Polymorphism

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OOP Class, April 26-27, 2010

Polymorphism: The Motto

One Thing, Many Shapes.....

One Variable, Many Values

```
1  char a;
2  switch(a){
3  case 1:
4    return 1 * 1;
5  case 2:
6    return 2 * 2;
7  case 3:
8    return 3 * 3;
9  ...
10 case 127:
11   return 127 * 127;
12 }
```

return a*a;

- better ways?
- mechanism? raw memory interpretation

One Class, Many Instances

```
1  Student s;
2  if (s equals student1)
3    show(score1);
4  else if (s equals student2)
5    show(score2);
6  ...
7  else if (s equals student100)
8    show(score100);
```

- better ways?
- mechanism? data abstraction

One Method Name, Many Parameter Lists

```
1  //no overloading
2  System.out.printString("abc");
3  System.out.printInt(3);
4  System.out.printDouble(4.0);
5  //overloading
6  System.out.print("abc");
7  System.out.print(3);
8  System.out.print(4.0);
```

- mechanism? signature by name + parameter types

A Twist in Method Overloading

```
1  //overloading
2  System.out.print("abc");
3  System.out.print(3);
4  System.out.print(4.0);
5  //a twist (of course, not exactly workable
6  String("abc").print();
7  Integer(3).print();
8  Double(4.0).print();
```

- mechanism? just write print() for every class (we'll see)

Polymorphic Behavior

- all cases above: some polymorphic behavior
- **BUT** almost no one calls them real “polymorphism”

Why Not?

Polymorphic Behavior on Known Stuff

- polymorphic behavior of **known** primitive-type variables
- polymorphic behavior of **known** classes (extended types)
- polymorphic behavior of **known** parameter types

Unknown Stuff: Future Extensions

Backward Compatibility

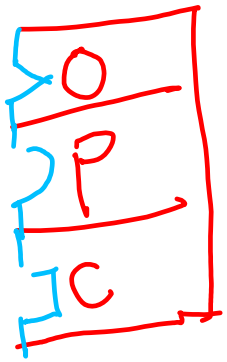
inheritance hierarchy

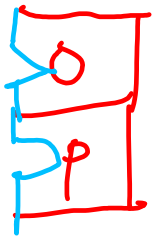
Forward Advance

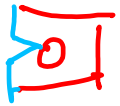
newly added variables/methods

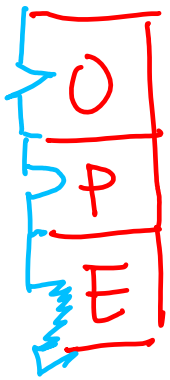
Polymorphism of Instance Content

one **advanced** content, many **compatible** ways to access



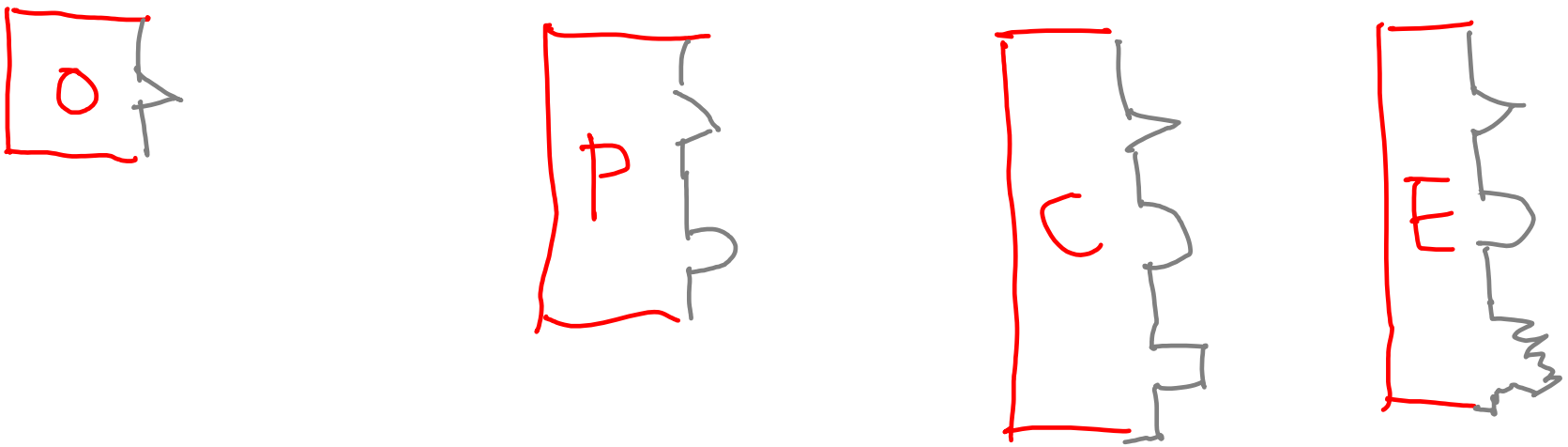






Polymorphism of Instance References

one **compatible** reference, many **advanced** contents to point to



Reference Upcast versus Reference Downcast

```
1  CSIEProfessor c = new CSIEProfessor();
2  Professor p = c;
3  //Professor p = new CSIEProfessor();
```

Upcast

simple (backward compatibility)

```
1  CSIEProfessor c = new CSIEProfessor();
2  Professor p = c;
3  CSIEProfessor c2 = (CSIEProfessor)p;
```

Downcast

need to check whether content fits (forward advance)

need RTTI (run-time type information/identification) to make downcast work **(where did we see it?)**

Content/Reference Polymorphism: Summary

backward compatibility handled

forward advance: only via downcast (RTTI)

simpler mechanism for forward advance?