JOINING DATA IN R WITH DATA.TABLE

Concatenating data.tables

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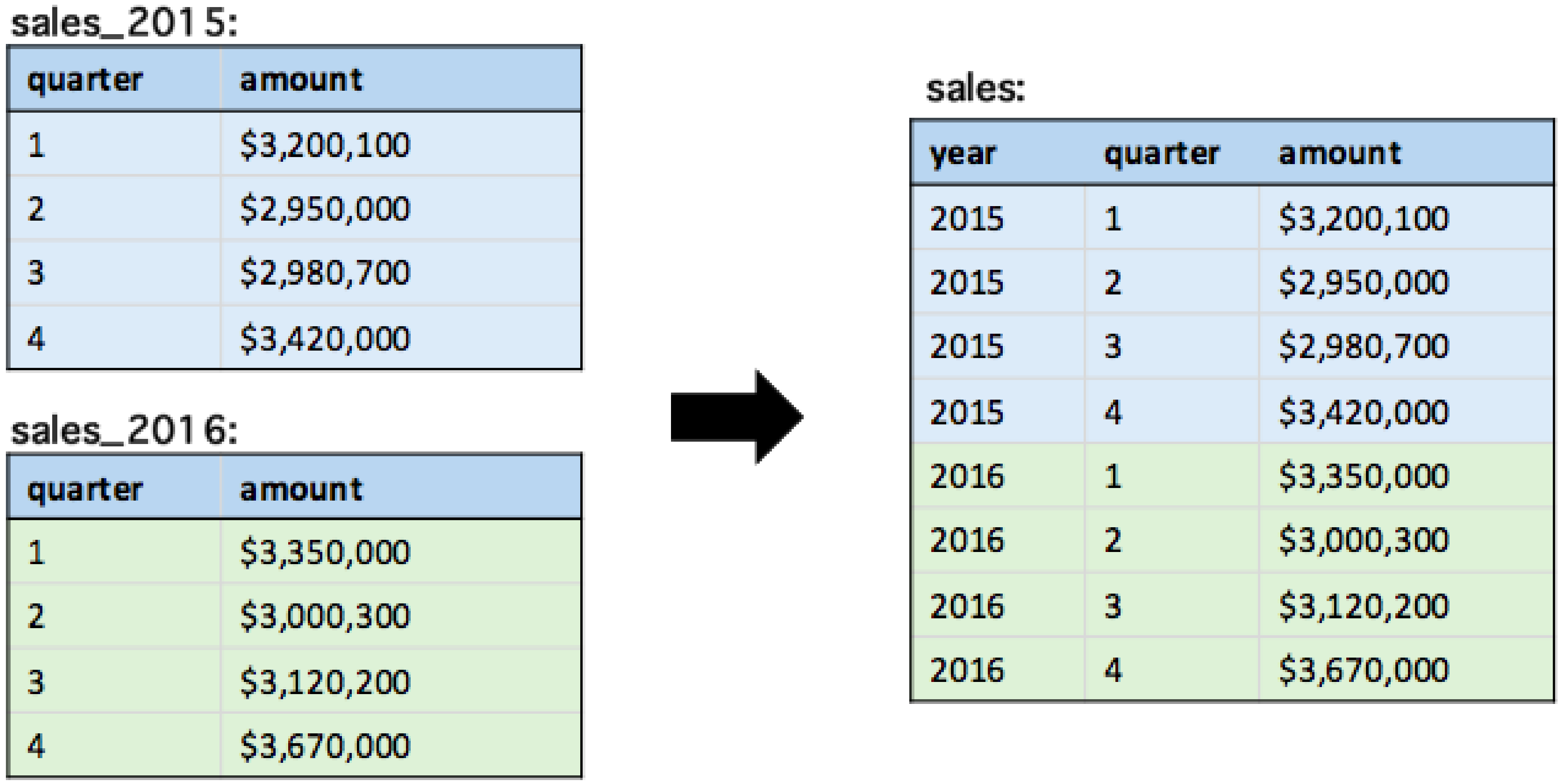
Same columns, different data.tables

Concatenating `data.tables`



sales_2015:

quarter	amount
1	$3,200,100
2	$2,950,000
3	$2,980,700
4	$3,420,000

sales_2016:

quarter	amount
1	$3,350,000
2	$3,000,300
3	$3,120,200
4	$3,670,000

sales:

year	quarter	amount
2015	1	$3,200,100
2015	2	$2,950,000
2015	3	$2,980,700
2015	4	$3,420,000
2016	1	$3,350,000
2016	2	$3,000,300
2016	3	$3,120,200
2016	4	$3,670,000

Concatenation functions

`rbind()`: concatenate rows from `data.tables` stored in different variables

`rbindlist()`: concatenate rows from a `list` of `data.tables`

The rbind() function

Concatenate two or more `data.tables` stored as variables

```
# ... takes any number of arguments
rbind(...)
```

```
rbind(sales_2015, sales_2016)

   quarter  amount
1:       1 3200100
2:       2 2950000
3:       3 2980700
4:       4 3420000
5:       1 3350000
6:       2 3000300
7:       3 3120200
8:       4 3670000
```

Adding an identifier column

The `idcol` argument adds a column indicating the `data.table` of origin

```
rbind("2015" = sales_2015, "2016" = sales_2016, idcol = "year")

   year quarter  amount
1: 2015       1 3200100
2: 2015       2 2950000
3: 2015       3 2980700
4: 2015       4 3420000
5: 2016       1 3350000
6: 2016       2 3000300
7: 2016       3 3120200
8: 2016       4 3670000
```

Adding an identifier column

```
rbind(sales_2015, sales_2016, idcol = "year")

   year quarter  amount
1:    1       1 3200100
2:    1       2 2950000
3:    1       3 2980700
4:    1       4 3420000
5:    2       1 3350000
6:    2       2 3000300
7:    2       3 3120200
8:    2       4 3670000
```

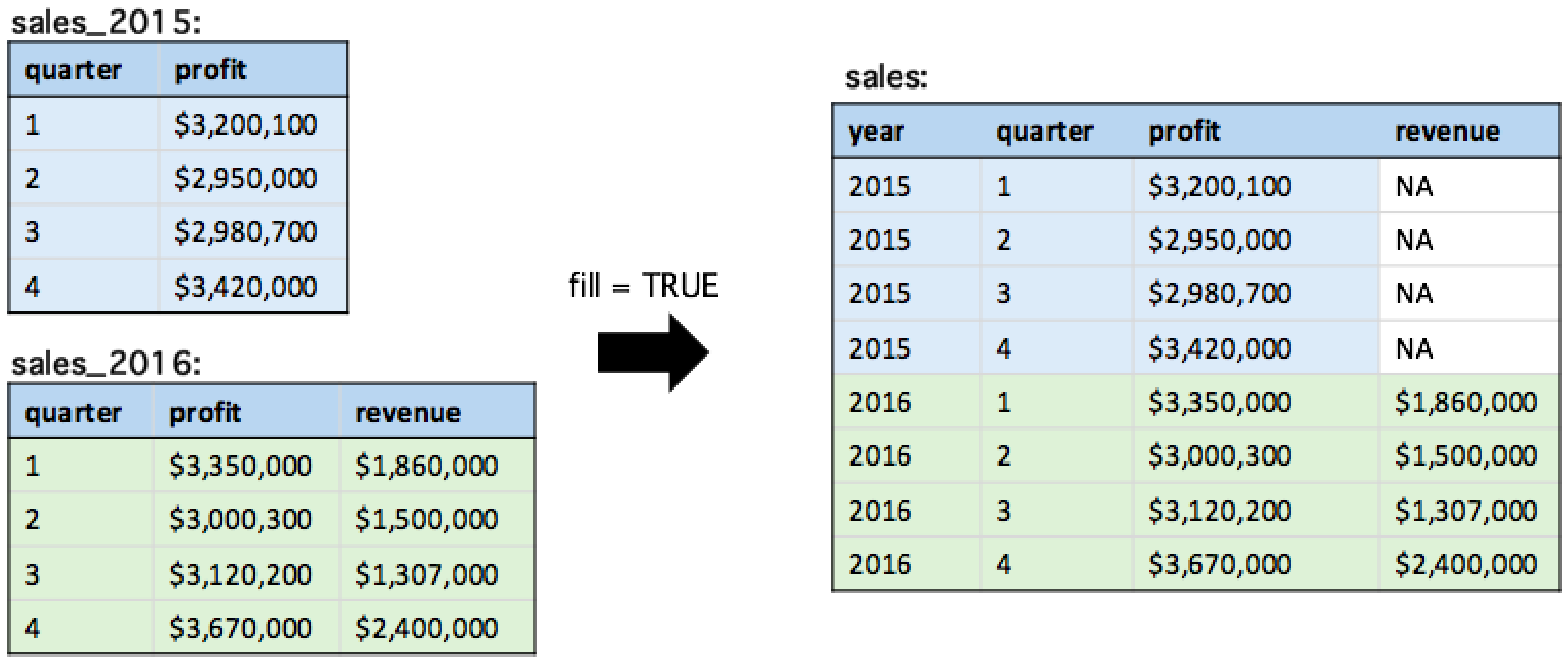
Adding an identifier column

```
rbind(sales_2015, sales_2016, idcol = TRUE)

   .id quarter  amount
1:   1       1 3200100
2:   1       2 2950000
3:   1       3 2980700
4:   1       4 3420000
5:   2       1 3350000
6:   2       2 3000300
7:   2       3 3120200
8:   2       4 3670000
```

