Waterfall Model, Prototyping Model, and Agile Model

A comprehensive guide to software development methodologies for computer science students

Software Development Life Cycle (SDLC)

What is SDLC?

A systematic approach to software development that defines the phases and processes from initial concept to final deployment and maintenance.

Why SDLC Matters

SDLC frameworks ensure quality, reduce risks, improve efficiency, and provide structure for teams to deliver reliable software solutions.

Waterfall

Sequential linear approach

Prototyping

Iterative user feedback

Agile

Flexible adaptive cycles

Waterfall Model: Definition

Linear Sequential Flow

Each phase must be completed before the next phase begins, with no overlapping or iteration.

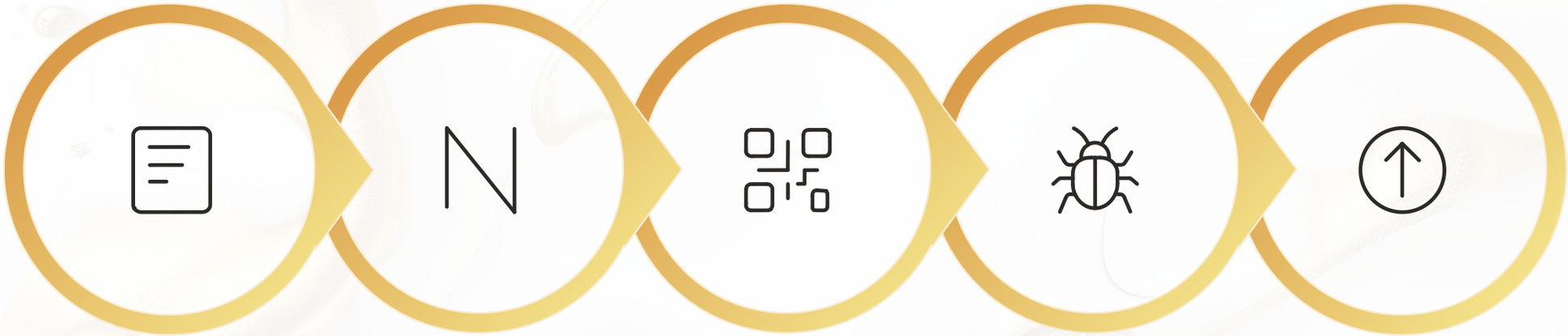
Rigid Structure

Clear separation between requirements, design, implementation, testing, and deployment phases.

Document-Driven

Extensive documentation at each stage ensures traceability and clear requirements.

Waterfall Model: Diagram



Key Characteristics

- Phases executed in strict order
- No backward movement allowed
- Deliverables at each phase
- Extensive documentation

Best Applied When

- Requirements are stable and clear
- Technology is well understood
- Fixed budget and timeline
- Regulatory compliance needed

Waterfall Model: Advantages

Clear Structure

Well-defined phases with specific deliverables and review points make project management straightforward.

Comprehensive Documentation

Extensive documentation at each stage ensures knowledge transfer and future maintenance is easier.

Predictable Timeline

Fixed phases allow for accurate scheduling, budgeting, and resource allocation from the outset.

Goal-Oriented

Clear objectives at each phase help teams stay focused and measure progress effectively.

Waterfall Model: Disadvantages

Minimal Customer Involvement

Users see the product only at the end, leading to potential mismatches between expectations and delivered functionality.

Inflexible to Changes

Modifying requirements mid-project is difficult and costly, as it requires restarting from earlier phases.

High Risk of Failure

Testing occurs late in the cycle, meaning major issues may not be discovered until deployment.

Time-Consuming

Long development cycles mean products reach market slowly, potentially missing opportunities.

Prototyping Model: Overview

01

Requirements Gathering

Initial requirements are collected through stakeholder discussions and analysis.

02

Quick Design

Rapid creation of a basic prototype focusing on key features and user interface.

03

User Evaluation

Stakeholders test the prototype and provide feedback on functionality and design.

