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Part I

Agile Software Development

1 *Agile Outline*

1. Customer Satisfaction by early and continuous delivery of valuable software.
2. Welcome changing requirements, even in late development.
3. Deliver working software frequently.
4. Close, daily cooperation between business people and developers.
5. Projects are built around motivated individuals who should be trusted.
6. Face to face conversation is the best form of communication.
7. Working software is the primary measure of progress.
8. Sustainable development, able to maintain a constant pace.
9. Continuous attention to technical excellence and good design.
10. Simplicity - the art of maximising the amount of work not done is essential.
11. Best architectures and designs emerge from self organising teams.
12. The team regularly reflects on how to become more effective and adjusts accordingly.

1.1 *How can one enforce Agile Software Development?*

- Break product development into small increments that minimise the amount of up front planning and designs.
- Enforce iterations or sprints, which involves a multi-disciplinary team working on: planning, analysis, design, coding, unit testing, and acceptance testing.
- Fail often and fail early with incremental development; working software is the primary measure of progress.
- Enforce Face to face communication with team members and stakeholders.
 - Delegate a customer representative to act on behalf of the opinions of stakeholders.
 - Customer opinions determine the direction of the next sprint / workflow.

- Daily standup: 15 minute session where members collectively review how they are progressing towards their goal, and note criticisms and improvements.
- Focus on quality of architecture:
 - Continuous integration.
 - Unit testing, test driven development.
 - Pair programming.
 - Enforcing design patterns onto the architecture.

1.2 *Where is ASD appropriate?*

- Complex systems with dynamic, non deterministic and non linear characteristics, since accurate estimates and stable plans are hard to get in early stages.
- In a desire to reduce the *leap of faith* that is needed before any evidence of value can be obtained, in system development.

Part II

Legal, Ethical and Professional Conduct

There are a number of *standards* which highlight a set of axioms by which software engineers should operate, to encourage ethical and legal behaviour:

2 *ACM (Association for Computing Machinery)* ***[58,68]***

ACM are the worlds largest computing society which provide activities, guidance and principles to support professional growth.

2.1 *General Ethical Principles:*

- Contribute to society and to human well being, acknowledging that all people are stakeholders in computing.
 - Avoid harm.
 - Be honest and trustworthy.
 - Be fair and take action not to discriminate.
 - Respect the work required to produce new ideas, inventions, creative works, and computing artifacts.
 - Respect privacy.
 - Honor confidentiality.

3 *IEEE (Institute of Electrical and Electronics Engineers)* ***[69,74]***

IEEE is the worlds largest technical professional organisation which enforces 8 practices which software engineers should take with regards to ethics and professional practices.

3.1 *IEE Code of Ethics.*

- Uphold the highest standards of integrity, responsible behaviour and ethical conduct in professional activities.
- Treat all persons fairly and with respect, to not engage in harassment or discrimination, and to avoid injuring others.
- Strive to ensure code is upheld by colleagues and co-workers.

4 *BCS [75,77]*

BCS is a Chartered Institute for IT, and is known as an independent professional body. BCS enforces four key principles:

4.1 *General Ethical Principles:*

- You make IT/ software for everyone.
 - Address wider societal issues, and upholding standards by conducting yourself professionally and fairly at all times, to make software accessible.
- Show what you know, learn what you don't.
 - Keep on learning, continuously learn and develop yourself. You must know the boundaries of what you do or don't know.
- Respect the organisation or individual you work for.
 - Work with due care and diligence while taking personal and collective responsibility for your actions; mustn't work with conflicts of interest.
- Keep IT real. Keep IT professional. Pass IT on.
 - Uphold the reputation of the profession and encourage others to grow.

5 *Research Ethics [158,159]*

5.1 *EIRA [https://moodle.bath.ac.uk/pluginfile.php/1469988/mod_resource/content/1/eira1.pdf]*

Engaging with research involves ethical, legal and professional considerations.

- The University of Bath requires the EIRA1 electronic form to be completed and submitted for review for all projects that involve human participants.

