The OO Paradigm

Without a Language or Syntax!

What is the object world all about?

The Object-Oriented System Ontology

This ontology is consistent with the practice in computer science and information science categorizing a domain of concepts (i.e. individuals, attributes, relationships and classes). In this ontology of the object-oriented paradigm I attempt to minimize the vestiges of implementation languages and development methodologies in order to expose the core nature and value of object-oriented concepts.

1. Individuals

The most concrete concept in the object-oriented paradigm is the ***object***. It derives from the living physical experience of humans seeing and touching things. In that experience objects are separable – distinguishable from other objects by nature of their physical presence and location regardless of any other discernible characteristics they may possess. This characteristic of "individual-ness" leads to the property of ***identity***. Identity enables the unambiguous designation or selection of every object physical or abstract within a domain of discourse.

Objects have an "inside," an "outside," and a "surface" that separates the inside from the outside. An object contains anything that exists on the "inside" of the object. Since the surface of most physical objects is opaque, usually the contents are invisible and untouchable by anyone on the outside. This property renders the object's contents impervious to meddling and is called ***encapsulation*** (or ***information hiding*****).**

2. Attributes

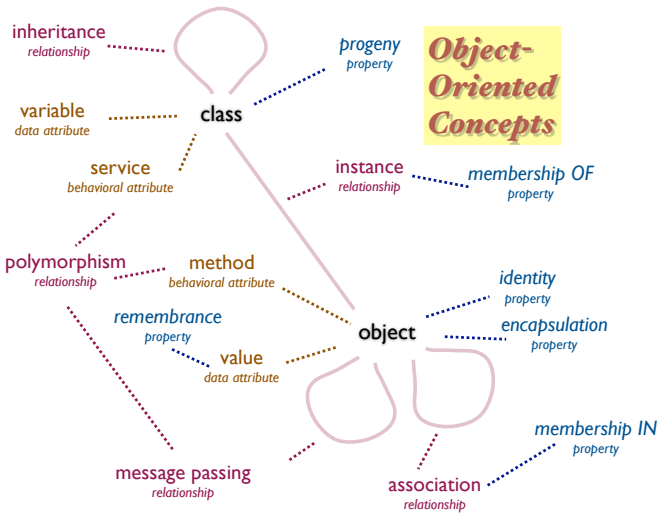
Attributes are those characteristics that are inherent to an *object*. In the object paradigm attributes define either data or behavioral characteristics - each of which has a static and dynamic form. Attributes in static form combine to define what is called the *structure* of an *object*. From inception to extinction the *structure* of an *object* is immutable.

2.1. Data Attributes

Data attributes serve to store information (data) within an *object* and implement the property of ***remembrance***. Data attributes are completely contained within an object protected by *encapsulation*. *Remembrance* is manifest statically as "what *can* be remembered," a ***data attribute variable***. It is manifest dynamically as a definition of "what *is* remembered," a particular ***data attribute value***.

2.2. Behavioral Attributes

Behavioral attributes serve to define the animate nature of an *object*. In its static form each behavioral attribute defines "*what* an object can do," usually called a ***service***. In its corresponding dynamic form this behavioral attribute defines "*how* a service is accomplished," usually called a ***method*** (or ***operation***). *Methods* define "activity" performed in an object model. A *method* may simply be access to *remembrance* inside an object or it may be complex sometimes employing the involvement of other *services* of the same or other objects to accomplish its responsibility. *Methods* reside within the *object* subject to *encapsulation* while *services* are visible at the surface of the *object* available for collaboration.



3. Classes

The ***class*** concept combines both a definition of *structure* and the generation of *object(s)* based on that *structure*. Every *object* is an ***instance*** of a specific *class* and shares the same static *structure* defined by that *class* with every other *object* of that *class*. The responsibility of generating *instances* that share the same *structure* is the property of ***progeny***. The *class* concept thereby fuses the existence of the *objects* to that of their *class*; *objects* cannot exist independent of their defining *class*. *Objects* are said to be ***members of*** their *class*.

Along with the static behavioral structure of *service* defined in the *class*, the dynamic behavioral attribute, *method*, may also be defined. Defined in the *class* this dynamic behavioral attribute, "*how* a service is accomplished," is identical for each and every *object* generated of that *class*.

