Agile and Evolutionary Software Development

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Contents

- Staged model of software lifespan
- Agile and evolutionary development
- Software change
- Software maintenance

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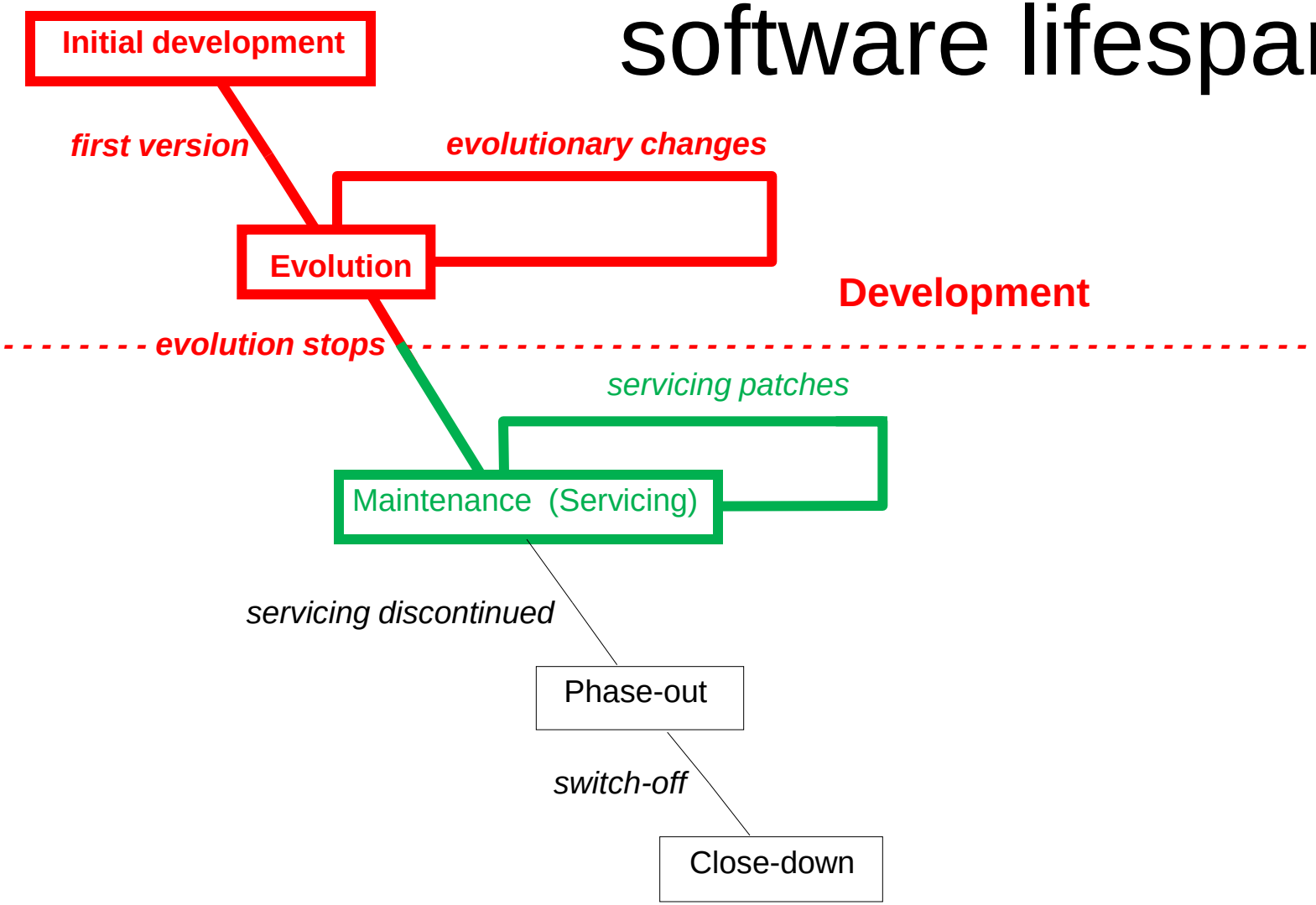
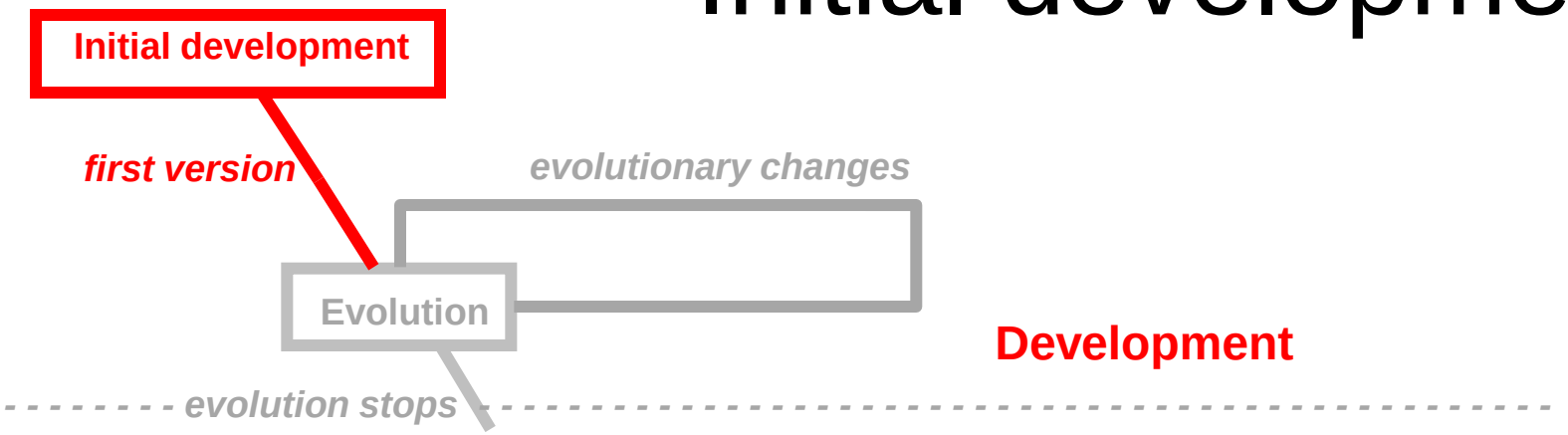
Staged model of software lifespan



Initial development



- Fundamental project decisions
  - Technologies, architecture, GUI design, …
- First (incomplete) version
- Phases: requirements, design, implementation

Evolution

- Repeated software changes
- Each change adds/modifies functionality or property of existing (and running) software

Evolutionary Software Development (ESD)

- Bulk of development is done in evolution
- Offers stakeholders regular feedback about the progress of the project
- Allows the developers to react to the volatility
  - Volatility of requirements, technology, or knowledge

Waterfall

- Bulk is done in initial development
- Little or no evolution
- Suitable for projects without volatility
  - Stable technology and domain
  - Stable knowledge → small projects

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ESD

- Current mainstream
- There are numerous ESD processes with track record of success
  - Example: Agile
  - There are other effective ESD processes

Iterative development

- Iterations are milestones with specific goals
- Volatility is frozen during iteration
  - Allows planning of iteration
- Stakeholders assess the past iteration and plan the next one
  - Iteration meeting of all stakeholders
  - Volatilities are taken into account during iteration meeting

Agile development

- Autonomous decision makings by developers during the iterations
  - Requires intensive communication within the team
  - Very short iterations
- Suitable for small teams
  - SCRUM, eXtreme

Safeguarded development

- Presence of guardians of the code base
  - They accept or disallow code changes
- Software with high quality expectations
  - Avionics

Open source development

- Open source development
  - Safeguarded
  - Code ownership
  - Wide community of developers, variable skills

- Inner source development
  - Leverages the experience of open source
  - Practiced within a corporation

Directed development

- Default process
- Managers assign tasks to the developers
- Allows different specialized roles
  - Developers, testers, architects, technology experts, managers, …
- Suitable for large or delocalized projects

Exploratory development

- Features are establish by trial-and-error
- Common in research projects

Solo development

- Single developer
- More and more common
  - Mobile apps

Success of small projects*

- Budget of less than $1 M
- 76 % of small projects are successful
  - Only 4% of small projects are cancelled
  - Historically high success rate

*Chaos Manifesto 2013

Future directions of ESD

- Associate individual practices with specific project circumstances
- Tailor new processes that exactly fit specific project needs

Example

Project circumstances	**Practice suitable for the circumstances**
Exploratory programming is necessary	Developers are domain experts
Gap between programmer capability and expected quality	Code guardians, permission to commit
Frequent turnover of developers	Concept location practices
High volatility of requirements, technologies, or knowledge	Short initial development, short iterations
Low volatility	Long initial development
. . . (we need a very large table)	. . .

Problem with large projects*

- Budget larger than $10 M
- Low (10%) probability of success
  - 38% of them were cancelled
  - Large financial losses
  - Embarrassment to our community
  - Something needs to be done

*Chaos Manifesto 2013

Confused debate about processes

- False dichotomy: “waterfall vs. agile”
  - Note waterfall is suitable for stable small projects
  - Agile is suitable for small teams
- Contributing to the low success rate of large projects

Better debate

- What is the appropriate size of the initial development?
  - Volatility requires small initial development
  - Stability allows large initial development
- After initial development, which ESD process is the most appropriate?
  - Which combination of ESD practices is the most appropriate?

