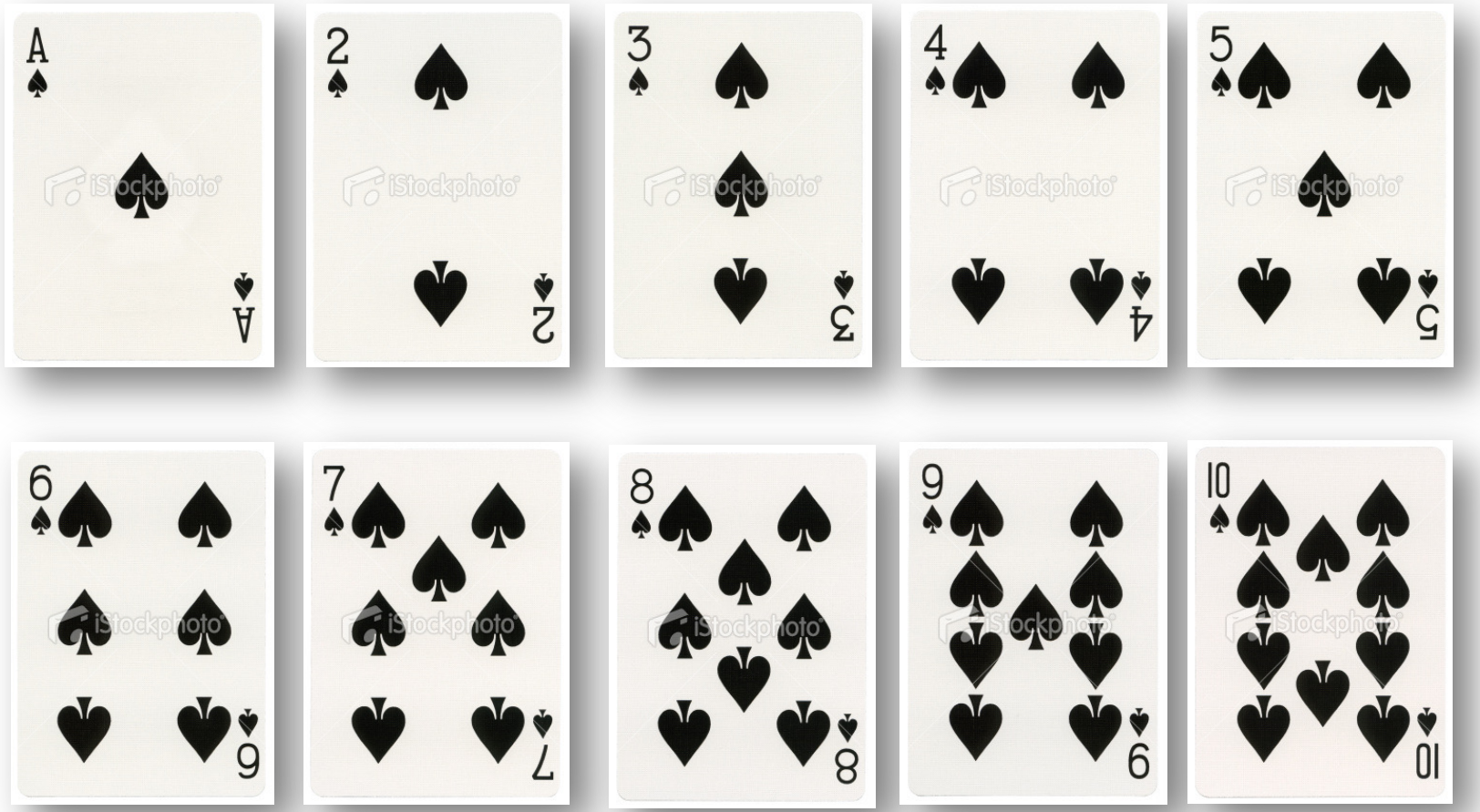
One-Pass Data stream

Danupon Nanongkai

Part 1
Warm-up: Finding a missing number

There are 10 cards: A, 2, 3, …, 10



There are 10 cards: A, 2, 3, …, 10

What is the removed card?

