TÜRKİYE CUMHURİYETİ

YILDIZ TEKNİK ÜNİVERSİTESİ
BİLGİSAYAR MÜHENDİSLİĞİ BÖLÜMÜ

Dönem Projesi
Müzik Türü Tahmini için Kısa Zamanlı Fourier Dönüşümü (STFT) ve KNN Algoritması
Kullanarak Frekans Tabanlı Özellik Çıkarımı

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Giriş:

Projede STFT (Short Time Fourier Transform) kullanarak kendi yazdığımız fft fonksiyonu ile frekans düzleminde özellik çıkarımı yaparak müzik özellik çıkarımı yaptım. Özellik çıkarımı olarak STFT sonucu oluşan ayrık zamanların herbirinden frekans gücü, frekans düzleminde genlik ortalaması ve genliğe göre ağırlıklı frekans ortalaması aldım. Bunu yaparaken 3 adet window tipi kullandım. Bu window tipleri olarak Hamming, Hanning ve Blackmen kullandım.
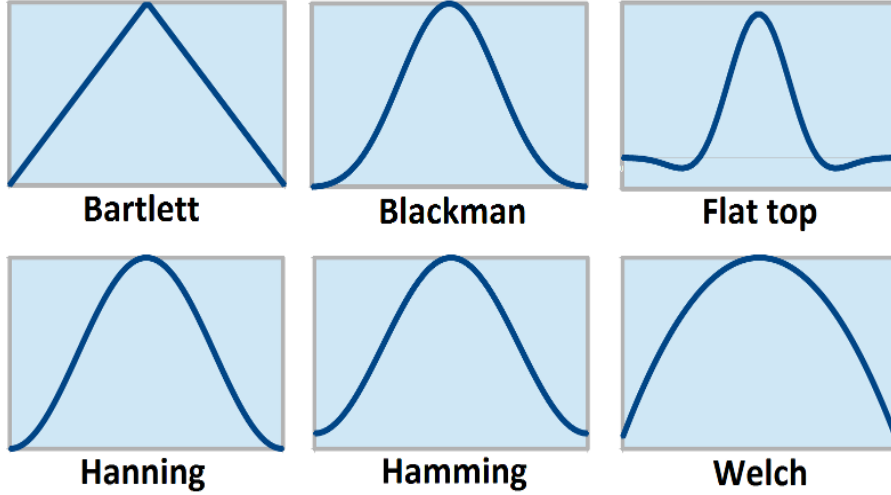

Figure 1: Window tipleri(link)

 Sonrasında bu özelliklerin her biri için tüm ayrık zamanlardaki ortalaması, medyanı ve ortalama sapmasını hesapladım. Bu yaptığım işlemler sonucunda ses dosyasından belirli bir sayıda özellik çıkarmış oldum. Bunun yapılmasının sebebi ise bir ses dosyasında yaklaşık 661504 adet ayrık zamanlı veri bulunmakta ve bunları sınıflandırmak için knn'e vermek hem çok masraflı hemde işlevsel değil. Ancak yukarıdaki gibi bir özellik çıkarımı yaptığımız zaman ise kesin olarak 9 adet özellik çıkarımı yapıyoruz. Ancak bu çıkarılan 9 adet özellik ses dosyasının karatersitik özelliğini tam olarak temsil edemeyebiliyor bunu ileriki sayfalarda sonuçlarda göreceğiz. Projede k=1, k=3 , k=5 için denemler yapılmış ve sonuçları projenin sonunda tablo olarak gösterdim.

Fonksiyonlar:

```python
def stft(x, window, num_threads):
    window_size = len(window)
    hop_size = int(window_size // 1.25)#%20 overlap
    N = len(x)
    num_frames = (N - window_size) // hop_size + 1
    stft_matrix = np.zeros((window_size, num_frames), dtype=np.complex64)
    target_length = getPowerLength(window_size)

    def process_frame(i):
        start = i * hop_size
        end = start + window_size
        frame = x[start:end]
        windowed_frame = frame * window
        apply_zero_padding(windowed_frame, target_length)
        return fft(windowed_frame)

    with ThreadPoolExecutor(max_workers=num_threads) as executor:
        futures = [executor.submit(process_frame, i) for i in range(num_frames)]
        for i, future in tqdm(enumerate(futures), leave=False, position=2, total=num_frames):
            stft_matrix[:, i] = future.result()

    return stft_matrix
```

