
AWS
re:Invent
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Modernizing HPC workloads using AWS services

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Agenda

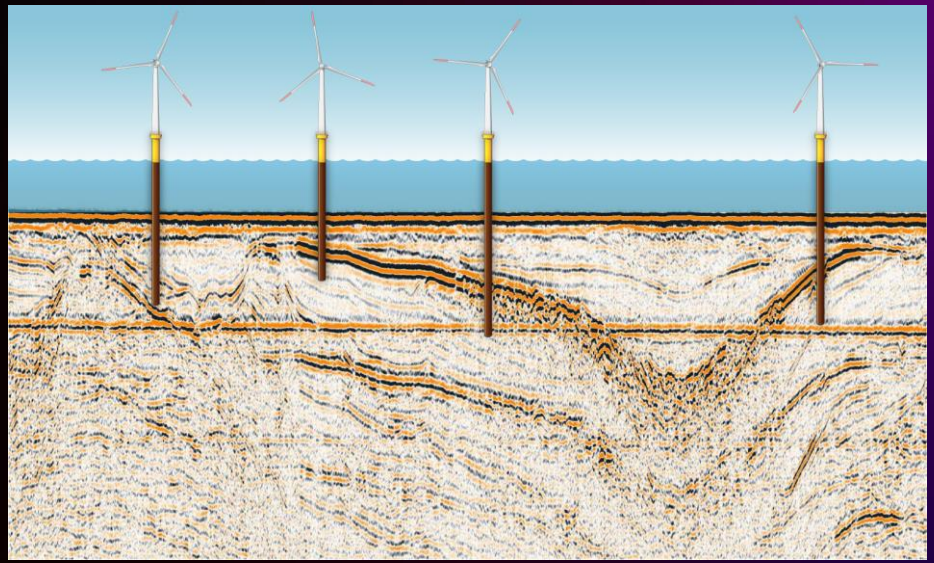
- What is seismic processing?
- FWI: A high-end seismic imaging problem
- A traditional approach
- Can we do better?

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What is a seismic image?

