[301] Copying

Tyler Caraza-Harter

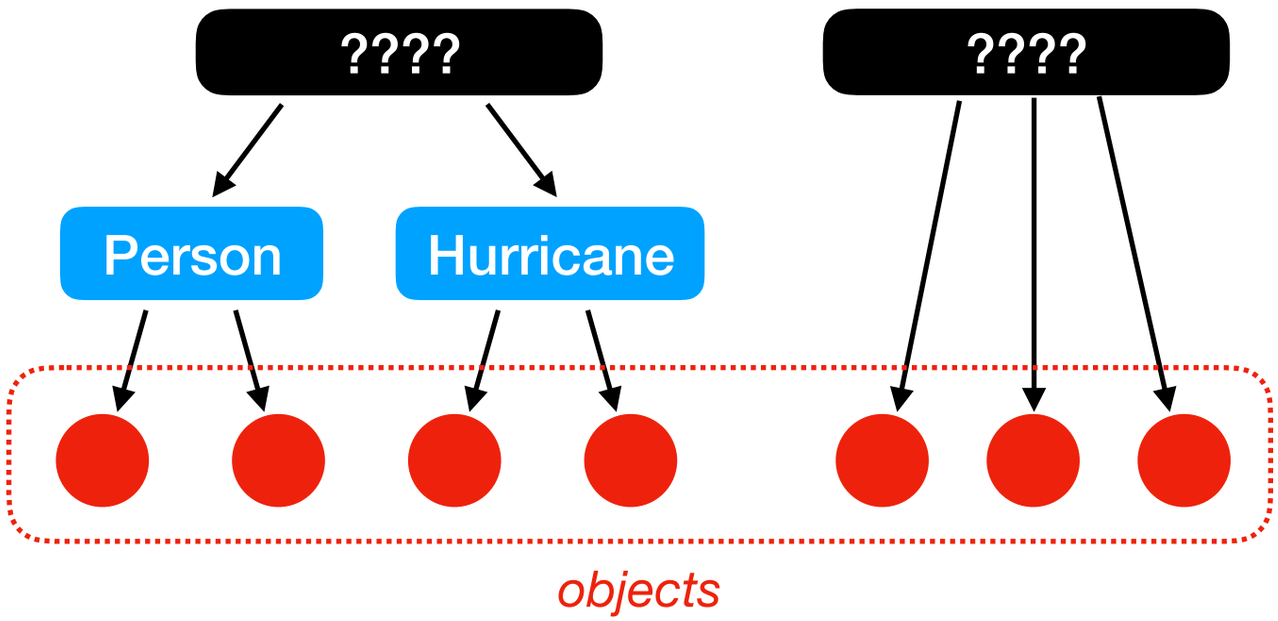
Test yourself!

A **what do variables contain?**

1. objects
2. references to objects

B **how should we label the blanks in the hierarchy?**

1. namedtuple, tuple
2. tuple, namedtuple



C **which of the following live inside frames?**

1. objects
2. variables

Learning Objectives Today

Practice objects/references!

Levels of copying

- Making a new reference
- Shallow copy
- Deep copy

https://www.copymachinesdirect.com/copier-leasing.php

Read:

✦ Sweigart Ch 4 ("References" to the end)
https://automatetheboringstuff.com/chapter4/

Today's Outline

Review

More references

Copying

- reference
- shallow
- deep

Worksheet

Worksheet Problem 1

What does assignment ACTUALLY do?

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x = ["A","B","C"]
y = x
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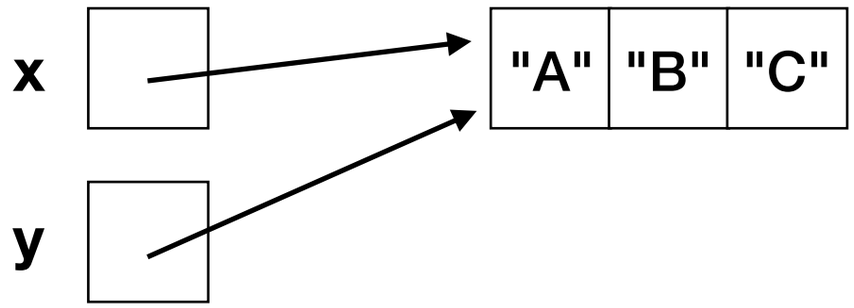

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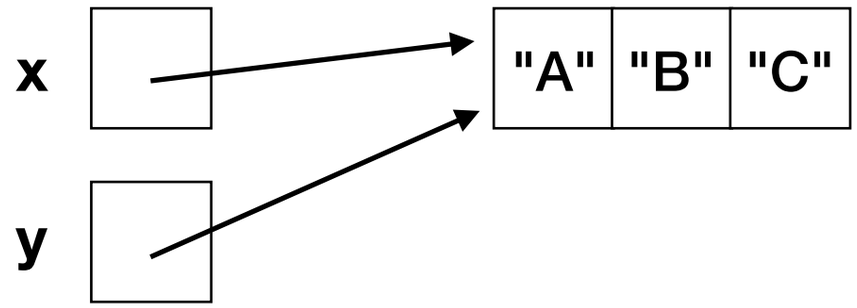

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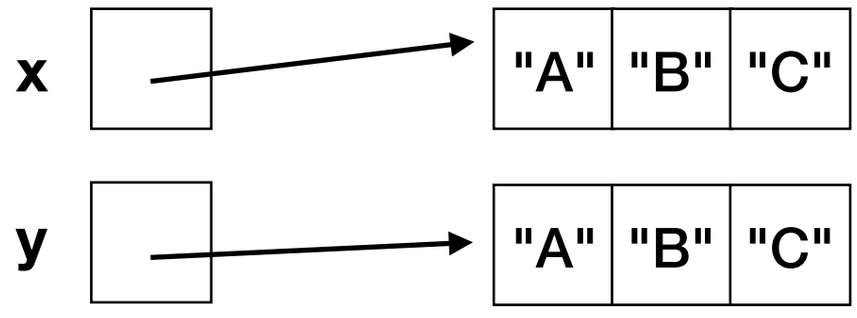

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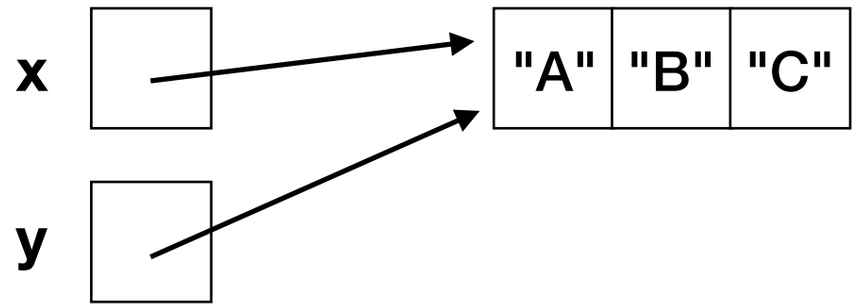

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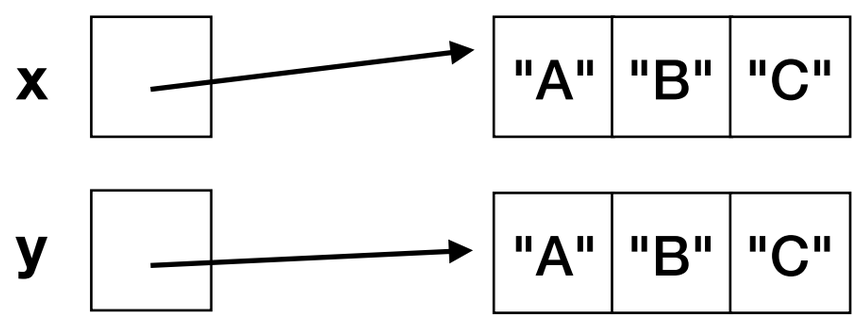

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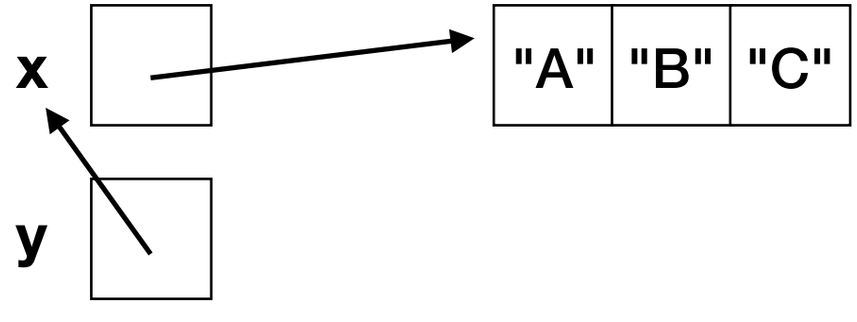

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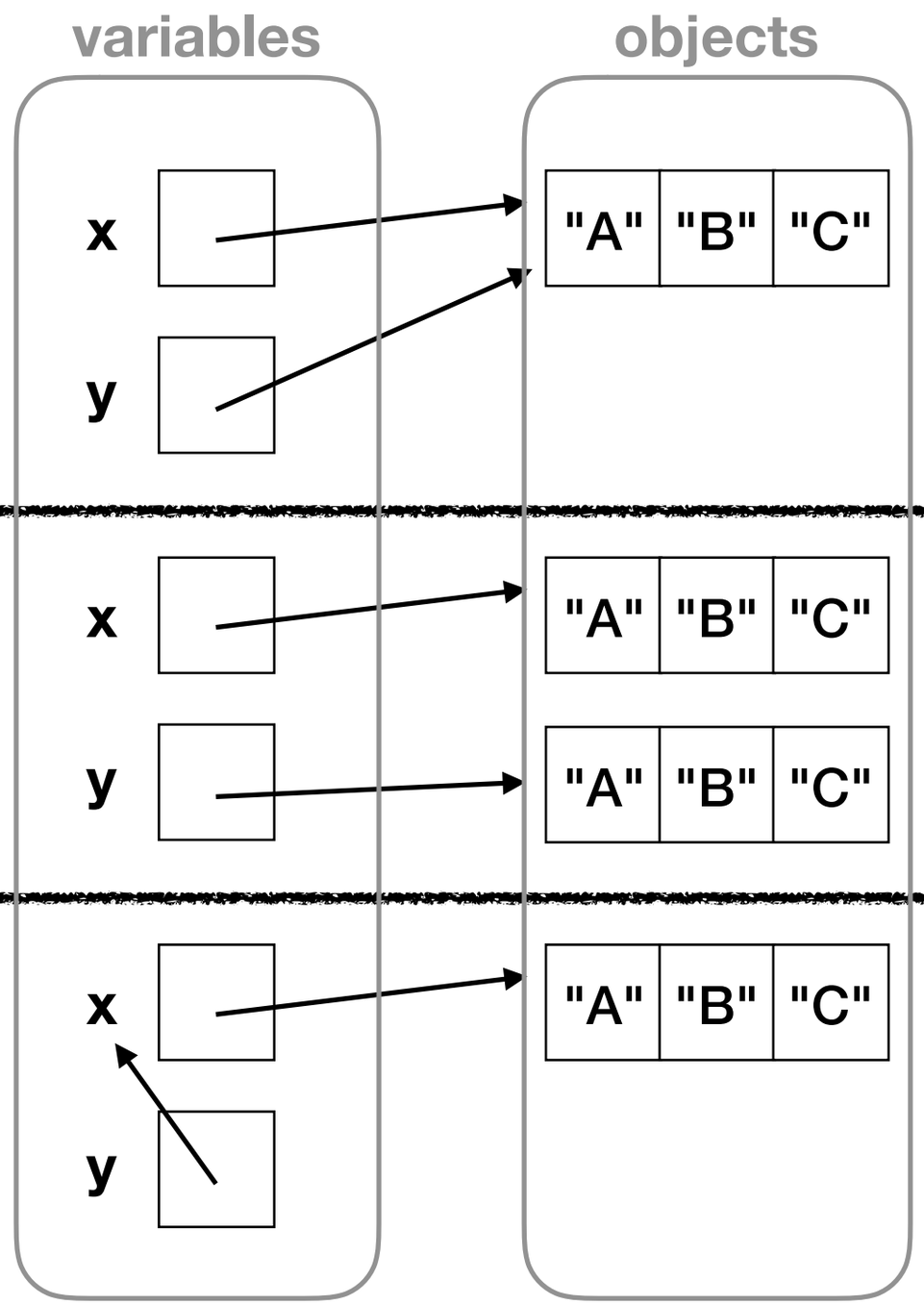

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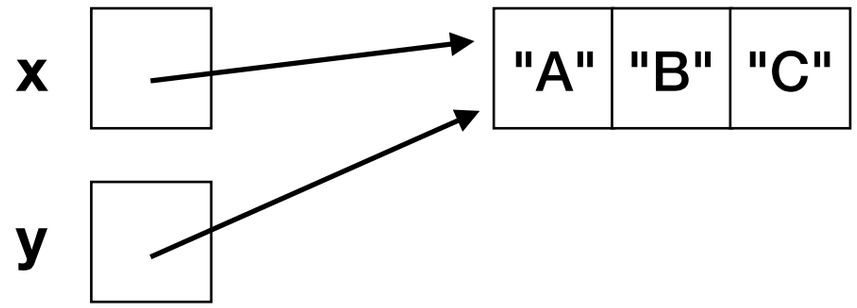

What does assignment ACTUALLY do?

