Uniwersytet Pedagogiczny im. Komisji Edukacji Narodowej Instytut Bezpieczeństwa i Informatyki



PROJEKT INŻYNIERSKI DOKUMENTACJA UŻYTKOWA

EKSPLORACJA DANYCH ZA POMOCĄ TOPOLOGICZNEJ ANALIZY DANYCH NA PRZYKŁADZIE AMERYKAŃSKO-KANADYJSKIEJ LIGI KOSZYKARSKIEJ NBA

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Kraków 2023

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1 Szczegółowa dokumentacja projektowa

W zależności od specyfiki projektu! Wymienione niżej podpunkty mają charakter orientacyjny.

1.1 Projekt bazy danych

Opis kolumn

- RK ranking w danym sezonie
- Team nazwa drużyny
- TRB całkowita lczba zbiórek (w offensywie i w defensywie)
- AST Liczba asyst
- STL przechwycenie piłki
- BLK liczba bloków
- PTS liczba zdobytych punktów

Tabele:

							1000				Service Contract		
Rk	Team	TRB	AST		BLK	Control Control	Rk	Team	TRB	AST		BLK	PTS
1		4050	2005	856	406	9828		Golden State Warriors*	3513	2064	854	375	9732
2		3419	1954	803	378	9564	2	Indiana Pacers*	3647	2398	705	393	9197
3	Portland Trail Blazers*	3763	2254	724	410	9407	3	Phoenix Suns*	3646	2202	673	582	9194
4	Phoenix Suns*	3730	2209	687	535	9348	4	Portland Trail Blazers*	3843	2065	753	410	9135
5	Indiana Pacers*	3394	2181	658	357	9159	5	Chicago Bulls*	3612	2279	672	480	9011
6	Boston Celtics*	3785	2160	672	565	9145	6	Charlotte Hornets	3531	2284	822	309	8980
7	Chicago Bulls*	3490	2212	822	438	9024	7	Cleveland Cavaliers*	3491	2260	616	621	8926
8	Atlanta Hawks*	3655	1864	729	374	9003	8	Utah Jazz*	3640	2188	715	448	8877
9	San Antonio Spurs*	3788	2140	670	571	8782	9	Boston Celtics*	3678	2072	636	484	8745
10	Houston Rockets*	3783	1906	796	409	8753	10	Seattle SuperSonics*	3539	1877	775	448	8737
11	Seattle SuperSonics*	3395	2042	861	380	8744	11	Atlanta Hawks	3786	2123	793	320	8711
12	Milwaukee Bucks*	3241	2075	894	330	8727	12	New Jersey Nets*	3904	1937	736	615	8641
13	Los Angeles Lakers*	3518	2091	642	384	8717	13	Milwaukee Bucks	3469	2018	863	317	8609
14	Orlando Magic	3662	1809	602	306	8684	14	Miami Heat*	3553	1749	670	373	8608
15	Philadelphia 76ers*	3480	1824	678	479	8641	15	Sacramento Kings	3408	1957	727	618	8549
16	Utah Jazz*	3341	2217	652	451	8527	16	San Antonio Spurs*	3781	2010	729	608	8524
17	Los Angeles Clippers	3746	2119	725	507	8491	17	Los Angeles Clippers*	3525	2053	824	498	8440
18	New York Knicks*	3489	2172	638	418	8455	18	Washington Bullets	3414	2011	713	422	8395
19	New Jersey Nets	3748	1782	748	600	8441	19	Houston Rockets	3506	2058	656	571	8366
20	Charlotte Hornets	3227	2019	759	304	8428	20	Philadelphia 76ers	3367	1755	692	482	8358
21	Miami Heat	3534	1904	756	387	8349	21	Orlando Magic	3500	1792	643	367	8330
22		3340	2240	643	450	8343	22	New York Knicks*	3674	2130	634	382	8328
23	Washington Bullets	3563	2081	588	468	8313	23	Minnesota Timberwolves	3335	2025	619	526	8237
24	Detroit Pistons*	3658	1825	487	367	8205	24	Los Angeles Lakers*	3352	1803	756	400	8229
25	Dallas Mavericks	3344	1821	581	397	8195	25	Denver Nuggets	3702	1553	773	461	8176
26	Minnesota Timberwolves	3388	1885	712	440	8169		Detroit Pistons*	3631	1899	546	357	8113
20	Sacramento Kings	3245	1991	631	513	7928		Dallas Mavericks	3633	1630	536	349	8007
27		52 15	TOOT	001	213	1220	21	Dallas Mavericks	3033	1030	330	345	8007
27	Tay to the same of	3547	2029	704	431	8717		League Average	2501	2007	700	450	2635
27	League Average	3547	2029	704	431	8717		League Average		2007	Parameter (
Rk	League Average Team	TRB	AST	STL	BLK	PTS	Rk	Team	TRB	AST	STL	BLK	PTS
Rk	Team Phoenix Suns*	TRB 3651	AST 2087	STL 752	BLK 455	PTS 9298	Rk 1	Team Chicago Bulls*	TRB 3658	AST 2033	STL 745	BLK 345	PTS 8625
