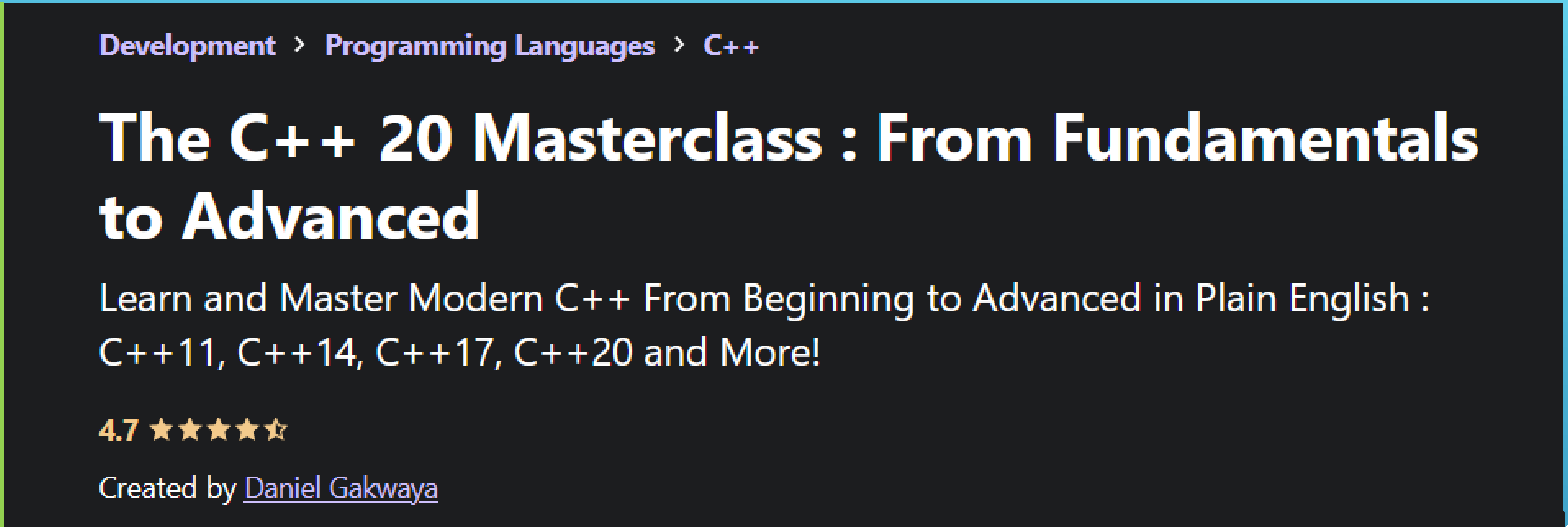

Development › Programming Languages › C++

The C++ 20 Masterclass : From Fundamentals to Advanced

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4.7 ★★★★☆

Created by Daniel Gakwaya

Slides

Section : Box Container class – Practicing what we know

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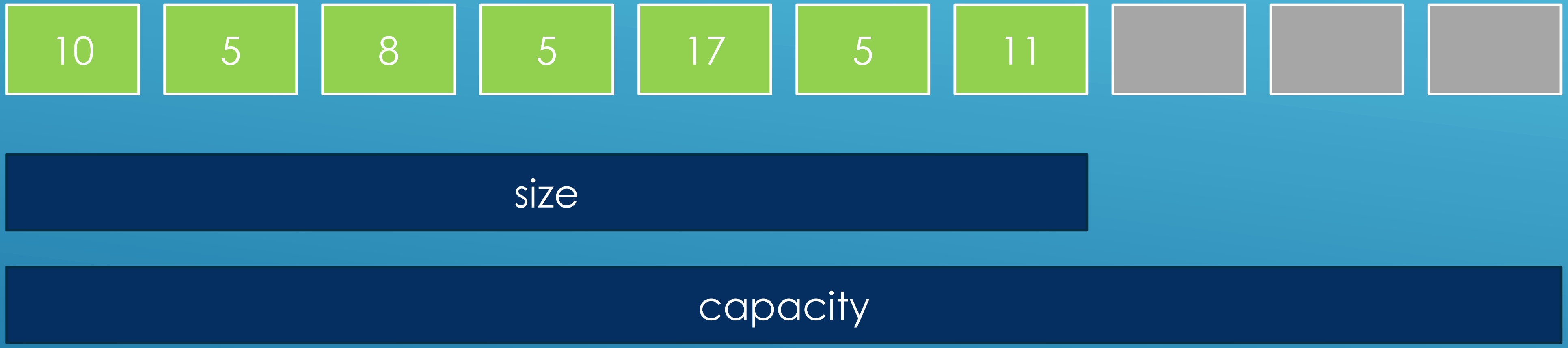
BoxContainer : Introduction

```
. BoxContainer is a container class that provides the features
        . add_item
        . remove_item
        . remove_all

. We can add BoxContainer's up with :
        . +=
        . +

. Additionaly we can :
        . Stream insert BoxContainers with opreator<<
        . Copy construct BoxContainer's
        . Copy assign BoxContainer's
```


10
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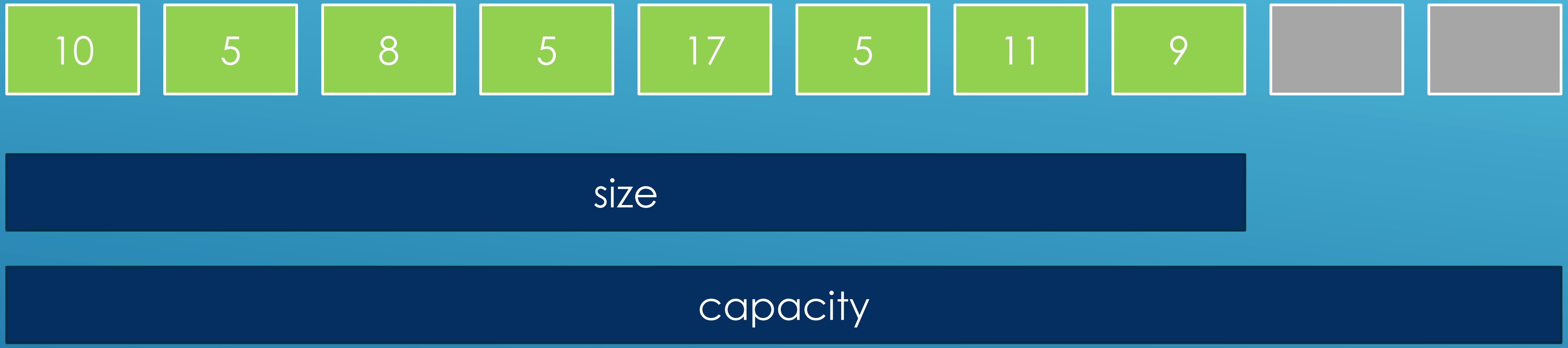
Adding elements



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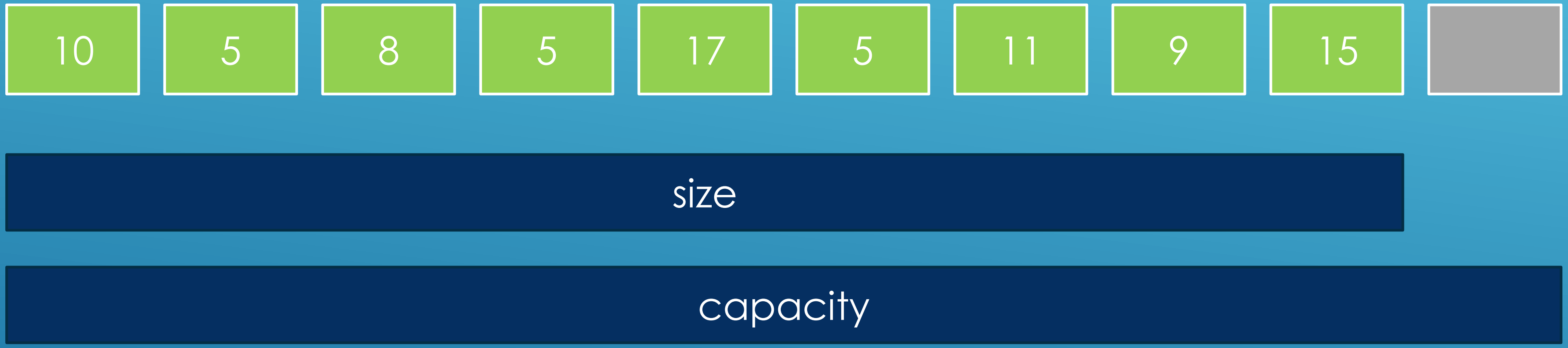

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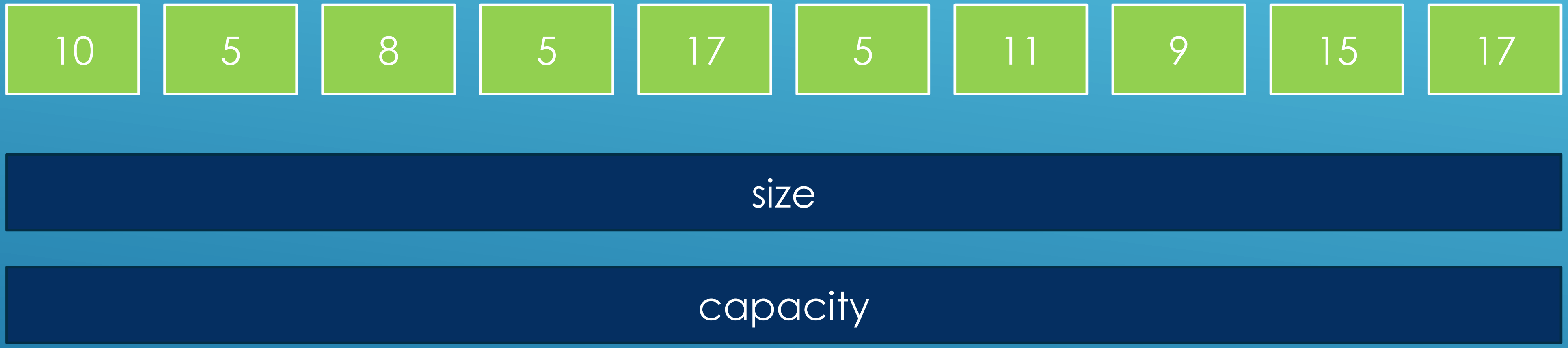

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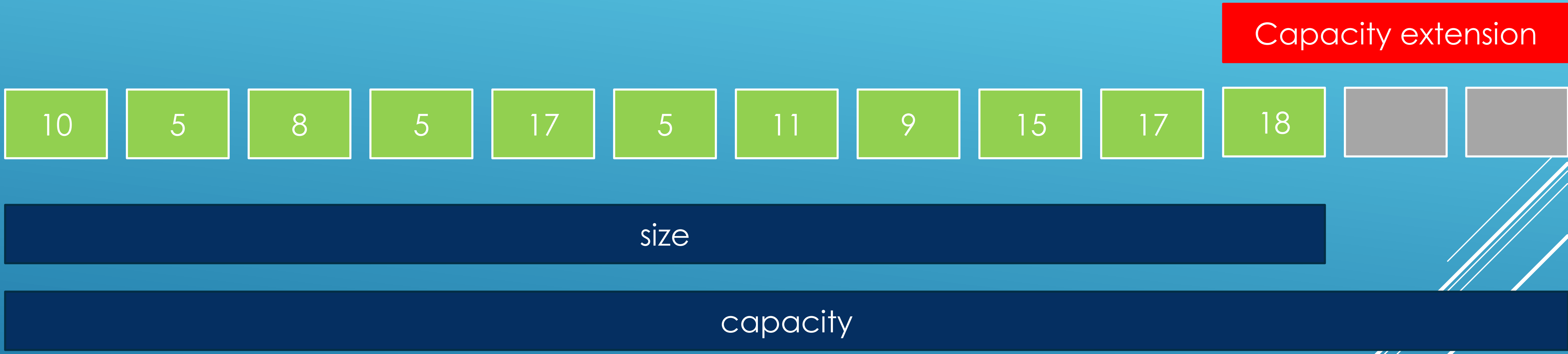

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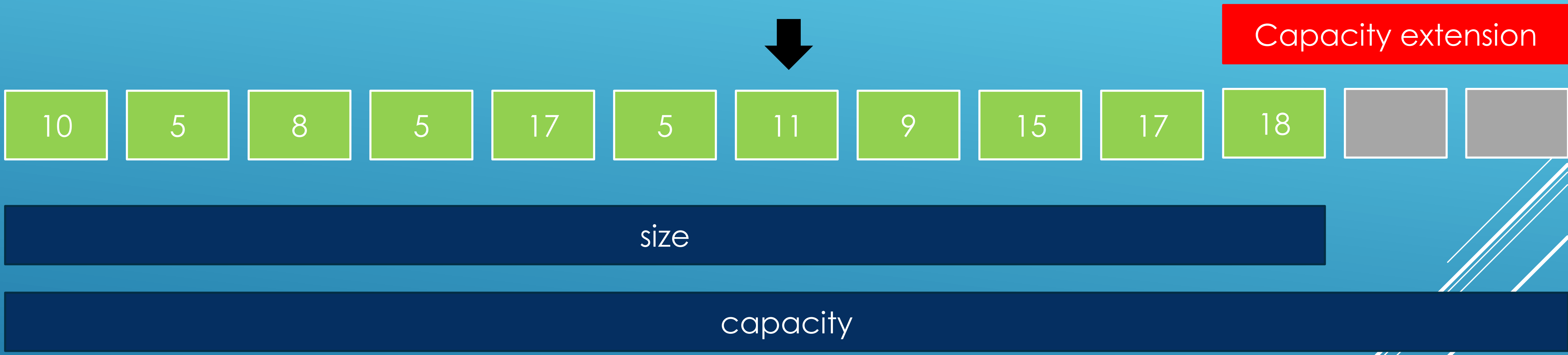