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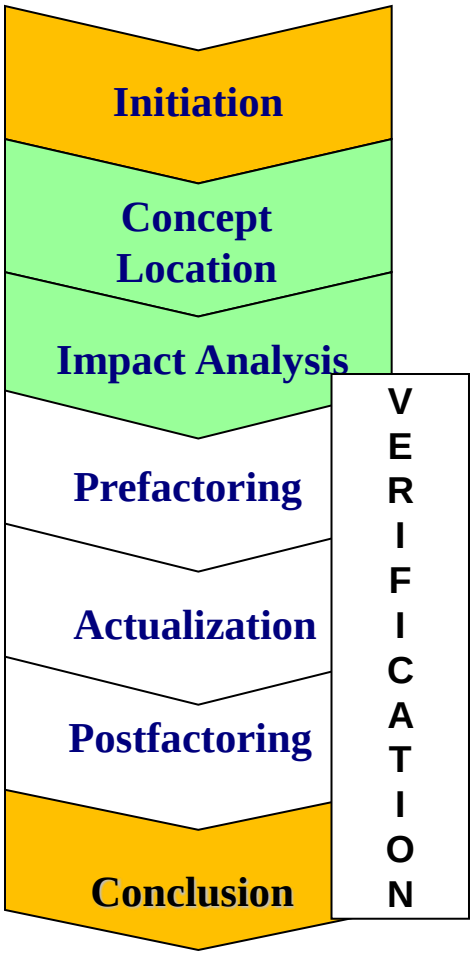
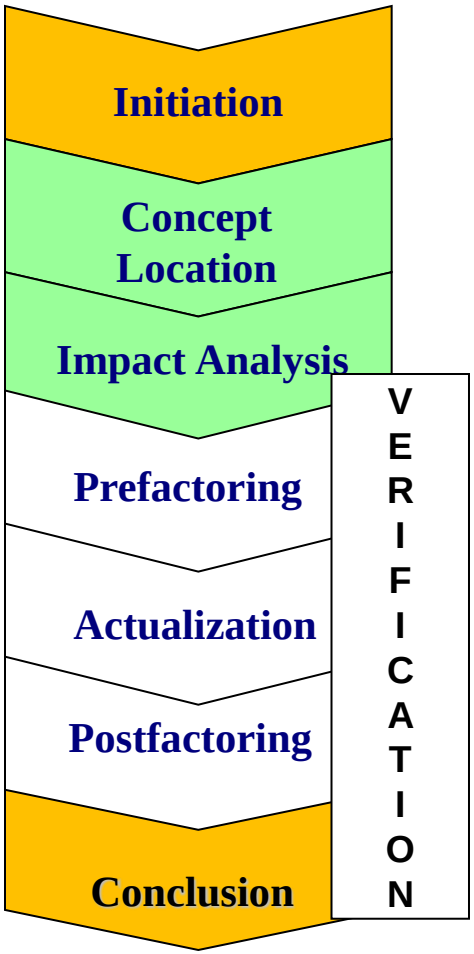
Phased Model of Software Change (PMSC)



- Process model for changes with limited impact
- Enactment of PMSC contains a subset of phases

Phased Model of Software Change (PMSC)



. . Requirements

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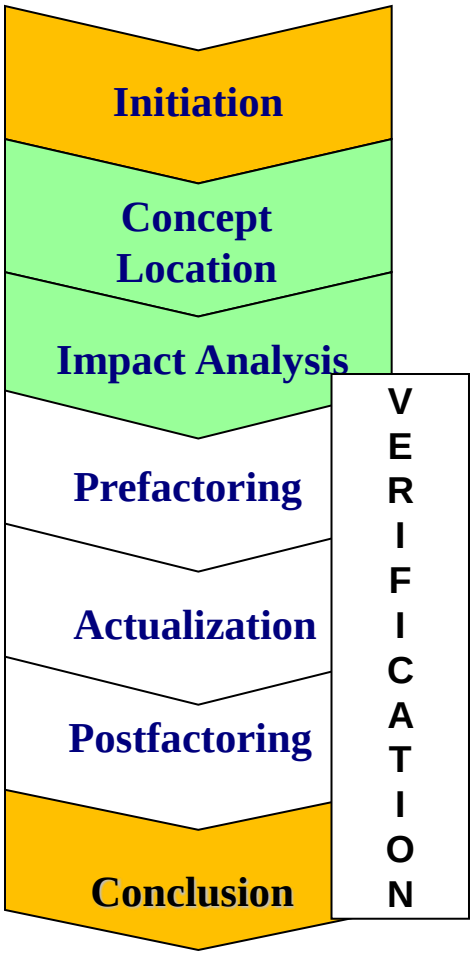

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. . Finds what needs to change

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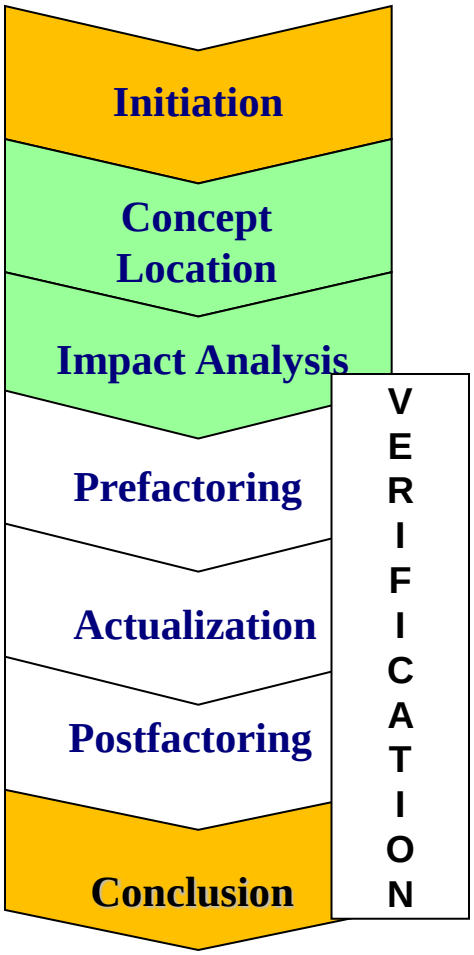

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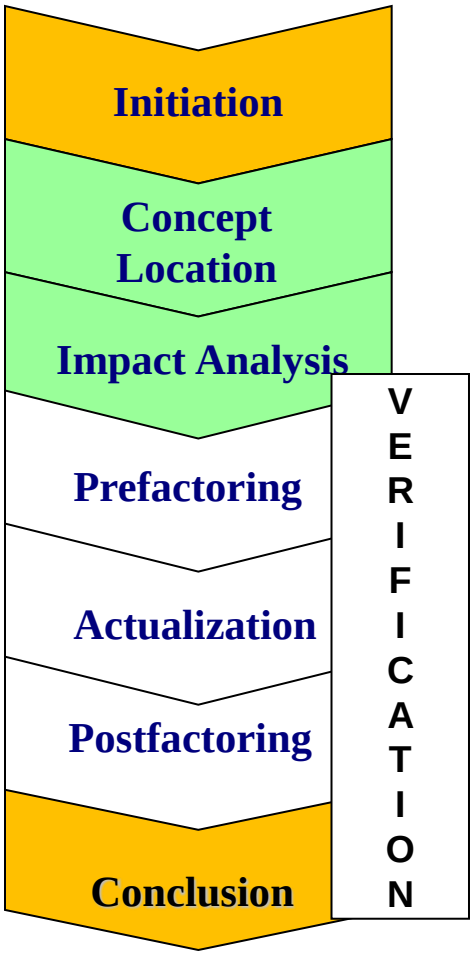

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. . How big is the change?

. . Prepare for the change

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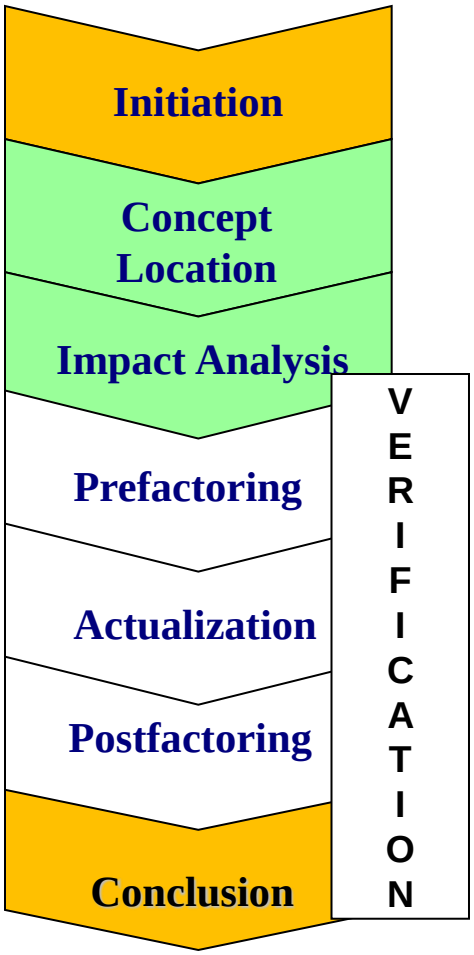

