Object Oriented Methods by Ian Graham

Answers to selected exercises

Multiple choice questions: Recommended marks are given in brackets after each possible answer. Note that some wrong answers may accrue negative marks.

Answers to most (but not all) questions without answers can be found in the text.

Chapter 1

1. Choose two characteristic features of OO
   a) Polymorphism (0)
   b) Inheritance (2)
   c) Reusability (-1)
   d) Abstraction (1)
   e) Encapsulation (2)
   f) Genericity (-1)
   g) Information hiding (0)
   h) Object identity (1)
   i) Dynamic binding (0)

2. Which artificial intelligence concept is closest to the idea of an object?
   1. Slot (0)
   2. Inference engine (-1)
   3. Knowledge base (-1)
   4. Frame (3)
   5. Facet (0)
   6. Rule (0)

3. What is the difference between the following? (sample sentences given here)
   a) an instance and a class
   Classes are collections of instances, which are individual things. A class is also a template for creating instances.
   b) a data type and a class
   Data types are predefined primitives; classes can be defined by the user.
   c) a class and a rôle
   Instances can adopt different rôles during their lifetime.
   d) an object type and an entity type
   Data types have no operations, unlike classes and object types.
   e) a class and a component
   In most programming languages outbound interfaces are not made explicit for classes, although in analysis there should be no difference.
   f) dynamic binding and polymorphism
The former is one way of implementing the latter.
g) genericity and inheritance
Generic containers allow their content’s type to vary, rather than their subclasses.
h) inheritance and classification
Classification refers to the relationship between instances and their classes/types, while
generalization (or specialization) refers to the analogous relationship between classes;
both are often referred to as inheritance. *Students may also discuss the difference between*
*implementation and type inheritance but that was not the point in the chapter.*

4. Justify including attributes in class descriptions.
Attributes and associations are really exactly the same thing. Convenience is the main
criterion. Don’t clutter diagrams with primitive concepts. Ultimately, everything becomes
a ‘pointer’. Extra mark for discussing the bidirectionality issue.

*Refer to definition via index.*

7. Define and give examples of a:
a) class attribute/method;
Average height/age of a class of people.
b) instance attribute/method.
Height/DoB of a person.

8. What is multiple inheritance? When should it be used?
The phenomenon of something acquiring characteristics from two parents in an
inheritance structure. Good for modelling. Dangers should be pointed out; e.g. name
conflicts. Discuss interface v. class multiple inheritance a la Java. Extra marks for
spotting that rules can disabiguate.

Chapter 2

1. What is the essential difference between object-oriented and conventional systems?
1. OO is more reusable (0)
2. OO uses inheritance (0)
3. OO systems reduce development costs (-1)
4. Changes to data structures are localized (3)
5. OO is more fashionable (1)

2. Name up to eight benefits of object technology in general.
Localized maintenance, reuse, extensibility, conceptual integrity, seamlessness, etc. *Refer
to chapter summary.*

3. Name up to five pitfalls.
New things to learn, etc.
*Refer to chapter summary.*
Chapter 3

1. Which programming language is associated with the beginnings of OO?
   a) Algol 68 (-1)
   b) PL/1 (-1)
   c) Simula (3)
   d) Pascal (-1)
   e) Ada (-1)
   f) Lisp (0)

2. Which of the following did not help with the development of Smalltalk?
   a) Adele Goldberg (0)
   b) Alan Kay (0)
   c) Bjarne Stroustrup (1)
   d) Dan Ingalls (0)
   e) Brad Cox (1)

4. Why did Java succeed so quickly, while Eiffel didn’t?
   *Might mention C-like syntax and cleverer, better funded marketing.*

5. What are the major benefits and pitfalls associated with C++?
   *Might mention performance and memory/resource leaks. Might also discuss the differences between languages for application and systems programming.*

   *Might mention different levels of complexity and the various distribution issues.*

Chapter 4

6. Describe the OMA.
   *This is the OMG Object Management Architecture that underpins CORBA.*

9. What is the name given to the OMG standard for inter-object communication?
   a) Object Services Architecture (-1)
   b) Common Object Request Broker Architecture (3)
   c) Object Interface Definition Standard (0)
   d) None of the above (-1)

12. Why is having XML and middleware not enough to ensure successful Enterprise Application Integration? Discuss the problems to be expected on a typical EAI project.
   *This question is about the need for domain modelling to capture the semantics of inter-component communication.*

14. What does the S in XSL stand for?
15. Which concept is said to help with migration to object technology but safeguards investment in existing code?
   a) Coupling (-1)  
   b) Object wrapper (3)  
   c) Overloading (-1)  
   d) Cohesion (-1)  
   e) Polymorphism (-1)  

Chapter 5

1. In object-oriented databases, what is the name given to the ability of objects to exist after an application program has terminated?
   a) Static Binding (-1)  
   b) Persistence (3)  
   c) Two-phase commit (-1)  
   d) Object integrity (-1)  

3. How can inheritance be implemented in a relational database?
   Using the concept of entity-subtypes or as shared IDs with a secondary index.

