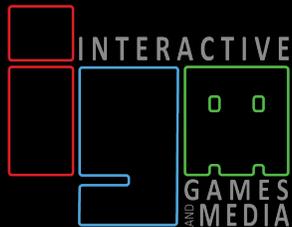


IGNITING GENJAM

A FIVE-MINUTE RIFF

AI Biles



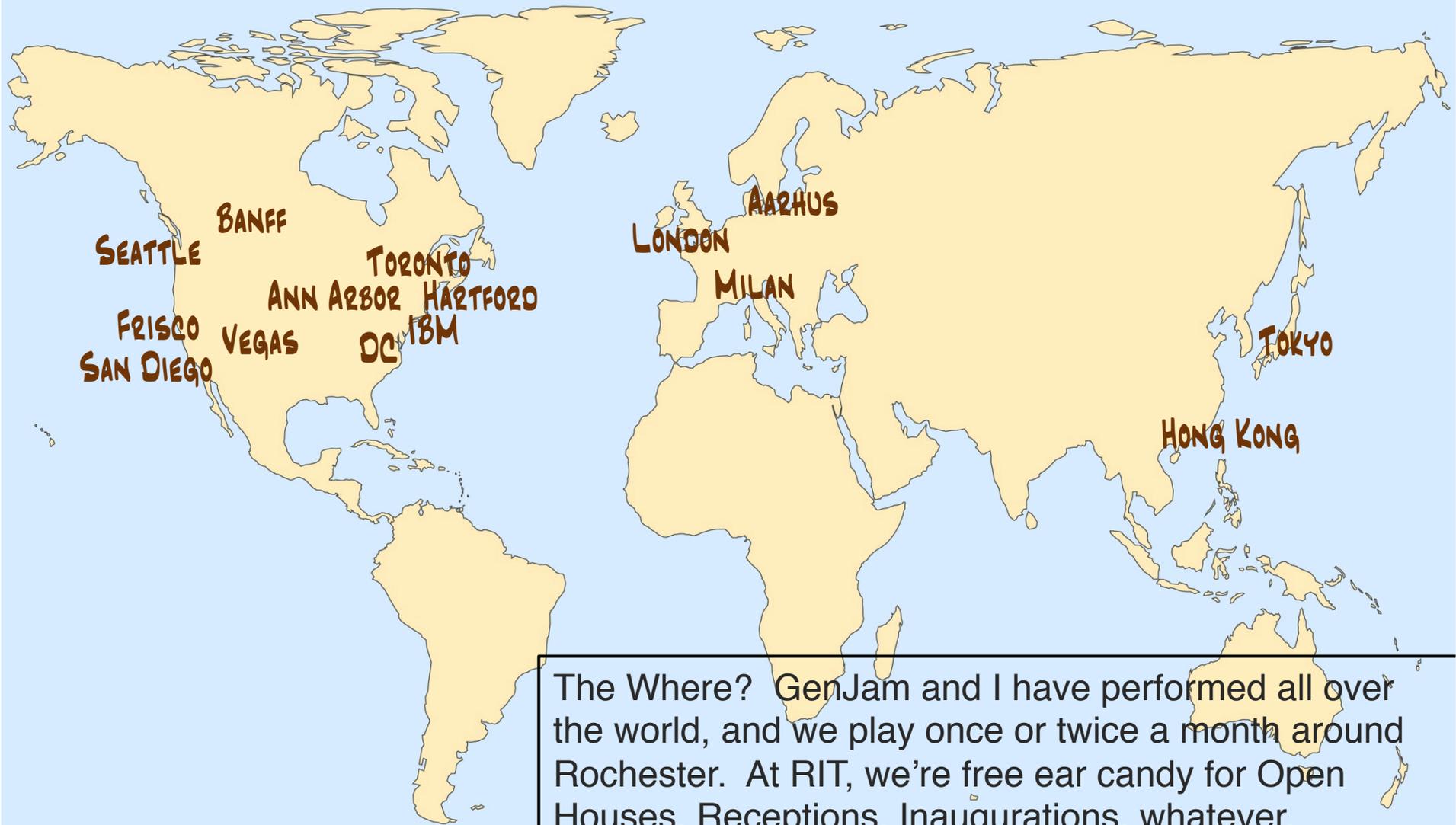
I've given dozens of different talks on GenJam, so for this Ignite presentation, I'm gonna try to squeeze one down to 5 minutes. I'll cover the What, Where, When, Who, How, Why, and Next of GenJam.