- Rk 1	Team Phoenix Suns* Charlotte Hornets*	TRB 3651 3603	AST 2087 2161	STL 752 639	BLK 455 473	PTS 9298 9030	Rk 1 2	Team Chicago Bulls* Seattle SuperSonics*	TRB 3658 3403	AST 2033 1999	STL 745 882	BLK 345 393	PTS 8625 8572
Rk	Team Phoenix Suns*	TRB 3651	AST 2087	STL 752	BLK 455	PTS 9298	Rk 1	Team Chicago Bulls*	TRB 3658	AST 2033 1999 2080	STL 745 882 663	BLK 345 393	PTS 8625 8572 8572
	Team Phoenix Suns* Charlotte Hornets*	TRB 3651 3603	AST 2087 2161	STL 752 639	BLK 455 473	PTS 9298 9030	Rk 1 2	Team Chicago Bulls* Seattle SuperSonics*	TRB 3658 3403	AST 2033 1999	STL 745 882 663	BLK 345 393 406	PTS 8625 8572 8572
- Rk 1 2 3	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors	TRB 3651 3603 3603	AST 2087 2161 2010	STL 752 639 693	BLK 455 473 383	PTS 9298 9030 9014	Rk 1 2 3	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic*	TRB 3658 3403 3367	AST 2033 1999 2080	STL 745 882 663 623	BLK 345 393 406 331	8625 8572 8573 8573
1 2 3 4	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers*	TRB 3651 3603 3603 3733	AST 2087 2161 2010 1969	752 639 693 770	BLK 455 473 383 425	PTS 9298 9030 9014 8898	Rk 1 2 3 4	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns*	TRB 3658 3403 3367 3510	AST 2033 1999 2080 2001	STL 745 882 663 623 653	BLK 345 393 406 331 406	PTS 8625 8572 8571 8552 8495
Rk 1 2 3 4 5 6	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics*	TRB 3651 3603 3603 3733 3476	AST 2087 2161 2010 1969 1906	752 639 693 770 944	455 473 383 425 409	PTS 9298 9030 9014 8898 8884	Rk 1 2 3 4 5	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics	TRB 3658 3403 3367 3510 3477	2033 1999 2080 2001 1792 2044	5TL 745 882 663 623 653 645	BLK 345 393 406 331 406 536	PTS 8625 8572 8572 8552 8495 8477
Rk 1 2 3 4 5 6	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics* Sacramento Kings	TRB 3651 3603 3603 3733 3476 3418	AST 2087 2161 2010 1969 1906 2075	5TL 752 639 693 770 944 768	BLK 455 473 383 425 409 348	9298 9030 9014 8898 8884 8847	Rk 1 2 3 4 5	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics San Antonio Spurs*	TRB 3658 3403 3367 3510 3477 3523	2033 1999 2080 2001 1792 2044	5TL 745 882 663 623 653 645 722	BLK 345 393 406 331 406 536 516	PTS 8625 8572 8572 8552 8495 8477 8438
Rk 1 2 3 4 5 6 7	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics* Sacramento Kings Indiana Pacers*	TRB 3651 3603 3603 3733 3476 3418 3675	AST 2087 2161 2010 1969 1906 2075 2144	752 639 693 770 944 768 615	BLK 455 473 383 425 409 348 403	9298 9030 9014 8898 8884 8847 8836	Rk 1 2 3 4 5 6 7	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics San Antonio Spurs* Los Angeles Lakers*	TRB 3658 3403 3367 3510 3477 3523 3298	2033 1999 2080 2001 1792 2044 2080	5TL 745 882 663 623 653 645 722 582	BLK 345 393 406 331 406 536 516 277	PTS 8625 8572 8572 8572 8495 8495 8438
Rk 1 2 3 4 5 6 7 8	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics* Sacramento Kings Indiana Pacers* Cleveland Cavaliers*	TRB 3651 3603 3603 3733 3476 3418 3675 3425	2087 2161 2010 1969 1906 2075 2144 2349	752 639 693 770 944 768 615 615	BLK 455 473 383 425 409 348 403 536	9298 9030 9014 8898 8884 8847 8836 8832	Rk 1 2 3 4 5 6 7	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics San Antonio Spurs* Los Angeles Lakers* Charlotte Hornets	TRB 3658 3403 3367 3510 3477 3523 3298 3243	AST 2033 1999 2080 2001 1792 2044 2080 1907	5TL 745 882 663 623 653 645 722 582 642	BLK 345 393 406 331 406 536 516 277 342	8625 8572 8572 8552 8495 8477 8438 8433 8405
