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Object Oriented Design

Week 4-2

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Inheritance

- One thing you cannot avoid
  - the use of `class`.
- Two ways to use `class`
  - Create an instance
  - Inheritance

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Creating an instance

```
class Monster {
        char name[64];
        int power;
        int status;
    public:
        void DisplayData();
};

int main(void) {
    class Monster aMon;

    ...
    return 0;
}
```

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Define a new class through inheritance

```
class Monster {
    ...
};

class FlyingMonster : public Monster {
    ...
};
```

- The colon (:) represents ***inheritance***.
- `Monster` is the base (super) class
- The new class inherits things from the super class

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```cpp
#include <string.h>
#include <iostream.h>

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

```cpp
class FlyingMonster : public Monster
{
    // members
    int flyingPower;
};

int main(void) {
    FlyingMonster aMon;

    strcpy(aMon.name, "Neko");
    aMon.power = 500;
    aMon.status = 5;
    aMon.flyingPower = 300;
    aMon.DisplayData();

    return 0;
}
```

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```
#include <string.h>
#include <iostream.h>

class FlyingMonster {
    public:
        char name[64];
        int power;
        int status;
        int flyingPower;
        FlyingMonster();
        void DisplayData();
};

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

    return;
}
```

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

    return;
}

int main(void) {
    FlyingMonster aMon;

    strcpy(aMon.name, "Neko");
    aMon.power = 500;
    aMon.status = 5;
    aMon.flyingPower = 300;
    aMon.DisplayData();

    return 0;
}
```

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Access Specifiers - revisited

- There are three access specifiers
  - public:
  - private:
  - protected

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private:

- Any members under private:
  - stay invisible to outside
    - objects of other classes
    - derived classes/objects
    - under both instantiation and inheritance.

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public:

- Any members under public:
  - accessible from outside.

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protected:

- won't be accessible from outside classes/objects

  but
- accessible from a derived classes/objects.

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```
   class BaseClass {
public:
        int public_data;
private:
        int private_data;
protected:
        int protected_data;
};

int main() {
    BaseClass bclass;

    bclass.public_data = 123;
    bclass.private_data = 456;    // <- compile error
    bclass.protected_data = 789;  // <- compile error

    return 0;
}
```

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```
   class BaseClass {
public:
        int public_data;
private:
        int private_data;
protected:
        int protected_data;
};

class DerivedClass : public BaseClass {
    public:
        void NewFunc();
};
```

```
void DerivedClass::NewFunc() {
    public_data = 123;
    private_data = 456;    // c.error
    protected_data = 789;

    return;
}

int main() {
    DerivedClass dclass;

    dclass.NewFunc();

    return 0;
}
```

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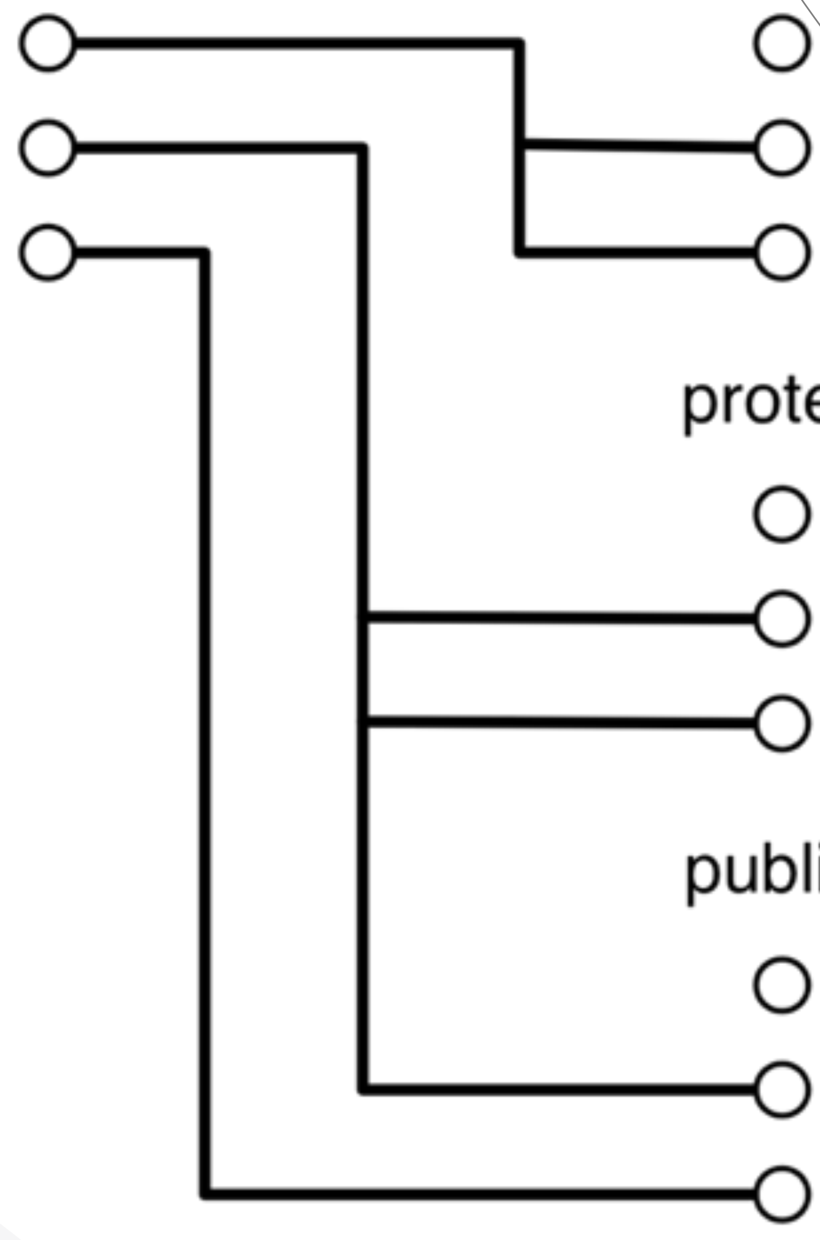
combination of a.s.