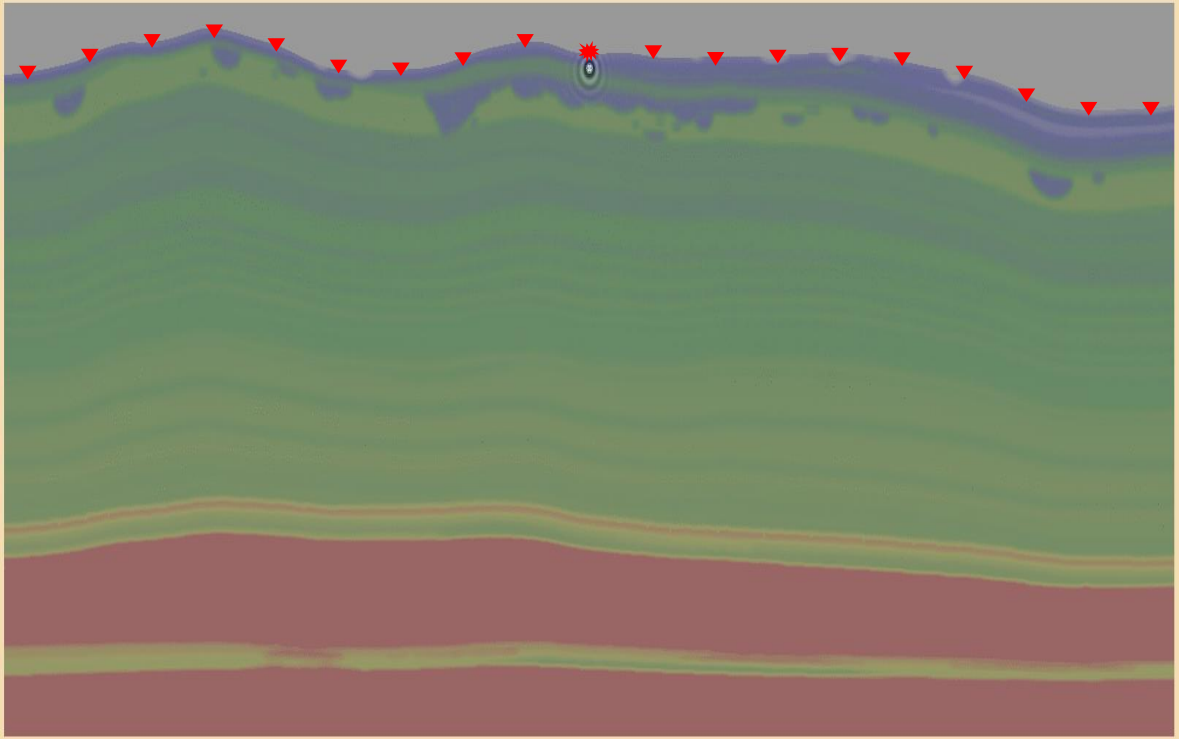




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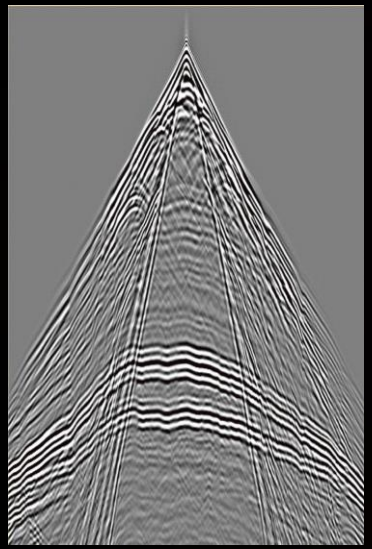
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What is seismic data?



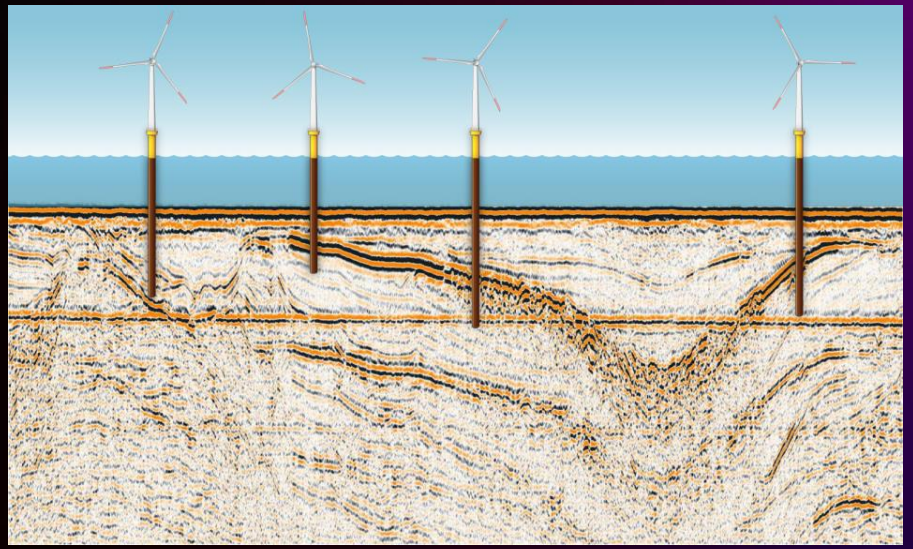
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What is seismic processing?



Millions of shots
~100TB

Seismic processing

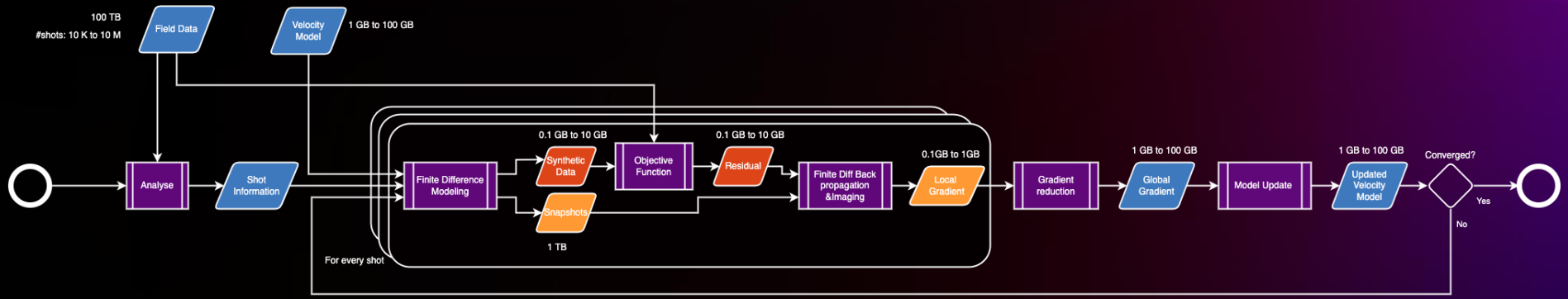


3D subsurface image
~100Gb

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FWI: A high-end seismic imaging problem



