**Machine Learning Algorithm**

1. **Supervised learning**

More commonly .

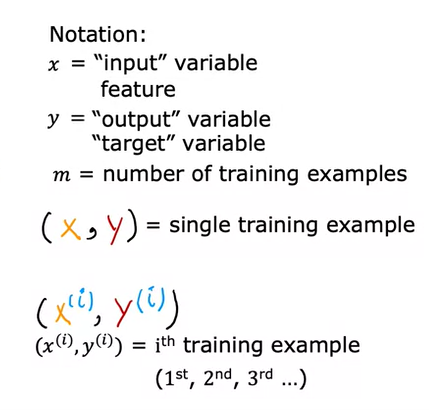
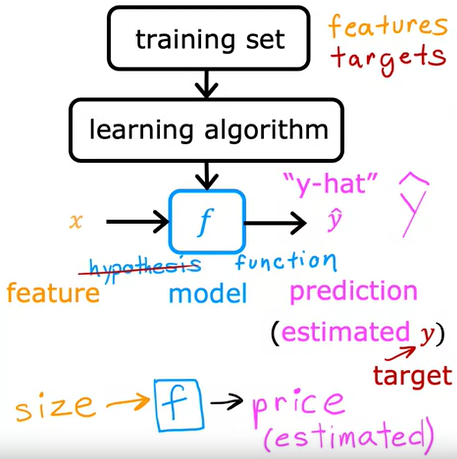
Input to output **Labled.**

„learn from being given „right answers” “.

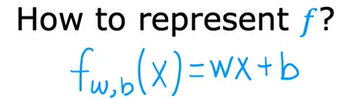
Data has “right” answers.

**Regression (predict a number)**

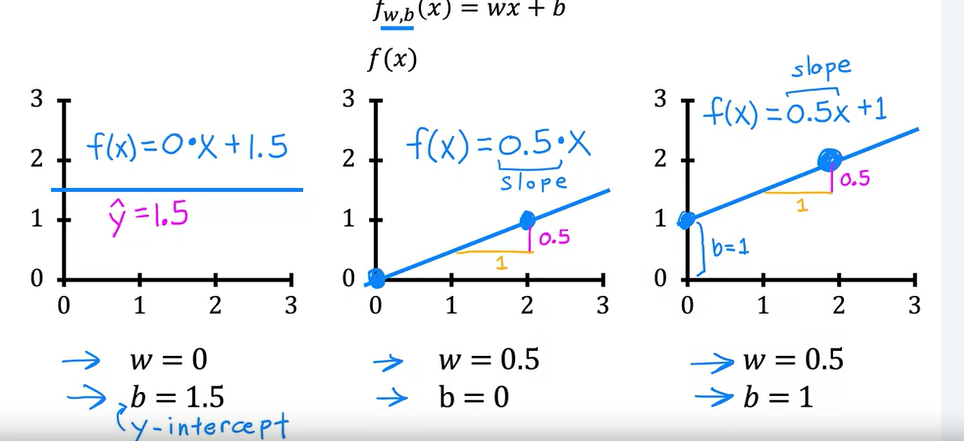
* Predicts a number

**Linear Regression with one feature**



f is a linear function – means only has one   
variable (**univariate linear regression**)  
**w=slope, b=intercept**

****

**Cost function  
Goal:** minimize J(w,b) to find the best fitting f(x)

**IF THE PREDICTIONS ARE CLOSE TO THE TRUTH,**

**THE COST IS LOW**

**IF THEY ARE FAR OFF, THE COST IS HIGH**

* **Loss**: Measures error for a single instance.
* **Cost**: Measures average error across all instances.

**Gradient Descent**

Find the local minima for the cost function J to minimize it.

