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KELAS: IK23-A
PERAN: SISTEM CERDAS

DOKUMEN PENGGUNA
Sistem Penentuan Rute Pengangkutan Sampah Menggunakan
Algoritma Haversine & Nearest Neighbor

1) Fungsi Sistem

Menentukan urutan kunjungan TPS dari depot DLH berdasarkan jarak terdekat:

- Total jarak pergi
- Jarak kembali ke depot (DLH)
- Total jarak PP (round trip)

2) Data yang dibutuhkan (CSV)

File dataset: **algoritma_LNS.csv**

Adapun isi kolom file csv seperti berikut:

	A	B	C	D	E	F	G
1	id_lokasi	kode_node	nama_lokasi	latitude	longitude	volume	jenis

3) Parameter yang digunakan

- Menggunakan ambang batas (thresold) untuk TPS yang dimana diatur menjadi default 80%,
- Dan TPS yang dikunjungi hanya yang memenuhi volume $\geq 80\%$.

4) Cara Kerja Algoritma

- Haversine, menghitung jarak lintasan terpendek dipermukaan bumi (great-circle distance) antara dua titik GPS.
- Titik Koordinat
 - **A (Lapangan Andi Makassau):** $lat_1 = -4.011759159264$, $lon_1 = 119.6219777202376$
 - **B (Kampus 2 ITH):** $lat_2 = -4.027365560201711$, $lon_2 = 119.62996182209022$
 - **C (Kampus 1 ITH):** $lat_3 = -4.0285297488409535$, $lon_3 = 119.63330687790976$

a) Contoh perhitungan Haversine: A → B (Lapangan → Kampus 2)

- Rumus:

$$a = \sin^2\left(\frac{\Delta\varphi}{2}\right) + \cos(\varphi_1)\cos(\varphi_2)\sin^2\left(\frac{\Delta\lambda}{2}\right)$$

$$c = 2 \cdot \arctan 2(\sqrt{a}, \sqrt{1-a}), \quad d = R \cdot c$$

- Langkah 1 — Konversi ke radian

$$\varphi_1 = \text{rad}(\text{lat}_1) = -0.0700184$$

$$\varphi_2 = \text{rad}(\text{lat}_2) = -0.0702908$$

$$\Delta\varphi = \text{rad}(\text{lat}_2 - \text{lat}_1) = -0.000272383$$

$$\Delta\lambda = \text{rad}(\text{lon}_2 - \text{lon}_1) = 0.000139349$$

- Langkah 2 — Hitung a

$$a = 2.33788 \times 10^{-8}$$

- Langkah 3 — Hitung c

$$c = 0.000305803$$

- Langkah 4 — Jarak d

$$d = 6,371,000 \times 0.000305803 = 1948.27 \text{ m} = 1.94827 \text{ km}$$

Hasil A → B = 1.94827 km

b) Hasil jarak

- A → C (Lapangan → Kampus 1) = 2.24870 km
- B → C (Kampus 2 → Kampus 1) = 0.392969 km

c) Rute Nearest Neighbor (mulai dari Lapangan A)

Dari A, memilih titik terdekat:

- Jarak A → B = 1.94827 km (lebih dekat daripada A → C = 2.24870 km)

Lalu dari B, sisa titik hanya C:

- B → C = 0.392969 km

➤ Rute NN (pergi): A → B → C

- Total jarak
 - ❖ Total pergi = A→B + B→C
= 1.94827 + 0.392969 = 2.34124 km
 - ❖ Jika kembali ke awal (round trip): tambah C→A (= A→C)
Total PP = 2.34124 + 2.24870 = 4.58994 km

5) Cara Menggunakan & Menguji Algoritma

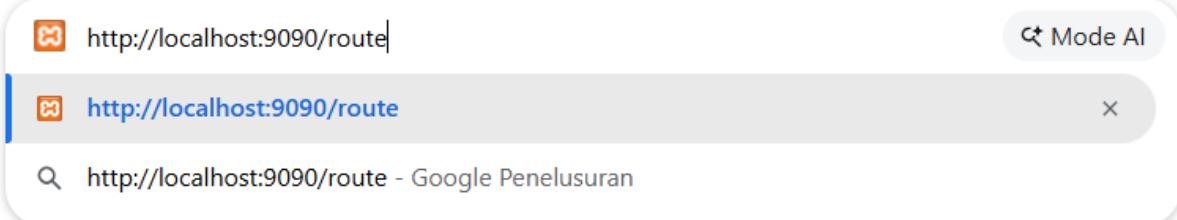
Pertama Siapkan Dataset Titik Koordinat di Kota ParePare, lalu di hubungkan pada kode

```
// Path ke file CSV
private static final String CSV_PATH =
    "C:\\\\Users\\\\ACER\\\\project sistem cerdas LNS\\\\algoritma_LNS.csv";
```

