Week 13 assignment – usability test

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Wednesday 6:30-8 W209

Background

Our project, "Neural Networks – The good, the bad and the math" is building a website for beginners to learn about and interact with neural network machine learning models. Website link: http://machinelearningalgorithmsillustrated.azurewebsites.net/

Task List

Since our website is publically available to anyone, and it is under construction, we built a task list to solicit user feedbacks about our site, and see how they interact with it, where can we make improvements etc. Then we can make decisions on how to continue constructing the website.

We consolidated our task list into a survey with 21 questions, targeting different parts of our website (home page, learn page, play page, math (TL;DR) page, and overall site experience). Here is the link to the survey https://berkeley.qualtrics.com/jfe/form/SV_8odiD2hhiltQfvT

To see details about the questions, see appendix at the end of this document.

Participants

User 1 does not have much machine learning background, with basic math knowledge such as function, input, linear. But does not have any knowledge about logistic regression, concept of feature, loss, decision boundary etc.
User 2 is a software engineer, with some knowledge about machine learning basic concepts, such as model, input, but does not know much about math.

Findings:

For user who does not know machine learning basic concepts, they are completely lost, and didn't know what to do. I had to explain in person and explain in simple words, such as this chart with a slop line is showing how wrong the trained "brain" (model) is. And those black and white dots representing a person, and x axis and y axis showing weights and heights, color of the dot showing healthy or unhealthy. This red line "smartly" finds the right parameters (in terms of linear function ax+b=y) and separates the black dots and white dots.
For user with some machine learning background, they can understand the concept, but since the texts were not obvious, they skipped text and only looked at charts and started clicking on buttons, I had to ask them to read text in person and point at things they need to read.

Home page:

Both read the title, and skipped the explaining text and started clicking on learn or play button. I had to ask them to read those texts. They read words like "LR" and "NN" and looking

confused. They didn't know what "LR" or "NN" mean, they didn't even know what model means. I had to explain to them in person.

To do: add explanation for math terms. Use simple and graphically vivid words.

Learn page:

User 1 saw YouTube video and directly clicked on it. The video helped. They both didn't read the text until I asked them to. They looked at the charts and didn't know where to click, they tried to double click on the charts and try clicking on things they feel like clickable. They both found the play button after all, but didn't know what the charts mean. I had to explain to them again. They didn't know what is a node, and I had to explain to them where neural network algorithm came from, and explain how neuron works biologically and how a node represents a neuron and what is activation between neurons. Then they understand the node charts on the left. Then I had to explain in person again what is weight. I told them it's the number on the lines. Node on the left gets to the node on the right by multiplying the number on the line. Then they get it. When they looked at the weight chart, they didn't know the purple boxes are the weights, I had to again tell them, each box represents a number on the line. Then they get it.

To do: reduce technical terms to minimal, and use simple words. Instead of saying weights, just say a number used to multiply things. Instead of saying losses, just say a measure for how wrong the predictions from the model are. Then people understand. Need to add label to charts, need to make text more readable and gets people's attention.

Play page:

Again, both user didn't read, the looked at the digit pictures directly then ask me what to do. I explained what is MNIST dataset, and what is image recognition on hand written digits, and they can build a model on this page by specifying number of layers and number of nodes on each layer. One user didn't know "+" sign means to add a layer. One user added too many layers that it took forever to render and user just gave up and went to other pages. They also didn't know they can write into the box and click "recognize" button, I had to tell them about it. They were excited to see the recognition in action, but was puzzled when they wrote something and that didn't get recognized. I had to explain to them, try different layers and different nodes you can get different accuracy. Three layers with 20 nodes each give pretty good result at the end and they were happy about it.

To do: Make text more obvious, the embedded frame is hard to scroll around, it is better to display the whole frame without scrolling. There is a bug that we allow user to enter too many layers, need to restrict that. We are also only showing training loss, but one user thought it was testing loss. Need to add clear label for all charts.

Math page (TL;DR page):

User 1 saw that page and impatiently navigated away, since he does not have any math background. User 2 showed interest and read the page and said it was useful. He did noticed

that equation contains "x" "w" and "b", and asked what "b" is, I explained that that's bias and what bias is, it is just an extra node on each layer with a fixed number. And that we skipped bias to make things simpler.

To do: add disclaimer about skipping bias in the learn view.

Prioritized list
1. Add clear label for all charts
2. Use simple words, avoid math terms as much as possible, or at least add explanations
3. Use color and font to make text more readable and draw people's attention
4. Add disclaimer to say we skipped the part for bias and data normalization and others
5. Fix the bug that we allow user to enter too many layers

Note:
I first send the link to user via mobile app, and user said he cannot see the site. Our site does not work on mobile it looks like.

Appendix:

Survey Report

Site user experience survey for
http://machinelearningalgorithmsillustrated.azurewebsites.net/
December 4th 2016, 1:03 am MST

