|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 500 | 20 | 9.79478 | 11.1067 | 10.049 | 31248 | 30781 | 30636 | 30888 | 10.3168 | Normal (26997) |
| 200 | 10 | 11.081 | 10.7892 | 11.4464 | 12550 | 12241 | 12304 | 12365 | 11.1055333 | ex10942 |
| 100 | 10 | 2.6193 | 1.95679 | 2.24937 | 6079 | 6648 | 6530 | 6419 | 2.27515333 | ex5375 |
| 20 | 10 | 0.90700 | 0.98847 | 0.58559 | 1976 | 1964 | 1990 | 1976.66667 | 0.82702 | ex1557 |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 500 | 20 | 37.7346 | 37.7871 | 30.132 | 30119 | 30370 | 30132 | 30207 | 35.2179 | Better  Solution |
| 200 | 10 | 38.6801 | 41.7135 | 39.8671 | 11887 | 11877 | 12087 | 11950.3333 | 40.0869 |  |
| 100 | 10 | 2.53261 | 2.84434 | 3.94788 | 6153 | 6361 | 6278 | 6264 | 3.10827667 |  |
| 20 | 10 | 0.91858 | 0.99498 | 0.71558 | 1790 | 1755 | 1770 | 1771.66667 | 0.87638 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 13.4779 | 14.3776 | 11.5622 | 12488 | 12249 | 12213 | 12316.6667 | 13.1392333 | U=0.85 |
| 100 | 10 | 3.5478 | 2.2102 | 6.47028 | 6331 | 6368 | 6396 | 6365 | 4.07609333 | 5375 |
| 20 | 10 | 1.63185 | 1.00662 | 1.28603 | 1802 | 1976 | 1814 | 1864 | 1.30816667 | 1557 |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 20.8194 | 31.2834 | 33.1302 | 12627 | 12336 | 12364 | 12442.3333 | 28.411 | U=0.90 |
| 100 | 10 | 4.47439 | 4.91548 | 4.8405 | 6595 | 6665 | 6254 | 6504.66667 | 4.74345667 |  |
| 20 | 10 | 1.54846 | 3.50408 | 3.60959 | 1857 | 1947 | 2014 | 1939.33333 | 2.88737667 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 60.3023 | 61.7782 | 28.7128 | 12388 | 12356 | 12160 | 12301.3333 | 50.2644333 | U=0.95 |
| 100 | 10 | 11.0257 | 9.59069 | 10.0927 | 6591 | 6486 | 6707 | 6594.66667 | 10.2363633 |  |
| 20 | 10 | 2.2555 | 6.29053 | 7.24047 | 1923 | 1881 | 2043 | 1949 | 5.26216667 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 281.622 | 306.659 | 249.123 | 12108 | 12246 | 12237 | 12197 | 279.134667 | U=0.99 |
| 100 | 10 | 50.0593 | 54.1099 | 49.2825 | 6606 | 6430 | 6411 | 6482.33333 | 51.1505667 |  |
| 20 | 10 | 24.2676 | 34.7333 | 27.5138 | 1954 | 1861 | 1882 | 1899 | 28.8382333 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 10.71 | 12.604 | 9.9587 | 12336 | 12266 | 12197 | 12266.3333 | 11.0909 | insert |
| 100 | 10 | 3.75461 | 2.25607 | 2.06128 | 6008 | 6481 | 6442 | 6310.33333 | 2.69065333 |  |
| 20 | 10 | 0.65490 | 0.54025 | 0.78714 | 2015 | 1871 | 1871 | 1919 | 0.66076333 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 13.0668 | 12.8122 | 14.07 | 12063 | 12210 | 12256 | 12176.3333 | 13.3163333 | Neh first |
| 100 | 10 | 7.23128 | 6.63464 | 5.6642 | 6373 | 6492 | 6418 | 6427.66667 | 6.51004 |  |
| 20 | 10 | 2.58338 | 1.34068 | 1.4856 | 1883 | 2003 | 1808 | 1898 | 1.80322 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 9.92298 | 9.61885 | 6.34718 | 12167 | 12404 | 12321 | 12297.3333 | 8.62967 | Cmax rozn |
| 100 | 10 | 3.82554 | 7.01085 | 2.96395 | 6545 | 6235 | 6421 | 6400.33333 | 4.60011333 |  |
| 20 | 10 | 1.35584 | 0.66608 | 0.57893 | 1903 | 1840 | 1820 | 1854.33333 | 0.86695 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 4.62727 | 3.21787 | 3.36373 | 12125 | 12499 | 11968 | 12197.3333 | 3.73629 | prawdop |
| 100 | 10 | 7.74764 | 4.89998 | 4.12278 | 6512 | 6456 | 6681 | 6549.66667 | 5.59013333 |  |
| 20 | 10 | 1.42768 | 0.90342 | 0.77282 | 2029 | 1909 | 1909 | 1949 | 1.03464 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 2.27899 | 2.22605 | 3.50874 | 12357 | 12175 | 12313 | 12281.6667 | 2.67126 | Tk=1  Tp=1000 |
| 200 | 10 | 1.65846 | 1.05938 | 0.52259 | 12259 | 12197 | 12203 | 12219.6667 | 1.08014333 | Tk=1  Tp = 10 |
| 100 | 10 | 1.3746 | 0.83076 | 1.1703 | 6322 | 6503 | 6583 | 6469.33333 | 1.12522 | Tk=1  Tp=1000 |
| 100 | 10 | 0.57644 | 0.44346 | 0.38447 | 6569 | 6505 | 6505 | 6526.33333 | 0.46812333 | Tk=1  Tp = 10 |
| 20 | 10 | 1.10059 | 0.27576 | 0.27058 | 1921 | 1838 | 1838 | 1865.66667 | 0.54897667 | Tk=1  Tp=1000 |
| 20 | 10 | 0.11003 | 0.09740 | 0.05750 | 1739 | 1739 | 1739 | 1739 | 0.08339 | Tk=1  Tp = 10 |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 224.186 | 257.354 | 219.245 | 10942 | 10942 | 10942 | 10942 | 233,595 | Q\_NEH |
| 100 | 10 | 33.0503 | 37.8120 | 29.3650 | 5375 | 5375 | 5375 | 5375 | 33.4091 |  |
| 20 | 10 | 1.21354 | 1.02658 | 1.14967 | 1557 | 1557 | 1557 | 1557 | 1.12993 |  |