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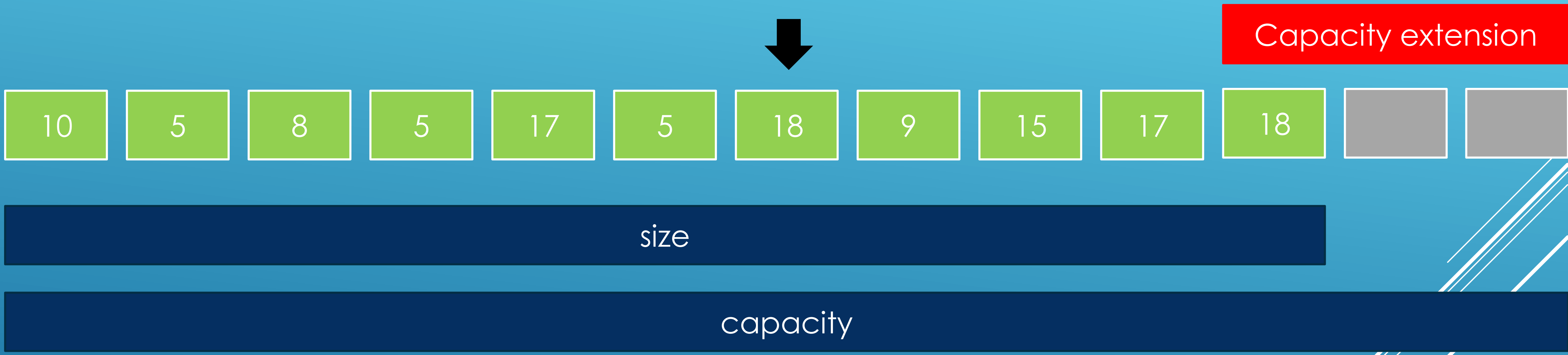

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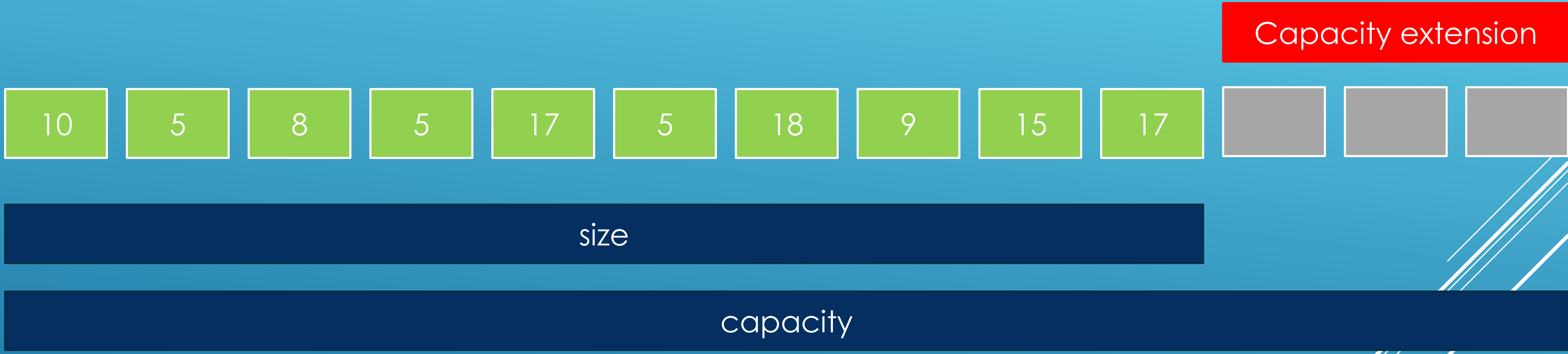

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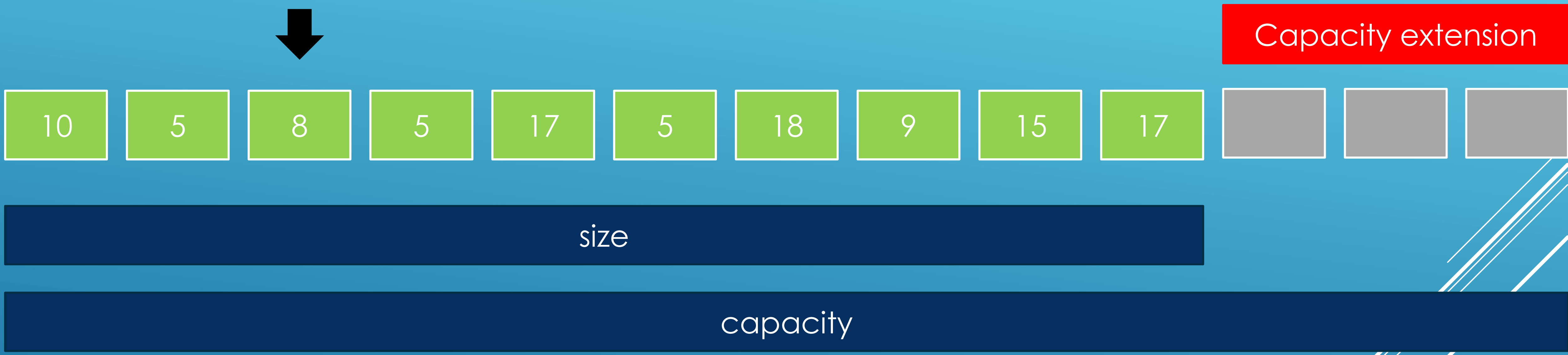

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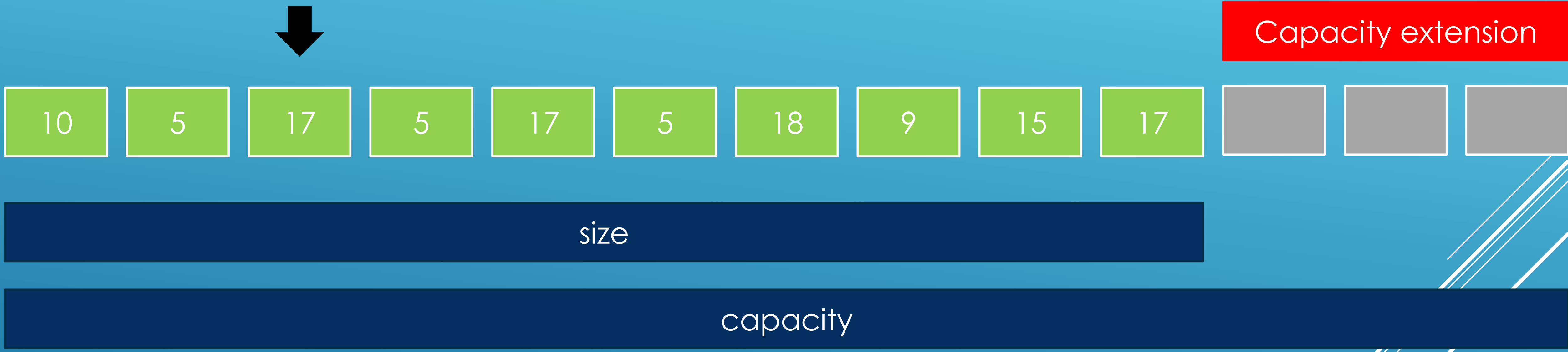

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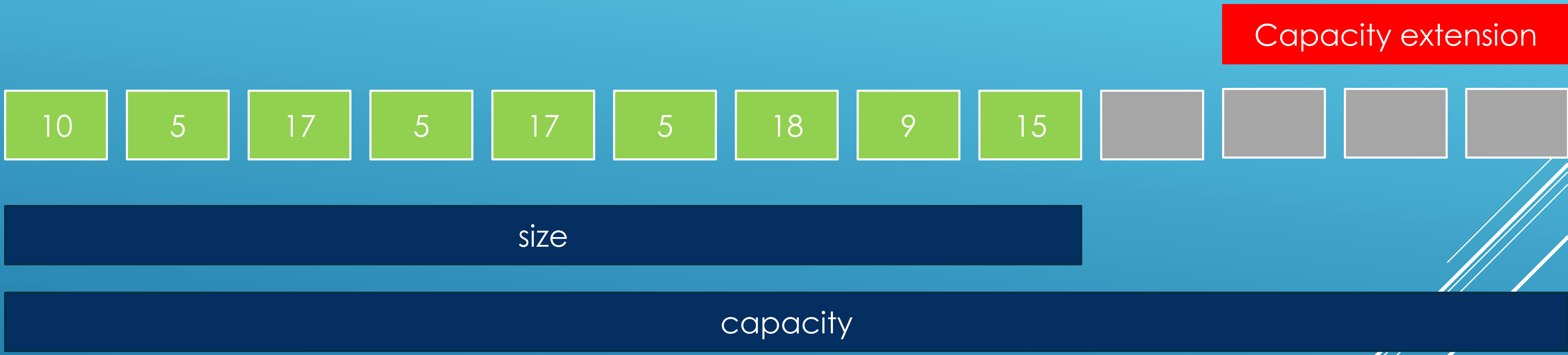

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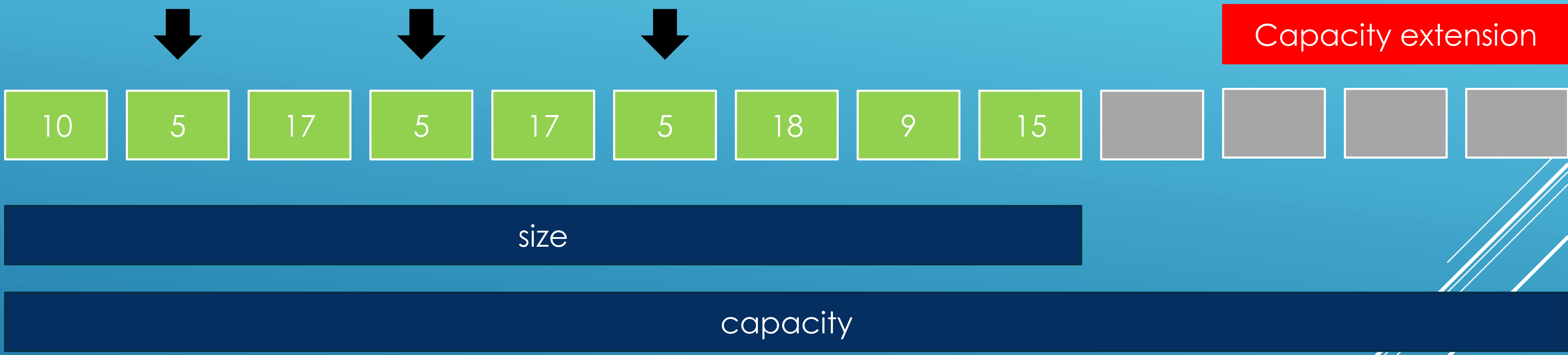

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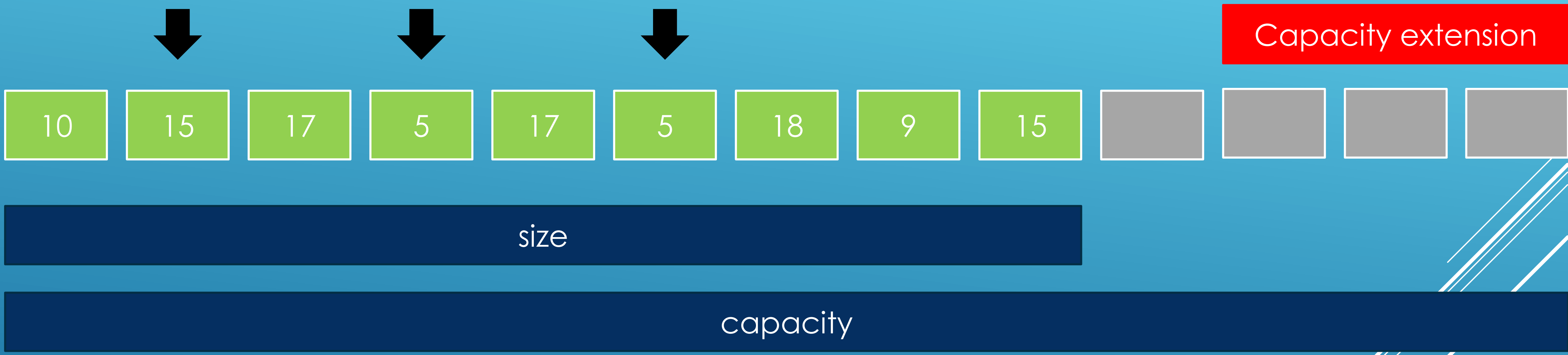

