Fall 2023 Data 605 Homework 1

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2023-08-31

Assignment

For this weeks homework assignment, we had to draw our initials onto a plot in R and then perform shear, scaling, rotation, and projection and then animate the plots.

I am lucky that my initials are JJ.

My strategy was to first draw the letter J.

```r
#My initials are JJ

# Vertical line of J
x1 = rep(0, 1000)
y1 = seq(-1, 1, length.out=1000)

# horizontal bottom of J
x2 = seq(-0.25,0, length.out=125)
y2 = rep(-1,125)

# horizontal top of J
x3 = seq(-0.25,0.25, length.out=250)
y3 = rep(1,250)

#small vertical part of J
x4 = rep(-0.25, 250)
y4 = seq(-1,-0.5, length.out=250)


# Combine the coordinates for the first J
first_x = c(x1,x2,x3,x4)
first_y = c(y1,y2,y3,y4)
plot(first_y~first_x, xlim=c(-3,3), ylim=c(-3,3))
```
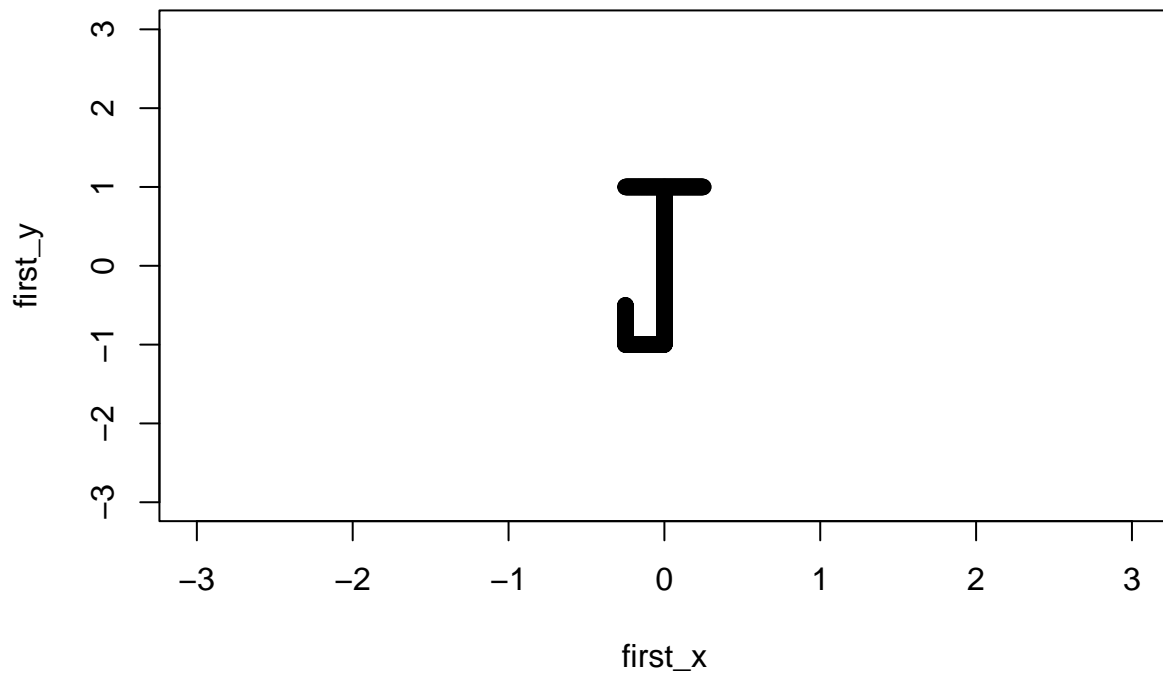
Then I repeated it but shifted to the right. I then combined the two J's on the same graph.

```
#Shifting the second J by 2 to the right so i add 2 to x

second_x=first_x+2
second_y=first_y

#Both Js combined
x=c(first_x,second_x)
y=c(first_y,second_y)


# plot
plot(y~x, xlim=c(-3,3), ylim=c(-3,3))
```
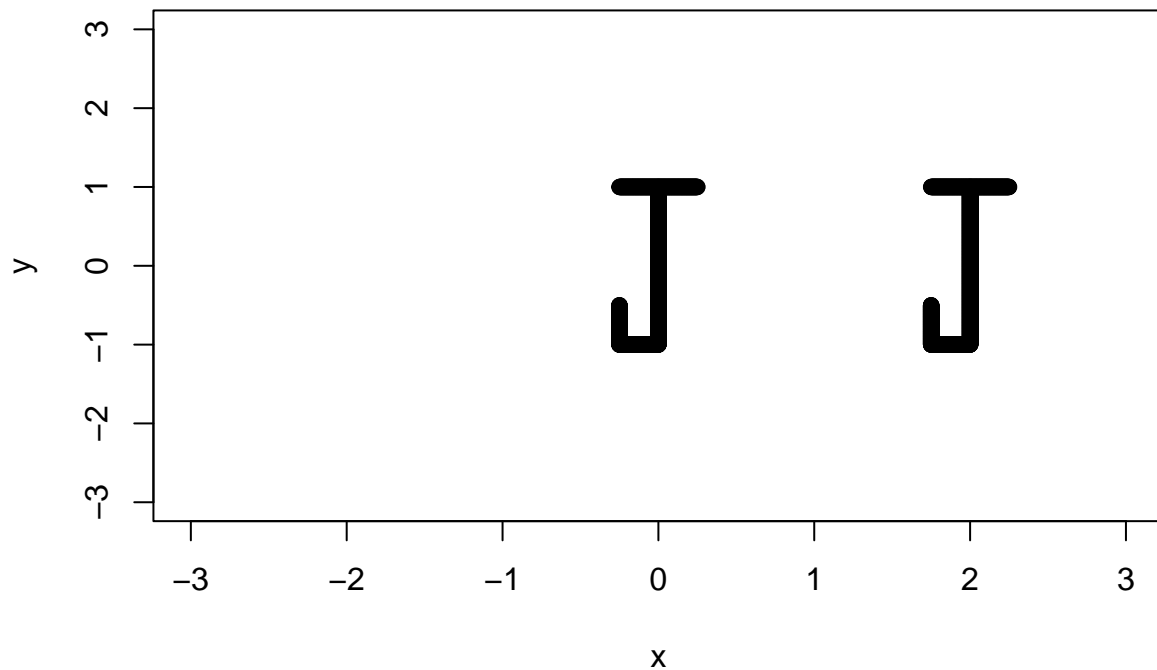
Afterwards, I turned the coordinates of JJ into a matrix.

```
# matrix from the x and y coordinates
coord_matrix = matrix(c(x, y), ncol=2)
coord_matrix
```

```
##                  [,1]           [,2]
##    [1,]   0.000000000 -1.000000000
##    [2,]   0.000000000 -0.997997998
##    [3,]   0.000000000 -0.995995996
##    [4,]   0.000000000 -0.993993994
##    [5,]   0.000000000 -0.991991992
##    [6,]   0.000000000 -0.989989990
##    [7,]   0.000000000 -0.987987988
##    [8,]   0.000000000 -0.985985986
##    [9,]   0.000000000 -0.983983984
##   [10,]   0.000000000 -0.981981982
##   [11,]   0.000000000 -0.979979980
##   [12,]   0.000000000 -0.977977978
##   [13,]   0.000000000 -0.975975976
##   [14,]   0.000000000 -0.973973974
##   [15,]   0.000000000 -0.971971972
##   [16,]   0.000000000 -0.969969970
##   [17,]   0.000000000 -0.967967968
##   [18,]   0.000000000 -0.965965966
##   [19,]   0.000000000 -0.963963964
```

```
##    [20,]  0.000000000  -0.961961962
##    [21,]  0.000000000  -0.959959960
##    [22,]  0.000000000  -0.957957958
##    [23,]  0.000000000  -0.955955956
##    [24,]  0.000000000  -0.953953954
##    [25,]  0.000000000  -0.951951952
##    [26,]  0.000000000  -0.949949950
##    [27,]  0.000000000  -0.947947948
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##    [29,]  0.000000000  -0.943943944
##    [30,]  0.000000000  -0.941941942
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##    [36,]  0.000000000  -0.929929930
##    [37,]  0.000000000  -0.927927928
##    [38,]  0.000000000  -0.925925926
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##    [40,]  0.000000000  -0.921921922
##    [41,]  0.000000000  -0.919919920
##    [42,]  0.000000000  -0.917917918
##    [43,]  0.000000000  -0.915915916
##    [44,]  0.000000000  -0.913913914
##    [45,]  0.000000000  -0.911911912
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## [2583,]  2.000000000  0.915915916
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## [2863,]   1.974899598   1.000000000
## [2864,]   1.976907631   1.000000000
## [2865,]   1.978915663   1.000000000
## [2866,]   1.980923695   1.000000000
## [2867,]   1.982931727   1.000000000
## [2868,]   1.984939759   1.000000000
## [2869,]   1.986947791   1.000000000
## [2870,]   1.988955823   1.000000000
## [2871,]   1.990963855   1.000000000
## [2872,]   1.992971888   1.000000000
## [2873,]   1.994979920   1.000000000
## [2874,]   1.996987952   1.000000000
## [2875,]   1.998995984   1.000000000
## [2876,]   2.001004016   1.000000000
## [2877,]   2.003012048   1.000000000
## [2878,]   2.005020080   1.000000000
## [2879,]   2.007028112   1.000000000
## [2880,]   2.009036145   1.000000000
## [2881,]   2.011044177   1.000000000
```