SubClass

private
protected
public



private SuperClass

private
protected
public

protected SuperClass

private
protected
public

public SuperClass

private
protected
public

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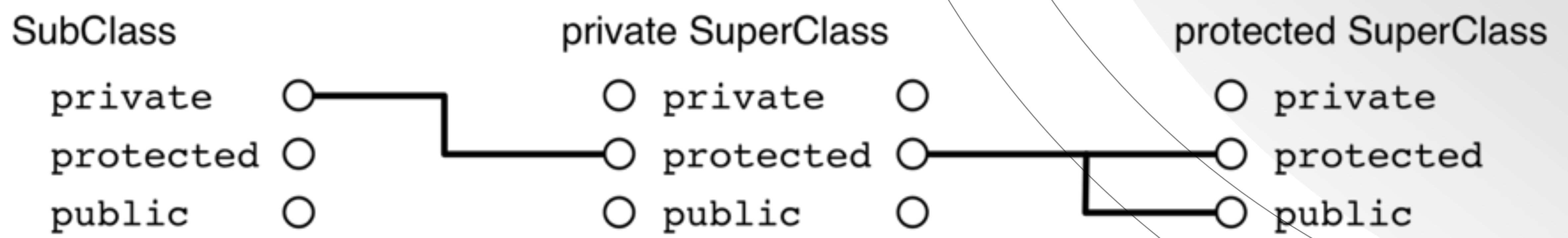
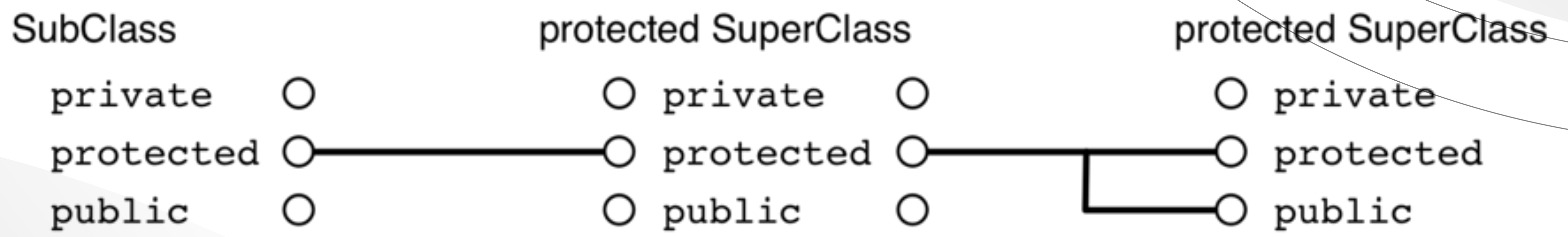
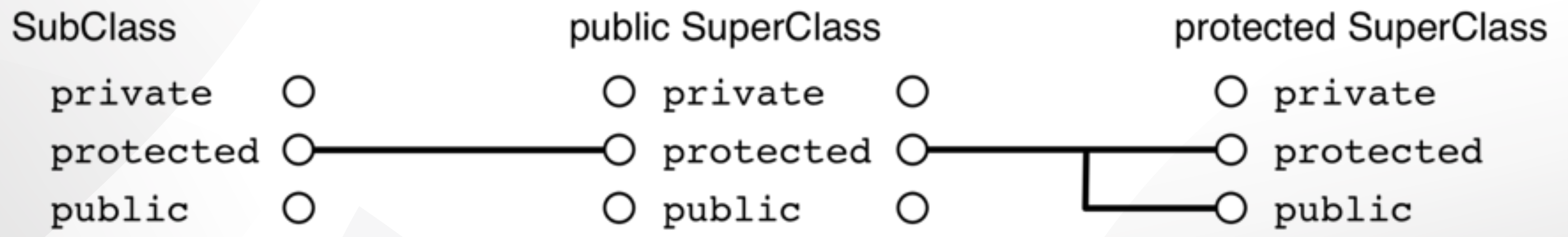
combination of a.s.