1. Wykonanie programu na 3.0
2. Porównanie najlepszego rozwiązania dla symulowanego wyżarzania z NEHem

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 500 | 20 | 37.7346 | 37.7871 | 30.132 | 30119 | 30370 | 30132 | 30207 | 35.2179 | BetSol |
| 200 | 10 | 38.6801 | 41.7135 | 39.8671 | 11887 | 11877 | 12087 | 11951 | 40.0869 |  |
| 100 | 10 | 2.53261 | 2.84434 | 3.94788 | 6153 | 6361 | 6278 | 6264 | 3.10828 |  |
| 20 | 10 | 0.91858 | 0.99498 | 0.71558 | 1790 | 1755 | 1770 | 1772 | 0.87638 |  |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 224.186 | 257.354 | 219.245 | 10942 | 10942 | 10942 | 10942 | 233,595 | Q\_NEH |
| 100 | 10 | 33.0503 | 37.8120 | 29.3650 | 5375 | 5375 | 5375 | 5375 | 33.4091 |  |
| 20 | 10 | 1.21354 | 1.02658 | 1.14967 | 1557 | 1557 | 1557 | 1557 | 1.12993 |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | Cśr  BetSol | Cśr NEH | Tśr | Tśr |
| 200 | 10 | 11951 | 10942 | 40.0869 | 233,595 |
| 100 | 10 | 6264 | 5375 | 3.10828 | 33.4091 |
| 20 | 10 | 1772 | 1557 | 0.87638 | 1.12993 |

Najbardziej zbliżony do najlepszych wyników (do wyników NEHa) okazuje się algorytm z modyfikacją zapamiętywania najlepszego rozwiązania. Okazuje się znacznie szybszy od NEHa, ale nie tak dokładny (jednak dużo dokładniejszy niż dla pozostałych modyfikacji).

