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Object Oriented Design

Week 3-2

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Encapsulation and Constructor

- Encapsulation : one of three important OO technique
- Constructor : being called when an object is instantiated
- Destructor : being called when an object is destroyed

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Access Specifier - Encapsulation -

- applied to class's members
- determine their visibility/accessibility

```
class Monster {
    public:
        char name[64];     // the name of the monster
        int power;         // the current power
        int status;        // the current status such as live/dead/paused

        void DisplayData();
};

int main(void) {
    class Monster aMon;

    strcpy(aMon.name, "Pikachu");     //  <- OK.
    aMon.power = 100;                 //  <- OK.
    aMon.status = 0;                  //  <- OK.

    aMon.DisplayData();               //  <- OK.

    return 0;
}
```

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Access Specifiers

- public: open to everything
- private: only within the class
- protected: bit more complicated...

- You can assign different access specifiers to each member.

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private: Access Specifiers

- cannot access from the outside of an object of the class

```
class Monster {
    private:
        char name[64];      // the name of the monster
        int power;          // the current power
        int status;         // the current status such as live/dead/paused

    public:
        void DisplayData();
};

int main(void) {
    class Monster aMon;

    strcpy(aMon.name, "Pikachu");    //  <- compile error
    aMon.power = 100;                //  <- compile error
    aMon.status = 0;                 //  <- compile error

    aMon.DisplayData();              //  <- OK.

    return 0;
}
```

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private: Access Specifiers

- If you omit an access specifier, a typical C++ compiler will use private: as default

```
class Monster {
        char name[64];    // the name of the monster
        int power;        // the current power
        int status;       // the current status such as live/dead/paused

    public:
        void DisplayData();
};

class Monster {
    private:
        char name[64];    // the name of the monster
        int power;        // the current power
        int status;       // the current status such as live/dead/paused

    public:
        void DisplayData();
};
```

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protected: Access Specifiers

- behaves like public: or private: depending on how a class is used
- there are many possible access specifier combinations
- the combination occurs by inheritance.
  - you can specify how the new subclass inherit things from its superclass
  - the behaviour of access specifiers in the superclass differ

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protected: Access Specifiers

- behaves like public: or private: depending on how a class is used

```
// public inheritance
class ASubClass1 : public APublicSuperClass {
        ...
};

// protected inheritance
class ASubClass2 : protected AProtectedBaseClass {
        ...
};

// private inheritance
class ASubClass3 : private APrivateBaseClass {
        ...
};

// the class inheritance without an access specifier is private inheritance as default
class ASubClass4 : APrivateBaseClass {
        ...
};

// the struct inheritance without an access specifier is public inheritance as default
struct ASubClass5 : APublicBaseClass {
        ...
};
```

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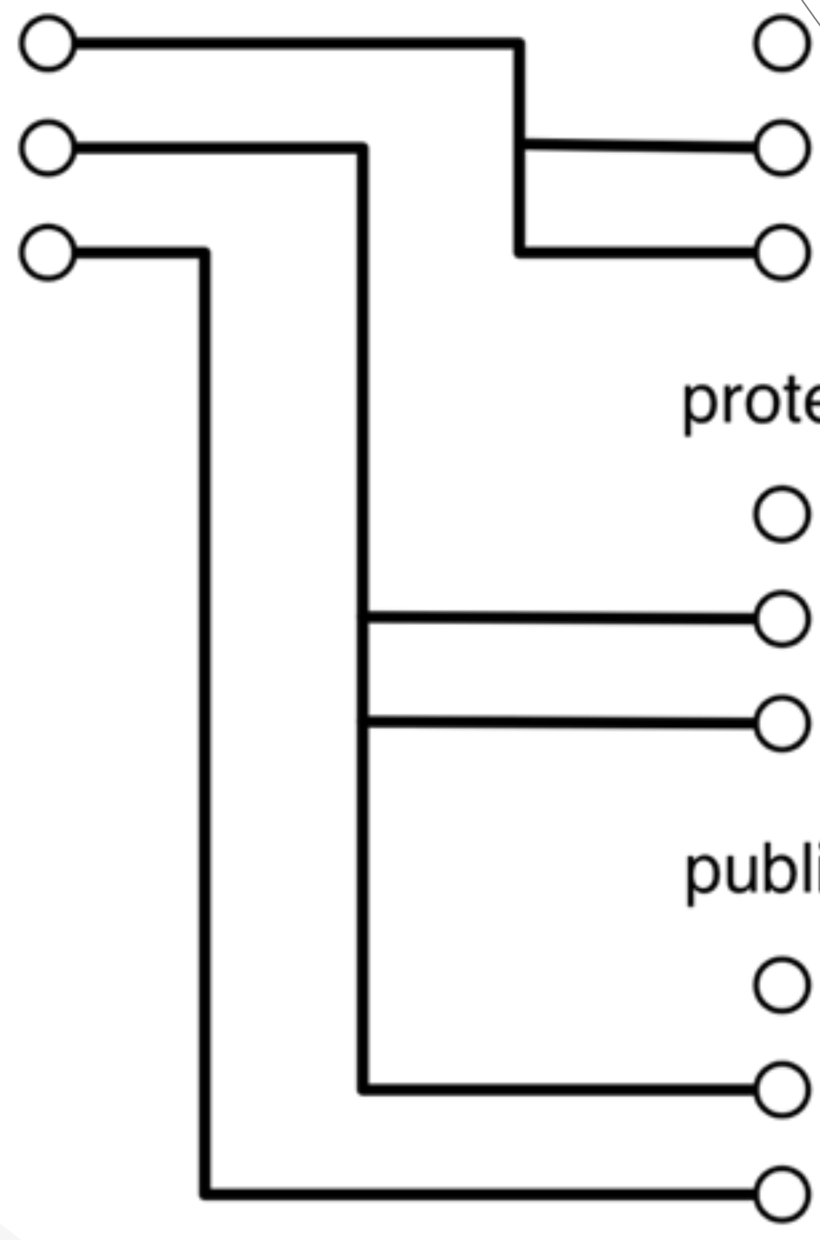
combination of a.s.