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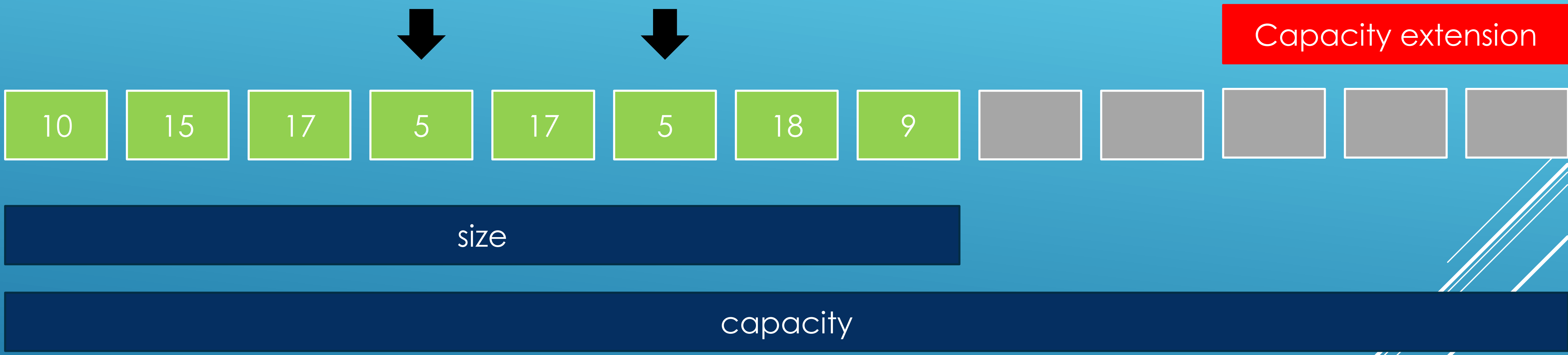

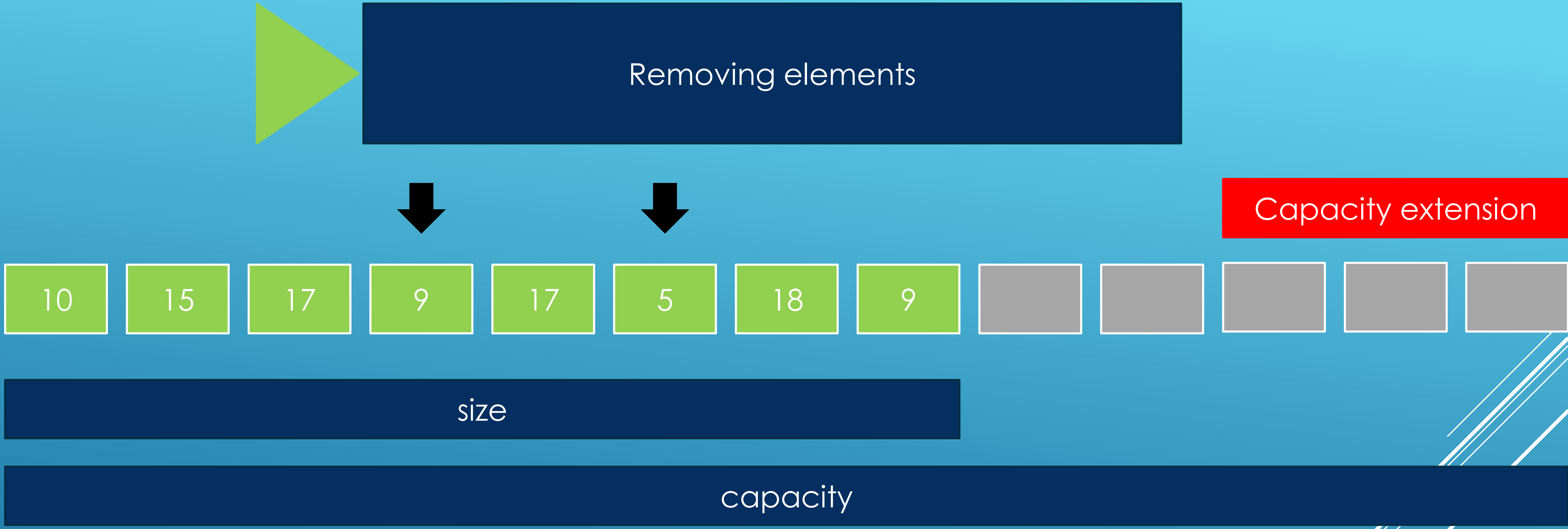
Removing elements
Capacity extension
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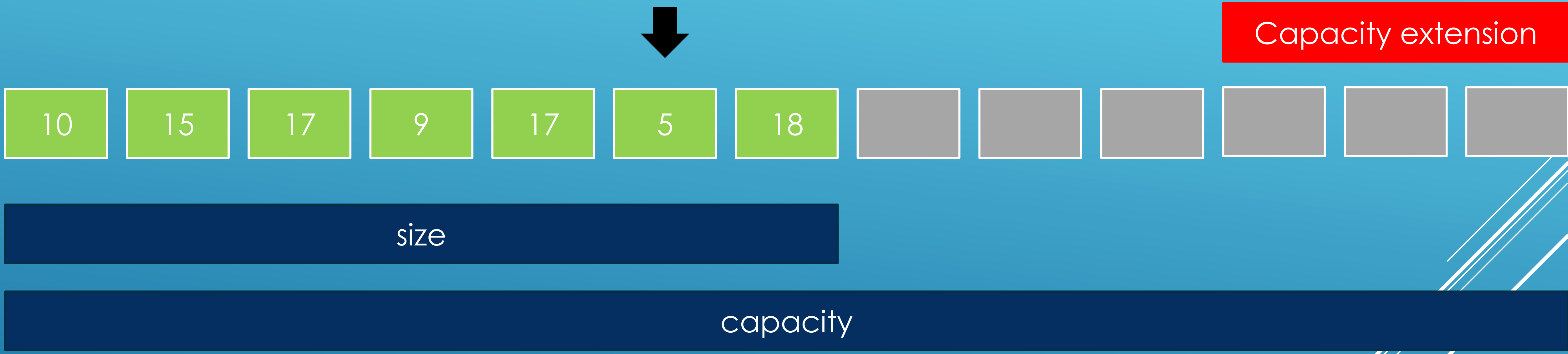
size
capacity

Removing elements



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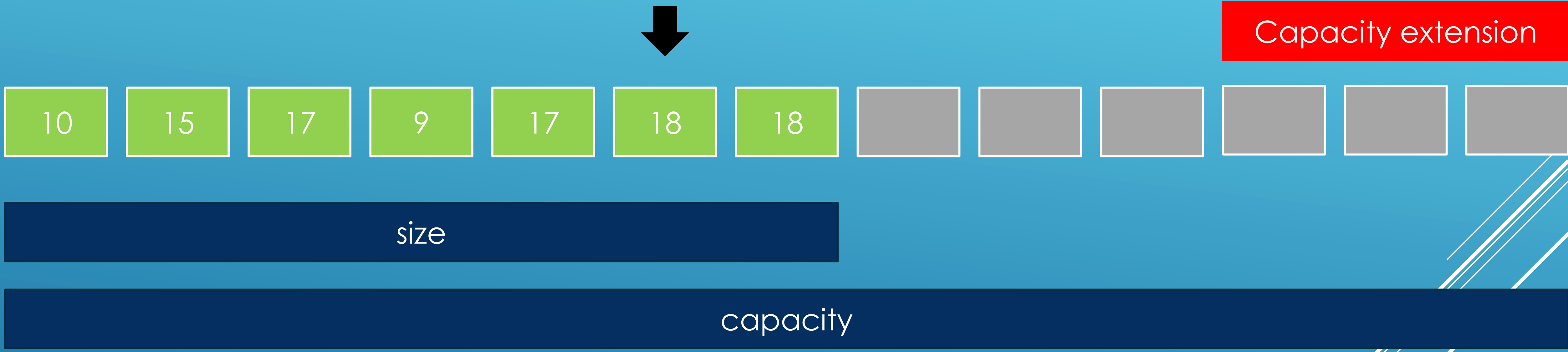

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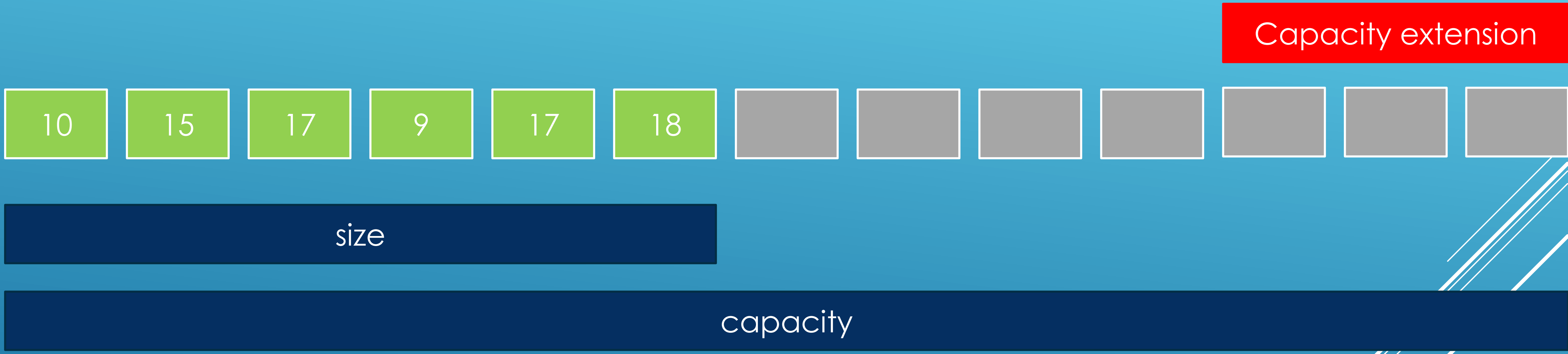
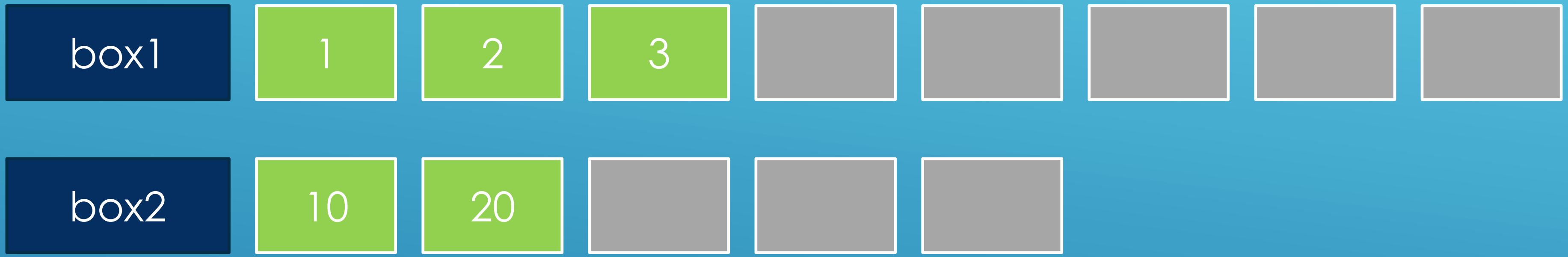
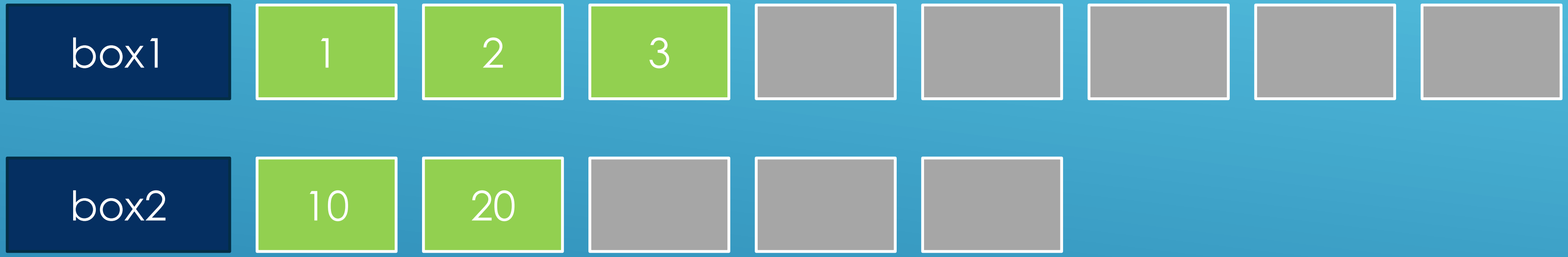