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. . Prepare for the change

. . Do the change

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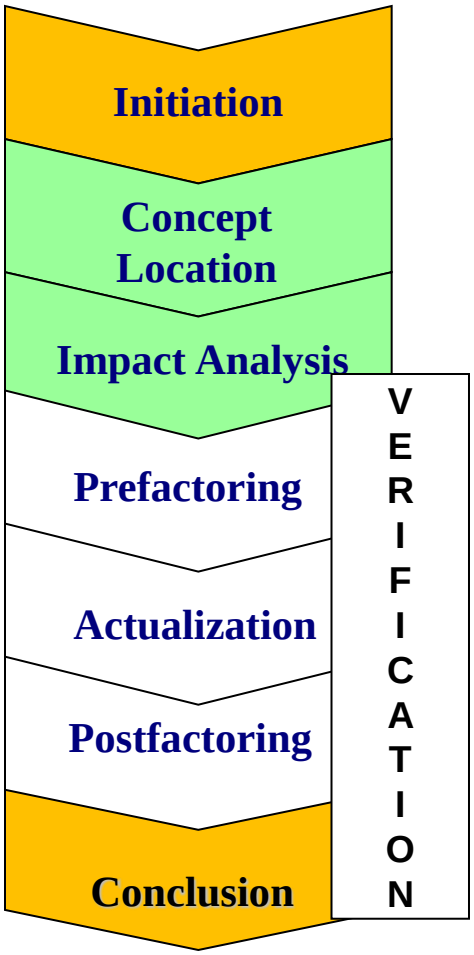

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. . Do the change

. . Clean up

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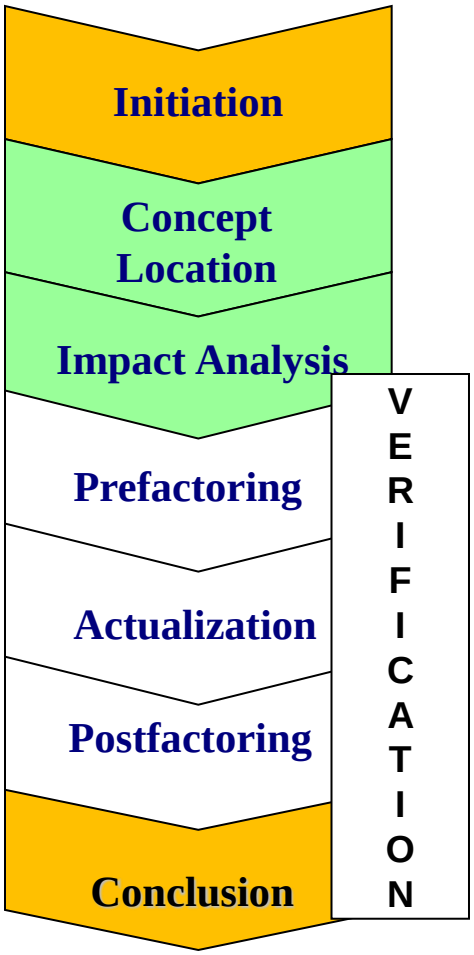

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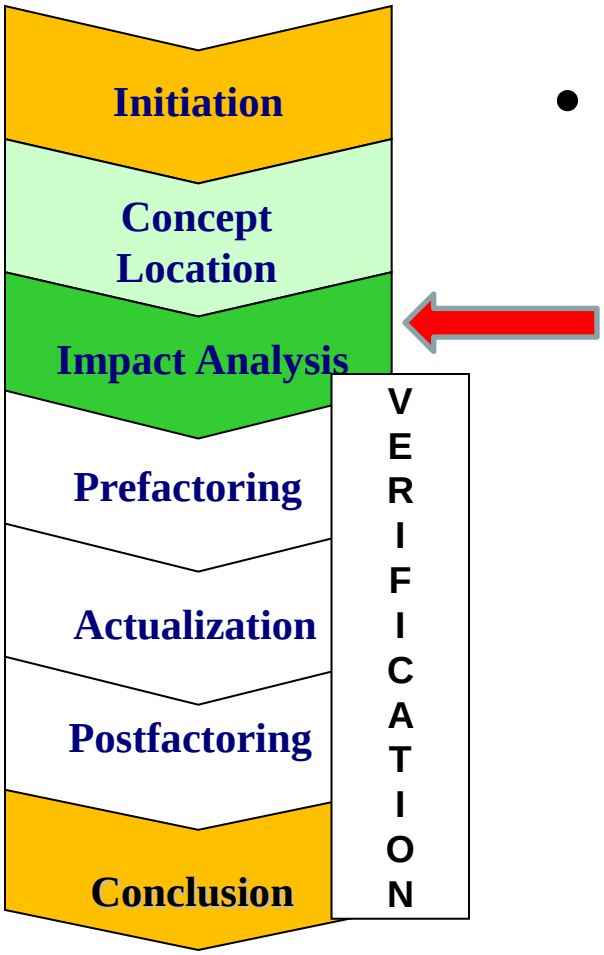
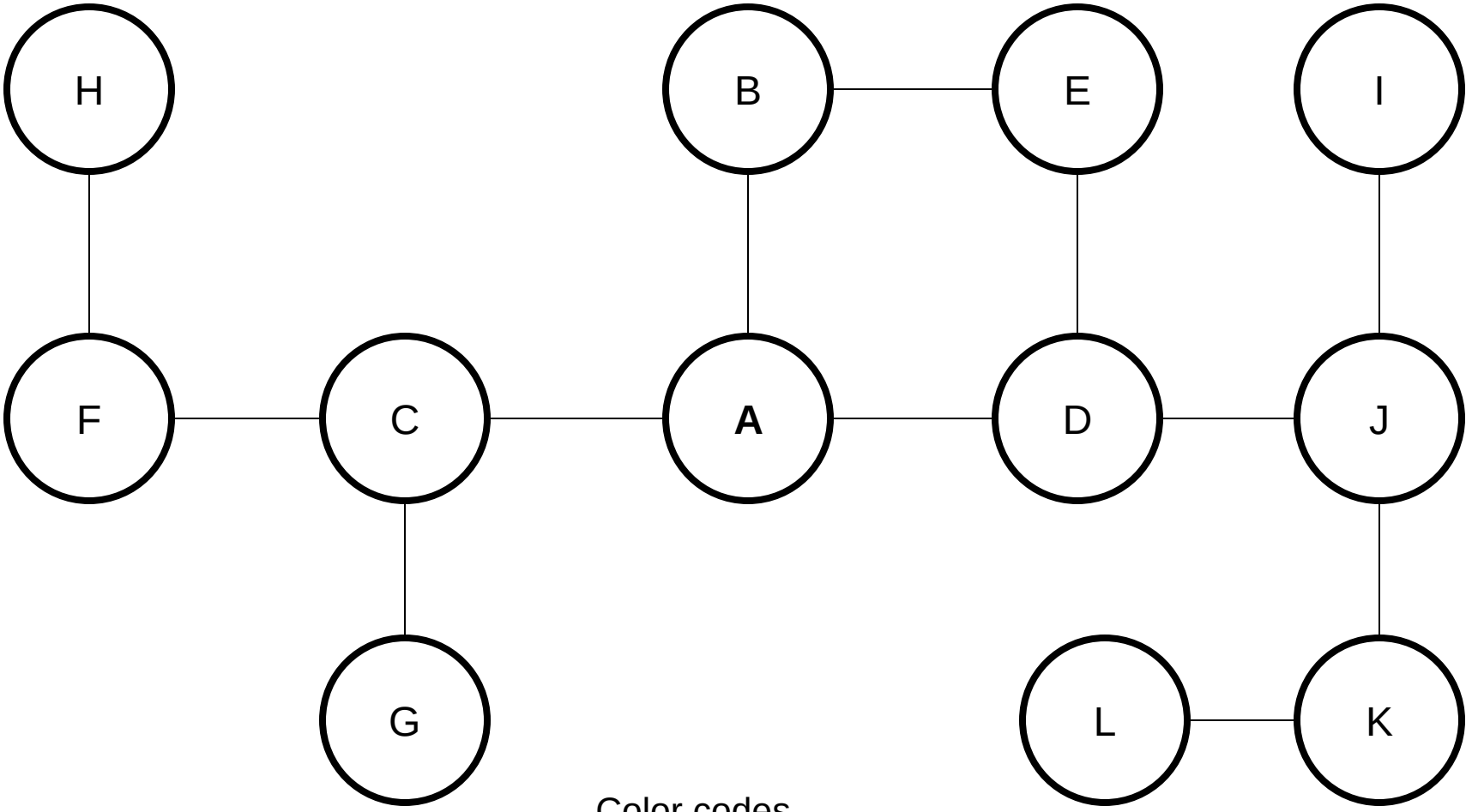
. . Commit

Impact analysis (IA)



- IA predicts prefactoring and actualization
  - Currently unable to predict postfactoring
  - Postfactoring often resolves technical debt after it accumulates beyond acceptable limit