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Inheritance for Reuse

- Main objective
  - efficient programming (not execution)
  - you don’t have things already coded

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Inheritance for Reuse

- OOP is for large-scale program dev.
    - programmers
        - use classes
        - build classes

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Inheritance for Reuse

- When you build classes, you need to think...
  - will your classes be used to
    - create instances?
    - create new classes through inheritance.
  - Sometimes, you would build classes, which can be used for both.

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Generalization and Inheritance

- How do we come across with inheritance?

- HR system for uni.
  - Academic Staff
  - Admin Staff
  - Technical Staff

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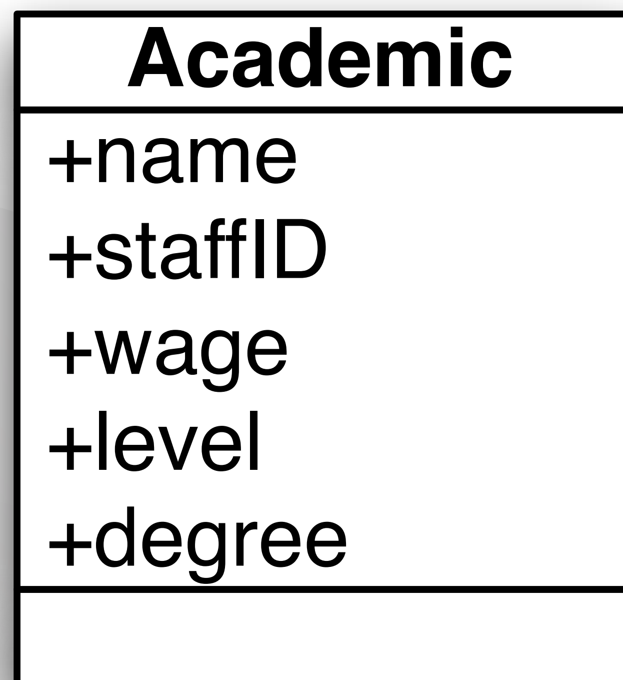
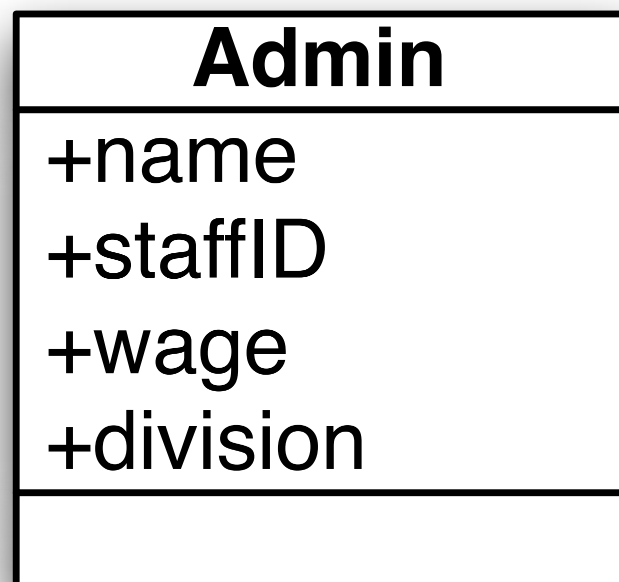
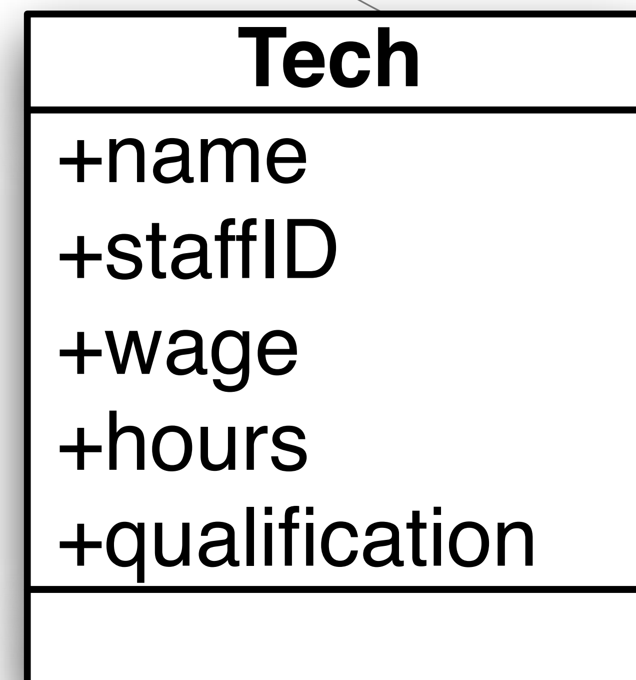
- after listing out all the facts,
- after deciding the view point
- design the first set of classes







