CSC 211: Computer Programming

Dynamic Memory Allocation, Destructors

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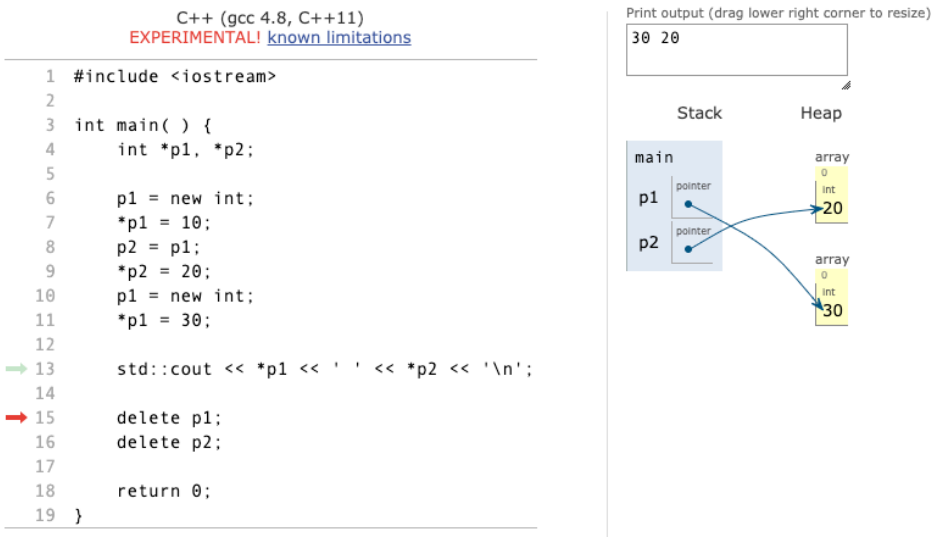
Dynamic Memory Allocation

The `new` and `delete` operators

- Used to create and destroy variables, objects, or arrays while the program is running
- Memory allocated with the `new` operator does **NOT** use the **call stack**
  - new allocations go into the **heap** (area of memory reserved for dynamic memory allocation)
- Programmer **must** destroy all variables, objects, and arrays created dynamically
  - using the `delete` operator


```
#include <iostream>

int main( ) {
    int *p1, *p2;

    p1 = new int;
    *p1 = 10;
    p2 = p1;
    *p2 = 20;
    p1 = new int;
    *p1 = 30;

    std::cout << *p1 << ' ' << *p2 << '\n';

    delete p1;
    delete p2;

    return 0;
}
```

Tracing the code

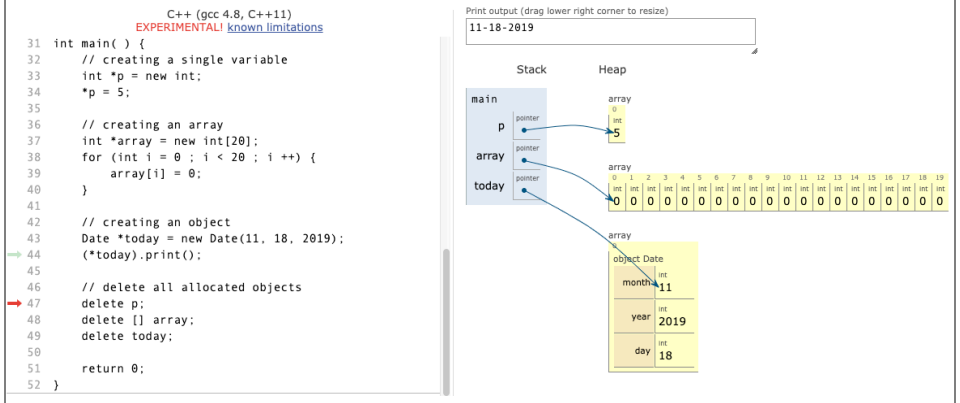


http://pythontutor.com/cpp.html#mode=edit

Syntax for `new` and `delete`

```
#include "date.h"
#include <iostream>

int main( ) {
    // creating a single variable
    int *p = new int;
    *p = 5;

    // creating an array
    int *array = new int[20];
    for (int i = 0 ; i < 20 ; i ++) {
        array[i] = 0;
    }

    // creating an object
    Date *today = new Date(11, 18, 2019);
    (*today).print();

    // delete all allocated objects
    delete p;
    delete [] array;
    delete today;

    return 0;
}
```


Tracing the code



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Pointers and objects

- Data members and methods of an object can be accessed by dereferencing a pointer

```
Date *today = new Date(11, 18, 2019);
(*today).print();
```

- Or … can use the **–> operator**

```
Date *today = new Date(11, 18, 2019);
today->print();
```

Destructors

Destructor

- Special `method` automatically called when objects are destroyed
  - it is used to delete any memory created dynamically
- Objects are destroyed when …
  - … they exist in the stack and go out of scope
  - … they exist in the heap and the delete operator is used
- A destructor …
  - … is a member function (usually `public`)
  - … must have the same name as its class preceded by a ~
  - … is automatically called when an object is destroyed
  - … does not have a return type (not even `void`)
  - … takes no arguments

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Live Example (dynamic array)