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

Let’s try again

- Hint: It is enough to just memorize one number

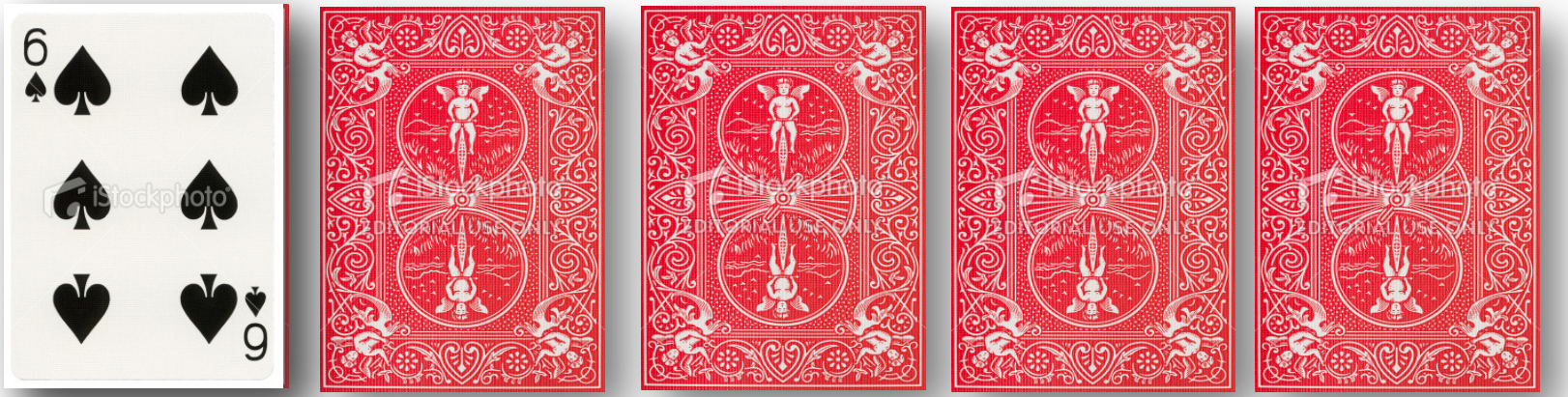
I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time



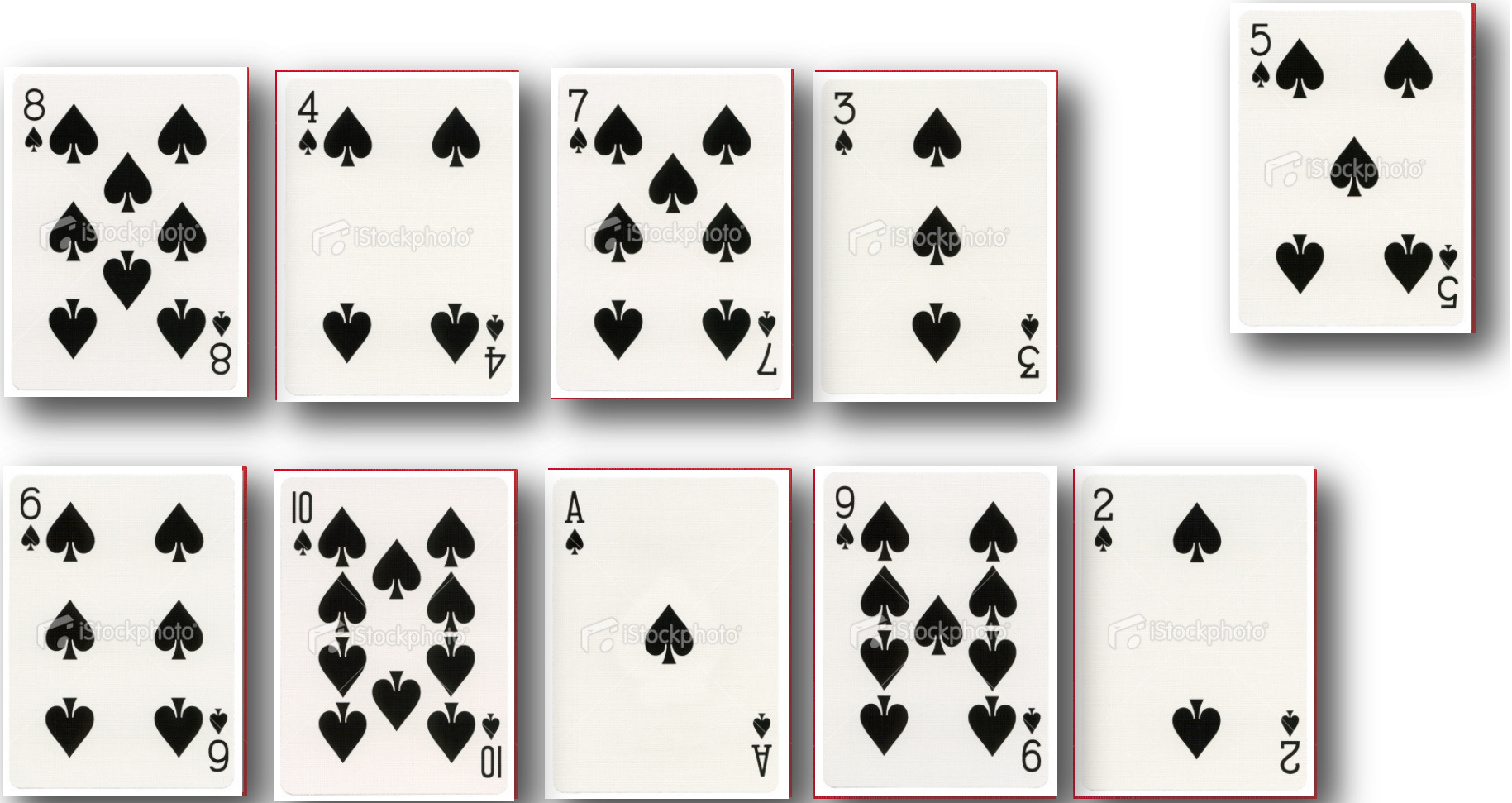
I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

