CSE 550: Systems for all

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Distributed programming challenges

Suppose you have a program that takes 100 hours to run on a computer.

You want to run it faster by distributing work across multiple computers.

What challenges would you need to solve?
Parallelize the program
  • Decompose into “units” of work and interfaces between them
Transfer data between application units
Balance load
  • Hard even with homogeneous nodes; harder with heterogeneous ones
Handle node and network failures

The whole enterprise becomes even more complicated if the infrastructure is shared by multiple programs
Goals of distributed programming frameworks

Solve (some of) these challenges in a re-usable manner

Provide acceptable performance (throughput, latency)

The catch: Need to express your program in a specific model
  • A blessing and a curse
Traditional 3-tier model

**Presentation tier**
The top-most level of the application is the user interface. The main function of the interface is to translate tasks and results to something the user can understand.

**Logic tier**
This layer coordinates the application, processes commands, makes logical decisions and evaluations, and performs calculations. It also moves and processes data between the two surrounding layers.

**Data tier**
Here information is stored and retrieved from a database or file system. The information is then passed back to the logic tier for processing, and then eventually back to the user.

https://en.wikipedia.org/wiki/Multitier_architecture
Map reduce model
TensorFlow model (example)
Timely dataflow (Naiad)

Figure 1: A Naiad application that supports real-time queries on continually updated data. The dashed rectangle represents iterative processing that incrementally updates as new data arrive.

Virtual actor (Orleans)

https://github.com/dotnet/orleans
Model selection considerations

Application type: Batch, interactive, streaming
  • Often dictates performance metric

Computational graph: Stages, cycles, ..

Transparency: Black box, gray box, white box
Over to Emmanuel