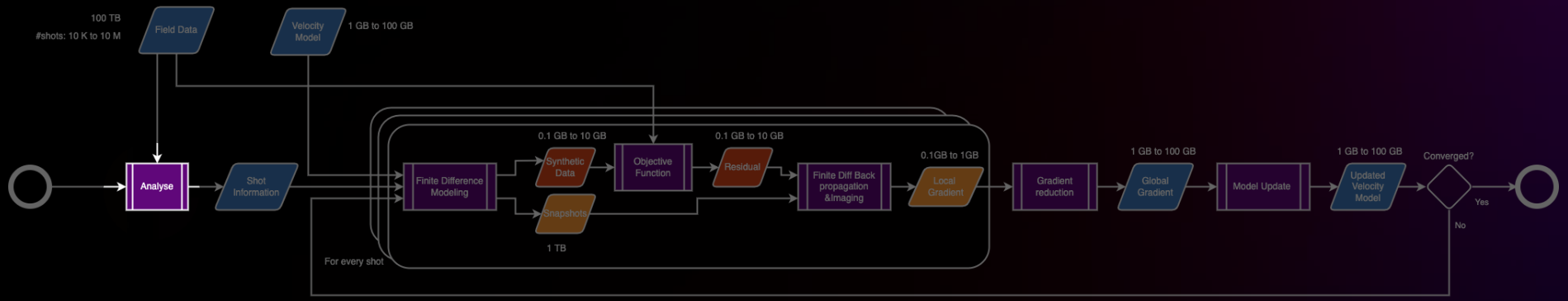


This is an inverse problem.

Determine a velocity model of the subsurface by iterating through simulations of shots propagation through the model and model adjustment until simulation results match observed data.

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FWI: A high-end seismic imaging problem



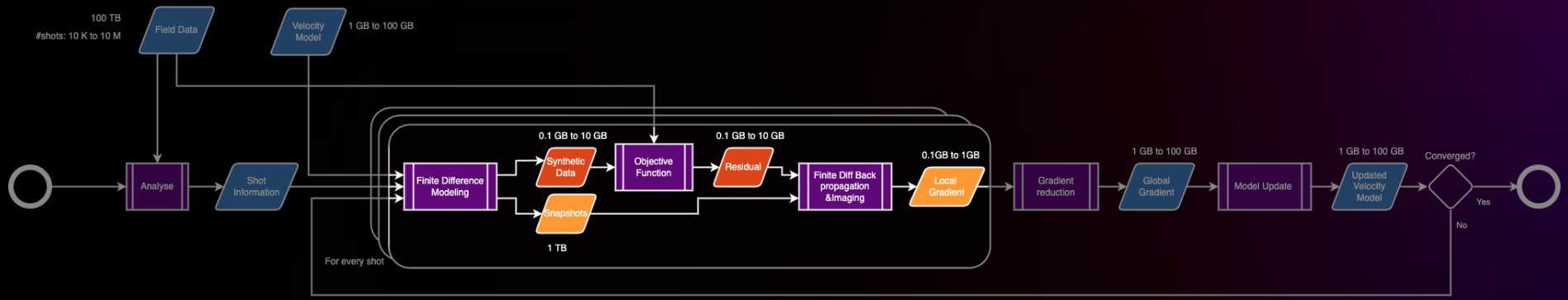


The analyze phase (to discover the partitions) scans through the input data to discover shots.

Input data is in the 100TB range, and the number of shots is in the 10K to 10M range.

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FWI: A high-end seismic imaging problem



Every shot discovered is processed in parallel.

Large temporary data is generated (snapshots ~1TB).

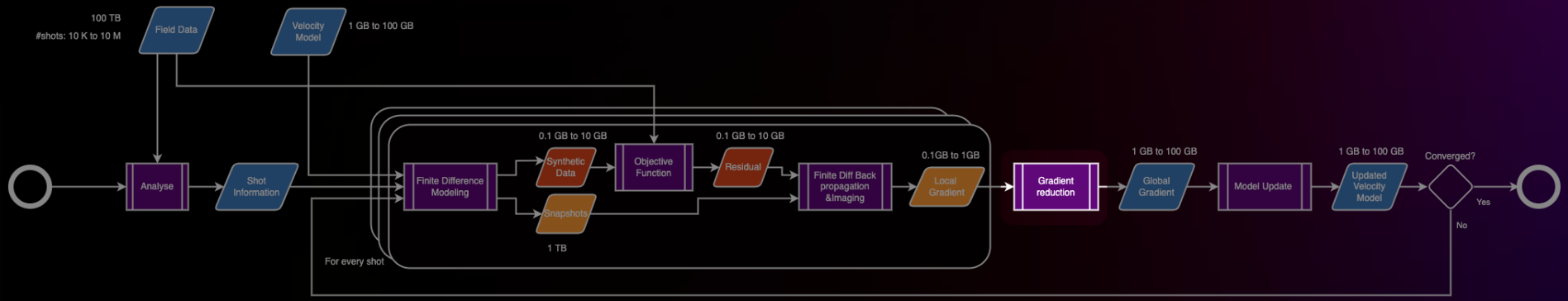
In some instances, this simulation of one shot might require more than one compute nodes resource.

