

Bogdan Korel

CS589

Software Testing and
Analysis

Syllabus is posted on
the Blackboard

korel@iit.edu

Fall 2021

Course: CS 589
Course title: Software Testing and Analysis
Location: 121 Pritzker Science Center
Time: Monday and Wednesday, 5:10pm-6:25pm
Instructor: Dr. Bogdan Korel
Office: 236D Stuart Building
Address: Department of Computer Science
Illinois Institute of Technology
10 West 31th Street
Chicago, IL 60616
Phone: 312-567-5145 (Main Campus)
Fax: 312-567-5067
Email: korel@iit.edu
Prerequisites: CS487
Office hours: Monday and Wednesday, 4:00-4:45pm or by appointment

Course Contents:

Concepts and techniques for testing and analysis of software. Software testing at the unit, subsystem, and system levels. Specification-based testing. Code-based testing. Model-based testing. Methods for test generation and validation. Static analysis. Dynamic analysis. Regression testing. Formal methods and verification. Oracles. Program slicing. Reliability analysis. Object-oriented testing. Software testing management.

Required Textbook:

Paul C. Jorgensen and Byron DeVries, Software Testing. A Craftsman's Approach, Fifth Edition, Auerbach Publications, 2021, ISBN 9780367358495.

Homework: There will be three homework exercises.

Project: A term project will be required. The detailed description of the project will be presented later in the term.

Examinations:

Exam #1	October 4
Exam #2	November 3
Exam #3	December 6

Grading:

	Grade	Points
Homework:	A	90-100 points
Exams:	B	70-89 points
Project:	C	50-69 points
	E	below 50 points

Deadlines:

Homework Assignment #1 (5 points):	September 22
Exam #1 (15 points):	October 4
Homework Assignment #2 (5 points):	October 20
Exam #2 (15 points):	November 3
Homework Assignment #3 (5 points):	November 22
Project (35 points):	December 1
Exam #3 (20 points):	December 6

Teaching Assistants for the course: TBD

I. Code of Academic Honesty

A. Code

IIT expects students to maintain high standards of academic integrity. Students preparing for the practice of a profession are expected to conform to a code of integrity and ethical standards commensurate with the high expectations society places upon the practitioners of a learned profession. No student may seek to gain an unfair advantage over another.

It shall be a violation of this Code for a student to engage in conduct that violates the established standards of his or her major academic discipline, the established standards of the academic discipline in which she or he is engaged, the established standards of the profession of which she or he is training, or the standards of IIT set forth herein.

In addition, it is a violation of this Code for a student, whether or not currently enrolled at IIT, to knowingly engage or attempt to engage in the following:

- The misrepresentation of any work submitted for credit or otherwise as the product of a student's sole independent effort, such as using the ideas of others without attribution and other forms of plagiarism;
- The use of any unauthorized assistance in taking quizzes, tests or examinations;
- The acquisition, without permission, of tests, answers sheets, problem solutions or other academic material when such material has been withheld from distribution by the instructor;
- Deliberate and harmful obstruction of the studies, research or academic work of any member of the IIT community;
- Making material misrepresentation in any submission to or through any office of the University to a potential employer, professional society, meeting or organization; or
- The intentional assistance of others in the violation of the standards set forth in this Code.

B. Academic Discipline

Any member of the IIT community who is aware of a violation of the IIT Code of Academic Honesty, or who has evidence that a violation has occurred, is urged to inform the appropriate course instructor, academic unit head or dean or send an email to academichonesty@iit.edu. Faculty members or administrators who are aware of a violation, or who have good evidence of a violation, must inform the Chair of the Academic Honesty Committee for the appropriate academic unit and the Designated Dean for Academic Discipline ("DDAD"). The appropriate academic unit is the unit responsible for the course in which the alleged academic honesty violation occurred.

For the Main Campus, Rice Campus, Moffett and Institute of Design the DDAD is either the Vice Provost for Undergraduate Affairs or the Associate Dean for Graduate Academic Affairs, as appropriate given the status of the student. For Chicago-Kent College of Law, the DDAD is the Assistant Dean of Students, and for the Stuart School of Business it is the Dean.

The DDAD will provide a record of all incidents to the Office of Student Affairs. A student who believes that his or her record is factually inaccurate should inform the Dean of Students, who will investigate, as he or she deems appropriate, and, if he or she determines necessary, in his or her sole discretion, will correct any factual inaccuracies in the record. The decision of the Dean of Students as to such matters shall be final.

