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Quality Assurance
Introduction to Part II

Part II - Lecture 1

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- From Berlin, Germany
- Some years ago this was the first lecture given by me (you can watch the old lectures on video)
- My research interests: HCI, SE tools, …
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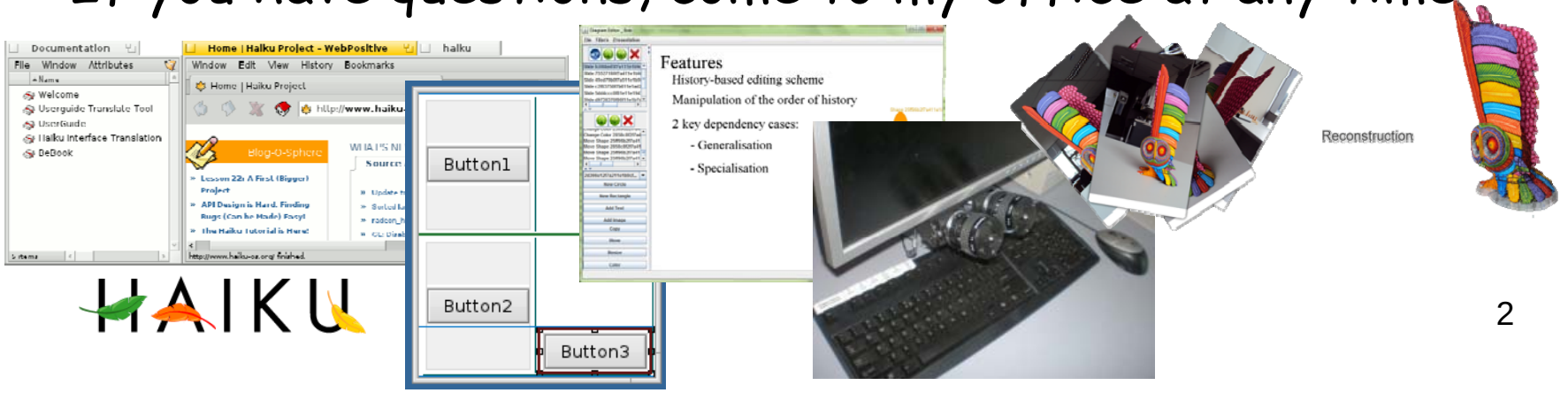
- If you have questions, come to my office at any time



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Introduction to Part II

Quality means doing it right when no one is looking
(Henry Ford)

Why not just Dynamic Detection of Defects?

- First half mostly about dynamic detection of defects
- Can be time consuming, costly, complicated…but is necessary!!!
- Requires a (partially) running system already. What if we don't have it yet?
- Usually in the implementation stage of a project. What if the defect has its origin in the specification or design?
- What if our test cases contain defects?

How can we avoid defects in the first place?

Static Detection of Defects

- If we cannot avoid defects, detect them as early as possible
- "Static" means before runtime
- Most compilers detect many type errors (type systems), other tools detect even more errors
- The more specification we give, the more we can verify; formal specification languages (e.g. Z, Alloy, Hoare Calculus)
- Sad result from theory:
  some errors cannot be detected statically!!!
- But we can be "conservative":
  prohibit even code that **might** be an error

Best Practices

- Avoiding the mistakes that cause defects by "doing the right thing"
  - **Software development processes**:
    how to undertake a software project
  - **Software tools**:
    use the best suitable tools to get the best results
  - **Design & coding guidelines**:
    how to avoid design/programming mistakes
- Learn from other's experience & mistakes
  (not as effective as learning from own mistakes, but saves time ☺)
- But: what works for others does not necessarily work for you (nothing can replace your own experience)

