Sisteme Tolerante la Defecte
RAID & Spark

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RAID

Redundant Array of Inexpensive Disks

sau

Redundant Array of Independent Disks

RAID 0

Avantaj: Performanță

Dezavantaj: Chiar și dacă un singur disc este pierdut se pierd toate datele

RAID 1

Avantaj: Redundant. Se poate pierde un disc.
Dezavantaj: Spațiu de stocare este înjumătățit (1/2).

Coduri de Paritate

A	B	A xor B
0	0	0
1	0	1
0	1	1
1	1	0

Numărul de 1-uri total e par pe fiecare linie

Coduri de Paritate

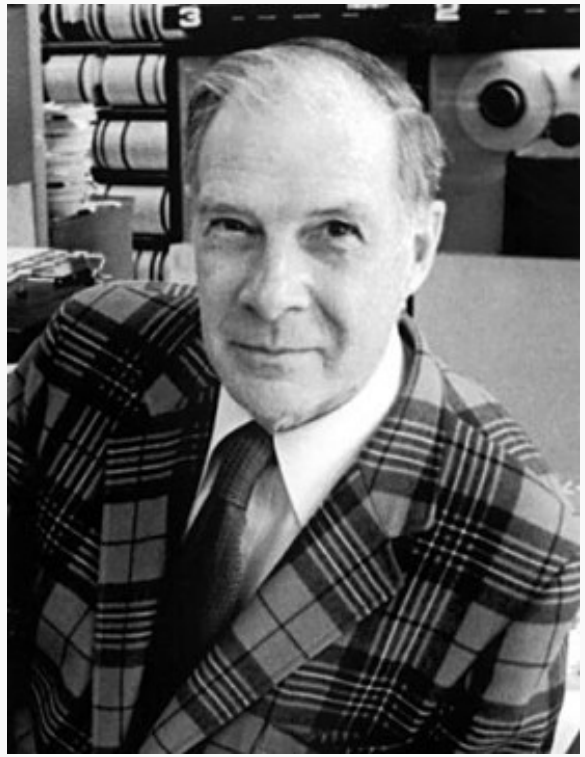
A	B	A xor B	A xor B xor A = B
0	0	0	0
1	0	1	0
0	1	1	1
1	1	0	1

Două discuri cu date.
Un disc xor între cele două discuri.

Oricare din cele 3 discuri poate fi refăcut folosind datele din celelalte două.

Coduri de paritate – Hamming - 1950

A man asked me to check some arithmetic he had done, and I agreed, thinking to fob it off on some subordinate. When I asked what it was, he said, "**It is the probability that the test bomb will ignite the whole atmosphere.**" I decided I would check it myself! The next day when he came for the answers I remarked to him, "The arithmetic was apparently correct but I do not know about the formulas for the capture cross sections for oxygen and nitrogen—after all, there could be no experiments at the needed energy levels." He replied, like a physicist talking to a mathematician, that he wanted me to check the arithmetic not the physics, and left. I said to myself, "What have you done, Hamming, you are involved in risking all of life that is known in the Universe, and you do not know much of an essential part?" I was pacing up and down the corridor when a friend asked me what was bothering me. I told him. His reply was, "**Never mind, Hamming, no one will ever blame you**."



Coduri de paritate – Hamming

	P1	P2	D3	P4	D5	D6	D7	P8	D9	D10	D11	D12	D13	D14	D15
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Coduri de paritate – Hamming

			1		**0**	**1**	**0**		**1**	**1**	**1**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Coduri de paritate – Hamming

	0		**1**		**0**	**1**	**0**		**1**	**1**	**1**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Coduri de paritate – Hamming

	0	**0**	**1**		**0**	**1**	**0**		**1**	**1**	**1**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Coduri de paritate – Hamming

	0	**0**	**1**	**1**	**0**	**1**	**0**		**1**	**1**	**1**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Coduri de paritate – Hamming

	0	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Coduri de paritate – Hamming

	0	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Coduri de paritate – Hamming

