

Introduction to Deep Learning – Assignment 3

Melody Integration

From every MIDI file of a song we had to extract valuable features from it that we can feed to our model for better learning. In order to do that, we decided to use an external software designed to parse MIDI files and extract important information from it, in the form of a numeric vector of size 1495 features. The software was developed as part of a research paper by McKay et al. [1], who worked on a smart automatic feature extractor for MIDI files. The paper was cited a considerable amount of times and seems valid, so we decided to use jSymbolic, their software, for our model.

At first, we fed the raw features from jSymbolic to our LSTM model, by simply concatenating it with the other input features (sequence of word embeddings). Then, at our second try, we decided to first train an autoencoder on those MIDI features, with the middle layer having only 64 dense neurons, and then take the encoder part (all the encoding layers up to the middle one) and integrate it in the original model, so that the LSTM layers receive the word embeddings as before, but with the addition of only 64 input features that were created by the encoder to represent the previously 1495 features. Images of the architecture follow in this report.

Model Architecture

After many experiments, we decided that the best architecture for learning from the MIDI and words together includes two layers of LSTM of sizes 256 and 128 units, and then a dense layer of size 1024, not including the input and output layers. As we said before, we tried out two ways of implementing the information from the MIDI files, so the input to the first layer of the LSTM varies between those options.

As for the sequence of words, we decided to have a window of size 5, meaning the input to the model is technically an array of vectors of 5 word embeddings. To support the request that we generate songs with only 1 initial word, we simply used some sort of padding (4 null words).

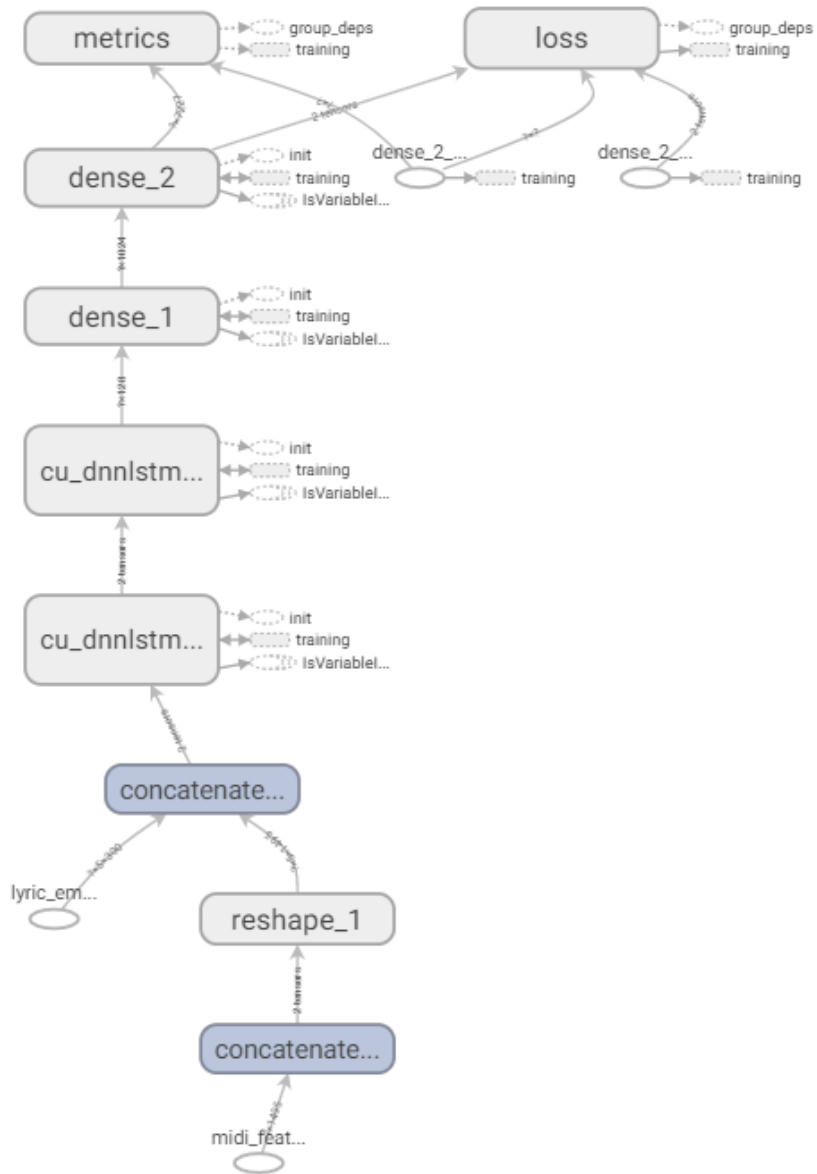
Since our implementation was similar to the simplistic way of combining the same melody features to each sequence of words, we need to duplicate the MIDI feature vector to fit the word sequence size (5). A visual representation of the more basic architecture, as extracted from TensorBoard is as follows.