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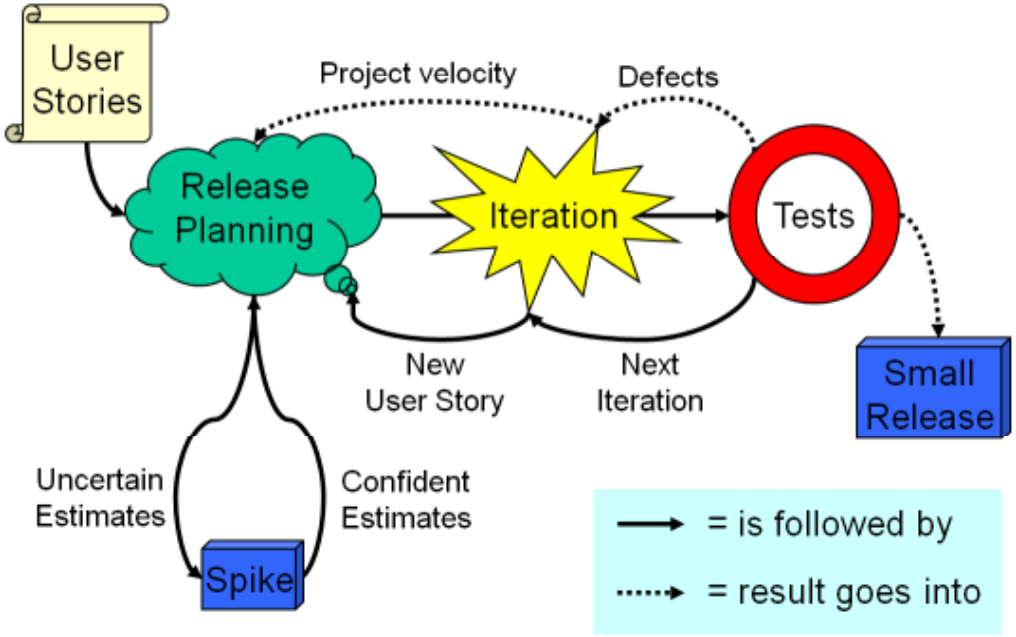
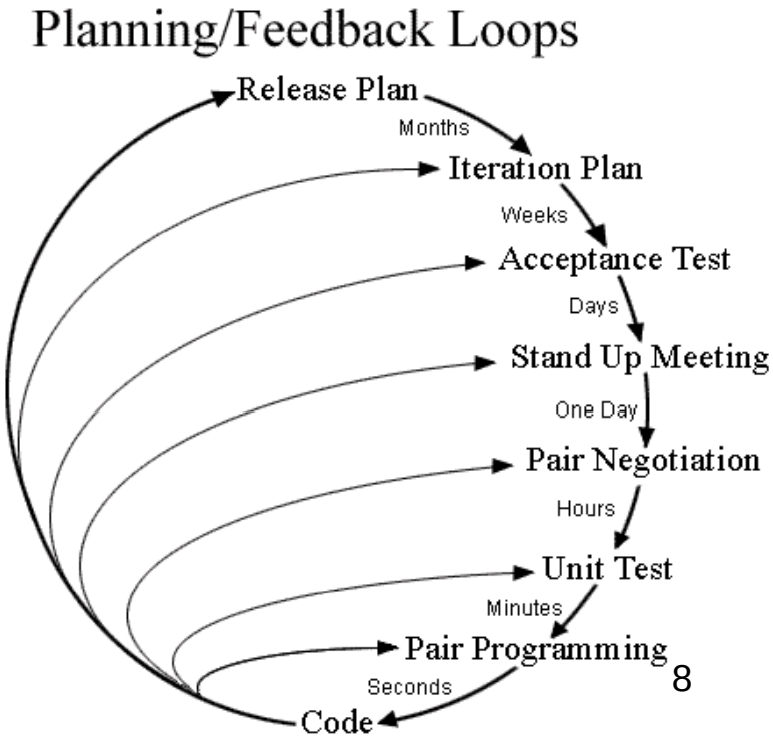
Software Development Processes

"I love it when a plan comes together! "

eXtreme Programming (XP)