	0	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

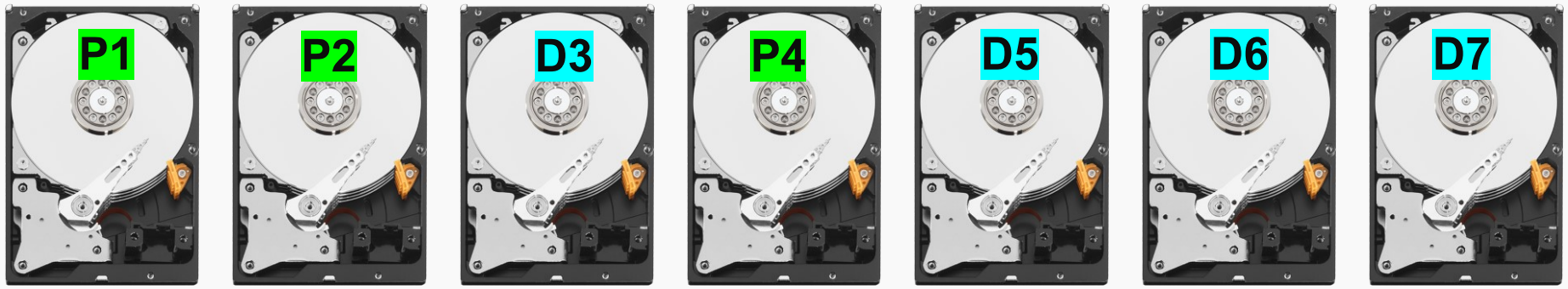
Coduri de paritate – Hamming

	0	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

Coduri de paritate – Hamming

	0	**0**	**1**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**1**	**1**
P8	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
P4	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
P2	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
P1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

RAID 2



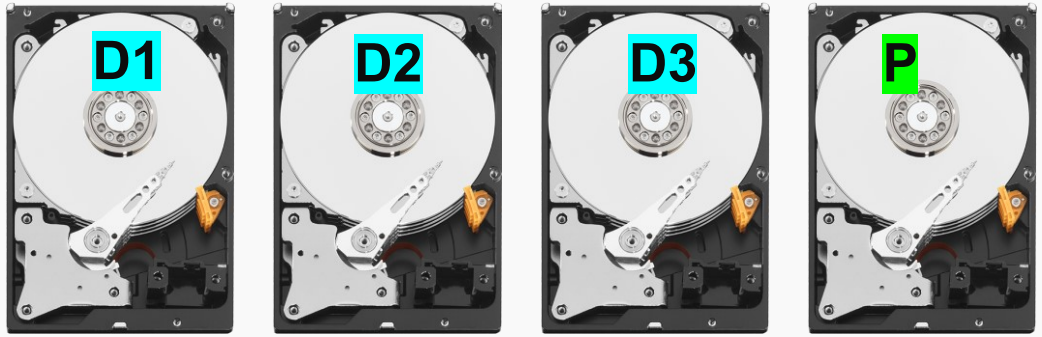
Avantaj: Redundant. Se poate pierde un disc.

Dezavantaj: Doar 4/7 spațiu folosibil (poate fi îmbunătățit cu mai multe HDD)

Se face la nivel de bit.

Durează refacerea.

RAID 3



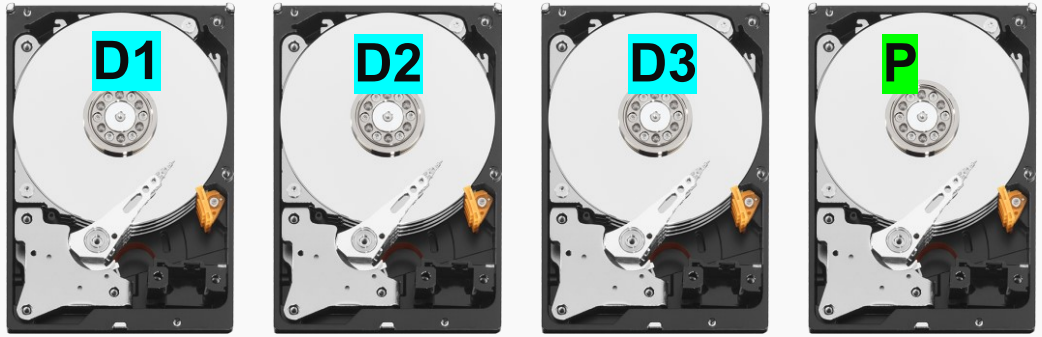
Avantaj: Redundant. Se poate pierde un disc.