Q1 - Thanks for taking the time to answer this survey. It will take you about 15 minutes for this survey. Section 1, prerequisites(Answer before visiting site) What's your math level in terms of machine learning?Site url: http://machinelearningalgorithmsillustrated.azurewebsites.net/
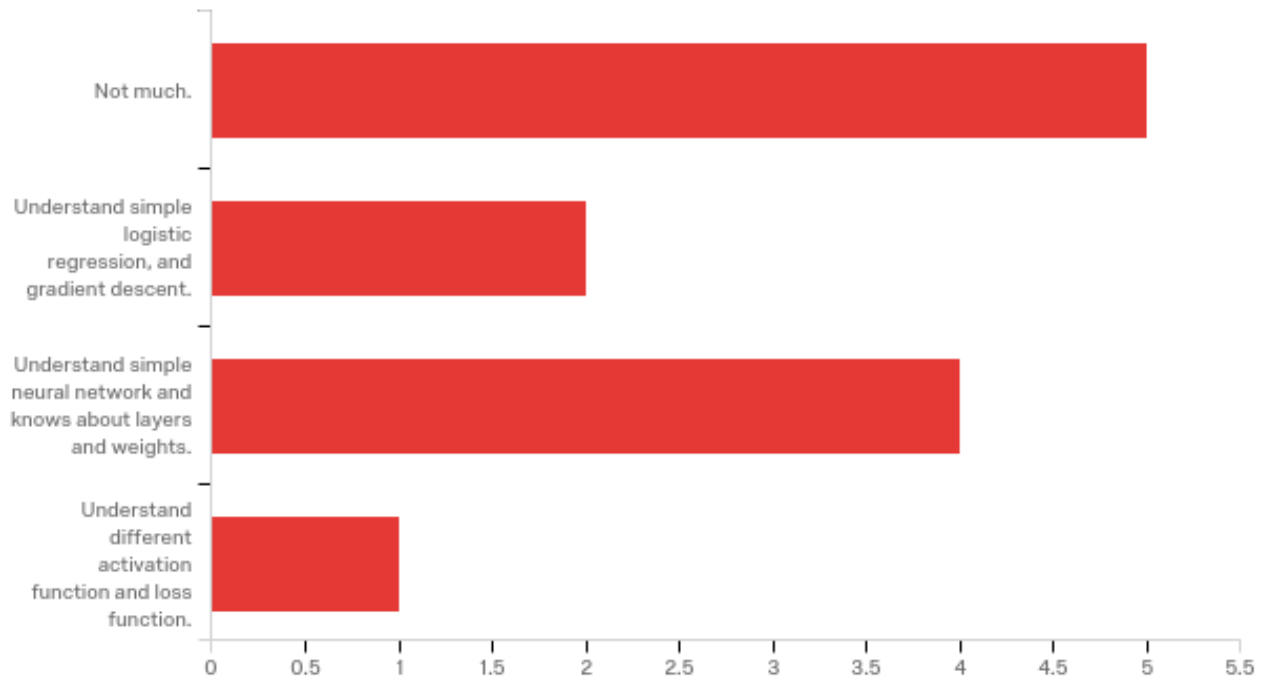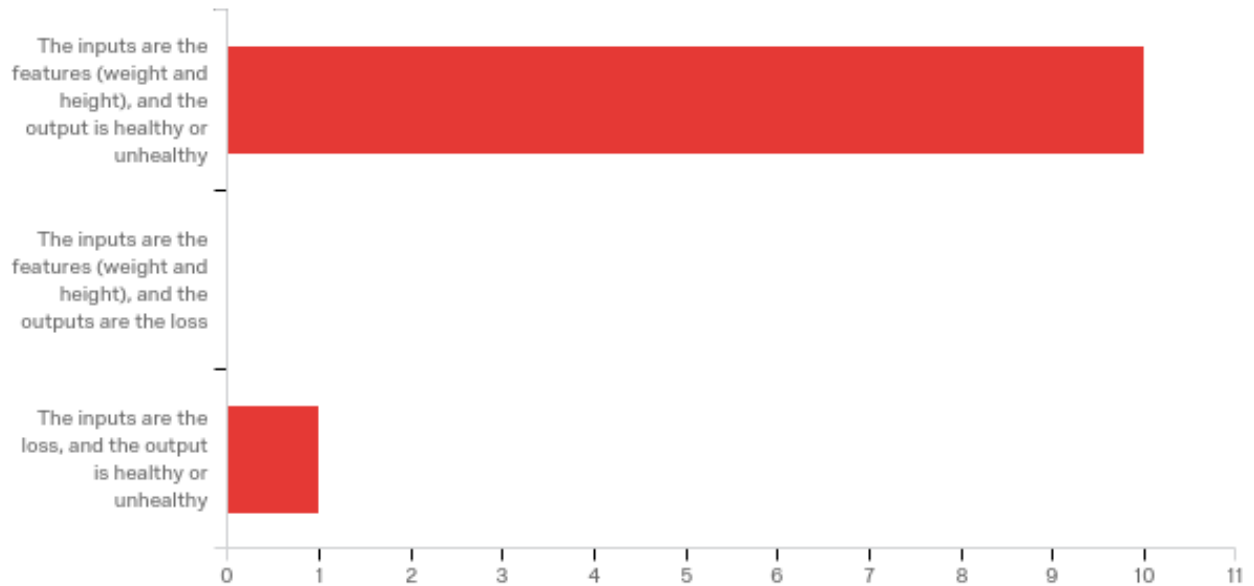
#	Answer	%	Count
1	Not much.	41.67%	5
2	Understand simple logistic regression, and gradient descent.	16.67%	2
3	Understand simple neural network and knows about layers and weights.	33.33%	4
4	Understand different activation function and loss function.	8.33%	1
	Total	100%	12

Q2 - Section 2, home page(Answer after viewing home page) Describe the goal of the project:
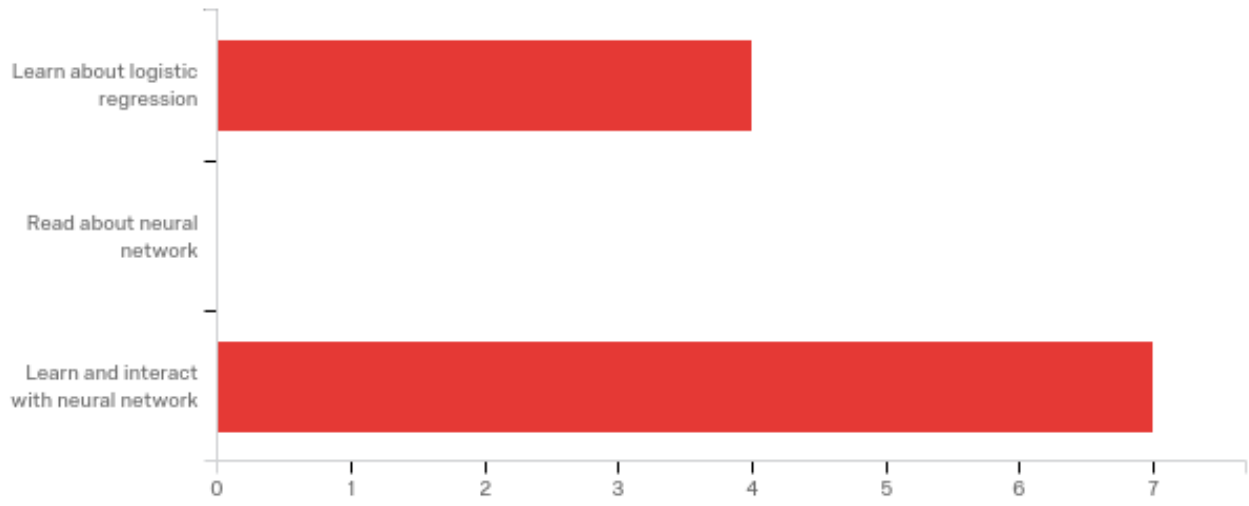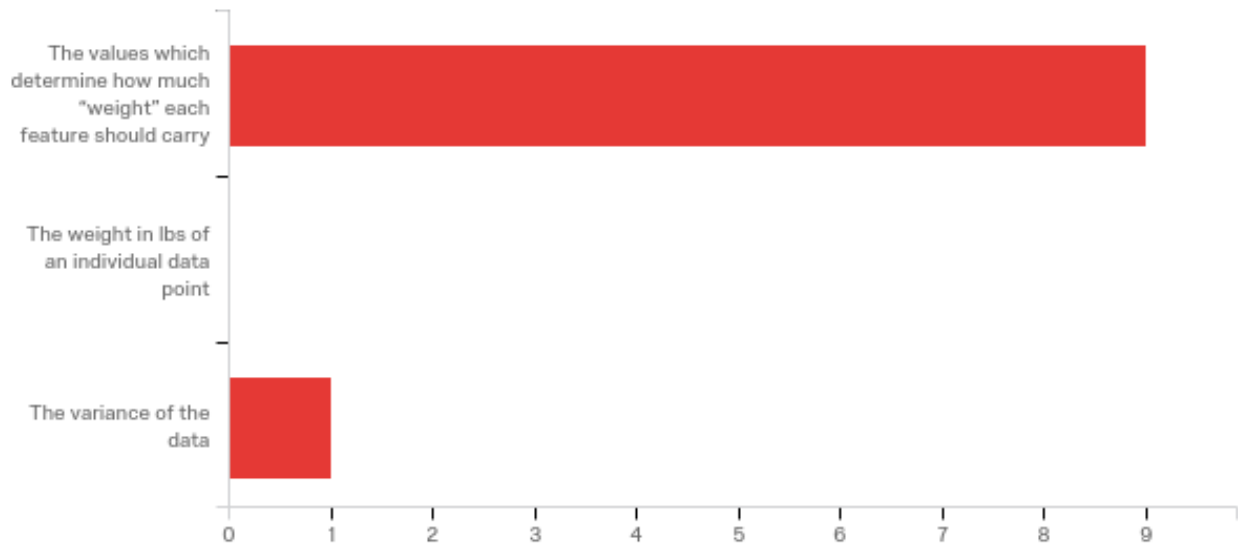