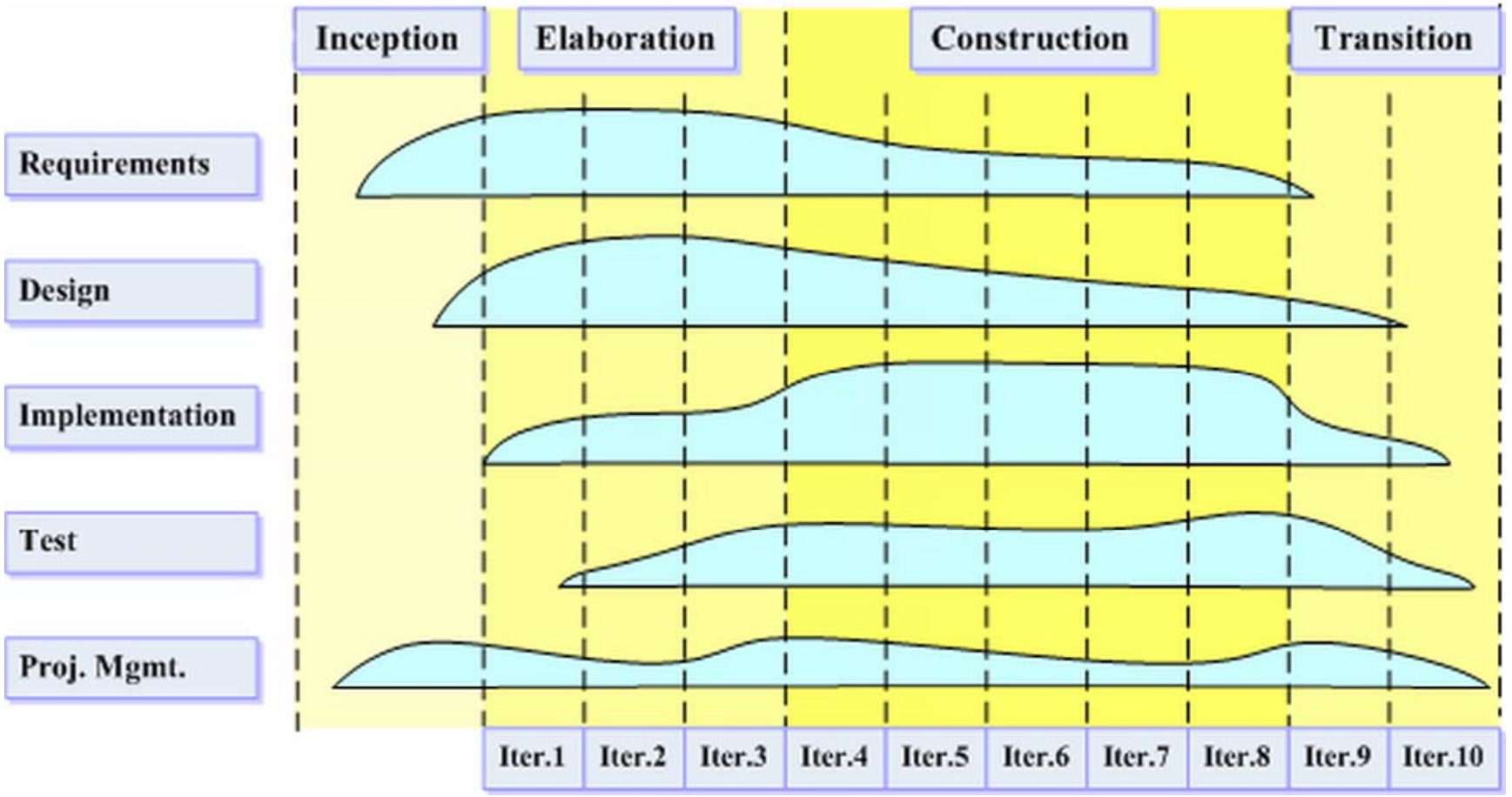


Don Wells



- Generic plan of how to conduct a project
- 12 best practices
- Relies heavily on feedback about the software

Rational Unified Process (RUP)



- Comprehensive process framework
- Used esp. For large projects

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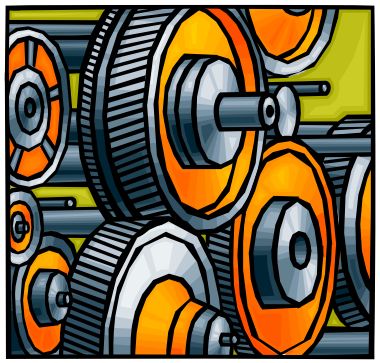
Software Development Tools

First we shape our tools and then our tools shape us
(Marshall McLuhan)

Software Tools

- Humans are necessary for creative, intelligent tasks
- Tools can **support** such tasks
  - Increase productivity with useful functionality
  - Guide the developer (e.g. context help)
  - Avoid defects

- Humans are not necessary for highly repetitive, routine work
- Tools can **automate** such tasks
  - Increase productivity; more time for creative work
  - Avoid defects introduced by the human factor



Modeling tools

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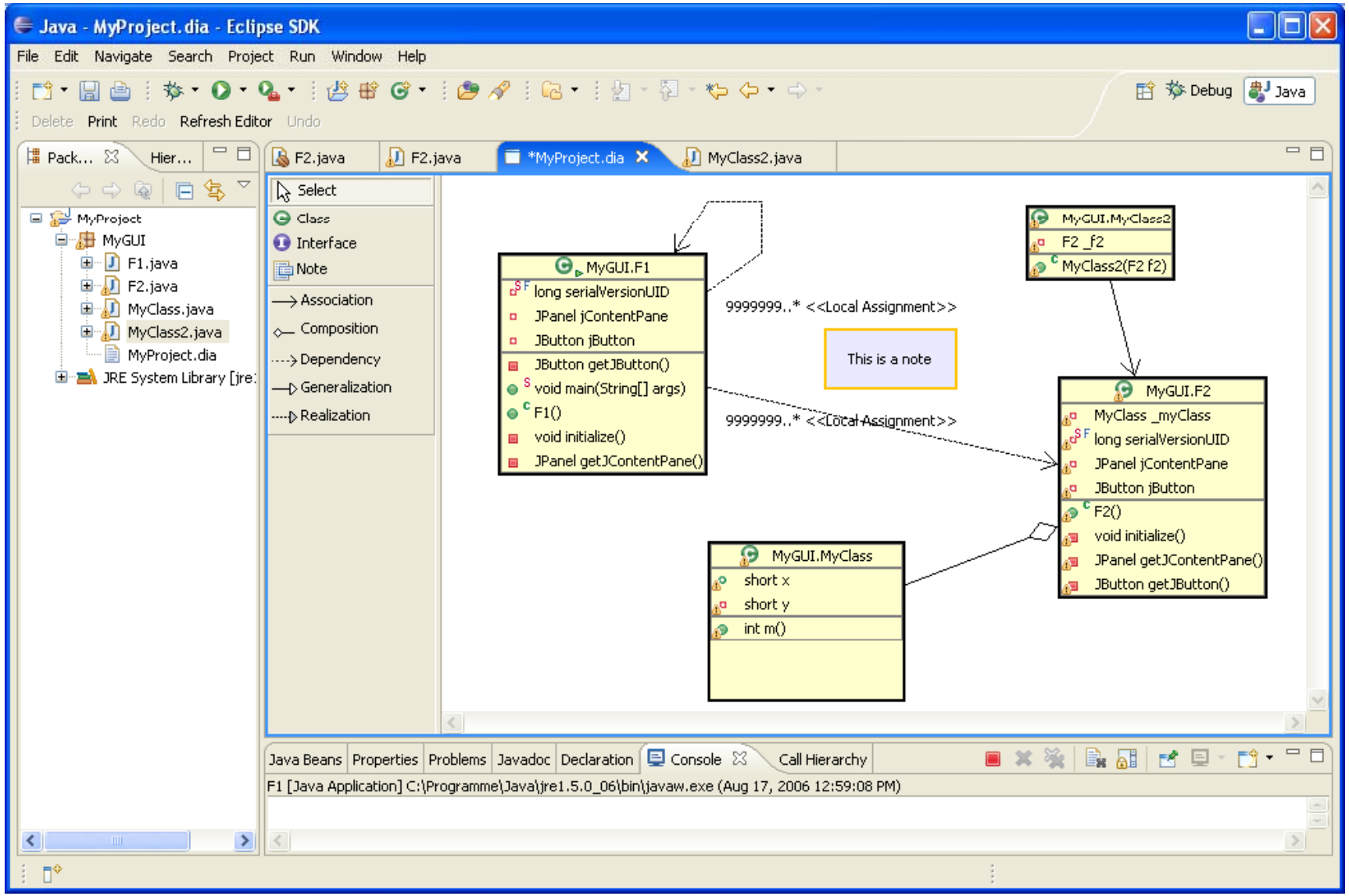