If a violation concerns conduct relating to coursework, the course instructor may meet with the student and impose one of the sanctions below if after the meeting the instructor has satisfied himself or herself that a violation has in fact occurred. The meeting may be held in consultation with the academic unit head, or with the Academic Honesty Committee of the academic unit. The course instructor will report the violation, a summary of the facts evidencing the violation and the sanction to the DDAD. Appropriate sanctions include:

- **Expulsion from a course.** The student is assigned a punitive failing grade of 'E' for the course and can no longer participate in the course or receive evaluation of coursework from the instructor.
- **Reduction in grade.** A reduction in grade for the assignment or exam involved or for the course may be applied.

Upon receipt of information about a violation of the Code, the DDAD will review the report and any record of prior violation of the Code by the student. If there are one or more prior violations, the DDAD will consult with the Chair of the Academic Grievance Committee of the University Faculty Council to determine whether the matter should be referred to a hearing before the Academic Grievance Committee for further sanctions. The DADD's decision to refer a matter to the Academic Grievance Committee shall be made in his or her sole discretion and shall be final. If the matter is referred for a hearing, the Academic Grievance Committee shall supplement its membership as necessary so that the Committee includes at least one faculty member from the Academic Honesty Committee of the academic unit where the violation occurred, one member of the student's major faculty, one other faculty member, two students and the Dean of Students or his or her designee. The Academic Grievance Committee so supplemented will form a disciplinary committee for the purpose of investigating the matter and making findings and a recommendation to the DDAD. The chair of the Academic Grievance Committee shall chair this disciplinary committee.

A student who is to appear before such a disciplinary committee shall be notified in writing by the Dean of Students of the charges, in summary fashion, placed against him or her and the time and place of the hearing. This notice shall be delivered to the student at least five days before the hearing. A student appearing before the disciplinary committee has the right to be accompanied by an advisor, witnesses on his or her behalf, and his or her parents. The advisor is limited to advising the student and may not participate in presenting the case, questioning witnesses, or making statements during the hearing. A student shall have the right to make an oral statement both at the start and the conclusion of the hearing and to submit written evidence to the committee. Further, as a general rule, a student shall have the right (i) to present and to question any witnesses of his or her choosing that have information relevant to the charges against him or her, provided that the chair may, in his or her sole discretion, disallow witnesses whose testimony would be redundant or not germane to the charges; and (ii) to cross-examine any witness that is called to testify in support of the charges, provided that the chair may, in his discretion, limit such cross-examination to the extent it is not germane to the charges, is redundant or becomes abusive or harassing. Members of the committee may, as each deems appropriate, ask questions of any witness called or regarding any evidence submitted. To the extent deemed necessary to maintain decorum or to protect students from harassment or to ensure the integrity of the process, the chair may require a student to direct questions to the chair who will then ask them of a witness or witnesses.

An audio tape recording of the hearing will be made. The audio tape will remain the sole property of the University. No other record of the hearing may be made.

Once proper notification has been given, the University reserves the right to hold the hearing whether or not the student elects to participate. Email correspondence will be considered sufficient written notification in all instances where written notification is required.

Upon receipt of the findings of the disciplinary committee, which findings may include recommended sanctions, the DDAD shall determine the appropriate action to be taken and shall so notify the student. The disciplinary committee may recommend, and the DDAD may impose, any of the following sanctions:

- **Expulsion from a course.** The student is assigned a punitive failing grade of 'E' for the course and can no longer participate in the course or receive evaluation of coursework from the instructor.
- **Suspension.** Suspension is a status assigned for various periods of time in which a student's enrollment is interrupted. A suspended student may not attend day or evening classes, participate in student activities, or live in campus housing. A suspended student may apply for reinstatement at the end of the period of suspension. If reinstated, the student may be placed on disciplinary probation for a period of time designated by the DDAD.
- **Expulsion.** Expulsion is the complete severance of association with the University. Notation of the violation of the Code is made on the student's transcript.

In any matter where the DDAD's determination is to impose a sanction of suspension or expulsion, the DDAD's determination shall automatically be stayed and the matter referred to the Provost for review. With respect to such a proposed determination by the DDAD, the Provost may make any of the determinations set forth under the Appeals Procedures heading immediately following. Once the Provost's review has been completed, the DDAD's determination, as it may have been modified by the Provost, shall become effective. Notwithstanding any other provision of this Student Handbook, no matter so referred to the Provost shall be subject to any further appeals on the basis that the sanction imposed was inappropriate to the offense.

