UNIVERSITÉ DE RENNES 1

ESIR ECOLE SUPERIEURE D'INGENIEURS DE RENNES

Méthodes de Développement Industriel (MDI)

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http://www.mathieuacher.com

Associate Professor

University of Rennes 1

UMR IRISA

Inria informatics mathematics

Disclaimer

- Matériel basé sur le travail de Benoit Combemale
  - http://www.combemale.fr/modeling
- Supports en Français / Anglais
  - http://www.mathieuacher.com/teaching/MDI
- Je suis enseignant-chercheur en génie logiciel / software engineering
  - Comment synthétiser des variantes?

Objectifs de MDI

- Méthodes de développement industriel (MDI)
  - En fait: génie logiciel / software engineering
  - Comment développer des systèmes logiciels de plus en plus complexe?
- #1 Prendre conscience de la complexité des systèmes logiciels actuels et à venir
  - Les enjeux et l'impact sur le métier
- #2 Modélisation
  - UML, SysML
- #3 Design patterns, refactoring, test
  - OO avancé
- #4 Méthodes

Modalités d'Evaluation

- Note de TP (40%)
  - Implémentation de design patterns et refactoring d'un système +/- complexe
  - Binôme
- Contrôle continu (60%)
  - 2 notes au cours des TDs
  - Questions de cours + exercices
    - UML
    - Design patterns

Aujourd'hui / Today

- Méthodes de développement industriel (MDI)
  - En fait: génie logiciel / software engineering
  - Comment développer des systèmes logiciels de plus en plus complexe?
- **#1 Prendre conscience de la complexité des systèmes logiciels actuels et à venir**
  - Les enjeux et l'impact sur le métier

Outline

① Issues in Software Engineering

② Evolution in Software Engineering

③ State of the Practice

④ Modeling in Software Engineering

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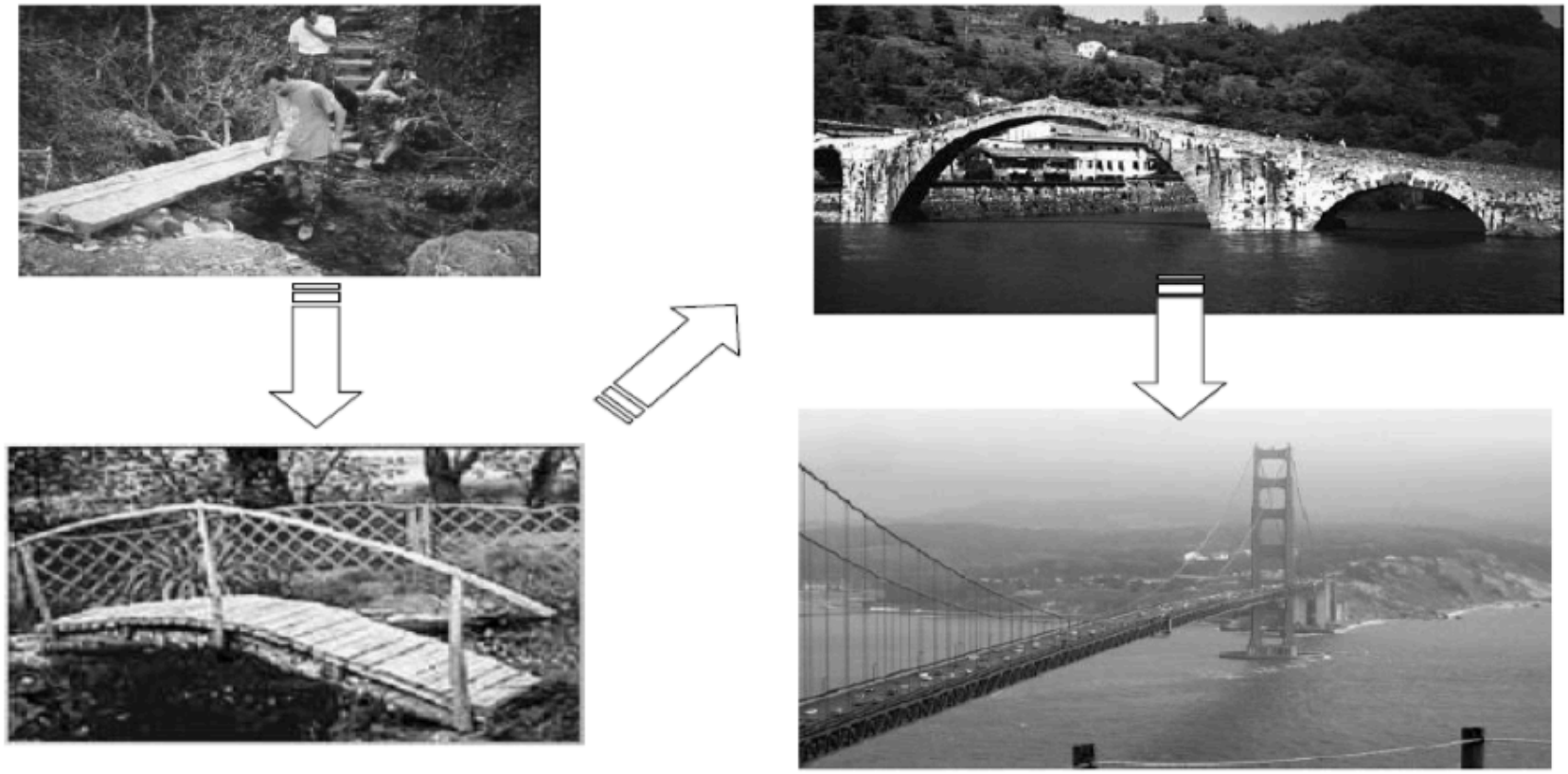
② Evolution in Software Engineering

③ State of the Practice

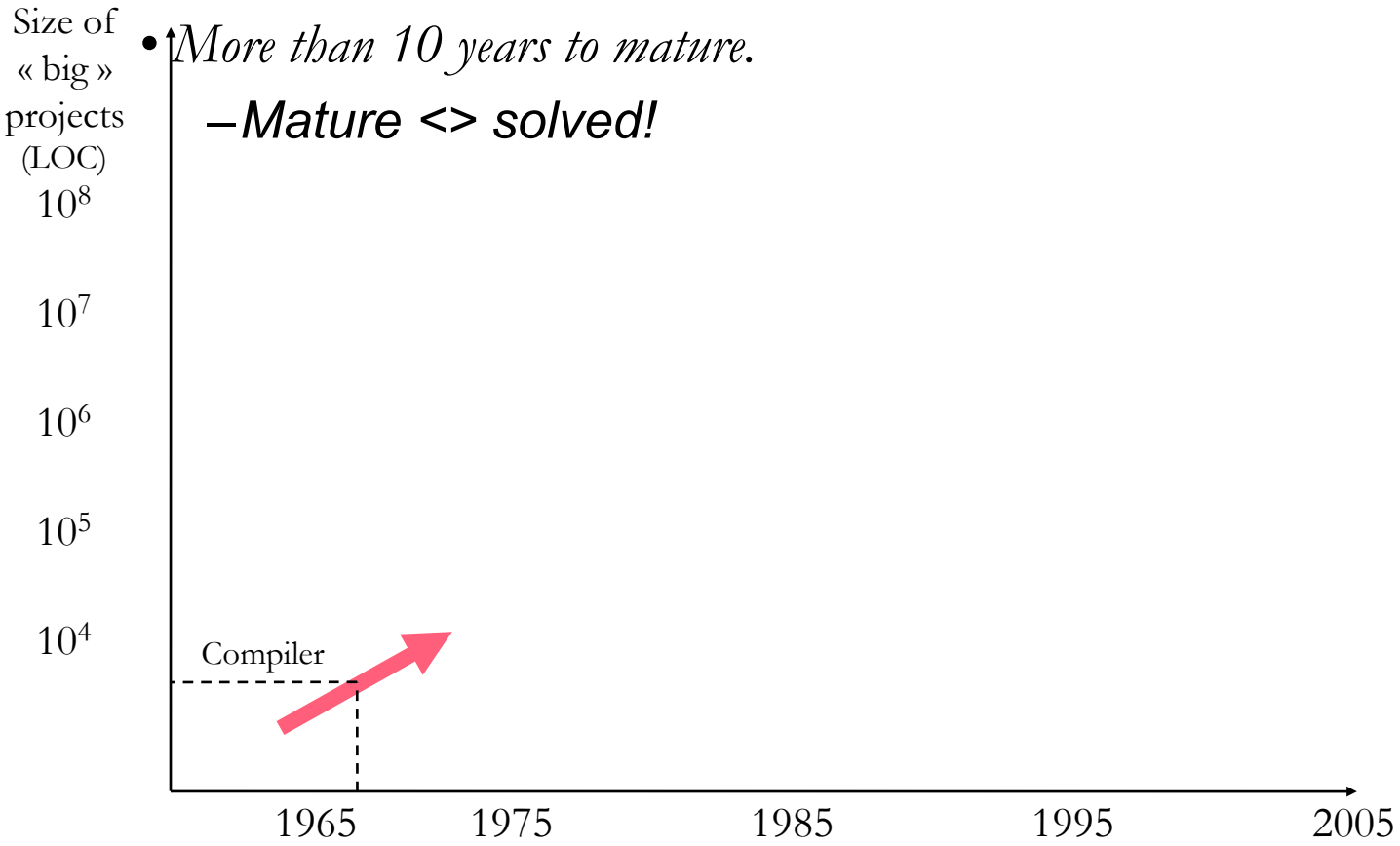
④ Modeling in Software Engineering

Software Complexity



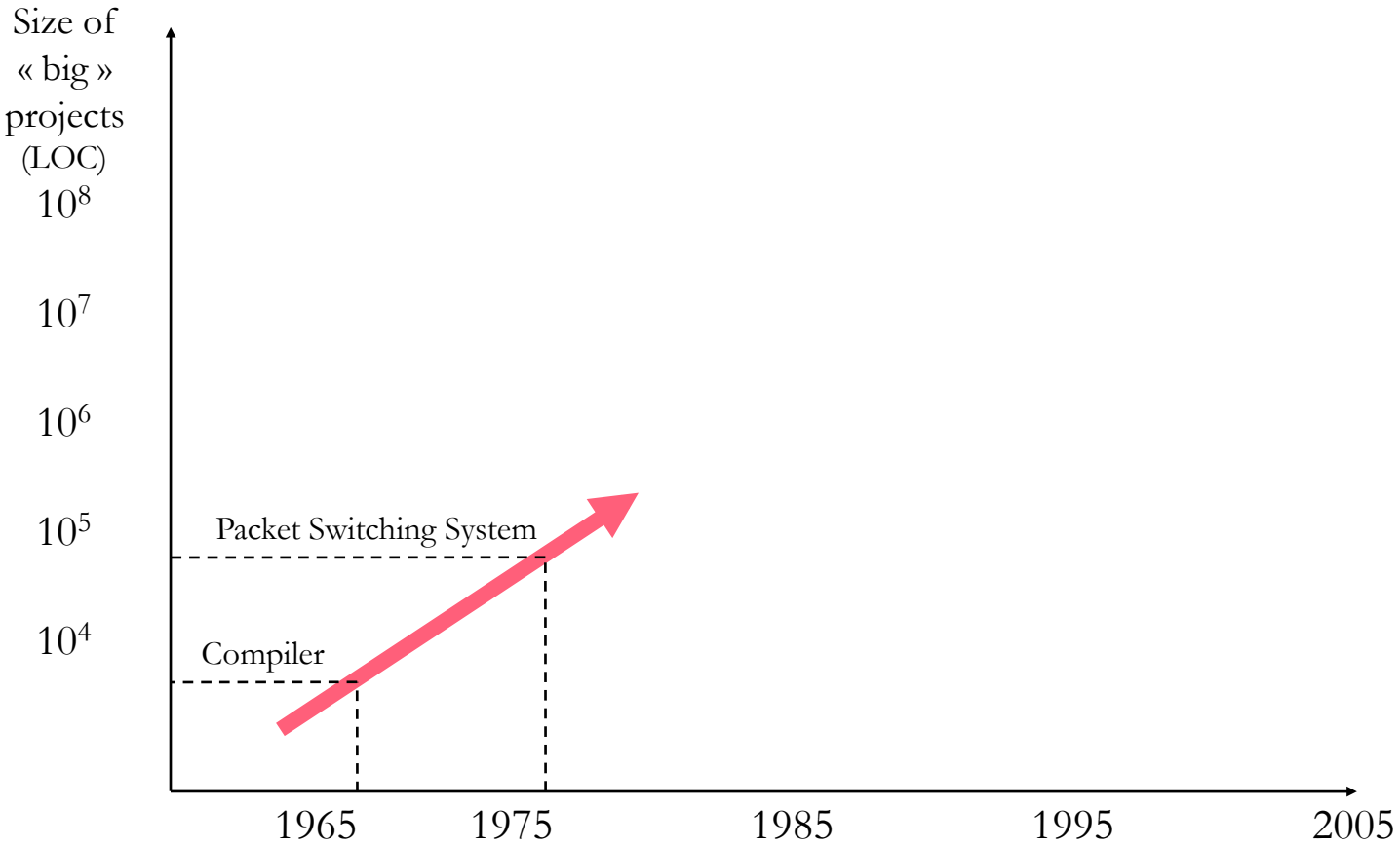
Problems addressed in SE

- 1960's: Cope with inherent complexity of software (Correctness)
  - Milestone: Floyd '*assigning meaning to programs*'



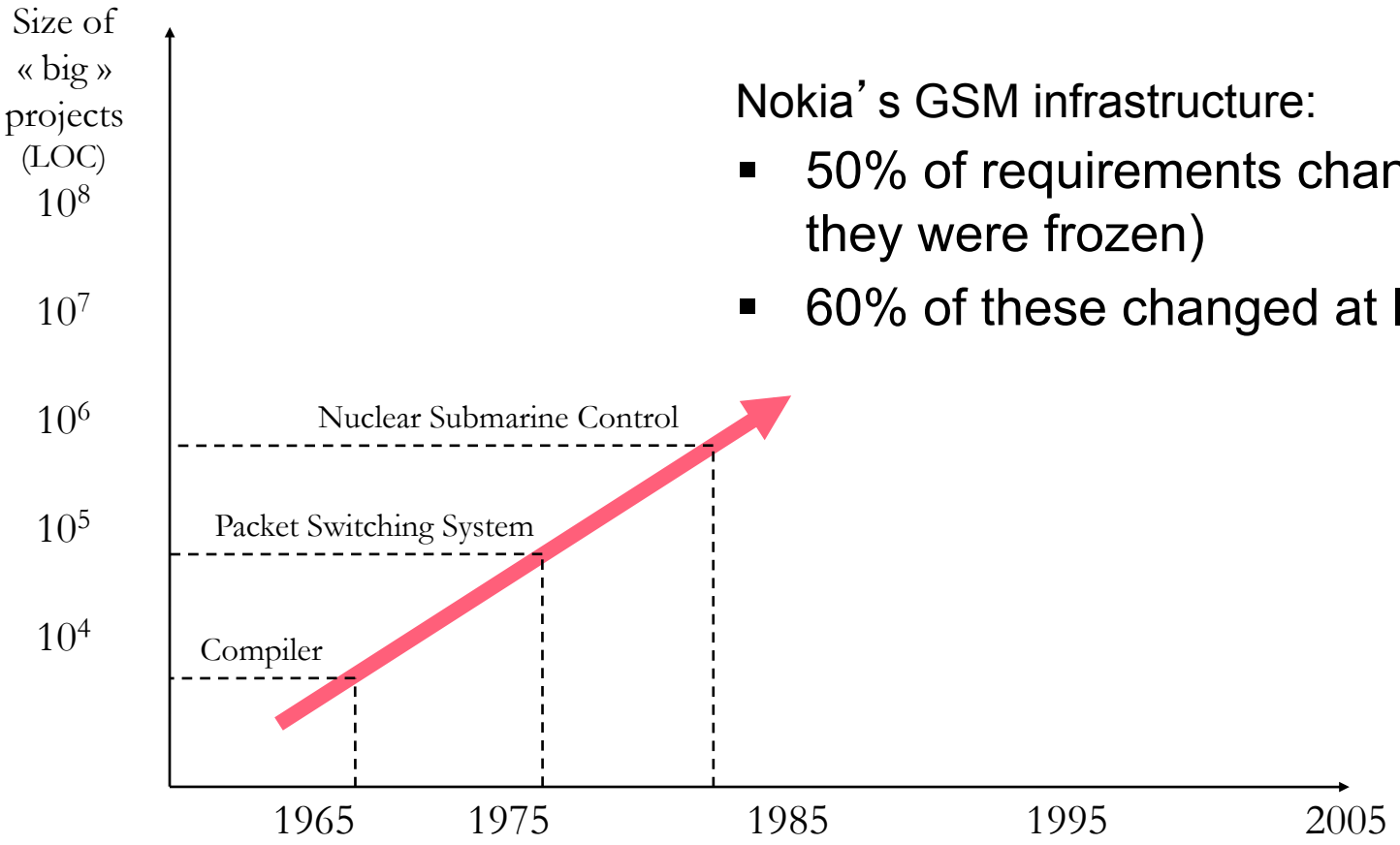
Problems addressed in SE

- 1970's: Cope with project size
  - Milestone: Parnas, Yourdon: *modularity & structure*
    - *More than 10 years to mature*



Problems addressed in SE

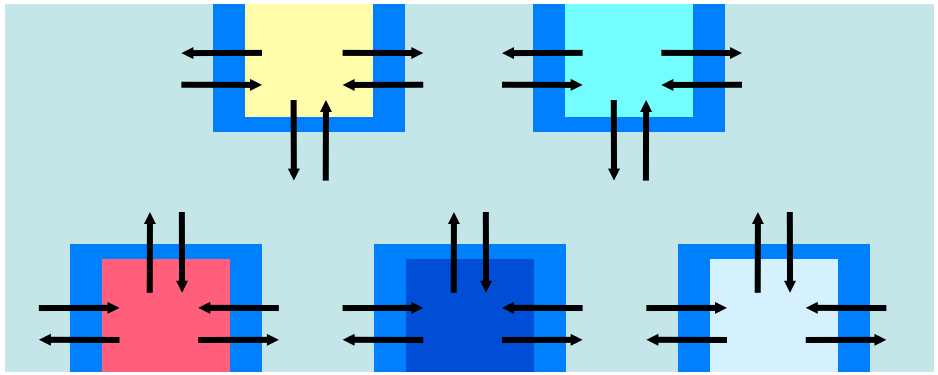
- 1980's: Cope with variability in requirements
  - Milestone: Jackson, Meyer: *modeling, object orientation*
    - *More than 10 years to mature*