1. Porównanie wyników dla ruchów Swap i Insert

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 500 | 20 | 9.79478 | 11.1067 | 10.049 | 31248 | 30781 | 30636 | 30888 | 10.3168 | Normal (26997) |
| 200 | 10 | 11.081 | 10.7892 | 11.4464 | 12550 | 12241 | 12304 | 12365 | 11.1055333 | ex10942 |
| 100 | 10 | 2.6193 | 1.95679 | 2.24937 | 6079 | 6648 | 6530 | 6419 | 2.27515333 | ex5375 |
| 20 | 10 | 0.90700 | 0.98847 | 0.58559 | 1976 | 1964 | 1990 | 1976.66667 | 0.82702 | ex1557 |
|  |  |  |  |  |  |  |  |  |  |  |
| 200 | 10 | 10.71 | 12.604 | 9.9587 | 12336 | 12266 | 12197 | 12266.3333 | 11.0909 | insert |
| 100 | 10 | 3.75461 | 2.25607 | 2.06128 | 6008 | 6481 | 6442 | 6310.33333 | 2.69065333 |  |
| 20 | 10 | 0.65490 | 0.54025 | 0.78714 | 2015 | 1871 | 1871 | 1919 | 0.66076333 |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | Cśr  Swap | Cśr Insert | Tśr | Tśr |
| 200 | 10 | 12365 | 12266.3333 | 11.1055333 | 11.0909 |
| 100 | 10 | 6419 | 6310.33333 | 2.27515333 | 2.69065333 |
| 20 | 10 | 1976.66667 | 1919 | 0.82702 | 0.66076333 |

Dużo lepszy oraz szybszy okazuje się ruch typu Insert od ruchu typu Swap.

1. Analiza wpływu współczynnika u na wynik

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 13.4779 | 14.3776 | 11.5622 | 12488 | 12249 | 12213 | 12316 | 13.1392 | U=0.85 |
| 100 | 10 | 3.5478 | 2.2102 | 6.47028 | 6331 | 6368 | 6396 | 6365 | 4.07609 |  |
| 20 | 10 | 1.63185 | 1.00662 | 1.28603 | 1802 | 1976 | 1814 | 1864 | 1.30816 |  |
|  |  |  |  |  |  |  |  |  |  |  |
| 200 | 10 | 20.8194 | 31.2834 | 33.1302 | 12627 | 12336 | 12364 | 12442 | 28.411 | U=0.90 |
| 100 | 10 | 4.47439 | 4.91548 | 4.8405 | 6595 | 6665 | 6254 | 6504.6 | 4.74345 |  |
| 20 | 10 | 1.54846 | 3.50408 | 3.60959 | 1857 | 1947 | 2014 | 1940 | 2.88737 |  |
|  |  |  |  |  |  |  |  |  |  |  |
| 200 | 10 | 60.3023 | 61.7782 | 28.7128 | 12388 | 12356 | 12160 | 12302 | 50.2644 | U=0.95 |
| 100 | 10 | 11.0257 | 9.59069 | 10.0927 | 6591 | 6486 | 6707 | 6595 | 10.2363 |  |
| 20 | 10 | 2.2555 | 6.29053 | 7.24047 | 1923 | 1881 | 2043 | 1949 | 5.26216 |  |
|  |  |  |  |  |  |  |  |  |  |  |
| 200 | 10 | 281.622 | 306.659 | 249.123 | 12108 | 12246 | 12237 | 12197 | 279.134 | U=0.99 |
| 100 | 10 | 50.0593 | 54.1099 | 49.2825 | 6606 | 6430 | 6411 | 6484 | 51.1505 |  |
| 20 | 10 | 24.2676 | 34.7333 | 27.5138 | 1954 | 1861 | 1882 | 1899 | 28.8382 |  |

Oczywistym wnioskiem jest fakt, że im większy współczynnik u tym więcej operacji musi zostać wykonanych, ponieważ temperatura zmniejsza się tym wolniej im większy jest współczynnik, zatem ilość iteracji rośnie. Cmax jest w losowych przypadkach leszy dla różnej wartości współczynników.