Genetic Jammer

First the What: GenJam stands for the Genetic Jammer. The Genetic part comes from Genetic Algorithms, and the Jammer part stands for jamming (improvising), so GenJam uses genetic algorithms to improvise jazz in real time.





The Where? GenJam and I have performed all over the world, and we play once or twice a month around Rochester. At RIT, we're free ear candy for Open Houses, Receptions, Inaugurations, whatever. By the way, we are definitely available for your event...



GenJam: A Genetic Algorithm for Generating Jazz Solos

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Abstract

This paper describes GenJam, a genetic algorithm-based model of a novice jazz musician learning to improvise. GenJam maintains hierarchically related populations of melodic ideas that are mapped to specific notes through scales suggested by the chord progression being played. As GenJam plays its solos over the accompaniment of a standard rhythm section, a human mentor gives real-time feedback, which is used to derive fitness values for the individual measures and phrases. GenJam then applies various genetic operators to the populations to breed improved generations of ideas.

1 Introduction

As with most problem-solving activities, musical tasks like composition, arranging and improvising involve a great deal of search. Composers search for the right chord progression; arrangers search for the right melody and counterpoint for constituent parts; and improvisers search for the right phrases to play or

respond by "gonging him off," as Jo Jones did to a young Charlie Parker by sailing a cymbal at his feet during a Kansas City jam session. GenJam uses similar, though less dramatic, feedback to

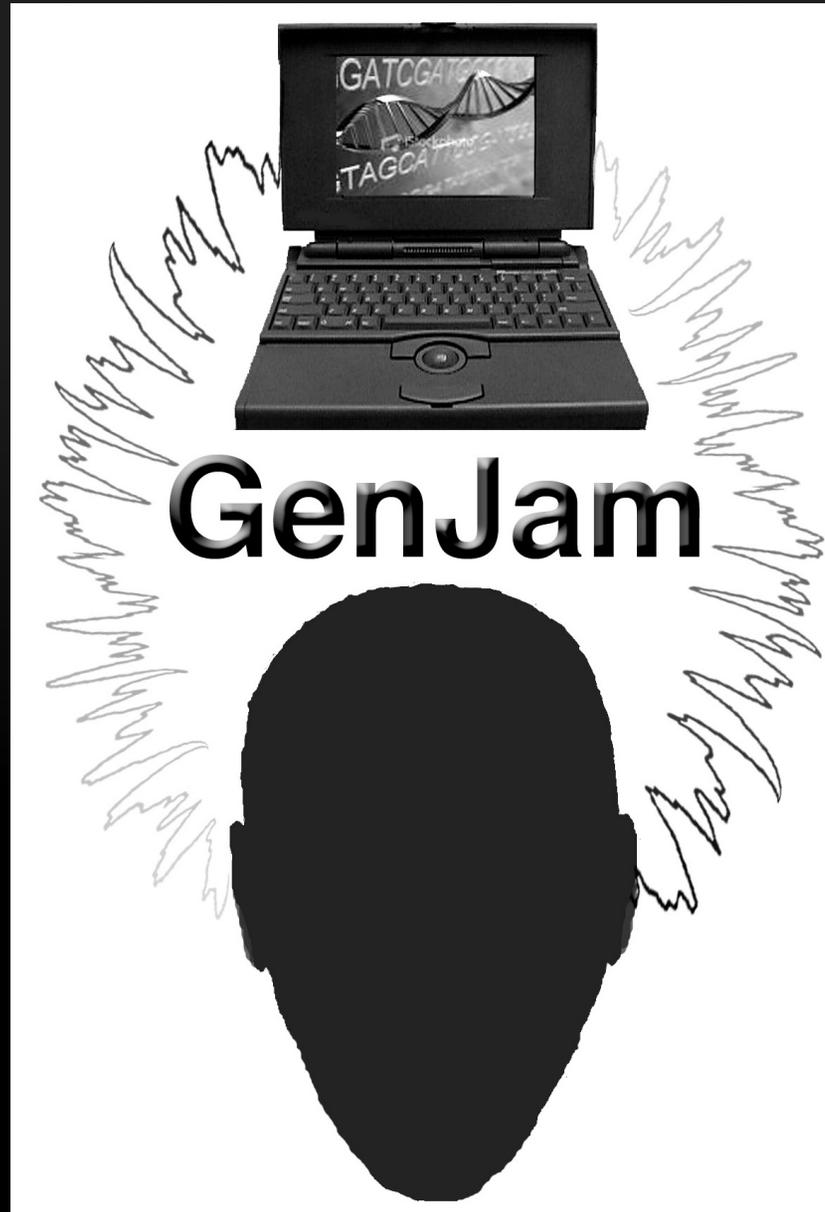
As for When, I started building GenJam in 1993. We played our first gig in early 94, and I gave the first paper at ICMC 94. I've been enhancing it ever since, and I'm always doing new tunes, adding new mutation operators, basically messing with it.