5.2 *Scientific Integrity*

- We are expected to act with **Scientific Integrity**, which enforces the following principles:
 - *Honesty*: The work you present must be clear and your intentions must be accurate. Interpretations of data should be clear, and justifications of data; acknowledging sources, and honesty in the farming of data.
 - *Rigour*: Research to be rigorous and explore and exhaust all nodes.

- *Transparency and open communication:* highlight limitations of studies and negative results. Must be transparent in your methodologies, and share criticisms as part of the research process.
- *Care and respect:* to all beneficiaries of the experiment, including animals, environments and cultural objects.
- *Accountability:* Individuals are held to account when their behaviour falls short of the standards we set.

5.3 *Misconduct types:*

- *Falsification:* Manipulating research, equipments or process; changing data to fit narratives or other goal without any justification. Remember, negative and null results are valid; it is a skill to show negative results in a positive light so as to learn from them.
- *Plagiarism:* Using other peoples work and ideas without giving proper credit to the original source. Violates the rights of the authors to their intellectual output.
- *Fabrication:* Making up results and recording them as though they were real.

5.4 *Key Principles of Human Research*

5.4.1 *Ethical Principles in Human Research*

In collecting data from people, there are some basic ethical principles to consider:

- *Respect for persons:* Individuals should be treated as autonomous agents (they can make their own decisions and choices), persons with diminished responsibilities are entitled to protection.
- *Beneficence:* The obligation to do no harm, and to maximise the benefits and reduce the risk.
- *Justice:* Do not deny benefits or impose burdens of research to people without good reason.

5.4.2 *Informed consent*

The participants should choose what does and does not happen to them. There are three core elements to informed consent.

- *Information:* Participants should have access to the risks or benefits of the research; the ability to ask questions and withdraw at any time.
- *Comprehension:* Information must be provided in a coherent manner which would not curtail the participants ability to make an informed decision. It is your responsibility to ensure that they have comprehended the information.

- *Agreement to Participate*: Valid if given voluntarily and not through coercion or threat, or undue influence such as an improper reward (eg a bribe).

5.4.3 *Withdrawal*

- Participants must have the right to withdraw:
 - After having read the information sheet.
 - Part way through the study
 - After the study;
- When working with anonymised data, it may not be possible to extract an individuals data. Participants must be made aware of this, and depending on how the data is anonymised, you may want to consider a *grace period* where you can give participants to withdraw their data, after which the data will be anonymised.

5.4.4 *Data*

- Only collect data that is absolutely necessary.
- Clearly tell participants what you are recording and why. You must provide consent if you use images in publications and reports.
- Anonymise the data if possible (pixelating images).
- Secure storage of data
 - All participant data should be stored securely on the University drives, access files with files.bath.ac.uk remotely.
 - All paper data like consent forms should be stored in locked filing cabinets with clear labels.

5.4.5 *Recruitment of Participants*

- Use emails, social media, posters, word of mouth.
- You musn't coerce or pressurise people into taking part. Compensation should be to compensate their time, not entice them.
- Must provide fundamental information of the study such as:
 - Study title
 - What will be involved, and duration of study.
 - Criteria for inclusion (eg, healthy adults 18+)
 - Compensation for their time information.
 - Contact information.

5.4.6 *Participant Impairments*

You must consider the impairments of your participants of the study as the ethical process will take longer and will be more complicated. Consent could be more problematic if under 18 / those with diminished responsibility.

