

MACHINE LEARNING PROJECT

DELIVERABLE 2

Question 1.

Supervenience

The notion of supervenience provide an ideal framework to discuss the key issues on consciousness.

In general, supervenience is a relation between two sets of properties: B-properties—the *high-level* properties—and A-properties, which are the more basic *low-level* properties. Intuitively, we believe that all facts about our universe are dependent on the most fundamental facts, which are invoked by a completed theory of physics. The notion of supervenience formalizes this intuitive idea and provides a unifying framework within which these dependence relations can be discussed.

The template for the definition of supervenience, given by David Chalmers, is the following:

B-properties supervene on A-properties if no two possible situations are indiscernible with respect to their A-facts while differing in their B-facts.

More precise notions can be obtained by filling in this template. Depending on whether we take the situations in question to be individuals or entire worlds, we obtain notions of *local* and *global* supervenience respectively. And depending on how we interpret the notion of possibility, we obtain notions of *logical* and *natural* supervenience.

Local and global supervenience

B-properties supervene *locally* on A-properties if the A-properties of an *individual* determine the B-facts about that individual—that is, if any two possible individuals that instantiate the same A-properties instantiate the same B-properties.

By contrast, B-properties supervene *globally* on A-properties if the A-facts about the entire *world* determine the B-facts in that world—that is, if there are no two possible worlds indiscernible with respect to their A-properties but discernible with respect to their B-properties.

Local supervenience of a property on the physical fails if an object's possession of that property depends not only on the object's physical constitution but also on its environment and its history. Local supervenience implies global supervenience, but not vice versa. However, the difference between global and local supervenience does not matter too much when it comes to conscious experience. A more important distinction for our purposes is that between *logical* supervenience and *natural* supervenience.

Natural vs. logical supervenience

B-properties supervene *logically* on A-properties if no two *logically possible* situations are identical with respect to their A-properties but distinct with respect to their B-properties.

B-properties supervene *naturally* on A-properties if any two *naturally possible* situations with indiscernible A-properties have indiscernible B-properties.

One can think of logical possibility loosely as possibility in the broadest sense, corresponding roughly to conceivability, quite unconstrained by the laws of our world. The constraints are mainly conceptual. While a naturally possible situation is one that could actually occur in nature, without violating any natural laws; this is a much stronger constraint than mere logical possibility.

Logical supervenience implies natural supervenience, but not vice versa.

Logical and natural supervenience have quite different ramifications for ontology. If B-properties are logically supervenient on A-properties, then once the A-facts are given, the B-facts come along for free. Once God creates a world with certain A-facts, the B-facts come along automatically. If B-properties merely supervene naturally on A-properties, then there *could* have been a world in which our A-facts held without the B-facts. God had to do more work in order to make sure of the B-facts: he had to make sure there was a law relating the A-facts and the B-facts.

Reductive explanation

The epistemology of reductive explanation meets the metaphysics of supervenience in a straightforward way. A natural phenomenon is reductively explainable in terms of some lower-level properties when it is globally logically supervenient on those properties. A phenomenon is reductively explainable *simpliciter* if the property of exemplifying that phenomenon is globally logically supervenient on physical properties.

Is consciousness logically supervenient on the physical?

Consciousness, although is difficult to have a restricted definition, we can say that a mental state is conscious if it has a *qualitative feel*—an associated quality of experience. These qualitative feels are also known as phenomenal qualities, or *qualia* for short.

Conscious experience is not all there is to the mind. There exist two quite distinct concepts of mind—the *phenomenal* concept of mind as conscious experience, and the *psychological* concept of mind as the causal or explanatory basis for behavior. Consciousness has both phenomenal and psychological senses. It seems reasonable to say that the psychological and the phenomenal exhaust the mental. This division of mental properties has the effect of dividing the mind–body problem into two parts: an easy part and a hard part.

The *psychological* mind–body problem, which is the easy part, has been dissolved. The paradigm of reductive explanation via functional analysis works beautifully in most areas of cognitive science, at least in principle. Psychological states are characterizable by their causal roles. To explain these states, we explain how the relevant causation is performed. Although enormous technical problems exist, there is a clearly-defined research program for their answer. The in-principle possibility of such explanation is a straightforward consequence of the functional nature of psychological concepts. Thus we can say that consciousness, *in psychological sense*, is logically supervenient on physical.