The more advanced architecture includes 2 encoding layers of sizes 256 and 64. Before training on our model, we trained an autoencoder with those same layers of encoding, and more layers with reverse sizes for decoding. After training the autoencoder, we took the weights of the encoding layers and copied them to our main model, and froze them so they don't change.

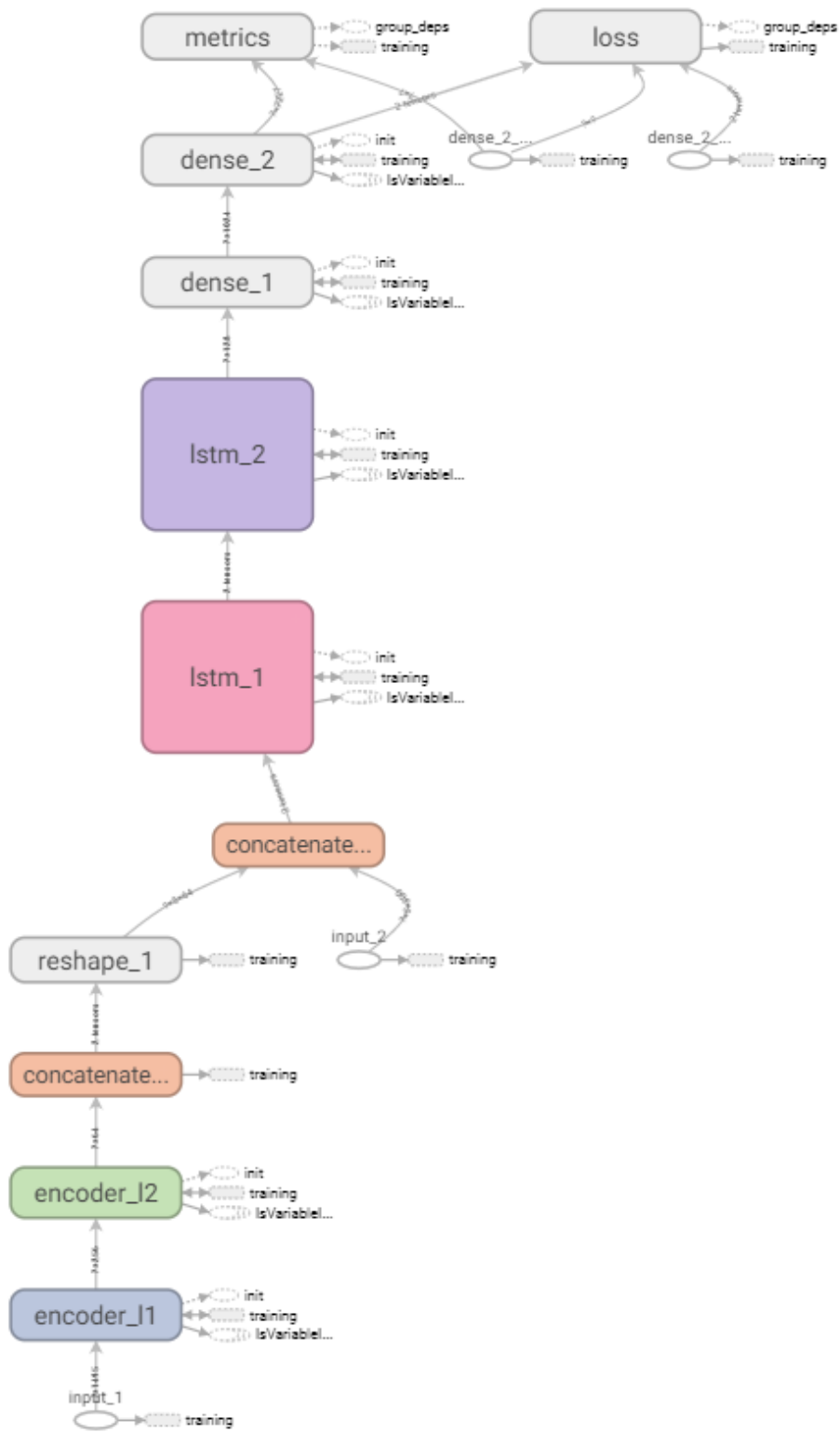
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Basic Architecture