STFT: Burada STFT için parametre olarak ses datası, window ve thread sayısı veriyorum. Performansı arttırmak için thread pool kullandım. Burada kısaca ses dosyasını window boyutlarına bölerek üzerinde fft çalıştırıyor.

```python
def fft(x):
    N = len(x)

    if N <= 1:
        return x

    even = fft(x[0::2])
    odd = fft(x[1::2])

    factor = np.exp(-2j * np.pi * np.arange(N) / N)

    return np.concatenate([even + np.multiply(factor[:N // 2], odd),
                           even + np.multiply(factor[:N // 2], odd)])
```
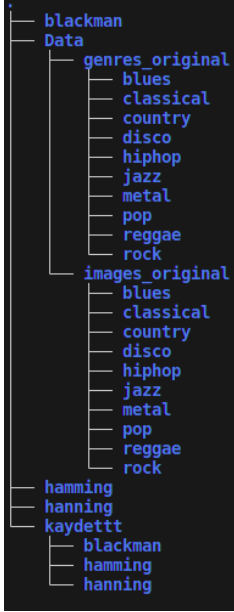
FFT: Burada kendi yazdığım fft fonksiyonunda zaman tabanlı ayrık veriyi alarak tek ve çift zamanlı verileri ayırarak fourier transformu yaptırıyorum.

SONUÇLAR:

Proje Dizini yapısı:

```
├── blackman
├── Data
│   ├── genres_original
│   │   ├── blues
│   │   ├── classical
│   │   ├── country
│   │   ├── disco
│   │   ├── hiphop
│   │   ├── jazz
│   │   ├── metal
│   │   ├── pop
│   │   ├── reggae
│   │   └── rock
│   └── images_original
│       ├── blues
│       ├── classical
│       ├── country
│       ├── disco
│       ├── hiphop
│       ├── jazz
│       ├── metal
│       ├── pop
│       ├── reggae
│       └── rock
├── hamming
├── hanning
└── kaydettt
    ├── blackman
    ├── hamming
    └── hanning
```

Burada stft sonucu çıkarlan bölünmemiş dataset proje dizininde olur. Dataset bölütlendikten sonra uygulanan pencere tipine göre klasörün içine koyulur. Ayrıca bu klasörde test_result ve train_result csv dosyalarıda bulunur.

