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Multimodal Model Based Frame Rate Prediction

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#GDC22



OUTLINE

Introduction

Background & Multimodal model introduction

Model Implementation

More details on training data, model structure

Model Value

How fps prediction can help you & How to apply the model in your own games

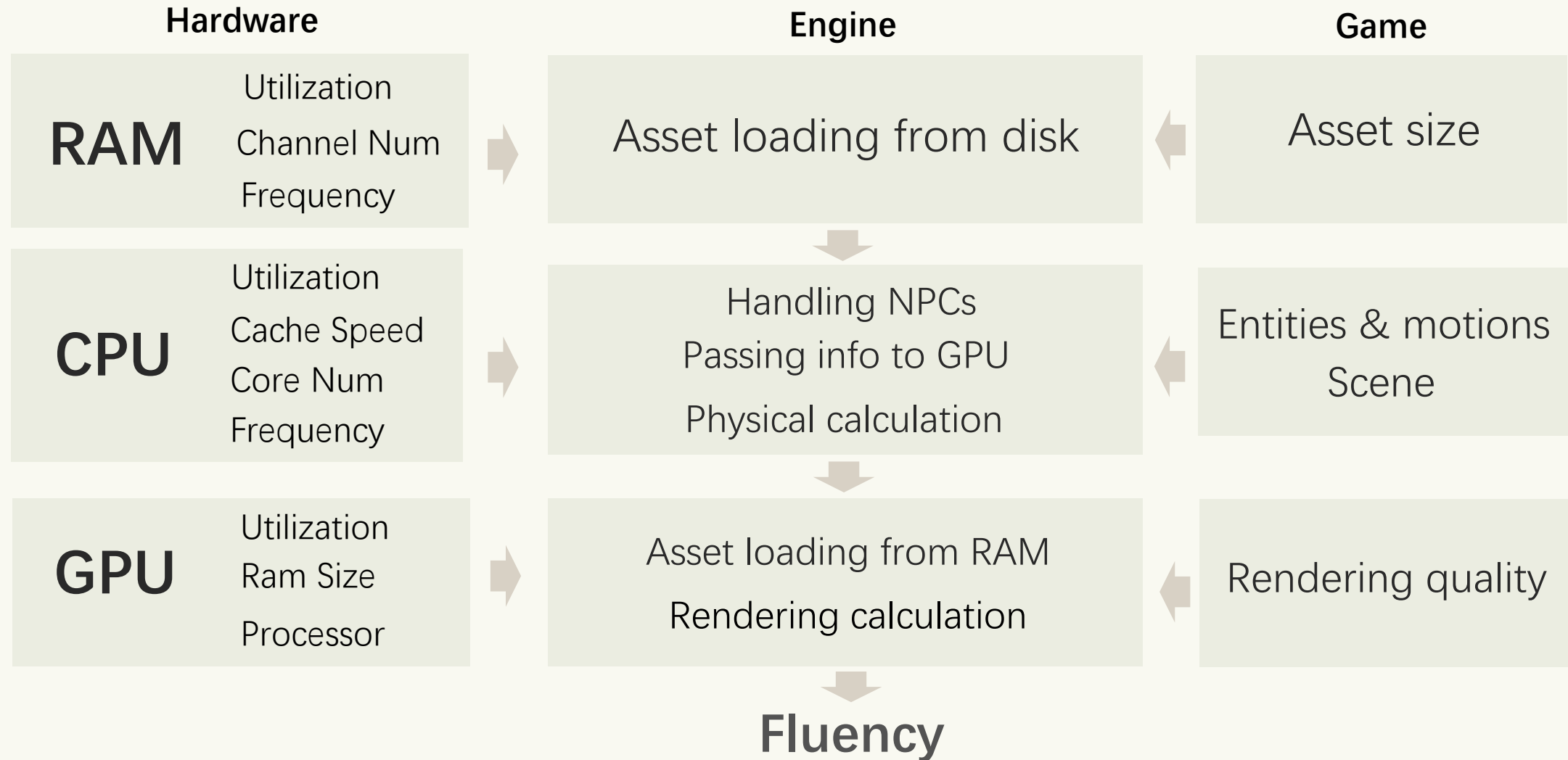
Introduction



Challenge: Sophisticated Scene



Bucket Law In Fluency Optimization



Diverse Data Type

Static Data

Hardware specification
Rendering quality setting
Game setting



Simple ML Model

Time Series Data

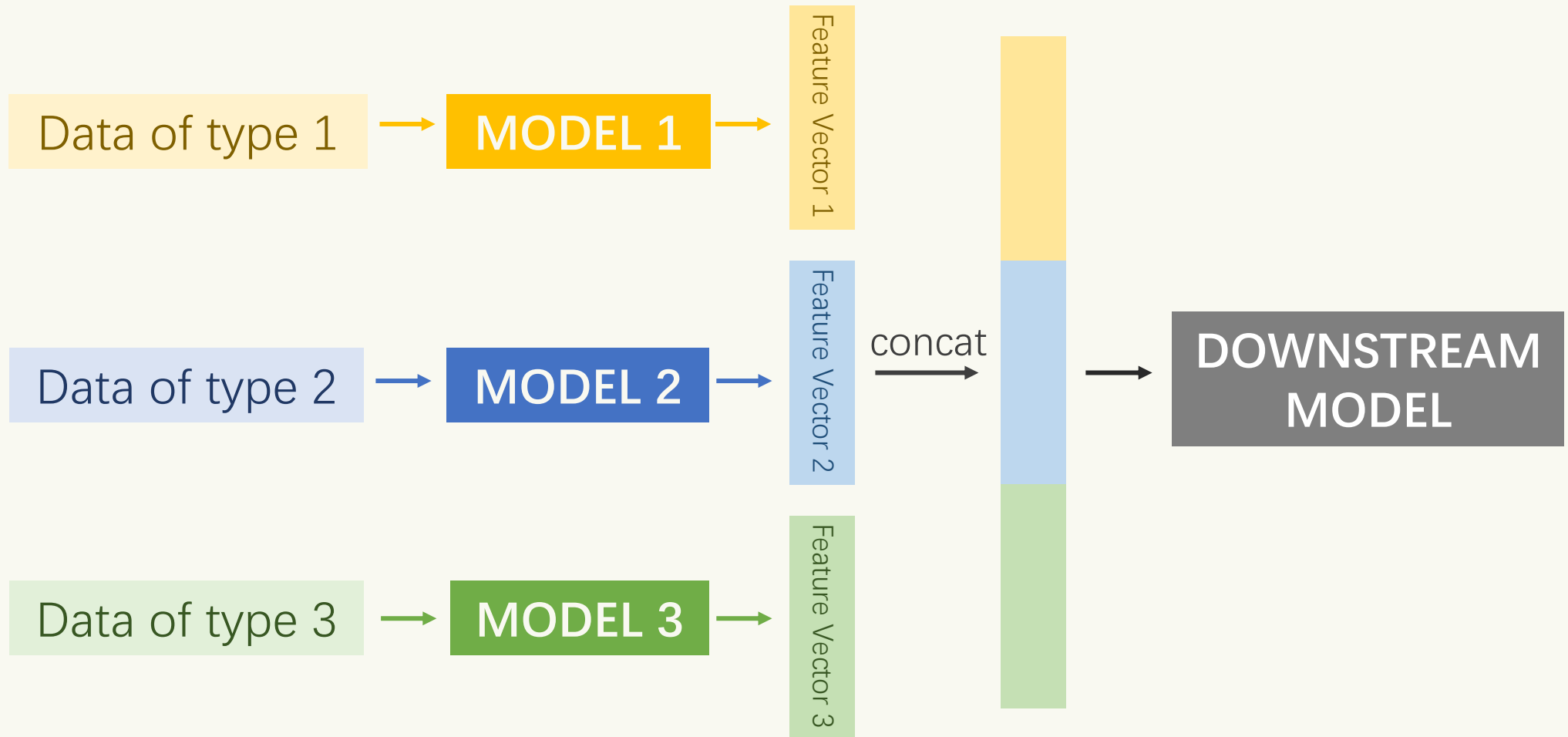
Change in hardware utilization
Changing Scene
Players' interaction with the environment



