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DAT402-PT2

Amazon DynamoDB advanced design patterns – Part 2

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Agenda

- Pessimistic Locking
- Shard Key Optimization
- Single versus Multi-table Shootout



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Pessimistic locks

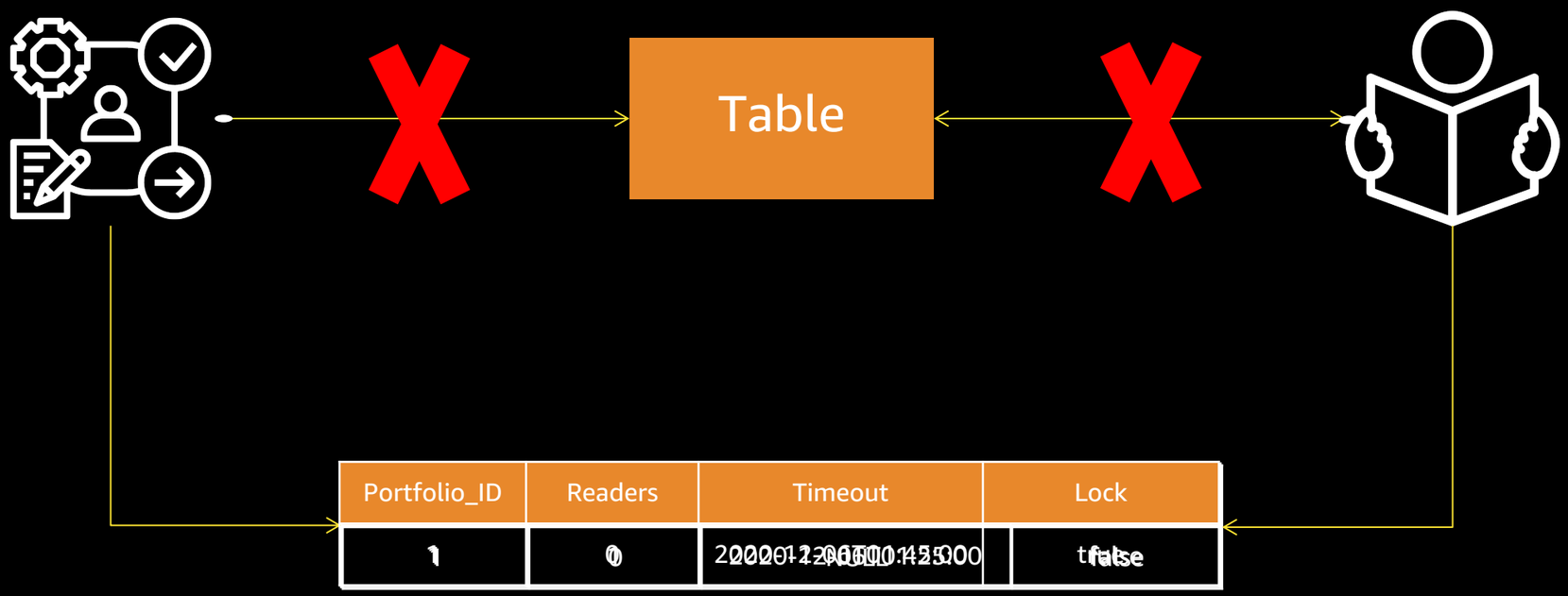


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Trading Data Analytics Platform

- Legacy Service Replacement
  - Supports ~500 data scientists engaged in market research
  - Aggregates anonymized customer portfolio data from multiple brokers
    - Random low frequency imports will overwrite existing portfolio data
  - Strong consistency requirement
    - Queries must not return partially updated data

Process overview



Semaphore items

Obtain Write Lock:

update portfolio_1 set lock = true, writeTimeout = timestamp if lock = false

return all values and then poll until readers = 0 or readTimeout expires

PK	readers	readTimeout	lock	writeTimeout
portfolio_1	5	2020-12-T12:00:00	false	NULL

Set Read Lock:

update portfolio_1 set readers += 1, readTimeout = timestamp if writeLock = false

return all values and poll until writeLock = false

call error handler if writeTimeout expires

Optimizing shard keys



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Getting the most out of DynamoDB throughput

