

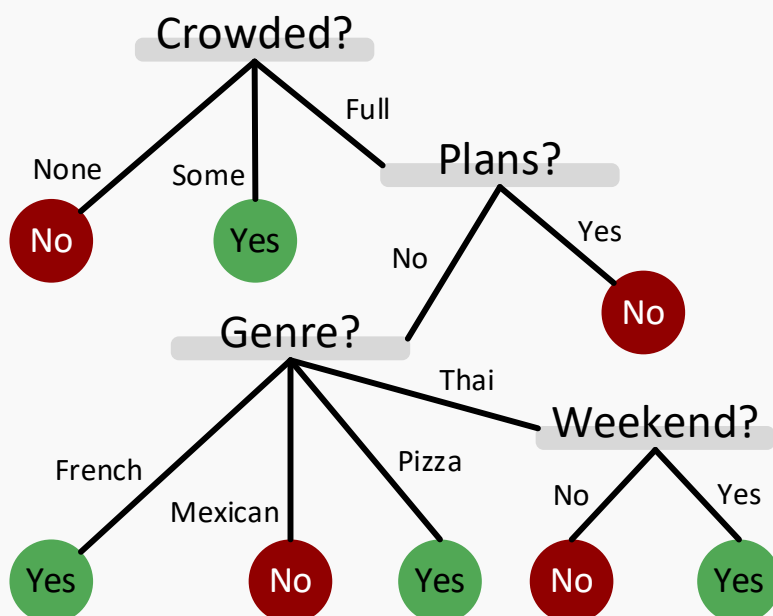
module4 · tree and ensemble methods

decision tress

Example: Will the customer wait for a table at a restaurant?

- OthOptions: Other options, True if there are restaurants nearby.
- Weekend: This is true if it is Friday, Saturday or Sunday.
- Area: Does it have a bar or other nice waiting area to wait in?
- Plans: Does the customer have plans just after dinner?
- Price: This is either \$, \$\$, \$\$\$, or \$\$\$\$
- Precip: Is it raining or snowing?
- Genre: French, Mexican, Thai, or Pizza
- Wait: Wait time estimate: 0-5 min, 6-15 min, 16-30 min, or 30+
- Crowded: Whether there are other customers (no, some, or full)

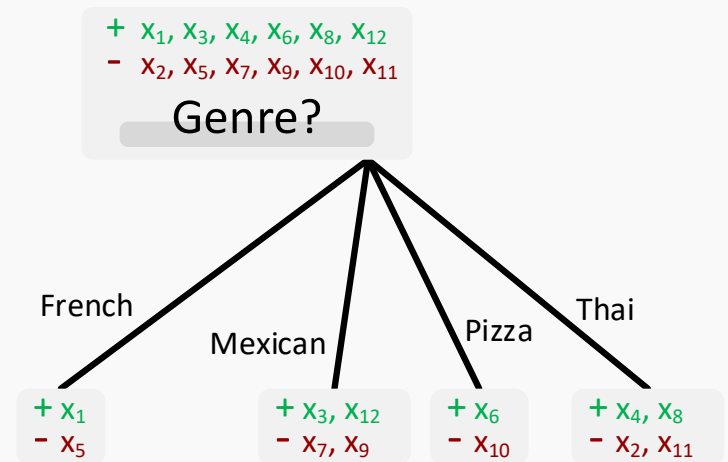
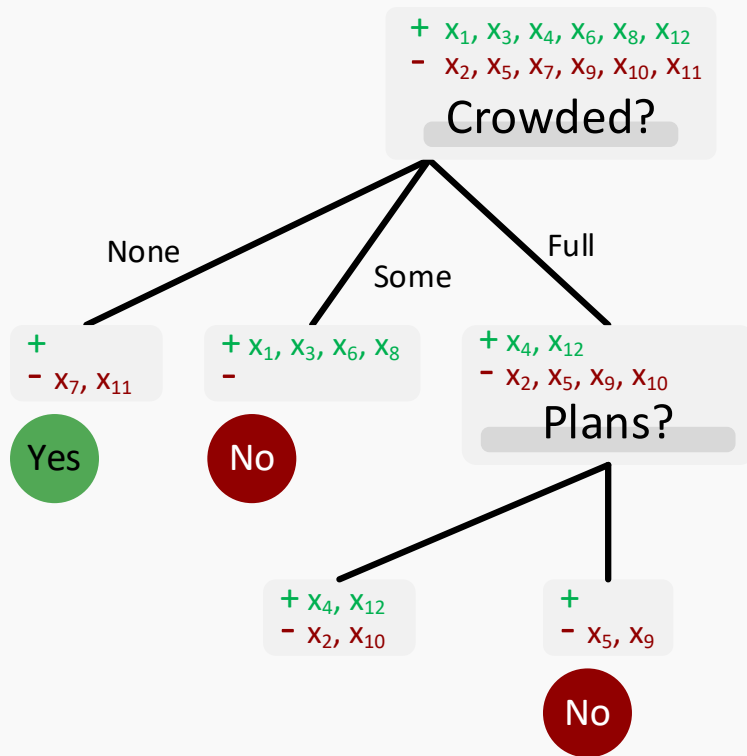
	OthOptions	Weekend	Area	Plans	Price	Precip	Genre	Wait	Crowded	Stay?
x_1	Yes	No	No	Yes	\$\$\$	No	French	0-5	some	Yes
x_2	Yes	No	No	Yes	\$	No	Thai	16-30	full	No
x_3	No	No	Yes	No	\$	No	Pizza	0-5	some	Yes
x_4	Yes	Yes	No	Yes	\$	No	Thai	6-15	full	Yes
x_5	Yes	Yes	No	No	\$\$\$	No	French	30+	full	No
x_6	No	No	Yes	Yes	\$\$	Yes	Mexican	0-5	some	Yes
x_7	No	No	Yes	No	\$	Yes	Pizza	0-5	none	No
x_8	No	No	No	Yes	\$\$	Yes	Thai	0-5	some	Yes
x_9	No	Yes	Yes	No	\$	Yes	Pizza	30+	full	No
x_{10}	Yes	Yes	Yes	Yes	\$\$\$	No	Mexican	6-15	full	No
x_{11}	No	No	No	No	\$	No	Thai	0-5	none	No
x_{12}	Yes	Yes	Yes	Yes	\$	No	Pizza	16-30	full	Yes



As illustrated in the example, **decision trees** apply a hierarchy of **nested logic** with associated **probabilities** of occurrence to determine labels. The rule-based logic applied to the table above produces an answer to the predicted value on the **Stay?** column. The **decision tree** itself is illustrated in the graphic to the **left** showing the progression from the first, to the last question determining the ultimate binary response to the problem set. **Decision Trees** are generally interpretable, straight forward, and applicable to an array of varying logical problems applied to a dataset.

constructing decision ress

In determining which features to split within a **Decision Tree**, it is ideal to split upon the feature that provides the most information about that questions; “**will the customer have to wait?**”:



The example illustrates properties such as:

- “ If there is **no crowd**, no one (**2**) waits for a table
- “ If there is **some crowd**, everyone (**4**) waits
- “ If the restaurant is **fully crowded**, **2** leave; **4** wait
- “ If the menu is **French**, half leave and half wait
- “ If the menu is **Mexican**, half leave and half wait
- “ If the menu is **Pizza**, half leave and half wait
- “ If the menu is **Thai**, half leave and half wait

Examining the **Decision Tree** above displays clearly that splitting on the **genre** feature offers

no predictive power; the outcomes of each property are equally likely given the training data.