

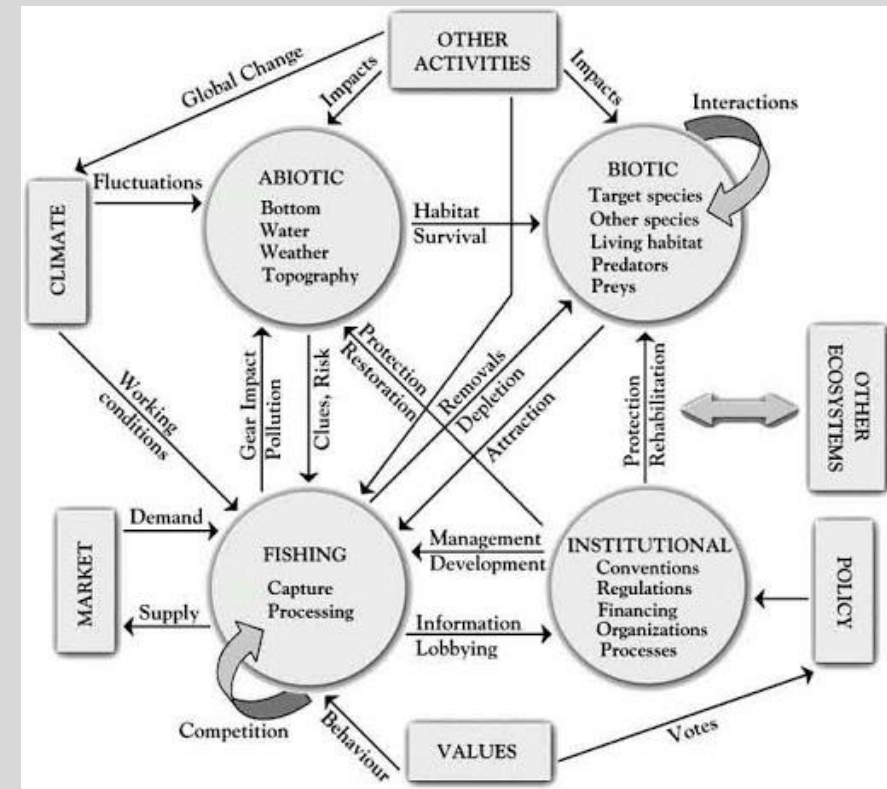


PREDICTIVE MODEL ECOSYSTEMS

Paul Speaker

Predictive Model Ecosystems

- A predictive model on its own does nothing more than satisfy curiosity
- To be useful, a predictive model has to fit within a decision framework
- Often, more than one predictive model can fit within a decision framework
- This set of predictive models aligned to a decision framework is called a **predictive model ecosystem**



Example of Predictive Model Ecosystem—Autonomous Driving

- Self-driving vehicles represent both the promise and challenges of Artificial Intelligence
- To “look under the hood” at how it works, it is important to understand that there is no single model which govern autonomous driving, but an ecosystem of models
 - Route determination
 - Image recognition
 - Go/no go at intersection
 - Collision avoidance, etc.
- These models live within an ecosystem of driving rules
 - Traffic laws
 - Vehicle limits

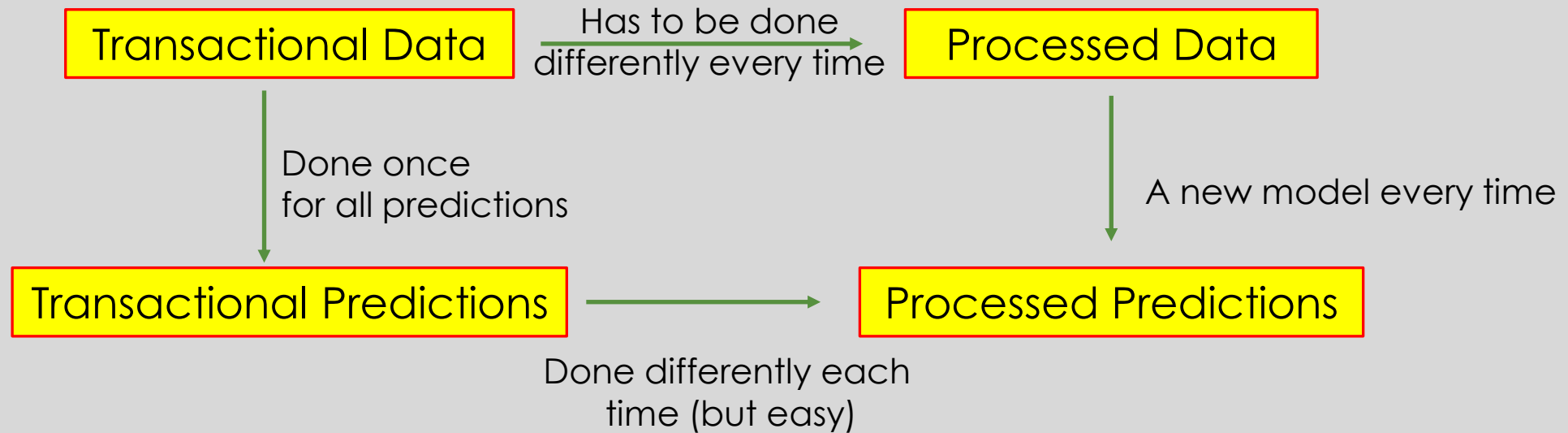
Example of Predictive Model Ecosystem—Autonomous Driving

- There are two principal problems I see with this
- One is that the models are siloed
 - Separate teams are looking at their own problems
 - Errors in one system may not be independent of errors in another system
 - Important to remember in sequential systems you care about the expected value of the product—if errors are not independent, this is not the product of expected values!
- Second: the split of different models are determined by the way humans think through decisions
 - Does that mean ML systems should be split up in the same way?
 - A successful ML driving system will likely have a completely different view of how to drive a car than we do

Example of Predictive Model Ecosystem—Financial Modeling

- Had to create many different predictive models for different aspects of business
- Traditional Approach to Financial Predictive modeling was to combine the data to what we want to model and then model it
 - Target of model was what business would use
- Problems with this approach
 - Every time we needed a new target, we had to build separate predictive models
 - The ways data needed to be aggregated changed over time (realignments)
 - Data itself changed
- The most flexible solution was to reverse the order of modeling
 - Make predictive models at the lowest possible level, and then combine the predictions

Getting Models to Work Together



Getting Models to Work Together

- It's not just the ultimate predictions that can be useful
- Intermediate modeling steps for one model type can be used for other model types
- Example: **The Texas Two-Step**
 - The fitted values of the final hidden layer enter an activation function to make the final predictions
 - The Texas Two-Step has, wait for it, 2 steps
 - Fit the neural network with all parameters
 - Create the outputs of final hidden layer that neural network and use them as features in another model
 - Creating the outputs of the final hidden layer is just some simple algebraic operations
 - xgboost for example can take the outputs and often (not always) create a better model
 - Alternative to neural network: genetic programming (aka symbolic regression) can also provide good features for other models