Session 35 ML

11 October 2024 07:17 PM

# Gradient Boosting Algorithm →

Pseudo Residuals

| Age | Category | Purchase Weight (kg) | Amount ($USD) |
|---|---|---|---|
| 25 | Electronics | 2.5 | 123.45 |
| 34 | Clothing | 1.3 | 56.78 |
| 42 | Electronics | 5.0 | 345.67 |
| 19 | Homeware | 3.2 | 98.01 |

$x_1$ $x_2$ $x_3$ — $y$

123.45 − 156 = −32.55

56.78 − 156 = −99.22

345.67 − 156 = 189.4

Avg 156

## Steps 1 Make an initial Prediction

Avg = [123.45 + 56.78 + 345.67 + 98.01] / 4

Avg = 156

## Step 2: Calculate the Pseudo-residuals

$x_1$ $x_2$ $x_3$ $y$ $R_1$

| Age | Category | Purchase Weight (kg) | Amount ($USD) | Pseudo residuals |
|---|---|---|---|---|
| 25 | Electronics | 2.5 | 123.45 | -32.55 |
| 34 | Clothing | 1.3 | 56.78 | -99.22 |
| 42 | Electronics | 5.0 | 345.67 | 189.45 |

→ 123.45 − 156 =

| Age | Category | Purchase Weight (kg) | Amount ($USD) | Pseudo residuals |
|---|---|---|---|---|
| 25 | Electronics | 2.5 | 123.45 | -32.55 |
| 34 | Clothing | 1.3 | 56.78 | -99.22 |
| 42 | Electronics | 5.0 | 345.67 | 189.45 |
| 19 | Homeware | 3.2 | 98.01 | -58.01 |

→ 123.45 − 156 =

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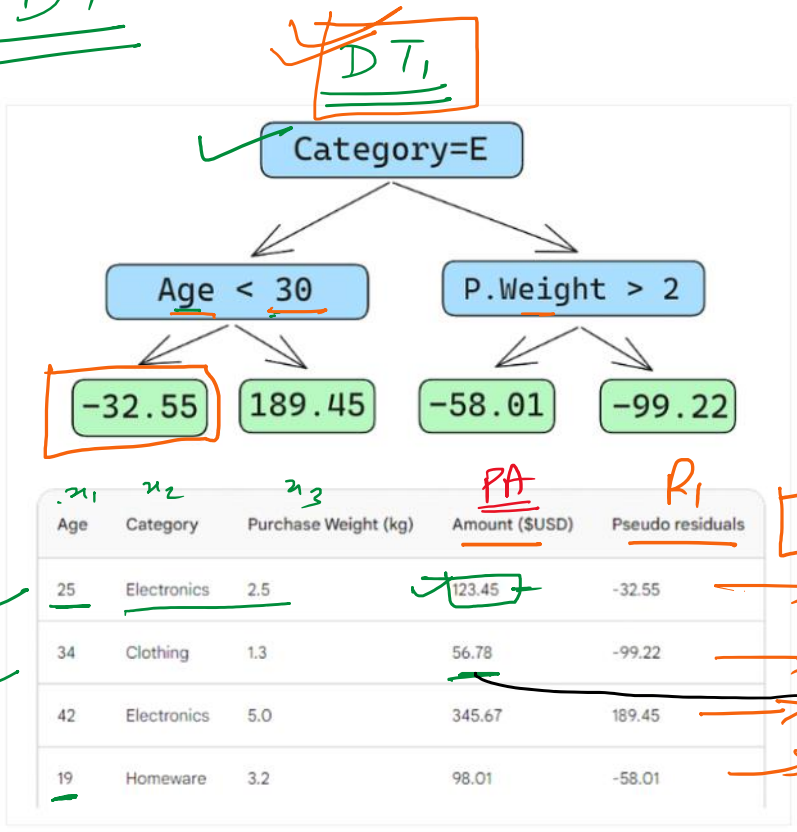
# step3 Build a weak learner