#	Answer	%	Count
1	Learn about logistic regression	36.36%	4
2	Read about neural network	0.00%	0
3	Learn and interact with neural network	63.64%	7
	Total	100%	11

Q4 - Section 3, learn page(Answer after viewing learn page) What are the inputs and output of the toy example?

#	Answer	%	Count
1	The inputs are the features (weight and height), and the output is healthy or unhealthy	90.91%	10
2	The inputs are the features (weight and height), and the outputs are the loss	0.00%	0
3	The inputs are the loss, and the output is healthy or unhealthy	9.09%	1
	Total	100%	11

Q5 - What are model parameters?

#	Answer	%	Count
1	The values which determine how much "weight" each feature should carry	90.00%	9
2	The weight in lbs of an individual data point	0.00%	0
3	The variance of the data	10.00%	1
	Total	100%	10

Q6 - What question will a trained model be able to answer in the toy example?
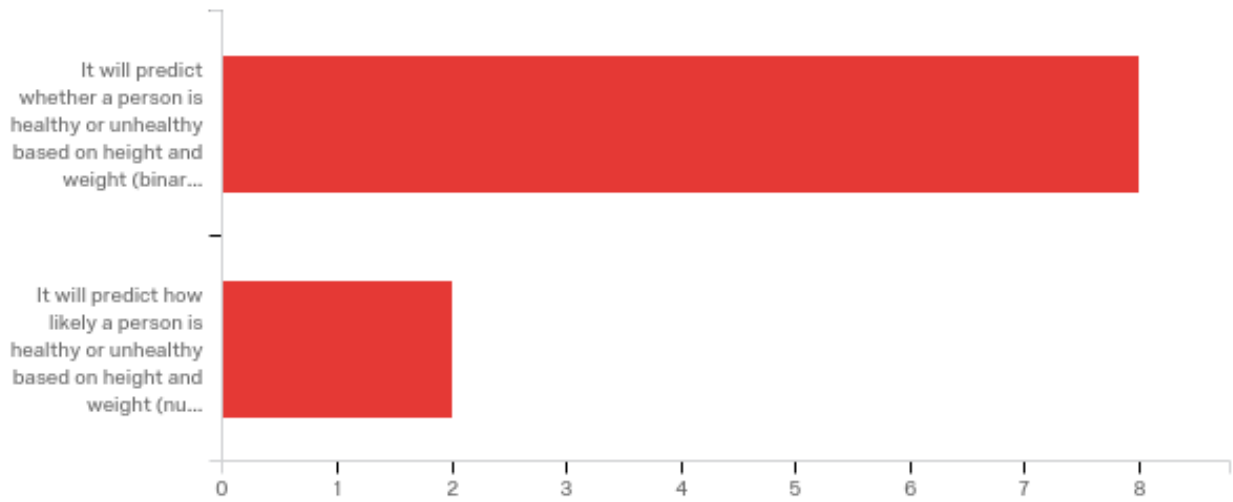
#	Answer	%	Count
1	It will predict whether a person is healthy or unhealthy based on height and weight (binary output)	80.00%	8
2	It will predict how likely a person is healthy or unhealthy based on height and weight (numeric output)	20.00%	2
	Total	100%	10

Q7 - How many phases are in the learning of a neural network?
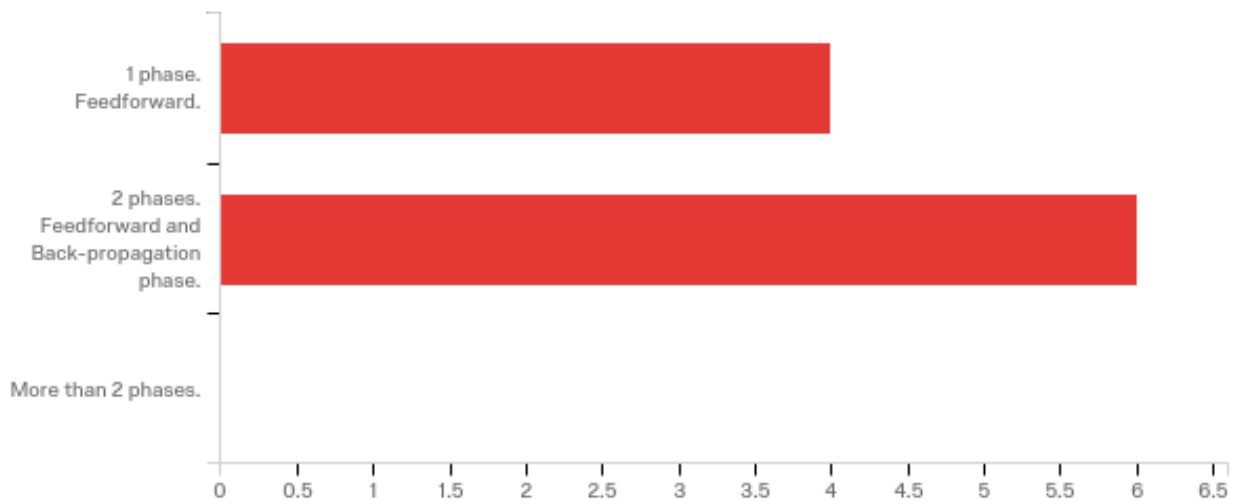
#	Answer	%	Count
4	1 phase. Feedforward.	40.00%	4
5	2 phases. Feedforward and Back-propagation phase.	60.00%	6
6	More than 2 phases.	0.00%	0
	Total	100%	10