Time Series Model

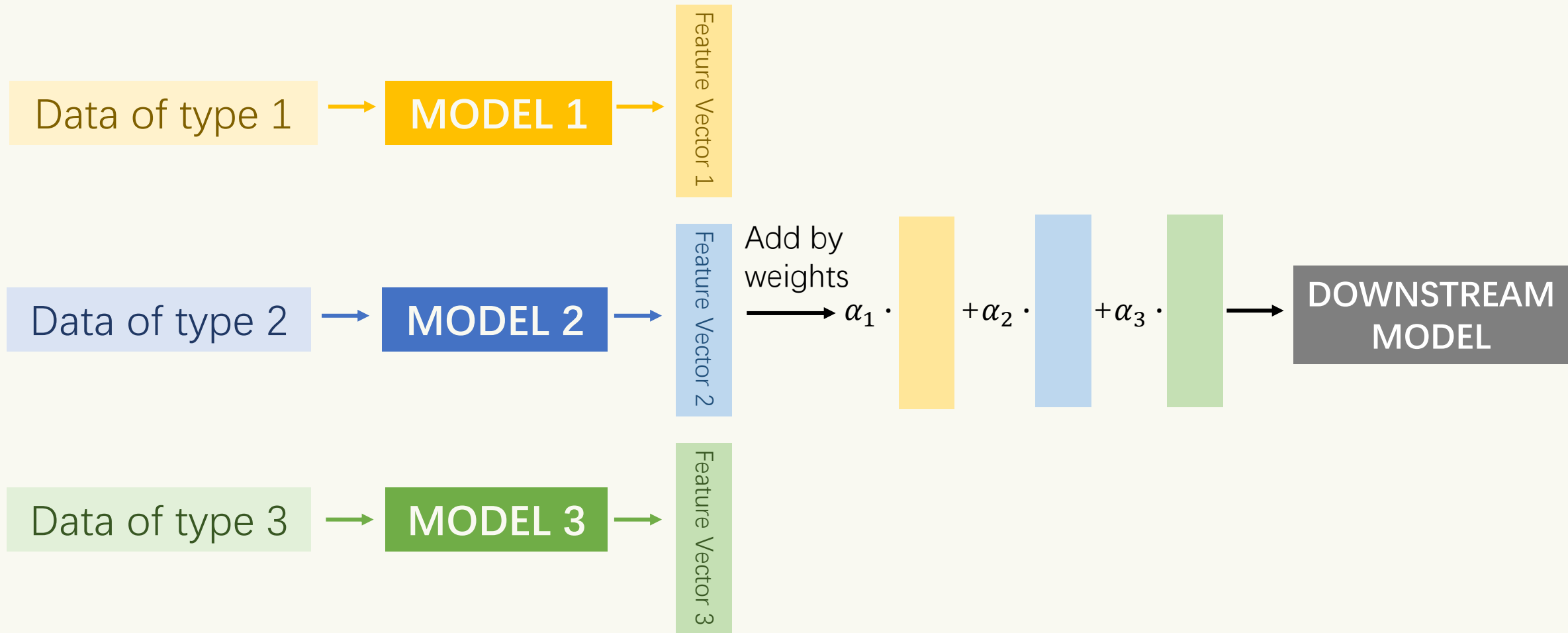
Multimodal Model

Different types of data require different models to extract features and multimodal models combine them together



