

PATRICK SIMPSON
#7 SCRIPT

[DANIEL JOHNSON - NEURAL NETWORK COMPOSITION #1]

WHAT YOU'RE LISTENING TO IS AN UNTITLED PIECE FOR SOLO PIANO BY DANIEL JOHNSON. OBVIOUSLY, IT'S NOT BEING PLAYED BY AN ACTUAL PERSON. IT'S JUST A COMPUTER. BUT OTHER THAN THAT, IT SOUNDS KIND OF NORMAL. THAT IS, UNTIL IT GETS TO THIS PART.

[COMP #1]

WHICH JUST SOUNDS LIKE THE COMPUTER CRASHED. SO, WHAT HAPPENED? WELL, WHEN I SAID THIS WAS WRITTEN BY DANIEL JOHNSON, I WASN'T REALLY TELLING THE WHOLE STORY. TECHNICALLY YES, JOHNSON WOULD BE CONSIDERED THE ULTIMATE AUTHOR OF THIS PIECE. BUT HE DIDN'T COMPOSE IT HIMSELF. WHAT HE DID WAS WRITE A COMPUTER PROGRAM FOR COMPOSING MUSIC, WHICH THEN MADE THIS, AND A BUNCH OF OTHER PIECES. SO ESSENTIALLY, THIS WAS COMPOSED BY ARTIFICIAL INTELLIGENCE.

[COMP #1]

AND OTHER THAN THAT GLITCH FROM BEFORE, IT ACTUALLY SOUNDS LIKE MAYBE SOMETHING BEETHOVEN WOULD HAVE WRITTEN. WELL, NOT REALLY, BUT IT'S APPROXIMATING IT PRETTY WELL. AND THERE ARE EVEN SOME PARTS THAT SOUND REALLY GOOD, LIKE THIS CHORD PROGRESSION HERE:

[COMP #1]

SO, DOES THIS MEAN THAT COMPUTERS ARE GONNA START STEALING ALL OUR CREATIVE JOBS, JUST LIKE THEY'RE REPLACING MANUAL LABORERS NOW, AND BEFORE YOU KNOW IT, ROBOT REVOLUTION?

[ROBOT REVOLUTION SFX]

WELL, NO. BUT WHAT IT DOES MEAN IS THAT MUSIC HAS A LOT MORE TO DO WITH THINGS LIKE MATH AND SCIENCE THAN YOU MIGHT THINK. WE LIKE TO BELIEVE THAT MUSIC IS THIS PURE EXPRESSION OF THE MUSICIAN'S THOUGHTS AND FEELINGS, BUT REALLY, A LOT OF IT JUST COMES DOWN TO FOLLOWING SIMPLE, TOTALLY NOT CREATIVE RULES. AND ON THIS EPISODE, WE'RE GOING TO LOOK AT HOW THAT ISN'T NECESSARILY A BAD THING.

I'M PATRICK SIMPSON, AND THIS IS MELOMANIA.

[DISPARITION - EXTRAORDINARY RENDITION]

SO LET'S HAVE A LITTLE SCIENCE LESSON. THE REASON WHY CERTAIN PITCHES SOUND GOOD TOGETHER, OR IN MUSIC THEORY TERMS, CONSONANT IS JUST A RESULT OF SIMPLE PHYSICS. YOU SEE, AS YOU PROBABLY ALREADY KNOW, SOUND IS A WAVE, AND EVERY SOUND HAS A FREQUENCY, OR HOW FAST THE WAVE MOVES. THIS IS MEASURED IN HERTZ, WHICH IS CYCLES PER SECOND. HIGHER FREQUENCIES HAVE HIGHER PITCHES, AND LOWER FREQUENCIES ARE LOWER.

NORMALLY, WHEN YOU PLAY TWO PITCHES TOGETHER, THE WAVES INTERFERE WITH EACH OTHER, AND YOU GET THIS KIND OF "WAWAWAWAWA" EFFECT. THIS IS DISSONANCE.

[DISSONANT SINE WAVES]

BUT THERE ARE CERTAIN FREQUENCIES THAT FIT WELL TOGETHER, SOMETIMES SO WELL THAT YOU CAN'T EVEN TELL THAT THERE ARE SEVERAL PITCHES HAPPENING SIMULTANEOUSLY. THESE ARE CALLED OVERTONES.

[CONSONANT SINE WAVES (OVERTONES)]

HOW IT WORKS IS YOU TAKE A FREQUENCY, LET'S SAY ABOUT 261.6 HERTZ, WHICH IS MIDDLE C ON A PIANO, AND THAT'S CALLED THE FUNDAMENTAL.