The Who? Well, it's me on trumpet and the computer on everything else. One issue when we play is that a lot of listeners think I'm playing against a music-minus-one CD, but in fact GenJam is a creative agent that truly improvises, so it's really a who too.





And now the How:
My son David made
this logo, which
shows how playing
with GenJam is a
musical conversation.
GenJam listens to me
as I play, maps what
it hears to
chromosomes,
evolves those
chromosomes & uses
them to improvise.

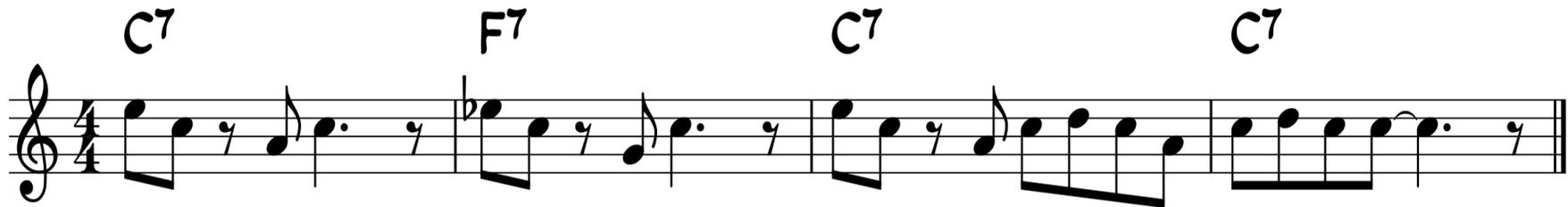


23	-12	57	57	11	38

Phrase Population

11	6	9	7	0	5	7	8	7	5
38	-4	7	8	7	7	15	15	15	0
57	22	9	7	0	5	7	15	15	0

Measure Population



Chromosomes?! GenJam maintains 2 co-evolving populations of melodic ideas, or licks. This example shows a phrase chromosome made up of 4 measure pointers.

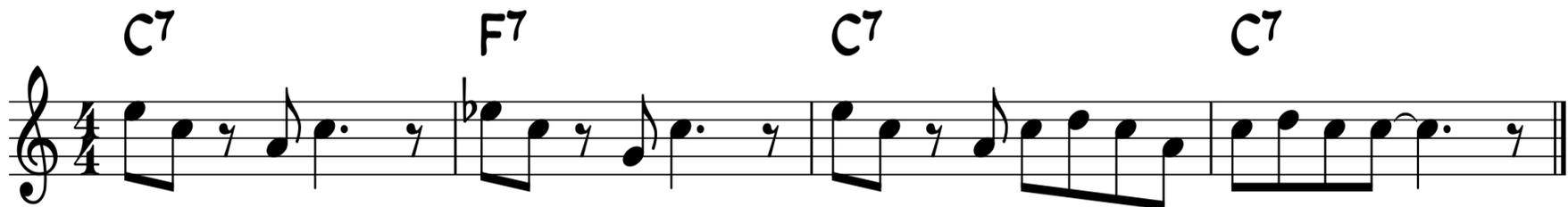


23	-12	57	57	11	38

Phrase Population

11	6	9	7	0	5	7	8	7	5
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57	22	9	7	0	5	7	15	15	0