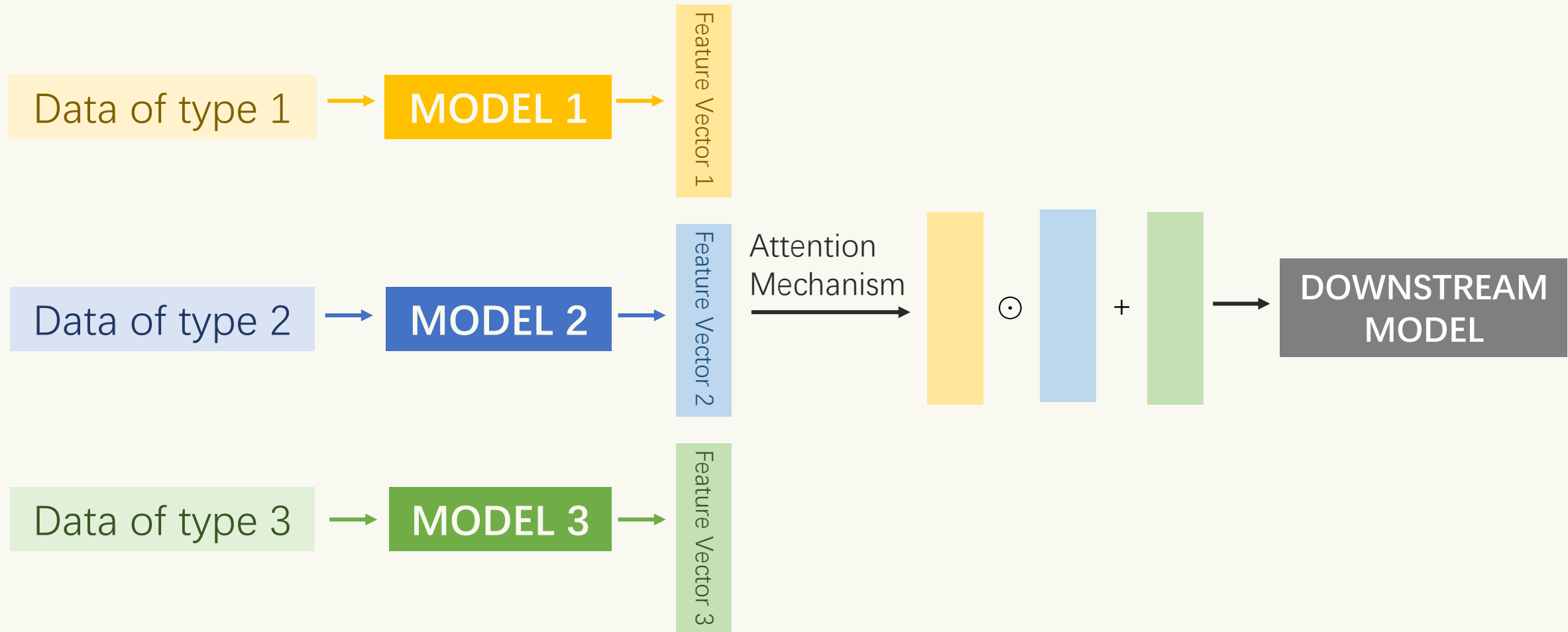
Multimodal Model

Different types of data require different models to extract features and multimodal models combine them together



Multimodal Model

Different types of data require different models to extract features and multimodal models combine them together



