

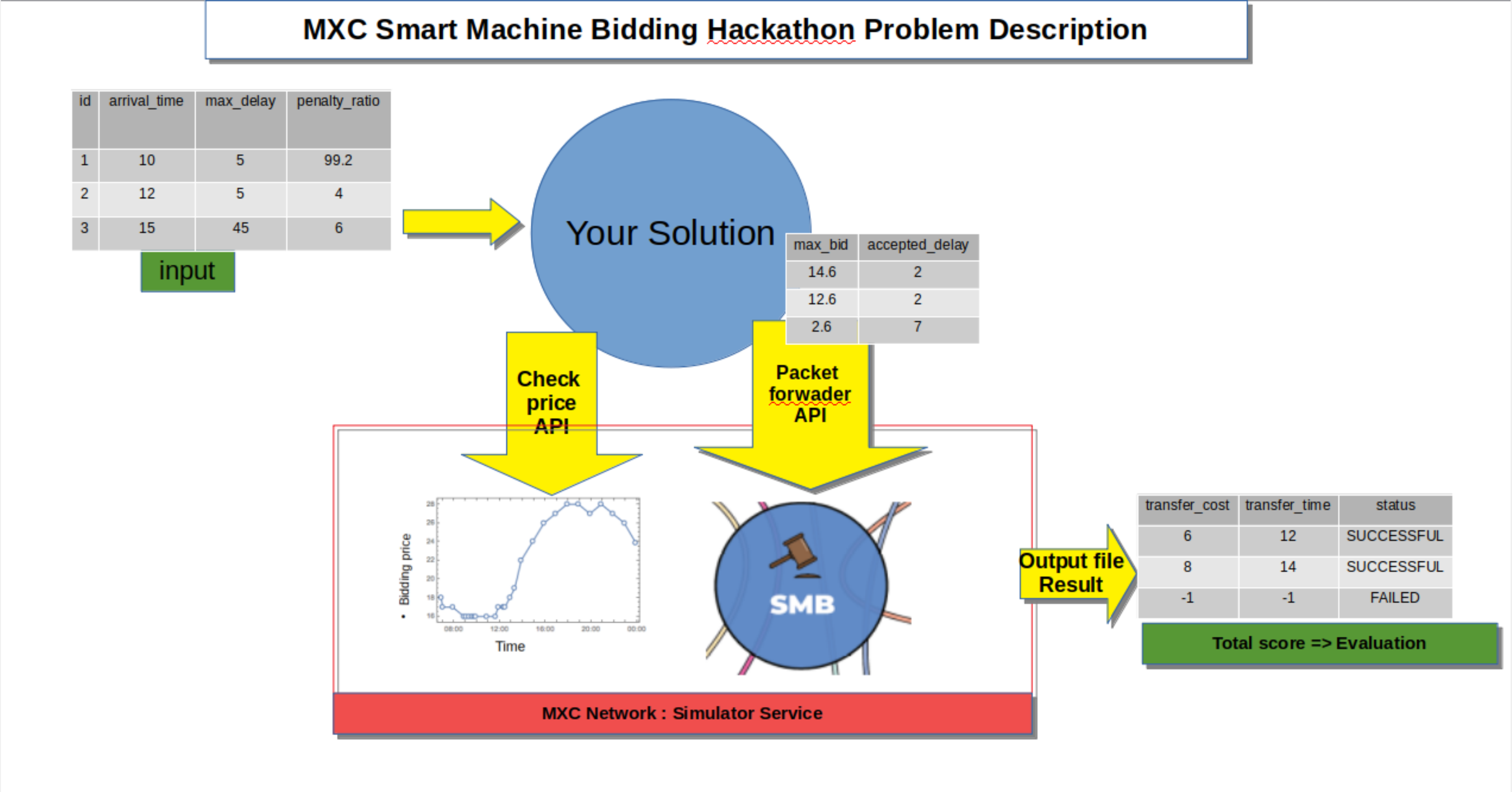
Longhash Hackathon Challenge #2

From Branch Prediction to Neural Network

Hanwen Cheng

Overview

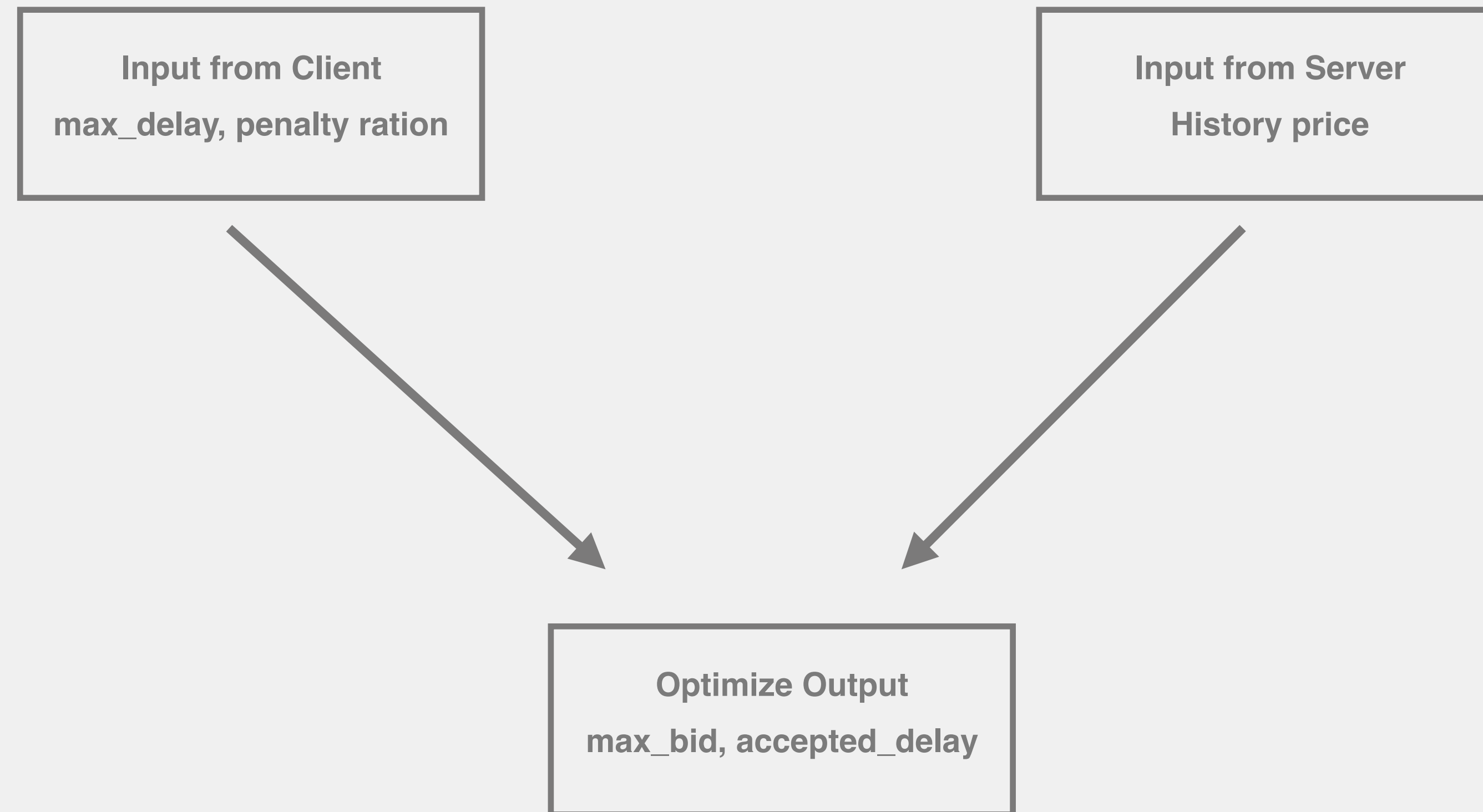
Question Explained



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Question Explained



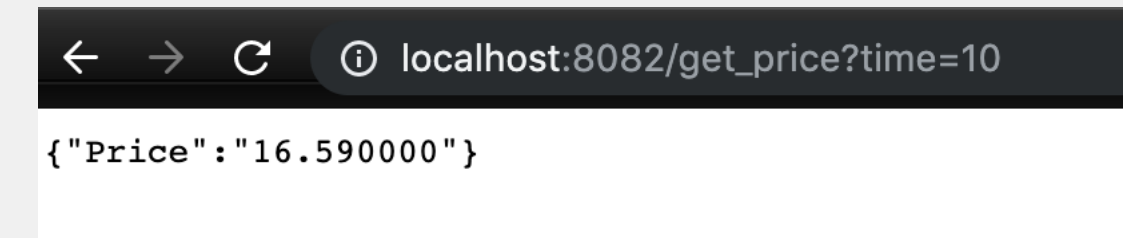
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Data Model

Data Model

- If max delay is 5, then we care the price at 0, 1, 2, 3, 4.
- For each time, there is a price from the server, so we know the max_bid can win.
- for price at each moment, we calculate the total cost in the condition that if wins and it lost.
- we compare all the total cost in all these 5 time, and get the optimized one.
- If it wins, the max_bid is the current price.
- If it lost, we calculate the according max_bid so that it does not worth lost.