1. Analiza doboru temperatury końcowej i początkowej

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 2.27899 | 2.22605 | 3.50874 | 12357 | 12175 | 12313 | 12282 | 2.67126 | Tk=1  Tp=1000 |
| 200 | 10 | 1.65846 | 1.05938 | 0.52259 | 12259 | 12197 | 12203 | 12220 | 1.08014 | Tk=1  Tp = 10 |
| 100 | 10 | 1.3746 | 0.83076 | 1.1703 | 6322 | 6503 | 6583 | 6470 | 1.12522 | Tk=1  Tp=1000 |
| 100 | 10 | 0.57644 | 0.44346 | 0.38447 | 6569 | 6505 | 6505 | 6527 | 0.46812 | Tk=1  Tp = 10 |
| 20 | 10 | 1.10059 | 0.27576 | 0.27058 | 1921 | 1838 | 1838 | 1866 | 0.54898 | Tk=1  Tp=1000 |
| 20 | 10 | 0.11003 | 0.09740 | 0.05750 | 1739 | 1739 | 1739 | 1739 | 0.08339 | Tk=1  Tp = 10 |

Im większy stosunek temperatury początkowej do końcowej tym więcej iteracji musi wykonać algorytm przy założeniu, że nie zmieniamy współczynnika u. Zatem operacja dla większego stosunku tych temperatur jest wolniejsza, przy tym w losowych przypadkach lepsza. Dla naszych badań lepszy daje rezultat, gdy stosunek temperatur jest mniejszy.

1. Analiza z pominięciem ruchu, gdy pomijamy prawdopodobieństwo równe 1 dla lepszego rozwiązania

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 11.081 | 10.7892 | 11.4464 | 12550 | 12241 | 12304 | 12365 | 11.1055 | normal |
| 100 | 10 | 2.6193 | 1.95679 | 2.24937 | 6079 | 6648 | 6530 | 6419 | 2.27515 |  |
| 20 | 10 | 0.90700 | 0.98847 | 0.58559 | 1976 | 1964 | 1990 | 1977 | 0.82702 |  |
|  |  |  |  |  |  |  |  |  |  |  |
| 200 | 10 | 4.62727 | 3.21787 | 3.36373 | 12125 | 12499 | 11968 | 12197 | 3.73629 | Prawd. |
| 100 | 10 | 7.74764 | 4.89998 | 4.12278 | 6512 | 6456 | 6681 | 6550 | 5.59013 |  |
| 20 | 10 | 1.42768 | 0.90342 | 0.77282 | 2029 | 1909 | 1909 | 1949 | 1.03464 |  |

Losowo raz jedna raz druga metoda jest lepsza i szybsza.

1. Analiza dla różnych Cmaxów

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 11.081 | 10.7892 | 11.4464 | 12550 | 12241 | 12304 | 12365 | 11.1055 | normal |
| 100 | 10 | 2.6193 | 1.95679 | 2.24937 | 6079 | 6648 | 6530 | 6419 | 2.27515 |  |
| 20 | 10 | 0.90700 | 0.98847 | 0.58559 | 1976 | 1964 | 1990 | 1977 | 0.82702 |  |
|  |  |  |  |  |  |  |  |  |  |  |
| 200 | 10 | 9.92298 | 9.61885 | 6.34718 | 12167 | 12404 | 12321 | 12297 | 8.62967 | Cmax R |
| 100 | 10 | 3.82554 | 7.01085 | 2.96395 | 6545 | 6235 | 6421 | 6400 | 4.60011 |  |
| 20 | 10 | 1.35584 | 0.66608 | 0.57893 | 1903 | 1840 | 1820 | 1854 | 0.86695 |  |

Metoda dla pominięcia i uwzględniania tylko różnych Cmax’ów okazuje się znacznie lepsza od standardowej, jednak nie jest zawsze szybsza (tylko w jednym przypadku dla większej ilości zadań).

