CS 520

Theory and Practice of Software Engineering
Fall 2017

Best and worst programming practices

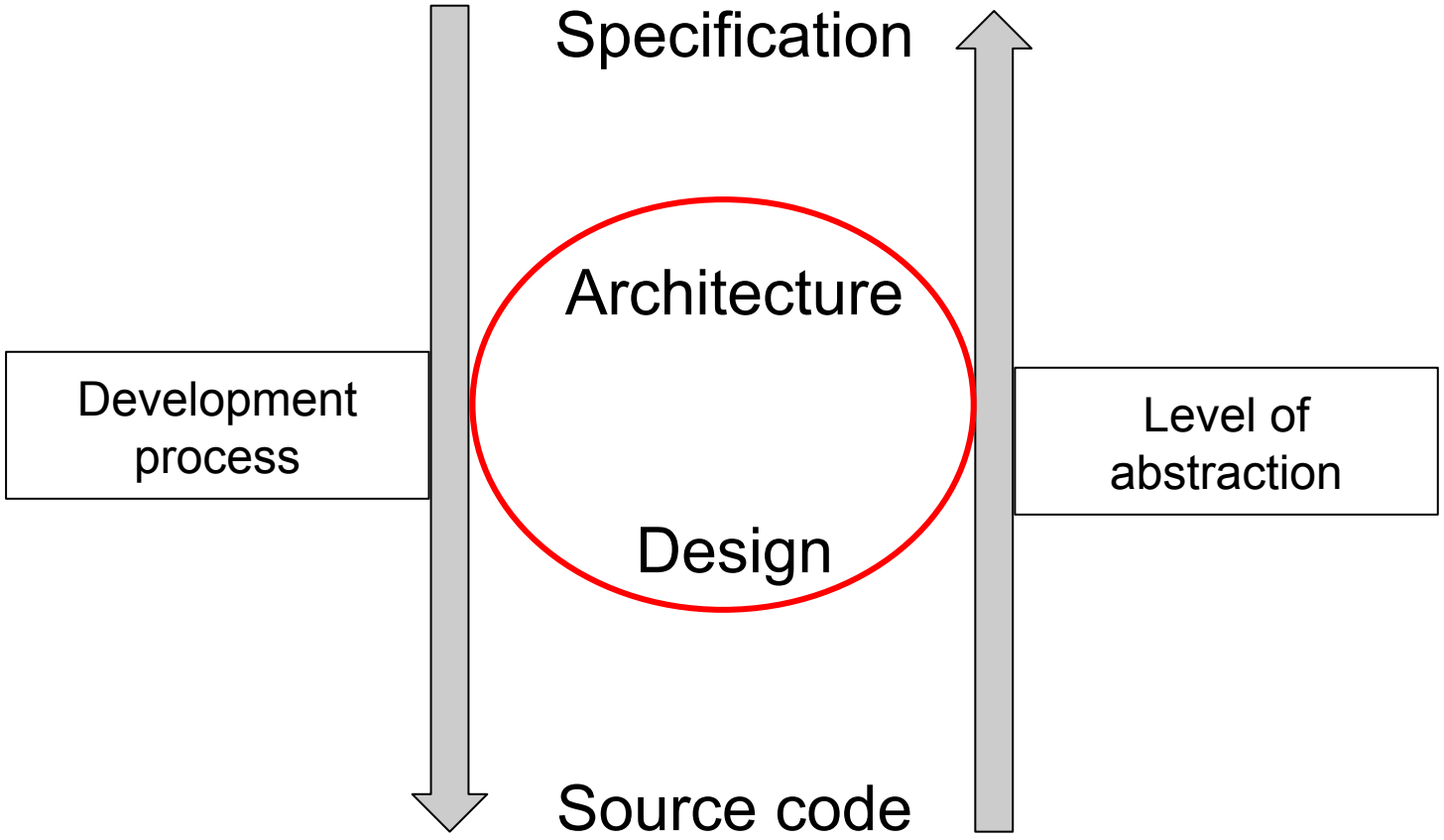
September 12, 2017

Logistics

Course material

Date	Topic	Material	Homework
09/05/2017	Course introduction	Slides, Slides (4pages)	
09/07/2017	Software architecture and design/UML crash course	Slides, Slides (4pages)	
09/12/2017	Best and worst programming practices		
09/14/2017	OO design principles		
09/19/2017	Version control systems/Git tutorial		
09/21/2017	**In-class exercise**: Advanced uses of git		
09/26/2017	OO design patterns		
09/28/2017	OO design patterns		HW 1 online
10/03/2017	Functional programming in Java 8		
10/05/2017	Intro to empirical software engineering		**PR 1 is due (10am)**
10/10/2017	**No class**: Monday class schedule will be followed!		
10/12/2017	Experimental design and validity		**PR 2 is due (10am)**
10/17/2017	Intro to program analysis and software testing		**HW 1 is due**
10/19/2017	**In-class exercise**: Software testing		