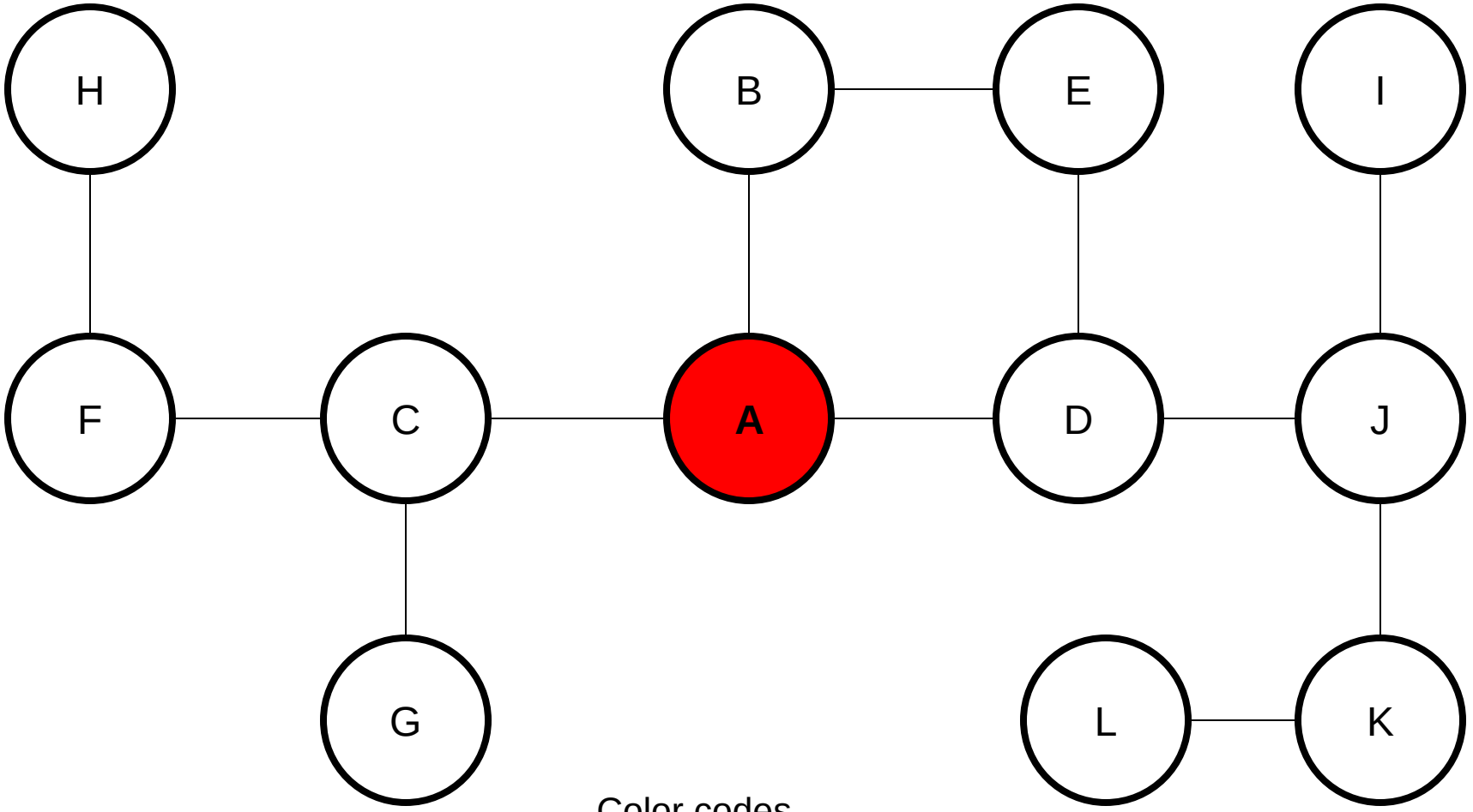
Incremental IA



Color codes

Unknown | Changed | To be inspected | Inspected and unchanged | Propagating

Incremental IA



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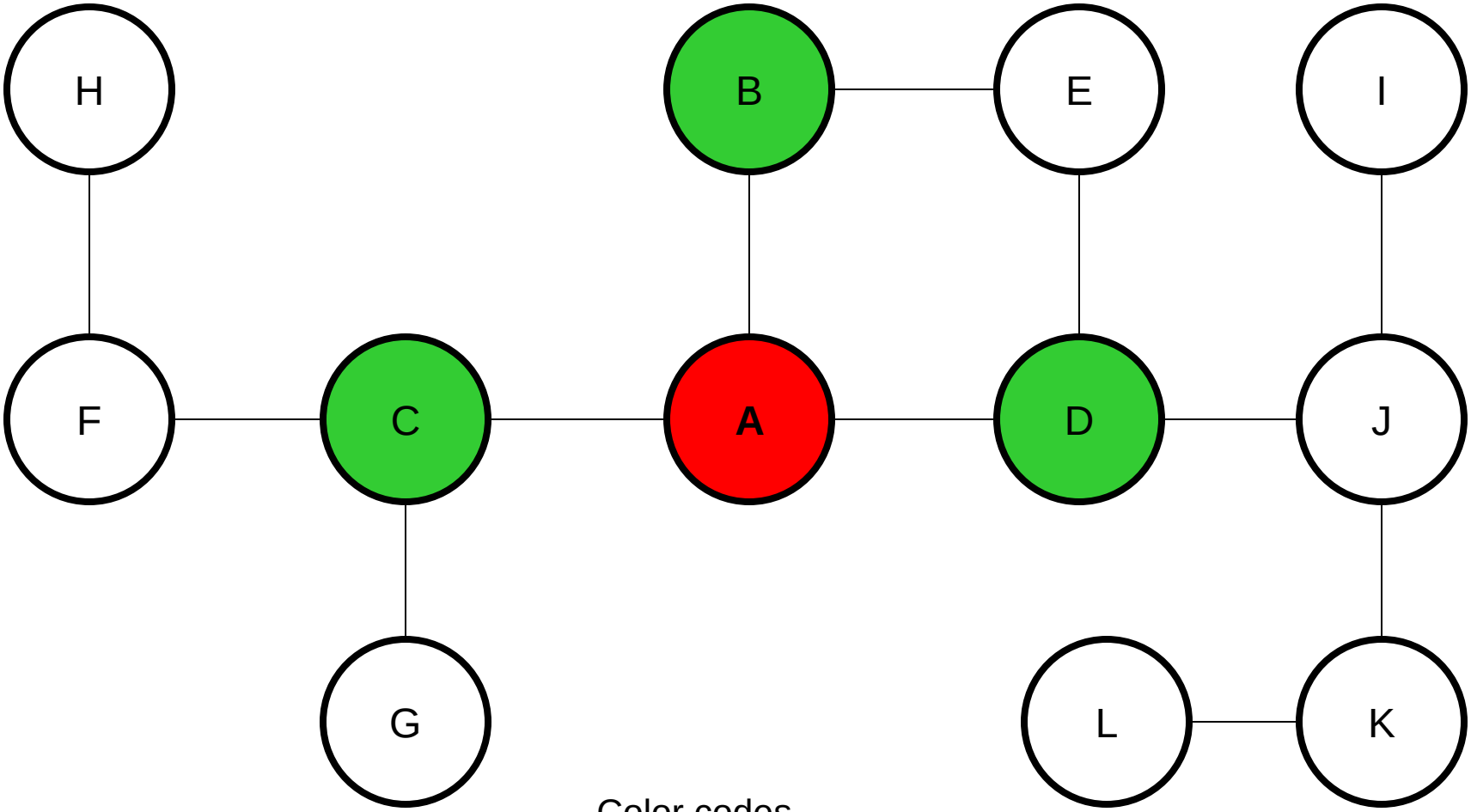

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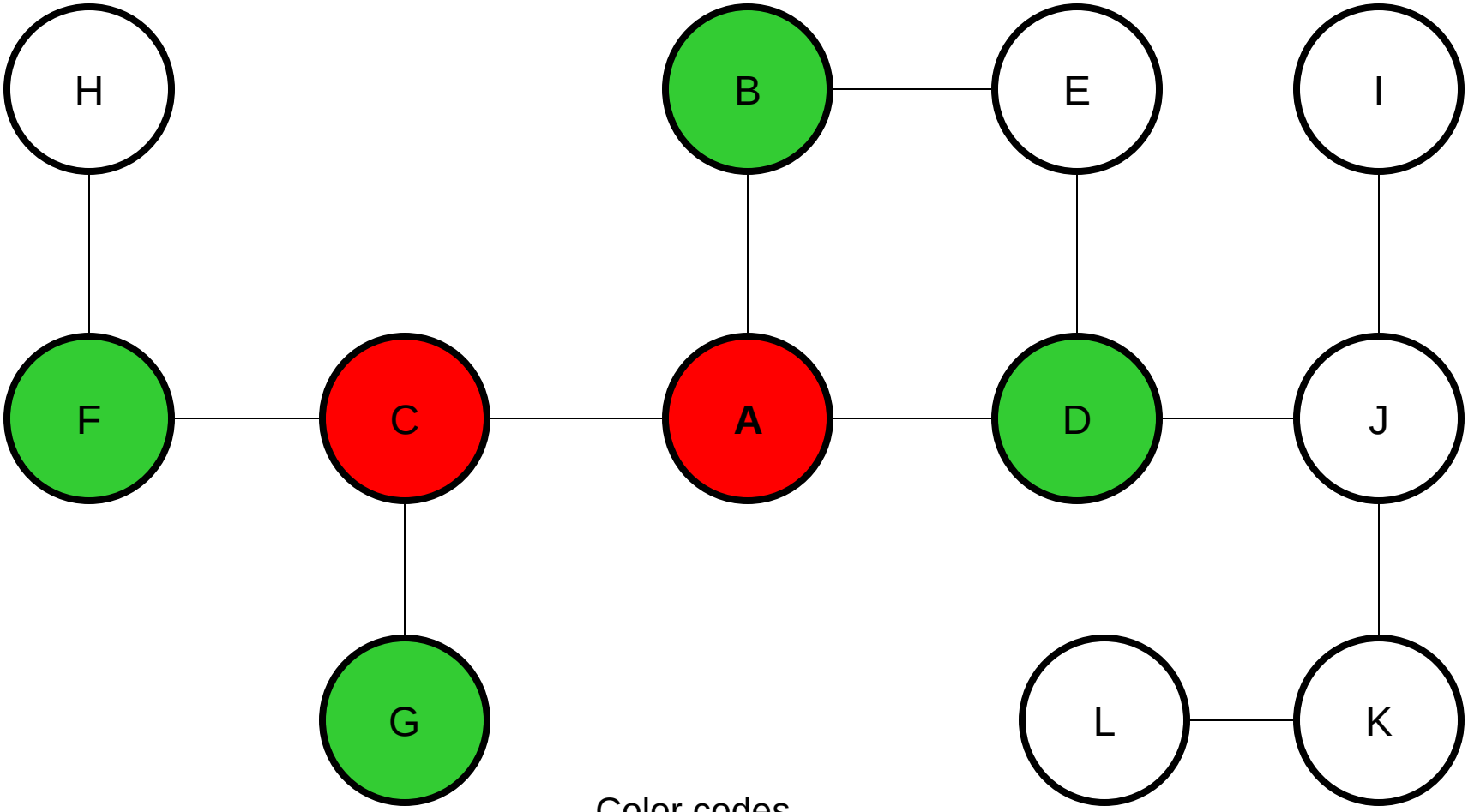