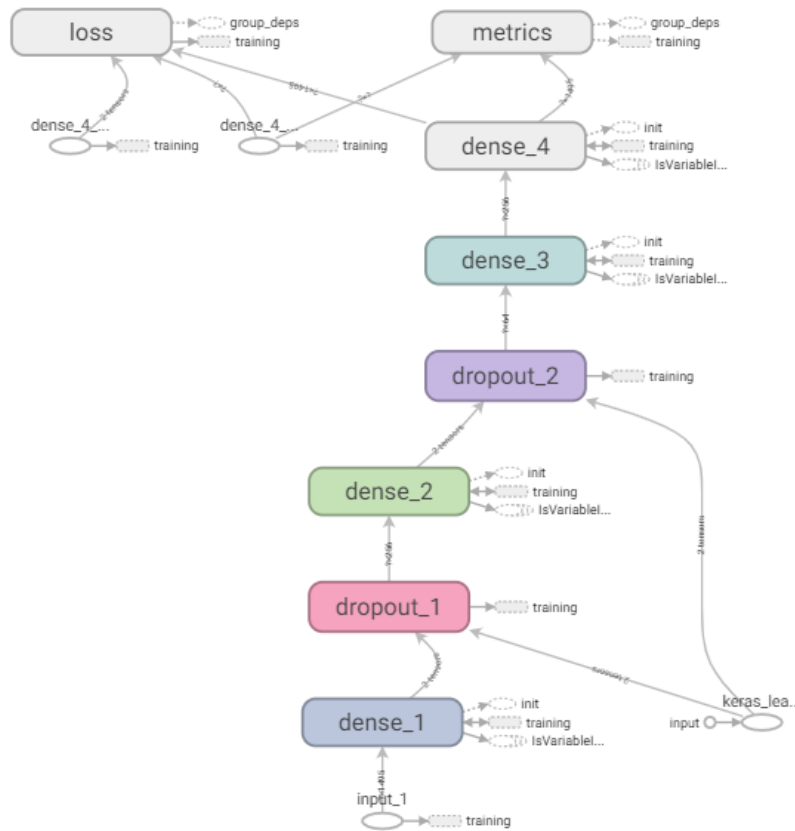
Advanced Architecture



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Autoencoder Architecture



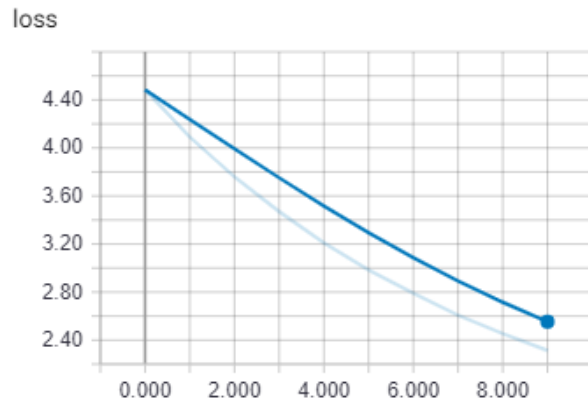
Layer (type)	Output Shape	Param #
input_1 (InputLayer)	(None, 1495)	0
dense_1 (Dense)	(None, 256)	382976
dropout_1 (Dropout)	(None, 256)	0
dense_2 (Dense)	(None, 64)	16448
dropout_2 (Dropout)	(None, 64)	0
dense_3 (Dense)	(None, 256)	16640
dense_4 (Dense)	(None, 1495)	384215
Total params: 800,279		
Trainable params: 800,279		
Non-trainable params: 0		