The hard part of the mind–body problem is the problem of explaining the phenomenal qualities. Unfortunately, the functional explanation does not seem to work in explaining phenomenal states. Whatever functional account of human cognition we give, there is always a *further question*: Why is this kind of functioning accompanied by consciousness? Because phenomenal states are not

defined by the causal roles that they play. Modern cognitive science has almost nothing to say about consciousness in this sense. There is an *explanatory gap* between physical accounts and consciousness itself.

Chalmers argued that consciousness is not logically supervenient on the physical *in phenomenal sense*. No explanation given wholly in physical terms can ever account for the emergence of conscious experience. The arguments in his book are given in three various strategies—conceivability, epistemology and analysis.

Argument from conceivability

In order to argue directly for the logical possibility of a situation in which the physical facts are the same but the facts about experience are different, we consider the conceivability of *phenomenal zombies* and *the Inverted Spectrum*. A *philosophical zombie* is indistinguishable from a normal human being but lacks conscious experience. Since a zombie is defined as physiologically indistinguishable from human beings, even its logical possibility would refuse the logically supervenient of consciousness on the physical, because it would establish the existence of conscious experience as a further fact. *The inverted spectrum* is the hypothetical concept of two people sharing their color vocabulary and discriminations, although the colors one sees—one's *qualia*—are systematically different from the colors the other person sees. Since we can imagine this happening without contradiction, it follows that we are imagining physically identical world in which conscious experiences are *different*. Therefore, consciousness does not logically supervene.

Argument from epistemology

From epistemic point of view, we are lacking a right sort of link between knowledge of physical facts and knowledge of consciousness. Even if every last detail about the physics of the universe is known, that information would not lead us to postulate the existence of conscious experience. Our knowledge that conscious experience exists derives solely from our own experience of it. There is an *epistemic asymmetry* in our knowledge of consciousness that is not present in our knowledge of other phenomena. This *epistemic asymmetry* in knowledge of consciousness makes it clear that consciousness cannot logically supervene.

Argument from analysis

At last, we appeal directly to the concept of consciousness, arguing that there is no analysis of the concept that could ground an entailment from the physical to the phenomenal. Any attempt to demonstrate an entailment of consciousness by physical facts is doomed to failure. The only analysis of consciousness that seems even remotely tenable for these purposes is a functional analysis. But functional analysis misses what it means to be a conscious experience. Conscious states are not *defined* by their causal roles. And phenomenal feel is not something that can be functionally defined away. The alternative might be a structural analysis, which look even worse. Whether or not consciousness *is* a biochemical structure, that is not what “consciousness” *means*. Consciousness is simply not to be characterized as a functional property or as a structural property.

Physical explanation is well suited to the explanation of *structure* and of *function*. But the explanation of consciousness is not just a matter of explaining structure or function. The failure of consciousness to logically supervene on the physical tells us that no reductive explanation of consciousness can succeed. There is an *explanatory gap* between the physical level and conscious experience.

Does AI have qualia?

Since consciousness is not logically supervenient on the physical, there is not much we can say about the consciousness of AI. Due to the *epistemic asymmetry* in knowledge of consciousness, even when we know everything physical about the computers, we do not know what their conscious experiences are like, if they have any. It is consistent with the physical facts about AI that it has conscious experience, and it is consistent with the physical facts that it does not—both statements are logically conceivable. We can't say more before a positive theory of consciousness is concretely established.