[261.6 HERTZ SINE WAVE, OVERTONES CONTINUING TO GET ADDED]

THEN YOU JUST MULTIPLY 261.6 BY TWO, AND YOU GET 523.2 HERTZ, THE FIRST OVERTONE, WHICH IS AN OCTAVE ABOVE THE FUNDAMENTAL. FOR THE REST OF THE OVERTONE SERIES, JUST KEEP ADDING 261.6 AGAIN AND AGAIN, AND YOU EVENTUALLY GET SOMETHING LIKE THIS.

[SINE WAVE WITH FIVE OVERTONES]

AND EVEN THOUGH THAT JUST SOUNDS LIKE A SINGLE NOTE, IT'S ACTUALLY FIVE: C, THE C ABOVE IT, THE G ABOVE THAT, THE C ABOVE THAT, AND THE E ABOVE THAT, WHICH FORMS A MAJOR CHORD. AND THERE ARE MORE OVERTONES BEYOND THAT STILL. WHEN YOU HEAR AN INSTRUMENT, LIKE A VIOLIN PLAYING A NOTE...

[VIOLIN PLAYING C]

YOU'RE NOT JUST HEARING THAT NOTE, BUT ALL THE OVERTONES AS WELL, IN VARYING RATIOS.

SO THIS IS THE CORE OF ALL WESTERN HARMONY. IT'S ALSO SEEN IN MUSIC OF MOST OTHER CULTURES AS WELL, BUT WE'RE GOING TO FOCUS

ON WHAT WAS HAPPENING IN EUROPE, SPECIFICALLY DURING THE COMMON PRACTICE PERIOD, WHICH BASICALLY MEANS THE LOOSE TIME PERIOD BETWEEN 1650 AND 1900 WHEN COMPOSERS WERE MOSTLY STILL FOLLOWING THE RULES OF TONALITY.

SO THE GUY THAT KIND OF STARTED EVERYTHING IS JOHANN SEBASTIAN BACH. OF COURSE, THE GREEKS AND ROMANS HAD THEIR OWN WEIRD SCALES AND THERE WAS SOME STUFF IN THE MIDDLE AGES, BUT BACH WAS ONE OF THE FIRST TO THINK OF MUSIC IN TERMS OF THE 12 MAJOR AND 12 MINOR KEYS THAT WE KNOW TODAY. SO, TO GET A GRASP ON HOW BACH LAID THE FOUNDATION FOR EVERYTHING TO FOLLOW, LET'S TAKE A LOOK AT ONE OF HIS MOST FAMOUS PIECES, THE PRELUDE IN C MAJOR.

[BACH - PRELUDE IN C MAJOR (GULDA)]

WHAT'S GREAT ABOUT THIS PRELUDE IS HOW SIMPLE IT IS; IT'S JUST BROKEN CHORDS, OVER AND OVER AGAIN. SO IT'S REALLY EASY TO ANALYZE. SO HERE'S HOW IT WORKS.

SO YOU START ON A C MAJOR TRIAD.

[C MAJOR TRIAD ON PIANO, CONTINUE TO PLAY WHATEVER I SAY ON PIANO
THROUGHOUT ANALYSIS]

THE PRELUDE IS IN THE KEY OF C MAJOR, SO THAT MAKES SENSE. THEN YOU GO TO D MINOR SEVEN, AND THAT WORKS BECAUSE THE C IS NOW THE SEVENTH OF D, AND D IS ONLY A WHOLE STEP AWAY FROM C... AND THEN G SEVEN, WHICH WORKS BECAUSE D MINOR AND G SEVEN SHARE A COUPLE NOTES... AND THEN YOU RESOLVE BY GOING BACK TO C MAJOR.

THAT RESOLVE WORKS PARTICULARLY WELL BECAUSE IF YOU LOOK AT THE NOTES IN G SEVEN, THE G IS ALREADY A PART OF THE C MAJOR TRIAD, AND ALL THE OTHER NOTES ARE SO CLOSE TO THE TRIAD THAT IT SOUNDS NATURAL WHEN YOU SWITCH BACK. THE F WANTS TO GO DOWN A HALF STEP TO E, THE D CAN GO EITHER WAY TO C OR E, AND THE B IS JUST DYING TO GO UP A HALF STEP TO C. SO YOU HAVE THIS...

[G7]

AND THEN...

[C]

THERE.