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```
  class Academic {
public:
  string name;
  int staffID;
  float wage;
  int level;
  string degree;
};

class Admin {
public:
  string name;
  int staffID;
  float wage;
  int division;
};
```

```
class Tech {
public:
  string name;
  int staffID;
  float wage;
  int hours;
  string
qualification;
};
```

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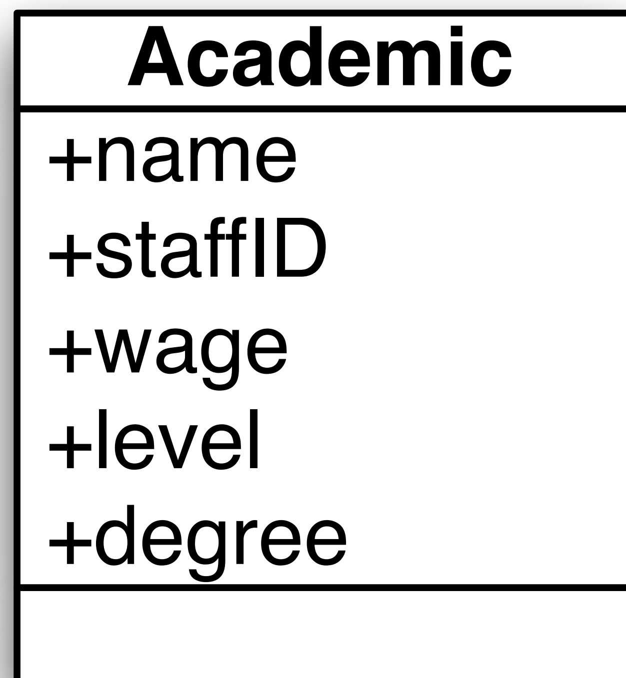

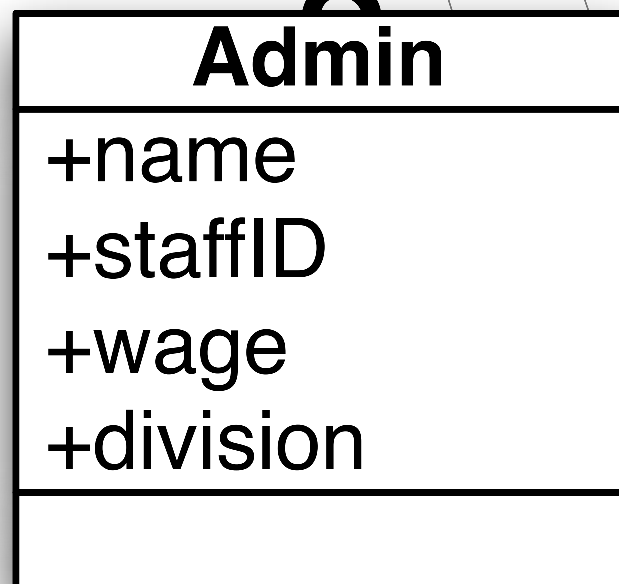

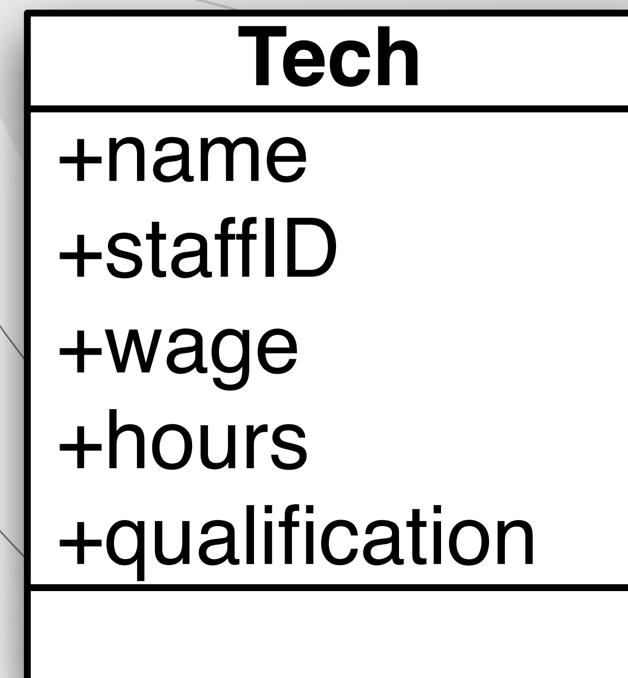

- name, staffID and wage are common members