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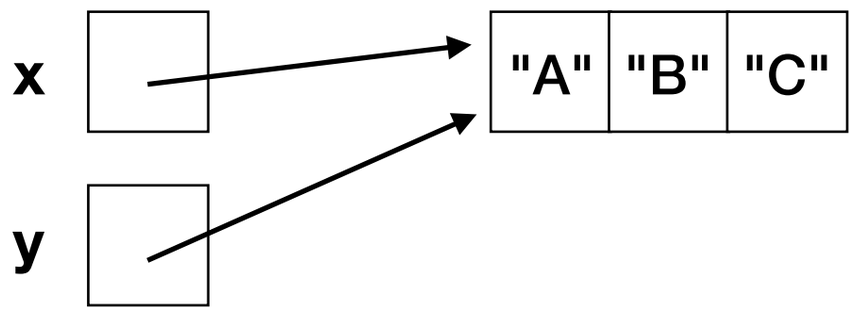
x = ["A","B","C"]
y = x

def f(y):
    pass

x = ["A", "B", "C"]
f(x)
```



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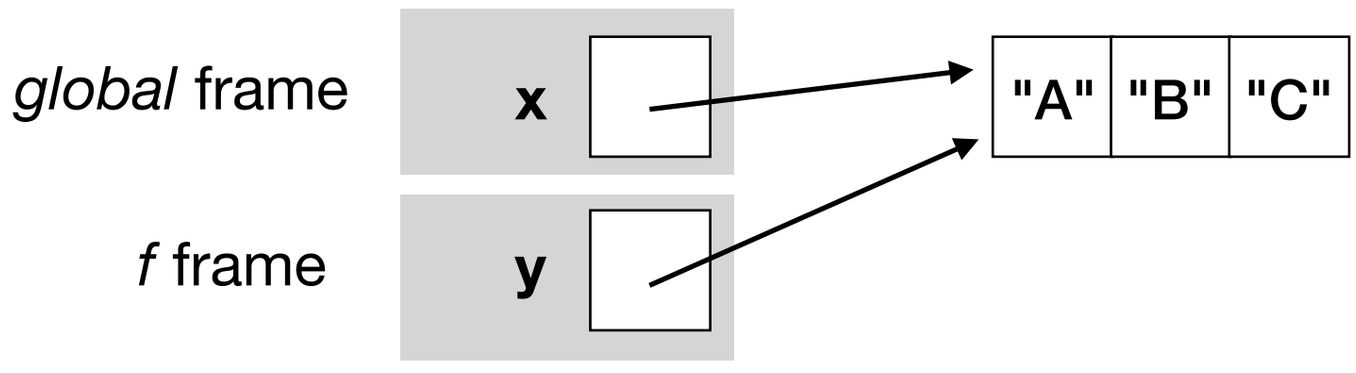
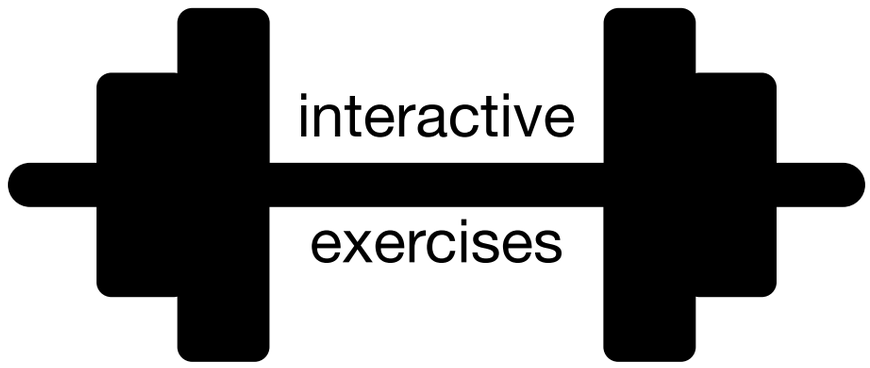


Example 1

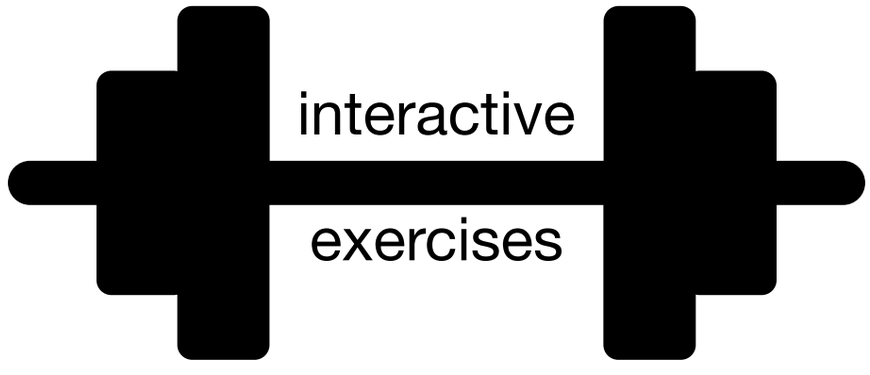
```
x = {}

y = x
y["WI"] = "Madison"
print(x["WI"])
```



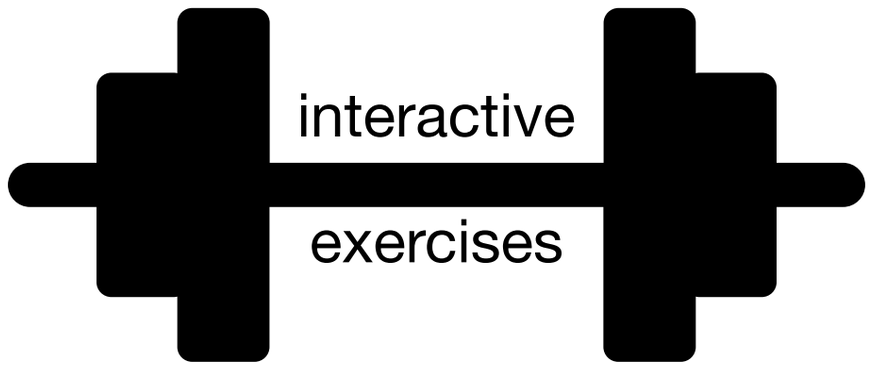
Example 2

```
def foo(nums):
    nums.append(3)
    print(nums)
items = [1,2]
numbers = items
foo(numbers)
print(items)
print(numbers)
```



Example 3

```
x = ["aaa", "bbb"]
y = x[:]
x.pop(0)
print(len(y))
```



Worksheet Problems 2-6

Today's Outline

Review

More references

Copying

- reference
- shallow
- deep

Worksheet

```python
from recordclass import recordclass

Person = recordclass("Person", ["name", "score", "age"])