C. Appeal Procedures

An appeal of a decision on academic honesty must be submitted in writing to the Office of Student Affairs within five business days of notification of the decision. Supporting information must be submitted with the appeal. An appeal or submission made after this deadline will not be considered. Decisions rendered by the DDAD without referral to the University Faculty Council's Academic Grievance Committee and sanctions, excluding non-punitive grades, imposed by a course instructor may be appealed to the Academic Grievance Committee, which in the latter instance only may either affirm or overturn the course instructor's finding of academic dishonesty. Upon such an appeal, the Academic Grievance Committee will supplement its membership to form a disciplinary committee that is composed as described above and that follows hearing procedures as described above.

Decisions of the DDAD following a disciplinary committee hearing and decisions of a disciplinary committee hearing upholding a course instructor's finding of academic dishonesty may be appealed to the Provost, whose decision shall be final. An appeal to the Provost is limited to the following reasons:

- Appropriate procedures were not followed;
- The sanction imposed was inappropriate for the offense; and
- New evidence that was not available at the time of the original decision, not due to the fault of the student, has become available.

The Provost may make one of the following determinations:

- Uphold the decision and the sanction;
- Reverse the decision and the sanction; or
- Uphold the decision, but return the matter to the DDAD to reconsider the sanction.

prereq. CS487

Introduction to SE

Required textbook.

I:	3 homeworks	15 pts
II:	3 exams	50 pts
III	1 project	35 pts

No extra point assignments! | 100 points.

Exam #1: 15 points

Exam #2: 15 points

Exam #3: 20 points.

50 points.

<u>Grade</u>	<u># of points</u>
A	90-100 points
B	70 - 89 - 11 -
C	50 - 69 - 11 -
E	below 50 points

Every assignment:

0-100 points

Exams

Exam #1: October 5

Exam #2: November 3

Exam #3: December 6

Project:

- * individual project
- A project will involve programming.

Introduction to SE

1960s

- 3rd generation of computers
- high-level prog. languages.

many attempts to
develop ~~etc~~ "large"
systems.

software development



ad hoc activity



engineering
activity



software engineering.

Many problems

- cost overruns
- late delivery
- lack of reliability.
- inefficient
- lack of user acceptance

A . . .

SE is a "systematic" approach to the development and maintenance of software systems.

Goals SE

- ✓ 1. improve the quality of software systems
- 2. to improve the productivity of software developers.

Software Quality.

a set of ~~quality~~ attributes

Quality attributes

1. reliability.
2. efficiency
 - * speed
 - * resource consumption
3. user friendly
4. security.
5. scalability
6. portability
7. maintainability — easy to change code
8. robustness
9. testability — easy to test
10. . .

safety
critical
system

text
editor

① reliability.

2. efficiency

3. user friendly

① User friendly

2. efficiency

3. reliability.

software
users

software
engineers.

- 1. reliability
- 2. efficiency
- 3. user friendly

1. -

2. -

3. -

4. maintainability.
5. testability.