features0.csv

id	frequency_power_mean	frequency_power_median	frequency_power_deviation	amplitude_mean_mean	amplitude_mean_median	amplitude_mean_deviation	weighted_frequency_mean	weighted_frequency_median	weighted_frequency_deviation	label
disco_74	12775655000000	1469314800000	44838940000000	71213.625	44726.453	89182.11	144.836183463363	97.4522265639479	152.392244296344	disco
disco_73	3844698000000	639276740000	12688620000000	41425.387	29688.541	49341.832	152.530921839162	104.354680327323	152.320802891995	disco
disco_94	3784178100000	310360600000	26599326000000	31413.645	19730.268	65672.49	74.2068306336786	48.3789143988383	93.6793959323865	disco
disco_95	4377370700000	391343960000	27184310000000	30511.23	18146.658	54143.973	122.077024657696	80.3780492525261	131.447257775375	disco
disco_87	5225293300000	285375140000	19664042000000	40298.08	18917.191	64167.945	102.222239928475	66.0435877985959	129.065982863878	disco
disco_78	2141774200000	110552710000	11057855000000	20597.586	10595.106	35075.5	84.4846389194455	54.1555754483433	116.239204878395	disco
disco_75	4710255500000	665505264000	22734200000000	42256.297	31232.617	60328.598	118.188143940874	78.7076877765514	127.893608776719	disco
disco_96	3558205300000	678355300000	18408289000000	33298.25	24886.95	48244.16	147.198681305428	99.0647723603544	146.712193127765	disco
disco_85	3809426500000	308504950000	30591588000000	27969.656	19895.736	52468.74	66.6767742564943	44.3480311127211	83.8648305563727	disco
disco_97	4925058000000	464121950000	43615780000000	35683.625	24217.969	66840.76	84.8513978662485	57.1103351744883	95.1045070165727	disco
disco_91	14497641000000	1511926400000	90199880000000	52050.19	29777.898	100631.94	103.651202380509	68.8883434579171	115.877909731233	disco
disco_72	3094934200000	647133130000	14481759000000	35441.25	25186.402	39747.113	173.203558943075	121.732293173644	156.953343914491	disco
disco_89	3901479200000	267852610000	14152421000000	36498.805	17028.582	56118.387	122.61687764277	80.3795581776663	140.698142893516	disco
disco_81	2994105000000	127058936000	15405554000000	23731.682	10946.076	41484.92	87.4537232407729	55.8451812642798	114.289761649509	disco
disco_92	4512192400000	452556300000	22952840000000	35877.535	24374.303	62193.23	113.435617131512	74.3849195425759	127.858717328625	disco
disco_79	3116914200000	275843060000	24305375000000	26418.748	16934.184	50451.19	78.5645674791523	51.3024055452276	96.457962552513	disco
disco_86	10520196000000	534767000000	37162674000000	53859.77	21694.996	88058.55	122.210347203752	79.4717687494168	142.431910355051	disco
disco_93	9643047000000	929483500000	47169415000000	54740.402	28354.559	84472.42	129.471548090113	87.1852403757029	133.76636320729	disco
disco_90	3909109000000	269798950000	23687466000000	31259.809	19512.523	52928.76	80.7137203321076	51.7473134743955	103.251844551024	disco
disco_88	5993557000000	388122250000	32749346000000	41155.094	20864.254	66670.75	114.610947974548	74.27647616875	129.562522135391	disco
disco_83	3091822000000	93403230000	16696933000000	24923.188	10547.911	51800.06	70.0278882806947	44.1218945838966	105.275371617089	disco
disco_76	6384040000000	320910520000	20484582000000	44846.65	20009.912	61571.277	122.256566302376	80.2769354168991	146.679978820963	disco
disco_80	1580499900000	106557680000	11052024000000	15535.781	8759.3125	34448.395	62.2542163656707	40.6401370743055	86.6202607948845	disco