4. Relationships

Relationships in the object paradigm exist on two dimensions: structural and behavioral. The structural relationships are based primarily on the properties of *identity, remembrance* and *progeny*.

4.1. Structural Relationships

4.1.1. Inheritance

Inheritance is a relationship between *classes*. The *structure* defined in one *class* is used as the foundation of *structure* in another. By foundation it is meant that all the *structure* of the first is replicated in the second and additional *structure* in terms of *data attributes* or *services* may be added or *methods* for replicated *services* may be altered (***overridden***). The replicated *structure* defines how the two *classes* are alike. The additions or alterations define how they are different. The *class* defining all the *structure* shared between them is called the ***parent class*** (*super class*, *generalization*) while the other is called the ***child class*** (*sub class*, *specialization*). It is said that the *child class* proceeds from or is derived from the *parent class*. Successive application of *inheritance* defining related *classes* results in a ***class hierarchy***.

4.2. Behavioral Relationships

The behavioral relationships are based primarily on the property of ***membership IN***, and the capacity of *objects* to "act."

4.2.1. Association

An ***association*** is a relationship between *objects*. *Objects* are intrinsically separable by way of the *identity* property. At the same time, humans are compelled to categorize their experience of things in the physical world. Humans superimpose groupings that collect *objects* ***into*** sets (a foundation of mathematics based on human experience). *Objects* become members in a group only by designation. This property is called ***membership***. *Membership* is independent of *identity* or *attribute*. This property also permits humans to identify an *object* that is not in a set (i.e. discrimination). (*Membership in a group is discretionary and is distinct from membership of a class which is intrinsic by way of progeny.*)

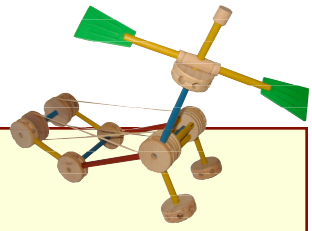
Variations on *membership* derive from the intent of the relationship and generally fall into the categories of *association* and *composition*. Any designated collection of objects defines a relationship between those *objects* called ***association***. By the simple fact that they are members in the same relationship that membership defines how they relate. When the existence of the *objects* themselves is coupled with their membership; that is to say, if one (or the other or both) would not exist if it were not related to the other then the relationship is called a ***composition***.

4.2.2. Message Passing

Message passing is a relationship between *objects*. *Message passing* relies on the *identity* property and *services*. A ***message*** is a communication between a ***sender*** *object* and ***receiver*** *object* where the *sender* requests that the *receiver* render one of its *services*. The *sender* and *receiver* may be one in the same *object*. The *message* designates the *receiver*'s *identity*, the *receiver*'s *service* to be performed along with any parameters that the *service*'s protocol may require. Since the *message* is a request there are no implicit timing constraints determining when the *service* is accomplished. Unless explicitly designated a *message* results in an asynchronous activity on the part of the *receiver* without acknowledgment or returned information.

4.2.3. Polymorphism

Polymorphism results from the interplay of *message passing*, *behavioral attributes* and *classes*. A *sender* directs a *message* to a *receiver* designating a *service* of that *receiver*. A *message* does not designate a *method*. The regime that determines which *method* satisfies a service request is called ***binding***. If the *method* (corresponding to the *service*) is defined in the *class* of the *receiver object*, that *method* is invoked. If the *service* of the *receiver*'s *class* is *inherited* (and not *overridden*), the corresponding *method* defined in the nearest progenitor (*parent class*) of the receiving *object*'s *class* is invoked.



Without syntax?

Every *language* that is invented to express concepts carries with it the understanding and the biases of the inventor. Depending on his/her purpose(s) those biases simplify certain tasks performed with the language but may obscure the underlying concepts.

Programming language design must deal with the feasibility of automated translation and interoperability with other programming languages and operating systems. Compromises and assumptions are chosen to make the resulting language efficient, effective and marketable.

The goal of this description of the object-oriented paradigm is to succinctly make the concepts understandable - an ambitious task to say the least!

- Professor Waguespack