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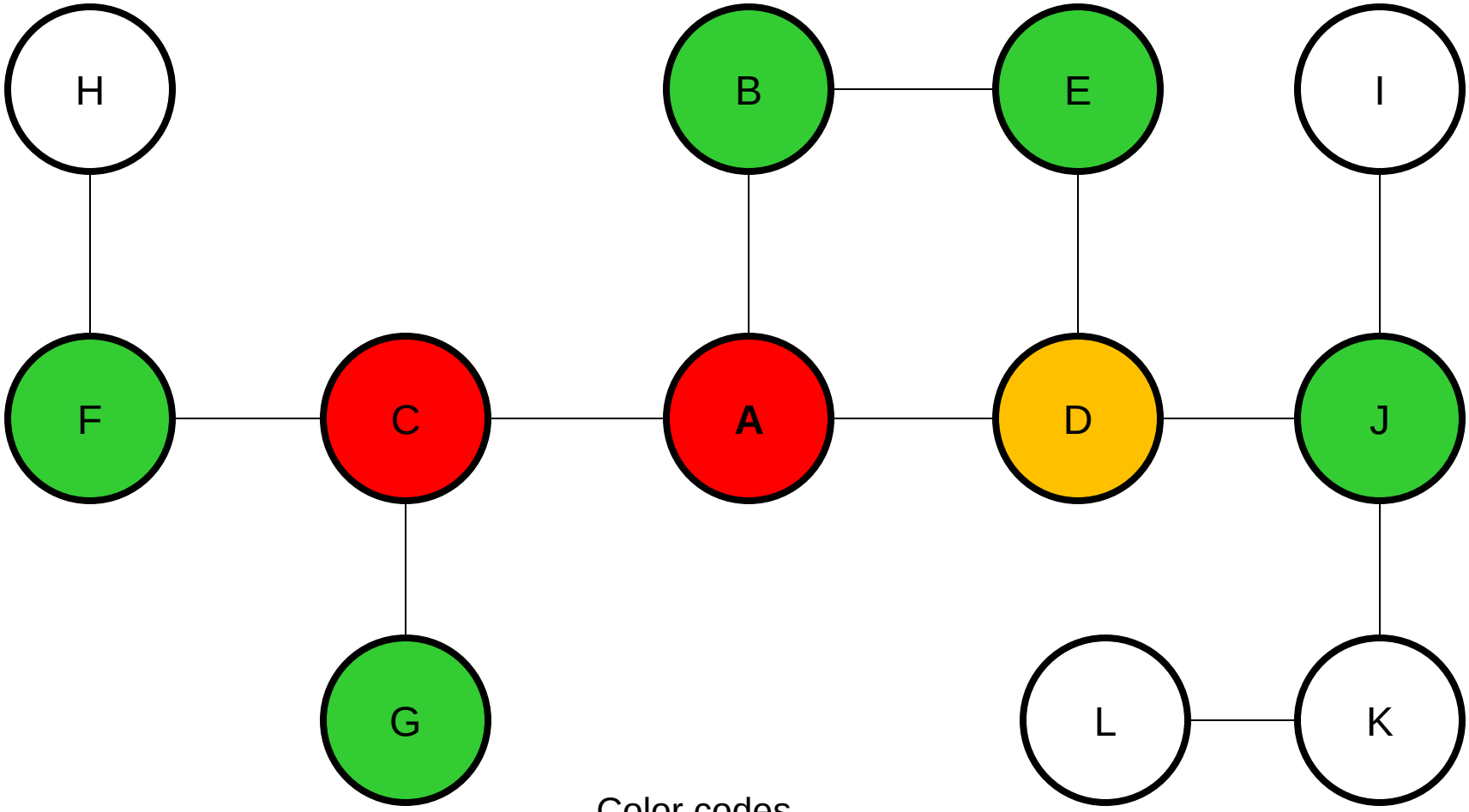

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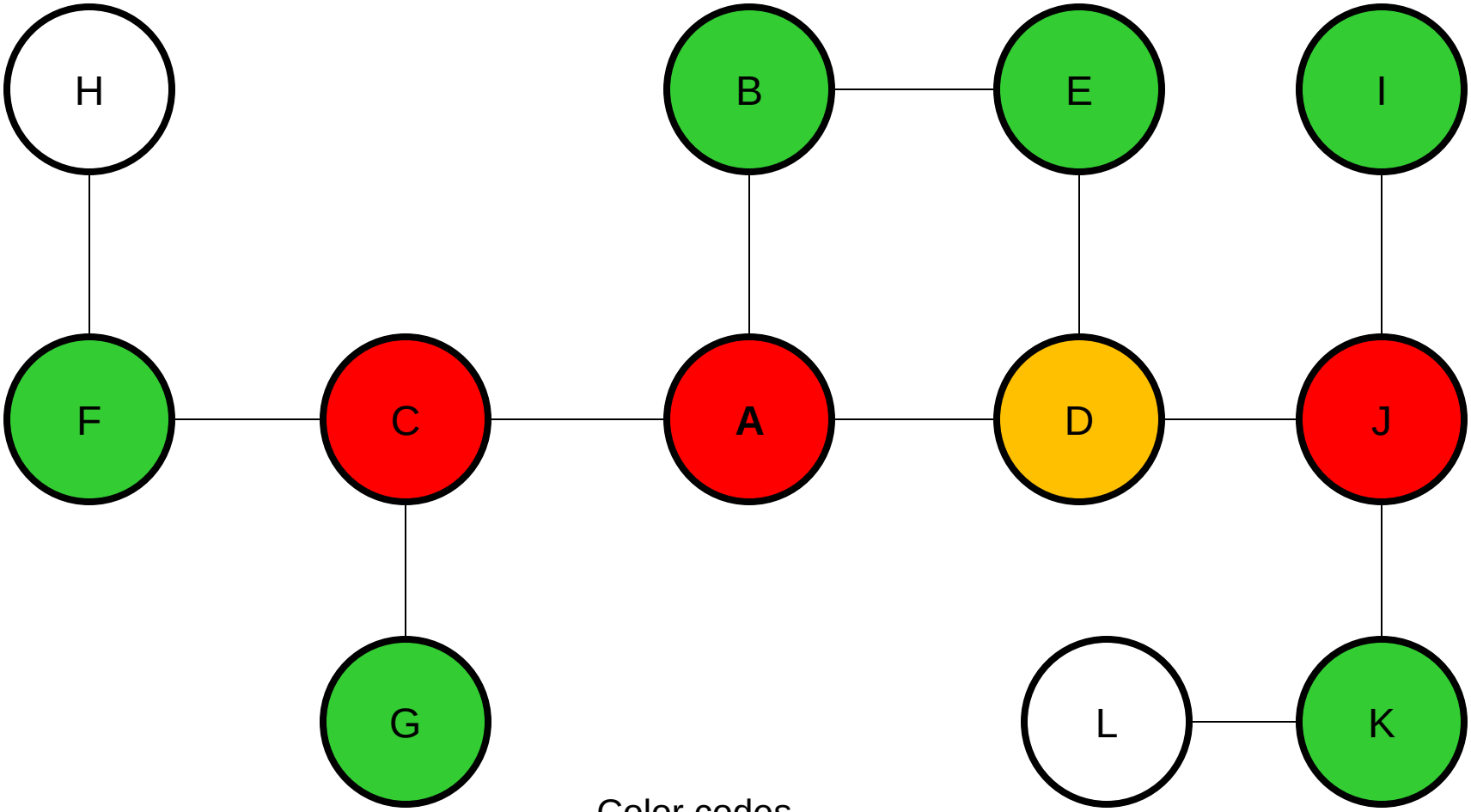