Q8 - Why is simple logistic regression no longer suitable when "tall skinny guys" show up?
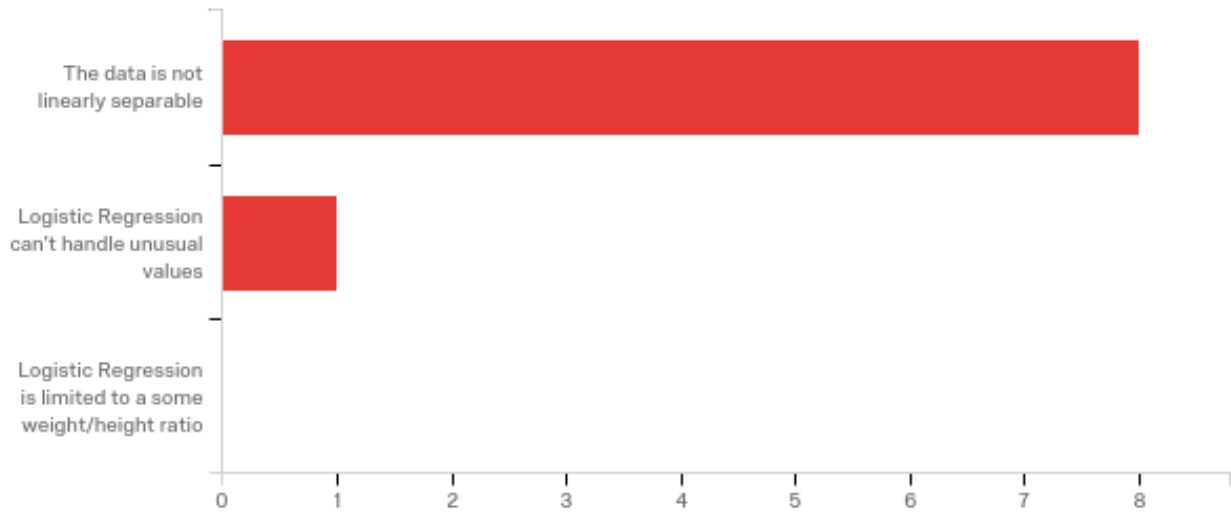
#	Answer	%	Count
1	The data is not linearly separable	88.89%	8
2	Logistic Regression can't handle unusual values	11.11%	1
3	Logistic Regression is limited to a some weight/height ratio	0.00%	0
	Total	100%	9

Q9 - What does the loss chart show?
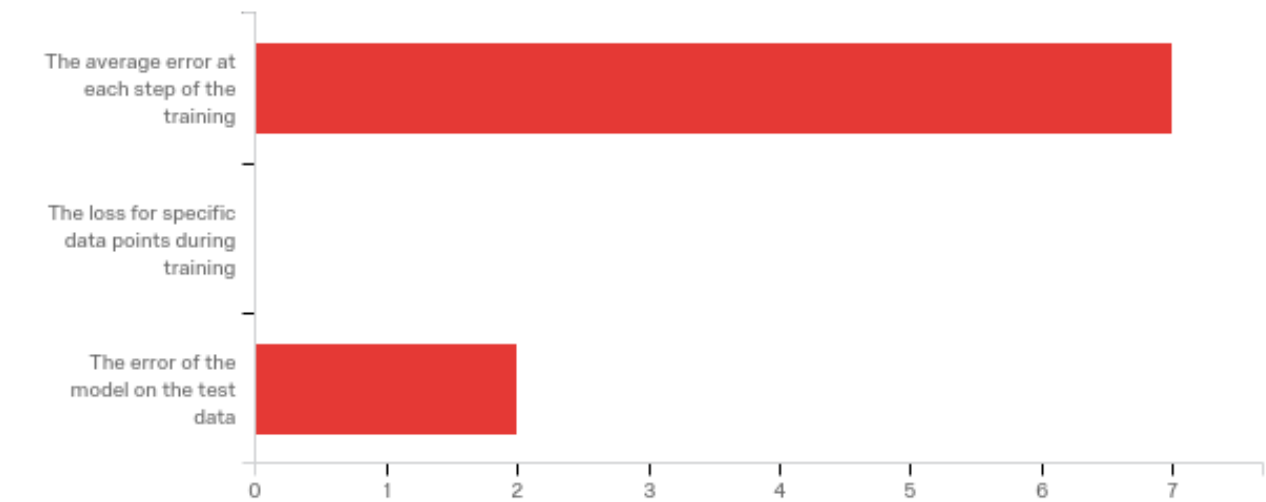
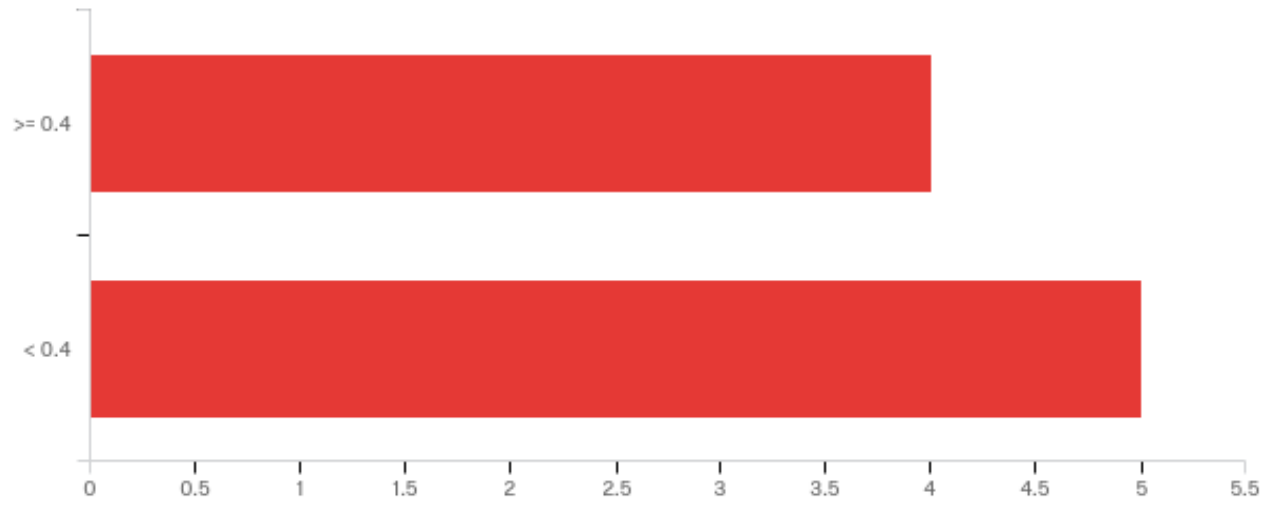| #	Answer	%	Count
1	The average error at each step of the training	77.78%	7
2	The loss for specific data points during training	0.00%	0
3	The error of the model on the test data	22.22%	2
	Total	100%	9