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Data Model

If success:

Average = (Sum_payment + current_price) / (Sum_Successful + 1);

totalCost = (Sum_payment + current_price) + Average * sum_Penalty;

If fail:

Average = Sum_payment / Sum_Successful;

totalCost = Sum_payment + Average * (sum_Penalty + penalty_ration);

Calculate the max_bid if fail:

$$\frac{ac}{b+1} + \left(\frac{c}{b+1} + 1 \right) x + a = totalCost$$

a: sum_payment, b: sum_successful, c: sum_penalty — —> x: max_bidsu

Success_cost > fail_cost ? Should wait at this moment : should fail

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Data Model

Time_Delayed	CurrentPrice	totalCost:Win	totalCost:lost	Lost max_bid	Win max_bid
0	16	33	42	5,4	16
1	5	45	82	3,5	5
2	11	89	25	7	11
3	17	56	100	4,6	17
4	9	77	22	7	9

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Data Model

The ways to achieve high probability result includes:

- Statistical branch probabilities collected by instrumentation runs
- Statistical distribution of variable values collected by instrumentation runs; it can then predict the average outcome of a conditional and thus the branch
- Programmer-assertions as to frequency or bias of a conditional
- Estimates of loop bounds based on ranges

A particularly interesting set of optimizations done by some compilers is trace scheduling, which determines the sets of paths through code based on probabilities of sequentially encountered branches.

By determining the highest probability path, the compiler can do optimizations across that entire path rather than just within a basic block.

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Solutions Overview

With different Usage of the Computing resources and history data.

- *Branch Prediction

- *CNN

- *RNN

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Branch Prediction

Branch Prediction

With less computing power and less history data.

Branch predictors play a critical role in achieving high effective performance in many microprocessor architectures such as x86.

Example in Compiler: if else, switch



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Branch Prediction

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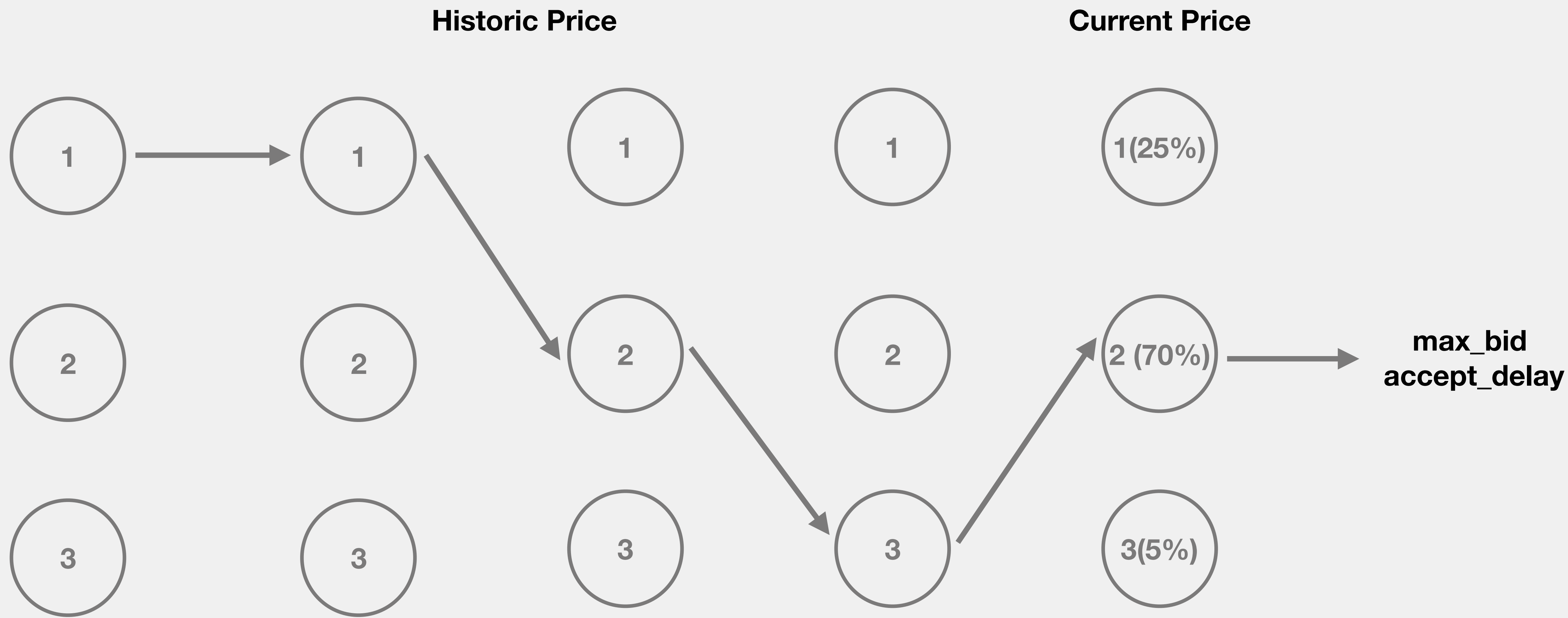
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Branch Prediction



