EE386: Digital Signal Processing
Lab 8: Music Synthesis
of Take on Me by A-Ha using MATLAB

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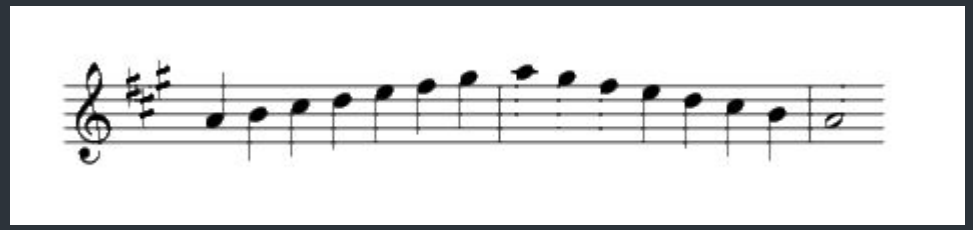
Take On Me

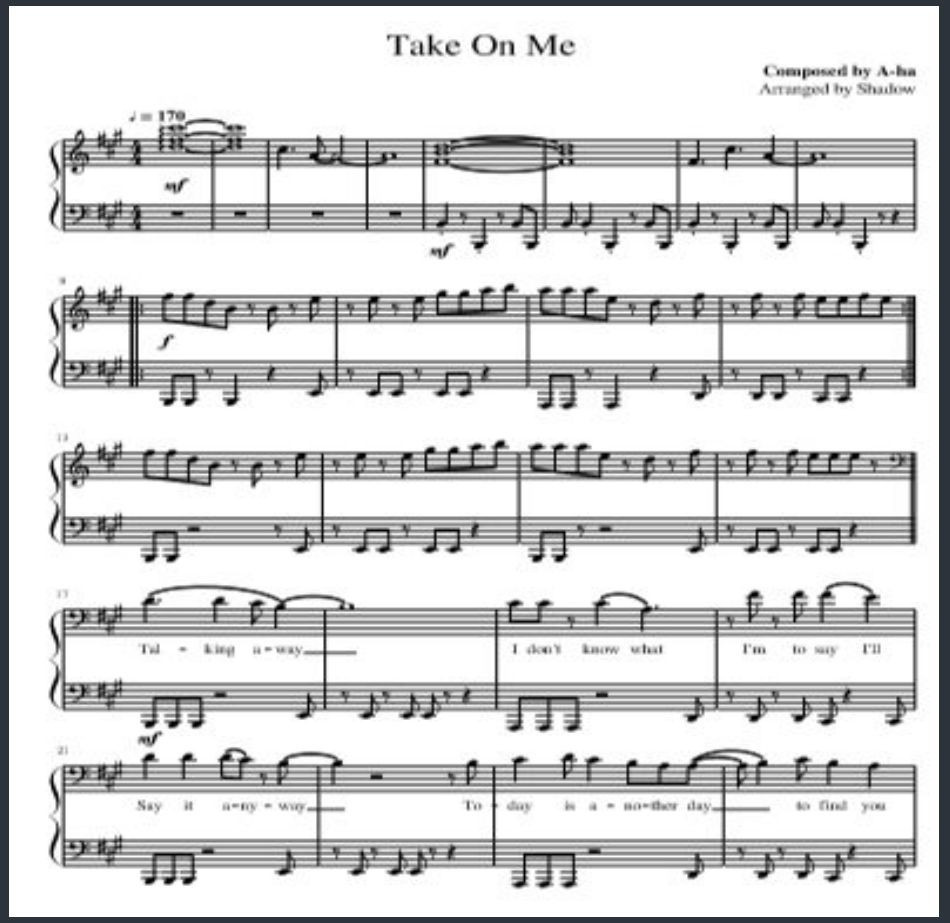
- Released in October 19, 1984 by A-Ha
  - Norwegian new wave band
- Duration: 3 minutes 10 seconds
- Music Video
  https://www.youtube.com/watch?v=djV11Xbc914
- Sheet Music
  https://musescore.com/user/7339591/scores/4536026

Musical Analysis

- Musical Score found on MuseScore by user "Shadow"
- Played in A-major at 170 BPM