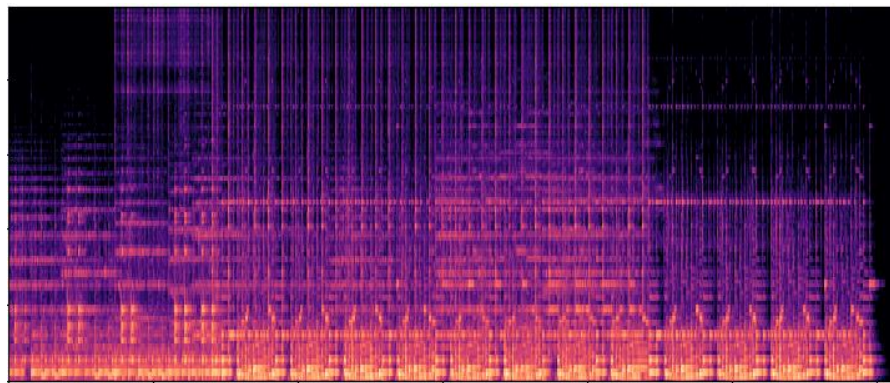
Question 2. Discussion of techniques underpinning your classifiers.

1.

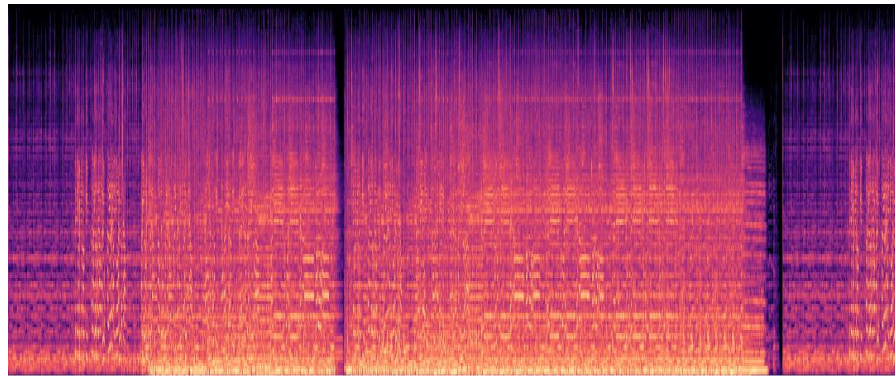
First of all, minimum duration song, *min_duration* was found. Then, all songs were divided into chunks of minimum of 30 seconds or *min_duration*. Librosa is used to analyze music extract frequencies. It is a Python module to analyze audio signals in general but geared more towards music. It includes the nuts and bolts to build a MIR (Music information retrieval) system.

After building features, two approaches were considered to build genre classifier

- I) Extract a Mel spectrogram of song chunk and then design a convolution neural net to run on input spectrograms. Spectrograms of a prog and non prog song are shown in Fig. 1. The accuracy with spectrograms was 70-73%.
- II) Extract 21 Mfcc features, zero crossing rate, chroma frequencies, spectral bandwidth, spectral centroid, roll off for each chunk. Then, all the features were appended into csv file using pandas. Create a model that uses LSTM with 2 layers and runs on input features. The accuracy with LSTM was 80-85%. An image of features is shown in Fig. 2.