Q10 - What does the gradient descent chart show?
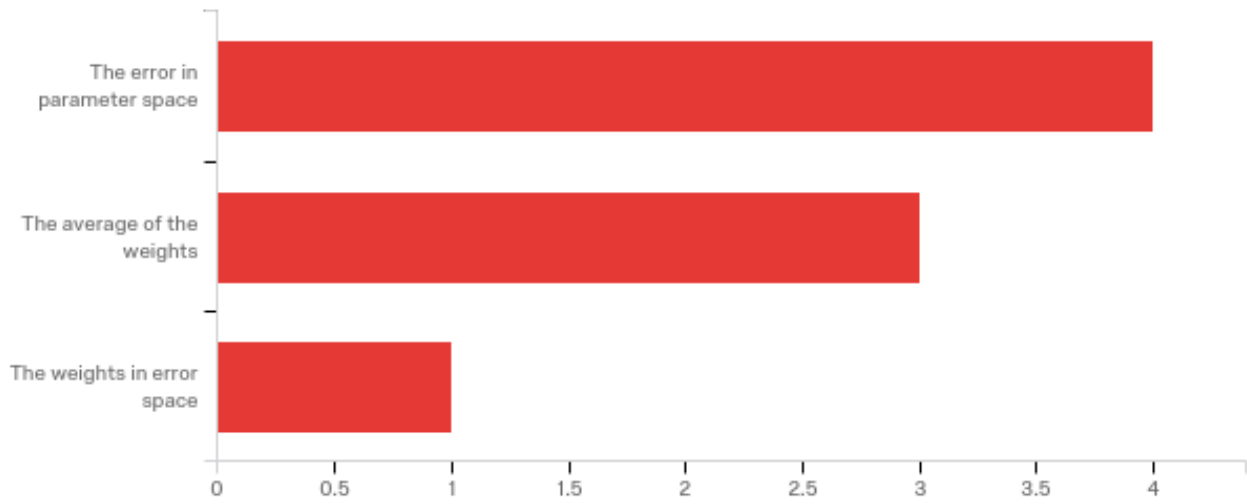
#	Answer	%	Count
1	The error in parameter space	50.00%	4
4	The average of the weights	37.50%	3
3	The weights in error space	12.50%	1
	Total	100%	8

## Q11 - Why is the hyperplane different between logistic regression and single layer neural network?
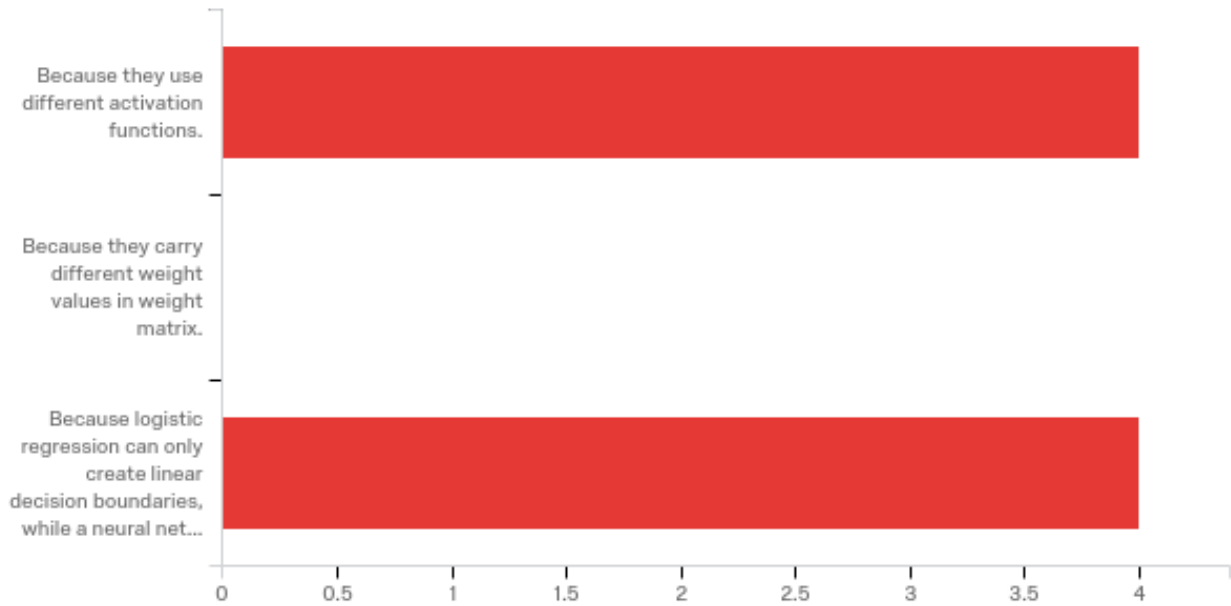
#	Answer	%	Count
1	Because they use different activation functions.	50.00%	4
2	Because they carry different weight values in weight matrix.	0.00%	0
3	Because logistic regression can only create linear decision boundaries, while a neural network with hidden layers is capable of creating non-linear decision boundaries	50.00%	4
	Total	100%	8