Recap: software architecture vs. design

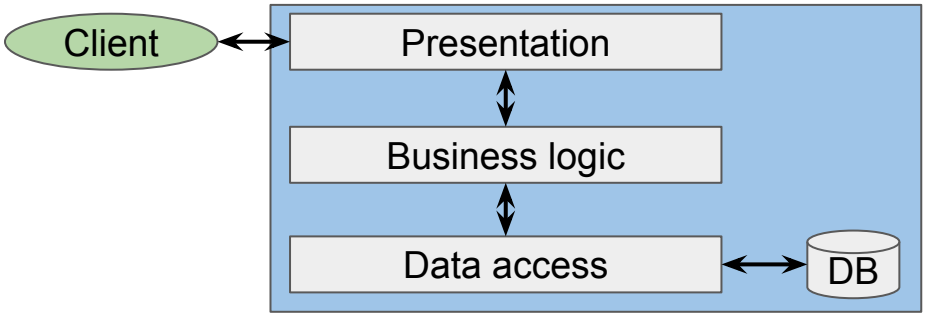


What's the difference?

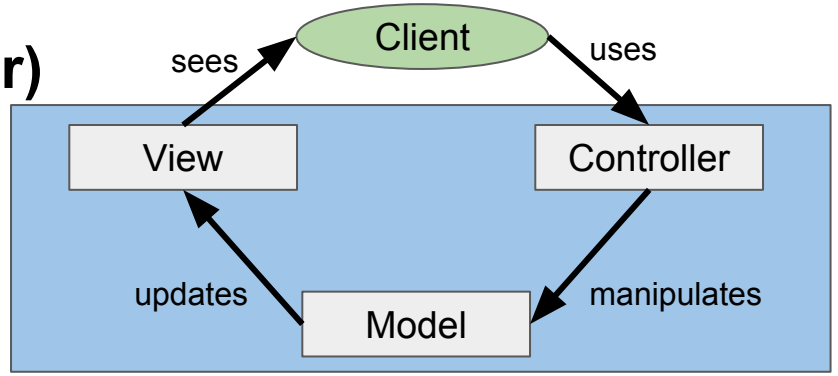
Recap: software architecture examples

- **Pipe and filter**

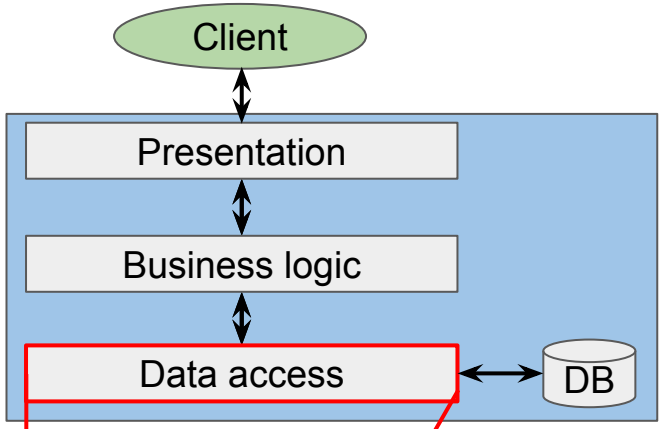
- **N-tier / client-server**

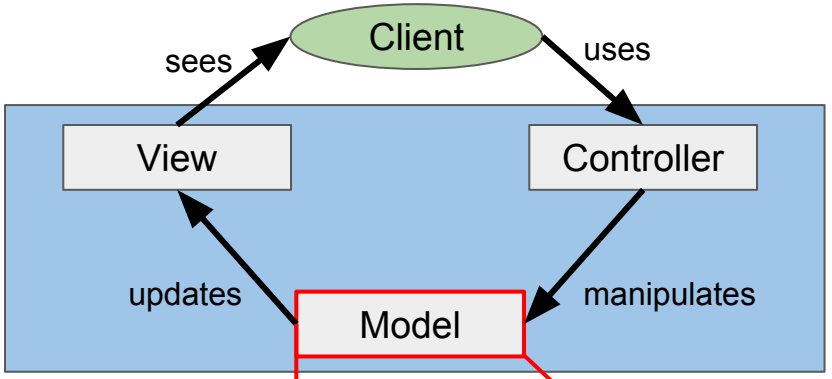


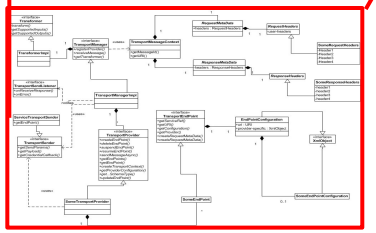
- **MVC (Model-View-Controller)**

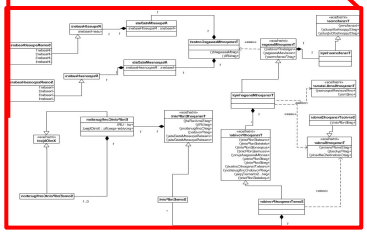


Recap: software architecture and design goals







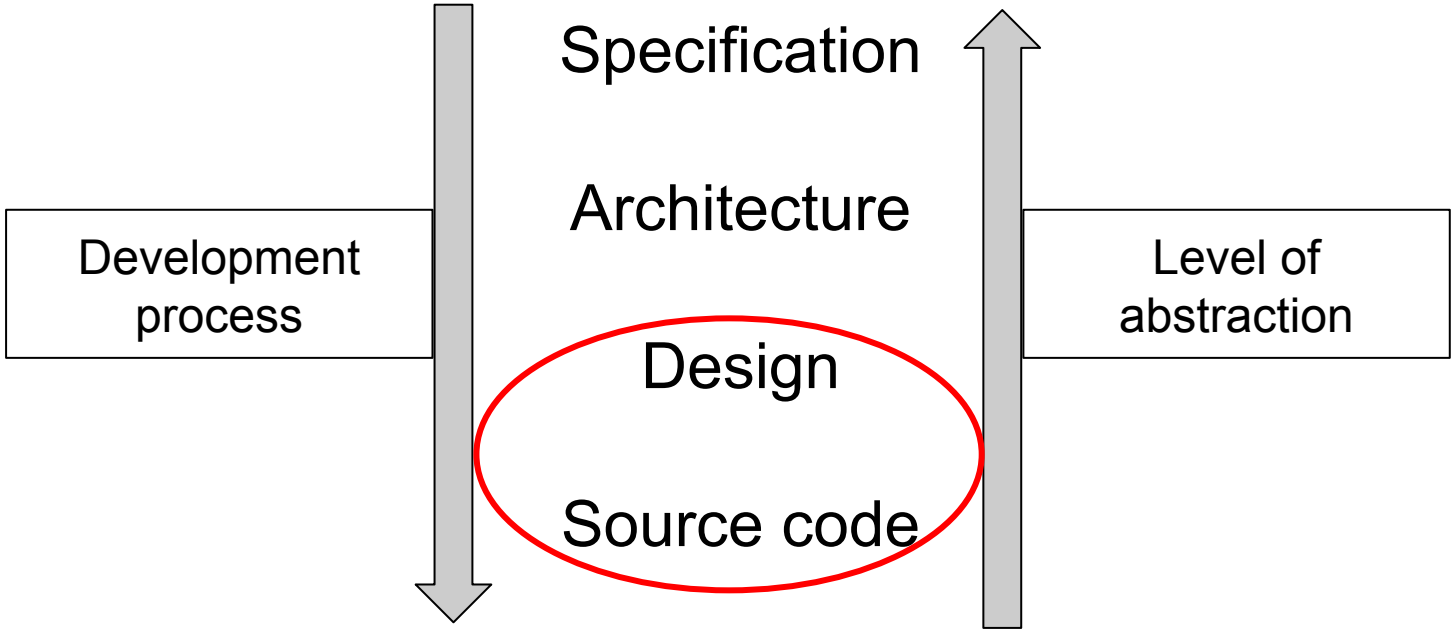


Architecture and design goals

- Lower complexity: separation of concerns, well defined interfaces
- Simplify communication
- Allow effort estimation and progress monitoring

Today

- A little quiz on best/worst programming practices.



Quiz: setup and goals

- 6-12 teams
- 6 code snippets
- 2 rounds
  - **First round**
    - For each code snippet, decide whether it represents good or bad practice.
    - **Goal:** discuss and reach consensus on good or bad practice.
  - **Second round** (known solutions)
    - For each code snippet, try to understand why it is good or bad practice.
    - **Goal:** come up with one or more explanations or a counter argument.

Round 1: good or bad?

Snippet 1: good or bad?


```
public File[] getAllLogs(Directory dir) {
   if (dir == null || !dir.exists() || dir.isEmpty()) {
      return null;
   } else {
      int numLogs = … // determine number of log files
      File[] allLogs = new File[numLogs];
      for (int i=0; i<numLogs; ++i) {
         allLogs[i] = … // populate the array
      }
      return allLogs;
   }
}
```

Snippet 2: good or bad?

```
public void addStudent(Student student, String course) {
   if (course.equals("CS520")) {
      cs520Students.add(student);
   }
   allStudents.add(student)
}
```

Snippet 3: good or bad?


```
public enum PaymentType {DEBIT, CREDIT}

public void doTransaction(double amount, PaymentType payType) {
  switch (payType) {
    case DEBIT:
       … // process debit card
       break;
    case CREDIT:
       … // process credit card
       break;
    default:
       throw new IllegalArgumentException("Unexpected payment type");
   }
}
```