GUI Builders

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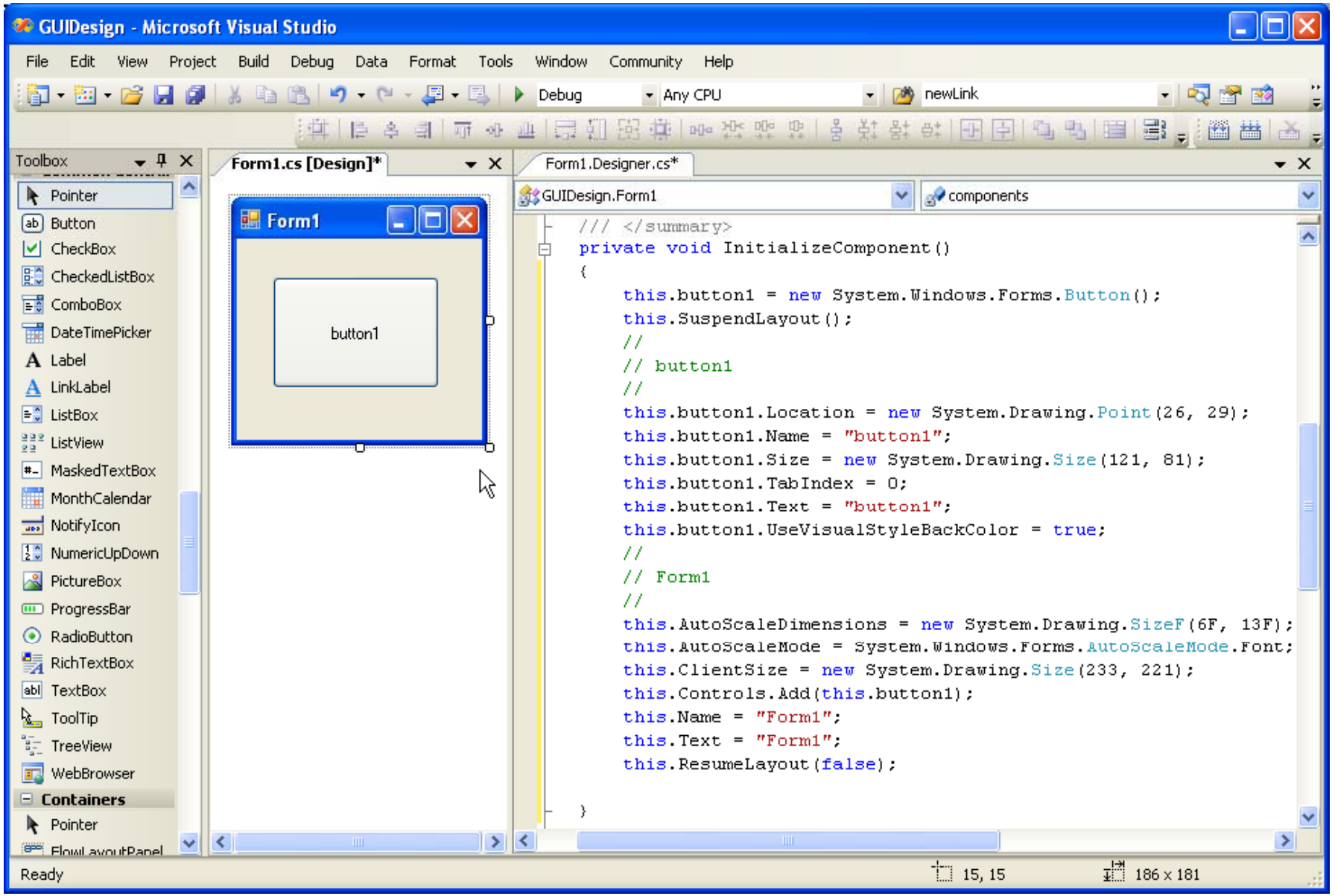