Nokia's GSM infrastructure:

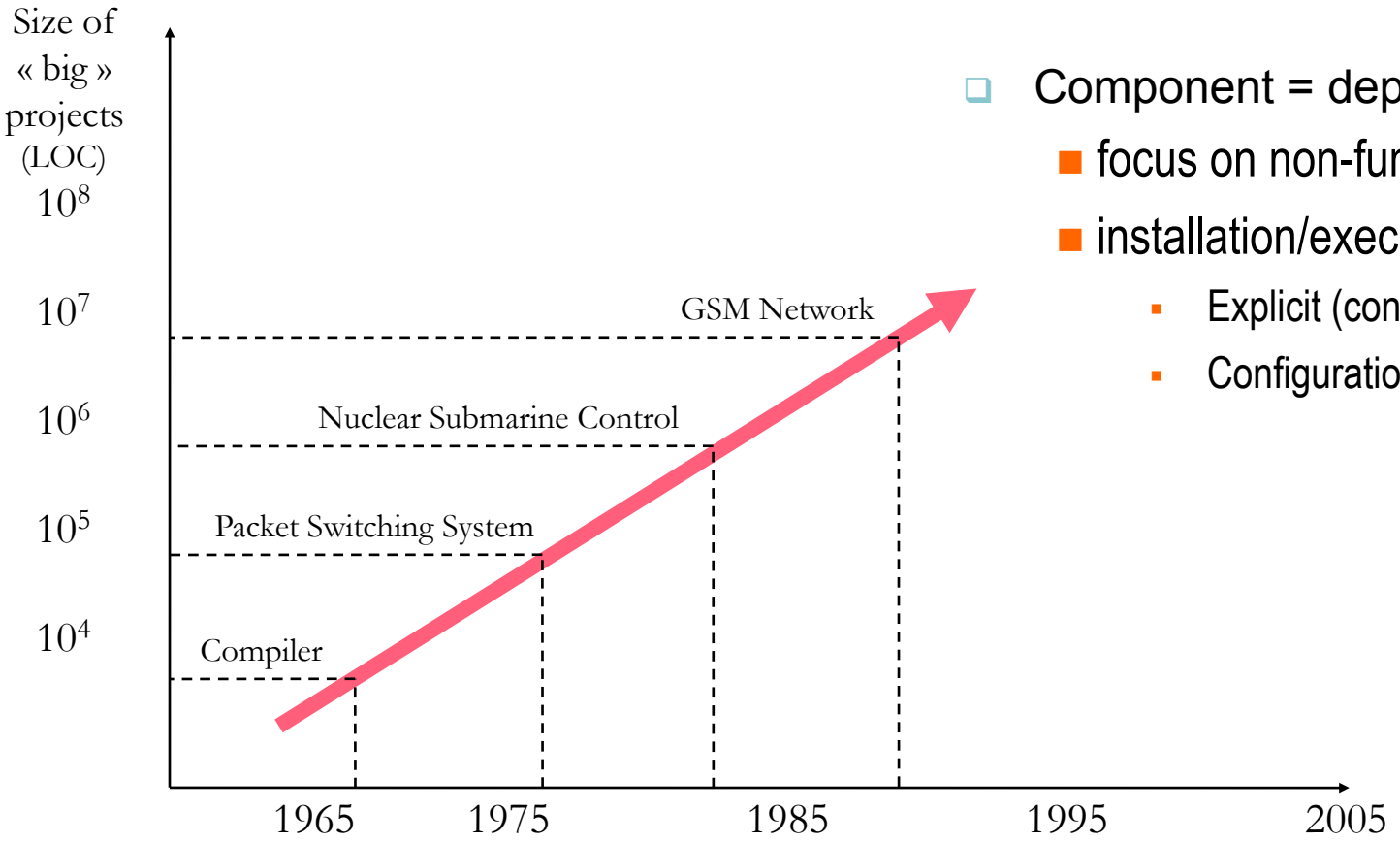
- 50% of requirements changed (after they were frozen)
- 60% of these changed at least twice!

OO approach: frameworks



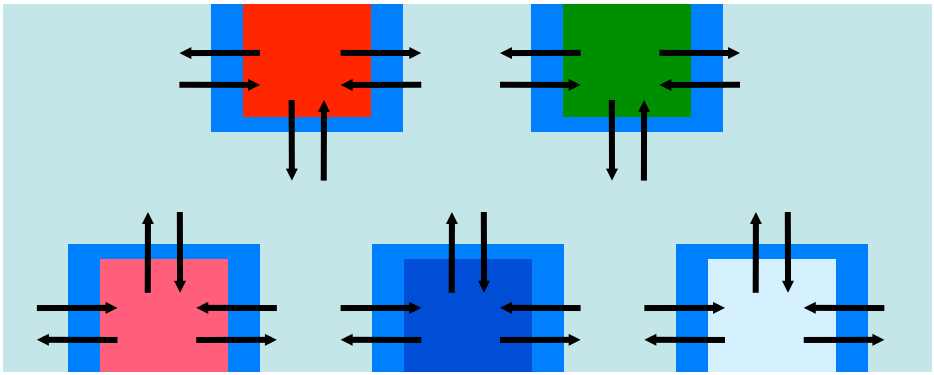
Problems addressed in SE

- 1990's: Cope with distributed systems and mass deployment:
  - Milestone: MS (COM), Szyperski: *product-lines & components*



- Component = deployment unit
  - focus on non-functional properties
  - installation/execution concept
    - Explicit (contractual) dependencies
    - Configuration and connection

OO approach: Models and Components

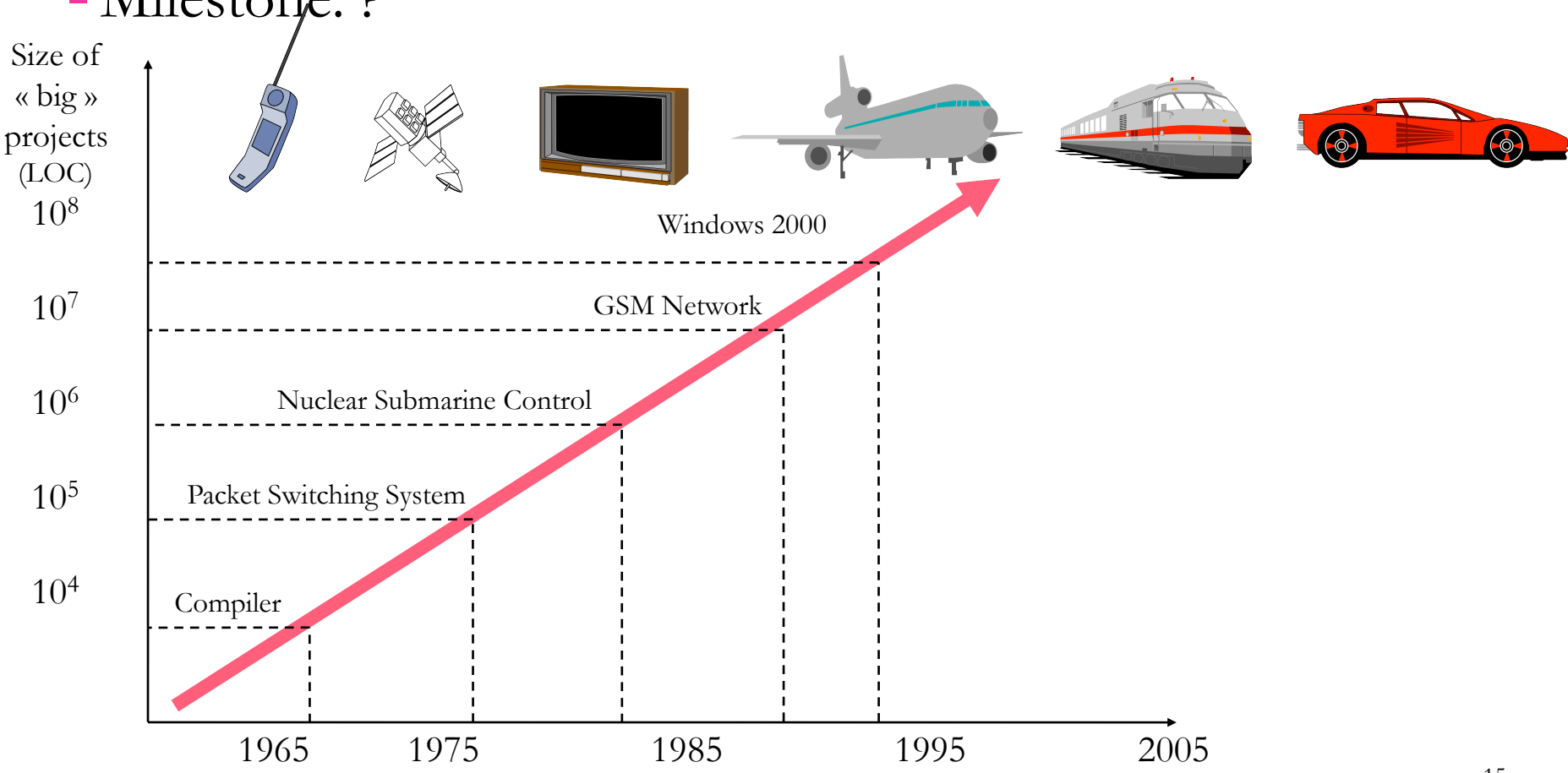


- Frameworks
  - Changeable software, from distributed/unconnected sources even after delivery, by the end user
  - Guarantees ?

    Functional , synchronization, performance, QoS

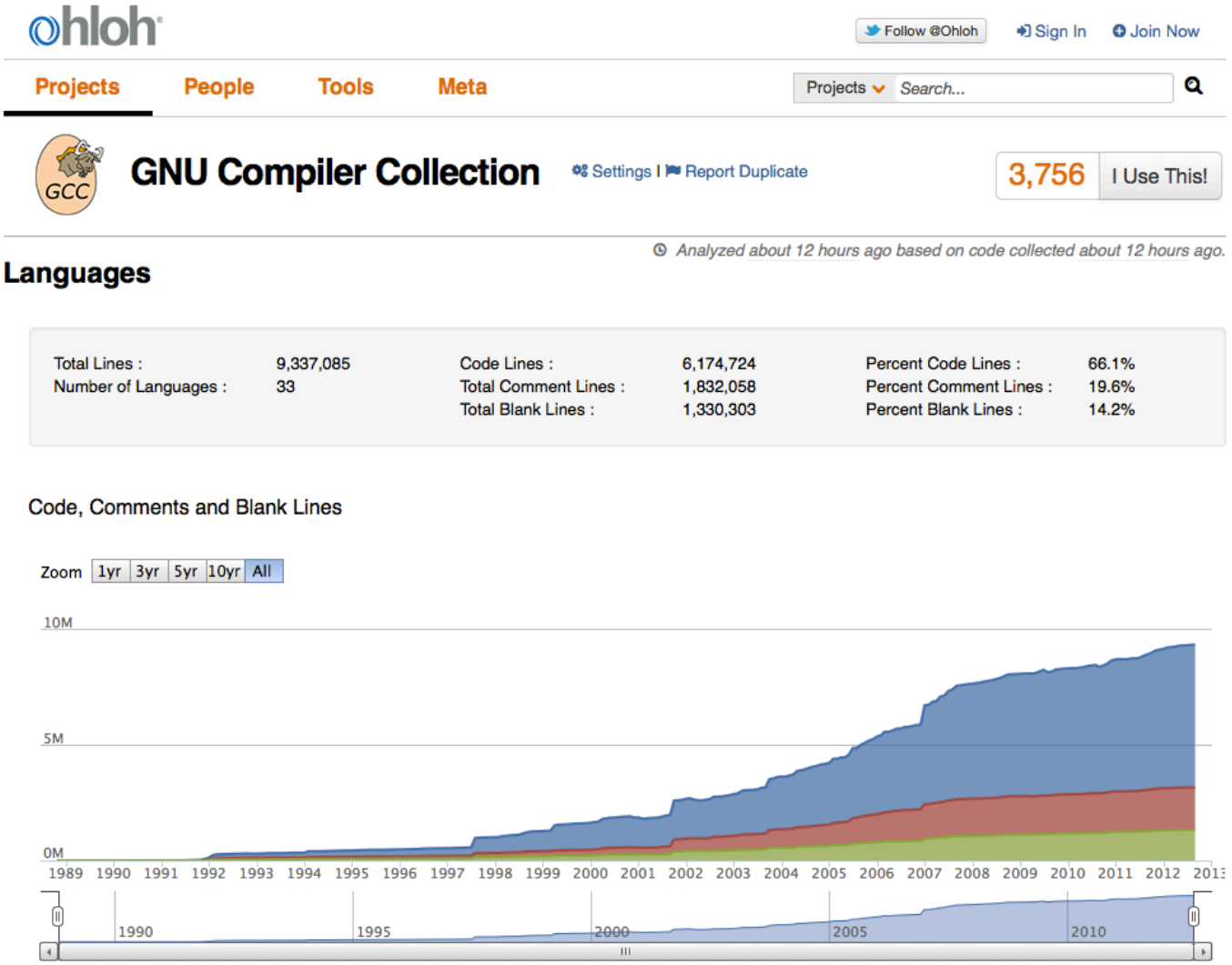
Problems addressed in SE

- 2000's: pervasive software integration, accelerating technological changes (platforms)
  - Milestone: ?




CHANGE
AHEAD

Software Complexity



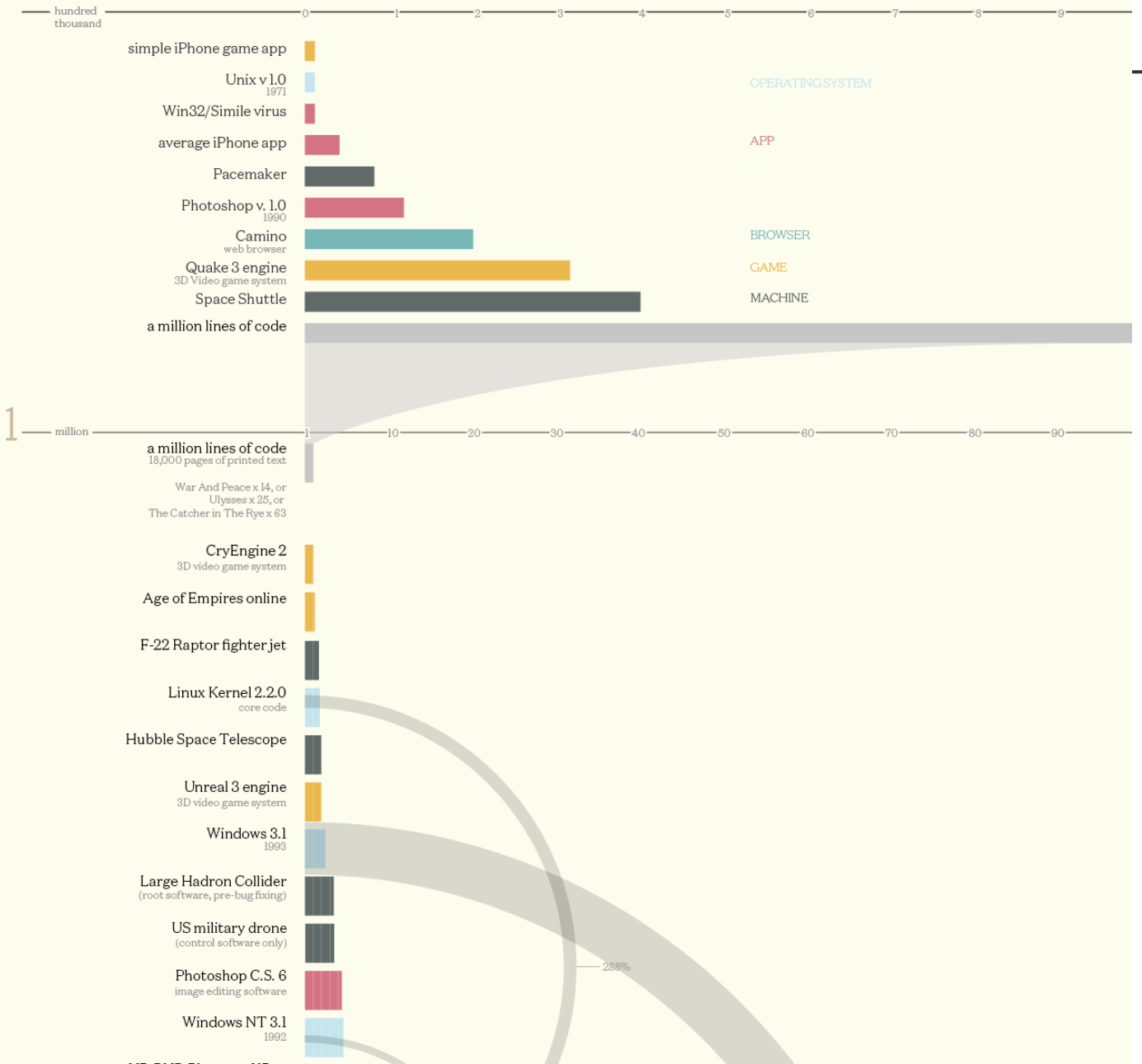
See http://www.ohloh.net/p/gcc. Retrieved 2012-09-16.