Snippet 4: good or bad?


```
public int getAbsMax(int x, int y) {
  if (x<0) {
    x = -x;
  }
  if (y<0) {
    y = -y;
  }
  return Math.max(x, y);
}
```

Snippet 5: good or bad?


```
public class ArrayList<E> {
    public E remove(int index) {
        …
    }
    public boolean remove(Object o) {
        …
    }
    …
}
```

Snippet 6: good or bad?

```
public class Point {
   private final int x;
   private final int y;

   public Point(int x, int y) {
      this.x = x;
      this.y = y;
   }
   public int getX() {
      return this.x;
   }
   public int getY() {
      return this.y;
   }
}
```

Solutions


- Snippet 1: bad


- Snippet 2: bad


- Snippet 3: good


- Snippet 4: bad


- Snippet 5: bad


- Snippet 6: good

Round 2: why is it good or bad?

Snippet 1: this is bad! why?

```
public File[] getAllLogs(Directory dir) {
   if (dir == null || !dir.exists() || dir.isEmpty()) {
      return null;
   } else {
      int numLogs = … // determine number of log files
      File[] allLogs = new File[numLogs];
      for (int i=0; i<numLogs; ++i) {
         allLogs[i] = … // populate the array
      }
      return allLogs;
   }
}
```

Snippet 1: this is bad! why?

```
public File[] getAllLogs(Directory dir) {
   if (dir == null || !dir.exists() || dir.isEmpty()) {
      return null;
   } else {
      int numLogs = … // determine number of log files
      File[] allLogs = new File[numLogs];
      for (int i=0; i<numLogs; ++i) {
         allLogs[i] = … // populate the array
      }
      return allLogs;
   }
}
```

```
File[] files = getAllLogs();
for (File f : files) {
    …
}
```

Don’t return null; return an empty array instead.

Snippet 2: short but bad! why?

```
public void addStudent(Student student, String course) {
   if (course.equals("CS520")) {
      cs520Students.add(student);
   }
   allStudents.add(student)
}
```

Snippet 2: short but bad! why?

```
public void addStudent(Student student, String course) {
   if (course.equals("CS520")) {
      cs520Students.add(student);
   }
   allStudents.add(student)
}
```

Defensive programming: write the literal first (or add an explicit assertion).

Snippet 3: this is good, but why?

```
public enum PaymentType {DEBIT, CREDIT}

public void doTransaction(double amount, PaymentType payType) {
  switch (payType) {
    case DEBIT:
       … // process debit card
       break;
    case CREDIT:
       … // process credit card
       break;
    default:
       throw new IllegalArgumentException("Unexpected payment type");
   }
}
```

Snippet 3: this is good, but why?

```
public enum PaymentType {DEBIT, CREDIT}

public void doTransaction(double amount, PaymentType payType) {
  switch (payType) {
    case DEBIT:
       … // process debit card
       break;
    case CREDIT:
       … // process credit card
       break;
    default:
      throw new IllegalArgumentException("Unexpected payment type");
   }
}
```

Type safety using an enum; throws an exception for unexpected cases (e.g., future extensions of PaymentType).

Snippet 4: also bad! huh?

```
public int getAbsMax(int x, int y) {
  if (x<0) {
    x = -x;
  }
  if (y<0) {
    y = -y;
  }
  return Math.max(x, y);
}
```

Snippet 4: also bad! huh?

```
public int getAbsMax(int x, int y) {
  if (x<0) {
    x = -x;
  }
  if (y<0) {
    y = -y;
  }
  return Math.max(x, y);
}
```

Method parameters should be final; use local variables to sanitize inputs.

Snippet 5: Java API, but still bad! why?

```
public class ArrayList<E> {
    public E remove(int index) {
        …
    }
    public boolean remove(Object o) {
        …
    }
    …
}
```

Snippet 5: Java API, but still bad! why?

```
public class ArrayList<E> {
    public E remove(int index) {
        …
    }
    public boolean remove(Object o) {
        …
    }
    …
}
```

```
ArrayList<String> l = new ArrayList<>();
Integer index = new Integer(1);
l.remove(index);
```

Avoid method overloading, which is statically resolved.
Autoboxing/unboxing adds additional confusion.

Snippet 6: this is good, but why?

```
public class Point {
   private final int x;
   private final int y;

   public Point(int x, int y) {
      this.x = x;
      this.y = y;
   }
   public int getX() {
      return this.x;
   }
   public int getY() {
      return this.y;
   }
}
```

Snippet 6: this is good, but why?

```
public class Point {
    private final int x;
    private final int y;

    public Point(int x, int y) {
        this.x = x;
        this.y = y;
    }
    public int getX() {
        return this.x;
    }
    public int getY() {
        return this.y;
    }
}
```

Good encapsulation; immutable object.