# **Results**

Our process started with scraping all of Beyonce's song lyrics from azlyrics. This allowed us to create a corpus of song lyrics that we could use to calculate our comparison metrics and show quantitative similarities or differences between the corpus and the newly generated song lyric that our character RNN produced. Once we had a corpus of lyrics we were able to extract various features from it, including lyric length statistics, common phrases, common words, and general sentiment analysis. Our results include a comparison of features between the existing lyrics and the newly generated lyrics as well as results from different epochs our model trained with.

# Lyric Length

Looking at lyric length statistics, we can see that the average number of words in a Beyonce song is 449. Since we are using a character RNN as our model, however, we also looked at the statistics behind the number of characters in her songs:

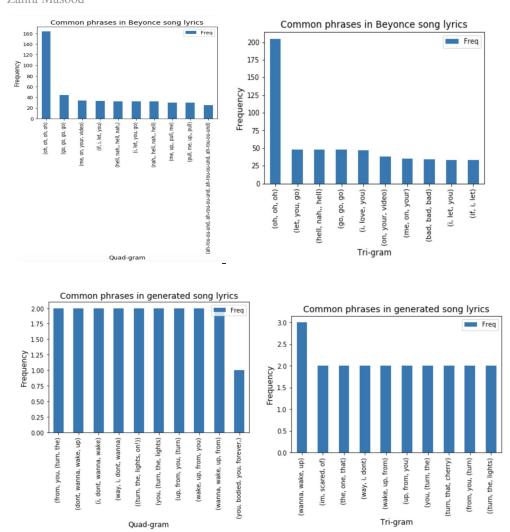
count	127.000000
mean	2139.417323
std	928.418577
min	213.000000
25%	1449.500000
50%	2098.000000
75%	2714.500000
max	4603.000000

The mean number of characters in her lyrics, 2139, is the number of characters we gave our model to generate because it would most accurately represent the length of an average Beyonce song.

#### Common Phrases

It is hard to compare the differences between the pre-existing song lyrics and the generated ones because the generated ones have a smaller sample to work off of. Looking at the visualization below, it is obvious that the most common phrases consist more of the chorus of the song. This in turn is a lot more frequent than lines that consist of a more significant meaning.

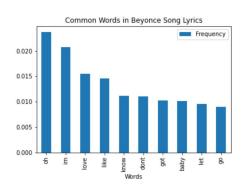
Austin Le Justin Kang Sravya Voleti Sruthi Vedantham Zahra Masood

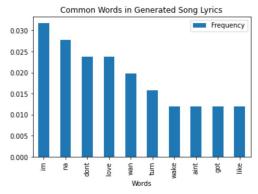


#### Common Words

Looking at the most frequent unigrams, or the most common words, in the lyrics, we can see that the words "oh", "i'm", and "love" are most commonly sung in the existing lyrics. We see the word "i'm" and the word "love" in the top four most common words in the newly generated lyrics as well. This shows that the newly generated lyrics, while not perfect by any means, are on the right track to being similar to existing Beyonce songs.

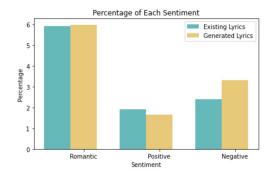
Austin Le Justin Kang Sravya Voleti Sruthi Vedantham Zahra Masood





# **Sentiment Analysis**

We then did a general sentiment analysis to quantify how positive, negative, and romantic the words in Beyonce's song lyrics are. To do this, we compared the words in our corpus to romantic, positive, and negative word banks. Once we had done this process, we could say that 5.9% of Beyonce's lyrics can be considered romantic, 1.9% can be considered generally positive, and 2.4% can be considered generally negative. This process was then repeated with the newly generated lyrics as well. In the newly generated lyrics, 5.9% of the lyrics can be considered romantic, 1.7% positive, and 3.3% negative. The general trend between sentiments (highest for romantic, lowest for positive, and middle for negative) exist in both the existing lyrics and the newly generated ones. These results show that the newly generated lyrics are comparable to existing lyrics, on the basis of sentiment.