5.4.7 *Debriefing*

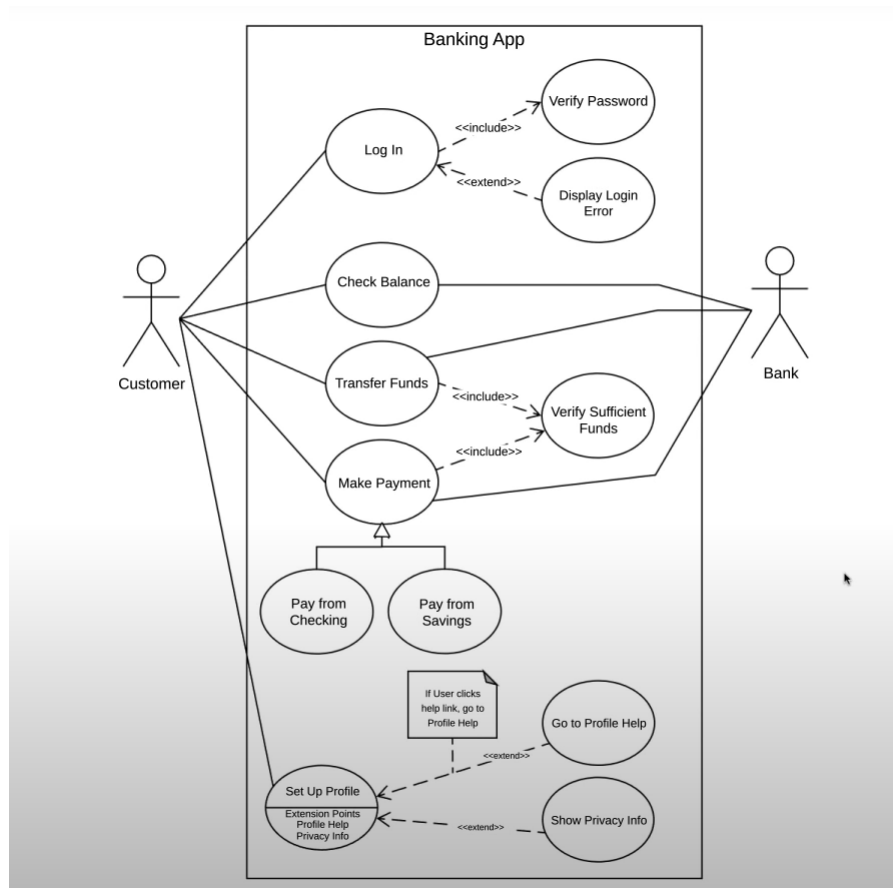
- Thank the participant for their time
- Provide participants with a full explanation of what was being tested.
- What were the hypotheses and what were they based upon.
- Explain how the results will be used.
- Where they can find more information.
- Reminder of their right to withdraw.

Part III

UML Models

6 *UML Case Diagrams*

- All application events are inside a box. All external interactions which produce these events are outside of the box.
- **Actors** produce events, in which case a line is drawn from the actor to the event(s).
- **Events** are drawn in circles.
- **Event chains** are defined by:
 - <<include>>, which \implies the next event.
 - <<extend>>, which could be \implies the next event.
- Events can be defined further by establishing a hierarchy which explains the proper subtypes of said event.