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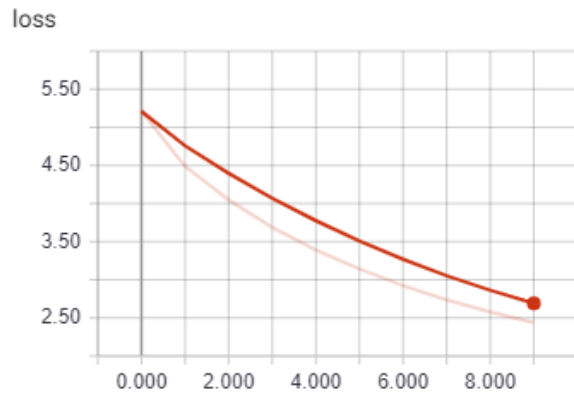
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Learning Process

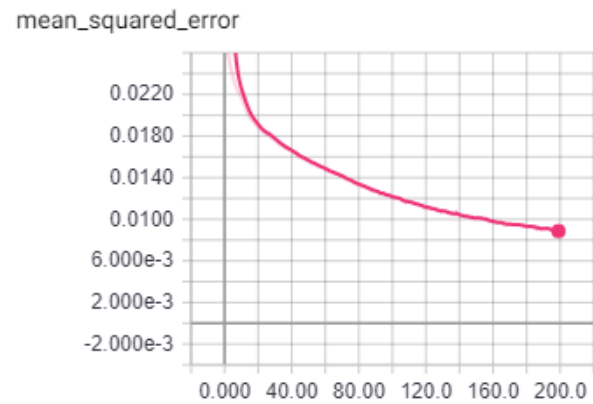
Basic Architecture



Advanced Architecture



Autoencoder



Conclusions

The more advanced architecture including the autoencoder reduced learning time significantly, since less features are fed to the LSTM layers. We also saw that despite the loss graphs and values being similar in both architectures, the advanced one produces more logical lyrics with a bit more sense than the basic model does.

We did not use validation while training the models, since we came to the conclusion it does not improve our results and we preferred to train on bigger data set instead of putting away samples for validation purposes.

Generated lyrics on the test set are included in the end of the report. The three words we chose are: love, believe, rage.

References

[1] McKay, C., & Fujinaga, I. (2006). jSymbolic: A Feature Extractor for MIDI Files. In *ICMC*.

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Songs generated by Basic Model #####

Artist: aqua
Title: barbie girl
Starting word: love

love start start bus suit sad shadow that find deep find sad sad sad
surely that shadow must find find sad bus bus wo die find find find sad
sad sad sad find start sad earl find walls start glad find find start die
find sad sad die find deep shadow bus bus that find find die name die
quick deep sad recognize earl find start find die find sad sad die deep
find walls start sad die find find find find find find quick gentle sad
find stop die die

Artist: aqua
Title: barbie girl
Starting word: believe

believe bye fun earl earl shadow that find find die sad sad find sad sad
find deep sad find walls quick bus that find find die die die quick
special that find start sad sad sad sad find die shadow bus bus that find
find die sad die sad sad sad my
shadow different start sad life find sad sad bus must find find find find
quick sad sad find stuff sad sad suit our must find walls die walls earl
find find die die die quick special much find

Artist: aqua
Title: barbie girl
Starting word: rage

rage had find start sad die sad sad sad find sad shadow missed
die sad die walls sad sad must sad sad find longest find find find find
find gentle find find find sad sad sad sad surely find start shadow shadow
bus that must find find sad sad earl sad find find die earl bus sad suit
find surely find die die name die quick deep sad my that shadow earl find
sad sad find start sad find find quick find die sad die sad sad must my
name