7. Why can the performance of a pure object-oriented database exceed a relational or object-relational one?
   Because of the need to perform many joins to reconstruct a complex object in a relational engine. OODBs traverse pointers instead of doing joins. *Include explanation of the architecture of all three options in this answer.*

Chapter 6

How many published methods or fragments of methods for OOA/D have been published?
   a) (-1)  
   b) between 13 and 25 (0)  
   c) (0)  
   d) between 26 and 44 (0)  
   e) (0)  
   f) over 44 (3)  

Which of the following OOA/D methods is associated with Jim Rumbaugh?
   a) CRC (-1)  
   b) HOOD (-1)  
   c) Ptech (-1)  
   d) ObjectOry (-1)  
   e) OMT (2)  
   f) UML (1)
3. Define ‘object’ (one sentence). Name the four components of an object.
An object is anything with unique identity throughout its life.
Identifier
Attributes and associations (state)
Operations (methods, behaviour)
Rules (invariants, assertions)

4. What is the difference between types, classes, instances and rôles?
Types represent ideas and have no implementation (e.g. Person), classes represent collections of things with an implementation (People), instances are members of these collections (fredBloggs) and rôles are dynamic types taken on by instances (Holidaymaker). Also mention the difference between types and interfaces (invariants) in a good answer.

5. What is a ‘facet’? Give three completely different examples.
An attribute of an object feature.
Keyword of an object description (ID)
Range constraint or default (init) value for an association.
Pre-condition of an operation
Régime of a ruleset

6. Why is analysis more important for OO systems?
Because of the need for stable interfaces.

9. Name the four principal structures of an object model.
Association, Inheritance (generalization, etc.), Aggregation (composition) and Usage (uses, message passing).

10. Redraw the inheritance structure of Figure 6.16 with due attention to different discriminators.
Hint: ProductType, PaymentMethod

11. What is the difference between a wrapper and a subsystem or package in most OOA methods?
Wrappers enforce encapsulation.

26. Why is analysis important for OO programmers?
See Q 6.

27. Does God throw exceptions?
No, but she might do if she existed.

Chapter 7
4. Distinguish between a patterns catalogue and a pattern language, giving examples. A pattern language lets you string patterns together to create design ‘sentences’ that help with the construction of a solution.

6. Write patterns to deal with the following situations:
   a) the need to inform all users of e-mail of a change to their e-mail addresses, when some may be on holiday;
   b) users in a workshops continually disagree with each other;
   Hint: look up ‘lead user’ in the index.
   c) management resist object technology because they consider it too risky.

10. Mini project
    Produce a framework template for school timetable preparation: allocating suitable classrooms, qualified teachers, ten subjects and five one-hour time-slots per weekday. Include all invariants; e.g. Chemistry needs a classroom with sinks and there must be at least five hours of Maths and English per week. Are there any rules that are hard to express in OCL? Why is this? Apply the same framework to factory production scheduling.
    *This question is advanced and requires some knowledge of AI.*

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## Chapter 8

5. What is the first thing a facilitator does in a workshop? What is the last?
   First: Say good morning, introduce participants, agree the mission.
   Last: Get sign-off

6. Name ten of the key tasks of a workshop – in order.
   *Hint: see checklists on pages 447-450.*

7. Discuss the use of voting in workshops.
   *Bring out the need for speed and consensus as opposed to more scientific methods such as pairwise ranking.*

10. What is the grammatical structure of an atomic task? Define atomic. How else can scripts be specified?
    a) SVDPI
    b) Its atomic when it is a single (possibly long) sentence that if decomposed further would need to introduce terms outside the domain ontology (vocabulary).
    c) By numbered lists of natural language statements or as sequence diagrams.

11. Discuss the validation of requirements models.
    a) How is the Business Object Model tested?
       Walkthrough against the use cases in the TOM
    b) How are objectives tested?
       By measures
c) How is the Task Object Model tested?
By cross-reference to the business objectives and by the walkthrough.

12. How is a Task Object Model transformed into a Business Object Model?
By creative thinking, reference to domain knowledge and textual analysis.
How is a Business Object Model transformed into an Implementation Object Model?
See Chapter 6 and (esp.) 7.