AND THAT'S BASICALLY HOW TONAL MUSIC WORKS. NOW STAY WITH ME HERE, I KNOW I'M REALLY OVERSIMPLIFYING THINGS, BUT IF YOU LOOK AT THE BIG PICTURE, ALL MUSIC, AT LEAST TONAL MUSIC, IS JUST STARTING IN A CERTAIN KEY, GOING TO NOTES AND CHORDS OUTSIDE OF THAT KEY TO BUILD TENSION, AND THEN RESOLVING THAT TENSION BY GOING BACK TO THE ORIGINAL KEY. IT'S LIKE A PUZZLE—YOU CAN'T BE TOO PREDICTABLE, BUT YOU STILL HAVE TO FOLLOW THE RULES. IT'S ALL ABOUT THAT BALANCE BETWEEN SUBVERTING AND SATISFYING EXPECTATIONS WE INNATELY HAVE BASED ON THE PHYSICS OF PITCH THAT WE TALKED ABOUT EARLIER. AND THIS IS HOW IT WORKS IN MUSIC TODAY TOO... I MEAN, MAROON FIVE'S SUNDAY MORNING HAS LITERALLY THE EXACT SAME CHORD PROGRESSION AS THE FIRST FOUR MEASURES OF THE BACH PRELUDE. IT'S EVEN IN THE SAME KEY. JUST LISTEN:

[PRELUDE IN C MAJOR SYNCED UP WITH SUNDAY MORNING]

AND IF YOU THINK ABOUT IT, IT'S ACTUALLY A LOT EASIER TO BE CREATIVE WHEN YOU LIMIT YOURSELF WITH THESE RULES. JUST IMAGINE IF YOU HAD NOTHING TO START WITH... JUST THE LIMITLESS POSSIBILITIES OF ALL THE FREQUENCIES THAT CAN BE HEARD WITH THE HUMAN EAR, AND YOU CAN PLAY THEM IN WHATEVER ORDER YOU LIKE, FOR ANY AMOUNT OF TIME, IN ANY KIND OF RHYTHM. IT'S IMPOSSIBLE TO MAKE ANYTHING BEYOND JUST RANDOM NOTES. IT'S LIKE WHEN YOU'RE IN A GROCERY STORE, AND THERE ARE SO MANY DIFFERENT KINDS OF PASTA... THERE'S SPAGHETTI, LASAGNE, MACARONI, FETTUCINE, LINGUINE, RIGATONI... SO MANY MORE ES WHERE THAT CAME FROM. AND EVEN IF YOU SETTLE ON A TYPE, YOU'VE GOT ALL THE BRANDS TO CHOOSE FROM, AND DON'T EVEN GET ME STARTED ON THE SAUCE, AND WHAT IF YOU DON'T EVEN WANT PASTA, MAYBE YOU WANT A STEAK DINNER, OR A BURRITO FROM CHIPOTLE, OR... YOU GET THE POINT. IT'S DEBILITATING. BUT WHEN YOU START IN A CERTAIN KEY, AND YOU CAN ONLY GO TO A FEW CHORDS THAT WORK FROM THERE, YOU DON'T HAVE TO MAKE SO MANY CHOICES, AND YOU CAN BE MORE CREATIVE.

OKAY, SO NOW THAT WE'VE COVERED HOW PEOPLE USE RULES AND LIMITATIONS TO COMPOSE MUSIC, LET'S GO BACK TO COMPUTERS.

[NEURAL NET COMP #3]

SO THIS MUSIC WAS WRITTEN BY SOMETHING CALLED A "NEURAL NETWORK."

[Parker Lawrence Interview: “A neural network is a, it’s a program inspired by human brain that will gradually learn given a specific task.”]

THIS IS PARKER LAWRENCE.

[“Sophomore at the high school, and I’ve been working with neural nets for a little while.”]

HE KNOWS A LOT ABOUT THIS KIND OF STUFF.

[“It’s divided up into layers, and each layer is essentially a mathematical function based off of the layer before it. And then, depending on how far off the result, it’ll make a series of guesses, and depending on how far off that guess was from the expected answer, it’ll adjust each mathematical expression in each layer.”]

SO BASICALLY, THEY LEARN BY TRIAL AND ERROR. SO A REALLY SIMPLIFIED EXAMPLE WITH MUSIC MIGHT BE YOU GIVE IT A CHORD, LIKE THE G SEVEN FROM THE BACH PRELUDE. AND THEN IT’LL GUESS WHAT SHOULD COME NEXT. AND WHEN IT’S FIRST STARTING OUT, IT’S REALLY BAD. IT’LL MOSTLY JUST BE RANDOM, LIKE...

[UGLY CHORD]

AND THEN THE ALGORITHM WILL CHANGE A LITTLE, SO MAYBE, THIS TIME, LESS NOTES.

[UGLY CHORD WITH SLIGHTLY LESS NOTES]

OK OK, MAYBE JUST THREE NOTES.

[UGLY TRIAD]

ALRIGHT, NOW, YOU CAN’T HAVE ANY TRITONES.

[SLIGHTLY MORE CONSONANT CHORD]

OK, THAT'S A LITTLE BETTER, BUT...