Artist: billy joel
Title: honesty
Starting word: love

love
open 23 create someday we
oh la free
only repeat if still in more more ever more wrong thinking more danger
troupe-p-per
than would ever smart ugly more 'til cried capture c'mon die
we down dancing hair angels hair blues troupe-p-per listen blues c'mon ting
information
how me someday buy in old more man could could always more falling needs
more danger loved
open c'mon information cried
ah walk still in a

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still gave danger loud in life
ever fools

Artist: billy joel
Title: honesty
Starting word: believe

believe
still livin golden enough in
still could never board ugly
our old man in

open only falling tellin falling
no songs loud information needs capture ah
games someday still saw in had ... more a more ever fought b memory heaven
old apart times
upon beyond impregnate nice people once
never fun always wish wish in ...
if never set set riot a hair
follow meant loud c'mon
say dead a friends gettin bones
like filled 23

Artist: billy joel
Title: honesty
Starting word: rage

rage
apart prints someday
the apart still walk son taught quick
how clearly knowing nice
how me memories two in oh golden upon
a sister nose memory
wrong have the daddy in more more affecting wrong more danger ahead
knocked
how me coal needs two than
holding loud loud nice
once hide die needs in
oh yes
a 'd all only could ever black drag taught
how me a child takin cried hair
oh
a ... in

Artist: blink 182
Title: all the small things
Starting word: love

love an ya this this i nothing rhythm people old this rest talk this water
ha ha ha ha c'mon run run ha ha ha ha run run run ha ha ha run run run ha
ha ha ha run run run ha ha ha ha run run run ha ha ha ha ha ha run run run
ha ha ha ha run run run ha ha ha ha run run run ha ha ha ha run run run ha
ha ha ha run run run ha ha ha ha run

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Artist: blink 182

Title: all the small things

Starting word: believe

believe this stayin this old old people water hills since since since ha
ha great run run ha ha ha ha run run run ha ha ha ha run run run ha ha ha
ha run run run run ha ha ha ha ha ha ha ha run run run ha ha ha ha run
run run ha ha ha run run run ha ha ha ha run run run ha ha ha ha run run
run ha ha ha ha run run run ha ha ha ha ha ha

Artist: blink 182

Title: all the small things

Starting word: rage

rage this an goodbye this this rhythm rhythm old born this stayin this
since this early this early water old this this over this nothing late
damned this found blues this smoke blues this ha blues ha ha ha ha c'mon
run run ha run ha ha ha run run run ha ha ha ha ha run run run ha ha ha ha
run run run ha ha ha ha run run run ha ha ha ha ha run run run ha ha ha ha
ha ha run run run ha

Artist: cardigans

Title: lovefool

Starting word: love

love minutes bear talk it it help talk part egyptian dee bye stayin sleigh
sleigh wiggy dee dee sleigh sleigh egyptian molasses clearly shu-bop shu-
bop egyptian minutes shu-bop shu-bop egyptian shu-bop icy albums dee eight
egyptian egyptian egyptian egyptian shu-bop egyptian shu-bop egyptian shu-
bop shu-bop icy shu-bop egyptian dee egyptian egyptian sleigh egyptian
egyptian shu-bop shu-bop sears shu-bop shu-bop sleigh egyptian shu-bop dee
stayin sleigh sleigh meter dee freak sleigh sleigh egyptian clearly dee
eight sleigh egyptian shu-bop clearly shu-bop dee eight swerve shu-bop
shu-bop clearly shu-bop shu-bop sleigh sleigh bye

Artist: cardigans

Title: lovefool

Starting word: believe

believe shu-bop egyptian shu-bop dee bye sleigh sleigh egyptian clearly
dee eight egyptian marry egyptian cream shu-bop egyptian shu-bop egyptian
shu-bop shu-bop icy shu-bop shu-bop sleigh icy dee eight sleigh sleigh
egyptian shu-bop icy bye shu-bop egyptian meter egyptian albums shu-bop
egyptian shu-bop egyptian shu-bop shu-bop egyptian meter shu-bop sleigh
egyptian shu-bop shu-bop sleigh sleigh sleigh sleigh sleigh sleigh sleigh
icy dee bye sleigh sleigh egyptian shu-bop sleigh pinky meter shu-bop shu-
bop icy egyptian shu-bop shu-bop icy shu-bop shu-bop sleigh icy minutes
clearly shu-bop shu-bop egyptian icy shu-bop sooner shu-bop egyptian