alice = Person(name="Alice", score=10, age=30)
bob = Person(name="Bob", score=8, age=25)
team = [alice, bob]
players = {"A": alice, "B": bob}
```

State:

references *objects*

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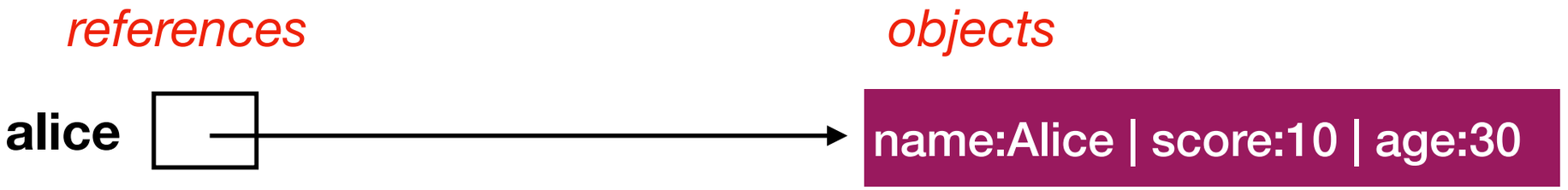

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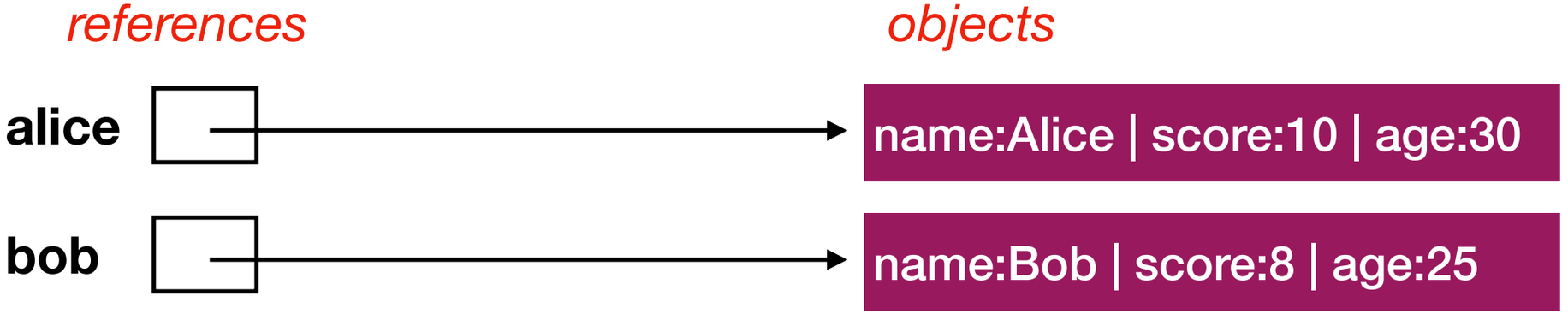

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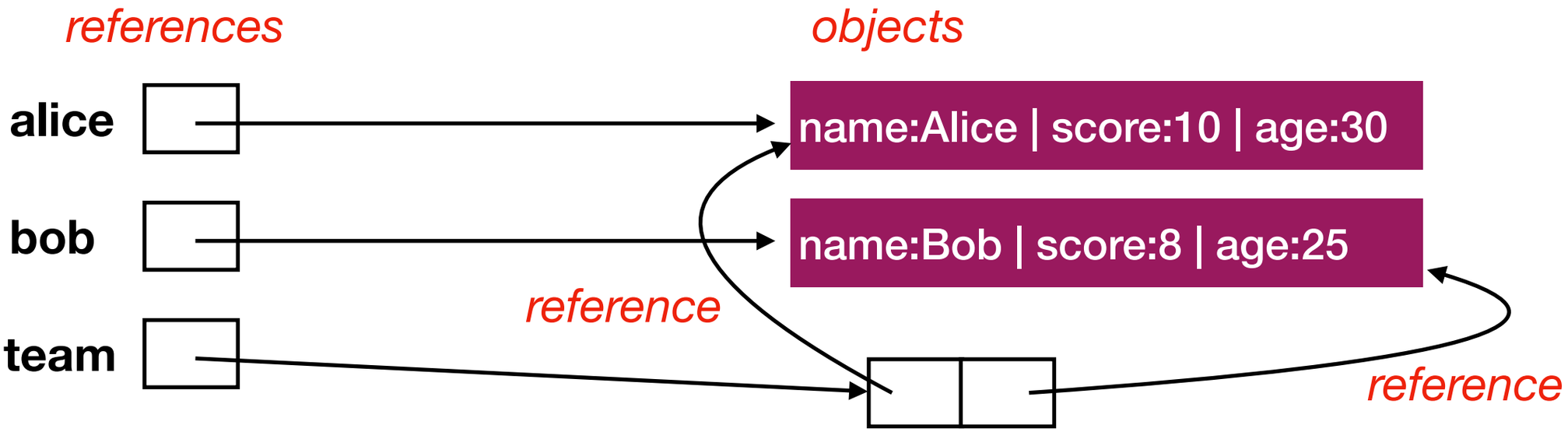

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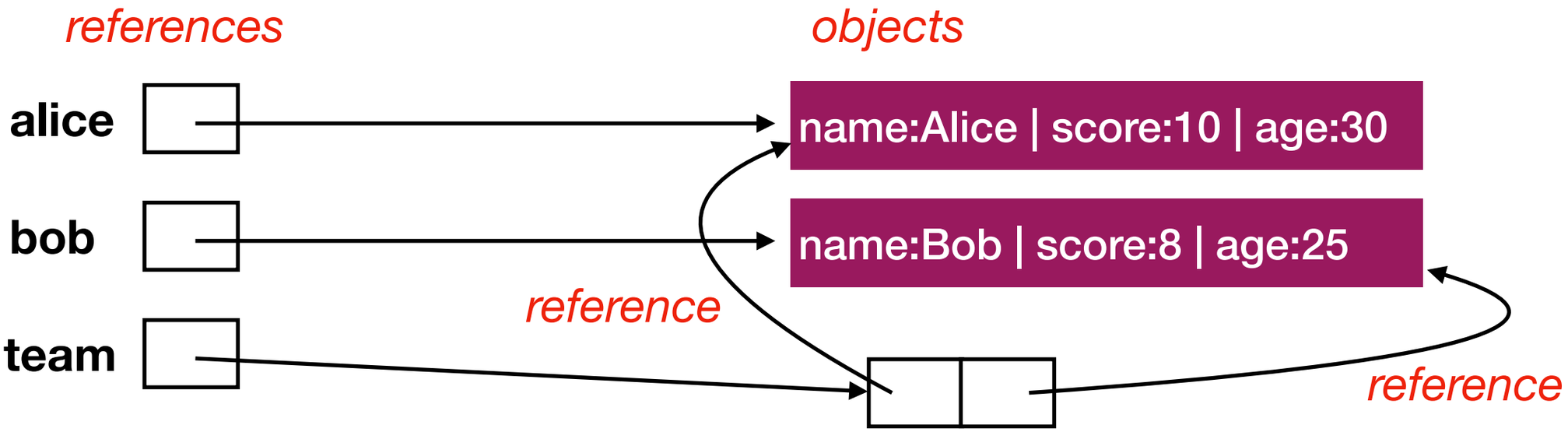

what DID NOT happen: `team` contains the `alice` and `bob` variables

what DID happen: `team` contains references to the objects referenced by `bob` and `alice`

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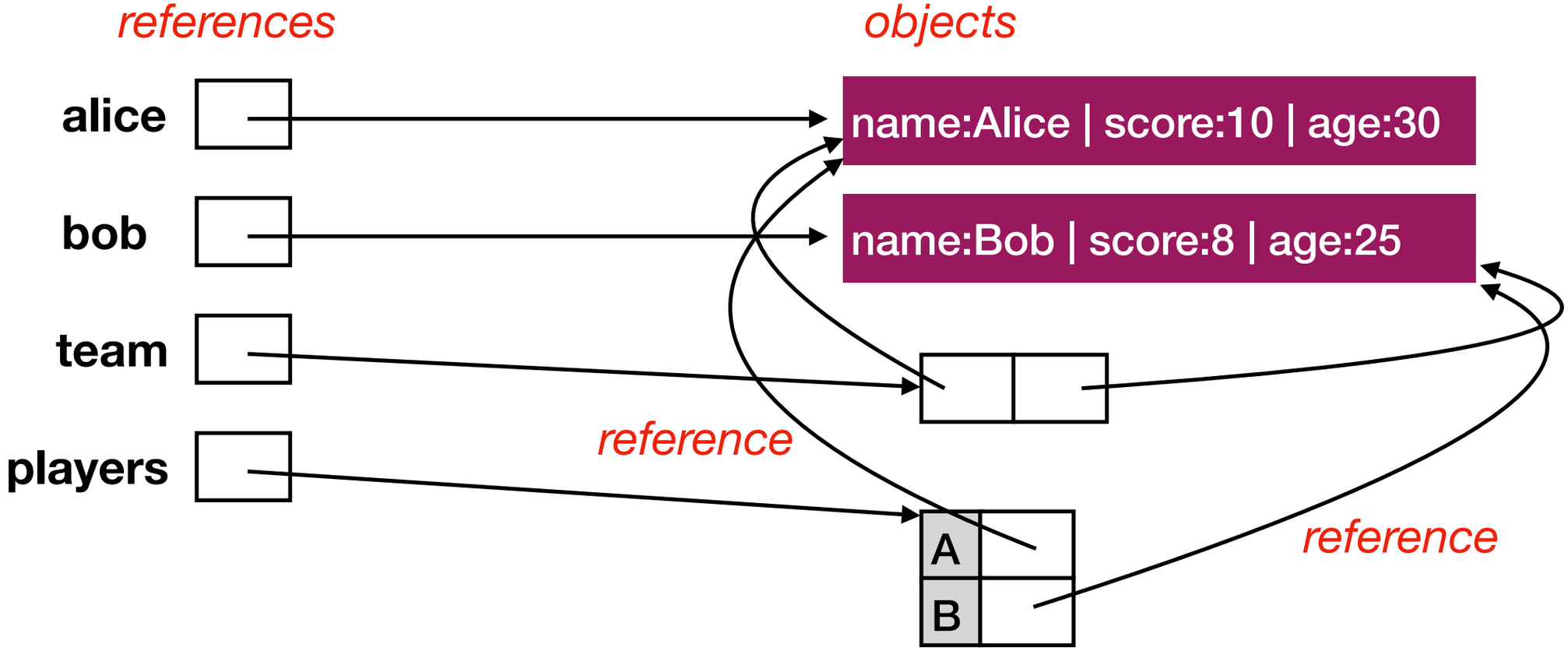

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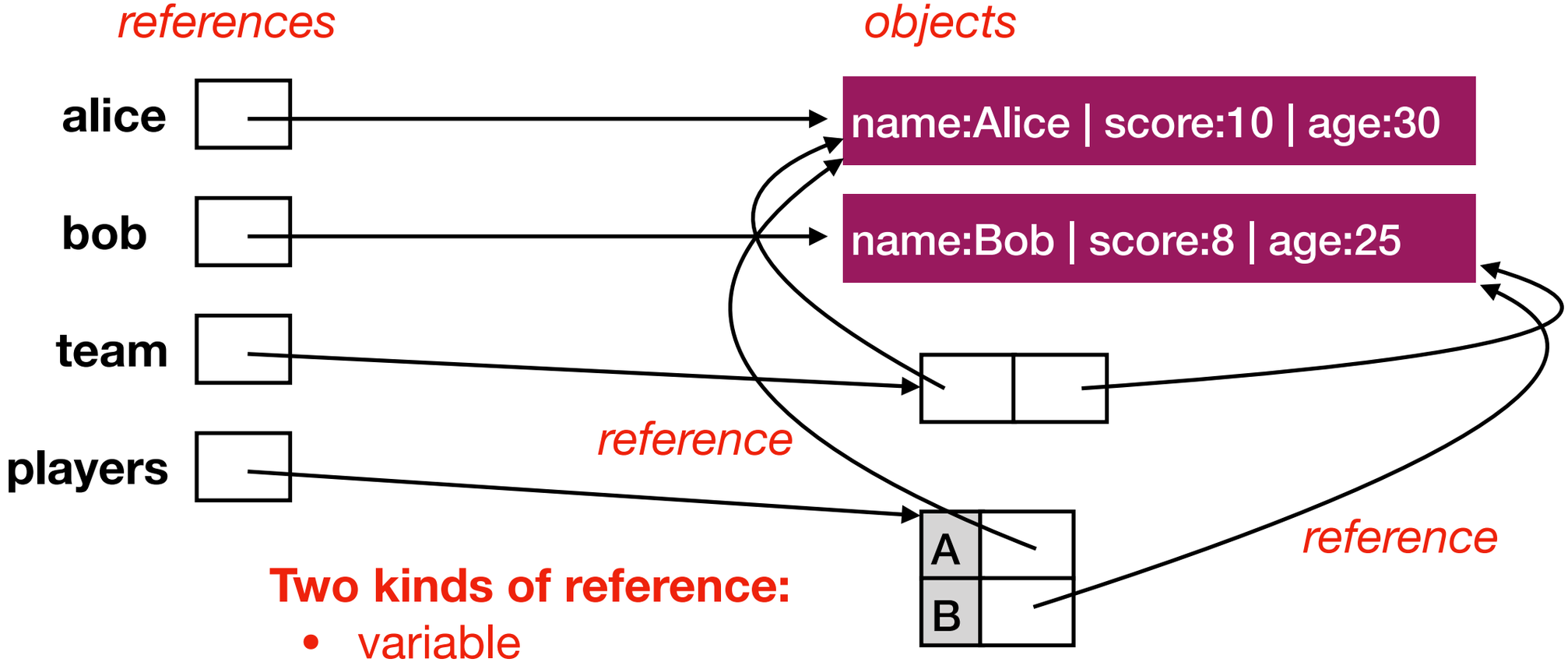

Two kinds of reference:

- variable
- item in list, dict, etc

Today's Outline

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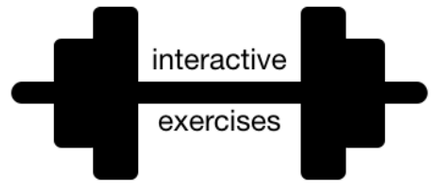
Worksheet

Three Levels of Copy

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import copy
x = [
   {"name":"A", "score":88},
   {"name":"B", "score":111},
   {"name":"C", "score":100}
]

# uncomment one of these
#y = x
#y = copy.copy(x)