Handling missing columns

```
rbind("2015" = sales_2015, "2016" = sales_2016, idcol = "year",
      fill = TRUE)
```



sales_2015:

quarter	profit
1	$3,200,100
2	$2,950,000
3	$2,980,700
4	$3,420,000

sales_2016:

quarter	profit	revenue
1	$3,350,000	$1,860,000
2	$3,000,300	$1,500,000
3	$3,120,200	$1,307,000
4	$3,670,000	$2,400,000

fill = TRUE

sales:

year	quarter	profit	revenue
2015	1	$3,200,100	NA
2015	2	$2,950,000	NA
2015	3	$2,980,700	NA
2015	4	$3,420,000	NA
2016	1	$3,350,000	$1,860,000
2016	2	$3,000,300	$1,500,000
2016	3	$3,120,200	$1,307,000
2016	4	$3,670,000	$2,400,000

Handling missing columns

```
rbind(sales_2015, sales_2016, idcol = "year")

Error in rbindlist(l, use.names, fill, idcol) :
  Item 2 has 3 columns, inconsistent with item 1 which has 2 columns.
  If instead you need to fill missing columns, use set argument 'fill'
  to TRUE.
```

The rbindlist() function

Concatenate rows from a `list` of `data.tables`

```
# Read in a list of data.tables
table_files <- c("sales_2015.csv", "sales_2016.csv")
list_of_tables <- lapply(table_files, fread)
```

```
rbindlist(list_of_tables)

   quarter  amount
1:       1 3200100
2:       2 2950000
3:       3 2980700
4:       4 3420000
5:       1 3350000
6:       2 3000300
7:       3 3120200
8:       4 3670000
```

Adding an identifier column

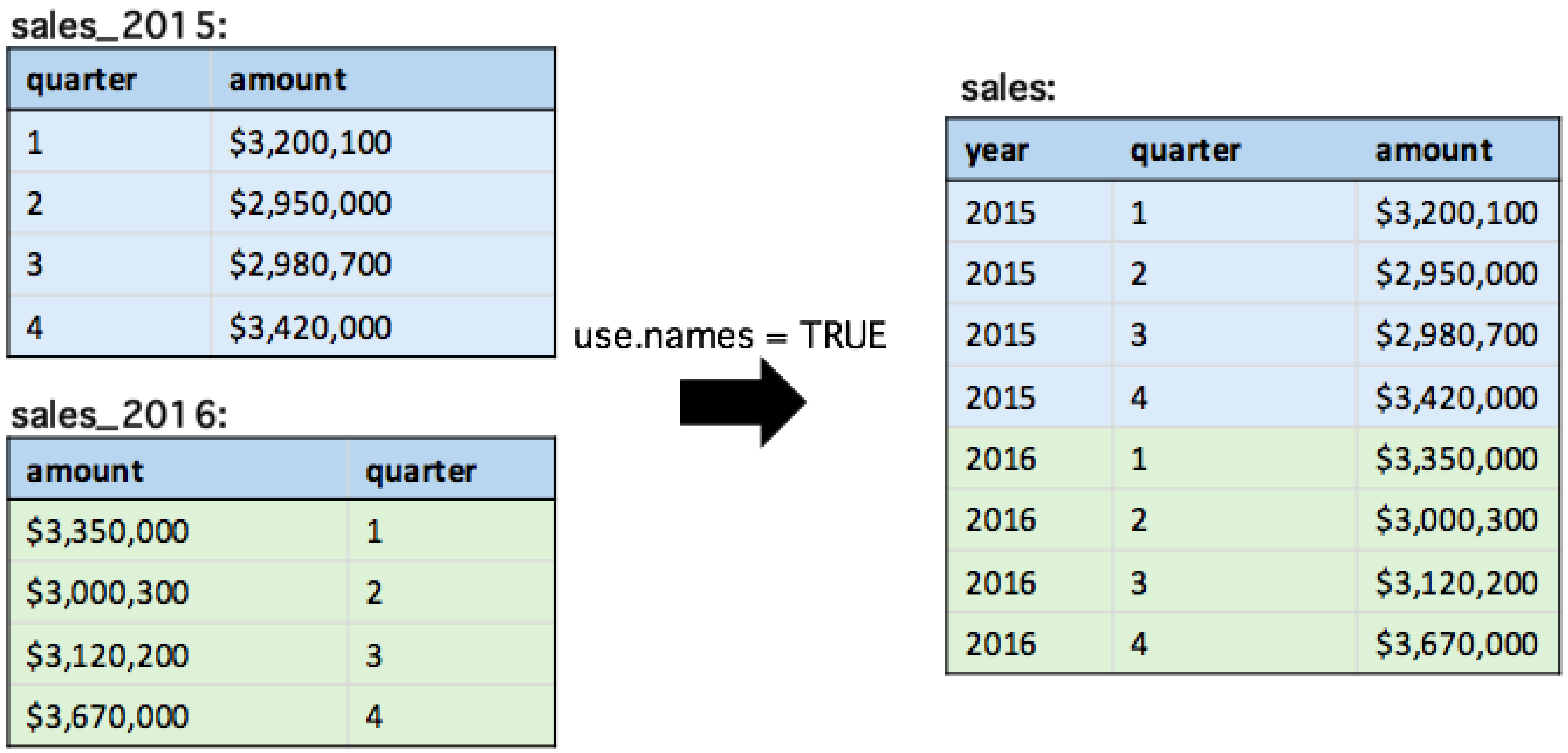
The `idcol` argument takes names from the input list

```
names(list_of_tables) <- c("2015", "2016")
rbindlist(list_of_tables, idcol = "year")

   year quarter  amount
1: 2015       1 3200100
2: 2015       2 2950000
3: 2015       3 2980700
4: 2015       4 3420000
5: 2016       1 3350000
6: 2016       2 3000300
7: 2016       3 3120200
8: 2016       4 3670000
```

Handling different column orders

```
rbind("2015" = sales_2015, "2016" = sales_2016, idcol = "year",
      use.names = TRUE)
```



sales_2015:

quarter	amount
1	$3,200,100
2	$2,950,000
3	$2,980,700
4	$3,420,000

sales_2016:

amount	quarter
$3,350,000	1
$3,000,300	2
$3,120,200	3
$3,670,000	4

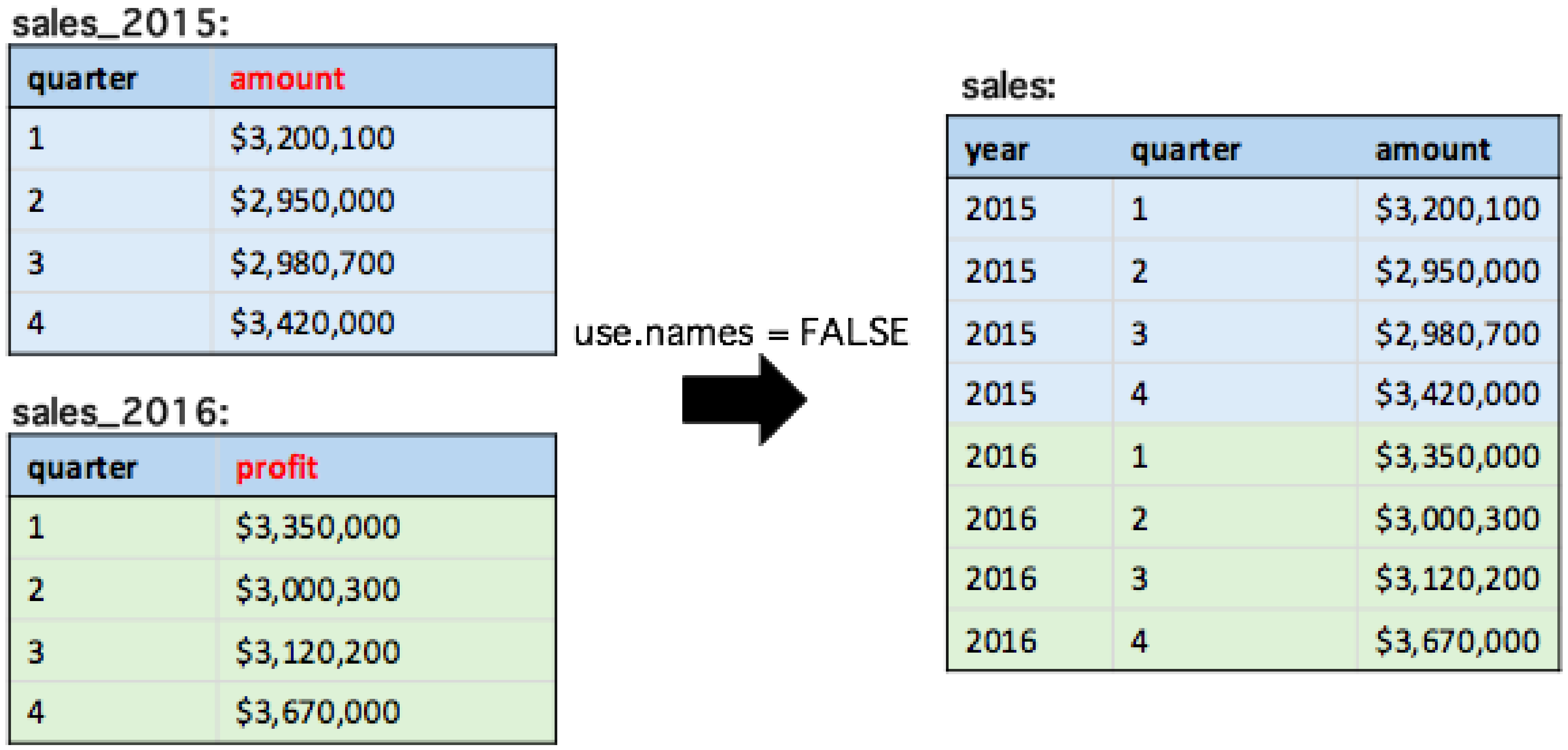
use.names = TRUE

sales:

year	quarter	amount
2015	1	$3,200,100
2015	2	$2,950,000
2015	3	$2,980,700
2015	4	$3,420,000
2016	1	$3,350,000
2016	2	$3,000,300
2016	3	$3,120,200
2016	4	$3,670,000