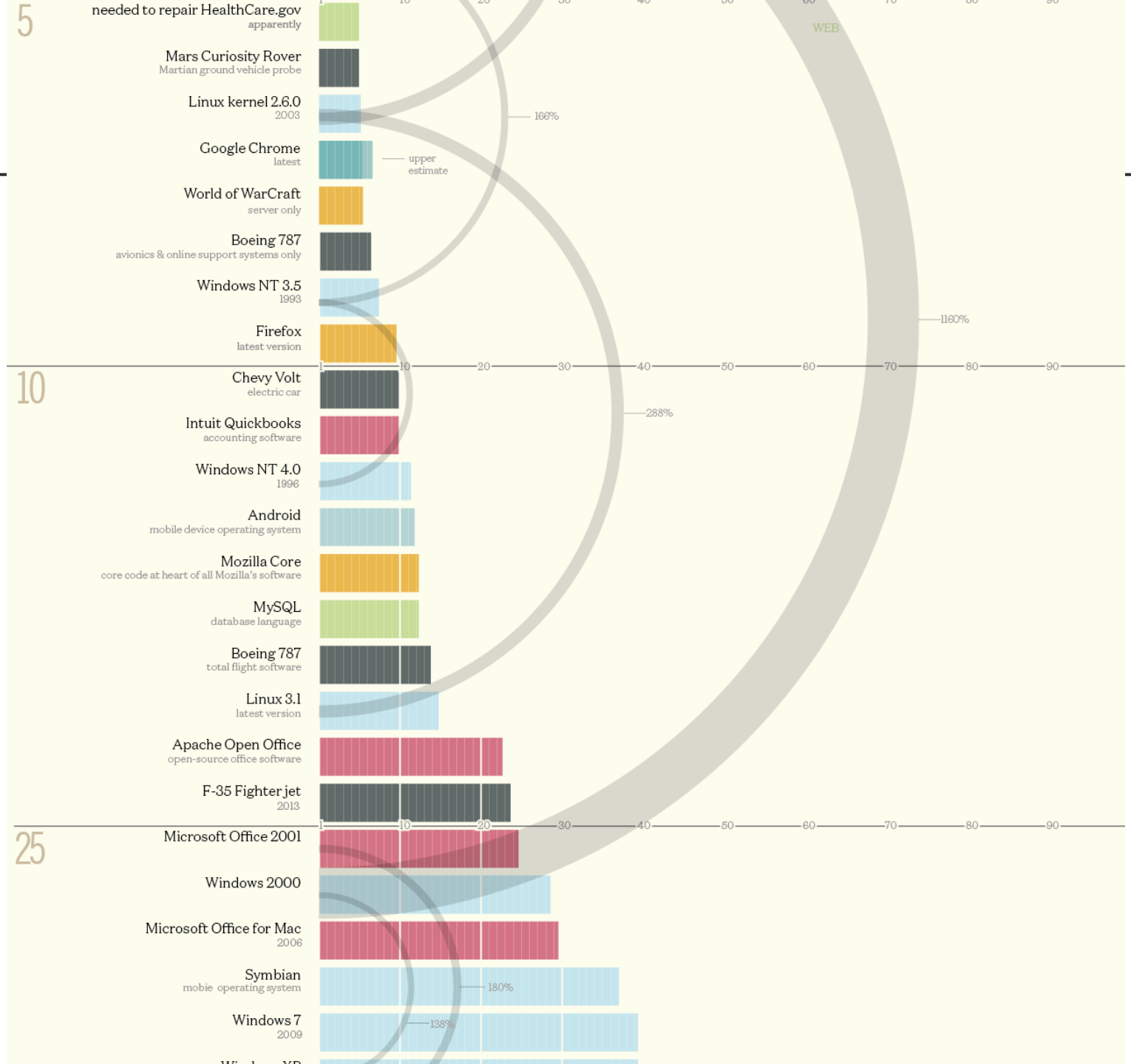
Software Complexity

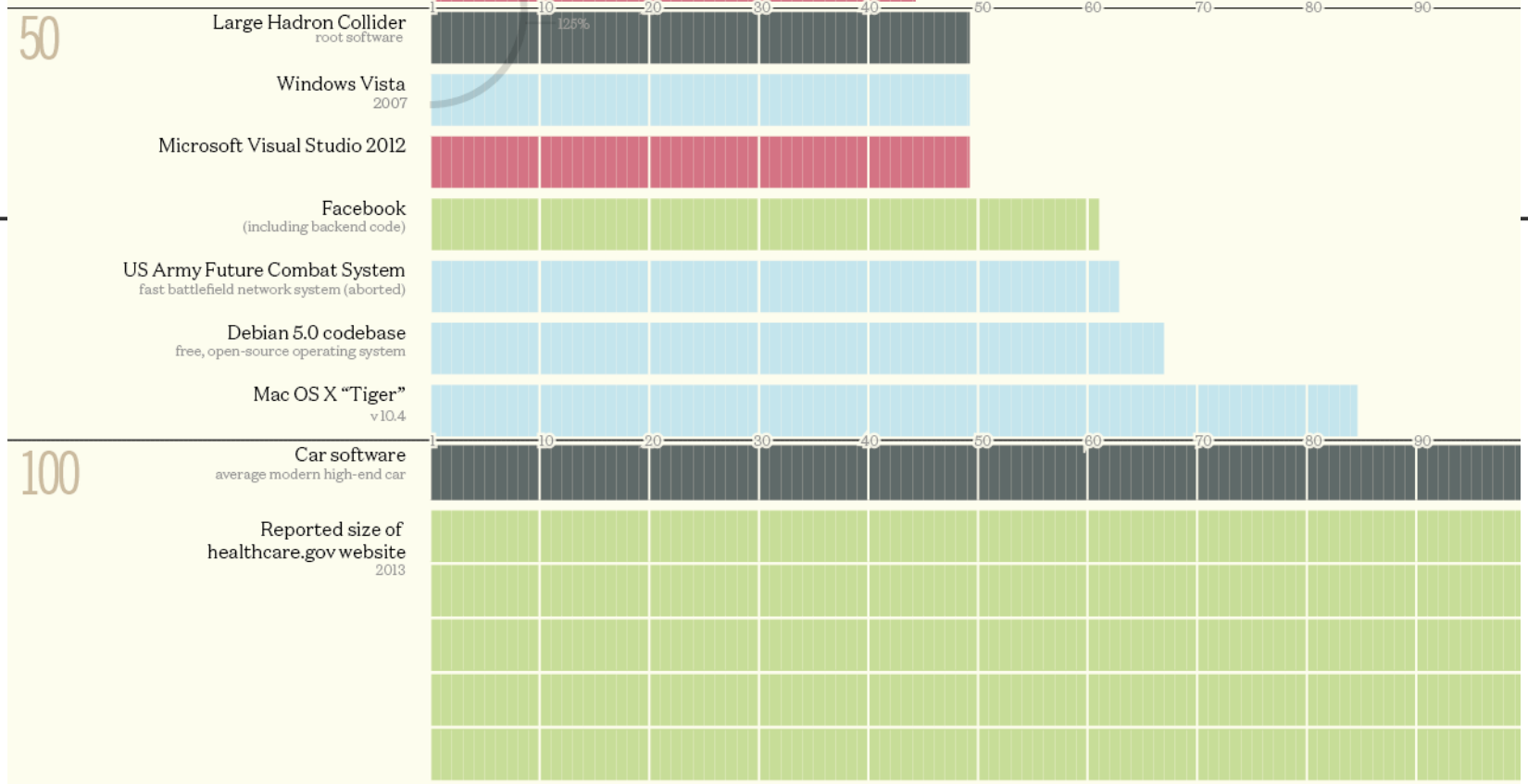
But also…

Codebases

Millions of lines of code




5
needed to repair HealthCare.gov
apparently
Mars Curiosity Rover
Martian ground vehicle probe
Linux kernel 2.6.0
2003
Google Chrome
latest
upper estimate
World of WarCraft
server only
Boeing 787
avionics & online support systems only
Windows NT 3.5
1993
Firefox
latest version
10
Chevy Volt
electric car
Intuit Quickbooks
accounting software
Windows NT 4.0
1996
Android
mobile device operating system
Mozilla Core
core code at heart of all Mozilla's software
MySQL
database language
Boeing 787
total flight software
Linux 3.1
latest version
Apache Open Office
open-source office software
F-35 Fighter jet
2013
25
Microsoft Office 2001
Windows 2000
Microsoft Office for Mac
2008
Symbian
mobie operating system
Windows 7
2009
1 10 20 30 40 50 60 70 80 90
WEB
166%
1160%
288%
180%
138%



concept & design: David McCandless

informationisbeautiful.net

research: Pearl Doughty-White, Miriam Quick

sources NASA, Quora, Ohloh, Wired & press reports
note some guess work, rumours & estimates
data bit.ly/KIB_linescode

work in progress
v 0.62 // Oct 2013

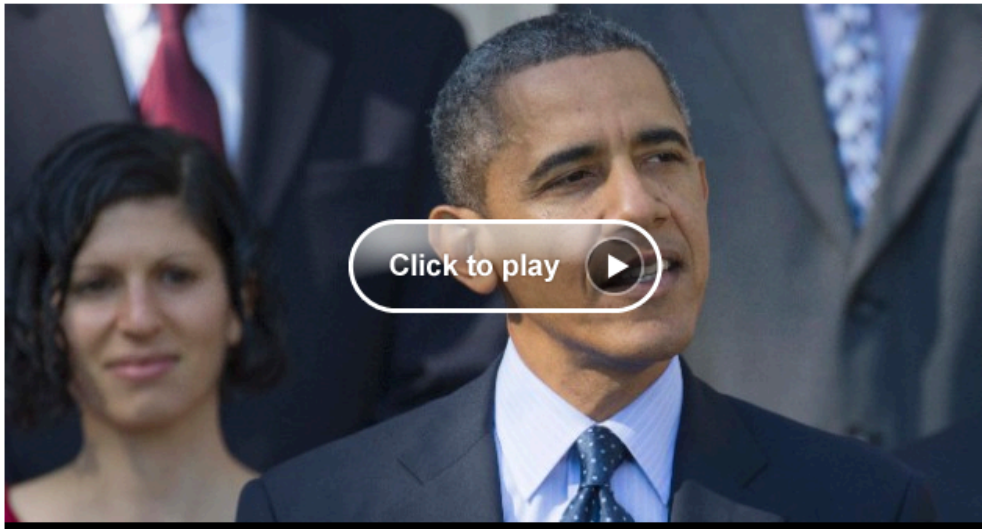
Language	Code Lines	Comment Lines	Comment Ratio	Blank Lines	Total Lines	Total Percentage
C	2,300,710	476,978	17.2%	452,773	3,230,461	34.6%
C++	1,206,025	250,128	17.2%	252,971	1,709,124	18.3%
Java	743,003	699,939	48.5%	179,887	1,622,829	17.4%
Ada	729,322	335,302	31.5%	252,886	1,317,510	14.1%
Autoconf	450,574	756	0.2%	71,979	523,309	5.6%
HTML	214,572	6,279	2.8%	43,661	264,512	2.8%
Fortran (Fixed-format)	113,138	2,326	2.0%	15,909	131,373	1.4%
Make	112,507	3,917	3.4%	14,123	130,547	1.4%
Go	66,921	11,083	14.2%	4,904	82,908	0.9%
Assembly	51,774	13,375	20.5%	10,080	75,229	0.8%
XML	49,875	675	1.3%	6,062	56,612	0.6%
Objective-C	28,137	5,215	15.6%	8,279	41,631	0.4%
shell script	19,657	5,823	22.9%	4,417	29,897	0.3%
Fortran (Free-format)	17,068	3,305	16.2%	1,686	22,059	0.2%
Perl	16,549	3,869	18.9%	2,463	22,881	0.2%
TeX/LaTeX	12,823	6,358	33.1%	1,639	20,820	0.2%
Scheme	11,023	1,010	8.4%	1,205	13,238	0.1%
Automake	10,775	1,210	10.1%	1,626	13,611	0.1%
Modula-2	4,326	983	18.5%	826	6,135	0.1%
Objective Caml	2,930	578	16.5%	389	3,897	0.0%
XSL Transformation	2,896	450	13.4%	576	3,922	0.0%
AWK	2,318	569	19.7%	376	3,263	0.0%
CSS	2,049	171	7.7%	453	2,673	0.0%
Python	1,735	410	19.1%	404	2,549	0.0%
Pascal	1,044	141	11.9%	218	1,403	0.0%
C#	879	506	36.5%	230	1,615	0.0%
DCL	698	154	18.1%	15	867	0.0%
JavaScript	655	404	38.1%	144	1,203	0.0%
Tcl	392	113	22.4%	72	577	0.0%
Haskell	154	0	0.0%	17	171	0.0%
CMake	134	31	18.8%	25	190	0.0%
Matlab	57	0	0.0%	8	65	
DOS batch script	4	0	0.0%	0	4	
Totals	6,174,724	1,832,058		1,330,303	9,337,085	

- Interoperability

See http://www.ohloh.net/p/gcc. Retrieved 2012-09-16.

Report: Healthcare website failed test ahead of rollout

By **Ed Payne, Matt Smith** and **Tom Cohen**, CNN
October 23, 2013 -- Updated 0103 GMT (0903 HKT)



Report: Obamacare site failed early test

STORY HIGHLIGHTS

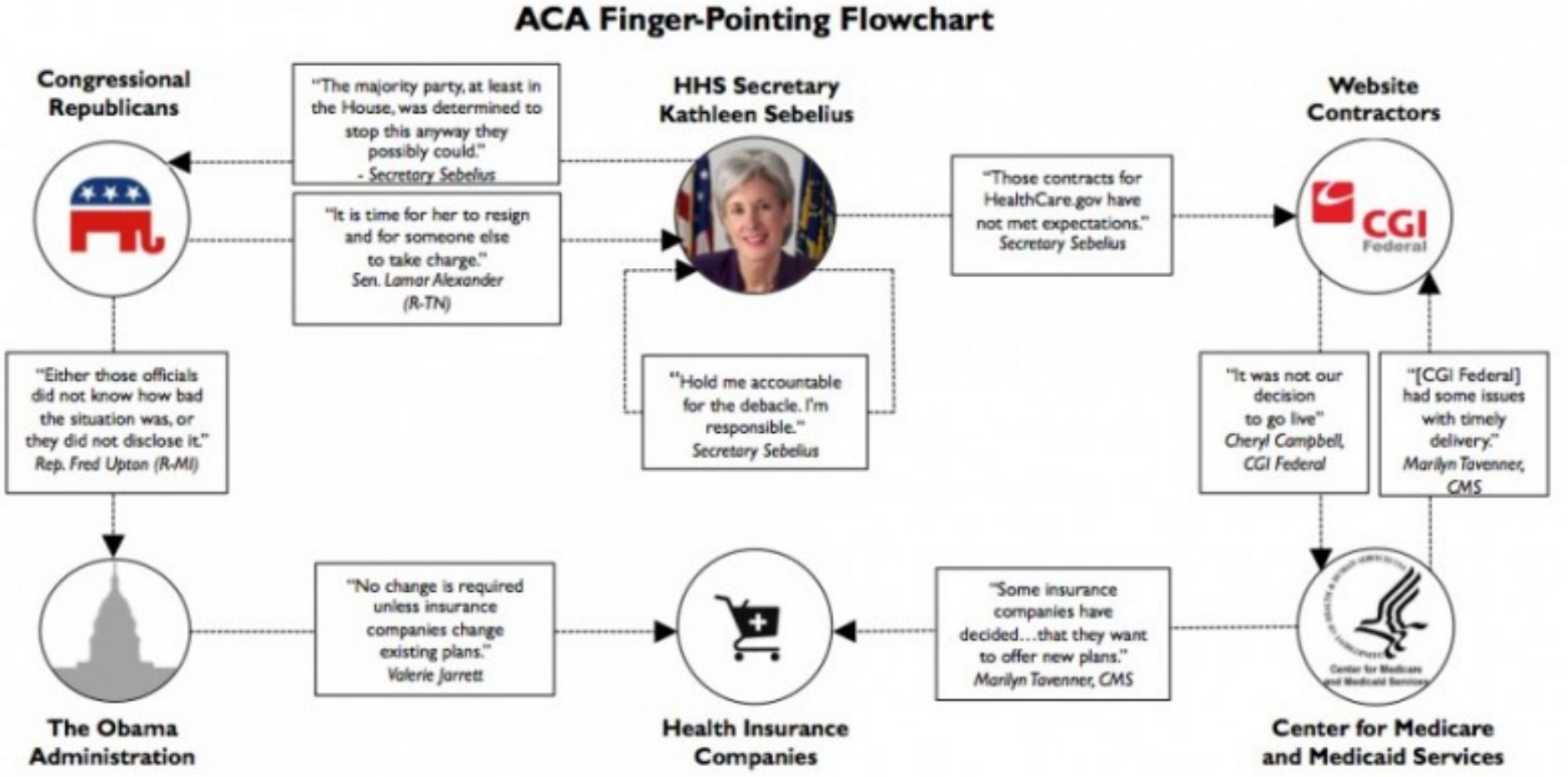
- **NEW:** Top White House official part of "tech surge" on Obamacare
- Obamacare "is not failing" despite website woes, White House spokesman says
- Obama says HealthCare.gov problems are "going to get fixed"
- Secretary Sebelius expected to testify at a congressional hearing next week

Washington (CNN) -- The President's healthcare sign-up web page was supposed to handle tens of thousands of people at once. But in a trial run days before its launch, just a few hundred users flatlined the site.

Despite the problems, federal health officials pushed aside the crash cart and rolled out HealthCare.gov on October 1 as planned, The Washington Post reported.

The result? The website crashed shortly after midnight as a couple thousand people tried to start the process, two people familiar with the project told the Post.