Rk 1 2 3 4 5 6 7 8	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics* Sacramento Kings Indiana Pacers* Cleveland Cavaliers* Atlanta Hawks*	TRB 3651 3603 3603 3733 3476 3418 3675 3425 3634	2087 2161 2010 1969 1906 2075 2144 2349 2084	752 639 693 770 944 768 615 615	BLK 455 473 383 425 409 348 403 536 278	9298 9030 9014 8898 8884 8847 8836 8832 8814	Rk 1 2 3 4 5 6 7 8 9	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics San Antonio Spurs* Los Angeles Lakers* Charlotte Hornets Dallas Mavericks	TRB 3658 3403 3367 3510 3477 3523 3298 3243 3787	AST 2033 1999 2080 2001 1792 2044 2080 1907	5TL 745 882 663 623 653 645 722 582 642 592	BLK 345 393 406 331 406 536 516 277 342 506	8625 8572 8572 8573 8495 8477 8438 8438 8408
Rk 1 2 3 4 5 6 7 8 9 10	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics* Sacramento Kings Indiana Pacers* Cleveland Cavaliers* Atlanta Hawks* Los Angeles Clippers* Utah Jazz*	TRB 3651 3603 3603 3733 3476 3418 3675 3425 3634 3543	2087 2161 2010 1969 1906 2075 2144 2349 2084 2242	752 639 693 770 944 768 615 615 806	BLK 455 473 383 425 409 348 403 536 278 491	PTS 9298 9030 9014 8898 8884 8847 8836 8832 8814 8783	Rk 1 2 3 4 5 6 7 8 9 10	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics San Antonio Spurs* Los Angeles Lakers* Charlotte Hornets Dallas Mavericks Washington Bullets	TRB 3658 3403 3367 3510 3477 3523 3298 3243 3787 3257	AST 2033 1999 2080 2001 1792 2044 2080 1907 1913 1815	STL 745 882 663 623 653 645 722 582 642 592 645	BLK 345 393 406 331 406 536 516 277 342 506 476	PTS 8625 8572 8572 8552 8495 8477 8438 8409 8408
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Rk 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics* Sacramento Kings Indiana Pacers* Cleveland Cavaliers* Atlanta Hawks* Los Angeles Clippers* Utah Jazz* Orlando Magic San Antonio Spurs* Denver Nuggets Chicago Bulls* Philadelphia 76ers Los Angeles Lakers* Houston Rockets* Boston Celtics* Miami Heat	788 3651 3603 3603 3733 3476 3418 3675 3634 3504 3606 3461 3830 3573 3462 3391 3517 3512 3518	AST 2087 2161 2010 1969 1906 2075 2144 2349 2084 2242 2177 1952 2012 1735 2038 2013 2115 1999 1688	752 639 693 770 944 768 615 615 806 847 746 542 582 651 783 672 782 682 647	BLK 455 473 383 425 409 348 403 536 491 344 467 514 565 410 566 431 543 458 350	9298 9030 9014 8898 8884 8847 8836 8832 8814 8709 8652 8652 8656 8625 8556 8546 8531 8502 8495	Rk 1 1 2 3 3 4 4 5 6 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics San Antonio Spurs* Los Angeles Lakers* Charlotte Hornets Dallas Mavericks Washington Bullets Houston Rockets* Utah Jazz* Golden State Warriors Sacramento Kings* Los Angeles Clippers Portland Trail Blazers* Indiana Pacers* Atlanta Hawks* Minnesota Timberwolves Denver Nuggets	TRB 3658 3403 3367 3510 3477 3523 3298 3243 3787 3374 3366 3458 3459 3737 3272 3330 3256 3544	AST 2033 1999 2080 2001 1792 2044 2080 1907 1913 1815 1982 2139 1889 1672 1760 1917 1609 1867 1851	5TL 745 882 663 623 653 645 722 582 642 592 645 667 706 643 703 594 579 771 650 521	BLK 345 393 406 331 406 536 577 342 506 476 418 470 436 411 417 323 319 481 597	PTS 8625 857. 8557 849. 847. 843. 840. 840. 840. 833. 816. 815. 814. 805. 802. 801.