Artist: cardigans

Title: lovefool

Starting word: rage

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rage ride capture egyptian egyptian egyptian shu-bop egyptian shu-bop
egyptian shu-bop weather icy clearly shu-bop shu-bop shu-bop egyptian
minutes dee eight marry lurkin clearly icy ride ride egyptian sleigh meter
meter dee egyptian egyptian lurkin marry clearly shu-bop ride egyptian
egyptian shu-bop shu-bop icy shu-bop shu-bop sleigh sleigh icy bye clearly
bye conductors shu-bop clearly egyptian dee egyptian egyptian egyptian
egyptian shu-bop icy shu-bop egyptian shu-bop egyptian shu-bop shu-bop
swerve shu-bop sleigh freak sleigh freak sleigh shot eight meter dee eight
shu-bop egyptian virgin clearly shu-bop egyptian minutes shu-bop egyptian
shu-bop

Artist: the bangles

Title: eternal flame

Starting word: love

love evil women women change wherever
mony
fade
lose die see fade turning face goin

change
lose die die duty roller huh broke fight train fight shore
fade
change change die die duty
face awake lord start run fight fight
go change
fade run die bought die shore
tenderly
fade change
change die stand face g
goin awake
change
change
lose die die duty dust warm morning shore

change

Artist: the bangles

Title: eternal flame

Starting word: believe

believe na na na tail without day change proud
see see change
see see see start see
see see start see see see start

see change start die die goin nowhere ' quit

get see each see
see
see lose see see start

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see die start reach die goin run reach
change paperlate
change roller
change morning singing
must
see change start
die die mornin way bought secret
change change train
bad

Artist: the bangles
Title: eternal flame
Starting word: rage

rage change change shore
hangin . singing dead bought mony repeat train dance fight morning shore
rules fade
change singing
fade names
change earl
change die singing names forget shore
mony
change change
change die nowhere
die city myself fight bought
singing
sign fade fade
run shore
fade fade
change sign singing
everywhere
fade
lose
lose die die duty may fly awake repeat change singing train train shore
wrote
fade

Songs generated by Advanced Model

Artist: aqua
Title: barbie girl
Starting word: love

love me high are like
everybody gives the broken
then it 's true
so i listen to you
i 've got a cards face for you need and i do n't mind a
still there 's somebody you
yes i 'd still i
chasing that you sugar until all
faded all the blues
love no know i live
i do n't give your
i if give a straight trying

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'cause i feel because
to live until a man

Artist: aqua

Title: barbie girl

Starting word: believe

believe where you are at a were
what can it be wrong
may it be gon na try like taking
so has feelings
i still alone clouds but now
ride the sad
i 'll hold somebody
i 'm letting you till down
ice
tempted in you i want to give you still
i 'm gon na find
but now you know i could get away
and tell me a soul to dance
you gon na start the best

Artist: aqua

Title: barbie girl

Starting word: rage

rage nowhere it about dream
so
never there we had to help
together to you
think i can live together
here to heaven with
but i do have to learn
there 'd can play forever
if i wrong when the way my life
just caught your hand
but there 's somebody
and i will still wait
lying
tender has disappeared old midnight
so i do have to let you tight
say you i do give you

Artist: billy joel

Title: honesty

Starting word: love

love 's late on your rising at the things you do from you
stay me mend you to see why me it means when this life ago you were
and there 's nothing never leave
this folks again until you can tell me my eyes to see me something true to
me
waterloo us to remain before
i saw the window again

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meet he being to each up true
it does n't it just
give me the spark again
it really n't

