Introduction to Object-Oriented Programming

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Agenda

- Principles of OO Programming
  - Classes, Objects, Methods
  - Encapsulation
  - Inheritance
  - Composition
  - Polymorphism
  - Reuse
- Potential Benefits and Concerns of OO
- Summary of concepts

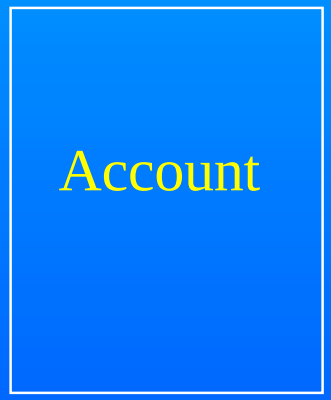
Classes and Objects and Methods... (oh my!)

- Class - template used to create objects
  - the cookie cutter
- Object - the space allocation
  - the cookie
- Class Characteristics:
  - Combine data and behavior in one package
    - Protective of their hidden data
    - Known as encapsulation
  - Described by nouns
  - Contain Methods (the verbs) providing functions and procedures

Object Concepts - Methods

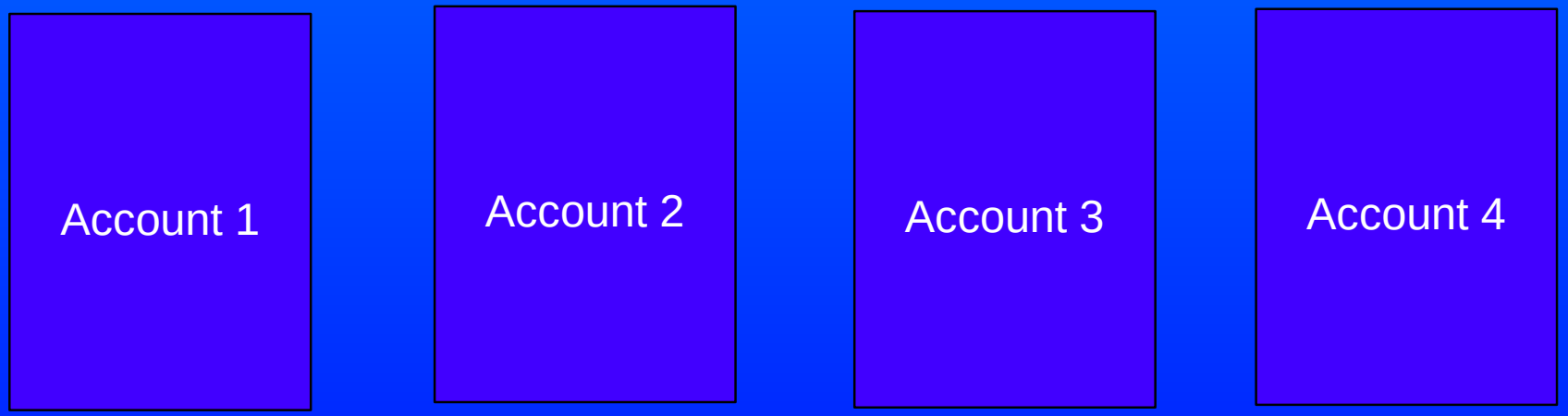
- Constructors
  - Runs when object is instantiated
  - Same name as object
  - Initializes object's data
- Overloading - write_check(int)
  write_check(int,int)
  - Same method, different arguments
  - Method with args matching the call is run
- Overriding - deposit(int)
  - Same method name in different objects
  - Used by child object to replace a parent's method

Object or Class?