disco_84	2111276600000	183547890000	12429549000000	22366.44	11827.49	33795.33	116.603782502197	76.422290042562	125.907120233367	disco
disco_99	5859502500000	572479770000	28694448000000	44711.33	27250.45	70662.336	98.3663874387464	64.8790268258944	117.245159795429	disco
disco_70	4807335000000	531465400000	16814454000000	45134.586	27346.615	61713.18	130.174548857478	86.4771047302043	142.762073010989	disco
disco_77	16745072000000	1191358600000	93968870000000	67474.04	37403.76	117498.09	110.296554138366	71.8369006619775	128.276018345234	disco
disco_71	3934528200000	514948100000	20098381000000	37687.785	26163.996	50193.23	125.726794391592	84.693866030053	130.955880784381	disco
disco_98	5859502500000	572479770000	28694448000000	44711.33	27250.45	70662.336	98.3663874387464	64.8790268258944	117.245159795429	disco
disco_82	14079799000000	1987689300000	69706040000000	66750.97	46175.902	95476.75	116.310758034003	79.1254230800817	123.363426410528	disco
jazz_22	1160633400000	4050204000	8220007500000	7896.5938	2082.054	22808.082	74.7105842796318	47.8066471697808	133.544020546917	jazz
jazz_27	660241840000	7848195000	3838903300000	9559.866	3217.6606	22295.096	90.922510372321	57.439321295083	122.314502893723	jazz
jazz_8	5481912300000	24359162000	36338760000000	23021.646	4760.746	64364.16	51.7442856247827	31.4526930829138	91.279284047191	jazz
jazz_14	90646014000	2967268900	603721670000	6227.0596	847.8561	16691.516	130.770155129751	85.8714542025721	165.256066964769	jazz
jazz_1	267324690000	4819138700	1152757700000	5918.673	1455.0942	13408.752	81.4110703717606	51.5861882675386	122.234487538666	jazz
jazz_9	2808628000000	1125428700	18872216000000	11875.033	1034.5612	44826.688	46.5773524548113	28.8165643027442	103.577730496833	jazz
jazz_7	3882644700000	11124856000	19340714000000	13361.301	2162.2258	35717.605	114.490170761511	75.3405254736861	165.027801735744	jazz
jazz_2	2641670700000	4110775300	10968464000000	16866.727	1376.5068	39452.44	99.5450727678156	63.3042707691822	140.757368004573	jazz
jazz_10	2045140500000	4104234600	11711865000000	12225.175	1164.6771	34603.05	76.3295466231436	47.1628838481618	114.735737457232	jazz
jazz_17	1224076000000	18364969000	7562583300000	12457.09	4714.7944	26699.932	84.1448539338089	53.0363246803947	124.676982830904	jazz
jazz_0	1323835900000	60420520000	6585522000000	14452.305	4728.4375	25631.773	104.724810552888	68.3800183173615	134.413484650318	jazz
jazz_5	4856385400000	48733725000	27479108000000	19480.715	5347.6104	52203.836	90.3426324159482	57.214939423684	136.253400337437	jazz
jazz_11	2162597700000	30340313000	9921021000000	17680.867	6104.757	36626.465	108.353279851325	69.679223316519	146.145475887902	jazz
jazz_16	1733717000000	9869320000	5758190600000	11898.692	2476.6643	24562.75	135.606930483252	88.9559956922218	166.236167963356	jazz
jazz_15	1595016200000	23387783000	6250482000000	16636.246	5421.0913	31906.428	111.509374250776	71.6385477592676	146.820853062881	jazz
jazz_3	1691591400000	1824443900	9543306000000	12933.494	1192.0093	39509.715	67.9738611671766	42.9001233545135	125.776384061207	jazz

İsimlendirme olarak her window için bir numara verdim(Figure 1). Yani burası hamming window için. Burada 9 adet feature ile birlikte resim id si ve resim label'ı bulunuyor. Ayrıca burada seçtiğim 5 adet türdeki 30 ses dosyasının hepsi burada bulunuyor.
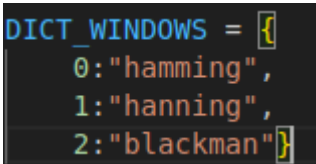
```
DICT_WINDOWS = {
    0:"hamming",
    1:"hanning",
    2:"blackman"}
```

