Composition and initialization

- Version 1: Dr. Ofir Pele
- Version 2: Dr. Miri Ben-Nissan
- Version 3: Dr. Erel Segal-Halevi

Composition

```
class Line {
   Point p1, p2;
};
```

C++	Java
Members are **objects**	Members are **pointers**

	C++	Java
Stack:	line.p1.x line.p1.y line.p2.x line.p2.y	line
Heap:		p1.x p1.y p1 p2 p2.x p2.y

```
int main () {  Line line; }
```

Construction

```
int main() {
   B b;
}
```

```
class A {
public:
 A() {
  std::cout <<
  "A - " <<
  "parameterless" <<
  " ctor\n";
 }
};
```

```
class B {
   A _a1,_a2;
public:
   B() {
      std::cout <<
      "B - parameterless " <<
      "ctor\n";
   }
};
```

Question: In what order are the constructors called?

Construction order

```
int main() {
   B b;
}
```

```
class A {
public:
 A() {
  std::cout <<
  "A - " <<
  "parameterless" <<
  " ctor\n";
 }
};
```

```
class B {
   A _a1,_a2;
public:
   B() {
      std::cout <<
      "B - parameterless " <<
      "ctor\n";
   }
};
```

```
// Answer: small to large
A - parameterless ctor
A - parameterless ctor
B - parameterless ctor
```

Destruction

```
int main() {
    B b;
}
```

```
class A {
public:
 ~A() {
  std::cout <<
  "A - " <<
  " dtor\n";
 }
};
```

```
class B {
    A _a1,_a2;
public:
    ~B() {
      std::cout <<
      "B - dtor\n";
    }
};
```

Question: In what order are the destructors called?

Destruction order

```
int main() {
   B b;
}
```

```
class A {
public:
 A() { … }
 ~A() {
  std::cout <<
  "A - " <<
  " dtor\n";
 }
};
```

```
class B {
   A _a1,_a2;
public:
   B() {...}
   ~B() {
     std::cout <<
     "B - dtor\n";
   }
};
```

```
// Answer: large to small
B - dtor
A - dtor
A - dtor
```

The paramaterless ctor (aka **default ctor**)

```
int main() {
   B b;
}
```

```
class A {
public:
  A(int a) {
    std::cout <<
    "A ctor with one
     parameter\n";
  }
};
```

```
class B {
   A _a1,_a2;
public:
   B() {
     std::cout <<
     "B – parameterless " <<
     "ctor\n";
   }
};
```

```
// compilation error
No parameterless ctor for _a1, _a2
```

The paramaterless ctor (aka **default ctor**)

```
int main() {
   B b;
}
```

```
class A {
public:
  A(int a) {
    std::cout <<
    "A ctor with one
     parameter\n";
  }
};
```

```
class B {
   A _a1,_a2;
public:
   B()
   : _a1(5), _a2(10) {
     std::cout <<
     "B – parameterless " <<
     "ctor\n";
   }
};
```

The initialization list

```
int main() {
    B b(2);
}
```

```
class A {
public:
    A(int a) {
        std::cout <<
        "A (" << a << ") "

        << std::endl;
    }
};
```

```
class B {
    A _a1,_a2;
public:
    B(int i)
    :_a1 (i), _a2(2*i)
    {
        std::cout
        << "B cons"
        << std::endl;
    }
};
```

```
// output
A (2)
A (4)
B cons
```

Initialization using pointers - Java-like

```
int main() {
    B b(2);
}
```

```
class A {
public:
    A(int a) {
        std::cout <<
        "A (" << a << ") "

        << std::endl;
    }
};
```

```
class B {
    A *_ap;
public:
    B(int i);
    ~B();
};

B::B(int i) {
    _ap = new A (i);
    cout << "B cons\n";
}
```

```
// output
A (2)
B cons
```

Initialization using pointers (2)

```
int main() {
    B b(2);
}
```

```
class A {
public:
    A(int a) {
        std::cout <<
        "A (" << a << ") "

        << std::endl;
    }
};
```

```
class B {
    A *_ap;
public:
    B(int i);
    ~B();
};

B::B(int i)
    : _ap (new A(i))
{
    cout << "B cons\n";
}
```

```
output //
A (2)
B cons
```

Advantages of using initialization list *(folder 0)*

1. Faster – no need for default initializaiton.
2. Safer – be sure that all components are ready.
3. Can initialize constants and reference variables.
4. Can initialize parent class.