1. Analiza między kolejnością neutralną a kolejnością uzyskana przy pomocy algorytmu NEH

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 200 | 10 | 11.081 | 10.7892 | 11.4464 | 12550 | 12241 | 12304 | 12365 | 11.1055 | normal |
| 100 | 10 | 2.6193 | 1.95679 | 2.24937 | 6079 | 6648 | 6530 | 6419 | 2.27515 |  |
| 20 | 10 | 0.90700 | 0.98847 | 0.58559 | 1976 | 1964 | 1990 | 1977 | 0.82702 |  |
|  |  |  |  |  |  |  |  |  |  |  |
| 200 | 10 | 13.0668 | 12.8122 | 14.07 | 12063 | 12210 | 12256 | 12176 | 13.316 | Neh first |
| 100 | 10 | 7.23128 | 6.63464 | 5.6642 | 6373 | 6492 | 6418 | 6428 | 6.51004 |  |
| 20 | 10 | 2.58338 | 1.34068 | 1.4856 | 1883 | 2003 | 1808 | 1898 | 1.80322 |  |

Dokładniejsza okazuje się metoda, gdy najpierw posortujemy algorytmem neh, następnie dokonamy symulacji. Jest to jednak bardziej czasochłonna operacja.

1. Analiza dodatkowej modyfikacji

Modyfikacja została zrealizowana w taki sposób, że zostaje zainicjalizowane na samym początku dodatkowe rozwiązanie, które w późniejszym etapie służy do zapamiętywania lepszego rozwiązania, które jest zwracane na sam koniec. Dokładany dodatkowe operacje, zatem metoda ta jest wolniejsza od standardowej, jednak jej efekty są zdecydowanie lepsze.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 500 | 20 | 9.79478 | 11.1067 | 10.049 | 31248 | 30781 | 30636 | 30888 | 10.3168 | Normal ex26997 |
| 200 | 10 | 11.081 | 10.7892 | 11.4464 | 12550 | 12241 | 12304 | 12365 | 11.1055 | ex10942 |
| 100 | 10 | 2.6193 | 1.95679 | 2.24937 | 6079 | 6648 | 6530 | 6419 | 2.27515 | ex5375 |
| 20 | 10 | 0.90700 | 0.98847 | 0.58559 | 1976 | 1964 | 1990 | 1977 | 0.82702 | ex1557 |
| L. z. | L. m. | T1 | T2 | T3 | C1 | C2 | C3 | Cśr | Tśr | metoda |
| 500 | 20 | 37.7346 | 37.7871 | 30.132 | 30119 | 30370 | 30132 | 30207 | 35.2179 | Better  Solution |
| 200 | 10 | 38.6801 | 41.7135 | 39.8671 | 11887 | 11877 | 12087 | 11950 | 40.0869 |  |
| 100 | 10 | 2.53261 | 2.84434 | 3.94788 | 6153 | 6361 | 6278 | 6264 | 3.10827 |  |
| 20 | 10 | 0.91858 | 0.99498 | 0.71558 | 1790 | 1755 | 1770 | 1771 | 0.87638 |  |

|  |  |
| --- | --- |
| **Cmax** | |
| Better Solution | Normal |
| 30207 | 30888 |
| 11950 | 12365 |
| 6264 | 6419 |
| 1771 | 1977 |

|  |  |
| --- | --- |
| **Tśr** | |
| Better Solution | Normal |
| 35.2179 | 10.3168 |
| 40.0869 | 11.1055 |
| 3.10827 | 2.27515 |
| 0.87638 | 0.82702 |

Wykorzystane instancje:

200 10

17 30 28 15 52 5 53 55 81 47

37 26 82 67 82 44 43 65 44 51

22 2 88 57 17 2 43 38 46 44

71 29 33 64 66 98 56 76 3 27

79 98 69 23 62 27 48 45 93 76

37 67 28 9 57 10 83 99 14 4

69 92 92 1 58 25 34 84 86 76

53 51 66 2 91 27 93 67 23 49

59 53 92 43 42 41 95 40 59 5

64 82 30 73 69 59 48 93 47 25

11 86 67 94 48 89 63 70 76 23

67 47 53 96 46 36 93 45 45 67

27 36 93 78 18 62 91 75 64 55

64 23 45 14 94 29 94 91 10 40

59 34 7 32 83 17 32 21 4 58

31 66 70 23 48 37 81 72 29 26

43 43 58 83 81 35 69 15 69 36

42 71 58 29 57 47 29 73 46 83

56 31 17 75 93 37 44 43 68 65

88 36 41 55 67 52 2 62 89 91

71 41 56 91 19 3 66 40 48 77

86 6 34 44 65 87 25 43 68 62

6 28 62 46 49 4 60 96 13 6

54 43 81 59 45 50 69 39 36 57

92 18 44 11 22 96 44 23 85 87

75 64 95 20 92 74 34 79 35 4

83 28 50 68 41 68 68 66 25 11

2 13 88 3 38 30 77 19 21 60

60 7 19 17 26 69 31 41 44 23

62 13 50 55 2 17 10 71 40 87

83 93 25 59 90 34 57 60 20 50

73 93 88 18 79 95 21 72 83 18

55 56 1 31 17 3 56 62 76 23

3 72 6 84 61 24 36 17 26 24

71 71 45 61 81 51 26 25 50 82

34 28 29 55 67 55 11 59 98 16

40 95 2 46 18 60 6 95 6 96

13 96 54 77 1 61 86 47 83 37

62 55 71 59 36 15 2 10 51 29

56 58 81 98 31 38 89 94 46 19

28 66 22 23 85 83 28 39 99 26

53 3 57 18 92 62 62 53 65 56

71 77 16 17 6 84 63 50 46 33

5 80 88 70 78 44 52 99 24 53

73 2 5 73 83 80 12 63 47 6

95 82 52 38 39 48 13 59 24 95

23 86 23 13 74 45 43 30 32 63

49 16 21 77 77 54 99 67 66 84

17 29 21 74 85 71 11 18 48 13

81 24 58 79 88 10 70 12 83 6

88 89 96 51 25 96 82 9 3 19

62 96 37 48 33 23 14 41 74 16

35 99 46 16 36 8 39 67 97 80

78 15 78 93 32 56 83 52 39 37

90 49 87 29 82 35 4 39 80 20

36 78 91 28 98 72 86 90 27 62

46 48 9 6 3 53 93 25 70 81

98 64 96 82 46 13 87 13 65 52

75 3 93 40 68 72 82 81 1 14

36 63 98 9 11 38 78 3 26 67

74 14 31 88 30 1 32 8 46 19

86 95 78 51 75 69 82 66 8 86

67 88 20 48 42 85 24 67 74 1

87 9 75 1 93 2 88 51 47 53

68 61 18 4 36 28 45 54 19 21

1 24 34 77 97 18 48 85 85 33

87 38 48 48 1 10 67 10 62 68

87 50 49 6 63 70 14 95 33 28

7 47 69 1 86 67 34 59 96 25

34 42 88 32 54 95 76 64 33 69

1 30 30 79 33 72 1 90 5 71

91 97 34 40 71 64 51 28 23 60

7 49 22 14 1 19 15 48 43 69

6 79 81 20 18 60 67 57 63 99

46 19 50 86 75 31 57 85 10 53

3 80 40 40 55 29 3 78 47 77

45 30 73 25 62 43 37 18 73 27

55 24 91 94 21 17 15 59 1 29

92 58 7 73 71 78 50 11 19 83

67 43 1 44 80 28 75 67 92 22

13 6 71 98 5 47 80 36 31 10

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