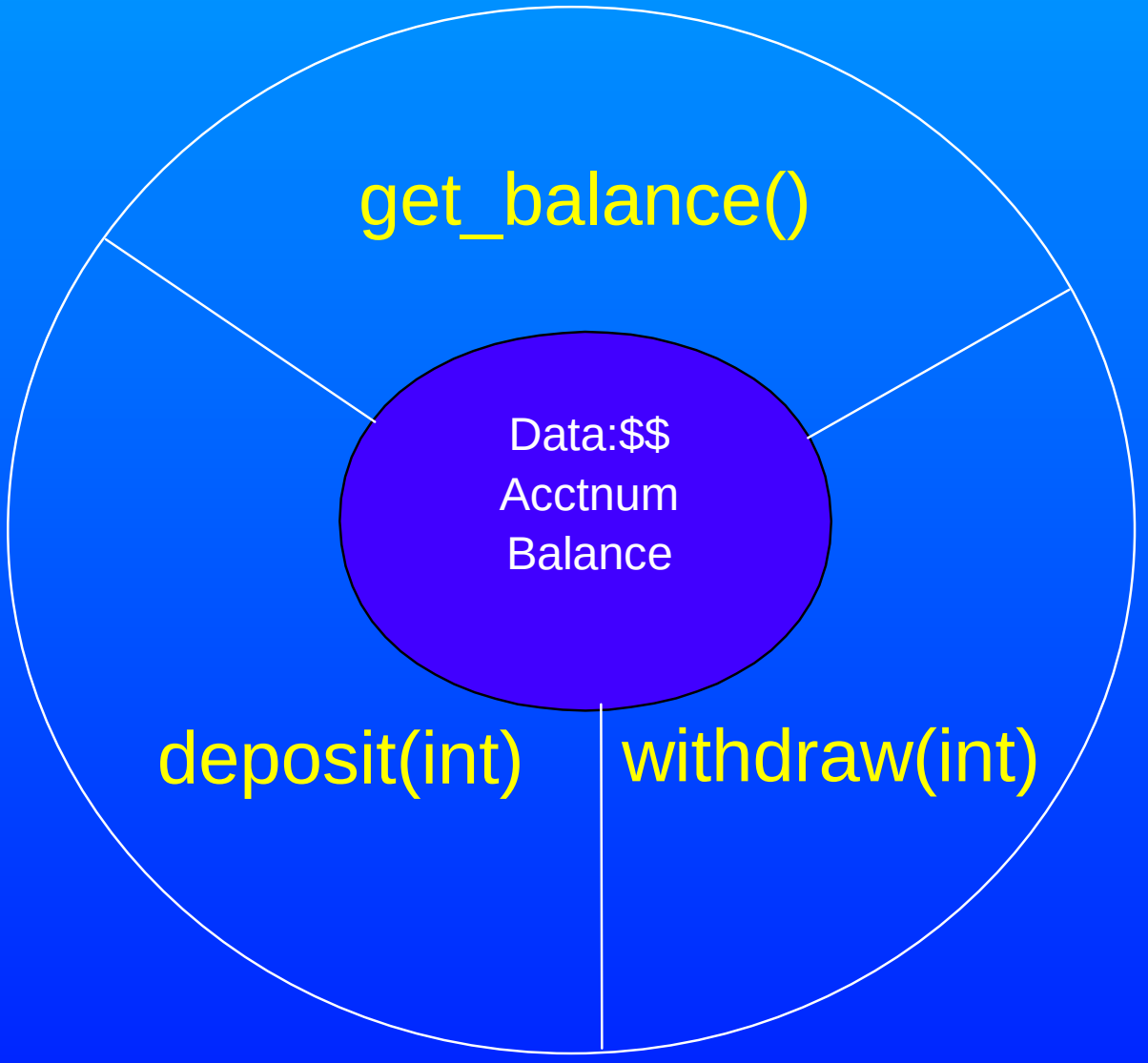


Class (use as template)

Objects
(instantiated from class)



Object Concept - Encapsulation



packaging of related data and procedures together

Class, Object, and Method Example in Java

```
class  Account  {

        int Balance;                // object data
        void Account( )  {          //  constructor
            Balance = 0;            //  initialize
    }
        void deposit(int  i)  {     //  methods
            Balance += i;
    }
        void withdraw(int  i)  {
            Balance  -= i;
    }
        void get_balance( )  {
            return Balance;
    }
```