Q13 - Section 4, play page(Answer after viewing play page, and build a model with two layers with 10 nodes each) What is the training loss?
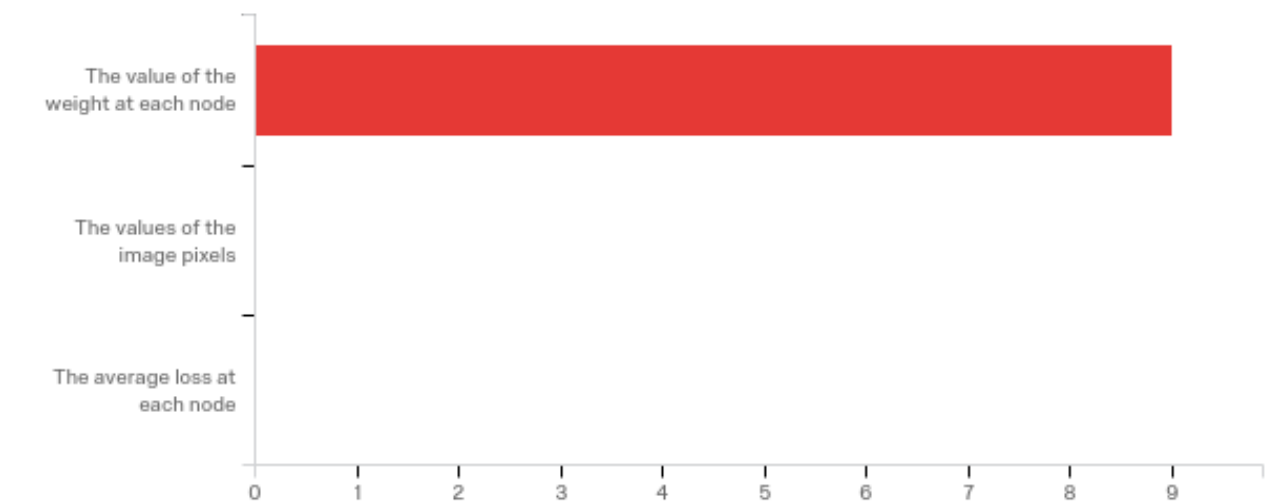

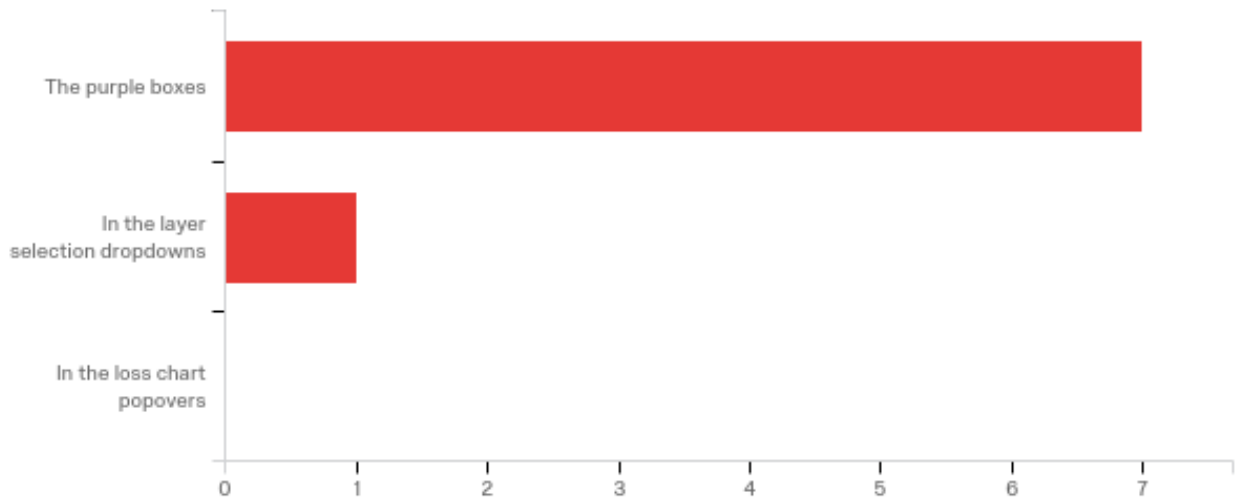| #	Answer	%	Count
1	>= 0.4	44.44%	4
2	< 0.4	55.56%	5
	Total	100%	9

Q14 - What is the test loss?
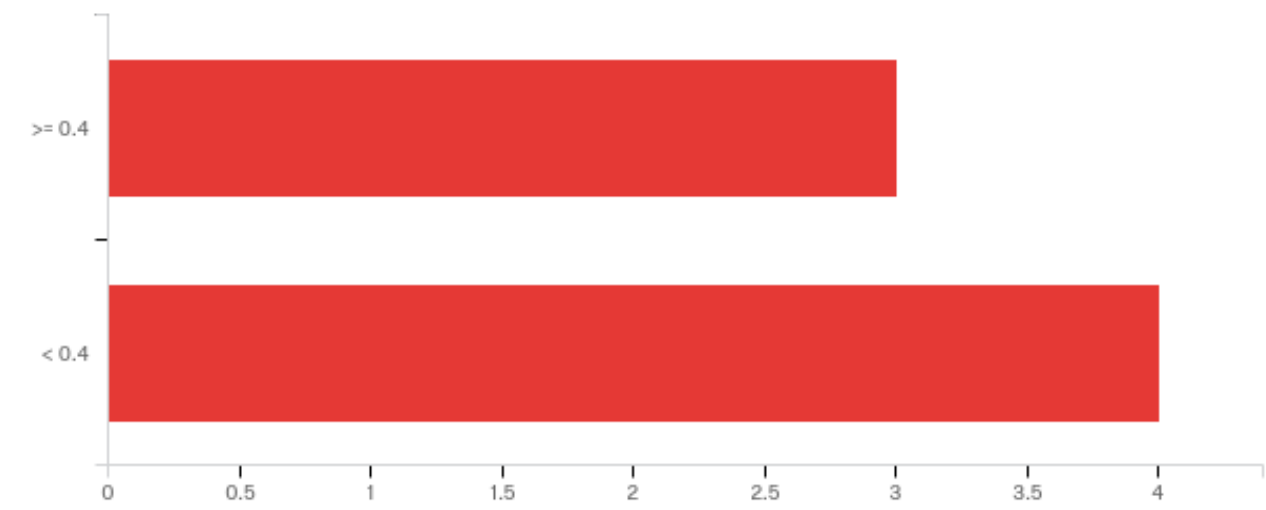
#	Answer	%	Count
1	>= 0.4	42.86%	3
2	< 0.4	57.14%	4
	Total	100%	7