SubClass

private
protected
public



private SuperClass

private
protected
public

protected SuperClass

private
protected
public

public SuperClass

private
protected
public

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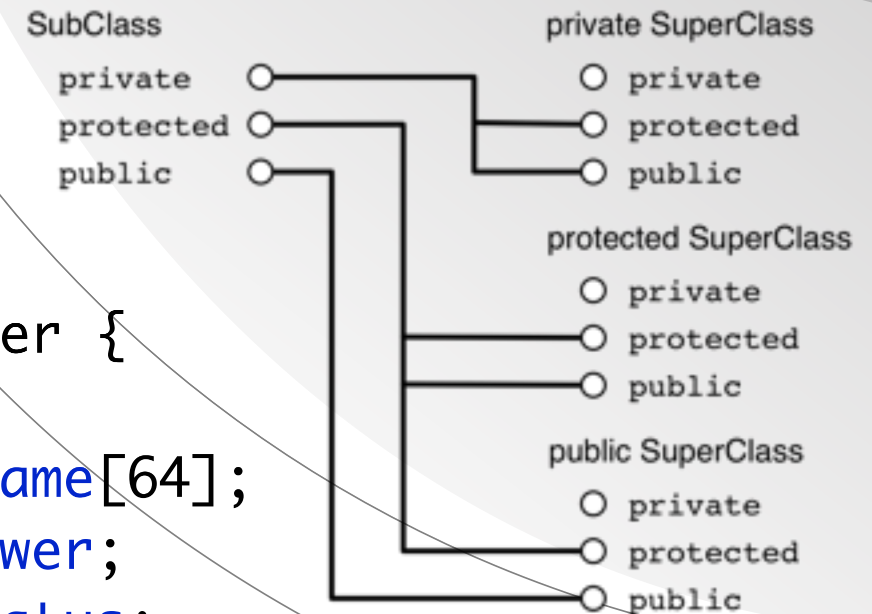
combination of a.s.




```
class My Monster : private Monster {
    public:
        void DoSomething() {
            power *= 2; // double the power
        }
};

int main(void) {
    class Monster aMon;
    class MyMonster mMon;

    aMon.power = 100;
    mMon.DoSomething();

    return 0;
}
```

```
class Monster {
  protected:
      char name[64];
      int power;
      int status;

  public:
      void DisplayData();
};
```