- gather these three members and create a class to store them.
- Generalization

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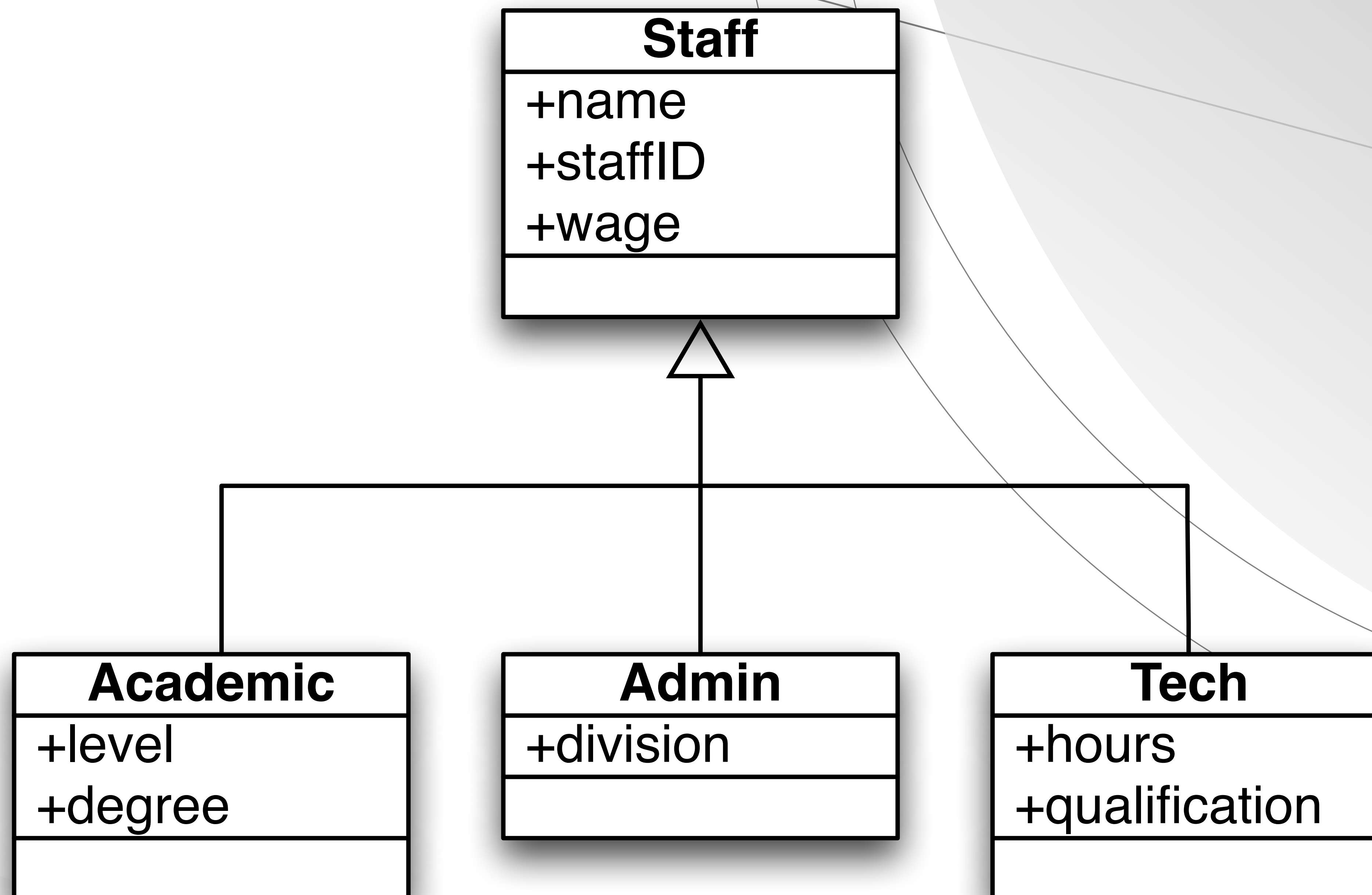

- Generalization during OO Design
- Inheritance the base (super) class to ease the OO Programming

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```
  class Staff {
public:
  string name;
  int staffID;
  float wage;
};

class Tech: public Staff {
public:
  int hours;
  string qualification;
};

class Academic: public Staff {
public:
  int level;
  string degree;
};

class Admin: public Staff {
public:
  int division;
};
```