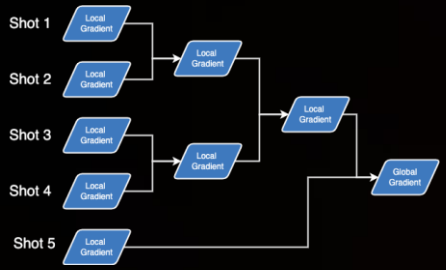
Processing one shot takes on the order of 0.1~1 hour.



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FWI: A high-end seismic imaging problem





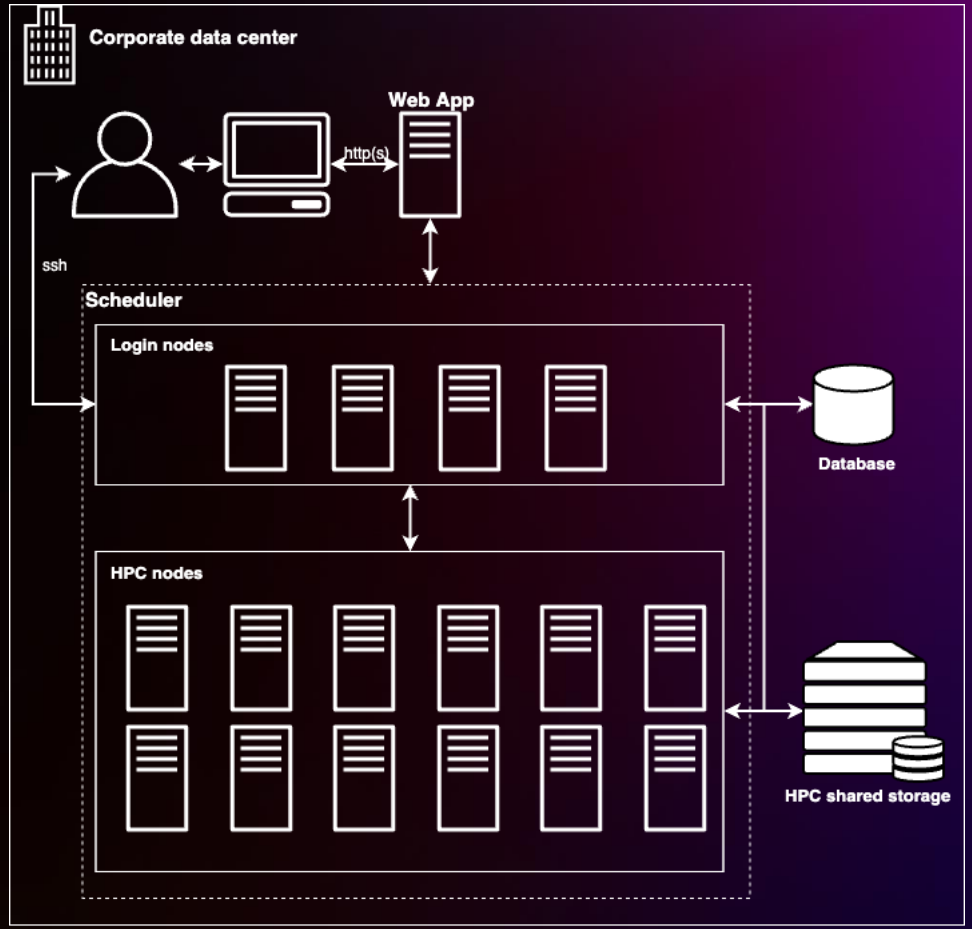
After shots have been processed, the local gradients need to be reduced. This can be done following a tree scheme.



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Traditional on-prem architecture

- Each phase is scheduled sequentially
- Each task inside a phase is a job submitted to a job scheduler
- Turnaround time is limited by infrastructure
- Compute nodes are underutilized for certain tasks due to the uniformity of hardware
- Scheduler or dispatcher is typically a single point of failure



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FWI: Traditional scheduling



- Sequential scheduling between phases; no overlapping between shot processing and gradient reduction
- Puts significant bandwidth requirement on hardware for reduction (IO and network)
- Creates a huge storage requirement for the intermediate data (local gradient)

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Modernized solution

How do you create resilient architecture that

- Allows phases to overlap
- Allows use of different instance types for different tasks
  - Use fit-for-purpose instance type for individual tasks
  - Achieve better cost optimization by leveraging instance heterogeneity
- Allows for worker node to come and go or fail
  - Minimize idle time by dynamically adjusting the number of resources
  - Open the door to use spot instance

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FWI: Better scheduling



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Thank you!

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