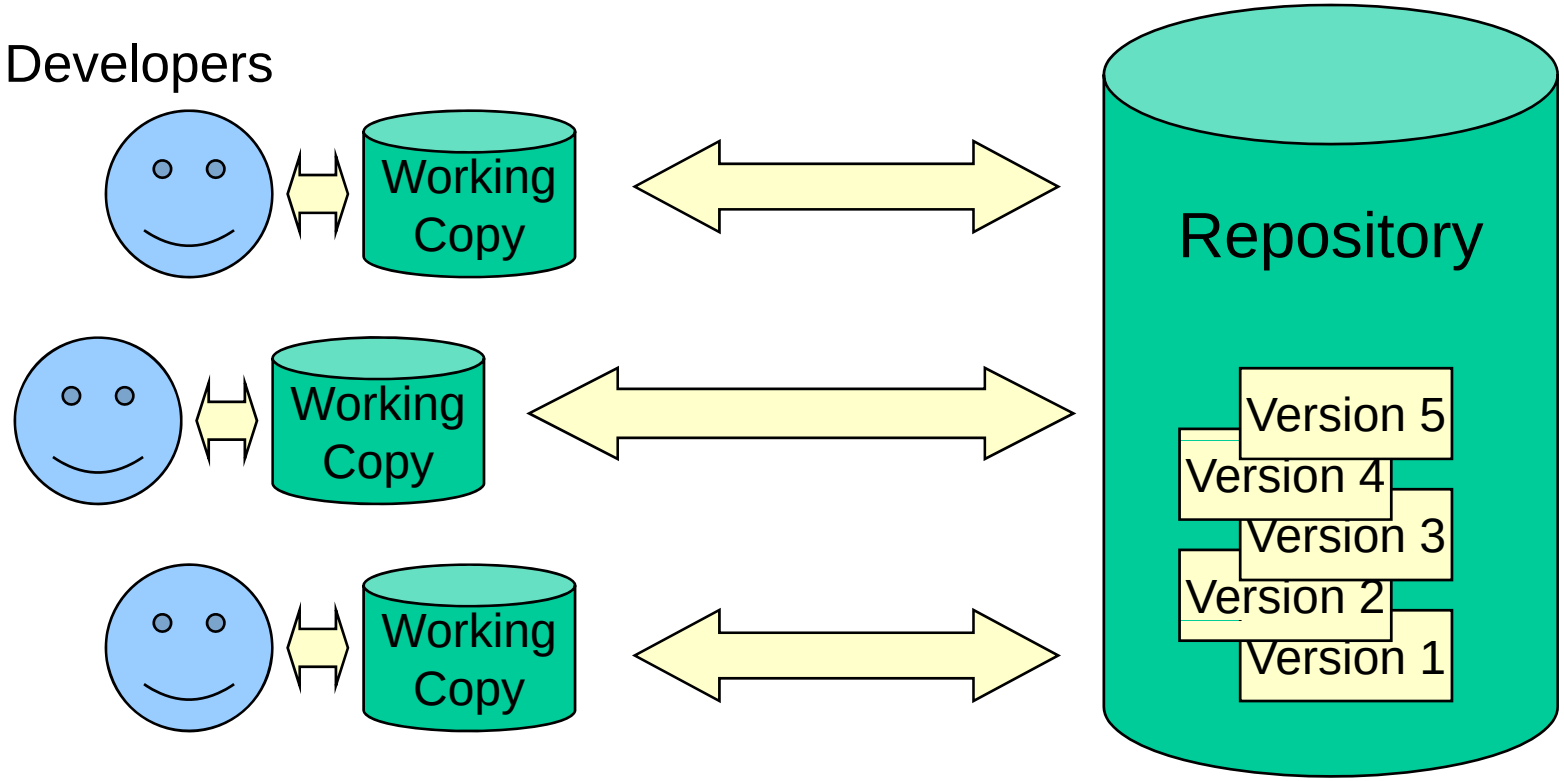
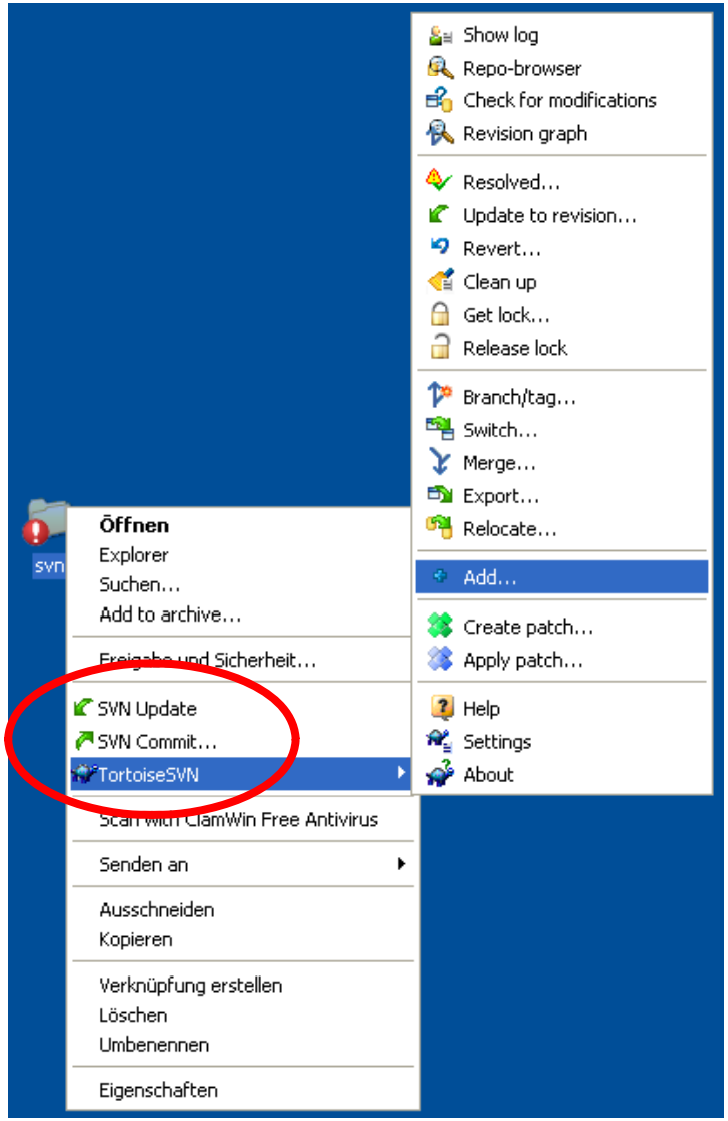