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FRk 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics* Sacramento Kings Indiana Pacers* Cleveland Cavaliers* Atlanta Hawks* Los Angeles Clippers* Utah Jazz* Orlando Magic San Antonio Spurs* Denver Nuggets Chicago Bulls* Philadelphia 76ers Los Angeles Lakers* Houston Rockets* Boston Celtics* Miami Heat New Jersey Nets* Milwaukee Bucks Washington Bullets New York Knicks*	TRB 3651 3603 3733 3476 3418 3675 3425 3634 3504 3606 3461 3830 3517 3512 3518 3797 3163 3348 3810	AST 2087 2161 2010 1969 1906 2075 2144 2349 2084 22177 1952 2012 1735 2038 2013 2115 1999 1688 1872 2084 2110 2125	752 639 693 770 944 768 615 806 847 746 542 651 783 672 782 682 647 609 693 863 673 680	BLK 455 473 383 425 409 348 403 536 491 344 467 514 565 410 566 431 543 458 350 526 393 359 372	9298 9030 9014 8898 8884 8847 8836 8832 8814 8783 8709 8652 8652 8656 8556 8546 8531 8502 8495 8431 8392 8353 8328	Rk 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics San Antonio Spurs* Los Angeles Lakers* Charlotte Hornets Dallas Mavericks Washington Bullets Houston Rockets* Utah Jazz* Golden State Warriors Sacramento Kings* Los Angeles Clippers Portland Trail Blazers* Indiana Pacers* Atlanta Hawks* Minnesota Timberwolves Denver Nuggets Toronto Raptors New York Knicks* Milwaukee Bucks	TRB 3658 3403 3367 3510 3477 3523 3298 3243 3787 3357 3374 3366 3458 3459 3737 3272 3330 3256 3544 3284 3278 3494 3137	AST 2033 1999 2080 2001 1792 2044 2080 1907 1913 1815 1982 2139 1672 1760 1917 1609 1867 1851 1927 1822 1752	5TL 7455 8822 6633 6453 7222 582 6452 592 6453 667 706 6433 594 579 771 650 521 745 645 574 582 506	BLK 345 393 406 331 406 536 516 277 342 506 476 418 470 436 411 417 323 319 481 597 493 377 439 307 352	8625 8577 8557 8557 8498 8477 8438 8406 8406 8406 8406 8406 8157 8158
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Rk 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	Team Phoenix Suns* Charlotte Hornets* Golden State Warriors Portland Trail Blazers* Seattle SuperSonics* Sacramento Kings Indiana Pacers* Cleveland Cavaliers* Atlanta Hawks* Los Angeles Clippers* Utah Jazz* Orlando Magic San Antonio Spurs* Denver Nuggets Chicago Bulls* Philadelphia 76ers Los Angeles Lakers* Houston Rockets* Boston Celtics* Miami Heat New Jersey Nets* Milwaukee Bucks Washington Bullets New York Knicks* Detroit Pistons Dallas Mavericks	TRB 3651 3603 3733 3476 3418 3675 3634 3504 3504 3517 3512 3518 3797 3163 3348 3810 3608 3499 3144	AST 2087 2161 2010 1969 1906 2075 2144 2349 2084 2242 2177 1952 2012 1735 2038 2013 2015 1999 1688 1872 2084 2110 2125 1941 1683	752 639 693 770 944 768 615 615 806 847 746 542 582 651 783 672 782 647 609 693 863 673 680 580 649	BLK 455 473 383 425 409 348 403 536 491 344 467 514 565 410 566 431 543 458 350 526 393 359 372 249 355 455	9298 9030 9014 8898 8884 8847 8836 8832 8814 8783 8709 8652 8652 8656 8546 8531 8502 8495 8431 8392 8353 8328 8252 8141 8046	Rk 1 1 2 3 3 4 4 5 6 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	Team Chicago Bulls* Seattle SuperSonics* Orlando Magic* Phoenix Suns* Boston Celtics San Antonio Spurs* Los Angeles Lakers* Charlotte Hornets Dallas Mavericks Washington Bullets Houston Rockets* Utah Jazz* Golden State Warriors Sacramento Kings* Los Angeles Clippers Portland Trail Blazers* Indiana Pacers* Atlanta Hawks* Minnesota Timberwolves Denver Nuggets Toronto Raptors New York Knicks* Miami Heat* Milwaukee Bucks Detroit Pistons* Philadelphia 76ers	TRB 3658 3403 3367 3510 3477 3523 3298 3243 3787 3374 3366 3458 3459 3169 3737 3272 3330 3256 3544 3284 3137 3324 3137	AST 2033 1999 2080 2001 1792 2044 2080 1907 1913 1815 1982 2139 1672 1760 1917 1609 1867 1851 1927 1755 1610 1629 1752	5TL 745 882 663 623 653 645 722 582 642 592 645 667 706 643 703 594 579 771 650 521 745 645 574 582 506 643 627	BLK 345 393 406 331 406 536 516 277 342 506 476 418 470 436 411 417 323 319 481 597 493 377 439 307 352 420 571	8625 8577 8557 8557 8498 8477 8438 8408 8406 8406 833 8163 8163 8144 8055 8024 8013 7994 7977 7905 7837 7822 7746

Rk		TRB	AST	STL	BLK	PTS
1	Michael Jordan	492	453	223	83	2580
2	Scottie Pippen	595	511	193	93	1461
3	Horace Grant	659	178	95	69	1000
4	Bill Cartwright	486	126	32	15	760
5	John Paxson	91	297	62	3	710
6	B.J. Armstrong	149	301	70	4	720
7	Stacey King	208	65	24	42	419
8	Cliff Levingston	225	56	29	43	314
9	Will Perdue	336	47	23	57	307
10	Craig Hodges	42	97	34	2	362
11	Dennis Hopson	109	65	25	14	264
12	Scott Williams	98	16	12	13	127
		3490	2212	822	438	9024

Rk		TRB	AST	STL	BLK	PTS
1	Chris Mullin	443	329	173	63	2107
2	Tim Hardaway	332	793	214	12	1881
3	Mitch Richmond	452	238	126	34	1840
4	Rod Higgins	354	113	52	37	776
5	Alton Lister	483	93	20	90	491
6	Tom Tolbert	275	76	35	38	500
7	Tyrone Hill	383	19	33	30	390
8	<u>Šarūnas Marčiulionis</u>	118	85	62	4	545
9	Jim Petersen	200	27	13	41	279
10	Kevin Pritchard	65	81	30	8	243
11	Mario Elie	109	44	19	10	231
12	Paul Mokeski	67	9	8	3	57
13	Steve Johnson	57	17	4	4	90
14	<u>Larry Robinson</u>	23	11	9	1	56
15	Les Jepsen	37	1	1	3	28
16	Vincent Askew	11	13	2	0	33
17	Mike Smrek	7	1	2	0	14
18	Bart Kofoed	3	4	0	0	3
		3419	1954	803	378	9564

1.2 Szczegółowa dokumentacja kodu

```
main.py ×

import matplotlib.pyplot as plt

import gudhi

off_file = 'chicago91.off'

point_cloud = gudhi.read_points_from_off_file(off_file=off_file)

rips_complex = gudhi.RipsComplex(points=point_cloud, max_edge_length=700)

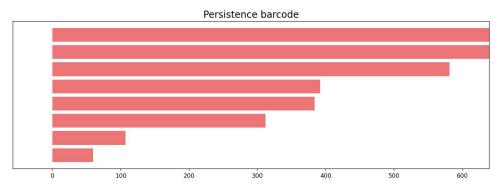
simplex_tree = rips_complex.create_simplex_tree(max_dimension=1)

diag = simplex_tree.persistence(min_persistence=2)

gudhi.plot_persistence_barcode(diag)

plt.show()
```

Output:



Zmienne:

- off-ile zmienna z plikiem w tym przypadku chicago91.off
- point-coud zmienna przechowująca chmurę punktów pobraną z pliku .off
- rips-complex zmienna przechowująca wartośc z wykonania funkcji RipsComplex(). czyli dystans diagramu.
- simplex-tree zmienna przechowuje wynik operacji creat-simplex-tree() wykonanej na obiekcie rips-complex (Maksymalna liczba wymiaru)
- diag zmienna przechowująca wynik metody persistance() wykonanej na obiekcie simplex-tree. Minimalny rozmiar interwału trwałości.

Metody:

gudhi.read_points_from_off_file()

Read points from an OFF file.

Parameters: off_file (string) - An OFF file style name.

Returns: The point set.

Return type: List[List[float]]

__init__()

SimplexTree constructor.

Parameters: other (SimplexTree (Optional)) – If other is None (default value), an empty

SimplexTree is created. If other is a SimplexTree, the SimplexTree is constructed from a deep copy of other.

Returns: An empty or a copy simplex tree.

Return type: SimplexTree

Raises: TypeError – In case other is neither None, nor a SimplexTree.

Note: If the *SimplexTree* is a copy, the persistence information is not copied. If you need it in the clone, you have to call compute_persistence() on it even if you

had already computed it in the original.

persistence()

This function computes and returns the persistence of the simplicial complex.

Parameters: • homology_coeff_field (int) - The homology coefficient field. Must be a prime number. Default value is 11. Max is 46337. • min_persistence (float) - The minimum persistence value to take into

- account (strictly greater than min_persistence). Default value is 0.0. Set min persistence to -1.0 to see all values.
- persistence_dim_max (bool) If true, the persistent homology for the maximal dimension in the complex is computed. If false, it is ignored.

Returns: The persistence of the simplicial complex.

Return type: list of pairs(dimension, pair(birth, death))

gudhi.plot_persistence_barcode(persistence=[], persistence_file=", alpha=0.6, max_intervals=20000, inf_delta=0.1, legend=False, colormap=None, axes=None, [source] fontsize=16)

This function plots the persistence bar code from persistence values list, a np.array of shape (N x 2) (representing a diagram in a single homology dimension), or from a persistence diagram file.

- Parameters: persistence (an array of (dimension, array of (birth, death)) or an array of (birth, death).) - Persistence intervals values list. Can be grouped by dimension or not
 - persistence_file (string) -A persistence diagram file style name (reset persistence if both are set).
 - alpha (float.) barcode transparency value (0.0 transparent through 1.0 opaque - default is 0.6).
 - max_intervals (int.) maximal number of intervals to display. Selected intervals are those with the longest life time. Set it to 0 to see all. Default value is
 - inf delta (float.) Infinity is placed at ((max death min birth) x inf delta) above max death value. A reasonable value is between 0.05 and 0.5 - default is 0.1.
 - legend (boolean.) Display the dimension color legend (default is False).
 - colormap (tuple of colors (3-tuple of float between 0. and 1.).) A matplotliblike qualitative colormaps. Default is None which means matplotlib.cm.Set1.colors.
 - axes (matplotlib.axes.Axes) A matplotlib-like subplot axes. If None, the plot is drawn on a new set of axes.
 - fontsize (int) Fontsize to use in axis. (matplotlib.axes.Axes): The axes on which the plot was drawn.

Returns:

Przykłady użytych bibliotek:

Gudhi:

```
import matplotlib.pyplot as plot
import gudhi
__copyright__ = "Copyright (C) 2016 Inria"
print("###########################")
gudhi.plot_persistence_barcode(persistence)
print("##########################")
gudhi.plot_persistence_diagram(persistence)
plot.show()
gudhi.plot_persistence_diagram(persistence, band=0.2)
plot.show()
fig, axes = plot.subplots(nrows=1, ncols=2)
gudhi.plot_persistence_barcode(persistence, axes_=_axes[0])
gudhi.plot_persistence_diagram(persistence, axes_=_axes[1])
fig.suptitle("barcode versus diagram")
plot.show()
```

Matplotlib:

Example

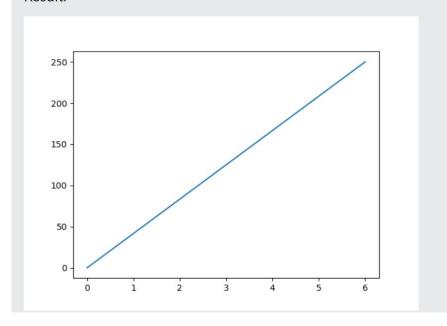
Draw a line in a diagram from position (0,0) to position (6,250):

```
import matplotlib.pyplot as plt
import numpy as np

xpoints = np.array([0, 6])
ypoints = np.array([0, 250])

plt.plot(xpoints, ypoints)
plt.show()
```

Result:



1.3 Środowisko programistyczne

Wymagania:

Srodowisko PyCharm Community Edition 2020.2.3

- Platforam sprzętowa Windows, macOS, Linux.
- System operacyjny Windows 8/10/11 (64 bit), macOS 10.14 lub nowszy, dowolna dystrybucja Linuksa obsługująca Gnome, KDE lub Unity DE.
- Procesor Wielordzeniowy procesor
- Pmięć RAM min 4GB
- Miejsce na dysku twardym 2,5GB i 1GB pamięci podręcznej
- Wielordzeniowy procesor.
- Minimum 4 GB.
- 2,5 GB i 1 GB na pamięć podreczną
- Ekran. 1024x768.

Instalacja bibliotek gudhi i matplotlib

- python -m pip install -U pip
- python -m pip install -U matplotlib
- python pip install gudhi

Literatura

- [1] Encyklopedia Zarządzania Analiza Danych
- [2] Zastosowanie Topologicznej Analizy Danych Autorstwa: Artura Żuwała
- [3] Moneyball 2.0: How Missile Tracking Cameras Are Remaking The NBA
- [4] Analyzing NBA basketball data with R
- [5] Game of Waveforms

Książki

- [6] Lutz Mark Python Wprowadzenie
- [7] **Vaughan Lee** Python z życia wzięty. Rozwiązywanie Problemów za pomocą kilku linii kodu

Kursy online

- [8] Kanał o Wszystkim Kurs Python Programowanie
- [9] Greg Hogg Complete Beginner's Tutorial to Google Colab

Linki, które były pomocne w czasie realizacji pracy

```
[10] https://gudhi.inria.fr/python/latest/simplex<sub>t</sub>ree<sub>r</sub>ef.html
https://gudhi.inria.fr/python/latest/persistence<sub>g</sub>raphical<sub>t</sub>ools<sub>r</sub>ef.html
https://gudhi.inria.fr/doc/3.4.1
https://www.w3schools.com/python/matplotlib<sub>p</sub>yplot.asp
https://snyk.io/advisor/python/gudhi/functions/gudhi.plot<sub>p</sub>ersistence<sub>b</sub>arcode
```

Prace własne

[11] **Piotr Maliga** - Metody-Badawcze-w-Informatyce-Piotr-Maliga