Figure 2: pencere
isimleri

hamming/test.csv

id	frequency_power_mean	frequency_power_median	frequency_power_deviation	amplitude_mean_mean	amplitude_mean_median	amplitude_mean_deviation	weighted_frequency_mean	weighted_frequency_median	weighted_frequency_deviation	label
disco_83	3091822000000	93403230000	16696933000000	24923.188	10547.911	51800.06	70.0278882806947	44.1218945838966	105.275371617089	disco
disco_76	6384040000000	320910520000	20484582000000	44846.65	20009.912	61571.277	122.256566302376	80.2769354168991	146.679978820963	disco
disco_80	1580499900000	106557680000	11052024000000	15535.781	8759.3125	34448.395	62.2542163656707	40.6401370743055	86.6202607948845	disco
disco_84	2111276600000	183547890000	12429549000000	22366.44	11827.49	33795.33	116.603782502197	76.422290042562	125.907120233367	disco
disco_99	5859502500000	572479770000	28694448000000	44711.33	27250.45	70662.336	98.3663874387464	64.8790268258944	117.245159795429	disco
disco_70	4807335000000	531465400000	16814454000000	45134.586	27346.615	61713.18	130.174548857478	86.4771047302043	142.762073010989	disco
disco_77	16745072000000	1191358600000	93968870000000	67474.04	37403.76	117498.09	110.296554138366	71.8369006619775	128.276018345234	disco
disco_71	3934528200000	514948100000	20098381000000	37687.785	26163.996	50193.23	125.726794391592	84.693866030053	130.955880784381	disco
disco_98	5859502500000	572479770000	28694448000000	44711.33	27250.45	70662.336	98.3663874387464	64.8790268258944	117.245159795429	disco
disco_82	14079799000000	1987689300000	69706040000000	66750.97	46175.902	95476.75	116.310758034003	79.1254230800817	123.363426410528	disco
jazz_19	983656900000	4336398300	4933691000000	9999.87	2140.1992	25005.107	82.0851445733085	51.6468889743536	130.016481207606	jazz
jazz_25	2210282900000	21083668000	12281841000000	13789.332	4679.811	33202.902	99.3425476854453	64.1070023955998	147.506687802129	jazz
jazz_26	469513670000	551843600	3394212000000	3984.3872	685.87524	13775.337	80.5071601123093	51.3592684326366	135.432350569717	jazz
jazz_24	1518510900000	47023300000	6579796000000	16445.402	7373.3203	29004.082	105.361044359349	67.5829615674418	140.844263865032	jazz
jazz_6	3864778500000	28239413000	19231335000000	19461.115	3926.873	48871.266	78.9657212931421	49.5711268663288	119.011177202869	jazz
jazz_13	1190428900000	15968925000	7129183000000	13219.279	4948.357	32642.373	60.2775438834639	37.6371099916587	106.654112282436	jazz
jazz_28	1041479600000	16196728000	3521080700000	12020.481	4351.055	22302.012	119.873303693786	77.8682655373717	154.786724310272	jazz
jazz_4	4921650000000	11786435000	35527850000000	15540.551	2493.3064	52051.727	73.3058976511806	46.5056697973519	130.101237436765	jazz
jazz_12	594526700000	8262413300	2743601200000	9658.33	3118.3723	20869.332	88.3741963437786	55.6997885435403	126.533438476104	jazz
jazz_18	1056877700000	20331401000	6634157000000	14845.832	5561.5522	29990.018	91.0404127445335	57.3923824711285	125.867957964671	jazz
blues_98	6131095000000	849261900000	23253083000000	46776.93	30629.758	69341.28	155.559546829225	104.868220194259	155.555838652213	blues
blues_3	9294131000000	33327290000	125361560000000	24927.107	5258.627	97302.73	29.3460280901081	17.7448509390151	73.6459025482139	blues
blues_93	2204591700000	9502850000	21733591000000	9094.088	878.758	44467.414	31.9288525485598	19.6896077828403	80.6065968994672	blues
blues_14	2523385000000	15465747000	11182489000000	12956.999	2643.4573	31800.158	122.531233528142	79.3459205160885	149.541858654074	blues
blues_22	5842097700000	41348747000	24627357000000	23249.984	4270.449	55188.8	116.21698241059	74.7911384738374	139.573441874675	blues
blues_97	14899616000000	211709590000	101127400000000	41154.195	11100.035	125247.125	47.3027700371632	29.2938199413895	90.2129623242361	blues
blues_21	4781303000000	22942298000	27688025000000	19235.916	3241.888	52988.39	102.236480307874	64.8191464448396	131.266083511061	blues
blues_12	6418730000000	34449870000	65292780000000	24547.445	5065.8784	69840.51	96.9936546901159	61.7279021989136	130.068017368349	blues
blues_10	10548468000000	204960560000	54796262000000	33887.805	10705.541	72865.81	110.763122655363	72.8254141325299	157.615297198849	blues
blues_8	7684661700000	220523100000	55393183000000	38326.58	15107.63	92702.78	67.2115286003589	41.8973835763541	102.326039544032	blues
metal_2	6466561000000	527510800000	21228587000000	55995.344	27307.883	76905.61	140.490945235737	93.110578645775	154.764144790384	metal
metal_17	4702731000000	802245500000	22044127000000	49111.984	34943.777	71648.71	127.997934405906	86.5212455407414	128.453765583938	metal
metal_97	13161036000000	811587500000	85294810000000	58340.805	31030.324	123768.055	74.6972376990546	47.499521496337	94.8676394403	metal
metal_14	2218291400000	431540600000	9153844000000	35881.906	25680.598	44181.957	196.569066496761	138.022947423904	179.286990073423	metal
metal_9	3460117500000	2604023400000	23031682000000	110839.42	67614.58	222762.48	74.8903559257102	48.1985857334123	97.6587384776076	metal
metal_16	26431460000000	4315539000000	78246790000000	133873.12	85935.91	145240.83	191.681228907663	133.054507870203	180.832510152666	metal
metal_7	1745837900000	201933030000	8741605300000	31030.773	18276.414	40591.2	144.633990221459	99.6878766999034	141.154194872208	metal
metal_3	8338608000000	1535229100000	36765155000000	67937.25	47313.54	82323.74	172.48867031774	118.26824417142	165.684938270455	metal
metal_6	928047000000	227019160000	3150601800000	23949.67	18217.799	24176.072	202.270752891664	145.900994127935	175.06751777292	metal
metal_96	13580334000000	2017350400000	76651640000000	69201.78	51779.76	112966.91	100.767520704788	66.514179309101	110.734990579805	metal
reggae_96	11027805000000	189443110000	125388785000000	35829.906	11173.1045	93078.164	72.1959458977559	45.0224361981417	94.268095015919	reggae
reggae_3	3843739400000	86538010000	34649114000000	21504.727	8599.705	54227.535	61.8227809919743	38.4099272121725	93.2358471753252	reggae
reggae_5	4430574000000	92037630000	31309766000000	25651.129	9839.168	54637.145	78.3441153380704	48.9112984320484	113.230934283222	reggae
reggae_81	14901471000000	1360691100000	189528870000000	47869.33	31207.98	115160.59	65.5529748709914	43.1178254207787	78.9753452496309	reggae
reggae_97	5256587000000	133089420000	26850842000000	31282.402	10733.265	54789.17	114.520958890945	74.8373290387379	142.103518205595	reggae
reggae_95	10684075000000	652262000000	68331150000000	55305.867	29243.953	97753.32	98.0144531584428	65.6156826437587	115.144826701697	reggae