a) Mel spectrogram of a non prog song chunk of duration 30 seconds



b) Mel spectrogram of a prog song chunk of duration 30 seconds

80%

View

Zoom

Insert

Table

Chart

Text

Shape

Media

Comment

Collaborate

+

Sheet 1

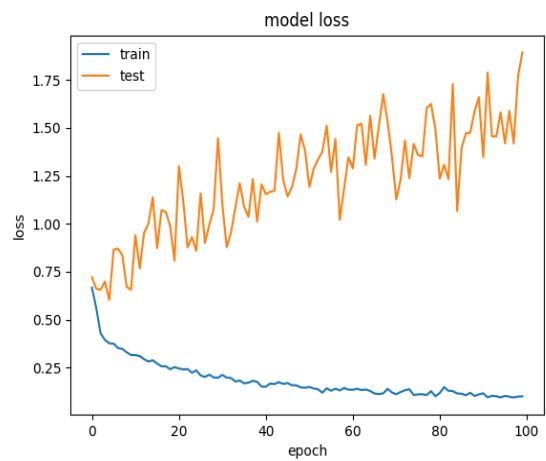
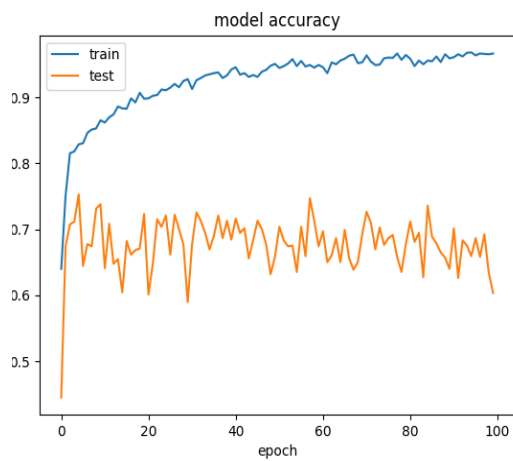
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	test
1	name	genre	chroma	srts	rms	spectral_centroid	spectral_bandwidth	rolloff	zero_crossing_rate	mfc1	mfc2	mfc3	mfc4	mfc5	mfc6	mfc7	mfc8	mfc9	mfc10	mfc11	mfc12	mfc13	mfc14	mfc15	mfc16	mfc17
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25	reg01_Protogee_Autumn.Rackk1	rng	0.2657861573075	0.08387866959857	268.1443478769293	3625.19848																				

Fig. 2. Features extracted for each song

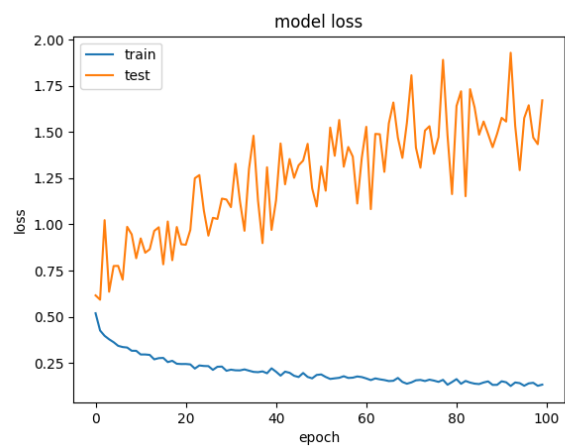
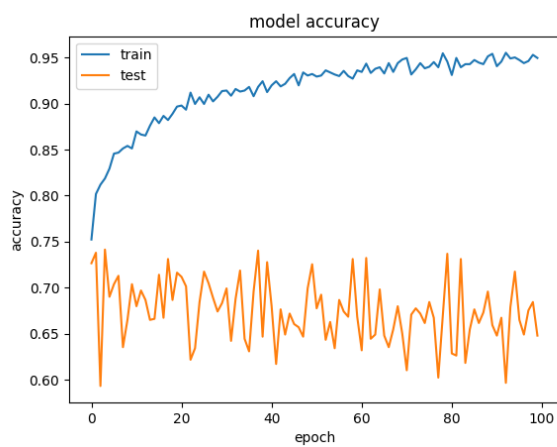
2. Discussion and explanation of the performance of the classifiers on the training set.

Performance on training set

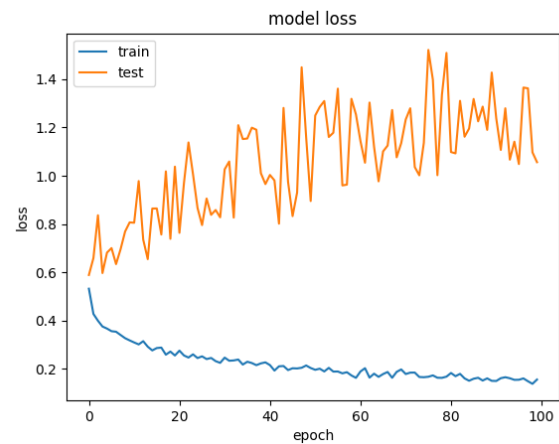
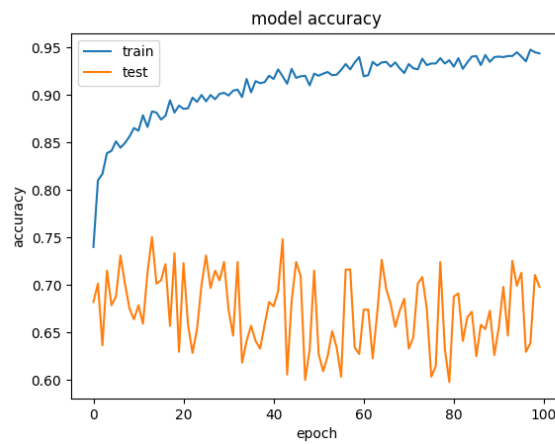
K-Fold validation is used to train model. Here K= 3. The training and validation accuracy and loss in each fold is shown below:



Accuracy and loss with epochs in the 1st fold



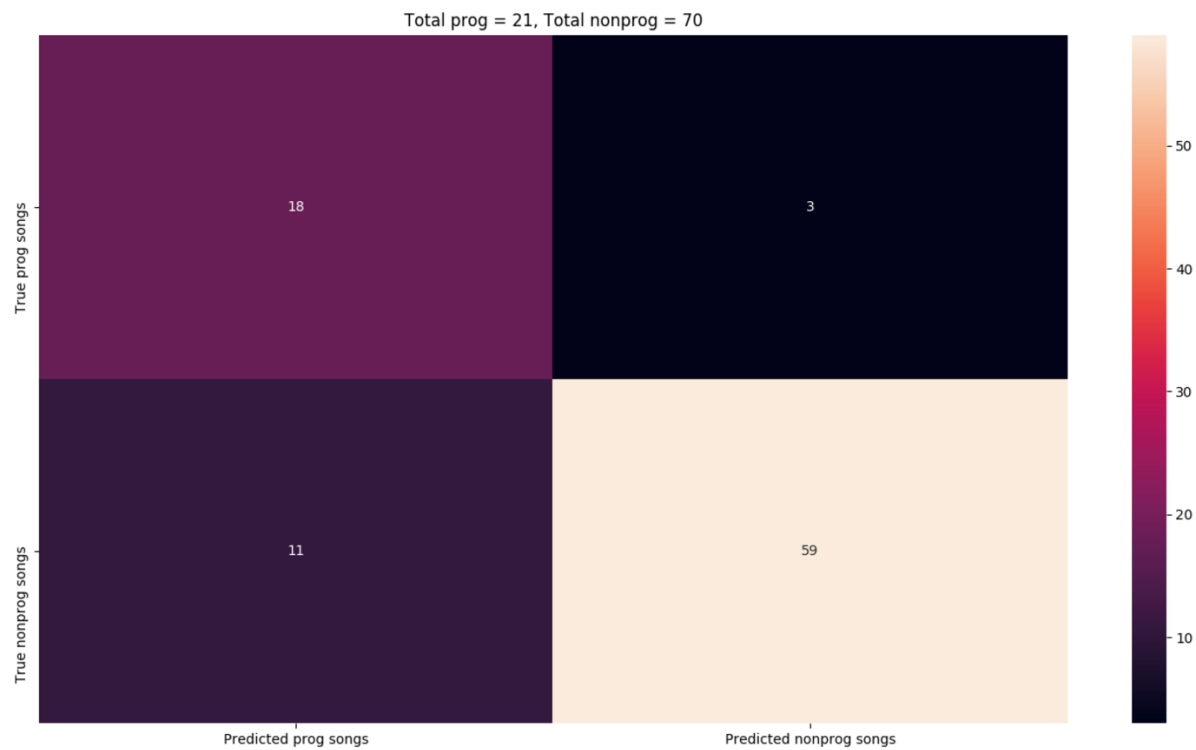
Accuracy and loss with epochs in the 2nd fold