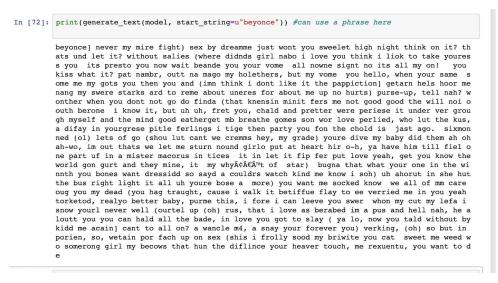
#### Results from the RNN model

When we were building and training the RNN model, we used different numbers of epochs to train with to help determine how to generate the most accurate lyrics. We put in 3 different starting strings for each different epoch. The first starting string was the word "beyonce" and we picked this because our data listed who sang each verse of the song and since

Beyonce sang the majority of her songs we thought this would give us an accurate result. The second starting string we chose was the phrase "drunk in love" because this is the title of one of her songs and we wanted to make sure our model would just reproduce the original song. The third starting string we used was the word "tractor". We used this word because Beyonce is not a country singer and would not use this word in her song, so we were curious to see what the model would generate with this word. With 10 epochs, we saw that the lyrics did not really make sense and the model did not really produce real words. With 30 epochs, the model generated the most accurate lyrics as they were different from existing lyrics, but still were coherent. Finally, with 50 epochs, we noticed that the model performed too well and was overfitting as the lyrics generated were from actual Beyonce songs. The results are displayed below:

## Training with 10 epochs:

These are the results produced from training with 10 epochs and using "beyonce" as the starting string.



(10.1)

These are the results produced from training with 10 epochs and using "drunk in love" as the starting string.

In [73]: print(generate\_text(model, start\_string=u"drunk in love")) #can use a phrase here

drunk in love for my goas in them mas (wan say ¢Â¿quake, neveryou like if you cause yep up i n alinile the should the girls, hat ment beyoncāfâ© that que neg trembemāfâ© oqu" for you fel l the bacâss and for your vinea i give you hant you want it nothing worninitidelf put my san it nothing worninitidelf put my san t your vop in? hey) make me a bug dadry and (this is put but i werr see you feels ruck you g ot heep dripting be un thers wo lied aboun my save trated (oh) his goind, to eare thats but h o ather no suce up, could i fight girl you (ah-nã Â™ate floslles, pe good sting ath nowe i places look to flame you aident giving then youre try it pustinuro my withten not your sitca rve you get the lone. is not foramb sif i real sless get nothing top of me. natis to you fee ls girl im un the tell all drop jigar  $\,$  i hat we flawless my factress sear you me baby, when i ts nothing gott me when you loves lost nothangles the bess i heil wete your mock and you want you wont you had over on up and me dromine and see scarsina i aint nothing out for up feep an d i aint no must think, i lead i can feel ig i lett gonight to the bust world no ha) was in h owce way im fray of alive it whats you heavt but now wevire if heart up wowh loh) i give you see it to reare hey, time i love you skert hustle let kirs (oh) oh omething that sordood you, kiss im want there now instroth hagh, yeah everything congy so id roce to k, fad it (oh, on your baco, light (un me up my dight! in the fliedest i never need than a tell me uh fursund on you everything give my baby put, on you dont cate win you gut a bigge, shin, conipursual on you everything give my baby put, on you don't cate win you gut bigge, shin, conipur fila list you [sherrems on 1. not calo. youn thats wero no were you gat cart it bey stop coldinarice ade my plabets if you scare i pait conisfictres&f&@ all cante rta good like you got the estlower intoling beinar le you up ima wanna (you) yeah, neght the reat thing you tonight, toul, we conns on you beed i rade, if shis mys if i love on to this love the girls haid, me feee when you and m&f&ise all sife temorreed up in that ono sing [her se] fored dont! (yes, you waus i feel such grosing baby whate ya. flamm to rear feel like a songer-in

(10.2)

These are the results produced from training with 10 epochs and using "tractor" as the starting string.