data.tables with different column names

```r
rbind("2015" = sales_2015, "2016" = sales_2016, idcol = "year",
      use.names = FALSE)
```



sales_2015:

quarter	amount
1	$3,200,100
2	$2,950,000
3	$2,980,700
4	$3,420,000

sales_2016:

quarter	profit
1	$3,350,000
2	$3,000,300
3	$3,120,200
4	$3,670,000

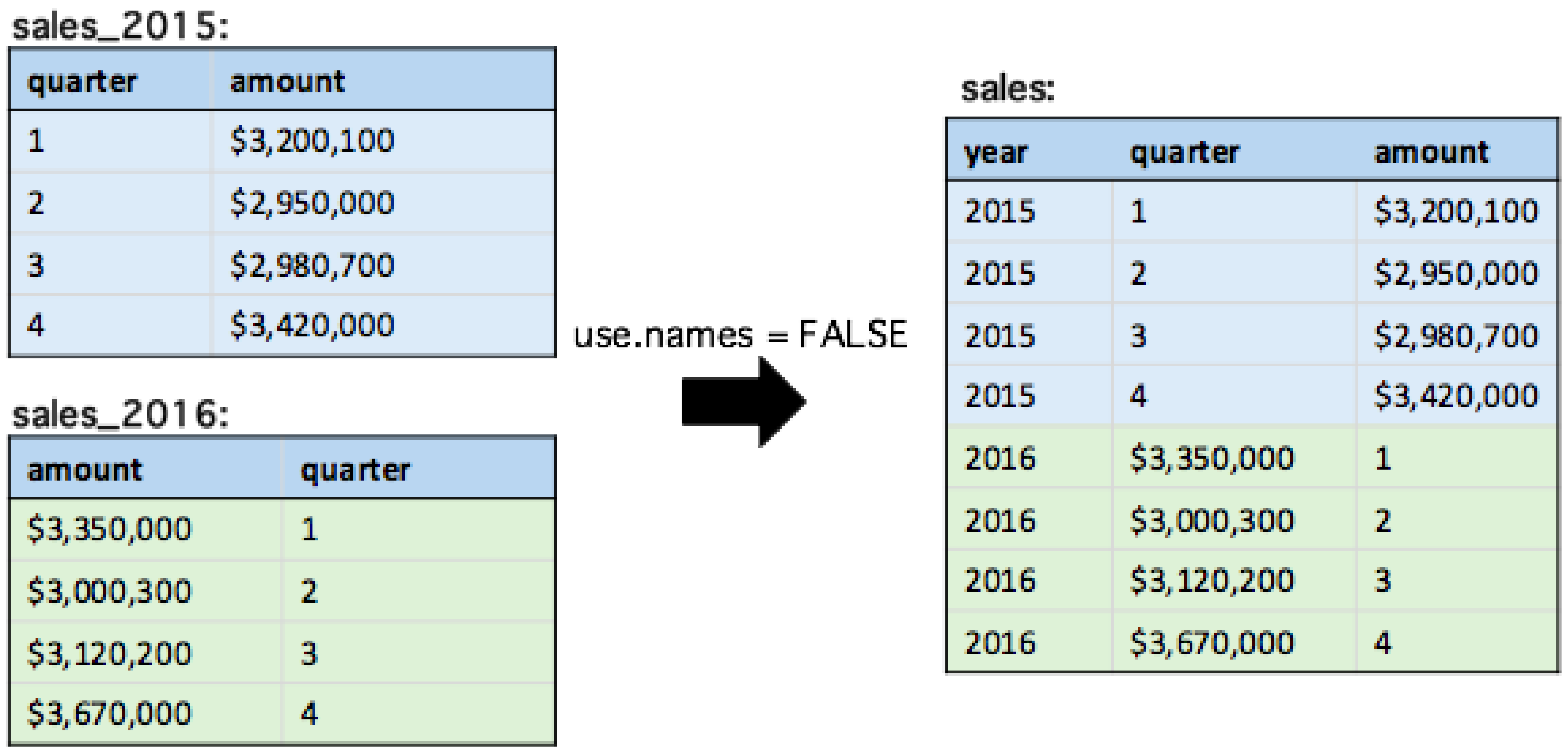
use.names = FALSE

sales:

year	quarter	amount
2015	1	$3,200,100
2015	2	$2,950,000
2015	3	$2,980,700
2015	4	$3,420,000
2016	1	$3,350,000
2016	2	$3,000,300
2016	3	$3,120,200
2016	4	$3,670,000

Pitfalls of use.names = FALSE

```
rbind("2015" = sales_2015, "2016" = sales_2016, idcol = "year",
      use.names = FALSE)
```



sales_2015:

quarter	amount
1	$3,200,100
2	$2,950,000
3	$2,980,700
4	$3,420,000

sales_2016:

amount	quarter
$3,350,000	1
$3,000,300	2
$3,120,200	3
$3,670,000	4

sales:

year	quarter	amount
2015	1	$3,200,100
2015	2	$2,950,000
2015	3	$2,980,700
2015	4	$3,420,000
2016	$3,350,000	1
2016	$3,000,300	2
2016	$3,120,200	3
2016	$3,670,000	4

Differing defaults

- Default for `rbind()` is `use.names = TRUE`
- Default for `rbindlist()` is `use.names = FALSE` unless `fill = TRUE`.

JOINING DATA IN R WITH DATA.TABLE

Let's practice!

JOINING DATA IN R WITH DATA.TABLE

Set operations

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Set operation functions

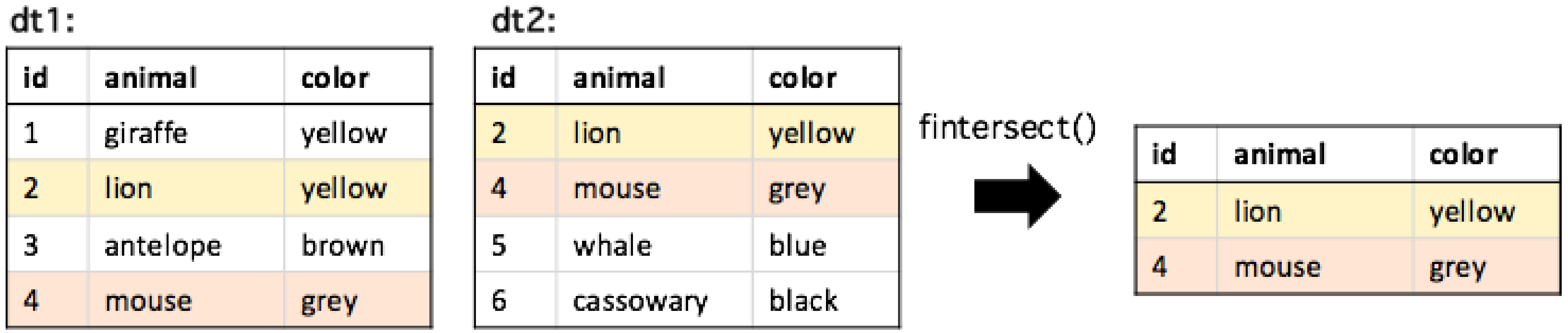
Given two `data.tables` with the same columns:

- `fintersect()`: what rows do these two `data.tables` share in common?
- `funion()`: what is the unique set of rows across these two `data.tables`?
- `fsetdiff()`: what rows are unique to this `data.table`?

Set operations: fintersect()

Extract rows that are present in both `data.tables`

```
fintersect(dt1, dt2)
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
3	antelope	brown
4	mouse	grey

dt2:

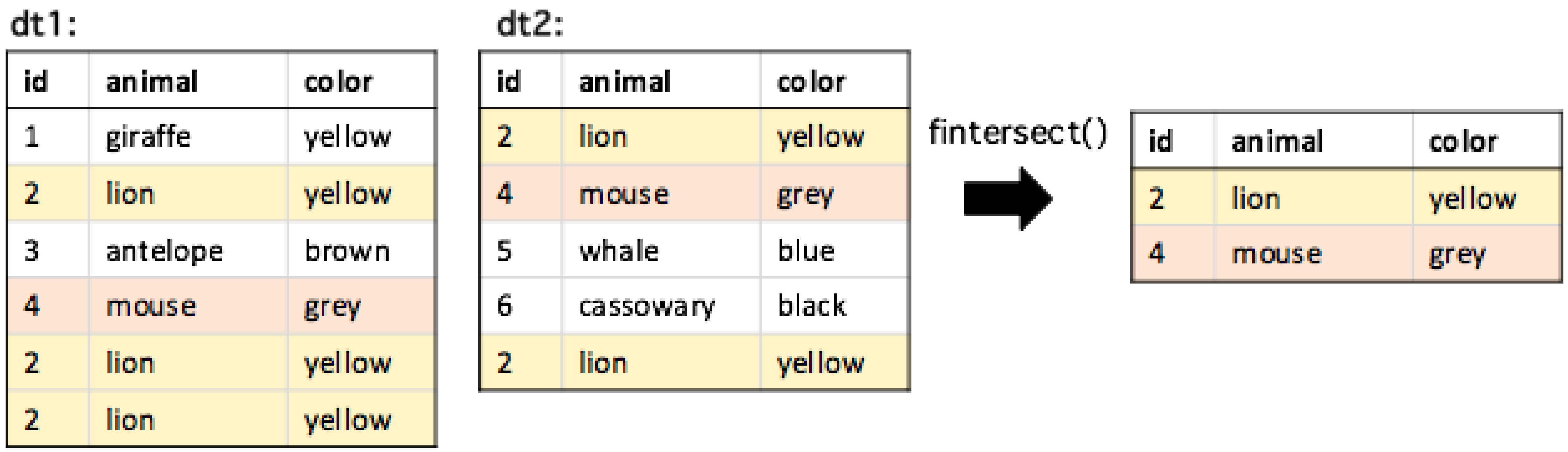
id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
6	cassowary	black

id	animal	color
2	lion	yellow
4	mouse	grey

fintersect() and duplicate rows

Duplicate rows are ignored by default:

```
fintersect(dt1, dt2)
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
3	antelope	brown
4	mouse	grey
2	lion	yellow
2	lion	yellow

dt2:

id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
6	cassowary	black
2	lion	yellow

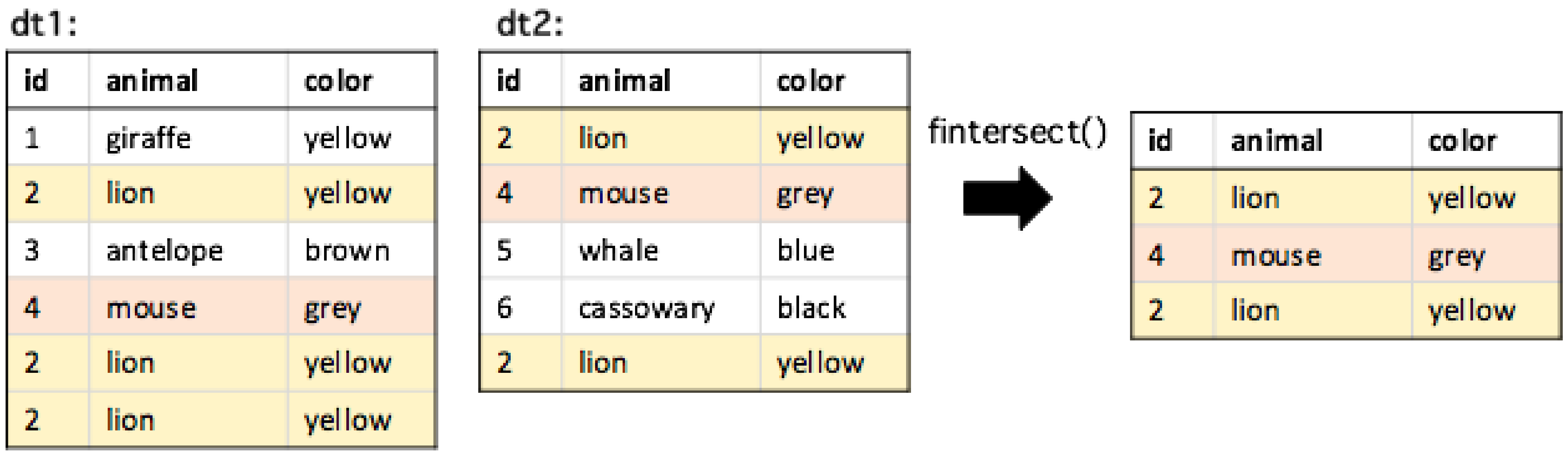
fintersect()

id	animal	color
2	lion	yellow
4	mouse	grey

fintersect() and duplicate rows

`all = TRUE`: keep the number of copies present in both `data.tables`:

```
fintersect(dt1, dt2, all = TRUE)
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
3	antelope	brown
4	mouse	grey
2	lion	yellow
2	lion	yellow

dt2:

id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
6	cassowary	black
2	lion	yellow

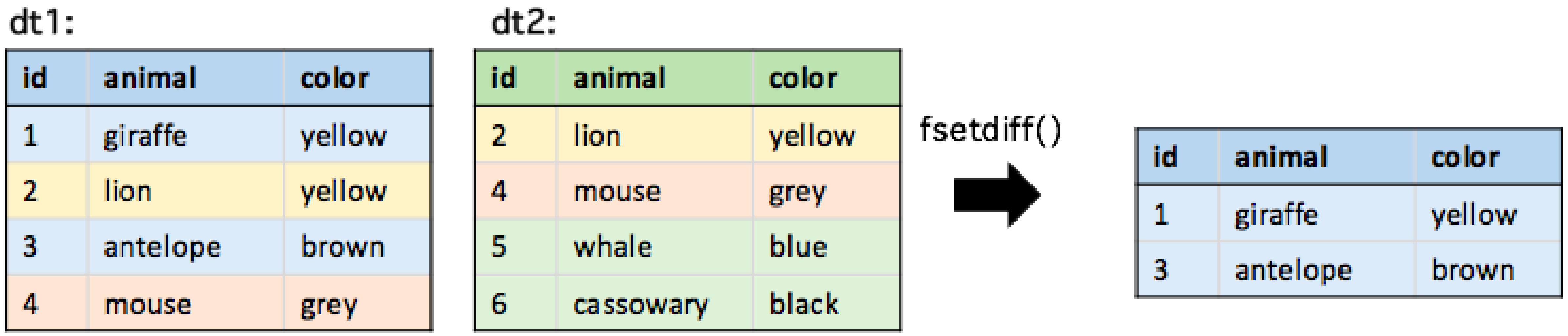
fintersect()

id	animal	color
2	lion	yellow
4	mouse	grey
2	lion	yellow

Set operations: fsetdiff()

Extract rows found exclusively in the first `data.table`

```
fsetdiff(dt1, dt2)
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
3	antelope	brown
4	mouse	grey

dt2:

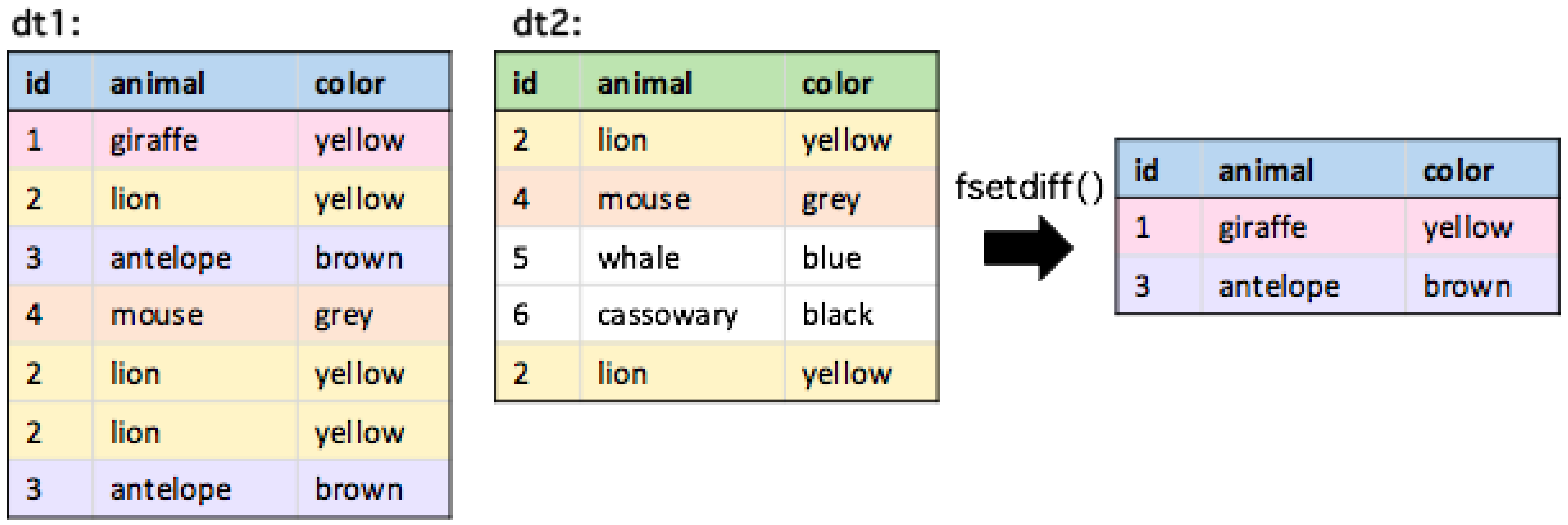
id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
6	cassowary	black

id	animal	color
1	giraffe	yellow
3	antelope	brown

fsetdiff() and duplicates

Duplicate rows are ignored by default:

```
fsetdiff(dt1, dt2)
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
3	antelope	brown
4	mouse	grey
2	lion	yellow
2	lion	yellow
3	antelope	brown

dt2:

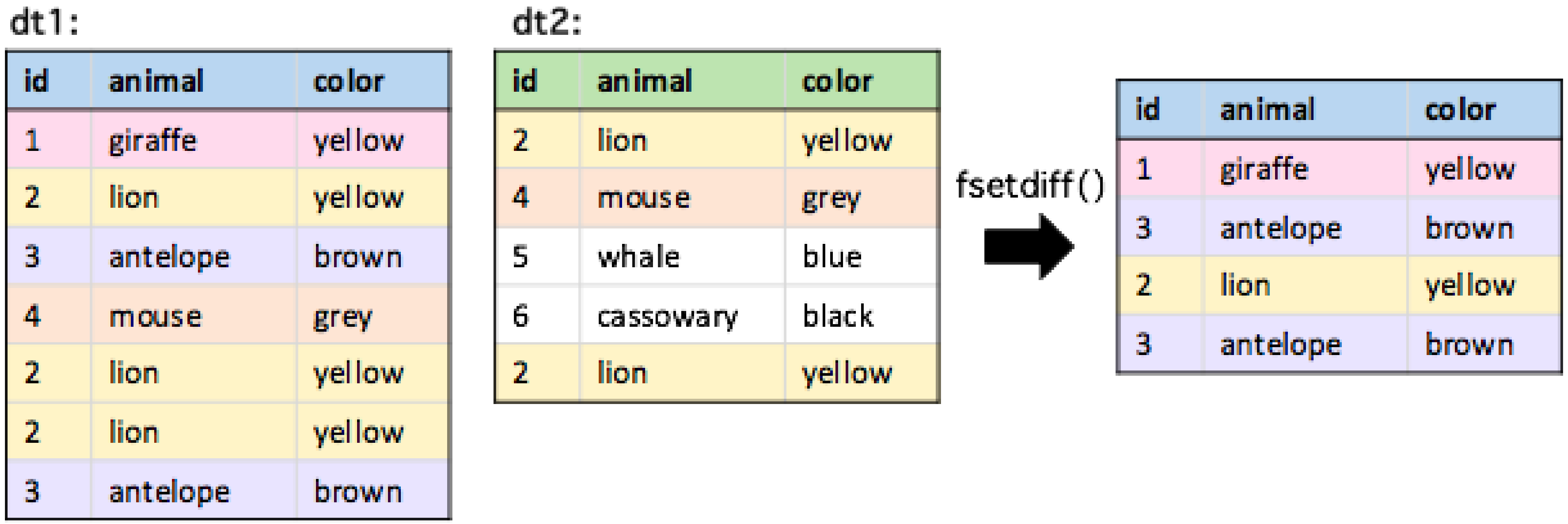
id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
6	cassowary	black
2	lion	yellow

id	animal	color
1	giraffe	yellow
3	antelope	brown

fsetdiff() and duplicates

`all = TRUE`: return all extra copies:

```
fsetdiff(dt1, dt2, all = TRUE)
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
3	antelope	brown
4	mouse	grey
2	lion	yellow
2	lion	yellow
3	antelope	brown

dt2:

id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
6	cassowary	black
2	lion	yellow

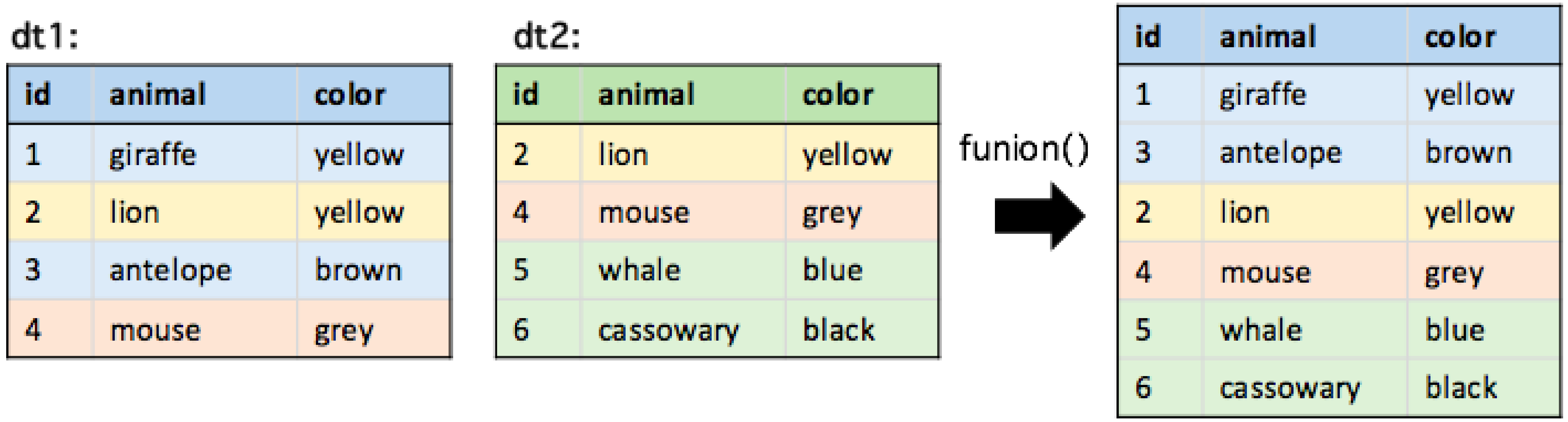
fsetdiff()

id	animal	color
1	giraffe	yellow
3	antelope	brown
2	lion	yellow
3	antelope	brown

Set operations: funion()

Extract all rows found in either `data.table`:

```
funion(dt1, dt2)
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
3	antelope	brown
4	mouse	grey

dt2:

id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
6	cassowary	black

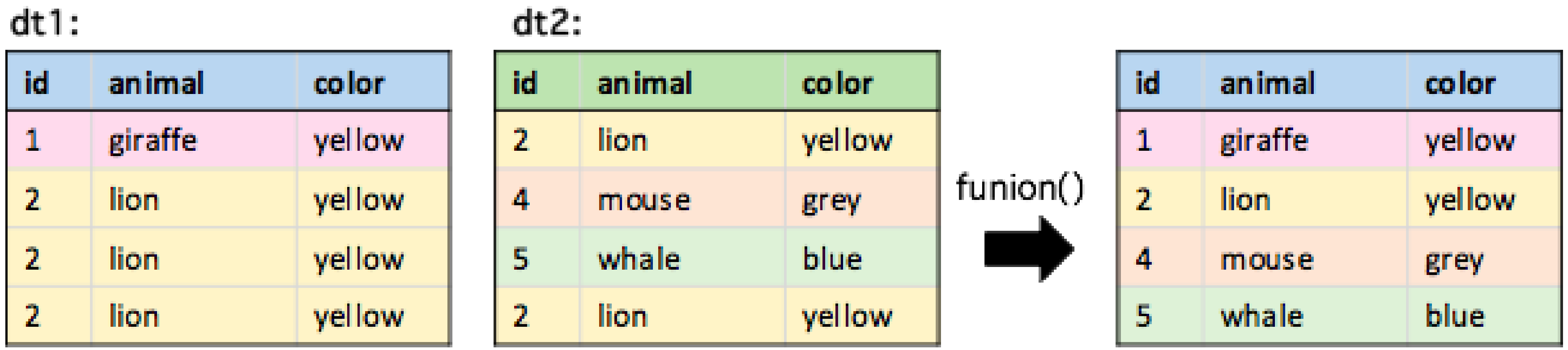
funion()

id	animal	color
1	giraffe	yellow
3	antelope	brown
2	lion	yellow
4	mouse	grey
5	whale	blue
6	cassowary	black

funion() and duplicates

Duplicate rows are ignored by default:

```
funion(dt1, dt2)
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
2	lion	yellow
2	lion	yellow

dt2:

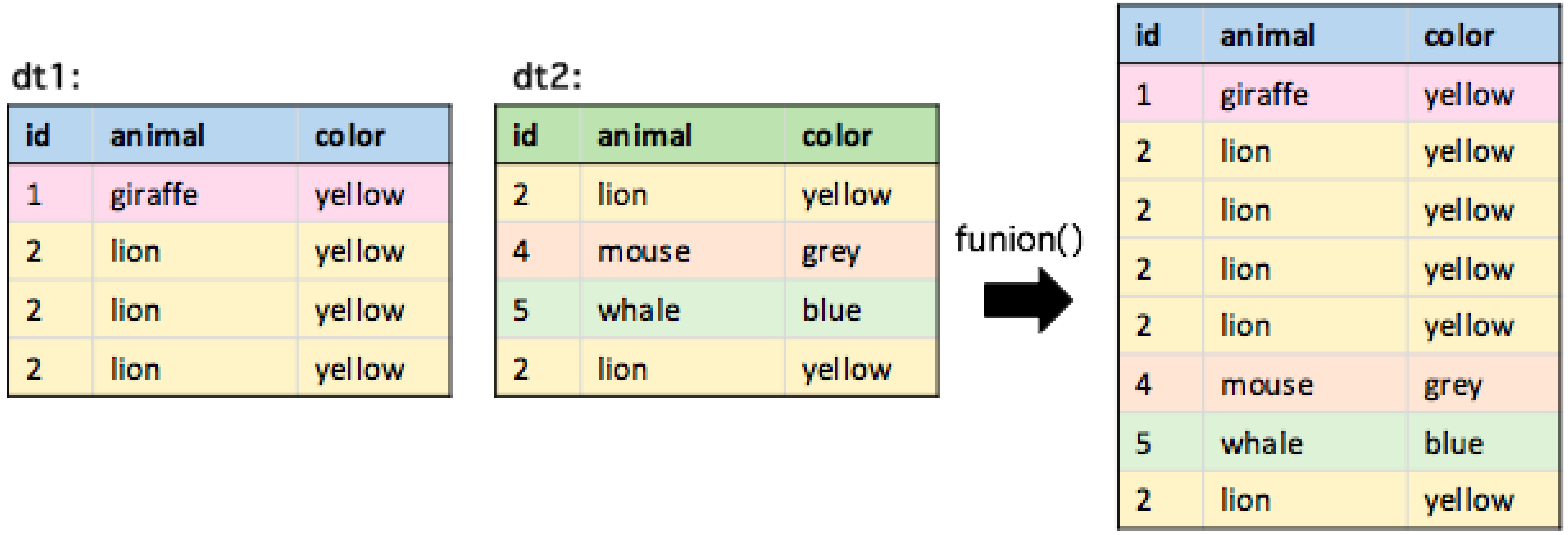
id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
2	lion	yellow

id	animal	color
1	giraffe	yellow
2	lion	yellow
4	mouse	grey
5	whale	blue

funion() and duplicates

`all = TRUE`: return all rows:

```r
funion(dt1, dt2, all = TRUE) # rbind()
```



dt1:

id	animal	color
1	giraffe	yellow
2	lion	yellow
2	lion	yellow
2	lion	yellow

dt2:

id	animal	color
2	lion	yellow
4	mouse	grey
5	whale	blue
2	lion	yellow

id	animal	color
1	giraffe	yellow
2	lion	yellow
2	lion	yellow
2	lion	yellow
2	lion	yellow
4	mouse	grey
5	whale	blue
2	lion	yellow

Removing duplicates when combining many data.tables

Two `data.tables`:

1. Use `funion()` to concatenate unique rows

Three or more:

1. Concatenate all `data.tables` using `rbind()` or `rbindlist()`
2. Identify and remove duplicates using `duplicated()` and `unique()`

JOINING DATA IN R WITH DATA.TABLE

Let's practice!