Class, Object, and Method Example in Java (cont.)

```
public static void main(String argv[ ] )
 {
  //  create new objects and call methods

   Account account1 = new Account( );
   Account account2 = new Account( );

   account1.deposit(25);
   account2.deposit(100);
   account1.withdraw(5);

System.out.println("balance="+account1.get_balance());
   }
 }
```

Method Example in NetRexx

```
/* NetRexx Method Example */

A = Account(  )              -- set up an account object
A.deposit(int 25)            -- call deposit method
A.deposit(int 100)           -- call deposit to add more money
A.withdraw(int 5)            -- call withdraw method
new_Balance = A.Get_Balance(  )   -- call Get_Balance
say "Balance =" new_Balance       -- print new balance
```

Method Example in NetRexx

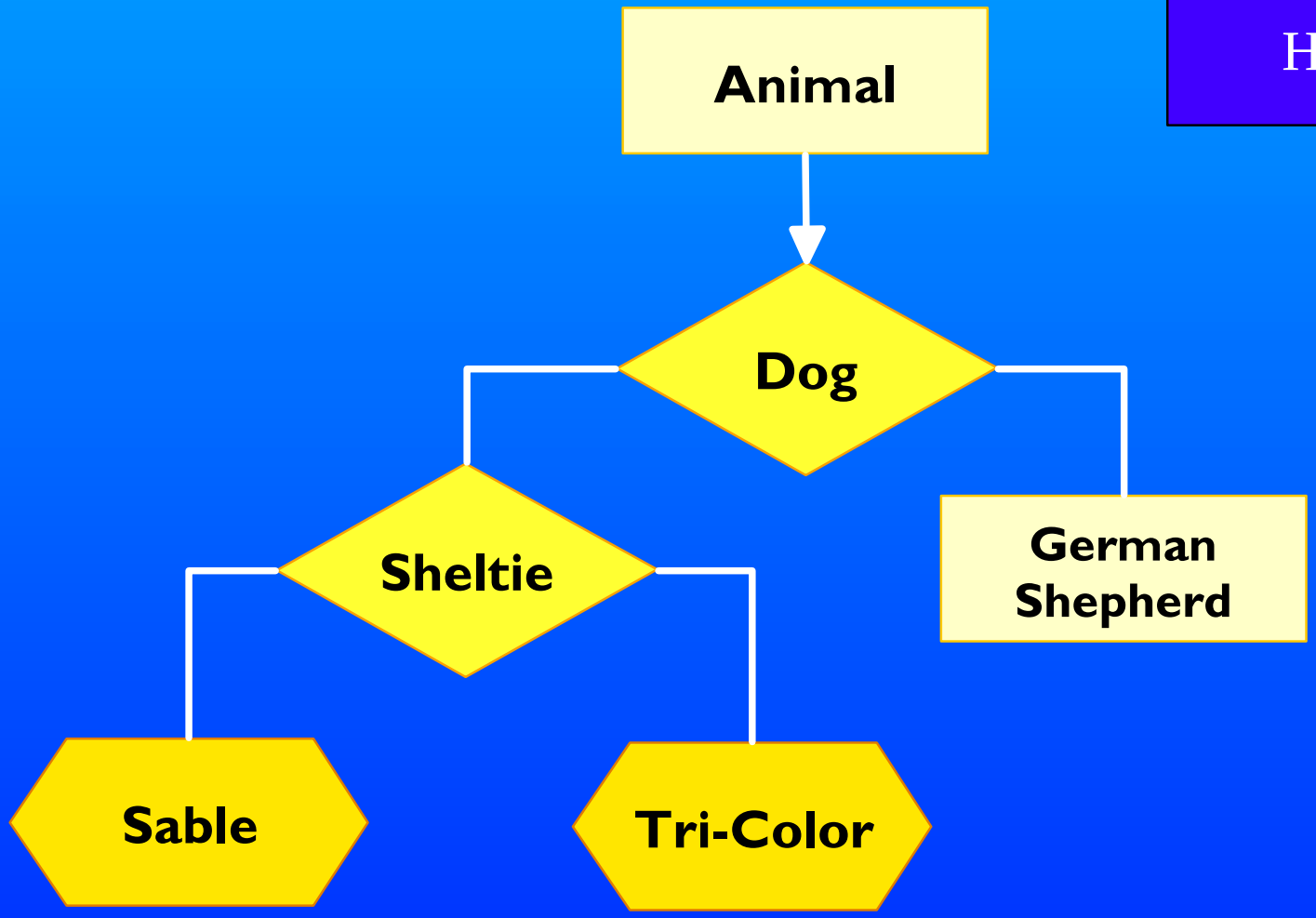
```
class Account
   Balance = int                    -- property  type integer

   method Account(  )               -- constructor
      Balance = 0

   method deposit(in_money)
      Balance = Balance + in_money

   method withdraw(out_money)
      Balance = Balance - out_money

   method Get_Balance returns int
      return Balance
```