14. Complete the following well-known phrases and sayings:-
Better Systems faster!
I keep six honest serving men,
    They taught me all I knew.
    Their names are What and Why and When
    And How and Where and Who.

18. Mini-project
A dealer has already found an opportunity to deal in the FX market with a certain counterparty. The dealer is obliged to execute the deal only within given counterparty limits and within her personal position limits. They must complete the deal once they have agreed it verbally. If these conditions are satisfied then:
The dealer strikes a bargain with the counterparty at agreed terms and rates;
A confirmation must be sent to the counterparty;
The Settlements Department must be notified of the deal so that they can arrange payment. Settlements also provide standing settlement instructions and notify the Accounts Department of the deal;
Accounts post on the deal date and on its value date;
The dealer's position and the counterparty's limit availability must be adjusted to reflect the new position.

Based on the above scenario, draw a business process model for the above situation, including agents and conversations and the tasks associated with them. Write a task script for one of the tasks. Sketch a Business Object Model using any elements that seem appropriate. Try to find the key objects and their four structural relationships: classification, usage, composition and association. Make up some class cards. If you are part of a group try to walk through and debug your model. Use the walkthrough to produce sequence charts and/or activity diagrams.

This isn’t as hard as it looks. You should end up with about 8 objects including Deal, Counterparty, CptyAvailability (=CptyPosition − CptyLimit), etc. Note the red herring Accounts stuff: value date etc. The main point is to get to a walkthrough.

Chapter 9

1. Why would a company wish to standardize on a development process? What disadvantages might they see?
2. Enumerate the benefits of time-boxes.

3. Give examples of product and process metrics. How might they be related?  
   Product: SLOCs, function points, task points, mean time to failure, bugs reported per annum, etc.  
   Process: time to develop, PhDs per developer, average overrun on projects, etc.

4. Define the term ESTIMATION MODEL. Give an example of one.  
   An estimation model is a mathematical relationship between process and product metrics; e.g. it cost $60 to produce one line of COBOL.

10. How long does it take to go from the end of a requirements workshop to implementation?  
    It depends on many factors (*discuss them*). Anything from 11 hours to six months absolute maximum.

14. Complete the phrase: Users should be available but not too available.

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Entity types have no methods but generalize data types to user defined types. (1)

Define "object" (one sentence). Name the four components of an object.  
An object is anything with unique, immutable identity that has defined state and behaviour.

b) Give an example of a question that might elicit an abstract class from two more concrete classes. Give an example of a question that might elicit more concrete classes from a list of objects.

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What is a probe? Give two examples and name the type of probe.

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What is a (a) side-script (b) component script (c) subscript

__________________________3

Give examples of product and process metrics.

__________________________4

Define Lack of Cohesion in Methods (LCOM).
Enumerate the benefits of time-boxes.
See page ...

Describe the main tasks of two of the following activities:
1. Time box planning
2. The main time-box
3. Evaluation
4. Implementation planning

a) How long does it take to go from the end of a RAD to implementation?
b) What is the difference between education and training? Which is the most important?

Name 6 things that could be reused.

How can inheritance be implemented in a relational database?

Name 8 project rôles

Define object identity.

Define (a) class method (b) instance attribute (c) association
1. A dealer has already found an opportunity to deal in the FX market with a certain counterparty. The dealer is obliged to execute the deal only within given counterparty limits and within her personal position limits. If these conditions are satisfied then:

- The dealer strikes a bargain with the counterparty at agreed terms and rates;
- A confirmation must be sent to the counterparty;
- The Settlements Department must be notified of the deal so that they can prepare instructions for the dealer’s nostro banks. Settlements Department also provide standing settlement instructions and notify the Accounts Department of the deal;
- Accounts post on the deal date and on its value date;
- The dealer’s position and the counterparty’s limit availability must be adjusted to reflect the new position.

Based on the above scenario, draw an internal and an external context model for the above system. Write a message table for the same system. Draw a task card for one of its tasks. Draw a Business Object Model using any elements that seem appropriate. Try to find the key objects and their four structural relationships: classification, usage, composition and association.

2. Sketch the contract driven life cycle model. See figure ...

Associations violate encapsulation. Why? How is the problem overcome? Bidirectional associations violate encapsulation because the knowledge about the association is outside the classes they link. Use only one-directional associations and incorporate integrity rules as invariants of the source objects.

Discuss the use of normalization in object-oriented and conventional modelling.

Discuss the use of functional decomposition in object-oriented and conventional modelling.

Write a small ruleset to describe the behaviour of a technical analyst (chartist) dealing in a single security.

When should state models be used and what for?
Discuss the difference between task scripts and use cases.

Draw an event trace for a visit to your local supermarket.

Discuss the use of voting in RADs.