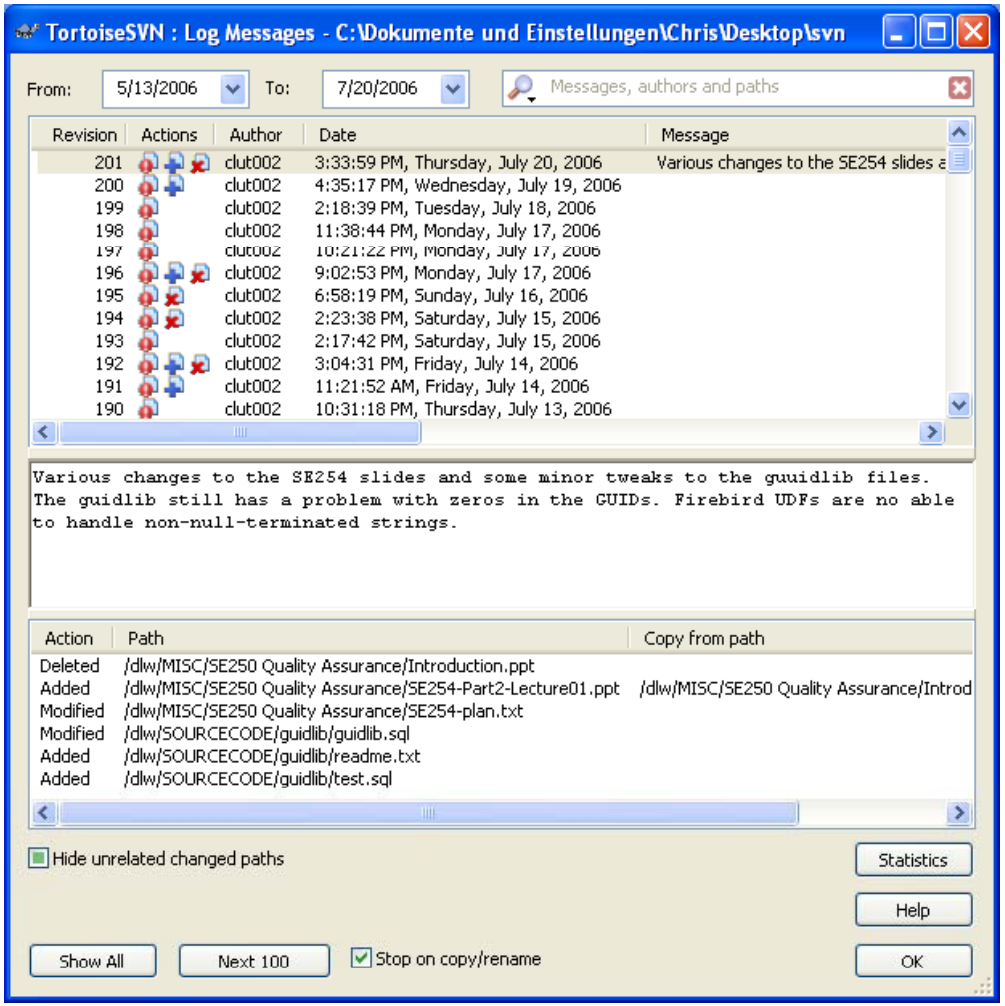
Version Control Systems

- Technology to manage changes that several developers do on a common repository
- Changes create new version of the changed files
- Old versions are always accessible



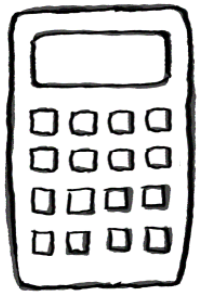
Version Control Systems
Example: Subversion



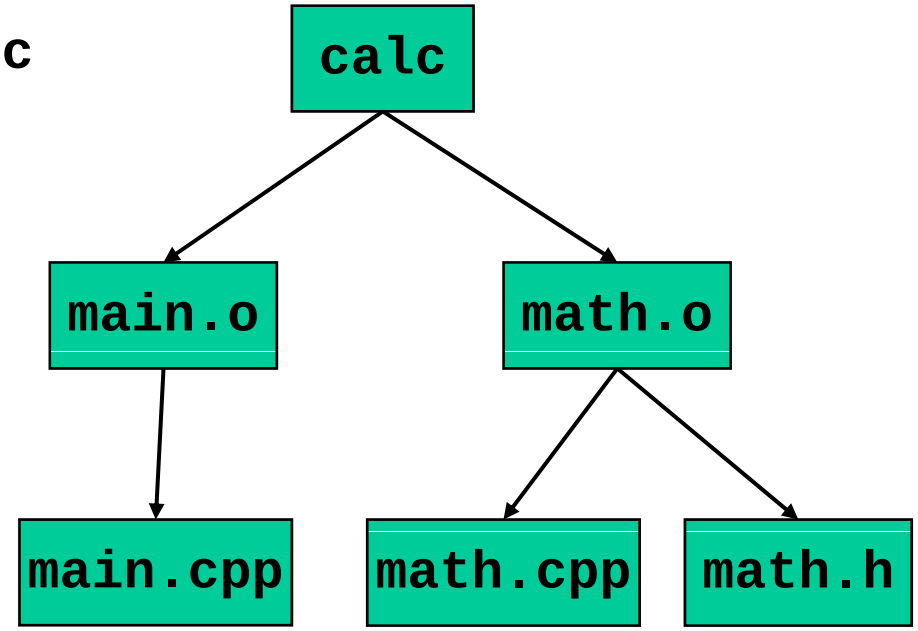


Build Tools
Example: make


```
all: calc

calc: main.o math.o
   g++ main.o math.o -o calc

main.o: main.cpp
   g++ -c main.cpp

math.o: math.cpp math.h
   g++ -c math.cpp

clean:
   rm *.o
```