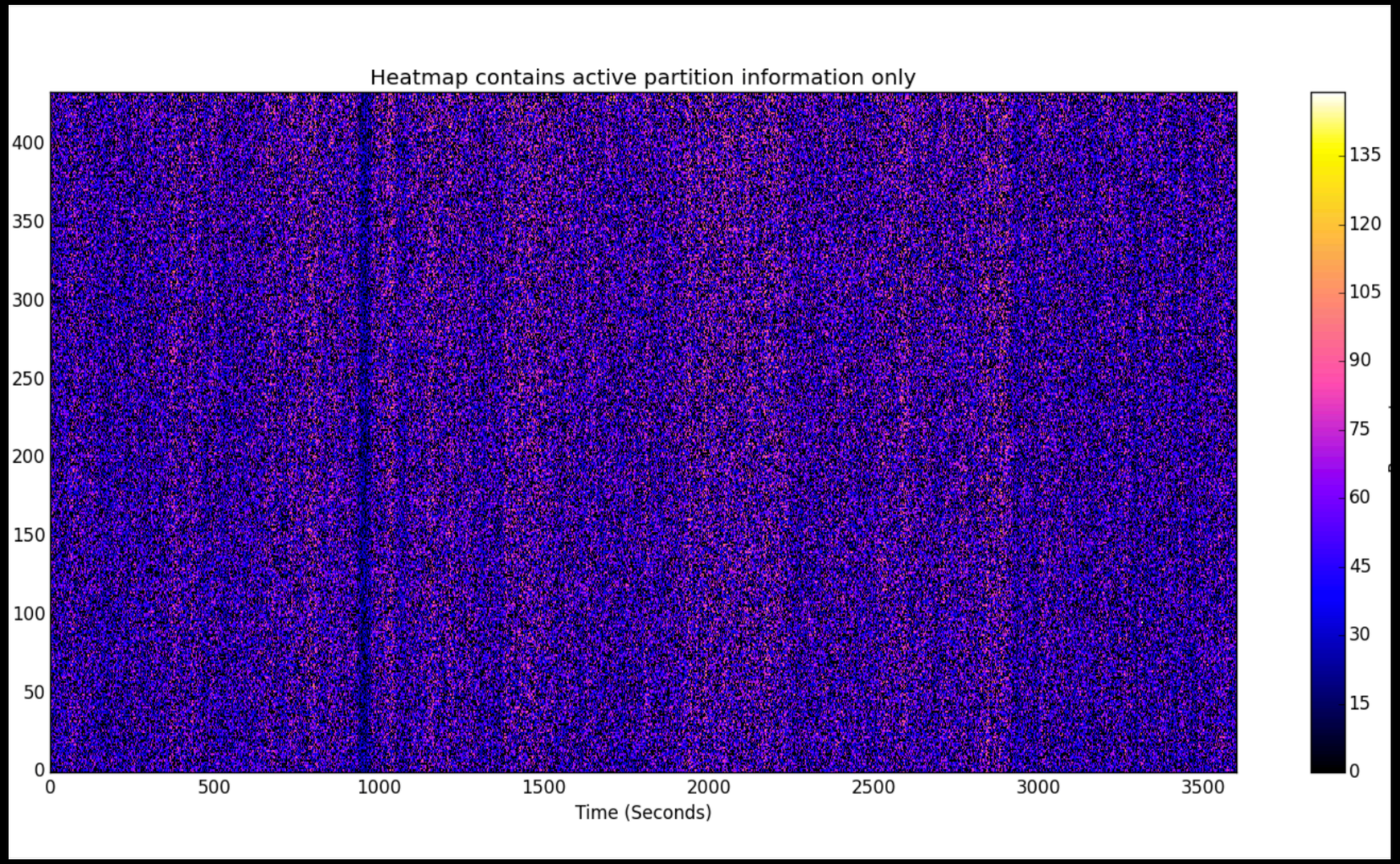
“To get the most out of DynamoDB throughput, create tables where the partition key element has a large number of distinct values, and values are requested fairly uniformly, as randomly as possible.”