```
## [2882,]   2.013052209   1.000000000
## [2883,]   2.015060241   1.000000000
## [2884,]   2.017068273   1.000000000
## [2885,]   2.019076305   1.000000000
## [2886,]   2.021084337   1.000000000
## [2887,]   2.023092369   1.000000000
## [2888,]   2.025100402   1.000000000
## [2889,]   2.027108434   1.000000000
## [2890,]   2.029116466   1.000000000
## [2891,]   2.031124498   1.000000000
## [2892,]   2.033132530   1.000000000
## [2893,]   2.035140562   1.000000000
## [2894,]   2.037148594   1.000000000
## [2895,]   2.039156627   1.000000000
## [2896,]   2.041164659   1.000000000
## [2897,]   2.043172691   1.000000000
## [2898,]   2.045180723   1.000000000
## [2899,]   2.047188755   1.000000000
## [2900,]   2.049196787   1.000000000
## [2901,]   2.051204819   1.000000000
## [2902,]   2.053212851   1.000000000
## [2903,]   2.055220884   1.000000000
## [2904,]   2.057228916   1.000000000
## [2905,]   2.059236948   1.000000000
## [2906,]   2.061244980   1.000000000
## [2907,]   2.063253012   1.000000000
## [2908,]   2.065261044   1.000000000
## [2909,]   2.067269076   1.000000000
## [2910,]   2.069277108   1.000000000
## [2911,]   2.071285141   1.000000000
## [2912,]   2.073293173   1.000000000
## [2913,]   2.075301205   1.000000000
## [2914,]   2.077309237   1.000000000
## [2915,]   2.079317269   1.000000000
## [2916,]   2.081325301   1.000000000
## [2917,]   2.083333333   1.000000000
## [2918,]   2.085341365   1.000000000
## [2919,]   2.087349398   1.000000000
## [2920,]   2.089357430   1.000000000
## [2921,]   2.091365462   1.000000000
## [2922,]   2.093373494   1.000000000
## [2923,]   2.095381526   1.000000000
## [2924,]   2.097389558   1.000000000
## [2925,]   2.099397590   1.000000000
## [2926,]   2.101405622   1.000000000
## [2927,]   2.103413655   1.000000000
## [2928,]   2.105421687   1.000000000
## [2929,]   2.107429719   1.000000000
## [2930,]   2.109437751   1.000000000
## [2931,]   2.111445783   1.000000000
## [2932,]   2.113453815   1.000000000
## [2933,]   2.115461847   1.000000000
## [2934,]   2.117469880   1.000000000
## [2935,]   2.119477912   1.000000000
```

```
## [2936,]   2.121485944   1.000000000
## [2937,]   2.123493976   1.000000000
## [2938,]   2.125502008   1.000000000
## [2939,]   2.127510040   1.000000000
## [2940,]   2.129518072   1.000000000
## [2941,]   2.131526104   1.000000000
## [2942,]   2.133534137   1.000000000
## [2943,]   2.135542169   1.000000000
## [2944,]   2.137550201   1.000000000
## [2945,]   2.139558233   1.000000000
## [2946,]   2.141566265   1.000000000
## [2947,]   2.143574297   1.000000000
## [2948,]   2.145582329   1.000000000
## [2949,]   2.147590361   1.000000000
## [2950,]   2.149598394   1.000000000
## [2951,]   2.151606426   1.000000000
## [2952,]   2.153614458   1.000000000
## [2953,]   2.155622490   1.000000000
## [2954,]   2.157630522   1.000000000
## [2955,]   2.159638554   1.000000000
## [2956,]   2.161646586   1.000000000
## [2957,]   2.163654618   1.000000000
## [2958,]   2.165662651   1.000000000
## [2959,]   2.167670683   1.000000000
## [2960,]   2.169678715   1.000000000
## [2961,]   2.171686747   1.000000000
## [2962,]   2.173694779   1.000000000
## [2963,]   2.175702811   1.000000000
## [2964,]   2.177710843   1.000000000
## [2965,]   2.179718876   1.000000000
## [2966,]   2.181726908   1.000000000
## [2967,]   2.183734940   1.000000000
## [2968,]   2.185742972   1.000000000
## [2969,]   2.187751004   1.000000000
## [2970,]   2.189759036   1.000000000
## [2971,]   2.191767068   1.000000000
## [2972,]   2.193775100   1.000000000
## [2973,]   2.195783133   1.000000000
## [2974,]   2.197791165   1.000000000
## [2975,]   2.199799197   1.000000000
## [2976,]   2.201807229   1.000000000
## [2977,]   2.203815261   1.000000000
## [2978,]   2.205823293   1.000000000
## [2979,]   2.207831325   1.000000000
## [2980,]   2.209839357   1.000000000
## [2981,]   2.211847390   1.000000000
## [2982,]   2.213855422   1.000000000
## [2983,]   2.215863454   1.000000000
## [2984,]   2.217871486   1.000000000
## [2985,]   2.219879518   1.000000000
## [2986,]   2.221887550   1.000000000
## [2987,]   2.223895582   1.000000000
## [2988,]   2.225903614   1.000000000
## [2989,]   2.227911647   1.000000000
```

