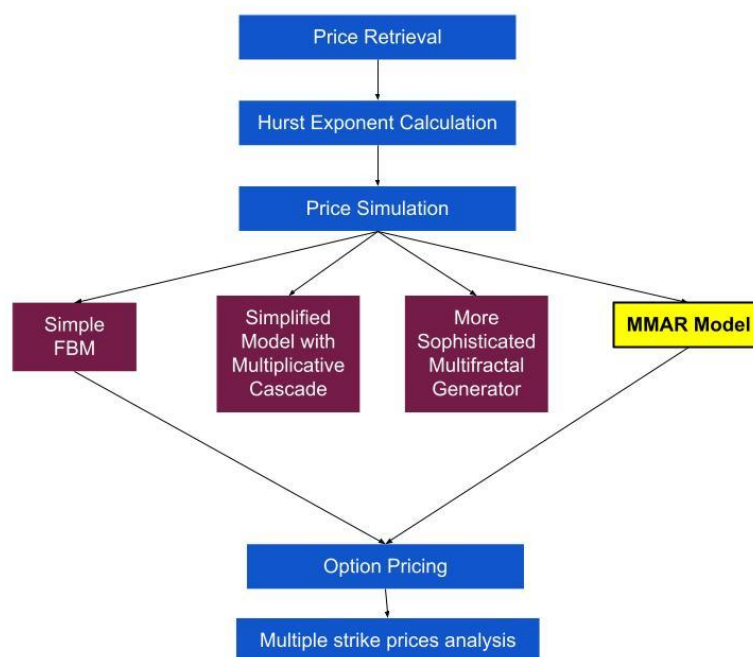


## Overview of the project:

We will apply MMAR to analyze approximately 23 years of data for crude oil prices (from August 2000 to August 2023) to simulate the returns and prices to facilitate option pricing. We also strive to provide numerical results from this representation using the calibrated parameters, which proves that the multifractal model shows more reasonable results than the Black-Scholes model and can be applied in the real trading world as well. As part of the deliverable of this research, we will provide the Python codes for others to use as the original implementation of the MMAR so that others can use our package to easily simulate the desired asset prices as they want.

## Solution Architecture Diagram:



The MMAR model is our focus point of study. Under the session of MMAR Model Simulations, the code blocks are acting as the following steps:

1. Get daily price data of WTI
2. Generate the statistical moments  $q$  that will be used for the partition function.
3. Define the suitable time window  $dt$
4. Calculate the partition values  $Fq(dt, q)$  for different values of  $dt$  and  $q$ ,
5. Calculate the scaling exponent  $\tau(q)$  (the regressions of the partition values).
6. Calculate the Hurst component  $H$ .
7. Calculate the Multifractal Spectrum  $f(\alpha)$ .
8. Calculate Hölder exponent  $\alpha_0$ .
9. Calculate  $\lambda$  &  $\sigma^2$  for the log-normal distribution parameters.
10. Determine the number of data points to simulate.
11. Generate a log-normal multiplicative cascade.
12. Calculate the trading time function  $\theta(t)$ .
13. Simulate a Fractional Brownian Motion with the estimated parameters.
14. Simulate the MMAR returns and prices.
15. Calculate the instinct value of options