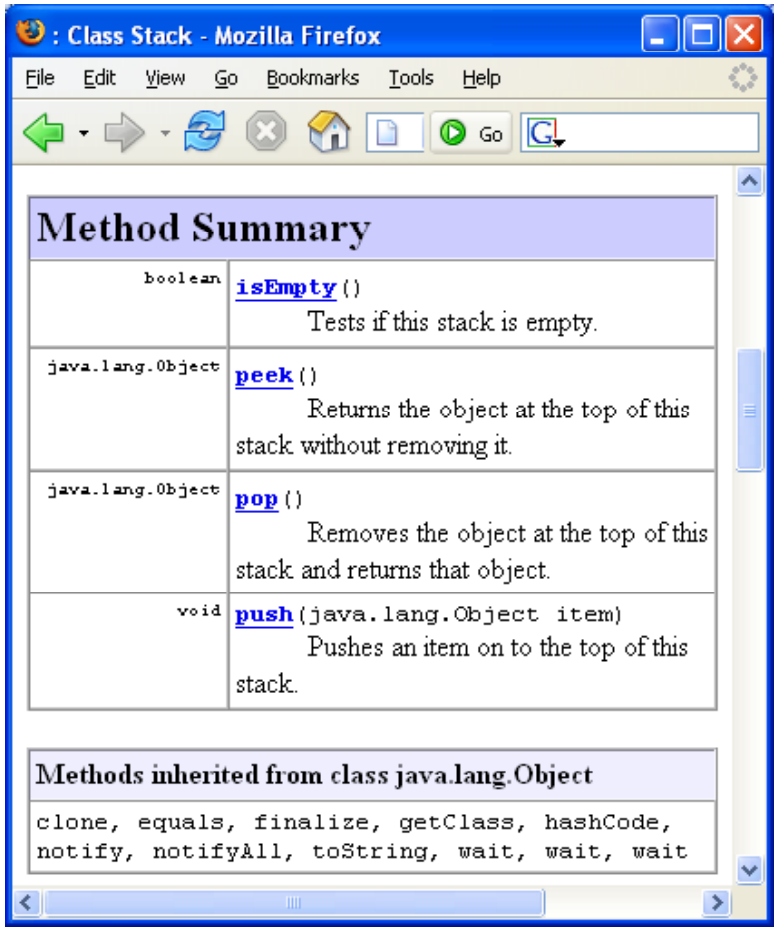


Dependency graph



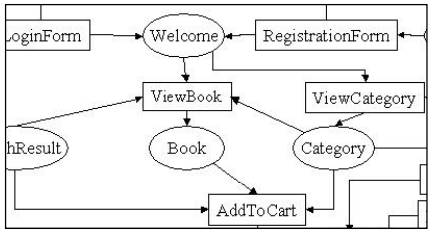
Documentation Tools Example: JavaDoc

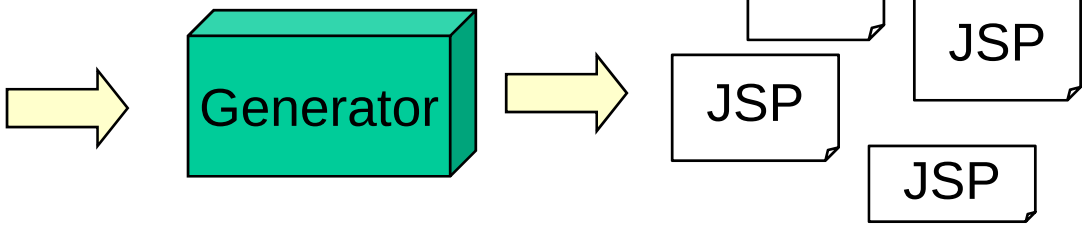

```
public class Stack {
  /**
   * Pushes an item on to
   * the top of this stack.
   * @param item the item to be pushed
   */
  public void push(Objec item){
        this.elements.add(item);}

  /**
   * Removes the object at the top
   * of this stack and returns that
   * object.
   * @return The object at the top
   *         of this stack.
   * @exception NoSuchElementException
   *         if this stack is empty.
   */
  public Object pop()
  throws NoSuchElementException {
    // ...
} }
```