Operator+=

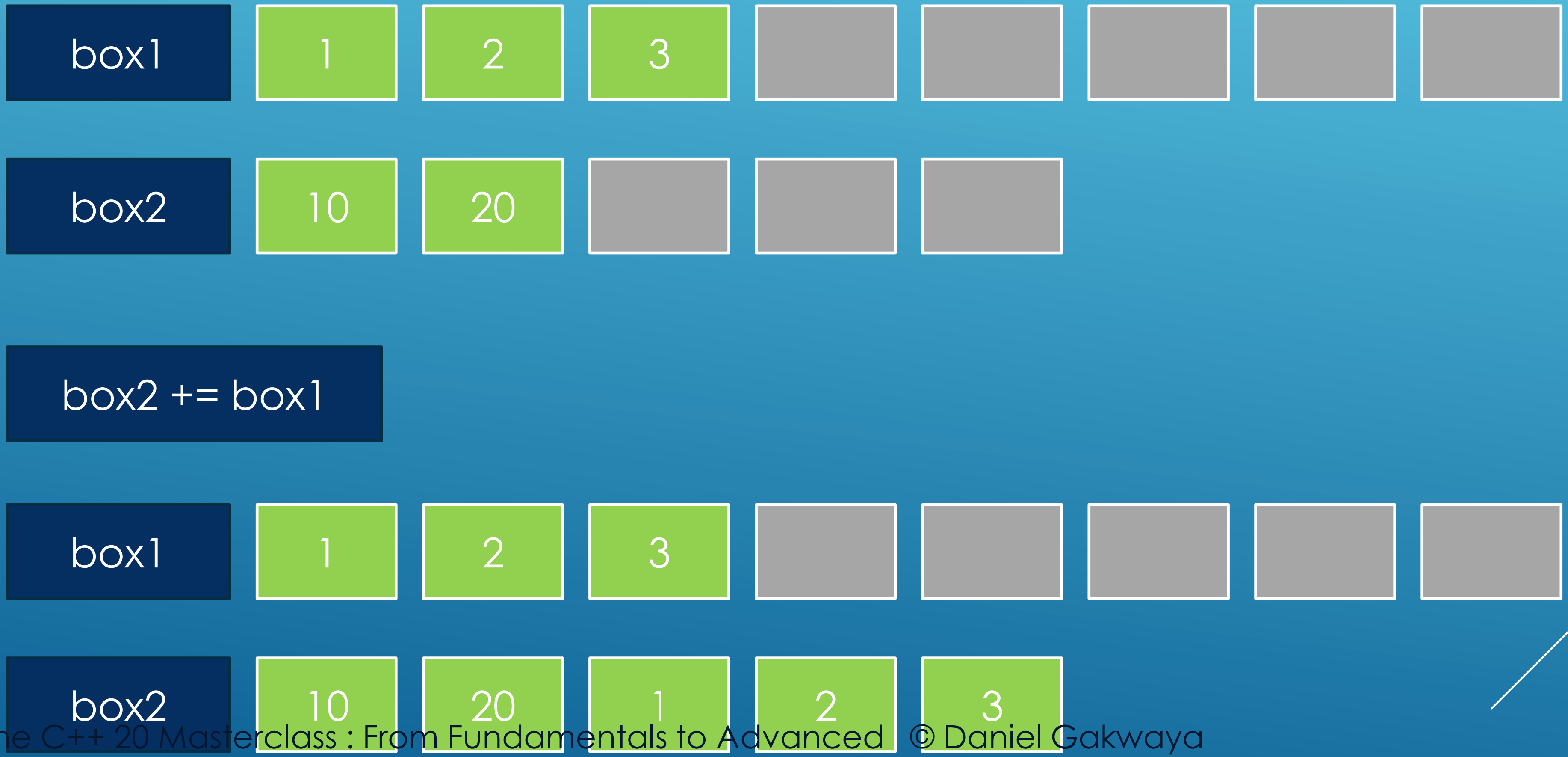


Operator+=

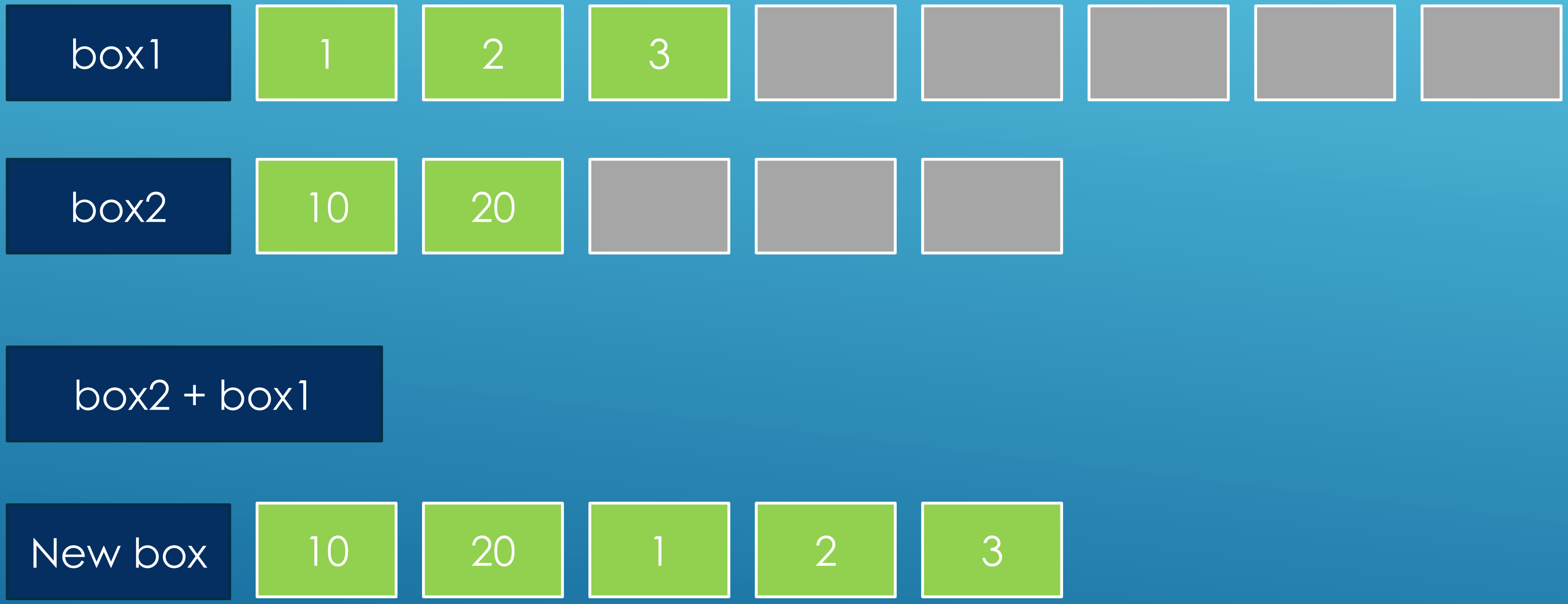


```
box2 += box1
```

Operator+=



Operator+



Class wrapping on top of raw array

```
class BoxContainer : public StreamInsertable
{
        typedef int value_type; // Allows us to change what's stored in the vector on the fly
                                // Can make it store int, double,...
        static const size_t DEFAULT_CAPACITY = 30;
public:
    BoxContainer(size_t capacity = DEFAULT_CAPACITY);
    BoxContainer(const BoxContainer& source);
    ~BoxContainer();

    //StreamInsertable Interface
    virtual void stream_insert(std::ostream& out)const;

    // Helper getter methods
    size_t size( ) const { return m_size; }
    size_t capacity() const{return m_capacity;};

    /* ...

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

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BoxContainer

Constructing, destructing

Building a box container

```
class BoxContainer : public StreamInsertable
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        typedef int value_type; // Allows us to change what's stored in the vector on the fly
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        static const size_t DEFAULT_CAPACITY = 30;
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    size_t size( ) const { return m_size; }
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    /* ...

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

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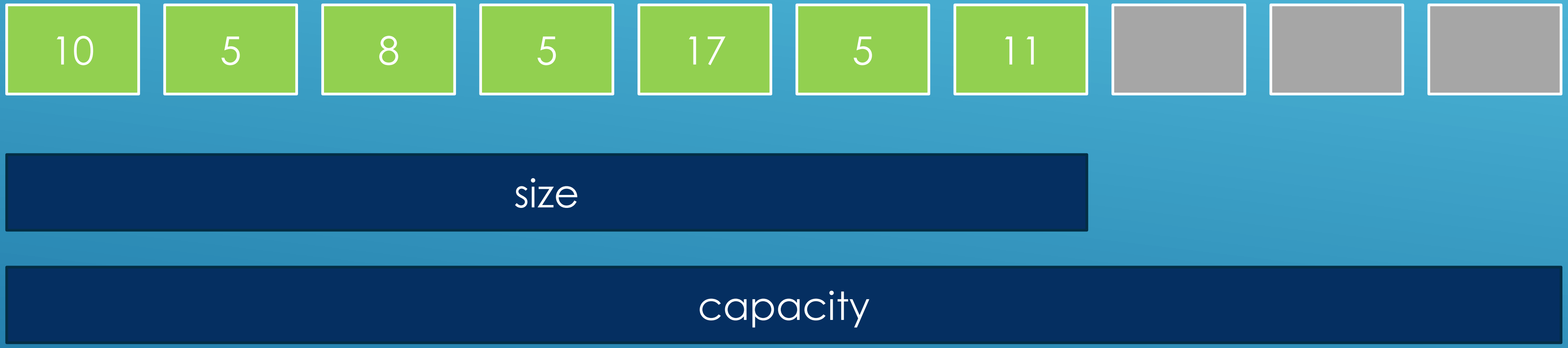
BoxContainer

Adding Items


10
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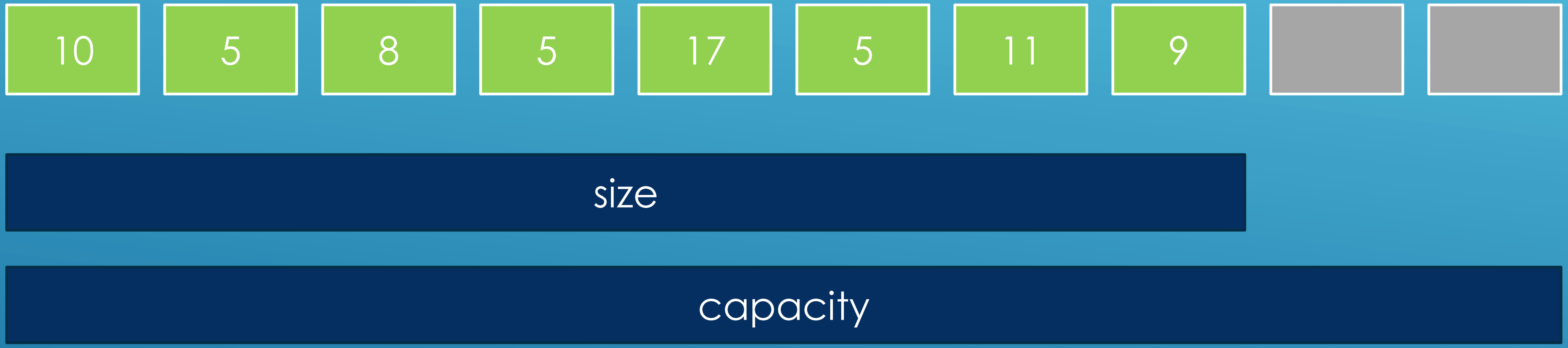
size
capacity

Adding elements



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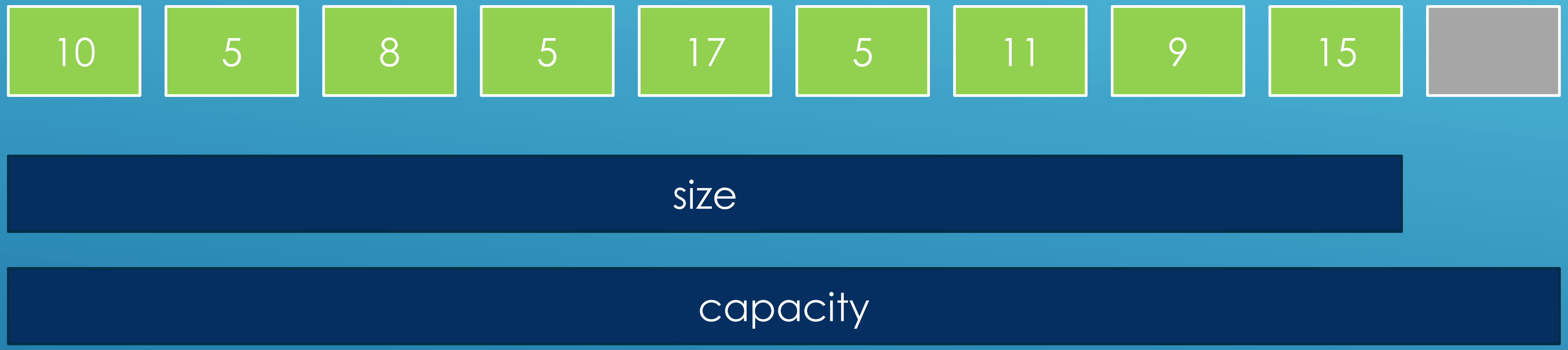