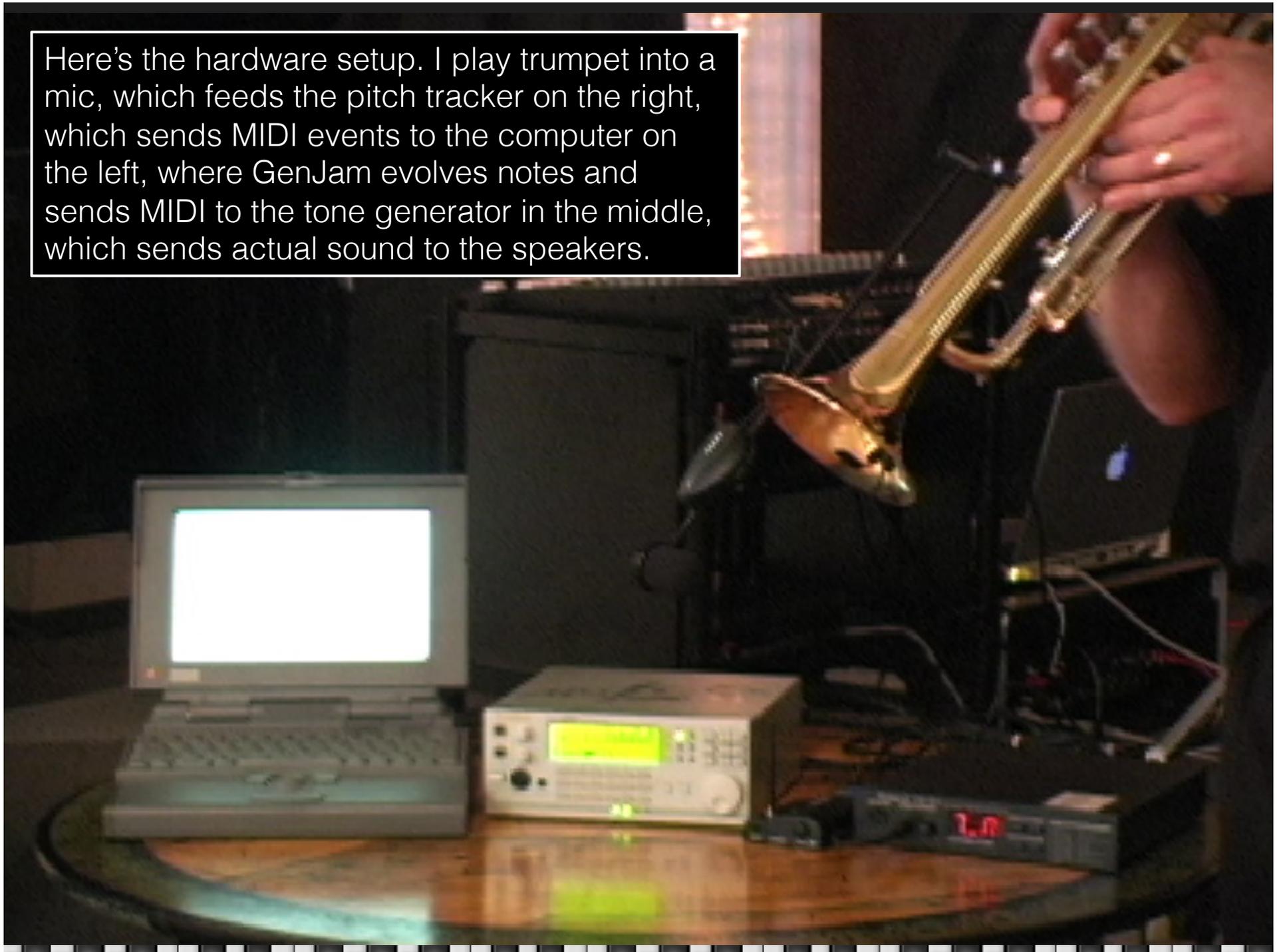
Measure Population



Each measure chromosome has 8 eighth-note-length events, which get mapped to actual pitches based on the chords the measures will be played against. The bottom line is that GenJam cannot play a wrong note, unlike me.



