》

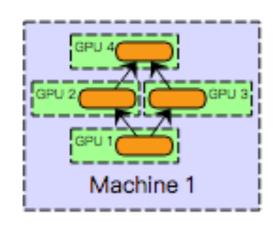
#### Model Parallelism

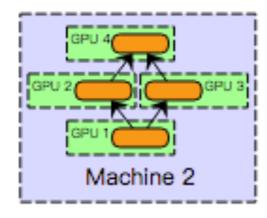
#### Data Parallelism

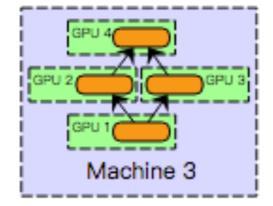


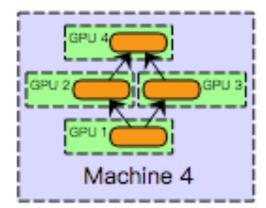


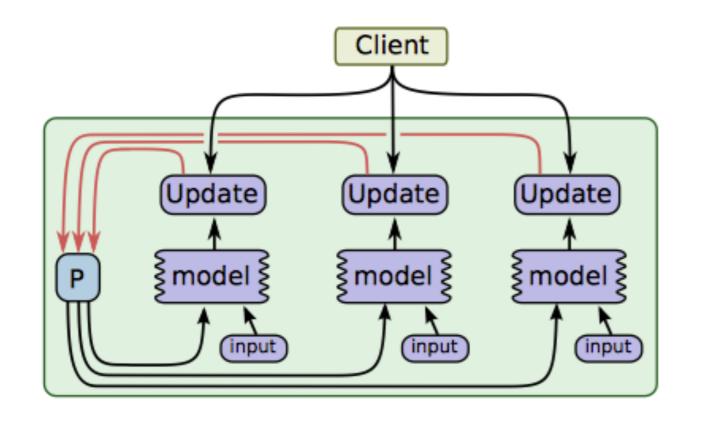
#### Model and Data Parallelism

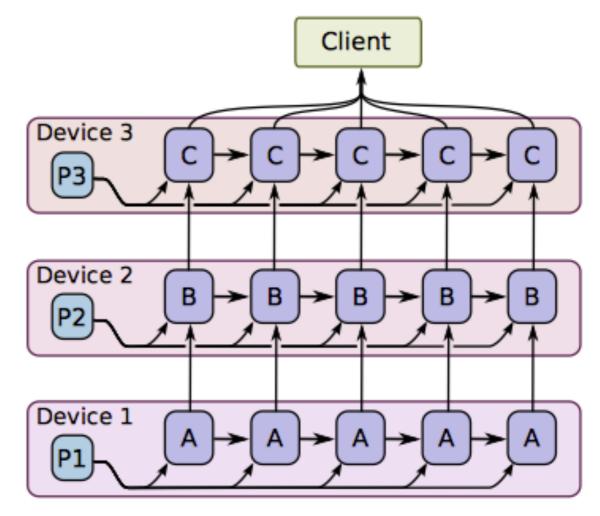










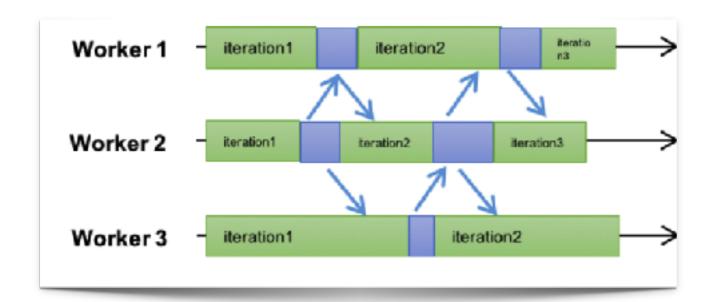


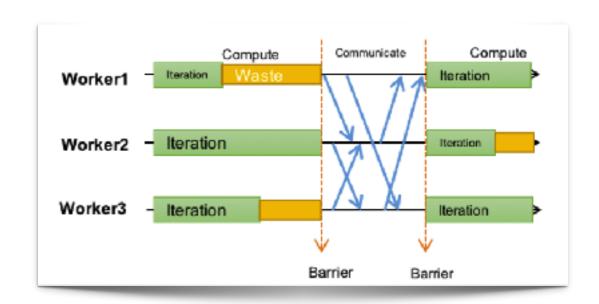
如果要修两栋楼,有一个工程队,怎么操作?第一个方案是将人分成两组,分别盖楼,改好了就装修;第二种做法是一组人盖楼,等第一栋楼盖好,另一组装修第一栋,然后第一组继续盖第二栋楼,改完以后等 装修队装修第二栋楼。

