

# COSC427: Advanced OO Design

## Exam 2005

Time allowed: **2 hours.**

Number of pages: **4.**

Number of questions: **7.**

Total marks: **100.**

Resources: **Open book:** You may use any printed or electronic resources. You may not communicate, directly or electronically, with other people.

If you want to print anything, ask a supervisor to collect it from the printer for you.

Answers: Write all answers in your **answer book.**

1. **[20 marks for whole question]** For each of the following descriptions (a) – (e):
  - i. **[1 mark each]** Name a *maxim* (or *pattern*, *code smell*, etc) that captures the idea.
  - ii. **[1 mark each]** Explain the rationale for this *maxim* (i.e. why the *maxim* exists).
  - iii. **[2 marks each]** Comment on the validity and value of this *maxim*.
  - (a) **[4 marks]** Methods that change attribute values should be distinct from methods that merely return values.
  - (b) **[4 marks]** Methods should not directly access attributes defined by a superclass.
  - (c) **[4 marks]** Classes should be designed around their behaviour, rather than their data.
  - (d) **[4 marks]** Classes that have subclasses should not be directly instantiated.
  - (e) **[4 marks]** Very badly designed software should be completely rewritten rather than progressively edited.
2. **[6 marks]** Some employers believe that aesthetic issues such as style and elegance have no place in OO software design: all that matters is functionality. Is this true? Write an argument to convince a sceptical employer of your view.
3. **[6 marks]** Identify *maxims* that either conflict with or support the *Law of Demeter*. For each one, explain how it conflicts with / supports the *Law of Demeter*. Using these ideas as justification, make a recommendation for how (or whether) experienced software engineers should apply the *Law of Demeter*.
4. **[10 marks]** If the *Gang of Four* decided to produce a new edition of their design patterns book, (updated with UML diagrams and examples in current OO languages), and they asked for your advice on specific ways to improve the book and its patterns, what would you tell them?
5. **[4 marks]** The wiki pages *ConflictingIdeas* and *DesignPatternsBreakRules* describe opposing OO design concepts. Identify and describe a conflict that has not already been documented on these pages.
6. **[18 marks]** Suggest a series of *refactorings* (from MartinFowler1999) that you would apply to the Java code of Figure 1. (Don't just name them – explain how the code would change.)

```

public class Snorkulator {
    public int startX;
    public int startY;

    public int endX;
    public int endY;

    private Crudule[] crudules;
    private int frubule;

    public Snorkulator(int theFrubule, Crudule[] theCrudules) {
        theFrubule++;
        frubule = theFrubule;
        initCrudules(theCrudules);
    }

    private void initCrudules(Crudule[] theCrudules) {
        crudule = theCrudules;
    }

    public Crudule[] getCrudules() {
        crudules[frubule-1].init();
        return crudules();
    }

    public void setStart(int x, int y) {
        startX = x;
        startY = y;
    }

    public void setEnd(int x, int y) {
        endX = x;
        endY = y;
    }

    public void glarp() {
        if (frubule == 1)
            crudule[0].exglarp((startX-endX)/2, (startY-endY)/2);
        else if (frubule == 2)
            crudule[1].inglarp((startY-endY)/2, (startX-endX)/2);
        else
            crudule[frubule-1].noglarp(startX + 18, startY + 32);
    }
}

```

**Figure 1: Snorkulator code**

7. [36 marks] Using good OO and as many *design patterns* and *maxims* (etc) as possible, produce a design for the following requirements. Draw a class diagram (or diagrams) and briefly explain how each *pattern* or *maxim* is applied. (It is not necessary to describe the intent of patterns or the meaning of maxims, etc, just make it clear how you are using them.)

- This system models sorcerers, such as witches and warlocks, and their victims.
- Sorcerers are practitioners of magic, and are not human.
- Victims are human (and not magic).
- Witches are female and ride brooms. Warlocks are male and ride pitchforks.
- Sorcerers cast magic spells; different sorcerers know different spells. They can learn and forget spells, but when they know a spell they can cast it as much as they like.
- Warlocks have no magic powers of their own, but can steal from witches the power to cast spells.
- Warlocks are usually male witches, but some are wizards that turned evil.

- Princes and princesses are common victims, and are often turned into frogs or put to sleep for 100 years.
- Spells can be undone by counterspells, or by some event such as being kissed by a princess.
- Some spells don't take effect until a specific event occurs (possibly recurrently), such as a full moon or when the victim tells a lie. A regression spell, for example, is triggered by some event, and changes the victim back to what they were like at the time the spell was cast.
- The evil eye can be cast only by females. It can cause bad luck, disease, or even death, depending on the power of the sorcerer.
- Victims can be protected from some spells by talismans, e.g. a person might wear the hand of Fatima to ward off the evil eye.
- Making a spell involves several phases: preparation, overture, invocation, execution, sacrifice, and closure. Some of these may be omitted in particular spells.
- Any sorcerer becomes a necromancer when they have the power to raise dead spirits. A corpse reanimated this way can appear just like a normal human, but works differently internally.

**END OF PAPER**