Here's the hardware setup. I play trumpet into a mic, which feeds the pitch tracker on the right, which sends MIDI events to the computer on the left, where GenJam evolves notes and sends MIDI to the tone generator in the middle, which sends actual sound to the speakers.





I use a wireless mic when we play so that I can wander around the venue. This makes it a bit more interesting for the audience, and lets me mess with their heads a little. Note that I'm playing a gig with a pen in my pocket. Not exactly great stage presence...



LADY BIRD

- TADD DAMERON

Handwritten musical notation for the first system of 'Lady Bird'. The top staff is in treble clef with a 4/4 time signature. The melody consists of quarter notes: G4, A4, B4, C5, B4, A4, G4. The bottom staff shows chords: C major, F major, Bb7, and C major. A triplet of eighth notes (G4, A4, B4) is marked above the third measure.

Handwritten musical notation for the second system of 'Lady Bird'. The top staff continues the melody: G4, A4, B4, C5, B4, A4, G4. The bottom staff shows chords: C major, F major, Bb7, and C major. A triplet of eighth notes (G4, A4, B4) is marked above the third measure.

Handwritten musical notation for the third system of 'Lady Bird'. The top staff continues the melody: G4, A4, B4, C5, B4, A4, G4. The bottom staff shows chords: A minor, D major, A minor, and D major.

Handwritten musical notation for the fourth system of 'Lady Bird'. The top staff continues the melody: G4, A4, B4, C5, B4, A4, G4. The bottom staff shows chords: D major and G major.

When I set up a new tune to play, I usually start with a standard lead sheet from a fake book. This gives me the chord progression and the original melody, and it's basically what a human would see at a jam session. I'll use Lady Bird to step through the process.



Band-in-a-Box [2Lady Bird.SGU] 4:58

H Juke Combo Bass Piano Drums Piano (1) Acoustic Piano REV CHR PAN BANK VOL
 M Guitar Sol String Mel Thru 1 2 3 4 5 6 7 8 9 10 45 0 40 0 90 + Wz

Play Stop Replay Hold From Rec Lyrics Notation 1 2
 Open Save .MID .STY Melodist Solo Copy Print 3 4

F Song Lady Bird Memo M F D < no harmony > Emb
 F Style J_BOPPIN.STY C t= 160 (1 - 32) 6 T F D < no harmony >

1a	CMaj7	2	3	Fm7	4	Bb7			
5	CMaj7	6	7	Bbm7	8	Eb7			
9a	AbMaj7	10	11	Am7	12	D7			
13	Dm7	14	G7	15	CMaj7	EbMaj7	16	AbMaj7	DbMaj7
17a	CMaj7	18	19	Fm7	20	Bb7			
21	CMaj7	22	23	Bbm7	24	Eb7			
25a	AbMaj7	26	27	Am7	28	D7			
29	Dm7	30	G7	31	CMaj7	EbMaj7	32	AbMaj7	DbMaj7
33a		34	35	CMaj7	EbMaj7	36	AbMaj7	DbMaj7	
37	CMaj7	EbMaj7	38	AbMaj7	DbMaj7	39a	CMaj7	40	
41a		42	43		44				
45		46							
49		50							
53		54							
57		58							
61		62							

I knuckle the chord progression into Band in a Box, which then generates a MIDI file performing the rhythm section tracks. I usually create another MIDI file with written-out harmony parts, and these files are played back while GenJam and I play in real time.