#y = copy.deepcopy(x)
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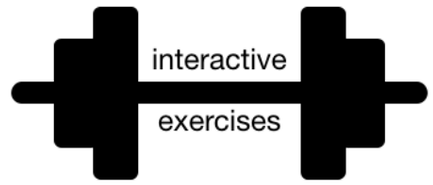


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reference copy

shallow copy

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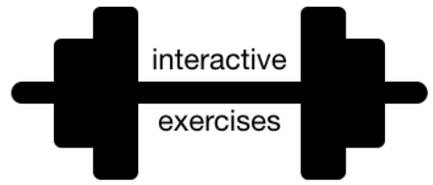


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reference copy [fastest, most dangerous]

shallow copy

deep copy [slowest, safest]

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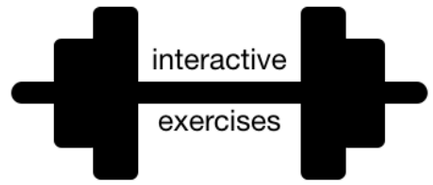

When should we use which one?

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Example: Player Scores

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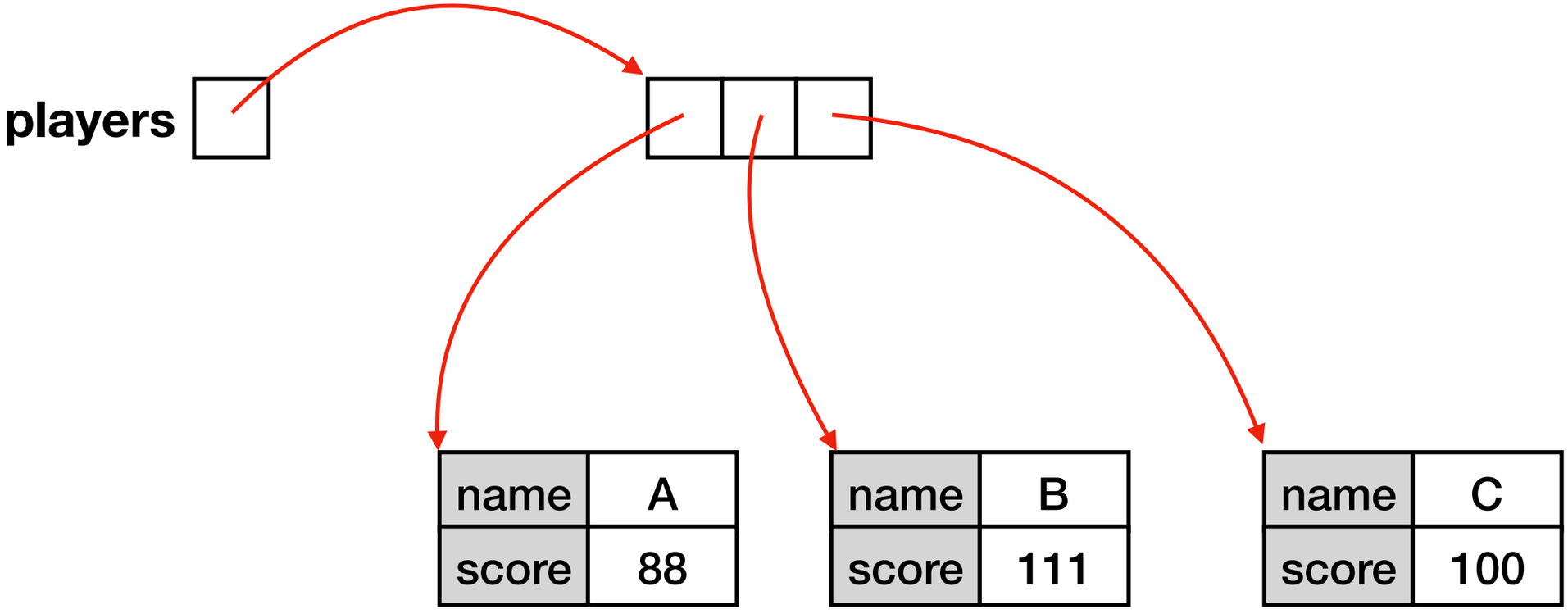
Depending on the use case, there are **three ways** we might "copy" the player's data



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Use Case 1

Get max score
(reference copy)

Use Case 2

Get median score
(shallow copy)

Use Case 3

Record historical scores
(deep copy)

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  highest = None
  for p in people:
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players = …
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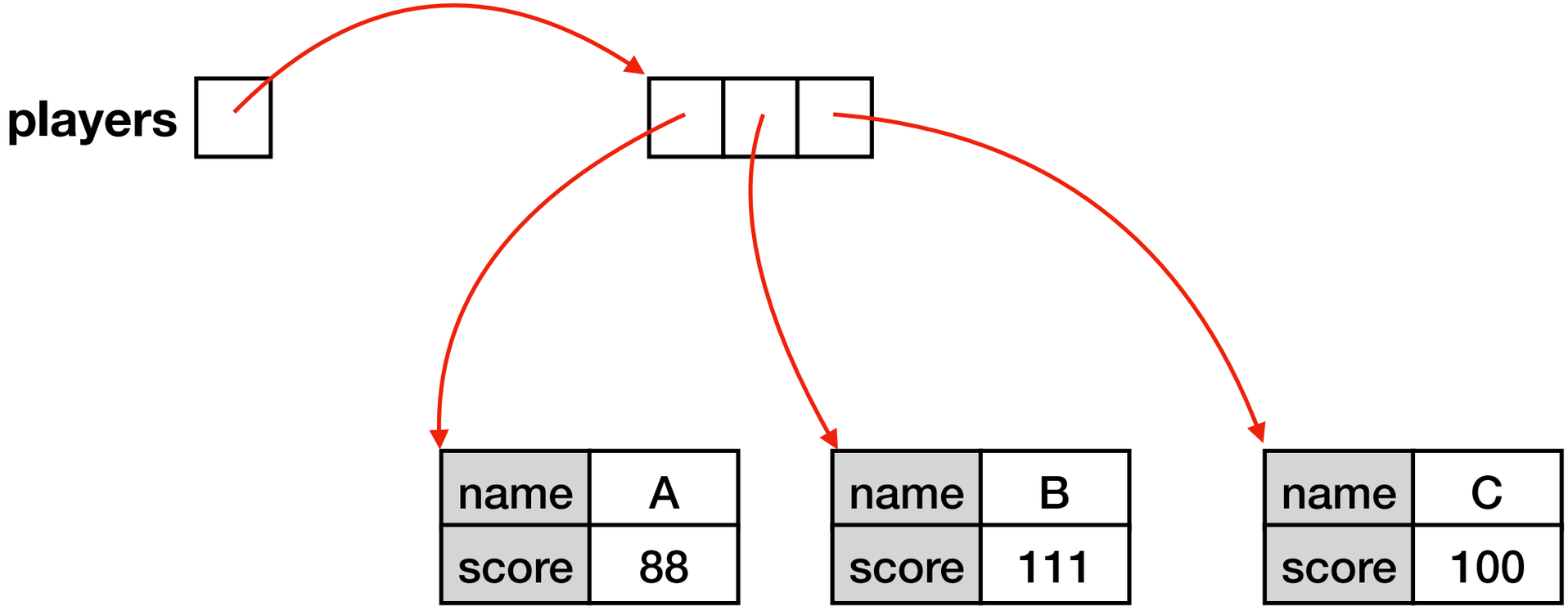

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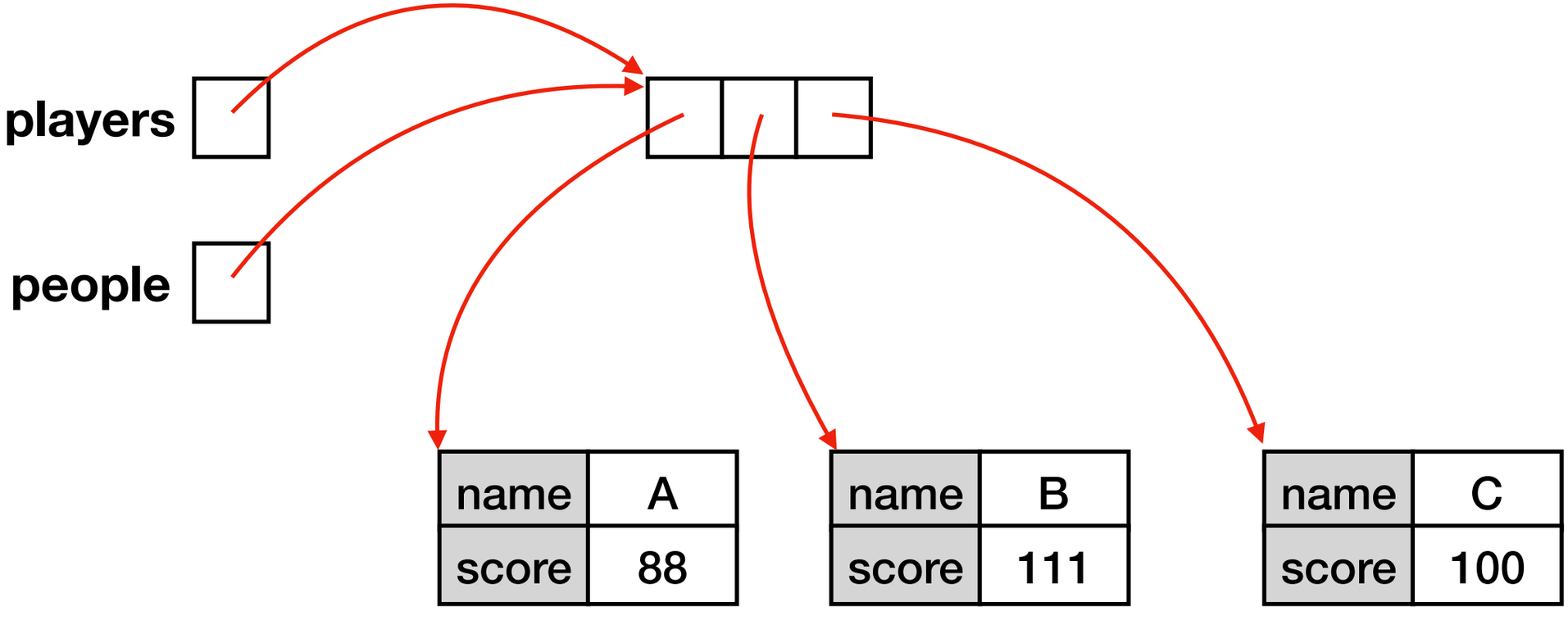