Requirements engineering/Management problem



http://www.washingtonpost.com/blogs/wonkblog/wp/2013/11/01/thirty-one-things-we-learned-in-healthcare-govs-first-31-days/

Thirty-one things we learned in HealthCare.gov's first 31 days

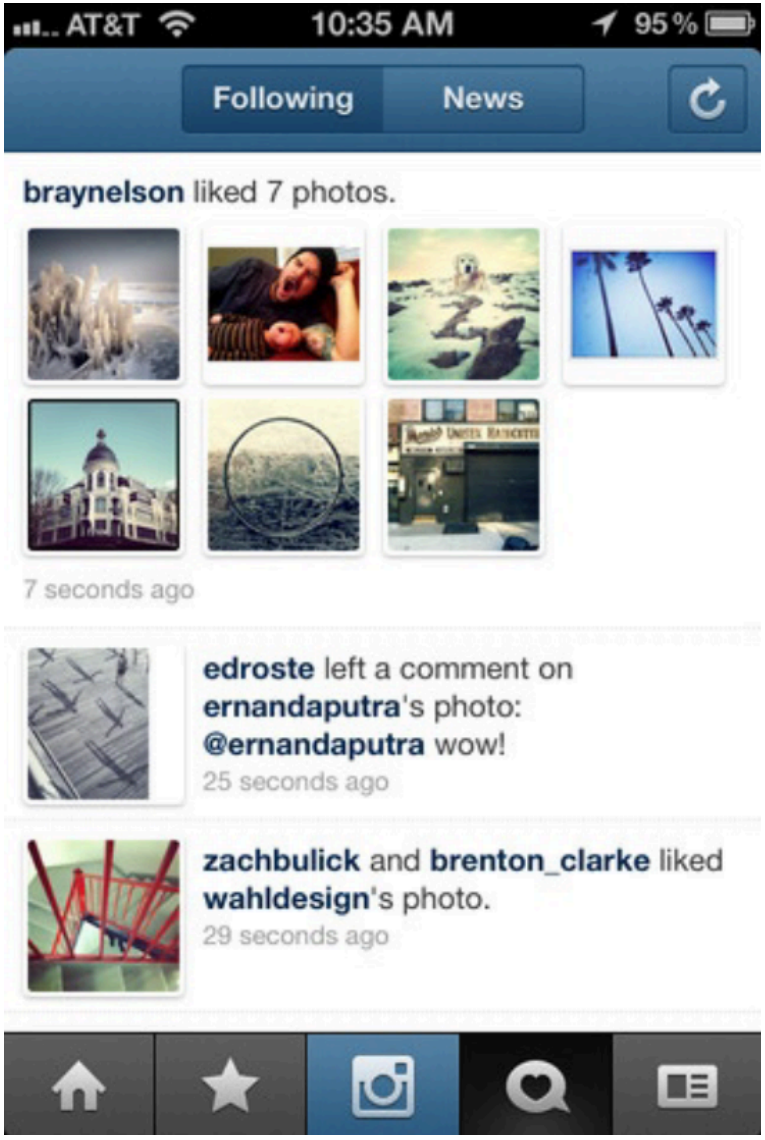
Scalability problem

Technical problems (e.g., inaccurate data, cancellation failures)

Testing issues

http://www.washingtonpost.com/blogs/wonkblog/wp/2013/11/01/thirty-one-things-we-learned-in-healthcare-govs-first-31-days/

Instagram Story



Instagram Story

« Instagram is an app that **only took 8 weeks** to build and ship, but was a product of over a year of work. »

http://www.forbes.com/sites/limyunghui/2012/04/09/inspiring-insights-by-instagram-ceo-kevin-systrom-the-man-who-built-a-1-billion-startup/

Instagram Story

« While I was there working in marketing, I started doing more and more engineering at night on simple ideas that helped me learn how to program **(I don't have any formal CS degree or training) »**

http://www.forbes.com/sites/limyunghui/2012/04/09/inspiring-insights-by-instagram-ceo-kevin-systrom-the-man-who-built-a-1-billion-startup/

Instagram Story

« We spent 1 week prototyping a version that focused solely on photos.
It was pretty awful. So we went back to creating a native version of Burbn. We actually got an entire version of Burbn done as an iPhone app, but it felt cluttered, and overrun with features. It was really difficult to decide to start from scratch, but we went out on a limb, and basically cut everything in the Burbn app except for its photo, comment, and like capabilities. What remained was Instagram. »

http://www.forbes.com/sites/limyunghui/2012/04/09/inspiring-insights-by-instagram-ceo-kevin-systrom-the-man-who-built-a-1-billion-startup/

Instagram Story

« So 8 weeks later, we gave it to our friends, beta tested, bug fixed, etc. and this Monday we decided it was ready to ship. »

http://www.forbes.com/sites/limyunghui/2012/04/09/inspiring-insights-by-instagram-ceo-kevin-systrom-the-man-who-built-a-1-billion-startup/

Instagram Story

« Who is responsible for Instagram's UI design?

For better or for worse, I've done most of the pixel pushing in our app. ;) »

http://www.forbes.com/sites/limyunghui/2012/04/09/inspiring-insights-by-instagram-ceo-kevin-systrom-the-man-who-built-a-1-billion-startup/

Instagram Story

- 30+ millions d'utilisateur en 2 ans
- 25k inscriptions le premier jour
  - « best & worst day of our lives so far »
  - « favicon » cause des milliers d'erreurs 404
    - « 404-ing on Django, causing tons of errors »
- Un seul serveur au lancement
  - Moins puissant qu'un MacBook Pro
- La suite: passage à l'échelle, cloud (EC2) et ingénierie du logiciel

https://speakerdeck.com/mikeyk/scaling-instagram
http://zoompf.com/blog/2012/04/instagram-and-optimizing-favicons

Instagram Story

- Sur la trentaine de composants, 4 seulement ont été écrits à partir de zéro
  - App iOS, App Android, Android Push Notification Service et Redis Query analyzer

node2dm

Fabric

Instagram Story (key lessons)

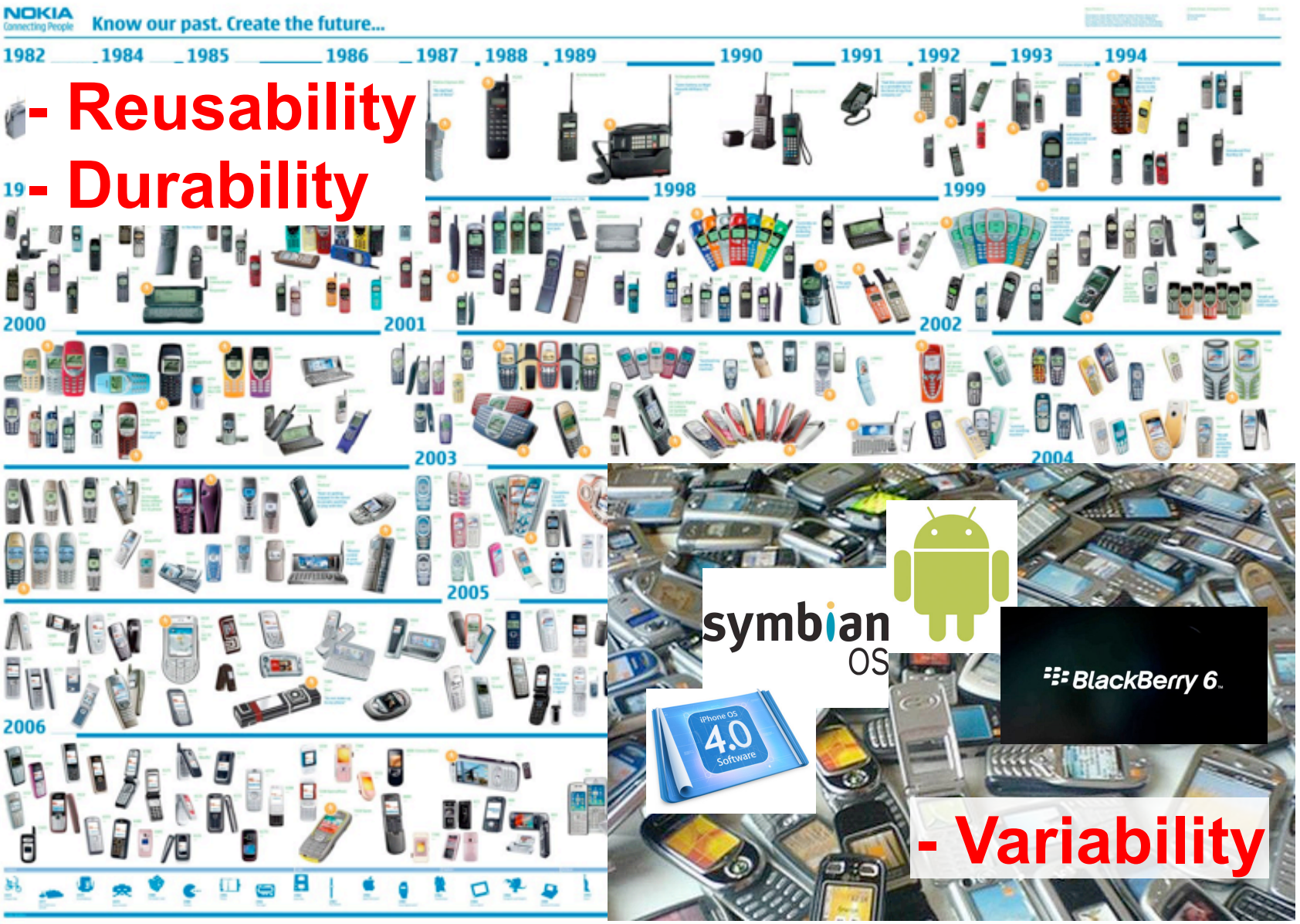
- Sélection et intégration de multiples librairies

- Open source community
  - Apprendre, partager, demander, répondre, etc.
- Auto-apprentissage
  - « Product guys » sont maintenant à même de rivaliser…

- Agilité, développement incrémental

http://instagram-engineering.tumblr.com/

Software Complexity

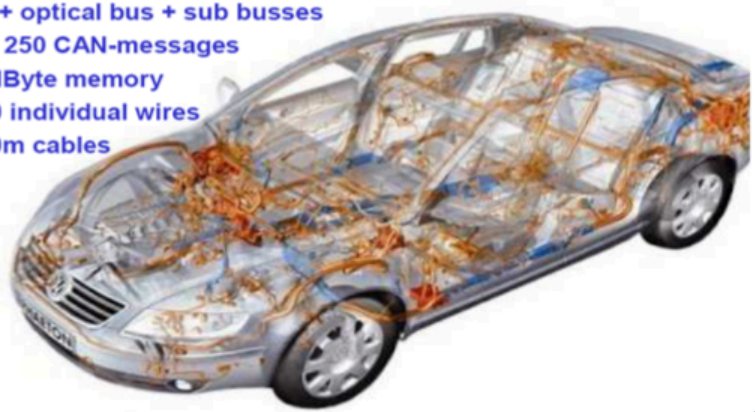


Software Complexity

- **Critical**
- **Real-time**
- **Embedded**

Phaeton

- 61 networked ECUs
- 3 bus systems + optical bus + sub busses
- 2500 signals in 250 CAN-messages
- more than 50 MByte memory
- more than 2000 individual wires
- more than 3800m cables



Software Complexity

- *"The avionics system in the F-22 Raptor […] consists of about 1.7 million lines of software code."*
- *"F-35 Joint Strike Fighter […] will require about 5.7 million lines of code to operate its onboard systems."*
- *"Boeing's new 787 Dreamliner […] requires about 6.5 million lines of software code to operate its avionics and onboard support systems."*
- *"if you bought a premium-class automobile recently, it probably contains close to 100 million lines of software code. […] All that software executes on 70 to 100 microprocessor-based electronic control units (ECUs) networked throughout the body of your car."*
- *"Alfred Katzenbach, the director of information technology management at Daimler, has reportedly said that the radio and navigation system in the current S-class Mercedes-Benz requires over 20 million lines of code alone and that the car contains nearly as many ECUs as the new Airbus A380 (excluding the plane's in-flight entertainment system)."*
- *"IBM claims that approximately 50 percent of car warranty costs are now related to electronics and their embedded software"*

"This Car Runs on Code", By Robert N. Charrette, IEEE Spectrum, Feb. 2009, see http://spectrum.ieee.org/green-tech/advanced-cars/this-car-runs-on-code

Long term availability…

AIRBUS A300 Life Cycle

Program began in 1972, production stopped in 2007

2007-1972 = 35 years...

Support will last until 2050

2050-1972 = 78 years !!

On board software development for very long lifecycle products

From the OPEES ITEA2 project (2009-2012)

AIRBUS

Software Complexity

- Distributed
- Large-scale

- **Google (2012 Update from Larry Page, CEO):**
  - *Over 850,000 Android devices are activated daily through a network of 55 manufacturers and more than 300 carriers.*
  - *Google Chrome browser has over 200 million users.*
  - *Google launched Gmail in 2004 and now is used by more than 350 million people.*
  - *YouTube has over 800 million monthly users who upload an hour of video per second.*

See http://investor.google.com/corporate/2012/ceo-letter.html

Software Complexity

- Google, Building for Scale:
  - 6,000 developer / 1,500+ projects
  - Each product has custom release cycles
    - few days to few weeks
  - 1(!!) code repository
  - No binary releases
    - everything builds from HEAD
  - 20+ code changes per minute
    - 50% of the code changes every month

Google

Innovation Factory: Testing, Culture, & Infrastructure

Patrick Copeland, Google

ICST 2010

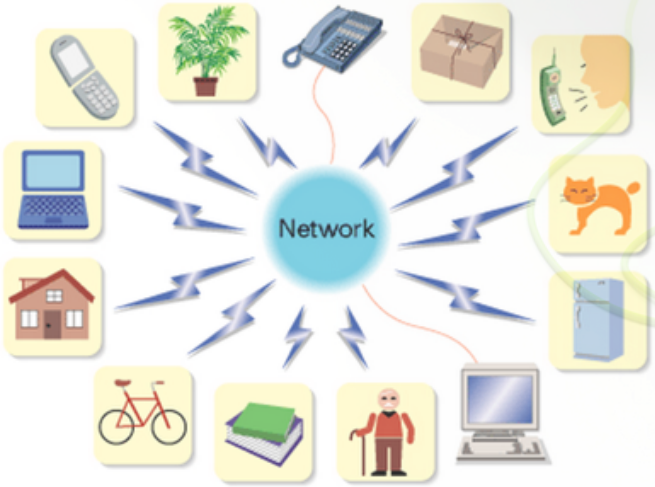
Source: http://googletesting.blogspot.com/search/label/Copeland

Software Complexity

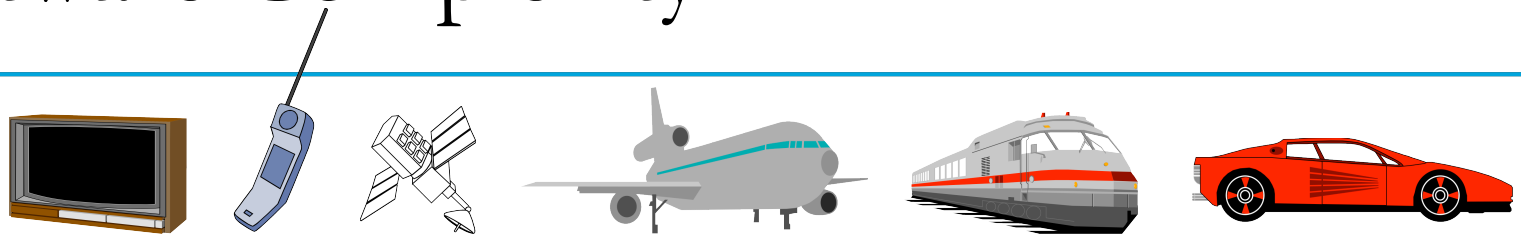
- **Free Mobile (10/01/2012):**
  - *"A 9h45, le site mobile.free.fr cumulait déjà plus d'un million d'accès simultanés alors que le site proposait seulement une page invitant à patienter" !!*

Software Complexity

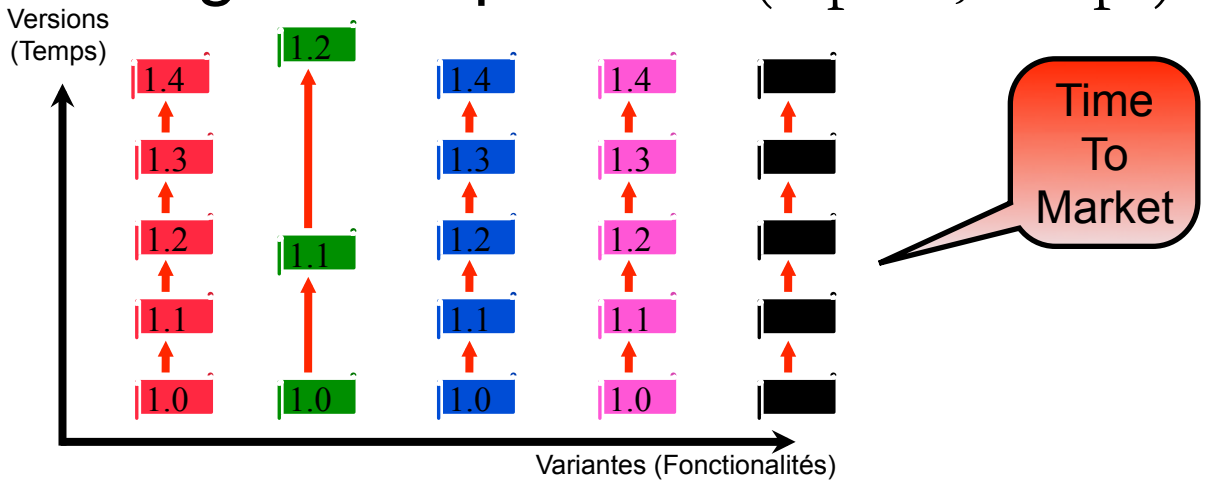
- Autonomic Computing
- Cloud Computing
- PaaS, SaaS, IoS, IoT...