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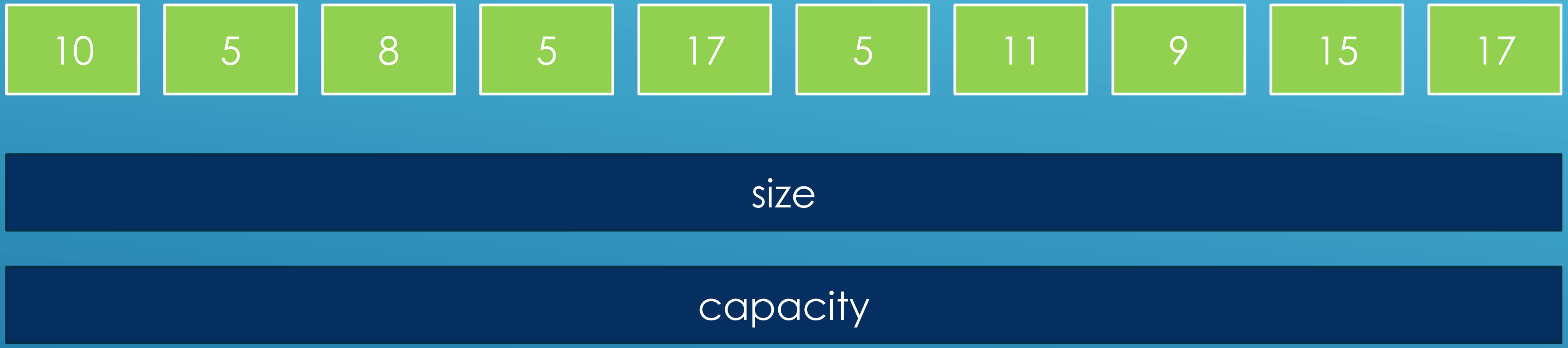

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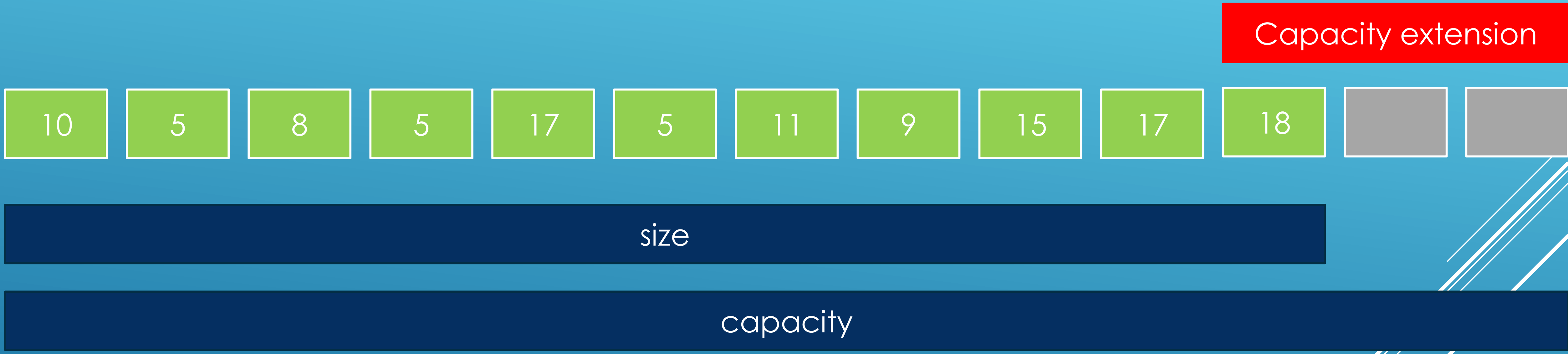

Expanding

```
void BoxContainer::expand(size_t new_capacity){
    std::cout << "Expanding to " << new_capacity << std::endl;
    value_type *new_items_container;

    if (new_capacity <= m_capacity)
        return; // The needed capacity is already there

    //Allocate new(larger) memory
    new_items_container = new value_type[new_capacity];

    //Copy the items over from old array to new
    for(size_t i{} ; i < m_size; ++i){
        new_items_container[i] = m_items[i];
    }

    //Release the old array
    delete [ ] m_items;

    //Make the current box wrap around the new array
    m_items = new_items_container;

    //Use the new capacity
    m_capacity = new_capacity;
}
```

Adding

```
void BoxContainer::add(const value_type& item){
    if (m_size == m_capacity)
        expand(m_size+5); // Let's expand in increments of 5 to optimize on the calls to expand
    m_items[m_size] = item;
    ++m_size;
}
```

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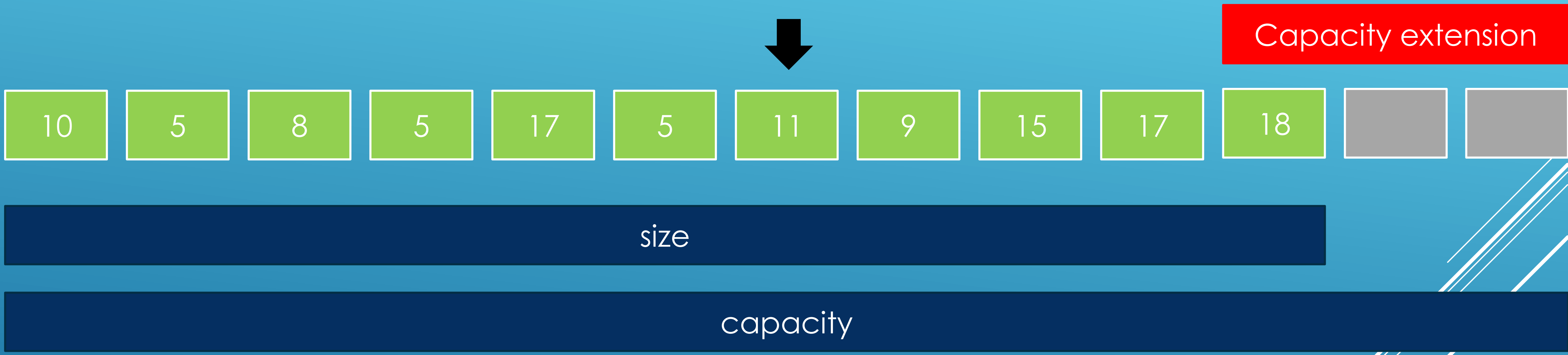
BoxContainer

Removing Items

Removing elements



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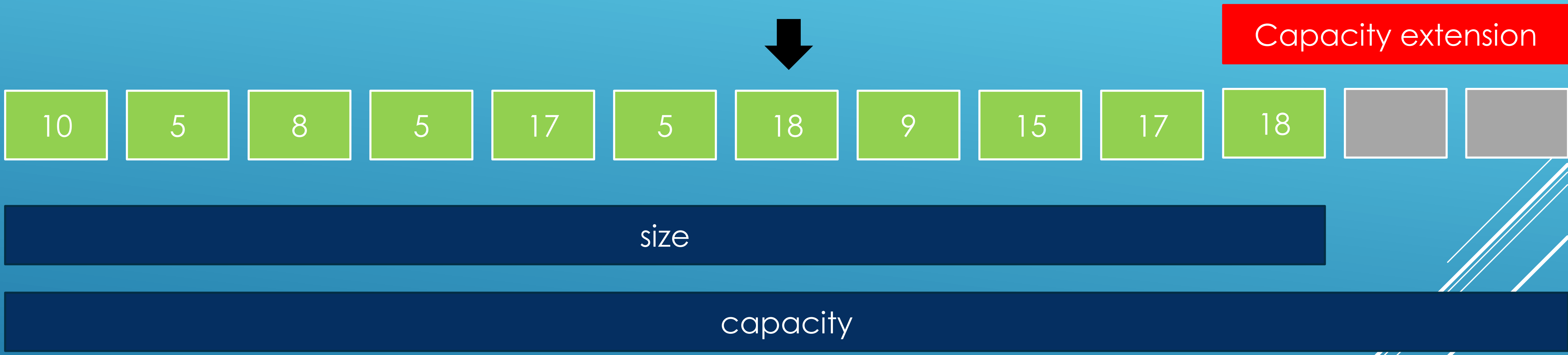

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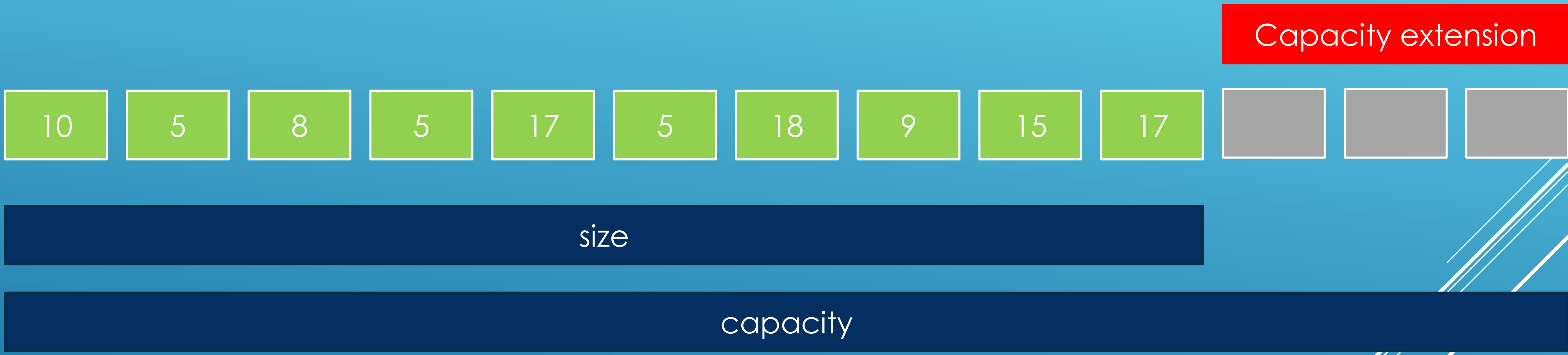

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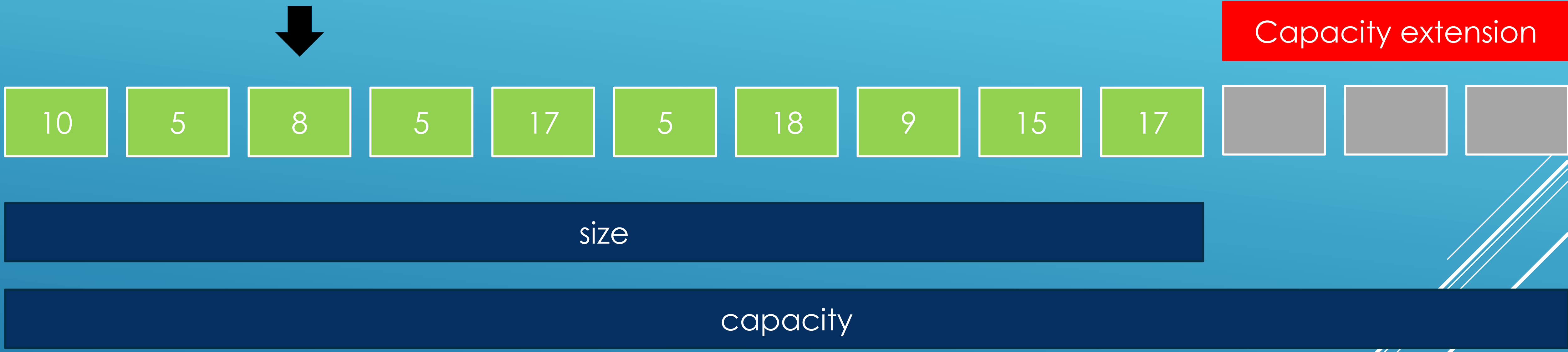