Dezavantaj: Doar 3/4 spațiu folosibil (poate fi îmbunătățit cu mai multe HDD)

Se face la nivel de byte.

Durează refacerea.

RAID 4



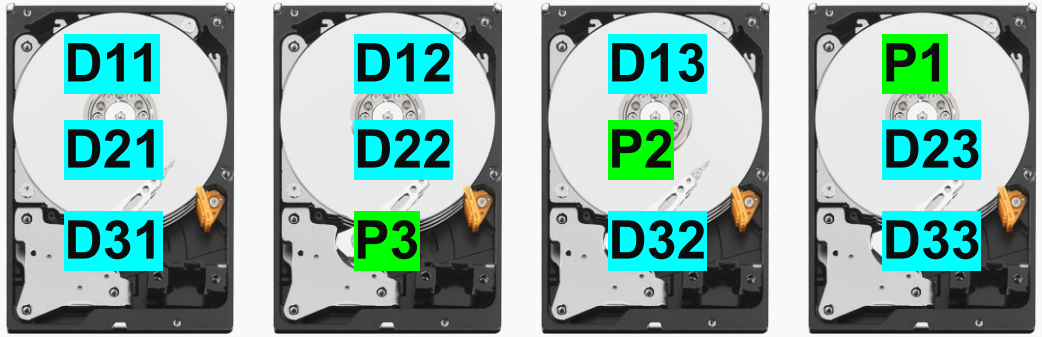
Avantaj: Redundant. Se poate pierde un disc.

Dezavantaj: Doar 3/4 spațiu folosibil (poate fi îmbunătățit cu mai multe HDD)

Se face la nivel de bloc.

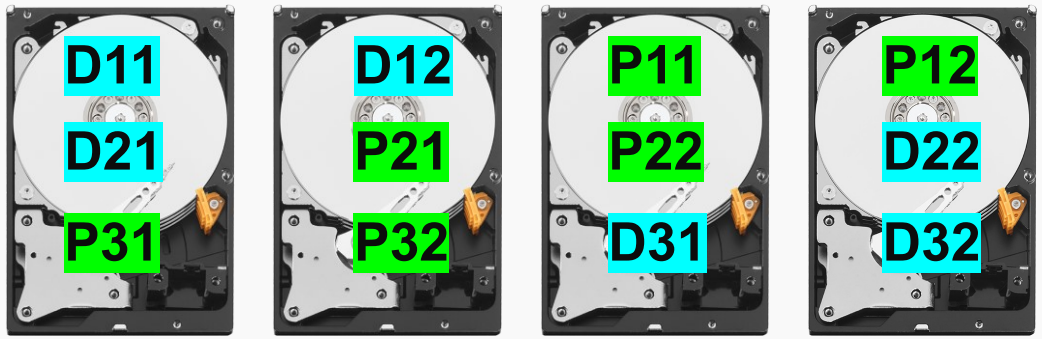
Durează refacerea.

RAID 5



Avantaj: Redundant. Se poate pierde un disc. Unele date sunt accesibile fără refacere.
Dezavantaj: Doar 3/4 spațiu folosibil (poate fi îmbunătățit cu mai multe HDD)
Se face la nivel de bloc.