—*DynamoDB Developer Guide*

Space: Access is evenly spread over the key space

Time: Requests arrive evenly spaced in time

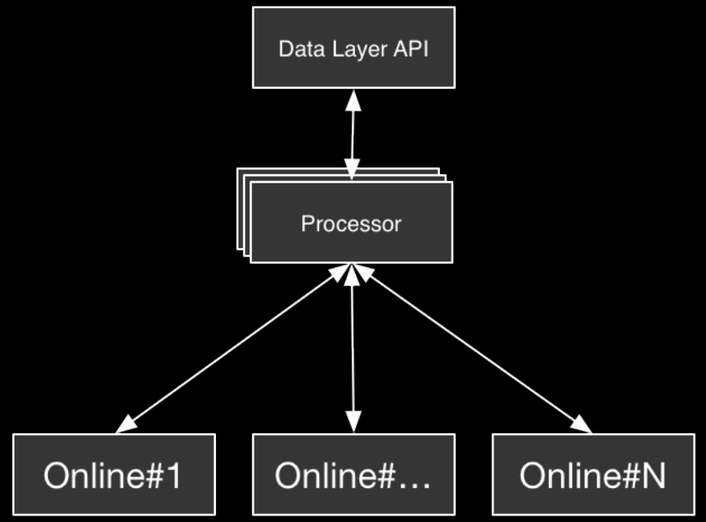
NoSQL workload distribution



Write sharding

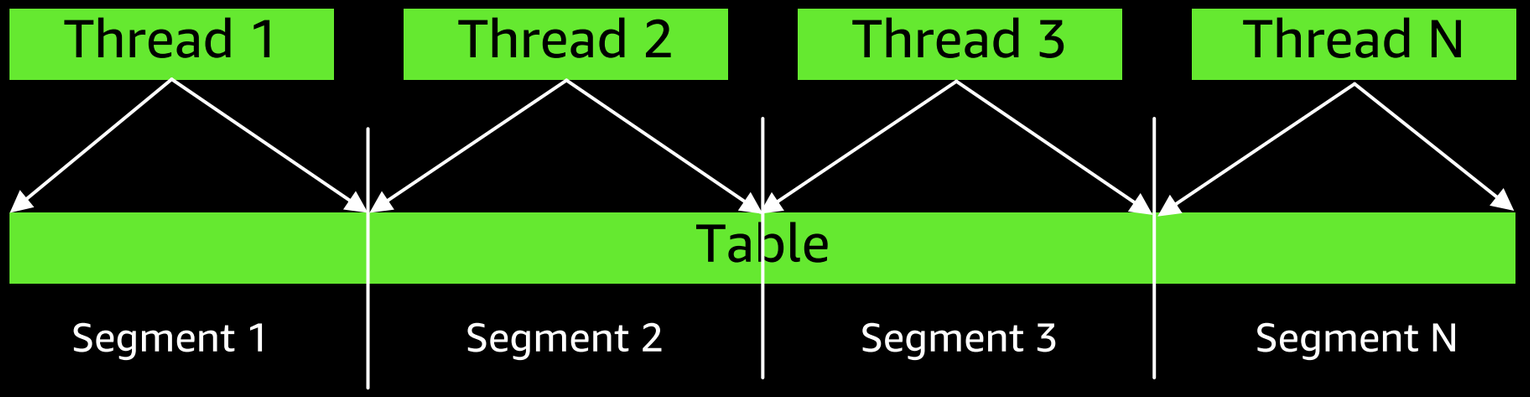
Salt indexed keys to support high-density aggregations on GSIs

Primary Key		Attributes			
PK	SK				
Customer_1	2019-11-29T08:31:28Z#O1	Source	Location	Store	CustomerType
		Online#(0-N)	US	www.amazon.com	Regular
	2019-11-29T08:31:28Z#O1#I1	ASIN	Status	Product	FCCID
		B07G6CQQYG#(0-N)	PROCESSING	BOOM 3	JNZS00170
	Customer_1	Login	Email	Name	Address
		jdoe	john@example.com	John Doe	23 5th Street, Anytown, USA



- Abstract partitioning from clients behind an API
- Write across many partitions
- Use parallel processes to increase read throughput