Inheritance

- Used in implementing OO-relationships
  - sending messages between objects
  - create objects as part of a new object
- Kind-of (Is A)
  - Dog is a "Kind-of" animal
  - "Is a" inheritance to reuse by extending other classes
- Part-of (Has A)
  - Tail is a "Part-of" dog (Dog "has a" Tail)
  - "Has a" composition to reuse by including other classes

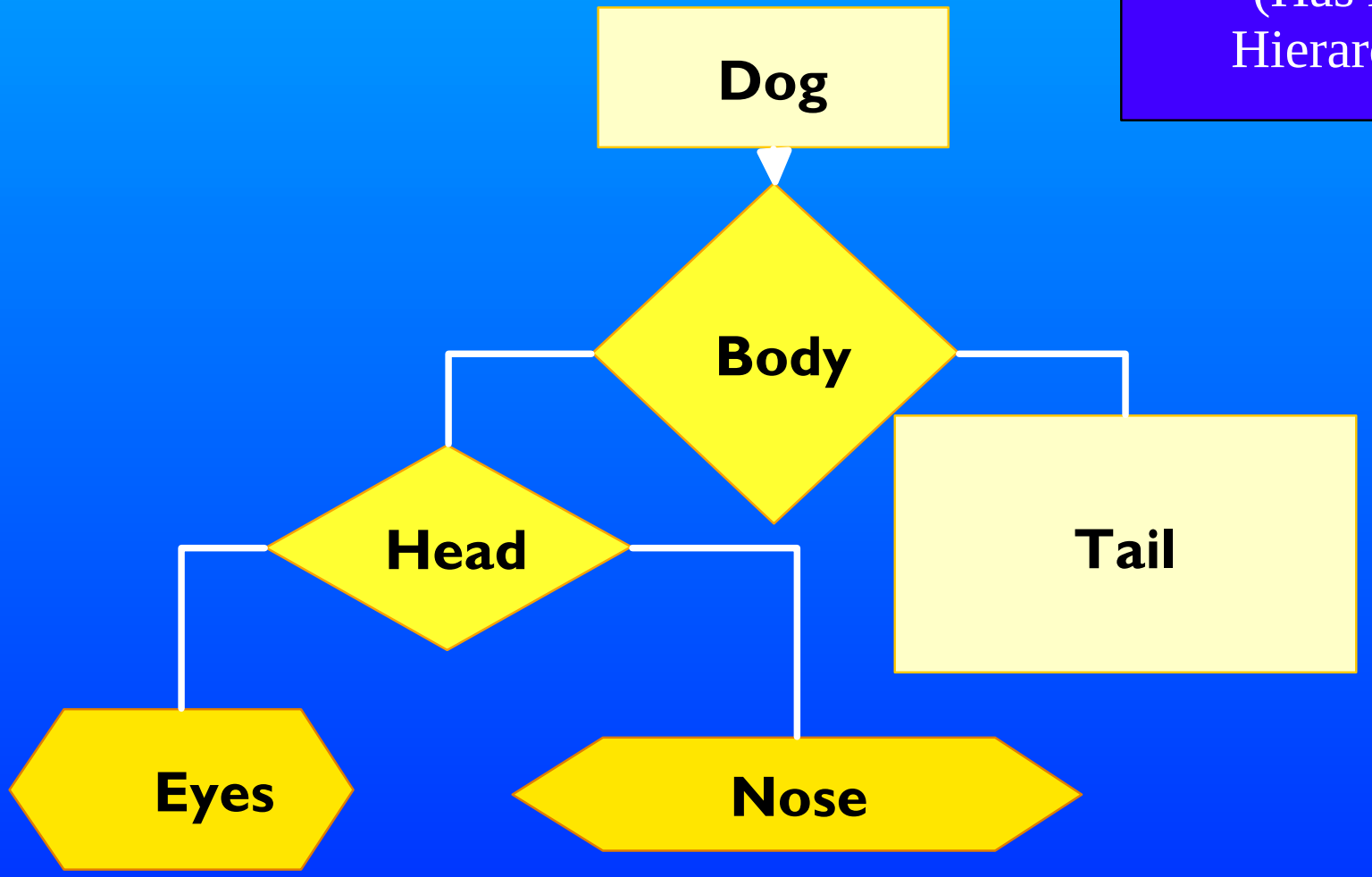
Inheritance

Example of Kind-Of (Is A) Hierarchy



Inheritance

Example of Part-Of (Has A) Hierarchy



Composition

- Build class consisting of other classes
- Instances are composite objects
- Related to "Has A" concept

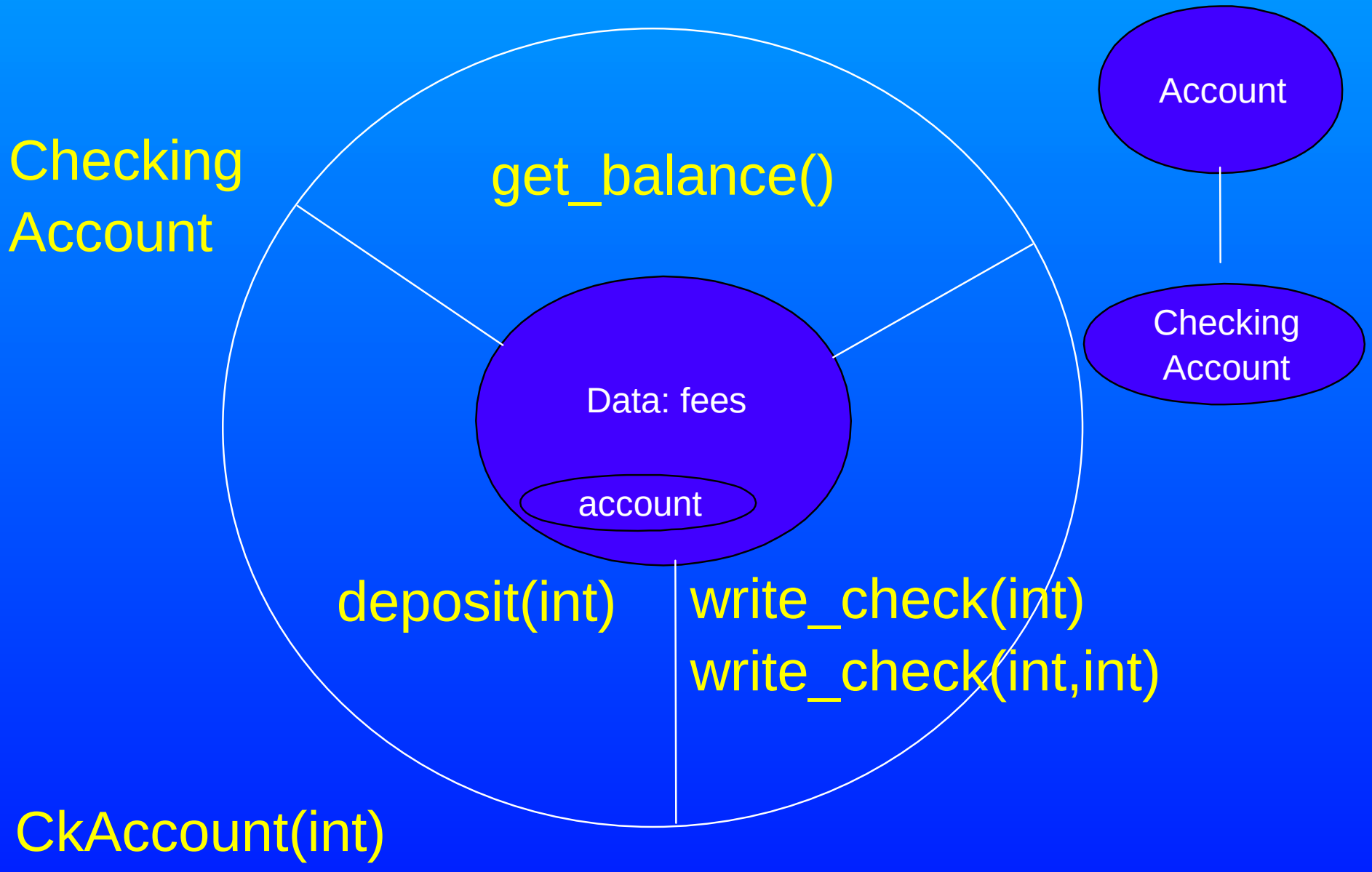
Inheritance and Composition Example: Is a, Has a