Project size

small

1 - 20 KLOC

medium

large

very large

20 - 100 MLOC

life cycle Models

* waterfall model

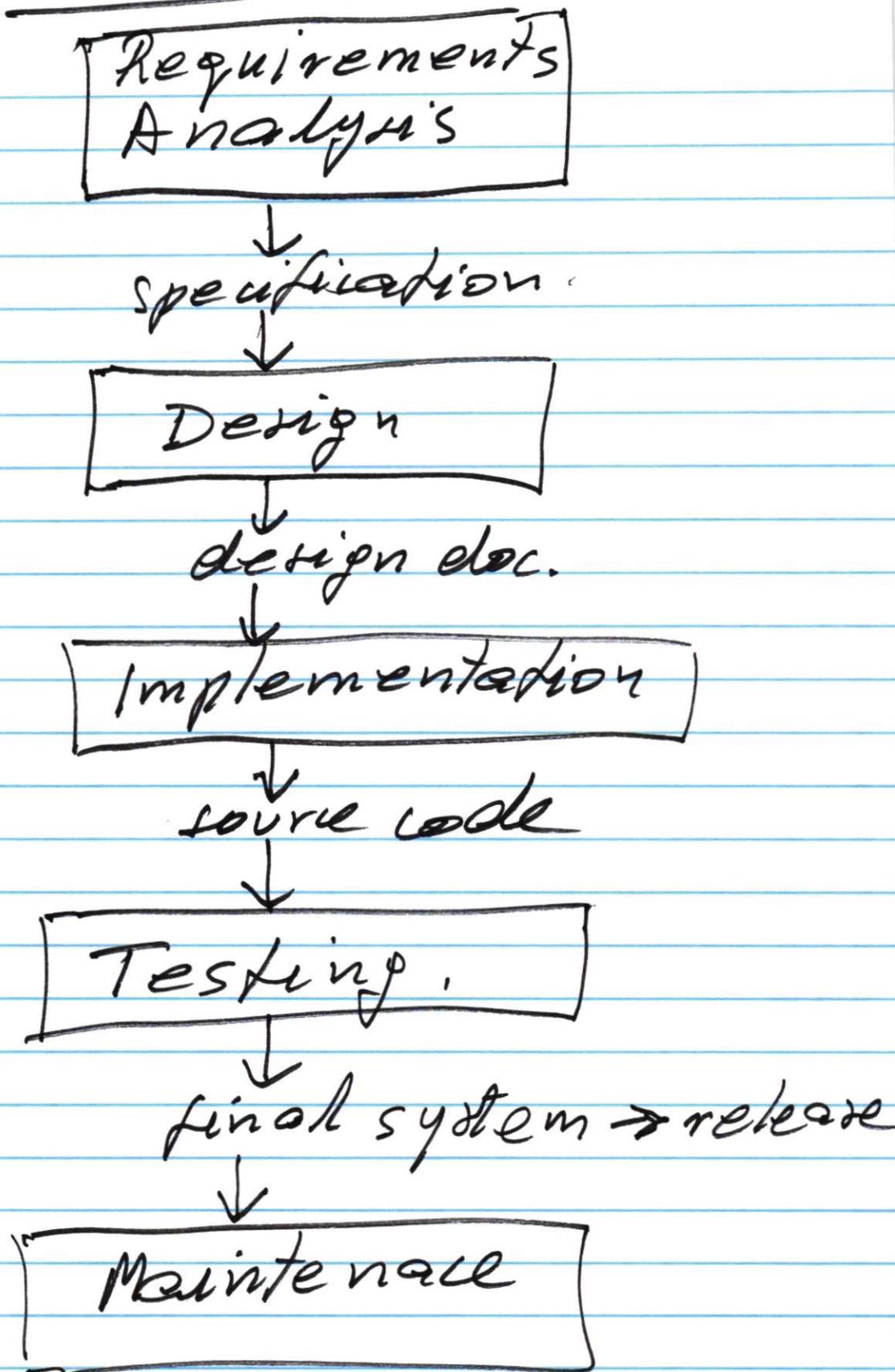
* spiral -v1-

* prototyping -v2-

* evolutionary -v3-

* ...

Waterfall model



Requirements analysis

What the system is,
supposed to do?

Identify requirements.

1. functional requirements,
2. non-functional -LL-



specification.

ATM-system

1. functional requirements

- * deposit
- * withdraw
- * check balance
- * get cash

no transfer !!!

2. non-functional requirements

1. reliability
2. performance
3. easy to use

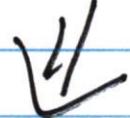
Design

How the system will do it?