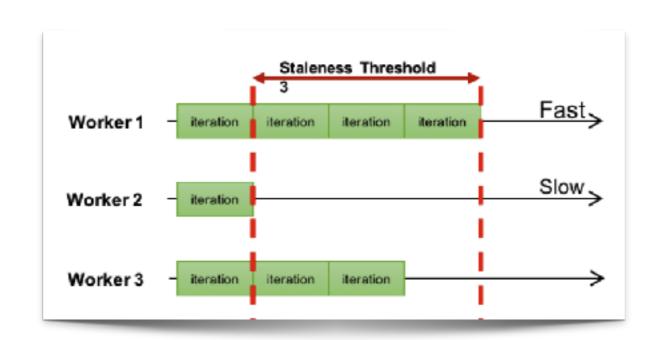
(第一种方案需要每个工程人员都拥有"盖楼"和"装修"两种能力,而第二个方案只需要每个人拥有其中一种能力即可)

### 问题:

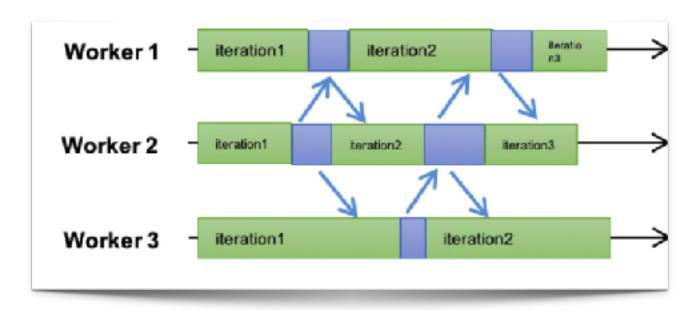
假设将一个模型的参数切分成3个分片K1, K2, K3, 样本集合也切分成3个分片S1, S2, S3, 如何分布式/并行化?