Parallel scan segmentation



Single vs. multi-table shootout



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All data is relational



Social network



Document management



Process control

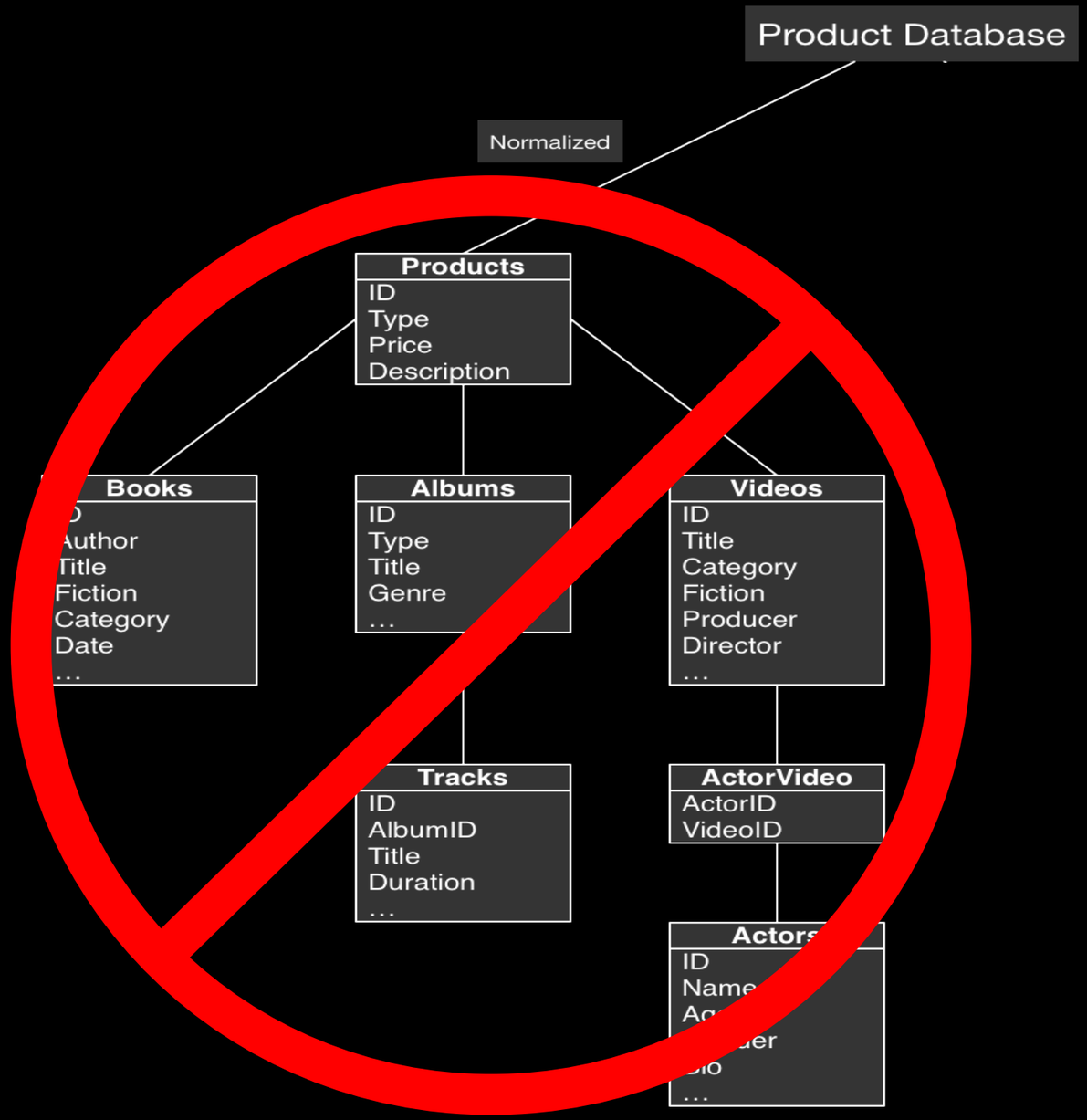


IT monitoring



Data trees

SQL vs. NoSQL design pattern



Ad hoc “joins” in SQL

```
SELECT * FROM PRODUCTS
INNER JOIN BOOKS ON
productId = productId
WHERE name = “Book Title”
```

```
SELECT * FROM PRODUCTS
INNER JOIN ALBUMS ON
productId = productId
INNER JOIN TRACKS ON
albumId = albumId
WHERE name = “Album Title”
```

```
SELECT * FROM PRODUCTS
INNER JOIN VIDEOS ON
productId = productId
INNER JOIN ACTORVIDEO ON
videoId = videoId
INNER JOIN ACTORS ON
actorId = actorId
WHERE name = “Movie Title”
```

productId	name	type	price
1	Frankenstein	Book	11.99
2	Dire Straits	Album	17.49
3	Big	Video	14.99
4	Jane Eyre	Book	10.99
5	The Dark Side of the Moon	Album	17.49
6	Saving Private Ryan	Video	18.99

bookId	productId	author	publisher	ISBN-10
1	1	Mary Shelley	Bantam	553212478
2	4	Charlotte Brontë	Wordsworth	1853260207

albumId	productId	artist	producer	releaseDate
1	2	Dire Straits	Muff Winwood	10/7/78
2	5	Pink Floyd	Pink Floyd	3/1/73

videoId	productId	writer	director	releaseDate
1	3	Ann Spielberg	Penny Marshall	6/5/88
2	6	Robert Rodat	Steven Spielberg	7/21/98