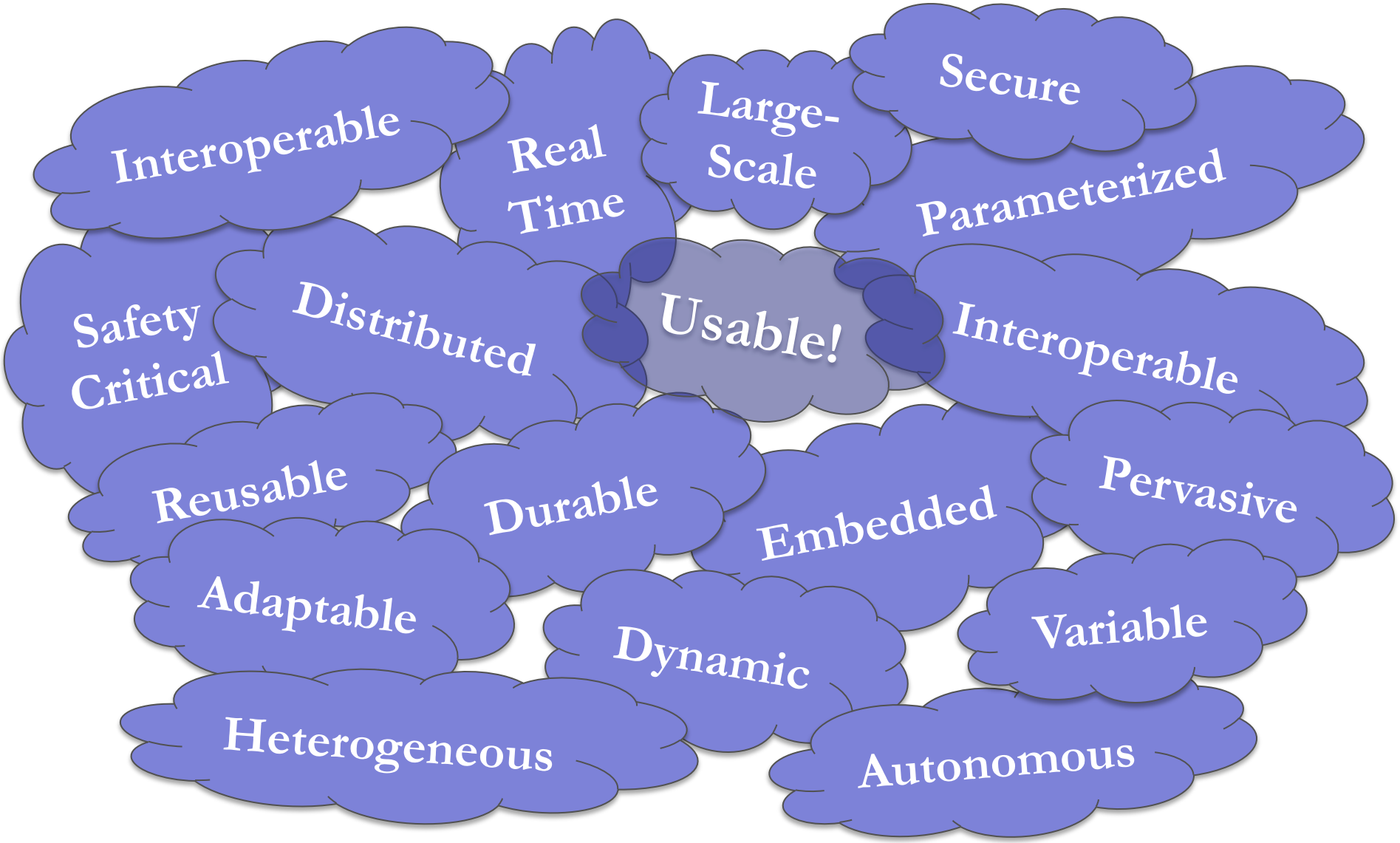
Software Complexity



- Importance des aspects non fonctionnels
  - systèmes répartis, parallèles et asynchrones
  - qualité de service : fiabilité, latence, performances...
- Flexibilité accrue des aspects fonctionnels
  - notion de **lignes de produits** (espace, temps)



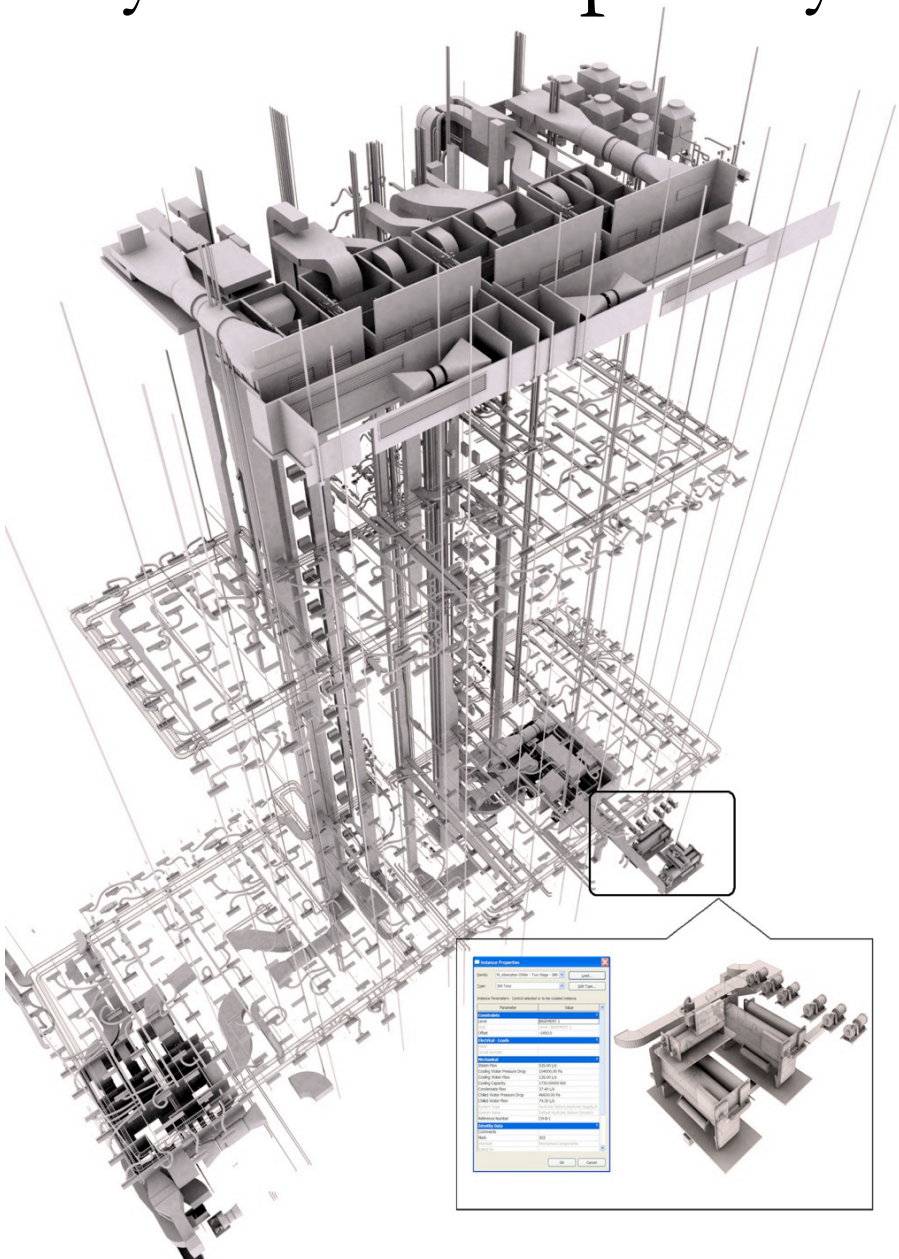
Software Complexity: Some Dimensions

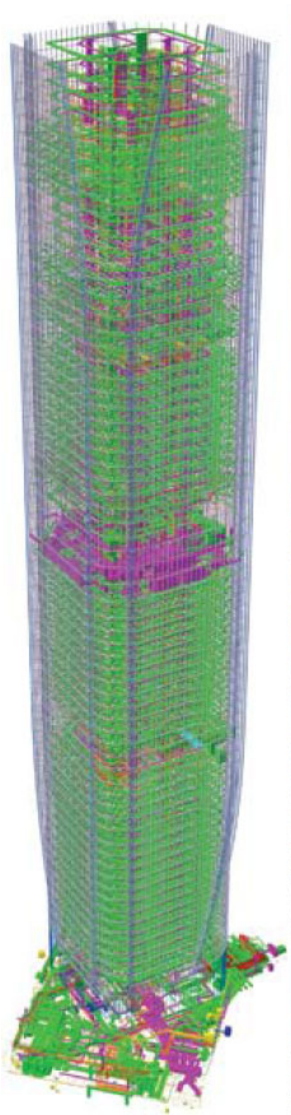


Défaillances

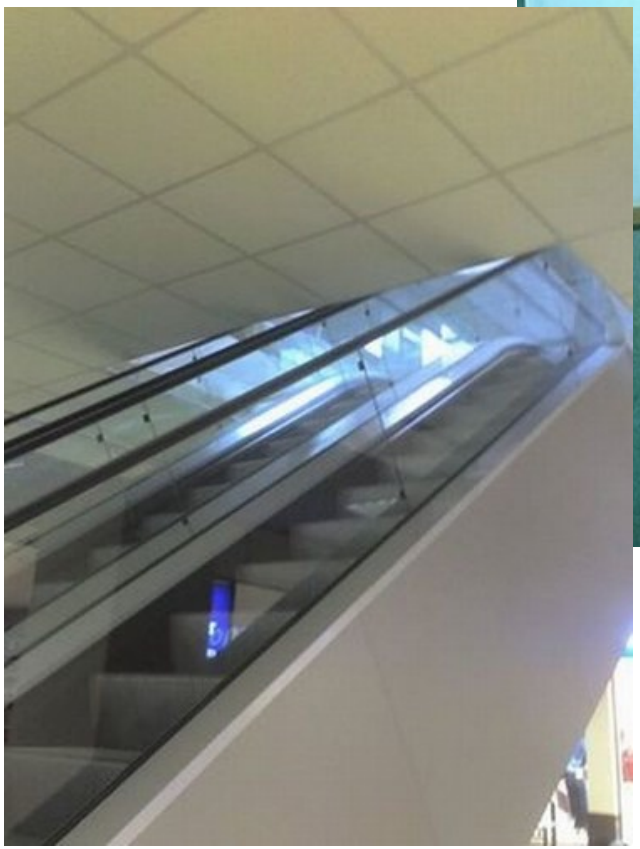
- Catastrophe humaine ou financière:
  - Therac-25 (1985-1987) – radiologie et contrôle d'injection de substances radioactives
  - Iran Air Flight 655 (1988) – guerre d'Irak et missile américain – système radar
  - London Ambulance System (1992) – central et dispatch ambulances
  - Ariane 5 (1996)
  - Mars Climate Orbiter (1999) – sonde spatiale – unité de mesure
  - Bourse de Londres (Taurus, 1993) – SI qui n'a pas pu être déployé
  - SI du FBI (2005) – SI qui n'a pas pu être déployé
  - Un canon-robot anti-aérien sud-africain tue neuf soldats dans un mode tout automatique qui avait été rajouté (2007)
- Image de marque :
  - FT et Bouygues en 2004 – crash des serveurs – indisponibilité 48h
  - Playstation 3 : le système de jeux en ligne croyait qu'il y avait un 29 février 2010, ce qui bloqua le fonctionnement des jeux en ligne toute la journée du 1 mars 2010
  - IPhone 4 : problème de réveil après le passage à l'heure d'hiver à l'automne 2010, après le passage à 2011
- Succès financier: Windows ;)
- Sans conséquence mais énervant : bugs @ Irisa, …
- D'autres : http://en.wikipedia.org/wiki/Computer_bug

System Complexity





Failures in System Engineering



Failures in System Engineering

Outline

① Issues in Software Engineering

② Evolution in Software Engineering

③ State of the Practice

④ Modeling in Software Engineering

Software Engineering

The production of operational software satisfying defined standards of quality...

... includes programming, but is more than programming!

The five components of Software Engineering [Meyer]:

- **Describe**: *requirements, design, specification, documentation...*
- **Implement**: *modeling, programming*
- **Assess**: *testing and other V&V techniques*
- **Manage**: *plans, schedules, communication, reviews*
- **Operate**: *deployment, installation...*

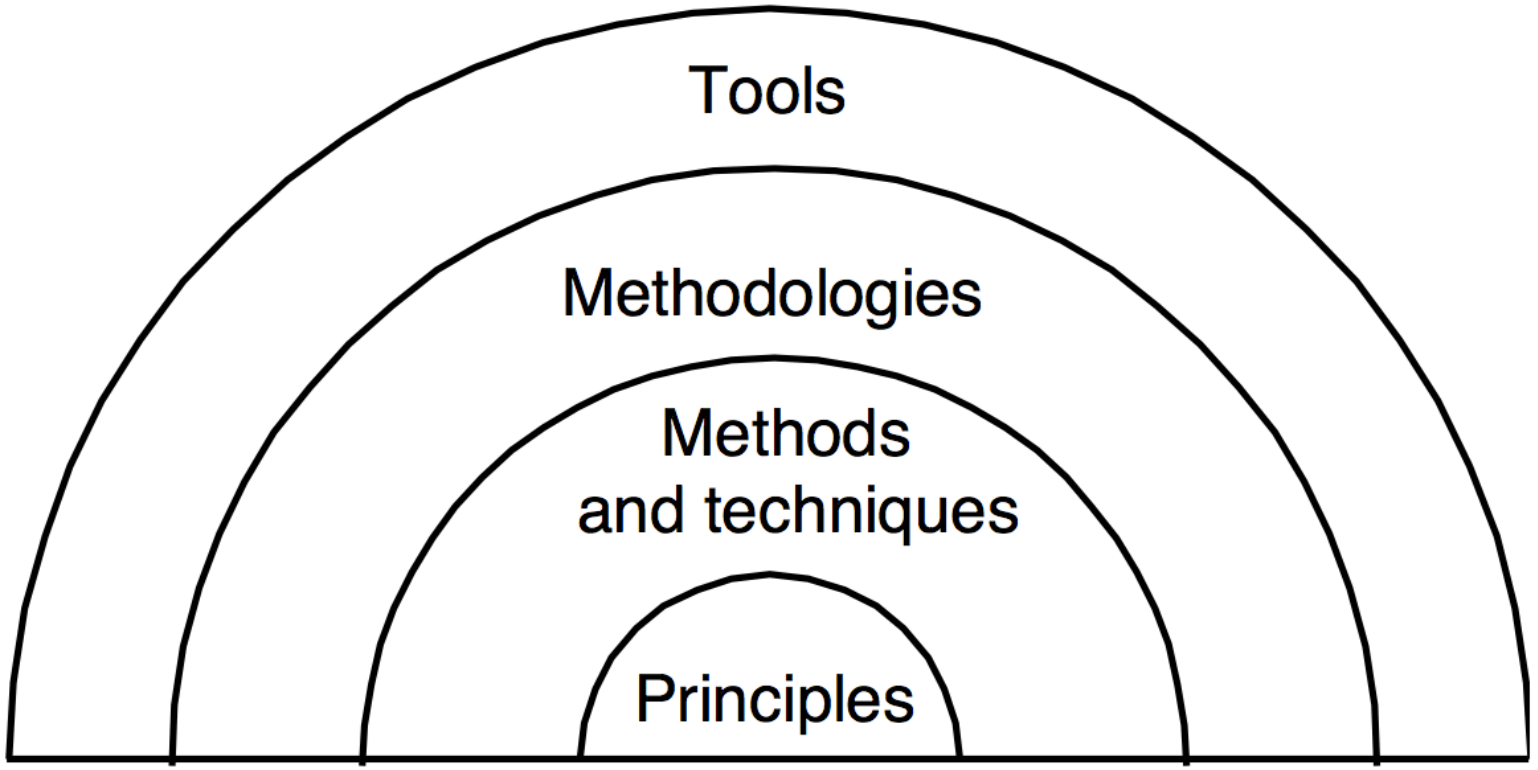
Software Engineering: definition

- is a **profession** dedicated to designing, implementing, and modifying software so that it is of higher quality, more affordable, maintainable, and faster to build.

- is a **systematic approach** to the analysis, design, assessment, implementation, test, maintenance and re-engineering of a software by applying engineering to the software.

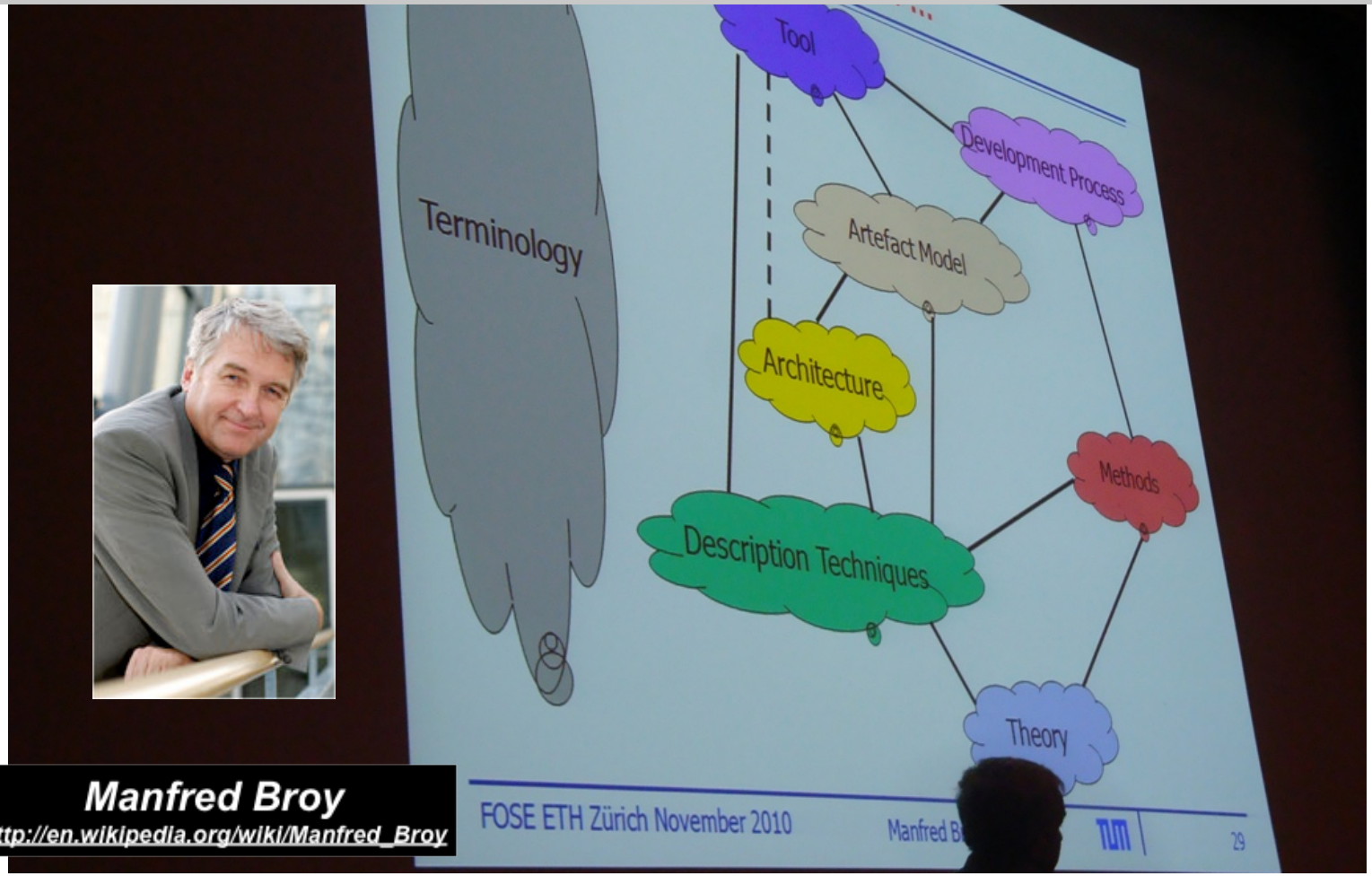
- first appeared in the 1968 NATO Software Engineering Conference (to provoke thought regarding the perceived "software crisis" at the time).