JOINING DATA IN R WITH DATA.TABLE

Melting data.tables

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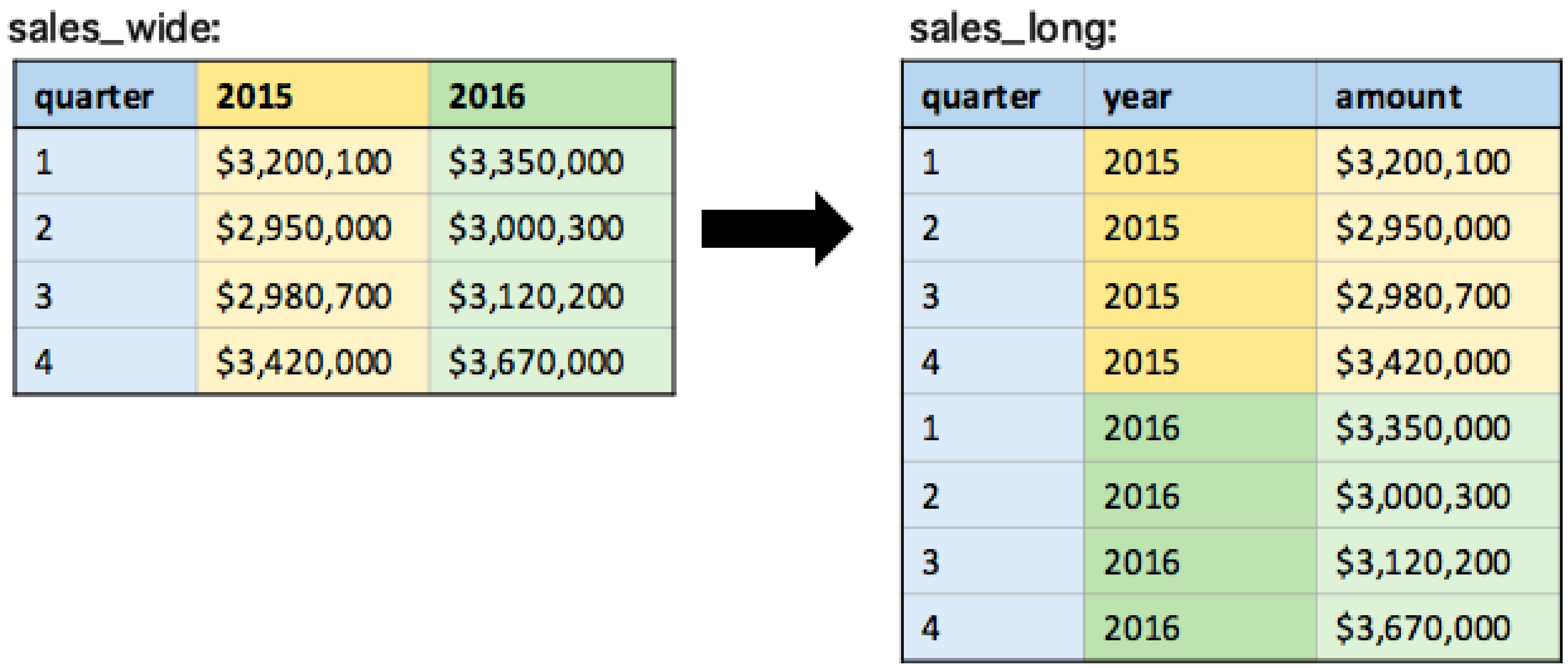
Melting a wide data.table



sales_wide:

quarter	2015	2016
1	$3,200,100	$3,350,000
2	$2,950,000	$3,000,300
3	$2,980,700	$3,120,200
4	$3,420,000	$3,670,000

sales_long:

quarter	year	amount
1	2015	$3,200,100
2	2015	$2,950,000
3	2015	$2,980,700
4	2015	$3,420,000
1	2016	$3,350,000
2	2016	$3,000,300
3	2016	$3,120,200
4	2016	$3,670,000

The melt() function

Use `measure.vars` to specify columns to stack:

```
melt(sales_wide, measure.vars = c("2015", "2016"))

   quarter variable   value
1:       1     2015 3200100
2:       2     2015 2950000
3:       3     2015 2980700
4:       4     2015 3420000
5:       1     2016 3350000
6:       2     2016 3000300
7:       3     2016 3120200
8:       4     2016 3670000
```

The melt() function

Use `variable.name` and `value.name` to rename these columns in the result:

```
melt(sales_wide, measure.vars = c("2015", "2016"),
     variable.name = "year", value.name = "amount")

   quarter year  amount
1:       1 2015 3200100
2:       2 2015 2950000
3:       3 2015 2980700
4:       4 2015 3420000
5:       1 2016 3350000
6:       2 2016 3000300
7:       3 2016 3120200
8:       4 2016 3670000
```

The melt() function

Use `id.vars` to specify columns to keep aside

```
melt(sales_wide, id.vars = "quarter",
     variable.name = "year", value.name = "amount")

   quarter year  amount
1:       1 2015 3200100
2:       2 2015 2950000
3:       3 2015 2980700
4:       4 2015 3420000
5:       1 2016 3350000
6:       2 2016 3000300
7:       3 2016 3120200
8:       4 2016 3670000
```

The melt() function

Use both to keep only a subset of columns

```
melt(sales_wide, id.vars = "quarter", measure.vars = "2015",
     variable.name = "year", value.name = "amount")

   quarter year  amount
1:       1 2015 3200100
2:       2 2015 2950000
3:       3 2015 2980700
4:       4 2015 3420000
```

JOINING DATA IN R WITH DATA.TABLE

Let's practice!

JOINING DATA IN R WITH DATA.TABLE

Casting data.tables

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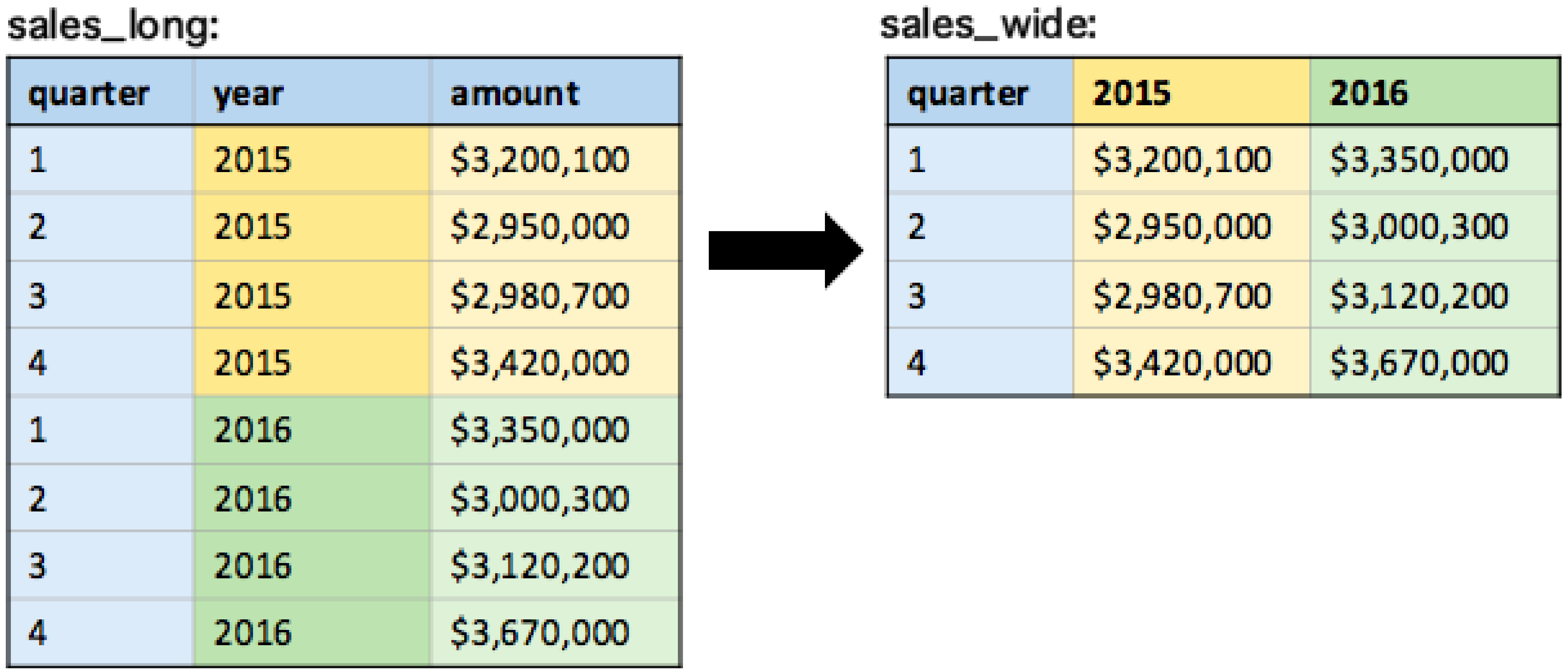
Casting a long data.table

```
sales_wide <- dcast(sales_long, quarter ~ year, value.var = "amount")
```



sales_long:

quarter	year	amount
1	2015	$3,200,100
2	2015	$2,950,000
3	2015	$2,980,700
4	2015	$3,420,000
1	2016	$3,350,000
2	2016	$3,000,300
3	2016	$3,120,200
4	2016	$3,670,000

sales_wide:

quarter	2015	2016
1	$3,200,100	$3,350,000
2	$2,950,000	$3,000,300
3	$2,980,700	$3,120,200
4	$3,420,000	$3,670,000