```
## [2990,]  2.229919679  1.000000000
## [2991,]  2.231927711  1.000000000
## [2992,]  2.233935743  1.000000000
## [2993,]  2.235943775  1.000000000
## [2994,]  2.237951807  1.000000000
## [2995,]  2.239959839  1.000000000
## [2996,]  2.241967871  1.000000000
## [2997,]  2.243975904  1.000000000
## [2998,]  2.245983936  1.000000000
## [2999,]  2.247991968  1.000000000
## [3000,]  2.250000000  1.000000000
## [3001,]  1.750000000 -1.000000000
## [3002,]  1.750000000 -0.997991968
## [3003,]  1.750000000 -0.995983936
## [3004,]  1.750000000 -0.993975904
## [3005,]  1.750000000 -0.991967871
## [3006,]  1.750000000 -0.989959839
## [3007,]  1.750000000 -0.987951807
## [3008,]  1.750000000 -0.985943775
## [3009,]  1.750000000 -0.983935743
## [3010,]  1.750000000 -0.981927711
## [3011,]  1.750000000 -0.979919679
## [3012,]  1.750000000 -0.977911647
## [3013,]  1.750000000 -0.975903614
## [3014,]  1.750000000 -0.973895582
## [3015,]  1.750000000 -0.971887550
## [3016,]  1.750000000 -0.969879518
## [3017,]  1.750000000 -0.967871486
## [3018,]  1.750000000 -0.965863454
## [3019,]  1.750000000 -0.963855422
## [3020,]  1.750000000 -0.961847390
## [3021,]  1.750000000 -0.959839357
## [3022,]  1.750000000 -0.957831325
## [3023,]  1.750000000 -0.955823293
## [3024,]  1.750000000 -0.953815261
## [3025,]  1.750000000 -0.951807229
## [3026,]  1.750000000 -0.949799197
## [3027,]  1.750000000 -0.947791165
## [3028,]  1.750000000 -0.945783133
## [3029,]  1.750000000 -0.943775100
## [3030,]  1.750000000 -0.941767068
## [3031,]  1.750000000 -0.939759036
## [3032,]  1.750000000 -0.937751004
## [3033,]  1.750000000 -0.935742972
## [3034,]  1.750000000 -0.933734940
## [3035,]  1.750000000 -0.931726908
## [3036,]  1.750000000 -0.929718876
## [3037,]  1.750000000 -0.927710843
## [3038,]  1.750000000 -0.925702811
## [3039,]  1.750000000 -0.923694779
## [3040,]  1.750000000 -0.921686747
## [3041,]  1.750000000 -0.919678715
## [3042,]  1.750000000 -0.917670683
## [3043,]  1.750000000 -0.915662651
```

```
## [3044,]   1.750000000  -0.913654618
## [3045,]   1.750000000  -0.911646586
## [3046,]   1.750000000  -0.909638554
## [3047,]   1.750000000  -0.907630522
## [3048,]   1.750000000  -0.905622490
## [3049,]   1.750000000  -0.903614458
## [3050,]   1.750000000  -0.901606426
## [3051,]   1.750000000  -0.899598394
## [3052,]   1.750000000  -0.897590361
## [3053,]   1.750000000  -0.895582329
## [3054,]   1.750000000  -0.893574297
## [3055,]   1.750000000  -0.891566265
## [3056,]   1.750000000  -0.889558233
## [3057,]   1.750000000  -0.887550201
## [3058,]   1.750000000  -0.885542169
## [3059,]   1.750000000  -0.883534137
## [3060,]   1.750000000  -0.881526104
## [3061,]   1.750000000  -0.879518072
## [3062,]   1.750000000  -0.877510040
## [3063,]   1.750000000  -0.875502008
## [3064,]   1.750000000  -0.873493976
## [3065,]   1.750000000  -0.871485944
## [3066,]   1.750000000  -0.869477912
## [3067,]   1.750000000  -0.867469880
## [3068,]   1.750000000  -0.865461847
## [3069,]   1.750000000  -0.863453815
## [3070,]   1.750000000  -0.861445783
## [3071,]   1.750000000  -0.859437751
## [3072,]   1.750000000  -0.857429719
## [3073,]   1.750000000  -0.855421687
## [3074,]   1.750000000  -0.853413655
## [3075,]   1.750000000  -0.851405622
## [3076,]   1.750000000  -0.849397590
## [3077,]   1.750000000  -0.847389558
## [3078,]   1.750000000  -0.845381526
## [3079,]   1.750000000  -0.843373494
## [3080,]   1.750000000  -0.841365462
## [3081,]   1.750000000  -0.839357430
## [3082,]   1.750000000  -0.837349398
## [3083,]   1.750000000  -0.835341365
## [3084,]   1.750000000  -0.833333333
## [3085,]   1.750000000  -0.831325301
## [3086,]   1.750000000  -0.829317269
## [3087,]   1.750000000  -0.827309237
## [3088,]   1.750000000  -0.825301205
## [3089,]   1.750000000  -0.823293173
## [3090,]   1.750000000  -0.821285141
## [3091,]   1.750000000  -0.819277108
## [3092,]   1.750000000  -0.817269076
## [3093,]   1.750000000  -0.815261044
## [3094,]   1.750000000  -0.813253012
## [3095,]   1.750000000  -0.811244980
## [3096,]   1.750000000  -0.809236948
## [3097,]   1.750000000  -0.807228916
```

```
## [3098,]  1.750000000 -0.805220884
## [3099,]  1.750000000 -0.803212851
## [3100,]  1.750000000 -0.801204819
## [3101,]  1.750000000 -0.799196787
## [3102,]  1.750000000 -0.797188755
## [3103,]  1.750000000 -0.795180723
## [3104,]  1.750000000 -0.793172691
## [3105,]  1.750000000 -0.791164659
## [3106,]  1.750000000 -0.789156627
## [3107,]  1.750000000 -0.787148594
## [3108,]  1.750000000 -0.785140562
## [3109,]  1.750000000 -0.783132530
## [3110,]  1.750000000 -0.781124498
## [3111,]  1.750000000 -0.779116466
## [3112,]  1.750000000 -0.777108434
## [3113,]  1.750000000 -0.775100402
## [3114,]  1.750000000 -0.773092369
## [3115,]  1.750000000 -0.771084337
## [3116,]  1.750000000 -0.769076305
## [3117,]  1.750000000 -0.767068273
## [3118,]  1.750000000 -0.765060241
## [3119,]  1.750000000 -0.763052209
## [3120,]  1.750000000 -0.761044177
## [3121,]  1.750000000 -0.759036145
## [3122,]  1.750000000 -0.757028112
## [3123,]  1.750000000 -0.755020080
## [3124,]  1.750000000 -0.753012048
## [3125,]  1.750000000 -0.751004016
## [3126,]  1.750000000 -0.748995984
## [3127,]  1.750000000 -0.746987952
## [3128,]  1.750000000 -0.744979920
## [3129,]  1.750000000 -0.742971888
## [3130,]  1.750000000 -0.740963855
## [3131,]  1.750000000 -0.738955823
## [3132,]  1.750000000 -0.736947791
## [3133,]  1.750000000 -0.734939759
## [3134,]  1.750000000 -0.732931727
## [3135,]  1.750000000 -0.730923695
## [3136,]  1.750000000 -0.728915663
## [3137,]  1.750000000 -0.726907631
## [3138,]  1.750000000 -0.724899598
## [3139,]  1.750000000 -0.722891566
## [3140,]  1.750000000 -0.720883534
## [3141,]  1.750000000 -0.718875502
## [3142,]  1.750000000 -0.716867470
## [3143,]  1.750000000 -0.714859438
## [3144,]  1.750000000 -0.712851406
## [3145,]  1.750000000 -0.710843373
## [3146,]  1.750000000 -0.708835341
## [3147,]  1.750000000 -0.706827309
## [3148,]  1.750000000 -0.704819277
## [3149,]  1.750000000 -0.702811245
## [3150,]  1.750000000 -0.700803213
## [3151,]  1.750000000 -0.698795181
```

```
## [3152,]   1.750000000 -0.696787149
## [3153,]   1.750000000 -0.694779116
## [3154,]   1.750000000 -0.692771084
## [3155,]   1.750000000 -0.690763052
## [3156,]   1.750000000 -0.688755020
## [3157,]   1.750000000 -0.686746988
## [3158,]   1.750000000 -0.684738956
## [3159,]   1.750000000 -0.682730924
## [3160,]   1.750000000 -0.680722892
## [3161,]   1.750000000 -0.678714859
## [3162,]   1.750000000 -0.676706827
## [3163,]   1.750000000 -0.674698795
## [3164,]   1.750000000 -0.672690763
## [3165,]   1.750000000 -0.670682731
## [3166,]   1.750000000 -0.668674699
## [3167,]   1.750000000 -0.666666667
## [3168,]   1.750000000 -0.664658635
## [3169,]   1.750000000 -0.662650602
## [3170,]   1.750000000 -0.660642570
## [3171,]   1.750000000 -0.658634538
## [3172,]   1.750000000 -0.656626506
## [3173,]   1.750000000 -0.654618474
## [3174,]   1.750000000 -0.652610442
## [3175,]   1.750000000 -0.650602410
## [3176,]   