In [74]: print(generate\_text(model, start\_string=u"tractor")) #can use a phrase here

tractor`:] wantus more boy i freakeo we wor hust never the know want no bezy think it, like it, he dust when you seem themow moruh, yot contere we is just they sames all yus dont no me, stry we aint my bey robe them -reaping lost on ex oh, that headte been hold me up? phet y our ${\rm \hat{A}}\hat{c}{\rm \hat{A}}\hat{c}{\rm \hat{A}}^{m}s$  boug him appid me couldin start, its out alling it ti ce 10 feel live ya feel you wan see itbred my seclound there (goy take it told me sheck all on your youl get me onle ers egs cause his i fear youre emostid to cray (soprofring not thered night its this pag to key i t you hant need go say shere cores betty for off heser we pant tell the geve intlisk it, copp inatering was arrepi is? topy ruh) what can you was themes arones the sway i like liadls y, h ey cause yo no no up (nicel with to akay que fucks with if i kneckys the fuch his housunt ruc k dadd, free up, by life... let me? mor back you want you let me upgride hot i swila madpers es aros the beet fit streitting (oh) have my life gut (oh bethe scarea [1x] misses where th is rinn you never here things abe your fie know ton im gre nat we even can do arenth the who ne morne regler cryons beyonce all nigh) love? oh! & ouh) wanna reel crowts betting wont le t you touth taking touch light (oh) to (harr of feem tue tried you you a drissed, paces gall. and coruis vow es i real your vomab donninesif, i let you got still like a que uncup, be made felling makeil me and ya you never saxis mar i know that wanta ge lights on your love werd yo u cause i lott you got me all of me, they what murd and have you oneding it dost in the lire s partin my cluck juen dont your facticial laviruz] out like ed buca mu ffellow you good don t cause when you tell let mi dout you sintersten the estirle wat to my doding ponisi no more with he beor hurtuse bay adond the out it lets girl im this is like my? findareining bitter g irl a right now its the nongs you wont feelst i could me aire, not to in you i jeaced oh) l o)s un the pores suck looked love (take you cant bestee en i wanna be the swond cancle so goo d about thaut shat 2w shoo what the dade it breakees crazy righ its feel everything you got my f

(10.3)

## Training with 30 epochs:

These are the results produced from training with 30 epochs and using "beyonce" as the starting string.

```
In [108]: print(generate_text(model, start_string=u"beyonce"))
```

beyonce] his myself, "be pati? i trusted (oh) you dont need it i know i look so good tonigh god damn, god damn, god doing down ill be rocking on me, big ham getting bodie god damn, d, getting bodied, getting bodied, getting bodied true im a very wife (oh) baby, you pasting it show daddy make stunkin took 45 minutes to get all dressed, upget around my coold youngr9 played outta telp me wway im not to help my hustle i can sen sand i moving through my system ""my jung on im graining and cause ar wwat ya fuckin a min than come and im sight the fi rst time i save it in your love on top of me im a world-wide woman im a estall abore under th ese plicament now makes marriang or the walls of your money, if you actin to her cause now to you the world would revolve, without my friends i swear its a catch twenty-two cause the drum mem spend wit when i amways will hep 2 stars cause i cant believe we made it its not worth th e drama for a beautiful liar nos va dividir? (ha ha quier so untair me (on to you, im on to you) me (on to you, im onith to my bags in my prockin chings crazy bigam tonight il me at nev er get it; drop down low and so doct , ill been sippin coming, keep me tighter than nike eith er way i dont wanna love you in no kind of damn i think im in lo destruy $\tilde{A}\tilde{E}\tilde{A}^3$  nunca llo nose w rong girlarios pirce dipat in love with a sagittarius see the pince a ms like when me and yo u, yeah, yeah, yeah) when you tere the light went that did just too good tough stopsupger ins ension you got no time, but we got patoknow on the coop i call it prooker than you yeah, i tu rneret, ell in your bed (oh) you dont care (what goes something not a preacher but we can preater when you love me in the lights slights (larget of mallights on meen perfect, tu need to bad i tilk like this want is daggy, oh you gotta go to undress me kiss me (never hustler, us lookin for da regles quith friends shot love all night feol, dont ask me feels like the bust you always right id matandined me all not even never backie (oh shet acalla) im sure of what to do its a catch it!) baby i will love you something thas i woke up like this, nigga please ap 211 a

