Dynamic Storage Exercise

Dynamic Storage Exercise

We saw that by

```
int i;
while (std::cin >> i) ...
```

we can read inputs as long as there are more available in `std::cin`.

Your task is to write a code snippet which reads inputs as described above, and which then stores these inputs in an array. For this exercise you are not allowed to use the Standard Library (i.e. **no** `std::vector`).

To achieve this you will have to use `new[]` and `delete[]`.

(From: Script Exercise 158.a)

Dynamic Storage Solution

- Idea:
  1. Allocate some range (using `new[]`)

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(From: Script Exercise 158.a)

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  2. As soon as range full, allocate larger range (using `new[]`)
  3. Copy over initial range
  4. Delete initial range (using `delete[]`)
  5. Go back to 2. with newly generated memory

Dynamic Storage Solution

- New range… *How* much larger?
  - much larger → Pro: ranges less often full
    → copy ranges less often
    Con: larger memory consumption

- Important: Larger by a factor, not by a constant…
  - ```
    length_n = length_o * 2
    length_n = length_o + 2
    ```

(From: Script Exercise 158.a)
    ```

Dynamic Storage Solution

- Larger by: a) factor 2 b) constant 2

elements	Case a)	Case b)
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		

(From: Script Exercise 158.a)

Dynamic Storage Solution

- Larger by: a) factor 2 b) constant 2

elements	Case a)	Case b)
2	2	2
3	4	4
4	4	4
5	8	6
6	8	6
7	8	8
8	8	8
9	16	10
10	16	10
11	16	12
12	16	12
13	16	14
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15	16	16
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arbitr. chosen

Case a):

Significantly fewer resizings.

(From: Script Exercise 158.a)

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Each resizing means:

Copy WHOLE array.

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(From: Script Exercise 158.a)

Dynamic Storage Solution

- Larger by: a) factor 2 b) c[illegible]

elements	Case a)	[illegible]
2	2	[illegible]
3	4	[illegible]
4	[illegible]	[illegible]
5	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	8
[illegible]	[illegible]	8
[illegible]	[illegible]	10
[illegible]	16	10
[illegible]	16	12
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...chosen

Each resizing means:

Copy WHOLE array...

...ificantly fewer resizings.

Factor 2 is an arbitrary, but good choice.

(From: Script Exercise 158.a)

Dynamic Storage Solution

- And the code...

```
int n = 1; // current array size
int k = 0; // number of elements read so far

// dynamically allocate array
int* a = new int[n]; // this time, a is NOT a constant

// read into the array
while (std::cin >> a[k]) {
  if (++k == n) {
    // next element wouldn't fit; replace the array a by
    // a new one of twice the size
    int* b = new int[n*=2];  // get pointer to new array
    for (int i=0; i<k; ++i)  // copy old array to new one
        b[i] = a[i];
    delete[] a;              // delete old array
    a = b;                   // let a point to new array
  }
}
```

(From: Script Exercise 158.a)

By the way, ...

- ... this is exactly how

  `my_vec.push_back(...)`

  works. **`push_back`** is a member function.

- ... all dynamic containers (vector, set, list, ...) are **based on `new`, `delete`!**

Vector…

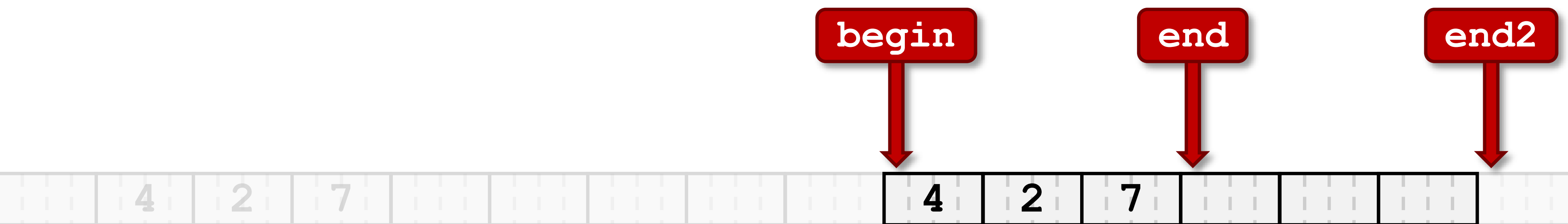
Dynamic Storage in Vectors

- Vectors store 3 pointers:

  `begin`: begin of memory

  `end`: end of *user-accessible* part

  `end2`: end of allocated part



Dynamic Storage in Vectors

- Important for vectors:
  - **In constructor:** Set initial range
  - **In copy-constructor:** Don't copy just pointers;
    i.e. copy the ranges behind them
  - **In `operator=`:** Like copy-constructor, in addition:
    i) prevent self-assignments
    ii) don't forget to delete old range