RAID 5

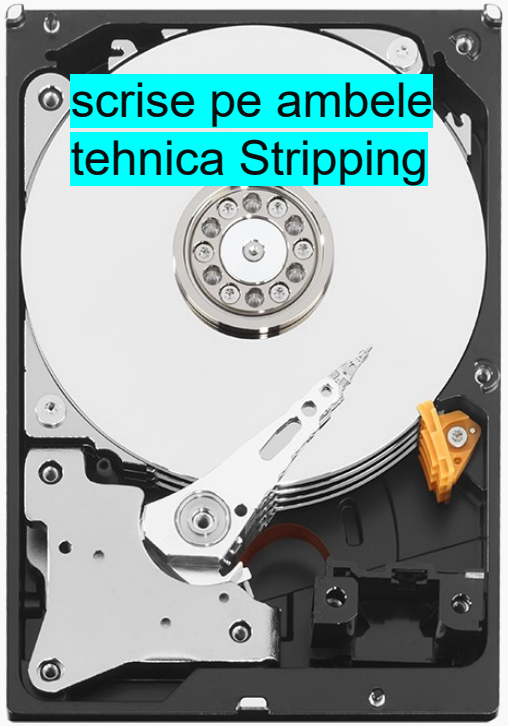


Avantaj: Redundant. Se pot pierde două discuri. Unele date sunt accesibile fără refacere.
Dezavantaj: Doar 2/4 spațiu folosibil (poate fi îmbunătățit cu mai multe HDD)
Se face la nivel de bloc.

RAID 10

RAID 1

RAID 0

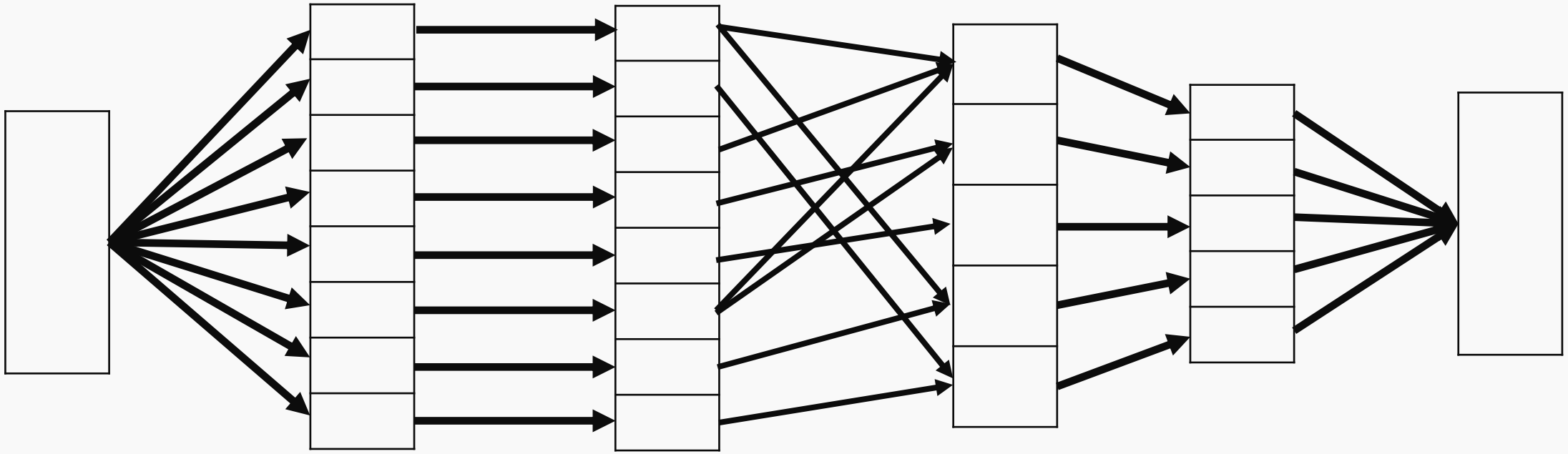


RAID 0

RAID-uri

	Descriere	Număr minim discuri	Spațiu folosibil	Toleranță la defecte
RAID 0	Block-level striping without parity or mirroring	2	1	Fără
RAID 1	Mirroring without parity or striping	2	$1/n$	$n - 1$ discuri
RAID 2	Bit-level striping with Hamming code for error correction	3	$1 - 1/n \log_2 (n + 1)$	Doar un disc
RAID 3	Byte-level striping with dedicated parity	3	$1 - 1/n$	Doar un disc
RAID 4	Block-level striping with dedicated parity	3	$1 - 1/n$	Doar un disc
RAID 5	Block-level striping with distributed parity	3	$1 - 1/n$	Doar un disc
RAID 6	Block-level striping with double distributed parity – Reed-Solomon coding	4	$1 - 2/n$	Două discuri
RAID 10	Raid 1 and Raid 0	4	2/n	n/2 discuri

Map Reduce




hadoop

Ion Stoica

Matei Zaharia

RDD

Resilient Distributed Dataset