Java class description in English:

"A home **is a** house which **has a** family and a pet"

```
public class Home extends House  {
        Family  humans;              // composition
        Pet  animal;
}

//  extend by inheriting (is a)   or
//  compose by building blocks  (has a)
```

Object Concept - Inheritance



Code Example: Inheritance, Overloading

```
class CkAccount extends Account  {

  int  fees;
  CkAccount(int  f)  {
      fees = f;                        //  set fee passed in
   }
  void write_check(int amount)  {
      withdraw(amount);
   }
  void write_check(int amount,int f)  {
       withdraw(amount);
       System.out.println("We need the fees");
  }
}
```

Code Example: Inheritance, Overloading (cont.)

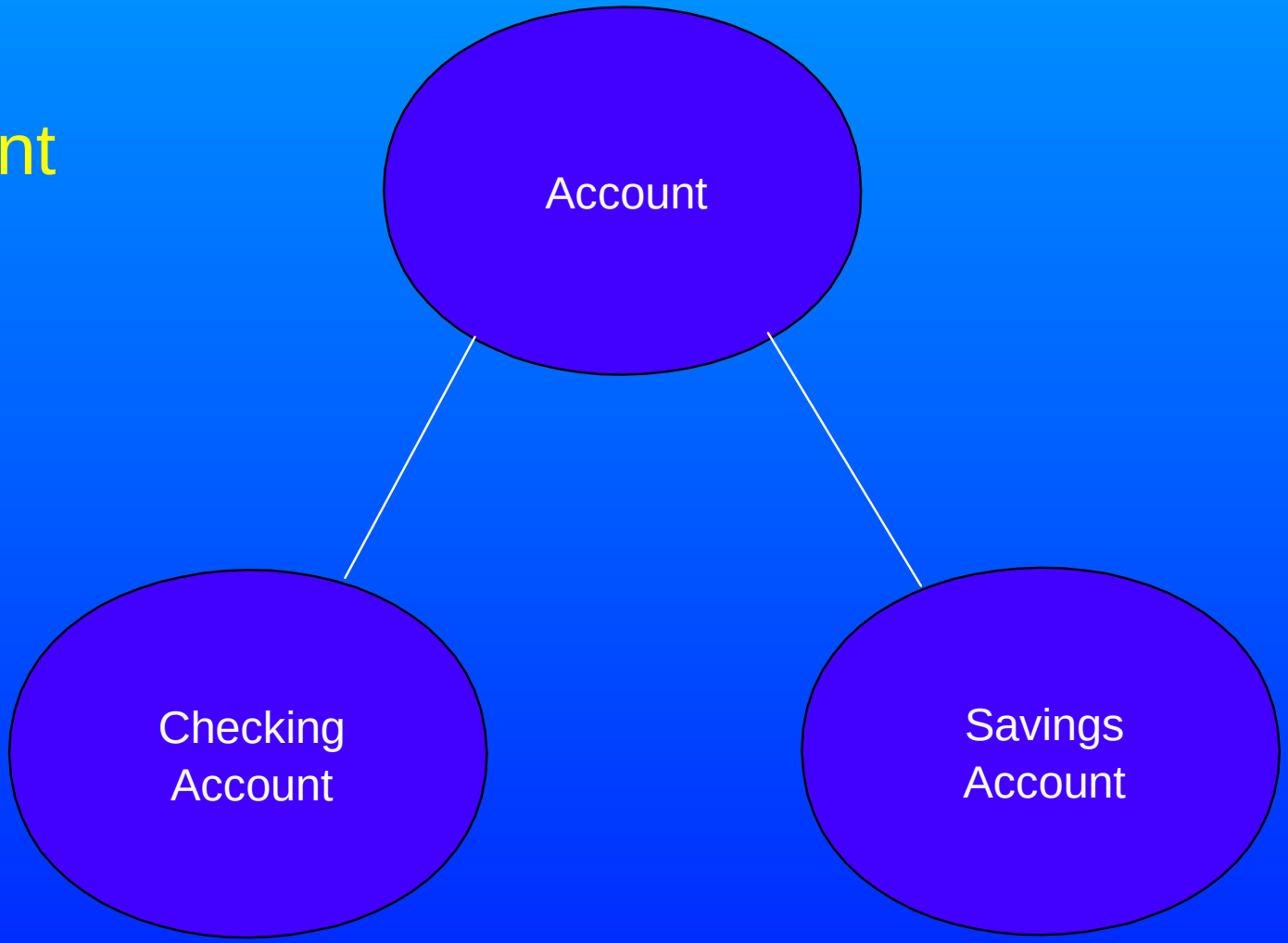
```
public static void main (String argv[ ] )  {
  CkAccount ck1 = new CkAccount(1);
  System.out.println("Bal 0 ="+ck1.get_balance( ));
  ck1.deposit(100);
  System.out.println("Bal 1 ="+ck1.get_balance( ) );
  ck1.write_check(10);
  System.out.println("Bal 2 ="+ck1.get_balance( ) );
  ck1.write_check(20,0);
  System.out.println("Bal 3 ="+ck1.get_balance( ) );
   }
}
```