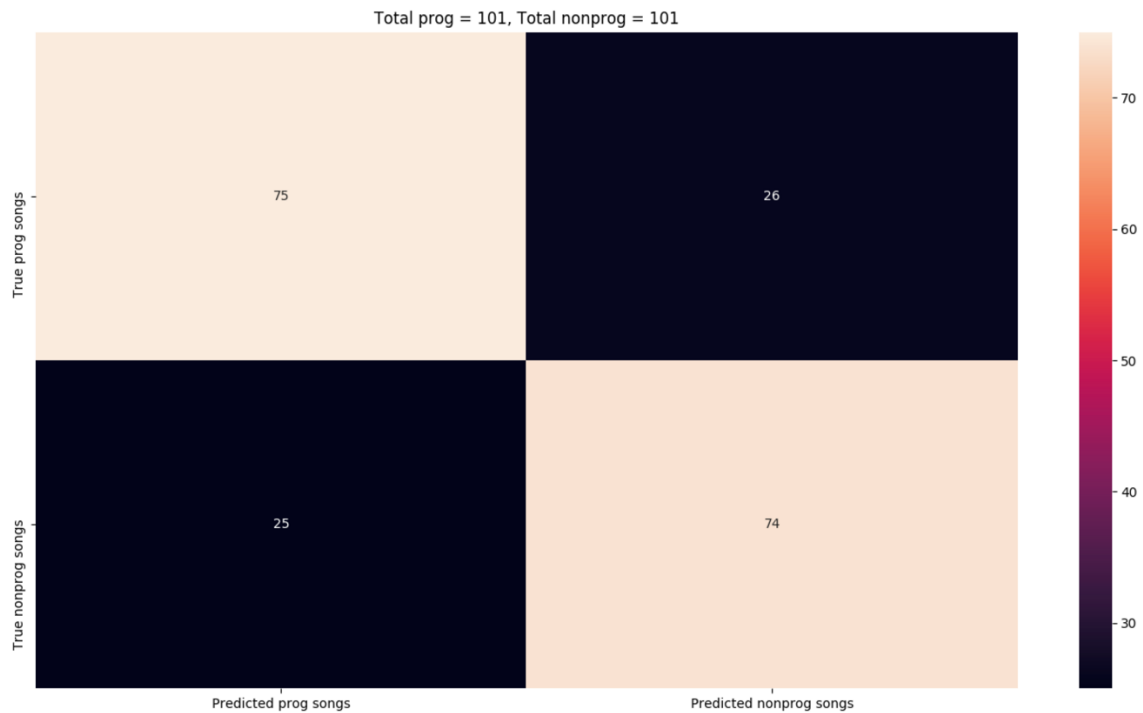
Accuracy and loss with epochs in the 3rd fold

Performance on Validation set

Accuracy on validation set: 84.61 %



Confusion matrix of test results are shown below:



```
122 for i in range(row) :
123     new_predicted_ind.append(np.argmax(predictions[i]))
124     new_true_ind.append(np.argmax(y_test[i]))
125
126 def calc_majority(indices,predicted,true) :
127     name = indices[0]
128     start = indices[1]
129     end = indices[2]
130     new_predicted = predicted[start:end+1]
131     new_true = true[start:end+1]
132     maj_pred = 0
133     maj_true = 0
134     for i in range(len(new_predicted)) :
135         if new_predicted[i] == 0 :
136             maj_pred += 1
137     if maj_pred <= len(new_predicted)//2 :
138         ret_pred_val = 1
139     else:
140         ret_pred_val=0
141
142     if name.find("nonprog") != -1 :
143         ret_true_val = 1
144     else :
145         ret_true_val = 0
146     return [ret_pred_val,ret_true_val]
147
148
149
150 majority_pred = []
151 majority_true = []
152
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
3: bash
true 1 predicted 1
true 1 predicted 1
true 1 predicted 0
true 1 predicted 0
true 1 predicted 1
true 1 predicted 1
true 1 predicted 1
true 1 predicted 0
true 1 predicted 0
true 1 predicted 0
true 1 predicted 1
true 1 predicted 1
true 1 predicted 1
true 1 predicted 0
true 1 predicted 1
true 1 predicted 1
true 1 predicted 1
true 1 predicted 0
true 1 predicted 1
true 1 predicted 1
true 1 predicted 1
Accuracy 149 / 202 73.7623762376 %
(myenv) Richas-MacBook-Pro:~ richadutt$
```

Case 2: As professor asked that whether djent songs is related to prog or non prog songs, we predicted djent input features using trained model. Below is the confusion matrix for predicted results:

