Metody rozpoznawania obrazów i podstawy uczenia maszynowego

Projekt 3

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1). Wprowadzenie:

Eksperyment polegał na porównaniu klasyfikatora SVM trenowanego na pełnym zbiorze danych i pełnym zbiorze cech oraz zespołu 10 podklasyfikatorów SVM trenowanych na niepełnych zestawach danych i cech. Użyty został domyślny kernel SVM (radial basic function).

Raport obejmuje wyniki eksperymentu dla zbioru danych 20 TNG newsgroups (zawierającego 20 klas i 18 846 przykładów) oraz dla zbioru FMIST obejmującego 10 klas i 70 000 przykładów. Liczby cech zostały zostały przed treningiem zmniejszone odpowiednio do 500 dla TNG i 50 dla FMNIST.

Wzięte do budowy podklasyfikatorów części zbiorów danych i cech:

przykłady uczące = 10%, 35%, 70%

cechy = 25%, 50%, 75%.

Przykłady uczące i cechy zostały wybrane losowo.

Wykonanych zostało 6 eksperymentów, dla każdej liczby cech/danych został stworzony osobny zespół klasyfikatorów.

Wszystkie wartości prezentowane w poniższych tabelach powstały przy 5-cio krotnej cross-validacji i zawierają uśrednione wartości.

2). Wybór metody fuzji decyzji podklasyfikatorów wchodzących w skład klasyfikatora zespołowego:

TNG[1)]

	procent danych/ cech	accuracy	loss	error	roc	f1	recall	precision
average voting	10%/ 100%	0.735	-1.013	-15.174	0.970	0.736	0.744	0.734
	35%/ 100%	0.822	-0.625	-9.635	0.986	0.823	0.826	0.822
	70%/ 100%	0.855	-0.500	-8.012	0.990	0.855	0.857	0.855
	100%/ 25%	0.849	-0.751	-6.105	0.988	0.849	0.851	0.849
	100%/ 50%	0.863	-0.530	-7.501	0.991	0.862	0.864	0.863
	100%/ 75%	0.869	-0.468	-7.264	0.992	0.869	0.870	0.869

majority voting	10%/ 100%	0.726	-1.012	-14.327	0.970	0.729	0.747	0.726
	35%/ 100%	0.818	-0.624	-9.650	0.986	0.819	0.826	0.818
	70%/ 100%	0.854	-0.499	-7.841	0.990	0.854	0.858	0.854
	100%/ 25%	0.834	-0.710	-9.246	0.985	0.834	0.841	0.834
	100%/ 50%	0.855	-0.528	-7.851	0.990	0.856	0.860	0.855
	100%/ 75%	0.863	-0.469	-7.217	0.992	0.864	0.867	0.863
borda voting	10%/ 100%	0.735	-2.401	-15.066	0.953	0.736	0.744	0.735
	35%/ 100%	0.822	-2.344	-9.589	0.974	0.823	0.826	0.822
	70%/ 100%	0.856	-2.332	-8.107	0.980	0.856	0.857	0.856
	100%/ 25%	0.847	-2.360	-8.257	0.982	0.849	0.851	0.847
	100%/ 50%	0.861	-2.334	-7.462	0.985	0.862	0.863	0.861
	100%/ 75%	0.866	-2.327	-7.368	0.985	0.866	0.867	0.866

FMNIST[2)]

	procent danych/ cech	accuracy	loss	error	roc	f1	recall	precision
average voting	10%/ 100%	0.839	-0.445	-2.073	0.984	0.837	0.837	0.839
	35%/ 100%	0.862	-0.384	-1.813	0.988	0.861	0.861	0.862
	70%/ 100%	0.872	-0.357	-1.703	0.989	0.871	0.871	0.872
	100%/ 25%	0.848	-0.533	-2.002	0.985	0.846	0.846	0.848
	100%/ 50%	0.869	-0.373	-1.752	0.989	0.868	0.868	0.869

	100%/ 75%	0.874	-0.349	-1.686	0.990	0.873	0.873	0.874
majority voting	10%/ 100%	0.837	-0.445	-2.072	0.984	0.835	0.836	0.837
	35%/ 100%	0.862	-0.384	-1.790	0.988	0.861	0.861	0.862
	70%/ 100%	0.871	-0.356	-1.697	0.989	0.870	0.871	0.871
	100%/ 25%	0.842	-0.510	-2.101	0.983	0.840	0.841	0.842
	100%/ 50%	0.868	-0.373	-1.771	0.989	0.866	0.867	0.868
	100%/ 75%	0.874	-0.349	-1.669	0.990	0.873	0.873	0.874
borda voting	10%/ 100%	0.839	-1.642	-2.073	0.969	0.837	0.837	0.839
	35%/ 100%	0.862	-1.636	-1.812	0.973	0.861	0.861	0.862
	70%/ 100%	0.872	-1.634	-1.703	0.975	0.871	0.871	0.872
	100%/ 25%	0.844	-1.663	-2.040	0.979	0.843	0.844	0.844
	100%/ 50%	0.868	-1.637	-1.772	0.982	0.867	0.867	0.868
	100%/ 75%	0.873	-1.633	-1.692	0.981	0.873	0.872	0.873

Została przyjęta większa dokładność uśrednionych wyników, by lepiej pokazać różnice między metodami fuzji.

Dla zbioru danych TNG wyniki uzyskane przy pomocy wszystkich trzech metod fuzji decyzji były podobne. Najlepiej prezentuje się jednak metoda average voting, pozwalając uzyskać najlepsze accuracy oraz precision i recall (a co za tym idzie f1) przy wartości loss porównywalnej do tej osiągniętej przy pomocy majority voting (osiągającej gorsze wyniki powyższych miar jakości). Metoda borda voting pozwoliła uzyskać accuracy pomiędzy wynikami average voting a majority voting, jednak przy znacznie większej wartości loss.

W przypadku FMNIST wyniki wszystkich 3 metod były bardzo zbliżone. Najbardziej efektywną biorąc pod uwagę wszystkie eksperymenty okazała się metoda average voting (zawsze uzyskiwała najlepsze accuracy, w porównaniu do innych metod i tylko niekiedy uzyskiwała delikatnie gorsze miary jakości). Metoda borda voting okazała się lepsza niż

majority voting dla mniejszej ilości przykładów branych do uczenia klasyfikatorów i równocześnie gorsza, gdy brano mniejszą ilość cech.

W obu przypadkach najlepsza okazała się metoda average, co może sugerować, że jest to najlepsza metoda wyboru fuzji decyzji w przypadku klasyfikatorów SVM.

3). Ocenić jakość klasyfikatorów w zależności od liczby przykładów uczących:

m - liczba przykładów w pełnym zbiorze
Liczba przykładów uczących = liczba przykładów branych do procesu cross-validacji, rzeczywista liczba przykładów uczących wynosi 0.8 * x%/100 * m, zaś liczba przykładów brana do testowania to 0.2 * x%/100 * m.

TNG

Pojedynczy klasyfikator SVM[3)]:

	accuracy	loss	error	roc	f1	precision	recall
100%	0.87	-0.45	-7.33	0.99	0.87	0.87	0.87
75%	0.86	-0.47	-7.28	0.99	0.86	0.87	0.86
50%	0.87	-0.45	-6.63	0.99	0.87	0.88	0.87
25%	0.84	-0.59	-9.08	0.99	0.84	0.85	0.84
10%	0.76	-0.90	-12.29	0.97	0.76	0.79	0.76

Zespoły podklasyfikatorów[4)]:

	procent danych/ cech	accuracy	loss	error	roc	f1	precision	recall
100%	10%/ 100%	0.74	-1.01	-15.17	0.97	0.74	0.74	0.73
	35%/ 100%	0.82	-0.63	-9.64	0.99	0.82	0.83	0.82
	70%/ 100%	0.86	-0.50	-8.01	0.99	0.86	0.86	0.86
	100%/ 25%	0.85	-0.75	-6.11	0.99	0.85	0.85	0.86
	100%/ 50%	0.86	-0.53	-7.50	0.99	0.86	0.86	0.86
	100%/ 75%	0.87	-0.47	-7.26	0.99	0.87	0.87	0.87

75%	10%/ 100%	0.72	-1.11	-15.58	0.96	0.72	0.73	0.72
	35%/ 100%	0.82	-0.65	-9.31	0.99	0.82	0.83	0.82
	70%/ 100%	0.85	-0.52	-7.87	0.99	0.85	0.86	0.85
	100%/ 25%	0.85	-0.74	-7.88	0.99	0.85	0.85	0.85
	100%/ 50%	0.86	-0.55	-7.33	0.99	0.86	0.86	0.86
	100%/ 75%	0.86	-0.48	-7.201	0.99	0.86	0.87	0.86
50%	10%/ 100%	0.68	-1.30	-17.30	0.96	0.69	0.70	0.68
	35%/ 100%	0.82	-0.68	-9.85	0.99	0.82	0.82	0.82
	70%/ 100%	0.86	-0.50	-7.41	0.99	0.86	0.86	0.86
	100%/ 25%	0.86	-0.74	-7.23	0.99	0.86	0.86	0.86
	100%/ 50%	0.87	-0.53	-6.47	0.99	0.87	0.88	0.87
	100%/ 75%	0.88	-0.47	-6.50	0.99	0.88	0.88	0.88
25%	10%/ 100%	0.53	-2.01	-23.52	0.91	0.52	0.58	0.53
	35%/ 100%	0.76	-0.95	-12.43	0.97	0.77	0.78	0.76
	70%/ 100%	0.82	-0.68	-9.62	0.99	0.82	0.83	0.82
	100%/ 25%	0.82	-0.94	-9.46	0.98	0.82	0.83	0.82
	100%/ 50%	0.84	-0.70	-8.73	0.99	0.84	0.84	0.84
	100%/ 75%	0.84	-0.62	-7.97	0.99	0.84	0.85	0.84
10%	10%/ 100%	0.13	-3.05	-62.22	0.47	0.07	0.09	0.13
	35%/	0.62	-1.61	-20.10	0.93	0.62	0.67	0.62

	100%							
	70%/ 100%	0.74	-1.084	-13.52	0.96	0.74	0.76	0.74
	100%/ 25%	0.76	-1.33	-11.76	0.96	0.76	0.78	0.76
	100%/ 50%	0.77	-1.08	-11.78	0.97	0.77	0.79	0.77
	100%/ 75%	0.77	-0.96	-11.26	0.97	0.77	0.79	0.77

FMNIST

Pojedynczy klasyfikator SVM[5)]:

	accuracy	loss	error	roc	f1	precision	recall
100%	0.88	-0.34	-1.66	0.99	0.87	0.87	0.88
75%	0.87	-0.35	-1.66	0.99	0.87	0.87	0.87
50%	0.87	-0.36	-1.73	0.99	0.87	0.88	0.87
25%	0.86	-0.39	-1.84	0.99	0.86	0.86	0.86
10%	0.84	-0.43	-1.96	0.99	0.84	0.84	0.84

Zespoły podklasyfikatorów[6)]:

	procent danych/ cech	accuracy	loss	error	roc	f1	precision	recall
100%	10%/ 100%	0.84	-0.45	-2.07	0.98	0.84	0.84	0.84
	35%/ 100%	0.86	-0.38	-1.81	0.99	0.861	0.86	0.86
	70%/ 100%	0.87	-0.36	-1.70	0.99	0.87	0.87	0.87
	100%/ 25%	0.85	-0.53	-2.00	0.99	0.85	0.85	0.84
	100%/ 50%	0.87	-0.37	-1.75	0.9	0.87	0.87	0.87
	100%/ 75%	0.87	-0.35	-1.69	0.99	0.87	0.87	0.87
75%	10%/ 100%	0.83	-0.46	-2.14	0.98	0.83	0.83	0.83

	35%/ 100%	0.86	-0.39	-1.83	0.99	0.86	0.86	0.86
	70%/ 100%	0.87	-0.36	-1.72	0.99	0.87	0.87	0.87
	100%/ 25%	0.85	-0.55	-1.99	0.98	0.85	0.85	0.85
	100%/ 50%	0.87	-0.38	-1.74	0.99	0.87	0.87	0.87
	100%/ 75%	0.87	-0.35	-1.70	0.99	0.87	0.87	0.87
50%	10%/ 100%	0.82	-0.48	-2.29	0.98	0.82	0.82	0.82
	35%/ 100%	0.85	-0.41	-1.93	0.99	0.85	0.85	0.85
	70%/ 100%	0.86	-0.38	-1.79	0.99	0.86	0.86	0.86
	100%/ 25%	0.84	-0.59	-2.10	0.98	0.84	0.84	0.84
	100%/ 50%	0.86	-0.4	-1.81	0.99	0.86	0.86	0.86
	100%/ 75%	0.87	-0.37	-1.76	0.99	0.87	0.87	0.87
25%	10%/ 100%	0.81	-0.53	-2.39	0.98	0.81	0.81	0.81
	35%/ 100%	0.84	-0.44	-2.05	0.98	0.84	0.84	0.84
	70%/ 100%	0.85	-0.41	-1.91	0.99	0.85	0.85	0.85
	100%/ 25%	0.84	-0.61	-2.14	0.98	0.83	0.83	0.83
	100%/ 50%	0.85	-0.43	-1.92	0.99	0.85	0.85	0.85
	100%/ 75%	0.86	-0.39	-1.83	0.99	0.86	0.86	0.86
10%	10%/ 100%	0.77	-0.65	-2.85	0.97	0.77	0.77	0.77
	35%/ 100%	0.82	-0.5	-2.21	0.98	0.82	0.82	0.82
	70%/	0.84	-0.45	-1.99	0.98	0.84	0.84	0.84

	100%							
	100%/ 25%	0.82	-0.68	-2.24	0.98	0.82	0.82	0.82
	100%/ 50%	0.84	-0.47	-2.00	0.98	0.84	0.84	0.84
	100%/ 75%	0.85	-0.44	-1.97	0.99	0.84	0.84	0.84

W przypadku TNG pojedynczy klasyfikator osiągnął najwyższe (porównywalne) wyniki dla liczby przykładów w zbiorze branym do cross-validacji znajdującej się pomiędzy 50% a 100% pierwotnego zbioru - spośród powyższych przy 50% osiągnął najlepsze accuracy oraz precision oraz najmniejszy error. Poniżej 50% przykładów jakość klasyfikacji maleje.
W przypadku klasyfikatorów zespołowych klasyfikatory trenowane na niepełnych zestawach danych i pełnych zestawach cech radzą sobie znacznie gorzej niż klasyfikatory trenowane na pełnych zestawach danych i niepełnych zestawach cech (każde zmniejszenie zbioru danych powoduje wyraźny spadek jakości klasyfikacji). Podobnie jak dla pojedynczego klasyfikatora liczby przykładów z przedziału 50%-100% pierwotnego zbioru pozwalają osiągnąć podobną jakość klasyfikacji odpowiednio dla każdego klasyfikatora (poza klasyfikatorem trenowanym na 10% przykładów i 100% danych - w jego przypadku straty na jakości klasyfikacji są wysokie oraz szybko rosną (dla 100%, 75%, 50%, 25% i 10% danych wartości accuracy wynoszą odpowiednio 0.74, 0.72, 0.68, 0.53, 0.13)). Poniżej 50% danych jakość klasyfikacji maleje. Klasyfikatory o stosunkach liczb danych do cech 70%/100% i 100%/25% uzyskują podobne wyniki. Najlepsze wyniki uzyskują klasyfikatory o stosunkach liczb danych do cech 100%/50% i 100%/75% i są to wyniki porównywalne do wyników osiągniętych przez pojedynczy klasyfikator SVM. Najlepsza jakość klasyfikacji została osiągnięta przez klasyfikator o stosunku danych do cech 100%/75% przy 50% pierwotnego zbioru danych i jest ona nieco lepsza niż ta uzyskana przy pomocy najlepszego pojedynczego klasyfikatora.
Uzyskane wyniki pozwalają wysnuć wniosek, że około połowa zbioru danych wystarcza klasyfikatorom do nauczenia się tego zbioru (o ile nie są one trenowane na dodatkowo pomniejszonym zestawie danych), przez co zwiększanie liczby przykładów uczących nie wpływa na jakość klasyfikacji. Pokazują one też, że liczba przykładów uczących nie może być zbyt mała - szczególnie widoczne to jest dla klasyfikatorów trenowanych na niepełnych zestawach danych, dla których dodatkowe zmniejszenie liczby przykładów uczących powoduje ogromny spadek jakości klasyfikacji (nawet do accuracy na poziomie 0.13 dla klasyfikatora o stosunku danych do cech wynoszącym 10%/100% - dla niego liczba przykładów uczących wyniosła 0.1 * 0.1 * 0.8 * 18846, a więc było to zaledwie 0.008 pierwotnego zbioru danych).

W przypadku FMINST zespoły klasyfikatorów zawierające mniejszy procent cech/liczby przykładów uczących radzą sobie gorzej niż pojedynczy klasyfikator. Dla zespołów klasyfikatorów, które zawierały 70% przykładów i 100% cech oraz 100% przykładów i 50% cech wyniki były podobne do pojedynczego klasyfikatora, natomiast dla 100% przykładów i

75% cech accuracy było lepsze, przy podobnych wynikach dla innych miar jakości.
Wszystkie klasyfikatory radziły sobie tym gorzej, im bardziej zmniejszana była ilość danych. Najgorzej ze zmniejszaniem liczby przykładów uczących poradził sobie zespół 10% przykładów i 100% cech, gdzie spadki jakości klasyfikacji były największe. Zespoły 35% przykładów i 100% cech oraz 100% przykładów i 25% cech radziły sobie podobnie ze zmniejszeniem liczby przykładów, trochę gorzej w porównaniu do pojedynczego klasyfikatora. Podobne do siebie wyniki uzyskiwały także 70% przykładów i 100% cech oraz 100% przykładów i 50% cech - wyniki tych dwóch zespołów były dla większej ilości danych lekko gorsze niż dla pojedynczego klasyfikatora, lecz wraz ze zmniejszaniem się ich ilości zyskiwały one praktycznie takie same miary jakości jak pojedynczy klasyfikator.
Jakość klasyfikacji dla pojedynczego klasyfikatora, jak i dla zespołów osiągających podobne do niego wyniki, zaczęła znacząco spadać dopiero przy ograniczeniu przykładów uczących do 50%. Przy 50% danych klasyfikatory te uzyskiwały accuracy o 1 p.p. gorsze niż dla 100% danych. Dla 25% danych wyniki też nie były najgorsze - tutaj spadek accuracy wynosił 2 p.p.
Można wywnioskować, że zmniejszenie liczby przykładów uczących w zespołach o połowę w stosunku do normalnej klasyfikacji wystarcza do nauczenia tego zbioru (o ile nie ograniczamy znacząco liczb przykładów i cech w zespołach klasyfikatorów). Nawet przy 25% danych jakość klasyfikacji jest akceptowalna. Wyniki pokazują, że w zespołach klasyfikatorów nie można brać też zbyt małej liczby przykładów, ani zbyt małej ilości cech, gdyż przy zmniejszaniu się startowej liczby przykładów uczących, spadki miar jakości są zdecydowanie bardziej znaczące, niż w przypadku pojedynczego klasyfikatora.

W obu przypadkach wyniki lepsze od pojedynczego klasyfikatora uzyskał tylko zespół klasyfikatorów 100% przykładów i 75% cech. Jego miara accuracy było w niektórych przypadkach lepsza niż dla pojedynczego klasyfikatora (jednak niewiele, o 1 punkt procentowy).
Powodem tego, że większa liczba klasyfikatorów nie zawsze oznacza lepszą jakość klasyfikacji może być fakt, że wszystkie klasyfikatory wchodzące w skład zespołu są podobne i tak naprawde uczą się na tych samych przykładach co pojedynczy, a w niektórych przypadkach nawet na mniejszej liczbie unikalnych przykładów (np. dla klasyfikatora 10% przykładów uczących i 100% cech, by otrzymać w zbiorze uczenia wszystkie przykłady uczące, zbiór danych musiałby zostać podzielony dokładnie na 10 odrębnych części, co w przypadku losowości jest trudne do osiągnięcia).

4). Ocenić jakość klasyfikatorów w zależności od czasów uczenia (przyjąć 3 budżety czasowe - długi T1, średni T2, krótki T3).

Dla zespołów podklasyfikatorów obliczany był sumaryczny czas uczenia. Wszystkie klasyfikatory wchodzące w skład zespołu posiadały tę samą maksymalną liczbę iteracji. Każde z ograniczeń zostało dobrane do czasu wykonywania obliczeń przez pojedynczy klasyfikator (na pełnym zestawie danych i cech).

Czasy zostały ograniczone za pomocą ustawienia odpowiedniej maksymalnej liczby iteracji dla SVM (parametr max_iter) dobranymi tak, aby uzyskać konkretny czas uczenia, odpowiednio:
* Liczba epok i czasy dla pojedynczego klasyfikatora:
T1 = 560.72 s (300 epok)
T2 = 336.43 s (130 epok) ~= 0.6 * T1
T3 = 168.22 s (60 epok) ~= 0.3 * T1

Pojedynczy klasyfikator SVM[7)]:

	accuracy	loss	error	roc	f1	precision	recall
T1=T	0.87	-0.46	-7.20	0.99	0.87	0.87	0.87
T2=0.6T*	0.84	-0.65	-8.76	0.99	0.84	0.84	0.84
T3=0.3T*	0.75	-1.07	-15.75	0.98	0.75	0.77	0.75

Zespół 12 podklasyfikatorów[8)]:

	procent danych/ cech	accuracy	loss	error	roc	f1	precision	recall
T1=T	10%/ 100%	0.73	-1.01	-15.08	0.97	0.74	0.74	0.73
	35%/ 100%	0.76	-0.92	-15.43	0.98	0.77	0.80	0.76
	70%/ 100%	0.63	-1.53	-32.59	0.96	0.65	0.71	0.63
	100%/ 25%	0.56	-2.11	-51.56	0.93	0.59	0.72	0.56
	100%/ 50%	0.53	-2.06	-53.29	0.91	0.57	0.69	0.53
	100%/ 75%	0.47	-2.19	-60.98	0.88	0.51	0.65	0.47
T2=0.6T	10%/ 100%	0.73	-1.01	-15.08	0.97	0.74	0.74	0.73
	35%/ 100%	0.68	-1.28	-24.39	0.97	0.70	0.76	0.68
	70%/ 100%	0.49	-2.02	-54.55	0.90	0.53	0.64	0.49
	100%/ 25%	0.43	-2.46	-68.6	0.87	0.47	0.67	0.43

	100%/ 50%	0.43	-2.43	-66.51	0.85	0.48	0.63	0.43
	100%/ 75%	0.36	-2.55	-74.91	0.81	0.41	0.59	0.36
T3=0.3T	10%/ 100%	0.73	-1.01	-15.08	0.97	0.74	0.74	0.73
	35%/ 100%	0.55	-1.82	-40.91	0.94	0.57	0.67	0.55
	70%/ 100%	0.33	-2.56	-74.30	0.80	0.36	0.54	0.33
	100%/ 25%	0.32	-2.76	-75.99	0.77	0.36	0.57	0.32
	100%/ 50%	0.31	-2.75	-78.2	0.75	0.34	0.54	0.31
	100%/ 75%	0.24	-2.85	-80.76	0.7	0.26	0.47	0.24

FMNIST

Czasy zostały ograniczone za pomocą ustawienia odpowiedniej maksymalnej liczby iteracji dla SVM (parametr max_iter) dobranymi tak, aby uzyskać konkretny czas uczenia, odpowiednio:

* Liczba epok i czasy dla pojedynczego klasyfikatora:

T1 = 273.70 s (800 epok)

T2 = 170.15 s (400 epok) ~= 0.6 * T1

T3 = 88.34 s (150 epok) ~= 0.3 * T1

Pojedynczy klasyfikator SVM[9)]:

	accuracy	loss	error	roc	f1	recall	precision
T1*	0.76	-0.84	-3.35	0.97	0.76	0.76	0.80
T2=0,6*T1*	0.66	-1.10	-3.86	0.94	0.67	0.67	0.69
T3=0,3*T1*	0.58	-1.18	-4.73	0.93	0.56	0.58	0.58

Zespół 12 podklasyfikatorów[10)]:

	procent danych/ cech	accuracy	loss	error	roc	f1	precision	recall
T1	10%/ 100%	0.84	-0.45	-2.07	0.98	0.84	0.84	0.84

	35%/ 100%	0.71	-0.72	-4.29	0.97	0.69	0.81	0.71
	70%/ 100%	0.56	-1.22	-6.0	0.93	0.54	0.56	0.56
	100%/ 25%	0.29	-1.97	-19.27	0.83	0.24	0.48	0.29
	100%/ 50%	0.50	-1.52	-10.25	0.91	0.49	0.57	0.50
	100%/ 75%	0.54	-1.41	-7.84	0.92	0.53	0.57	0.54
T2 = 0,6 * T1	10%/ 100%	0.84	-0.45	-2.07	0.98	0.84	0.84	0.84
	35%/ 100%	0.62	-1.02	-4.35	0.95	0.62	0.70	0.62
	70%/ 100%	0.51	-1.38	-7.44	0.91	0.49	0.54	0.51
	100%/ 25%	0.27	-2.07	-20.59	0.77	0.24	0.44	0.27
	100%/ 50%	0.46	-1.71	-12.14	0.88	0.45	0.55	0.46
	100%/ 75%	0.42	-1.76	-13.71	0.87	0.39	0.58	0.42
T3 = 0,3 * T1	10%/ 100%	0.84	-0.45	-2.07	0.98	0.84	0.84	0.84
	35%/ 100%	0.59	-1.12	-4.97	0.94	0.57	0.61	0.59
	70%/ 100%	0.40	-1.59	-10.23	0.88	0.38	0.47	0.40
	100%/ 25%	0.23	-2.17	-19.58	0.70	0.23	0.36	0.23
	100%/ 50%	0.42	-1.83	-14.08	0.85	0.40	0.50	0.42
	100%/ 75%	0.39	-1.83	-15.41	0.86	0.36	0.57	0.39

Dla TNG pojedynczy klasyfikator osiągnął znacznie lepsze wyniki niż klasyfikatory zespołowe w każdym budżecie czasowym.

W przypadku pojedynczego klasyfikatora SVM jakość klasyfikacji maleje wraz ze zmniejszającym się czasem uczenia. Najlepszy wynik osiągnięto dla budżetu T1 - accuracy 0.87, loss -0.46 i f1 0.87.
W przypadku klasyfikatorów zespołowych każde zmniejszenie budżetu czasowego powoduje spadek jakości klasyfikacji (poza klasyfikatorem o stosunku liczb danych do cech 10%/100%, w przypadku którego treningi zakończyły się przed końcem każdego ograniczenia czasowego). Najlepsza jakość klasyfikacji została uzyskana dla klasyfikatora 35%/100% dla największego budżetu czasowego - osiągnięto accuracy na poziomie 0.76, przy lossie -0.92 i f1 0.77. Dla budżetów czasowych 0.6T1 i 0.3T1 najlepsza jakość klasyfikacji została osiągnięta dla klasyfikatora 10% danych 100% cech i malała ze wzrostem liczby danych, malejąc dalej dla klasyfikatorów o niepełnych zestawach cech przy pełnych danych (im więcej cech tym gorsza jakość klasyfikacji). Dla czasu T1 wynik osiągnięty przez klasyfikator 35%/100% jest lepszy niż wynik klasyfikatora 10%/100%, a następnie wyniki maleją podobnie jak dla pozostałych budżetów czasowych.

Dla FMINST ograniczenia czasowe znacząco zmniejszały jakość klasyfikacji. Najlepiej poradził sobie zespół klasyfikatorów, który uczył się na 10% przykładów uczących. Czas jego uczenia był bardzo mały, więc zmieścił się on we wszystkich 3 ograniczeniach czasowych, bez zmniejszania ilości epok. Jego wyniki okazały się lepsze niż dla pojedynczego klasyfikatora i wszystkich innych zespołów. Zespół klasyfikatorów 35% przykładów i 100% cech poradził sobie z ograniczeniami czasowymi na podobnym poziomie co pojedynczy klasyfikator. Reszta zespołów klasyfikatorów (70% przykładów uczących i wszystkie zespoły z mniejszą ilością cech) miały bardzo duże czasy uczenia się. By zmieścić czas uczenia się w narzuconych ograniczeń należało znacząco zmniejszyć ilość epok dla tych klasyfikatorów, stąd też wyniki dla nich są zdecydowanie gorsze od pozostałych, dla ograniczenia T2 i T3 accuracy jest mniejsze 50%.

Im więcej cech i liczb przykładów w zespołach klasyfikatorów, tym gorsze osiągają one wyniki. Wynika to z tego, że czasy uczenia się były liczone jako sumaryczny czas wszystkich klasyfikatorów wchodzących w skład zespołu, stąd były one niewystarczające dla klasyfikatorów zespołowych do nauczenia się zbioru danych. Liczba epok była znacznie ograniczona (przy największym ograniczeniu czasowym zespoły z większą ilością przykładów\cech miały nałożone ograniczenia co do liczby epok do mniej niż 10). Takie ograniczenia czasowe znacząco wpływają na jakość klasyfikacji. Dla uzyskania zadowalających wyników przy krótkim czasie uczenia należy wykorzystywać zespoły klasyfikatorów o bardzo małej liczbie przykładów uczących.
Prawdopodobnie inna sytuacja byłaby w przypadku, gdyby klasyfikatory zespołowe były uczone równolegle - wtedy klasyfikatory miałyby większą szansę na nauczenie się zbioru danych w założonym czasie, a czas uczenia każdego z klasyfikatorów wchodzących w skład zespołu byłby krótszy niż pojedynczego klasyfikatora i jedynym narzutem czasowym byłoby wyliczanie wyników wybraną metodą fuzji. W takim przypadku wyniki klasyfikacji mogłyby być znacząco różne i zespoły o większych liczbach danych i cech prawdopodobnie wypadłyby o wiele lepiej niż w przypadku uczenia szeregowego. Możliwe nawet, że czas równoległego uczenia zespołów klasyfikatorów byłby mniejszy niż pojedynczego klasyfikatora.

5). Ocenić moc (robustness) klasyfikatorów ze względu na ich jakość w zależności od stopnia zaszumienia wejściowych danych. Założyć dwa typy szumów - szum na wektorze danych ale dobra etykieta, pomylone x% etykiet i wektor nietknięty.

TNG

Pojedynczy klasyfikator SVM:

Szum na wektorze danych[11)]:

	accuracy	loss	error	roc	f1	precision	recall
5%	0.86	-0.45	-7.28	0.99	0.86	0.87	0.86
10%	0.86	-0.46	-7.20	0.99	0.86	0.87	0.86
20%	0.86	-0.48	-7.60	0.99	0.86	0.86	0.86
40%	0.84	-0.54	-8.13	0.99	0.84	0.85	0.84

Szum na etykietach[12)]:

	accuracy	loss	error	roc	f1	precision	recall
5%	0.82	-0.82	-10.76	0.94	0.82	0.82	0.82
10%	0.77	-1.10	-13.47	0.92	0.77	0.77	0.77
20%	0.68	-1.56	-20.57	0.87	0.68	0.68	0.68
40%	0.49	-2.27	-34.51	0.77	0.49	0.49	0.49

Zespół 12 podklasyfikatorów:

Szum na wektorze danych[13)]:

	procent danych/ cech	accuracy	loss	error	roc	f1	precision	recall
5%	10%/ 100%	0.73	-1.02	-15.01	0.97	0.74	0.74	0.73
	35%/ 100%	0.82	-0.63	-9.69	0.97	0.82	0.83	0.82
	70%/ 100%	0.86	-0.50	-8.04	0.99	0.86	0.86	0.86
	100%/ 25%	0.85	-0.75	-8.21	0.99	0.85	0.85	0.85

	100%/ 50%	0.86	-0.53	-7.47	0.99	0.86	0.87	0.86
	100%/ 75%	0.87	-0.47	-7.34	0.99	0.87	0.87	0.87
10%	10%/ 100%	0.73	-1.02	-14.97	0.97	0.74	0.74	0.73
	35%/ 100%	0.82	-0.63	-9.87	0.99	0.82	0.82	0.82
	70%/ 100%	0.85	-0.51	-8.11	0.99	0.85	0.86	0.85
	100%/ 25%	0.85	-0.74	-8.16	0.99	0.85	0.85	0.85
	100%/ 50%	0.86	-0.53	-7.23	0.99	0.86	0.86	0.86
	100%/ 75%	0.87	-0.48	-7.19	0.99	0.87	0.87	0.87
20%	10%/ 100%	0.72	-1.05	-15.43	0.97	0.73	0.74	0.72
	35%/ 100%	0.82	-0.65	-10.25	0.99	0.816	0.82	0.82
	70%/ 100%	0.85	-0.52	-8.29	0.99	0.85	0.85	0.85
	100%/ 25%	0.84	-0.78	-8.45	0.99	0.84	0.85	0.84
	100%/ 50%	0.86	-0.56	-7.55	0.99	0.86	0.86	0.86
	100%/ 75%	0.86	-0.49	-7.55	0.99	0.86	0.86	0.86
40%	10%/ 100%	0.70	-1.14	-17.44	0.96	0.70	0.71	0.70
	35%/ 100%	0.80	-0.72	-11.09	0.98	0.80	0.80	0.80
	70%/ 100%	0.83	-0.59	-9.64	0.99	0.83	0.83	0.83
	100%/ 25%	0.83	-0.91	-9.39	0.98	0.82	0.83	0.83
	100%/ 50%	0.84	-0.64	-8.68	0.99	0.84	0.84	0.84

	100%/ 75%	0.84	-0.57	-8.72	0.99	0.84	0.85	0.84

Szum na etykietach[14)]:

	procent danych/ cech	accuracy	loss	error	roc	f1	precision	recall
5%	10%/ 100%	0.69	-1.27	-17.44	0.94	0.70	0.70	0.69
	35%/ 100%	0.78	-0.96	-12.97	0.96	0.78	0.78	0.78
	70%/ 100%	0.81	-0.86	-10.96	0.96	0.81	0.81	0.81
	100%/ 25%	0.81	-1.03	-11.35	0.96	0.80	0.81	0.80
	100%/ 50%	0.82	-0.88	-10.27	0.96	0.82	0.82	0.82
	100%/ 75%	0.82	-0.83	-10.04	0.96	0.82	0.82	0.82
10%	10%/ 100%	0.64	-1.51	-21.63	0.92	0.64	0.65	0.64
	35%/ 100%	0.73	-1.23	-16.50	0.93	0.73	0.73	0.73
	70%/ 100%	0.76	-1.13	-14.58	0.94	0.76	0.76	0.76
	100%/ 25%	0.76	-1.23	-14.86	0.94	0.76	0.76	0.76
	100%/ 50%	0.77	-1.15	-14.09	0.94	0.77	0.77	0.77
	100%/ 75%	0.77	-1.11	-14.06	0.94	0.77	0.77	0.77
20%	10%/ 100%	0.55	-1.93	-28.61	0.86	0.55	0.56	0.55
	35%/ 100%	0.64	-1.66	-22.81	0.88	0.63	0.64	0.64
	70%/ 100%	0.67	-1.58	-20.99	0.88	0.67	0.67	0.67
	100%/	0.67	-1.72	-20.89	0.88	0.66	0.67	0.67

	25%							
	100%/ 50%	0.68	-1.59	-20.22	0.88	0.68	0.68	0.68
	100%/ 75%	0.68	-1.56	-20.46	0.889	0.68	0.68	0.68
40%	10%/ 100%	0.38	-2.47	-39.48	0.76	0.38	0.39	0.38
	35%/ 100%	0.45	-2.30	-35.97	0.77	0.45	0.46	0.45
	70%/ 100%	0.48	-2.25	-34.17	0.78	0.48	0.48	0.48
	100%/ 25%	0.48	-2.33	-33.20	0.78	0.48	0.49	0.48
	100%/ 50%	0.49	-2.26	-33.46	0.78	0.489	0.49	0.49
	100%/ 75%	0.49	-2.23	-33.31	0.78	0.49	0.49	0.49

FMIST

Pojedynczy klasyfikator SVM:

Szum na wektorze danych[15)]:

	accuracy	loss	error	roc	f1	precision	recall
10%	0.87	-0.35	-1.69	0.99	0.87	0.87	0.87
20%	0.87	-0.37	-1.75	0.99	0.87	0.87	0.87
30%	0.86	-0.39	-1.83	0.99	0.86	0.86	0.86

Szum na etykietach[16)]:

	accuracy	loss	error	roc	f1	precision	recall
1%	0.87	-0.41	-1.83	0.98	0.87	0.87	0.87
5%	0.83	-0.62	-2.47	0.92	0.83	0.83	0.83
10%	0.79	-0.84	-3.31	0.93	0.79	0.79	0.79

Zespół 12 podklasyfikatorów:

Szum na wektorze danych[17)]:

	procent danych/ cech	accuracy	loss	error	roc	f1	precision	recall
10%	10%/ 100%	0.84	-0.45	-2.09	0.98	0.83	0.83	0.84
	35%/ 100%	0.86	-0.39	-1.83	0.99	0.86	0.86	0.86
	70%/ 100%	0.87	-0.36	-1.74	0.99	0.87	0.87	0.87
	100%/ 25%	0.85	-0.56	-2.05	0.98	0.84	0.84	0.85
	100%/ 50%	0.87	-0.38	-1.77	0.99	0.87	0.87	0.87
	100%/ 75%	0.87	-0.36	-1.70	0.99	0.87	0.87	0.87
20%	10%/ 100%	0.83	-0.47	-2.16	0.98	0.83	0.83	0.83
	35%/ 100%	0.85	-0.41	-1.90	0.99	0.85	0.85	0.85
	70%/ 100%	0.86	-0.38	-1.81	0.99	0.86	0.86	0.86
	100%/ 25%	0.84	-0.59	-2.12	0.98	0.84	0.84	0.84
	100%/ 50%	0.86	-0.4	-1.86	0.99	0.86	0.86	0.86
	100%/ 75%	0.86	-0.38	-1.79	0.99	0.86	0.86	0.86
30%	10%/ 100%	0.82	-0.49	-2.25	0.98	0.82	0.82	0.82
	35%/ 100%	0.84	-0.43	-2.01	0.99	0.84	0.84	0.84
	70%/ 100%	0.86	-0.40	-1.91	0.99	0.85	0.85	0.86
	100%/ 25%	0.83	-0.63	-2.25	0.98	0.83	0.83	0.83
	100%/ 50%	0.86	-0.42	-1.91	0.99	0.85	0.85	0.86

	100%/ 75%	0.86	-0.39	-1.85	0.99	0.86	0.86	0.86

Szum na etykietach[18)]:

	procent danych/ cech	accuracy	loss	error	roc	f1	precision	recall
1%	10%/ 100%	0.83	-0.51	-2.23	0.98	0.83	0.83	0.83
	35%/ 100%	0.85	-0.45	-1.97	0.98	0.85	0.85	0.85
	70%/ 100%	0.86	-0.42	-1.87	0.98	0.86	0.86	0.86
	100%/ 25%	0.84	-0.60	-2.15	0.98	0.84	0.84	0.84
	100%/ 50%	0.86	-0.44	-1.94	0.98	0.86	0.86	0.86
	100%/ 75%	0.87	-0.42	-1.85	0.98	0.86	0.86	0.87
5%	10%/ 100%	0.80	-0.71	-2.88	0.96	0.79	0.79	0.80
	35%/ 100%	0.82	-0.66	-2.63	0.96	0.82	0.82	0.82
	70%/ 100%	0.83	-0.63	-2.56	0.96	0.83	0.83	0.83
	100%/ 25%	0.81	-0.79	-2.86	0.96	0.80	0.80	0.81
	100%/ 50%	0.82	-0.65	-2.60	0.96	0.82	0.82	0.82
	100%/ 75%	0.83	-0.62	-2.51	0.96	0.83	0.83	0.83
10%	10%/ 100%	0.75	-0.92	-3.75	0.93	0.75	0.75	0.75
	35%/ 100%	0.78	-0.87	-3.50	0.93	0.77	0.77	0.78
	70%/ 100%	0.78	-0.84	-3.36	0.93	0.78	0.78	0.78
	100%/ 25%	0.76	-0.98	-3.66	0.93	0.76	0.76	0.76

	100%/ 50%	0.78	-0.86	-3.40	0.93	0.78	0.78	0.78
	100%/ 75%	0.79	-0.84	-3.36	0.93	0.78	0.78	0.79

TNG

W obydwu przypadkach znacznie większy wpływ na jakość klasyfikacji miał szum na etykietach - każdy kolejny poziom zaszumienia powodował znaczny spadek jakości (a przy szumie na poziomie 40% pojedynczy klasyfikator SVM osiągał accuracy na poziomie 49%, a zespoły klasyfikatorów osiągały 38%, 45% oraz 48-49%). Spadki jakości są podobne dla wszystkich klasyfikatorów - dla szumu 5% accuracy klasyfikatorów spadają o 4-5 punktów procentowych w stosunku do braku szumu, szum 10% powoduje spadek o kolejnych 5 pp, 20% to spadek o kolejnych 8-9 pp, 40% powoduje spadek o kolejnych 17-19 pp. Obydwa rodzaje klasyfikatorów są mało odporne na szum na etykietach.

W przypadku szumu na wektorze danych klasyfikatory radzą sobie dobrze - szumy pomiędzy 5% a 20% pozwalają odpowiednio każdemu klasyfikatorowi uzyskiwać bardzo podobną jakość klasyfikacji, podobną również do jakości uzyskanej bez szumu. Dopiero szum 40-sto procentowy powoduje zauważalny, choć nadal nieduży spadek jakości klasyfikacji. Wszystkie klasyfikatory dobrze radzą więc sobie z danymi, które zawierają szum.

Przy obydwu rodzajach szumów najlepsze wyniki uzyskują pojedynczy klasyfikator oraz zespoły o stosunkach danych do cech 100%/50% i 100%/75%

Warto zauważyć, że można by się spodziewać, że drobny szum może poprawić jakość klasyfikacji - w przypadku tego eksperymentu nie miało to jednak miejsca.

FMNIST

W przypadku FMNIST również większy wpływ na jakość klasyfikacji miał szum na etykietach. Nawet małe szumy (1%) powodowały delikatny spadek jakości. Przy zaszumieniu 10% spadek jakości wynosił już 8 pp. we wszystkich klasyfikatorach. W przypadku szumu na wektorze danych spadek jakości był bardzo niewielki - dla pojedynczego klasyfikatora o 1 pp. dla 30% zaszumienia.

Przy zaszumieniu zarówno danych jak i etykiet pojedynczy klasyfikator uzyskiwał wyniki prawie identyczne jak zespół klasyfikatorów 100% danych i 75% cech, chociaż przy niezmienionych danych miał je trochę gorsze. Szumy powodowały spadki na podobnym poziomie we wszystkich zespołach klasyfikatorów.

Drobne szumy nie poprawiły jakości klasyfikacji także i w przypadku tego zbioru danych.

Wszystkie klasyfikatory wykazały znacznie mniejszą odporność na szumy na etykietach (gdzie ich moc można ocenić na niską) niż na szumy na danych (gdzie ich moc można określić na wysoką). Zarówno w przypadku TNG jak i FMNIST drobne szumy nie przyczyniły się do poprawy jakości klasyfikacji.

6). Podsumowanie

W tym eksperymencie (przy nienakładaniu ograniczeń czasowych) w przypadku zbioru danych TNG najlepsze jakości klasyfikacji zostały uzyskane przy użyciu pojedynczego klasyfikatora SVM trenowanego na pełnym zbiorze danych i pełnym zbiorze cech oraz zespołów klasyfikatorów o stosunkach liczb danych do cech 100%/50% i 100%/75% (przy nieco lepszych wynikach tego drugiego). Przy ograniczeniach czasowych zdecydowanie najlepiej wypada pojedynczy klasyfikator, zaś spośród zespołu klasyfikatorów lepsze wyniki uzyskują klasyfikatory uczące się najkrócej - klasyfikatory wymagające dłuższych czasów uczenia nie zdążały wystarczająco nauczyć się zbioru danych i osiągały bardzo niskie wyniki.

W przypadku FMINST najlepsze wyniki uzyskał zespół klasyfikatorów 100%/75%, który był przeważnie delikatnie lepszy niż pojedynczy klasyfikator, a przy szumie danych pojedynczy klasyfikator osiągnął wyniki podobne do tego zespołu. Zespoły 100%/50% i 70%/100% cech osiągały przeważnie porównywalne wyniki do pojedynczego klasyfikatora, jednak przy zaszumieniu danych były lekko gorsze. Zespoły o mniejszej ilości danych/cech radziły sobie gorzej niż pojedynczy klasyfikator. Przy ograniczeniach czasowych najlepiej wypadł zespół 10%/100%, klasyfikatory o większej ilości przykładów/cech uzyskiwały wywczas bardzo niskie wyniki.

Dla obu zbiorów danych szumy na danych powodowały bardzo niskie spadki jakości klasyfikacji wszystkich klasyfikatorów, wobec czego ich moc można w tym przypadku określić jako wysoką. Moc ze względu na jakość klasyfikacji przy szumach na etykietach jest już jednak niska - przy każdym kolejnym progu zaszumienia wybranym do tego eksperymentu można było zaobserwować znaczny spadek jakości klasyfikacji. Warto zauważyć, że drobne szumy nie poprawiają jakości klasyfikacji.

Ograniczenia czasowe bardzo wpłynęły na jakość klasyfikacji zarówno pojedynczego klasyfikatora, jak i zespołów. Najgorzej radziły sobie klasyfikatory o dużej ilości przykładów uczących/cech a najlepiej (lepiej nawet od pojedynczego klasyfikatora) te z małą ilością przykładów, ze względu na to, że czas uczenia się był sumarycznym czasem uczenia się wszystkich elementów klasyfikatorów zespołowych. Jeżeli klasyfikatory byłyby uczone równolegle wyniki tego eksperymentu mogłyby być znacząco różne.

Przewagą klasyfikatorów zbiorowych nad pojedynczym klasyfikatorem SVM jest fakt, że wchodzące w jego skład klasyfikatory mogą być trenowane równolegle, co może znacznie przyspieszyć proces trenowania. Uzyskane w tym eksperymencie wyniki miar jakości klasyfikacji są porównywalne dla pojedynczego klasyfikatora SVM oraz dla zespołów klasyfikatorów o stosunkach liczb danych do cech 100%/75% i 100%/50% (przy czym zwykle nieznacznie lepszy był klasyfikator 100%/75%), w związku z czym przy uczeniu zespołów klasyfikatorów szeregowo (tak jak było to przeprowadzone w tym eksperymencie) nie jest opłacalne wykorzystywanie klasyfikatorów zespołowych. W przypadku uczenia równoległego można przewidywać, że najbardziej opłacalne jest wykorzystanie klasyfikatora zespołowego o stosunkach danych do cech 100%/75%, gdyż uzyskiwał on najlepsze wyniki, a dodatkowo przy uczeniu równoległym jego czas uczenia mógłby być mniejszy niż dla pojedynczego klasyfikatora (dla klasyfikatora zespołowego istnieje dodatkowy narzut czasowy związany z fuzją decyzji klasyfikatorów, jest on jednak niewielki).

Wyniki uzyskane dla klasyfikatora SVM i zespołów klasyfikatorów nie są jednak wynikami bardzo wysokimi. Ponieważ eksperyment dotyczył porównania pojedynczego klasyfikatora oraz klasyfikatorów zespołowych, nie były w nim szukane ustawienia hiperparametrów dających najlepsze wyniki, a jedynie porównywane domyślne ustawienia. W przypadku chęci klasyfikacji tych zbiorów, należałoby poszukać ustawień hiperparametrów SVM dających lepsze wyniki miar jakości lub użyć innego klasyfikatora.

1)

Average voting

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([146.8439374 , 144.80648851, 143.79742622, 145.58774638, 147.87192154]),
  'score_time': array([80.36888385, 81.76582313, 79.61906075, 80.60673547, 80.74169636]),
  'test_accuracy': array([0.74801061, 0.75033165, 0.74714778, 0.71185991, 0.7153091]),
  'test_neg_log_loss': array([-1.03524361, -1.00071083, -1.02679065, -1.01529485, -0.98524062]),
  'test_neg_mean_squared_error': array([-13.54403183, -13.90342266, -15.05465641, -17.12470151, 16.24383125]),
  'test_roc_auc_ovr': array([0.96871381, 0.97247651, 0.97267578, 0.96675164, 0.97066632]),
  'test_f1_weighted': array([0.75050395, 0.75064552, 0.7487207 , 0.71419086, 0.7175339]),
  'test_precision_weighted': array([0.75794872, 0.75521117, 0.75493644, 0.72484796, 0.72781026]),
  'test_recall_weighted': array([0.74801061, 0.75033165, 0.74714778, 0.71185991, 0.7153091])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([1245.0476675 , 1233.07420564, 1240.46790099, 1298.18706274, 1375.52531981]), 'score_time':
  array([241.46969342, 239.65606356, 239.90298343, 252.33758998, 253.46594477]), 'test_accuracy':
  array([0.82997347, 0.83603078, 0.84239851, 0.79968161, 0.80260016]),
  'test_neg_log_loss': array([-0.60636518, -0.59657614, -0.58318611, -0.67147571, -0.66831819]),
  'test_neg_mean_squared_error': array([-8.66737401, -8.99787742, -7.14858053, -12.68957283, -10.67285752]),
  'test_roc_auc_ovr': array([0.98829961, 0.98791808, 0.98871027, 0.98304115, 0.98391441]),
  'test_f1_weighted': array([0.83160303, 0.83591043, 0.84290936, 0.80073353, 0.80291456]),
  'test_precision_weighted': array([0.83689153, 0.83682349, 0.84412285, 0.80486094, 0.80552514]),
  'test_recall_weighted': array([0.82997347, 0.83603078, 0.84239851, 0.79968161, 0.80260016])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([3798.87090921, 3771.22222114, 3804.12885094, 3781.27404881, 3819.44489145]),
  'score_time': array([425.04678464, 424.58478308, 423.47455168, 423.74662948, 424.82061243]), 'test_accuracy':
  array([0.86551724, 0.87131865, 0.87397188, 0.82700982, 0.83921465]),
  'test_neg_log_loss': array([-0.47167396, -0.46131831, -0.44601712, -0.57126354, -0.55038548]),
  'test_neg_mean_squared_error': array([-6.7193634 , -6.98567259, -5.96975325, -10.72724861, -9.65906076]),
  'test_roc_auc_ovr': array([0.99222851, 0.99206161, 0.99257211, 0.98691676, 0.98868385]),
  'test_f1_weighted': array([0.86601719, 0.87044379, 0.8741804 , 0.82749219, 0.83926556]),
  'test_precision_weighted': array([0.86811887, 0.87093762, 0.87491489, 0.82950981, 0.84051076]),
  'test_recall_weighted': array([0.86551724, 0.87131865, 0.87397188, 0.82700982, 0.83921465])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([2281.95107698, 2330.20973825, 2151.09354782, 2193.16417956, 2643.95939922]), 'score_time':
  array([190.85880518, 190.48813796, 186.87274694, 201.85751939, 188.68607354]), 'test_accuracy':
  array([0.86445623, 0.87609445, 0.87556381, 0.80870257, 0.82011144]),
  'test_neg_log_loss': array([-0.70773792, -0.70564157, -0.65773751, -0.86489208, -0.81664553]),
  'test_neg_mean_squared_error': array([-7.07002653, -6.75271955, -5.71583975, -11.42929159, 0.44096577]),
  'test_roc_auc_ovr': array([0.98992051, 0.99046396, 0.99112022, 0.98117012, 0.98519135]),
  'test_f1_weighted': array([0.86489471, 0.87529191, 0.87597226, 0.80858776, 0.82026867]),
  'test_precision_weighted': array([0.8671393 , 0.87621393, 0.87797803, 0.81189392, 0.82347155]),
  'test_recall_weighted': array([0.86445623, 0.87609445, 0.87556381, 0.80870257, 0.82011144])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([4033.96309447, 3976.64540076, 3695.23385167, 3863.29221559, 3646.45507908]), 'score_time':
  array([332.50816226, 319.59201884, 313.23572469, 314.42769027, 308.69905376]), 'test_accuracy':
  array([0.87267905, 0.88246219, 0.88113558, 0.83417352, 0.84239851]),
  'test_neg_log_loss': array([-0.49310756, -0.50000078, -0.46860449, -0.62200783, -0.56569459]),
  'test_neg_mean_squared_error': array([-6.79681698, -6.21517644, -5.11912974, -10.06686124, -9.30565137]),
  'test_roc_auc_ovr': array([0.99281596, 0.99249456, 0.99356212, 0.98666853, 0.98955512]),
  'test_f1_weighted': array([0.87308006, 0.88204915, 0.88132505, 0.83408165, 0.84184358]),
  'test_precision_weighted': array([0.87469516, 0.88264163, 0.88237563, 0.83564874, 0.8432353]),
  'test_recall_weighted': array([0.87267905, 0.88246219, 0.88113558, 0.83417352, 0.84239851])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([5274.93986201, 5298.10231161, 5271.32885218, 5271.60440087, 5355.16425753]), 'score_time':
  array([433.91859674, 435.51864266, 440.18325472, 435.85291576, 548.34734297]), 'test_accuracy':
  array([0.87771883, 0.88750332, 0.88803396, 0.84319448, 0.84956222]),

'test_neg_log_loss': array([-0.43363743, -0.42771007, -0.41022757, -0.54512746, -0.52446636]),
'test_neg_mean_squared_error': array([-6.01564987, -6.01034757, -5.40700451, -9.53011409, -9.35606262]),
'test_roc_auc_ovr': array([0.99347842, 0.99323656, 0.99411536, 0.9881019 , 0.98989235]),
'test_f1_weighted': array([0.87812411, 0.88699197, 0.88831418, 0.84322129, 0.84926589]),
'test_precision_weighted': array([0.87988723, 0.88769422, 0.88904282, 0.84449945, 0.85015312]),
'test_recall_weighted': array([0.87771883, 0.88750332, 0.88803396, 0.84319448, 0.84956222])}

Majority voting

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([148.16808438, 144.66432762, 150.11508965, 146.71330357, 152.67174196]),
  'score_time': array([79.51726079, 80.98261666, 81.92676306, 80.95609522, 91.16656756]),
  'test_accuracy': array([0.74217507, 0.7460865 , 0.73839215, 0.70443088, 0.70018573]),
  'test_neg_log_loss': array([-1.03196103, -1.00154019, -1.02316711, -1.01814237, -0.98306089]),
  'test_neg_mean_squared_error': array([-13.57824934, -12.46590608, -13.52241974, -16.59007694,
  -15.47704962]),
  'test_roc_auc_ovr': array([0.96893701, 0.97255294, 0.97254623, 0.96643783, 0.9706301]),
  'test_f1_weighted': array([0.74581488, 0.74695513, 0.73995017, 0.70787399, 0.7053624]),
  'test_precision_weighted': array([0.76351305, 0.7598769 , 0.75137709, 0.72947445, 0.73186469]),
  'test_recall_weighted': array([0.74217507, 0.7460865 , 0.73839215, 0.70443088, 0.70018573])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([1358.10335183, 1233.21016026, 1266.36326027, 1428.89073133, 1407.69289255]), 'score_time':
  array([241.78180552, 239.807935 , 247.23661757, 257.159688 , 265.13278794]),
  'test_accuracy': array([0.82758621, 0.83576546, 0.83762271, 0.79145662, 0.79570178]),
  'test_neg_log_loss': array([-0.60306622, -0.59579122, -0.58363438, -0.67024373, -0.66684183]),
  'test_neg_mean_squared_error': array([-8.99151194, -8.87874768, -7.05730963, -12.45768108, -10.86680817]),
  'test_roc_auc_ovr': array([0.98846674, 0.98789954, 0.98869185, 0.9830242 , 0.98394505]),
  'test_f1_weighted': array([0.83004187, 0.8362623 , 0.83956773, 0.7925548 , 0.79712815]),
  'test_precision_weighted': array([0.83845222, 0.83928276, 0.84596856, 0.80147209, 0.80576784]),
  'test_recall_weighted': array([0.82758621, 0.83576546, 0.83762271, 0.79145662, 0.79570178])}

- zespół klasyfikatorów 70 % przykładów uczących
  {'fit_time': array([4186.98154902, 3698.79037523, 3701.62542629, 3690.48692656, 3712.43054771]), 'score_time':
  array([421.06923532, 418.78575683, 418.78843951, 416.03404784, 417.98472476]), 'test_accuracy':
  array([0.86180371, 0.87131865, 0.87317591, 0.82621385, 0.83523481]),
  'test_neg_log_loss': array([-0.47046596, -0.45771233, -0.44617231, -0.57085434, -0.54958944]),
  'test_neg_mean_squared_error': array([-7.22944297, -6.58185195, -5.72857522, -10.09233218, -9.57362696]),
  'test_roc_auc_ovr': array([0.99230937, 0.99207463, 0.9925938 , 0.9868456 , 0.98863684]),
  'test_f1_weighted': array([0.86348141, 0.87099868, 0.8736036 , 0.82636424, 0.8357518]),
  'test_precision_weighted': array([0.86869759, 0.87258466, 0.87651123, 0.83040402, 0.84046848]),
  'test_recall_weighted': array([0.86180371, 0.87131865, 0.87317591, 0.82621385, 0.83523481])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([2123.0187602 , 2328.10113835, 2130.03873754, 2262.60542345, 2224.20159721]), 'score_time':
  array([184.16752505, 188.42198515, 182.65628862, 186.28675795,185.49685168]), 'test_accuracy':
  array([0.84509284, 0.85088883, 0.86017511, 0.80339613, 0.80817193]),
  'test_neg_log_loss': array([-0.67818089, -0.6935077 , -0.65360072, -0.7736253 , -0.7487655]),
  'test_neg_mean_squared_error': array([-8.2469496 , -8.35261343, -6.8636243 , -11.2313611 , -11.53568586]),
  'test_roc_auc_ovr': array([0.98680469, 0.98653828, 0.98741179, 0.9796341 , 0.98294391]),
  'test_f1_weighted': array([0.84664627, 0.85088935, 0.8607229 , 0.80422587, 0.80820575]),
  'test_precision_weighted': array([0.85399917, 0.85586139, 0.86588041, 0.81218996, 0.81584979]),
  'test_recall_weighted': array([0.84509284, 0.85088883, 0.86017511, 0.80339613, 0.80817193])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([3732.21069098, 3707.21517015, 4304.63950086, 3730.34877706, 3639.71654034]), 'score_time':
  array([311.27939749, 312.06267571, 329.64711332, 309.05300546, 309.10915327]), 'test_accuracy':
  array([0.86657825, 0.87529849, 0.879013 , 0.82223401, 0.83364288]),
  'test_neg_log_loss': array([-0.4965013 , -0.48362121, -0.47090905, -0.61371386, -0.57773996]),
  'test_neg_mean_squared_error': array([-7.266313 , -6.43672062, -5.51472539, -10.0581056 , -9.97850889]),
  'test_roc_auc_ovr': array([0.99229644, 0.99221043, 0.99283366, 0.98617835, 0.98840493]),

'test_f1_weighted': array([0.86797378, 0.87528969, 0.8799738 , 0.82245052, 0.83363793]),
'test_precision_weighted': array([0.87320142, 0.87828094, 0.88364735, 0.82700221, 0.83791792]),
'test_recall_weighted': array([0.86657825, 0.87529849, 0.879013 , 0.82223401, 0.83364288])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([5188.2153573 , 5497.5731864 , 5385.4952879 , 5176.5284121 , 5050.39310646]),
'score_time': array([447.86245584, 433.81258988, 437.94887686, 430.12526989, 431.00632048]), 'test_accuracy':
array([0.87241379, 0.88352348, 0.88458477, 0.83205094, 0.8434598]),
'test_neg_log_loss': array([-0.43314932, -0.4263861 , -0.41693012, -0.55004344, -0.51968396]),
'test_neg_mean_squared_error': array([-6.61697613, -6.03343062, -5.63040594, -9.00928628, -8.79304855]),
'test_roc_auc_ovr': array([0.99361115, 0.99316946, 0.99372101, 0.9879893 , 0.98994875]),
'test_f1_weighted': array([0.87346651, 0.8835413 , 0.88538945, 0.83201572, 0.84331676]),
'test_precision_weighted': array([0.87769976, 0.88532076, 0.88875194, 0.83500499, 0.84724015]),
'test_recall_weighted': array([0.87241379, 0.88352348, 0.88458477, 0.83205094, 0.8434598])}

Borda voting

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([143.1978569 , 143.10595918, 143.31464124, 144.04252505, 144.58688164]),
'score_time': array([80.07836199, 79.91525245, 79.21023536, 80.16977859, 80.10908532]),
'test_accuracy': array([0.74827586, 0.7508623 , 0.74661714, 0.71318652, 0.71477846]),
'test_neg_log_loss': array([-2.40542955, -2.40699472, -2.39584182, -2.41391118, -2.38489124]),
'test_neg_mean_squared_error': array([-13.16312997, -14.0498806 , -15.08357655, -17.29981427, -15.73282038]),
'test_roc_auc_ovr': array([0.95123034, 0.95686273, 0.95652897, 0.94880725, 0.95190248]),
'test_f1_weighted': array([0.75050928, 0.75082233, 0.74826756, 0.71584472, 0.71695438]),
'test_precision_weighted': array([0.75700721, 0.75539527, 0.75482369, 0.72681102, 0.72742506]),
'test_recall_weighted': array([0.74827586, 0.7508623 , 0.74661714, 0.71318652, 0.71477846])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([1222.33014894, 1214.1776011 , 1220.71215248, 1255.46160603, 1255.32957554]), 'score_time':
array([240.86590266, 239.20943999, 239.18338108, 239.90986109, 239.37554264]), 'test_accuracy':
array([0.82864721, 0.83496949, 0.8458477 , 0.798355 , 0.80339613]),
'test_neg_log_loss': array([-2.33448534, -2.33366921, -2.33368843, -2.36025016, -2.35637513]),
'test_neg_mean_squared_error': array([-8.7994695 , -8.77447599, -7.06845317, -12.71610507, -10.58423985]),
'test_roc_auc_ovr': array([0.97559452, 0.9750306 , 0.97655446, 0.97106172, 0.97113276]),
'test_f1_weighted': array([0.83026937, 0.83476477, 0.84654585, 0.7992925 , 0.80398288]),
'test_precision_weighted': array([0.8349403 , 0.83554618, 0.84800446, 0.80309214, 0.80697958]),
'test_recall_weighted': array([0.82864721, 0.83496949, 0.8458477 , 0.798355 , 0.80339613])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([3675.6033895 , 3681.59163308, 3692.32481289, 3705.25194049, 3726.5288682]), 'score_time':
array([419.92994571, 420.15382314, 419.29371762, 419.5678525 , 418.38241053]), 'test_accuracy':
array([0.86180371, 0.8742372 , 0.87609445, 0.82727514, 0.83894932]),
'test_neg_log_loss': array([-2.33384392, -2.32466932, -2.32429665, -2.33823609, -2.3390592]),
'test_neg_mean_squared_error': array([-7.4005305 , -6.63836561, -5.61528257, -10.88352348, -9.99655081]),
'test_roc_auc_ovr': array([0.98092412, 0.98195238, 0.98279602, 0.9760103 , 0.97780221]),
'test_f1_weighted': array([0.86245277, 0.87342537, 0.87624197, 0.82760371, 0.83901792]),
'test_precision_weighted': array([0.86456617, 0.87388416, 0.87676482, 0.82913083, 0.84055781]),
'test_recall_weighted': array([0.86180371, 0.8742372 , 0.87609445, 0.82727514, 0.83894932])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([2190.24026656, 2300.69199038, 2097.90712023, 2242.84924984, 2076.44754887]), 'score_time':
array([186.41214776, 188.11607647, 184.01620197, 186.12888288, 184.08656311]), 'test_accuracy':
array([0.8602122 , 0.87105333, 0.86999204, 0.81294773, 0.81984611]),
'test_neg_log_loss': array([-2.35468829, -2.35424144, -2.34994394, -2.37217533, -2.36907061]),
'test_neg_mean_squared_error': array([-7.44084881, -7.36932873, -6.13902892, -10.40408596, -9.92942425]),
'test_roc_auc_ovr': array([0.98273386, 0.98350088, 0.98503611, 0.9778055 , 0.97843329]),
'test_f1_weighted': array([0.86154592, 0.87158924, 0.87105257, 0.81400017, 0.82089379]),
'test_precision_weighted': array([0.86531797, 0.87385601, 0.87448235, 0.81811259, 0.82545239]),
'test_recall_weighted': array([0.8602122 , 0.87105333, 0.86999204, 0.81294773, 0.81984611])}

- zespół klasyfikatorów 50% cech

{'fit_time': array([3869.10345006, 3843.47206473, 3612.73425889, 3794.17781258, 3604.67475128]), 'score_time': array([314.03146791, 316.82461762, 308.79971576, 313.6022191 , 311.20412183]), 'test_accuracy': array([0.8734748 , 0.88087026, 0.88299284, 0.83072433, 0.838684]), 'test_neg_log_loss': array([-2.33324503, -2.32945829, -2.33060984, -2.34056075, -2.33796621]), 'test_neg_mean_squared_error': array([-6.32095491, -6.00106129, -5.92332184, -9.60785354, -9.45449721]), 'test_roc_auc_ovr': array([0.98608608, 0.98770734, 0.98684618, 0.98106492, 0.98216681]), 'test_f1_weighted': array([0.87408639, 0.88037591, 0.88350422, 0.83098397, 0.8388703]), 'test_precision_weighted': array([0.87629491, 0.88109681, 0.88530988, 0.83342773, 0.84099954]), 'test_recall_weighted': array([0.8734748 , 0.88087026, 0.88299284, 0.83072433, 0.838684])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([5152.01870775, 5203.89438987, 5332.218431 , 5689.703866 , 5304.3261261]), 'score_time': array([436.82141876, 436.67957926, 433.14529037, 431.27408504, 437.87617302]), 'test_accuracy': array([0.87427056, 0.88431945, 0.88405413, 0.83523481, 0.85115415]), 'test_neg_log_loss': array([-2.32635537, -2.32313035, -2.32410327, -2.33239824, -2.3313233]), 'test_neg_mean_squared_error': array([-6.54774536, -5.93871053, -5.65428496, -9.75749536, -8.94215972]), 'test_roc_auc_ovr': array([0.98605353, 0.98776894, 0.98706457, 0.98130371, 0.98297533]), 'test_f1_weighted': array([0.87470904, 0.88375774, 0.88441979, 0.83550744, 0.85128566]), 'test_precision_weighted': array([0.8764648 , 0.88447663, 0.88546575, 0.83701462, 0.852533]), 'test_recall_weighted': array([0.87427056, 0.88431945, 0.88405413, 0.83523481, 0.85115415])}

2)

Average voting

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([84.31182337, 41.57707858, 39.99521232, 40.09037495, 40.52187133]), 'score_time': array([96.89617443, 56.92793465, 57.37920856, 56.68667912, 57.90234208]), 'test_accuracy': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286]), 'test_neg_log_loss': array([-0.43518617, -0.44896716, -0.43659481, -0.44667309, -0.45587556]), 'test_neg_mean_squared_error': array([-2.15207143, -2.07292857, -1.97335714, -2.02228571, -2.14457143]), 'test_roc_auc_ovr': array([0.98494211, 0.98453555, 0.98471949, 0.98439707, 0.98370706]), 'test_f1_weighted': array([0.8391561 , 0.83337703, 0.84363625, 0.83927396, 0.83025872]), 'test_precision_weighted': array([0.83913872, 0.83298658, 0.84356639, 0.83908444, 0.8299967]), 'test_recall_weighted': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([360.26168919, 359.53345442, 370.93991184, 350.37274957, 406.04506087]), 'score_time': array([169.18066072, 165.01349115, 163.29849243, 175.5123682 , 177.11645555]), 'test_accuracy': array([0.867 , 0.85828571, 0.86785714, 0.86228571, 0.85578571]), 'test_neg_log_loss': array([-0.37458176, -0.38662288, -0.37690371, -0.38751696, -0.39584564]), 'test_neg_mean_squared_error': array([-1.80964286, -1.82535714, -1.76028571, -1.78785714, -1.88057143]), 'test_roc_auc_ovr': array([0.98839966, 0.98803457, 0.98807114, 0.98767671, 0.98709211]) 'test_f1_weighted': array([0.86592419, 0.85763402, 0.86674151, 0.86152713, 0.85510894]), 'test_precision_weighted': array([0.86584839, 0.85747452, 0.8664719 , 0.86140608, 0.85495778]), 'test_recall_weighted': array([0.867 , 0.85828571, 0.86785714, 0.86228571, 0.85578571])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([1514.74044871, 1490.03760457, 1489.57918429, 1557.11085701, 1580.86998367]), 'score_time': array([300.04744554, 298.80243111, 300.57700396, 321.65545154, 306.73347664]), 'test_accuracy': array([0.87621429, 0.869 , 0.87614286, 0.87357143, 0.86457143]) 'test_neg_log_loss': array([-0.34643838, -0.35749936, -0.35016429, -0.3578869 , -0.37156872]), 'test_neg_mean_squared_error': array([-1.67171429, -1.72214286, -1.67221429, -1.65978571, -1.78964286]), 'test_roc_auc_ovr': array([0.98989582, 0.98951393, 0.98949146, 0.98935415, 0.98848604]), 'test_f1_weighted': array([0.87533626, 0.86835481, 0.87530097, 0.87302834, 0.8640845]), 'test_precision_weighted': array([0.87525365, 0.8681826 , 0.87508912, 0.87299039, 0.86393884]), 'test_recall_weighted': array([0.87621429, 0.869 , 0.87614286, 0.87357143, 0.86457143])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([2394.2928412 , 1960.99851084, 2471.14348221, 2081.36675572, 2105.00464439]), 'score_time': array([280.95140767, 269.65448427, 290.43191671, 268.81477118, 273.1422286]), 'test_accuracy': array([0.84964286, 0.84171429, 0.85321429, 0.85421429, 0.8415]), 'test_neg_log_loss': array([-0.53515091, -0.52443103, -0.55339481, -0.516753 , -0.53514556]), 'test_neg_mean_squared_error': array([-2.00807143, -1.98685714, -1.99378571, -1.93942857, -2.08421429]),

'test_roc_auc_ovr': array([0.98554685, 0.9844101 , 0.9840532 , 0.98527447, 0.98432231]),
'test_f1_weighted': array([0.84723568, 0.84032391, 0.8513564 , 0.85238464, 0.84009398]),
'test_precision_weighted': array([0.84760981, 0.84005744, 0.85122244, 0.85240706, 0.83954669]),
'test_recall_weighted': array([0.84964286, 0.84171429, 0.85321429, 0.85421429, 0.8415])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([2142.20317793, 2244.65578413, 2453.77488136, 2172.01262736, 2166.03626943]),
'score_time': array([291.30873466, 294.23416042, 308.30326986, 289.80146146, 292.52090454]),
'test_accuracy': array([0.87235714, 0.86585714, 0.87242857, 0.8725 , 0.8605]),
'test_neg_log_loss': array([-0.36242727, -0.37406484, -0.37196683, -0.3672616 , -0.38742483]),
'test_neg_mean_squared_error': array([-1.71771429, -1.72378571, -1.74535714, -1.67721429, -1.89528571]),
'test_roc_auc_ovr': array([0.98949683, 0.98922866, 0.98897006, 0.98930304, 0.98799145]),
'test_f1_weighted': array([0.87094315, 0.86488645, 0.87129578, 0.87159843, 0.85986083]),
'test_precision_weighted': array([0.8709689 , 0.86455858, 0.8710122 , 0.87150367, 0.85963261]),
'test_recall_weighted': array([0.87235714, 0.86585714, 0.87242857, 0.8725 , 0.8605])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([2711.44500089, 2607.53262281, 2772.10728812, 2646.71011305, 2579.34009337]),
'score_time': array([339.0933516 , 335.56114912, 341.27255893, 335.52530169, 331.70359492]),
'test_accuracy': array([0.8785 , 0.87 , 0.87907143, 0.87578571, 0.866]),
'test_neg_log_loss': array([-0.33902438, -0.35276752, -0.34072237, -0.34939575, -0.36285993]),
'test_neg_mean_squared_error': array([-1.63835714, -1.68878571, -1.64507143, -1.64628571, -1.81264286]),
'test_roc_auc_ovr': array([0.99040597, 0.98983261, 0.99005958, 0.98987116, 0.98901895]),
'test_f1_weighted': array([0.87751414, 0.86934825, 0.87811709, 0.87516897, 0.86558132]),
'test_precision_weighted': array([0.87738762, 0.86913624, 0.87787283, 0.87506395, 0.86548127]),
'test_recall_weighted': array([0.8785 , 0.87 , 0.87907143, 0.87578571, 0.866])}

Majority voting

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([56.82572389, 57.20369482, 56.38576436, 55.56382656, 56.58639836]),
'score_time': array([84.32776642, 84.74555922, 84.77660441, 83.66742492, 84.6532557]),
'test_accuracy': array([0.83978571, 0.83428571, 0.84357143, 0.83792857, 0.83142857]),
'test_neg_log_loss': array([-0.43522308, -0.44909969, -0.43698738, -0.44666182, -0.45577667]),
'test_neg_mean_squared_error': array([-2.12764286, -2.05285714, -1.9915 , -2.04007143, -2.14814286]),
'test_roc_auc_ovr': array([0.98495772, 0.98454974, 0.98470733, 0.9844151 , 0.98372447]),
'test_f1_weighted': array([0.83755568, 0.83249143, 0.84130593, 0.83561584, 0.82991786]),
'test_precision_weighted': array([0.83841189, 0.83256783, 0.84176772, 0.83601731, 0.82983928]),
'test_recall_weighted': array([0.83978571, 0.83428571, 0.84357143, 0.83792857, 0.83142857])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([513.24694347, 517.16748118, 521.75415373, 520.95773458, 512.52031517]),
'score_time': array([239.9120698 , 238.51359606, 240.22011065, 239.46867299, 240.4794147]),
'test_accuracy': array([0.86635714, 0.858 , 0.86728571, 0.86114286, 0.85692857]),
'test_neg_log_loss': array([-0.37426228, -0.386454 , -0.37657858, -0.38739646, -0.39562683]),
'test_neg_mean_squared_error': array([-1.79428571, -1.77885714, -1.74778571, -1.79128571, -1.83871429]),
'test_roc_auc_ovr': array([0.98844376, 0.98807516, 0.98808896, 0.9877098 , 0.98713332]),
'test_f1_weighted': array([0.86511361, 0.85695245, 0.86600306, 0.86017125, 0.8561139]),
'test_precision_weighted': array([0.86550264, 0.85705626, 0.86608642, 0.8603553 , 0.85611341]),
'test_recall_weighted': array([0.86635714, 0.858 , 0.86728571, 0.86114286, 0.85692857])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([1880.41483665, 1879.87240267, 1845.331388 , 1891.06411743, 1825.38930392]),
''score_time': array([439.49662161, 441.63532591, 439.82338405, 439.32263541, 432.66143107]),
'test_accuracy': array([0.87528571, 0.86864286, 0.87521429, 0.87271429, 0.8645]),
'test_neg_log_loss': array([-0.34649926, -0.35757049, -0.35002678, -0.35754694, -0.37079704]),
'test_neg_mean_squared_error': array([-1.67942857, -1.69414286, -1.68157143, -1.65621429, -1.77492857]),
'test_roc_auc_ovr': array([0.98991023, 0.98952195, 0.98949659, 0.98940314, 0.98854075]),
'test_f1_weighted': array([0.87428347, 0.86781542, 0.87429759, 0.8720271 , 0.86383894]),
'test_precision_weighted': array([0.87471002, 0.86788598, 0.87436427, 0.87216102, 0.86381796]),
'test_recall_weighted': array([0.87528571, 0.86864286, 0.87521429, 0.87271429, 0.8645])}

- zespół klasyfikatorów 25% cech

{'fit_time': array([1994.98081112, 2244.21755433, 2709.3277669 , 2609.40332222, 2512.08097243]),
'score_time': array([262.07268548, 285.20339274, 293.27308083, 301.28070331, 301.85783958]),
'test_accuracy': array([0.84785714, 0.8445 , 0.8465 , 0.83585714, 0.83714286]),
'test_neg_log_loss': array([-0.47265377, -0.5008297 , -0.51453981, -0.54041144, -0.51947203]),
'test_neg_mean_squared_error': array([-2.0615 , -1.96171429, -2.10042857, -2.172   , -2.20814286]),
'test_roc_auc_ovr': array([0.98535331, 0.98421307, 0.98330474, 0.98174569, 0.98286903]),
'test_f1_weighted': array([0.84506616, 0.84129602, 0.84411816, 0.83290101, 0.83494919]),
'test_precision_weighted': array([0.84693262, 0.84287294, 0.84485821, 0.8337488 , 0.8354364]),
'test_recall_weighted': array([0.84785714, 0.8445 , 0.8465 , 0.83585714, 0.83714286])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([4204.93122792, 5284.03524017, 3679.60178447, 2805.31469369, 2788.13469672]),
'score_time': array([673.03787684, 374.67341709, 318.09577322, 305.07084799, 305.72039342]),
'test_accuracy': array([0.87164286, 0.86371429, 0.87307143, 0.87071429, 0.85964286]),
'test_neg_log_loss': array([-0.36222779, -0.37695921, -0.36218935, -0.37224564, -0.390588]),
'test_neg_mean_squared_error': array([-1.73014286, -1.7745 , -1.74328571, -1.74171429, -1.86321429]),
'test_roc_auc_ovr': array([0.98945143, 0.98893759, 0.98915476, 0.98912179, 0.98789032]),
'test_f1_weighted': array([0.87001144, 0.8623377 , 0.87158427, 0.86943992, 0.85871086]),
'test_precision_weighted': array([0.87082634, 0.86249901, 0.8717851 , 0.86958638, 0.85862503]),
'test_recall_weighted': array([0.87164286, 0.86371429, 0.87307143, 0.87071429, 0.85964286])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([2761.49133754, 2652.03639197, 2739.06208396, 2804.5443151 , 2818.78636312])
 'score_time': array([337.29083252, 331.38901472, 335.53851533, 337.30032897, 335.85870934]),
'test_accuracy': array([0.87642857, 0.87235714, 0.87807143, 0.87521429, 0.86942857]),
'test_neg_log_loss': array([-0.34188342, -0.34991326, -0.34357185, -0.35009621, -0.35995782]),
'test_neg_mean_squared_error': array([-1.65657143, -1.6585 , -1.65521429, -1.65492857, -1.72214286]),
'test_roc_auc_ovr': array([0.99021871, 0.9899847 , 0.98991472, 0.98986872, 0.98920473]),
'test_f1_weighted': array([0.87521184, 0.87145714, 0.8769392 , 0.87430367, 0.86874891]),
'test_precision_weighted': array([0.87578388, 0.87149641, 0.87698329, 0.87437086, 0.86874838]),
'test_recall_weighted': array([0.87642857, 0.87235714, 0.87807143, 0.87521429, 0.86942857])}

Borda voting

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([87.44013858, 88.77895427, 86.76357579, 86.24450612, 87.22120094]),
'score_time': array([126.74483824, 126.52158928, 128.14419055, 124.89729929, 127.32271028]),
'test_accuracy': array([0.84042857, 0.8345 , 0.84542857, 0.84078571, 0.83185714]),
'test_neg_log_loss': array([-1.64024205, -1.64302593, -1.63951448, -1.63986571, -1.64830953]),
'test_neg_mean_squared_error': array([-2.1585 , -2.076   , -1.97057143, -2.02171429, -2.13864286]),
'test_roc_auc_ovr': array([0.96908014, 0.96860216, 0.96924101, 0.96847257, 0.96730666]),
'test_f1_weighted': array([0.83886394, 0.8331168 , 0.84362075, 0.83900183, 0.83048114]),
'test_precision_weighted': array([0.83885455, 0.83268507, 0.8435643 , 0.83884806, 0.83024321]),
'test_recall_weighted': array([0.84042857, 0.8345 , 0.84542857, 0.84078571, 0.83185714])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([787.80688047, 785.43082952, 779.7077179 , 475.55766678, 373.69895101]),
'score_time': 170.18277478]), 'test_accuracy': array([0.86692857, 0.85842857, 0.86792857, 0.86221429,
0.85535714]), 'test_neg_log_loss': array([-1.63420047, -1.63546082, -1.63412704, -1.6375947 , -1.63903849]),
'test_neg_mean_squared_error': array([-1.80692857, -1.82164286, -1.75892857, -1.78757143, -1.884   ]),
'test_roc_auc_ovr': array([0.97441792, 0.97336825, 0.97413472, 0.97317529, 0.97145035]),
'test_f1_weighted': array([0.86584072, 0.85775889, 0.86680874, 0.86145207, 0.85464599]),
'test_precision_weighted': array([0.86578147, 0.85759397, 0.86654267, 0.86132432, 0.85447726]),
'test_recall_weighted': array([0.86692857, 0.85842857, 0.86792857, 0.86221429, 0.85535714])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([1531.61813498, 1591.28403544, 1597.65157795, 1606.35030055, 1450.25359893]),
'score_time': array([312.3092556 , 300.84918523, 307.59736991, 297.90743399, 296.78846765]),
'test_accuracy': array([0.87614286, 0.86921429, 0.87614286, 0.8735 , 0.8645]),
'test_neg_log_loss': array([-1.6320791 , -1.63318441, -1.63199348, -1.63486331, -1.63704148]),
'test_neg_mean_squared_error': array([-1.672   , -1.71814286, -1.67257143, -1.66042857, -1.79014286]),
'test_roc_auc_ovr': array([0.97621378, 0.97528196, 0.97618503, 0.97580872, 0.97373034]),
'test_f1_weighted': array([0.87526257, 0.86857018, 0.87530819, 0.8729595 , 0.86401153]),

'test_precision_weighted': array([0.87518614, 0.86839942, 0.87509498, 0.87291673, 0.86386313]),
'test_recall_weighted': array([0.87614286, 0.86921429, 0.87614286, 0.8735 , 0.8645])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([2218.77630258, 1880.55881095, 2218.70034719, 2322.72533512, 2278.91890955]),
'score_time': array([288.58477283, 263.5721097 , 283.76553035, 294.49964976, 284.27154446]),
'test_accuracy': array([0.84707143, 0.8445 , 0.85228571, 0.83578571, 0.83971429]),
'test_neg_log_loss': array([-1.66295888, -1.65608827, -1.66179807, -1.66703475, -1.66673294]),
'test_neg_mean_squared_error': array([-2.0335 , -1.99114286, -1.966 , -2.0875 , -2.12242857]),
'test_roc_auc_ovr': array([0.97991293, 0.97906903, 0.97995666, 0.97696914, 0.9779222]),
'test_f1_weighted': array([0.84602389, 0.84341745, 0.851722 , 0.83625663, 0.83999477]),
'test_precision_weighted': array([0.84602452, 0.84350124, 0.85184411, 0.83735285, 0.84055896]),
'test_recall_weighted': array([0.84707143, 0.8445 , 0.85228571, 0.83578571, 0.83971429])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([2272.30232358, 2095.31115675, 2307.40432787, 2377.66865659, 2132.91378164]),
'score_time': array([300.01999784, 302.45008826, 305.47822928, 310.82766032, 290.98504281]),
'test_accuracy': array([0.87157143, 0.86678571, 0.87142857, 0.86678571, 0.86171429]),
'test_neg_log_loss': array([-1.63604058, -1.63649691, -1.63683169, -1.63869419, -1.63794516]),
'test_neg_mean_squared_error': array([-1.75271429, -1.71928571, -1.77535714, -1.73778571, -1.87457143]),
'test_roc_auc_ovr': array([0.98335186, 0.98246607, 0.98242427, 0.98217543, 0.98159786]),
'test_f1_weighted': array([0.87030401, 0.86607078, 0.87039456, 0.86622052, 0.86100535]),
'test_precision_weighted': array([0.87042722, 0.86589863, 0.87030766, 0.86615552, 0.86078251]),
'test_recall_weighted': array([0.87157143, 0.86678571, 0.87142857, 0.86678571, 0.86171429])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([5016.02863884, 5303.52745461, 4046.92791653, 4616.64603686, 2963.68739772]),
'score_time': array([731.7498951 , 345.82485294, 686.00152421, 347.10690069, 342.09947658]),
'test_accuracy': array([0.87735714, 0.87157143, 0.87628571, 0.87578571, 0.86585714]),
'test_neg_log_loss': array([-1.63288506, -1.63348665, -1.63245591, -1.63340968, -1.63470393]),
'test_neg_mean_squared_error': array([-1.67078571, -1.68821429, -1.64478571, -1.65892857, -1.79964286]),
'test_roc_auc_ovr': array([0.98229079, 0.98125302, 0.98140759, 0.98185407, 0.98057153]),
'test_f1_weighted': array([0.87631374, 0.87089328, 0.8753102 , 0.87511388, 0.86534639]),
'test_precision_weighted': array([0.87625498, 0.87080896, 0.87514963, 0.87498929, 0.86517786]),
'test_recall_weighted': array([0.87735714, 0.87157143, 0.87628571, 0.87578571, 0.86585714])}

3)

- 100% przykładów uczących podanych do klasyfikatora
{'fit_time': array([769.33637071, 772.59549665, 749.85074735, 752.04376197, 725.95951343]),
'score_time': array([63.4211514 , 59.82949114, 59.67970324, 59.71268415, 58.05852199]),
'test_accuracy': array([0.87718833, 0.88591138, 0.88750332, 0.83788803, 0.83974529]),
'test_neg_log_loss': array([-0.41717589, -0.40097721, -0.39930141, -0.52782357, -0.51695601]),
'test_neg_mean_squared_error': array([-6.40159151, -6.63305917, -4.97399841, -9.20960467, -9.45608915]),
'test_roc_auc_ovr': array([0.99351403, 0.99341685, 0.99371947, 0.9886126 , 0.98974137]),
'test_f1_weighted': array([0.87848693, 0.88579029, 0.88833248, 0.83790885, 0.84019642]),
'test_precision_weighted': array([0.88215933, 0.88701031, 0.89080091, 0.84100458, 0.84330728]),
'test_recall_weighted': array([0.87718833, 0.88591138, 0.88750332, 0.83788803, 0.83974529])}

- 75% przykładów uczących podanych do klasyfikatora
{'fit_time': array([452.04024029, 444.14072919, 474.42083859, 488.87921643, 411.06017375]),
'score_time': array([34.45381308, 35.25208569, 36.98923898, 37.14761209, 32.55669475]),
'test_accuracy': array([0.8779625 , 0.89105058, 0.87548638, 0.87725504, 0.79016277]),
'test_neg_log_loss': array([-0.40971018, -0.38838488, -0.41684494, -0.4068118 , -0.71823574]),
'test_neg_mean_squared_error': array([-6.52564556, -6.08312699, -5.64732932, -5.37743191, -12.75690021]),
'test_roc_auc_ovr': array([0.99381515, 0.9939857 , 0.99314257, 0.99342776, 0.97998584]),
'test_f1_weighted': array([0.87916624, 0.89152777, 0.87603679, 0.87858962, 0.7907403]),
'test_precision_weighted': array([0.88335334, 0.89361083, 0.87870993, 0.88282955, 0.79605097]),
'test_recall_weighted': array([0.8779625 , 0.89105058, 0.87548638, 0.87725504, 0.79016277])}

- 50% przykładów uczących podanych do klasyfikatora
{'fit_time': array([230.9017427 , 226.9593904 , 216.34397388, 214.33700252, 215.32460999]),

'score_time': array([16.57521439, 15.91247177, 15.87459874, 15.85029078, 16.05206919]),
'test_accuracy': array([0.88116711, 0.85729443, 0.8795756 , 0.86464968, 0.86995754]),
'test_neg_log_loss': array([-0.43016885, -0.48247695, -0.41676799, -0.47114028, -0.43457614]),
'test_neg_mean_squared_error': array([-6.55702918, -7.17559682, -6.51777188, -6.62845011, -6.29458599]),
'test_roc_auc_ovr': array([0.99263034, 0.99140626, 0.99374228, 0.990755 , 0.99257277]),
'test_f1_weighted': array([0.88236581, 0.85984487, 0.88065874, 0.86486429, 0.87126633]),
'test_precision_weighted': array([0.88715099, 0.86681279, 0.88485341, 0.86979945, 0.87565735]),
'test_recall_weighted': array([0.88116711, 0.85729443, 0.8795756 , 0.86464968, 0.86995754])}

- 25% przykładów uczących podanych do klasyfikatora
{'fit_time': array([83.64171767, 80.64578342, 88.01526761, 91.73247552, 77.29073405]),
'score_time': array([4.59546661, 4.94455338, 4.79917359, 4.53600168, 4.4785409]),
'test_accuracy': array([0.84517497, 0.82908705, 0.83227176, 0.83014862, 0.85138004]),
'test_neg_log_loss': array([-0.59236632, -0.58708185, -0.59318972, -0.62032719, -0.55519439]),
'test_neg_mean_squared_error': array([-7.65323436, -10.8970276 , -8.43418259, -8.79299363, -9.6358811]),
'test_roc_auc_ovr': array([0.98699012, 0.98858461, 0.98895223, 0.98598679, 0.98848998]),
'test_f1_weighted': array([0.84841679, 0.82645668, 0.83391334, 0.83134153, 0.84980303]),
'test_precision_weighted': array([0.86155098, 0.83277484, 0.8416644 , 0.84333734, 0.85489292]),
'test_recall_weighted': array([0.84517497, 0.82908705, 0.83227176, 0.83014862, 0.85138004])}

- 10% przykładów uczących podanych do klasyfikatora
{'fit_time': array([14.91580057, 15.06390715, 14.86017299, 15.14462852, 14.84050035]),
'score_time': array([0.81200314, 0.88047385, 0.82571363, 0.86820745, 0.83200431]),
'test_accuracy': array([0.74005305, 0.76392573, 0.75596817, 0.77984085, 0.76329787]),
'test_neg_log_loss': array([-0.92504631, -0.88011954, -0.86235334, -0.91682823, -0.8994923]),
'test_neg_mean_squared_error': array([-12.45623342, -11.89124668, -10.86737401, -15.56233422, -10.68882979]),
'test_roc_auc_ovr': array([0.96962844, 0.9748243 , 0.97635786, 0.97246687, 0.97234457]),
'test_f1_weighted': array([0.74120052, 0.76714738, 0.75899161, 0.78198566, 0.76637321]),
'test_precision_weighted': array([0.7736512 , 0.79603742, 0.78608896, 0.80605311, 0.80339669]),
'test_recall_weighted': array([0.74005305, 0.76392573, 0.75596817, 0.77984085, 0.76329787])}

4)

10% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([2.04304957, 2.02259231, 2.00164914, 2.03755426, 2.02558446]),
'score_time': array([0.97146487, 1.01927519, 1.02426267, 0.9853642 , 0.98536587]),
'test_accuracy': array([0.07161804, 0.09018568, 0.17241379, 0.15119363, 0.17021277]),
'test_neg_log_loss': array([-3.19020093, -3.10281415, -3.00445549, -3.00571257, -2.95726079]),
'test_neg_mean_squared_error': array([-39.53846154, -104.82493369, -71.44827586, -36.97082228,
-58.29521277]),
'test_roc_auc_ovr': array([0.31531642, 0.36624458, 0.54186031, 0.55364908, 0.58277161]),
'test_f1_weighted': array([0.0265942 , 0.04633946, 0.11129425, 0.08442051, 0.10913568]),
'test_precision_weighted': array([0.01871217, 0.04590093, 0.15144588, 0.08521993, 0.1624026]),
'test_recall_weighted': array([0.07161804, 0.09018568, 0.17241379, 0.15119363, 0.17021277])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([19.5063293 , 19.7070272 , 19.40145373, 22.81924558, 21.96205091]),
'score_time': array([3.14459348, 3.20566154, 2.99921346, 3.90187478, 3.52956533]),
'test_accuracy': array([0.62864721, 0.63395225, 0.63660477, 0.59151194, 0.6037234]),
'test_neg_log_loss': array([-1.65054821, -1.58882555, -1.54026709, -1.60450815, -1.68222927]),
'test_neg_mean_squared_error': array([-17.19628647, -20.15649867, -17.4270557 , -25.68700265, -20.   ]),
'test_roc_auc_ovr': array([0.92800784, 0.9380133 , 0.93695025, 0.92655022, 0.91646354]),
'test_f1_weighted': array([0.62875875, 0.63673272, 0.64228784, 0.5976282 , 0.60744797]),
'test_precision_weighted': array([0.68461973, 0.67463013, 0.68479209, 0.64290353, 0.64356476]),
'test_recall_weighted': array([0.62864721, 0.63395225, 0.63660477, 0.59151194, 0.6037234])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([76.41327071, 75.94379377, 76.88744974, 73.38574314, 73.52283382]),
'score_time': array([5.86673832, 5.99670053, 5.93612862, 5.71173048, 6.10567951]),
'test_accuracy': array([0.74535809, 0.73474801, 0.72413793, 0.75596817, 0.7287234]),

'test_neg_log_loss': array([-1.08154999, -1.05632682, -1.05962249, -1.10169275, -1.11996161]),
'test_neg_mean_squared_error': array([-13.16710875, -11.50928382, -14.54376658, -15.23607427, -13.1462766
]),
'test_roc_auc_ovr': array([0.95871098, 0.96679956, 0.96866598, 0.96282195, 0.95810908]),
'test_f1_weighted': array([0.74606982, 0.73582449, 0.72886921, 0.75608787, 0.72404682]),
'test_precision_weighted': array([0.77087507, 0.75137784, 0.75825003, 0.77764468, 0.73074313]),
'test_recall_weighted': array([0.74535809, 0.73474801, 0.72413793, 0.75596817, 0.7287234])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([37.82601118, 39.73937774, 36.21517968, 38.26620841, 40.9665103]),
'score_time': array([2.39360309, 2.302845 , 2.34572697, 2.68388987, 2.34575438]),
'test_accuracy': array([0.75066313, 0.77188329, 0.75331565, 0.75066313, 0.74734043]),
'test_neg_log_loss': array([-1.32390097, -1.2782545 , -1.32400778, -1.31701455, -1.42190578]),
'test_neg_mean_squared_error': array([-11.30238727, -8.94429708, -14.11405836, -14.19893899,
-10.22340426]),
'test_roc_auc_ovr': array([0.96327452, 0.96572019, 0.96470815, 0.96340502, 0.95643374]),
'test_f1_weighted': array([0.74960954, 0.77504475, 0.75310638, 0.75119335, 0.74796618]),
'test_precision_weighted': array([0.76845563, 0.79099622, 0.76643537, 0.77739161, 0.77169359]),
'test_recall_weighted': array([0.75066313, 0.77188329, 0.75331565, 0.75066313, 0.74734043])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([73.87050843, 73.81565332, 73.55244756, 74.62607288, 74.40508246]),
'score_time': array([4.26758933, 4.24469256, 4.20476079, 4.25162983, 4.17184305]),
'test_accuracy': array([0.76127321, 0.76127321, 0.77453581, 0.77984085, 0.7606383]),
'test_neg_log_loss': array([-1.07236846, -1.0520798 , -1.0515092 , -1.08520207, -1.11914611]),
'test_neg_mean_squared_error': array([-13.05570292, -9.61803714, -12.37665782, -15.4535809 ,
-8.39361702]),
'test_roc_auc_ovr': array([0.96584707, 0.97054124, 0.9723725 , 0.9701882 , 0.96618461]),
'test_f1_weighted': array([0.76158292, 0.76298106, 0.77494798, 0.77904335, 0.75913545]),
'test_precision_weighted': array([0.78067669, 0.77430716, 0.79489005, 0.80018986, 0.78392592]),
'test_recall_weighted': array([0.76127321, 0.76127321, 0.77453581, 0.77984085, 0.7606383])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([109.74061298, 109.6398809 , 109.94893742, 109.50924778, 124.6062243]),
'score_time': array([6.14363289, 6.13260245, 6.07280231, 6.07974482, 6.43691611]),
'test_accuracy': array([0.76392573, 0.77718833, 0.76923077, 0.78249337, 0.75531915]),
'test_neg_log_loss': array([-1.00366876, -0.91668165, -0.91172845, -0.98382643, -0.98129783]),
'test_neg_mean_squared_error': array([-10.84350133, -9.9204244 , -11.70026525, -14.0132626 , -9.79521277]),
'test_roc_auc_ovr': array([0.96649614, 0.97320133, 0.97679944, 0.97333321, 0.96745693]),
'test_f1_weighted': array([0.76508056, 0.77797217, 0.77099324, 0.78391162, 0.75453214]),
'test_precision_weighted': array([0.78402552, 0.79013132, 0.78770298, 0.80584146, 0.77217282]),
'test_recall_weighted': array([0.76392573, 0.77718833, 0.76923077, 0.78249337, 0.75531915])}

25% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([11.02671313, 10.99442601, 11.55432534, 10.48497033, 10.44607425]),
'score_time': array([5.54240823, 7.7331965 , 5.46345472, 5.52323437, 5.44145155]),
'test_accuracy': array([0.52067869, 0.50530786, 0.54140127, 0.53397028, 0.55838641]),
'test_neg_log_loss': array([-2.03858738, -2.01973787, -1.99472741, -1.98456324, -2.00527427]),
'test_neg_mean_squared_error': array([-30.28632025, -21.42993631, -22.83333333, -21.30360934,
-21.72717622]),
'test_roc_auc_ovr': array([0.91127572, 0.90954723, 0.90694465, 0.90290336, 0.90702053]),
'test_f1_weighted': array([0.49751083, 0.47202078, 0.53685489, 0.53713815, 0.55599365]),
'test_precision_weighted': array([0.58879759, 0.54356895, 0.58599259, 0.5813757 , 0.61987748]),
'test_recall_weighted': array([0.52067869, 0.50530786, 0.54140127, 0.53397028, 0.55838641])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([113.54947138, 113.16744852, 112.834337 , 112.56901598, 112.40648341]),
'score_time': array([17.68172956, 17.64881468, 17.58104801, 17.58903074, 17.59096909]),
'test_accuracy': array([0.78579003, 0.75583864, 0.74522293, 0.75690021, 0.77600849]),

'test_neg_log_loss': array([-0.92400752, -0.96403931, -0.97548703, -0.96838938, -0.93038917]),
'test_neg_mean_squared_error': array([-10.53764581, -12.15180467, -12.5329087 , -14.21762208,
-12.69957537]),
'test_roc_auc_ovr': array([0.97493324, 0.97430551, 0.97291858, 0.97165619, 0.97319097]),
'test_f1_weighted': array([0.78675269, 0.75671342, 0.74982461, 0.75676262, 0.77608703]),
'test_precision_weighted': array([0.80085144, 0.76567776, 0.76255766, 0.76654454, 0.7827417]),
'test_recall_weighted': array([0.78579003, 0.75583864, 0.74522293, 0.75690021, 0.77600849])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([422.98991966, 442.01739025, 432.92568946, 456.66984463,
456.49571562]), 'score_time': array([34.30745649, 32.75343418, 36.98967481, 36.82970405, 36.48362112]),
'test_accuracy': array([0.82396607, 0.81953291, 0.79936306, 0.81210191, 0.84288747]), 'test_neg_log_loss':
array([-0.68965652, -0.66118488, -0.71518651, -0.67848868, -0.65004818]), 'test_neg_mean_squared_error': array([
-8.57370095, -9.88428875, -11.72717622, -8.7866242 ,
-9.09872611]), 'test_roc_auc_ovr': array([0.98261013, 0.98662418, 0.98444698, 0.9852991 , 0.98571707]),
'test_f1_weighted': array([0.82520268, 0.81975614, 0.80120546, 0.81232597, 0.84214123]),
'test_precision_weighted': array([0.83354153, 0.82283145, 0.80604166, 0.81714861, 0.84378376]),
'test_recall_weighted': array([0.82396607, 0.81953291, 0.79936306, 0.81210191, 0.84288747])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([189.4613235 , 186.99318814, 200.89061856, 191.52180386, 211.25531721]),
'score_time': array([13.44865489, 13.44509411, 13.5508976 , 13.45901966, 13.7383213]),
'test_accuracy': array([0.8271474 , 0.81316348, 0.81104034, 0.82059448, 0.82908705]),
'test_neg_log_loss': array([-0.92343166, -0.94973967, -0.97118687, -0.91842328, -0.92366706]),
'test_neg_mean_squared_error': array([-9.4485684 , -9.22505308, -9.71019108, -9.21762208, -9.69639066]),
'test_roc_auc_ovr': array([0.98095158, 0.98490508, 0.97880135, 0.98265592, 0.98400387]),
'test_f1_weighted': array([0.82903932, 0.81184477, 0.81193693, 0.82003429, 0.82833545]),
'test_precision_weighted': array([0.84093193, 0.81682647, 0.81716161, 0.82998577, 0.8330962]),
'test_recall_weighted': array([0.8271474 , 0.81316348, 0.81104034, 0.82059448, 0.82908705])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([356.31160593, 375.74469781, 363.07950068, 366.48329163, 388.23468995]),
'score_time': array([23.97490692, 24.10292721, 23.88792896, 24.00797129, 24.0725739]),
'test_accuracy': array([0.83775186, 0.82802548, 0.82165605, 0.83014862, 0.85562633]),
'test_neg_log_loss': array([-0.71542314, -0.69763924, -0.71506996, -0.71963061, -0.64786479]),
'test_neg_mean_squared_error': array([-8.30010604, -7.80573248, -9.91719745, -9.67834395, -7.95329087]),
'test_roc_auc_ovr': array([0.9836711 , 0.98813689, 0.98623581, 0.98475348, 0.98887671]),
'test_f1_weighted': array([0.83844052, 0.82845109, 0.82357459, 0.82912067, 0.85505944]),
'test_precision_weighted': array([0.84868392, 0.83213879, 0.83091781, 0.83457019, 0.85747509]),
'test_recall_weighted': array([0.83775186, 0.82802548, 0.82165605, 0.83014862, 0.85562633])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([553.28245592, 565.41914153, 562.77914071, 580.28920484, 561.4669416]),
'score_time': array([34.11537409, 34.39056182, 34.30164051, 34.70491195, 34.50970268]),
'test_accuracy': array([0.84517497, 0.83970276, 0.83014862, 0.84076433, 0.85987261]),
'test_neg_log_loss': array([-0.6098517 , -0.61604158, -0.64297103, -0.6251767 , -0.58722916]),
'test_neg_mean_squared_error': array([-7.94273595, -7.10403397, -9.02441614, -7.62208068, -8.14861996]),
'test_roc_auc_ovr': array([0.9866044 , 0.98910207, 0.9877699 , 0.98727687, 0.98886242]),
'test_f1_weighted': array([0.84520077, 0.83941604, 0.83199063, 0.8405355 , 0.85883987]),
'test_precision_weighted': array([0.8527469 , 0.84278645, 0.83862774, 0.84541217, 0.86049467]),
'test_recall_weighted': array([0.84517497, 0.83970276, 0.83014862, 0.84076433, 0.85987261])}

50% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([38.97144747, 38.93799639, 38.93380094, 38.86411381, 38.93688989]),
'score_time': array([20.56501722, 20.57872272, 20.60395384, 20.56280899, 20.49427271]),
'test_accuracy': array([0.6795756 , 0.68435013, 0.68541114, 0.67887473, 0.69267516]),
'test_neg_log_loss': array([-1.32007195, -1.29272278, -1.29270178, -1.31736324, -1.29850868]),
'test_neg_mean_squared_error': array([-16.93740053, -18.45411141, -17.2265252 , -17.13481953,
-16.74416136]),
'test_roc_auc_ovr': array([0.95275729, 0.95785748, 0.95609211, 0.95571466, 0.95605129]),

'test_f1_weighted': array([0.6804954 , 0.68425032, 0.68919132, 0.67917779, 0.6895557]),
'test_precision_weighted': array([0.69243823, 0.69747736, 0.70617586, 0.70418202, 0.70689157]),
'test_recall_weighted': array([0.6795756 , 0.68435013, 0.68541114, 0.67887473, 0.69267516])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([408.07505727, 410.1683054 , 408.81960201, 409.74310946, 410.42904139]),
'score_time': array([66.0088923 , 65.54372859, 66.43339276, 65.77892852, 66.22598743]),
'test_accuracy': array([0.81485411, 0.80530504, 0.82334218, 0.82218684, 0.81794055]),
'test_neg_log_loss': array([-0.6913294 , -0.69809595, -0.6551816 , -0.65976382, -0.68574358]),
'test_neg_mean_squared_error': array([-10.16180371, -11.99469496, -9.77612732, -7.37632696, -9.94426752]),
'test_roc_auc_ovr': array([0.98524753, 0.98446948, 0.98648471, 0.98614261, 0.98444822]),
'test_f1_weighted': array([0.81594336, 0.80753904, 0.82384949, 0.82140285, 0.81790884]),
'test_precision_weighted': array([0.82251123, 0.81471445, 0.8257205 , 0.82441657, 0.82144675]),
'test_recall_weighted': array([0.81485411, 0.80530504, 0.82334218, 0.82218684, 0.81794055])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([1468.00019145, 1476.77560854, 1458.67821002, 1375.67358685,
1281.04136801]), 'score_time': array([133.75397754, 131.90742254, 131.75512958, 118.53511381,
119.45966196]), 'test_accuracy': array([0.86259947, 0.84774536, 0.85782493, 0.8604034 , 0.86571125]),
'test_neg_log_loss': array([-0.4949615 , -0.53840243, -0.50328724, -0.50461271, -0.48829809]),
'test_neg_mean_squared_error': array([-7.04827586, -9.11405836, -7.45517241, -6.64490446, -6.77919321]),
'test_roc_auc_ovr': array([0.99074673, 0.99033814, 0.99106972, 0.99035786, 0.99109362]), 'test_f1_weighted':
array([0.86359704, 0.84903383, 0.85791523, 0.86028061, 0.86679466]), 'test_precision_weighted':
array([0.86727506, 0.85324071, 0.85896055, 0.8631071 , 0.86992906]), 'test_recall_weighted': array([0.86259947,
0.84774536, 0.85782493, 0.8604034 , 0.86571125])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([597.29305911, 573.58817244, 620.43271112, 634.7895987 , 642.49652719]),
'score_time': array([50.39611053, 49.89980173, 50.86202097, 50.21516323, 50.48405266]),
'test_accuracy': array([0.86578249, 0.84615385, 0.86896552, 0.8529724 , 0.86677282]),
'test_neg_log_loss': array([-0.75114627, -0.742775 , -0.73934176, -0.76031349, -0.72047735]),
'test_neg_mean_squared_error': array([-6.9464191 , -8.57029178, -6.79681698, -7.42144374, -6.40605096]),
'test_roc_auc_ovr': array([0.98852432, 0.98865759, 0.98853141, 0.98768334, 0.98877418]),
'test_f1_weighted': array([0.86639088, 0.84761547, 0.86874191, 0.85207356, 0.86781503]),
'test_precision_weighted': array([0.8692149 , 0.85238721, 0.8702758 , 0.85491542, 0.87063963]),
'test_recall_weighted': array([0.86578249, 0.84615385, 0.86896552, 0.8529724 , 0.86677282])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([1206.85411072, 1061.50794315, 1121.9106555 , 1078.12215233, 1109.67406058]), 'score_time':
array([88.62138915, 86.87930036, 87.27847958, 85.46325159, 87.69962072]),
'test_accuracy': array([0.88381963, 0.8535809 , 0.87533156, 0.86995754, 0.87685775]),
'test_neg_log_loss': array([-0.517055 , -0.55411943, -0.52937502, -0.51093879, -0.53013978]),
'test_neg_mean_squared_error': array([-6.30928382, -7.57188329, -6.21750663, -5.7022293 , -6.54087049]),
'test_roc_auc_ovr': array([0.99145888, 0.99079024, 0.99207847, 0.99154145, 0.99160938]),
'test_f1_weighted': array([0.88467013, 0.85519735, 0.87513572, 0.86978373, 0.87776258]),
'test_precision_weighted': array([0.88739847, 0.8601612 , 0.87618679, 0.87266727, 0.88019705]),
'test_recall_weighted': array([0.88381963, 0.8535809 , 0.87533156, 0.86995754, 0.87685775])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([1567.75115323, 1674.40178061, 1612.77263451, 1607.24906373, 1626.82290578]), 'score_time':
array([122.13752413, 123.8779242 , 123.5144875 , 123.6300776 , 122.42720175]), 'test_accuracy':
array([0.88381963, 0.86843501, 0.8806366 , 0.86677282, 0.88322718]),
'test_neg_log_loss': array([-0.45536568, -0.49717623, -0.44766225, -0.48987183, -0.43939947]),
'test_neg_mean_squared_error': array([-6.16392573, -7.50344828, -6.04297082, -6.6358811 , -6.1395966]),
'test_roc_auc_ovr': array([0.99248212, 0.99182926, 0.99301321, 0.99109626, 0.9928571]),
'test_f1_weighted': array([0.88440636, 0.86985882, 0.88037742, 0.86637701, 0.88382266]),
'test_precision_weighted': array([0.88687015, 0.87460832, 0.8810535 , 0.8691682 , 0.88570663]),
'test_recall_weighted': array([0.88381963, 0.86843501, 0.8806366 , 0.86677282, 0.88322718])}

75% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([84.42341566, 84.27466202, 83.87508512, 84.45134258, 84.33888698]),

'score_time': array([45.54324126, 45.32706356, 45.51431942, 45.85546732, 45.73842597]),
'test_accuracy': array([0.73010258, 0.72090555, 0.74708171, 0.73859215, 0.65109696]),
'test_neg_log_loss': array([-1.10423523, -1.10450394, -1.05416567, -1.08104649, -1.22084228]),
'test_neg_mean_squared_error': array([-16.36045278, -16.49239476, -11.9267775 , -14.17686594,
-18.92427459]),
'test_roc_auc_ovr': array([0.96800033, 0.96339215, 0.96978197, 0.96499344, 0.9536777]),
'test_f1_weighted': array([0.73198685, 0.72173848, 0.74730999, 0.73846995, 0.65634828]),
'test_precision_weighted': array([0.74737994, 0.73590126, 0.75217224, 0.744436 , 0.68402949]),
'test_recall_weighted': array([0.73010258, 0.72090555, 0.74708171, 0.73859215, 0.65109696])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([828.16756606, 832.37208152, 902.1900599 , 934.76579952, 869.30996871]),
'score_time': array([140.99516416, 141.75305748, 155.10818982, 154.30035901, 142.20186782]), 'test_accuracy':
array([0.84046693, 0.83622214, 0.8468341 , 0.84046693, 0.75230007]),
'test_neg_log_loss': array([-0.59027092, -0.60921689, -0.57523845, -0.60258363, -0.84738142]),
'test_neg_mean_squared_error': array([-8.84152812, -8.70569508, -6.94729395, -7.87760877, -14.18400566]),
'test_roc_auc_ovr': array([0.98849155, 0.98750411, 0.98835982, 0.98749962, 0.97349827]),
'test_f1_weighted': array([0.84102271, 0.83695526, 0.84625294, 0.84035655, 0.75492248]),
'test_precision_weighted': array([0.84353511, 0.83925149, 0.84694963, 0.84221421, 0.76187785]),
'test_recall_weighted': array([0.84046693, 0.83622214, 0.8468341 , 0.84046693, 0.75230007])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([2331.30258441, 2332.92710805, 2337.25086331, 2338.55006886,
2317.97078848]), 'score_time': array([251.46775293, 250.71164012, 250.14967012, 251.42606688,
247.25242615]), 'test_accuracy': array([0.86805801, 0.86664308, 0.87619385, 0.8712416 , 0.78308563]),
'test_neg_log_loss': array([-0.46532776, -0.46519154, -0.43489741, -0.46389107, -0.7445676]),
'test_neg_mean_squared_error': array([-7.04563141, -8.04704634, -5.56844712, -6.18677043,
-12.48690729]), 'test_roc_auc_ovr': array([0.99235407, 0.99200648, 0.99295904, 0.99169158, 0.97850828]),
'test_f1_weighted': array([0.86852143, 0.86711366, 0.87586568, 0.87142975, 0.78375541]),
'test_precision_weighted': array([0.87050655, 0.86857593, 0.87747038, 0.87266213, 0.78732943]),
'test_recall_weighted': array([0.86805801, 0.86664308, 0.87619385, 0.8712416 , 0.78308563])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([1202.3296442 , 1280.48280644, 1309.96050262, 1285.13528633, 1345.76539445]), 'score_time':
array([107.35398841, 109.80038071, 110.2343998 , 109.42648602, 110.49167871]), 'test_accuracy':
array([0.86876548, 0.86628935, 0.86416696, 0.8712416 , 0.76928521]),
'test_neg_log_loss': array([-0.67038025, -0.71007626, -0.67256875, -0.6691431 , -0.99335634]),
'test_neg_mean_squared_error': array([-6.90130881, -7.34029006, -6.50442165, -5.74991157, -12.92427459]),
'test_roc_auc_ovr': array([0.99092961, 0.9896234 , 0.99122922, 0.99062642, 0.97309737]),
'test_f1_weighted': array([0.86945427, 0.86629062, 0.86377859, 0.87177029, 0.76898453]),
'test_precision_weighted': array([0.87200832, 0.86780931, 0.86567977, 0.87438021, 0.77219535]),
'test_recall_weighted': array([0.86876548, 0.86628935, 0.86416696, 0.8712416 , 0.76928521])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([2254.94259667, 2417.75751925, 2280.6160419 , 2381.35749364, 2248.36806893]), 'score_time':
array([185.3256166 , 189.01570797, 186.33044648, 187.38306451, 185.21725869]), 'test_accuracy':
array([0.8790237 , 0.88185356, 0.87760877, 0.87407145, 0.78343949]),
'test_neg_log_loss': array([-0.4842799 , -0.48360649, -0.47342174, -0.49306049, -0.79531556]),
'test_neg_mean_squared_error': array([-6.64626813, -6.26777503, -5.48107534, -5.41528122, -12.81316348]),
'test_roc_auc_ovr': array([0.99327918, 0.99322559, 0.99352856, 0.99264482, 0.97763394]),
'test_f1_weighted': array([0.87966715, 0.88181929, 0.87754899, 0.87455748, 0.7830259]),
'test_precision_weighted': array([0.88199604, 0.88255689, 0.87872147, 0.87639457, 0.7850861]),
'test_recall_weighted': array([0.8790237 , 0.88185356, 0.87760877, 0.87407145, 0.78343949])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([3377.24166489, 3561.75196481, 3274.92822313, 3201.5929327 , 3113.40193605]), 'score_time':
array([269.10458922, 274.85769653, 260.22325587, 257.27590084, 254.4726491]), 'test_accuracy':
array([0.88079236, 0.88503714, 0.88362221, 0.87937743, 0.78520878]),
'test_neg_log_loss': array([-0.42735281, -0.4311792 , -0.41737192, -0.42539764, -0.71428295]),
'test_neg_mean_squared_error': array([-6.57410683, -6.30173329, -5.22002122, -5.58118146, -12.36624204]),
'test_roc_auc_ovr': array([0.99379182, 0.99335247, 0.99372341, 0.99351443, 0.98031443]),

'test_f1_weighted': array([0.88120652, 0.88491375, 0.88342331, 0.87987363, 0.78569093]),
'test_precision_weighted': array([0.8831768 , 0.88550094, 0.88480511, 0.88156841, 0.78915265]),
'test_recall_weighted': array([0.88079236, 0.88503714, 0.88362221, 0.87937743, 0.78520878])}

100% przykładów uczących podanych do klasyfikatorów
Wyniki w pp 1) przy wynikach average voting

5)

- 100% przykładów uczących podanych do klasyfikatora
  {'fit_time': array([669.86481285, 651.72993231, 646.2879405 , 637.6679287 , 629.35418653]),
  'score_time': array([83.53599739, 82.88043523, 87.86544251, 87.93028927, 87.7683835]),
  'test_accuracy': array([0.87957143, 0.87371429, 0.87942857, 0.8755 , 0.86864286],
  'test_neg_log_loss': array([-0.33503206, -0.34384465, -0.33921104, -0.34550541, -0.35841912],
  'test_neg_mean_squared_error': array([-1.61807143, -1.66321429, -1.60985714, -1.667 , -1.72778571]),
  'test_roc_auc_ovr': array([0.99039816, 0.99013146, 0.99001696, 0.98997341, 0.98916013]),
  'test_f1_weighted': array([0.87865963, 0.87303826, 0.87855185, 0.87455877, 0.86817124]),
  'test_precision_weighted': array([0.87874954, 0.87301748, 0.87866448, 0.87458393, 0.86819786],
  'test_recall_weighted': array([0.87957143, 0.87371429, 0.87942857, 0.8755 , 0.86864286])}

- 75% przykładów uczących podanych do klasyfikatora
  {'fit_time': array([355.27873778, 357.044734 , 356.61458135, 353.90271115, 618.08012938]),
  'score_time': array([51.46062374, 50.9471097 , 51.34017158, 51.87794113, 205.29470491]),
  'test_accuracy': array([0.87695238, 0.86933333, 0.87485714, 0.87619048, 0.87457143]),
  'test_neg_log_loss': array([-0.34426562, -0.35253936, -0.35041945, -0.35276727, -0.34918659]),
  'test_neg_mean_squared_error': array([-1.64457143, -1.69485714, -1.62857143, -1.662 , -1.66609524]),
  'test_roc_auc_ovr': array([0.98995309, 0.9894113 , 0.98979999, 0.989257 , 0.98982545]),
  'test_f1_weighted': array([0.8760322 , 0.86826792, 0.87452954, 0.8750861 , 0.87366723]),
  'test_precision_weighted': array([0.87598482, 0.86807695, 0.87460283, 0.87497703, 0.87374333]),
  'test_recall_weighted': array([0.87695238, 0.86933333, 0.87485714, 0.87619048, 0.87457143])}

- 50% przykładów uczących podanych do klasyfikatora
  {'fit_time': array([157.34583926, 159.19057536, 158.20579958, 159.6858511, 157.40149546]),
  'score_time': array([24.30846524, 24.30150461, 24.49132228, 24.25741816, 24.33670592]),
  'test_accuracy': array([0.86985714, 0.87157143, 0.85957143, 0.86857143, 0.86785714]),
  'test_neg_log_loss': array([-0.3558425 , -0.36074491, -0.37402082, -0.36586798, -0.36498248]),
  'test_neg_mean_squared_error': array([-1.68185714, -1.72671429, -1.79442857, -1.67685714, -1.79314286]),
  'test_roc_auc_ovr': array([0.9893281 , 0.98935184, 0.98838706, 0.98926911, 0.98852189]),
  'test_f1_weighted': array([0.86844061, 0.87089449, 0.85837353, 0.86814927, 0.86676328]),
  'test_precision_weighted': array([0.86852243, 0.87080292, 0.85813941, 0.86827549, 0.86656395]),
  'test_recall_weighted': array([0.86985714, 0.87157143, 0.85957143, 0.86857143, 0.86785714])}

- 25% przykładów uczących podanych do klasyfikatora
  {'fit_time': array([41.9435215 , 42.20122242, 42.48432755, 42.21398687, 42.232687]),
  'score_time': array([6.50708723, 6.74044418, 6.71140122, 6.69530249, 6.45516753]),
  'test_accuracy': array([0.854 , 0.86257143, 0.862 , 0.85857143, 0.84771429]),
  'test_neg_log_loss': array([-0.39991224, -0.37769559, -0.38652712, -0.39350907, -0.40332501]),
  'test_neg_mean_squared_error': array([-2.01485714, -1.71828571, -1.77714286, -1.76942857, -1.932]),
  'test_roc_auc_ovr': array([0.98694742, 0.98843437, 0.98823638, 0.98694968, 0.98679918]),
  'test_f1_weighted': array([0.85211979, 0.86170417, 0.86158473, 0.85748651, 0.84700676]),
  'test_precision_weighted': array([0.85180776, 0.86186462, 0.86206842, 0.85746569, 0.84712032]),
  'test_recall_weighted': array([0.854 , 0.86257143, 0.862 , 0.85857143, 0.84771429])}

- 10% przykładów uczących podanych do klasyfikatora
  {'fit_time': array([8.91829824, 9.04934096, 9.01065564, 9.01567984, 8.9721787]),
  'score_time': array([1.24403715, 1.26893306, 1.24067163, 1.23582816, 1.18962312]),
  'test_accuracy': array([0.84142857, 0.84642857, 0.84571429, 0.85142857, 0.83857143]),
  'test_neg_log_loss': array([-0.42529794, -0.4478282 , -0.43038987, -0.42007939, -0.44236618]),
  'test_neg_mean_squared_error': array([-2.13071429, -1.99785714, -1.98214286, -1.72214286, -1.94285714]),
  'test_roc_auc_ovr': array([0.98543426, 0.98416837, 0.98486909, 0.98632917, 0.98545636]),
  'test_f1_weighted': array([0.83972866, 0.84445202, 0.84366043, 0.84972413, 0.83798416]),
  'test_precision_weighted': array([0.84064899, 0.84454686, 0.84327672, 0.85082018, 0.83908056]),
  'test_recall_weighted': array([0.84142857, 0.84642857, 0.84571429, 0.85142857, 0.83857143])}

6)

10% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([2.29719567, 1.70368028, 2.15973496, 2.0188539 , 2.19210458]),
  'score_time': array([2.05231571, 1.92805362, 1.89582109, 1.60407615, 2.13352513]),
  'test_accuracy': array([0.75142857, 0.78571429, 0.77785714, 0.77 , 0.76142857]),
  'test_neg_log_loss': array([-0.67599502, -0.63176933, -0.63846399, -0.65180112, -0.64980752]),
  'test_neg_mean_squared_error': array([-2.92714286, -2.61214286, -2.92285714, -2.73285714, -3.07785714]),
  'test_roc_auc_ovr': array([0.97005722, 0.973803 , 0.97332964, 0.97245143, 0.97235581]),
  'test_f1_weighted': array([0.75158389, 0.78841656, 0.77606978, 0.7684865 , 0.76034427]),
  'test_precision_weighted': array([0.75540541, 0.79454754, 0.77798412, 0.7690227 , 0.76119575]),
  'test_recall_weighted': array([0.75142857, 0.78571429, 0.77785714, 0.77 , 0.76142857])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([14.8534503 , 14.45188546, 13.14409876, 15.0696094 , 14.83215594]),
  'score_time': array([4.61056232, 4.28737545, 5.24730945, 5.22190976, 4.88353729]),
  'test_accuracy': array([0.82071429, 0.825 , 0.81714286, 0.82571429, 0.81357143]),
  'test_neg_log_loss': array([-0.49598387, -0.50333139, -0.5040695 , -0.49373583, -0.51808733]),
  'test_neg_mean_squared_error': array([-2.14857143, -2.23357143, -2.515 , -1.95857143, -2.18214286]),
  'test_roc_auc_ovr': array([0.9815027 , 0.98105366, 0.98126028, 0.98224021, 0.98062016]),
  'test_f1_weighted': array([0.81966752, 0.82465531, 0.81353138, 0.82348213, 0.81223074]),
  'test_precision_weighted': array([0.82018186, 0.82664645, 0.81414878, 0.82369227, 0.81282785]),
  'test_recall_weighted': array([0.82071429, 0.825 , 0.81714286, 0.82571429, 0.81357143])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([45.26402068, 45.26498032, 46.27083135, 49.10364127, 45.55311656]), 'score_time':
  array([7.93588758, 8.73243022, 9.39694262, 9.34031606, 5.01372552]), 'test_accuracy': array([0.84642857,
  0.84714286, 0.835 , 0.83642857, 0.83857143]), 'test_neg_log_loss': array([-0.43800903, -0.4636884 ,
  -0.45369796, -0.44282774, -0.45504717]), 'test_neg_mean_squared_error': array([-1.88214286, -1.88 , -2.26 ,
  -1.89071429, -2.02357143]), 'test_roc_auc_ovr': array([0.98487314, 0.98335975, 0.98362156, 0.98530277,
  0.98481709]), 'test_f1_weighted': array([0.84669268, 0.84627718, 0.83222786, 0.835683 , 0.83822527]),
  'test_precision_weighted': array([0.84830707, 0.84672989, 0.83174256, 0.83621605, 0.83861607]),
  'test_recall_weighted': array([0.84642857, 0.84714286, 0.835 , 0.83642857, 0.83857143])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([40.16971684, 42.55537534, 36.34723687, 34.63014388, 31.16177106]),
  'score_time': array([4.70806313, 4.74266338, 4.34139085, 4.21400356, 4.06661868]),
  'test_accuracy': array([0.83 , 0.82071429, 0.82 , 0.83285714, 0.81]),
  'test_neg_log_loss': array([-0.6542037 , -0.73005354, -0.68498621, -0.67316963, -0.64077983]),
  'test_neg_mean_squared_error': array([-2.19785714, -2.375 , -2.31928571, -1.96571429, -2.36071429]),
  'test_roc_auc_ovr': array([0.97898259, 0.9762434 , 0.9805418 , 0.98045639, 0.97814941]),
  'test_f1_weighted': array([0.82791802, 0.81860557, 0.81552664, 0.83055965, 0.80846347]),
  'test_precision_weighted': array([0.82846433, 0.81982152, 0.8165182 , 0.8307278 , 0.80956855]),
  'test_recall_weighted': array([0.83 , 0.82071429, 0.82 , 0.83285714, 0.81])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([37.99137735, 35.76625824, 43.34552121, 36.57986355, 38.46422768]),
  'score_time': array([4.87872434, 5.01110291, 5.09046078, 4.78820467, 5.06547332]),
  'test_accuracy': array([0.84357143, 0.84142857, 0.84 , 0.84714286, 0.83785714]),
  'test_neg_log_loss': array([-0.46794924, -0.47995785, -0.4822572 , -0.45249898, -0.47195871]),
  'test_neg_mean_squared_error': array([-2.09 , -2.14214286, -2.09714286, -1.70428571, -1.97357143]),
  'test_roc_auc_ovr': array([0.98438625, 0.98341205, 0.98428848, 0.98608344, 0.9846362]),
  'test_f1_weighted': array([0.84129651, 0.84024434, 0.83639879, 0.84623245, 0.83721316]),
  'test_precision_weighted': array([0.84209756, 0.84099712, 0.83665918, 0.84663221, 0.83782598]),
  'test_recall_weighted': array([0.84357143, 0.84142857, 0.84 , 0.84714286, 0.83785714])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([41.59972906, 36.76106071, 38.15844107, 39.78490734, 42.77064967]),
  'score_time': array([5.56852674, 5.14522791, 5.63194275, 5.57695222, 5.60506392]),
  'test_accuracy': array([0.84642857, 0.84928571, 0.84142857, 0.84857143, 0.84285714]),

'test_neg_log_loss': array([-0.43128757, -0.45829074, -0.44499666, -0.43183933, -0.44611792]),
'test_neg_mean_squared_error': array([-1.995 , -2.03571429, -2.10571429, -1.715 , -2.00928571]),
'test_roc_auc_ovr': array([0.98570362, 0.98379559, 0.98426405, 0.98612288, 0.9854077]),
'test_f1_weighted': array([0.84477941, 0.8482598 , 0.83892186, 0.84815884, 0.84253085]),
'test_precision_weighted': array([0.84509675, 0.84905161, 0.83895989, 0.84903248, 0.84314256]),
'test_recall_weighted': array([0.84642857, 0.84928571, 0.84142857, 0.84857143, 0.84285714])}

25% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([5.36078715, 5.39070725, 5.35878658, 5.35429025, 5.35678625]),
  'score_time': array([6.20897388, 6.00106788, 6.03539419, 5.83018851, 5.85897374]),
  'test_accuracy': array([0.81228571, 0.81742857, 0.81142857, 0.80485714, 0.80085714]),
  'test_neg_log_loss': array([-0.52646662, -0.52106435, -0.53542966, -0.5369258 , -0.54761284]),
  'test_neg_mean_squared_error': array([-2.336 , -2.32057143, -2.51857143, -2.29228571, -2.462]),
  'test_roc_auc_ovr': array([0.98042094, 0.98141517, 0.97984827, 0.97833685, 0.97822873]),
  'test_f1_weighted': array([0.81123288, 0.81785687, 0.81000346, 0.80097963, 0.79986598]),
  'test_precision_weighted': array([0.81274116, 0.81967129, 0.81038283, 0.80224814, 0.80051901]),
  'test_recall_weighted': array([0.81228571, 0.81742857, 0.81142857, 0.80485714, 0.80085714])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([38.65981269, 39.35018611, 38.35749507, 38.50873518, 34.86923313]),
  'score_time': array([15.52197337, 15.6254406 , 14.87927628, 12.98631787, 14.58481908]),
  'test_accuracy': array([0.84228571, 0.84685714, 0.83 , 0.83771429, 0.83371429]),
  'test_neg_log_loss': array([-0.44095008, -0.43299008, -0.45087914, -0.44937925, -0.44888657]),
  'test_neg_mean_squared_error': array([-2.05457143, -1.91857143, -2.22314286, -2.01771429, -2.05742857]),
  'test_roc_auc_ovr': array([0.98478842, 0.98554796, 0.98457444, 0.98359169, 0.98415201]),
  'test_f1_weighted': array([0.84052224, 0.84621102, 0.82877642, 0.83603753, 0.83322495]),
  'test_precision_weighted': array([0.84025084, 0.84626163, 0.82897452, 0.8360639 , 0.83353877]),
  'test_recall_weighted': array([0.84228571, 0.84685714, 0.83 , 0.83771429, 0.83371429])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([121.73323083, 122.54178333, 119.67870903, 158.24120259, 168.42779207]),
  'score_time': array([26.91180301, 27.13946176, 28.03855252, 37.29426527, 31.16595411]), 'test_accuracy':
  array([0.854 , 0.85914286, 0.85 , 0.85085714, 0.84714286]),
  'test_neg_log_loss': array([-0.4077091 , -0.38798991, -0.41122665, -0.40961171, -0.411409]),
  'test_neg_mean_squared_error': array([-1.91142857, -1.81571429, -1.93028571, -1.93028571, -1.95657143]),
  'test_roc_auc_ovr': array([0.98656384, 0.9879528 , 0.98686239, 0.98613248, 0.98629926]), 'test_f1_weighted':
  array([0.85269969, 0.85880347, 0.84948328, 0.84975511, 0.84686235]), 'test_precision_weighted':
  array([0.85230883, 0.85873506, 0.84961423, 0.84982682, 0.84698424]), 'test_recall_weighted': array([0.854 ,
  0.85914286, 0.85 , 0.85085714, 0.84714286])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([201.91174626, 197.138381 , 243.79176903, 210.29370999, 227.78905797]),
  'score_time': array([25.26755214, 28.21205568, 25.54564238, 26.02450728, 26.8792038]),
  'test_accuracy': array([0.83914286, 0.84228571, 0.83485714, 0.83657143, 0.82857143]),
  'test_neg_log_loss': array([-0.57392636, -0.59675076, -0.6118953 , -0.6187032 , -0.62486247]),
  'test_neg_mean_squared_error': array([-2.19857143, -2.08428571, -2.20342857, -2.07914286, -2.15371429]),
  'test_roc_auc_ovr': array([0.98260943, 0.98341397, 0.98248689, 0.98088372, 0.98227521]),
  'test_f1_weighted': array([0.83670622, 0.84067289, 0.83357058, 0.83441525, 0.82719663]),
  'test_precision_weighted': array([0.83651706, 0.84088802, 0.83371248, 0.8344132 , 0.82698627]),
  'test_recall_weighted': array([0.83914286, 0.84228571, 0.83485714, 0.83657143, 0.82857143])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([192.97073984, 205.45588923, 173.9368968 , 175.31263471, 184.64827466]),
  'score_time': array([28.03897595, 27.23800111, 25.3146553 , 25.29203749, 26.43889213]),
  'test_accuracy': array([0.84942857, 0.85628571, 0.852 , 0.84914286, 0.84114286]),
  'test_neg_log_loss': array([-0.42618665, -0.41256305, -0.42656799, -0.43070748, -0.43520494]),
  'test_neg_mean_squared_error': array([-1.97885714, -1.79485714, -1.90428571, -1.92428571, -1.99314286]),
  'test_roc_auc_ovr': array([0.98629641, 0.98770577, 0.98678364, 0.98585703, 0.98579907]),

'test_f1_weighted': array([0.84772714, 0.85543236, 0.85114852, 0.84761935, 0.84086479]),
'test_precision_weighted': array([0.84718769, 0.85526102, 0.85118413, 0.8477256 , 0.84095856]),
'test_recall_weighted': array([0.84942857, 0.85628571, 0.852 , 0.84914286, 0.84114286])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([186.57287383, 198.81872892, 231.52305603, 205.95697236, 201.02394795]),
'score_time': array([27.52937961, 32.14547896, 31.12843013, 31.14599347, 30.64687014]),
'test_accuracy': array([0.85742857, 0.86657143, 0.86171429, 0.85657143, 0.85057143]),
'test_neg_log_loss': array([-0.39643224, -0.37616444, -0.4016364 , -0.39823357, -0.40093489]),
'test_neg_mean_squared_error': array([-1.91771429, -1.71714286, -1.76742857, -1.86971429, -1.90142857]),
'test_roc_auc_ovr': array([0.98725879, 0.98880917, 0.98761389, 0.98715425, 0.98699848]),
'test_f1_weighted': array([0.85570531, 0.86589504, 0.86091988, 0.85537281, 0.85042407]),
'test_precision_weighted': array([0.85538882, 0.86576617, 0.86106933, 0.85536547, 0.85056705]),
'test_recall_weighted': array([0.85742857, 0.86657143, 0.86171429, 0.85657143, 0.85057143])}

50% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([15.64068699, 15.47464299, 15.49176264, 15.52384329, 16.35122681]),
'score_time': array([20.2165339 , 19.66538143, 20.07005477, 19.88838553, 20.18729544]),
'test_accuracy': array([0.83042857, 0.82228571, 0.81685714, 0.81685714, 0.81928571]),
'test_neg_log_loss': array([-0.47326206, -0.48746092, -0.49441201, -0.48304502, -0.48303232]),
'test_neg_mean_squared_error': array([-2.16414286, -2.25971429, -2.28385714, -2.30685714, -2.43171429]),
'test_roc_auc_ovr': array([0.98313164, 0.98228462, 0.98210567, 0.98273719, 0.98192486]),
'test_f1_weighted': array([0.82874555, 0.82058827, 0.81577283, 0.81714451, 0.81881346]),
'test_precision_weighted': array([0.82887697, 0.82071472, 0.81518672, 0.81756147, 0.81918099]),
'test_recall_weighted': array([0.83042857, 0.82228571, 0.81685714, 0.81685714, 0.81928571])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([112.21678519, 111.01020765, 110.47042012, 112.14960647, 120.94055724]),
'score_time': array([49.5735209 , 49.22872281, 49.79207587, 51.20974708, 53.52238345]),
'test_accuracy': array([0.85528571, 0.85085714, 0.84028571, 0.854 , 0.85114286]),
'test_neg_log_loss': array([-0.39950192, -0.41391632, -0.42242911, -0.40979588, -0.41254768]),
'test_neg_mean_squared_error': array([-1.90885714, -1.93185714, -1.99514286, -1.83542857, -2.00214286]),
'test_roc_auc_ovr': array([0.98719024, 0.98647565, 0.98605558, 0.98699749, 0.98597476]),
'test_f1_weighted': array([0.85372798, 0.84970313, 0.83926536, 0.8534197 , 0.85069354]),
'test_precision_weighted': array([0.85358686, 0.84959946, 0.83868516, 0.85336699, 0.85115256]),
'test_recall_weighted': array([0.85528571, 0.85085714, 0.84028571, 0.854 , 0.85114286])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([409.78464055, 403.85244417, 402.47634506, 416.12956953, 405.90862489]),
'score_time': array([88.96355057, 88.62163663, 87.57865214, 88.98052526, 88.82175589]),
'test_accuracy': array([0.86757143, 0.86228571, 0.85257143, 0.86728571, 0.86457143]),
'test_neg_log_loss': array([-0.36903768, -0.38181274, -0.38953803, -0.37620809, -0.3774549]),
'test_neg_mean_squared_error': array([-1.72857143, -1.826 , -1.86942857, -1.71471429, -1.83614286]),
'test_roc_auc_ovr': array([0.98867582, 0.98818202, 0.98780552, 0.98883287, 0.98793323]),
'test_f1_weighted': array([0.86638806, 0.86109537, 0.85165449, 0.86722039, 0.86404656]),
'test_precision_weighted': array([0.86626309, 0.86083355, 0.8512197 , 0.86740355, 0.86396699]),
'test_recall_weighted': array([0.86757143, 0.86228571, 0.85257143, 0.86728571, 0.86457143])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([667.15164876, 764.68696404, 650.26399422, 707.68619704, 684.42625499]),
'score_time': array([81.2483871 , 87.48828697, 91.00654745, 83.37867141, 87.13956022]),
'test_accuracy': array([0.84785714, 0.84342857, 0.827 , 0.83885714, 0.83657143]),
'test_neg_log_loss': array([-0.55936505, -0.60839661, -0.57708722, -0.57567894, -0.61282386]),
'test_neg_mean_squared_error': array([-1.98414286, -2.05342857, -2.19828571, -2.00828571, -2.28]),
'test_roc_auc_ovr': array([0.98371062, 0.98341049, 0.98242906, 0.98400126, 0.98168408]),
'test_f1_weighted': array([0.84526791, 0.84113165, 0.82432838, 0.83800791, 0.83490014]),
'test_precision_weighted': array([0.8457808 , 0.84154653, 0.82356105, 0.83787354, 0.83423214]),
'test_recall_weighted': array([0.84785714, 0.84342857, 0.827 , 0.83885714, 0.83657143])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([620.54054689, 650.33564472, 649.95941401, 720.40635729, 623.16636348]),

'score_time': array([88.42167473, 91.45456815, 90.89007878, 91.08347344, 87.4806118]),
'test_accuracy': array([0.86685714, 0.85485714, 0.85257143, 0.86871429, 0.86357143]),
'test_neg_log_loss': array([-0.38466015, -0.41425341, -0.41042483, -0.39152408, -0.3930272]),
'test_neg_mean_squared_error': array([-1.71285714, -1.86371429, -1.88728571, -1.71457143, -1.86557143]),
'test_roc_auc_ovr': array([0.98863538, 0.98734729, 0.98749577, 0.9888412 , 0.98743542]),
'test_f1_weighted': array([0.86530296, 0.85324676, 0.851411 , 0.8684646 , 0.86245437]),
'test_precision_weighted': array([0.86528611, 0.85312073, 0.85085382, 0.86860882, 0.8620575]),
'test_recall_weighted': array([0.86685714, 0.85485714, 0.85257143, 0.86871429, 0.86357143])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([796.18179464, 741.56004333, 698.68824458, 721.5308156, 756.84417391]),
'score_time': array([99.15236473, 98.54911542, 98.12615514, 99.24074578, 98.69685173]),
'test_accuracy': array([0.87328571, 0.868 , 0.85785714, 0.86614286, 0.867]),
'test_neg_log_loss': array([-0.35272612, -0.37393258, -0.38008048, -0.37347118, -0.36854331]),
'test_neg_mean_squared_error': array([-1.64314286, -1.74157143, -1.81385714, -1.75642857, -1.82628571]),
'test_roc_auc_ovr': array([0.98983331, 0.98878748, 0.98835658, 0.9890295 , 0.98837353]),
'test_f1_weighted': array([0.87200689, 0.8668975 , 0.85677456, 0.86594158, 0.86606279]),
'test_precision_weighted': array([0.8718447 , 0.86665076, 0.85636559, 0.86610167, 0.8656588]),
'test_recall_weighted': array([0.87328571, 0.868 , 0.85785714, 0.86614286, 0.867])}

75% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([26.49708414, 26.6001842 , 27.11083412, 26.3745079 , 26.39560008]),
'score_time': array([36.63833809, 37.04918814, 37.52236485, 37.16498947, 37.47938466]),
'test_accuracy': array([0.82961905, 0.82333333, 0.83133333, 0.83742857, 0.83457143]),
'test_neg_log_loss': array([-0.46309971, -0.47630018, -0.46068197, -0.45014632, -0.45208614]),
'test_neg_mean_squared_error': array([-2.1847619 , -2.20533333, -2.11733333, -2.08609524, -2.12895238]),
'test_roc_auc_ovr': array([0.98341318, 0.98266576, 0.98377223, 0.98373756, 0.98419757]),
'test_f1_weighted': array([0.82755415, 0.82104078, 0.8299181 , 0.8359764 , 0.83376877]),
'test_precision_weighted': array([0.82798976, 0.82080925, 0.83004327, 0.83553268, 0.83406289]),
'test_recall_weighted': array([0.82961905, 0.82333333, 0.83133333, 0.83742857, 0.83457143])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([232.67174935, 231.65103102, 233.08213925, 230.33221221, 229.14817142]),
'score_time': array([102.92052436, 102.53610206, 103.57509732, 105.47508979, 105.03571296]),
'test_accuracy': array([0.86285714, 0.85152381, 0.86 , 0.8632381 , 0.85809524]),
'test_neg_log_loss': array([-0.38311919, -0.40285263, -0.39014847, -0.38606989, -0.38998387]),
'test_neg_mean_squared_error': array([-1.80914286, -1.85019048, -1.84971429, -1.81438095, -1.84419048]),
'test_roc_auc_ovr': array([0.98801829, 0.98678089, 0.98773906, 0.9874593 , 0.98771384]),
'test_f1_weighted': array([0.86195117, 0.85038523, 0.85936851, 0.86209753, 0.85747326]),
'test_precision_weighted': array([0.86197086, 0.85014023, 0.85921184, 0.86159682, 0.8574702]),
'test_recall_weighted': array([0.86285714, 0.85152381, 0.86 , 0.8632381 , 0.85809524])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([992.65783238, 972.19321179, 969.12032366, 992.69585729, 982.43080115]), 'score_time':
array([184.77053499, 185.0336144 , 184.29363942, 187.15090632, 186.47876716]),
'test_accuracy': array([0.87361905, 0.8647619 , 0.87133333, 0.87133333, 0.87104762]),
'test_neg_log_loss': array([-0.35374136, -0.37110207, -0.36068511, -0.36008983, -0.36138627]),
'test_neg_mean_squared_error': array([-1.67028571, -1.766 , -1.70485714, -1.75219048, -1.71619048]),
'test_roc_auc_ovr': array([0.98954335, 0.9884767 , 0.98932537, 0.98889936, 0.98919016]),
'test_f1_weighted': array([0.87266227, 0.8633564 , 0.87105127, 0.87034925, 0.87038592]),
'test_precision_weighted': array([0.87253932, 0.86324064, 0.87101501, 0.86987684, 0.87032348]),
'test_recall_weighted': array([0.87361905, 0.8647619 , 0.87133333, 0.87133333, 0.87104762])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([1525.12347174, 1419.57922053, 1441.5380671 , 1403.44258237,1370.16653538]), 'score_time':
array([177.09619665, 175.07892275, 175.88075233, 174.331846 , 172.03710747]),
'test_accuracy': array([0.8512381 , 0.84238095, 0.8532381 , 0.85228571, 0.8507619]),
'test_neg_log_loss': array([-0.55220562, -0.56029173, -0.55004711, -0.53880909, -0.53733281]),
'test_neg_mean_squared_error': array([-2.02990476, -2.05057143, -1.88761905, -2.00828571, -1.96647619]),
'test_roc_auc_ovr': array([0.98465409, 0.98398505, 0.98481039, 0.98454241, 0.98489242]),

'test_f1_weighted': array([0.84943756, 0.84013038, 0.85206799, 0.85034545, 0.84928655]),
'test_precision_weighted': array([0.85003885, 0.83987974, 0.85203538, 0.85004265, 0.84938009]),
'test_recall_weighted': array([0.8512381 , 0.84238095, 0.8532381 , 0.85228571, 0.8507619])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([1492.9442184 , 1696.32618785, 1533.81937957, 1501.59954166, 1570.65728688]),
'score_time': array([185.10443568, 189.06018066, 184.74184918, 189.12457919,189.37597942]),
'test_accuracy': array([0.86961905, 0.86714286, 0.86819048, 0.87 , 0.86695238]),
'test_neg_log_loss': array([-0.37143045, -0.38055582, -0.37708394, -0.37545976, -0.38162883]),
'test_neg_mean_squared_error': array([-1.72342857, -1.73495238, -1.73314286, -1.718 , -1.79390476]),
'test_roc_auc_ovr': array([0.98943623, 0.98873429, 0.98919421, 0.98848621, 0.98873453]),
'test_f1_weighted': array([0.86839885, 0.8660162 , 0.86761877, 0.86894256, 0.86615081]),
'test_precision_weighted': array([0.86806885, 0.86578839, 0.86760746, 0.8685697 , 0.86597064]),
'test_recall_weighted': array([0.86961905, 0.86714286, 0.86819048, 0.87 , 0.86695238])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([1807.33623052, 1867.73326397, 1525.82269597, 1396.55309963,1488.07841372]), 'score_time':
array([215.91505957, 233.36999917, 195.4089942 , 200.88372612,b194.26213312]),
'test_accuracy': array([0.87457143, 0.8672381 , 0.87257143, 0.87438095, 0.87457143]),
'test_neg_log_loss': array([-0.34906405, -0.36193228, -0.35397589, -0.35401035, -0.35264719]),
'test_neg_mean_squared_error': array([-1.67190476, -1.72961905, -1.70019048, -1.67866667, -1.70980952]),
'test_roc_auc_ovr': array([0.98996723, 0.98912028, 0.98976768, 0.98934014, 0.98973955]),
'test_f1_weighted': array([0.87364695, 0.86608728, 0.87216753, 0.87342338, 0.8740762]),
'test_precision_weighted': array([0.87345168, 0.86596732, 0.87214639, 0.87306639, 0.87407694]),
'test_recall_weighted': array([0.87457143, 0.8672381 , 0.87257143, 0.87438095, 0.87457143])}

100% przykładów uczących podanych do klasyfikatorów

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([84.31182337, 41.57707858, 39.99521232, 40.09037495, 40.52187133]),
'score_time': array([96.89617443, 56.92793465, 57.37920856, 56.68667912, 57.90234208]),
'test_accuracy': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286]),
'test_neg_log_loss': array([-0.43518617, -0.44896716, -0.43659481, -0.44667309, -0.45587556]),
'test_neg_mean_squared_error': array([-2.15207143, -2.07292857, -1.97335714, -2.02228571, -2.14457143]),
'test_roc_auc_ovr': array([0.98494211, 0.98453555, 0.98471949, 0.98439707, 0.98370706]),
'test_f1_weighted': array([0.8391561 , 0.83337703, 0.84363625, 0.83927396, 0.83025872]),
'test_precision_weighted': array([0.83913872, 0.83298658, 0.84356639, 0.83908444, 0.8299967]),
'test_recall_weighted': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([360.26168919, 359.53345442, 370.93991184, 350.37274957, 406.04506087]),
'score_time': array([169.18066072, 165.01349115, 163.29849243, 175.5123682 , 177.11645555]),
'test_accuracy': array([0.867 , 0.85828571, 0.86785714, 0.86228571, 0.85578571]),
'test_neg_log_loss': array([-0.37458176, -0.38662288, -0.37690371, -0.38751696, -0.39584564]),
'test_neg_mean_squared_error': array([-1.80964286, -1.82535714, -1.76028571, -1.78785714, -1.88057143]),
'test_roc_auc_ovr': array([0.98839966, 0.98803457, 0.98807114, 0.98767671, 0.98709211])
'test_f1_weighted': array([0.86592419, 0.85763402, 0.86674151, 0.86152713, 0.85510894]),
'test_precision_weighted': array([0.86584839, 0.85747452, 0.8664719 , 0.86140608, 0.85495778]),
'test_recall_weighted': array([0.867 , 0.85828571, 0.86785714, 0.86228571, 0.85578571])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([1514.74044871, 1490.03760457, 1489.57918429, 1557.11085701, 1580.86998367]),
'score_time': array([300.04744554, 298.80243111, 300.57700396, 321.65545154, 306.73347664]),
'test_accuracy': array([0.87621429, 0.869 , 0.87614286, 0.87357143, 0.86457143])
'test_neg_log_loss': array([-0.34643838, -0.35749936, -0.35016429, -0.3578869 , -0.37156872]),
'test_neg_mean_squared_error': array([-1.67171429, -1.72214286, -1.67221429, -1.65978571, -1.78964286]),
'test_roc_auc_ovr': array([0.98989582, 0.98951393, 0.98949146, 0.98935415, 0.98848604]),
'test_f1_weighted': array([0.87533626, 0.86835481, 0.87530097, 0.87302834, 0.8640845]),
'test_precision_weighted': array([0.87525365, 0.8681826 , 0.87508912, 0.87299039, 0.86393884]),
'test_recall_weighted': array([0.87621429, 0.869 , 0.87614286, 0.87357143, 0.86457143])}

- zespół klasyfikatorów 25% cech

{'fit_time': array([2394.2928412 , 1960.99851084, 2471.14348221, 2081.36675572, 2105.00464439]),
 'score_time': array([280.95140767, 269.65448427, 290.43191671, 268.81477118, 273.1422286]),
'test_accuracy': array([0.84964286, 0.84171429, 0.85321429, 0.85421429, 0.8415   ]),
'test_neg_log_loss': array([-0.53515091, -0.52443103, -0.55339481, -0.516753 , -0.53514556]),
'test_neg_mean_squared_error': array([-2.00807143, -1.98685714, -1.99378571, -1.93942857, -2.08421429]),
'test_roc_auc_ovr': array([0.98554685, 0.9844101 , 0.9840532 , 0.98527447, 0.98432231]),
'test_f1_weighted': array([0.84723568, 0.84032391, 0.8513564 , 0.85238464, 0.84009398]),
'test_precision_weighted': array([0.84760981, 0.84005744, 0.85122244, 0.85240706, 0.83954669]),
'test_recall_weighted': array([0.84964286, 0.84171429, 0.85321429, 0.85421429, 0.8415   ])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([2142.20317793, 2244.65578413, 2453.77488136, 2172.01262736, 2166.03626943]),
'score_time': array([291.30873466, 294.23416042, 308.30326986, 289.80146146, 292.52090454]),
'test_accuracy': array([0.87235714, 0.86585714, 0.87242857, 0.8725   , 0.8605   ]),
'test_neg_log_loss': array([-0.36242727, -0.37406484, -0.37196683, -0.3672616 , -0.38742483]),
'test_neg_mean_squared_error': array([-1.71771429, -1.72378571, -1.74535714, -1.67721429, -1.89528571]),
'test_roc_auc_ovr': array([0.98949683, 0.98922866, 0.98897006, 0.98930304, 0.98799145]),
'test_f1_weighted': array([0.87094315, 0.86488645, 0.87129578, 0.87159843, 0.85986083]),
'test_precision_weighted': array([0.8709689 , 0.86455858, 0.8710122 , 0.87150367, 0.85963261]),
'test_recall_weighted': array([0.87235714, 0.86585714, 0.87242857, 0.8725   , 0.8605   ])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([2711.44500089, 2607.53262281, 2772.10728812, 2646.71011305, 2579.34009337]),
'score_time': array([339.0933516 , 335.56114912, 341.27255893, 335.52530169, 331.70359492]),
'test_accuracy': array([0.8785   , 0.87   , 0.87907143, 0.87578571, 0.866   ]),
'test_neg_log_loss': array([-0.33902438, -0.35276752, -0.34072237, -0.34939575, -0.36285993]),
'test_neg_mean_squared_error': array([-1.63835714, -1.68878571, -1.64507143, -1.64628571, -1.81264286]),
'test_roc_auc_ovr': array([0.99040597, 0.98983261, 0.99005958, 0.98987116, 0.98901895]),
'test_f1_weighted': array([0.87751414, 0.86934825, 0.87811709, 0.87516897, 0.86558132]),
'test_precision_weighted': array([0.87738762, 0.86913624, 0.87787283, 0.87506395, 0.86548127]),
'test_recall_weighted': array([0.8785   , 0.87   , 0.87907143, 0.87578571, 0.866   ])}

7)

- T1
{'fit_time': array([562.93116689, 562.83924198, 561.86122465, 558.63007069,
       557.33135796]), 'score_time': array([50.83319187, 51.06287003, 50.92495847, 50.41782594, 50.80374217]),
'test_accuracy': array([0.87188329, 0.88936057, 0.88193155, 0.83921465, 0.8410719]), 'test_neg_log_loss':
array([-0.42623447, -0.40478624, -0.40388631, -0.53291046, -0.51709512]), 'test_neg_mean_squared_error':
array([-6.81909814, -5.86256301, -5.16741841, -8.82674449, -9.32793845]), 'test_roc_auc_ovr': array([0.9933504 ,
0.9934361 , 0.99375567, 0.98848411, 0.98978386]), 'test_f1_weighted': array([0.87318645, 0.8891092 ,
0.88278395, 0.83897054, 0.84150245]), 'test_precision_weighted': array([0.8771908 , 0.89048686, 0.88506253,
0.84157337, 0.84512648]), 'test_recall_weighted': array([0.87188329, 0.88936057, 0.88193155, 0.83921465,
0.8410719])}

- T2
{'fit_time': array([349.97228909, 332.89484262, 332.94227552, 331.75345349,
       331.66004205]), 'score_time': array([40.90028977, 41.29549599, 41.03101397, 40.17039728, 40.43398356]),
'test_accuracy': array([0.83846154, 0.85062351, 0.85009286, 0.81905015, 0.81666224]), 'test_neg_log_loss':
array([-0.62555108, -0.62987654, -0.6286315 , -0.66268624, -0.68706849]), 'test_neg_mean_squared_error': array([
-7.9872679 , -7.75723003, -6.62642611, -10.20801274,
       -11.19899178]), 'test_roc_auc_ovr': array([0.9903969 , 0.9895292 , 0.98983432, 0.98681415, 0.98668778]),
'test_f1_weighted': array([0.83867623, 0.85029454, 0.85089911, 0.8190994 , 0.81751722]),
'test_precision_weighted': array([0.84271581, 0.85269431, 0.85598384, 0.82667508, 0.82855683]),
'test_recall_weighted': array([0.83846154, 0.85062351, 0.85009286, 0.81905015, 0.81666224])}

- T3
{'fit_time': array([160.55420876, 160.31492424, 159.88336587, 159.85737753,
       161.1360631]), 'score_time': array([28.85886645, 28.78711581, 29.04045343, 28.20144725, 28.12108278]),
'test_accuracy': array([0.74960212, 0.74980101, 0.75855665, 0.73494296, 0.75616875]), 'test_neg_log_loss':
array([-1.06782259, -1.08355699, -1.08235768, -1.08656571, -1.04117837]), 'test_neg_mean_squared_error':
array([-14.85251989, -15.80737596, -13.89519767, -18.45741576,

-15.74980101]), 'test_roc_auc_ovr': array([0.98045306, 0.97840346, 0.98050336, 0.97573777, 0.97877233]), 'test_f1_weighted': array([0.75122 , 0.752579 , 0.76120373, 0.74565294, 0.75955601]), 'test_precision_weighted': array([0.75937205, 0.76404097, 0.77575887, 0.77977702, 0.77843889]), 'test_recall_weighted': array([0.74960212, 0.74980101, 0.75855665, 0.73494296, 0.75616875])}

8)

T1

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([143.74664235, 143.4343214 , 142.68970346, 144.4288826 , 145.07612896]), 'score_time': array([79.37870693, 79.00381422, 78.88554025, 79.96405578, 79.68736148]), 'test_accuracy': array([0.74721485, 0.7484744 , 0.7460865 , 0.7129212 , 0.71477846]), 'test_neg_log_loss': array([-1.03030245, -1.00152858, -1.02694075, -1.01946636, -0.98732007]), 'test_neg_mean_squared_error': array([-13.12493369, -13.94375166, -14.71610507, -17.35261343, -16.24064739]), 'test_roc_auc_ovr': array([0.96907619, 0.97254683, 0.97261814, 0.96660486, 0.97042594]), 'test_f1_weighted': array([0.74962856, 0.74849211, 0.74763184, 0.71551568, 0.71743782]), 'test_precision_weighted': array([0.75651728, 0.75341645, 0.75364292, 0.72618261, 0.72899139]), 'test_recall_weighted': array([0.74721485, 0.7484744 , 0.7460865 , 0.7129212 , 0.71477846])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([552.34787416, 541.3920517 , 542.13603902, 542.2991457 , 541.66053224]), 'score_time': array([181.61350226, 183.52007818, 182.02906919, 180.00202489, 181.05537295]), 'test_accuracy': array([0.78249337, 0.77951711, 0.77500663, 0.72751393, 0.74316795]), 'test_neg_log_loss': array([-0.90358993, -0.92197339, -0.91951682, -0.94885831, -0.91105022]), 'test_neg_mean_squared_error': array([-13.90344828, -14.10665959, -12.78588485, -19.70655346, -16.65083577]), 'test_roc_auc_ovr': array([0.98358329, 0.98278093, 0.98308693, 0.97780141, 0.97878412]), 'test_f1_weighted': array([0.78781884, 0.78261763, 0.77589813, 0.73747437, 0.7471857]), 'test_precision_weighted': array([0.8123188 , 0.81028381, 0.7993413 , 0.77990371, 0.78239465]), 'test_recall_weighted': array([0.78249337, 0.77951711, 0.77500663, 0.72751393, 0.74316795])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([557.4581275 , 557.87601018, 557.11426044, 558.04654264, 558.00818896]), 'score_time': array([164.09793568, 159.56093526, 159.1605742 , 156.58893991, 157.1965394]), 'test_accuracy': array([0.64350133, 0.64022287, 0.65587689, 0.60811886, 0.58530114]), 'test_neg_log_loss': array([-1.54497817, -1.54879283, -1.53300453, -1.50880266, -1.52695008]), 'test_neg_mean_squared_error': array([-31.97639257, -28.93579199, -29.01724595, -33.5717697 , -39.46245689]), 'test_roc_auc_ovr': array([0.95203273, 0.95151557, 0.95487603, 0.95894532, 0.95687504]), 'test_f1_weighted': array([0.65978691, 0.65306382, 0.66221334, 0.63523244, 0.62949919]), 'test_precision_weighted': array([0.70726112, 0.69077771, 0.69182468, 0.72518419, 0.73321374]), 'test_recall_weighted': array([0.64350133, 0.64022287, 0.65587689, 0.60811886, 0.58530114])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([555.75384307, 559.56569028, 559.6182642 , 558.76342058, 559.1712389]), 'score_time': array([97.22147369, 96.8145082 , 96.0690465 , 94.39497876, 92.1265347]), 'test_accuracy': array([0.58302387, 0.60440435, 0.57946405, 0.49907137, 0.54656408]), 'test_neg_log_loss': array([-2.09836408, -2.02466279, -2.1420835 , -2.20278194, -2.09449683]), 'test_neg_mean_squared_error': array([-46.16604775, -44.03210401, -49.33271425, -63.2894667 , -54.99363226]), 'test_roc_auc_ovr': array([0.92454674, 0.93497974, 0.91770921, 0.93153972, 0.93208022]), 'test_f1_weighted': array([0.61046096, 0.63091561, 0.60634022, 0.5351385 , 0.58115379]), 'test_precision_weighted': array([0.70852733, 0.72774097, 0.70339212, 0.7148566 , 0.72475351]), 'test_recall_weighted': array([0.58302387, 0.60440435, 0.57946405, 0.49907137, 0.54656408])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([568.19140482, 586.37390924, 543.64614224, 547.91092396, 555.43582177]), 'score_time': array([119.62154579, 111.0768137 , 108.85527968, 109.19729185, 106.73456955]), 'test_accuracy': array([0.56233422, 0.53091006, 0.53011409, 0.57203502, 0.46670204]), 'test_neg_log_loss': array([-2.01439551, -2.10124608, -2.11982117, -1.94219811, -2.13217459]), 'test_neg_mean_squared_error': array([-47.75278515, -53.95622181, -54.98142743, -45.92730167, -63.83788803]), 'test_roc_auc_ovr': array([0.91404782, 0.9061534 , 0.89225259, 0.94186771, 0.91659064]), 'test_f1_weighted': array([0.59710848, 0.57174781, 0.55837735, 0.60626789, 0.52083042]), 'test_precision_weighted': array([0.68701621, 0.69149985, 0.6638014 , 0.71241671, 0.70157132]), 'test_recall_weighted': array([0.56233422, 0.53091006, 0.53011409, 0.57203502, 0.46670204])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([543.2848134 , 542.75682473, 545.0330205 , 543.90491152, 544.73181605]),
  'score_time': array([116.60086894, 114.68820333, 116.33433199, 115.2073648 , 109.53170824]),
  'test_accuracy': array([0.47427056, 0.4460069 , 0.46166092, 0.49986734, 0.46908994]),
  'test_neg_log_loss': array([-2.1958687 , -2.24638702, -2.24491859, -2.09166133, -2.16360361]),
  'test_neg_mean_squared_error': array([-60.82281167, -66.05253383, -62.43565933, -55.53356328, -60.0628814]),
  'test_roc_auc_ovr': array([0.87283345, 0.86794023, 0.86200725, 0.91351472, 0.90002562]),
  'test_f1_weighted': array([0.52055165, 0.49776334, 0.50178686, 0.54129777, 0.51213135]),
  'test_precision_weighted': array([0.65198465, 0.64723404, 0.64109106, 0.67440219, 0.65932564]),
  'test_recall_weighted': array([0.47427056, 0.4460069 , 0.46166092, 0.49986734, 0.46908994])}

T2

- zespół klasyfikatorów 10% przykładów uczących
  wyniki uzyskane w czasie T1 dla tego klasyfikatora

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([331.37923431, 332.66124415, 331.92640615, 331.51932669,
  331.31372976]), 'score_time': array([150.83965302, 150.49776673, 148.94946837, 148.34948683,
  149.22491384]), 'test_accuracy': array([0.7066313 , 0.70761475, 0.70602282, 0.64367206, 0.63438578]),
  'test_neg_log_loss': array([-1.27358719, -1.28382723, -1.28036336, -1.27947631, -1.29149313]),
  'test_neg_mean_squared_error': array([-21.37082228, -21.39957548, -20.86176705, -28.08384187,
  -30.21040064]), 'test_roc_auc_ovr': array([0.97558053, 0.97314962, 0.97516072, 0.96727272, 0.96794843]),
  'test_f1_weighted': array([0.71497346, 0.71586849, 0.70882662, 0.6768126 , 0.66548412]),
  'test_precision_weighted': array([0.76301142, 0.76476431, 0.75454763, 0.76746248, 0.76570663]),
  'test_recall_weighted': array([0.7066313 , 0.70761475, 0.70602282, 0.64367206, 0.63438578])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([341.79230094, 343.3571496 , 342.34976411, 341.98819757,
  341.85069942]), 'score_time': array([106.65240788, 105.72991347, 105.054847 , 102.85468841,
  99.70738578]), 'test_accuracy': array([0.50424403, 0.47731494, 0.4958875 , 0.5017246 , 0.44786415]),
  'test_neg_log_loss': array([-2.02426948, -2.06989556, -2.05990069, -1.9497137 , -2.01026221]),
  'test_neg_mean_squared_error': array([-53.10557029, -60.4555585 , -52.39771823, -49.18466437,
  -57.6274874]), 'test_roc_auc_ovr': array([0.89390592, 0.88854979, 0.88692634, 0.9273053 , 0.90996748]),
  'test_f1_weighted': array([0.53647367, 0.52604928, 0.52166639, 0.54521141, 0.49506146]),
  'test_precision_weighted': array([0.63707549, 0.65611734, 0.61412632, 0.66747681, 0.6350969]),
  'test_recall_weighted': array([0.50424403, 0.47731494, 0.4958875 , 0.5017246 , 0.44786415])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([335.63943529, 332.738415 , 339.48606753, 333.25363588, 333.44349122]),
  'score_time': array([66.02936602, 65.90219331, 66.77987671, 65.8019774 , 64.49197388]),
  'test_accuracy': array([0.44854111, 0.37171664, 0.41602547, 0.46404882, 0.43114885]),
  'test_neg_log_loss': array([-2.450547 , -2.50481542, -2.48972129, -2.42505484, -2.41978305]),
  'test_neg_mean_squared_error': array([-63.50503979, -76.17829663, -70.23268772, -63.31122314, -69.75457681]),
  'test_roc_auc_ovr': array([0.86284376, 0.84860148, 0.84037468, 0.89849713, 0.88779606]),
  'test_f1_weighted': array([0.48742804, 0.41699899, 0.46267296, 0.49553046, 0.4760672]),
  'test_precision_weighted': array([0.65158164, 0.66446863, 0.66066056, 0.68075653, 0.6807329]),
  'test_recall_weighted': array([0.44854111, 0.37171664, 0.41602547, 0.46404882, 0.43114885])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([326.70945597, 328.47471452, 326.34596229, 326.71032429, 327.04601884]),
  'score_time': array([70.79618835, 71.21680522, 71.14517403, 69.11581302, 65.8418386]),
  'test_accuracy': array([0.3867374 , 0.38710533, 0.40196339, 0.49217299, 0.47784558]),
  'test_neg_log_loss': array([-2.53810166, -2.47862545, -2.45818872, -2.34341286, -2.30864039]),
  'test_neg_mean_squared_error': array([-75.49363395, -75.53409392, -72.07031043, -55.28601751, -54.17458212]),
  'test_roc_auc_ovr': array([0.81146765, 0.83137794, 0.83139789, 0.88372071, 0.88146139]),
  'test_f1_weighted': array([0.43869523, 0.44499755, 0.45288991, 0.525556 , 0.51345627]),
  'test_precision_weighted': array([0.62449705, 0.62911972, 0.62526292, 0.65123637, 0.62964143]),
  'test_recall_weighted': array([0.3867374 , 0.38710533, 0.40196339, 0.49217299, 0.47784558])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([313.81512237, 315.01926184, 315.6699419 , 316.18299389, 313.71451807]),

'score_time': array([71.72010326, 71.46488166, 72.00461149, 68.82487416, 65.875911]),
'test_accuracy': array([0.33156499, 0.33351021, 0.32475458, 0.4234545 , 0.39877952]),
'test_neg_log_loss': array([-2.60271595, -2.58509251, -2.64581455, -2.43916448, -2.45705621]),
'test_neg_mean_squared_error': array([-80.46525199, -81.33297957, -83.05226851, -63.88511542, -65.80366145]),
'test_roc_auc_ovr': array([0.78987905, 0.79998341, 0.77094091, 0.85266154, 0.83826409]),
'test_f1_weighted': array([0.3775018 , 0.39111919, 0.37290265, 0.46704879, 0.43357864]),
'test_precision_weighted': array([0.56420576, 0.58946058, 0.56980663, 0.61955335, 0.58746608]),
'test_recall_weighted': array([0.33156499, 0.33351021, 0.32475458, 0.4234545 , 0.39877952])}

T3

- zespół klasyfikatorów 10% przykładów uczących
  Wyniki otrzymane dla tego klasyfikatora w czasie T1

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([170.76959729, 170.729491 , 170.73375201, 170.86403394,
  170.97561479]), 'score_time': array([94.92840934, 94.34453869, 94.43074822, 93.24886131, 91.80771637]),
  'test_accuracy': array([0.57559682, 0.56964712, 0.56991244, 0.50437782, 0.51074556]), 'test_neg_log_loss':
  array([-1.81902736, -1.8315846 , -1.81931019, -1.81184169, -1.81899491]), 'test_neg_mean_squared_error':
  array([-36.22811671, -38.88829928, -38.42876094, -46.78455824,
  -44.21278854]), 'test_roc_auc_ovr': array([0.92840088, 0.93501789, 0.9310363 , 0.94184957, 0.93880368]),
  'test_f1_weighted': array([0.58591736, 0.59282698, 0.5800717 , 0.54927694, 0.5518135]),
  'test_precision_weighted': array([0.65209905, 0.66981066, 0.6459285 , 0.69052462, 0.68374176]),
  'test_recall_weighted': array([0.57559682, 0.56964712, 0.56991244, 0.50437782, 0.51074556])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([163.48288536, 163.17852306, 162.81571603, 162.85702705,
  162.94164491]), 'score_time': array([52.49703074, 54.60026574, 55.01369143, 54.24818039, 51.63275695]),
  'test_accuracy': array([0.31485411, 0.30405943, 0.30379411, 0.37808437, 0.33536747]), 'test_neg_log_loss':
  array([-2.60395101, -2.62071942, -2.61853389, -2.46254405, -2.50721086]), 'test_neg_mean_squared_error':
  array([-78.4198939 , -80.33191828, -79.87768639, -63.48766251,
  -69.36747148]), 'test_roc_auc_ovr': array([0.77684977, 0.78127085, 0.78537512, 0.84619761, 0.82530602]),
  'test_f1_weighted': array([0.34993632, 0.35013506, 0.34015569, 0.41864387, 0.36073942]),
  'test_precision_weighted': array([0.53620605, 0.54795833, 0.53149469, 0.56951726, 0.51844868]),
  'test_recall_weighted': array([0.31485411, 0.30405943, 0.30379411, 0.37808437, 0.33536747])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([164.39329934, 162.27841687, 167.68766785, 165.13241696, 167.21511054]),
  'score_time': array([38.00784135, 37.08639002, 38.05272174, 36.68836689, 34.82594943]),
  'test_accuracy': array([0.33129973, 0.29211993, 0.29105864, 0.30405943, 0.37543115]),
  'test_neg_log_loss': array([-2.73221991, -2.76460477, -2.81760962, -2.77883778, -2.68310712]),
  'test_neg_mean_squared_error': array([-78.37453581, -81.47068188, -82.17723534, -72.67100027, -65.25364818]),
  'test_roc_auc_ovr': array([0.77903982, 0.7545565 , 0.73509122, 0.78493461, 0.81122771]),
  'test_f1_weighted': array([0.37550804, 0.33968268, 0.3307604 , 0.332058 , 0.40148497]),
  'test_precision_weighted': array([0.57764553, 0.58462264, 0.57491473, 0.52942048, 0.59195944]),
  'test_recall_weighted': array([0.33129973, 0.29211993, 0.29105864, 0.30405943, 0.37543115])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([144.9206686 , 166.44730639, 166.02456474, 165.11131692, 163.69526696]),
  'score_time': array([39.73367906, 39.67960811, 41.04520416, 38.35888076, 37.21409965]),
  'test_accuracy': array([0.29469496, 0.26956752, 0.26956752, 0.35791987, 0.36481825]),
  'test_neg_log_loss': array([-2.77523933, -2.77462647, -2.84233997, -2.69538992, -2.66544632]),
  'test_neg_mean_squared_error': array([-83.50026525, -87.75935261, -86.83841868, -64.85062351, -68.06155479]),
  'test_roc_auc_ovr': array([0.7398455 , 0.74526962, 0.70472902, 0.79057637, 0.79033756]),
  'test_f1_weighted': array([0.32864982, 0.31694594, 0.29976518, 0.38750127, 0.38391606]),
  'test_precision_weighted': array([0.54722527, 0.52857479, 0.52732321, 0.55805479, 0.52695154]),
  'test_recall_weighted': array([0.29469496, 0.26956752, 0.26956752, 0.35791987, 0.36481825])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([144.6208396 , 145.08518982, 145.80395412, 144.94858265, 144.84199882]), 'score_time':
  array([35.57569957, 36.61703134, 34.7765727 , 34.84597135, 31.93229795]), 'test_accuracy': array([0.20557029,
  0.21172725, 0.2194216 , 0.2799151 , 0.29981427]), 'test_neg_log_loss': array([-2.87825814, -2.88095561,
  -2.91086788, -2.78753094, -2.79013936]), 'test_neg_mean_squared_error': array([-81.30344828, -91.65348899,

-91.26850624, -68.51499071, -71.08224993]), 'test_roc_auc_ovr': array([0.69667086, 0.69754482, 0.67800833, 0.72023747, 0.73043098]), 'test_f1_weighted': array([0.24324792, 0.23637009, 0.2317789 , 0.3001158 , 0.30691546]), 'test_precision_weighted': array([0.48582467, 0.46314854, 0.4409292 , 0.48916202, 0.46735043]), 'test_recall_weighted': array([0.20557029, 0.21172725, 0.2194216 , 0.2799151 , 0.29981427])}

9)

- T1

{'fit_time': array([268.49231243, 270.47176385, 274.89406872, 282.98455596, 271.60984707]),
'score_time': array([32.86756682, 34.2289772 , 33.26482916, 36.63378453, 31.50107074]),
'test_accuracy': array([0.76364286, 0.76157143, 0.78378571, 0.73871429, 0.76592857]),
'test_neg_log_loss': array([-0.79471302, -0.836688 , -0.82049978, -0.89372988, -0.83243672]),
'test_neg_mean_squared_error': array([-3.38771429, -3.27492857, -3.165 , -3.61707143, -3.31528571]),
'test_roc_auc_ovr': array([0.96845503, 0.96680759, 0.96788232, 0.9684521 , 0.9693496]),
'test_f1_weighted': array([0.75952819, 0.76216814, 0.78354667, 0.72532567, 0.76561288]),
'test_precision_weighted': array([0.80279123, 0.79242146, 0.81372721, 0.79975356, 0.80461454]),
'test_recall_weighted': array([0.76364286, 0.76157143, 0.78378571, 0.73871429, 0.76592857])}

- T2

{'fit_time': array([169.78876853, 170.64779186, 170.36103034, 170.39319086, 169.5521059]),
'score_time': array([22.95931482, 22.83487535, 22.81313467, 22.78349543, 22.98829341]),
'test_accuracy': array([0.677 , 0.68321429, 0.63707143, 0.63164286, 0.70964286]),
'test_neg_log_loss': array([-1.08670584, -1.02812242, -1.13246654, -1.16859031, -1.0744041]),
'test_neg_mean_squared_error': array([-3.90014286, -3.71557143, -4.53885714, -4.02442857, -3.10528571]),
'test_roc_auc_ovr': array([0.9394987 , 0.94849325, 0.93504347, 0.93088563, 0.93814107]),
'test_f1_weighted': array([0.67837373, 0.68697439, 0.64258247, 0.62774827, 0.70924032]),
'test_precision_weighted': array([0.69171156, 0.70522007, 0.67686811, 0.65040435, 0.71485179]),
'test_recall_weighted': array([0.677 , 0.68321429, 0.63707143, 0.63164286, 0.70964286])}

- T3

{'fit_time': array([87.91286635, 88.58666968, 88.71988821, 88.33225298, 88.12497497]),
'score_time': array([12.3018477 , 12.46776652, 12.30523252, 12.27081656, 12.26265287]),
'test_accuracy': array([0.61464286, 0.59164286, 0.54007143, 0.57585714, 0.56771429]),
'test_neg_log_loss': array([-1.10343767, -1.27323033, -1.28397075, -1.1111919 , -1.13579455]),
'test_neg_mean_squared_error': array([-4.49442857, -4.36507143, -5.49335714, -4.46364286, -4.81364286]),
'test_roc_auc_ovr': array([0.93929826, 0.92563028, 0.92711858, 0.93997434, 0.9348088]),
'test_f1_weighted': array([0.60758766, 0.56649061, 0.53495911, 0.56497117, 0.54736532]),
'test_precision_weighted': array([0.61144946, 0.56724206, 0.54080434, 0.5945054 , 0.57911227]),
'test_recall_weighted': array([0.61464286, 0.59164286, 0.54007143, 0.57585714, 0.56771429])}

10)

T1

- zespół klasyfikatorów 10% przykładów uczących

{'fit_time': array([84.31182337, 41.57707858, 39.99521232, 40.09037495, 40.52187133]),
'score_time': array([96.89617443, 56.92793465, 57.37920856, 56.68667912, 57.90234208]),
'test_accuracy': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286]),
'test_neg_log_loss': array([-0.43518617, -0.44896716, -0.43659481, -0.44667309, -0.45587556]),
'test_neg_mean_squared_error': array([-2.15207143, -2.07292857, -1.97335714, -2.02228571, -2.14457143]),
'test_roc_auc_ovr': array([0.98494211, 0.98453555, 0.98471949, 0.98439707, 0.98370706]),
'test_f1_weighted': array([0.8391561 , 0.83337703, 0.84363625, 0.83927396, 0.83025872]),
'test_precision_weighted': array([0.83913872, 0.83298658, 0.84356639, 0.83908444, 0.8299967]),
'test_recall_weighted': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286])}

- zespół klasyfikatorów 35% przykładów uczących

{'fit_time': array([272.20656681, 272.8075633 , 301.00371122, 273.41464877, 270.1839304]),
'score_time': array([130.04804945, 136.5688436 , 129.10406375, 130.21395874, 126.81948853]),
'test_accuracy': array([0.69492857, 0.71714286, 0.72057143, 0.70221429, 0.69764286]),
'test_neg_log_loss': array([-0.73153558, -0.72855036, -0.69474643, -0.72889211, -0.69621021]),
'test_neg_mean_squared_error': array([-4.66171429, -3.73721429, -3.87871429, -4.4805 , -4.69692857]),
'test_roc_auc_ovr': array([0.97085696, 0.96877766, 0.97141086, 0.97214607, 0.97363734]),
'test_f1_weighted': array([0.66684237, 0.69666593, 0.70379803, 0.68220469, 0.68098542]),
'test_precision_weighted': array([0.80080046, 0.81082563, 0.80123557, 0.81184496, 0.80110919]),

'test_recall_weighted': array([0.69492857, 0.71714286, 0.72057143, 0.70221429, 0.69764286])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([279.00218487, 274.27297997, 272.11184263, 269.39266396, 268.51408267]),
  'score_time': array([60.85277581, 60.66021705, 59.99221563, 61.5861783 , 61.05079293]),
  'test_accuracy': array([0.55271429, 0.57828571, 0.53921429, 0.57228571, 0.5485]),
  'test_neg_log_loss': array([-1.24739813, -1.21778978, -1.27137555, -1.15264473, -1.23066381]),
  'test_neg_mean_squared_error': array([-5.75578571, -5.8255 , -5.83335714, -5.83028571, -6.7485]),
  'test_roc_auc_ovr': array([0.92090773, 0.92841288, 0.9198478 , 0.93292489, 0.92382675]),
  'test_f1_weighted': array([0.5501913 , 0.5687654 , 0.52360922, 0.5503146 , 0.52183911]),
  'test_precision_weighted': array([0.57353519, 0.58204052, 0.54820956, 0.57320188, 0.54034695]),
  'test_recall_weighted': array([0.55271429, 0.57828571, 0.53921429, 0.57228571, 0.5485])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([265.96350861, 266.65783262, 264.39328361, 261.26265049, 255.28132033]),
  'score_time': array([64.82917142, 68.22424054, 65.33852911, 65.99755692, 63.65140676]),
  'test_accuracy': array([0.31207143, 0.21092857, 0.26292857, 0.35364286, 0.29957143]),
  'test_neg_log_loss': array([-1.94160416, -2.06878118, -2.00303763, -1.89074224, -1.93251037]),
  'test_neg_mean_squared_error': array([-20.60542857, -22.31664286, -20.72635714, -16.45971429, -16.2455]),
  'test_roc_auc_ovr': array([0.84506382, 0.76765372, 0.83343897, 0.84421467, 0.83795812]),
  'test_f1_weighted': array([0.25817451, 0.15522835, 0.21411381, 0.3203743 , 0.25664232]),
  'test_precision_weighted': array([0.57190506, 0.49181366, 0.44279824, 0.47493635, 0.42628197]),
  'test_recall_weighted': array([0.31207143, 0.21092857, 0.26292857, 0.35364286, 0.29957143])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([277.88545871, 272.85462189, 271.8572371 , 269.76975107, 265.66976762]),
  'score_time': array([54.46540213, 55.07202053, 80.74313474, 59.2318666 , 55.4976337]),
  'test_accuracy': array([0.49492857, 0.50385714, 0.52314286, 0.51192857, 0.46842857]),
  'test_neg_log_loss': array([-1.53348639, -1.53948784, -1.47043889, -1.50447709, -1.52873079]),
  'test_neg_mean_squared_error': array([-10.33471429, -11.40121429, -8.95792857, -10.02414286, -10.54478571]),
  'test_roc_auc_ovr': array([0.91828632, 0.9090065 , 0.91733758, 0.91413551, 0.9077846]),
  'test_f1_weighted': array([0.48075827, 0.49734934, 0.51062444, 0.50629545, 0.4508824]),
  'test_precision_weighted': array([0.55795908, 0.60774645, 0.55956679, 0.57680614, 0.52480659]),
  'test_recall_weighted': array([0.49492857, 0.50385714, 0.52314286, 0.51192857, 0.46842857])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([273.32174778, 271.16651583, 273.85580778, 273.92159462, 270.96831465]),
  'score_time': array([45.28265023, 45.72998571, 46.74565887, 46.54114032, 46.86298275]),
  'test_accuracy': array([0.52378571, 0.49642857, 0.574 , 0.54971429, 0.55085714]),
  'test_neg_log_loss': array([-1.44575697, -1.4449028 , -1.33478778, -1.38130774, -1.41827536]),
  'test_neg_mean_squared_error': array([-8.4225 , -7.76142857, -7.38257143, -7.55757143, -8.09921429]),
  'test_roc_auc_ovr': array([0.91710446, 0.90759177, 0.93052242, 0.92412435, 0.91418887]),
  'test_f1_weighted': array([0.51690324, 0.48606984, 0.5660404 , 0.54168244, 0.54089977]),
  'test_precision_weighted': array([0.55839568, 0.55729187, 0.59377446, 0.57639462, 0.56293116]),
  'test_recall_weighted': array([0.52378571, 0.49642857, 0.574 , 0.54971429, 0.55085714])}

T2

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([84.31182337, 41.57707858, 39.99521232, 40.09037495, 40.52187133]),
  'score_time': array([96.89617443, 56.92793465, 57.37920856, 56.68667912, 57.90234208]),
  'test_accuracy': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286]),
  'test_neg_log_loss': array([-0.43518617, -0.44896716, -0.43659481, -0.44667309, -0.45587556]),
  'test_neg_mean_squared_error': array([-2.15207143, -2.07292857, -1.97335714, -2.02228571, -2.14457143]),
  'test_roc_auc_ovr': array([0.98494211, 0.98453555, 0.98471949, 0.98439707, 0.98370706]),
  'test_f1_weighted': array([0.8391561 , 0.83337703, 0.84363625, 0.83927396, 0.83025872]),
  'test_precision_weighted': array([0.83913872, 0.83298658, 0.84356639, 0.83908444, 0.8299967]),
  'test_recall_weighted': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([171.25957131, 167.23069859, 165.14174056, 163.58293629, 163.4891398]),
  'score_time': array([82.69252539, 85.02434945, 81.92288828, 80.1411829 , 83.26068544]),
  'test_accuracy': array([0.63907143, 0.61507143, 0.61442857, 0.61364286, 0.61492857]),

'test_neg_log_loss': array([-0.93658792, -1.0396887 , -0.98166522, -1.06591713, -1.05640836]),
'test_neg_mean_squared_error': array([-4.01264286, -3.8065 , -4.59385714, -4.62592857, -4.68785714]),
'test_roc_auc_ovr': array([0.95764981, 0.94423691, 0.95411729, 0.94365022, 0.94747456]),
'test_f1_weighted': array([0.62501887, 0.61381167, 0.61504007, 0.60866136, 0.61454495]),
'test_precision_weighted': array([0.70689379, 0.67438205, 0.69712075, 0.68619174, 0.71361828]),
'test_recall_weighted': array([0.63907143, 0.61507143, 0.61442857, 0.61364286, 0.61492857])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([167.97897172, 167.95495629, 168.66336131, 168.4537673 , 168.52511621]),
'score_time': array([40.83498216, 40.67140341, 41.19097114, 40.7477138 , 41.09799814]),
'test_accuracy': array([0.525 , 0.47642857, 0.49128571, 0.52278571, 0.51385714]),
'test_neg_log_loss': array([-1.33984928, -1.46743225, -1.37512639, -1.33583124, -1.35874479]),
'test_neg_mean_squared_error': array([-6.37135714, -8.80242857, -7.79328571, -7.09857143, -7.123]),
'test_roc_auc_ovr': array([0.92039049, 0.88552589, 0.9064088 , 0.91192555, 0.90119968]),
'test_f1_weighted': array([0.50031763, 0.47059719, 0.48385736, 0.49695447, 0.4981503]),
'test_precision_weighted': array([0.58274083, 0.53870349, 0.53314898, 0.52247604, 0.5365456]),
'test_recall_weighted': array([0.525 , 0.47642857, 0.49128571, 0.52278571, 0.51385714])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([165.6325357 , 164.51508284, 162.56578517, 162.96758914, 161.52698874]),
'score_time': array([46.35500693, 45.67637897, 45.67880726, 47.13040233, 44.58344316]),
'test_accuracy': array([0.2275 , 0.28564286, 0.30971429, 0.2315 , 0.3035]),
'test_neg_log_loss': array([-2.14310534, -2.06058168, -1.96417382, -2.15067018, -2.04924856]),
'test_neg_mean_squared_error': array([-23.62321429, -19.69271429, -18.2245 , -24.20471429, -17.22]),
'test_roc_auc_ovr': array([0.71841049, 0.8001375 , 0.81916642, 0.71612803, 0.80549721]),
'test_f1_weighted': array([0.18803853, 0.2568765 , 0.29148854, 0.20523895, 0.27213389]),
'test_precision_weighted': array([0.42837694, 0.44018942, 0.46379113, 0.44356723, 0.43278922]),
'test_recall_weighted': array([0.2275 , 0.28564286, 0.30971429, 0.2315 , 0.3035])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([161.27654696, 160.75344968, 161.34567857, 160.96548104, 161.19671416]),
'score_time': array([34.27233601, 32.95263433, 34.39874053, 33.71570063, 34.43368149]),
'test_accuracy': array([0.42264286, 0.49378571, 0.45978571, 0.52464286, 0.41421429]),
'test_neg_log_loss': array([-1.73169733, -1.64848449, -1.72606124, -1.66644639, -1.76431247]),
'test_neg_mean_squared_error': array([-14.83328571, -9.48028571, -12.67907143, -9.31078571, -14.41407143]),
'test_roc_auc_ovr': array([0.8680238 , 0.89165678, 0.87168552, 0.90624531, 0.85536688]),
'test_f1_weighted': array([0.4197386 , 0.47609794, 0.45735867, 0.50415674, 0.40078745]),
'test_precision_weighted': array([0.51460272, 0.57019784, 0.55577576, 0.58295985, 0.51722292]),
'test_recall_weighted': array([0.42264286, 0.49378571, 0.45978571, 0.52464286, 0.41421429])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([172.64684129, 169.97237182, 171.74696231, 169.80978394, 170.8199513]),
'score_time': array([24.77425051, 25.73271847, 26.45276165, 24.33645201, 26.15456057]),
'test_accuracy': array([0.41557143, 0.40085714, 0.38478571, 0.42492857, 0.45042857]),
'test_neg_log_loss': array([-1.71969 , -1.78580732, -1.79796292, -1.74872575, -1.75318983]),
'test_neg_mean_squared_error': array([-13.61785714, -14.20814286, -13.96821429, -12.83821429,
-13.89585714]),
'test_roc_auc_ovr': array([0.8674437 , 0.85326139, 0.86218945, 0.87298115, 0.87083457]),
'test_f1_weighted': array([0.40157312, 0.37942085, 0.35014852, 0.38429183, 0.42290584]),
'test_precision_weighted': array([0.5682469 , 0.55210136, 0.59483029, 0.57054368, 0.59093747]),
'test_recall_weighted': array([0.41557143, 0.40085714, 0.38478571, 0.42492857, 0.45042857])}

T3

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([84.31182337, 41.57707858, 39.99521232, 40.09037495, 40.52187133]),
'score_time': array([96.89617443, 56.92793465, 57.37920856, 56.68667912, 57.90234208]),
'test_accuracy': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286]),
'test_neg_log_loss': array([-0.43518617, -0.44896716, -0.43659481, -0.44667309, -0.45587556]),
'test_neg_mean_squared_error': array([-2.15207143, -2.07292857, -1.97335714, -2.02228571, -2.14457143]),
'test_roc_auc_ovr': array([0.98494211, 0.98453555, 0.98471949, 0.98439707, 0.98370706]),
'test_f1_weighted': array([0.8391561 , 0.83337703, 0.84363625, 0.83927396, 0.83025872]),

'test_precision_weighted': array([0.83913872, 0.83298658, 0.84356639, 0.83908444, 0.8299967]),
'test_recall_weighted': array([0.84071429, 0.83478571, 0.84542857, 0.84107143, 0.83164286])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([83.15531611, 83.90358305, 84.11916018, 84.99377131, 83.63079143]),
'score_time': array([46.45082307, 46.89669585, 45.71877241, 46.01510477, 46.73188281]),
'test_accuracy': array([0.5745 , 0.57264286, 0.61435714, 0.65035714, 0.54092857]),
'test_neg_log_loss': array([-1.12836647, -1.17872121, -1.09114444, -1.02428432, -1.17571353]),
'test_neg_mean_squared_error': array([-5.804 , -5.24514286, -4.34107143, -4.34192857, -5.13764286]),
'test_roc_auc_ovr': array([0.93659325, 0.93538302, 0.94217975, 0.95056589, 0.93448474]),
'test_f1_weighted': array([0.553685 , 0.56224468, 0.59892286, 0.64254125, 0.51605662]),
'test_precision_weighted': array([0.59309169, 0.5911449 , 0.61528258, 0.66604915, 0.56102059]),
'test_recall_weighted': array([0.5745 , 0.57264286, 0.61435714, 0.65035714, 0.54092857])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([80.41246128, 79.24889326, 79.92349625, 79.97187304, 79.83688998]),
'score_time': array([21.56283808, 20.69777656, 21.44565177, 21.18762422, 21.67076564]),
'test_accuracy': array([0.37642857, 0.34371429, 0.40857143, 0.42364286, 0.44592857]),
'test_neg_log_loss': array([-1.60958337, -1.69969677, -1.59288056, -1.55483473, -1.47080487]),
'test_neg_mean_squared_error': array([-10.82721429, -11.08342857, -9.40728571, -11.01492857, -8.81935714]),
'test_roc_auc_ovr': array([0.88238917, 0.84631275, 0.87818853, 0.87154743, 0.91117233]),
'test_f1_weighted': array([0.33454128, 0.31082798, 0.38547232, 0.40443118, 0.4458218]),
'test_precision_weighted': array([0.46939045, 0.40462287, 0.5041977 , 0.44760012, 0.54795977]),
'test_recall_weighted': array([0.37642857, 0.34371429, 0.40857143, 0.42364286, 0.44592857])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([88.28466296, 81.65510488, 80.80373263, 80.65896988, 80.52924061]),
'score_time': array([25.35922766, 25.53961873, 25.12945032, 25.54995346, 25.32177567]),
'test_accuracy': array([0.18771429, 0.26342857, 0.24678571, 0.24757143, 0.21042857]),
'test_neg_log_loss': array([-2.19027528, -2.14533155, -2.13428563, -2.19354463, -2.16679224]),
'test_neg_mean_squared_error': array([-16.72914286, -22.79985714, -17.81671429, -22.34085714,
-18.22685714]),
'test_roc_auc_ovr': array([0.6388361 , 0.72616958, 0.69476046, 0.7155396 , 0.71689516]),
'test_f1_weighted': array([0.18197434, 0.24892668, 0.24679065, 0.24254143, 0.20638936]),
'test_precision_weighted': array([0.31022523, 0.37675377, 0.33870295, 0.43676287, 0.33988329]),
'test_recall_weighted': array([0.18771429, 0.26342857, 0.24678571, 0.24757143, 0.21042857])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([84.78406477, 85.2114253 , 84.52296591, 85.14145398, 85.18974996]),
'score_time': array([20.00648618, 19.81563163, 19.56334424, 19.91039801, 19.85698318]),
'test_accuracy': array([0.41007143, 0.36985714, 0.46978571, 0.43271429, 0.40785714]),
'test_neg_log_loss': array([-1.8360594 , -1.91415748, -1.72030452, -1.83050794, -1.85369325]),
'test_neg_mean_squared_error': array([-14.05721429, -16.21614286, -12.49542857, -13.70535714, -13.9145]),
'test_roc_auc_ovr': array([0.84619769, 0.81956502, 0.88025529, 0.85719179, 0.82722386]),
'test_f1_weighted': array([0.40696028, 0.35560659, 0.45343374, 0.41044796, 0.38920592]),
'test_precision_weighted': array([0.4743215 , 0.508099 , 0.56248155, 0.50343365, 0.45044322]),
'test_recall_weighted': array([0.41007143, 0.36985714, 0.46978571, 0.43271429, 0.40785714])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([85.36399961, 85.32352495, 85.47160029, 85.20026016, 85.55496907]),
'score_time': array([13.97271538, 13.69775796, 13.81598949, 13.6288631 , 13.59755087]),
'test_accuracy': array([0.35992857, 0.37478571, 0.36828571, 0.43171429, 0.43057143]),
'test_neg_log_loss': array([-1.91410148, -1.8417944 , -1.89110759, -1.74065176, -1.76524238]),
'test_neg_mean_squared_error': array([-16.38735714, -15.83721429, -16.65371429, -13.9195 , -14.24221429]),
'test_roc_auc_ovr': array([0.84746911, 0.84917054, 0.84929931, 0.88103235, 0.86712117]),
'test_f1_weighted': array([0.34526788, 0.34949244, 0.34131278, 0.39863914, 0.38757032]),
'test_precision_weighted': array([0.56909061, 0.57195762, 0.58783102, 0.58259735, 0.53038963]),
'test_recall_weighted': array([0.35992857, 0.37478571, 0.36828571, 0.43171429, 0.43057143])}

11)

- 5% szum na wektorze danych:
{'fit_time': array([714.10467768, 699.99005127, 721.55515337, 778.71660495, 795.39420342]),

'score_time': array([58.76022601, 57.11110663, 56.64833307, 62.29998899, 64.55566335]),
'test_accuracy': array([0.87241379, 0.8861767 , 0.88644203, 0.83470417, 0.84080658]),
'test_neg_log_loss': array([-0.42142284, -0.406026 , -0.40029779, -0.5317129 , -0.51451489]),
'test_neg_mean_squared_error': array([-6.6602122 , -6.05041125, -5.09339347, -9.07747413, -9.524277]),
'test_roc_auc_ovr': array([0.99350554, 0.99331718, 0.99374273, 0.98850601, 0.9899363]),
'test_f1_weighted': array([0.87384865, 0.8860088 , 0.887088 , 0.83452864, 0.84088504]),
'test_precision_weighted': array([0.87823768, 0.88739488, 0.88941373, 0.83800338, 0.84422754]),
'test_recall_weighted': array([0.87241379, 0.8861767 , 0.88644203, 0.83470417, 0.84080658])}

- 10% szum na wektorze danych:
{'fit_time': array([692.99030781, 688.80696726, 677.90746284, 776.30322981, 697.78721881]),
'score_time': array([57.02524328, 56.87297487, 56.35742235, 59.8460443 , 56.14660645]),
'test_accuracy': array([0.87400531, 0.88431945, 0.88405413, 0.83682674, 0.83788803]),
'test_neg_log_loss': array([-0.42382627, -0.40908491, -0.40193279, -0.53880022, -0.51822831]),
'test_neg_mean_squared_error': array([-6.27108753, -6.11541523, -4.97930486, -9.01034757, -9.60838419]),
'test_roc_auc_ovr': array([0.99332031, 0.99322819, 0.9938003 , 0.98810666, 0.98983084]),
'test_f1_weighted': array([0.87531569, 0.88410447, 0.88469496, 0.83662988, 0.83793714]),
'test_precision_weighted': array([0.87911394, 0.88548665, 0.88704441, 0.83977702, 0.8411314]),
'test_recall_weighted': array([0.87400531, 0.88431945, 0.88405413, 0.83682674, 0.83788803])}

- 20% szum na wektorze danych:
{'fit_time': array([798.9847033 , 722.19495916, 718.2690506 , 711.63825989, 713.01748633]),
'score_time': array([63.74908185, 58.36801839, 59.3613236 , 57.68580127, 58.12409878]),
'test_accuracy': array([0.86472149, 0.88166622, 0.88219687, 0.82780578, 0.83443884]),
'test_neg_log_loss': array([-0.44079049, -0.42509446, -0.4189065 , -0.55859826, -0.53571499]),
'test_neg_mean_squared_error': array([-6.77267905, -6.24701512, -5.48368267, -9.51446007, -9.99681613]),
'test_roc_auc_ovr': array([0.99285752, 0.99282648, 0.99312087, 0.98753675, 0.98936894]),
'test_f1_weighted': array([0.86599734, 0.88148685, 0.88292083, 0.82726098, 0.83465237]),
'test_precision_weighted': array([0.87039809, 0.88314786, 0.88557681, 0.83139796, 0.8382006]),
'test_recall_weighted': array([0.86472149, 0.88166622, 0.88219687, 0.82780578, 0.83443884])}

- 40% szum na wektorze danych:
{'fit_time': array([804.94559169, 790.64058089, 798.30791259, 798.15249848, 1389.62684917]),
'score_time': array([62.31147027, 61.56646609, 62.91781831, 62.04366422, 63.17164683]),
'test_accuracy': array([0.85809019, 0.86866543, 0.86229769, 0.8137437 , 0.81427434]),
'test_neg_log_loss': array([-0.49747472, -0.48699676, -0.48513806, -0.62716035, -0.6086002]),
'test_neg_mean_squared_error': array([-7.07718833, -6.70628814, -5.87317591, -10.46192624, -10.55080923]),
'test_roc_auc_ovr': array([0.99073304, 0.99116845, 0.99118355, 0.98458992, 0.98639951]),
'test_f1_weighted': array([0.85891125, 0.86848158, 0.86247152, 0.81377194, 0.81434425]),
'test_precision_weighted': array([0.86281133, 0.86982341, 0.86513562, 0.81777216, 0.81792279]),
'test_recall_weighted': array([0.85809019, 0.86866543, 0.86229769, 0.8137437 , 0.81427434])}

12)

- 5% szum na etykietach:
{'fit_time': array([806.81425142, 772.13194489, 762.82271099, 752.83477163, 752.52486014]),
'score_time': array([59.92133784, 59.03220415, 58.88771701, 58.68690872, 58.65899467]),
'test_accuracy': array([0.82864721, 0.83523481, 0.838684 , 0.79198726, 0.79702839]),
'test_neg_log_loss': array([-0.77516345, -0.80088014, -0.76551566, -0.87139582, -0.86650792]),
'test_neg_mean_squared_error': array([-10.05676393, -9.96020164, -8.69249138, -12.32767312, -12.78376227]),
'test_roc_auc_ovr': array([0.93928688, 0.93279267, 0.94132188, 0.93661633, 0.94360486]),
'test_f1_weighted': array([0.82880489, 0.83422287, 0.83850507, 0.79075368, 0.79608673]),
'test_precision_weighted': array([0.83189081, 0.83472842, 0.84026157, 0.79356081, 0.79853303]),
'test_recall_weighted': array([0.82864721, 0.83523481, 0.838684 , 0.79198726, 0.79702839])}

- 10% szum na etykietach:
{'fit_time': array([913.66336584, 899.53108215, 932.34218025, 1016.64339685, 1022.58276606]),
'score_time': array([63.36781263, 64.28840947, 65.00089335, 67.42313433, 90.54450059]),
'test_accuracy': array([0.7872679 , 0.79251791, 0.79570178, 0.74555585, 0.75245423]),
'test_neg_log_loss': array([-1.0520629 , -1.06871916, -1.06845687, -1.17612468, -1.14553194]),
'test_neg_mean_squared_error': array([-11.95835544, -13.26558769, -11.55531971, -15.69381799, -14.89891218]),
'test_roc_auc_ovr': array([0.92878961, 0.91763105, 0.91854482, 0.91229377, 0.91831722]),
'test_f1_weighted': array([0.78614909, 0.79064177, 0.79485764, 0.74318309, 0.75066866]),

'test_precision_weighted': array([0.78866242, 0.79112859, 0.79669673, 0.74484976, 0.75239315]),
'test_recall_weighted': array([0.7872679 , 0.79251791, 0.79570178, 0.74555585, 0.75245423])}

- 20% szum na etykietach:
{'fit_time': array([1159.37425041, 1178.93766809, 1133.39814615, 1172.41257453, 1091.37064838]),
'score_time': array([79.6407733 , 70.66509104, 71.52881551, 68.11683297, 71.29851985]),
'test_accuracy': array([0.69575597, 0.69806315, 0.69249138, 0.66648979, 0.65773415]),
'test_neg_log_loss': array([-1.53486374, -1.55047927, -1.53824228, -1.57354929, -1.6081661]),
'test_neg_mean_squared_error': array([-20.50079576, -19.05041125, -19.91721942, -20.66569382, -22.72459538]),
'test_roc_auc_ovr': array([0.87067045, 0.86925172, 0.86949105, 0.87142391, 0.86701961]),
'test_f1_weighted': array([0.69257324, 0.69500228, 0.68940979, 0.66247837, 0.65419979]),
'test_precision_weighted': array([0.692072 , 0.69408023, 0.68961356, 0.66427754, 0.65340184]),
'test_recall_weighted': array([0.69575597, 0.69806315, 0.69249138, 0.66648979, 0.65773415])}

- 40% szum na etykietach:
{'fit_time': array([1244.50412655, 1570.05026317, 1476.82827353, 1522.17273259, 1421.41617584]),
'score_time': array([72.63192344, 82.25924134, 82.61139894, 88.18289876, 73.61998105]),
'test_accuracy': array([0.5   , 0.50464314, 0.4887238 , 0.49376492, 0.47545768]),
'test_neg_log_loss': array([-2.27421874, -2.24522513, -2.30234006, -2.23431492, -2.29031023]),
'test_neg_mean_squared_error': array([-34.75251989, -34.11488458, -34.23985142, -35.36004245, -34.06924914]),
'test_roc_auc_ovr': array([0.77234373, 0.77954066, 0.75769786, 0.7747673 , 0.76451044]),
'test_f1_weighted': array([0.49584589, 0.49774046, 0.48334969, 0.48867876, 0.46880907]),
'test_precision_weighted': array([0.49512082, 0.49420359, 0.48109027, 0.48748494, 0.46745597]),
'test_recall_weighted': array([0.5   , 0.50464314, 0.4887238 , 0.49376492, 0.47545768])}

13)

5% szum na wektorze danych

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([154.17217922, 150.05866861, 153.23058915, 151.83258295,
156.07881832]), 'score_time': array([84.33436298, 87.54580879, 84.91181469, 84.54791069, 82.25219893]),
'test_accuracy': array([0.74535809, 0.74767843, 0.74422924, 0.7105333 , 0.71477846]), 'test_neg_log_loss':
array([-1.03093654, -1.00874163, -1.02946624, -1.02003515, -0.98535182]), 'test_neg_mean_squared_error':
array([-13.14615385, -13.65640754, -15.24860706, -17.15388697,
-15.84505174]), 'test_roc_auc_ovr': array([0.96907094, 0.97211317, 0.97235117, 0.9662398 , 0.97053474]),
'test_f1_weighted': array([0.74770109, 0.74781188, 0.74619186, 0.71335642, 0.7177339]),
'test_precision_weighted': array([0.75464193, 0.75303739, 0.75324298, 0.72433503, 0.72822271]),
'test_recall_weighted': array([0.74535809, 0.74767843, 0.74422924, 0.7105333 , 0.71477846])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([1257.66017866, 1234.03320789, 1240.05512547, 1274.67126441,
1272.04563308]), 'score_time': array([242.19577718, 239.53850675, 240.33082843, 241.37191796,
241.52037406]), 'test_accuracy': array([0.83236074, 0.83762271, 0.84292916, 0.79968161, 0.80286548]),
'test_neg_log_loss': array([-0.60370979, -0.59691848, -0.58650801, -0.67555496, -0.67221652]),
'test_neg_mean_squared_error': array([-8.67984085, -8.68479703, -7.31838684, -12.82700982,
-10.95171133]), 'test_roc_auc_ovr': array([0.98849713, 0.98776332, 0.98849033, 0.98286824, 0.98369101]),
'test_f1_weighted': array([0.83389332, 0.83767082, 0.84344834, 0.80034868, 0.80308745]),
'test_precision_weighted': array([0.83856941, 0.83871851, 0.84499442, 0.80429732, 0.8059247]),
'test_recall_weighted': array([0.83236074, 0.83762271, 0.84292916, 0.79968161, 0.80286548])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([3723.9217782 , 3736.63300037, 3749.52140594, 3745.84755063,
3771.90114355]), 'score_time': array([424.25946569, 423.126019 , 423.18175101, 420.43654037,
424.52818537]), 'test_accuracy': array([0.86392573, 0.8742372 , 0.87476784, 0.82647917, 0.83550013]),
'test_neg_log_loss': array([-0.47101477, -0.45918007, -0.44841884, -0.57402647, -0.55678746]),
'test_neg_mean_squared_error': array([-6.92466844, -6.66755107, -5.89811621, -10.84558238,
-9.86813478]), 'test_roc_auc_ovr': array([0.99222946, 0.99206042, 0.99247653, 0.98678805, 0.9883045]),
'test_f1_weighted': array([0.86455896, 0.87362217, 0.87503484, 0.82683029, 0.83576424]),
'test_precision_weighted': array([0.86651571, 0.87423048, 0.87593225, 0.82836935, 0.83740296]),
'test_recall_weighted': array([0.86392573, 0.8742372 , 0.87476784, 0.82647917, 0.83550013])}

- zespół klasyfikatorów 25% cech

{'fit_time': array([2402.52454042, 2207.54183578, 2201.43411326, 2251.81046581,
2414.07797265]), 'score_time': array([191.59526038, 185.6243856 , 188.20949769, 190.3480444 ,
191.82433271]), 'test_accuracy': array([0.86339523, 0.87025736, 0.86495092, 0.81719289, 0.82382595]),
'test_neg_log_loss': array([-0.72598009, -0.65730393, -0.73431914, -0.82580419, -0.79745706]),
'test_neg_mean_squared_error': array([-7.21193634, -6.0557177 , -6.86442027, -10.47758026,
-10.42186256]), 'test_roc_auc_ovr': array([0.98987577, 0.99096931, 0.9890546 , 0.982729 , 0.98518039]),
'test_f1_weighted': array([0.86397244, 0.86950263, 0.86525012, 0.81717959, 0.82408045]),
'test_precision_weighted': array([0.86655682, 0.87074841, 0.86841497, 0.82014942, 0.82750113]),
'test_recall_weighted': array([0.86339523, 0.87025736, 0.86495092, 0.81719289, 0.82382595])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([3671.98287511, 3886.76133585, 3967.413908 , 3669.68683338,
4005.50819421]), 'score_time': array([312.06331539, 315.37220383, 318.80692887, 311.09884524,
321.4195478]), 'test_accuracy': array([0.87533156, 0.88246219, 0.88829928, 0.83231626, 0.84372513]),
'test_neg_log_loss': array([-0.48397705, -0.48785698, -0.47412544, -0.59993177, -0.59432119]),
'test_neg_mean_squared_error': array([-6.87453581, -6.0734943 , -5.25630141, -9.75112762, -9.37145131]),
'test_roc_auc_ovr': array([0.99298282, 0.99261861, 0.99372709, 0.98751003, 0.98843869]), 'test_f1_weighted':
array([0.87583426, 0.88178461, 0.8885128 , 0.83179877, 0.84339487]), 'test_precision_weighted': array([0.8778509
, 0.88282337, 0.88939499, 0.83307876, 0.84448064]), 'test_recall_weighted': array([0.87533156, 0.88246219,
0.88829928, 0.83231626, 0.84372513])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([5115.60392451, 5136.16936398, 5016.35994744, 5340.06014729,
5407.03906083]), 'score_time': array([435.35699534, 435.23274755, 431.87063074, 441.40927482,
434.34838152]), 'test_accuracy': array([0.87745358, 0.88564606, 0.88538074, 0.83523481, 0.84611303]),
'test_neg_log_loss': array([-0.43415404, -0.42621478, -0.41833587, -0.54902137, -0.52848181]),
'test_neg_mean_squared_error': array([-6.51511936, -6.01326612, -5.73706553, -9.51870523, -8.93075086]),
'test_roc_auc_ovr': array([0.99352986, 0.99342062, 0.99353632, 0.98799967, 0.98962627]), 'test_f1_weighted':
array([0.8779943 , 0.88501469, 0.88583851, 0.83518191, 0.84588977]), 'test_precision_weighted':
array([0.87981418, 0.88573473, 0.88714644, 0.83637649, 0.84698654]), 'test_recall_weighted': array([0.87745358,
0.88564606, 0.88538074, 0.83523481, 0.84611303])}

10% szum na wektorze danych

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([144.31267309, 144.21645117, 143.68274546, 145.08099914,
145.50137544]), 'score_time': array([79.8195765 , 79.32898927, 79.48854518, 79.90747547, 79.68184161]),
'test_accuracy': array([0.74403183, 0.75033165, 0.74449456, 0.71212523, 0.71477846]), 'test_neg_log_loss':
array([-1.03523963, -1.0090973 , -1.03310516, -1.0253377 , -0.99033755]), 'test_neg_mean_squared_error':
array([-13.34297082, -13.89519767, -14.89387105, -17.1435394 ,
-15.58768904]), 'test_roc_auc_ovr': array([0.96845737, 0.97196742, 0.97235928, 0.9661439 , 0.97042546]),
'test_f1_weighted': array([0.74608469, 0.75027239, 0.74612315, 0.7136134 , 0.71735984]),
'test_precision_weighted': array([0.75283054, 0.75531436, 0.75255818, 0.7224942 , 0.72707058]),
'test_recall_weighted': array([0.74403183, 0.75033165, 0.74449456, 0.71212523, 0.71477846])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([1252.06844974, 1238.51931286, 1248.6714015 , 1289.36426592,
1291.03914022]), 'score_time': array([241.69937277, 239.95767665, 240.83180237, 241.72777629,
241.33973217]), 'test_accuracy': array([0.83156499, 0.83496949, 0.84054126, 0.79782436, 0.80153887]),
'test_neg_log_loss': array([-0.61115437, -0.60158744, -0.59269965, -0.68161777, -0.67564294]),
'test_neg_mean_squared_error': array([-9.04986737, -9.17511276, -7.10719024, -12.54842133,
-11.47917219]), 'test_roc_auc_ovr': array([0.98815346, 0.98765992, 0.98833784, 0.98259519, 0.98360913]),
'test_f1_weighted': array([0.83292995, 0.8349248 , 0.84122551, 0.79859144, 0.80181184]),
'test_precision_weighted': array([0.83718169, 0.83582084, 0.84279072, 0.80206947, 0.8042511]),
'test_recall_weighted': array([0.83156499, 0.83496949, 0.84054126, 0.79782436, 0.80153887])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([3757.29161954, 3782.29490685, 3779.4893837 , 3788.74973273,
3803.95630217]), 'score_time': array([426.52229667, 423.90548587, 423.94980145, 422.42169118,
425.14528346]), 'test_accuracy': array([0.86180371, 0.87609445, 0.87344123, 0.82064208, 0.83576546]),
'test_neg_log_loss': array([-0.47827653, -0.46497104, -0.45414353, -0.58254745, -0.56055555]),
'test_neg_mean_squared_error': array([-7.36047745, -6.54656408, -5.75643407, -11.01910321,

-9.84850093]), 'test_roc_auc_ovr': array([0.99190895, 0.99178555, 0.99228316, 0.98647148, 0.98816695]),
'test_f1_weighted': array([0.86253274, 0.87551028, 0.87370807, 0.82075706, 0.83607238]),
'test_precision_weighted': array([0.86452597, 0.87607756, 0.87464679, 0.82219326, 0.83746141]),
'test_recall_weighted': array([0.86180371, 0.87609445, 0.87344123, 0.82064208, 0.83576546])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([2190.41731381, 2789.97905612, 2215.39269423, 2163.12483358,
2247.47101498]), 'score_time': array([185.98359036, 188.51723886, 186.65708566, 185.49601769,
189.07675886]), 'test_accuracy': array([0.86206897, 0.86495092, 0.87025736, 0.81719289, 0.82674449]),
'test_neg_log_loss': array([-0.69851264, -0.68856221, -0.7029378 , -0.77838363, -0.81765113]),
'test_neg_mean_squared_error': array([-7.60689655, -6.53833908, -6.32608119, -10.26505704,
-10.05704431]), 'test_roc_auc_ovr': array([0.98966955, 0.99082477, 0.99048491, 0.98383667, 0.98516087]),
'test_f1_weighted': array([0.86230041, 0.86404418, 0.87063871, 0.81660714, 0.82624912]),
'test_precision_weighted': array([0.86424244, 0.86453404, 0.87301063, 0.81855143, 0.82891761]),
'test_recall_weighted': array([0.86206897, 0.86495092, 0.87025736, 0.81719289, 0.82674449])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([3887.04473448, 3979.57309031, 3839.72717118, 3762.76277852,
3931.58019376]), 'score_time': array([315.352211 , 317.44698024, 317.20530248, 313.24389148,
318.80638123]), 'test_accuracy': array([0.87427056, 0.88458477, 0.88458477, 0.8315203 , 0.84186787]),
'test_neg_log_loss': array([-0.49783675, -0.49412846, -0.48165129, -0.61265261, -0.57796264]),
'test_neg_mean_squared_error': array([-7.04270557, -5.42504643, -5.10400637, -9.7224728 , -8.83921465]),
'test_roc_auc_ovr': array([0.9925213 , 0.99250592, 0.99320857, 0.98667697, 0.98915912]), 'test_f1_weighted':
array([0.8749937 , 0.8840639 , 0.88483512, 0.83140918, 0.84108109]), 'test_precision_weighted':
array([0.87692341, 0.88463625, 0.88603959, 0.8327402 , 0.84182772]), 'test_recall_weighted': array([0.87427056,
0.88458477, 0.88458477, 0.8315203 , 0.84186787])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([5225.5091362 , 5437.13613319, 5360.36702347, 5503.38156438,
5232.76609731]), 'score_time': array([440.17045689, 441.52261329, 440.35918593, 441.12917733,
438.59052753]), 'test_accuracy': array([0.87904509, 0.88591138, 0.88644203, 0.83709207, 0.84850093]),
'test_neg_log_loss': array([-0.44465644, -0.43513147, -0.42410134, -0.55273076, -0.52780511]),
'test_neg_mean_squared_error': array([-6.39655172, -5.93340409, -5.34889891, -9.42027063, -8.85486867]),
'test_roc_auc_ovr': array([0.99310841, 0.99317983, 0.9935636 , 0.98789819, 0.98961526]), 'test_f1_weighted':
array([0.87967859, 0.88532455, 0.8868116 , 0.83690431, 0.84847583]), 'test_precision_weighted':
array([0.88165026, 0.88618648, 0.88792701, 0.83814968, 0.84959125]), 'test_recall_weighted': array([0.87904509,
0.88591138, 0.88644203, 0.83709207, 0.84850093])}

20% szum na wektorze danych

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([144.78130221, 144.43403316, 144.36266184, 145.74020052,
145.84427881]), 'score_time': array([80.09651423, 79.71949196, 79.72385836, 80.34153032, 80.14996696]),
'test_accuracy': array([0.74137931, 0.74210666, 0.73759618, 0.69540992, 0.70124702]), 'test_neg_log_loss':
array([-1.06592651, -1.03347226, -1.06055566, -1.06250447, -1.03239289]), 'test_neg_mean_squared_error':
array([-12.90742706, -14.28522154, -15.39135049, -17.37383921,
-17.20058371]), 'test_roc_auc_ovr': array([0.96548035, 0.970461 , 0.97157133, 0.96399423, 0.96727008]),
'test_f1_weighted': array([0.74342249, 0.74233632, 0.73914474, 0.69950342, 0.70453365]),
'test_precision_weighted': array([0.74978075, 0.74788318, 0.74602251, 0.71309102, 0.71693194]),
'test_recall_weighted': array([0.74137931, 0.74210666, 0.73759618, 0.69540992, 0.70124702])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([1284.28856063, 1287.4709177 , 1284.13022661, 1341.12376666,
1345.19236135]), 'score_time': array([243.84613466, 242.50124121, 243.4507854 , 245.74147773,
245.90927291]), 'test_accuracy': array([0.82679045, 0.83072433, 0.83576546, 0.78906872, 0.79384452]),
'test_neg_log_loss': array([-0.62710207, -0.61630632, -0.60380586, -0.70597132, -0.70126959]),
'test_neg_mean_squared_error': array([-9.48355438, -9.11461926, -7.61713982, -13.0201645 ,
-12.00849032]), 'test_roc_auc_ovr': array([0.98718705, 0.98689089, 0.98792447, 0.98124369, 0.98243423]),
'test_f1_weighted': array([0.82808211, 0.83037401, 0.83643704, 0.79044275, 0.79394654]),
'test_precision_weighted': array([0.83249148, 0.83129721, 0.83797882, 0.79484673, 0.79702917]),
'test_recall_weighted': array([0.82679045, 0.83072433, 0.83576546, 0.78906872, 0.79384452])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([3872.00635171, 3884.94728017, 3889.3459456 , 4101.66430306,
  3919.79562998]), 'score_time': array([433.50264835, 431.76427007, 432.96658254, 432.6580677 ,
  433.22025537]), 'test_accuracy': array([0.85941645, 0.86893075, 0.86919607, 0.81905015, 0.83019369]),
  'test_neg_log_loss': array([-0.49219678, -0.4780926 , -0.46757336, -0.59841675, -0.58091585]),
  'test_neg_mean_squared_error': array([-7.34403183, -6.77765986, -5.98912178, -10.97824357,
  -10.35287875]), 'test_roc_auc_ovr': array([0.99135528, 0.99147482, 0.99195254, 0.98573357, 0.98744921]),
  'test_f1_weighted': array([0.85991771, 0.86810799, 0.869369 , 0.81896322, 0.83031421]),
  'test_precision_weighted': array([0.86191761, 0.86841994, 0.87014916, 0.82021795, 0.83200897]),
  'test_recall_weighted': array([0.85941645, 0.86893075, 0.86919607, 0.81905015, 0.83019369])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([2276.40489554, 2312.86744857, 2290.26166344, 2288.80716443,
  2288.37163162]), 'score_time': array([190.15023446, 189.89534616, 189.11942863, 189.19446921,
  190.76364946]), 'test_accuracy': array([0.86312997, 0.86256301, 0.86707349, 0.81055983, 0.81692757]),
  'test_neg_log_loss': array([-0.74935053, -0.72940205, -0.71454136, -0.83064875, -0.85367946]),
  'test_neg_mean_squared_error': array([-7.60450928, -6.70761475, -6.40382064, -10.97850889,
  -10.57495357]), 'test_roc_auc_ovr': array([0.98875732, 0.99009549, 0.99069171, 0.98237671, 0.98340735]),
  'test_f1_weighted': array([0.86374224, 0.86179212, 0.86700264, 0.80979361, 0.81619583]),
  'test_precision_weighted': array([0.86651758, 0.86272863, 0.86891862, 0.81117828, 0.81944292]),
  'test_recall_weighted': array([0.86312997, 0.86256301, 0.86707349, 0.81055983, 0.81692757])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([3759.60306239, 4186.18649459, 4049.9468267 , 4061.79991341,
  3930.31182146]), 'score_time': array([318.26168299, 328.48977351, 324.20653319, 323.73130703,
  324.00506639]), 'test_accuracy': array([0.87108753, 0.87503317, 0.87848236, 0.82356063, 0.83735739]),
  'test_neg_log_loss': array([-0.52400111, -0.51665574, -0.51015171, -0.64966737, -0.602347]),
  'test_neg_mean_squared_error': array([-6.31830239, -6.5290528 , -5.93658795, -9.70496153, -9.26983285]),
  'test_roc_auc_ovr': array([0.99211193, 0.99232605, 0.99249713, 0.98528064, 0.9884824]), 'test_f1_weighted':
  array([0.87141164, 0.87419066, 0.87866587, 0.82278678, 0.83704018]), 'test_precision_weighted':
  array([0.87361458, 0.87439686, 0.87996699, 0.82389668, 0.83863772]), 'test_recall_weighted': array([0.87108753,
  0.87503317, 0.87848236, 0.82356063, 0.83735739])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([5330.764292 , 5281.3418982 , 5453.33337831, 5389.32220364,
  6096.57883668]), 'score_time': array([446.57297683, 445.74785852, 450.69730687, 447.64610124,
  489.8886447]), 'test_accuracy': array([0.8729443 , 0.87689042, 0.88113558, 0.83337755, 0.84266384]),
  'test_neg_log_loss': array([-0.46064062, -0.44985621, -0.43820101, -0.56954426, -0.54147344]),
  'test_neg_mean_squared_error': array([-6.84429708, -6.59697533, -5.26028124, -9.63120191, -9.43831255]),
  'test_roc_auc_ovr': array([0.99272034, 0.99271122, 0.99336339, 0.98721732, 0.98932792]), 'test_f1_weighted':
  array([0.87360079, 0.87612708, 0.88139456, 0.83316107, 0.84236143]), 'test_precision_weighted':
  array([0.87564959, 0.87667858, 0.88252323, 0.83434305, 0.84352204]), 'test_recall_weighted': array([0.8729443 ,
  0.87689042, 0.88113558, 0.83337755, 0.84266384])}

40% szum na wektorze danych

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([151.77259469, 157.23863006, 149.60978246, 149.95386791,
  161.13001037]), 'score_time': array([85.43307638, 86.97605586, 85.99227571, 86.95770073, 91.50636387]),
  'test_accuracy': array([0.71246684, 0.71822765, 0.70947201, 0.67577607, 0.67206155]), 'test_neg_log_loss':
  array([-1.16363772, -1.10689844, -1.14988487, -1.16219887, -1.12287933]), 'test_neg_mean_squared_error':
  array([-15.27851459, -16.04961528, -18.71371717, -18.59564871,
  -18.56805519]), 'test_roc_auc_ovr': array([0.96029134, 0.96668294, 0.9650497 , 0.95596214, 0.96025207]),
  'test_f1_weighted': array([0.71482256, 0.71812887, 0.7131621 , 0.68013736, 0.67691825]),
  'test_precision_weighted': array([0.72114138, 0.72350596, 0.72492918, 0.69174158, 0.69198594]),
  'test_recall_weighted': array([0.71246684, 0.71822765, 0.70947201, 0.67577607, 0.67206155])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([1641.44273043, 1718.46974969, 1472.13879156, 1448.70062947,
  1496.61953115]), 'score_time': array([293.14886475, 275.36277533, 250.72489977, 252.45433259,
  253.06104946]), 'test_accuracy': array([0.8127321 , 0.81692757, 0.82488724, 0.7710268 , 0.77553728]),
  'test_neg_log_loss': array([-0.68946807, -0.68265943, -0.67433647, -0.77968096, -0.77617027]),
  'test_neg_mean_squared_error': array([-10.46843501, -9.67232688, -8.9572831 , -14.31175378,

-12.04643141]), 'test_roc_auc_ovr': array([0.98461305, 0.98433688, 0.98476984, 0.9776198 , 0.97848259]), 'test_f1_weighted': array([0.81454 , 0.81671465, 0.82577155, 0.77266733, 0.77589447]), 'test_precision_weighted': array([0.81942297, 0.81728658, 0.82752182, 0.77702791, 0.77922738]), 'test_recall_weighted': array([0.8127321 , 0.81692757, 0.82488724, 0.7710268 , 0.77553728])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([4754.13093948, 4343.07299876, 4221.38828945, 4277.95838237, 4303.87766171]), 'score_time': array([501.75028634, 456.31798673, 454.77140641, 456.92040133, 459.5886271]), 'test_accuracy': array([0.84137931, 0.85195012, 0.86017511, 0.79676307, 0.80711064]), 'test_neg_log_loss': array([-0.55641008, -0.54709967, -0.5256149 , -0.67119989, -0.65484963]), 'test_neg_mean_squared_error': array([-9.15888594, -8.13823295, -6.79623242, -12.48686654, -11.6418148]), 'test_roc_auc_ovr': array([0.98904029, 0.98917666, 0.99016616, 0.98296026, 0.98423189]), 'test_f1_weighted': array([0.84208157, 0.85108148, 0.86040717, 0.79731334, 0.80726987]), 'test_precision_weighted': array([0.84379865, 0.85102208, 0.86160535, 0.79980474, 0.80919648]), 'test_recall_weighted': array([0.84137931, 0.85195012, 0.86017511, 0.79676307, 0.80711064])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([2600.77160215, 2531.09497333, 2682.15796685, 2506.54630566, 2474.66666698]), 'score_time': array([200.83801031, 202.93345404, 203.04444909, 200.46589804, 198.27422619]), 'test_accuracy': array([0.84615385, 0.84637835, 0.84850093, 0.78349695, 0.80260016]), 'test_neg_log_loss': array([-0.8741497 , -0.87764136, -0.90958936, -0.99232883, -0.90247515]), 'test_neg_mean_squared_error': array([-8.19522546, -8.16317326, -7.57521889, -11.83682674, -11.15945874]), 'test_roc_auc_ovr': array([0.98653291, 0.98618729, 0.98619222, 0.97789464, 0.9824186]), 'test_f1_weighted': array([0.84604056, 0.84538703, 0.8488024 , 0.78224568, 0.8017776]), 'test_precision_weighted': array([0.84706189, 0.8459865 , 0.85191267, 0.78546421, 0.8062739]), 'test_recall_weighted': array([0.84615385, 0.84637835, 0.84850093, 0.78349695, 0.80260016])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([4238.90240455, 4304.15989304, 4239.21653605, 4147.52989602, 4555.82554483]), 'score_time': array([339.72203875, 339.66929793, 338.87362742, 338.82052326, 341.08986115]), 'test_accuracy': array([0.85729443, 0.86521624, 0.86999204, 0.80551871, 0.81533563]), 'test_neg_log_loss': array([-0.6174621 , -0.60375556, -0.58495785, -0.71172145, -0.69013328]), 'test_neg_mean_squared_error': array([-7.91962865, -6.88485009, -6.09153622, -11.53250199, -10.9466702]), 'test_roc_auc_ovr': array([0.98968949, 0.99008431, 0.99132493, 0.98350336, 0.98498393]), 'test_f1_weighted': array([0.85757573, 0.86447648, 0.87000167, 0.80501763, 0.81476256]), 'test_precision_weighted': array([0.85870464, 0.86483084, 0.87104273, 0.80725124, 0.81666126]), 'test_recall_weighted': array([0.85729443, 0.86521624, 0.86999204, 0.80551871, 0.81533563])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([6075.33158469, 6016.73251224, 5931.01872444, 5922.29472375, 6058.08679771]), 'score_time': array([481.52587414, 477.89186764, 477.00712895, 478.6428237 , 481.05119061]), 'test_accuracy': array([0.85782493, 0.8660122 , 0.8718493 , 0.80604935, 0.81984611]), 'test_neg_log_loss': array([-0.53526882, -0.51838282, -0.50767695, -0.65088746, -0.62348119]), 'test_neg_mean_squared_error': array([-7.64933687, -7.28389493, -5.81188644, -12.19527726, -10.67471478]), 'test_roc_auc_ovr': array([0.99052626, 0.99071939, 0.99163279, 0.98460312, 0.98602143]), 'test_f1_weighted': array([0.85831121, 0.86517176, 0.87198258, 0.80579069, 0.81937599]), 'test_precision_weighted': array([0.85954015, 0.86539978, 0.87299116, 0.8076948 , 0.82080278]), 'test_recall_weighted': array([0.85782493, 0.8660122 , 0.8718493 , 0.80604935, 0.81984611])}

14)

5% szum na etykietach

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([147.3920486 , 145.00769901, 143.99762869, 149.63122702, 154.37247801]), 'score_time': array([80.12688184, 79.6095295 , 82.08589077, 80.63044739, 94.53331995]), 'test_accuracy': array([0.69708223, 0.71371717, 0.71000265, 0.66569382, 0.6821438]), 'test_neg_log_loss': array([-1.31655301, -1.25115119, -1.30059008, -1.27777832, -1.22312223]), 'test_neg_mean_squared_error': array([-16.8403183 , -15.20854338, -16.46059963, -19.75643407, -18.91085168]), 'test_roc_auc_ovr': array([0.93925082, 0.9462846 , 0.94184798, 0.93913961, 0.94616271]), 'test_f1_weighted': array([0.69827101, 0.71298166, 0.71034135, 0.66821722, 0.68428299]), 'test_precision_weighted': array([0.70417301, 0.71538463, 0.71374635, 0.67812542, 0.69424198]), 'test_recall_weighted': array([0.69708223, 0.71371717, 0.71000265, 0.66569382, 0.6821438])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([1306.8132813 , 1265.42759252, 1278.12685347, 1294.75572419,
  1297.61899185]), 'score_time': array([245.97686124, 243.65156913, 242.41935372, 244.07620525,
  244.60766053]), 'test_accuracy': array([0.78408488, 0.78827275, 0.78986469, 0.75882197, 0.76253648]),
  'test_neg_log_loss': array([-0.94273263, -0.92751853, -0.94806801, -0.99724525, -0.97509452]),
  'test_neg_mean_squared_error': array([-12.87400531, -11.75112762, -10.93764924, -15.31467233,
  -13.96922261]), 'test_roc_auc_ovr': array([0.96010053, 0.9603854 , 0.95840816, 0.95534952, 0.95875109]),
  'test_f1_weighted': array([0.78477431, 0.78744894, 0.79017875, 0.75944437, 0.76284208]),
  'test_precision_weighted': array([0.78828101, 0.78833553, 0.79249739, 0.76326562, 0.76660249]),
  'test_recall_weighted': array([0.78408488, 0.78827275, 0.78986469, 0.75882197, 0.76253648])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([4016.69452429, 4010.67513466, 4016.50594711, 4016.05088878,
  4055.68919349]), 'score_time': array([434.06287718, 433.96723914, 434.5279336 , 432.23394203,
  434.21637464]), 'test_accuracy': array([0.81909814, 0.82754046, 0.82700982, 0.78561953, 0.79304855]),
  'test_neg_log_loss': array([-0.83545135, -0.81501941, -0.83031826, -0.91822227, -0.8771909]),
  'test_neg_mean_squared_error': array([-10.13342175, -9.34359246, -8.75431149, -13.69408331,
  -12.86999204]), 'test_roc_auc_ovr': array([0.96398702, 0.96459931, 0.96256664, 0.95928002, 0.96385166]),
  'test_f1_weighted': array([0.81935031, 0.82642729, 0.82728867, 0.78542383, 0.79344283]),
  'test_precision_weighted': array([0.82134235, 0.82759341, 0.82887568, 0.78659047, 0.7959266]),
  'test_recall_weighted': array([0.81909814, 0.82754046, 0.82700982, 0.78561953, 0.79304855])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([2472.57892013, 2402.90915751, 2315.7508626 , 2347.97362995,
  2352.45372391]), 'score_time': array([190.20527649, 190.09657097, 185.80544662, 190.75335193,
  190.38378572]), 'test_accuracy': array([0.82068966, 0.82143805, 0.82515256, 0.76890422, 0.78270098]),
  'test_neg_log_loss': array([-1.00413688, -1.00514953, -0.96047806, -1.12564552, -1.05169757]),
  'test_neg_mean_squared_error': array([-10.60026525, -10.02175643, -9.62165031, -13.72724861,
  -12.77633324]), 'test_roc_auc_ovr': array([0.96176466, 0.96397188, 0.96228729, 0.95628769, 0.96077598]),
  'test_f1_weighted': array([0.82090312, 0.82033919, 0.82476082, 0.76801165, 0.7822217]),
  'test_precision_weighted': array([0.82246295, 0.82226472, 0.82668394, 0.77055055, 0.78623018]),
  'test_recall_weighted': array([0.82068966, 0.82143805, 0.82515256, 0.76890422, 0.78270098])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([4371.81589031, 4385.70851135, 3877.38749146, 4236.7240417 ,
  4125.54274368]), 'score_time': array([331.43236399, 330.61781383, 314.93180227, 322.7687366 ,
  321.11043811]), 'test_accuracy': array([0.83289125, 0.83470417, 0.8339082 , 0.7935792 , 0.80260016]),
  'test_neg_log_loss': array([-0.86725875, -0.8473991 , -0.8446426 , -0.9222723 , -0.89184342]),
  'test_neg_mean_squared_error': array([-9.34535809, -8.80870257, -8.57442292, -12.84982754,
  -11.76704696]), 'test_roc_auc_ovr': array([0.96470778, 0.96551079, 0.96289559, 0.96014296, 0.96449714]),
  'test_f1_weighted': array([0.83305788, 0.83396581, 0.83412445, 0.79350615, 0.80238659]),
  'test_precision_weighted': array([0.83455924, 0.83473639, 0.83657371, 0.79491464, 0.80489741]),
  'test_recall_weighted': array([0.83289125, 0.83470417, 0.8339082 , 0.7935792 , 0.80260016])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([5698.81972599, 5884.4567225 , 6125.28159952, 5823.06517267,
  5776.60185504]), 'score_time': array([452.07239723, 495.41415668, 456.08260536, 453.36809158,
  455.51222515]), 'test_accuracy': array([0.83129973, 0.83815336, 0.83470417, 0.79702839, 0.80684532]),
  'test_neg_log_loss': array([-0.80896658, -0.78806936, -0.80856616, -0.88948346, -0.8594212]),
  'test_neg_mean_squared_error': array([-9.06206897, -8.6524277 , -8.51419475, -12.89227912,
  -11.09976121]), 'test_roc_auc_ovr': array([0.96466648, 0.96629864, 0.963639 , 0.96059491, 0.96461173]),
  'test_f1_weighted': array([0.83145529, 0.83720286, 0.83478747, 0.79653611, 0.80640035]),
  'test_precision_weighted': array([0.83304537, 0.83854789, 0.83656054, 0.79736513, 0.80881002]),
  'test_recall_weighted': array([0.83129973, 0.83815336, 0.83470417, 0.79702839, 0.80684532])}

10% szum na etykietach

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([145.23566103, 145.41430879, 144.31302881, 145.83480978,
  146.28584337]), 'score_time': array([80.34066272, 80.05587006, 79.68137765, 80.37469339, 81.27898717]),
  'test_accuracy': array([0.65809019, 0.65879544, 0.64738657, 0.61873176, 0.62828336]), 'test_neg_log_loss':
  array([-1.49944885, -1.49141088, -1.53189905, -1.54091708, -1.48770493]), 'test_neg_mean_squared_error':
  array([-19.69124668, -20.45874237, -22.43990448, -23.28256832,

-22.25868931]), 'test_roc_auc_ovr': array([0.91774367, 0.92034867, 0.91865922, 0.90840614, 0.91644341]),
'test_f1_weighted': array([0.65976533, 0.65782309, 0.64839091, 0.62009931, 0.63117856]),
'test_precision_weighted': array([0.66691577, 0.66331038, 0.65710643, 0.63490928, 0.64382202]),
'test_recall_weighted': array([0.65809019, 0.65879544, 0.64738657, 0.61873176, 0.62828336])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([1330.38190031, 1333.58085394, 1333.75477266, 1357.00448012,
1360.31822872]), 'score_time': array([249.73740768, 247.81502867, 249.10569477, 249.52580404,
249.56090713]), 'test_accuracy': array([0.73925729, 0.74927036, 0.74316795, 0.69673653, 0.70681878]),
'test_neg_log_loss': array([-1.1822708 , -1.17720827, -1.19763579, -1.31485891, -1.25797144]),
'test_neg_mean_squared_error': array([-16.05649867, -15.0533298 , -14.49721412, -18.8837888 ,
-18.02706288]), 'test_roc_auc_ovr': array([0.9367224 , 0.93588695, 0.93637457, 0.92327563, 0.93118944]),
'test_f1_weighted': array([0.73951589, 0.74836356, 0.74353404, 0.69609531, 0.70722927]),
'test_precision_weighted': array([0.74261814, 0.74997692, 0.7452328 , 0.69970509, 0.71106473]),
'test_recall_weighted': array([0.73925729, 0.74927036, 0.74316795, 0.69673653, 0.70681878])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([4410.54866695, 4424.3319664 , 4433.26335406, 4373.8935647 ,
4419.64900899]), 'score_time': array([450.33713388, 450.80085683, 452.17055821, 447.11391926,
451.61216855]), 'test_accuracy': array([0.76737401, 0.7829663 , 0.77739453, 0.72486071, 0.73653489]),
'test_neg_log_loss': array([-1.08426351, -1.07855853, -1.08697185, -1.23341933, -1.16762884]),
'test_neg_mean_squared_error': array([-13.90397878, -12.73680021, -12.7758026 , -16.75112762,
-16.73971876]), 'test_roc_auc_ovr': array([0.94071118, 0.93921718, 0.94123734, 0.92818807, 0.93639411]),
'test_f1_weighted': array([0.76732225, 0.78186089, 0.7769845 , 0.72358054, 0.73656963]),
'test_precision_weighted': array([0.76978205, 0.78308023, 0.77798883, 0.72570159, 0.73895701]),
'test_recall_weighted': array([0.76737401, 0.7829663 , 0.77739453, 0.72486071, 0.73653489])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([2476.74277997, 2654.88554287, 2576.51068449, 2585.66794276,
2601.84307599]), 'score_time': array([191.27840281, 196.28116226, 195.15280557, 196.45232058,
196.67285275]), 'test_accuracy': array([0.77453581, 0.77686389, 0.78031308, 0.71239055, 0.73441231]),
'test_neg_log_loss': array([-1.23864436, -1.25529951, -1.25698892, -1.38449053, -1.30219753]),
'test_neg_mean_squared_error': array([-14.09575597, -13.28548687, -12.41655612, -17.56725922,
-16.95171133]), 'test_roc_auc_ovr': array([0.93930005, 0.93987811, 0.94001751, 0.92726927, 0.93583262]),
'test_f1_weighted': array([0.7742789 , 0.77591472, 0.78010623, 0.71069867, 0.73404903]),
'test_precision_weighted': array([0.77821258, 0.77781663, 0.78190174, 0.71441351, 0.73836498]),
'test_recall_weighted': array([0.77453581, 0.77686389, 0.78031308, 0.71239055, 0.73441231])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([4653.22140098, 4476.5926919 , 4587.05533099, 4499.70081139,
4637.06842899]), 'score_time': array([335.92143774, 332.81360936, 335.58371782, 332.94712138,
337.47496176]), 'test_accuracy': array([0.78037135, 0.78906872, 0.78615017, 0.73202441, 0.74794375]),
'test_neg_log_loss': array([-1.11186426, -1.10133025, -1.10412853, -1.23772095, -1.17725273]),
'test_neg_mean_squared_error': array([-13.34509284, -12.54842133, -12.282303 , -16.49907137,
-15.77739453]), 'test_roc_auc_ovr': array([0.94062509, 0.9406932 , 0.94178923, 0.92906682, 0.93596105]),
'test_f1_weighted': array([0.78048486, 0.7884564 , 0.78634281, 0.73085363, 0.74749657]),
'test_precision_weighted': array([0.78330802, 0.78966377, 0.78795441, 0.73342932, 0.75044887]),
'test_recall_weighted': array([0.78037135, 0.78906872, 0.78615017, 0.73202441, 0.74794375])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([6366.471174 , 6344.73523259, 6602.1999054 , 6388.5762136 ,
6481.70191026]), 'score_time': array([470.70466161, 469.85243034, 476.83791852, 470.37852025,
472.11167693]), 'test_accuracy': array([0.78275862, 0.79145662, 0.78986469, 0.73759618, 0.75059698]),
'test_neg_log_loss': array([-1.06407025, -1.05694887, -1.06402348, -1.20236855, -1.13562206]),
'test_neg_mean_squared_error': array([-13.57506631, -12.35871584, -11.97877421, -16.04643141,
-16.36322632]), 'test_roc_auc_ovr': array([0.94093295, 0.94112506, 0.94159439, 0.92933518, 0.93769253]),
'test_f1_weighted': array([0.78272308, 0.79058664, 0.79019342, 0.73636512, 0.75018257]),
'test_precision_weighted': array([0.78516799, 0.79178935, 0.79200152, 0.73846812, 0.75208249]),
'test_recall_weighted': array([0.78275862, 0.79145662, 0.78986469, 0.73759618, 0.75059698])}

20% szum na etykietach

- zespół klasyfikatorów 10% przykładów uczących
  {'fit_time': array([146.2017262 , 146.5606699 , 145.71020985, 147.68754864,
  147.45946264]), 'score_time': array([80.92160773, 81.06727099, 81.00210476, 81.22569489, 81.14382958]),
  'test_accuracy': array([0.55172414, 0.54603343, 0.55372778, 0.54099231, 0.54178827]), 'test_neg_log_loss':
  array([-1.93902927, -1.95744355, -1.94032656, -1.90897141, -1.8916886]), 'test_neg_mean_squared_error':
  array([-26.51299735, -29.68479703, -29.82382595, -28.95622181,
  -28.07402494]), 'test_roc_auc_ovr': array([0.85558291, 0.85489474, 0.86762687, 0.86075844, 0.86327307]),
  'test_f1_weighted': array([0.55170517, 0.54523684, 0.55639999, 0.5419406 , 0.5444859]),
  'test_precision_weighted': array([0.5602037 , 0.55246807, 0.56630596, 0.55171839, 0.55993493]),
  'test_recall_weighted': array([0.55172414, 0.54603343, 0.55372778, 0.54099231, 0.54178827])}

- zespół klasyfikatorów 35% przykładów uczących
  {'fit_time': array([1431.51008034, 1433.29543734, 1443.44066215, 1464.8341794 ,
  1457.06414795]), 'score_time': array([258.78914499, 256.10563993, 257.04602647, 259.33555794,
  258.79094291]), 'test_accuracy': array([0.64005305, 0.64154948, 0.64367206, 0.6298753 , 0.61767047]),
  'test_neg_log_loss': array([-1.6782734 , -1.68268021, -1.62911642, -1.64936661, -1.68019125]),
  'test_neg_mean_squared_error': array([-23.46949602, -22.21570708, -20.46272221, -24.12841603,
  -23.7781905]), 'test_roc_auc_ovr': array([0.87278625, 0.87565521, 0.88612335, 0.88015846, 0.87706967]),
  'test_f1_weighted': array([0.63999288, 0.64034036, 0.64351965, 0.62934481, 0.61780737]),
  'test_precision_weighted': array([0.64499213, 0.64228643, 0.64733945, 0.63143962, 0.62385845]),
  'test_recall_weighted': array([0.64005305, 0.64154948, 0.64367206, 0.6298753 , 0.61767047])}

- zespół klasyfikatorów 70% przykładów uczących
  {'fit_time': array([5042.14959764, 5036.34483671, 5075.37366533, 5335.5267818 ,
  5320.02227259]), 'score_time': array([478.38395262, 473.30460334, 477.02725792, 489.73596931,
  495.76548004]), 'test_accuracy': array([0.67082228, 0.67710268, 0.68453171, 0.65216238, 0.64659061]),
  'test_neg_log_loss': array([-1.5890457 , -1.57566754, -1.53128087, -1.5837803 , -1.61790755]),
  'test_neg_mean_squared_error': array([-20.93580902, -20.10984346, -18.46749801, -23.2194216 ,
  -22.21676837]), 'test_roc_auc_ovr': array([0.87920621, 0.88163198, 0.8907065 , 0.88496614, 0.88109248]),
  'test_f1_weighted': array([0.66994331, 0.67588263, 0.68436984, 0.65130583, 0.64598749]),
  'test_precision_weighted': array([0.67238616, 0.67763221, 0.68746949, 0.65299415, 0.64982002]),
  'test_recall_weighted': array([0.67082228, 0.67710268, 0.68453171, 0.65216238, 0.64659061])}

- zespół klasyfikatorów 25% cech
  {'fit_time': array([3374.57454038, 3387.59861231, 3762.05414677, 3595.49873996,
  3263.581954]), 'score_time': array([237.78318834, 212.52116108, 240.6933763 , 205.43444037,
  209.82250452]), 'test_accuracy': array([0.67506631, 0.68055187, 0.68426638, 0.64738657, 0.63783497]),
  'test_neg_log_loss': array([-1.72442914, -1.6977657 , -1.69429056, -1.74930893, -1.72976158]),
  'test_neg_mean_squared_error': array([-21.05994695, -19.64446803, -18.16423454, -23.18944017,
  -22.41178031]), 'test_roc_auc_ovr': array([0.87796549, 0.88332333, 0.88895266, 0.87892243, 0.87981681]),
  'test_f1_weighted': array([0.67413262, 0.67905927, 0.68478674, 0.6459544 , 0.63708421]),
  'test_precision_weighted': array([0.67711652, 0.68195507, 0.68978984, 0.64914173, 0.64164257]),
  'test_recall_weighted': array([0.67506631, 0.68055187, 0.68426638, 0.64738657, 0.63783497])}

- zespół klasyfikatorów 50% cech
  {'fit_time': array([5460.91206169, 5354.85587764, 5317.16684318, 5328.50972986,
  5371.01957965]), 'score_time': array([351.7596755 , 353.72902846, 354.1087997 , 357.97168803,
  357.24124098]), 'test_accuracy': array([0.68541114, 0.69169541, 0.69487928, 0.65879544, 0.65375431]),
  'test_neg_log_loss': array([-1.60043523, -1.59095432, -1.56541305, -1.5968352 , -1.61645689]),
  'test_neg_mean_squared_error': array([-20.60530504, -19.20084903, -17.32395861, -22.44388432,
  -21.51684797]), 'test_roc_auc_ovr': array([0.88077134, 0.88345739, 0.8893994 , 0.88456289, 0.8818723]),
  'test_f1_weighted': array([0.68458629, 0.69038351, 0.69517519, 0.65689293, 0.65322361]),
  'test_precision_weighted': array([0.68736898, 0.69255663, 0.69848796, 0.65848376, 0.65657561]),
  'test_recall_weighted': array([0.68541114, 0.69169541, 0.69487928, 0.65879544, 0.65375431])}

- zespół klasyfikatorów 75% cech
  {'fit_time': array([7551.94472098, 7443.72902513, 7390.33701324, 7478.15292716,
  7421.89090276]), 'score_time': array([502.07054543, 498.52443957, 500.75733495, 503.10337687,
  501.84055614]), 'test_accuracy': array([0.6862069 , 0.69328734, 0.69461396, 0.66383656, 0.65428496]),
  'test_neg_log_loss': array([-1.56218306, -1.54678722, -1.52019201, -1.5672194 , -1.59202679]),
  'test_neg_mean_squared_error': array([-20.47267905, -19.54046166, -17.55080923, -22.53117538,

-22.19235872]), 'test_roc_auc_ovr': array([0.88145259, 0.88459762, 0.88992603, 0.88566466, 0.88291005]),
'test_f1_weighted': array([0.68530681, 0.69213961, 0.69499391, 0.66273671, 0.65321526]),
'test_precision_weighted': array([0.68770591, 0.69434509, 0.69774894, 0.66432141, 0.65568618]),
'test_recall_weighted': array([0.6862069 , 0.69328734, 0.69461396, 0.66383656, 0.65428496])}

40% szum na etykietach

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([148.45590281, 148.10241199, 147.69073391, 149.08870769,
149.34623361]), 'score_time': array([81.74206185, 81.16076684, 81.03576756, 81.75452352, 81.81196594]),
'test_accuracy': array([0.36896552, 0.37277793, 0.39373839, 0.37118599, 0.38604404]), 'test_neg_log_loss':
array([-2.48038921, -2.49048042, -2.48602921, -2.46642726, -2.44031947]), 'test_neg_mean_squared_error':
array([-39.74854111, -40.4911117 , -39.20748209, -39.90130008,
-38.0581056]), 'test_roc_auc_ovr': array([0.75423857, 0.75494864, 0.75805243, 0.7534395 , 0.75872416]),
'test_f1_weighted': array([0.36955296, 0.37002099, 0.39282325, 0.37166737, 0.38647629]),
'test_precision_weighted': array([0.38262315, 0.37558405, 0.4063088 , 0.38992238, 0.39930549]),
'test_recall_weighted': array([0.36896552, 0.37277793, 0.39373839, 0.37118599, 0.38604404])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([1614.03037858, 1619.3231442 , 1772.12585592, 1634.8345387 ,
1653.14798617]), 'score_time': array([269.97479725, 270.31855321, 271.32790709, 270.90637183,
272.77972531]), 'test_accuracy': array([0.44509284, 0.44786415, 0.46006898, 0.44547625, 0.46113027]),
'test_neg_log_loss': array([-2.31845264, -2.32387836, -2.28826857, -2.29125873, -2.27560246]),
'test_neg_mean_squared_error': array([-36.53952255, -36.4507827 , -35.72273813, -35.4613956 ,
-35.6654285]), 'test_roc_auc_ovr': array([0.7699079 , 0.7713057 , 0.77671481, 0.77461312, 0.77744929]),
'test_f1_weighted': array([0.44485334, 0.44799017, 0.45908816, 0.4437266 , 0.45950744]),
'test_precision_weighted': array([0.44691523, 0.45014181, 0.46154712, 0.44724808, 0.46697996]),
'test_recall_weighted': array([0.44509284, 0.44786415, 0.46006898, 0.44547625, 0.46113027])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([6813.23192263, 6201.19724369, 6200.78530812, 6187.20400405,
6221.60724497]), 'score_time': array([518.99287033, 516.62730479, 518.26143956, 520.71870971,
518.77536559]), 'test_accuracy': array([0.47612732, 0.47413107, 0.4887238 , 0.46829398, 0.48182542]),
'test_neg_log_loss': array([-2.26653771, -2.26814716, -2.22658226, -2.26174909, -2.22657176]),
'test_neg_mean_squared_error': array([-33.59071618, -33.92677103, -33.54178827, -35.02281772,
-34.78827275]), 'test_roc_auc_ovr': array([0.77576315, 0.77680069, 0.78608765, 0.7764357 , 0.78123108]),
'test_f1_weighted': array([0.47571956, 0.47390109, 0.48693187, 0.46741745, 0.48093589]),
'test_precision_weighted': array([0.47769613, 0.47683201, 0.48906016, 0.47025034, 0.48615523]),
'test_recall_weighted': array([0.47612732, 0.47413107, 0.4887238 , 0.46829398, 0.48182542])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([3601.09884953, 3549.66617465, 3626.84223938, 3633.32772803,
3640.51345968]), 'score_time': array([214.03367615, 213.38255739, 214.25007391, 215.00730658,
214.32548428]), 'test_accuracy': array([0.4867374 , 0.48527461, 0.49747944, 0.46696737, 0.48421332]),
'test_neg_log_loss': array([-2.34730036, -2.35107302, -2.31148163, -2.34045473, -2.30005309]),
'test_neg_mean_squared_error': array([-31.50981432, -33.42929159, -32.83364288, -34.83576546,
-33.38445211]), 'test_roc_auc_ovr': array([0.77306187, 0.7783646 , 0.78551164, 0.77341785, 0.78230533]),
'test_f1_weighted': array([0.48520635, 0.48488734, 0.49432129, 0.46502978, 0.48201466]),
'test_precision_weighted': array([0.48656026, 0.49057116, 0.49821953, 0.47046908, 0.49078679]),
'test_recall_weighted': array([0.4867374 , 0.48527461, 0.49747944, 0.46696737, 0.48421332])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([6617.13513756, 6685.11248755, 6684.49221778, 6789.82782602,
6876.47963524]), 'score_time': array([382.86829853, 383.82791853, 383.85392904, 386.82769227,
388.94206977]), 'test_accuracy': array([0.49257294, 0.48580525, 0.50092863, 0.47731494, 0.48898912]),
'test_neg_log_loss': array([-2.27593197, -2.286658 , -2.24109859, -2.25975567, -2.23256166]),
'test_neg_mean_squared_error': array([-31.8938992 , -34.16264261, -33.13186522, -34.10851685,
-34.01857257]), 'test_roc_auc_ovr': array([0.77614027, 0.77870544, 0.78634073, 0.7778405 , 0.78324123]),
'test_f1_weighted': array([0.49190884, 0.48537646, 0.49865059, 0.47543143, 0.48767043]),
'test_precision_weighted': array([0.49340537, 0.48900796, 0.50120626, 0.47855022, 0.49260653]),
'test_recall_weighted': array([0.49257294, 0.48580525, 0.50092863, 0.47731494, 0.48898912])}

- zespół klasyfikatorów 75% cech

{'fit_time': array([10128.85174417, 9543.87325501, 9609.45988846, 9571.25013781,
9627.83750868]), 'score_time': array([551.92353749, 551.88203812, 555.23478842, 553.3357985 ,
556.50002742]), 'test_accuracy': array([0.49575597, 0.48792783, 0.50570443, 0.47758026, 0.49456089]),
'test_neg_log_loss': array([-2.25111493, -2.25555696, -2.21265132, -2.24386797, -2.20925954]),
'test_neg_mean_squared_error': array([-31.93660477, -33.65428496, -32.85566463, -33.99787742,
-34.12496683]), 'test_roc_auc_ovr': array([0.7773251 , 0.77951056, 0.78750232, 0.77846741, 0.78335091]),
'test_f1_weighted': array([0.49514558, 0.48751568, 0.5035485 , 0.47616066, 0.49325795]),
'test_precision_weighted': array([0.49688637, 0.4904099 , 0.50654681, 0.47942406, 0.49751168]),
'test_recall_weighted': array([0.49575597, 0.48792783, 0.50570443, 0.47758026, 0.49456089])}

15)

- 10% szum na wektorze danych
{'fit_time': array([335.16422462, 327.06516981, 327.03140759, 327.65036035, 325.87822318]),
'score_time': array([41.13129163, 40.84853911, 41.08278942, 41.08039474, 40.58161283]),
'test_accuracy': array([0.87592857, 0.87107143, 0.87628571, 0.87371429, 0.867   ]),
'test_neg_log_loss': array([-0.34485705, -0.35188502, -0.34818601, -0.35379565, -0.36417264]),
'test_neg_mean_squared_error': array([-1.66864286, -1.67485714, -1.65121429, -1.67535714, -1.78507143]),
'test_roc_auc_ovr': array([0.98990667, 0.98979006, 0.98962629, 0.98960522, 0.98889103]),
'test_f1_weighted': array([0.87489508, 0.87021102, 0.87544506, 0.87274027, 0.86646516]),
'test_precision_weighted': array([0.87491337, 0.87021307, 0.87546261, 0.87283533, 0.86646843]),
'test_recall_weighted': array([0.87592857, 0.87107143, 0.87628571, 0.87371429, 0.867   ])}

- 20% szum na wektorze danych
{'fit_time': array([345.03928828, 344.67758179, 344.3567071 , 345.24975395, 342.82800603]),
'score_time': array([42.65864778, 42.38686109, 42.64503908, 42.31086516, 42.11522484]),
'test_accuracy': array([0.87185714, 0.86285714, 0.87057143, 0.86792857, 0.85992857]),
'test_neg_log_loss': array([-0.3603318 , -0.37012867, -0.3649978 , -0.36843547, -0.3828367]),
'test_neg_mean_squared_error': array([-1.71535714, -1.73835714, -1.70692857, -1.73907143, -1.83435714]),
'test_roc_auc_ovr': array([0.98911201, 0.98886503, 0.98873276, 0.98883689, 0.98784963]), 'test_f1_weighted':
array([0.87053299, 0.86199541, 0.86944421, 0.86696653, 0.85901372]), 'test_precision_weighted':
array([0.87054765, 0.86198686, 0.86941165, 0.86714467, 0.858861]), 'test_recall_weighted': array([0.87185714,
0.86285714, 0.87057143, 0.86792857, 0.85992857])}

- 30% szum na wektorze danych
{'fit_time': array([372.36974359, 371.36241293, 370.95187378, 368.94956183, 369.40231299]),
'score_time': array([44.48581433, 44.08111858, 44.58479953, 44.77840471, 44.00182605]),
'test_accuracy': array([0.86457143, 0.86021429, 0.86092857, 0.85728571, 0.85207143]),
'test_neg_log_loss': array([-0.38182241, -0.38821311, -0.38762734, -0.39384457, -0.40349357]),
'test_neg_mean_squared_error': array([-1.77407143, -1.79471429, -1.80578571, -1.86585714, -1.93407143]),
'test_roc_auc_ovr': array([0.98785506, 0.98793874, 0.98750657, 0.98737113, 0.98655805]),
'test_f1_weighted': array([0.86316481, 0.85909549, 0.85981644, 0.85608729, 0.85118119]),
'test_precision_weighted': array([0.86325331, 0.85898179, 0.85968767, 0.85619059, 0.85094219]),
'test_recall_weighted': array([0.86457143, 0.86021429, 0.86092857, 0.85728571, 0.85207143])}

16)

- 1% szum na etykietach
{'fit_time': array([393.26598954, 376.98522735, 384.51294541, 380.0687263, 379.72522259]),
'score_time': array([42.84672785, 42.49582314, 43.07048035, 42.75769901, 42.12421131]),
'test_accuracy': array([0.87007143, 0.86471429, 0.87021429, 0.86857143, 0.8595   ]),
'test_neg_log_loss': array([-0.4046705 , -0.42009579, -0.40487572, -0.40245594, -0.42887531]),
'test_neg_mean_squared_error': array([-1.80207143, -1.85578571, -1.79414286, -1.81592857, -1.90407143]),
'test_roc_auc_ovr': array([0.98470255, 0.98393199, 0.98479985, 0.98538935, 0.98318603]),
'test_f1_weighted': array([0.86919249, 0.86405304, 0.86938946, 0.86765874, 0.85896966]),
'test_precision_weighted': array([0.86928712, 0.86403236, 0.86949141, 0.86770046, 0.8590704]),
'test_recall_weighted': array([0.87007143, 0.86471429, 0.87021429, 0.86857143, 0.8595   ])}

- 5% szum na etykietach
{'fit_time': array([589.17062116, 590.23982215, 591.92367911, 587.76865768, 585.31568623]),
'score_time': array([49.72314978, 49.67547822, 49.93818092, 49.86061907, 49.63304615]),
'test_accuracy': array([0.83478571, 0.82971429, 0.83457143, 0.83171429, 0.82328571]),

'test_neg_log_loss': array([-0.6122032 , -0.61948375, -0.61424582, -0.61661866, -0.63561723]),
'test_neg_mean_squared_error': array([-2.38342857, -2.42878571, -2.41264286, -2.51007143, -2.60278571]),
'test_roc_auc_ovr': array([0.9627477 , 0.96265285, 0.96247255, 0.96298872, 0.9605508]),
'test_f1_weighted': array([0.83392724, 0.82908706, 0.83370431, 0.83077161, 0.8228607]),
'test_precision_weighted': array([0.8341276 , 0.82934312, 0.83379453, 0.83112618, 0.82300239]),
'test_recall_weighted': array([0.83478571, 0.82971429, 0.83457143, 0.83171429, 0.82328571])}

- 10% szum na etykietach
{'fit_time': array([835.6336 , 837.93950105, 830.96957421, 836.08984542, 821.65746665]),
'score_time': array([57.51543164, 57.15382242, 57.28482008, 57.38514972, 56.94285727]),
'test_accuracy': array([0.79157143, 0.78628571, 0.78835714, 0.78564286, 0.7785]),
'test_neg_log_loss': array([-0.82968806, -0.82549404, -0.8396411 , -0.83657447, -0.85487056]),
'test_neg_mean_squared_error': array([-3.33942857, -3.28542857, -3.28235714, -3.25842857, -3.42771429]),
'test_roc_auc_ovr': array([0.93526798, 0.93669271, 0.93347764, 0.93506103, 0.9323556]),
'test_f1_weighted': array([0.79066956, 0.7857195 , 0.78736098, 0.78477468, 0.77777034]),
'test_precision_weighted': array([0.79075287, 0.78593669, 0.78738352, 0.78501129, 0.77771365]),
'test_recall_weighted': array([0.79157143, 0.78628571, 0.78835714, 0.78564286, 0.7785])}

17)

10% szum na wektorze danych

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([47.13355684, 41.3211596 , 40.28899074, 40.85308266, 40.49138474]),
'score_time': array([57.35100174, 56.90003872, 57.0849297 , 56.27276921, 57.60540533]),
'test_accuracy': array([0.83871429, 0.83428571, 0.84192857, 0.83907143, 0.82864286]),
'test_neg_log_loss': array([-0.44221281, -0.45527807, -0.44261212, -0.45291123, -0.46276772]),
'test_neg_mean_squared_error': array([-2.18692857, -2.05435714, -2.002 , -2.05428571, -2.17128571]),
'test_roc_auc_ovr': array([0.98450359, 0.98417258, 0.98444783, 0.98402373, 0.98332779]),
'test_f1_weighted': array([0.83725635, 0.83282733, 0.83973607, 0.83713447, 0.82726621]),
'test_precision_weighted': array([0.83727799, 0.83233749, 0.83977594, 0.83682986, 0.82700069]),
'test_recall_weighted': array([0.83871429, 0.83428571, 0.84192857, 0.83907143, 0.82864286])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([377.78099251, 366.9104805 , 364.55141234, 360.51012778, 362.62381554]),
'score_time': array([164.09388328, 163.5110507 , 163.55359364, 163.81594038, 164.19827461]),
'test_accuracy': array([0.86228571, 0.85685714, 0.86721429, 0.85978571, 0.85292857]),
'test_neg_log_loss': array([-0.3823573 , -0.39543771, -0.38371095, -0.39485175, -0.40380441]),
'test_neg_mean_squared_error': array([-1.84742857, -1.81107143, -1.80178571, -1.77964286, -1.89385714]),
'test_roc_auc_ovr': array([0.98801155, 0.9875994 , 0.98772628, 0.98733893, 0.98670559]),
'test_f1_weighted': array([0.86120981, 0.85597129, 0.86606273, 0.85883127, 0.85236133]),
'test_precision_weighted': array([0.8610384 , 0.85578741, 0.86577143, 0.8586306 , 0.85225986]),
'test_recall_weighted': array([0.86228571, 0.85685714, 0.86721429, 0.85978571, 0.85292857])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([1559.40965796, 1933.1947906 , 1504.8209219 , 1501.83586097, 1498.67614794]),
'score_time': array([320.23951459, 378.17787671, 300.8551836 , 341.96551108, 299.25167537]),
'test_accuracy': array([0.87228571, 0.867 , 0.87421429, 0.87021429, 0.86257143]),
'test_neg_log_loss': array([-0.3534922 , -0.36471127, -0.35767186, -0.36636627, -0.3770069]),
'test_neg_mean_squared_error': array([-1.72592857, -1.7085 , -1.69742857, -1.71942857, -1.82564286]),
'test_roc_auc_ovr': array([0.98963715, 0.98920647, 0.98911681, 0.98896895, 0.98824463]),
'test_f1_weighted': array([0.87141116, 0.86634587, 0.87342139, 0.86953486, 0.86211472]),
'test_precision_weighted': array([0.87129071, 0.86621706, 0.87317649, 0.86947487, 0.8619527]),
'test_recall_weighted': array([0.87228571, 0.867 , 0.87421429, 0.87021429, 0.86257143])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([2224.88082004, 2411.26909709, 2318.90694642, 2667.67379546, 2701.40760589]),
'score_time': array([291.40307093, 285.88985085, 298.39761138, 316.54938412, 313.79181266]),
'test_accuracy': array([0.84785714, 0.84657143, 0.84928571, 0.84478571, 0.83714286]),
'test_neg_log_loss': array([-0.54935384, -0.55447637, -0.53133302, -0.56762743, -0.57904344]),
'test_neg_mean_squared_error': array([-2.06614286, -2.00957143, -2.00557143, -2.0035 , -2.1485]),
'test_roc_auc_ovr': array([0.9851749 , 0.98522665, 0.98442883, 0.98403126, 0.98289052]),

'test_f1_weighted': array([0.84500057, 0.84426455, 0.84703719, 0.84272013, 0.83538715]),
'test_precision_weighted': array([0.84590954, 0.84446227, 0.84711437, 0.84317886, 0.83481534]),
'test_recall_weighted': array([0.84785714, 0.84657143, 0.84928571, 0.84478571, 0.83714286])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([2975.80960894, 3152.75505757, 2910.98499799, 3802.38732123, 2606.87851191]),
'score_time': array([327.09618974, 333.63248277, 321.89317203, 324.42201781, 311.07228875]),
'test_accuracy': array([0.86892857, 0.86657143, 0.87121429, 0.86785714, 0.85785714]),
'test_neg_log_loss': array([-0.37432753, -0.38174922, -0.37641573, -0.3784291 , -0.39057122]),
'test_neg_mean_squared_error': array([-1.75485714, -1.69435714, -1.73121429, -1.75685714, -1.89328571]),
'test_roc_auc_ovr': array([0.98912003, 0.98903913, 0.98870208, 0.98888368, 0.9879088]),
'test_f1_weighted': array([0.86755894, 0.86577285, 0.87001207, 0.86690629, 0.85711796]),
'test_precision_weighted': array([0.86750419, 0.86559614, 0.8698834 , 0.86675198, 0.85681376]),
'test_recall_weighted': array([0.86892857, 0.86657143, 0.87121429, 0.86785714, 0.85785714])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([2754.33858395, 2744.28709292, 2810.83081818, 2836.99801421, 2791.20371914]),
'score_time': array([341.12729573, 337.74954224, 341.37871718, 341.40826845, 337.92550397]),
'test_accuracy': array([0.87478571, 0.87214286, 0.87657143, 0.87378571, 0.86457143]),
'test_neg_log_loss': array([-0.34774628, -0.35658306, -0.35056932, -0.35552071, -0.36775756]),
'test_neg_mean_squared_error': array([-1.69285714, -1.6255 , -1.68921429, -1.66035714, -1.81557143]),
'test_roc_auc_ovr': array([0.99000252, 0.98971961, 0.98959341, 0.98962922, 0.98875628]),
'test_f1_weighted': array([0.87388861, 0.8714815 , 0.8755923 , 0.87302599, 0.86405803]),
'test_precision_weighted': array([0.87368197, 0.8714165 , 0.87529095, 0.87286079, 0.86385446]),
'test_recall_weighted': array([0.87478571, 0.87214286, 0.87657143, 0.87378571, 0.86457143])}

20% szum na wektorze danych

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([42.57459688, 42.95613885, 42.12666059, 41.51720381, 42.08967209]),
'score_time': array([58.66705489, 59.15396285, 58.69545984, 58.38977313, 59.05227304]),
'test_accuracy': array([0.83371429, 0.82857143, 0.83364286, 0.83278571, 0.824]),
'test_neg_log_loss': array([-0.46059187, -0.47111595, -0.46153468, -0.47090507, -0.47711852]),
'test_neg_mean_squared_error': array([-2.18985714, -2.11807143, -2.12178571, -2.12242857, -2.229]),
'test_roc_auc_ovr': array([0.98343274, 0.98326148, 0.98314873, 0.98285127, 0.98240329]),
'test_f1_weighted': array([0.83200139, 0.8270098 , 0.83190646, 0.83099403, 0.82249007]),
'test_precision_weighted': array([0.8318335 , 0.82645881, 0.83165103, 0.83062181, 0.82203131]),
'test_recall_weighted': array([0.83371429, 0.82857143, 0.83364286, 0.83278571, 0.824])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([375.51024508, 379.36230016, 378.31723046, 375.16669631, 388.30557013]),
'score_time': array([168.33769846, 168.0994904 , 168.58001113, 167.89229369, 169.41719294]),
'test_accuracy': array([0.85685714, 0.85292857, 0.85842857, 0.85442857, 0.84828571]),
'test_neg_log_loss': array([-0.40061671, -0.4083805 , -0.40090183, -0.40636287, -0.42060685]),
'test_neg_mean_squared_error': array([-1.88214286, -1.86657143, -1.86985714, -1.87942857, -1.9915]),
'test_roc_auc_ovr': array([0.98717198, 0.98695134, 0.98677637, 0.98660801, 0.98572204]),
'test_f1_weighted': array([0.85546441, 0.85178726, 0.85701756, 0.85327687, 0.84757197]),
'test_precision_weighted': array([0.85532634, 0.85146285, 0.85666704, 0.85302595, 0.84743357]),
'test_recall_weighted': array([0.85685714, 0.85292857, 0.85842857, 0.85442857, 0.84828571])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([1574.25407338, 1572.11833668, 1579.63655066, 1576.12028766, 573.34072804]),
'score_time': array([309.47152472, 308.31269431, 346.69503093, 309.63179255, 309.33290958]),
'test_accuracy': array([0.86614286, 0.862 , 0.86685714, 0.86564286, 0.85435714]),
'test_neg_log_loss': array([-0.37101798, -0.38060476, -0.37409721, -0.38099042, -0.39484221]),
'test_neg_mean_squared_error': array([-1.81742857, -1.7415 , -1.79871429, -1.75928571, -1.91571429]),
'test_roc_auc_ovr': array([0.98867908, 0.98838588, 0.9883187 , 0.98811519, 0.98712381]),
'test_f1_weighted': array([0.8651705 , 0.86123903, 0.86570184, 0.86492587, 0.85358261]),
'test_precision_weighted': array([0.86497683, 0.86102308, 0.86536616, 0.8648038 , 0.85324126]),
'test_recall_weighted': array([0.86614286, 0.862 , 0.86685714, 0.86564286, 0.85435714])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([2314.35103226, 2528.5440414 , 2481.47806668, 2735.04084086, 2241.40684724]),

'score_time': array([293.74522138, 298.05489731, 303.40855646, 313.27855754, 291.43501329]),
'test_accuracy': array([0.84257143, 0.83628571, 0.843 , 0.84021429, 0.82964286]),
'test_neg_log_loss': array([-0.56697267, -0.59669335, -0.58403108, -0.61637713, -0.58353882]),
'test_neg_mean_squared_error': array([-2.05864286, -2.12035714, -2.05192857, -2.12571429, -2.2305]),
'test_roc_auc_ovr': array([0.98403006, 0.98309564, 0.9837784 , 0.98252267, 0.98210851]),
'test_f1_weighted': array([0.83962872, 0.83395893, 0.84058374, 0.83854728, 0.82750096]),
'test_precision_weighted': array([0.84032273, 0.83397485, 0.84049538, 0.83839649, 0.82689142]),
'test_recall_weighted': array([0.84257143, 0.83628571, 0.843 , 0.84021429, 0.82964286])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([2449.06383133, 2714.39082479, 2426.28336358, 2421.42372942, 2653.66901302]),
'score_time': array([312.70195961, 327.19612384, 316.39450645, 317.94203401, 318.79683685]),
'test_accuracy': array([0.864 , 0.85907143, 0.86414286, 0.86142857, 0.85607143]),
'test_neg_log_loss': array([-0.38483655, -0.40624795, -0.39526215, -0.40303768, -0.40678339]),
'test_neg_mean_squared_error': array([-1.82642857, -1.83692857, -1.84771429, -1.83692857, -1.94935714]),
'test_roc_auc_ovr': array([0.98880637, 0.9881393 , 0.98796058, 0.9877812 , 0.98740941]),
'test_f1_weighted': array([0.86261984, 0.85815696, 0.86285125, 0.86031367, 0.85522885]),
'test_precision_weighted': array([0.86247068, 0.85795957, 0.86257403, 0.86033349, 0.85482821]),
'test_recall_weighted': array([0.864 , 0.85907143, 0.86414286, 0.86142857, 0.85607143])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([2957.80772328, 2938.78233671, 2903.90740061, 2997.13972831, 2927.24250507]),
'score_time': array([351.9783566 , 353.18498373, 352.72194934, 356.66883755, 351.74329829]),
'test_accuracy': array([0.86835714, 0.8625 , 0.86742857, 0.86507143, 0.85878571]),
'test_neg_log_loss': array([-0.36513517, -0.37443188, -0.36951617, -0.37993348, -0.38682079]),
'test_neg_mean_squared_error': array([-1.72714286, -1.766 , -1.75678571, -1.80471429, -1.87092857]),
'test_roc_auc_ovr': array([0.98907347, 0.98884846, 0.9885837 , 0.98831854, 0.98770008]),
'test_f1_weighted': array([0.86690595, 0.86186062, 0.86636321, 0.86429969, 0.858209]),
'test_precision_weighted': array([0.86677717, 0.86162982, 0.86612391, 0.86415501, 0.85798469]),
'test_recall_weighted': array([0.86835714, 0.8625 , 0.86742857, 0.86507143, 0.85878571])}

30% szum na wektorze danych

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([45.06176853, 45.17624426, 44.42271161, 43.85479617, 44.28486943]),
'score_time': array([60.78019452, 60.27192879, 60.55587602, 60.17775273, 61.14507699]),
'test_accuracy': array([0.826 , 0.81707143, 0.82814286, 0.82457143, 0.81735714]),
'test_neg_log_loss': array([-0.48616086, -0.50092153, -0.48684495, -0.49799366, -0.50214682]),
'test_neg_mean_squared_error': array([-2.26428571, -2.33757143, -2.15714286, -2.19742857, -2.296]),
'test_roc_auc_ovr': array([0.9817314 , 0.98130382, 0.98172077, 0.98116992, 0.98105968]),
'test_f1_weighted': array([0.82386141, 0.81519492, 0.82582112, 0.82217985, 0.81613775]),
'test_precision_weighted': array([0.82348506, 0.81448828, 0.82551953, 0.82165904, 0.81599093]),
'test_recall_weighted': array([0.826 , 0.81707143, 0.82814286, 0.82457143, 0.81735714])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([406.49887872, 406.29330993, 406.92093277, 402.27075791, 404.30870366]),
'score_time': array([176.33080554, 176.14393806, 177.69540238, 176.17853737, 177.33101845]),
'test_accuracy': array([0.84678571, 0.84142857, 0.85121429, 0.84385714, 0.8385]),
'test_neg_log_loss': array([-0.42152348, -0.43512832, -0.42419093, -0.43709888, -0.4436452]),
'test_neg_mean_squared_error': array([-2.00621429, -2.03314286, -1.93978571, -2.00492857, -2.07492857]),
'test_roc_auc_ovr': array([0.98600947, 0.98544186, 0.98552394, 0.98487057, 0.98441069]),
'test_f1_weighted': array([0.8452417 , 0.8400778 , 0.84978951, 0.84248568, 0.83775193]),
'test_precision_weighted': array([0.84502227, 0.83953853, 0.84934766, 0.84212021, 0.83750534]),
'test_recall_weighted': array([0.84678571, 0.84142857, 0.85121429, 0.84385714, 0.8385])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([1699.64752245, 1700.9067235 , 1702.57826066, 1701.4609251 , 1703.20330858]),
'score_time': array([324.43864107, 323.88248515, 324.21705651, 324.78798676, 323.74053669]),
'test_accuracy': array([0.859 , 0.85435714, 0.85807143, 0.85435714, 0.8495]),
'test_neg_log_loss': array([-0.39706887, -0.39762668, -0.39717192, -0.40422252, -0.41698341]),
'test_neg_mean_squared_error': array([-1.857 , -1.8525 , -1.90092857, -1.92042857, -2.00242857]),
'test_roc_auc_ovr': array([0.98719163, 0.98746394, 0.98704144, 0.98698522, 0.98600495]),

'test_f1_weighted': array([0.85780303, 0.85363673, 0.85689169, 0.85356744, 0.84876797]),
'test_precision_weighted': array([0.85760091, 0.8534242 , 0.85659334, 0.85336285, 0.84848418]),
'test_recall_weighted': array([0.859 , 0.85435714, 0.85807143, 0.85435714, 0.8495])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([2304.89932704, 2827.17147064, 2631.35998726, 2763.06684756, 2852.91384745]),
'score_time': array([296.60593414, 312.67890096, 322.01983643, 322.08508134, 320.32628441]),
'test_accuracy': array([0.83307143, 0.83264286, 0.82407143, 0.83328571, 0.82421429]),
'test_neg_log_loss': array([-0.58420096, -0.62953609, -0.64027265, -0.64364023, -0.6598329]),
'test_neg_mean_squared_error': array([-2.21364286, -2.18464286, -2.29878571, -2.19928571, -2.33128571]),
'test_roc_auc_ovr': array([0.98286318, 0.98241916, 0.98002659, 0.98217012, 0.98032948]),
'test_f1_weighted': array([0.82909666, 0.83035361, 0.82124359, 0.83095742, 0.82205067]),
'test_precision_weighted': array([0.83088253, 0.82995995, 0.82124403, 0.83092724, 0.82139738]),
'test_recall_weighted': array([0.83307143, 0.83264286, 0.82407143, 0.83328571, 0.82421429])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([2845.88779664, 2766.0545814 , 2915.31258678, 2865.7593534 , 2592.3176043]),
'score_time': array([341.80979705, 335.83054304, 343.96807718, 342.71349025, 323.47451925]),
'test_accuracy': array([0.86157143, 0.85514286, 0.85557143, 0.85628571, 0.84735714]),
'test_neg_log_loss': array([-0.41462025, -0.42628342, -0.42709911, -0.42974973, -0.42674066]),
'test_neg_mean_squared_error': array([-1.90142857, -1.8665 , -1.96264286, -1.82214286, -2.01507143]),
'test_roc_auc_ovr': array([0.98763127, 0.98721741, 0.98656218, 0.9865938 , 0.98606315]),
'test_f1_weighted': array([0.85969479, 0.85375814, 0.85419355, 0.85492387, 0.84629382]),
'test_precision_weighted': array([0.85984874, 0.85342912, 0.85377494, 0.854875 , 0.84579669]),
'test_recall_weighted': array([0.86157143, 0.85514286, 0.85557143, 0.85628571, 0.84735714])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([3233.22758675, 3277.30818009, 3282.58442187, 3132.68713403, 3338.91807652]),
'score_time': array([370.05467463, 372.90003633, 372.03506446, 367.51247549, 377.80231023]),
'test_accuracy': array([0.866 , 0.85785714, 0.86292857, 0.858 , 0.85042857]),
'test_neg_log_loss': array([-0.37793016, -0.3959835 , -0.38894234, -0.39795344, -0.41202933]),
'test_neg_mean_squared_error': array([-1.79571429, -1.81642857, -1.84521429, -1.83471429, -1.9715]),
'test_roc_auc_ovr': array([0.98867325, 0.98782852, 0.98774278, 0.98746305, 0.98660149]),
'test_f1_weighted': array([0.86480925, 0.85699418, 0.86188476, 0.85671552, 0.84954632]),
'test_precision_weighted': array([0.86455999, 0.85669979, 0.86154854, 0.85644706, 0.84912329]),
'test_recall_weighted': array([0.866 , 0.85785714, 0.86292857, 0.858 , 0.85042857])}

18)

1% szum na etykietach

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([44.15251517, 44.40823722, 44.79876828, 43.93469787, 44.49649692]), 'score_time': array([58.73130631, 58.48243427, 58.53770328, 57.89160728, 58.73069668]), 'test_accuracy': array([0.83142857, 0.82771429, 0.83778571, 0.83185714, 0.8245]), 'test_neg_log_loss': array([-0.50686052, -0.50839664, -0.49776846, -0.51577597, -0.51521768]), 'test_neg_mean_squared_error': array([-2.31857143, -2.2025 , -2.13964286, -2.20085714, -2.29007143]), 'test_roc_auc_ovr': array([0.97865446, 0.97919225, 0.97944031, 0.97802815, 0.97875112]), 'test_f1_weighted': array([0.82986614, 0.82632357, 0.8357828 , 0.83005499, 0.82315756]), 'test_precision_weighted': array([0.8298868 , 0.8260838 , 0.83581026, 0.82992718, 0.82284182]), 'test_recall_weighted': array([0.83142857, 0.82771429, 0.83778571, 0.83185714, 0.8245])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([401.97660613, 411.0583744 , 404.74461555, 401.73142743,
400.05051756]), 'score_time': array([169.58967519, 167.61274648, 169.08238435, 168.96605492,
168.28341007]), 'test_accuracy': array([0.8565 , 0.85085714, 0.85885714, 0.85535714, 0.84671429]),
'test_neg_log_loss': array([-0.44770264, -0.45006962, -0.44559742, -0.44390688, -0.46453264]),
'test_neg_mean_squared_error': array([-2.03428571, -1.95914286, -1.90928571, -1.91414286, -2.03007143]),
'test_roc_auc_ovr': array([0.98229395, 0.98296311, 0.9821472 , 0.98303799, 0.98139415]), 'test_f1_weighted': array([0.85536221, 0.85022651, 0.85761901, 0.85453019, 0.84598033]), 'test_precision_weighted': array([0.85526612, 0.85019304, 0.85731315, 0.85440041, 0.84595719]), 'test_recall_weighted': array([0.8565 , 0.85085714, 0.85885714, 0.85535714, 0.84671429])}

- zespół klasyfikatorów 70% przykładów uczących

{'fit_time': array([1741.32118797, 1791.25573516, 1739.59996462, 1730.89535522,
1738.13037467]), 'score_time': array([314.07390332, 312.31813979, 323.11385942, 312.43164706,
310.3760457]), 'test_accuracy': array([0.86721429, 0.8615 , 0.86778571, 0.86442857, 0.85557143]),
'test_neg_log_loss': array([-0.41501777, -0.42268413, -0.41997306, -0.42518189, -0.43988001]),
'test_neg_mean_squared_error': array([-1.823 , -1.84471429, -1.879 , -1.818 , -1.96792857]),
'test_roc_auc_ovr': array([0.98416005, 0.98418442, 0.98357841, 0.98368362, 0.98260521]), 'test_f1_weighted':
array([0.86617913, 0.86095103, 0.86704101, 0.86387061, 0.8550219]), 'test_precision_weighted':
array([0.86607498, 0.86094958, 0.8669669 , 0.86383087, 0.85489932]), 'test_recall_weighted': array([0.86721429,
0.8615 , 0.86778571, 0.86442857, 0.85557143])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([2304.9132359 , 2502.29262018, 2689.18059635, 2602.62389445,
5360.12723851]), 'score_time': array([285.65596962, 291.78031278, 298.49259663, 322.10566306,
619.92622876]), 'test_accuracy': array([0.84242857, 0.83842857, 0.85057143, 0.84114286, 0.82942857]),
'test_neg_log_loss': array([-0.58620644, -0.59968511, -0.607684 , -0.61901264, -0.60915181]),
'test_neg_mean_squared_error': array([-2.14207143, -2.11371429, -2.10485714, -2.1425 , -2.25264286]),
'test_roc_auc_ovr': array([0.98000832, 0.98071815, 0.98000683, 0.97871846, 0.97771662]), 'test_f1_weighted':
array([0.83989982, 0.83671187, 0.84843688, 0.83972843, 0.82786235]), 'test_precision_weighted':
array([0.84061216, 0.83638386, 0.84846302, 0.83996198, 0.82739824]), 'test_recall_weighted': array([0.84242857,
0.83842857, 0.85057143, 0.84114286, 0.82942857])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([4009.12389874, 2775.6900773 , 2977.6118052 , 2984.1350348 ,
2889.6591413]), 'score_time': array([312.5659318 , 314.88363957, 311.60913849, 314.60512543,
313.18734026]), 'test_accuracy': array([0.86271429, 0.85814286, 0.86535714, 0.85807143, 0.84985714]),
'test_neg_log_loss': array([-0.43653484, -0.44067684, -0.42822288, -0.44559527, -0.45237213]),
'test_neg_mean_squared_error': array([-1.87521429, -1.92042857, -1.88342857, -1.94342857, -2.08742857]),
'test_roc_auc_ovr': array([0.98365533, 0.98345224, 0.98405119, 0.98309992, 0.98266577]), 'test_f1_weighted':
array([0.86128321, 0.85720465, 0.86423166, 0.85723584, 0.84909445]), 'test_precision_weighted':
array([0.86105552, 0.85708397, 0.86397949, 0.85717242, 0.84881032]), 'test_recall_weighted': array([0.86271429,
0.85814286, 0.86535714, 0.85807143, 0.84985714])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([3886.98062491, 3834.35294175, 3593.30036569, 3578.74257779,
3594.70912647]), 'score_time': array([382.57865071, 350.99613714, 356.85238719, 355.63727498,
353.74253893]), 'test_accuracy': array([0.86864286, 0.8635 , 0.8695 , 0.86742857, 0.85757143]),
'test_neg_log_loss': array([-0.40945646, -0.41945965, -0.41057907, -0.41454023, -0.43424984]),
'test_neg_mean_squared_error': array([-1.79835714, -1.85978571, -1.8365 , -1.8065 , -1.94842857]),
'test_roc_auc_ovr': array([0.9849214 , 0.98414931, 0.98465227, 0.98453635, 0.98325415]), 'test_f1_weighted':
array([0.86778746, 0.86293942, 0.86851675, 0.86666593, 0.85719922]), 'test_precision_weighted':
array([0.86772147, 0.86285561, 0.8682977 , 0.86656234, 0.85723624]), 'test_recall_weighted': array([0.86864286,
0.8635 , 0.8695 , 0.86742857, 0.85757143])}

5% szum na etykietach

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([56.25365233, 55.86305356, 55.67668533, 55.40608382, 54.89460754]),
'score_time': array([63.53641272, 62.37576437, 63.03551912, 62.47531509, 63.04701424]),
'test_accuracy': array([0.79771429, 0.78928571, 0.80307143, 0.79878571, 0.79128571]),
'test_neg_log_loss': array([-0.69149287, -0.73955589, -0.69669097, -0.70177369, -0.7130312]),
'test_neg_mean_squared_error': array([-2.90407143, -2.94171429, -2.78085714, -2.83228571, -2.91892857]),
'test_roc_auc_ovr': array([0.95868071, 0.95298184, 0.95799302, 0.95748313, 0.95671821]),
'test_f1_weighted': array([0.79580302, 0.78747686, 0.80070685, 0.79657145, 0.78982022]),
'test_precision_weighted': array([0.79607755, 0.7872923 , 0.80129391, 0.79682441, 0.78963334]),
'test_recall_weighted': array([0.79771429, 0.78928571, 0.80307143, 0.79878571, 0.79128571])}

- zespół klasyfikatorów 35% przykładów uczących
{'fit_time': array([583.37647462, 587.28346443, 582.50786138, 575.15845323, 581.09555459]),
'score_time': array([192.88321495, 192.38821697, 192.65851569, 191.71329165, 193.48158097]),
'test_accuracy': array([0.82171429, 0.81871429, 0.82342857, 0.81714286, 0.81378571]),
'test_neg_log_loss': array([-0.65690528, -0.6446089 , -0.64681264, -0.66549498, -0.66361195]),
'test_neg_mean_squared_error': array([-2.65507143, -2.56692857, -2.61721429, -2.64671429, -2.65642857]),
'test_roc_auc_ovr': array([0.95955657, 0.96175803, 0.96045491, 0.95943441, 0.95949071]),

'test_f1_weighted': array([0.82025907, 0.81791002, 0.82199713, 0.81602527, 0.81296722]),
'test_precision_weighted': array([0.82003814, 0.81794903, 0.82178121, 0.81603077, 0.81291589]),
'test_recall_weighted': array([0.82171429, 0.81871429, 0.82342857, 0.81714286, 0.81378571])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([2762.84314752, 2770.52354717, 3032.88755393, 3410.86001062, 2630.97443628]),
'score_time': array([360.23404527, 359.277457 , 774.81500936, 359.42235589, 358.99438643]),
'test_accuracy': array([0.83057143, 0.8305 , 0.831 , 0.8295 , 0.8195]),
'test_neg_log_loss': array([-0.62795893, -0.61158451, -0.63320314, -0.6251929 , -0.6475557]),
'test_neg_mean_squared_error': array([-2.52092857, -2.47142857, -2.59057143, -2.50292857, -2.69728571]),
'test_roc_auc_ovr': array([0.96092361, 0.96397157, 0.96033793, 0.96224406, 0.95981567]),
'test_f1_weighted': array([0.82977578, 0.82986064, 0.83023459, 0.82885705, 0.81896955]),
'test_precision_weighted': array([0.82977205, 0.82992963, 0.8299681 , 0.82873564, 0.81885409]),
'test_recall_weighted': array([0.83057143, 0.8305 , 0.831 , 0.8295 , 0.8195])}

- zespół klasyfikatorów 25% cech
{'fit_time': array([3219.99170589, 3396.41449213, 6179.34512091, 5532.94693232, 4555.20075798])
'score_time': array([315.23105788, 316.99068785, 638.27180672, 317.77032876, 605.60227275]),
'test_accuracy': array([0.80557143, 0.80314286, 0.81035714, 0.80507143, 0.80164286]),
'test_neg_log_loss': array([-0.78746973, -0.80679785, -0.78448045, -0.78028797, -0.80325696]),
'test_neg_mean_squared_error': array([-2.81478571, -2.92564286, -2.72464286, -2.91514286, -2.91485714]),
'test_roc_auc_ovr': array([0.95775337, 0.95684225, 0.95783552, 0.95804966, 0.95722419]),
'test_f1_weighted': array([0.80259693, 0.80143637, 0.80814527, 0.80299261, 0.79987129]),
'test_precision_weighted': array([0.80358827, 0.80148713, 0.80829181, 0.80317656, 0.79952045]),
'test_recall_weighted': array([0.80557143, 0.80314286, 0.81035714, 0.80507143, 0.80164286])}

- zespół klasyfikatorów 50% cech
{'fit_time': array([7456.3474493 , 4555.71863914, 4421.3907001 , 4470.64562774, 4042.51135516]),
'score_time': array([391.29696631, 345.14422894, 362.64291573, 353.39773846,346.18799686]),
'test_accuracy': array([0.82971429, 0.82092857, 0.82928571, 0.82121429, 0.81585714]),
'test_neg_log_loss': array([-0.63374688, -0.64638837, -0.63908584, -0.6578005 , -0.66521278]),
'test_neg_mean_squared_error': array([-2.52857143, -2.537 , -2.49314286, -2.67028571, -2.74814286]),
'test_roc_auc_ovr': array([0.96294216, 0.96115132, 0.96161057, 0.96014319, 0.95944963]),
'test_f1_weighted': array([0.82829739, 0.82002003, 0.82827487, 0.8203129 , 0.81496664]),
'test_precision_weighted': array([0.82843742, 0.81996462, 0.82844782, 0.82031528, 0.81471603]),
'test_recall_weighted': array([0.82971429, 0.82092857, 0.82928571, 0.82121429, 0.81585714])}

- zespół klasyfikatorów 75% cech
{'fit_time': array([5302.86048484, 5247.91040945, 8157.29574442, 5006.21922946, 11458.49424601]),
'score_time': array([405.33361697, 404.88391829, 414.40246129, 928.22925615, 404.0765717]),
'test_accuracy': array([0.83235714, 0.82771429, 0.8335 , 0.83207143, 0.82514286]),
'test_neg_log_loss': array([-0.61473317, -0.62763498, -0.6207325 , -0.62332388, -0.62573254]),
'test_neg_mean_squared_error': array([-2.491 , -2.50928571, -2.46307143, -2.5675 , -2.52371429]),
'test_roc_auc_ovr': array([0.9633662 , 0.96187163, 0.96208003, 0.96182906, 0.96292743]),
'test_f1_weighted': array([0.83107807, 0.82696035, 0.83252891, 0.83139968, 0.82431182]),
'test_precision_weighted': array([0.83105934, 0.82682208, 0.83250444, 0.83135621, 0.82390624]),
'test_recall_weighted': array([0.83235714, 0.82771429, 0.8335 , 0.83207143, 0.82514286])}

10% szum na etykietach

- zespół klasyfikatorów 10% przykładów uczących
{'fit_time': array([70.14235663, 71.79515266, 70.11104488, 69.89259338, 70.15532708]),
'score_time': array([68.27850747, 70.21312761, 69.49390078, 69.34435034, 69.09857512]),
'test_accuracy': array([0.75078571, 0.754 , 0.75835714, 0.75107143, 0.74871429]),
'test_neg_log_loss': array([-0.92102691, -0.91156672, -0.90981679, -0.93687844, -0.9207547]),
'test_neg_mean_squared_error': array([-3.83135714, -3.63971429, -3.635 , -3.76364286, -3.86935714]),
'test_roc_auc_ovr': array([0.92930471, 0.93153073, 0.93026331, 0.92639277, 0.93029405]),
'test_f1_weighted': array([0.7489261 , 0.75237745, 0.75593981, 0.74890726, 0.74730177]),
'test_precision_weighted': array([0.74899132, 0.75211289, 0.75637131, 0.74890711, 0.74695672]),
'test_recall_weighted': array([0.75078571, 0.754 , 0.75835714, 0.75107143, 0.74871429])}

- zespół klasyfikatorów 35% przykładów uczących

{'fit_time': array([778.09384632, 778.41116214, 774.26207066, 780.62753224, 780.8714056]),
'score_time': array([217.75725389, 216.75146151, 217.33139515, 217.20455384, 220.85880041]),
'test_accuracy': array([0.77864286, 0.77321429, 0.78007143, 0.77807143, 0.76728571]),
'test_neg_log_loss': array([-0.86790348, -0.87118874, -0.86773875, -0.8496059 , -0.8874863]),
'test_neg_mean_squared_error': array([-3.57957143, -3.58 , -3.4315 , -3.32828571, -3.58107143]),
'test_roc_auc_ovr': array([0.9318926 , 0.93209072, 0.93170441, 0.93580626, 0.93004996]),
'test_f1_weighted': array([0.777249 , 0.77184689, 0.77880436, 0.77683193, 0.7661708]),
test_precision_weighted': array([0.7777206 , 0.77201013, 0.77884034, 0.77660775, 0.76600535]),
'test_recall_weighted': array([0.77864286, 0.77321429, 0.78007143, 0.77807143, 0.76728571])}

- zespół klasyfikatorów 70% przykładów uczących
{'fit_time': array([3619.1237061 , 3618.64627123, 3780.30633068, 4140.83480501, 3621.32356715]),
'score_time': array([407.69695044, 407.42891407, 431.08076406, 410.0026195 , 407.03409338]),
'test_accuracy': array([0.78714286, 0.77992857, 0.7875 , 0.78721429, 0.77807143]),
'test_neg_log_loss': array([-0.84124966, -0.85111257, -0.84434551, -0.83508033, -0.85078257]),
'test_neg_mean_squared_error': array([-3.35471429, -3.39585714, -3.37457143, -3.26814286, -3.42157143]),
'test_roc_auc_ovr': array([0.93381856, 0.93340589, 0.93361794, 0.93590999, 0.93425125]),
'test_f1_weighted': array([0.78567944, 0.77909076, 0.78653693, 0.78699418, 0.77758164]),
'test_precision_weighted': array([0.78542673, 0.77910113, 0.78639032, 0.78722451, 0.7776729]),
'test_recall_weighted': array([0.78714286, 0.77992857, 0.7875 , 0.78721429, 0.77807143])}

- zespół klasyfikatorów 25% przykładów uczących
{'fit_time': array([4530.19982409, 3833.59613299, 3917.71867585, 4479.39819598, 3809.20365715]),
'score_time': array([745.20541477, 324.66265154, 368.68169117, 353.17766476, 321.97958589]),
'test_accuracy': array([0.76328571, 0.76171429, 0.76742857, 0.75671429, 0.76221429]),
'test_neg_log_loss': array([-0.98780555, -0.97098085, -0.96954057, -1.00615714, -0.96978196]),
'test_neg_mean_squared_error': array([-3.7475 , -3.54178571, -3.67557143, -3.66085714, -3.66842857]),
'test_roc_auc_ovr': array([0.9299134 , 0.93075374, 0.93042544, 0.92881109, 0.93212047]),
'test_f1_weighted': array([0.76054135, 0.75991454, 0.76561496, 0.75411341, 0.76018469]),
'test_precision_weighted': array([0.76169775, 0.75974556, 0.76569349, 0.75407443, 0.75992694]),
'test_recall_weighted': array([0.76328571, 0.76171429, 0.76742857, 0.75671429, 0.76221429])}

- zespół klasyfikatorów 50% przykładów uczących
{'fit_time': array([5061.75967383, 5088.49510145, 5075.65607142, 5047.08943272, 5143.00521779]),
'score_time': array([391.57755089, 387.84138322, 390.39206076, 389.7121911 , 387.89824247]),
'test_accuracy': array([0.78371429, 0.78085714, 0.78264286, 0.78257143, 0.77635714]),
'test_neg_log_loss': array([-0.8500118 , -0.8581088 , -0.86265937, -0.8490391 , -0.86310099]),
'test_neg_mean_squared_error': array([-3.467 , -3.31378571, -3.42878571, -3.33714286, -3.44392857]),
'test_roc_auc_ovr': array([0.9352133 , 0.93426362, 0.93307293, 0.93605432, 0.93483162]),
'test_f1_weighted': array([0.78238952, 0.77973654, 0.78181168, 0.78148687, 0.77533311]),
'test_precision_weighted': array([0.78270588, 0.77964174, 0.78173612, 0.78175258, 0.77482328]),
'test_recall_weighted': array([0.78371429, 0.78085714, 0.78264286, 0.78257143, 0.77635714])}

- zespół klasyfikatorów 75% przykładów uczących
{'fit_time': array([6750.2669158 , 6733.20253348, 6829.10204244, 6727.93177319, 6797.06084347]),
'score_time': array([458.50467825, 457.59793544, 465.71020389, 457.99263477, 460.5936842]),
'test_accuracy': array([0.78792857, 0.78692857, 0.78521429, 0.7865 , 0.78178571]),
'test_neg_log_loss': array([-0.83661911, -0.83249484, -0.84790068, -0.84701196, -0.84182176]),
'test_neg_mean_squared_error': array([-3.28457143, -3.26178571, -3.46435714, -3.3945 , -3.39242857]),
'test_roc_auc_ovr': array([0.93456409, 0.9362993 , 0.93271619, 0.9325671 , 0.93535169]),
'test_f1_weighted': array([0.78673636, 0.78596977, 0.78392989, 0.78553953, 0.78119989]),
'test_precision_weighted': array([0.78669504, 0.78603185, 0.78387072, 0.78534895, 0.78152674]),
'test_recall_weighted': array([0.78792857, 0.78692857, 0.78521429, 0.7865 , 0.78178571])}