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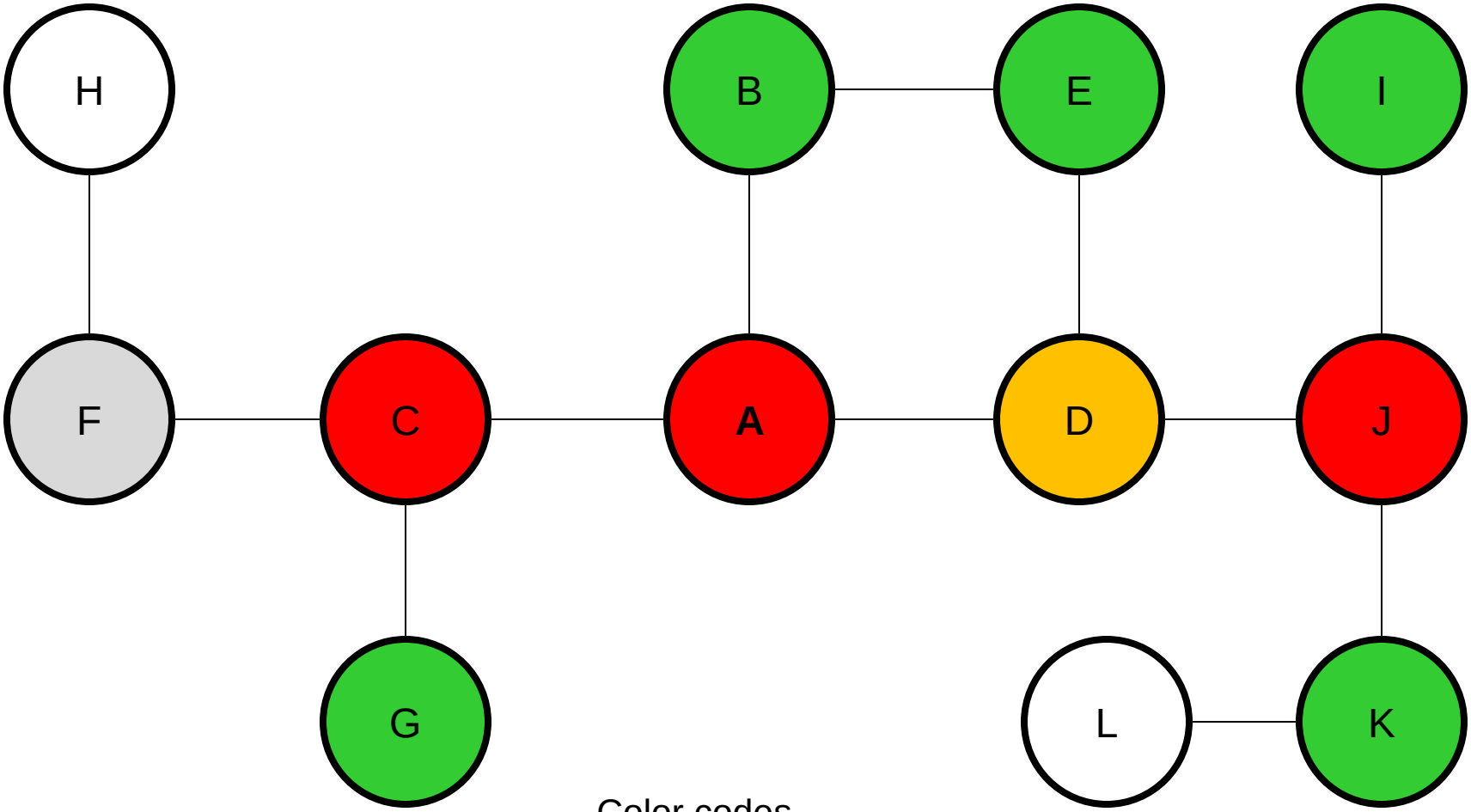

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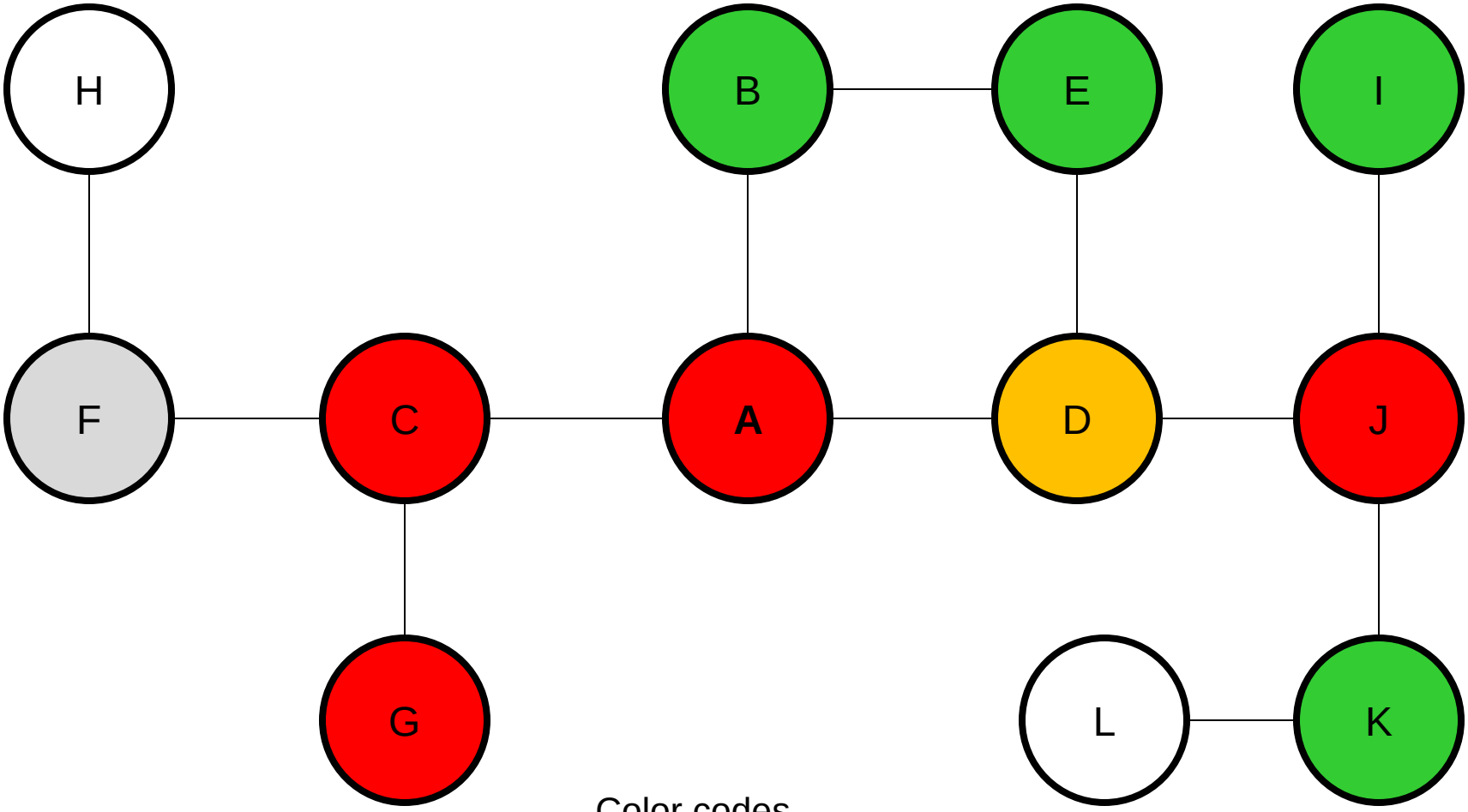

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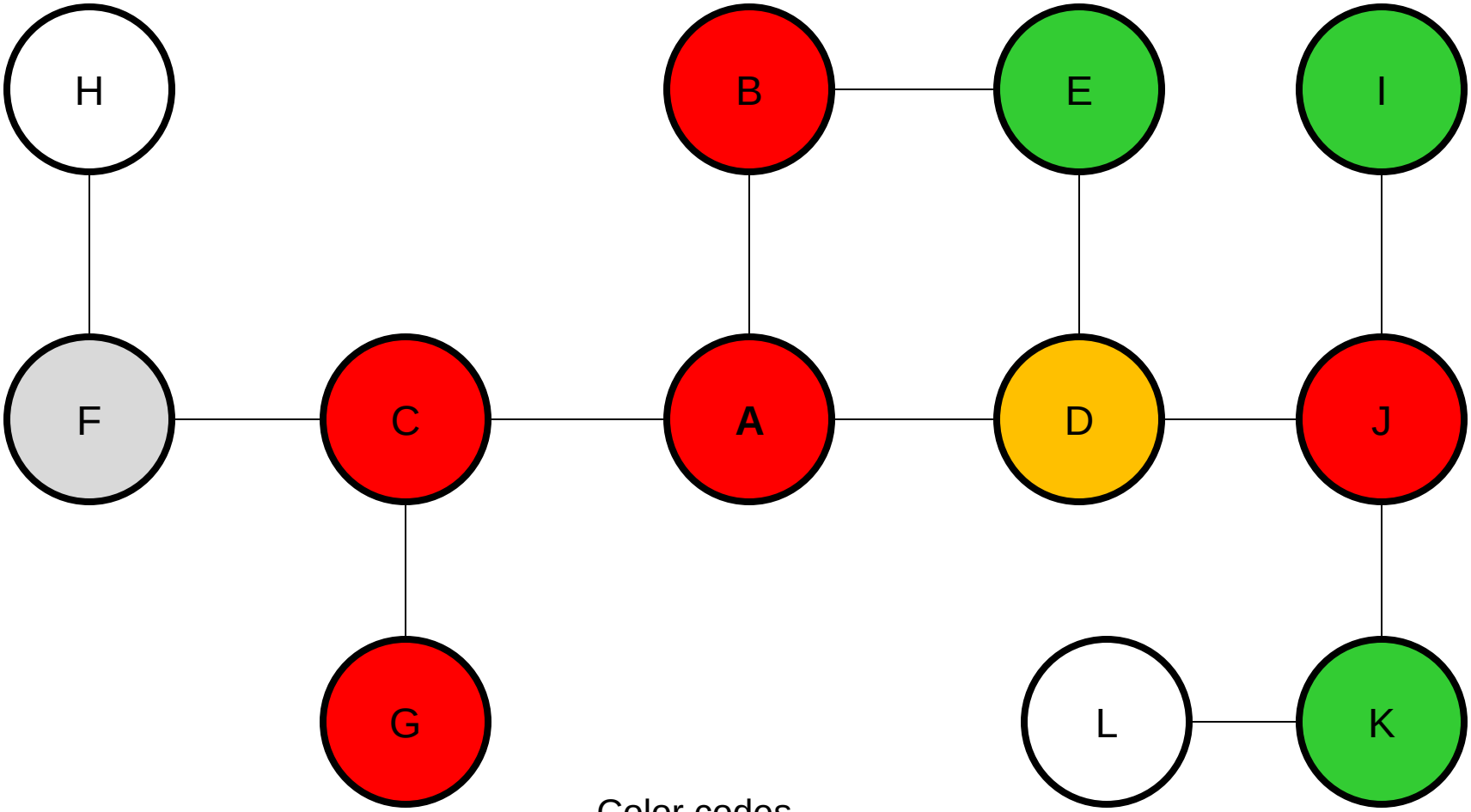