Kedua, setelah itu jalankan program pada CMD dengan mengetikkan kode seperti berikut:

```
C:\\\\Users\\\\ACER>cd /d \"C:\\\\Users\\\\ACER\\\\project sistem cerdas LNS\"  
C:\\\\Users\\\\ACER\\\\project sistem cerdas LNS>javac RouteModel.java RouteServer.java  
  
C:\\\\Users\\\\ACER\\\\project sistem cerdas LNS>java RouteServer  
Server berjalan di:  
  Peta : http://localhost:9090/  
  Route : http://localhost:9090/route
```

Ketiga, untuk melihat hasil salin paga bagian “Route” lalu jalan pada gchrome



Setelah itu nanti akan muncul hasil dari titik koordinat yang diuji

localhost:9090/route

```

Total lokasi terbaca: 500
Depot awal: [dnh] DLH KOTA PAREPARE (-3,988625, 119,652161) -%
Jumlah lokasi aktif (TPS > 80.0%) + depot: 149

*** RUTE OPTIMAL (Nearest Neighbor) ===
Start [0] [dnh] DLH KOTA PAREPARE (-3,988625, 119,652161) -%
-> [1] [tps_008] jalan latihan dan 2 (-3,986459, 119,651142) 96,0%
-> [2] [tps_003] jalan latihan dan 2 (-3,986199, 119,650912) 83,0%
-> [3] [tps_005] jalan sosial 4 (-3,986459, 119,646440) 91,0%
-> [4] [tps_024] jalan manunggal (-3,992492, 119,645540) 97,0%
-> [5] [tps_025] jalan ar malaka (-3,994463, 119,645866) 85,0%
-> [6] [tps_038] jalan manunggal (-3,997500, 119,644600) 100,0%
-> [7] [tps_061] jalan andi makkulau (-3,999689, 119,638134) 99,0%
-> [8] [tps_023] jalan musnika (-4,002588, 119,639145) 95,0%
-> [9] [tps_084] bukit indah (-4,003990, 119,637932) 80,0%
-> [10] [tps_052] lorong 1 ujung lars (-4,005830, 119,637208) 95,0%
-> [11] [tps_232] jalan h andi ajaih (-4,006720, 119,637202) 80,0%
-> [12] [tps_232] jalan lasiming (-4,011261, 119,632681) 87,0%
-> [13] [tps_228] jalan lasiming lorong1 (-4,011481, 119,632126) 85,0%
-> [14] [tps_239] jalan atletik (-4,013758, 119,630891) 93,0%
-> [15] [tps_218] jalan panorama indah (-4,014522, 119,630069) 95,0%
-> [16] [tps_217] jalan panorama indah (-4,014376, 119,629828) 96,0%
-> [17] [tps_241] jalan atletik (-4,015581, 119,630226) 95,0%
-> [18] [tps_244] jalan atletik (-4,015851, 119,630146) 82,0%
-> [19] [tps_250] jalan atletik (-4,015951, 119,630146) 82,0%
-> [20] [tps_261] jalan harapan 46 (-4,017466, 119,631355) 100,0%
-> [21] [tps_262] jalan harapan 46 (-4,017546, 119,631680) 97,0%
-> [22] [tps_263] jalan harapan 46 (-4,017617, 119,631988) 90,0%
-> [23] [tps_265] jalan harapan 46 (-4,017922, 119,632199) 96,0%
-> [24] [tps_256] jalan atletik timur 49 (-4,016626, 119,632248) 91,0%
-> [25] [tps_272] jalan kesuma timur (-4,019279, 119,631653) 91,0%
-> [26] [tps_269] jalan kesuma timur (-4,019412, 119,630638) 94,0%
-> [27] [tps_267] jalan kesuma timur (-4,020215, 119,629719) 84,0%
-> [28] [tps_250] jalan atletik (-4,019675, 119,629192) 87,0%
-> [29] [tps_283] jalan reformasi (-4,020916, 119,631688) 99,0%
-> [30] [tps_286] jalan jenderal sudirman (-4,022902, 119,633141) 99,0%
-> [31] [tps_289] jalan bambu runcing (-4,021239, 119,634215) 85,0%
-> [32] [tps_291] jalan bambu runcing (-4,021021, 119,634871) 89,0%
-> [33] [tps_296] jalan bambu runcing (-4,021549, 119,636409) 81,0%