04

Refinement Loop

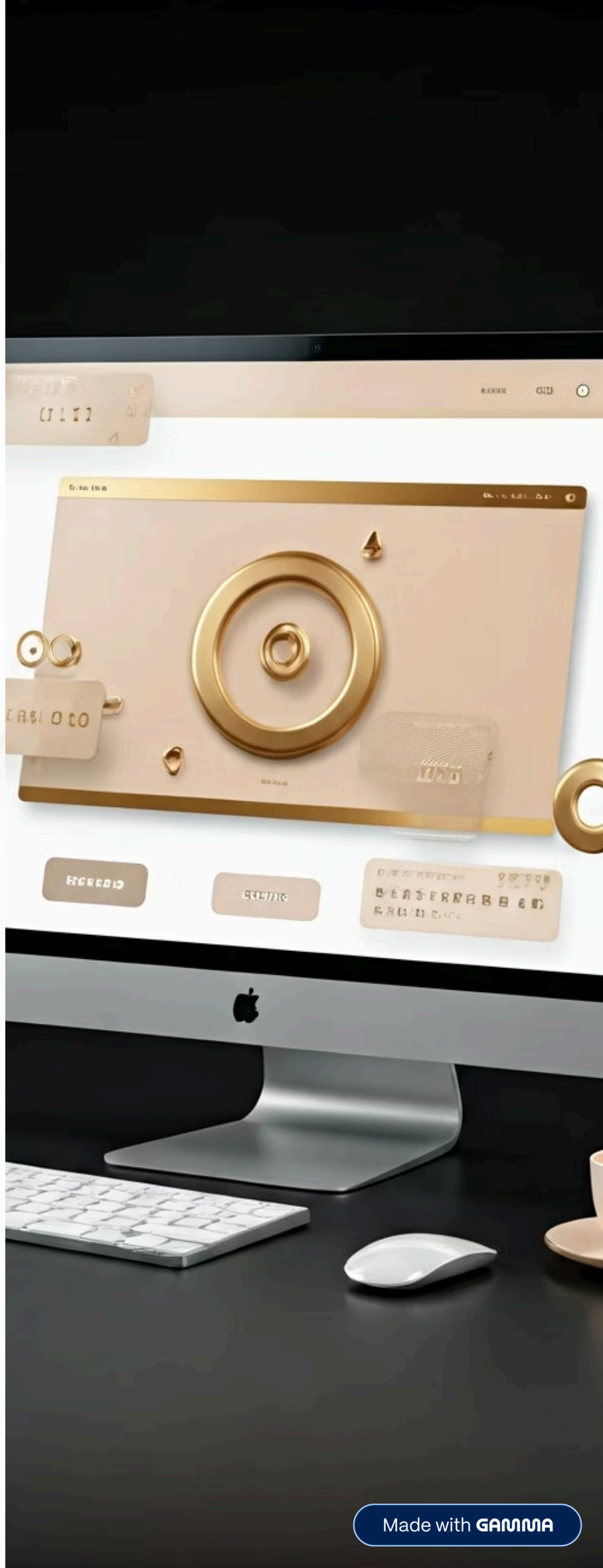
Prototype is iteratively improved based on feedback until requirements are validated.

Advantages

- Early user feedback
- Reduced development risk
- Better requirement validation
- Improved user satisfaction

Disadvantages

- Can be time-consuming
- Scope creep potential
- May focus on UI over architecture
- Additional documentation needed



Agile Model: Core Principles

Individuals and Interactions

Valuing collaboration and communication over rigid processes and tools.

Working Software

Delivering functional increments frequently rather than extensive documentation.

Customer Collaboration

Continuous stakeholder involvement throughout development for better alignment.

Responding to Change

Embracing changing requirements, even late in development, for better outcomes.

Methodology Comparison Summary

Waterfall

Best for: Stable requirements, regulated environments, fixed scope projects

Timeline: Long development cycles

Flexibility: Low

Prototyping

Best for: Unclear requirements, user-centric applications, complex UI

Timeline: Iterative refinement

Flexibility: Medium

Agile

Best for: Evolving requirements, fast-paced markets, collaborative teams

Timeline: Short sprints

Flexibility: High

Choosing the Right Model

Consider project requirements stability, team size, customer availability, and market dynamics when selecting a methodology. Many modern projects combine elements from multiple approaches.