burada hamming window ile üretilmiş datasetinin train ve test olarak bölünmüş halinin test dosyası burada her tür için 10 adet şarkı toplamda ise 50 adet şarkı bulunuyor. Test için 10 train için ise 20 şarkı seçilmiştir.

hamming/train.csv

id	frequency_power_mean	frequency_power_median	frequency_power_deviation	amplitude_mean_mean	amplitude_mean_median	amplitude_mean_deviation	weighted_frequency_mean	weighted_frequency_median	weighted_frequency_deviation	label
disco_74	12775655000000	1469314800000	44838940000000	71213.625	44726.453	89182.11	144.836183463363	97.4522265639479	152.392244296344	disco
disco_73	3844698000000	639276740000	12688620000000	41425.387	29688.541	49341.832	152.530921839162	104.354680327323	152.320802891995	disco
disco_94	3784178100000	310360600000	26599326000000	31413.645	19730.268	65672.49	74.2068306336786	48.3789143988383	93.6793959323865	disco
disco_95	4377370700000	391343960000	27184310000000	30511.23	18146.658	54143.973	122.077024657696	80.3780492525261	131.447257775375	disco
disco_87	5225293300000	285375140000	19664042000000	40298.08	18917.191	64167.945	102.222239928475	66.0435877985959	129.065982863878	disco
disco_78	2141774200000	110552710000	11057855000000	20597.586	10595.106	35075.5	84.4846389194455	54.1555754483433	116.239204878395	disco
disco_75	4710255000000	665052640000	22734200000000	42256.297	31232.617	60328.598	118.188143940879	78.7076877765514	127.893608776719	disco
disco_96	3558205300000	678355300000	18408289000000	33298.25	24886.95	48244.16	147.198681305428	99.0647723603544	146.712193127765	disco
disco_85	3809426500000	308504950000	30591588000000	27969.656	19895.736	52468.74	66.6767742564943	44.3480311127211	83.8648305563727	disco
disco_97	4925058000000	464121950000	43615780000000	35683.625	24217.969	66840.76	84.8513978662485	57.1103351744883	95.1045070165727	disco
disco_91	14497641000000	1511926400000	90199880000000	52050.19	29777.898	100631.94	103.651202380509	68.8883434579171	115.877909731233	disco
disco_72	3094934200000	647133130000	14481759000000	35441.25	25186.402	39747.113	173.203558943075	121.732293173644	156.953343914491	disco
disco_89	3901479200000	267852610000	14152421000000	36498.805	17028.582	56118.387	122.61687764277	80.3795581776663	140.698142893516	disco
disco_81	2994105000000	127058936000	15405554000000	23731.682	10946.076	41484.92	87.4537232407729	55.8451812642798	114.289761649509	disco
disco_92	4512192400000	452556300000	22952840000000	35877.535	24374.303	62193.23	113.435617131512	74.3849195425759	127.858717328625	disco
disco_79	3116914200000	275843060000	24305375000000	26418.748	16934.184	50451.19	78.5645674791523	51.3024055452276	96.457962552513	disco
disco_86	10520196000000	534767000000	37162674000000	53859.77	21694.996	88058.55	122.210347203752	79.4717687494168	142.431910355051	disco
disco_93	9643047000000	929483500000	47169415000000	54740.402	28354.559	84472.42	129.471548090113	87.1852403757029	133.76636320729	disco
disco_90	3909109000000	269798950000	23687466000000	31259.809	19512.523	52928.76	80.7137203321076	51.7473134743955	103.251844551024	disco
disco_88	5993557000000	388122250000	32749346000000	41155.094	20864.254	66670.75	114.610947974548	74.27647616875	129.562522135391	disco
jazz_22	1160633400000	4050204000	8220007500000	7896.9938	2082.054	22808.082	74.7105842796318	47.8066471697808	133.544020596344	jazz
jazz_27	660241840000	7848195000	3838903030000	9559.866	3217.6606	22295.096	90.922510372321	57.439321295083	122.314502893723	jazz
jazz_8	5481912300000	24359162000	36338760000000	23021.646	4760.746	64364.16	51.7442856247587	31.4526930829138	91.2791384074191	jazz
jazz_14	906460140000	2967268900	6037216700000	6227.0596	847.8561	16691.516	130.770155129751	85.8714532025721	165.256068964769	jazz
jazz_1	267324690000	4819188700	1152757700000	5918.673	1455.0942	13408.752	81.4110703171561	51.5861882675386	122.234487538666	jazz
jazz_9	2808628000000	1125428700	18872216000000	11875.033	1034.5612	44826.688	46.5773524548113	28.8165643027442	103.577730496833	jazz
jazz_7	3882644700000	11124856000	19340714000000	13361.301	2162.2258	35717.605	114.490170761551	75.3405254736861	165.027801735364	jazz
jazz_2	2641670700000	4110775300	10968464000000	16866.727	1376.5068	39452.44	99.5450727678156	63.3042707691822	140.757368004573	jazz
jazz_10	2045140500000	41042345000	11711865000000	12225.175	1164.6771	34603.05	76.3295466231436	47.1628838481618	114.735737457232	jazz
jazz_17	1224076000000	18364969000	7562583300000	12457.09	4714.7944	26699.932	84.144853933899	53.0363246803947	124.679982830904	jazz
jazz_0	1323835900000	60420520000	6585522000000	14452.305	4728.4375	25631.773	104.724810552888	68.3800183173615	134.413484650318	jazz
jazz_5	4856385400000	48733725000	27479108000000	19480.715	5347.6104	52203.836	90.3426324159482	57.214939423684	136.253400337437	jazz
jazz_11	2162597700000	30340313000	9921021000000	17680.867	6104.757	36626.465	108.353279851325	69.679223316519	146.145475887902	jazz
jazz_16	1733717000000	9869320000	5758190600000	11898.692	2476.6643	24562.75	135.606930483252	88.9559956922218	166.236167963376	jazz
jazz_15	1595016200000	23387783000	6250482000000	16636.246	5421.0913	31906.428	111.509374250776	71.6385477592676	146.820853062881	jazz
jazz_3	1691591400000	1824443900	9543306000000	12933.494	1192.0093	39509.715	67.9738611671761	42.9001233545135	125.776384061267	jazz
jazz_20	357827600000	1215333600	2051304800000	4230.3247	928.33026	12331.245	69.9976337149495	43.656765300356	118.889775748924	jazz
jazz_29	519387280000	19588348000	2041606000000	10817.094	4935.391	18301.275	110.610860735254	71.7228215850757	135.415261253507	jazz
jazz_23	3065458000000	60973883000	18944568000000	19397.346	8404.123	43759.613	93.7518153131316	60.3844064942871	138.603371257492	jazz
jazz_21	962874800000	141899280000	4343202600000	13818.713	3586.672	26503.06	145.047835886106	98.8186770853301	145.448820104742	jazz
blues_19	4268235000000	19416232000	20894070000000	20107.027	3519.1787	48908.91	116.567445014283	75.1264211173283	149.1723485497	blues
blues_7	8093221000000	266826060000	46850783000000	33171.656	11907.395	74636.09	116.235858044809	75.2653008044184	140.982915067785	blues
blues_4	3913619000000	364466240000	11705773000000	29878.996	15175.154	48482.27	167.116677046153	113.335815374605	177.43374978479	blues
blues_15	2838854400000	16390394000	16091994000000	16486.43	3511.632	42198.164	95.2951405413613	60.5711420132512	135.473801799718	blues
blues_18	3252620400000	25928286000	13563801000000	17658.86	4052.9287	37240.566	126.088150191428	82.0529887026044	156.035626175387	blues
blues_18	3265858400000	11661281000	22635472000000	14397.605	3459.7673	37338.19	83.9996956055123	53.7626289619213	129.296841523022	blues