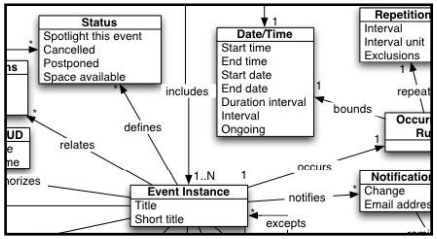
Generators

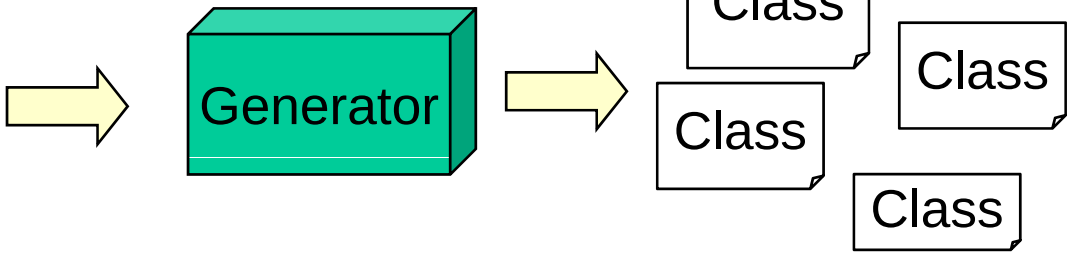
Generation of a web UI



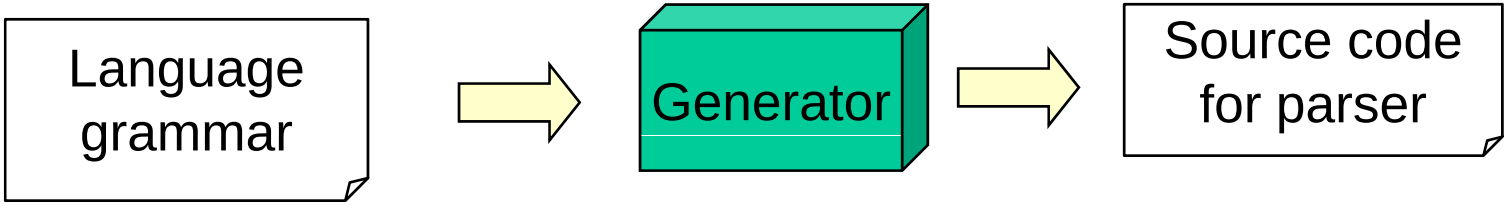


Generation of Java classes





Generation of language parsers



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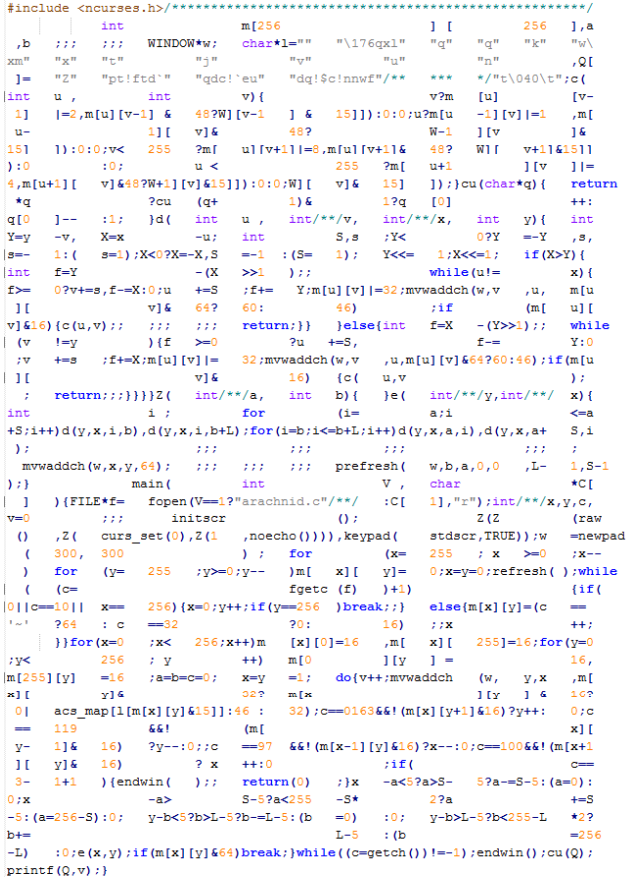
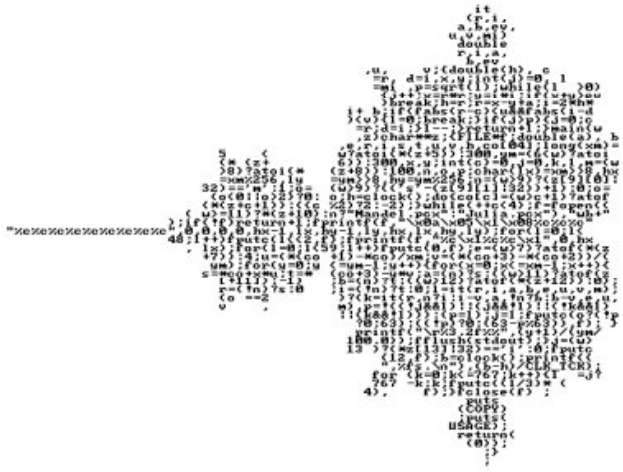
Coding Principles

"Use the source, Luke"

Coding Style





```
main(a,b){
while((a=getchar())+1)
putchar((b=64^a&223)
&&b<27?a&96
|(b+12)%26+1:a);}
```

- International Obfuscated C Code Contest (iocccc.org)
- Coding style guidelines help to achieve clear, consistent code (esp. when many people are involved)

Coding Principles

Handling Exceptions

Interface
vs
Implementation

Information Hiding
(painting by Bev Doolittle)

Today's summary

- **Dynamic detection** of defects (e.g. testing, debugging) is necessary, but not enough
- **Static checking** (e.g. with type systems) can detect some defects before runtime
- We can avoid defects by following **best practices** of software development and using tools
- **Software tools** support the developer in performing creative tasks and can automate routine tasks

This week no tutorial, no lab.
Friday: Part 4 Exhibition!

Quiz

1. How can defects be avoided?
   Name and explain 3 examples.

2. What tools exist for supporting software development?
   Name 5 examples and explain what they do.