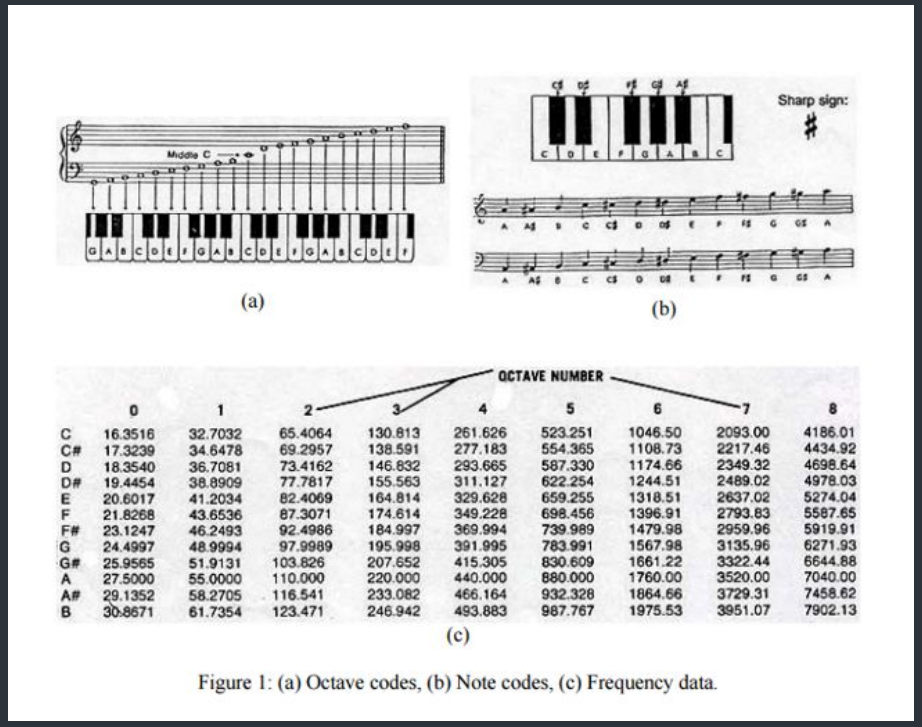


- 4/4 scale
- 60*1000 = 60000 ms/min
  - 60000/170 = 352.941176471 ms/beat



Note Duration Analysis

- Since 352.941176471 is ms / beat
- Half note -> 705.882352942 ms
- Dotted quarter note -> 529.411764707 ms
- Quarter note -> 352.941176471 ms
- Eighth note -> 176.470588236 ms



	0	1	2	3	4	5	6	7	8
C	16.3516	32.7032	65.4064	130.813	261.626	523.251	1046.50	2093.00	4186.01
C#	17.3239	34.6478	69.2957	138.591	277.183	554.365	1108.73	2217.46	4434.92
D	18.3540	36.7081	73.4162	146.832	293.665	587.330	1174.66	2349.32	4698.64
D#	19.4454	38.8909	77.7817	155.563	311.127	622.254	1244.51	2489.02	4978.03
E	20.6017	41.2034	82.4069	164.814	329.628	659.255	1318.51	2637.02	5274.04
F	21.8268	43.6536	87.3071	174.614	349.228	698.456	1396.91	2793.83	5587.65
F#	23.1247	46.2493	92.4986	184.997	369.994	739.989	1479.98	2959.96	5919.91
G	24.4997	48.9994	97.9989	195.998	391.995	783.991	1567.98	3135.96	6271.93
G#	25.9565	51.9131	103.826	207.652	415.305	830.609	1661.22	3322.44	6644.88
A	27.5000	55.0000	110.000	220.000	440.000	880.000	1760.00	3520.00	7040.00
A#	29.1352	58.2705	116.541	233.082	466.164	932.328	1864.66	3729.31	7458.62
B	30.8671	61.7354	123.471	246.942	493.883	987.767	1975.53	3951.07	7902.13

Figure 1: (a) Octave codes, (b) Note codes, (c) Frequency data.

MATLAB Translation

- Ratio is [125;625;250] for half notes

- [88.24; 441.18; 176.47] == Half
- [66.18; 330.89; 132.36] == Dotted Quarter
- [44.12; 220.59; 88.24] == Quarter
- [22.06; 110.3; 44.12] == Eighth