1.750000000 -0.648594378
## [3177,]   1.750000000 -0.646586345
## [3178,]   1.750000000 -0.644578313
## [3179,]   1.750000000 -0.642570281
## [3180,]   1.750000000 -0.640562249
## [3181,]   1.750000000 -0.638554217
## [3182,]   1.750000000 -0.636546185
## [3183,]   1.750000000 -0.634538153
## [3184,]   1.750000000 -0.632530120
## [3185,]   1.750000000 -0.630522088
## [3186,]   1.750000000 -0.628514056
## [3187,]   1.750000000 -0.626506024
## [3188,]   1.750000000 -0.624497992
## [3189,]   1.750000000 -0.622489960
## [3190,]   1.750000000 -0.620481928
## [3191,]   1.750000000 -0.618473896
## [3192,]   1.750000000 -0.616465863
## [3193,]   1.750000000 -0.614457831
## [3194,]   1.750000000 -0.612449799
## [3195,]   1.750000000 -0.610441767
## [3196,]   1.750000000 -0.608433735
## [3197,]   1.750000000 -0.606425703
## [3198,]   1.750000000 -0.604417671
## [3199,]   1.750000000 -0.602409639
## [3200,]   1.750000000 -0.600401606
## [3201,]   1.750000000 -0.598393574
## [3202,]   1.750000000 -0.596385542
## [3203,]   1.750000000 -0.594377510
## [3204,]   1.750000000 -0.592369478
## [3205,]   1.750000000 -0.590361446
```

```
## [3206,]  1.750000000 -0.588353414
## [3207,]  1.750000000 -0.586345382
## [3208,]  1.750000000 -0.584337349
## [3209,]  1.750000000 -0.582329317
## [3210,]  1.750000000 -0.580321285
## [3211,]  1.750000000 -0.578313253
## [3212,]  1.750000000 -0.576305221
## [3213,]  1.750000000 -0.574297189
## [3214,]  1.750000000 -0.572289157
## [3215,]  1.750000000 -0.570281124
## [3216,]  1.750000000 -0.568273092
## [3217,]  1.750000000 -0.566265060
## [3218,]  1.750000000 -0.564257028
## [3219,]  1.750000000 -0.562248996
## [3220,]  1.750000000 -0.560240964
## [3221,]  1.750000000 -0.558232932
## [3222,]  1.750000000 -0.556224900
## [3223,]  1.750000000 -0.554216867
## [3224,]  1.750000000 -0.552208835
## [3225,]  1.750000000 -0.550200803
## [3226,]  1.750000000 -0.548192771
## [3227,]  1.750000000 -0.546184739
## [3228,]  1.750000000 -0.544176707
## [3229,]  1.750000000 -0.542168675
## [3230,]  1.750000000 -0.540160643
## [3231,]  1.750000000 -0.538152610
## [3232,]  1.750000000 -0.536144578
## [3233,]  1.750000000 -0.534136546
## [3234,]  1.750000000 -0.532128514
## [3235,]  1.750000000 -0.530120482
## [3236,]  1.750000000 -0.528112450
## [3237,]  1.750000000 -0.526104418
## [3238,]  1.750000000 -0.524096386
## [3239,]  1.750000000 -0.522088353
## [3240,]  1.750000000 -0.520080321
## [3241,]  1.750000000 -0.518072289
## [3242,]  1.750000000 -0.516064257
## [3243,]  1.750000000 -0.514056225
## [3244,]  1.750000000 -0.512048193
## [3245,]  1.750000000 -0.510040161
## [3246,]  1.750000000 -0.508032129
## [3247,]  1.750000000 -0.506024096
## [3248,]  1.750000000 -0.504016064
## [3249,]  1.750000000 -0.502008032
## [3250,]  1.750000000 -0.500000000
```

```r
plot(coord_matrix, xlim=c(-3,3), ylim=c(-3,3))
```
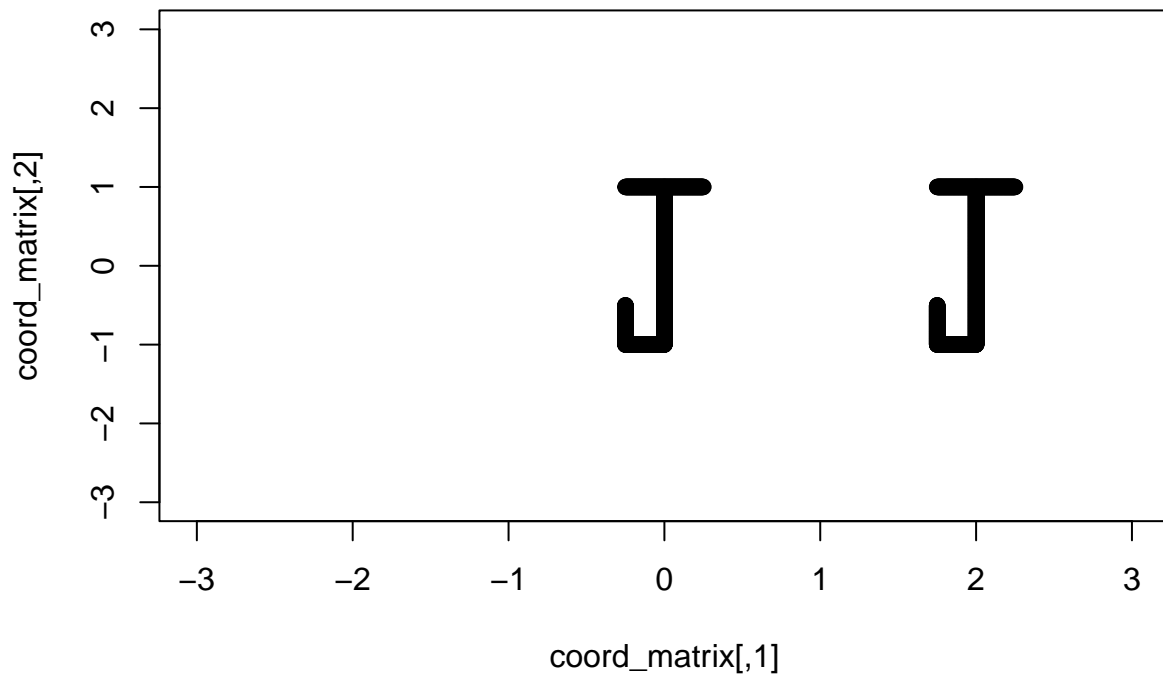
Then, I made plots for each of the linear transformations I performed. I also defined the identity matrix and used that for some of the plots.

```
# Identity matrix
identity_matrix = matrix(c(1, 0, 0, 1), ncol=2)
identity_matrix
```

```
##      [,1] [,2]
## [1,]    1    0
## [2,]    0    1
```

```
#shear randomly
shear_matrix=identity_matrix
shear_matrix[1,2]=3
shear_matrix[2,1]=2
transformed_matrix_shear= coord_matrix %*% shear_matrix
```

```
#scaling making JJ smaller by half
scale_matrix=identity_matrix
scale_matrix[1,1]=0.5
scale_matrix[2,2]=0.5
transformed_matrix_scale=coord_matrix %*% scale_matrix
```

```
#rotation clockwise .8 rad
```

```r
rot_matrix=matrix(c(cos(0.8),-sin(0.8),sin(0.8),cos(0.8)),ncol=2)
transformed_matrix_rot=coord_matrix %*% rot_matrix



#projecting onto x axis

proj_matrix=matrix(c(1,0,0,0),ncol=2)
transformed_matrix_proj=coord_matrix %*% proj_matrix
```