LADY BIRD.CRD

4 160 Swing

CMaj7

CMaj7

Fm7

Bb7

CMaj7

CMaj7

Bbm7

Eb7

AbMaj7

AbMaj7

Am7

D7

Dm7

G7

CMaj7 EbMaj7

AbMaj7 DbMaj7

GenJam gets to see the chord progression for the tune, up to 2 chords per measure, and it reads the tempo (160 BPM) and whether to use swing eighth notes (for Lady Bird here) or even eighth notes (for a Latin tune).

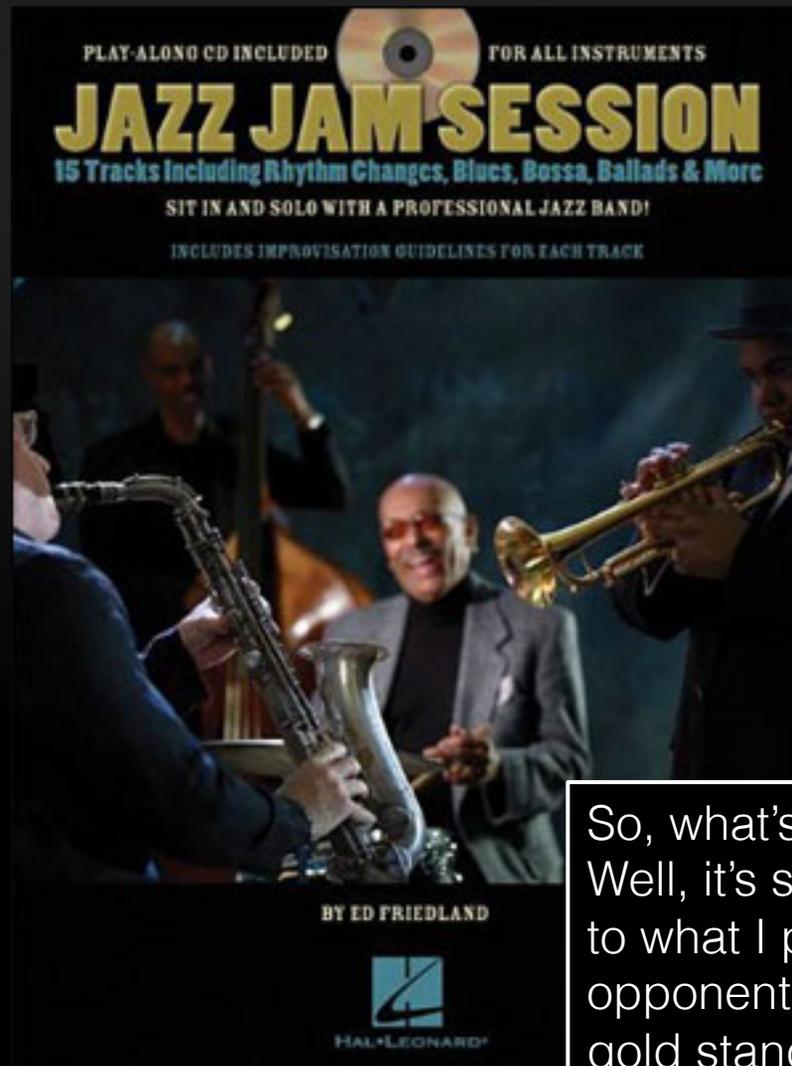


LADYBIRO.CHO

i 2
H 1
r 3
s 3
4 2 2
e 2
h 1
t 4

GenJam also sees what to do for each chorus of the chord progression: 2-bar intro, the head for 1 chorus, rest for 3 choruses while I improvise, solo for 3, trade fours for 2, intelligent echo for 2, a final head chorus, and a 4-bar tag.





So, what's it like playing with GenJam? Well, it's spontaneous, it's responsive to what I play, it's a formidable opponent trading fours, and that's the gold standard at a jam session. Actually, I prefer a GenJam gig to a "human" gig most of the time.