I will show you one number at a time

Answer

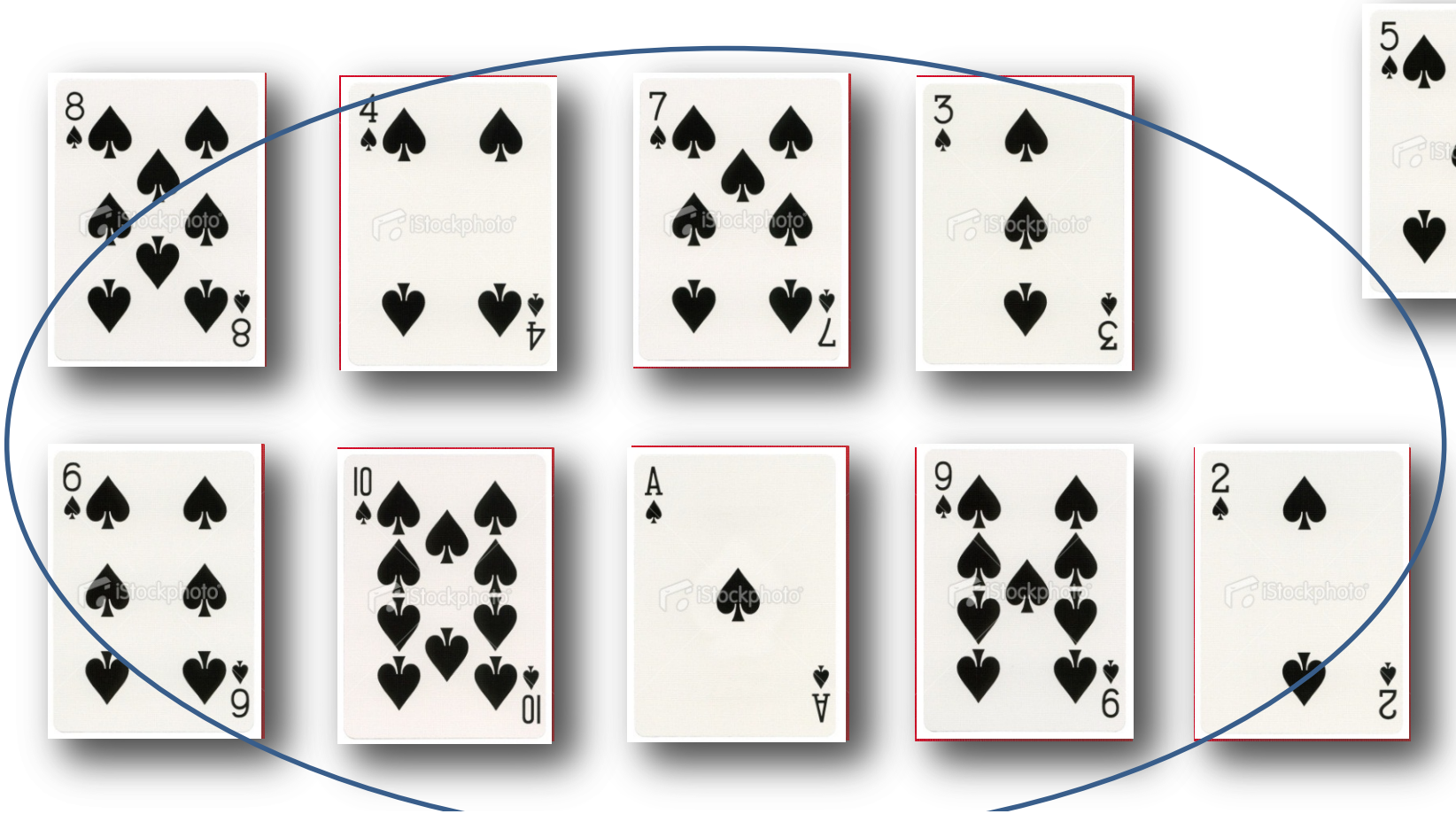


Algorithm

- Memorize the sum of all numbers
- 1+2+3+…+10 = 55