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Access Specifier in UML

- use
  - - for private
  - + for public
  - # for protected

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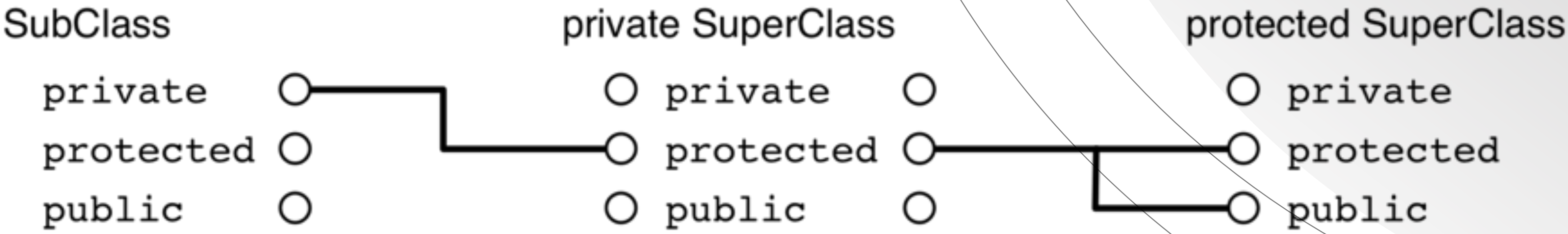
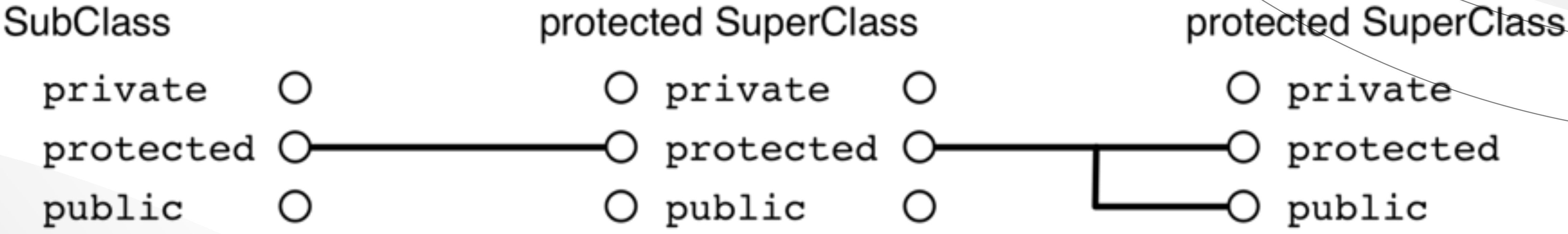
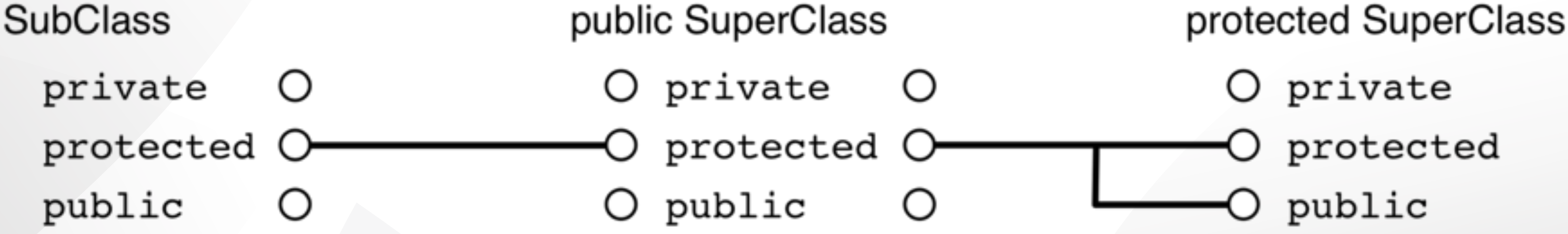
combination of a.s.







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FYI: combination of a.s. in Java

Specifier	class	subclass	package	world
private	Y			
protected	Y	Y	Y	
public	Y	Y	Y	Y
(none)	Y		Y	

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Purpose of Encapsulation

- Access specifiers
  - important mechanism for Encapsulation
  - make certain members inaccessible from others

- What will happen if Encapsulation is not available?

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Purpose of Encapsulation

- Example 1:
  - assume you designed a class as an independent soft. component
  - many objects are instantiated and used in a much larger system.
  - it has a few hundred member variables/functions.
  - only a handful functions need to be called from outside

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Purpose of Encapsulation

- Example 2:
  - your class has some member variables,
  - you might need to invoke a few internal function when the value of those variables are changed.

  - make those members "private", but
  - provide "public" accessor member functions

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Purpose of Encapsulation

- Protecting an Object
- Treating an Object as a blackbox.

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Constructor
Destructor

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Constructor

- Special member function defined in a class
  - automatically invoked at instantiation (when an object is placed in the memory space.
- Its name is the same as its class name.
- Does not have return value (not even void).

- Compiler can find it and generate a code to invoke constructors.