AND IT'LL CONTINUE LIKE THIS FOR A LONG TIME BEFORE IT GETS ANYWHERE. BUT IT DOESN'T LEARN BY SOMEONE LITERALLY TELLING THEM WHAT'S RIGHT AND WHAT'S WRONG, BUT BY LOOKING AT OTHER PIECES THAT HAVE ALREADY BEEN WRITTEN. SO YOU'LL FEED A BUNCH OF MUSIC INTO THE NEURAL NET, AND THEN IT'LL TRY AND COPY THE STYLE OF THAT MUSIC. SO WITH THE MUSIC FROM BEFORE, IT WAS GIVEN PRETTY MUCH EVERY KIND OF COMPOSER IN CLASSICAL MUSIC, FROM BACH...

[BACH - PRELUDE IN C SHARP MAJOR]

TO BEETHOVEN...

[BEETHOVEN - APPASSIONATA SONATA]

TO CHOPIN.

[CHOPIN - NOCTURNE IN C MINOR]

SO YOU KIND OF GET THIS WEIRD AMALGAM OF STYLES, KIND OF LIKE MUSIC BY COMMITTEE.

[NEURAL NET COMP #9]

SO THAT'S ONE PROBLEM, BUT THAT'S NOT INHERENT TO NEURAL NETWORKS IN GENERAL, JUST THIS ONE IN PARTICULAR. BUT ONE PROBLEM THAT ALL NEURAL NETWORKS HAVE IS OVERTRAINING.

["Which is if you give it, you have to have some function that evaluates how well the neural network did, and eventually that neural network is going to approximate that function very very well. So that function could judge similarity to some song that we

already have, or similarity to a set of songs, and the neural network might get so good at approximating that function that it's identical to a song we already gave it."]

SO YOU'RE ALWAYS TRYING TO FIND THAT BALANCE BETWEEN ORIGINALITY AND STILL MAKING SENSE, WHICH IF YOU THINK ABOUT IT, IS KIND OF THE SAME AS WHEN PEOPLE WRITE MUSIC. BUT THE DIFFERENCE BETWEEN NEURAL NETWORKS AND PEOPLE IS THAT THE NEURAL NET ONLY HAS ONE GOAL, WHICH IS TO IMITATE THE MUSIC IT'S BEEN GIVEN AS BEST IT CAN, SO IT DOESN'T MATTER IF IT LITERALLY COPIES IT NOTE FOR NOTE, AS LONG AS IT'S ACHIEVING THAT GOAL. IT LACKS THE DRIVE FOR CREATIVITY, SO WE HAVE TO LIMIT IT AND MAKE SURE IT DOESN'T GET TO THE POINT WHERE IT'S JUST PLAGIARISING.

["It shows the nature of what an artificial intelligence might be. It might be creative in the ways that it takes to accomplish a specific goal, but the goal is always set."]

SO WE'RE ALWAYS GONNA NEED PEOPLE GIVING IT THAT CREATIVE JOLT AND MEANING BEYOND JUST FULFILLING SOME ARTIFICIAL GOAL.

["If there's an artist out there who decides to use neural networks in that way, that artist would have to look at those different parts of the neural network that would ordinarily be forgotten, and just pick which things he thinks sound very original, or mean something to him. Because to the computer those thoughts, they don't mean anything to the computer, they're just steps in an optimizing process. So he would basically use the neural network as an instrument sort of."]

SO, LIKE WE SAID BEFORE, IT'S REALLY GOOD TO HAVE CERTAIN RULES AND LIMITATIONS SO YOU CAN FREE YOURSELF UP TO BE ABLE TO CREATE

MORE AND INNOVATE, BUT YOU ALWAYS NEED A LITTLE BIT OF THAT SPECIAL SPARK. COMPUTERS ARE GREAT AND ALL, AND THE MUSIC THEY'VE PRODUCED SO FAR, AS WE'VE HEARD, IS PRETTY IMPRESSIVE. BUT WITHOUT THE PEOPLE BEHIND THE SCENES PULLING ALL THE STRINGS, IT WOULDN'T MEAN A THING. SO DON'T WORRY ABOUT THE ROBOTS TAKING OVER EVERYTHING... THEY'LL NEVER BE AS GOOD AS THE REAL DEAL.

[BENOIT CARRE - DADDY'S CAR]

MELOMANIA IS WRITTEN AND PRODUCED BY ME, PATRICK SIMPSON. THE TRACKS THAT I USED ARE, IN ORDER OF APPEARANCE, A COUPLE OF THE UNTITLED NEURAL NET COMPOSITIONS BY DANIEL JOHNSON, DISPARITION'S EXTRAORDINARY RENDITION, AND WHAT YOU'RE HEARING RIGHT NOW IS DADDY'S CAR, A SONG BY A NEURAL NET IN THE STYLE OF THE BEATLES, ARRANGED AND PRODUCED BY BENOIT CARRE. MELOMANIA IS A PRODUCTION OF 91.3 WHJE, BROADCASTING FROM BEAUTIFUL, DOWNTOWN, CARMEL INDIANA. THANKS FOR LISTENING.