- High-level design
 - low-level - \sim -
-

High-level design

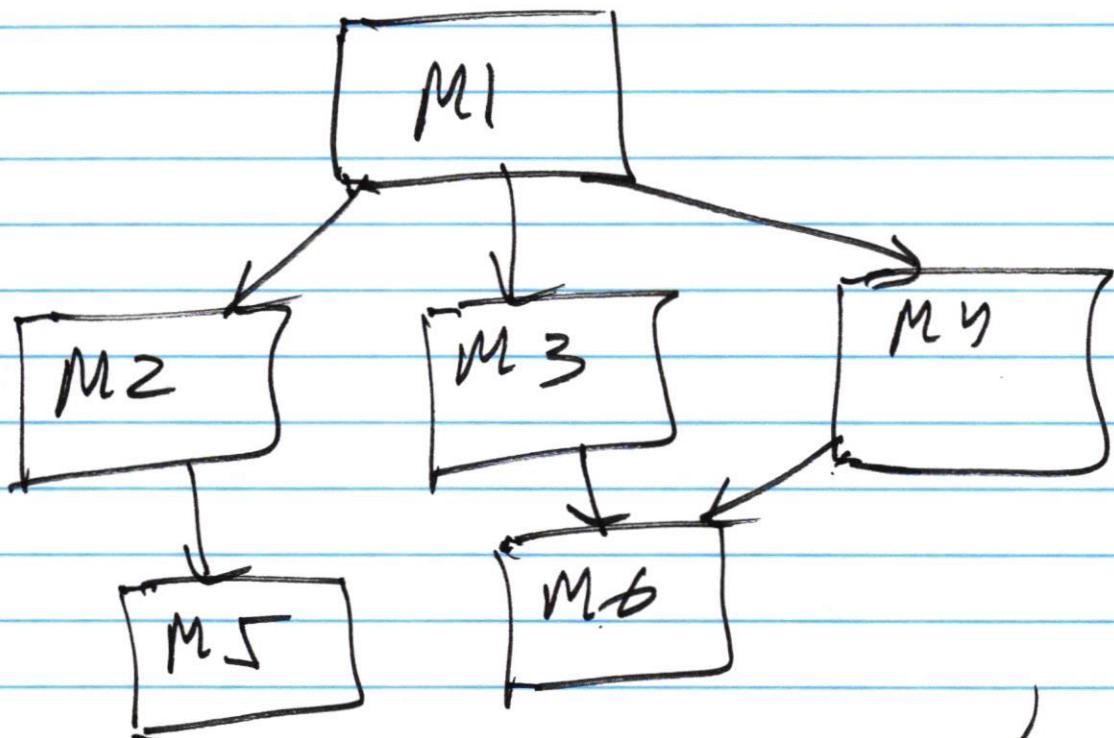
a system structure



a set of components
+

relationships between
components.

Modular design
modules (functions
procedures)
+
call relationships



structure chart!

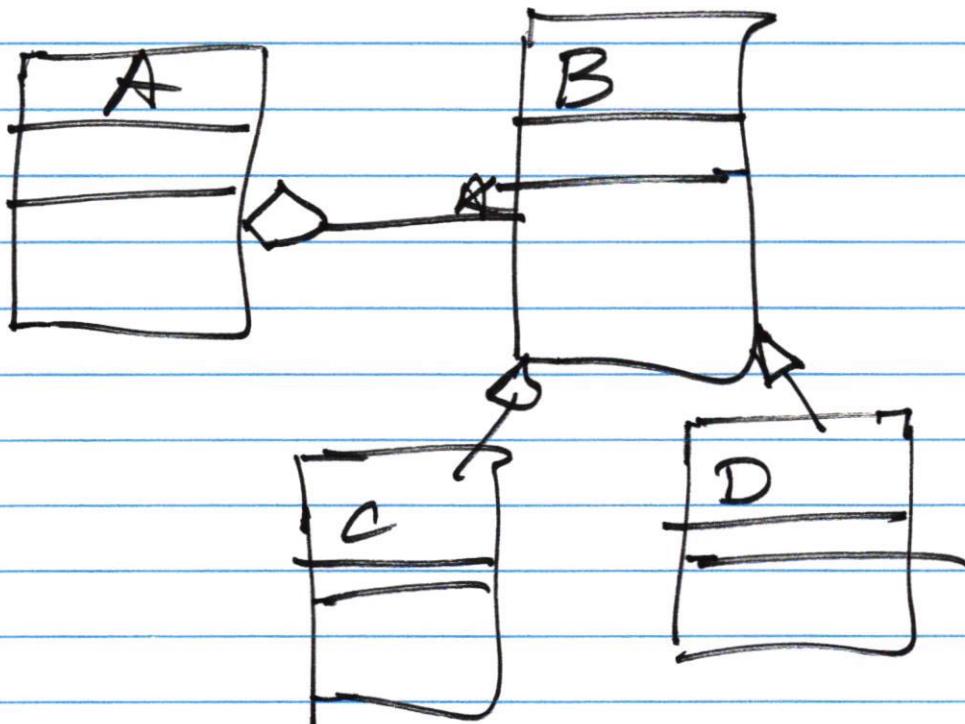
OO - design

* a set of classes

+
relationships

- inheritance
- association
- aggregation

class diagram



Low-level design

- * major algorithms
- * major data structures



sorting names
in alphabetical
order

Implementation

- coding
- low - level algorithms
- low - level data structures
- initial testing.

Software testing.