Artist: billy joel
Title: honesty
Starting word: believe

believe me there 'll mine someone light heaven time
even it better we will explain hungry time
time you left girl had too sad to me
and i would n't hear to decide you 'll find
you gave to give a sad
relax you feel forget me help
a thrill of hell that doubt in the wind in the night
and i lay break darlin night hollywood i keep you keep i start it burns
but in there weed that you say 's

Artist: billy joel
Title: honesty
Starting word: rage

rage runs in a shining i left a person ring-a-ring-a-ring of my heart
maybe the memory
in the time in my place you had to see me what it is me something caught
and you think of light the light are something as cats
all i 'd n't even to to do though nobody to do my world it 's like a bird
at my hands of the light
all there
i was friends the price of this way
before i 'd faded my shit i

Artist: blink 182
Title: all the small things
Starting word: love

love have ya from nothin
from the girls on out
the lady ai n't had
they du anyone to think that shit
and stop oo-hoo-hoo-oo-oo to fake
fa always on your knees
but do n't try anybody why they 've got married gon na be better they do
n't think he decency me
whom in the floors
we roll you safe to cling
ooh-ooh until the point can wonderful
i keep the meter and
some say they say in ya

Artist: blink 182
Title: all the small things
Starting word: believe

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believe do it war
mic
verse known for you can talk
why come and act the yo
chorus
they tried away to the king
chorus me sounding with the tune
while fields a garden
jealous boogie your old
gives sure did
they wo n't god afraid
they 're not 2 and oh would well you home a screams
but i 'm goin and you ca n't communicate if you 're part of
they got ta do n't want

Artist: blink 182
Title: all the small things
Starting word: rage

rage yo too everybody
prayer is the grease by
it 's beyond but did repeatx2
yo else 's the workin
the hand up looking and you will get him
get me up a ride
chorus to the chinese of the gaze
beneath in the door
the losing like the girls
independent by speakers and shoot soir
slick 's its and the sound are the tastes flow
low of talking where i 've done at least .
ak needs of

Artist: cardigans
Title: lovefool
Starting word: love

love come up tonight
mistletoe behind let
and watch and emptiness no
spark on the pavement as the peace
just touch to the place
where darkness of the names
got to be their
take my breath one of peace
make a film car of someone
the lights there was the names
where the things that we could be part to find to a poor
praying an chances when the phone
keep them a manager way
come much to

Artist: cardigans

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Title: lovefool

Starting word: believe

believe me weary let me
if you loved know passed
them folks and i 'm gone
when you just a great to fade to find
here here and down
believe me mm-mm
the snowbird in the faces
all the broken and old shepherd i saw to live .
where of this weekend not will be here
when that flies but should
your legs is all the id vision
i 'll be rushing
love was nice
waits of wanted

Artist: cardigans

Title: lovefool

Starting word: rage

rage
join the red-nosed of rage in
leave waits the molesta
blame with my thugging
would you live to suspended
and waits i 'll survive a love was lately and me sure to the last
california
father around the pour in the coming
want to be him here
but sometimes we 'll see
the beating fool to san
am the began one of the power
waitin that am one
then over we country fittest fantasy
but he talks

Artist: the bangles

Title: eternal flame

Starting word: love

love goes all an chico sweet
a laugh mistakes more more
if that cartoon day knows
the tracks then last you in mine
all that way me nothing
you 're my one destiny days
but maybe it still so tits at my horse
am the dry when you get away
and i ca n't believe that 's there
'cause i guess this is just all behind
your back around a child face
let me go this night

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let me

Artist: the bangles

Title: eternal flame

Starting word: believe

believe i go it high

it 's a breakin we got lost

love in my fire

walking my sooner to use

never turn back to go on

back around no stand on me

do n't know i just straight

a glimpse to make a fool

'til stay

so high i was sounding ' my way

becomes my hand around jive

window my heart

call your back and whisper away

forget her say i know

that i should

Artist: the bangles

Title: eternal flame

Starting word: rage

rage gun this by myself

you 're gon na do my love with you

but my heart ever give me no water fire

so my love

thank me to go

but it 's you run

does all alone

and who say i want

i need to see the light

it 's getting your eyes

you 're gone like a part way it

but just for this girl while moment

on the freeway buy

baby things we would fall