Software Engineering: Basics



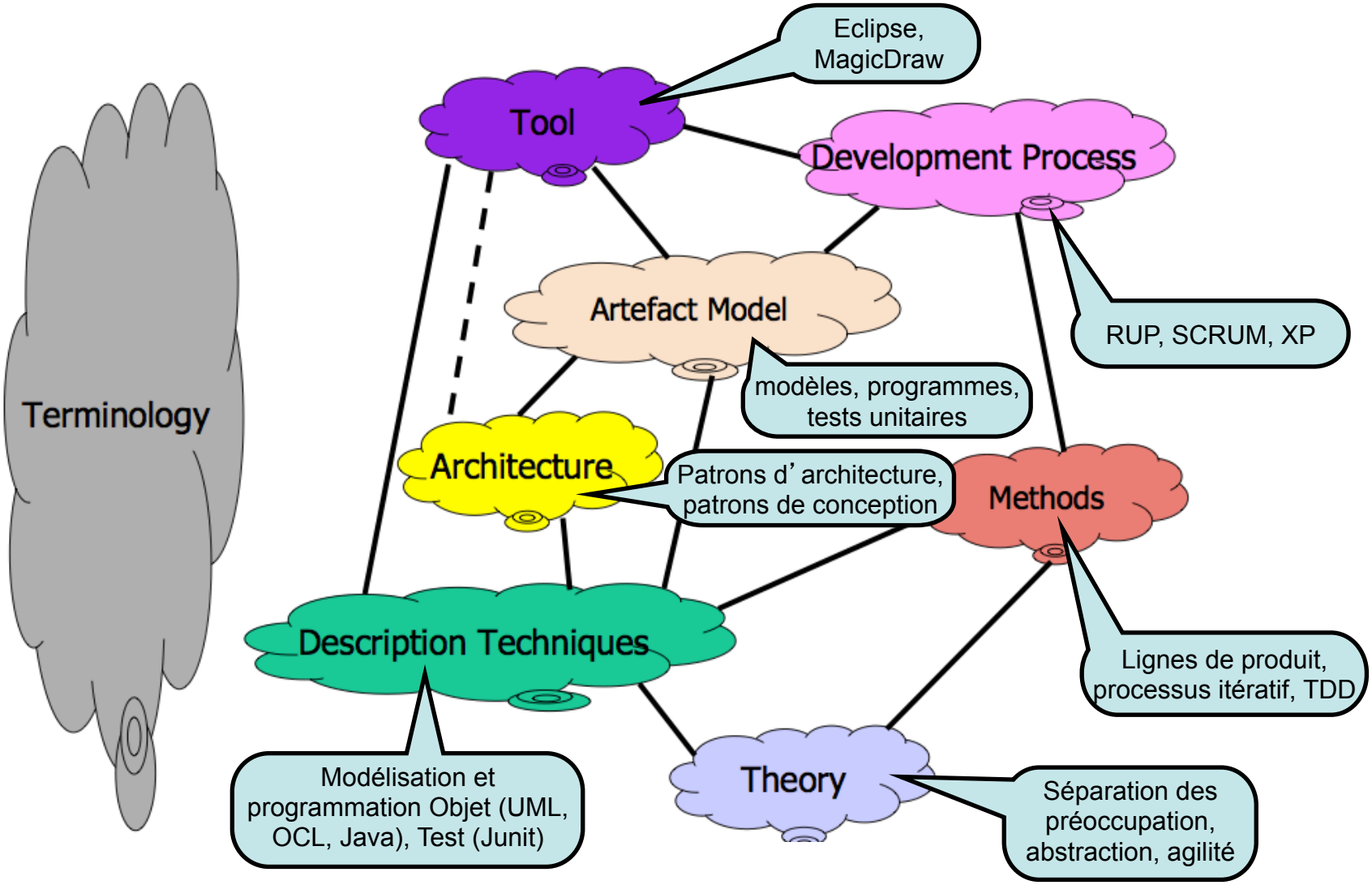
Carlo Ghezzi, Mehdi Jazayeri, and Dino Mandrioli. *Fundamentals of Software Engineering, 2nd edition*. 2002.

What we need?



Manfred Broy
http://en.wikipedia.org/wiki/Manfred_Broy

Software Engineering: Basics



Des logiciels complexes...

- Logiciels de grande taille
  - des millions de lignes de code
  - des équipes nombreuses
  - durée de vie importante
  - des lignes de produits
  - plateformes technologiques complexes
  - évolution continue
- Logiciels complexes
- Logiciels critiques
- …

Aujourd'hui / Today

- Méthodes de développement industriel (MDI)
  - En fait: génie logiciel / software engineering
  - Comment développer des systèmes logiciels de plus en plus complexe?
- **#1 Prendre conscience de la complexité des systèmes logiciels actuels et à venir**
  - Les enjeux et l'impact sur le métier

Exemple très concret (yet another)

- I insist: software engineering is difficult!
- Even on a very basic (apparently) example
- It will be our « running » example for the rest of the courses

Jeu d’échecs aka Chess

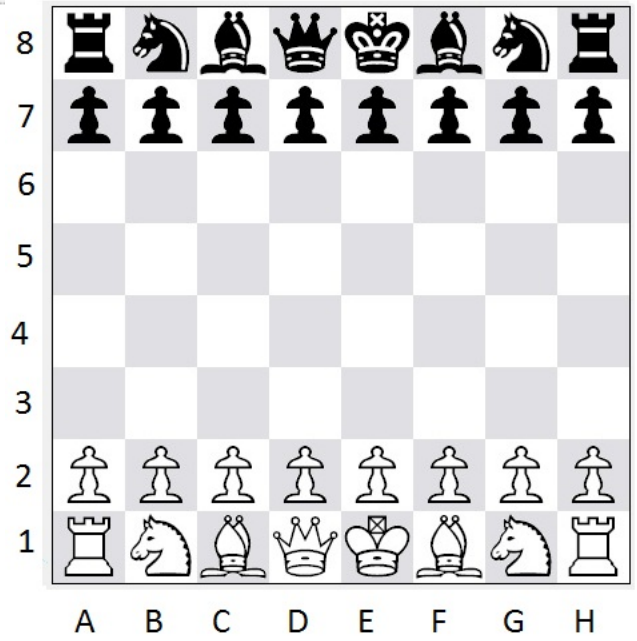
Day #0

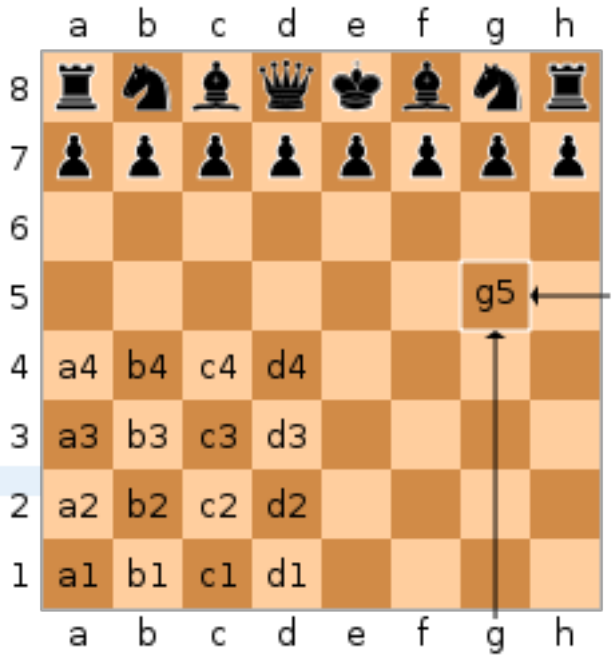
- Spécification du client
  - « Développer un jeu d'échecs pour jouer tout seul »
  - Quel langage?
  - Java
  - Combien?
  - 1000$
  - OK. Let us go

ChessDay0.java

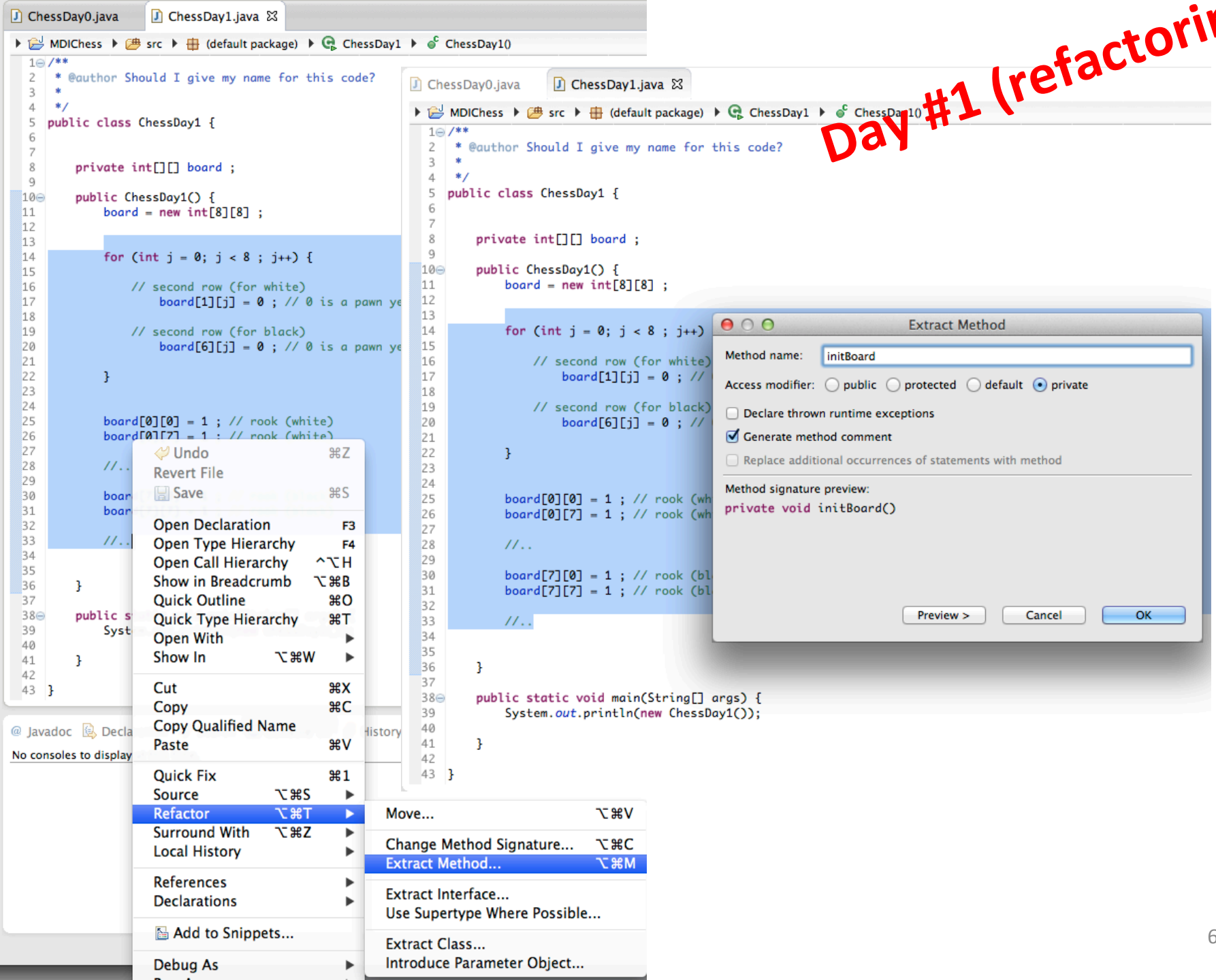
MDIChess ▸ src ▸ (default package) ▸ ChessDay0 ▸ main(String[]) : void

```java
/**
 * @author Should I give my name for this code?
 *
 */
public class ChessDay0 {


    private int[][] board ;

    public ChessDay0() {
        board = new int[8][8] ;


        for (int j = 0; j < 8 ; j++) {

            // second row (for white)
                board[1][j] = 0 ; // 0 is a pawn yes

            // second row (for black)
                board[6][j] = 0 ; // 0 is a pawn yes

        }


        board[0][0] = 1 ; // rook (white)
        board[0][7] = 1 ; // rook (white)

        //..

        board[7][0] = 1 ; // rook (black)
        board[7][7] = 1 ; // rook (black)

        //..


    }

    public static void main(String[] args) {
        System.out.println(new ChessDay0());

    }

}

```





Day #1 (refactoring)



```
        initBoard();


    }

    /**
     *
     */
    private void initBoard() {
        for (int j = 0; j < 8 ; j++) {

            // second row (for white)
                board[1][j] = 0 ; // 0 is a pawn yes

            // second row (for black)
                board[6][j] = 0 ; // 0 is a pawn yes

        }


        board[0][0] = 1 ; // rook (white)
        board[0][7] = 1 ; // rook (white)

        //..

        board[7][0] = 1 ; // rook (black)
        board[7][7] = 1 ; // rook (black)

        //..
    }
```

Day #1 (refactoring)

Piece	King	Queen	Rook	Bishop	Knight	Pawn
Number	1	1	2	2	2	8
Symbols	♔ ♚	♕ ♛	♖ ♜	♗ ♝	♘ ♞	♙ ♟

Day #1 (refactoring)

PieceType.java

```
MDIChess ▸ src ▸ (default package) ▸ P
1  /**
4
5  /**
6   * @author macher1
7   *
8   */
9  public enum PieceType {
10
11      PAWN,
12      ROOK,
13      KING,
14      QUEEN,
15      BISHOP,
16      KNIGHT
17
18
19 }
20
```

ChessDay0.java | ChessDay1.java

```
MDIChess ▸ src ▸ (default package) ▸ C
5  public class ChessDay1 {
6
7
8      private PieceType[][] board ;
9
```

```
private void initBoard() {
    for (int j = 0; j < 8 ; j++) {

        // second row (for white)
            board[1][j] = PieceType.PAWN ;
        // second row (for black)
            board[6][j] = PieceType.PAWN ;

    }


    board[0][0] = PieceType.ROOK ; // white
    board[0][7] = PieceType.ROOK ; // white

    //..

    board[7][0] = PieceType.ROOK ; // black
    board[7][7] = PieceType.ROOK ; // black
```


r n b q k b . r
p p p p p p p p
. . . . . n . .
. . . . . .
. . . P . . . .
. . . . . N . .
P P P . P P P P
R N B Q K B . R
Thinking...
white KQkq
r . b q k b . r
p p p p p p p p
. . n . . n . .
. . . . . .
. . . P . . . .
. . . . . N . .
P P P . P P P P
R N B Q K B . R
My move is : Nc6
White (3) :
Day #3 – Nice demo
I want my 1000$

Day #3

- Le client
  - « J'avais demandé une version graphique… Et on ne peut même pas sauvegarder une partie. Ou lire des parties. Et vous n'avez pas pris en compte la règle du pat! »

- Rappel (spécification du client à l'origine)
  - « Développer un jeu d'échecs pour jouer tout seul »

Restons calme. Analyse

- « **J'avais demandé une version graphique**…
  - Mauvaise analyse des besoins initiaux (cahier des charges)
  - Impact sur le code non négligeable: il va très certainement falloir adapter le code existant (en plus d'implémenter de nouvelles fonctionnalités)
    - Affichage graphique des pièces et des cases
    - Écouter des « évènements » et réagir en conséquence
    - Interdire des interactions (sur des coups impossibles)
  - Mais est-ce que le code est fait pour?

Retour au code

```
public void displayBoard() {

    for (int i = 0; i < 8; i++) {
        for (int j = 0; j < 8; j++) {
            if (board[i][j] == PieceType.ROOK) {
                System.out.println('R');
            }
            // ...
            else { // square without piece
                System.out.println('.');
            }
            //
            //...
        }
    }
```

Graphique! Evolution nécessaire…

System.out?

Couleur des pièces?

Encore une série de if-then-else?

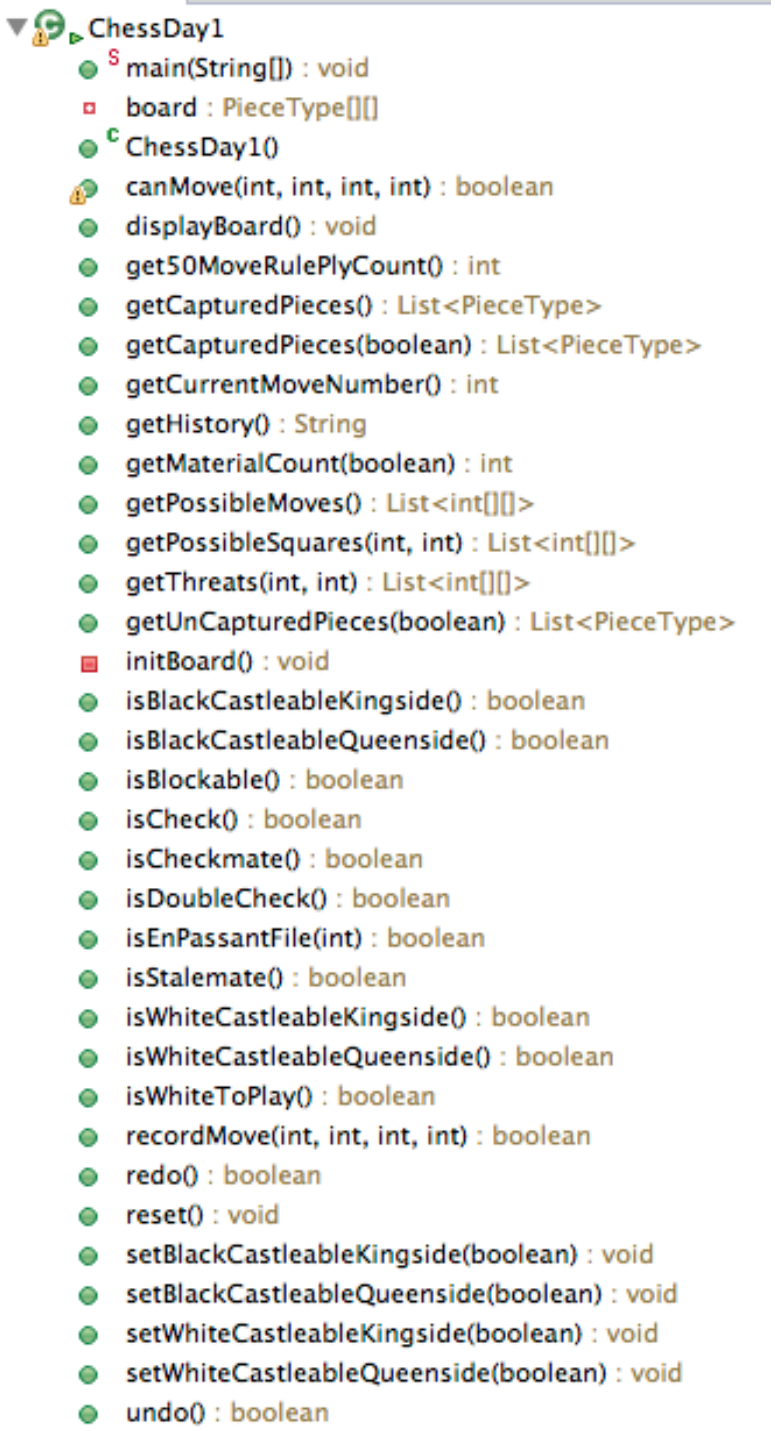
Comment garder la représentation textuelle malgré tout?