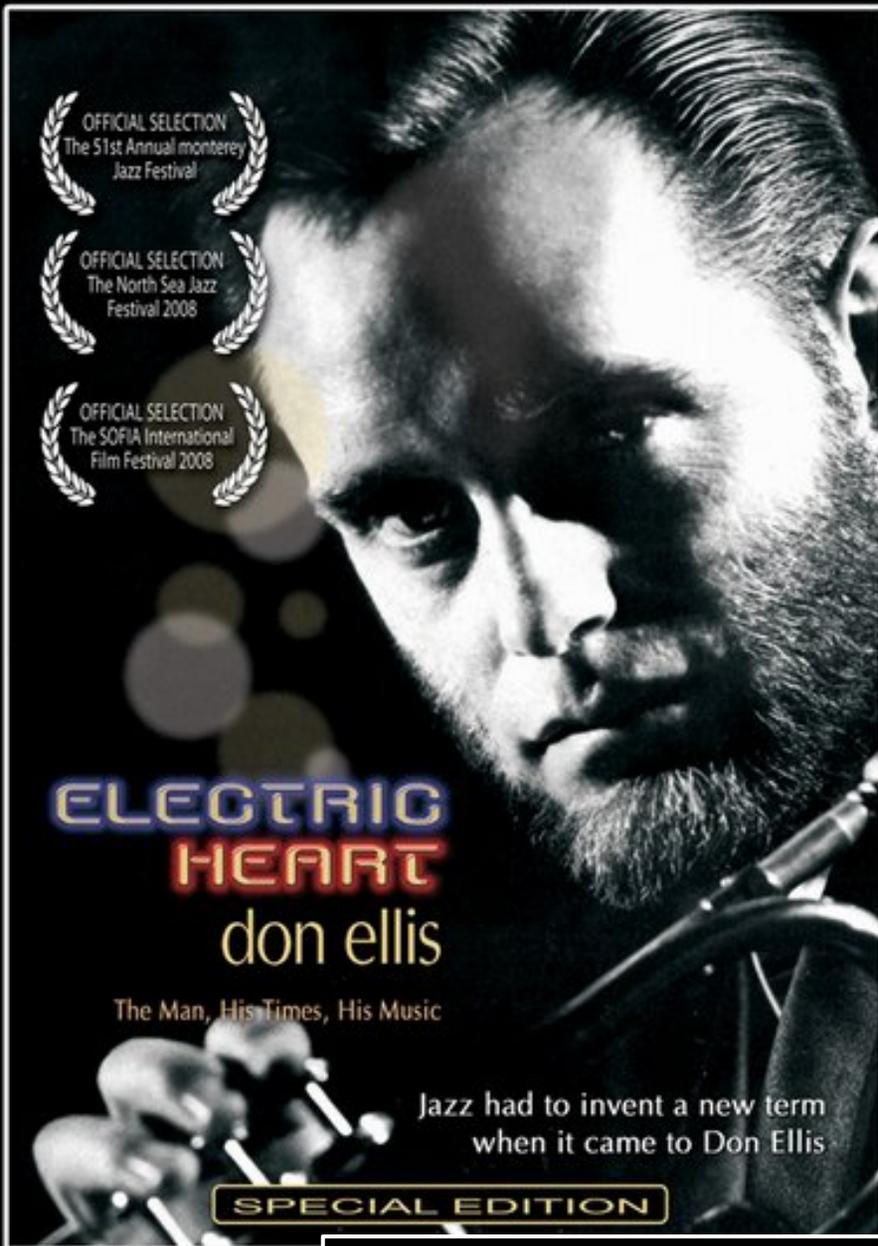


Another reason to prefer GenJam gigs is that the drummer shows up on time, sober, and doesn't rush. How can you tell there's a drummer at the door? The knocking speeds up!



Another advantage is that I can do off-beat tunes like the I Dream of Jeannie theme.