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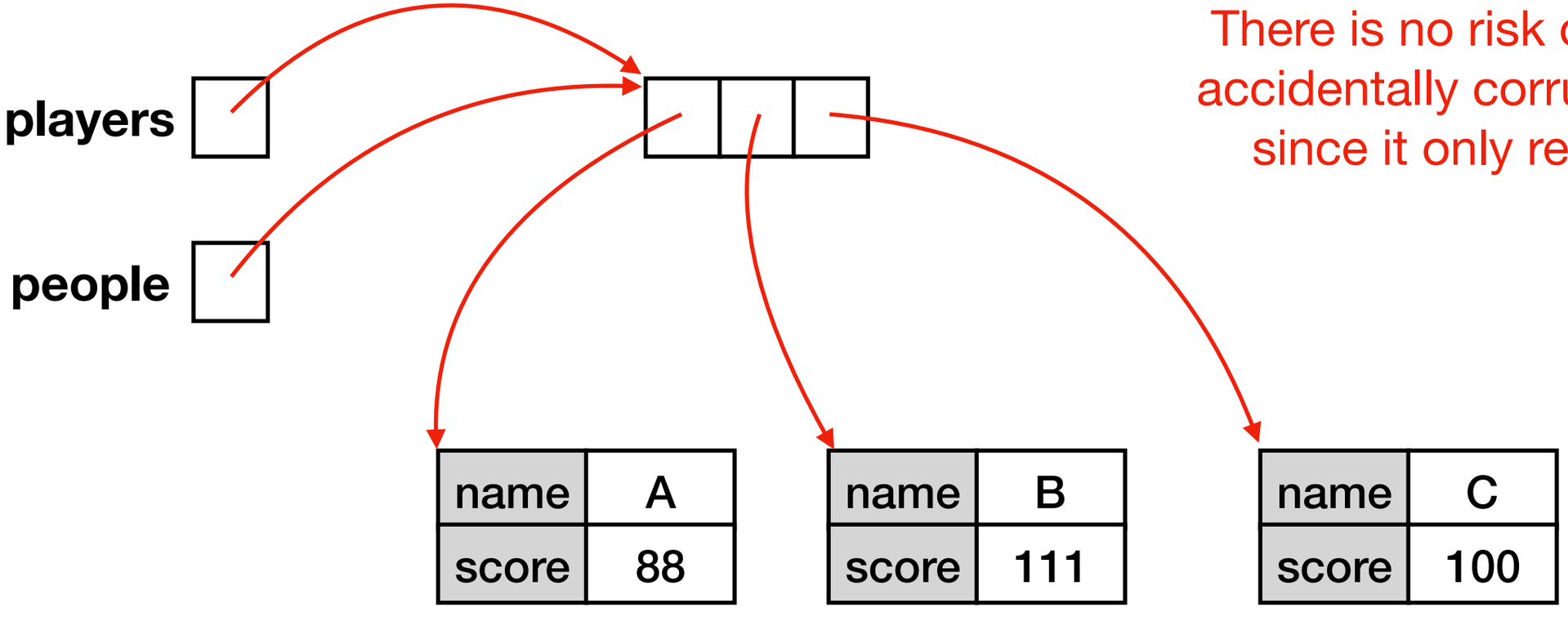

There is no risk of max_score accidentally corrupting players since it only reads people

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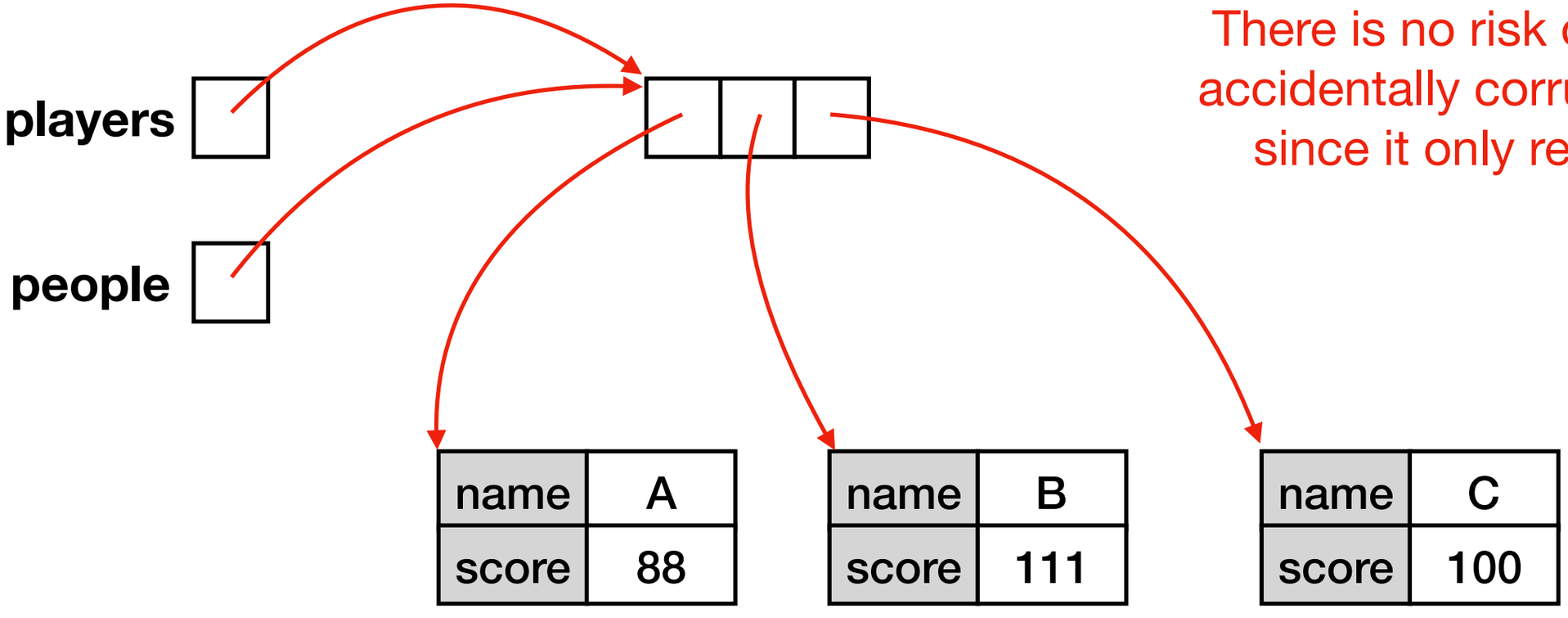

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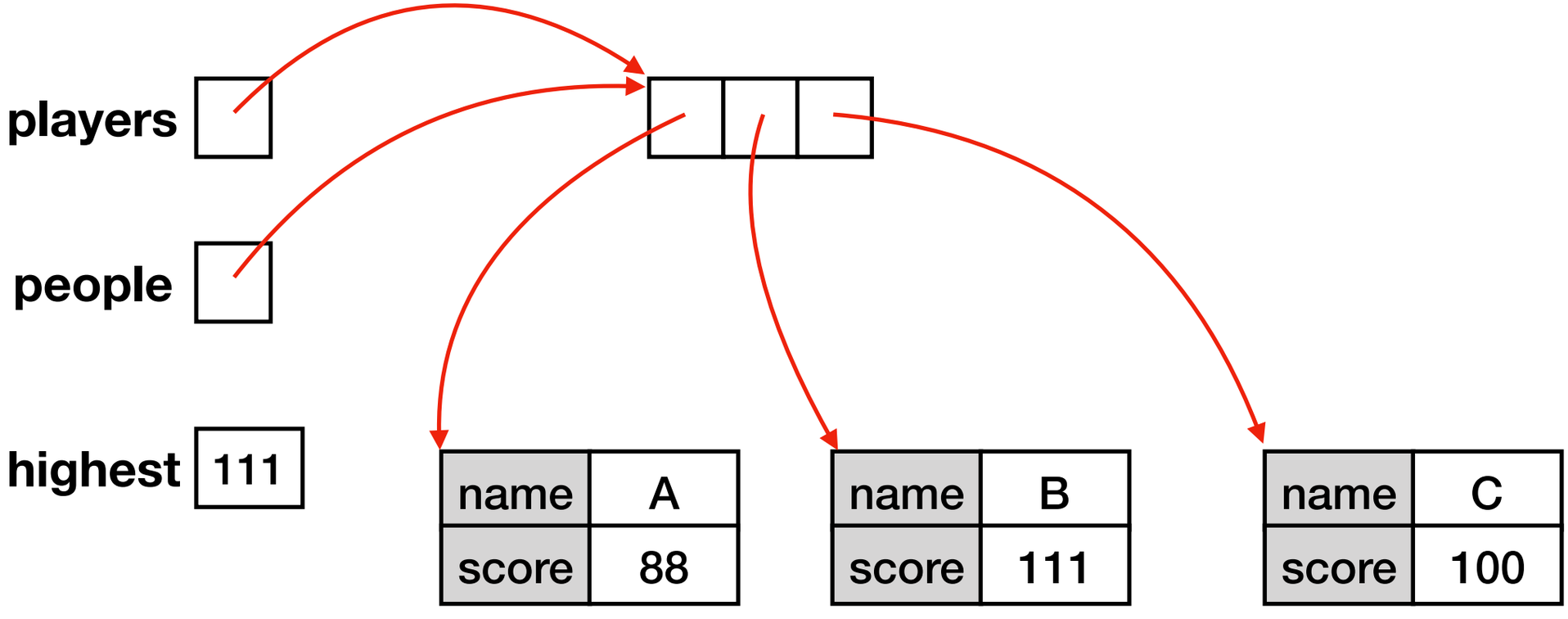

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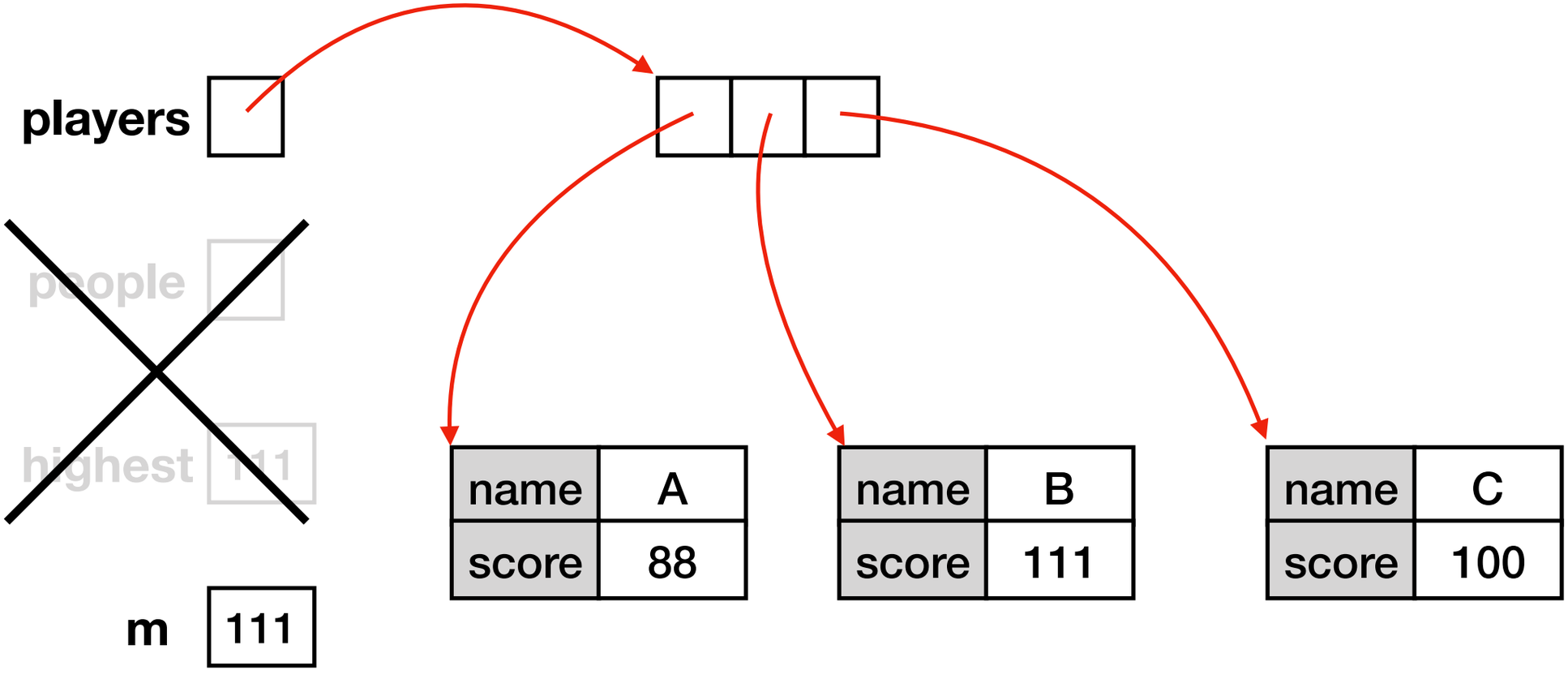

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(reference copy)

Use Case 2

Get median score
(shallow copy)

Use Case 3

Record historical scores
(deep copy)

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def median_score(people):
  people = copy.copy(people)
  people.sort(...)
  # TODO: return score for middle of people

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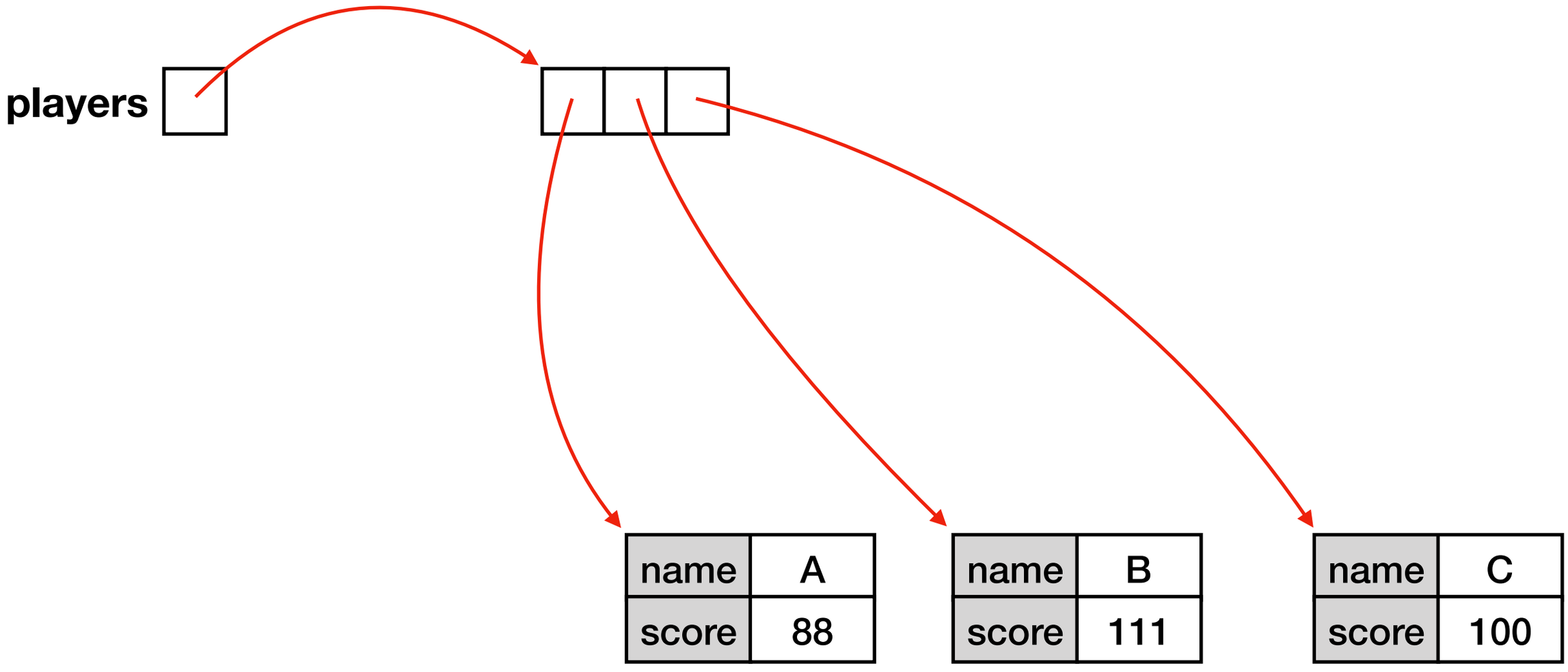

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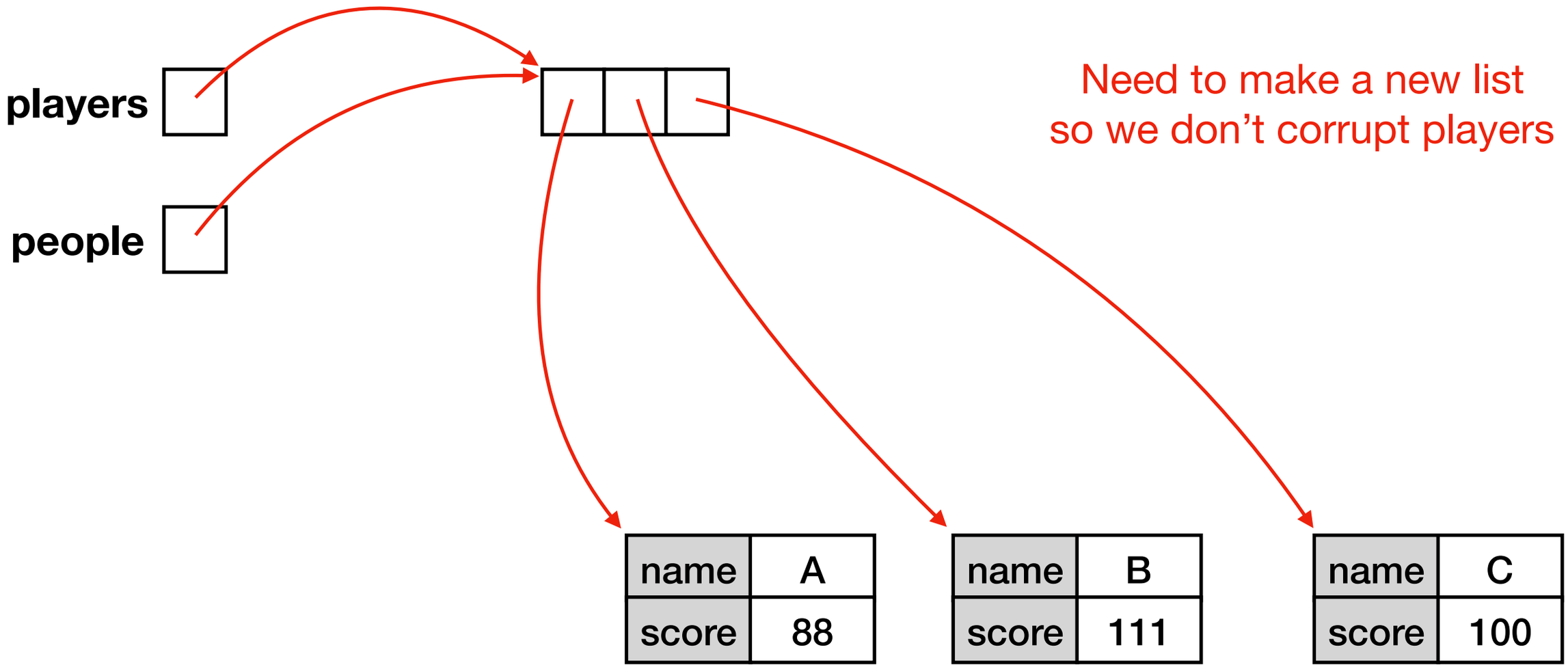

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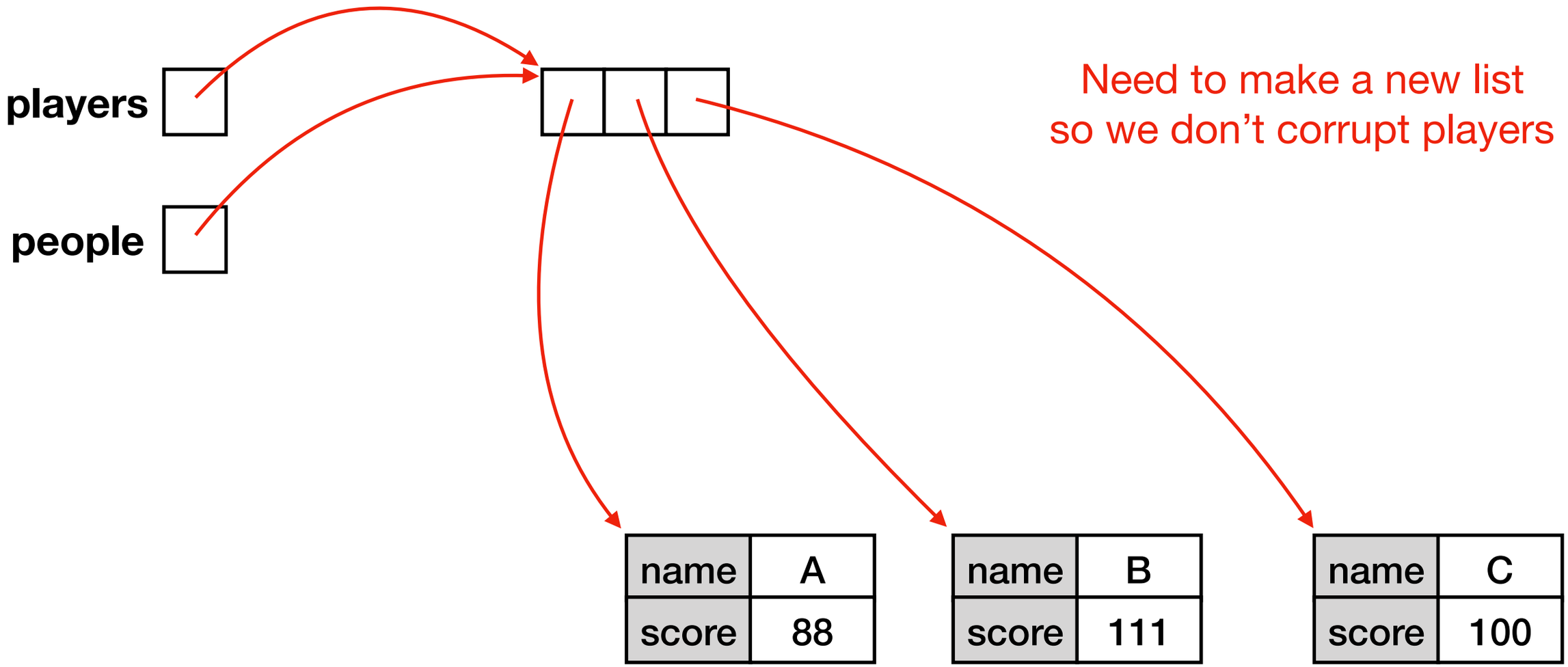

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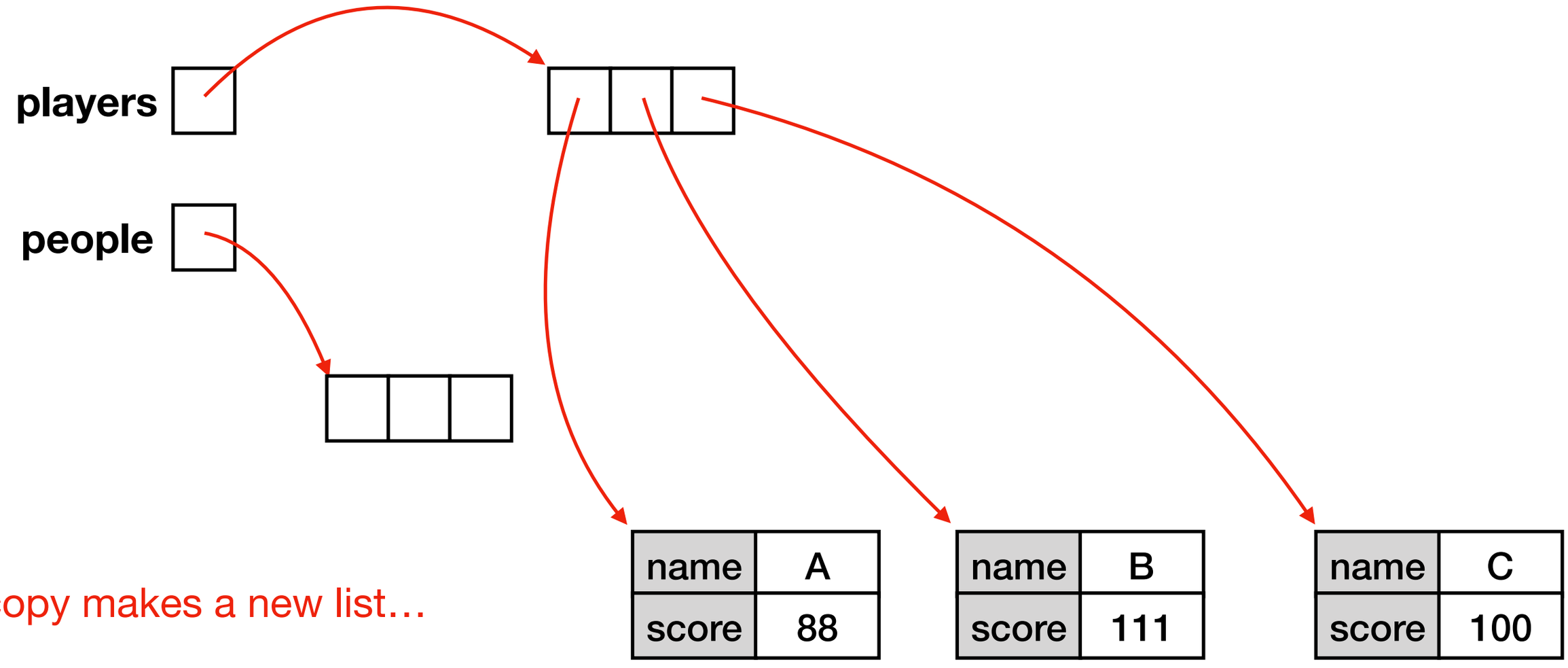
  # TODO: return score for middle of people


players = …
m = median_score(players)
```