Polymorphism

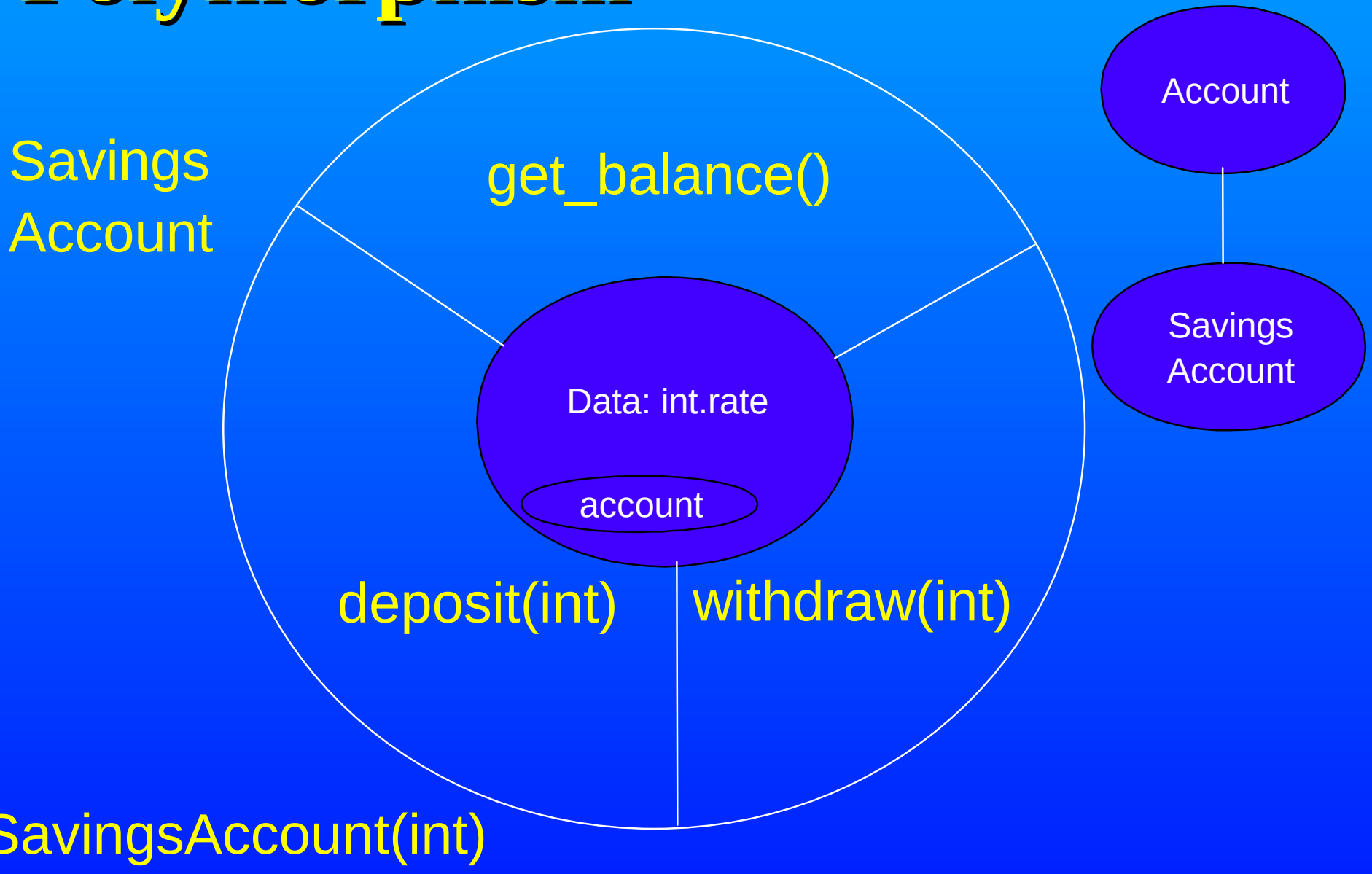
- Capability of a single variable to refer to different objects
  - Account can hold SavingsAccount or CheckingAccount object at different times
- This allows a new object to be added without rewriting existing procedures

Object Concept - Polymorphism

Account



Object Concept - Polymorphism



Reuse

- Once a class is defined, all instances of that class are guaranteed to be identical and perfectly formed
- Same name methods in unrelated class and unrelated methods
- Reusable objects are building blocks for future software
- Create classes complete enough for expected needs, but simple and independent of other classes

Potential Benefits of OO Programming

- Faster Development
- Higher Quality of Code
- Easier Maintenance
- Reduced Cost
- Increased Scalability
- Better Information Structures
- Increased Adaptability

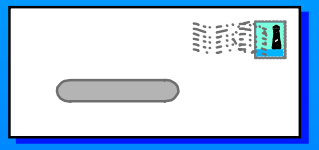
Potential Concerns of OO Programming

- Maturity of the Technology
- Need for Standards
- Need for Better Tools
- Speed of Execution
- Availability of Skilled people
- Costs of Conversion
- Support for Large-Scale Modularity

Summary

- Different way to design reusable software
- Keep it Simple:
  - choose meaningful variable, method, and class names
  - nouns for classes, verbs for methods
  - avoid large complex classes in favor of several smaller ones
  - data should be private with reasonable number of access methods
- You can do it !!

Contact Information



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