

Here are some very sketchy solutions for Problem Set 2.

Problem 1:

(a) How many hours to send map data?

100 PB of data at 100 GB/sec is  $10^6$  seconds. Divide by  $60 \cdot 60$  to get about **275 hours**.

(b) How many SD cards?

100 PB of data =  $100 \cdot 10^{15} / 10^{12}$  per card is  **$10^5$  cards**

(c) Transfer rate from SF to NY in hours?

2500 miles at 50 mph is 50 hours.  $100 \cdot 10^{15}$  bytes /  $10^9 = 10^8$  GB

$10^8$  GB in 50 hours, so  $10^8 / 50 / 3600 =$  about 550 GB/sec

**Anything like 500 GB/sec**

(d) How many U-Haul trucks?

Truck is maybe 3 by 2 by 2 meters, or say 10 cubic meters.

One SD card is  $0.01 \cdot 0.01 \cdot 0.001$  cubic meters =  $10^{-7}$ .

There are only  $10^5$  cards, so takes **way under** a cubic meter.

(e) Throughput of avian carriers in MB / sec?

1 TB in 2 hours is  $10^6$  MB in 2 hours. Divide by  $2 \cdot 60 \cdot 60$  to get **140 MB/sec**

Problem 2:

(a) How many meters thick is the folded paper?

Thickness is  $2^{25} \cdot 0.1$ mm.  $32$  million  $\cdot 0.1$  mm is 3.2 million mm or 3200 meters.

(b) How good is the thickness estimate of 0.1mm and why?

Pretty accurate. A ream of 500 sheets of paper is about 2 inches thick.

Problem 3:

(a) (i) How many bits for American cars?

Say 300 million cars, so probably 29 bits (covers 500 million) but 27 or 28 is ok

(ii) How many bytes is that?

4 bytes

(iii) How many bytes if Canadian cars are also included?

4 bytes – another 30 million cars makes no difference.

(b) (i) Range of numbers you can make with 10 fingers?

0 .. 1023 inclusive

(ii) Range with fingers and toes?

0 ..  $2^{20}-1$  inclusive