Finally, I combined all plots in a loop at the end.

I had to put all of the plots in a list so that I can loop through them all.

I also added a title for each transformation.

I added the sleep function so that it can slow down the loop an we can see it.

x11() to open new window

```r
matrices = list(coord_matrix, transformed_matrix_shear, coord_matrix, transformed_matrix_scale, coord_m
titles = c("Original JJ", "Shear Transformation", "Original JJ", "Scaling Transformation", "Original JJ

# Open a new plotting window
x11()

for (i in 1:length(matrices)) {

  # Clear the plot window
  plot.new()
  plot(matrices[[i]][,2] ~ matrices[[i]][,1], xlim=c(-3,5), ylim=c(-3,3))

  #cycle thru titles
  title(main=titles[i])

  #wait b4 continuing
  Sys.sleep(3)
}
```
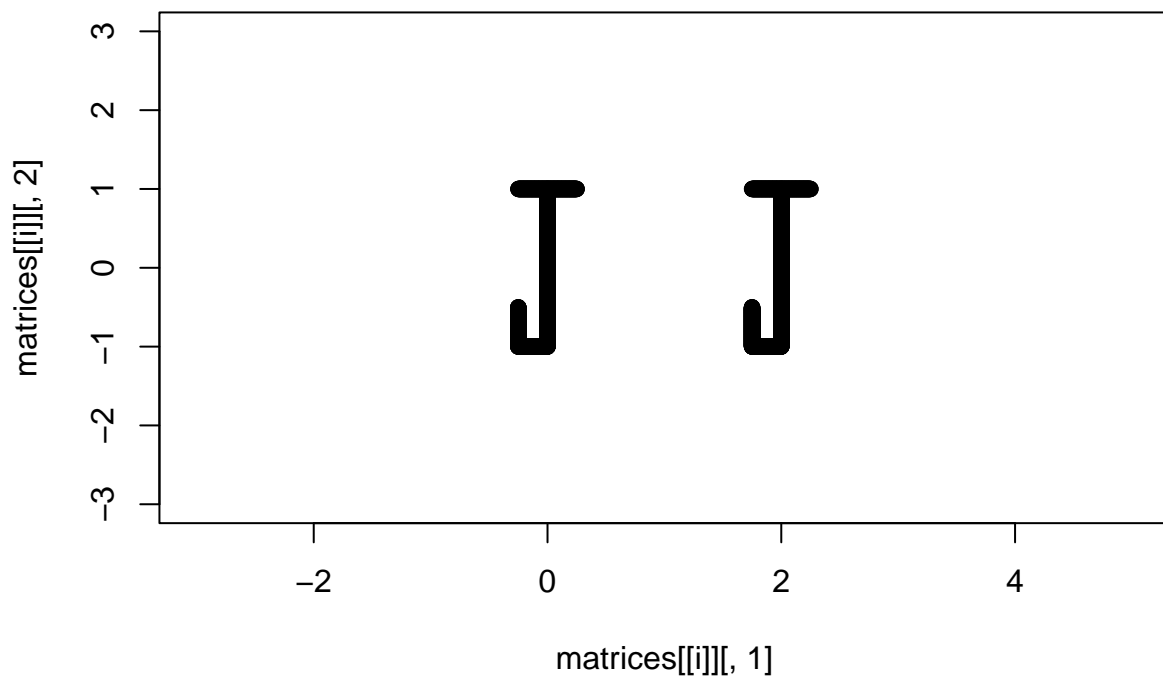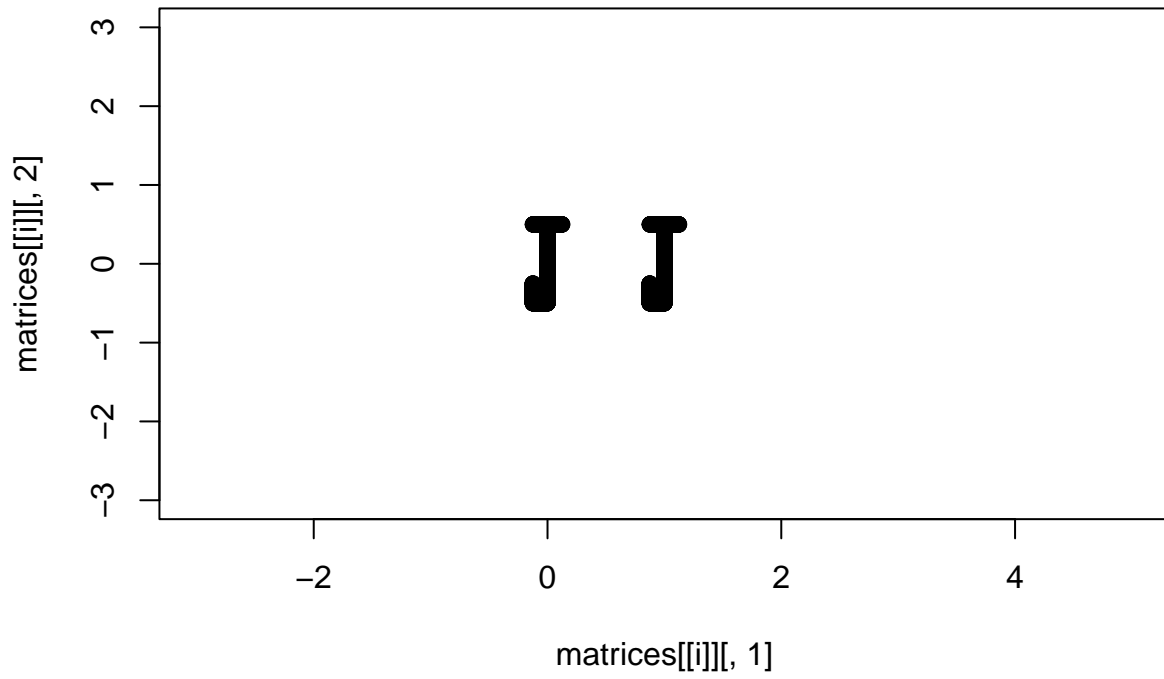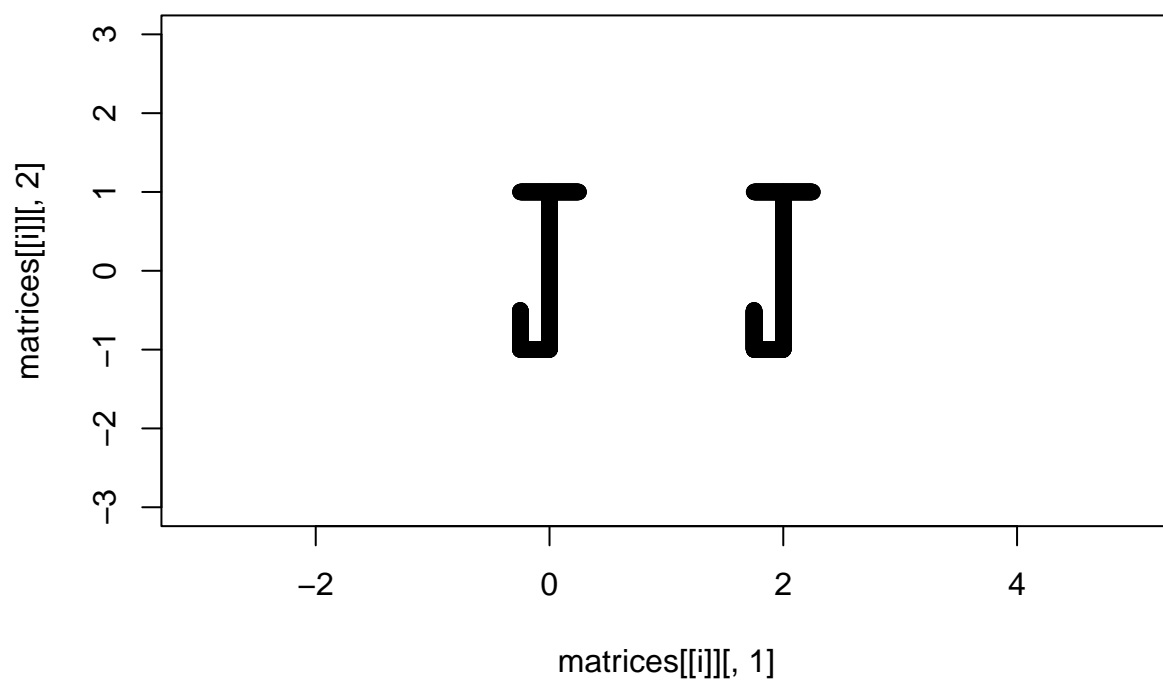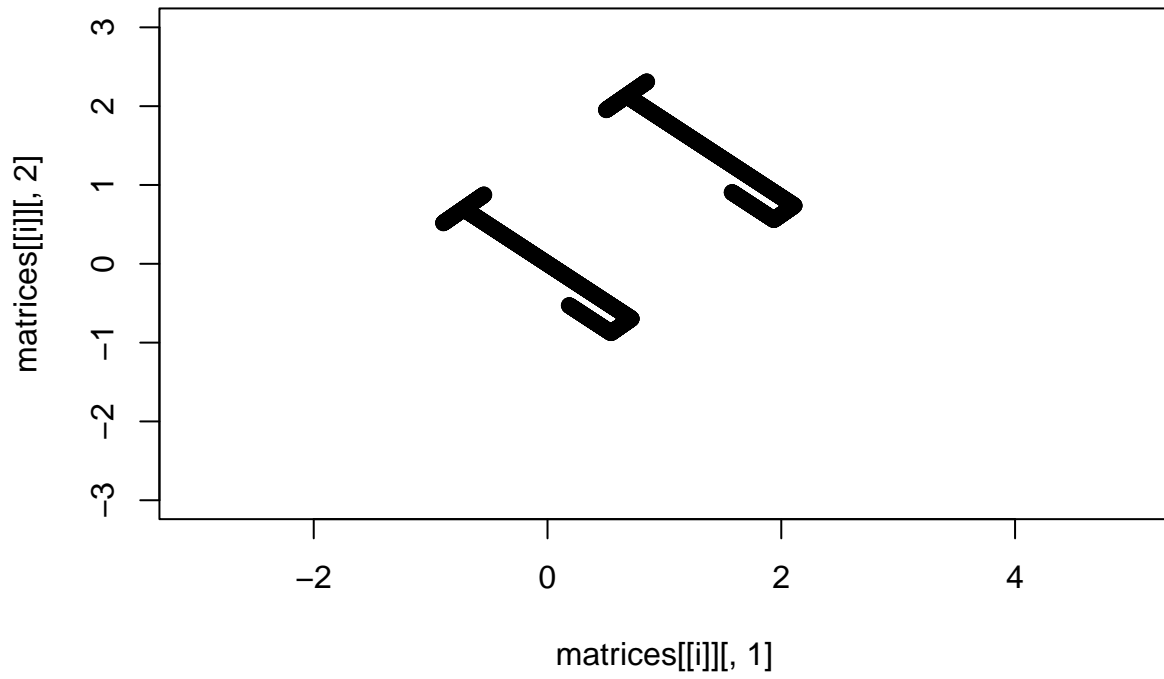
Original JJ
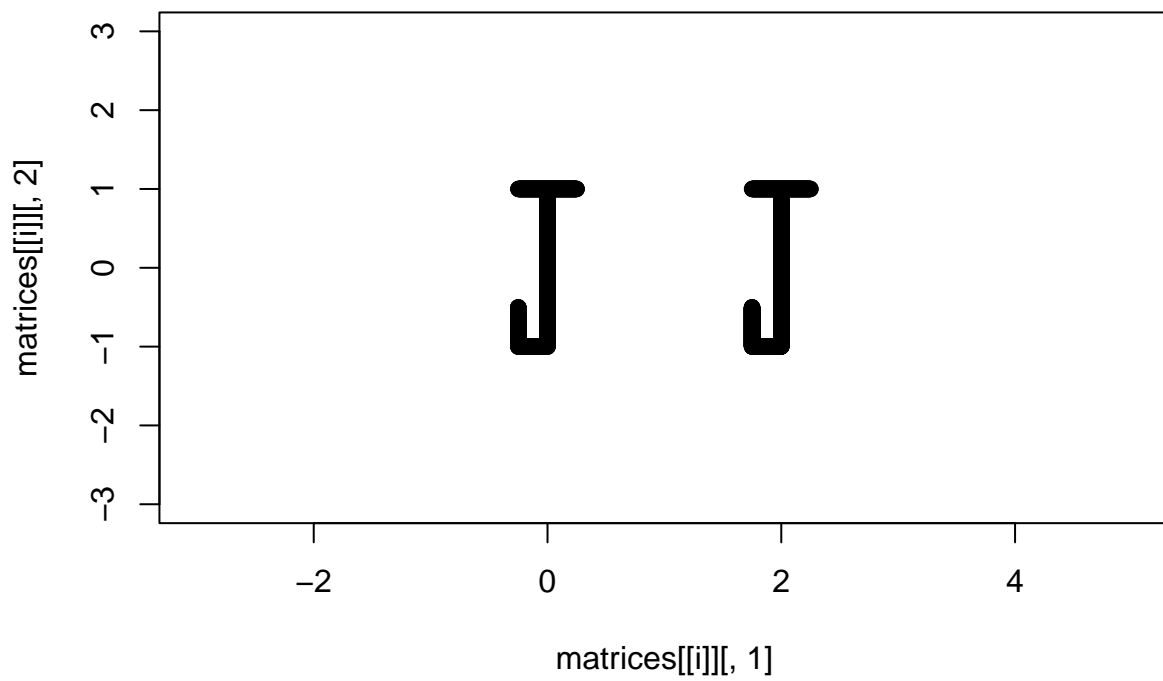
Shear Transformation
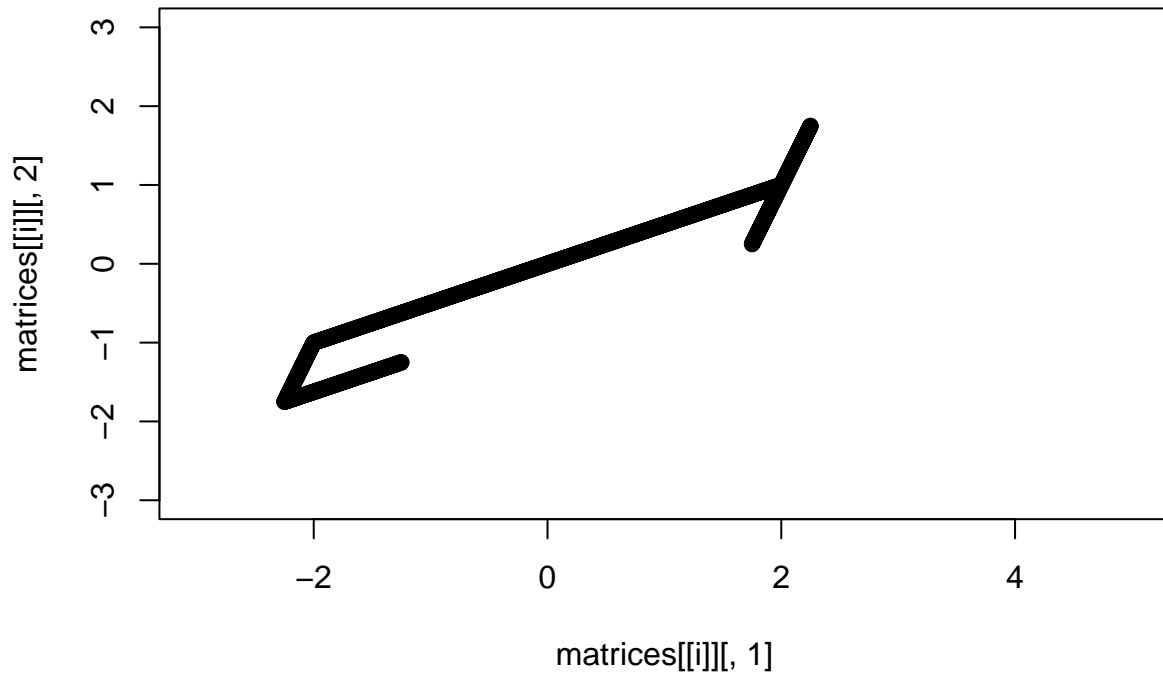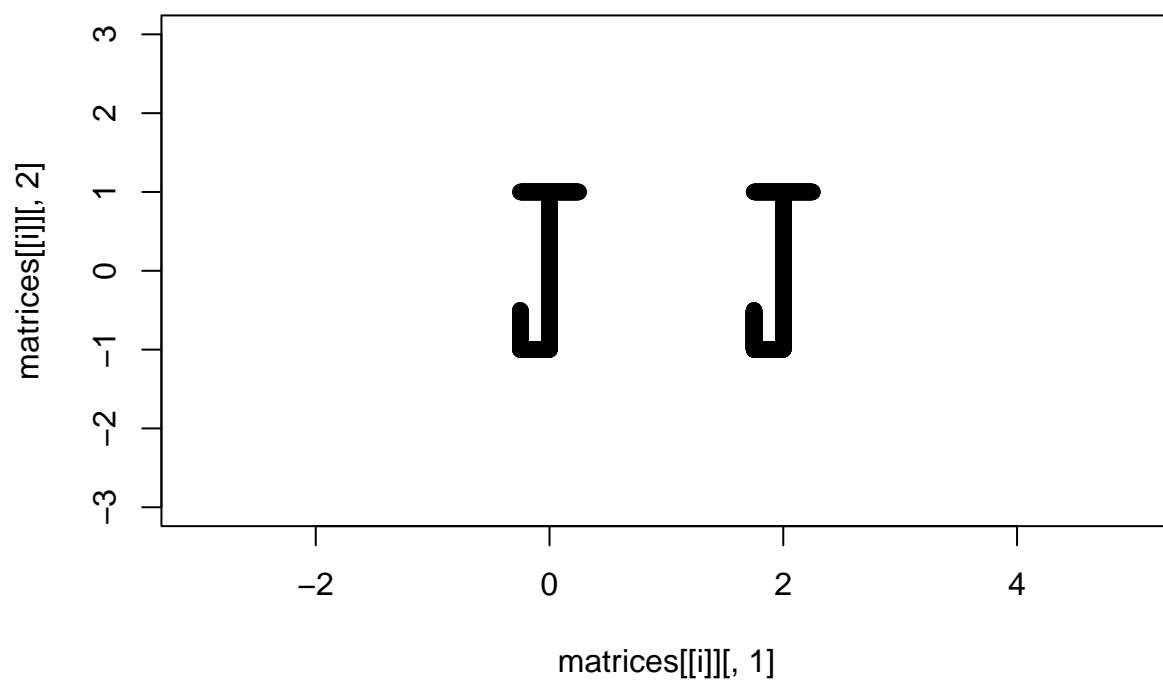
Original JJ

Scaling Transformation

Original JJ

Rotation Transformation

matrices[[i]][, 2]

matrices[[i]][, 1]

Original JJ

Projection Transformation