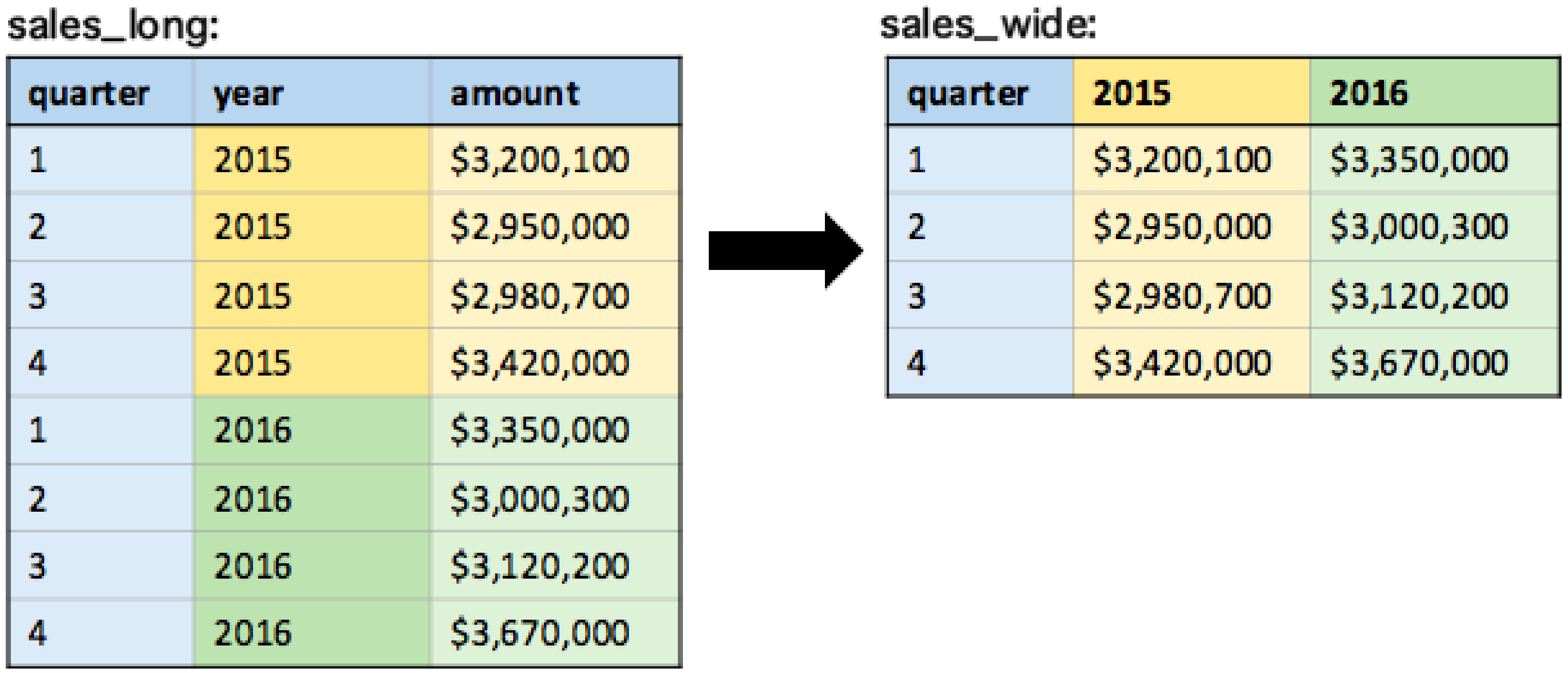
The dcast() function

The general form of `dcast()`:

```
dcast(DT, ids ~ group, value.var = "values")
      |   |     |                    |
      |   |     |                     --> column to split
      |   |      ------------------------> group labels to split by
      |    ------------------------------> rows to keep behind as identifiers
       ----------------------------------> data.table to reshape
```

The dcast() function

```
sales_wide <- dcast(sales_long, quarter ~ year, value.var = "amount")
```



sales_long:

quarter	year	amount
1	2015	$3,200,100
2	2015	$2,950,000
3	2015	$2,980,700
4	2015	$3,420,000
1	2016	$3,350,000
2	2016	$3,000,300
3	2016	$3,120,200
4	2016	$3,670,000

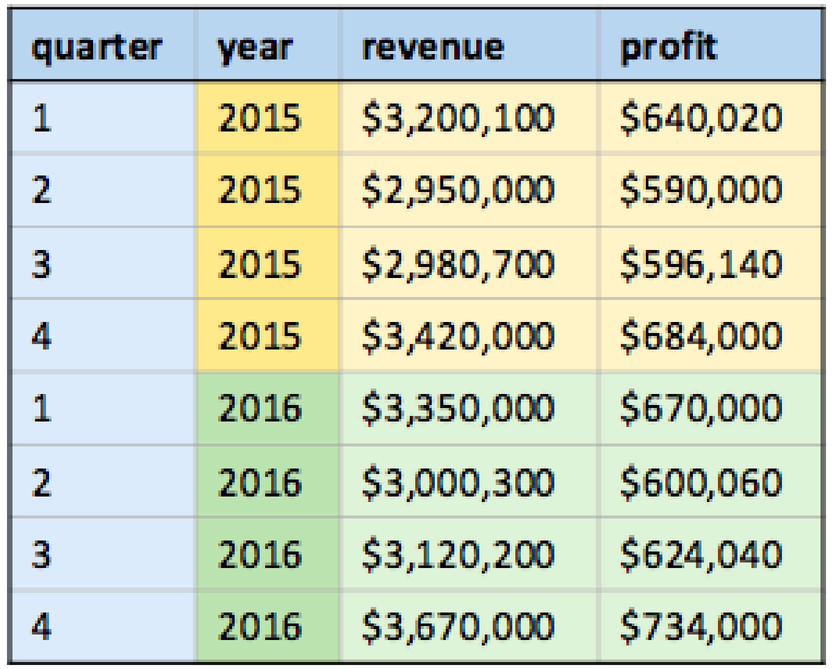
sales_wide:

quarter	2015	2016
1	$3,200,100	$3,350,000
2	$2,950,000	$3,000,300
3	$2,980,700	$3,120,200
4	$3,420,000	$3,670,000

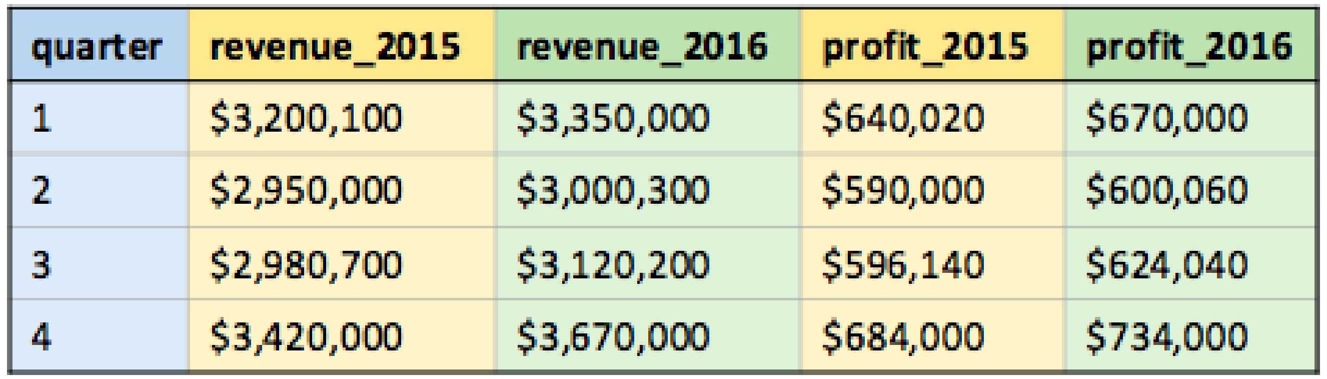
Splitting multiple value columns

```
dcast(profit_long, quarter ~ year, value.var = c("revenue", "profit"))
```

profit_long:



quarter	year	revenue	profit
1	2015	$3,200,100	$640,020
2	2015	$2,950,000	$590,000
3	2015	$2,980,700	$596,140
4	2015	$3,420,000	$684,000
1	2016	$3,350,000	$670,000
2	2016	$3,000,300	$600,060
3	2016	$3,120,200	$624,040
4	2016	$3,670,000	$734,000

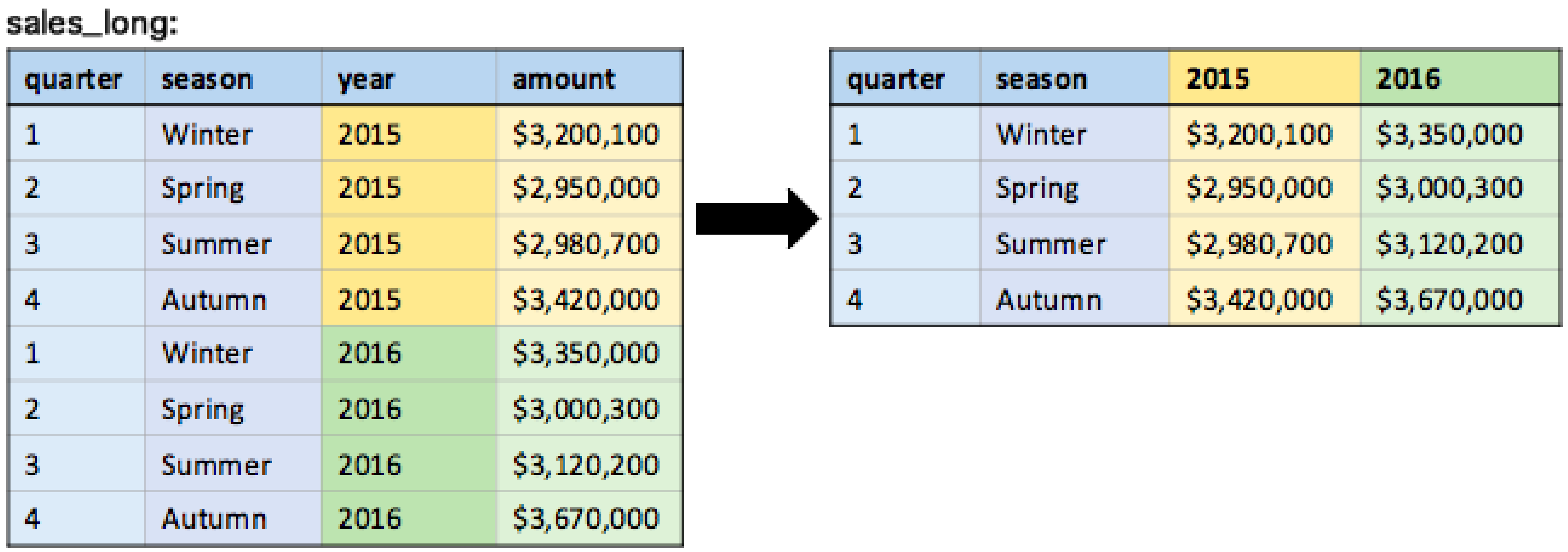


quarter	revenue_2015	revenue_2016	profit_2015	profit_2016
1	$3,200,100	$3,350,000	$640,020	$670,000
2	$2,950,000	$3,000,300	$590,000	$600,060
3	$2,980,700	$3,120,200	$596,140	$624,040
4	$3,420,000	$3,670,000	$684,000	$734,000