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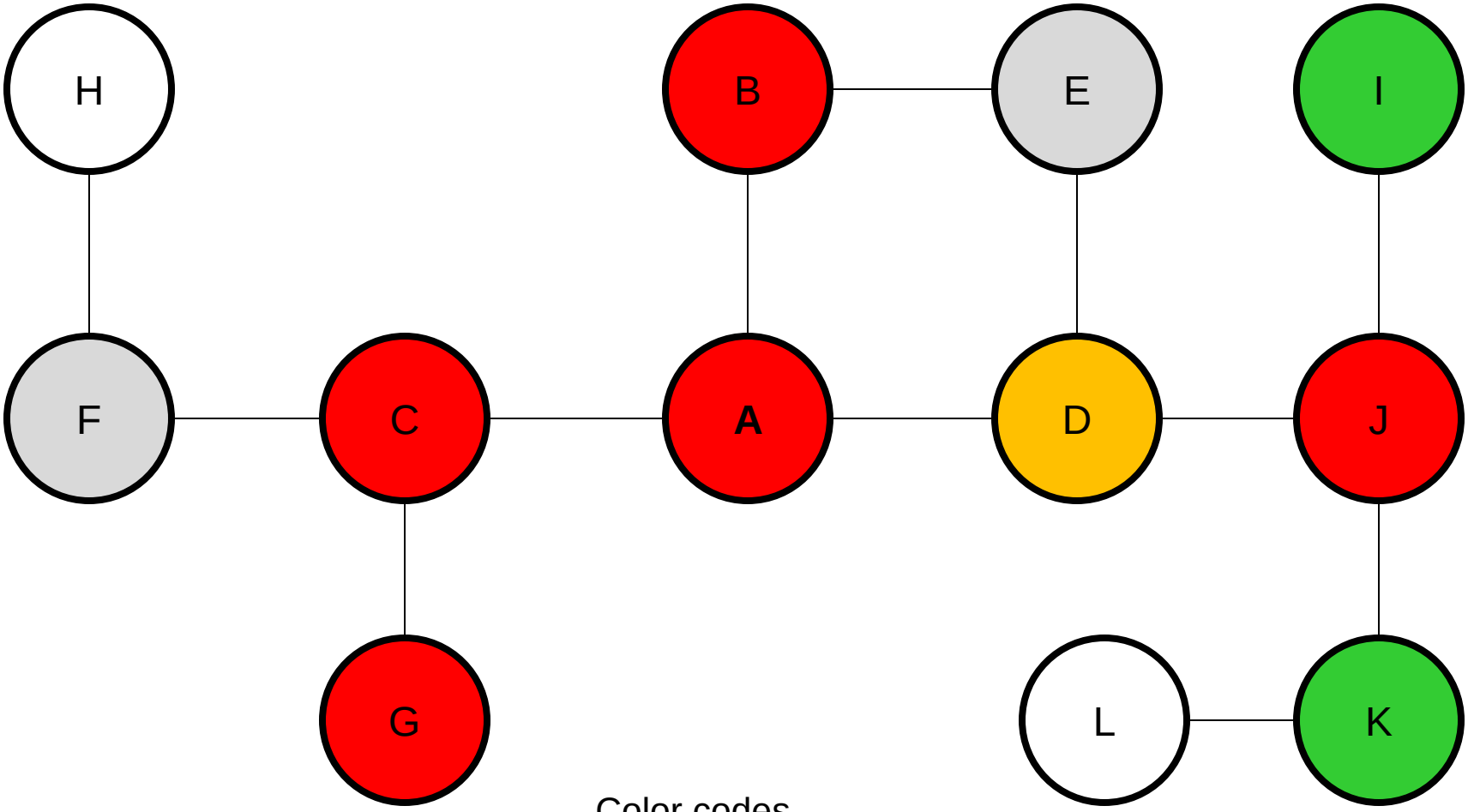

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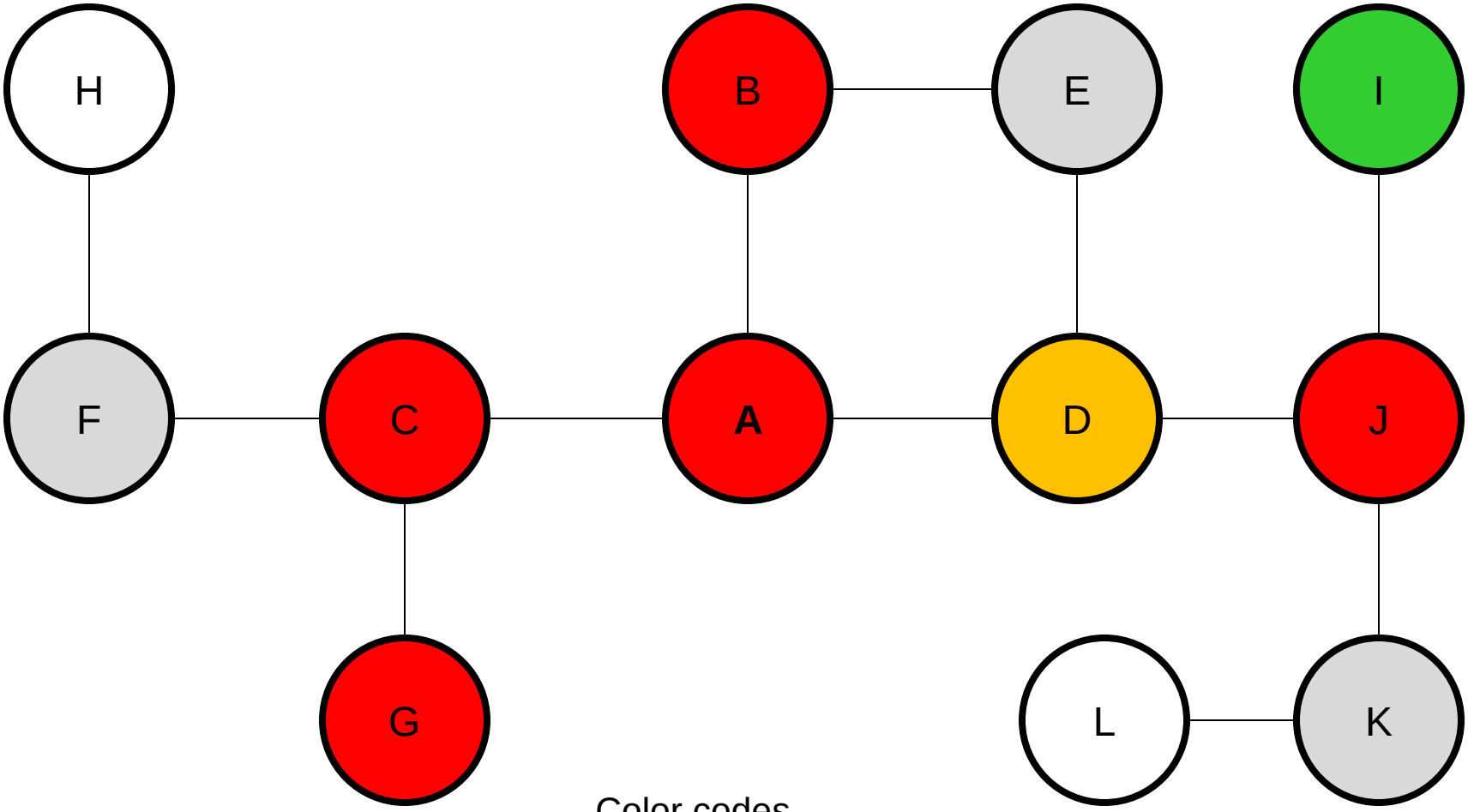