copy makes a new list…

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    people.sort(...)
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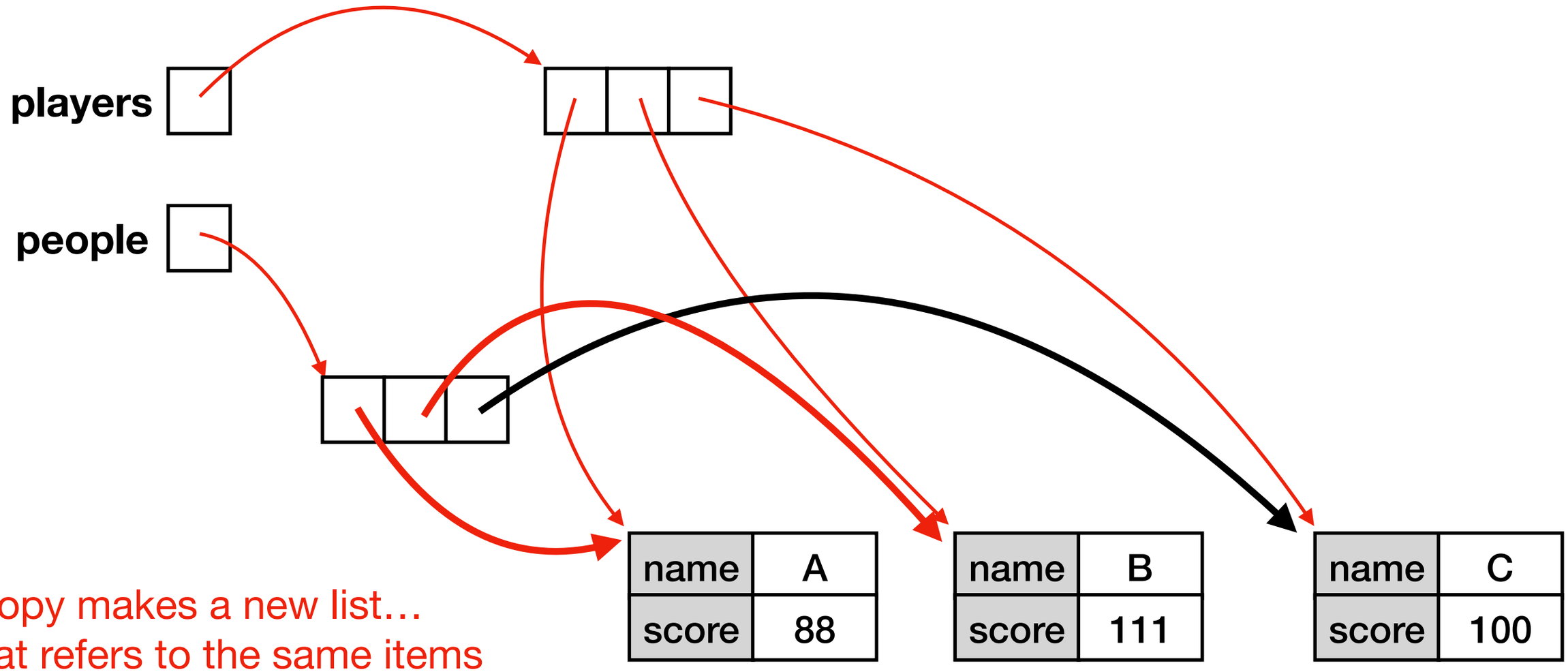