Multiple row identifiers

Keep multiple columns as row identifiers:

```
dcast(sales_long, quarter + season ~ year, value.var = "amount")
```



sales_long:

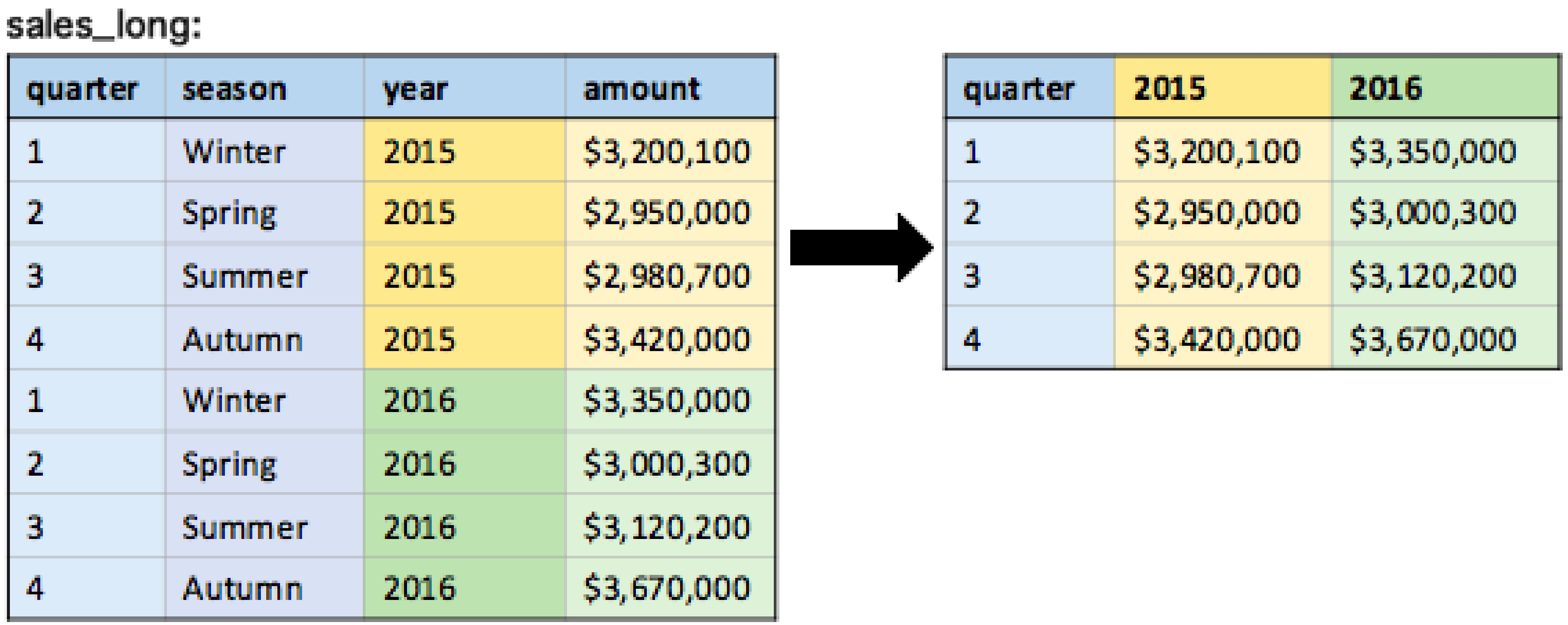
quarter	season	year	amount
1	Winter	2015	$3,200,100
2	Spring	2015	$2,950,000
3	Summer	2015	$2,980,700
4	Autumn	2015	$3,420,000
1	Winter	2016	$3,350,000
2	Spring	2016	$3,000,300
3	Summer	2016	$3,120,200
4	Autumn	2016	$3,670,000

quarter	season	2015	2016
1	Winter	$3,200,100	$3,350,000
2	Spring	$2,950,000	$3,000,300
3	Summer	$2,980,700	$3,120,200
4	Autumn	$3,420,000	$3,670,000

Dropping columns

Only columns included in the formula or `value.var` will be in the result:

```
sales_wide <- dcast(sales_long, quarter ~ year, value.var = "amount")
```



sales_long:

quarter	season	year	amount
1	Winter	2015	$3,200,100
2	Spring	2015	$2,950,000
3	Summer	2015	$2,980,700
4	Autumn	2015	$3,420,000
1	Winter	2016	$3,350,000
2	Spring	2016	$3,000,300
3	Summer	2016	$3,120,200
4	Autumn	2016	$3,670,000

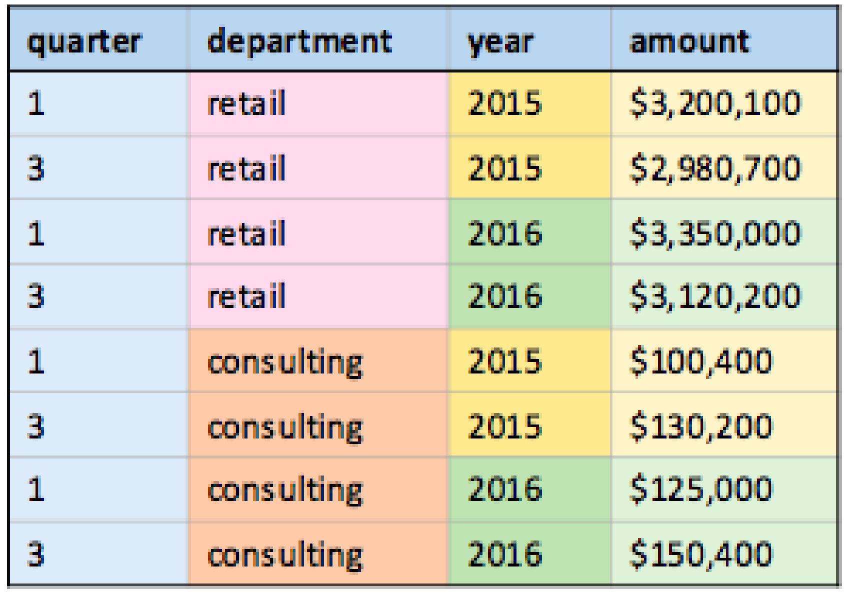
quarter	2015	2016
1	$3,200,100	$3,350,000
2	$2,950,000	$3,000,300
3	$2,980,700	$3,120,200
4	$3,420,000	$3,670,000

Multiple groupings

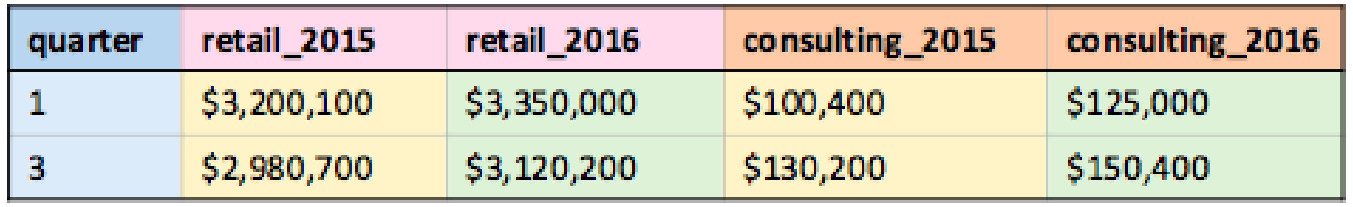
Split on multiple group columns:

```
dcast(sales_long, quarter ~ department + year, value.var = "amount")
```

sales_long:



quarter	department	year	amount
1	retail	2015	$3,200,100
3	retail	2015	$2,980,700
1	retail	2016	$3,350,000
3	retail	2016	$3,120,200
1	consulting	2015	$100,400
3	consulting	2015	$130,200
1	consulting	2016	$125,000
3	consulting	2016	$150,400



quarter	retail_2015	retail_2016	consulting_2015	consulting_2016
1	$3,200,100	$3,350,000	$100,400	$125,000
3	$2,980,700	$3,120,200	$130,200	$150,400

Converting to a matrix

```
sales_wide <- dcast(sales_long, season ~ year, value.var = "amount")
sales_wide

   season    2015    2016
1: Autumn 3420000 3670000
2: Spring 2950000 3000300
3: Summer 2980700 3120200
4: Winter 3200100 3350000
```

`as.matrix()` can take one of the columns to use as the matrix rownames:

```
mat <- as.matrix(sales_wide, rownames = "season")
mat

          2015    2016
Autumn 3420000 3670000
Spring 2950000 3000300
Summer 2980700 3120200
Winter 3200100 3350000
```

JOINING DATA IN R WITH DATA.TABLE

Let's practice!