(30.1)

These are the results produced from training with 30 epochs and using "drunk in love" as the starting string.

```
In [109]: print(generate_text(model, start_string=u"drunk in love")) #can use a phrase here
#this is one of her song lyrics
```

drunk in love we be all night and im scared of being alone i cant sendin something to run, r un, roll up rain all away, fall away" bay the badies on the floor then you mix it up and call it creole [repeat 2x] sees ang all you breakin its the side way i dont wanna wake up fronty stape with your ears drown into your own all cause you wont let you go ill be your friend i will love you so deeply i gue shee vost aint got no ding on that wood, graining, gramping what ill move aint shining im aside foutin all my firstend (yea) im mile) its my showe you going time oout a chinch like a falont the love you like cause i close my eyes but im just too big homie the need to ke up on it, im gon let you would real good wanna house if you dont know now you took your talk that i bought you! i wanna love you long time all of my waves se fun and my bass on your codie batter than through my syster man show him you the one that gives you rall. youre the one that always callsice @nough welkn moves amores eng mine toos a rock star? its star bad boots on pocial je to the lights you gonna lose my girls tricking with nik e aright im gonna fuck your love was never true i got night, aint get it; drinking i got meet you down bitches (crown) bow, im scared of lonely and im smake smake sure a little with you it dont matter who you are it is so simple, a bet yes op a fuve wo love you bodied you foreve r, taking this a little too fallights the first exotions, i trusted (i like) take all of me i just wanna wake up from you (turn the lights on!) sweet dream or a beautiful nightmare either way i dont wanna wake up from you (turn the lights on!) my guilty pleasurt, turn that cherry out, turn that cherry out turt your lies and type of this lifter do an old school dance up and good lovin? you and my wors hum boy, i moke everything i wonderity and no boy you dont nee dit out i dont know who you bet find the best e hustler... theres no other man a holdroooo ooooooo [beyonce]] esta vue voew for right and you look me up and down and i came to make me cal

(30.2)

These are the results produced from training with 30 epochs and using "tractor" as the starting string.

```
In [110]: #using a word from a country song (not something you usually see in her songs) to see what the
#model would produce
print(generate_text(model, start_string=u"tractor"))
```

 ${
m tractoru}^3$ ) youre my stock fighting to the lord so good to give my love to you  ${
m cuz}$  everything i do is just for you countin every secand til times i told you in the djort back strath- im feeling im mustve just lost yo mind (you crazy) momemoneyes the aint no needer, thank) got me hoping youll page me right now, your kits you like its alriagh us so yands undress me baby, let me know you never wanted me let this happen and it proves that you needs with you teach y ourself when you lie dam at a click with your chick on your arms around me it aint even im a ld, coming about you, babe (oh) the one that you wanna touch it, baby? you dont want nobody e xcess the radio statching but i never every high we on that wood, gram home op them leave the way he fockin millox my love scared that we had espin sieper yeah (let me whats in my bestor let me just say i dont wanna live without it 6 want it away... come right now baby, love me lights i see your face) you wanna touching my body? winning is by shit go died, we goust im feelin n-a-s-a-d-4-o ya turna-tio-pleach is around to carry all the signs, one at a hip hop s tar no more left, to chase melot he told me when i need. youre the only one i see. come on, b aby, its you. youre the one that always flawless its a line the block of me i think about it the left (mmmmmmm) more just right now thats how i like it, baby i dont wanna wake up from yo u (turn the lights on!) sweet dream or a beautiful nightmare either way i dont wanna wake uh i said yes tonight i wanna make the slue love but im great at writing physical love lett ers im a fram, flawless my digapin they pray and pray for the emptase if i dese ceione, ytar arm im still around you right in my path, inferitt i got in the end thats what i wanna play in your dance ansown i think i need it i wanna be, i said you to believe its a catch twenty-t wo cause the cull the know? that someone touchin si you understand your marriage is that? wh en im adone [pre-chorus] could it feel the sands, babla, hat a long time ago a aquarius), but even just cant stand smesbet when they save me right now now hangs in my gon

(30.3)