burada ise her tür için 20 ve toplamda 100 adet şarkı bulunuyor.

K=3 için

hamming/train_result.csv

id	predicted_label	expected_label
disco_74	disco	disco
disco_73	blues	disco
disco_94	disco	disco
disco_95	blues	disco
disco_87	disco	disco
disco_78	jazz	disco
disco_75	disco	disco
disco_96	disco	disco
disco_85	disco	disco
disco_97	disco	disco
disco_91	metal	disco
disco_72	disco	disco
disco_89	blues	disco
disco_81	blues	disco
disco_92	disco	disco
disco_79	blues	disco
disco_86	blues	disco
disco_93	disco	disco
disco_90	reggae	disco
disco_88	reggae	disco
jazz_22	jazz	jazz
jazz_27	jazz	jazz
jazz_8	reggae	jazz
jazz_14	blues	jazz
jazz_1	jazz	jazz
jazz_9	jazz	jazz
jazz_7	jazz	jazz
jazz_2	jazz	jazz
jazz_10	jazz	jazz
jazz_17	metal	jazz
jazz_0	jazz	jazz
jazz_5	blues	jazz
jazz_11	jazz	jazz
jazz_16	jazz	jazz
jazz_15	blues	jazz
jazz_3	jazz	jazz
jazz_20	jazz	jazz
jazz_29	jazz	jazz
jazz_23	jazz	jazz
jazz_21	jazz	jazz
blues_19	blues	blues
blues_7	disco	blues
blues_4	blues	blues
blues_20	blues	blues
blues_15	blues	blues
blues_18	blues	blues

Burada train sonucunda knn'in tahminleri bulunuyor.

hamming/train_result.csv

id	predicted_label	expected_label
disco_83	blues	disco
disco_76	disco	disco
disco_80	jazz	disco
disco_84	blues	disco
disco_99	blues	disco
disco_70	metal	disco
disco_77	metal	disco
disco_71	blues	disco
disco_98	blues	disco
disco_82	metal	disco
jazz_19	jazz	jazz
jazz_25	blues	jazz
jazz_26	jazz	jazz
jazz_24	jazz	jazz
jazz_6	jazz	jazz
jazz_13	jazz	jazz
jazz_28	jazz	jazz
jazz_4	reggae	jazz
jazz_12	jazz	jazz
jazz_18	jazz	jazz
blues_98	blues	blues
blues_3	disco	blues
blues_93	blues	blues
blues_14	jazz	blues
blues_22	blues	blues
blues_97	disco	blues
blues_21	blues	blues
blues_12	blues	blues
blues_10	blues	blues
blues_8	blues	blues
metal_2	blues	metal
metal_17	metal	metal
metal_97	metal	metal
metal_14	jazz	metal
metal_9	reggae	metal
metal_16	blues	metal
metal_7	jazz	metal
metal_3	blues	metal
metal_6	jazz	metal
metal_96	blues	metal
reggae_96	disco	reggae
reggae_3	reggae	reggae
reggae_5	disco	reggae
reggae_81	reggae	reggae
reggae_97	jazz	reggae
reggae_95	blues	reggae

Burada test dataseti için knn'in tahminleri bulunuyor.

Bu veriğim tablolar k=3 ile eğitelen model için oluşturulmuştur aynı şekilde knn.py kullanılarak diğerleride üretilmiştir ancak Çok yer kapladığı için rapora koymamayı tercih ettim.

İstatistikler:

bu istatistikler k=3 içindir.

Hamming TRAİN:

Toplam Doğru Tahmin Sayisi: 61
Toplam Yanlış Tahmin Sayisi: 39
Toplam Veri Sayisi: 100
Doğru Tahmin Yüzdesi: 61.00%
Yanlış Tahmin Yüzdesi: 39.00%

Sinif Bazinda Doğru Tahmin Yüzdesi:
expected_label
blues   80.0
disco   50.0
jazz   75.0
metal   60.0
reggae   40.0

Sinif Bazinda Yanlış Tahmin Yüzdesi:
expected_label
blues   20.0
disco   50.0
jazz   25.0
metal   40.0
reggae   60.0

Hamming TEST:

Toplam Doğru Tahmin Sayisi: 20
Toplam Yanlış Tahmin Sayisi: 30
Toplam Veri Sayisi: 50
Doğru Tahmin Yüzdesi: 40.00%
Yanlış Tahmin Yüzdesi: 60.00%

Sinif Bazinda Doğru Tahmin Yüzdesi:
expected_label
blues   70.0
disco   10.0
jazz   80.0
metal   20.0
reggae   20.0

Sinif Bazinda Yanlış Tahmin Yüzdesi:
expected_label
blues   30.0
disco   90.0
jazz   20.0
metal   80.0
reggae   80.0

Hanning TRAIN:

Toplam Doğru Tahmin Sayisi: 61
Toplam Yanlış Tahmin Sayisi: 39
Toplam Veri Sayisi: 100
Doğru Tahmin Yüzdesi: 61.00%
Yanlış Tahmin Yüzdesi: 39.00%

Sinif Bazinda Doğru Tahmin Yüzdesi:
expected_label
blues   75.0
disco   55.0
jazz   80.0
metal   60.0
reggae   35.0

Sinif Bazinda Yanlış Tahmin Yüzdesi:
expected_label
blues   25.0
disco   45.0
jazz   20.0
metal   40.0
reggae   65.0

Hanning TEST:

Toplam Doğru Tahmin Sayisi: 21
Toplam Yanlış Tahmin Sayisi: 29
Toplam Veri Sayisi: 50
Doğru Tahmin Yüzdesi: 42.00%
Yanlış Tahmin Yüzdesi: 58.00%

Sinif Bazinda Doğru Tahmin Yüzdesi:
expected_label
blues   60.0
disco   30.0
jazz   90.0
metal   10.0
reggae   20.0

Sinif Bazinda Yanlış Tahmin Yüzdesi:
expected_label
blues   40.0
disco   70.0
jazz   10.0
metal   90.0
reggae   80.0

Blackman TRAIN:

Toplam Doğru Tahmin Sayisi: 62
Toplam Yanlış Tahmin Sayisi: 38
Toplam Veri Sayisi: 100
Doğru Tahmin Yüzdesi: 62.00%
Yanlış Tahmin Yüzdesi: 38.00%

Sinif Bazinda Doğru Tahmin Yüzdesi:
expected_label
blues   80.0
disco   50.0

jazz   75.0
metal   60.0
reggae 45.0

Sinif Bazinda Yanlış Tahmin Yüzdesi:
expected_label
blues   20.0
disco   50.0
jazz   25.0
metal   40.0
reggae 55.0

Blackman TEST:

Toplam Doğru Tahmin Sayisi: 20
Toplam Yanlış Tahmin Sayisi: 30
Toplam Veri Sayisi: 50
Doğru Tahmin Yüzdesi: 40.00%
Yanlış Tahmin Yüzdesi: 60.00%

Sinif Bazinda Doğru Tahmin Yüzdesi:
expected_label
blues   70.0
disco   10.0
jazz   80.0
metal   20.0
reggae 20.0

Sinif Bazinda Yanlış Tahmin Yüzdesi:
expected_label
blues   30.0
disco   90.0
jazz   20.0
metal   80.0
reggae 80.0

TABLOLAR:

Table 1: window tipi ve şarkı türlerine göre k=1 knn test sonuçları

Şarkı türü\ Window tipi	Hamming	Hanning	Blackmen	Ortalama
Blues	%10	%10	%10	%66.66
Disco	%20	%20	%20	%16.66
Jazz	%90	%90	%90	%83.33
Metal	%30	%20	%10	%16.66
Reggae	%40	%50	%40	%20
Ortalama	%38	%38	%34	%40.66

Table 2: window tipi ve şarkı türlerine göre k=3 knn test sonuçları

Şarkı türü\ Window tipi	Hamming	Hanning	Blackmen	Ortalama
Blues	%70	%60	%70	%66.66
Disco	%10	%30	%10	%16.66
Jazz	%80	%90	%80	%83.33
Metal	%20	%10	%20	%16.66
Reggae	%20	%20	%20	%20
Ortalama	%40	%42	%40	%40.66

Table 3: window tipi ve şarkı türlerine göre k=5 knn test sonuçları

Şarkı türü\ Window tipi	Hamming	Hanning	Blackmen	Ortalama
Blues	%20	%10	%20	%16.66
Disco	%0	%20	%0	%6.66
Jazz	%80	%80	%80	%80
Metal	%50	%30	%50	%43.33
Reggae	%20	%20	%20	%20
Ortalama	%34	%32	%34	%33.33