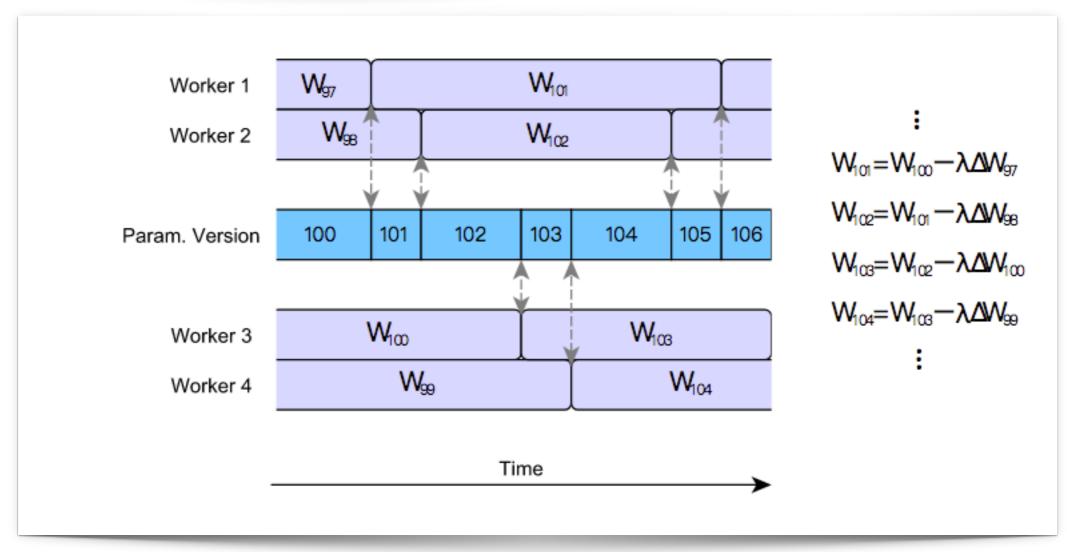
图片来源:张红林@腾讯云



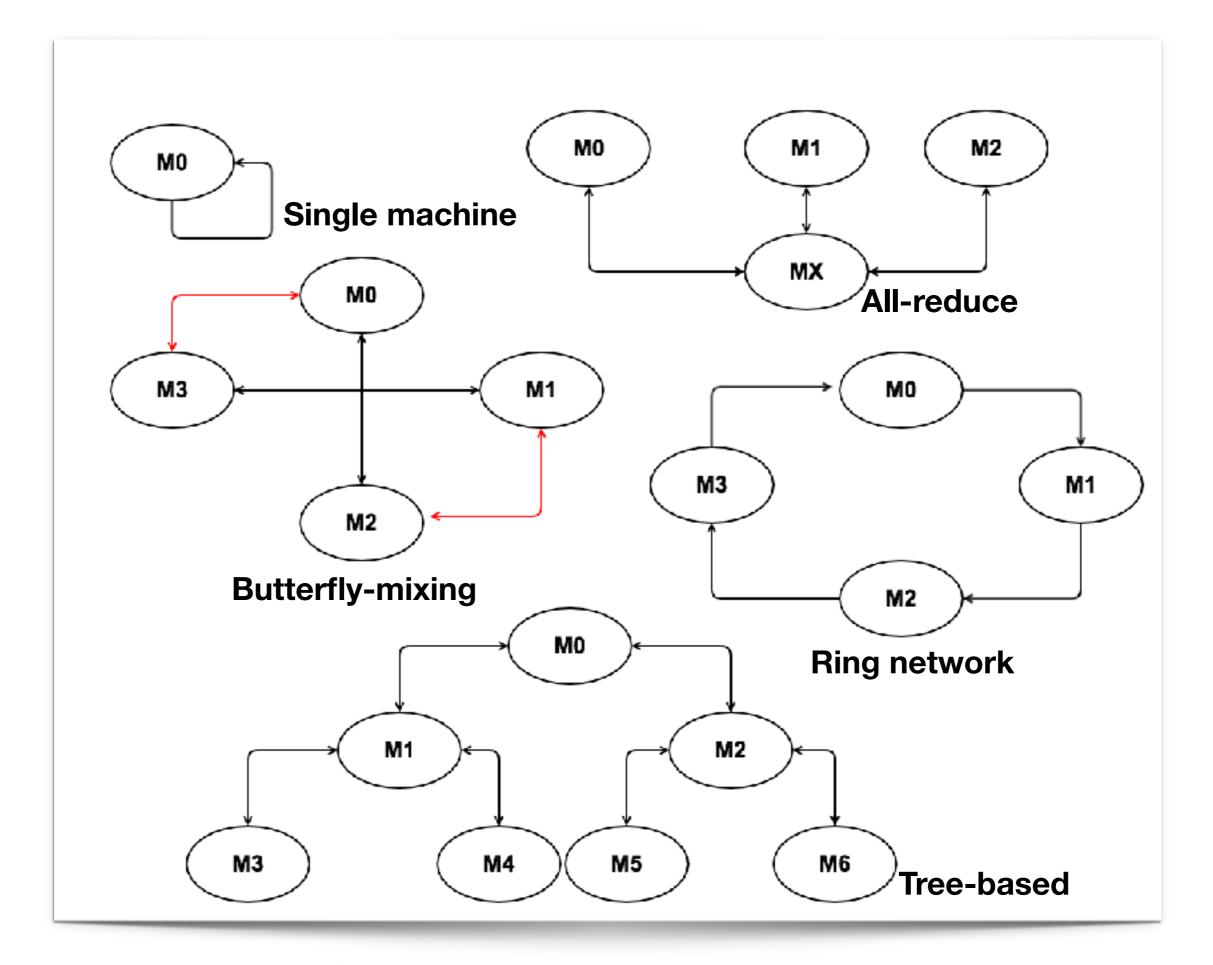
## 异步SGD

缺点: 模型可能无法收敛

优点: 最大限度发挥集群算力



#### GD及其变种



参考:《Parallelization of Neural Network Training using Model Averaging and Butterfly Mixing》

# 总结反思

- 1.网络通信,一致性(存储,缓存,数据库),扩展性,容错,易用
- 2.模型并行:流水线
- 3.异构计算
- 4.通信拓扑
- 5.计算,存储,通信

对于系统而言,设计是一门艺术而不是科学,这是设计者审美和哲学理念的体现。