Goals:

1. To show that the software satisfies the requirements (performs as expected)
2. To have "confidence" in the software system
↓
to make sure that the software does not contain any "major" defects.

Distribution of effort

req. analysis: 5-10%

design 10-20%

implementation: 20-30%

Testing: 50-70%

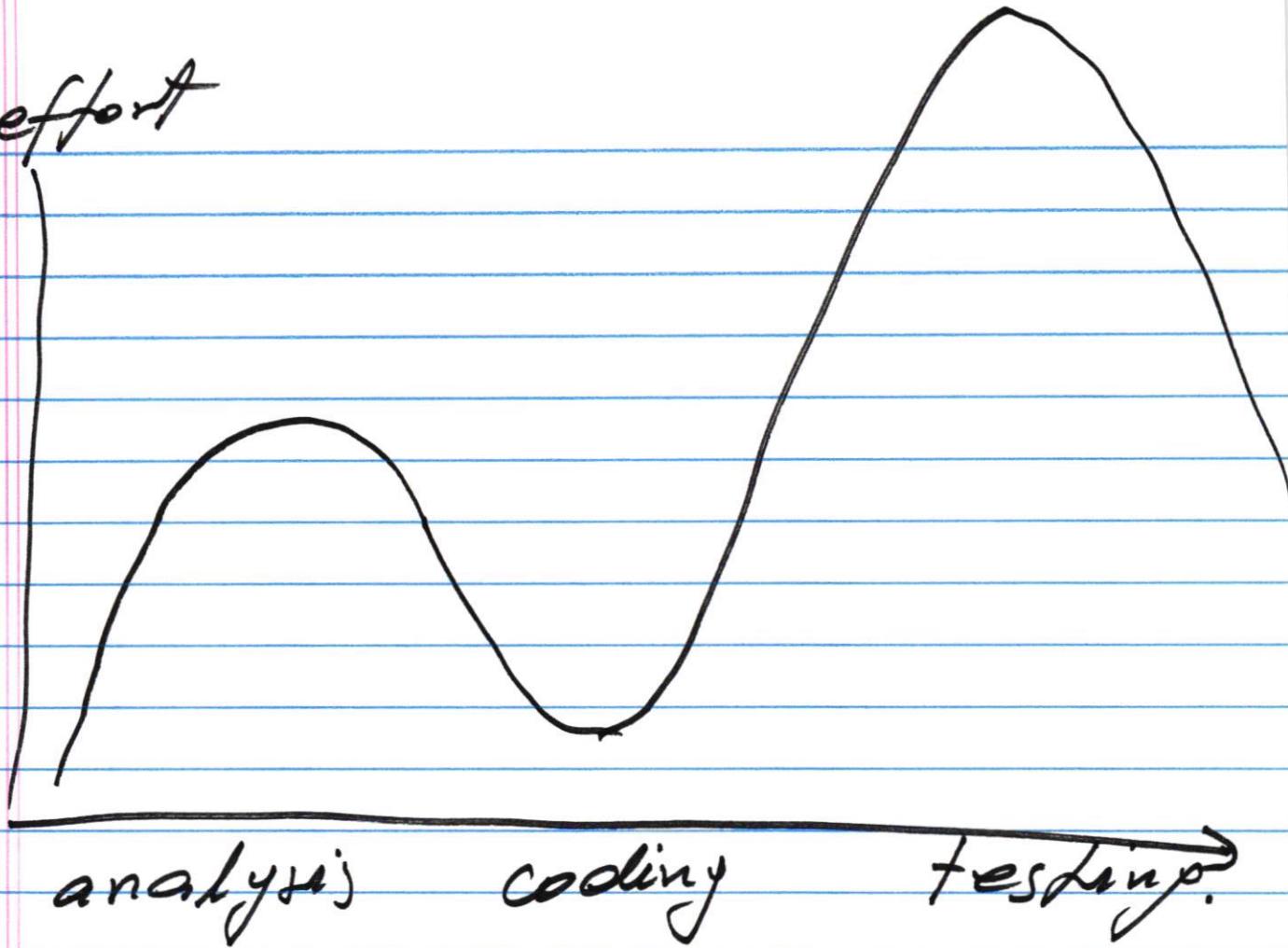
Maintenance

Making changes to the existing software system.

- * fixing defects
- * add/change functionality
- * improvements
 - + user interface
 - + performance
- * adapting to new environment (new OS)

* . . .

effort



Software Testing
is the most expensive
activity in software
development and
maintenance!!!