Tesla Autopilot Computer Vision Challenge

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1 Travel

A traveling salesman needs a route through seven cities and back to the starting point. The costs to travel between the cities are given in the matrix

$$\begin{bmatrix} - & 415 & 20 & 894 & 340 & 680 & 110 \\ & - & 29 & 654 & 140 & 718 & 243 \\ & & - & 318 & 914 & 138 & 14 \\ & & & - & 683 & 512 & 890 \\ & & & & - & 279 & 414 \\ & & & & & - & 659 \\ & & & & & & - \end{bmatrix}. \quad (1)$$

The matrix is assumed to be symmetric and only the upper half is displayed. Assume that the cities are numbered $1, \ldots, 7$. What is the lowest cost cycle, assuming that the salesman starts in the first city? Provide the answer as a sequence of seven digits. Between the two equivalent directions of the cycle, please disambiguate the answer by choosing the direction for which the first step prefers the city with the smaller sequence identification number.

2 Grass

An animal is chained to a thin pole in the ground using a chain of length $r = 10m$, allowing it to graze over a circular area in the ground with radius r. Assume that the chain is attached at ground level and that the mouth of the animal is exactly at the end of the chain. Also assume that the ground is perfectly flat. The owner wants to move the pole once in such a way that the animal can graze over a total area of $500m^2$ (when including both positions of the pole). What is the distance that the farmer should move the pole? Please provide the answer in meters to three decimal places or more.

3 Pillar

An animal is chained to a pillar in the ground. The pillar has a footprint on the ground that is square with a side length of $1m$. The chain is $r = 5m$

long and attached to one of the corners of the pillar. Assume that the chain is attached at ground level, that the mouth of the animal is exactly at the end of the chain and that the ground is perfectly flat. What is the total area on the ground that the animal can graze over? Please provide the answer in square meters to three decimal places or more.

4 Cards

Four (infinitely thin) playing cards are resting against one another like fallen dominoes, with the first one resting against a perfectly vertical wall. All cards have the height $h = 10cm$ and are equidistantly spaced on the floor by a distance $d = 1cm$. The first card is standing on the perfectly horizontal floor and resting against the perfectly vertical wall. The short side of the card is perfectly parallel to the wall at the distance d from the wall. The second card is resting on the first card in turn, again parallel to the wall with its base a distance d from the base of the first card (and thus $2d$ from the wall). This is continued until the fourth card. Assume that the friction between the cards and the ground is high enough that the cards do not slide (or if you prefer you may think of the cards as attached to the ground with a rotational hinge at the given distance). What is the closest distance from the wall of the resting point of the fourth card onto the third? Please provide the answer in centimeters to three decimal places or more.

5 Trajectory

A particle in one-dimensional space is at rest at the position $x = 0$ meters at time $t = 0$ seconds. Let the position of the particle at time t be denoted by $x(t)$. A force field is applied starting at time $t = 0$ seconds that causes the particle to accelerate by the acceleration $a = e^{t^2} + e^{x^2(t)}$ meters per second square. What is the position $x(t)$ of the particle at time $t = 0.1s$? Please provide the answer in meters to three decimal places or more.

Good Luck!