## Q15 - What information to the tooltips on the matrices provide?

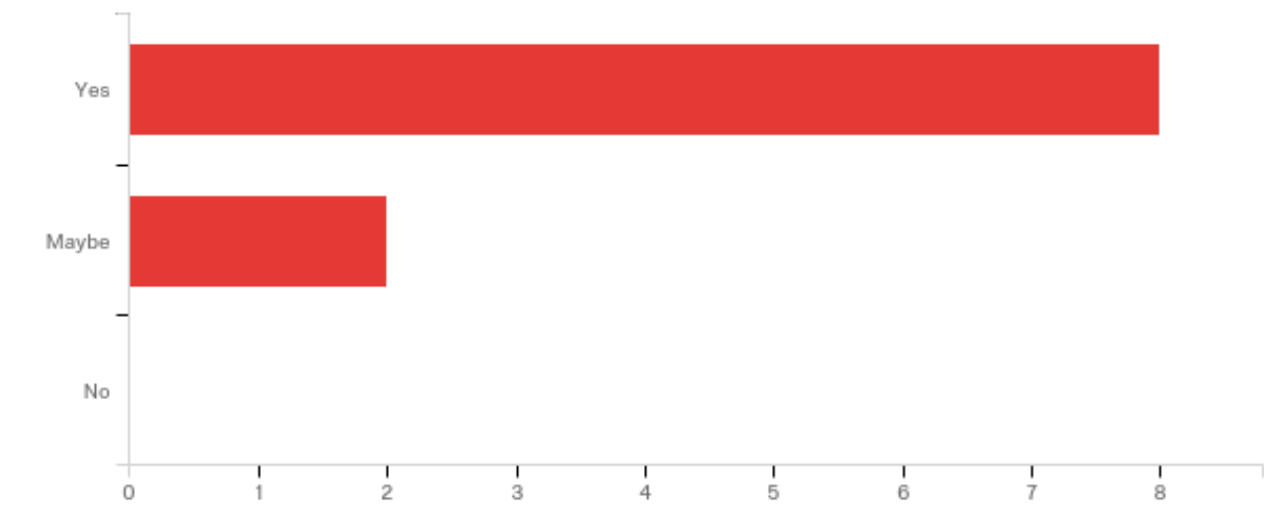| #	Answer	%	Count
1	The value of the weight at each node	100.00%	9
2	The values of the image pixels	0.00%	0
3	The average loss at each node	0.00%	0
	Total	100%	9

Q16 - Where on the page are the model parameters?

#	Answer	%	Count
1	The purple boxes	87.50%	7
2	In the layer selection dropdowns	12.50%	1
4	In the loss chart popovers	0.00%	0
	Total	100%	8

Q17 - Section 5, LR;DR page (too long didn't read lol)(Answer after viewing LR;DR page) Is this section helpful?
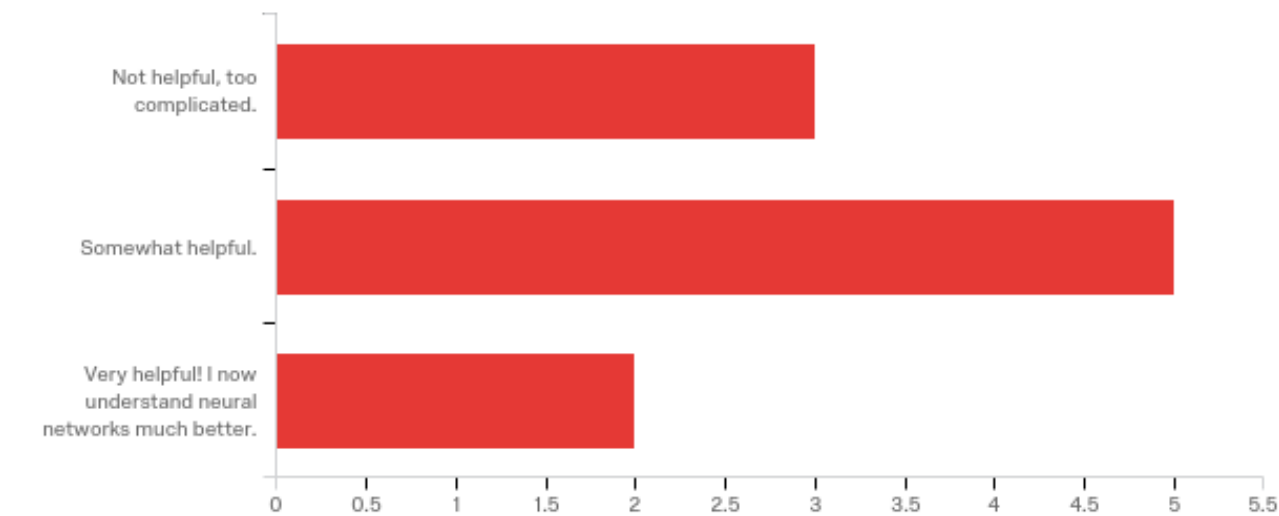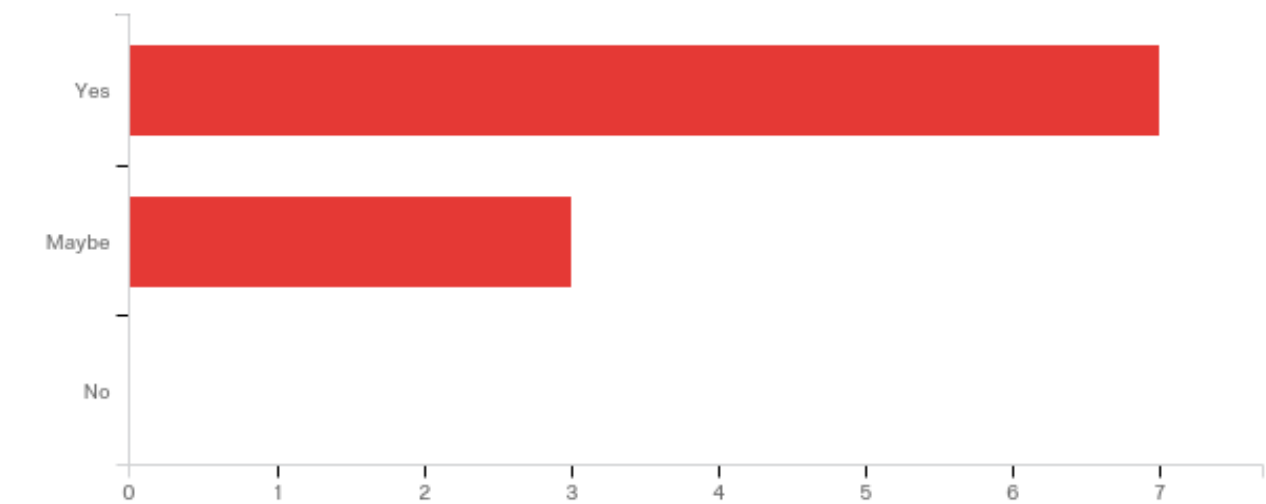