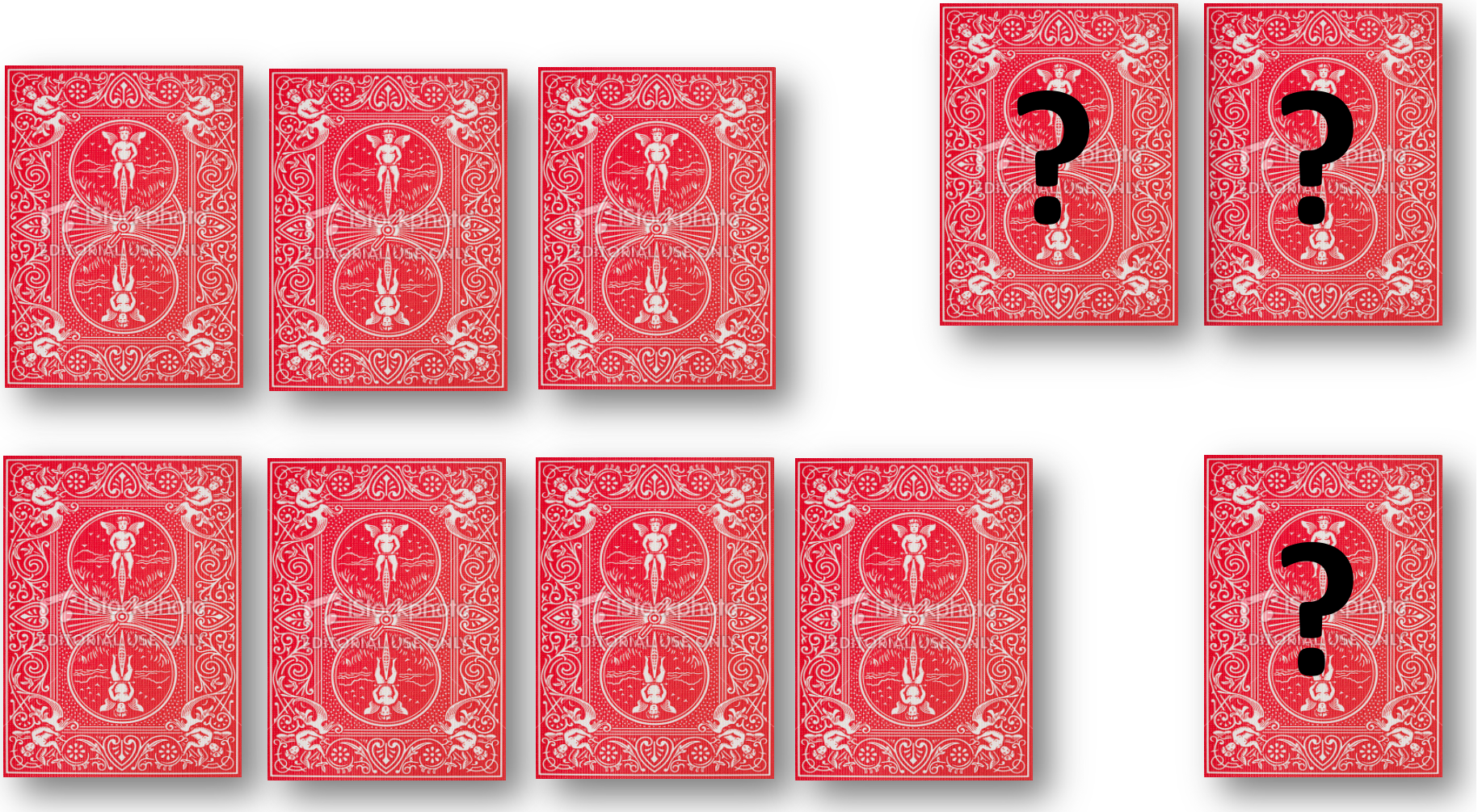
Algorithm

- Memorize the sum of all numbers
- 1+2+3+…+10 = 55



What are the removed cards?