actorVideoId	videoId	actorId	character
1	1	1	Josh
2	2	1	Captain Miller
3	1	2	Susan
4	1	3	MacMillan

actorId	gender	name	birthDate
1	M	Tom Hanks	7/9/56
2	F	Elizabeth Perki	11/18/60
3	M	Robert Loggia	1/3/30

trackId	albumId	song	duration
1	1	Down to the Waterline	3:55
2	1	Water of Love	5:23
3	1	Setting Me Up	3:18
4	1	Six Blade Knife	4:10
5	1	Southbound Again	2:58
6	1	Sultans of Swing	5:47
7	1	In the Gallery	6:16
8	1	Wild West End	4:42
9	1	Lions	5:05
10	2	Speak to Me	1:13
11	2	Breathe	2:43
12	2	On the Run	3:36
13	2	Time	4:36
14	2	The Great Gig in the Sky	19:27
15	2	Money	6:23
16	2	Us and Them	7:49
17	2	Any Colour You Like	3:26
18	2	Brain Damage	3:49
19	2	Eclipse	2:03

Time Complexity

$O(\log(N)+\log(M)+\log(M)+\log(M))$

Modeled “joins” in NoSQL

SELECT * WHERE PK=“Book Title”

SELECT * WHERE PK=“Album Title”

SELECT * WHERE PK=“Movie Title”

Time Complexity

O(log(N))

Primary Key		Attributes			
PK	SK				
Frankenstein	Mary Shelley	Type	Price	Publisher	ISBN-10
		book	11.99	Bantam	553212478
Dire Straits	Dire Straits	Type	Price	Producer	ReleaseDate
		album	17.49	Muff Winwood	10/7/78
	Down to the Waterline	Duration	TrackNo		
		3:55	1		
	Water of Love	Duration	TrackNo		
		5:23	2		
	Setting Me Up	Duration	TrackNo		
		3:18	3		
	Six Blade Knife	Duration	TrackNo		
		4:10	4		
	Southbound Again	Duration	TrackNo		
		2:58	5		
	Sultans of Swing	Duration	TrackNo		
		5:47	6		
	In the Gallery	Duration	TrackNo		
		6:16	7		
	Wild West End	Duration	TrackNo		
		4:42	8		
	Lions	Duration	TrackNo		
		5:05	9		
Big	Penny Marshall	Type	Price	Writer	ReleaseDate
		video	14.99	Ann Spielberg	6/5/88
	Tom Hanks	Character	Gender	BirthDate	
		Josh	Male	7/9/56	
	Elizabeth Perkins	Character	Gender	BirthDate	
		Susan	Female	11/18/60	
	Robert Loggia	Character	Gender	BirthDate	
		MacMillan	Male	1/3/30	
Tom Hanks	Tom Hanks	Gender	BirthDate	Bio	
		Male	7/9/56	{…}	

Modeled “joins” in NoSQL

SELECT * WHERE SK=“Author Name”

SELECT * WHERE SK=“Song Title”

SELECT * WHERE SK=“Actor Name”

SELECT * WHERE SK=“Director Name”

SELECT * WHERE SK=“Musician”

Swap PK and SK on index

Primary Key		Attributes			
PK	SK				
Mary Shelley	Frankenstein	Type	Price	Publisher	ISBN-10
		book	11.99	Bantam	553212478
Sultans of Swing	Dire Straits	Duration	TrackNo		
		5:47	6		
	Sultans of Swing: The Very Best of Dire Straits	Duration	TrackNo		
		5:50	1		
Tom Hanks	Big	Type	Gender	BirthDate	
		Josh	Male	7/9/56	
	Saving Private Ryan	Character	Gender	BirthDate	
		Captain Miller	Male	7/9/56	
	Tom Hanks	Gender	BirthDate	Bio	
		Male	7/9/56	{…}	
Penny Marshall	Big	Type	Price	Writer	ReleaseDate
		video	14.99	Ann Spielberg	6/5/88
Dire Straits	Dire Straits	Type	Price	Producer	ReleaseDate
		album	17.49	Muff Winwood	10/7/78
	Sultans of Swing: The Very Best of Dire Straits	Type	Price	Producer	ReleaseDate
		album	25.99	Various	10/19/98

In case you missed it...

DAT402–PT1

Amazon DynamoDB advanced design patterns - Part 1

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Related sessions

DAT305-PT1

Data modeling with Amazon DynamoDB – Part 1

DAT305-PT2

Data modeling with Amazon DynamoDB – Part 2

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