#	Answer	%	Count
1	Not helpful, too complicated.	30.00%	3
2	Somewhat helpful.	50.00%	5
3	Very helpful! I now understand neural networks much better.	20.00%	2
	Total	100%	10

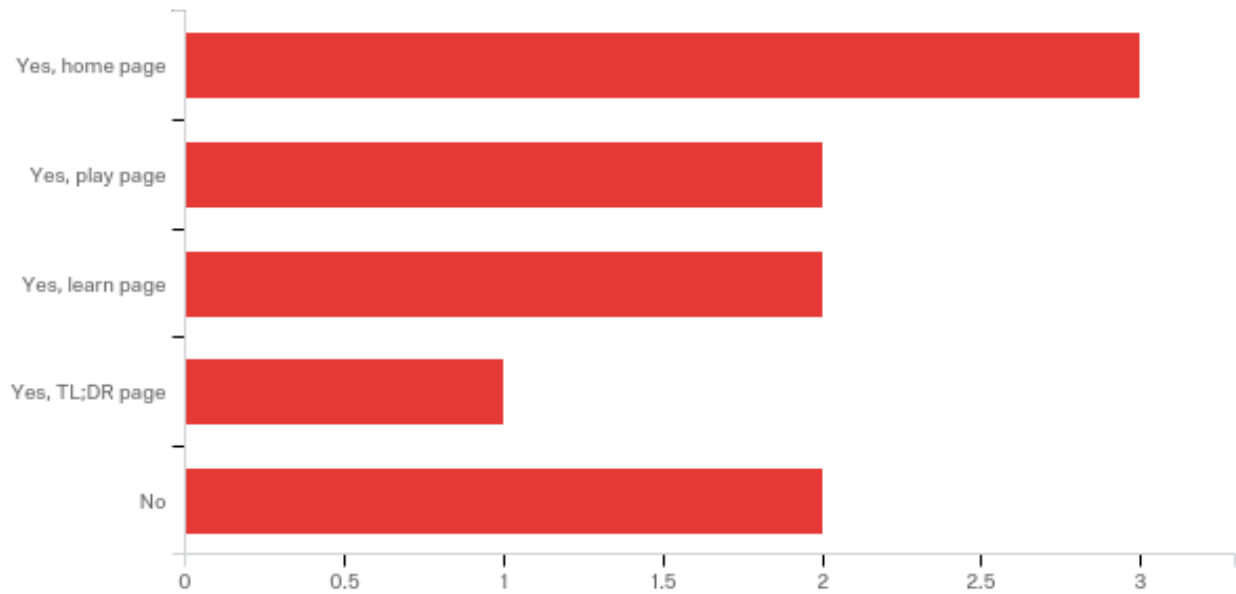**Q18 - Section 6, overall site experience(Last section) Did you learn anything new by using this project?**

#	Answer	%	Count
1	Yes	80.00%	8
2	Maybe	20.00%	2
3	No	0.00%	0
	Total	100%	10

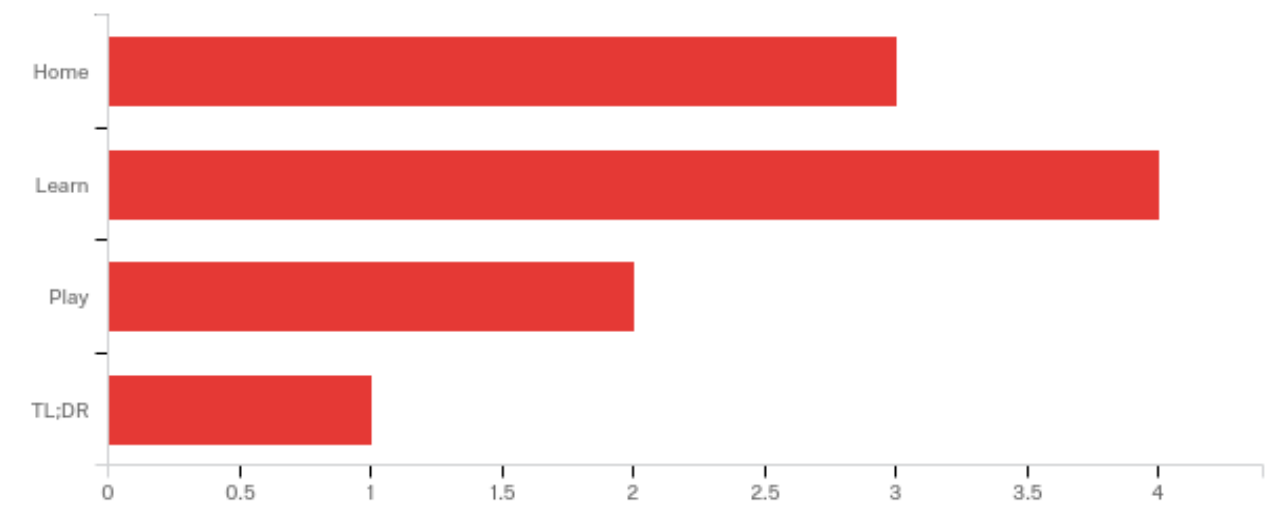## Q19 - Did this project help you get some insight into the mechanics of NNs?

#	Answer	%	Count
1	Yes	70.00%	7
2	Maybe	30.00%	3
3	No	0.00%	0
	Total	100%	10

Q20 - Was there anything particularly frustrating or unclear?

#	Answer	%	Count
1	Yes, home page	30.00%	3
2	Yes, play page	20.00%	2
4	Yes, learn page	20.00%	2
5	Yes, TL;DR page	10.00%	1
3	No	20.00%	2
	Total	100%	10

Q21 - What did you like best?

#	Answer	%	Count
1	Home	30.00%	3
2	Learn	40.00%	4
3	Play	20.00%	2
4	TL;DR	10.00%	1
	Total	100%	10