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Constructor

- How would you use it?
  - put object's initialisation code.
- How about access specifiers?....try it out.

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Constructor

- is a member function
  - implementation can be inline or separate definition.

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```
#include <iostream.h>

class Monster {
        char name[64];      // the name of the monster
        int power;          // the current power
        int status;         // the current status such as live/dead/paused

    public:
        Monster();
        void DisplayData();
};

void Monster::DisplayData() {
    cout << name << "\n";
    cout << power << "\n";
    cout << status << "\n";

    return;
}

Monster::Monster() {
    strcpy(name, "Unnamed");
    power = 100;
    status = 0;

    return;
}

int main(void) {
    Monster aMon;

    aMon.DisplayData();

    return 0;
}
```

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- If the initialization is done in the constructor
  - don't have to explicitly initialize the newly created object.
- "Constructor" is a mechanism to improve the efficiency of OO programming.

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Constructor with arguments

- Although it's special, it's a member function.
  - it can have arguments.
  - arguments are usually initial values of member variables.

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```
    #include <iostream.h>

class Monster {
        char name[64];    // the name of the monster
        int power;        // the current power
        int status;       // the current status such as live/dead/paused

    public:
        Monster(char* name, int power, int status);
        void DisplayData();
};

void Monster::DisplayData() {
    cout << name << "\n";
    cout << power << "\n";
    cout << status << "\n";

    return;
}

Monster::Monster(char* name, int power, int status) {
    strcpy(this->name, name);
    this->power = power;
    this->status = status;
}

int main(void) {
    Monster aMon("Unnamed", 100, 0);

    aMon.DisplayData();

    return 0;
}
```

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Overloading Constructor

- Since the constructor(s) is a method
  - you can overload. (same name but different implementation)

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```
#include <iostream.h>

class Monster {
        char name[64];
        int power;
        int status;

    public:
        Monster();
        Monster(char* name, int power, int status);
        void DisplayData();
};

void Monster::DisplayData() {
    cout << name << "\n";
    cout << power << "\n";
    cout << status << "\n";

    return;
}

Monster::Monster() {
    strcpy(name, "Unnamed");
    power = 100;
    status = 0;

    return;
}

Monster::Monster(char* name, int power, int status) {
    strcpy(this->name, name);
    this->power = power;
    this->status = status;

    return;
}

int main(void) {
    Monster aMon;
    aMon.DisplayData();

    Monster pikachu("Pikachu", 1000, 0);
    pikachu.DisplayData();

    return 0;
}
```

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- any ways to improve the efficiency of constructors?

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```
#include <string>
#include <iostream>

using namespace std;

class Monster {
        string name;
        int power;
        int status;

    public:
        Monster(string s);
        void DisplayData();
};

void Monster::DisplayData() {
    cout << name << "\n";
    cout << power << "\n";
    cout << status << "\n";

    return;
}
```

```
Monster::Monster(string s) {
    name = s;
    power = 100;
    status = 0;

    return;
}

int main(void) {
    Monster aMon("Pikachu");
    aMon.DisplayData();

    return 0;
}
```

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```
Monster::Monster(string s) {
    name = s;
    power = 100;
    status = 0;

    return;
}

int main(void) {
    Monster aMon("Pikachu");
    aMon.DisplayData();

    return 0;
}
```

- at instantiation
  - create “name” variable, then
  - substitute the value “s” to it.
- 2 step process....

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```
Monster::Monster(string s):name(s) {
    power = 100;
    status = 0;

    return;
}

int main(void) {
    Monster aMon("Pikachu");
    aMon.DisplayData();

    return 0;
}
```

- Compiler generates a code
    - initialize “name” when it is created.

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Initialization list

```
Monster::Monster(string s, int p, int st):name(s), power(p), status(st) {}

Monster::Monster(string s):name(s), power(100), status(0){}

int main(void) {
    Monster aMon("Pikachu");
    aMon.DisplayData();

    return 0;
}
```

- initialization via substitution
  - should use initialization list

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Destructor

- created objects need to be destroyed....
- Special member function
  - automatically invoked when an object is destroyed (deallocated).
- starts with “~” (tilda)
- public:
- no argument .....no overloading....(please check it)

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Destructor

- timing of invoking destructor:
  - when the program control goes out a block, which declares the object
  - when the program control goes out the main().

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Destructor (M$)

- Microsoft introduced Finalizer
  - !ClassName
  - can be deterministically invoked
  - used to release resources no longer needed
    - call free-like member function.

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