## DT




AC: → 100%

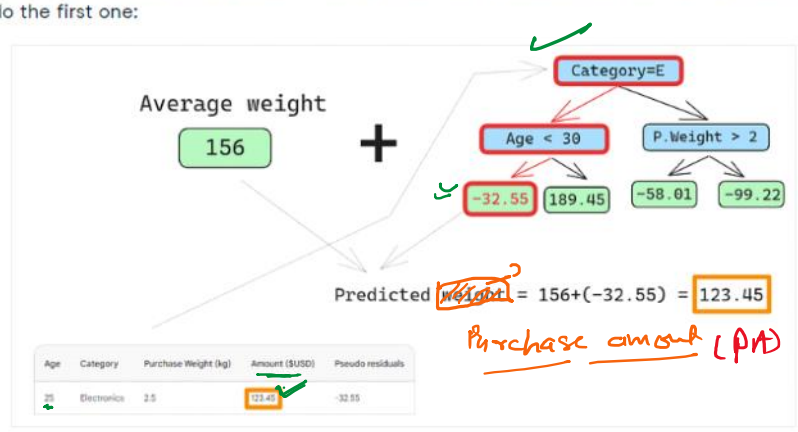
| Age | Category | Purchase Weight (kg) | Amount ($USD) | Pseudo residuals |
|---|---|---|---|---|
| 25 | Electronics | 2.5 | 123.45 | -32.55 |
| 34 | Clothing | 1.3 | 56.78 | -99.22 |
| 42 | Electronics | 5.0 | 345.67 | 189.45 |
| 19 | Homeware | 3.2 | 98.01 | -58.01 |

→ 123.45

→ 146.08

123.45 − 32.55 = 90.5

After the tree is fit to the data, we make a prediction for each row in the data. Here is how to do the first one:




*A small error in the images below: It should have been written "Predicted purchase amount," not "Predicted weight"*

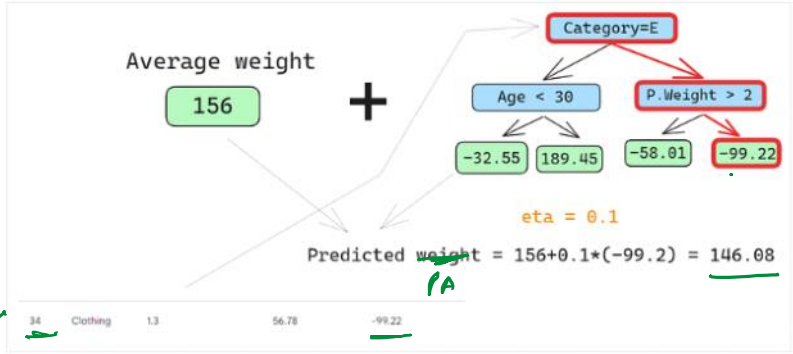
Learning Rate ($\alpha$)

$\alpha$ → 0 – 1 → 0 to 1 → 0.01, 0.02

```
eta = 0.1

Predicted weight = 156+0.1*(-32.55) = 152.75
```

Let's predict on the second row as well:




146.08

$a_1, x_2, x_3$ ; $y$ ; $R_1$ ; $\frac{1}{y_1}$

| Age | Category | Purchase Weight (kg) | Amount ($USD) | Pseudo residuals | New Predictions |
|---|---|---|---|---|---|
| 25 | Electronics | 2.5 | 123.45 | -32.55 | 152.745 |
| 34 | Clothing | 1.3 | 56.78 | -99.22 | 146.078 |
| 42 | Electronics | 5.0 | 345.67 | 189.45 | 174.945 |
| 19 | Homeware | 3.2 | 98.01 | -58.01 | 150.199 |

Next, we find the new pseudo-residuals by subtracting new predictions from the purchase amount. Let's add them as a new column to the table and drop the last two:

| Age | Category | Purchase Weight (kg) | Amount ($USD) | New pseudo residuals |
|---|---|---|---|---|
| 25 | Electronics | 2.5 | 123.45 | -29.295 |

| Age | Category | Purchase Weight (kg) | Amount ($USD) | New pseudo residuals |
|---|---|---|---|---|
| 25 | Electronics | 2.5 | 123.45 | -29.295 |
| 34 | Clothing | 1.3 | 56.78 | -89.298 |
| 42 | Electronics | 5.0 | 345.67 | 170.725 |
| 19 | Homeware | 3.2 | 98.01 | -52.189 |

## Step 4 Iterate

$\alpha_0 = 1$

$F(x) = \alpha_0 h_0(x) + \alpha_1 h_1(x) + \alpha_2 h_2(x) + \cdots \alpha_n h_n(x)$

$\{\alpha_0, \alpha_1, \alpha_2 \cdots \alpha_n\} \rightarrow$ learning Rate

$0 \leq 1$

$$F(x) = \sum_{i=0}^{n} \alpha_i h_i(x)$$