copy makes a new list…
…that refers to the same items

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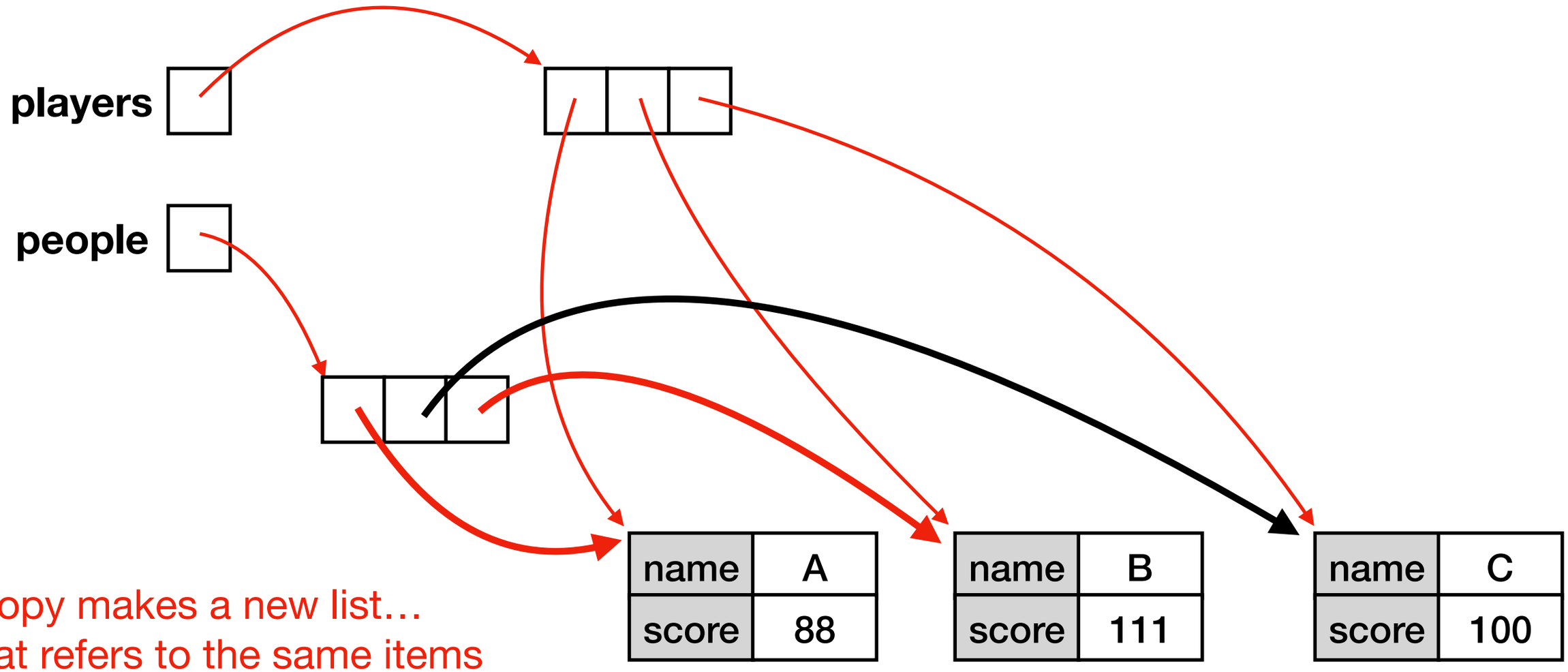

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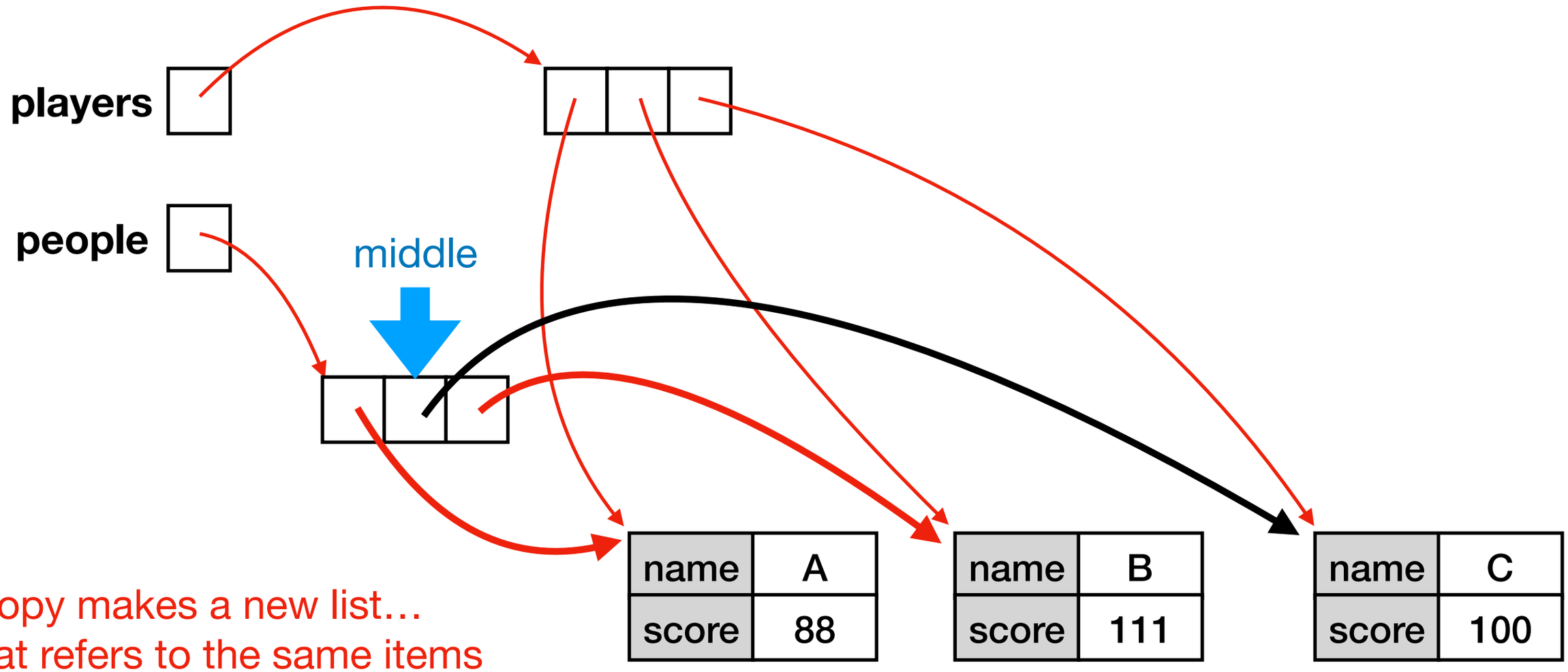

copy makes a new list…
…that refers to the same items

Example: Player Scores

```
players = [
  {"name":"A", "score":88},
  {"name":"B", "score":111},
  {"name":"C", "score":100}
]
```

Use Case 1

Get max score
(reference copy)

Use Case 2

Get median score
(shallow copy)