Like walking a hill to the valley

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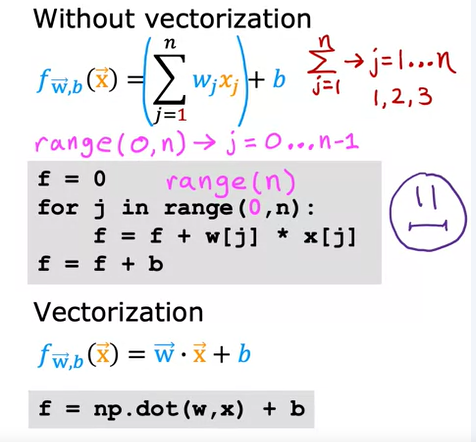
Automatisch generierte Beschreibung

**Multiple features**

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Automatisch generierte BeschreibungInstead of using just one x as a feature like the size of a house we are now going to use multiple features

(0.1, 4, 10, -2, 80 are randomly chosen)



**Features and Parameters**

The range of feature numbers and the parameters have impact on the accuracy of the prediction:

It has to be like:  
**Large range: small parameters**

**Small range: large parameters**

Otherwise the prediction is not accurate!!

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We need feature scaling!

**Feature scaling**

Mean normalization

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Notice mü\_1 is the average in this case 600

Z-score normalization

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Notice mü\_1 is the average and sigma\_1 is the standard deviation

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Choosing the learning rate

* Alpha can be to big -> use a smaller one
* Use a minus sign at the update of w
* With a small enough alpha the cost function J should decrease on every iteration
* Values of alpha to try: 0.0001, 0.0003 , 0.001, 0.003 , 0.1, 0.03, 1, 10, 1000

**Feature Engineering**

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Here we can combine the frontage and the depth to one new feature “area” which will optimize the model

Polynomial regression:

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Selecting Features: 

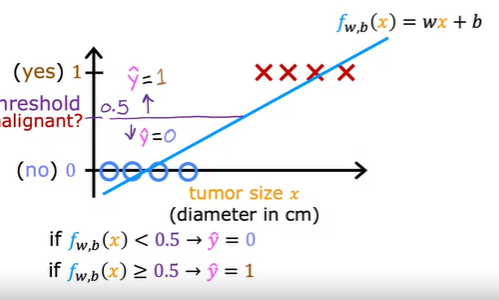
* less weight value implies less important/correct feature, and in extreme, when the weight becomes zero or very close to zero, the associated feature is not useful in fitting the model to the data.
* above, after fitting, the weight associated with the 𝑥2x2 feature is much larger than the weights for 𝑥x or 𝑥3x3 as it is the most useful in fitting the data.

**Classification**

* 1. predicts categories
     1. is email spam? yes or no (2 options)
     2. tumor recognition? malignant or non malignant

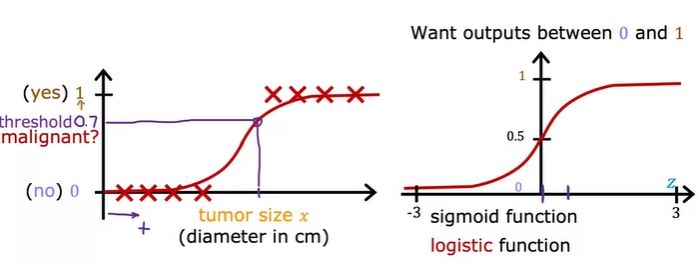
**binary classification**: y can only be one of two values (negative class / positive class)

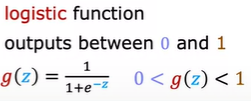
Threshold



**Logistric Regression**

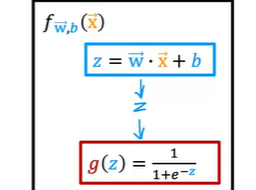
Sigmoid: output is 1 or 0





g(z) range:   
z very small: g(z) is near 0  
z very large: g(z) is near 1

**But what is z in logistic regression?**





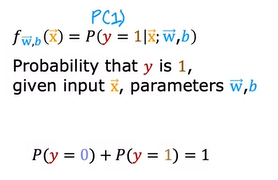
“probability” that class is 1

Example:

x is tumor size  
y is 0 or 1

f\_w,b(x) = 0.7 means that the chance is 70% the tumor is malignant (1)

AND that means:



p(y = 0) = 1-P(y=1) => 1-0.7 = 0.3

**Threshold**

Predict if the output is 1 or 0

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Decision boundary: when is z = 0?

Let’s say

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It’s like the neutral line between the two segments

**Non-linear decision boundaries**

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**Cost function**

It cant be the squared error function bc we would get too much local minima

Instead we use this loss function

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**Gradient Descent for log reg**

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1. **Unsupervised learning**

**No labels**

Find pattern / interesting informations in unlabeled data