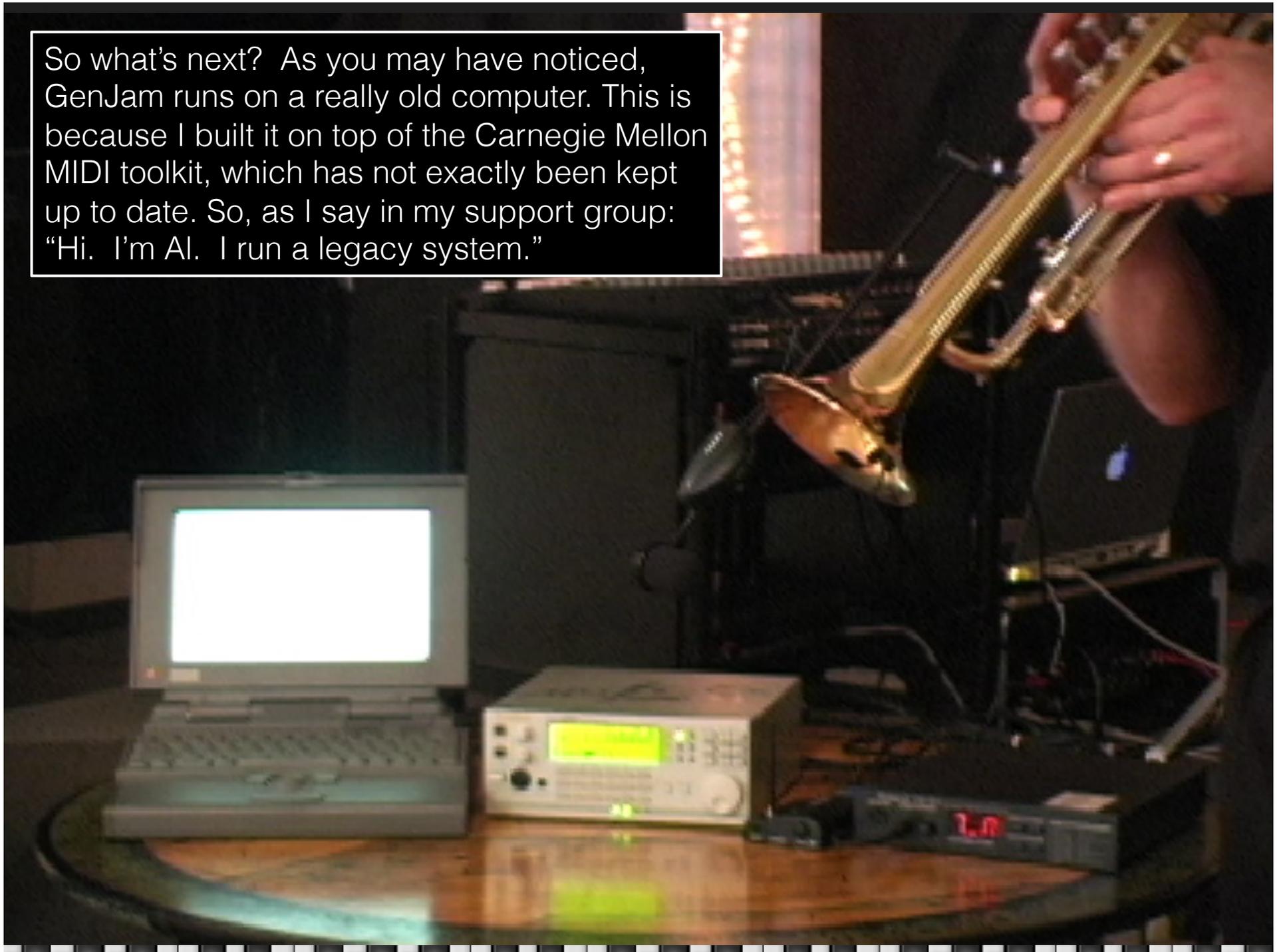




And tunes by obscure jazzmen like Don Ellis.



So what's next? As you may have noticed, GenJam runs on a really old computer. This is because I built it on top of the Carnegie Mellon MIDI toolkit, which has not exactly been kept up to date. So, as I say in my support group: "Hi. I'm Al. I run a legacy system."



Al Biles

Professor

Interactive Games and Media

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More on GenJam:

igm.rit.edu/~jabics/GenJam.html

... or just *Google* "GenJam"

To book GenJam for YOUR event:

jabics@rit.edu