Imaginons un code monolithique (une seule classe)

Graphique?

Sauvegarder une partie?

Charger une partie?



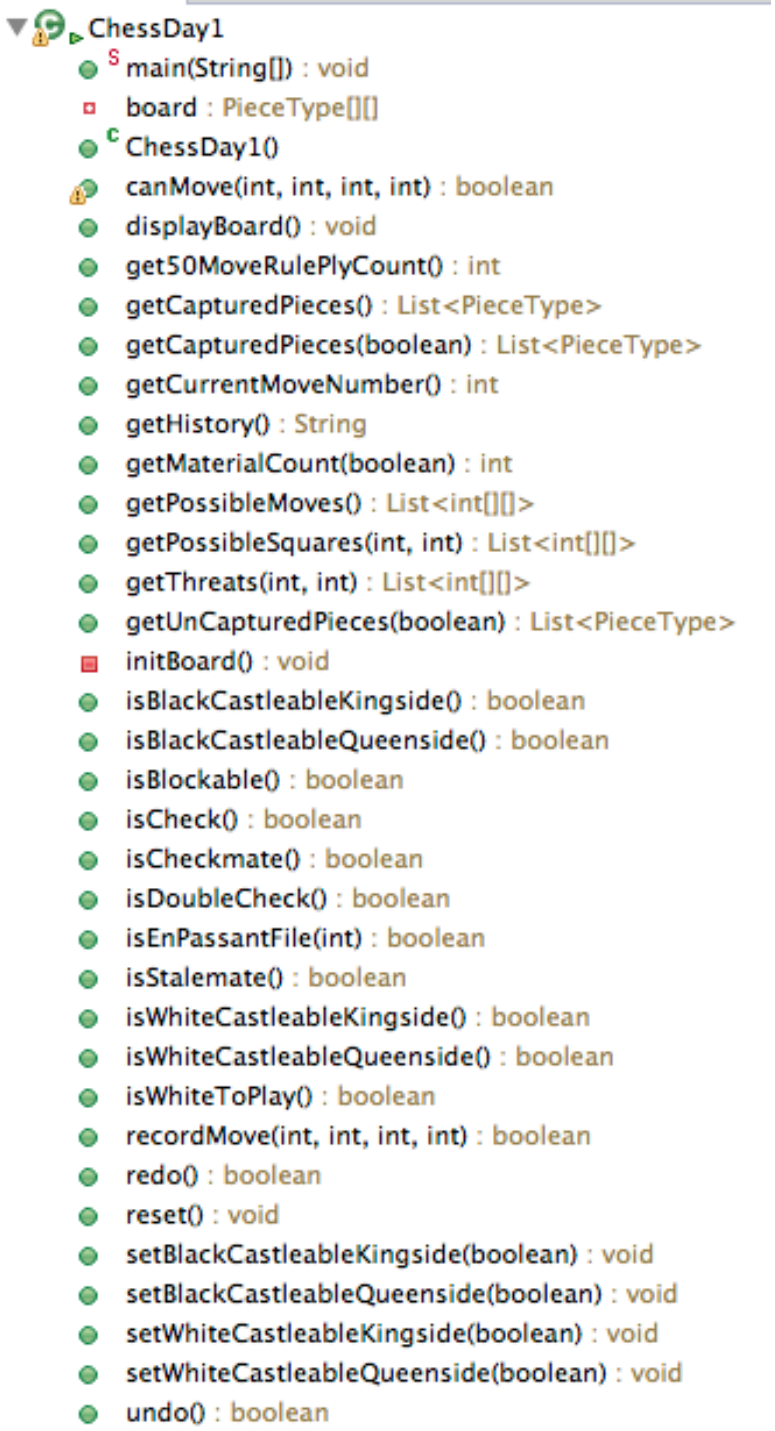
Restons calme. Analyse

- « J'avais demandé une version graphique…
- Et on ne peut même pas sauvegarder une partie
- Ou lire des parties.
- **Et vous n'avez pas pris en compte la règle du pat!** »

Imaginons un code monolithique (une seule classe)

Règle du pat?

Dans quelle méthode?



Day #23

- Le client (retour)
  - « C'est mieux mais la règle des 50 coups ne fonctionne pas. Le fou peut se déplacer comme une dame. Il est possible de manger le roi. Il y a parfois des échecs et mat qui n'en sont pas. »

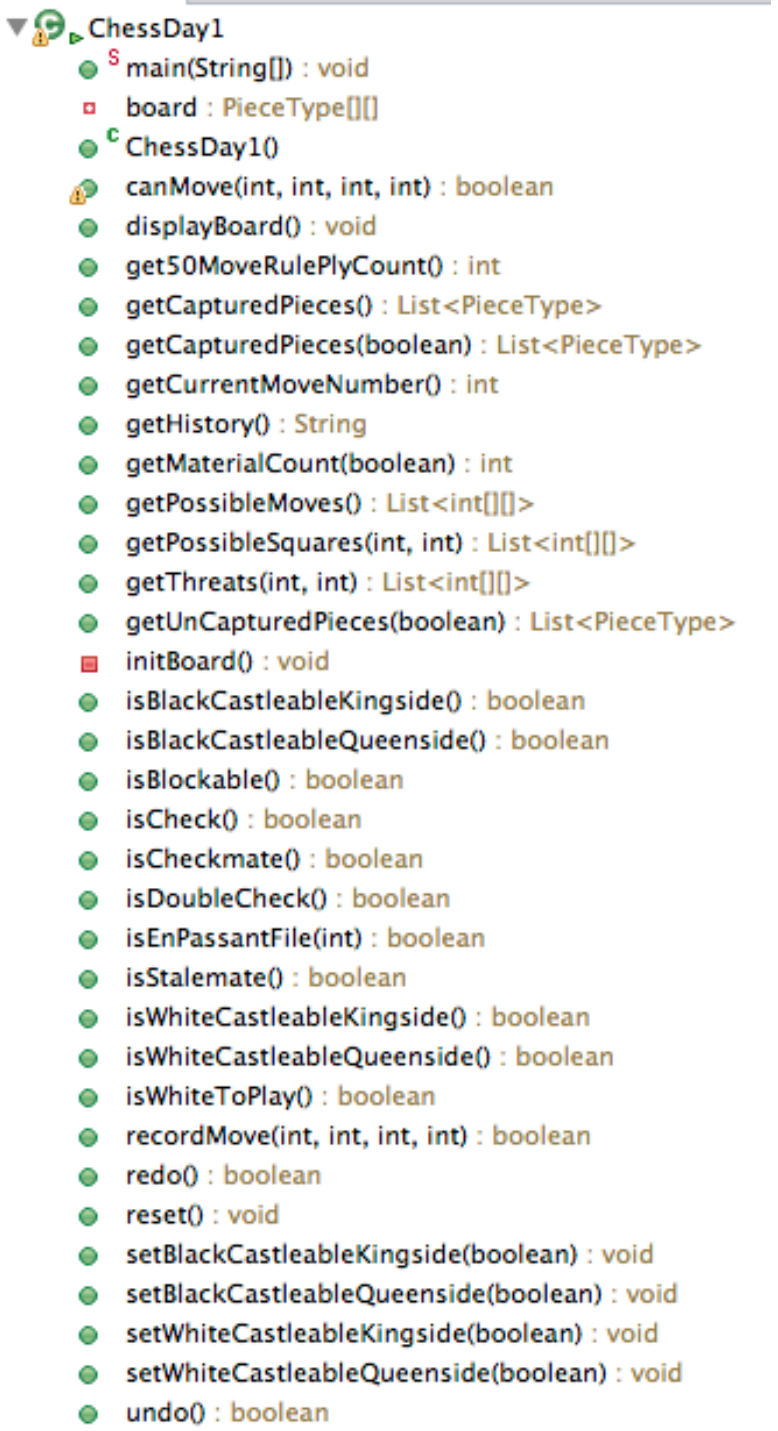
- Bugs

Imaginons un code monolithique (une seule classe)

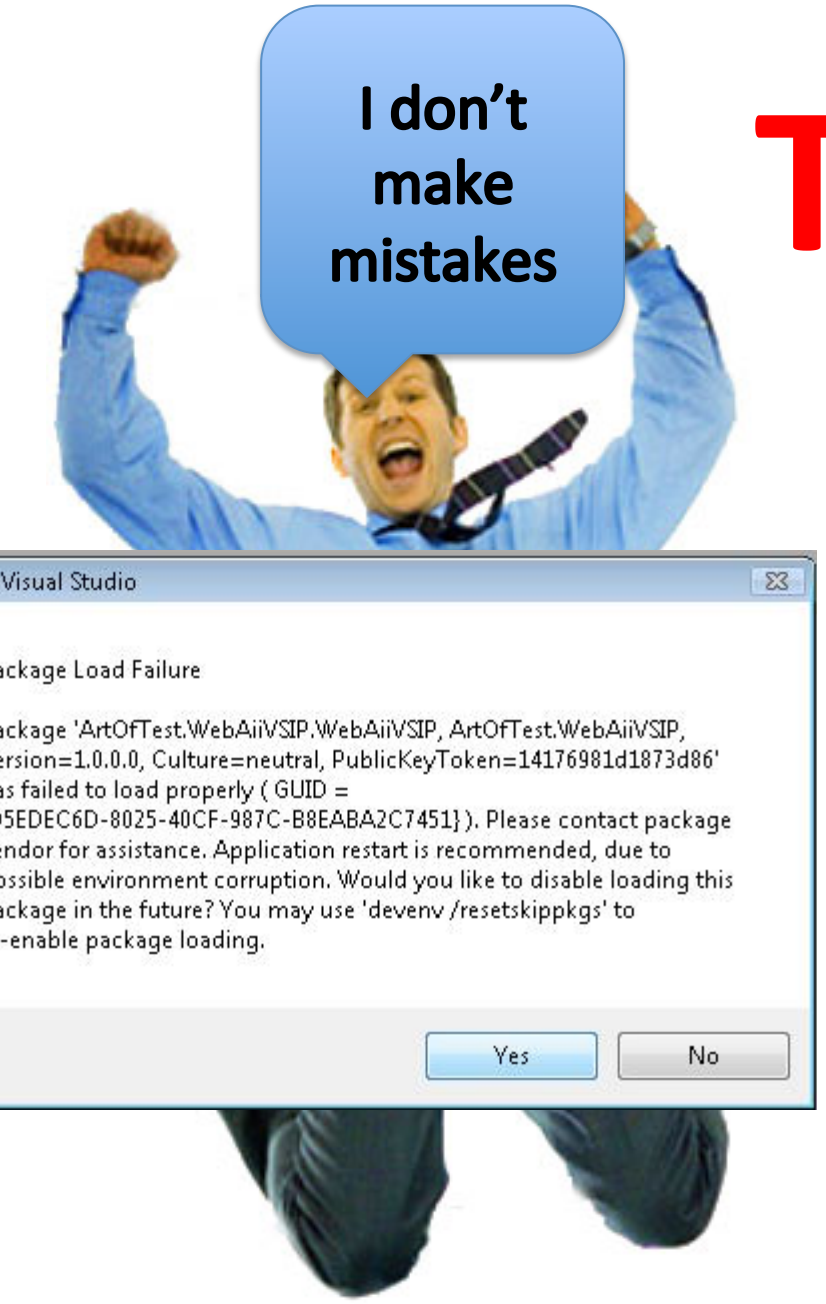
Ajouter la règle des 50 coups?

TESTS

Comment s'assurer que le fou n'a pas le comportement d'une dame? Qu'on ne peut pas manger le roi? etc.



Testing



- ChessDay1
  - main(String[]) : void
  - board : PieceType[][]
  - ChessDay1()
  - int, int, int, int) : boolean
  - () : void
  - RulePlyCount() : int
  - Pieces() : List<PieceType>
  - getCapturedPieces(boolean) : List<PieceType>
  - getCurrentMoveNumber() : int
  - getHistory() : String
  - getMaterialCount(boolean) : int
  - getPossibleMoves() : List<int[][]>
  - getPossibleSquares(int, int) : List<int[][]>
  - getThreats(int, int) : List<int[][]>
  - getUnCapturedPieces(boolean) : List<PieceType>
  - initBoard() : void
  - isBlackCastleableKingside() : boolean
  - isBlackCastleableQueenside() : boolean
  - isBlockable() : boolean
  - isCheck() : boolean
  - isCheckmate() : boolean
  - isDoubleCheck() : boolean
  - isEnPassantFile(int) : boolean
  - isStalemate() : boolean
  - isWhiteCastleableKingside() : boolean
  - isWhiteCastleableQueenside() : boolean
  - isWhiteToPlay() : boolean
  - recordMove(int, int, int, int) : boolean
  - redo() : boolean
  - reset() : void
  - setBlackCastleableKingside(boolean) : void
  - setBlackCastleableQueenside(boolean) : void
  - setWhiteCastleableKingside(boolean) : void
  - setWhiteCastleableQueenside(boolean) : void
  - undo() : boolean

Plus simple de contrôler le comportement d'un *Fou* dans une classe dédiée (et non dans une série de méthodes avec des if-then-else de partout)

```
 * @param i
 * @param j
 * @param x
 * @param y
 * @return true if the piece at i, j can move to x, y
 */
public boolean canMove(int i, int j, int x, int y) {

    PieceType p = board[i][j] ;
    PieceType p2 = board[x][y] ;

    if (p == PieceType.ROOK) {

    }

    else if (p == PieceType.BISHOP) {

    }
```

Testabilité d'un système

- ChessDay1
  - main(String[]) : void
  - board : PieceType[][]
  - ChessDay1()
  - canMove(int, int, int, int) : boolean
  - displayBoard() : void
  - get50MoveRulePlyCount() : int
  - getCapturedPieces() : List<PieceType>
  - getCapturedPieces(boolean) : List<PieceType>
  - getCurrentMoveNumber() : int
  - getHistory() : String
  - getMaterialCount(boolean) : int
  - getPossibleMoves() : List<int[][]>
  - getPossibleSquares(int, int) : List<int[][]>
  - getThreats(int, int) : List<int[][]>
  - getUnCapturedPieces(boolean) : List<PieceType>
  - initBoard() : void
  - isBlackCastleableKingside() : boolean
  - isBlackCastleableQueenside() : boolean
  - isBlockable() : boolean
  - isCheck() : boolean
  - isCheckmate() : boolean
  - isDoubleCheck() : boolean
  - isEnPassantFile(int) : boolean
  - isStalemate() : boolean
  - isWhiteCastleableKingside() : boolean
  - isWhiteCastleableQueenside() : boolean
  - isWhiteToPlay() : boolean
  - recordMove(int, int, int, int) : boolean
  - redo() : boolean
  - reset() : void
  - setBlackCastleableKingside(boolean) : void
  - setBlackCastleableQueenside(boolean) : void
  - setWhiteCastleableKingside(boolean) : void
  - setWhiteCastleableQueenside(boolean) : void
  - undo() : boolean

On aimerait:

* donner en entrée des mouvements de Fou
* vérifier qu'ils sont effectivement interdits ou autorisés

```
 * @param i
 * @param j
 * @param x
 * @param y
 * @return true if the piece at i, j can move to x, y
 */
public boolean canMove(int i, int j, int x, int y) {

    PieceType p = board[i][j] ;
    PieceType p2 = board[x][y] ;

    if (p == PieceType.ROOK) {

    }

    else if (p == PieceType.BISHOP) {

    }
```