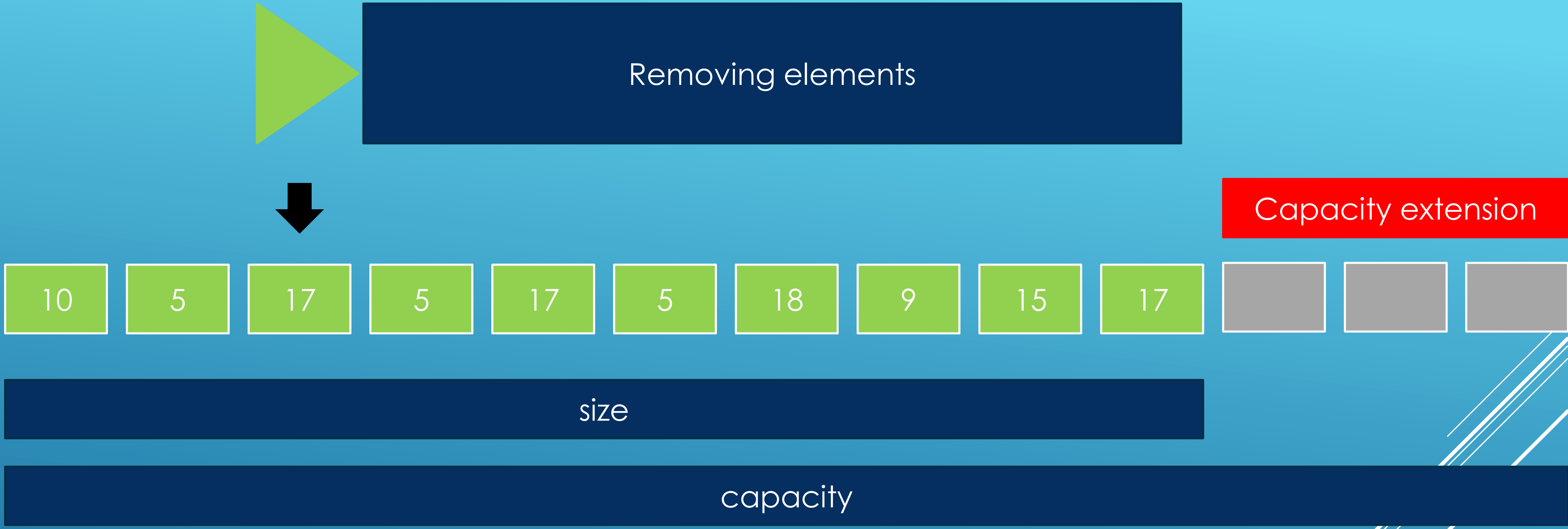
Removing elements
Capacity extension
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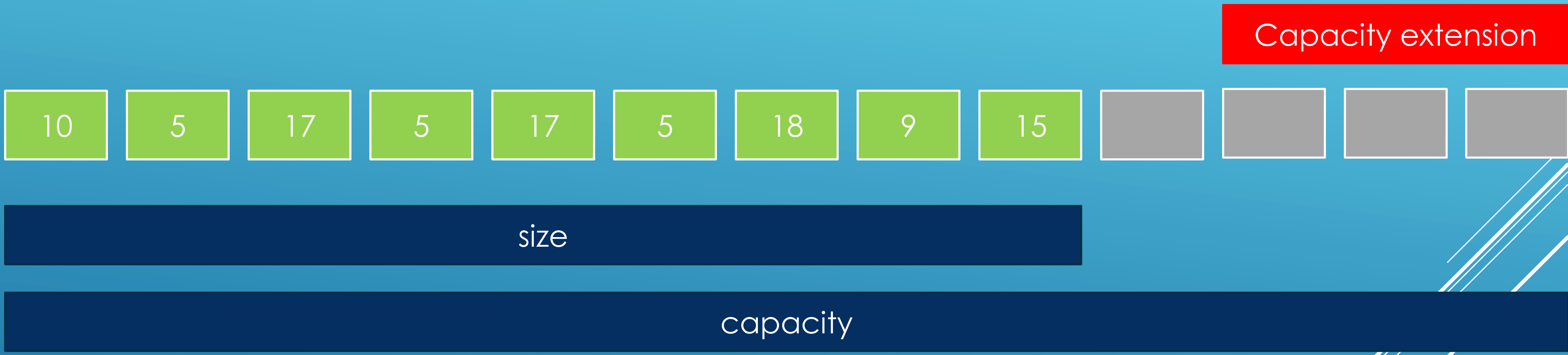
Removing elements



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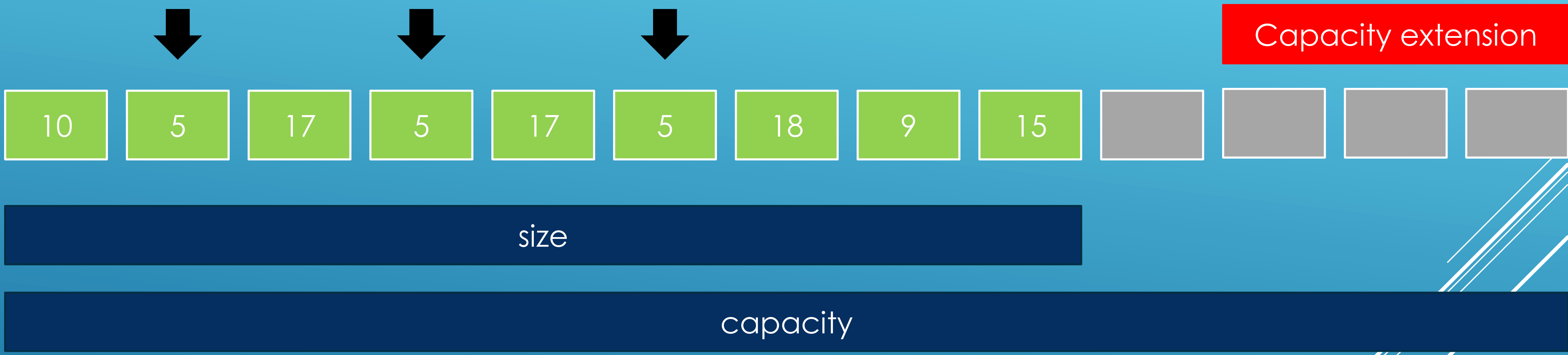

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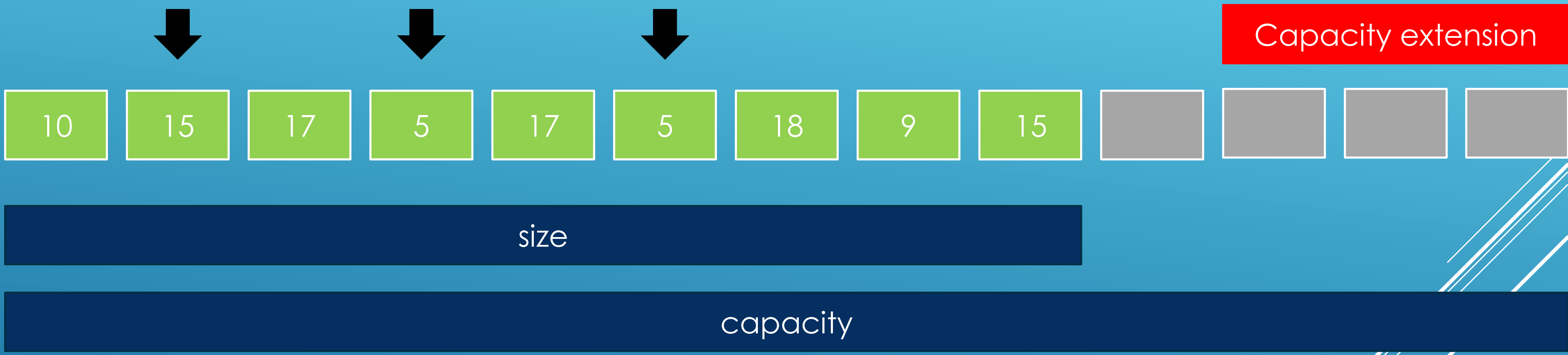

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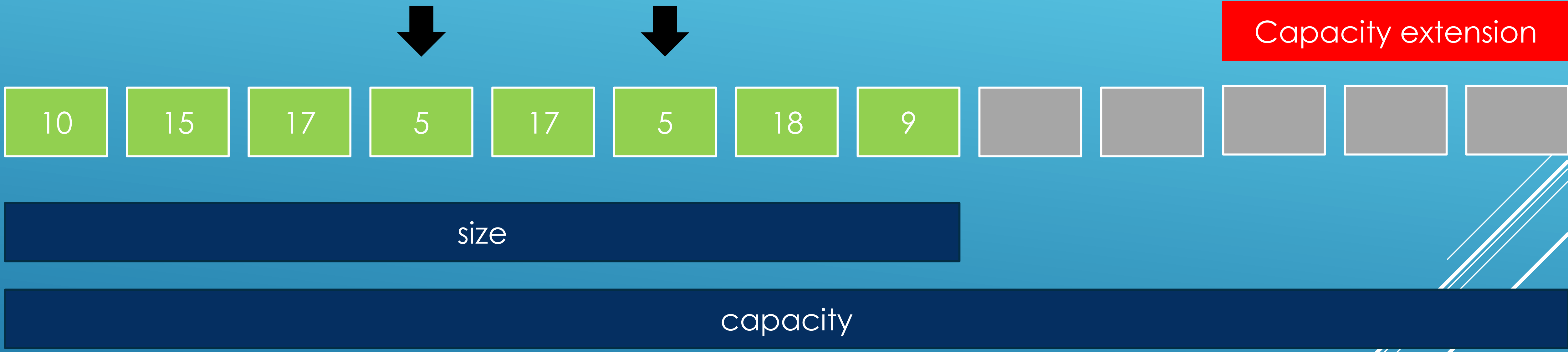

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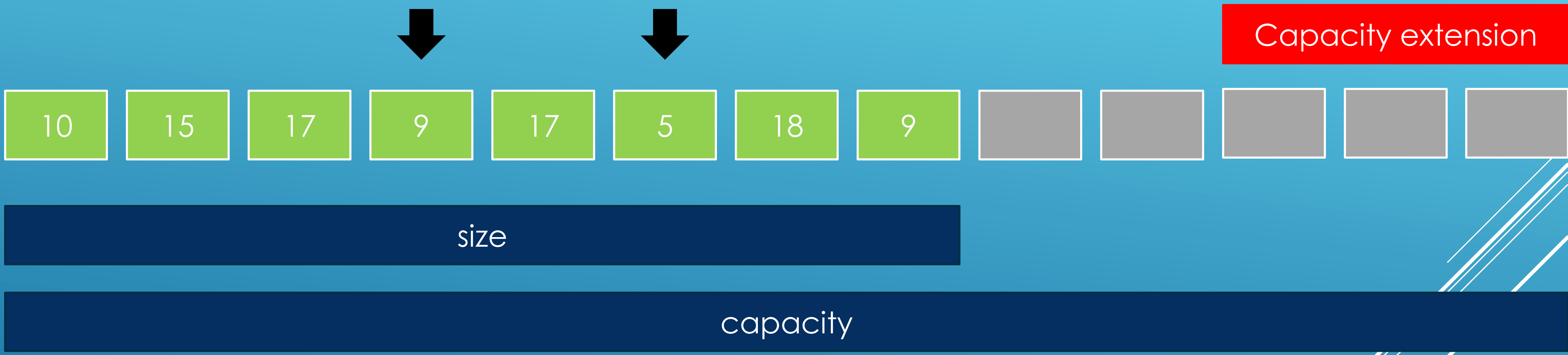

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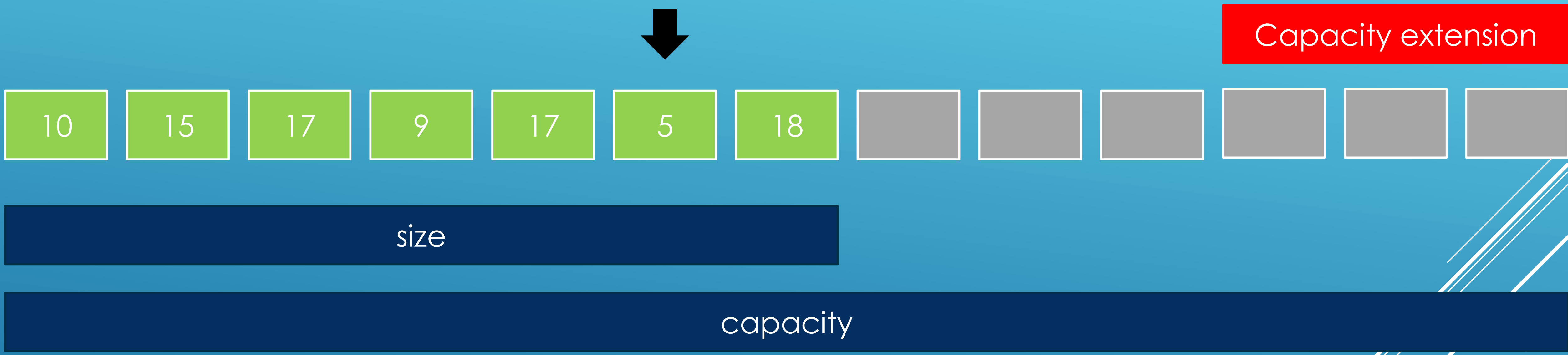

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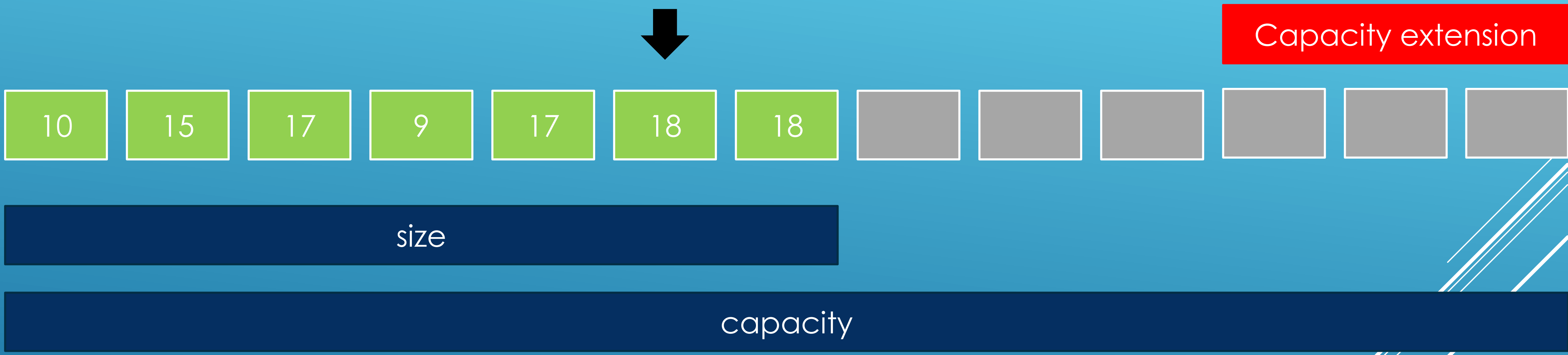