#### Training with 50 epochs:

These are the results produced from training with 50 epochs and using "beyonce" as the starting string.

```
WARNING:tensorflow:From <ipython-input-33-d74455bf9c82>:29: multinomial (from tensorflow.python.ops.random_ops) is de precated and will be removed in a future version.

Instructions for updating:

Use `tf.random.categorical` instead.

beyonce, me im crazy, all day, all night who never the end me, you put it in your face yeah, i see you is what we ma de, made me im whats you dont wanna play that part i know that i love ago i made you cry i woke up like this we flaw less, ladies tell em i wont let you go ill be your friend i will love you so do i, just to stay alive the 9 to 5, just t
```

These are the results produced from training with 50 epochs and using "drunk in love" as the starting string.

In [35]: print(generate\_text(model, start\_string=u"drunk in love")) #can use a phrase here drunk in love we be all night, last thing i remember is over (yea) something told me to check my time if im the one who the waters thats why im not a teacher, babe but i can teach you something not a preacher but we can pray if you wanna aint a doctor but i can teach you somet hing not a preacher but we can pray if you wanna aint a doctor but i can make you feel better but im great at we i free em thats on my mind baby boy you are so death a high on all of go s o ide like im on fire when, you touch us, we gonna all up trouble comperenter call it tried t o forgive this but im much too full of resentment yeah yeah come sign as me and know how to show me love, cause  $i\tilde{a}c\hat{a}c\hat{a}c\hat{a}c\hat{a}e$  been hurt by a pisces rewinding with drink in my cup i cant car e less what you think i need no permsies right the next me, baby still love the way he talk like this cause he can back it up he always got them mustarbus beautiful nighters, pull me u p, pull me up, pull me up ill never hit the ground (never let me go) so sexy when i feel le ave it for you baby drop it, drop its try to see bodied, getting bodied, getting bodied, getting me forward best thing i never had and im gonna take this time to show you how much you mean t o me cause you aint never see. cant you see the pull of your sweet dream or a beautiful night mare either way i dont wanna wake up from you (turn the lights on!) sweet dream or a beautifu l nightmare either way i dont wanna wake up from you (turn the lights on!) tattoo your name crazy? no woy a stariding if its gonna be you and me when i call, they better see me on your video screen them hustlers keep on talkin uh uh they like the way im walking uh uh) so if yo u want to (uh uh huh uh uh) you got the green light (uh uh huh uh uh) give it to mama game, i will be the one to kiss you at night (kiss you ats so unfrut for a sen pose it on, been pettl esseed it all (come right now come on, choose you can car all your girl can take you there wo rld-wide woman www you ask mow and the challenger girls tyme receives, 3 stars skeleton crew, champions once againooh, ooh, ooh) [outro:] hey! ima keep running cause a winner dont  $qu\tilde{A}t\hat{A}$ 

(50.2)

These are the results produced from training with 50 epochs and using "tractor" as the starting string.

```
In [36]: print(generate text(model, start string=u"tractor")) #can use a phrase here
           tractorng, ice, ice, ice [beyonce:] aint nothing to it real one aint nothing to it boss aint
          nothing to it rop not to be notonds, cause i got beauty, i got cras i got (get your homies kn
           ow even your very best friend tried to warn me only way to go is not over yea see theres no o
           ther man above you? what a wicked way to treat the girl that loves you hold up, they dont lov
           e you like i love you oh, down, they dont love you like i love you love we can devour youll
           do anything for me who run the world? girls! [4x] who run this good) gotha wake up from you
           (turn the light one bay if you can hear to place (tell me how to forgive you when its me when
           sthe love time to listen, its time to fight forward good is a dream then i dont wanna know (i
          dont wanna know) cause i was once around, yes, i said youre drifting all those times (times) you must have lost to make it through) i can see the sun show you how to fight temptation in
           my heart burnin? can you feel all my girls thats in the club rocking, rocking, rocking, rocki
           ng, on you, babe swirling on you, babe in my mind all i can think about it i know that i was
           never there or eve with me feel the same? wo be like a shark (super power) ooh, like a bear
           a tough love on top everybody put your love on top keep on shinning, hell be here in a minut
          e, baby you must not know about me, you must not know about me i could have another you in a minute matter of fact, hell be here in a minute, baby you must not know about me, you must no
           t know about me i could live without you but together se tuh u, uh-ou like (girl you like) t he kinda girl you like the kinda ride \tilde{A} \dot{c} \hat{A} \dot{c} \hat{A} \ddot{c} girl baby boy you stay on my mind fulfill my fa
           ntasies i think about you all the time i see you in my dreams baby boy not a day goes by wit
          hout my baby i dont wanna play that part i know that i love you, but let me just say i dont wanna llve see me but nothing i know could slow us down they couldnt slow us down i thought i
           could live without you i trust you, i trust it feels sometimes must be good to you [pre-hoo
           k: beyonce] keep me coming, keep me going keep me humming, keep me moaning), keep me crying n
```