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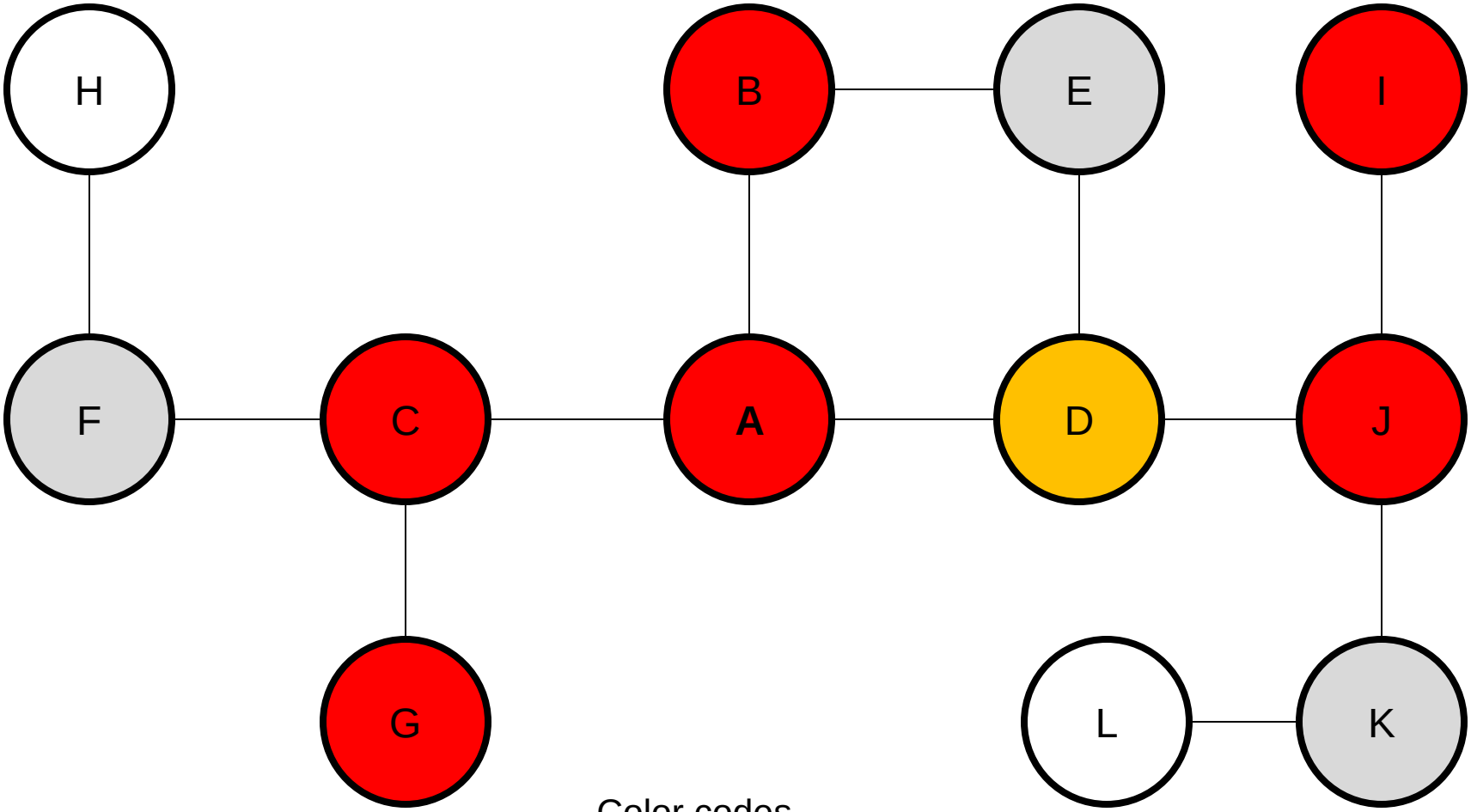
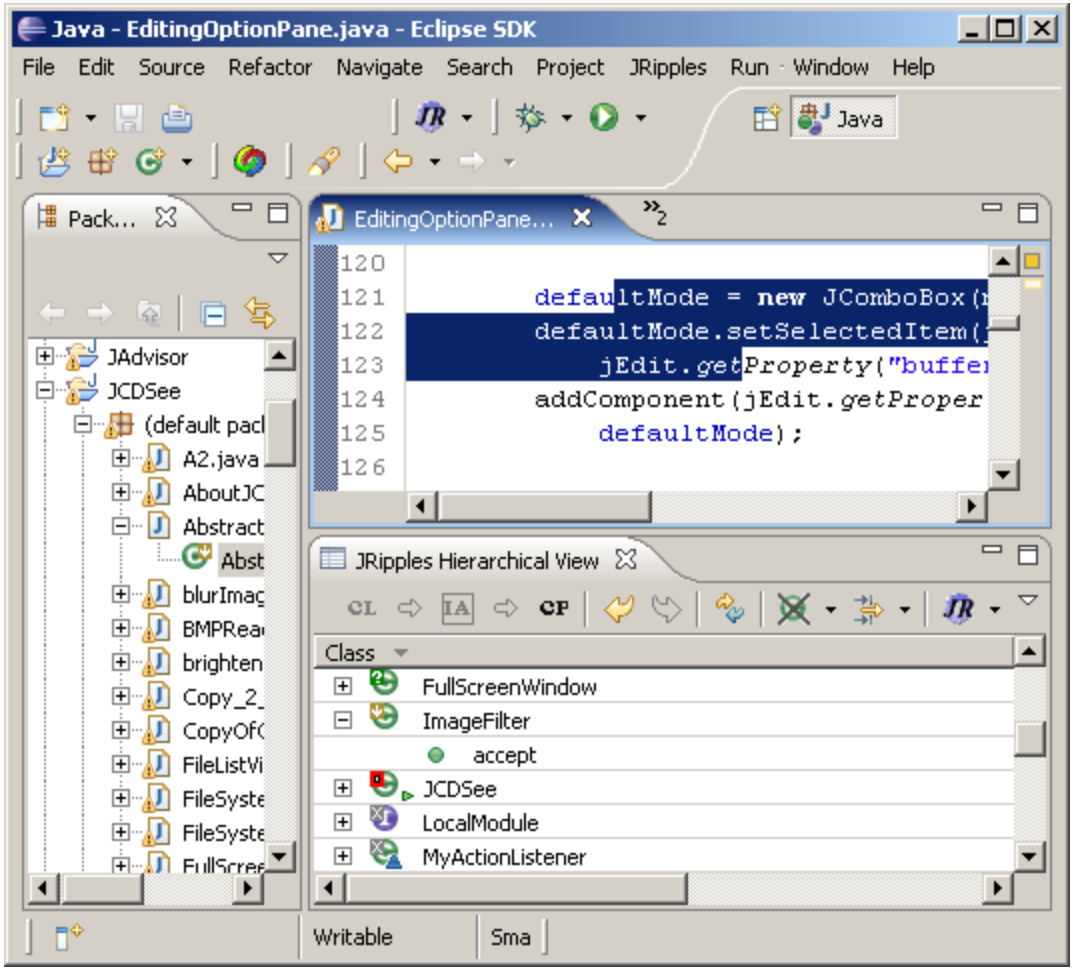


http://**jripples**.sourceforge.net

- Eclipse plug-in
  - Java
  - 15,000 LOC
  - 150 Classes
- Keeps track of marks

  Changed,
  Propagating,
  Unchanged,
  Next



Research in IA

- Navigates program dependencies
- Some dependencies propagate the change while others do not
  - Heuristics and tools that identify “likely to propagate” dependencies - need further attention
  - Heuristics for determining when the incremental impact analysis is completed
  - Hidden dependencies

Seamless IDE for PMSC

- PMSC currently needs multiple uncoordinated tools
  - JRipples for concept location, impact analysis
  - Mylyn for the workflow
  - Tasktop for timing data
  - JUnit for unit tests
  - Abbot for functional tests
  - Refactoring tools
  - . . .
- Future IDE will provide seamless support

Measuring impact of PMSC

- Introducing well-defined process often improves productivity and quality
- Preliminary data
  - PMSC may improve developer productivity up to 50%!
  - Needs additional measurements
- Seamless IDE may offer additional gains

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Software maintenance

- **Maintenance ≠ evolution !!**
- Maintenance also consists of repeated changes to software
  - Objectives are drastically reduced
  - The only goal is to keep software usable in a cost-effective way
  - No new functionality
- Software enters maintenance (servicing) stage when it is transferred to users

Parallel evolution and maintenance

- Several branches
  - One is evolved into new version
  - Other branches (released versions) are just maintained

How does evolution stop:

- Managerial decision
  - Expensive evolution stops if it is no longer needed
- Stabilization
  - No longer any volatility
- Technical debt gets out of hand ☹
  - Code is no longer evolvable
  - Can happen by accident

Future of maintenance

- Accidental code decay is a serious issue
- Research:
  - Keep software evolvable, clean technical debt
- Complementary approach:
  - Extend software evolution (PMSC) to the code that is currently considered non-evolvable

Conclusions

- Software evolution was historically an unexpected and peripheral phenomenon
- Moved into the center of software development
- It gained enormous importance to both developers and researchers

Conclusion

- We covered
  - Staged model of software lifespan
    - Includes evolution
  - Evolutionary software development
    - Many processes, some suitable for large projects
  - Phased model of software change
    - For changes that have limited impact
  - Software maintenance
    - Keeping software usable, no new functionality

Book on this topic