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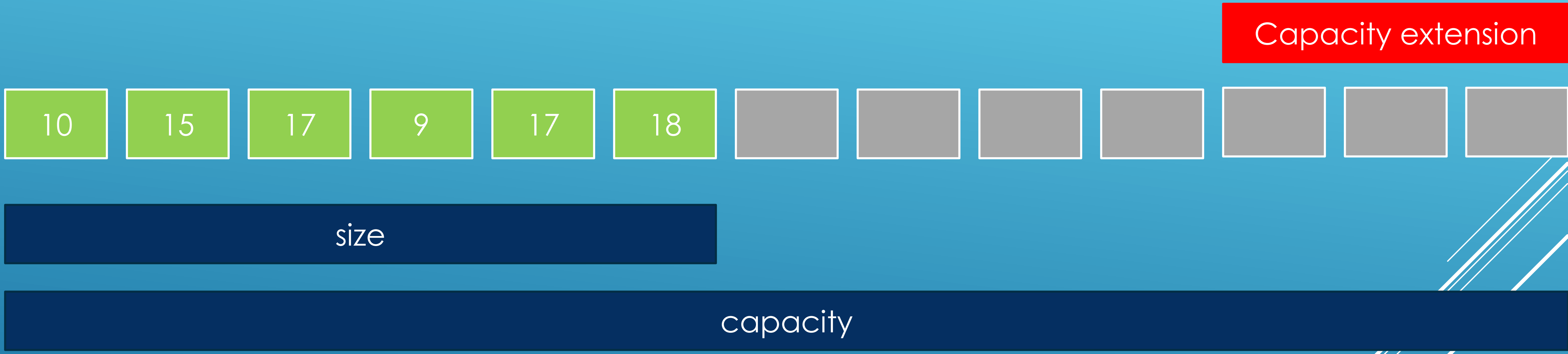
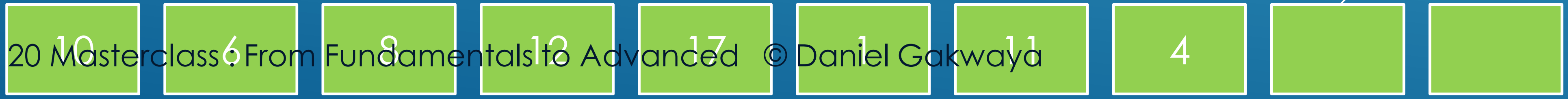
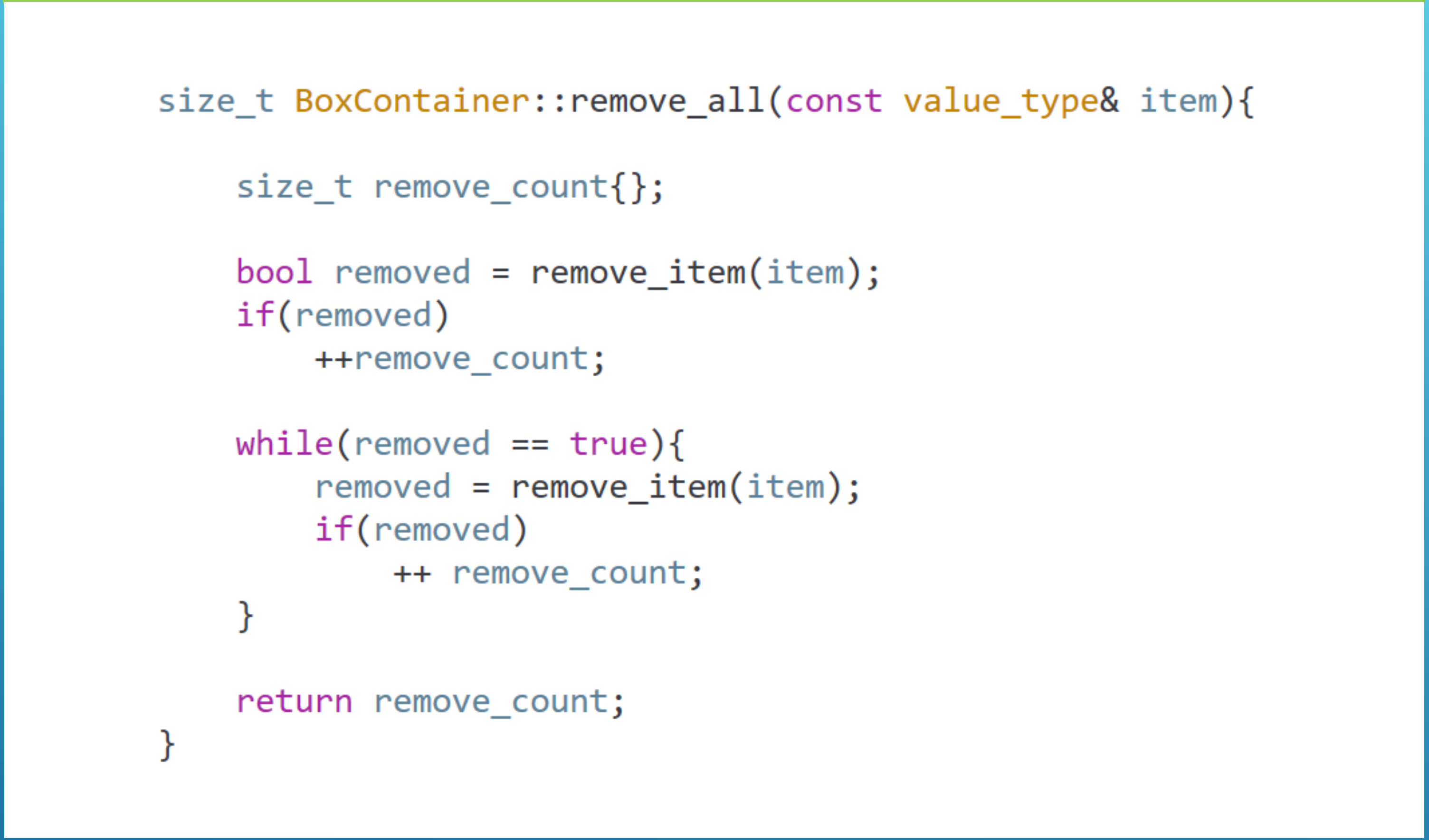


Removing one instance of an item

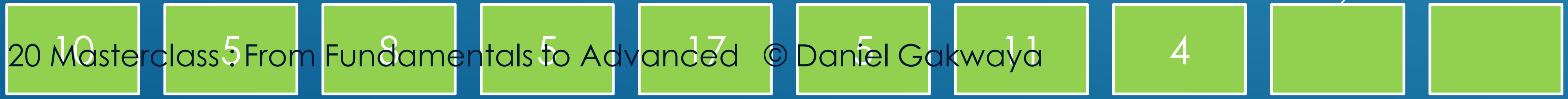
```
bool BoxContainer::remove_item(const value_type& item){

    //Find the target item
    size_t index {m_capacity + 999}; // A large value outside the range of the current
                                     // array
    for(size_t i{0}; i < m_size ; ++i){
        if (m_items[i] == item){
            index = i;
            break; // No need for the loop to go on
        }
    }

    if(index > m_size)
        return false; // Item not found in our box here

    //If we fall here, the item is located at m_items[index]

    //Overshadow item at index with last element and decrement m_size
    m_items[index] = m_items[m_size-1];
    m_size--;
    return true;
}
```



Removing all instances of an item : Multiple instances of same element



```
size_t BoxContainer::remove_all(const value_type& item){

    size_t remove_count{};

    bool removed = remove_item(item);
    if(removed)
        ++remove_count;

    while(removed == true){
        removed = remove_item(item);
        if(removed)
            ++ remove_count;
    }

    return remove_count;
}
```



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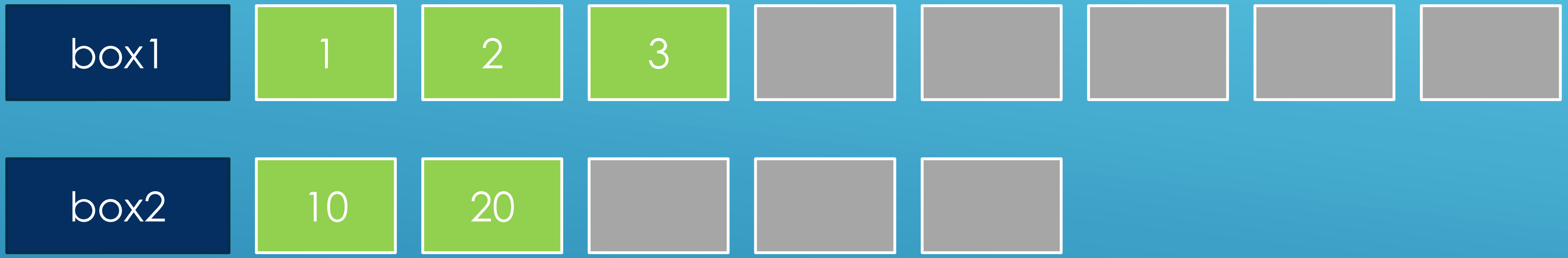
BoxContainer