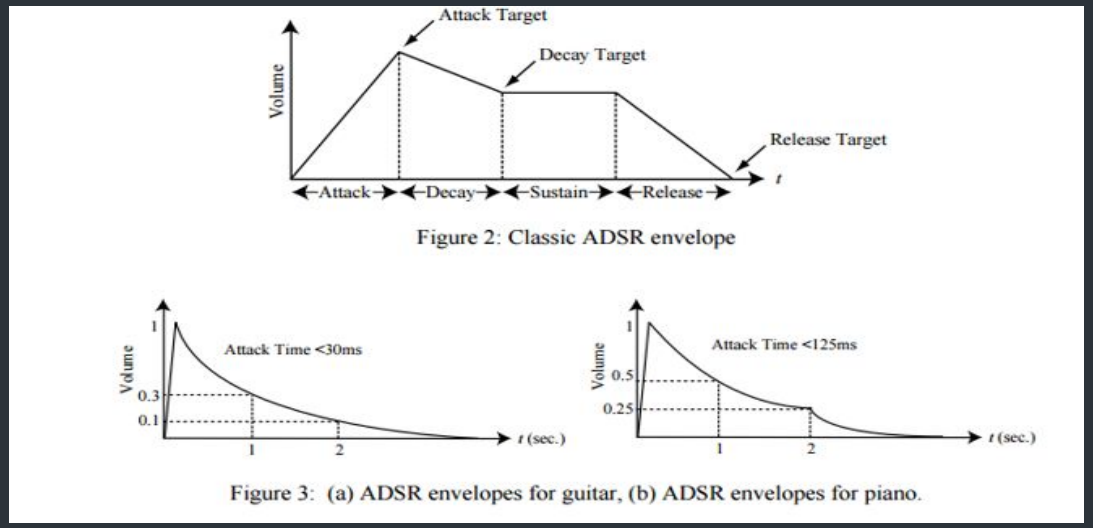


Figure 2: Classic ADSR envelope

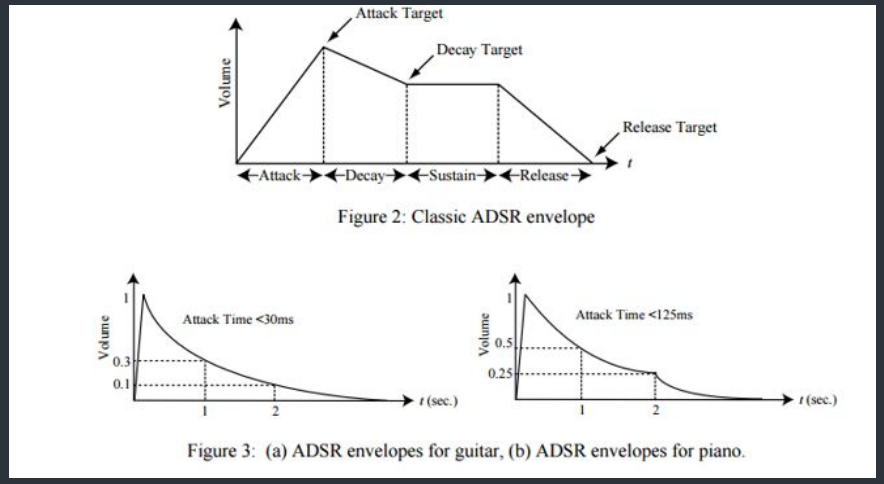
Figure 3: (a) ADSR envelopes for guitar, (b) ADSR envelopes for piano.

adsr_gen.m | TakeOnMe_AHa.m

```
function a = adsr_gen(target,gain,duration)

% Input
% target - vector of attack, sustain, release target values
% gain - vector of attack, sustain, release gain values
% duration - vector of attack, sustain, release durations in ms
% Output
% a - vector of adsr envelope values

fs = 11025;
a = zeros(fs,1); % assume 1 second duration ADSR envelope
duration = round(duration./1000.*fs); % envelope duration in samp

% Attack phase

start = 2;
stop = duration(1);

for n = [start:stop]
a(n) = target(1)*gain(1) + (1.0 - gain(1))*a(n-1);
end

% Sustain phase

start = stop + 1;
stop = start + duration(2);
for n = [start:stop]
a(n) = target(2)*gain(2) + (1.0 - gain(2))*a(n-1);
end

% Release phase

start = stop + 1;
stop = fs;
for n = [start:stop]
a(n) = target(3)*gain(3) + (1.0 - gain(3))*a(n-1);
end
```

Frequency Presets

- Sample Frequency = 11025 Hz
- Uses adsr * cos(2 * pi * f * t) where adsr == amplitude
- Sec0 == Treble note and Sec1 = Bass note




```
50 -    Duration = [22.06;110.3;44.12];  % eighth note -> 176.470588236 ms
51 -    adsr = adsr_gen(Target,Gain,Duration);
52 -    sec0 = adsr.*(cos(739.989*2*pi.*t'));   % F5#
53 -    sec1 = adsr.*(cos(61.7354*2*pi.*t'));   % B1
54 -    soundsc(sec0,11025)
55 -    soundsc(sec1,11025)
56 -    pause(0.176)
57
58 -    Duration = [22.06;110.3;44.12];  % eighth note -> 176.470588236 ms
59 -    adsr = adsr_gen(Target,Gain,Duration);
60 -    sec0 = adsr.*(cos(587.330*2*pi.*t'));   % D5
61 -    soundsc(sec0,11025)
62 -    pause(0.176)
```