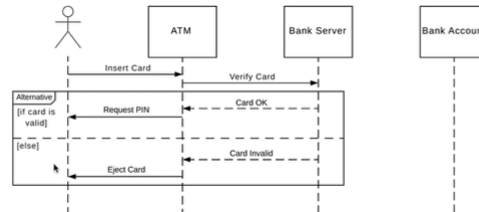


7 UML Sequence Diagrams

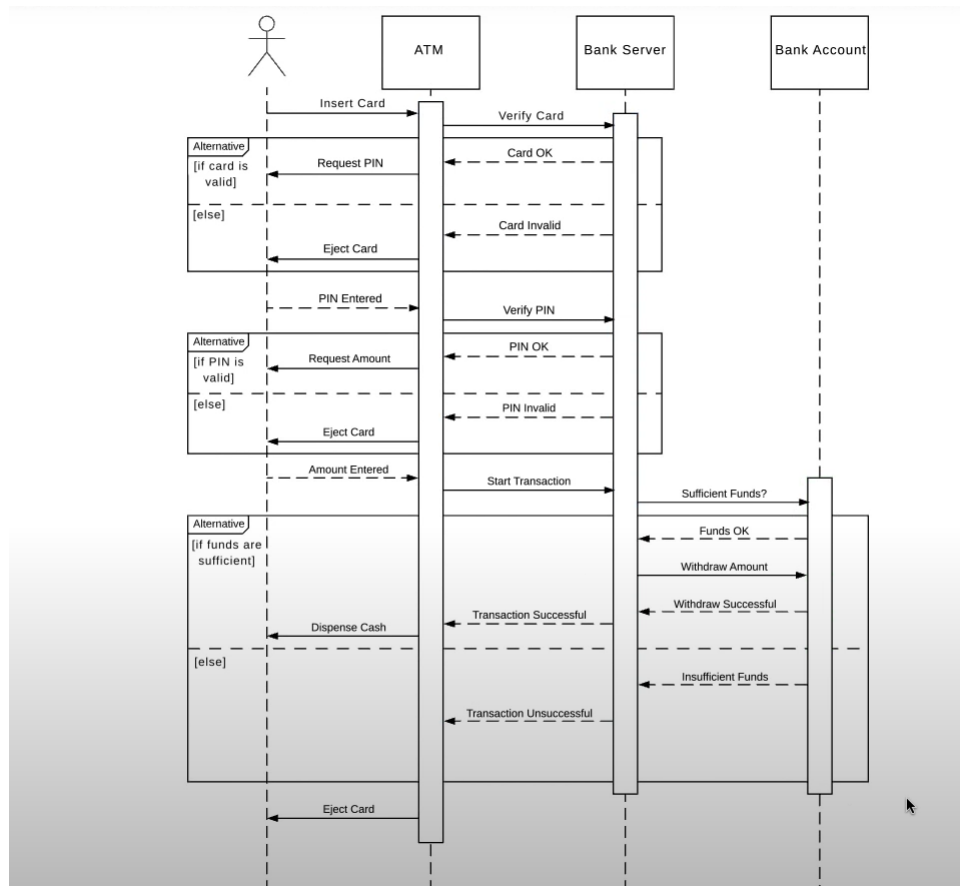
UML Sequence Diagrams are a type of UML diagram that show how classes in code interact with each other, in order, namely the sequence of events. Used to document processes and understand the requirements of a new program.

- **Actors** interact with **Objects**. Objects are placed in sequential order, and are in squares.
- **Lifelines** are vertical dashed lines which show the existence of the object over time (time axis is vertical).
- **Messages** show the messages being sent between objects. These are indicated with solid lines.
 - **Return Messages** are dashed lines and are responses to messages.

- **Alternative Frames** are basically conditional branches, which symbolises a choice between two message sequences. It is encapsulated in a box around the target message sequences.



- **Activation boxes** show when and how long objects perform processes and go along the lifelines.



8 *Additional Resources*

- <https://www.uml-diagrams.org/uml-25-diagrams.html>

Part IV

Data Analysis and Statistics

Part V

Idea Development

Part VI

Stakeholders[106,

9 *Stakeholder Engagement Plan (SEP)*

What is a stakeholder?

A person, group or company that is directly or indirectly involved in the project, and who may affect or get affected by the outcome of the project.

- *Context Definition*
 - Early on, describe the problem and proposed solution, indicate stakeholders and details of the problem/solution context.
 - Later, describe the system, product features, indicate target users and details of where the system/product is/will be used.
- *Engagement Goal*
 - Clarify the engagement outcome in terms of the broader project context.
- *Engagement Method*
 - Surveys
 - 1-1 Interviews
 - Focus Groups
 - Ethnographies
 - Diaries
 - Observations
- *Location and Profile*
 - Where will the engagement take place?
 - Who will be involved (consider if team members are required)?
 - What will be the role of the stakeholders?

10 *Sampling Data*

There are two major types of sampling methods.

10.1 *Probabilistic Sampling*

- *Census*: Every single person in the targeted user population is chosen to take part in the survey.
- *Random Sample*: not all people are chosen to participate, but it is known what the likelihood of being chosen to participate.

10.2 *Non-Probabilistic Sampling*

- You do not or cannot use a strict random sample.
- You do not know the likelihood of an individual being selected.
- You are not interested in a population estimate.
- There may not be a clearly defined population of interest.

Part VII

Conducting Experiments[453,