Use Case 3

Record historical scores
(deep copy)

```
players = …
players_before = copy.deepcopy(players)

# make changes to players
players[0]["score"] += 10


print("score change:",
      players[0]["score"] - players_before[0]["score"])
```

```
players = …
players_before = copy.deepcopy(players)

# make changes to players
players[0]["score"] += 10


print("score change:",
      players[0]["score"] - players_before[0]["score"])
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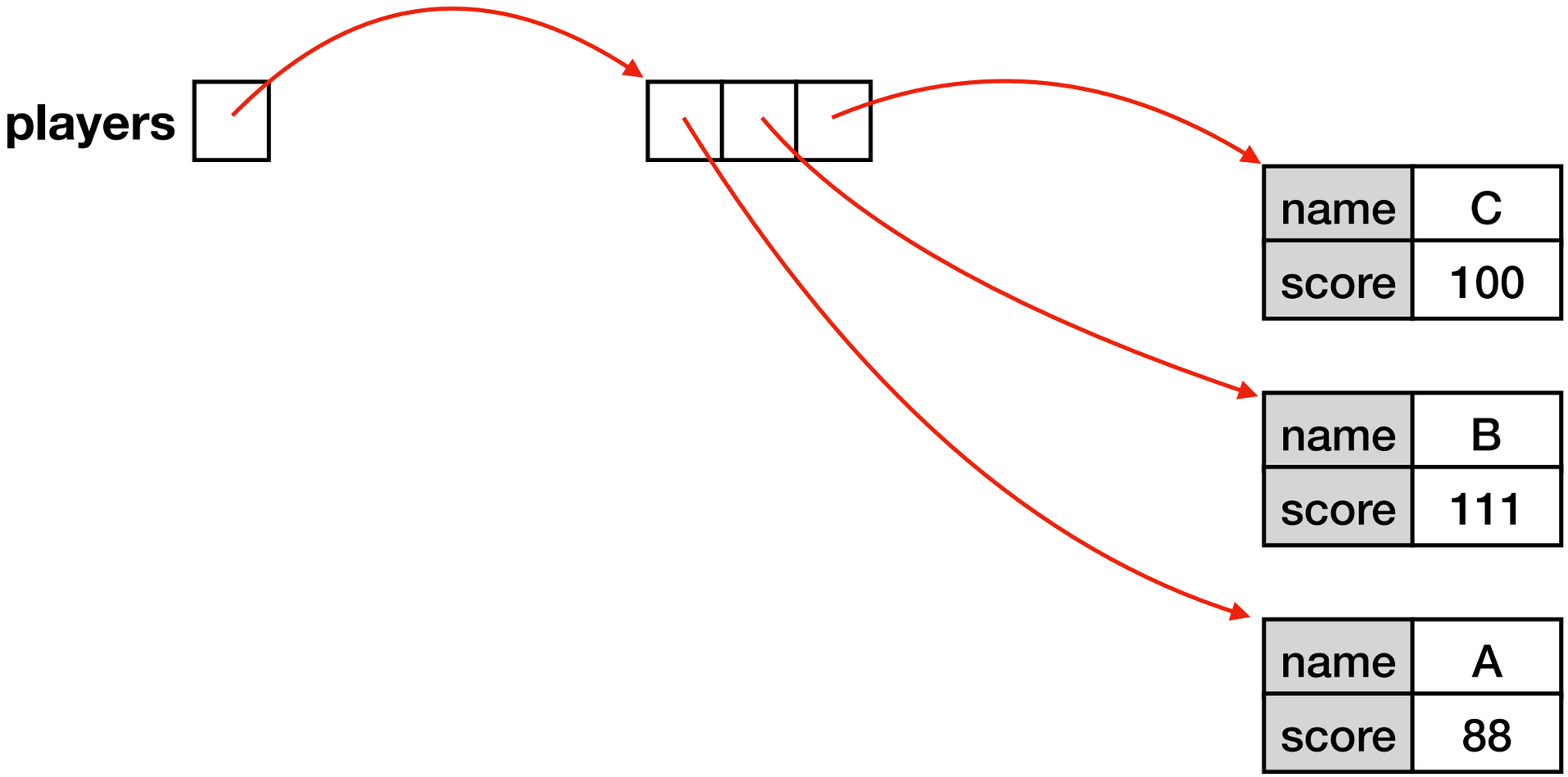

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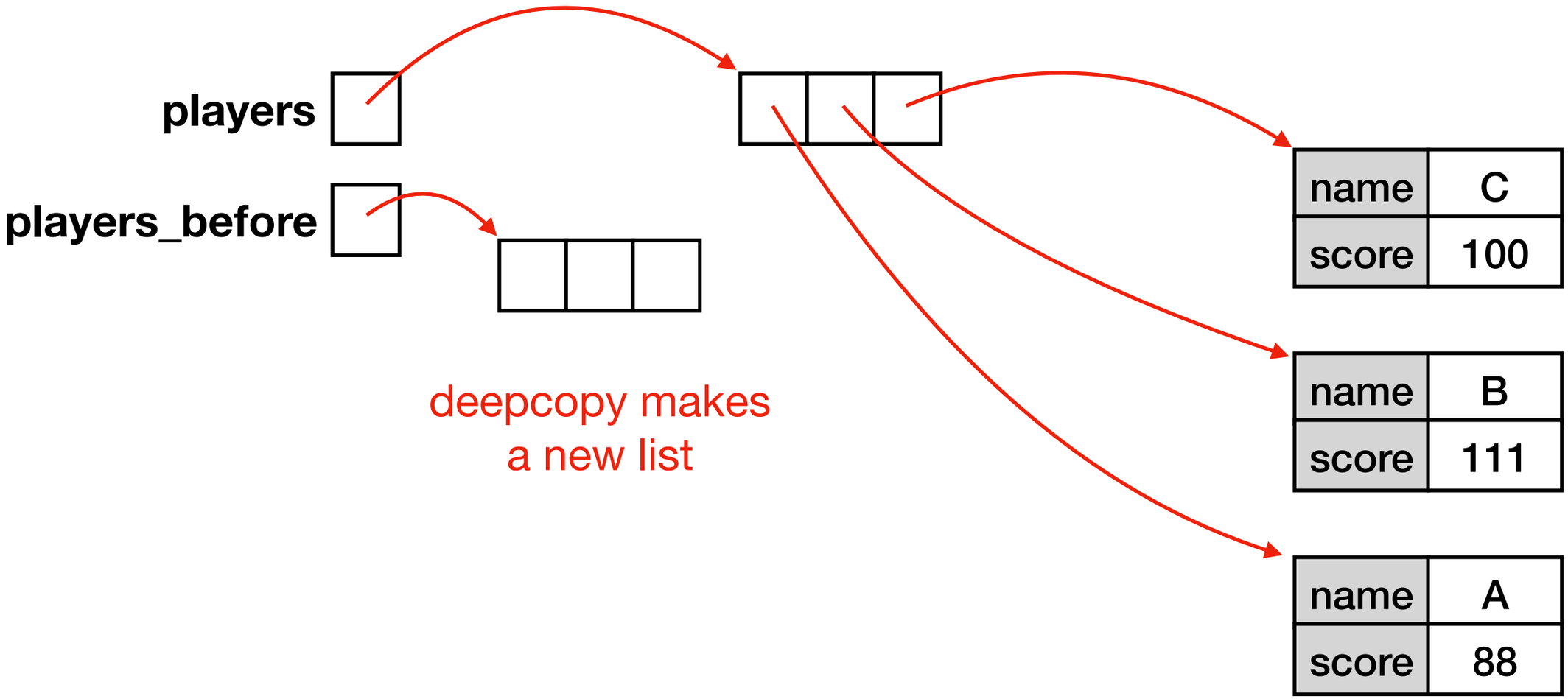

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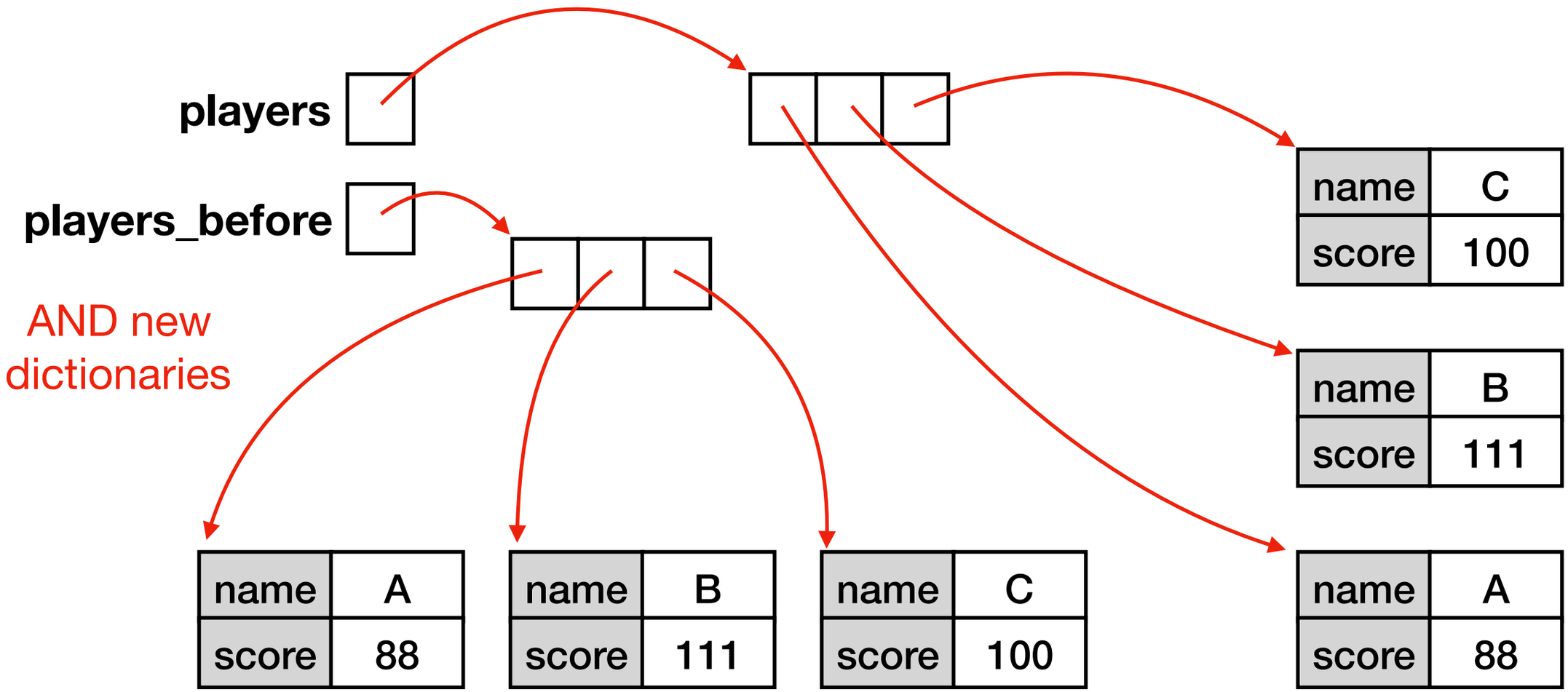

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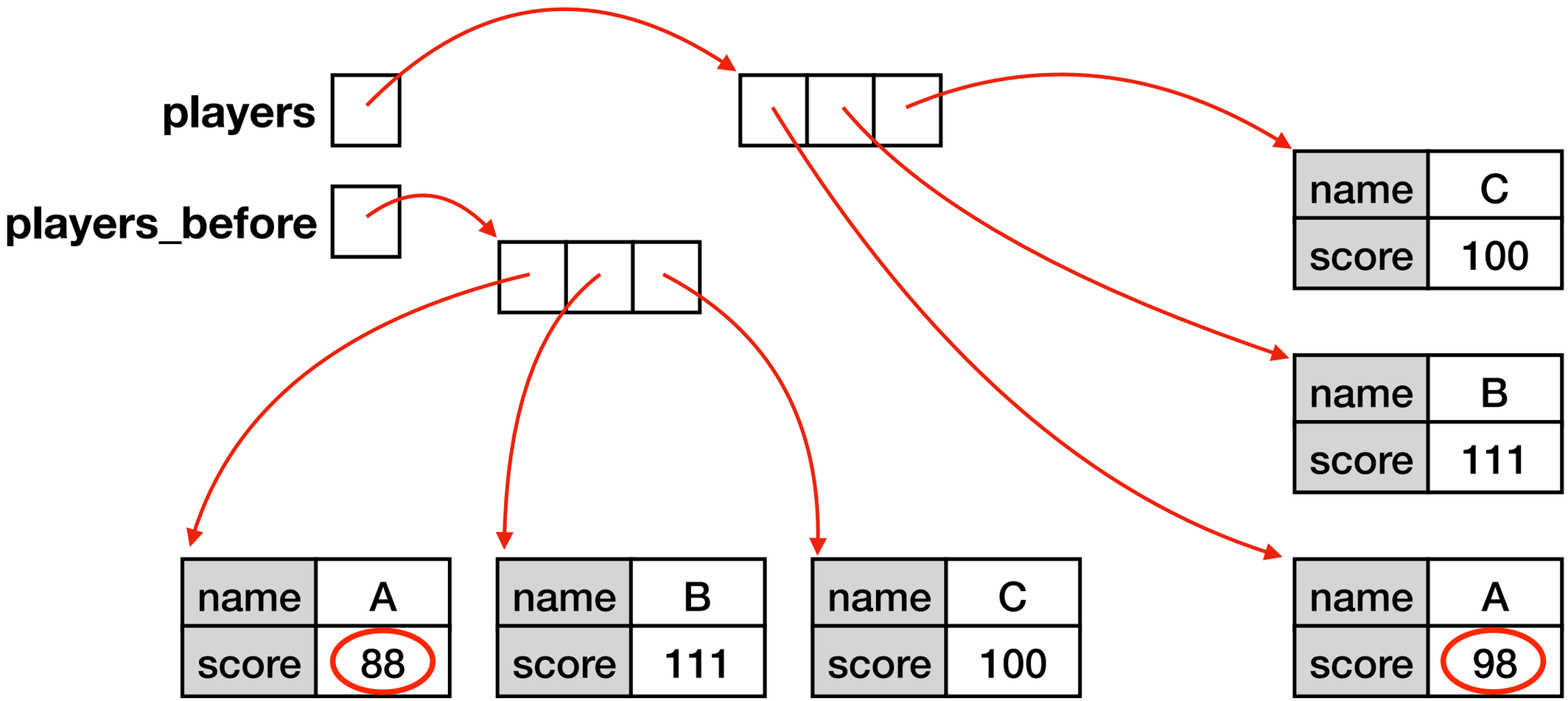

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players_before = copy.deepcopy(players)

# make changes to players
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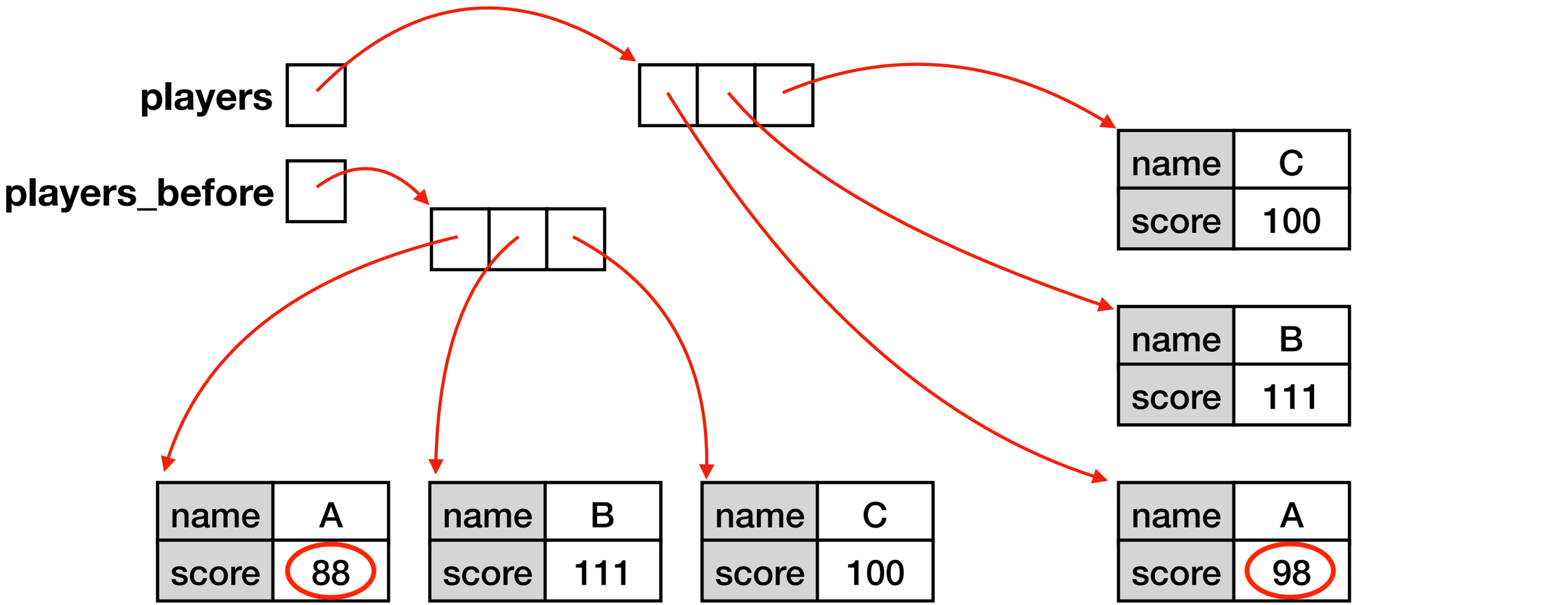
print("score change:",
      players[0]["score"] - players_before[0]["score"])
```

prints 10



Today's Outline

Review

More references

Copying
- reference
- shallow
- deep

Worksheet

Worksheet Problems 7-11