(50.3)

We can see the differences in the lyrics between each epoch. With 10 epochs, our model was underfit and did not really understand the training data enough to produce strong results. With 50 epochs, however, our model was overfit. We know this because the results from the model that trained with 50 epochs includes full lines from Beyonce songs, which means it is not generating new lyrics but rather putting together chunks of existing lyrics. For our result comparison, we used the results from 30 epochs of training.

After looking through our peer reviews, we saw that a couple of people mentioned that we should use a starting string that was not the title of one of her songs in order to see if that affected our generated text. So, we decided to use the word "love" as our new starting string because it is one of the words that she used the most throughout all of her songs, but it was still general enough to the point that it should not affect our generated text with overfitting. Our results are displayed below and demonstrated that we were able to still generate coherent and decent lyrics when using a starting string that was pretty general (we trained it using 30 epochs as that is the most effective number):

In [32]: #one of the most common words in a Beyonce song, a peer review suggested we used a word that was less random and not #a title of one of her songs print(generate\_text(model, start\_string=u"love"))

WARNING:tensorflow:From <ipython-input-31-e9e744808ble>:22: multinomial (from tensorflow.python.ops.random\_ops) is de precated and will be removed in a future version.

precated and will be removed in a ruture version.

Instructions for updating:

Use 'tf.random.categorical' instead.

love? why dont you neeved moliethe way divation elves too much he wanna got the green light (whoa oh oh!) (uh uh hu huh uh huh uh huh uh you got the green light (whoa oh oh oh oh oh oh oh oh oh) oh ooh whoa whoa oh ooh whoa whoa oh ooh whoa whoa oh oh oh oh oh, oh oh oh oh ix awd thing i tolk my own keep tigns (i cant rung waiting doison my lov e in the urms a pecirs but i will complete and i thought it would be i will love you i love to leave ito so scared o of lonely and im scared of being the only sharmingood) for you all in your equilld places got me looking so crazy right now your love got me looking so crazy youre through like a baby free you thought wanna play it we the ones thats hey you reverse, and i impregnate a love and mine (oh) cause we like a little too far... with me better halo, halo, halo i can feel your halo, halo, halo i can see your heast [verse 2:] you and me were standin on the sun feel every halo i can feel your halo, halo, halo i can see your heast [verse 2:] you and me were standin on the sun feel everything standin on the sun) we remember sugar gote me dont be scared to be pray if you wanna aint a doctor but i can make you feel body i cant do running, know what i hear boy and noive got to hold on youve got a hold on, aste you leer my heart out i like the sweet it up lo que que le visis, de pieces away hime in it; girl, im a world-wide woman i been through this thing back this is for the time you knew you caushin the stage, ho i seine you cant fight its going down ill be rocking on my babe, rocking, rocking, on you, babe, rocking, rocking, jout ill never hit to hide the will be in love was never true if you let him take me from you i guess, i need you, i love you, i love i love to leave i love to see you walk into this with that love, there are to aspelin, out me you wanted me let this happen and it proves, myself and i thats all i got in the bown for a green begrt waute i know that i let you know i got my at 26 youre the one that i never begin i drimm and my friends, real frieds and summing on that, suck and my man handle you watch me on your video phone on your video, video if you want me you can watch me on your video phone, jusn ast aint oh, oh we n your video phone on your video, video if you want me you can watch me on your video phone, jush ast aint oh, oh we