Model Implementation

Log Collection

Static Data

Hardware specification

Rendering quality setting

Game setting

Collect when players login

Time Series Data

Change in hardware utilization

Number & types of players around

Players' position sequence

Visual effect around the player

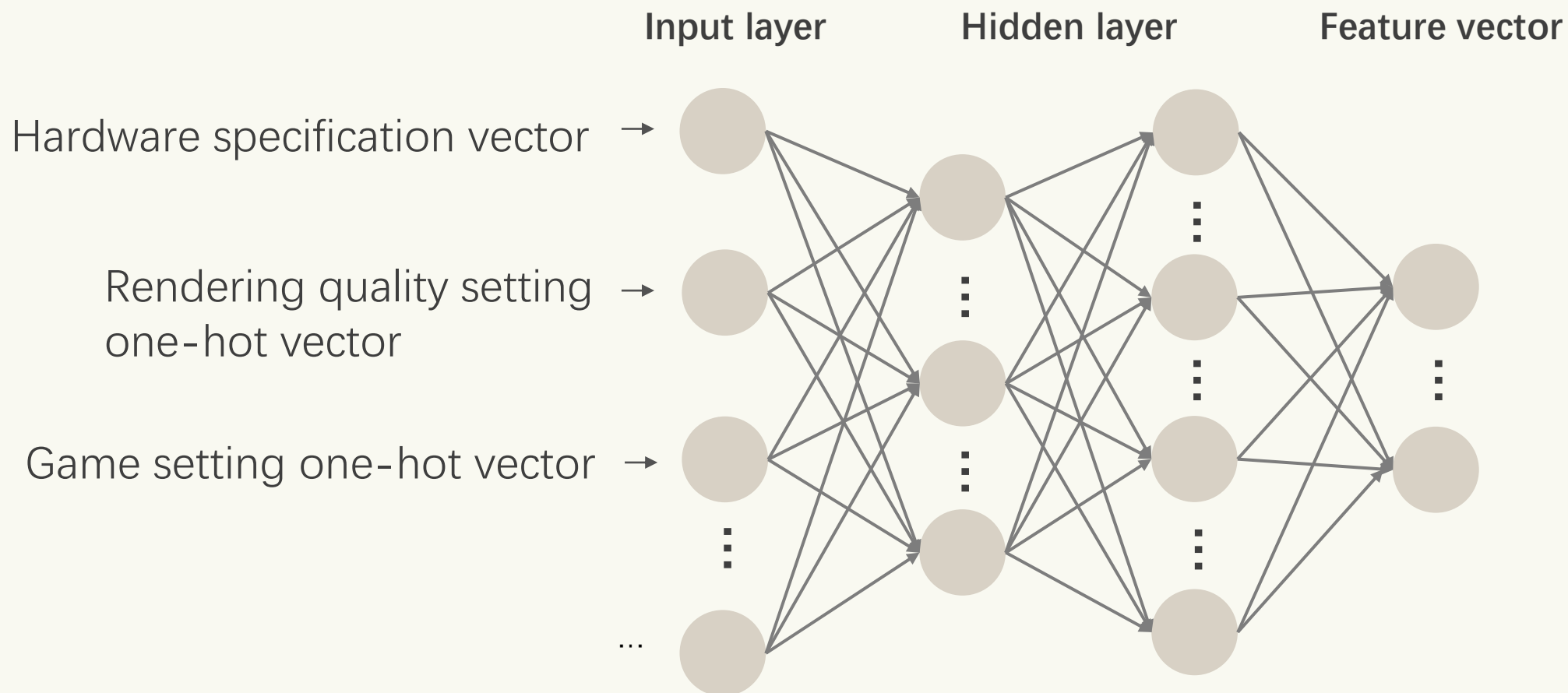
Collect as game log

* Data collected will be stored at big data cluster

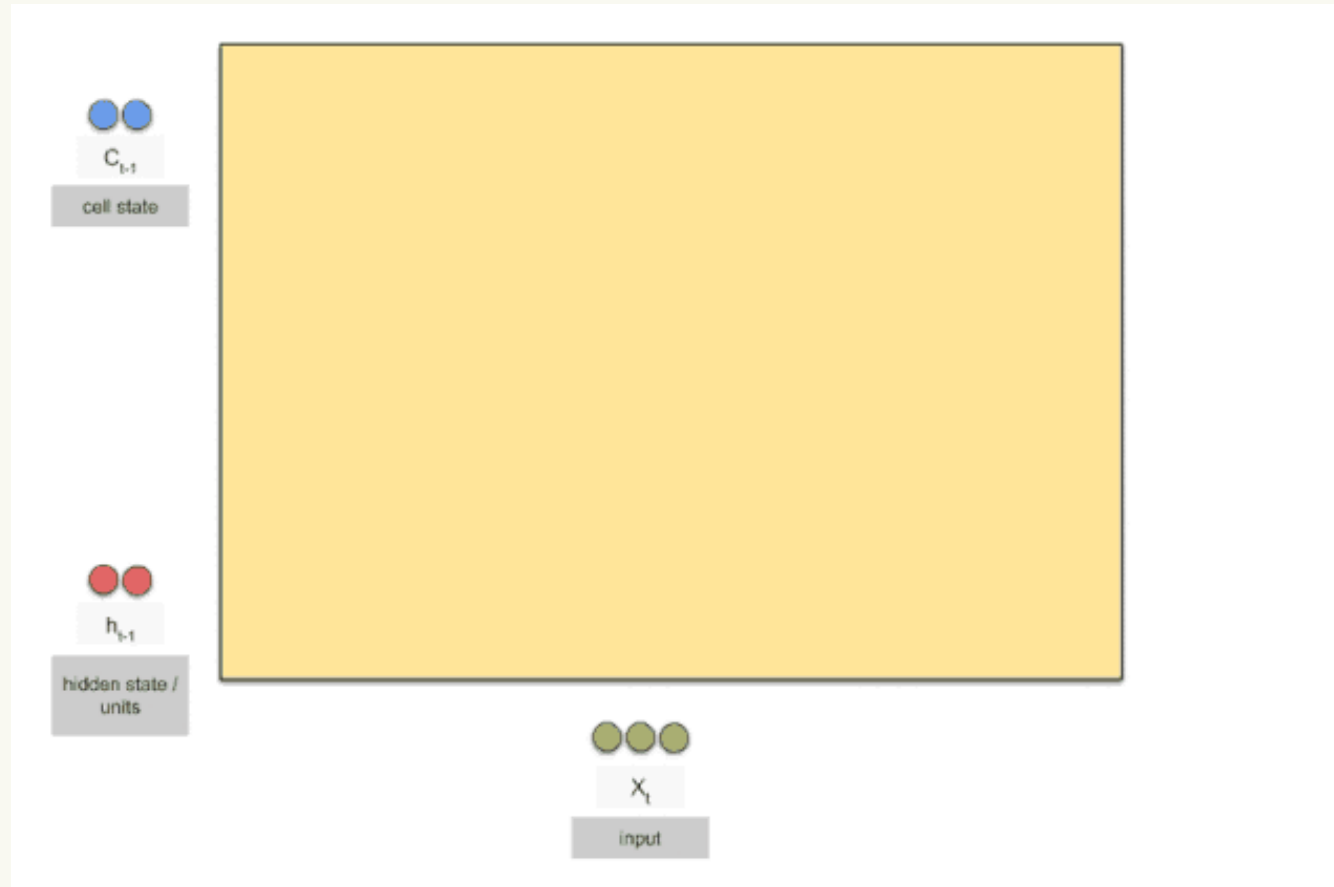


戰意

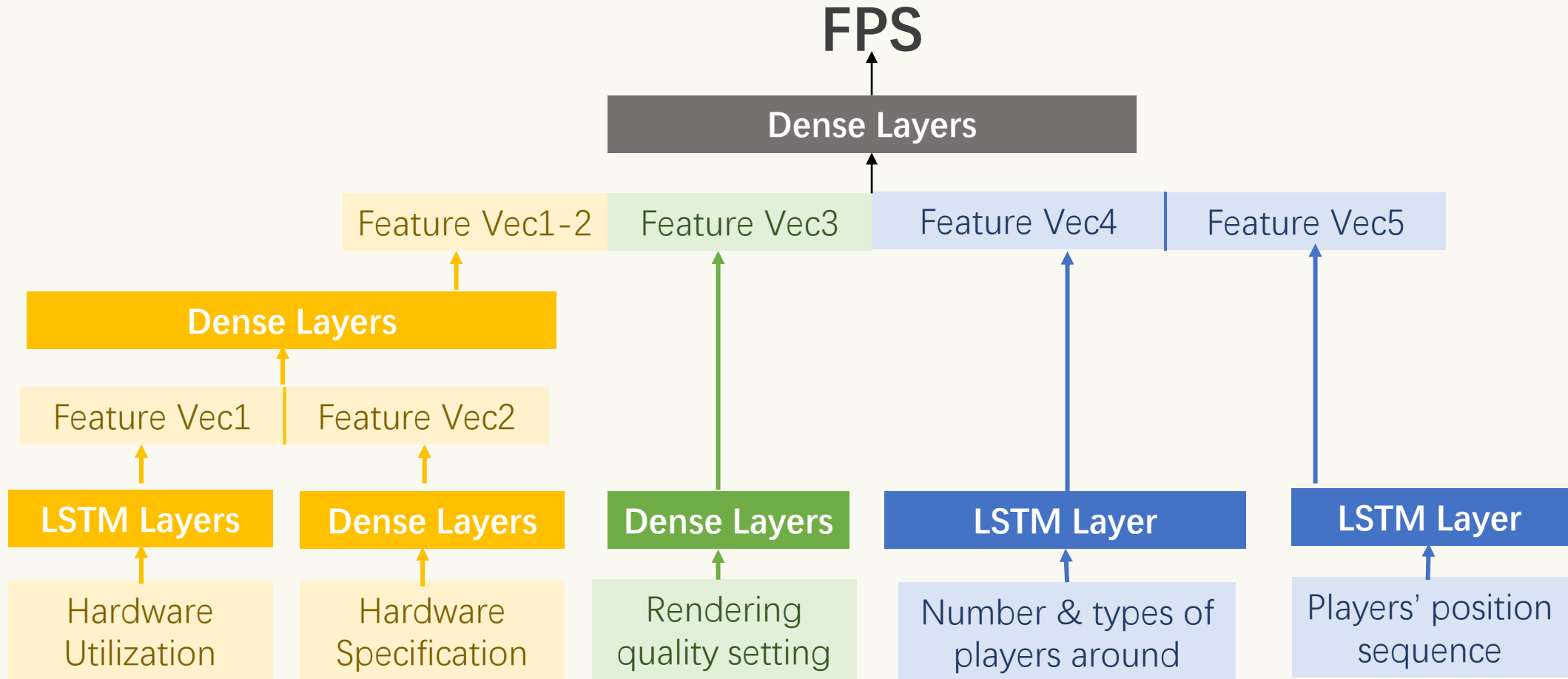
MLP For Static Data



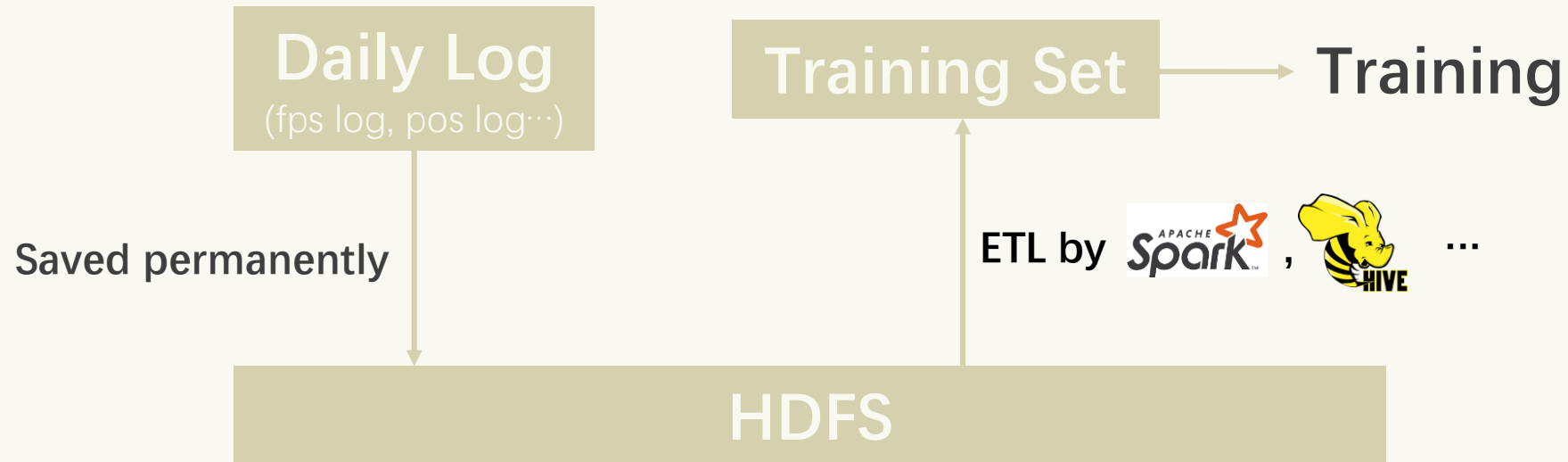
LSTM For Time Series Data



Multimodal Model Structure



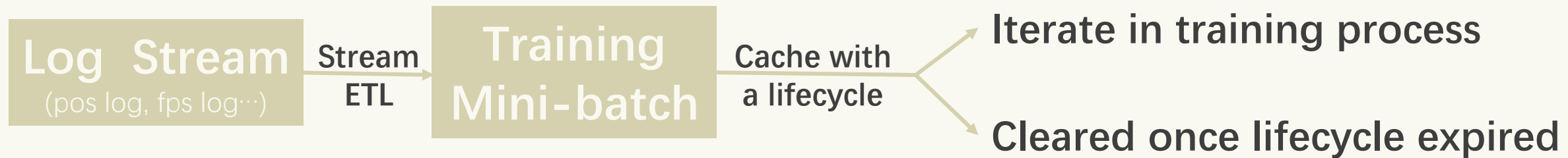
Batch learning technique



Advantages: big data set, reproducible results, generate best predictor

Disadvantages: costly cluster, slow ETL process

Online learning technique



Advantages: save storage resources, recommended to independent studio and small companies