-> [34] [tps_324] jalan bambu runcing (-4,021866, 119,636980) 87,0%
-> [35] [tps_298] jalan bambu runcing (-4,021906, 119,637010) 98,0%

localhost:9090/route
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-> [113] [tps_485] jalan latasakka (-4,049346, 119,622698) 86,0%
-> [114] [tps_462] jalan mattirotasi baru (-4,038642, 119,625310) 91,0%
-> [115] [tps_461] jalan mattirotasi baru (-4,038436, 119,625520) 83,0%
-> [116] [tps_389] jalan samsul alam bulu (-4,035293, 119,639105) 94,0%
-> [117] [tps_389] jalan samsul alam bulu (-4,034067, 119,643154) 84,0%
-> [118] [tps_403] jalan stadiun gelora mandiri (-4,033050, 119,640144) 88,0%
-> [119] [tps_405] jalan stadiun gelora mandiri (-4,034336, 119,642225) 92,0%
-> [120] [tps_409] jalan stadiun gelora mandiri (-4,035063, 119,642310) 85,0%
-> [121] [tps_411] jalan stadiun gelora mandiri (-4,035381, 119,642689) 86,0%
-> [122] [tps_417] jalan stadiun gelora mandiri (-4,036046, 119,643635) 94,0%
-> [123] [tps_419] jalan stadiun gelora mandiri (-4,036385, 119,644012) 87,0%
-> [124] [tps_420] jalan stadiun gelora mandiri (-4,036626, 119,644102) 95,0%
-> [125] [tps_421] jalan stadiun gelora mandiri (-4,036656, 119,644510) 91,0%
-> [126] [tps_422] jalan stadiun gelora mandiri (-4,036619, 119,644829) 99,0%
-> [127] [tps_423] jalan stadiun gelora mandiri (-4,036234, 119,644839) 88,0%
-> [128] [tps_424] jalan stadiun gelora mandiri (-4,035431, 119,644870) 83,0%
-> [129] [tps_425] jalan stadiun gelora mandiri (-4,035041, 119,644906) 81,0%
-> [130] [tps_426] jalan stadiun gelora mandiri (-4,034644, 119,645019) 95,0%
-> [131] [tps_401] jalan samsul alam bulu (-4,033440, 119,645590) 90,0%
-> [132] [tps_400] jalan samsul alam bulu (-4,032956, 119,644001) 90,0%
-> [133] [tps_399] jalan samsul alam bulu (-4,032835, 119,643316) 98,0%
-> [134] [tps_051] jalan bukit madani (-4,005681, 119,646668) 96,0%
-> [135] [tps_047] jalan wirabuana (-3,998290, 119,652142) 97,0%
-> [136] [tps_048] jalan el munawir (-3,999558, 119,653412) 86,0%
-> [137] [tps_045] jalan lisan hanum (-3,994816, 119,654142) 95,0%
-> [138] [tps_042] jalan el munawir (-3,997676, 119,657126) 98,0%
-> [139] [tps_019] jalan bukit madani (-4,002960, 119,660892) 84,0%
-> [140] [tps_027] jalan laupe (-3,992023, 119,637900) 83,0%
-> [141] [tps_064] jalan patukuk (-3,991026, 119,636818) 96,0%
-> [142] [tps_086] gang cantik (-3,991243, 119,635578) 96,0%
-> [143] [tps_073] gg tenro watang soreang (-3,999886, 119,635054) 83,0%
-> [144] [tps_066] gang ketamba (-3,999095, 119,634803) 96,0%
-> [145] [tps_070] gg bete watang soreang (-3,991546, 119,634429) 99,0%
-> [146] [tps_069] gg udang watang soreang (-3,991469, 119,634105) 91,0%
-> [147] [tps_068] gg keping watang soreang (-3,991558, 119,633777) 99,0%
-> [148] [tps_072] gg berongan watang soreang (-3,991716, 119,634992) 94,0%
Kembali ke depot: DLH KOTA PAREPARE

Total jarak pergi (tanpa kembalian): 38,56 km
Jarak kembalian ke depot: 1,94 km
Total jarak PP (round trip): 40,50 km
18.07
26/12/2025

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