- ChessDay1
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  - getCurrentMoveNumber() : int
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  - isCheck() : boolean
  - isCheckmate() : boolean
  - isDoubleCheck() : boolean
  - isEnPassantFile(int) : boolean
  - isStalemate() : boolean
  - isWhiteCastleableKingside() : boolean
  - isWhiteCastleableQueenside() : boolean
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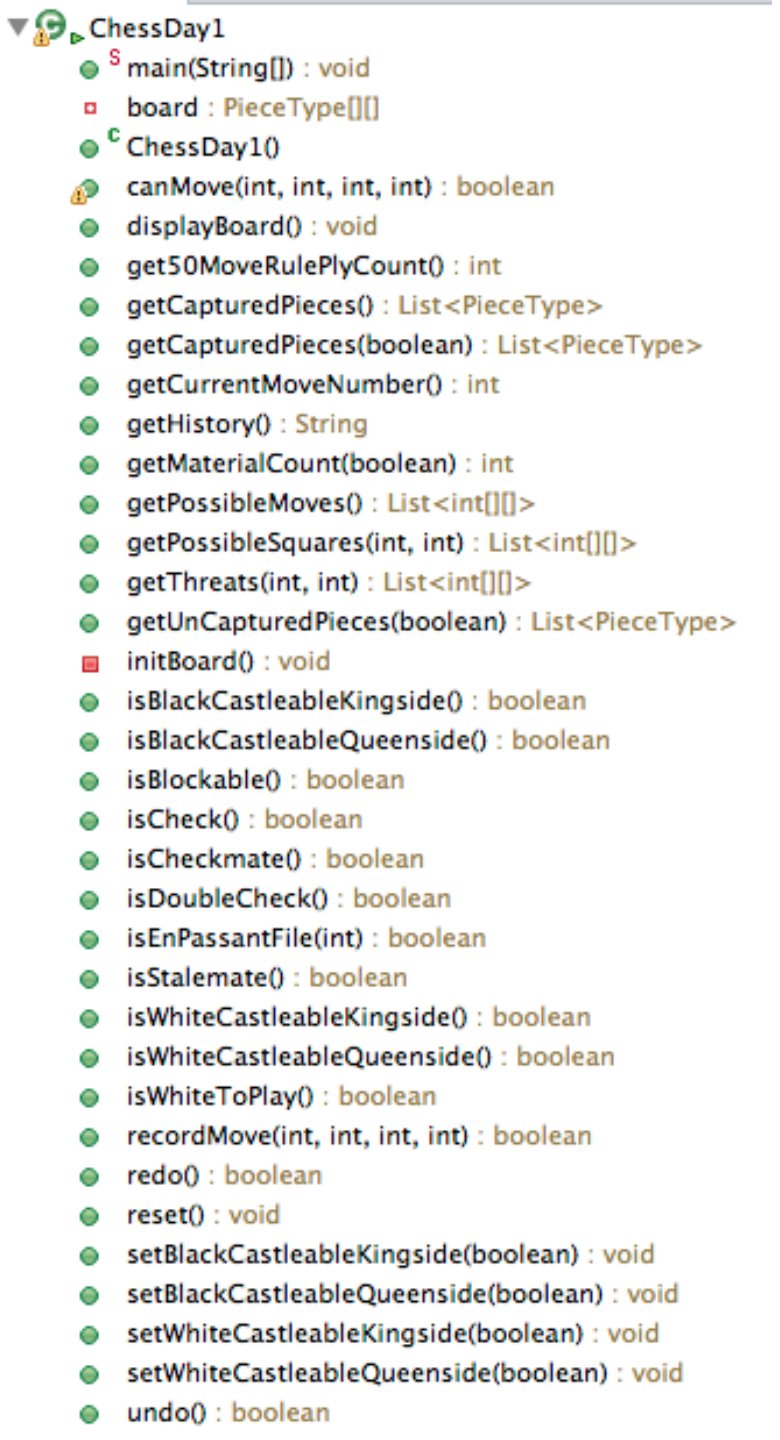
  - recordMove(int, int, int, int) : boolean
  - redo() : boolean
  - reset() : void
  - setBlackCastleableKingside(boolean) : void
  - setBlackCastleableQueenside(boolean) : void
  - setWhiteCastleableKingside(boolean) : void
  - setWhiteCastleableQueenside(boolean) : void
  - undo() : boolean

Testabilité d'un système

On aimerait:
*** donner en entrée des mouvements de Fou**
*** vérifier qu'ils sont effectivement interdits ou autorisés**

- Testability
  - degree to which a system or component facilitates the establishment of test criteria and the performance of tests to determine whether those criteria have been met."
  - Controllability + Observability
- **Controllability** ability to manipulate the **software's input** as well as to place this software into a particular **state**
- **Observability** deals with the possibility to observe the outputs and state changes
- How to improve Testability?
  - Improve Modularity (Refactoring, Design patterns)




0:00:55
0:00:41
Freechess – Fritz 5.32
Level=10"av. 26.06.2006
Day #97
1000$
"100, 000 nodes per second and he just goes on thinking."


New offer: 100000$
I want to play online
I want to broadcast live games
Chess AI engines
Variants of Chess
iOS and Android compatible
Very robust solution
0:00:55
0:00:41
Level=10"av. 26.06.2006
16384kB, ChessliBsPowerBook2005.ctg, PentiumII
13.axb4 0
13...♗xb4 (1/45)
depth=11/11
0:00:12
909kN/s
"100,000 nodes per second and he just goes on thinking."

www.chessvariants.org/Gindex.html

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Languages | Other Information | Advanced Search | Subject Index

0-9 - A - B - C - D - E - F - G - H - I - J - K - L - M - N - O - P - Q - R - S - T - U - V - W - X - Y - Z


Recognized chess variants: What are considered to be the `best chess variants'?


Member favorites: What have members of these pages chosen as their favorites?

Boards with an unusual shape


Three dimensional chess variants: Star Trek and others


Hexagonal chess variants


Round boards


Other boards with an unusual shape


Chess variants with usual equipment: Those variants that can be played with (mainly) a usual 8 by 8 board, and usual pieces.

- Different moving pieces.
- Moving your opponents pieces.
- Multi-move variants.
- Rules about the board.
- Winning in a different way.
- Different opening setups
- Capturing in a different way
- Other variants
- Modest variants


Oriental chess variants: **Xianqi** (Chinese Chess), **Shogi** (Japanese Chess), variants, other oriental chess varian


Historic chess variants: The first predecessor of chess: Chaturanga, Shatranj, and other chess variants from anci


Multi player variants: Chess with 3, 4, 6, 7 or any number of players.


Small chess variants: Chess on board of size 4 by 8, 6 by 6, etc.


Large chess variants: Chess on boards of 9 by 9 or larger.


Chess variants with unequal armies: Variants where white and black have a different set of pieces.

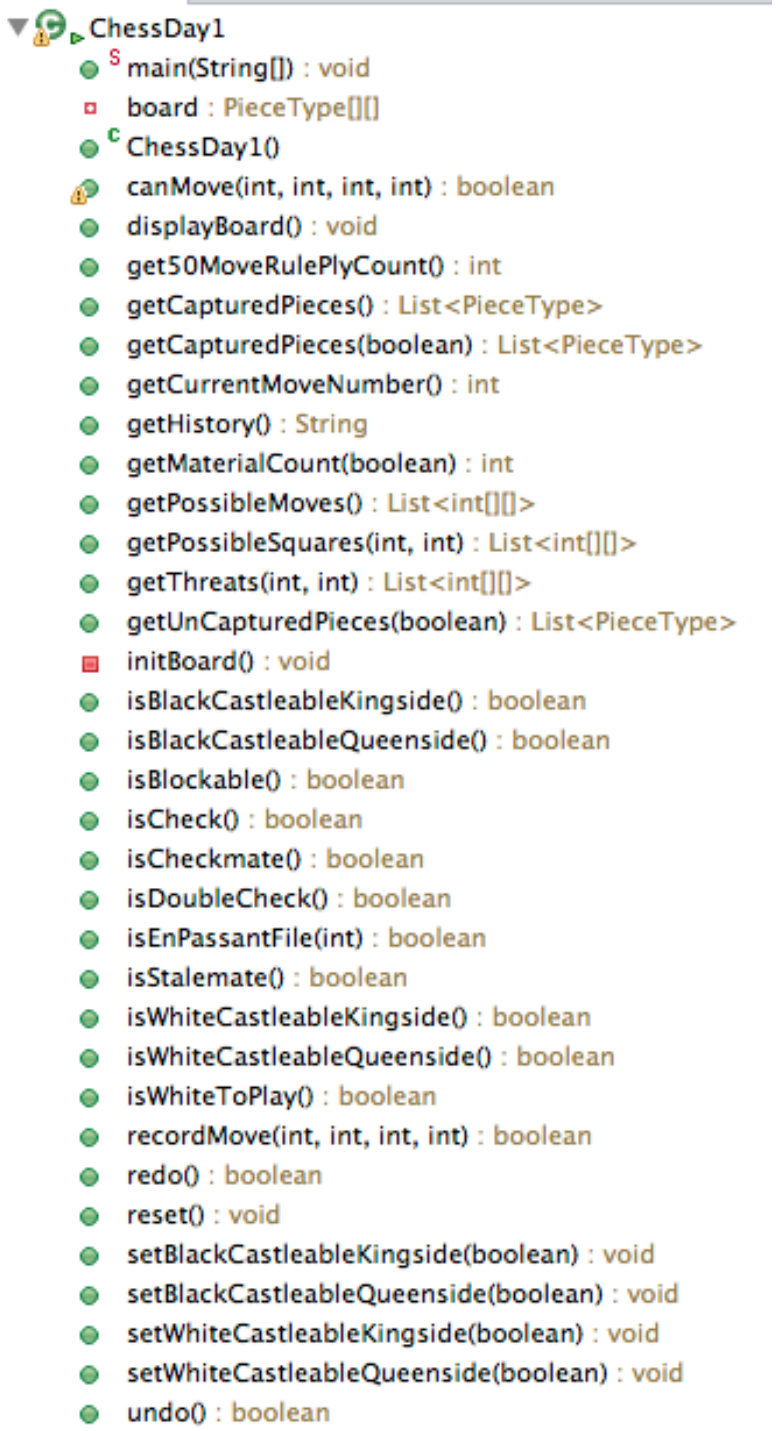
Other chess variants:

- Wargames and Hierarchical games.
- Chess with cards.
- Chess with dice.
- Crossovers. Variants that borrow ideas or rules from, or combine with other games.
- Chess with incomplete information. Kriegspiel and its variants.
- Other variants. Everything that didn't fit in another category: with several nice ones!

Variants of chess game

Not 8*8
Different moves
New pieces
New rules
New graphics
New AI engines
…

In this monolithic code?!

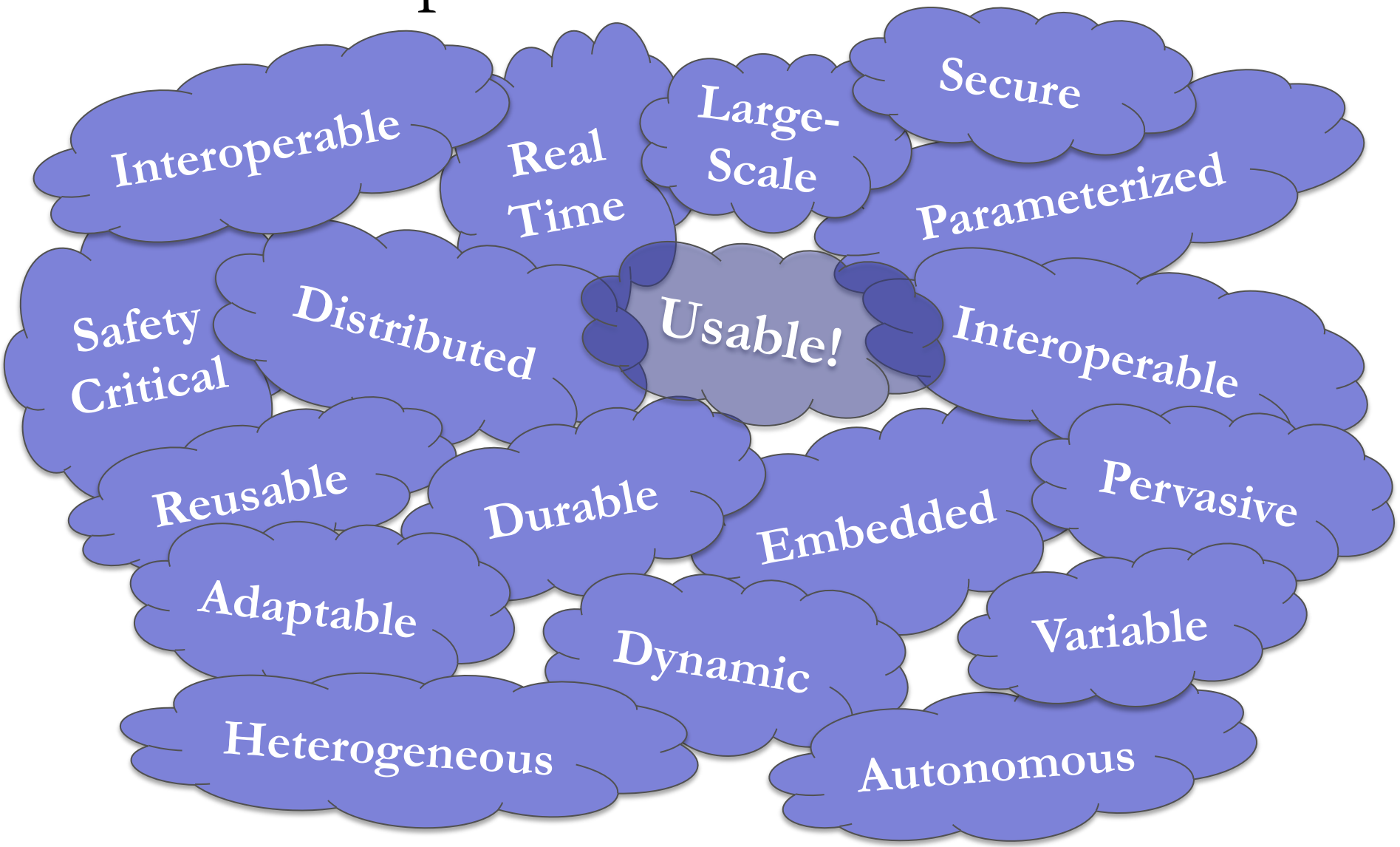


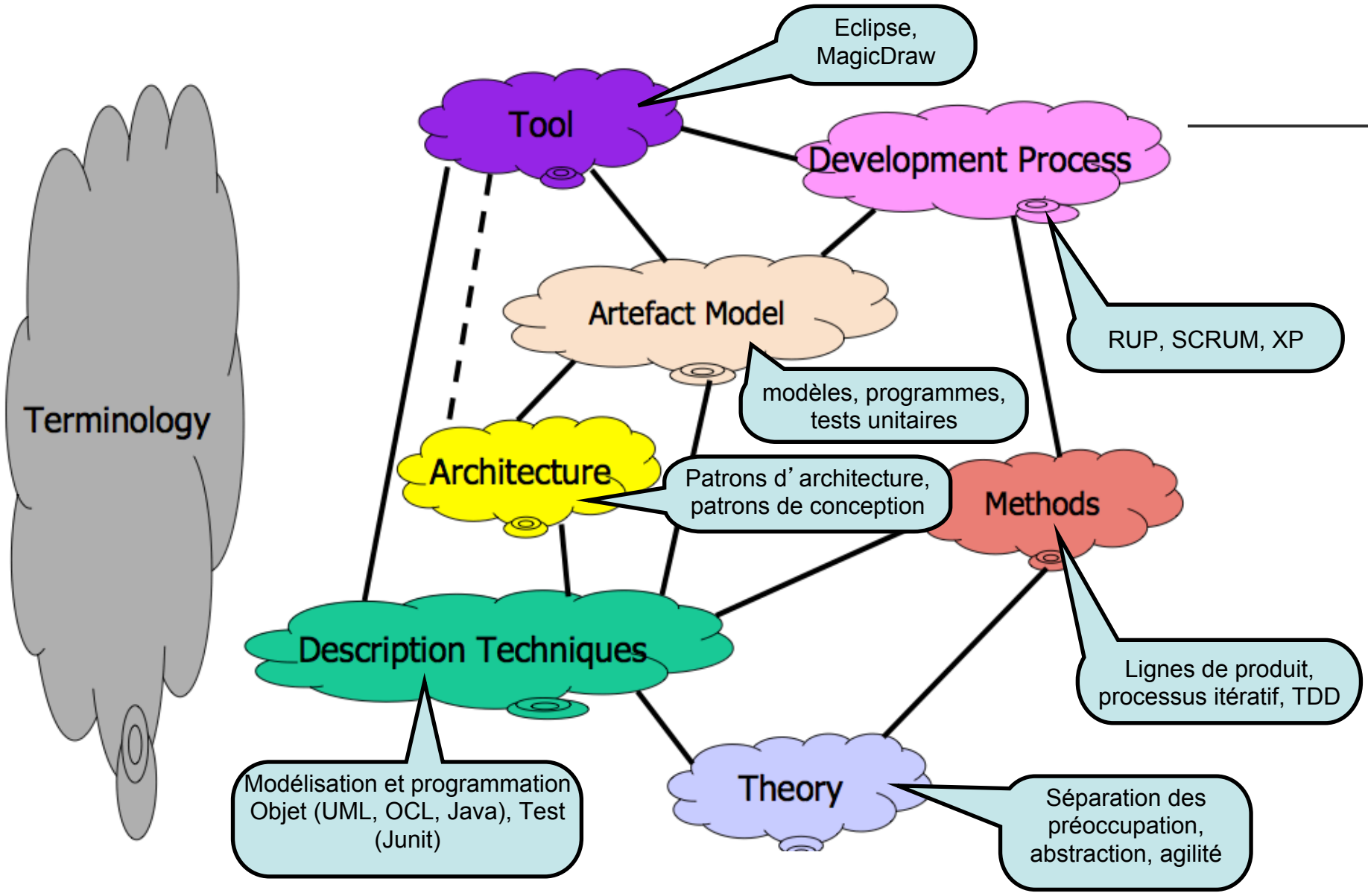
```
r n b q k b . r
p p p p p p p p
. . . . . n . .
. . . . . . . .
. . . P . . . .
. . . . . N . .
P P P . P P P P
R N B Q K B . R

Thinking...

white  KQkq
r . b q k b . r
p p p p p p p p
. . n . . n . .
. . . . . . . .
. . . P . . . .
. . . . . N . .
P P P . P P P P
R N B Q K B . R


My move is : Nc6
White (3) :
```

Broadcasting?

1,3 billions of people live in India

Software Complexity: Even Applies for a Basic Example like Chess Game




Terminology
Tool
Eclipse, MagicDraw
Development Process
RUP, SCRUM, XP
Artefact Model
modèles, programmes, tests unitaires
Architecture
Patrons d'architecture, patrons de conception
Methods
Lignes de produit, processus itératif, TDD
Description Techniques
Modélisation et programmation Objet (UML, OCL, Java), Test (Junit)
Theory
Séparation des préoccupation, abstraction, agilité

Conclusion

- **Le métier d'ingénieur logiciel est complexe**: *principes*, *techniques*, *méthodes*, et *outils* pour décrire, implémenter, vérifier, gérer, et rendre opérationnel un système logiciel

- Réponse de l'ingénierie du logiciel par l'utilisation de la modélisation
  - séparation des préoccupations
  - montée en abstraction
  - agilité des développements