Disadvantages: Instability, loss function fluctuation

Experiment Result

1354.6

Training Loss

1558.3

Validation Loss

Criterion: MSE

Model Value

Applicability In Testing Scenario

Mine those factors that affect fps most

- Monte Carlo method:

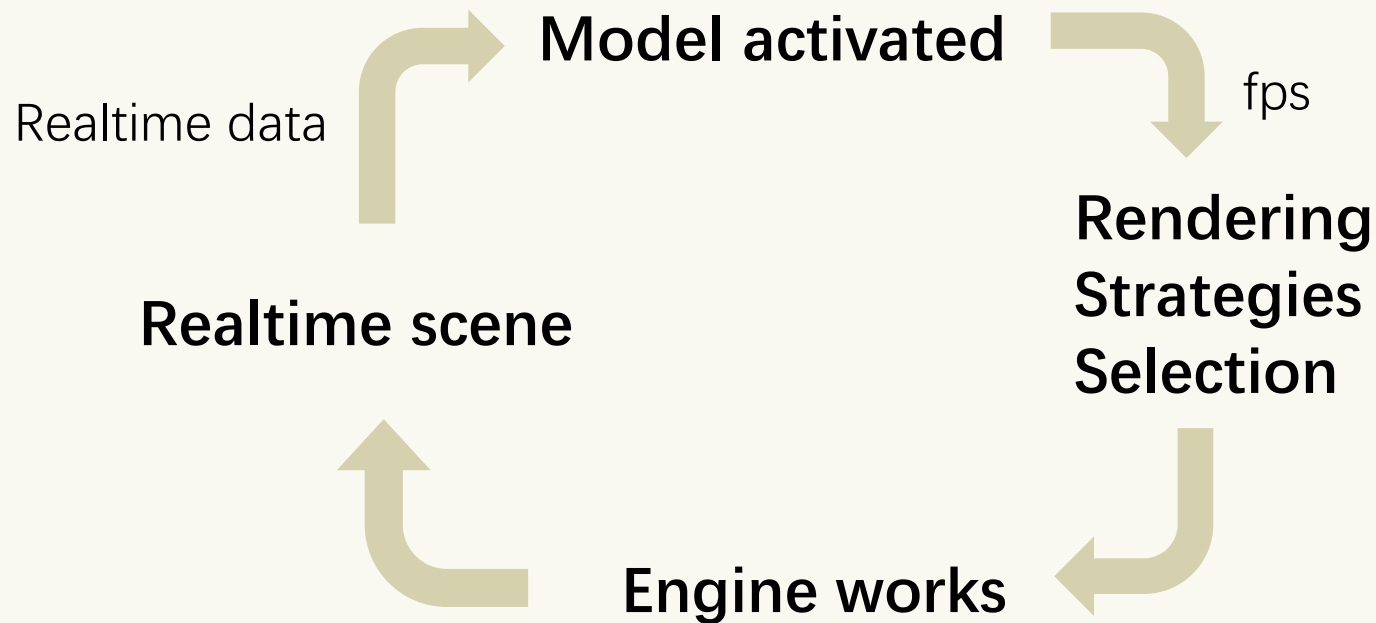
Feed simulated data to model and find the factors that affect fps most

- Model Interpretability method:

Partial Dependence Plots, Permutation Feature Importance ...

Applicability In Client

- The model is activated periodically
- The ultimate goal is to keep the frame rate above a lower limit



Generalizability

Model Transform

Transfer Learning

Model Transform

Regression model -> Classification model

FPS prediction -> Hardware utilization prediction

Predict fps value -> Predict fps change

Transfer Learning

The impact of hardware, engine setting on fps is consistent

Fine tune your own model based on our pre-trained one

⚠ The position of the features in your feature vectors must be the same as ours in transfer learning

Takeaway

- FPS prediction involves various input data so a multimodal model is advantageous
- FPS prediction can help mining the bottleneck of the performance and improving fluency
- Model can transform in terms of training strategies, model structures and be boosted by transfer learning

END