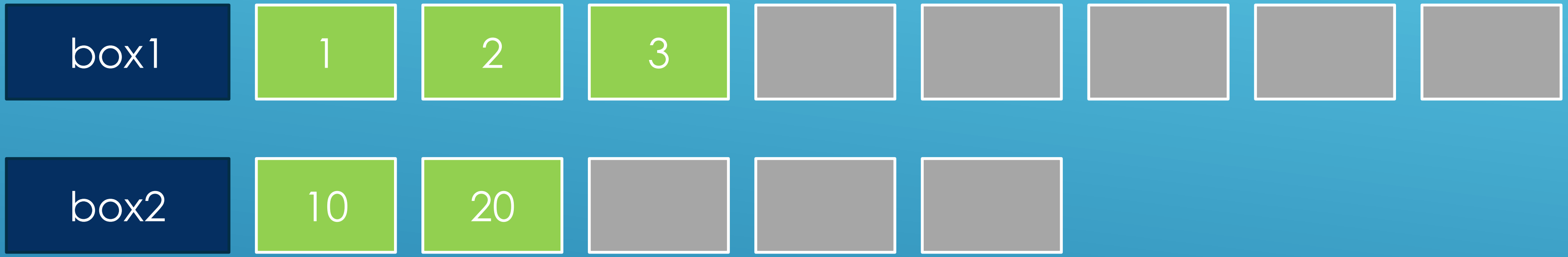
Other operators

- operator+=
- operator +
- operator=

Operator+=

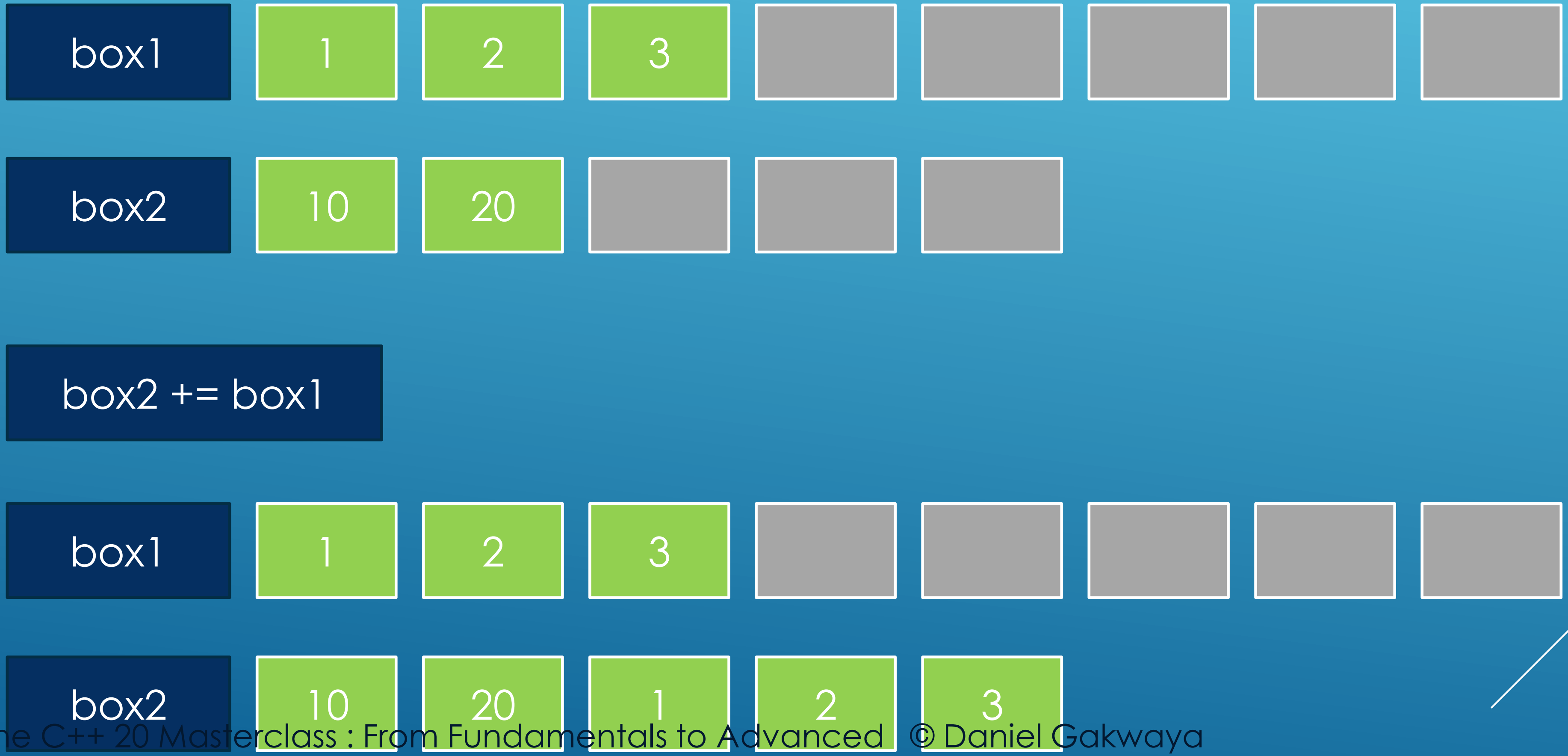


Operator+=

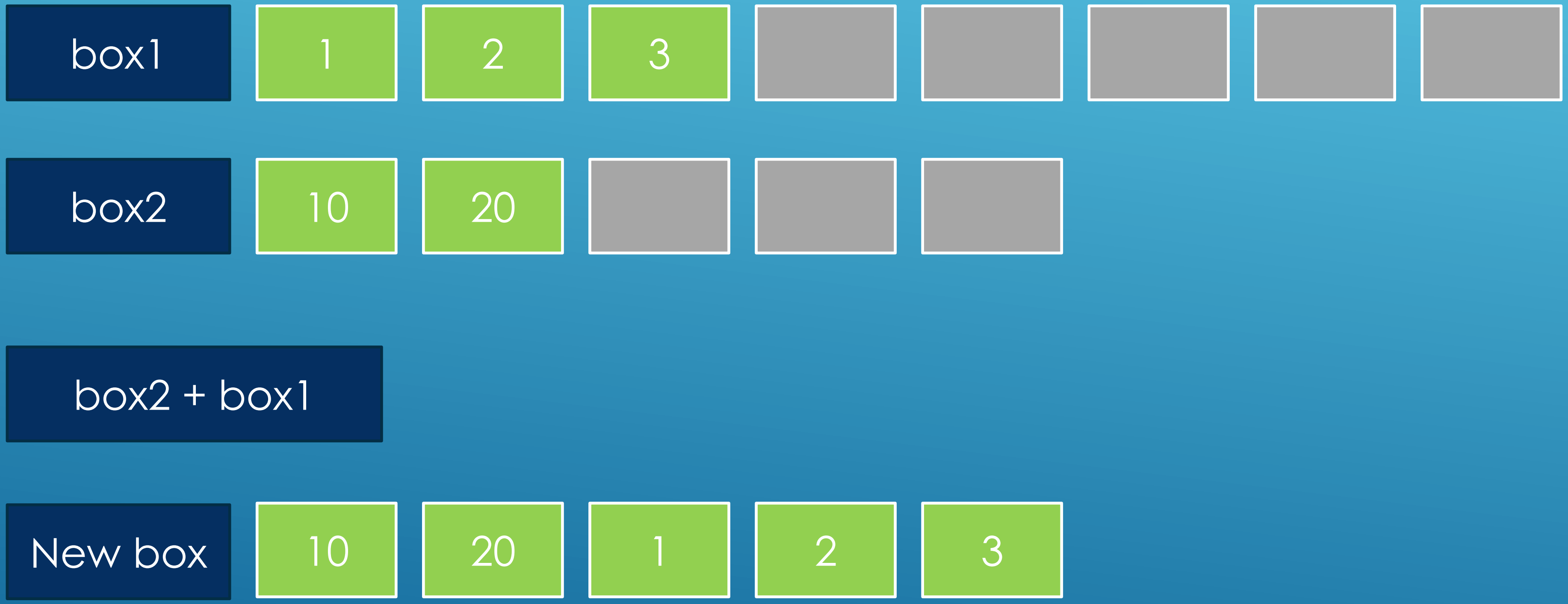


box2 += box1

Operator+=



Operator+



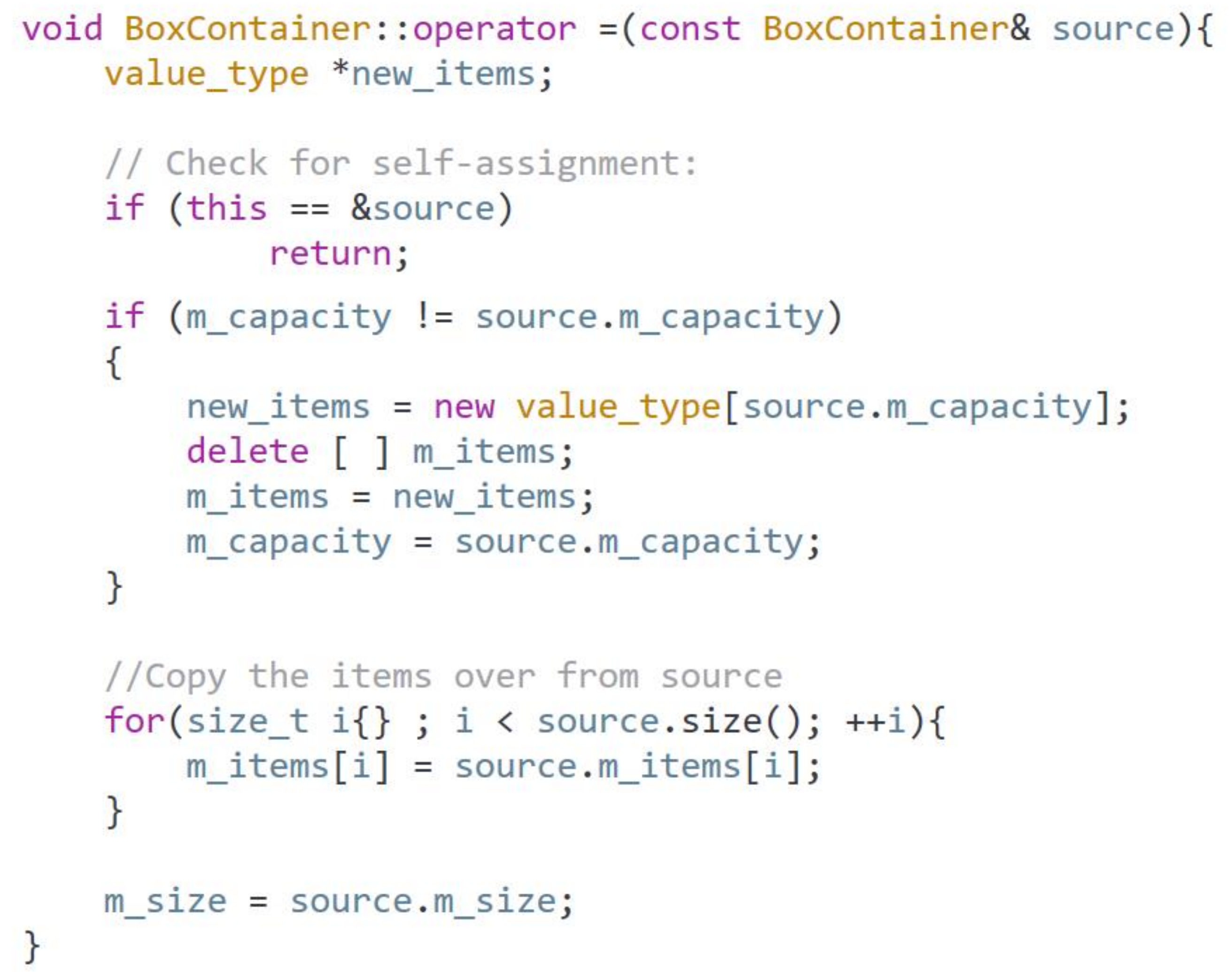
Operator+=

```
void BoxContainer::operator +=(const BoxContainer& operand){

    //Make sure the current box can acommodate for the added new elements
    if( (m_size + operand.size()) > m_capacity)
        expand(m_size + operand.size());

    //Copy over the elements
    for(size_t i{} ; i < operand.m_size; ++i){
        m_items [m_size + i] = operand.m_items[i];
    }

    m_size += operand.m_size;
}
```

Operator+

```
BoxContainer operator +(const BoxContainer& left, const BoxContainer& right){
    BoxContainer result(left.size( ) + right.size( ));
    result += left;
    result += right;
    return result;
}
```

Operator=



```
void BoxContainer::operator =(const BoxContainer& source){
    value_type *new_items;

    // Check for self-assignment:
    if (this == &source)
            return;

    if (m_capacity != source.m_capacity)
    {
        new_items = new value_type[source.m_capacity];
        delete [ ] m_items;
        m_items = new_items;
        m_capacity = source.m_capacity;
    }

    //Copy the items over from source
    for(size_t i{} ; i < source.size(); ++i){
        m_items[i] = source.m_items[i];
    }

    m_size = source.m_size;
}
```

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BoxContainer

Zooming out

```
. BoxContainer is a container class that provides the features
        . add_item
        . remove_item
        . remove_all

. We can add BoxContainer's up with :
        . +=
        . +

. Additionaly we can :
        . Stream insert BoxContainers with opreator<<
        . Copy construct BoxContainer's
        . Copy assign BoxContainer's
```

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BoxContainer

Storing in different types

IntContainer

```cpp
class IntContainer : public StreamInsertable
{
        typedef int value_type; // Allows us to change what's stored in the vector on the fly
                                // Can make it store int, double,...
        static const size_t DEFAULT_CAPACITY = 5;
        static const size_t EXPAND_STEPS = 5;
public:
    IntContainer(size_t capacity = DEFAULT_CAPACITY);
    IntContainer(const IntContainer& source);
    ~IntContainer();

    /* ...
private :
    void expand(size_t new_capacity);

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

DoubleContainer

```
class DoubleContainer : public StreamInsertable
{
        typedef double value_type; // Allows us to change what's stored in the vector on the fly
                                // Can make it store int, double,...
        static const size_t DEFAULT_CAPACITY = 5;
        static const size_t EXPAND_STEPS = 5;
public:
    DoubleContainer(size_t capacity = DEFAULT_CAPACITY);
    DoubleContainer(const DoubleContainer& source);
    ~DoubleContainer();
    /* ...
private :
    void expand(size_t new_capacity);

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

CharContainer

```
class CharContainer : public StreamInsertable
{
        typedef char value_type; // Allows us to change what's stored in the vector on the fly
                                // Can make it store int, double,...
        static const size_t DEFAULT_CAPACITY = 5;
        static const size_t EXPAND_STEPS = 5;
public:
    CharContainer(size_t capacity = DEFAULT_CAPACITY);
    CharContainer(const CharContainer& source);
    ~CharContainer();
    /* ...
private :
    void expand(size_t new_capacity);

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

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BoxContainer

```
. BoxContainer is a container class that provides the features
        . add_item
        . remove_item
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. We can add BoxContainer's up with :
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Class wrapping on top of raw array

```
class BoxContainer : public StreamInsertable
{
        typedef int value_type; // Allows us to change what's stored in the vector on the fly
                                // Can make it store int, double,...
        static const size_t DEFAULT_CAPACITY = 30;
public:
    BoxContainer(size_t capacity = DEFAULT_CAPACITY);
    BoxContainer(const BoxContainer& source);
    ~BoxContainer();

    //StreamInsertable Interface
    virtual void stream_insert(std::ostream& out)const;

    // Helper getter methods
    size_t size( ) const { return m_size; }
    size_t capacity() const{return m_capacity;};

    /* ...

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

IntContainer

```
class IntContainer : public StreamInsertable
{
        typedef int value_type; // Allows us to change what's stored in the vector on the fly
                                // Can make it store int, double,...
        static const size_t DEFAULT_CAPACITY = 5;
        static const size_t EXPAND_STEPS = 5;
public:
    IntContainer(size_t capacity = DEFAULT_CAPACITY);
    IntContainer(const IntContainer& source);
    ~IntContainer();

    /* ...
private :
    void expand(size_t new_capacity);

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

DoubleContainer

```
class DoubleContainer : public StreamInsertable
{
        typedef double value_type; // Allows us to change what's stored in the vector on the fly
                                // Can make it store int, double,...
        static const size_t DEFAULT_CAPACITY = 5;
        static const size_t EXPAND_STEPS = 5;
public:
    DoubleContainer(size_t capacity = DEFAULT_CAPACITY);
    DoubleContainer(const DoubleContainer& source);
    ~DoubleContainer();
    /* ...
private :
    void expand(size_t new_capacity);

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

CharContainer

```
class CharContainer : public StreamInsertable
{
        typedef char value_type; // Allows us to change what's stored in the vector on the fly
                                // Can make it store int, double,...
        static const size_t DEFAULT_CAPACITY = 5;
        static const size_t EXPAND_STEPS = 5;
public:
    CharContainer(size_t capacity = DEFAULT_CAPACITY);
    CharContainer(const CharContainer& source);
    ~CharContainer();
    /* ...
private :
    void expand(size_t new_capacity);

private :
    value_type * m_items;
    size_t m_capacity;
    size_t m_size;
};
```

Class templates to the rescue

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