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Optimization

- Use Types to present the number, for example “same as previous value”, “a little bit higher than previous value”, “much less than previous value”.
- Caching the exact data, still have linear complex.

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Neural Network

Convolutional neural network (CNN)

Categorization Problem.

Training:

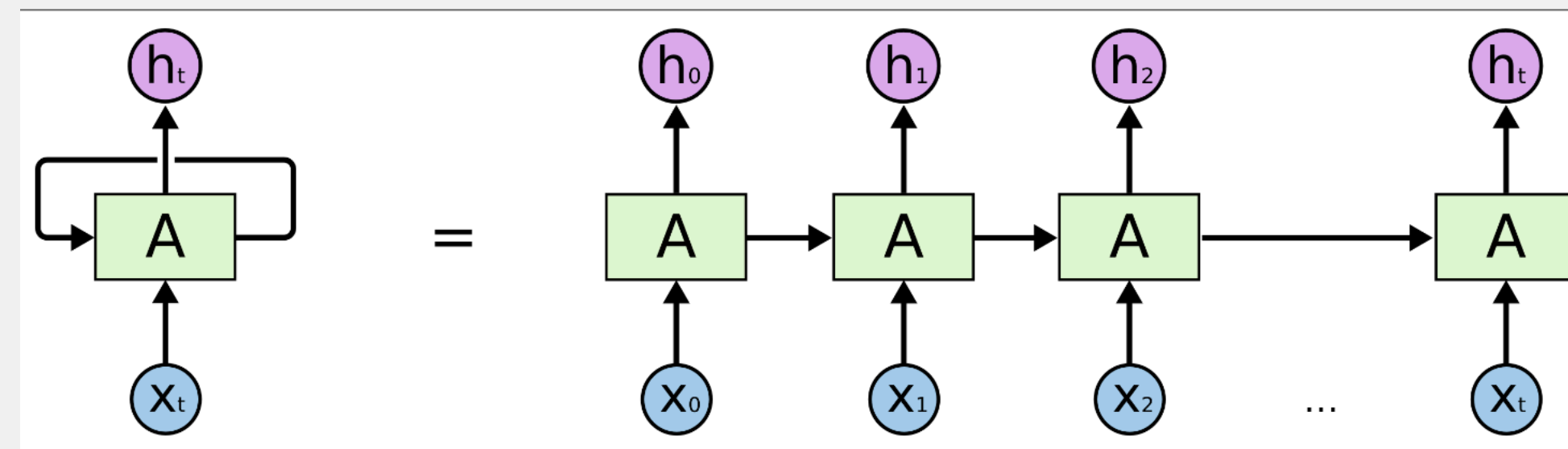
Single Data Sample: Previous data sets, optimizing accept_delay, max_bid, sumSuccess, sumPayment, sumFailure.

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Recurrent neural network (RNN) and Long Short-Term Memory Units (LSTM)

One important factor is missing in calculate the totalCost: time.



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Two ways

Single Data Sample: Previous data sets, optimizing accept_delay, max_bid, sumSuccess, sumPayment, sumFailure.

- * Predict the price at the next several moment. Then direct calculate the accept_delay and max_bid
- * Predict directly the accept_delay, max_bid, let the AI decide the coefficient with the previous data.

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Provided Solution & Next Steps

- Remote Price prediction and local calculation.
- Predict the next 5 time slot prices and calculate the max_bid and accept_delay. (e.g. max_delay = 5)
- Benchmarking and test with real data.

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Thank you