What are the removed cards?



Remove **x** cards → remember **x** numbers

Data Stream Model

Data Stream Model

1 3 5 9 2 10 11 12 20

Small memory

Data Stream Model

1 3 5 9 2 10 11 12 20

Small memory

Data Stream Model

1 3 5 9 2 10 11 12 20

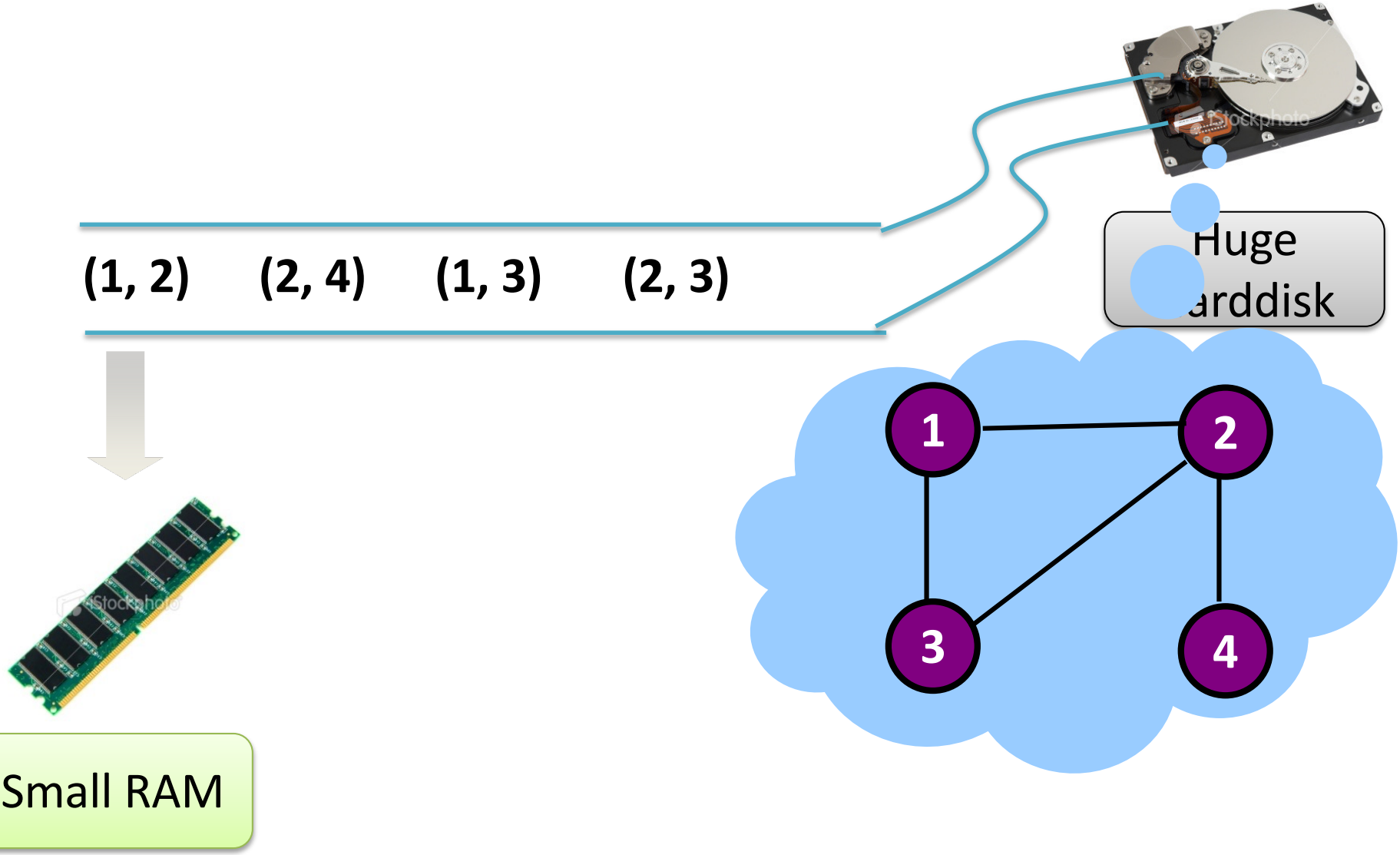
Small memory

Data Stream Model

3 5 9 2 10 11 12 20

Small memory

Graph Streaming model



Applications

- Synchronization in distributed systems
- Network monitoring and traffic engineering
- Sensor networks, RFID tags
- Telecom call records
- Financial applications
- Web logs and click-streams
- Manufacturing processes
- Databases (Data Stream Management Systems)