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Inheritance

- member variables/functions are inherited (public/protected)
- ...special member function?
  - Constructor(s)
  - Destructor

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Con/Destructor not inherited!

- Constructors and Destructor are not inherited.
- However, superclasses' constructors and destructors are automatically called.

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```cpp
#include <iostream.h>

class MyClass {
public:
    MyClass() {cout << "const of superclass" << endl;};
    ~MyClass() {cout << "dest of superclass" << endl;};
};

class NewClass : public MyClass {
public:
    NewClass() {cout << "const of subclass" << endl;};
    ~NewClass() {cout << "dest of subclass" << endl;};
};

int main() {
    NewClass obj;
    cout << "===============" << endl;
    return 0;
}
```

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Constructor w/ args

- You cannot overload a destructor
  - after calling subclass's destructor, superclass's destructor will be called.
- How about constructors?
  - There might be many constructors (with different args).

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Constructor w/ args

- You need to specify which constructor to call
  - specify the constructor after ":"
  - Initialization List

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```
   class MyClass {
   int myData;
public:
   MyClass(){};
   MyClass(int m):myData(m){};
   ~MyClass() {};
};

class NewClass : public MyClass {
   int newData;
public:
   NewClass() {/*do something */};
   NewClass(int m, int n):MyClass(m),newData(n) {};
   ~NewClass() {};
};
```

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overloading revisited

- in C, it does not work to have functions with the same name even though their args are different

```
int foo(char* a, int b) {...};

foo(5, 2.3, “test”);
```

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overloading revisited

- in C, it does not work to have functions with the same name even though their args are different

```
int foo(char* a, int b) {...};

int foo(int a, int b) {...};
```

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overloading revisited

- in C++, a function is identified with the combination of its name and args.

```
int foo(int a, int b);
int foo(char* a, int b);

int main() {
  foo(2, 5);
  foo("test", 6);
}

int foo(int a, int b) {...};
int foo(char* a, int b) {...};
```

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overloading revisited

- in C++, type checking is much more strict.

```
main.c
int foo(int a, int b);

int main() {
  foo(2, 5);
  foo("test", 6);
}

foo.c
int foo(char* a, int b) {...};
```

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overloading revisited

- A linker needs to look after producing code to jump to appropriate functions.
- a function call in `a.obj` can be linked to the function defined in `b.obj`
- How are multiple definitions dealt with?

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overloading revisited

- Internally generate identifiable function name:

- foo(int, int) fooii
- foo(char*, int) fooiPc

- Mangling....actual implementation depends on a system.

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overloading revisited

- To experience the effect of mangling...
- call a C function from a C++ code
- put the prototype declaration in `extern “C” {}`

```
extern "C" {
    void c_function(int, int);  // written in C
}

int main() {
   c_function(2, 3);
   return 0;
}
```

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